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Research Title/ Field	Article (Abstract)	Download
Effect of probiotic feed additives on broiler chickens health and performance 	**Original Research, B21** **Alloui N, Chafai S, Alloui MN.** ***Online J. Anim. Feed Res.*, 2(2): 103-107, 2012.** **ABSTRACT:** *Antibiotics were very important pieces of the puzzle that enabled the poultry production to move from a backyard flock based industry to the large-scale production facilities of today. Public health professionals have suggested that the use of subtherapeutic antibiotics in animal production may be partially responsible for the development of antibiotic resistant bacterial populations. The probiotics may be substituted by antibiotics (growth promoting) in certain cases. Pediococcus acidilactici is a bacterial probiotic used in this experience. 16000 broiler chickens were assigned in two experimental groups: treatment (10^9 cfu/kg of feed of Pediococcus acidilactici MA18/5M) and control. In each group 8000 broiler chickens were allocated in the same batch and divided by a physical barrier. Individual live weight of a sample of 200 birds for each group from day 0 to day 56 was measured weekly. Feed intake, feed efficiency, mortality, carcass quality, serum lipids (cholesterol and triglycerides) and number of white blood cells, were recorded per group. The administration of Pediococcus acidilactici affected positively the growth performance of broilers (2586.43 vs. 2252.79 g, p≤0.01) and feed conversion ratio (2.00 vs. 2.5). There were no significant difference between groups in dressing, breast meat and thigh percent, at the end of day 56. Analysis of variance showed significant difference between treatments for serum lipids (p≤0.01). Mortality was almost similar in both groups (6.56 vs. 6.51). The numbers of white blood cells were significantly affected by dietary treatment (p≤0.01).* **Key words:** *Probiotic, Broiler chickens, Health and Performance of production*	
Utilization of Leucaena (*Leucaena leucocephala)* leaf meal as partial replacement for fishmeal in the diet of broiler chickens 	**Original Research, B22** **Zanu HK, Mustapha M and Addo Nartey M. 2012.** ***Online J. Anim. Feed Res.*, 2(2): 108-112, 2012.** **ABSTRACT:** *A six-week experiment was conducted to assess the response of cobb broiler chicks to diets containing varying levels (0%, 5%, 10% and 15%) of Leucaena leaf meal (LLM). The 4 dietary treatments were allocated to the birds in a completely randomized design. Each treatment consisted of three replicates and fifteen birds per replicate. The birds were fed experimental starter diets (14-28 d) and finisher diets (28-56 d). Feed and water were provided ad libitum. Final weight, growth rate and feed conversion ratio significantly (P<0.05) declined as the level of LLM in the diets increased. Dressed and carcass weights also reduced significantly (P<0.05) with increasing level of LLM in the diets. All organ characteristics except liver kidney were significantly (P<0.05) affected by dietary treatments. Haematological variables were also not affected (P<0.05). The total cholesterol and Low Density Lipoprotein of serum decreased (P<0.05) when LLM was included to the diets. Feed cost reduced when LLM was incorporated in the diets, but the net revenue declined as LLM in diet increased. In this study inclusion of LLM in diets for broiler chickens did not affect their health status, but depressed their growth.* **Key words:** *Feed cost, Haematology, Leucaena leaf meal, Performance, Serum biochemistry*	
Anti-nutritional factors in sorghum: chemistry, mode of action and effects on livestock and poultry 	**Original Research, B23** **Etuk EB, Okeudo NJ, Esonu BO, Udedibie ABI. 2012.** ***Online J. Anim. Feed Res.*, 2(2): 112-119, 2012.** **ABSTRACT:** *Sorghum basically contains two major anti-nutritional factors; tannin, a polyphenolic compound located in the grain and, dhurrin a cyanogenic glucoside located mainly in the aerial shoot and sprouted seeds. Tannins are high in sorghum with brown pericarp and no testa and very low in unpigmented grains. The main anti-nutritional effects of tannins are: reduction in voluntary feed intake due to reduced palatability, diminished digestibility and utilisation of nutrients, adverse effects upon metabolism and toxicity. The level of tannins present in sorghum seems to be the predominant factor that influences its nutritional value. Drying, soaking, grinding and pelleting appear to reduce tannin content in feedstuffs while diet supplementation with methyl group donors like choline and methionine reduce the problems associated with tannins in livestock. Dhurrin, on enzyme action readily yields hydrogen cyanide (HCN). The quantity of HCN in sorghum varies with cultivar and the growth condition but diminishes with age. Excess cyanide ion can quickly produce anoxia of the central nervous system through inactivating the cytochrome oxidase system and death can result within a few seconds. Making fodder into hay or silage however, destroys the poison.* **Key words:** *Tannin, Dhurrin, Sorghum, Livestock, Poultry*	
Breed, Sex And Ambient Temperature Effects on Duration of Behavioural Traits of Rabbits (*Oryctolagus Cunniculus*) Reared in The Humid Tropics	**Original Research, B24** **Ogbu CC, Ani AO, Nwogwugwu P.** ***Online J. Anim. Feed Res.*, 2(2): 120-126, 2012.** **ABSTRACT:** *Breed, sex and ambient temperature effects on the nocturnal and diurnal duration of feed and water intakes, standing and lying down behaviour of rabbits were investigated. Twelve male and female weaner rabbits (New Zealand White, Dutch Black and American Chinchilla, 8 weeks old) were housed individually in cells measuring 51 cm x 51 cm each. They were fed an 18% Crude Protein pelleted diet, forages (Centrosema pubescens, Ipomea batatas and Tridax procumbens) and water ad libitum for 8 weeks. Data were collected at three hourly intervals from 18:00 hrs to 06:00 hrs (nocturnal) and from 06:00 hrs to 18:00 hrs (diurnal). Durations of feed intake, water intake, lying down and standing were measured. Ambient temperature differed significantly (P ≤ 0.05) between test periods. Breed and sex did not influence the parameters studied. While ambient temperature significantly (P ≤ 0.05) influenced*	

all traits, test period significantly (P ≤ 0.05) influenced duration of water intake, duration of standing and duration of lying down but not duration of feed intake. Interaction effects of test period x ambient temperature affected (P ≤ 0.05) duration of water intake and duration of lying down within the nocturnal period and duration of feed intake, duration of water intake and duration of lying down within the diurnal period. Highly significant (P < 0.01) phenotypic correlation was observed between duration of feed intake and duration of standing (r_p = 0.10), duration of feed intake and duration of lying down (r_p = - 0.46), duration of water intake and duration of standing (r_p = 0.09), duration of water intake and duration of lying down (r_p = - 0.29), ambient temperature and duration of water intake (r_p = 0.64), duration of standing and duration of lying down (r_p = - 0.51) and between ambient temperature and duration of lying down (r_p = - 0.42).

Key words: *Ambient Temperature, Behavioural Trait, Diurnal, Ethology, Nocturnal, Rabbit, Stress, Test Period, Thermoneutrality*

Nutrient digestibility, carcass characteristics and plasma metabolites in kids fed diets supplemented with chromium methionine

Original Research, B25

Emami A, Zali A., Ganjkhanlou M., Akbari Afjani A.

***Online J. Anim. Feed Res.*, 2(2): 127-132, 2012.**

ABSTRACT: *This study was carried out to evaluate the effects of different levels of chromium methionine (CrMet) on nutrient digestibility, carcass characteristics and plasma metabolites of male kids. Thirty-two male Mahabadi goat kids (average initial body weight (BW) = 22±2 kg, 4 months) were allocated in a completely randomized design with four treatments: 1) control (without Cr), 2) 0.5, 3) 1 and 4) 1.5 mg Cr as Cr-Met/animal/day. Diets were same (ratio of forage: concentrate was 30:70) except for top-dress addition of Cr-Met and fed in two equal meals (08.00 and 16.00h), Also orts collected before morning meal. Animals were kept in individual pens for 100 days. Kids were slaughtered at the end of the experiment and carcass characteristics determined. The results showed that dressing percentage was not affected by treatment, but, Cr supplementation reduced 10th rib back fat thickness by 30.30% (P<0.01), and tended to increase longissimus muscle area (P<0.09). Supplemental Cr increased percentage of neck (P<0.05) and proximal pelvic limb (P<0.08). Addition of different levels of Cr-Met failed to significantly effect on (P>0.01) the post-prandial changes in plasma levels of cholesterol, urea N, total protein, triglyceride and albumin, However, post-prandial of plasma glucose decreased by Cr (P<0.05). NDF and organic matter digestibility increased in the kids fed added dietary Cr compared with the control group. it was concluded that diet supplementation with chromium methionine could be improved nutrient digestibility, carcass characteristics and peripheral glucose utilization in goat kids.*

Key words: *Chromium-methionine, Mahabadi goat kid, Digestibility, Plasma metabolites, Glocuse*

Level of adoption and constraints of scientific backyard poultry rearing practices in rural tribal areas of Sikkim, India

Original Research, B26

Nath B.G., Toppo S., Chandra R., Chatlod L.R., Mohanty A.K.

***Online J. Anim. Feed Res.*, 2(2): 133-138, 2012.**

ABSTRACT: *A study was conducted on level of adoption and constraints of backyard poultry rearing practices in rural tribal areas of Sikkim. The data were collected from 125 respondents of Dzongu area, North Sikkim through personal interview with the help of questionnaire. From the present study it was found that 64.8% respondents were medium level adopters followed by high level (19.2%) and low level (16%) adopters. Housing (43.2%) were highly adopted followed by feeding and watering (41.6%), marketing (40.0%), general management (39.2%), health care practices (36.8%) and breeding practice (33.6%). The overall adoption of different backyard poultry rearing practices showed medium level adoption. Non availability of backyard poultry chicks, non-availability of medicine, high incidence of diseases, lack of knowledge about scientific practices, lack of market, attack of predators etc. were the major constraints faced by backyard poultry farmers. The study also pointed some suggestions for solving the constraints regarding backyard poultry rearing practices in Dzongu, North Sikkim.*

Key words: *Adoption, Backyard poultry, Farming practice, Constraint, Scientific*

Effects of different silage preservatives on silage quality of *Pennesitum Purpureum* harvested at different harvesting periods

Original Research, B27

Sebolai TM, Aganga AA, Nsinamwa M and Moreki JC.

***Online J. Anim. Feed Res.*, 2(2): 139-144, 2012.**

ABSTRACT: *The study was conducted to determine the effects of preservatives on the chemical composition of elephant grass (P. purpureum Bana cv.) harvested from N-fertilized and unfertilized treatments at different periods (3, 6 and 9 months). The plants were grown on 1st November 2008 and harvested every 3 months until July 2009. The grass was chopped and a 500 g sample obtained and was mixed with 4% molasses, 4% molasses+0.25% urea and 2.5% dicalcium phosphate, respectively with plain silage as a control. The samples were ensiled with respective preservative in duplicates and were analyzed for pH and proximate after 30 days of ensiling. Molasses added silage had a higher (P<0.05) DM at 3 months on both N-fertilized and unfertilized treatments, whereas molasses added silage prepared from unfertilized treatment harvested at 3 months of growth, had lowest (P<0.05) pH and was highly (P<0.05) digestible but digestibility declined as the plant matured.*

Key words: *Elephant grass, Harvesting periods, Silage preservatives, Silage quality.*

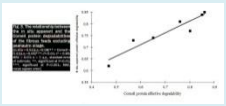
Characteristics and constraints of pig production under rural

Original Research, B28

Nath B.G., Chandra R., Toppo S., Chatlod L.R., Mohanty A.K.

***Online J. Anim. Feed Res.*, 2(2): 145-148, 2012.**

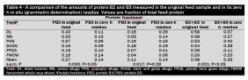
ABSTRACT: *The present study was undertaken to know the production and*

condition in Sikkim 	*management practices followed by the farmers and the common constraint of pig production in rural area of Sikkim. The data were collected from 100 respondents through personal interview with the help of questionnaire on different aspects namely housing, breeding, feeding, health care, management practices, economics and the common problems for pig production. In the present study it was observed that 95% farmers constructed their pigsty with locally available wood/bamboo with traditional system. Majority (60%) of the farmers reared cross-bred pigs and offered kitchen waste to their pigs while only 5% of them offered concentrate feeds. Vaccination and deworming was followed by 30 per cent and 35 per cent of farmers respectively. Daily cleaning of pigsty was followed by 50 percent of the farmers and castration and weaning was to be practiced by majority of farmers. Special attention to the pregnant sows and care after farrowing was followed by 69 and 75 per cent respectively. Farmers market their pigs at the age of 1 year or above when they attained the body weight of 85-90 kg or more. Lack of adequate credit facilities, inadequate scientific knowledge on pig farming, lack of veterinary facility, lack of breeding and lack of marketing facilities were observed to be the major constraints perceived by the farmers. The study revealed that the development of pig production is necessary in this area as it will not only fulfill the demand but also help to uplift the economic status of farmers.* **Key words:** *Production, Constraint, Pig, Breeding, Economic, Feeding, Health, Housing, Sikkim*	
Prediction of corrected in situ forage protein degradability by the Cornell method 	**Original Research, B29** **Avornyo FK.** ***Online J. Anim. Feed Res.*, 2(2): 149-154, 2012.** **ABSTRACT:** *An experiment was conducted on eight fibrous feeds to compare the Cornell rumen degradable protein values with those of the in situ method that have been corrected for microbial contamination. Samples of hay, sugarbeet pulp, dried lucerne, maize silage, peahaulm silage, fermented whole crop wheat and two different grass silages were used for the Cornell method. A corresponding in situ experiment was carried out on the same samples to estimate their rumen degradable protein values. Regression was used to relate the Cornell rumen degradable protein to that of the in situ technique. Rumen degradable protein estimates observed using the Cornell method were, on average, 0.06 and 0.16 lower than their corresponding in situ uncorrected and corrected values, respectively, with the latter being statistically significant (P<0.01). However, regression analysis between the Cornell and the in situ uncorrected rumen degradable protein, using all eight feeds, was statistically significant (r^2 0.59; P<0.05). The relationship did not improve when the Cornell values were compared with the in situ corrected values for the eight feeds (r^2 0.55; P<0.05). On the basis of inadequate preparation of the peahaulm silage sample for the in situ experiment, it was removed from the data set and the ensuing equation accounted for 0.89 of the variability in the in situ uncorrected rumen degradable protein (P<0.01). A better agreement was observed between the Cornell and the in situ corrected rumen degradable protein (r^2 0.95; P<0.001). The Cornell method therefore significantly correlated with the in situ technique for fibrous feeds. Correlation between the methods could improve if microbial contamination was removed from the analysis. The in situ rumen degradable protein values appeared to be bigger than the associated Cornell values. The Cornell adopted rates of degradation therefore need to be evaluated.* **Key words:** Cornell, in situ, protein, forages, degradability, feeds	
Rearing of fry to fingerling of Saul (*Channa striatus*) on artificial diets 	**Original Research, B30** **Srivastava PP, Dayal R, Chowdhary S, Jena JK, Raizada S., Sharma P.** ***Online J. Anim. Feed Res.*, 2(2): 155-161, 2012.** **ABSTRACT:** *Three diets (F1, F2 and F3) containing protein levels of 38.60 to 38.98 % crude protein were used to assess the growth performances of Channa striatus fry (weight 0.52±0.0 to 0.53±0.02 g) in a completely randomized experiment design in five replicate set for 12 weeks. The fry were reared in 15 FRP tanks at a stocking density of 100 fry m^3 and fed ad libitum. The diets F1 and F3 showed significantly (P<0.05) low survival levels of 74±1.2% and 76±4.4% in comparison to diets F2 (82±3.1%) 84th day of rearing. The net biomass gain %, length gain %, SGR, PER and per day weight gain were found significantly (P<0.05) higher and FCR low with diet F2 in comparison to diets F1 and F3. The proximate analysis of carcass showed that the fishes fed diets F2 had significantly (P<0.5) higher deposition of crude protein and lipids in the tissue. The study revealed that the growth performance of C. striatus fry is better in feed F2 and the fry could be reared to fingerling size on formulated diets.* **Key words:** *Channa striatus*, *Survival, Growth*	
Vitamin d_3 induced hypercalcemic response in threatened bronze feather back (*Notopterus notopterus*, Pallas)	**Original Research, B31** **Srivastava SM, Srivastava PP, Dayal R, Chowdhary S, Lakra WS, Singh SP, Pandey AK.** ***Online J. Anim. Feed Res.*, 2(2): 162-165, 2012.** **ABSTRACT:** *Vitamin D_3 (0.0 IU.100 g body weight $(BW)^{-1}.day^{-1}$, 100 IU.100 g $BW^{-1}.day^{-1}$, 500 IU.100 g $BW^{-1}.day^{-1}$ and 1000 IU.100 g $BW^{-1}.day^{-1}$) was administered intra-peritoneally (ip) to the freshwater threatened Bronze Featherback, Notopterus notopterus kept in freshwater for 9 days. Analyses of serum calcium levels were performed at 0, 6 hr. and 1, 2, 3, 5 and 9 days (four grow-out Notopterus notopterus from each group of ip doses at each interval). Administration of vitamin D_3 elevated the maximum serum calcium elevation occurred at day 2 freshwater in 500 IU.100 g $BW^{-1}.day^{-1}$ (11.2±0.92 $mg.dL^{-1}$) and in 1000 IU.100 g $BW^{-1}.day^{-1}$ (12.0±0.46 $mg.dL^{-1}$) of the fish maintained in the fresh water. There was gradual decrease in calcium levels from day 3 and became normocalcemia on day 9. Out of the three concentrations of ip*	

Vitamin D_3 (100 IU.100 g $BW^{-1}.day^{-1}$, 500 IU.100 g $BW^{-1}.day^{-1}$ and 1000 IU.100 g $BW^{-1}.day^{-1}$) the sharp elevation of serum calcium recorded in both 500 IU.100 g $BW^{-1}.day^{-1}$ and 1000 IU.100 g $BW^{-1}.day^{-1}$. The control (0.0 IU.100 g $BW^{-1}.day^{-1}$) fish serum calcium behaves like normocalcemia (8.25±0.21 mg.dL^{-1}) in every sampling up to day 2. Results demonstrated that ip Vitamin D_3 exerted a dose-dependent and pronounced hypercalcemic effect in freshwater threatened Bronze Featherback, Notopterus notopterus.

Key words: *Notopterus notopterus*, *Threatened fish, Vitamin D_3, Hypercalcemia*

Comparison of three approaches of estimating protein b2 and b3 degradation rates in the rumen of sheep



Original Research, B32

Avornyo F.K.

***Online J. Anim. Feed Res.*, 2(2): 166-173 2012.**

ABSTRACT: *A method that involved the gravimetric measurement of the amounts of feed protein B2 (feed protein that is insoluble in borate phosphate buffer but soluble in neutral detergent solution) and protein B3 (feed protein that is insoluble in neutral detergent solution but soluble in acid detergent solution) that remain after each in situ incubation period, was used to obtain the degradation rates of these protein pools in six different feeds. These degradation rates were then compared with degradation rates provided by the Cornell Net Carbohydrate and Protein System for nominally similar feeds in order to establish the extent of agreement between these sets of data. Curve peeling technique was also used on the in situ results of this experiment to generate degradation rates for comparison with the gravimetric and the Cornell values. The study showed that the gravimetric, the curve peeling and the Cornell values were not statistically different for the degradation rates of protein B2 even though the gravimetric estimates were the highest followed by curve peeling and then the Cornell values. For protein B3, the degradation rate estimated with the gravimetric method was highest followed by the curve peeling method and then the Cornell values (P<0.01). The degradation rates assigned to protein B3 in the Cornell databank needs re-examination. There is a need for further application of the gravimetric technique to establish if it gives higher estimates of the degradation rates of proteins B2 and B3 in a range of feedstuffs.*

Key words: *Gravimetric method, Cornell, In situ, Degradation rate, Curve peeling*

Comparative study of WLR of *Channa striatus* of fry- fingerling, grow-outs and adults of gangetic plains

Original Research, B33

Dayal R, Srivastava PP, Bhatnagar A, Chowdhary S, Lakra WS, Raizada S, Yadav AK. 2012.

***Online J. Anim. Feed Res.*, 2(2): 174-176, 2012.**

ABSTRACT: *In the present study the Weight – Length relationships (WLR) are described for the three stages of life of the Snakehead, Saul, Channa striatus, collected from the districts of Barabanki, Lucknow and Unnao in Uttar Pradesh in 2008-09. Method used for analysis of fisheries data on the WLR is ($W=aL^b$) and this study reports the parameters 'a' and 'b' of the length–weight relationships for one hundred numbers of fry/ fingerlings, thirty-seven grow-out fishes and eighty-nine number of adult fishes collected from the same geographical area. The weight and total length of fry/ fingerlings ranged from 340 to 650 mg and 35 to 45 mm respectively ($a=W/L^3$, 0.0060 to 0.0088; log W=log a + b*(log L), 3.92821 to 4.72919; b=(log W-log a)/log L, 3.89643 to 4.11143). The recorded weight and total length of the grow-outs ranged between 9 to 93g and 10.9 to 25.4 cm respectively ($a=W/L^3$, 0.0082 to 0.0146; log W=log a + b*(log L), 0.95424 to 1.96848; b= (log W-log a)/log L, 3.0). In case of adults the weight and total length recorded ranged between 74 to 476g and 22.9 to 42.4 cm respectively ($a=W/L^3$, 0.0054 to 0.0121; log W=log a + b*(log L), 2.39029 to 4.17039; b=(log W-log a)/log L, 3.40747 to 3.95845). Since fishes were collected during the months of April - May, 2008 and November, 2009, the parameters estimated in this study are considered only for these seasons, because WLR are not constant over the entire year and vary according to factors such as temperature, food availability, feeding rate, gonadal development and spawning period. The result suggests that these fishes grow in a pattern from early life stage to adult if grown in the same environmental conditions.*

Key words: *Weight-Length, Channa striatus, Fry, Fingerlings, Grow-outs, Adults, Gangetic plains*

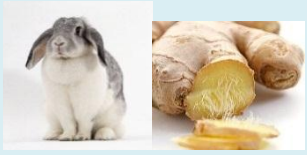
Current status, challenges and opportunities of rabbit production in Botswana

Original Research, B34

Moreki JC and Seabo D

***Online J. Anim. Feed Res.*, 2(2): 177-181, 2012.**

ABSTRACT: *This review highlights the current status of rabbit production, challenges facing the industry and opportunities available. Rabbit farming in Botswana is in its infancy and the rabbit population is estimated to be less than 1000. However, this value is a gross underestimate due to poor monitoring by government extension services. In Botswana, rabbits are mainly kept in the backyards, indicating that intensive systems have not yet been developed. Rabbits have small body size, short gestation period, high reproductive potential, rapid growth rate and ability to utilize forages. Compared to beef, chicken, mutton, chevon and chicken, rabbit meat has low cholesterol, high protein and low fat contents. Rabbit production can be integrated into small farming systems, with the rabbits being fed on crop residues, weeds, poultry droppings, and kitchen and garden wastes. The manure can be used to fertilize soils. The major challenges in rabbit production are inadequacy of breeding stock, inadequate rabbit feeds, poor management (feeding, housing and health care), lack of research support, lack of technical support from extension services, lack of access to credit and inadequate supply of equipment. The major opportunity available to the rearers is that the market is vast due to the small rabbit population in the country. The attributes of rabbits suggest that rabbit farming is likely to play an important role in nutrition, poverty alleviation and food security, especially in countries with higher unemployment levels and HIV/AIDS prevalence rates such as Botswana.*

	Key words: *Botswana, Challenges, Cholesterol, Manure, Opportunities, Rabbits*	
Use of *stylosanthes hamata* and *Sida acuta* as sole feeds for rabbits *(Oryctolagus cuniculus)* 	**Original Research, B35** **Naandam J, Padi BAY, Bigol P, Mensah-Kumi R.** ***Online J. Anim. Feed Res.*, 2(2): 182-188, 2012.** **ABSTRACT:** *A 42-day feeding trial was conducted to determine whether Stylosanthes hamata and Sida acuta could be used as sole feeds for local weaner rabbits. The experimental diets had three treatments with three replicates each in a Completely Randomized Design. The experimental diets were T1 (100% Stylosanthes hamata), T2 (50% Stylosanthes hamata 50% Sida acuta) and T3 (100% Sida acuta). The growth parameters measured/calculated were mean weekly and total feed intake (g), mean weekly and total weight gain (g) and final weight (g). Blood parameters considered included haemoglobin (Hb), packed cell volume (PCV), red blood cells (RBC), mean corpuscular volume (MCV), mean corpuscular haemoglobin (MCH), mean corpuscular haemoglobin concentration (MCHC) and white blood cell (WBC) differential counts (neutrophils, lymphocytes, eosinophils, and monocytes). Additionally, meat colour, juiciness, tenderness and flavour were also noted after animals were sacrificed. Data was analyzed using ANOVA in GenStat (Discovery Edition). There were significant differences (P<0.05) in mean weekly feed intake, total feed intake, mean weekly weight gain, total weight gain and final weight between treatments. T3 animals consumed the highest feed yet T2 animals had the heaviest weight gain at the end of the experiment. Whereas there were no significant differences (P>0.05) between treatments for MCHC and WBC differential counts like neutrophils lymphocytes and eosinophils, significant differences (P<0.05) were observed between treatments for PCV, RBC, MCV and monocytes. The sole Stylosanthes hamata feed significantly (P<0.05) improved meat colour and juiciness, whiles tenderness and flavour, did not record any significant differences (P>0.05) between treatments. The results suggest that Stylosanthes hamata and Sida acuta may have a potential to enhance rabbit growth as a combined feed. Any negative effect on rabbit health either when fed individually or in combination was inconclusive and Stylosanthes in particular as sole feed could improve colour and juiciness of rabbit meat.* **Key words:** *Blood indicators, Growth performance, Meat quality, Sida spp., Stylosanthes spp.*	
Nutritive profiles in different size groups and body parts of common whelk *Hemifuses pugilinus* (born, 1778) from Pazhayar, southeast coast of India 	**Original Research, B36** **Sekar V, Ravi V, Dhinakaran A, Rajasekaran R, Ilayaraja C.** ***Online J. Anim. Feed Res.*, 2(2): 189-196, 2012.** **ABSTRACT:** *The aim of this study was to determine instead of levels of protein, fat, carbohydrates (proximate composition) and essential fatty acids of different body parts as well as male and female of extensive marine whelk H. pugilinus on dry weight basis. There was a significant difference in protein, lipid, carbohydrate and water contents between various size groups as well as sex (P<0.05). Total protein content was found to be varying from 30.58±0.75 (digestive diverticula) to 57.23±1.48% (Gonads) in size group II of the female body parts respectively, the carbohydrate 3.66±0.28 to 10.35±0.14 whereas the lipid 10.18±0.04 to 14.67±0.35. The water content varied from 58±1.41 minimum digestive diverticula and maximum in 85±1.41 other body tissues. There was considerably 17 fatty acid composition were identified belongs to ten in saturated fatty acids four were monounsaturated fatty acid and 3 were polyunsaturated fatty acid among these, C16:0 (22.62%) and C18:0 (14.45%) were the major components saturated fatty acids and C18: 1 (5.3%) and C20:4n6 (8.66%) were found major mono and poly unsaturated fatty acids. All groups have good source of the nutritive value particularly the size group II (80-100 mm) is effectual results for the present findings and it's symptomatic of their high nutritional quality for human consumption.* **Key words:** *Common whelk, Fatty acids, Mollusc, Nutritional composition, Pazhayar*	
Biochemical effect of ginger on some blood and liver parameters in male Newzeland rabbits 	**Original Research, B37** **Lebda MA, Taha NM, Korshom MA, Mandour AElA, El-Morshedy AM.** ***Online J. Anim. Feed Res.*, 2(2): 197-202, 2012.** **ABSTRACT:** *The aim of the present study was to investigate the effects of different ginger rhizome treatments on hepatic oxidative stress markers and antioxidant status. Also, the study was extended to show the serum lipid profile, liver and kidney functions and serum glucose. Forty male New Zealand rabbits were allocated into four groups (10 rabbits in each); control, ginger powder, hot extract of ginger and cold extract of ginger. The results revealed that administration of ginger in its different forms significantly reduced malondialdehyde (MDA) level, glutathione peroxidase (GPX) and glutathione-S-transferase (GST) activities, meanwhile, the reduced glutathione (GSH) was significantly increased in liver. Moreover, ginger treatment depleted serum triacylglycerol (TAG), total cholesterol and low density lipoprotein-cholesterol (LDL-c) while the high density lipoprotein-cholesterol (HDL-c) was increased. Ginger administration improved liver functions but unfortunately, the serum creatinine and glucose levels were increased. We concluded that ginger especially hot extract maintain the antioxidant activities, improve liver functions and reduce lipid peroxidation.* **Key words:** *Ginger, Cholesterol, Malondialdehyde, Glutathione*	
	Original Research, B38 **Abdel Moniem M, El hag A, hassabo AA, Bushara I, Ishag IA, Eisa MO. 2012** ***Online J. Anim. Feed Res.*, 2(2): 203-209, 2012.**	

Effect of growth stages and range systems on vegetation attributes, carrying capacity, stocking rate and forage productivity, North Kordofan, Sudan

ABSTRACT: *The range vegetation attributes, carrying capacity, stocking rates and forage productivity were studied in close and open range systems at the flowering and seed setting stages during the September and November 2010, respectively, in El Rosa (El-khuwei locality). Sampling was done by locating 2Km^2 in close and open range systems in a radiating manner from the centre of each site. Completely Randomized Design (CRD) was used to analyses treatments. Biomass production of plants and plant cover at the flowering stage in the close range system were significantly (P<0.0001) higher than that at the seed setting stage in the open range system. The plant density was significant (P<0.05) higher in the close rang system at the flowering stage and lower at the seed setting stage in the open range system. Bare soil and litter was significantly higher (P<0.0001) in the open range system during the seed setting stage and lower in the close range system during the flowering stage. Forage productivity of plants and shrubs browse kg/ha on rangeland was significantly higher (P<0.05) in the close range system during the flowering stage and lower in open range system at the seed setting stage. Carrying capacity was significantly higher (P<0.0001) in the close range system at the seed setting stage and lower in the open range at the flowering stage. Stoking rates in open range system during the seed setting stage was significantly higher (P<0.0001) and lower in the close range system during the seed setting stage. The frequencies of Huskneet (Cenchrus biflorus), Bano, (Eragrostis tremula), Difra (Echinocloa colonum), leflef Luffa aegyptiaca, Gaw (Aristida sp), Shuleny Zornia glochidiata and Aborakhus* Andropogon gayanus were higher in close system during the two stages of growth. Plants such as *Abodaib Ceraotheca sesamoid, Bigual Blepharis linarifolia, Tmrfar (Oldenlandia senegalensis), Rabaa (Zalea sp), Himeira* Hymerocardia*, Diresa (Tribulus terrestris) and Huntot Merremia pinnata recorded higher frequencies in close range system during the flowering stage than in the open range system during the seed setting stage. The Nuida Sida cordofolia had highest frequency in the open range system* during the two stages of growth.
Key words: *Biomass, Cover, Density, Bare Soil, Litter and Frequency, Forage Productivity, Carrying Capacity, Stoking Rates*

The effects of parity number, season and year of calving of Sudanese Zebu cattle (Butana) on the lactation curve and milk yield

Original Research, B39

Ahmed MMM, Ariek KDA, Bushara I, A/Wabab KA.

***Online J. Anim. Feed Res.*, 2(2): 210-214, 2012.**

ABSTRACT: *The present study was conducted to investigate the effects of parity number, season and year of calving of Sudanese Zebu cattle (Butana) on the lactation curve and milk yield. A Wood's model (1967) was adopted for the description of the curve, it is a gamma function utilized for regression of milk yield on time lapse post-partum. The regression equation is presented by [$Y_{(n)} = an^b e^{-cn}$]; where: $Y_{(n)}$ is the total milk yield for n^{th} week, a, is the initial milk yield and is considered as a factor which could influence the height of the curve across time but has no effect on the curve. b is the rate of increase of milk yield pre-peak and is considered as the linear constant that measures the average slope of the curve during the increase phase. c is the rate of decrease of milk post-peak, a linear constant that describes the rate of change of the slope of the curve during the decline phase and determines the slope of the curve during this phase. Records of 178 cows were taken from the fifth days of lactation till 30 weeks from the year 1994 – 2001. The records were grouped according to parity (till eight parities), season of calving (dry and wet summer and winter) and year of calving. The results revealed that effect of parity on initial milk yield, although significant, but variable. The peak week, persistency and rate of increase of milk pre-peak were the highest (P<0.01) in parity 1 compared to other parities. However, rate of decrease post-peak was not affected by parity number. Peak yield and total yield increased steadily from parity one to parity 6 then decreased. Calving weight increased significantly (P<0.01) from 1 to 8. Season of calving was shown to have a significant effect on initial milk yield, a, peak week and persistency where, a, was the highest (P<0.01) in wet summer than winter and dry summer and hence was increased to the maximum peak during wet summer with shorter persistency around the peak compared to dry summer and winter. Year of calving significantly affected the rate of decrease post-peak, c, peak yield, weekly and total milk yields. It was shown that cows that calved in year 1997 and 2000 had the lowest (P<0.01) rate of decrease in milk yield, weekly and total yields.*
Key words: *Butana, Parity Number, Season of Calving, Lactation Curve, Milk Yield*

Effect of Parity on live Body weight, Daily Milk Yield and Lactation length of Sudanese Kenana Cattle

Original Research, B40

Musa AM, Idam NZ and Elamin KM. 2012.

***Online J. Anim. Feed Res.*, 2(2): 215-217, 2012.**

ABSTRACT: *Effect of parity (PA) on live body weight, daily milk yield and lactation length of Sudanese Kenana cattle breed were investigated using a surveyed random sample comprised of (200) animals on different numbers of parities, animals were reared on natural pastures. All parameters were determinated by standard statistical analysis models with multivariate ANOVA when daily milk yield (DMY), Live body weight (LBwt) and lactation length (LL) as response and parity numbers (PA_1, PA_2, PA_3 and PA_4) as independent (P≤0.05). The results revealed that parities had a significant effect on all quantitative parameters that investigated. These differences between observed means were separated using Duncan multiple range tests with equal variances assumed. This suggests that parities could be used as independent factor for estimation of quantitative parameters with relatively high accuracy in Sudanese Kenana cattle breed.*
Key words: *Parity, Live body weight, Daily Milk Yield, Lactation length, Kenana Cattle, Sudan*

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EFFECT OF PROBIOTIC FEED ADDITIVES ON BROILER CHICKENS HEALTH AND PERFORMANCE

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ABSTRACT: *Antibiotics were very important pieces of the puzzle that enabled the poultry production to move from a backyard flock based industry to the large-scale production facilities of today. Public health professionals have suggested that the use of subtherapeutic antibiotics in animal production may be partially responsible for the development of antibiotic resistant bacterial populations. The probiotics may be substituted by antibiotics (growth promoting) in certain cases. Pediococcus acidilactici is a bacterial probiotic used in this experience. 16000 broiler chickens were assigned in two experimental groups: treatment (10^9 cfu/kg of feed of Pediococcus acidilactici MA18/5M) and control. In each group 8000 broiler chickens were allocated in the same batch and divided by a physical barrier. Individual live weight of a sample of 200 birds for each group from day 0 to day 56 was measured weekly. Feed intake, feed efficiency, mortality, carcass quality, serum lipids (cholesterol and triglycerides) and number of white blood cells, were recorded per group. The administration of Pediococcus acidilactici affected positively the growth performance of broilers (2586.43 vs. 2252.79 g, p≤0.01) and feed conversion ratio (2.00 vs. 2.5). There were no significant difference between groups in dressing, breast meat and thigh percent, at the end of day 56. Analysis of variance showed significant difference between treatments for serum lipids (p≤0.01). Mortality was almost similar in both groups (6.56 vs. 6.51). The numbers of white blood cells were significantly affected by dietary treatment (p≤0.01).*

Key words: *Probiotic, Broiler chickens, Health and Performance of production*

ORIGINAL ARTICLE

INTRODUCTION

The development of resistance to certain antibiotics poses real problems to the animal and public health (Barton, 2000; Hofacre et al. 2001). Consequently, many additives (prebiotics, probiotics, symbiotics…) raise a particular interest as products of substitution to antibiotics in order to improve the production performances and the health of animals (Bach, 2001; Revington, 2002).

Pediococcus acidilactici is a probiotic bacterium that presents positive effects on the balance and the role of the intestinal flora; it also reinforces the immune defense and improves the production performances of animals (Jin et al. 2000; Coppola and Turnes, 2004; Stella, 2005).

The objective of this study is to evaluate in field conditions, the effect of probiotic feed additive (*Pediococcus acidilactici*) on the production performances (feed intake, weight gain, feed ratio and carcass yield), and on the blood lipids concentration and the immunity of broiler chickens.

MATERIALS AND METHODES

Place of the study

The trial has been conducted at the Poultry Center of Tazoult (Batna), Algeria. This centre is constituted of 10 buildings having the same technical features (materials of construction, surface area, extractors, pad colling, food and watering chains). Buildings having served to the experimentation have a surface area of 1000 m².

Animals

The trial has been conducted on 16 000 chicks of the strain ISA 15, coming from the same hatchery. They were allocated to two treatment groups of 8000 chicks each (control group and experimental group), raised separately in two identical buildings. Animals have been followed during all the trial period of 56 days of raising. At each weighing, 200 subjects were chosen randomly from both groups for individual weighing.

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Feed

The feed is supplied by the centre of Tazoult that possesses its own unit of feed manufacture. Three types of feed have been distributed according to periods of raising: a starter feed (d0-d21), a grower feed (d22-d42) and a finisher feed (d43-d56) (Table 1).

Two treatments have been compared in this survey:

A control group (Cont.) receiving a classic feed based on maize and soybean meal and an experimental group (Exp.) fed with the same feed than the (Cont.) combined with 10^9 ufc of Pediococcus acidilactici (MY 18/5M) /kg , equivalent to 100 grams of probiotic per ton of feed. Neither antibiotic, nor anticoccidial has been added to the feed.

Measured parameters

During the experimental period, feed intake, individual live weight of 200 birds per group, feed ratio and mortality rate have been measured weekly for both treatment groups.

At the end the experimental period 20 chickens from each group have been sacrificed then weighed in order to determine the carcass yield. Two types of yields have been calculated: weight of fat/weight of the carcass and weight of carcass eviscerated/weight of carcass non-eviscerated. The carcass yield permits to measure the probiotic effect on the quality of the carcass.

The number of white blood cells, the serum cholesterol and triglycerides concentration have been determined by blood withdrawals done on 80 chickens chosen randomly from each treatment group.

Statistical analyses were carried out using ANOVA and the general linear model procedures (GLM) of SPSS version 16.0 (SPSS Inc. Chicago, IL, USA), followed the post-hoc was performed by turkey test to determine the level of significance among mean values. The p-values less than 0.01 were considered to be significant.

RESULTS AND DISCUSSION

Broiler chickens performance

Results of production performances are summarised in Table 2. The evolution of the live weight of the Experimental group is marked, from the sixth week, by a significantly higher live weight than the Control (1703.67±34.4 vs. 1574.11±33.39 g). The average live weight at the end of the experimental period is 2586.48 g and 2252.79 g for the (Exp.) and (Cont.) group respectively, which corresponds to an improvement of 12.89%.

These results agree with the works of Cavazonni et al. (1998) and Stella (2005). Kabir et al. (2004) observed an improvement of the chickens' weights with other probiotics; however Karaoglu and Dardug (2005) did not establish any effect with *Saccharomyces cerevisiae*.

During all raising phases, chickens having received a supplemented diet with *P. acidilactici* presented feed ratios lower than the Control (Table 3). At the eighth week, chickens of the (Cont.) group had a feed ratio slightly higher than that of the (Exp.) group (2.45 vs. 2.37) respectively. Studies done by Pelicano et al. (2004); Silva et al. (2000); Franco et al. (2005) demonstrated an improvement of the feed ratio with chickens fed on probiotics such as *Bacillus subtilis*, *Lactobacillus acidophilus*, *Saccharomyces cerevisiae* and *Enterococcus faecium*. Johri (2004) did not observe any positive effect on the feed ratio of the chickens when *Streptococcus lactis* was incorporated in the feed.

The mortality rate in the two treatment groups is almost identical (6.57 vs. 6.51). Siwicki et al. (2005), Ramirez (2005) proved a reduction of the mortality rate due to the addition of probiotics in feeds of chickens.

Results concerning the carcass yield and the abdominal fat are summarised in Table 4. There was a clear influence of the use of *P. acididilactici* on the final quality of chickens' carcasses, a significant improvement ($p \leq 0.01$) of the carcass yield is noted (60.40 vs. 66.32%) for (Cont.) and (Exp.) respectively. However there was no significant reduction in the abdominal fat yield for the (Exp.) group in relation to the (Cont.) (1.90 vs. 2.27%). Kalavathy et al. (2003, 2006); Miazzo et al. (2005) observed a significant reduction of the abdominal fat content of the chickens, whereas Pelicano et al. (2004) and Arslan (2004) did not observe any effect of probiotics on the carcass yield of the chickens.

White blood-cells count

The number of white blood cells has been influenced by the addition of the probiotic in the diet. A significant difference ($p \leq 0.01$) has been observed between the (Cont.) group (25260 ± 3258 /mm^3) and the (Exp.) group (30365 ± 3210 /mm^3). (Table3). Sharef et al. (2009); Al-Mansour et al, (2011) observed that chicks fed supplemented diets with yeast culture in the rate of 1.5 g/kg had significantly ($p<0.05$) lower white blood cell counts compared to control

Serum lipids concentration

The analysis of serum lipids' concentration of the broiler chickens is summarised in the table 5. The content in lipids of blood that is represented by triglycerides and cholesterol is reduced in a significant manner ($p \leq 0.01$) in the group of chickens receiving *P. acidilactici*, during all raising phases. This could be explained by the fact that probiotics may possess the property of reducing cholesterol in the blood, which is due to the inhibition of the hepatic synthesis of cholesterol, and to their capacity of deconjuguating the biliary salts (Mercenier et al., 2002;

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Pereira et al., 2003; Lim et al., 2004). On the other hand, Kanashiro et al. (2001) and Djouvinov et al. (2005) did not observe any variations of cholesterol and triglycerides content in chickens' blood while using mixture of different strains of probiotics (*lactobacillus sp, bacillus sp, enterococcus faecium, streptococcus thermophilus*) in the diet.

Table 1 - Composition of the broiler chicken feeds (%)

Ingredients	Starting phase (d0-d21)	Growing phase (d22-d42)	Finishing phase (d43-d56)
Maize	58	60	60
Soyameal	30	25	18
Cereals by-products	9	13	18
Premix*	1.5	1	1
Bicalcic phosphate	1.5	1.5	1.5
Chemical composition			
ME kcal /kg	3040	3100	3180
Crude protein	21.500	18.500	17.500
Fiber	3.066	2.770	2.536
Ash	7.50	6.20	6.00

* Provided per kg of diet: vitamin A, 8,800 IU; vitamin D3, 3,300 IU; vitamin E, 40 IU; vitamin K3, 3.3 mg; thiamine, 4.0 mg; riboflavin, 8.0 mg; pantothenic acid, 15 mg; niacin, 50 mg; pyridoxine, 3.3 mg; choline, 600 mg; folic acid, 1 mg; biotin, 220 mg; vitamin B12, 12 mg; antioxidant, 120 mg; manganese, 70 mg; zinc, 70 mg; iron, 60 mg; copper, 10 mg; iodine, 1.0 mg; selenium, 0.3 mg

Table 2 - Evolution of the live weight (g) of broiler chickens in control and experimental groups

Age (days)	Control group (n= 200)	Experimental group (n =200)	P
0	46.11±0.20	44.08± 0.25	NS
14	241.88± 3.33	245.45± 3.61	NS
28	802.36± 15.06	842.97± 21.44	NS
42	1574.11± 33.39	1703.67± 34.4	*
56	2252.79± 24.50	2586.43± 27.6	*

* mean values were significantly different (p≤0.01); NS: not significant

Table 3 - Feed ratio, mortality rate, number of white blood cells of the broiler chickens in control and experimental groups at day 56

Parameters	Control group	Experimental group	P
Feed conversion ratio	2.45	2.37	NS
Mortality rate (%)	6.57	6.51	NS
White blood cells (n/mm^3)	25260±3258	30365±3210	*

* mean values were significantly different (p≤0.01); NS: not significant

Table 4 - Carcass yield of broiler chickens in the control and experimental groups

Parameters	Control group	Experimental group (n=20)	P
Live weight (g)	2285.57± 48.00	2629.90±45.20	*
Carcass weight (g)	1715.56±38.80	2091.84± 44.90	*
Carcass yield (%)	60.40	66.32	*
Fat weight (g)	37.36±5.66	39.92±4.42	NS
Fat Yield (%)	2.27	1.9	NS

* mean values were significantly different (p≤0.01); NS: not significant

Table 5 - Serum lipids concentration in the of broiler chickens in the control and experimental groups

Parameters		Ages (n=80)				P
		d14	d28	d42	d56	
Cholesterol (g/l)	Exp.	1.10± 0.06	0.94± 0.09	0.93± 0.05	0.84± 0.09	*
	Cont.	1.20± 0.01	1.13± 0.01	0.96± 0.12	1.09± 0.11	
Triglycerides (g/l)	Exp.	1.42 ±0.07	1.23± 0.04	0.86± 0.08	0.84 ±0.06	*
	Cont.	1.46± 0.09	1.25± 0.10	1.15 ±0.03	0.86 ±0.06	

* mean values were significantly different (p≤0.01); NS: not significant

REFERENCES

Al-Mansour S, Al-Khalf A, Al-Homidan I and Fathi MM (2011). Feed efficiency and blood hematology of broiler chicks given a diet supplemented with yeast culture. International Journal of Poultry Science 10 (8): 603-607.

Arslan M, Ozcan M, Matur E, Cotelioglu U and Ergul E (2004). The effects of probiotics on leptin level, body, liver, and abdominal fat weights during the rapid growth phase of broilers. Indian Veterinary Journal, 81: 416-420.

Barton M (2000). Antibiotic use in animal feed and its impact on human health. Nutrition Research Reviews, 13: 299-279.
Bach Knudsen KE (2001). Development of antibiotic resistance and options to replace antimicrobials in animal diets. Proceedings of the Nutrition Society, 60: 291-299.
Cavazzoni V, Adami A and Castrovilli C (1998). Performance of broiler chickens supplemented with *Bacillus coagulans* as probiotic. British Poultry Sciences, 39(4): 526-529.
Coppola M and Turnes CG (2004). Probiotics and immune reponse. Ciencia Rural., Santa Maria, 34 (4): 1297-1303.
Djouvinov D, Stefanov M, Boicheva S and Vlaikova T (2005). Effect of diet formulation on basis of digestible amino acids and supplementation of probiotic on performance of broiler chicks. Trakia Journal of Sciences, 3(1): 61-69.
Franco SG, Pedroso CA and Grigoletti CE (2005). Effect of inclusion of yeast (*Saccharomyces cerevisae*) associated or not with antibiotics in broilers. Ciencia Animal Brasileira, 6(2): 79-85.
Hofacre CL, White DG, Maurer J, Morales C, Lobsinger C and Hudson C (2001). Characterization of antibiotic-resistant bacteria in rendered animal products. Avian Diseases, 45(4): 953-961.
Jin IZ, Ho Y, Abdullah N and Jaludin S (2000). Digestive and bacterial enzyme activities in broilers fed diets supplemented with *lactobacillus* cultures. Poultry Science, 79: 886-891.
Johri TS (2004). Dietary additives for enhancing nutritional value of feeds. FAO-Roma
Kabir SML, Rahman MM, Rahman MB and Ahmed SU (2004). The dynamic of probiotics on growth performance and immune reponse in broilers. Poultry Science , 3(5): 361-364.
Kalavathy R, Abdullah N, Jalaludin S and Ho YW (2003). Effects of *lactobacillu*s cultures on growth performance, abdominal fat deposition, serum lipid and weight of organs of broiler chickens. British Poultry Sciences, 44(1): 139-144.
Kalavathy R, Abdullah N, Jalaludin S, Wong M.C and Ho YW (2006). Effects of *lactobacillus* feed supplementation on cholesterol, fat content and fatty acid composition of the liver, muscle, and carcass of broiler chickens. Animal Research., 55: 77-82.
Kanashiro AM, Bottino JA, Ferreira F, De Castro AG and Ferreira AJ (2001). Influence of probiotic continuous administration to broilers on serum enzymes activities and serum cholesterol concentration. Arquivo Instituto Biologia, Sao Paulo, 68(2): 11-17.
Karaoglu M and Durdag H (2005). The influence of dietary probiotic (*saccharomyces cerevisiae*) supplementation and different slaughter age on performance, slaughter and carcass properties of broilers. International Journal of Poultry Science, 4(5): 309-316.
Lim HL, Kim SY and Lee WK (2004). Isolation of cholesterol-lowering lactic acid bacteria from human intestine for probiotic use. Journal Veterinary Science, 5(4): 391-395.
Mercenier A , Pavan S and Pot B (2002). Probiotics as biotherapeutic agents : Present knowledge and future prospects. Current Pharmaceutical Design, 8: 99-110.
Miazzo RD, Peralta MF and Picco M (2005). Productive performance and carcass quality in broilers fed yeast (*S.cerevisae*). Revista Electronica de veterinaria RedVET, 6, 12.
Pelicano ER, De Souzaa PA , Souzaa HB, Leonel FR, Zeola NB and Boiago M (2004). Productive traits of broilers chickens fed diets containing different growth promoters. Revista Brasileiria de Ciencia do Solo, 6(03): 177-182.
Pereira DI, Mc Cartney AL and Gibson GR (2003). An *in vitro* study of the probiotic potential of a bile-salt-hydrolyzing *lactobacillus fermentum* strain and determination of its cholesterol-lowering prperties. Applied and Environmental Microbiology, 69(8): 4743-4752.
Ramirez RB, Zambrano SO, Ramirez PY, Rodriguez VY and Morales M.Y (2005). Evaluacion del efecto probiotico del *lactobacillus spp*. Origen aviar en pollitas de inicio reemplazo de ponedora comercial en los primeros 42 dias de edad. Revista Electronica de veterinaria RedVET, 6: 9.
Revington B (2002). Feeding poultry in the post-antibiotic era. Multi-State Poultry Meeting. http://ag.ansc.purdue.edu/poultry/multistate/multi-state.pdf.
Shareef A M and Al-Dabbagh ASA (2009). Effect of probiotic (Saccharomyces cerevisiae) on performance of broiler chickens. Iraqi Journal of Veterinary Sciences, Vol. 23, Supplement I, 2009 (23-29).
Silva EN, Teixeira AS, Bertechini AG, Ferreira CF and Ventura BG (2000). Performance the broiler for chickens in diets with probiotics, antibiotics, and two different phosphorus sources. Ciencia i Agrotecnologia, Lavras, 24, 225-232.
Siwicki AK, Bielecka M, Wjcik R and Biedrzycka E (2005). Effect of selected probiotics on non-specific cellular and humoral defense mechanisms and protection against salmonellosis-experimental study in broiler chicken. Roadshow 3. Guthealth support. Poland.
Stella Alberto V, Fava M, Bersani C, Del Degan G, Savoini G and Chevaux E (2005). Effets de l'addition de *pediococcus acidilactici* dans la ration de poulet de chair sur les performances zootechniques et la microflore intestinale. 6eme Journées de la Recherche Avicole, St-Malo, 208-211.

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RESPONSE OF BROILER CHICKENS TO DIETS CONTAINING VARYING LEVELS OF LEUCAENA (*Leucaena leucocephala)* LEAF MEAL

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ABSTRACT: *A six-week experiment was conducted to assess the response of Cobb broiler chicks to diets containing varying levels (0%, 5%, 10% and 15%) of Leucaena leaf meal (LLM). The 4 dietary treatments were allotted to the birds in a completely randomized design. Each treatment consisted of three replicates, with fifteen birds per each replicate. The birds were fed experimental starter diets (14-28 d) and finisher diets (28-56 d). Feed and water were provided ad libitum. Final weight, growth rate and feed conversion ratio significantly (P<0.05) declined as the level of LLM in the diets increased. Dressed and carcass weights also reduced significantly (P<0.05) with increasing level of LLM in the diets. All organ characteristics except liver kidney were significantly (P<0.05) affected by dietary treatments. Haematological variables were also not affected (P<0.05). The total cholesterol and Low Density Lipoprotein of serum decreased (P<0.05) when LLM was included to the diets. Feed cost reduced when LLM was incorporated in the diets, but the net revenue declined as LLM in diet increased. In this study inclusion of LLM in diets for broiler chickens did not affect their health status, but rather depressed their growth.*

ORIGINAL ARTICLE

Key words: *Feed cost, haematology, Leucaena leaf meal, performance, serum biochemistry*

INTRODUCTION

The meat and eggs from poultry are estimated to contribute between 20 and 30% of the total animal protein supply in many developing countries (FAO, 2004), thus, filling the gap for animal protein needs of people. However, feed cost remains a major challenge for efficient poultry production in developing countries. It accounts for about 80% of the total cost of production (El Boushy and Van Der Poel, 2000). Ani *et al.* (2009) advocated that any attempt to increase poultry production needs to focus on the utilization of cheap and locally available ingredients.

A possible cheap source of protein that can be exploited for this purpose is the leaves of tropical legumes and browse plants (Agbede and Aletor, 2003). However, constraints to the utilization of leaf meals as protein sources include high fibre content and presence of anti-nutritional factors (Tewe, 1991). One plant of interest is *Leucaena leucocephala.*

It is a vigorous and drought-resistant leguminous tree whose high protein leaves has been widely used in ruminant animal feeds in the tropics (Nuttaporn and Naiyatat, 2009). Ayodeji (2005) recorded 25.1% crude protein in the fresh leaves of leucaena. Eniolorunda (2011) reported proximate composition of leucaena leaf meal to be 88.2% dry matter, 21.8% crude protein, 15.1% crude fibre, 3.1% ash, 8.6% ether extract, and 50.7% nitrogen free extract.

There is lack of information on the usefulness of Leucaena leaf meal in poultry diets. Therefore, the objective of this study was to determine the effects of incorporating different levels of LLM on the performance of broiler chickens.

MATERIALS AND METHODS

Experimental diets and preparation of leucaena leaf meal (LLM)

Fresh leaves of *Leucaena leucoceplala* were harvested from a year-old leucaena stands on the premises of the College of Agriculture, University of Education, Winneba, Mampong campus. The branches were cut and spread out on a clean concrete floor of well ventilated room for a period of 3-4 days until they became crispy. The leaves were separated from the twigs and milled in a hammer mill to obtain the leaf meal.

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Chemical analysis of LLM and experimental diets

Samples of the LLM and experimental diets were subjected to proximate analysis using standard methods (AOAC, 1990) and results shown in Table 1.

Experimental design and statistical analysis

One hundred and eighty (180) day-old Cobb broiler chicks were procured from Darko Farms and Company, Kumasi. They were initially brooded for two weeks. At two weeks of age they were divided into four treatment groups with three replicate per each treatment, giving 15 birds per replicate in a Completely Randomized Design (CRD). The birds were allocated in such a way as to ensure that the average bird weight per replicate was around 260 g. Feed and water were provided *ad libitum* and all required managerial practices were the same for each treatment group. Daily feed intake and individual bird weights were recorded before and at the end of the experimental. Daily weight gains and feed conversion efficiency were calculated. Economics of production were also calculated at the end of the study. The data were analyzed using the analysis of variance (ANOVA) technique and differences among means were separated by means of Duncan multiple range test. Statistical significance was determined at P=0.05.

Haematology and blood serum biochemistry analysis

Blood samples were obtained from two birds per replicate making a total of six per treatment at the eighth week by inserting a new sterile needle into the wing vein of the birds and extracting 2 mls of blood which was placed inside sterile test tubes containing Ethylene Diamine Tetra Acetic Acid (EDTA). The blood samples were shaken to mix with the EDTA in order to prevent coagulation. The samples were then analyzed for Red Blood Cells (RBC), Packed Cell Volume (PCV), Haemoglobin (Hb) and White Blood Cells (WBC) using the Abbott Diagnostics Cell Dyn 3500 (Abbott Diagnostics, Abbott Park, IL) automated haematology analyzer. Again, blood samples were obtained from each bird by the same procedure into vacuumed capillary tubes to determine the blood cholesterol, triglyceride, high-density lipoprotein (HDL), low-density lipoprotein (LDL) levels, coronary risk, total protein and glucose. After coagulation, blood samples were centrifuged and then serum was collected for analysis. Blood serum biochemistry was determined by using Cobas integral 400 plus chemistry analyzer (Roche Diagnostics Ltd., Switzerland).

Carcass evaluation and chemical analysis of thigh muscle

Two birds were randomly selected from each replicate at the end of the study. They were weighed and killed. The birds were killed by severing the carotic arteries. They were bled and immersed in hot water for 5 minutes to loosen feathers. The defeathered carcass was weighed. After dressing, the following weights were taken: carcass weight, dressed weight, gizzard, liver, heart, neck, shanks, and intestine. Proximate composition of thigh muscle was also determined using the procedure of AOAC (1990).

RESULTS AND DISCUSSION

Results of proximate analysis of leucaena leaf meal are presented in Table 1. It reveals that it is rich in protein (23.00%) and high in fiber (14.30%) and ash (11.20%). The crude protein content was higher than those (23.0% and 21.3%) obtained respectfully by Onibi et al. (2008) and Hussain et al. (1991). The final body weight, mean body weight gain and feed conversion efficiency declined significantly (P<0.05) as the level of LLM increased in the diets (Table 3).

Other studies involving chickens and laying hens show that, feed intake, live weight gain and egg production declined when *Leucaena leucocephala* leaf meal was included at 5 %, 20 % and 30 % of the diet (Scott et al., 1982). This poor performance may be attributed to the high fiber and the presence of anti-nutritional factors such as mimosine in leucaena leaves. High fiber diet exerts deleterious effects through depressed nutrient absorption as a result of extensive disruption of intestinal microvilli (Moharrery and Mohammed, 2005). Mimosine also affects thyroid function, leading to poor growth (Nuttaporn and Naiyatat, 2009). According to Natanman *et al.*, (1996), 5% inclusion rate of leucaena leaf meal is recommended for broilers since it gives higher feed conversion. This was however not the case in the present study.

Table 1 - Proximate Composition of LLM (%)

Proximate fraction	%
Moisture	8.65
Crude protein	23.44
Crude fibre	14.30
Ash	11.20
Ether extract	6.40
Nitrogen free extract	36.01

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Table 2 - Percentage Composition of Experimental Diets

Items / Ingredient	Starter phase				Finisher phase			
	0% LLM	5% LLM	10% LLM	15% LLM	0% LLM	5% LLM	10% LLM	15% LLM
Maize	58	58	58	58	60	60	60	60
Fish Meal (64% CP)	10	10	7	7	6	6	6	6
Fish Meal (52% CP)	7	2	2	2	4	4	4	4
Leucaena leaf meal	0	5	10	15	0	5	10	15
Soybean meal	10.5	10.5	10.5	5.5	13	10	5	2
Wheat bran	12	12	10	10	12	12	10	10
Oyster shell	1	1	1	1	1	1	1	1
Vit/mineral premix	0.5	0.5	0.5	0.5	0	0	0	0.5
Salt	0.5	0.5	0.5	0.5	0	0.5	0.5	0.5
Di-calcium phosphate	0.5	0.5	0.5	0.5	1	1	1	1
Proximate analysis (% DM)								
Moisture	8.63	8.00	8.54	8.48	8.45	8.06	8.19	8.33
Crude protein	20.32	20.01	20.18	20.09	17.73	17.15	17.01	17.10
Crude fibre	3.33	4.82	5.59	6.87	3.11	3.06	7.97	6.81
Ether extract	4.24	4.72	4.37	4.34	3.89	3.78	4.47	4.90
Ash	3.12	3.15	3.32	3.46	3.12	2.87	2.44	2.45
Nitrogen free extract	59.78	59.30	58.00	56.76	63.70	65.08	59.92	60.41
Calculated composition (%)								
ME (K cal/kg)	2605	2611	2601	2600	2880	2878	2878	2880
Calcium	1.04	1.54	1.02	1.13	1.02	0.95	0.47	0.95
Phosphorus	0.70	0.74	0.53	1.30	0.64	0.57	0.51	0.50
Lysine	1.38	1.19	1.02	0.86	1.22	1.04	0.91	2.35
Methionine	0.44	0.32	0.31	0.28	0.36	0.32	0.95	0.26

*Composition of vitamin/mineral premix per kg: Vitamin E, 25mg; Vitamin A, 6250 IU; Vitamin D3, 1250 IU; Vitamin K3, 25mg; Vitamin B1, 25mg; Vitamin B2, 60mg; Vitamin B6, 40mg; Vitamin B12, 2mg; Elemental calcium, 25mg; Elemental phosphorus, 9mg; Elemental magnesium, 300mg; Iron, 400mg; Selenium 1.0mg, Iodine 20mg, Copper 60mg, Magnesium 100mg, cobalt 10mg, Zink, 150mg; Sodium Chloride, 1.5mg; Choline Chloride, 500mg; Live Lactobaccillus spore, 0.2 million cfu; Niacin, 40mg; Folic Acid, 10mg; d-Biotin, 5mcg.

Table 3 - Effect of LLM Meal on Performance of Birds

Variable	Level of dietary LLM (%)					
	LLM_0	LLM_5	LLM_{10}	LLM_{15}	P	SEM
Mean Initial Body Weight (g)	260.7	260.6	361.4	260.3	0.14	5.14
Mean Final Body Weight (g)	2236.7^{a}	1598.3^{b}	1380.0^{c}	1176.7^{cd}	0.00	90.98
Mean Total Body Weight Gain (g)	1983.3^{a}	1436.7^{b}	1118.3^{c}	915.0^{cd}	0.00	1211.30
Mean Daily Weight Gain (g)	47.3^{a}	34.2^{b}	26.6^{c}	21.8^{c}	0.00	2.85
Mean Feed Intake (g/day)	112.4^{a}	116.5^{a}	108.5^{ab}	97.5^{c}	0.00	2.31
FCE (Feed/Gain)	2.4^{a}	3.4^{b}	4.1^{bc}	4.5^{cd}	0.02	0.37
Mortality (%)	0.0^{a}	6.6^{b}	2.2^{a}	0.0^{a}	0.01	0.24
Feed cost/kg diet (GH₵)	1.1	1.1	0.9	0.9	-	-
Feed cost/bird (GH₵)	5.1	5.1	0.9	0.9	-	-
Price/bird at 8 weeks (wt/kg) (GH₵)	6.0	6.0	6.0	6.0	-	-
Value/ bird (GH₵)	13.4	9.6	8.3	7.1	-	-
Net revenue/bird (GH₵)	8.3	4.5	4.2	3.4	-	-

SEM = Standard error of mean; Treatment means with different superscripts within the same row are significantly different at p<0.05.

Table 4 - Effect of LLM Meal on Organ Weights of Broiler Chickens

Variable	Level of dietary LLM (%)					
	LLM_0	LLM_5	LLM_{10}	LLM_{15}	P	SEM
Dressed Weight (g)	1481.3^{a}	1267.3^{a}	1189.0^{b}	838.0^{c}	0.04	-
Dressing Percentage (%)	88.9^{a}	81.3^{b}	78.6^{b}	81.6^{b}	0.02	2.90
Carcass weight (g)	1665.7^{a}	1555.3^{a}	1513.3^{a}	1080.0^{b}	0.01	119.64
Liver (g)	53.7^{a}	22.0^{b}	44.0^{ab}	26.0^{bc}	0.03	9.49
Kidney (g)	1.0	1.0	1.0	1.0	-	-
Heart (g)	8.7^{ab}	7.0^{b}	9.0^{ab}	5.7^{bc}	0.29	0.97
Full crop (g)	8.0^{a}	13.0^{b}	8.3^{a}	9.0^{a}	0.04	1.03
Empty crop (g)	8.0^{a}	10.3^{a}	8.3^{a}	7.7^{b}	0.10	1.00
Full proventriculus (g)	9.0^{a}	10.0^{b}	8.0^{c}	7.3^{d}	0.00	0.24
Empty proventriculus (g)	9.0^{a}	9.0^{b}	8.0^{c}	6.7^{d}	0.00	0.47
Full gizzard (g)	58.7^{a}	50.7^{ab}	52.3^{ab}	44.7^{b}	0.04	4.53
Empty gizzard (g)	45.7^{a}	35.7^{b}	39.3^{ab}	30.3^{bc}	0.03	4.09
Small intestine:						
Full (g)	105.3^{ab}	109.0^{a}	116.3^{a}	90.0^{ab}	0.05	7.80
Empty (g)	66.3^{a}	68.0^{a}	62.7^{a}	52.7^{b}	0.21	4.04

SEM = Standard error of mean; $^{a,b,c,d:}$ Treatment means with different superscripts within the same row are significantly different at p<0.05.

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The feed cost of raising broilers progressively decreased with increasing levels of LLM such that it was cheaper to raise them on LLM based diets than the control diet; but economic analysis showed decreasing returns with increasing dietary levels of LLM. This was so because of the poor growth performance of the birds fed the LLM. The LLM diets gave the lowest financial returns averaging 51.5% lower than the control diet.

All carcass and organ characteristics measured (Table 5), except kidney, were significantly influenced ($P>0.05$) by dietary treatments. The dressed weight tended to decrease with higher inclusion of leucaena leaf meal.

There was a significant ($P<0.05$) increase in the fat contents of the muscles with increasing levels of LLM in the diets. This suggests that LLM would promote fat deposition in broiler chickens. This finding is not good because consumption of high levels of fat has been associated with high incidence of coronary heart diseases in human. A reduced dietary fat intake is therefore recommended. It was observed that fat concentration in thigh muscle of birds has a negative correlation with the cholesterol contents in serum.

Table 5 - Effect of LLM Meal on Meat Quality

Variable	Level of dietary LLM (%)					
	LLM_0	LLM_5	LLM_{10}	LLM_{15}	P	SEM
Moisture	62.1^a	70.2^b	60.4^c	68.6^d	0.00	0.05
Protein	51.6^a	65.5^b	47.0^c	56.4^d	0.00	0.00
Fat	31.5^a	33.0^b	36.0^c	43.5^d	0.00	0.00

SEM = Standard error of mean; $^{a,b,c,d:}$ Treatment means with different superscripts within the same row are significantly different at $p<0.05$.

The results of haematological variables suggested that though sub-clinical effects (growth depression and less feed intake) were observed, the experimental diets did not precipitate detrimental effect on the health status of broiler chickens. All the values recorded compete favourably with normal ranges for broiler chicken (Table 6) as stated by Campbell et al. (2003). Hematological parameters are usually related to health status and are of diagnostic importance in clinical evaluation of the state of health. They are good indicators of physiological, pathological and nutritional status of an animal. Changes in haematological parameters have the potential of being used to elucidate the impact of nutritional factors in diet on animals. In this study, addition of LLM to the broiler diet was shown to reduce serum cholesterol concentration. Broiler chickens fed animal-based protein diet tend to have higher total plasma cholesterol than those fed plant-based protein (Ogboko, 2011). Most of the circulating cholesterol is carried in birds by high-density lipoprotein cholesterol and LDL (Zantop, 1997). A high blood level of total cholesterol is a major risk factor for heart disease, along with high levels of LDL. The higher the LDL level, the higher the risk.

Table 6 - Effect of LLM on Blood Variables

Variable	Level of dietary LLM (%)					
	LLM_0	LLM_5	LLM_{10}	LLM_{15}	P	SEM
WBC ($x10^3/\mu L$)	233.7	220.6	233.9	241.8	0.25	9.59
RBC ($x10^6/\mu L$)	2.4	2.1	2.4	2.7	0.29	0.27
HGB (g/dL)	9.4	8.2	9.3	10.1	0.33	90.97
HCT (%)	29.6	26.7	30.5	32.4	0.35	3.00
MCV (fL)	123.0	127.5	125.1	121.0	0.22	2.91
MCH (pg)	39.0	39.1	38.3	37.8	0.39	0.82
MCHC (g/dL)	31.7	30.7	30.3	31.2	0.23	0.23

SEM = Standard error of mean; $^{a,b,c,d:}$ Treatment means with different superscripts within the same row are significantly different at $p<0.05$.

Table 7 - Effect of LLM on Blood Variables

Variable	Level of dietary LLM (%)					
	LLM_0	LLM_5	LLM_{10}	LLM_{15}	P	SEM
Total cholesterol (mmol/L)	3.3^a	2.7^b	2.7^b	2.9^b	0.01	0.16
Triglyceride (mmol/L)	1.3	1.5	1.4	2.2	0.20	0.43
HDL-Cholesterol (mmol/L)	2.2	2.0	2.0	1.9	0.24	0.17
LDL	0.5^a	0.1^b	0.2^b	0.2^b	0.00	0.07
Coronary Risk	1.5	1.3	1.4	1.6	0.20	0.10
VLDL	0.6	0.7	0.6	1.0	0.21	0.21
Total protein (g/L)	39.3	36.8	33.2	31.1	0.28	4.17
Glucose (mmol/L)	11.5	12.8	12.6	11.7	0.76	2.07

SEM = Standard error of mean; $^{a,b,c,d:}$ Treatment means with different superscripts within the same row are significantly different at $p<0.05$.

CONCLUSION

Results of this study indicate that the inclusion of LLM in diets as low as 5% had adverse effects on the growth performance and economy of gain of broiler chickens.

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REFERENCES

Agbede JO, Aletor VA (2003). Comparative evaluation of weaning foods from Gliricidia and Leucaena leaf protein concentrates and some commercial brands in Nigeria. Journal of the Science of Food and Agriculture. 84, 2-30.

Ani AO, Ugwuowo LC, Omeje OD (2009). The effects of graded levels of raw bambara nut (*Vigna subterranean*) waste and supplementary enzyme on the conformational characteristics of broiler finishers. Proc. of 34th Ann. Conf. Nig. Soc. Anim. Prod. March 15th-18th

Association of Official Analytical Chemists (1990). Association of official analytical chemists, official methods of Analysis, 15th Ed. AOAC Incorporation Virginia. U.S.A

Ayodeji OF (2005). Nutrient composition and processing effect on cassava leaf (*Manihot esculenta*, Crantz) antinutrients. Pakistan Journal of Nutrition. 4 (1), 37-42.

Campbell JR, Kenealy MD. and Campbell KL (2003). Anatomy and Physiology of Farm Animals. In: Animal Sciences. The biology, care and production of domestic Animals. 4th Edition. McGraw Hill Company Inc. New York. Pp.179-202.

El Boushy ARY, Van Der Poel, AFB (2000). Handbook of Poultry Feed from Waste: Processing and Use, 2 Edn., Kluwer Academic Publishers, Dordrecht, Netherlands

Eniolorunda OO (2011). Evaluation of biscuit waste meal and *Leucaena leucocephala* leaf hay as sources of protein and energy for fattening "yankassa" rams. African Journal of Food Science Vol. 5(2), 57 - 62

Esonu BO, Iheukwumere FC, Iwuji TC, Akamu N, Nwugo OH (2003). Evaluation of *Microdesmis puberula* leaf meal as feed ingredient in broiler starter diets. Nig. J. Anim. Prod. 30, 3-8.

Food and Agricultural Organization (2004). Small Scale Poultry Production. Animal Production and Health. Village Poultry Consultant. Waimana, New Zealand, pp: 1-5.

Hussain J, Satyanarayana PVV, Reddy VR (1991). Utilization of Leucaena leaf meal by broilers. Br. Poult. Sci., 32:131-137

Moharrery A and Mohammad AA (2005). Effect of diet containing different qualities of barley on growth performance and serum amylase and intestinal villus morphology. Int. J. Poultry Sci. 4(8) : 549-556.

Natanman R, and Chandrasekaran D (1996). Subabul leaf meal (*Leucaena leucocephala*) as a protein supplement for broilers. Indian Vet. J., 73 (10): 1042-1044.

Nuttaporn C and Naiyatat P (2009). The reduction of mimosine and tannin contents in leaves of *Leucaena leucocephala.* Asian Journal of Food and Agro-Industry, S137-S144

Ogboko B. (2011). Lipid profile of broiler fed bacitracin on plant and animal protein diets. Int. J. of Poult. Sci. 10(7): 567-573

Onibi, GR, Folorunso OR and Elumelu, C. (2008). Assessment of partial Equi-protein replacement of soyabean meal with cassava and leucaena leaf meals in the diets of broiler chicken finishers. Int. J. Poult. Sci., 7: 408-413

Scott ML, Nesheim MC, Young RJ (1982). Nutrition of chicken. ML Scott and Associates publishers, Ithaca, NY, USA.

Tewe OO (1991). Detoxification of cassava products and effects of residual toxins on consuming animals. Feeding Proceedings of the FAO Expert Consultation (Eds. D. Machin and S. Nyoid) Columbia. 21-25 January. pp: 16.

Zantop DW (1997). Avian medicine: Principles and Applications. Wingers Publ. Inc., pp 115-129.

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ANTINUTRITIONAL FACTORS IN SORGHUM: CHEMISTRY, MODE OF ACTION AND EFFECTS ON LIVESTOCK AND POULTRY

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ABSTRACT: *Sorghum basically contains two major anti-nutritional factors; tannin, a polyphenolic compound located in the grain and, dhurrin a cyanogenic glucoside located mainly in the aerial shoot and sprouted seeds. Tannins are high in sorghum with brown pericarp and no testa and very low in unpigmented grains. The main anti-nutritional effects of tannins are: reduction in voluntary feed intake due to reduced palatability, diminished digestibility and utilisation of nutrients, adverse effects upon metabolism and toxicity. The level of tannins present in sorghum seems to be the predominant factor that influences its nutritional value. Drying, soaking, grinding and pelleting appear to reduce tannin content in feedstuffs while diet supplementation with methyl group donors like choline and methionine reduce the problems associated with tannins in livestock. Dhurrin, on enzyme action readily yields hydrogen cyanide (HCN). The quantity of HCN in sorghum varies with cultivar and the growth condition but diminishes with age. Excess cyanide ion can quickly produce anoxia of the central nervous system through inactivating the cytochrome oxidase system and death can result within a few seconds. Making fodder into hay or silage however, destroys the poison.*

ORIGINAL ARTICLE

Key words: *Tannin, Dhurrin, Sorghum, Livestock, Poultry*

INTRODUCTION

Many plant components have the potential to precipitate adverse effects on the productivity of farm livestock (D'Mello, 2000). These compounds are present in the foliage and/or seeds of virtually every plant that is used in practical feeding. These compounds are often called anti-nutritional factors. Anti-nutritional factors are also those generated in natural feedstuff by the normal metabolism of the specie from original materials and by different mechanisms exert effects contrary to optimum nutrition (Chubb, 1982). Anti-nutritional factors may be grouped according to their mode of action as follows;

- Substances depressing digestion or metabolic utilisation of protein e.g. protease inhibitors, lectins (haemagglutinins), saponins and polyphenolic compounds
- Substances reducing or interfering with the utilisation of mineral elements e.g. Phytic acid, oxalic acids, gluccosinolates and gossypol
- Substances inactivating or increasing the requirements of certain vitamins e.g. Anti-vitamins A, D, E and K, anti-thiamine, nicotinic acid, pyridoxine and cyanocobalamin.

Some anti-nutritional factors may however exhibit more than one mode of activity (Liener, 1980; Jaffe, 1980; Chubb, 1982). Sorghum [*Sorghum bicolour* (L) Moench] is widely grown in the semi-arid and savannah regions of Nigeria. Maunder (2002) reported that sorghum is a traditional crop of much of Africa and Asia and an introduced and hybridized crop in the western hemisphere. It benefits from an ability to tolerate drought, soil toxicities and temperature extremes effectively than other cereals. Sorghum grains contain about 92.50% dry matter, 3270.00kcal/kg metabolisable energy for poultry, 9.50% crude protein, 2.55% ether extract, 2.70% crude fibre, 1.25% ash and 76.60% nitrogen free extract (NFE). Its protein is slightly higher than maize but as with most cereals deficient in lysine and tryptophan. More importantly, some varieties of sorghum grain have been reported to contain anti-nutritional factors chiefly tannin which binds proteins and impair digestion (Oyenuga, 1968; Aduku, 1993; Olomu, 1995; Tacon, 1995; Ngoka, 1997; Aletor, 1999. Aduku, 2004 and Etuk and Ukaejiofo, 2007).

This article discusses the chemistry, mode of action and effects of two important anti nutritional factors in sorghum; tannin and dhurrin on livestock and poultry.

ANTINUTRITIONAL FACTORS IN SORGHUM

Sorghum basically contain two important anti-nutritional factors, tannin, a polyphenolic compound located in the grain (Purseglove, 1972; Ologhobo et al, 1993; Kumar and D'Mello,1995) and the cyanogenic glycoside, dhurrin located mainly in the aerial shoot and sprouted seeds (Olomu, 1995; Oduguwa and Fafiolu, 2004).

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TANNIN: CHEMISTRY, DISTRIBUTION AND MODE OF ACTION

Chemistry

Tannins are water soluble polyphenolic heterogeneous compounds having molecular weight in excess of 5000 daltons and the ability to precipitate gelatine and other proteins from aqueous solution (de Lumen and Salamat, 1980; Singleton and Kratzer, 1973; Kumar and D'Mello, 1995). Tannins are generally considered to consist of polyphenolic systems of two types: the hydrolysable tannins (HT) (pyrogallol class), with esters of glucose and acids such as chebulic, ellagic, gallic and m-digallic and the condensed tannins (CT) (catechol tannins), based on leuco-anthocyanidin and like substances (Etherington and Roberts, 1982; Kumar and D'Mello, 1995). The pyrogallol tannins are readily hydrolysed by acids, bases and enzymes. Tannic acid, a gallotannin is a well known member of the group and contains 8-10 moles of gallic acid per mole of glucose (Fig.1). The commercial tannic acid has a chemical formula of $C_{76}H_{52}O_{46}$ though it contains a mixture of related compounds. Ellagitannins is another HT group member (Merck Index, 1976; Salunkhae et al, 1990; Kumar and D'Mello, 1995). HT is abundant in leaves, fruits, pods and galls of dicotyledons but not detected in monocotyledons (Lewis and Yamamoto, 1989). Condensed tannins are not hydrolysable and widespread, typically producing anthocyanidins on acid degradation. CT contains the familiar flavonoid skeleton, epicatechin and catechin linked together (Fig. 2). Flavan-3-ols and Flavan-3-4-diols linkages are commonly recognized (Porter, 1992; Salunkhae et al, 1990; Kumar and D'Mello, 1995). The pH has an effect on complex formation of tannin and protein. CT can react and form complexes by H-bonding with carbohydrates and proteins but at neutral pH form stronger bonds with proteins (McLeod, 1974). Condensed tannin in protein complex is stable and insoluble in the pH range of 3.5 – 7.0 but unstable and releases protein at pH of < 3.0 and >8.0 (Jones and Mangan, 1977). CT are widespread in legume forages (D'Mello, 1995) and sorghum (D'Mello, 2005).

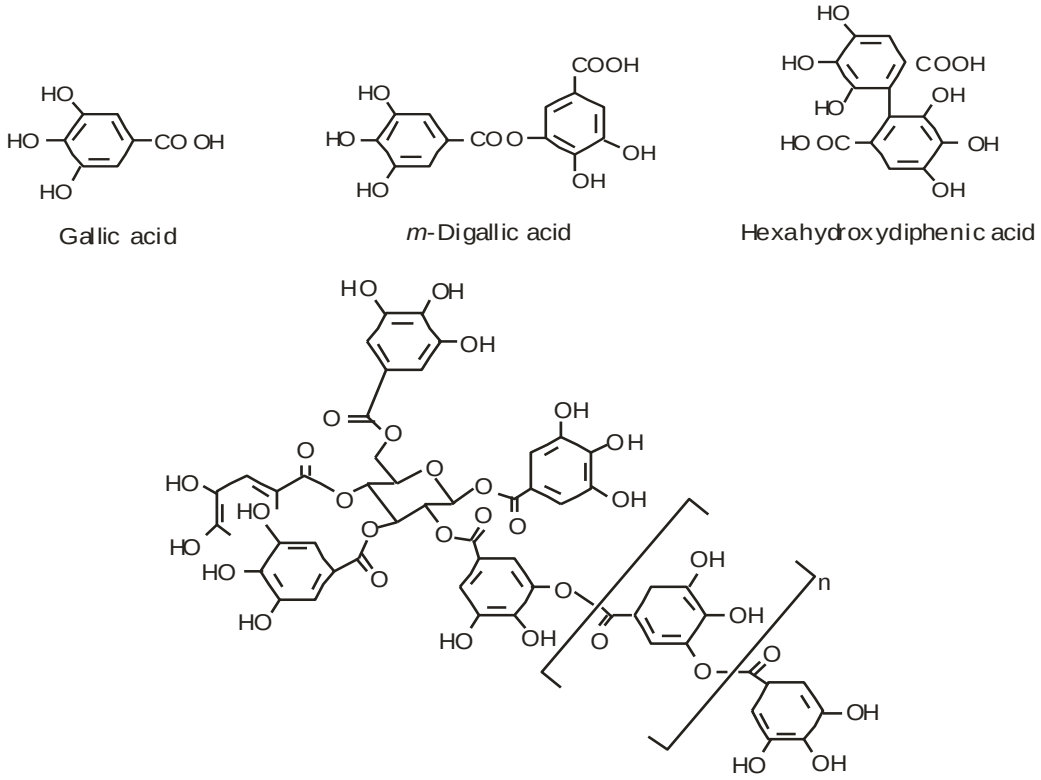

Fig. 1 - Constituents of hydrolysable tannin and structure of tannic acid (Source: Kumar and D'Mello, 1995)

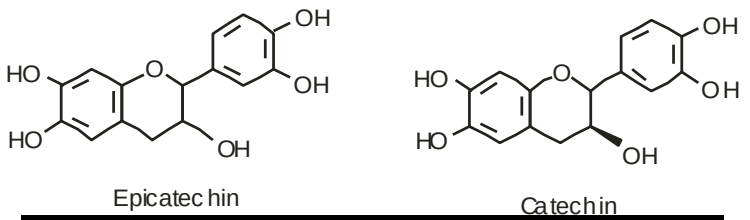

Fig. 2 - Constituent flavonoids of condensed tannins (Source: Porter, 1992).

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Distribution

Atteh (2002) reported that sorghum, especially the brown variety contains high levels of tannins and Purseglove (1972) opined that sorghum grain with testa contain tannins in varying proportion depending on variety, with certain strains containing up to 5%. It has been reported (Aningi et al., 1998) that polyphenols are high in sorghum with brown pericarp and no testa and very low in unpigmented grains. This characteristic has been utilised to develop sorghum varieties and hybrids to deter birds (Carter et al., 1989) because they are less palatable and tenacity of some bacteria is low (Schrägle and Müller, 1990). Etuk and Ukaejiofo (2007) reported 0.42% tannin content in brown coat coloured sorghum while Subramanian and Metta (2000) reported that the local Indian sorghum variety and ICSV 112 variety developed by ICRISAT and grown in India contain no tannins. 0.40% tannin was reported for samsorg 17, a variety previously coded (SSV) -3 (SK5912) and developed from local collections of Kaura through mutation breeding at the Institute of Agricultural Research (IAR), Samaru, Nigeria. ICSV 400, released by ICRISAT in 1996 recorded tannin value of 0.69% (IAR, 1995; NCGRB, 2004, Etuk, 2008). Red sorghum on the other hand contains about 23g/kg tannins which when reconstituted reduced to 16g/kg (Kumar et al., 2007).

Tannins are also found in soybean, sunflower seeds, faba beans and alfalfa and in browse plants like *Daniella oliveri* (Osakwe et al., 2004), sunflower seeds, *Leuceana leucocephala*, *Sesbania grandiflora, Acacia salicina* (Norton, 1994; D'Mello, 1995; Kumar and D'Mello, 1995). Drying, soaking, grinding and pelleting has been reported to reduce tannin content in feedstuffs while diet supplementation with methyl group donors like choline and methionine reduce the problems associated with tannins in livestock (Singleton and Kratzer, 1969; Atteh, 2002).

Mode of Action

Tannins reduce protein digestibility through the formation of complexes and the inhibition of activities of proteolytic enzymes in digestive secretions (Ahn et al., 1989; Kumar and D'Mello, 1995; Grosjean et al., 1999). The affinity of tannins for protein has been observed to increase with increase in molecular size of tannins. However tannins with extremely large molecular weight lose their affinity for protein and become insoluble (Kumar and Horigome, 1986). Proteins with high proline content impart an open structure which contains readily accessible sites for hydrogen bond formation with tannins (Hagerman, 1989). The polyphenols in brown sorghum may have a binding effect on minerals (Aningi et al., 1998).

Recent studies also revealed that polyphenols of the procyanidins (CT) have an antioxidant property (Corder, 2006) while tannic acid has anti-bacterial, anti-enzymatic and astringent property as well as constringing action upon mucous tissues. The ingestion of tannic acid causes constipation so it can be used to treat diarrhoea in the absence of inflammation (Phytolab, 2007).

EFFECT OF TANNINS ON LIVESTOCK

Ruminants appear to be more tolerant of CT than non-ruminants though ingestion of hydrolysable tannins can cause death (Ahn et al., 1989 and Norton, 1994). Condensed tannins present in legumes and browse trees according to Osakwe et al. (2000) may result in tannin protein complex formation and inhibit microbial attack. Primary effects of impaired rumen function, depressed feed intake, wool growth and live weight gains have been reported in sheep fed diets containing CT (D'Mello, 2000; Salem et al., 2005). Others are reduced palatability and diminished digestibility (D'Mello, 1982; Ola et al., 2005). Moderate levels of tannin (30 – 40g/kg legume dry matter) may however result in nutritional advantages in respect of increased bypass protein availability and bloat suppression in cattle (D'Mello, 2000). Feeding up to 30g/kg DM of wattle tannin extract nevertheless failed to show any improvement in protein status and therefore growth performance of goats to a considerable degree (Bengaly et al., 2007). Levels of CT above 60 – 100g/kg DM is considered to depress intake and growth (Bary and Duncan, 1984; van Hoven and Furstenburg, 1993). Feeding *Danielli oliveri* browse which contain 48g CT/kg DM to WAD sheep showed inhibitory effect on organic matter and detergent fibre digestibility (Osakwe, *et al.*, 2004). Tannin digestibility of 99.70% - 99.90% has been reported in goats fed *Tephrosia bracteoluta* which contains 0.40g of tannins (Ogungbesan et al., 2006).

Plant protein degradation in the rumen and decreased rumen availability of sulphur, which then depress the digestibility of plant cell wall has been reported (Norton, 1994). It is also possible that there is inhibition of microbial enzymes in the rumen and decreased availability of plant proteins for digestion in the intestine (Kumar and Singh, 1984; Bary and Duncan, 1984; Makkar et al., 1989). Binding of proteins to cell wall seem to be a factor in decreasing digestibility (Reed et al., 1990) and Kemalak et al. (2004) observed a negative relationship between tannin content of leaves and in vitro dry matter digestibility. Also, tannins diminish permeability of the guts wall by reducing nutrient flow. It also affects availability of amino acid and thus utilisation of protein (Ronstango, 1972; Eggum and Christensen, 1974; Mijavilla et al., 1977). Nevertheless, some ruminal microbes have been shown to possess the ability to metabolise tannins or at least remain active in a high tannin environment and may be used as inoculants to overcome detrimental effects of tannins in ruminants (Norton, 1994).

Increased levels of plasma growth hormones have been reported with increased intake of CT by sheep (Bary et al., 1986). Limited evidence indicates that tannins may have blood sugar and cholesterol lowering effect on rats. Wildens et al. (2004) reported lowered blood urea nitrogen and increased creatinine by goats and sheep fed diets containing 5% CT/kg/ DM. No effect was, however, observed on PCV and anthelmintic activity.

Earlier, D'Mello (2000) reported that higher levels of tannins (100 – 120 CT/kg legume DM) reduced gastrointestinal parasitism in lambs. Components and level of tannins tend to exert varied influences on blood constituents. Decreased blood levels of urea nitrogen and creatinine in rats fed epicatechin 3 - 0 - gallate and procyanidin B - 2 3, 3'-di-o-gallate up to 10mg/kg body weight have been reported (Yokozawa et al., 1991). However, 12.5mg of procyanidin C produced a significant increase in blood levels of urea nitrogen, creatinine and methylguanidine, a substance which accumulates in the blood with the progression of renal failures (Yokozawa et al., 1997).

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EFFECT OF TANNINS ON POULTRY AND PIGS

The main anti-nutritional effects of tannins are: reduction in voluntary feed intake due to reduced palatability, diminished digestibility and utilisation of nutrients, adverse effects upon metabolism and toxicity (Kumar and D'Mello, 1995; Atteh, 2002; Ola et al., 2005). These effects may be achieved via several mechanisms. Tannins exert inhibitory effect on a broad spectrum of digestive enzymes at several sites in the digestive tracts of poultry (Longstaff and McNab, 1991; Ahmed et al., 1991) and piglet (Jansman et al., 1993). In a study with broiler chickens, Iji et al (2004) reported that ideal digestibility of energy, protein, arginine and leucine were reduced as dietary tannin level rose to 20g/kg diet and beyond while methionine and phenylalanine were only negatively affected at tannin levels of 25g/kg diet. Protein efficiency ratio (PER) and net protein ratio are negatively correlated with tannic acid (Oke et al., 2004). Feed conversion efficiency increased with increasing level of tannin up to 15g/kg diet while pancreatic and jejenal enzymes activities were not affected. This suggests that a wider range of factors may be involved in regulating the effect of tannins on poultry (Iji et al., 2004).

Kumar et al. (2007) showed that tannin content of 16g/kg in red sorghum had no effect on nitrogen, calcium and phosphorus retention in broiler chickens. Similarly plasma albumin, globulin, protein, glucose, calcium, phosphorus, SGOT, SGTP and uric acid levels were not affected even at 100% replacement of maize with red sorghum. Mild histopathological changes in liver and kidney tissues as well as high cell mediated immune – response were, however, observed when raw red sorghum containing 23g tannins/kg were fed to the same group of broiler chickens. Elkins et al. (1978) reported that chickens fed high tannin sorghum developed leg abnormalities. Featherstone and Rogler (1975) showed that high tannin sorghum depressed growth in rats and chicken, which resulted from reduced protein and dry matter digestibility probably caused by interference of tannins with digestive action of trypsin and α-amylase either by binding the enzymes themselves or by combining with dietary protein to form indigestible complex. In laying birds, tannins decreased the rate of lay, adversely affect efficiency of feed utilisation and increase mortality (Rostangno et al., 1973; Guillaume and Belec, 1977). The level of tannins present in sorghum seems to be the predominant factor that influences its nutritional value (Vilijoen, 1998). Polyethylene glycol (PEG) when used as a dietary supplement can improve the nutritional value of high tannin feedstuff (Hewitt and Ford, 1982) while malting increases the protein, soluble sugars and reduces the tannin content of sorghum (Barrett and Larkin, 1974; Wu and Wall, 1980; Kubiezek et al., 1984). Boiling also reduces tannin content in taro cocoyam meals from 1.78mg/100g to 0.28mg/100g which resulted in negligible effect on carcass characteristics of broilers (Abdulrashid et al., 2007).

DHURRIN

Dhurrin is a cyanogenic glucoside which on enzyme action readily yields hydrogen cyanide (HCN) (Fig. 3, 4); it is located mainly in the aerial shoot of sorghum plant (Olomu, 1995; D'Mello, 2000). Dhurrin contains glucose of β-hydroxy-benzaldehyde cyanohydrin. Linamarin and amygdalin are other cyanogenic glycoside found in cassava, linseed and almonds respectively. Linamarin contains the glucose of acetone cyanohydrin while amygdalin contains glucose of benzaldehyde cyanohydrin (Chubb, 1982). Many commonly consumed legumes are also reported to be cyanogenic (Seigler et al., 1989). Cyanogenic glycosides when ingested and hydrolysed to free HCN cause cyanide toxicity (D'Mello, 1995). In Nigeria, HCN level of 15.18g/kg has been reported for malted sorghum sprouts (Oduguwa and Fafiolu, 2004).

Ruminants are more susceptible to HCN poisoning than horses and pigs but sheep appear less susceptible than cattle (Chubb, 1982). Hydrogen cyanide causes dysfunction of the central nervous system, respiratory failure and cardiac arrest. Metabolisable energy values for poultry tend to be lower in untreated cassava root presumably because of its cyanogenic potential (Keller, 1984; Tanner et al., 1990; D'Mello, 2000 and D'Mello 2005). The quantity of HCN in sorghum varies with cultivar and the growth condition but diminishes with age. Making fodder into hay or silage destroys the poison (Purseglove, 1972). Excess cyanide ion can quickly produce anoxia of the central nervous system through inactivating the cytochrome oxidase system and death can result within a few seconds (Chubb, 1982). Cyanide intake of up to 75.96mg/100g reduces apparent nutrient digestibility of broilers. Goats can also tolerate and degrade forage secondary metabolites below injury threshold (Ogungbesan et al., 2006). As little as 0.5g HCN is sufficient to kill a cow and more than 750ppm is regarded as dangerous to stock. Poor animal performance has also been reported as a result of cyanogens (Tanner et al., 1990).

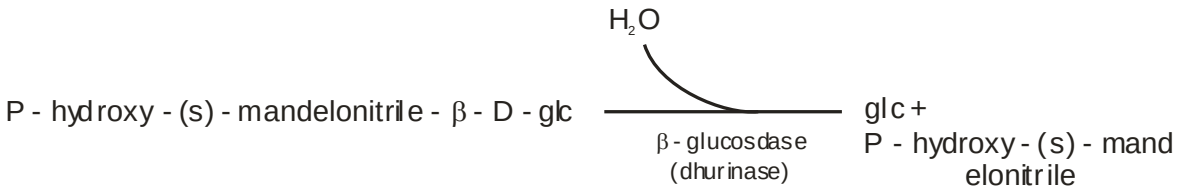

Fig. 3 - Hydrolysis of dhurrin by β-glucosidase (dhurrin). Source: Cicek and Esen (1998)

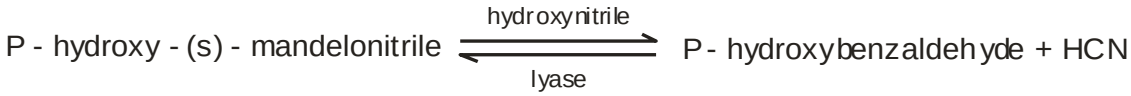

Fig. 4 - Production of hydrogen cyanide (HCN). Source: (Cicek and Esen, 1998)

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CONCLUSION

It would appear that the level of the anti-nutrients; tannin and dhurrin in sorghum and indeed other plant materials is a major determinant of the recognised effects on livestock and poultry. Similarly, the development of new varieties, age and processing seems to have an ameliorating effect on the content and intensity of toxicity of these anti nutritional factors in sorghum.

REFERENCES

Abdulrashid M, Agwunobi LN, Jokthan GE and Abdul SB (2007). Carcass Quality Characteristics of Broiler Finishers fed Taro (*Colocasia esculenta*) Cocoyam Meal. Proceedings of the 32nd Annual Conference of the Nigerian Society for Animal Production. March 18 – 21, 2007, University of Calabar, Calabar, pp. 457 – 459.

Aduku AO (1993). Tropical Feedstuff – Analysis Table. Department of Animal Science, Faculty of Agriculture, Ahmadu Bello University, Samaru, Zaria, Nigeria.

Aduku AO (2004). Animal Nutrition in the Tropics. Feeds and Feeding, Pasture Management, Monogastric and Ruminant Nutrition, Dascon Computers and Business Bureau, Zaria, pp. 17 -18.

Ahn JH, Robertson BM, Elliot R, Gutteridge RC and Ford CS (1989). Quality Assessment of Tropical Browse Legumes: Tannin Content and Protein Degradation. Animal Feed Science and Technology, 27: 147 – 156.

Aletor VA (1999). Anti-Nutritional Factors as Nature's Paradox in Food and Nutrition Securities. 15th Inaugural Lecture Delivered on August 12 at Federal University of Technology, Akure, Nigeria.

Aningi KG, Ologun AG, Alokan A, Adekola, AT and Aletor VA (1998). Effect of Replacing Dried Brewers' Grains with Sorghum Rootlets in Growth, Nutrient Utilisation and Some Blood Constituents in Rats. Animal Feed Science. Technology, 71: 185 – 190.

Atteh JO (2002). Principles and Practice of Livestock Feed Manufacturing. Aldek Printers, Ilorin, Nigeria pp.10 – 30.

Barrett MA and Larkin PJ (1974). Milk Production in the Tropics. Oxford University Press, London, pp. 55 – 57.

Bary TN and Duncan SJ (1984). The Role of Condensed Tannin in the Nutritional Value of *Lotus peduncalatus* for Sheep. I: Voluntary Intake. Journal of Association of Official Analytical Chemists, 65: 496 – 497.

Bary TN, Allsop TF and Redekopp C (1986). The Role of Condensed Tannin (CT) in the Nutritional Value of *Lotus pedunculatus* I: Effect on the Endocrine Systems and Adipose Tissue Metabolism. British Journal of Nutrition, 56: 607 – 614.

Bengaly K, Mhlongo S and Nsahlai IV (2007). The Effect of Wattle Tannin on Intake, Digestibility, Nitrogen Retention and Growth Performance of Goats in South Africa. Livestock Research for Rural Development. Volume 19, Article #50. Retrieved August 12, 2007, from http://www.cipav.org.colrrd/ lrrd19/4/beng19050.htm.

Carter PR, Hicks DR, Opinga EC, Dou JD, Bundy RG, Schuler RT and Holness BJ (1989). Milo. Co-operative Extension Services. University of Wisconsin – Madison.

Chubb IG (1982). Anti-nutritional Factors in Animal Feedstuff. In: Studies in the Agricultural and Food Sciences. Heresign, W. (ed.). Butterworths, London, pp. 21 – 37

Cicek M and Esen A (1998). Structure and Expression of a Dhurinase (β-Glucosidase) from Sorghum. Plant Physiology, 116: 1469 – 1478.

Corder R (2006). Tannins in Some European Reds have Greater Protective Effects on Heart than Other Red Wines. Nature Online Advance Edition. News Release, Queen Mary University of London. Retrieved on 05/06/07 at http://www.cbsnews.com/stories/2006/11/29/health/ webind/main2215429.html.

D'Mello JPF (1982). Toxic Factors in some Tropical Legumes. World Review of Animal Production October – December, xviii (4): 41 – 46.

D'Mello JPF (2000). Anti-nutritional Factors and Mycotoxins. In: Farm Animal Metabolism and Nutrition, JPF D'Mello (ed.). CAB International, Wallingford, UK, pp. 383 – 403.

D'Mello JPF (2005). Plant Toxins. In: Contaminants and Toxins in Animal Feeds. Retrieved on July 6, 2007 from http://www.fao.org/DOCREP/ARTICLE/AGRIPPA/ X9500E04.HTM. Pp. 1 of 3.

De Lumen BO and Salamat LA (1980). Trypsin Inhibitor Activity in Winged Bean (*Psophocarpus tetragnolobus*) and the Possible Role of Tannins. Journal of Agriculture and Food Chemistry, 28: 533 – 536.

Eggum BO and Christensen KD (1974). Inbreeding for Seed Protein Improvement Using Nuclear Technique. IAEA, Vienna, Pp. 135

Elkins RG, Featherstone WR and Rogler JC (1978). Investigations of Leg Abnormalities in Chick Consuming High Tannin Sorghum Grain Diet. Poultry Science, 57: 757 – 762.

Etherington D and Roberts MT (1982). Vegetable Tannins. Dictionary of Descriptive Terminology. Book Binding and Conservation Books. Retrieved on 01/06/07 from http://palim psest.standford.edu/don/dt/dt3686.html.

Etuk EB and Ukaejiofo UR (2007). Tannin Content and Dietary Effects of Brown Coat Coloured Sorghum on the Performance of Young Local Turkey. Animal Production Research Advances, 3(2): 86 – 90.

Etuk EB (2008). Nutrient Composition and Feeding Value of Sorghum in Turkey. PhD. Thesis. Federal University of Technology, Owerri, Nigeria.

Featherstone WR and Rogler JC (1975). Influence of Tannins on the Utilisation of Sorghum Grain by Rats and Chicks. Nutrition Report International, 11: 491 – 497.

Grosjean F, Barrier-Guillot B, Bastranelli D, Rudeaux F, Bourdillion A and Payronnet C (1999). Feeding Value of Three Categories of Pea (*Pisum sativum* L.) for Poultry. Animal Science, 69: 591 – 599.

Guillaume J and Belec R (1977). Use of Field Beans. (*Vicia faba* L.) in Diets for Laying Hens. British Poultry Science, 18: 573.

Hagerman AE (1989). Chemistry of Tannin-Protein Complexation. In: *Chemistry* and Significance of Condensed Tannins. Hemingway, R. W. and Karchesy, J. J. (eds).Plennum Press, New York, pp. 323 – 334.

Hewitt D and Ford JE (1982). Influence of Tannins on the Nutritional Quality of Food Grains. Proceedings of the Nutrition Society, 41: 7 – 17.

IAR (1995). Code and Description of Crop Varieties Released by Institute of Agricultural Research, Ahmadu Bello University, Samaru, Federal Ministry of Science and Technology, Abuja, pp. 14 – 15.

Iji PA, Khumalo K, Slippers S and Gous RM (2004). Intestinal Function and Body Growth of Broiler Chickens on Maize-based Diets Supplemented with Mimosa Tannins and a Microbial Enzyme. Journal of Science, Food and Agriculture, 84 (12): 1451 – 1458.

Jansman AJM, Verstegen MWA and Huisman J (1993). Effects of Dietary Inclusion of Hull of Faba Beans (*Vicia faba* L) with Low and High Content of Condensed Tannins on Digestion and Some Physiological Parameters in Piglets. Animal Feed Science and Technology, 43: 239 – 257.

Jones WT and Mangan JC (1977). Complexes of Condensed Tannins of Sainfoin (*Onobrychris vicifolia* scop) with Fraction I. Leaf Protein and with Submaxillay Mucoprotein and their Reversal by Glycol and pH. Journal of Science, Food and Agriculture, 28: 126 – 136.

Kamalak A, Filho JMP, Canbolat O, Gurbuz Y, Ozau O and Ozkan O (2004). Chemical Composition and its Relationship to In vitro Dry Matter Digestibility of Several Tannin-Containing Trees and Shrub Leaves. Livestock Research for Rural Development, 16 (14). Retrieved on 01/06/07 from http://www.cipav.org.co/lrrd/lrrd16/4/kama16027.htm

Keeler RW (1984). Terattogens in Plants. Journal of Animal Science, 58: 1229 – 1239.

Kubiezek RP, Obilana AT and Okoli PN (1984). Improvement of the Nutritional Quality of Nigerian Sorghum for Human Food: Pre-germination Effect on Quality of Protein. Paper presented at the 8th Annual Conference of Nigerian Institute of Science and Technology, 18 – 22 November, 1984.

Kumar L and Singh M (1984). Tannins: Their Adverse Role in Ruminant Nutrition. Journal Agriculture and Food Chemistry, 32: 447 – 497.

Kumar R and D'Mello JPF (1995). Anti-nutritional Factors in Forage Legumes. In: D'Mello JPF. and Devendra C (eds). Tropical Legumes in Animal Nutrition. CAB International, Wallingford, Oxon, UK, pp. 95 – 133

Kumar R and Horigome T (1986). Fractionation, Characterisation and Protein Precipitating Capacity of the Condensed Tannins from *Robinia pseudoacacia* L. leaves. Journal of Agriculture and Food Chemistry, 34: 487 – 489.

Kumar V, Elangovan AV, Mandal AB, Tyagi PK., Bhanja SK and Dash BB (2007). Effects of Feeding Raw or Reconstituted High Tannin Red Sorghum on Nutrient Utilisation and Certain Welfare Parameters of Broiler Chickens. British Poultry Science, 48 (2) 198 – 20

Lewis, NG and Yamamoto E (1989). Tannins: Their Place in Plant Metabolism. In: Chemistry and Significance of Condensed Tannins. Hemingway RW and Karchesy JJ (eds). Plennum Press, New York, pp. 22 – 46.

Liener IE (1980). Toxic Constituents of Plant Foodstuff. Academic Press, New York, USA.

Makkar HPS, Singh B and Negi SS (1989). Relationship of Rumen Degradability with Microbial Colonisation, Cell Wall Constituents and Tannin Levels in Some Tree Leaves. Animal Production, 49: 299 – 307.

Maunder B (2002). Sorghum - The Global Grain of the Future. Retrieved November 30, 2004 from http://www.sorghumgrowers.com/maunder.htm.

McLeod MN (1974). Plant Tannins, Their Role in Forage Quality. Nutrition Abstracts and Reviews, 44: 803 – 815.

Merck Index (1976). The Merck Index. 9th Edition. Merck and Co., Rahway, New Jersey.

Mijavilla SC, Lacombe G, Carrera R, Derache, R (1977). Tannin Acid and Oxidised Tannic Acid on the Functional State of Rat Intestine Epithelium. Journal of Nutrition, 107: 2113 – 2121.

NCGRB (2004). Crop Varieties Released and Registered in Nigeria. National Centre for Genetic Resources and Biotechnology, Ibadan, pp. 24 – 25.

Ngoka DA (1997). Crop Production in the Tropics: Theory and Practice. Alphabet Publishers, Owerri, pp. 120 -125.

Norton BW (1994). Anti-nutritional and Toxic Factors in Forage Tree Legumes. In: Forage Tree Legumes in Tropical Agriculture. Gutteridge RC and Shelton HM (eds.). CAB International Wallingford, UK, pp. 202 – 215

Oduguwa OO and Fafiolu AO (2004). Utilization of Malted Sorghum Sprouts in the Diets of Starting Chicken. Proceedings of 9th Annual Conference Animal Science Association of Nigeria September 13 – 16, 2004, Ebonyi State University, Abakiliki, pp. 67 – 69.

Ogungbesan AM, Akinboye OO, Apata SE and Olusanya TP (2006). Anti-Nutrients Digestibility in WAD Goats fed *Tephrosia bracteolate* Diets. In: Proceedings of 11th Annual Conference of Animal Science Association of Nigeria, September 18 – 21, 2006, IAR and T, Ibadan, Nigeria, pp 63 – 65.

Oke DB, Oke MO and Adeyemi OA (2004). Protein Quality of Autoclaved Cowpea Varieties as Influenced by Anti-nutritional Factors. Nigerian Journal of Animal Production, 31(1): 17 – 21.

Ola SI, Shobooye OO and Daramola EA (2005). Preliminary Studies on the Metabolism of Vegetative Parts of *Terminalia catappa* (Almond tree) in Chicken. Proc., 1st Nigeria International Poultry Summit (NIPS) February 20 – 25, 2005, Otta, Ogun State, pp. 152 – 154.

To cite this paper: Etuk EB, Okeudo NJ, Esonu BO, Udedibie ABI. 2012. Anti-nutritional factors in sorghum: chemistry, mode of action and effects on livestock and poultry. *Online J. Anim. Feed Res.*, 2(2): 113-119.
Scienceline/Journal homepages: http://www.science-line.com/index/; http://www.ojafr.ir

Ologhobo AD, Apata DF, Oyejide A and Akinpelu O (1993). Toxicity of Raw Lima Beans (*Phaseolus lunatus* L) and Lima Beans Fractions for Growing Chicken. British Poultry Science, 34: 505 – 522.

Olomu JM (1995). Monogastric Animal Nutrition – Principles and Practice. A Jachem Publication, Benin City, Nigeria, pp. 112 – 118.

Osakwe II, Steingass, H. and Drochner, W. (2004). *Daniella oliveri* as a Fodder Tree for Small Ruminants and the Interaction of its Tannin with Ruminal Ammonia. Nigeria Journal Animal Production, 31 (1): 56 – 64.

Oyenuga VA (1968). Nigeria's Food and Feeding stuff – Their Chemistry and Nutritive Value. Ibadan University Press, UI, Nigeria, pp 39 – 41.

Phytolab (2007). Phytochemicals Polyphenols – Tannic Acid. Retrieved July 6, 2007 from http://www.phytochemicalsinfolphytochemicals/tannic-acid.phD.

Porter LJ (1992). Structure and Chemical Properties of Condensed Tannins. In: Hemingway RW and Laks PE (eds). Plant Polyphenols, Synthesis, Properties, Significance. Plenum Press, New York, pp. 245 – 258.

Purseglove JW (1972). Tropical Crops – Monocotyledons. Longman Group Ltd., UK, pp 261 – 286.

Reed JD, Soller H and Wood A (1990). Fodder Tree and Straw Diets for Sheep: Intake, Growth, Digestibility and the Effect of Phenolics on Nitrogen Utilisation. Animal Feed Science and Technology, 30: 39 – 50.

Ronstango HS (1972). Nutritive Evaluation of Sorghum Grains in Chicies (Fishes). PhD Thesis. Purdue University, West Latayatte, U.S.A.

Rostangno HS, Featherstone WR and Rogler JC (1973). Studies on the Nutritional Value of Sorghum Grains with Varying Tannin Contents for Chick. I. Growth Studies. Poultry Science, 52: 765 – 772.

Salem HB, Nefzaoui A, Makkar HPS, Hochlef H, Salem IB and Salem LB (2005). Effect of Early Experience and Adaptation Period on Voluntary Intake, Digestion and Growth in Barbarine Lambs Given Tannin Containing (*Acacia cyanophylla* Lindl. Foliage) or Tannin-free (Oater hag) Diets Animal Feed Science and Technology, 122 (1 – 2): 59 – 77.

Salunkhae DK, Chavan JK, and Kedan SS (1990). Dietary Tannin: Consequences and Remedies. CRC Press, Boca Raton, Florida, pp. 10 – 15.

Schrägle R and Müller W (1990). The Influence of Selected Tannin Containing Plant Specie on the Tenacity of Pathogenic Bacteria in an In Vitro Rumen System. Journal of Veterinary Medicine B, 37:181 – 186.

Seigler DS, Maslin BR and Conn EE (1989). Cyanogenesis in the Leguminasae. In: Advances in Legume Biology. Stirton GH. and Zarvcchi JC. (eds). Monograph Systematic Botany, Missouri Botanical Garden 29, pp. 645 – 672.

Singleton VL and Kratzer FH (1969). Toxicity and Related Physiologicasl Activity of Phenolic Substances of Plant Origin. Journal of Agriculture, Food and Chemistry, 17: 497.

Singleton VL and Kratzer FH (1973). Plant Phenolics. In Toxicants Occurring Naturally in Foods, National Research Council, National Academy of Sciences, Washington, DC, pp. 309-345.

Subramanian V and Metta V. (2000). Sorghum Grain for Poultry Feed. In: Technical and Institution Options for Sorghum Grain Mold Management. Proc., International Consultation. Chandrasher A, Bandyopadhayi R and Hall AJ (eds.). International Crop Research for the Semi-Arid Tropics (ICRISAT). Patacheru 502 – 504, Andhra Pradesh, India, pp. 242 – 247.

Tacon AGJ (1995). Fishmeal Replacers: A Review of Anti-Nutrients within Oil Seeds and Pulses – A Limiting Factor for the Aquafeed Greed Revolution. Paper presented at Feed Ingredients Symposium, Singapore, Asia, September 19 – 20, pp 153 – 181.

Tanner JC, Reed JD and Owen E (1990). The Nutritive Value of Fruits (Pods with Seeds) from Four Acacia spp. Compared with Noug (*Guizotia abysriniea*) Meal as Supplements to Maize Stover for Ethiopian High land Sheep. Animal Production, 51: 127 – 133.

Van Hoven W and Furstenberg D (1993). The Use of Purified Condensed Tannins as a Reference in Determining its Influence on Rumen Fermentation. Comparative Biochemistry and Physiology, 101A: 381 – 385.

Viljoen J (1998). Sorghum as an Animal Feed. Paper Presented at the INTSORMIL Conference, December, 1998, Pretoria, South Africa. Retrieved July 6th, 2007 from http//:www.afma.co.za

Wildeus S, Zajac A., Turner K and Collins J (2004). Effect of Quebracho Tannin Supplementation on Growth and Parasitism in Young Goats and Grazing Parasite-Infected Pasture, 2004 ASAS Southern Meeting. Journal of Animal Science Abstract 82 (supplement 1): 29

Wu Y and Well JS (1980). Lysine Content of Protein Increased by Germination of Normal and High Lysine Sorghum. Nutritional Abstracts and Reviews B. Series 53 (11): 24 – 32.

Yokozawa T, Dong E and Oura H (1997). Proof that Green Tea Tannin Suppress the Increase in the Blood Methyl guanidine Level Associated with Renal Failure. Experimental and Toxicologic Pathology, 49 (1 – 2): 117 – 22.

Yokozawa T, Fujioka K, Oura H, Nonaka G and Nishioka I (1991). Effects of Rhubarb Tannins on Uremic Toxins. Nephron, 58 (2): 155 – 60.

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BREED, SEX AND AMBIENT TEMPERATURE EFFECTS ON DURATION OF BEHAVIOURAL TRAITS OF RABBITS (*Oryctolagus Cunniculus*) REARED IN THE HUMID TROPICS

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ABSTRACT: *Breed, sex and ambient temperature effects on the nocturnal and diurnal duration of feed and water intakes, standing and lying down behaviour of rabbits were investigated. Twelve male and female weaner rabbits (New Zealand White, Dutch Black and American Chinchilla, 8 weeks old) were housed individually in cells measuring 51 cm x 51 cm each. They were fed an 18% Crude Protein pelleted diet, forages (Centrosema pubescens, Ipomea batatas and Tridax procumbens) and water ad libitum for 8 weeks. Data were collected at three hourly intervals from 18:00 hrs to 06:00 hrs (nocturnal) and from 06:00 hrs to 18:00 hrs (diurnal). Durations of feed intake, water intake, lying down and standing were measured. Ambient temperature differed significantly (P ≤ 0.05) between test periods. Breed and sex did not influence the parameters studied. While ambient temperature significantly (P ≤ 0.05) influenced all traits, test period significantly (P ≤ 0.05) influenced duration of water intake, duration of standing and duration of lying down but not duration of feed intake. Interaction effects of test period x ambient temperature affected (P ≤ 0.05) duration of water intake and duration of lying down within the nocturnal period and duration of feed intake, duration of water intake and duration of lying down within the diurnal period. Highly significant (P < 0.01) phenotypic correlation was observed between duration of feed intake and duration of standing (r_p = 0.10), duration of feed intake and duration of lying down (r_p = - 0.46), duration of water intake and duration of standing (r_p = 0.09), duration of water intake and duration of lying down (r_p = - 0.29), ambient temperature and duration of water intake (r_p = 0.64), duration of standing and duration of lying down (r_p = - 0.51) and between ambient temperature and duration of lying down (r_p = - 0.42).*

Key words: *Ambient Temperature, Behavioural Trait, Diurnal, Ethology, Nocturnal, Rabbit, Stress, Test Period, Thermoneutrality*

ORIGINAL ARTICLE

INTRODUCTION

Ethology is the science of animal behaviour (Mathur, 2005). Animal behaviour is the totality of the observable behavioural repertoire of an animal in a given environment. Behaviour is also described as any observable action and interaction between the organism's motivational state and the perceived attributes (stimuli) of its environment (Marai and Rashwan, 2004; Dosenbery 2009). Behaviour is therefore one of the most important functions of animal life and animal behaviour is a vital link between the organism and the environment and between the body control systems (nervous, muscular, endocrine) and the ecosystem. Behaviour plays a critical role in animal adaptation and evolution. Through behaviour an animal interacts with its environment and such interactions provide clues of the state of the environment and its probable impacts on life forms. Welfare is a condition of the animal itself. Animal behaviour provides the barometer for assessing animal welfare and there can be no animal welfare without an understanding of the normal behaviour of the animal. Animal behaviour therefore constitutes an extremely important aspect of a species survival strategy (Mathur, 2005). Animals differ in their response to changes in external and internal environments and may be innate or acquired and depend on both genetic disposition and ontogenic experience. Even within the same species, genetic differences exist among individuals of a population in their response to the same environmental stimuli (Batchelor, 1991; Manteuffel, 2002; Anna and Lance, 2005; Ogunjimi et al., 2008). All animals possess a range of behavioural expectations regarding their environment, in order to maintain their physical and psychological health. Different behavioural attributes have a specific function to the animal which can be associated to relaxation, ingestion, excretion, reproduction, exploratory, freight, attack, adaptive and care soliciting. Thus an animal's behaviour at each point in time reflects

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its perception of the environment as favourable or stressful. Understanding the impact of the production environment is critical to animal welfare and performance and a clear perception of the proximate and ultimate causations of an animal's behaviour is important for its survival, well being and for maximum benefits from the animal (Mathur, 2005).

Among the many aspects of ethology, animal scientists are interested in the feeding and adaptive behaviours of animals under varied environmental conditions: ambient temperature (AT), relative humidity, air movement, solar radiation and photoperiod (Marai et al*.,* 1991; Marai and Rashwan, 2004). Ambient temperature is perhaps the most important environmental factor affecting nutrient intake and therefore the well being of animals in the humid tropics (Marai et al*.,* 1991; Marai and Rashwan, 2004; Svotwa et al*.,* 2007). Animals in their thermoneutral zone (TNZ) use the standing posture for exercise, exploration, nutrient ingestion and mating while the lying down posture is used mainly for relaxation. Both postures are however vital for thermoregulation during thermal stress. Animals alter posture to dissipate, or conserve heat depending on the AT.

In the wild, the rabbit is a nocturnal animal nesting in the warrens throughout the day and emerging at dusk to forage for food until early morning. This nocturnal behaviour may have evolved to escape predators (survival) and/or take advantage of the more benign environmental AT during this period especially in the tropics. However, domestication and intensive husbandry may have altered this behaviour. Krohn et al*.* (2000) reported that the welfare of rabbits reared intensively can be improved by feeding the animals in the afternoon rather than in the early morning while James and Kim (2010) reported that rabbits eat at all times of the day. The eating frequency and duration of animals including rabbits varies with AT (Armstrong, 1994). Fayez and Alnaimy (2000) reported that as AT fell from 21 ^{o}C to 10 ^{o}C, feed intake and feeding frequency in rabbits increased while feeding stopped as the AT fell below 10 ^{o}C. The same authors noted that as the AT increased from 21 to 30 ^{o}C feeding frequency; feed intake and duration reduced while feeding stopped entirely following rise in ambient temperature above 34 ^{o}C. In addition, Marai et al*.* (1991) reported that above 35 ^{o}C rabbit can no longer regulate their internal temperature while Marai and Rashwan (2004) stated that at 25 – 30 ^{o}C, rabbits stretch out to loose as much heat as possible by radiation and convection. Thus rabbits like other mammals tolerate lower ATs better than higher AT (Nedergard et al*.,* 1990; Carey et al*.,* 2003). AT range of 21 ^{o}C - 25 ^{o}C is known as the "comfort zone" or zone of thermo neutrality for rabbits (Marai et al*.,* 1991) and at this temperature range (21-25^{o}C) feed consumption is optimum. In the present study the effects of breed, sex, and ambient temperature (AT) on the diurnal and nocturnal feed and water intake durations and durations of standing (DS) and lying down (DLD) of rabbits reared in the humid tropics were determined.

MATERIALS AND METHODS

A total of twenty-four weaner rabbits about 8 weeks old belonging to three breeds namely: Newzeland White, Dutch Black and American Chinchilla were used for the study. The rabbits were housed initially in four hutches (114 cm x 102 cm x 51 cm) for two weeks to adapt to the environmental conditions of the rabbitry. The floor of the hutch was bedded with wood shavings to 2cm thick. During this period feed, water, vitamin and mineral supplements as well as prophylactic antibiotic medications were provided to the animals to ensure good health and vitality. After the two weeks pre-experimental period, 12 apparently healthy rabbits (4 per breed and 2 per sex) were selected, weighed and housed individually in cells measuring 51 cm x 51 cm each. The rabbits were fed with an 18% CP diet, a combination of forages-*Centrosema pubescens*, *Ipomea batatas* and *Tridax procumbens* - and water *ad libitum* during the 8 weeks experimental period. Data for the nocturnal activities were collected three days per week between time periods 18:00 hrs to 06:00 hrs while data for the diurnal activities were collected one day per week between time periods 06:00 hrs to 18:00 hrs. The parameters measured included the durations of feed and water intakes, lying down and standing to rest/explore the environment. The nocturnal and diurnal recordings were taken three hourly for four time intervals namely: 1800 hrs – 21:00 hrs, 21:00 hrs – 00:00 hrs, 00:00 – 03:00 hrs and 03:00 hrs – 06:00 hrs (nocturnal) and 06:00 hrs – 09:00 hrs, 09:00 hrs – 12:00 hrs, 12:00 hrs – 15:00 hrs and 15:00 hrs – 18:00 hrs (diurnal). The temperature (^{o}C) inside the rabbit hutches were measured within the same three hourly intervals. Observation of the animals took place from a building directly opposite the rabbitry. The dorsal pinnae of each rabbit was marked with a colour marker to enhance observation from a distance. Behavioural activities of the rabbits were recorded in minutes using stop watches. Data collected were subjected to analysis of variance (ANOVA) in a completely randomized design (CRD) using the ANOVA option of SPSS computer package version 17.0 (SPSS Incorporate, 2001). Significantly different means were separated using Duncan's New Multiple Range Test option of SPSS.

RESULTS

The ranges of ambient temperatures in the rabbitry during the test periods (nocturnal and diurnal test periods) are presented in Table 1 while the effects of the factors (breed, sex and ambient temperature) on the traits studied are presented in Table 2. Table 1 shows that within the nocturnal test period, ambient temperature range (AT range) was significantly ($P \leq 0.01$) highest within 18:00 – 21:00 hrs (mean, 25.89 ± 0.19 ^{o}C) and significantly ($P \leq 0.01$) lowest during 03:00 – 06:00 hrs (mean, 23.80 ± 0.19 ^{o}C). For the diurnal period, AT range was highest within 12:00 – 15:00 hrs (mean, 30.52 ± 0.27 ^{o}C) and least during 06:00 – 09:00 hrs (mean, 25.46 ± 0.27 ^{o}C).

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Table 1 - Range of ambient temperature in the rabbitry during the experiment

Test period					
Nocturnal			Diurnal		
Time period (hr)	ATR (oC)	Mean	Time period (hr)	ATR (oC)	Mean
18:00-21:00	24.8-28.3	25.89 ± 0.19[a]	06:00-09:00	24.0-27.8	25.46 ± 0.27[d]
21:00-00:00	22.5-26.5	24.49 ± 0.19[b]	09:00-12:00	26.8-30.5	28.16 ± 0.27[c]
00:00-03:00	22.0-25.8	23.88 ± 0.19[c]	12:00-15:00	29.5-32.0	30.52 ± 0.27[a]
03:00-06:00	22.5-25.5	23.80 ± 0.19[c]	15:00-18:00	28.5-31.0	29.21 ± 0.27[b]

[a,b,c,d:] means on the same column with different superscripts are significantly different (P ≤ 0.05), ATR: range of ambient temperature.

Thus, both the minimum and maximum mean ATs were higher for the diurnal period compared to the nocturnal period (25.46 ± 0.27 vs 23.80 ± 0.19 and 30.52 ± 0.27 vs 25.89 ± 0.19, respectively). Mean AT ranged from 22.0 – 28.3 °C during the nocturnal period and 24.0 – 32.0 °C during the diurnal period.

Table 2 shows that breed and sex of rabbits did not significantly influence any of the parameters studied. Duration of water intake (DWI), duration of standing (DS) and duration of lying down (DLD) were however, significantly (P ≤ 0.05) affected by test period (that is, nocturnal or diurnal periods).

Table 2 - Effects of breed, sex and test period on duration of behavioural traits of rabbits

Trait	Breed			Sex		Test period	
	NZW	DB	AC	M	F	Nocturnal	Diurnal
DFI	31.86 ± 1.0	33.95 ± 1.3	32.30 ± 0.9	31.86 ± 0.9	33.05 ± 0.8	32.10 ± 0.7	33.28 ± 1.1
DWI	1.98 ± 0.2	1.97 ± 0.2	1.98 ± 0.1	2.00 ± 0.1	1.95 ± 0.1	0.80 ± 0.1[b]	5.51 ± 0.2[a]
DS	34.45 ± 0.8	33.96 ± 1.6	33.94 ± 0.7	33.56 ± 0.7	34.57 ± 0.6	34.82 ± 0.5[a]	31.94 ± 1.1[b]
DLD	104.49 ± 1.6	102.78 ± 1.8	101.58 ± 1.3	102.97 ± 1.3	102.57 ± 1.2	110.44 ± 0.9[a]	79.68 ± 1.9[b]

[a,b:] means on the same row with different superscripts are significantly different (P ≤ 0.05), NZW: Newzeland White, DB: Dutch Black, AC: American Chinchilla, M: male, F: female, DFI: duration of feed intake, DWI: duration of water intake, DS: duration of standing, DLD: duration of lying down.

Duration of water intake was longer during the diurnal than nocturnal test period while durations of standing and lying down were respectively, longer during the nocturnal test period compared to the diurnal test period. Duration of feed intake did not differ according to test period.

Figures 1 and 2 present the effects of ambient temperature (AT) on the parameters studied. From Figure 1a, duration of feed intake (DFI) was longest at AT range of 24 – 28 °C followed by 28 – 30 °C and least at AT range of 30 – 32 °C. From AT range of 26 – 28 °C, duration of feed intake decreased progressively to its least value of 25.3 min. at AT range of 30 – 32 °C. For duration of water intake (DWI), rabbits drank for longest period at AT range of 30 – 32 °C (9.0 min.) followed by 26 – 28 °C (6.4 min) and for shortest duration of 0.5 min. at AT range of 22 – 24 °C. Contrary to the observed trend for feed intake, duration of water intake (Fig. 1b) significantly (P ≤ 0.05) increased from AT range of 22 – 24 °C (0.5 min.) to 26 – 28 °C (6.4 min.), decreased within AT range of 28 – 30 °C (5.0 min) and then significantly (P ≤ 0.05) rose to its highest value of 9.0 min at AT range of 30 – 32 °C. A milder response to the effect of AT was observed for duration of standing (DS) (Fig. 2a).

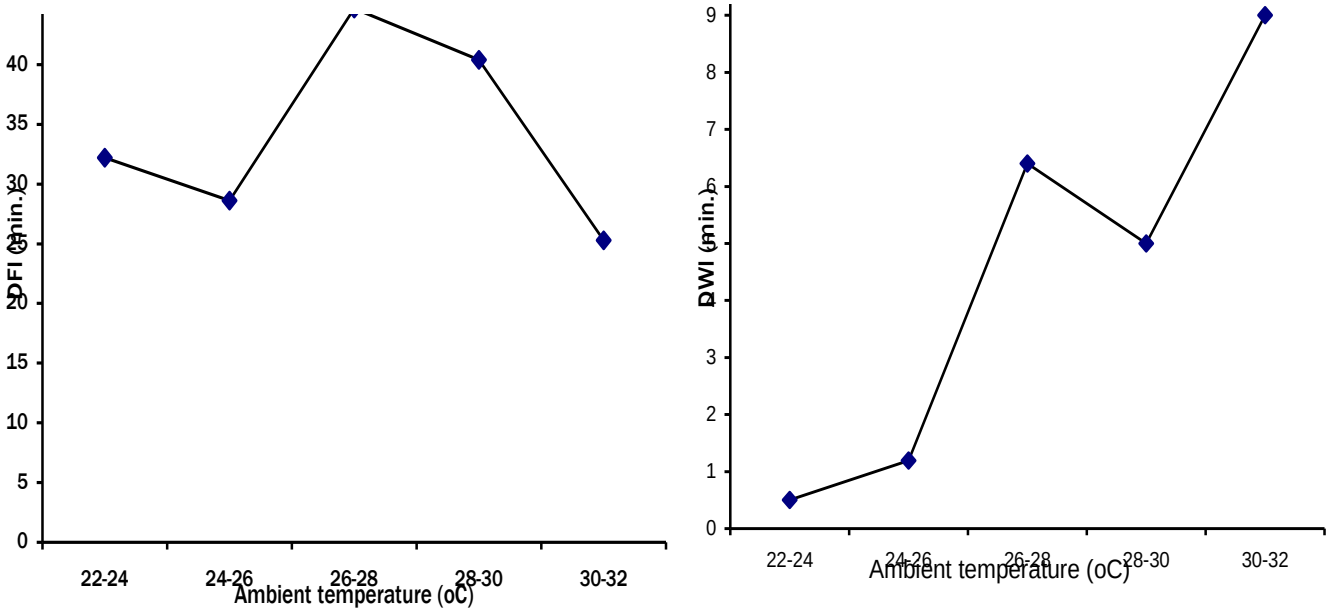

Figure 1 - Effect of ambient temperature on duration of feed and water intake: (A) feed intake, (B) water intake, DFI: duration of feed intake, DWI: duration of water intake, min.: time in minutes.

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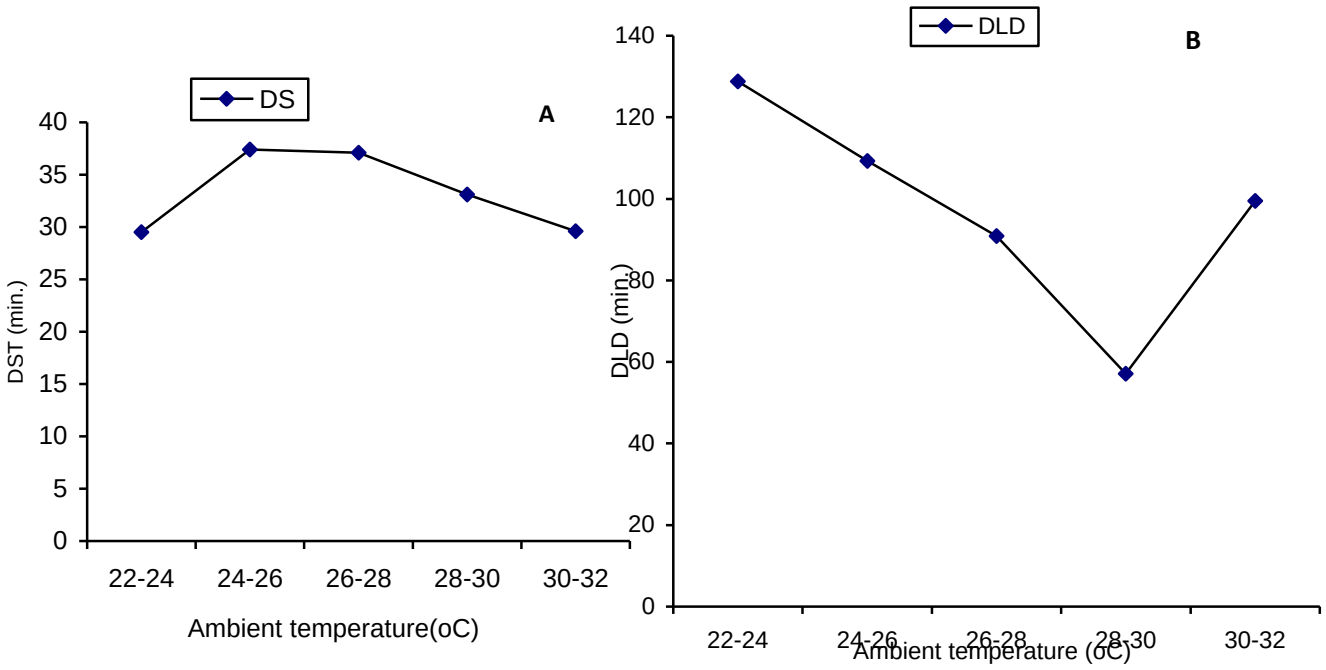

Figure 2 - Effect of ambient temperature on duration of standing and lying down in rabbits. (A) standing, (B) lying down, DS: duration of standing, DLD: duration of lying down, min.: time in minutes.

DS was longest within AT range of 24 – 26 °C and 26 – 28 °C (37.4 min. and 37.1 min., respectively) but shortest for 22 – 24 °C and 30 – 32 °C (29.5 min. and 29.6 min., respectively). For duration of lying down (DLD), rabbits laid down for longest duration within AT range of 22 – 24 °C (128.8 min) and least within AT range of 28 – 30 °C (57.1 min.). Duration of lying down decreased progressively from the highest value of 128.8 min. within AT range of 22 – 24 °C to its least value of 57.1 min. within AT range of 28 – 30 °C before it shot up again to 99.5 min within AT range of 30 – 32 °C which was similar to the value obtained for AT range of 24 – 26 °C and 26 – 28 °C (109.3 min. and 90.9 min, respectively).

The effects of interaction of test period (nocturnal or diurnal) x ambient temperature on duration of the parameters studied are presented in Table 3.

Table 3 - Effect of test period x ambient temperature interaction on duration of behavioural traits of rabbits

Test period									
Nocturnal					Diurnal				
ATR (oC)	DFI (min.)	DWI (min.)	DS (min.)	DLD (min.)	ATR (oC)	DFI (min.)	DWI (min.)	DS (min.)	DLD (min.)
21-23	22.7 ± 11.5	Nil	28.5 ± 10.7	131.9 ± 18.8^{a}	23-25	19.0 ± 15.6^{b}	1.8 ± 1.8^{c}	35.2 ± 14.0	120.3 ± 26.1^{a}
23-25	27.6 ± 6.9	0.6 ± 0.7^{b}	34.1 ± 5.4	117.9 ± 9.5^{a}	25-27	42.2 ± 13.5^{a}	4.1 ± 1.8^{bc}	39.6 ± 12.8	90.2 ± 16.4^{ab}
25-27	34.8 ± 9.3	1.8 ± 0.9^{ab}	37.3 ± 6.5	102.8 ± 11.4^{ab}	27-29	38.1 ± 12.0^{ab}	6.2 ± 1.6^{b}	36.6 ± 11.4	54.9 ± 20.0^{b}
27-29	26.0 ± 18.3	3.5 ± 1.8^{a}	39.5 ± 13.5	82.8 ± 23.8^{b}	29-31	31.5 ± 9.2^{ab}	7.3 ± 1.72^{ab}	35.5 ± 12.0	72.9 ± 21.1^{ab}
					31-32	11.4 ± 12.3^{b}	10.4 ± 1.7^{a}	19.4 ± 11.7	112.0 ± 20.6^{a}

$^{a,b:}$ means on the same column with different superscripts are significantly different (P ≤ 0.05), ATR: range of ambient temperature, DFI: duration of feed intake, DWI: duration of water intake, DS: duration of standing, DLD: duration of lying down, min.: time in minutes.

The table shows that DFI and DS did not differ significantly within the range of ATs observed during the nocturnal test period. DWI differed significantly (P ≤ 0.05) with rabbits spending significantly (P ≤ 0.05) longer time of 3.5 ± 1.8 min. drinking within AT range of 27 – 29 °C compared to the value of 0.6 ± 0.7 min obtained within AT range of 23 – 25 °C. Duration of feed and water intakes as well as lying down varied significantly (P ≤ 0.05) among AT range values within the diurnal test period. For DFI, rabbits spent significantly (P ≤ 0.05) longer time feeding within AT ranges of 25 – 27 °C (42.2 ± 13.5 min.), 27 – 29 °C (38.1 ± 12.0 min.) and 29 – 31 °C (31.5 ± 9.2 min.) compared to the time duration of 19.0 ± 15.6 min and 11.4 ± 12.3 min. obtained within AT ranges of 23 – 25 °C and 31 – 32 °C, respectively. For water intake, rabbits spent significantly (P ≤ 0.05) longer time drinking when AT was between 31 – 32 °C (10.4 ± 1.7 min.) and 29 – 31 °C (7.3 ± 1.7 min.) compared to the values for AT ranges of 27 – 29 °C (6.2 ± 1.6 min.), 25 – 27 °C (4.1 ± 1.8 min.) and 23 – 25 °C (1.8 ± 1.8 min.). Duration of lying down was significantly (P ≤ 0.05) shortest within AT range of 27 - 29 °C at 54.9 ± 20.0 min. compared to other AT range values.

The correlation matrix for ambient temperature and duration of behavioural traits studied is presented in Table 4. Significant (P ≤ 0.01) positive correlation (r_g) was obtained between DFI and DS; DWI and DS and DWI and AT. Duration of feed intake and DLD; DWI and DLD as well as DS and DLD were significantly (P ≤ 0.01) negatively correlated. Similarly, DLD was significantly (P ≤ 0.01) negatively correlated with AT (r_g, -0.42).

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Table 4 - Correlation matrix for ambient temperature and duration of behavioural traits of rabbits					
Trait	DFI	DWI	DS	DLD	AT
DFI		0.03	0.10**	-0.46**	0.31
DWI			0.09**	-0.29**	0.64**
DS				-0.51**	-0.02
DLD					-0.42**

**: significant at P ≤ 0.01 (2 tailed), DFI: duration of feed intake, DWI: duration of water intake, DS: duration of standing, DLD: duration of lying down.

DISCUSSION

The significantly higher AT range during the diurnal period compared to the nocturnal period was expected. Whereas direct solar radiation heats up the earth's atmosphere during the day (diurnal period), large amount of heat energy escapes from the earth into space during the night (nocturnal period) such that the earth's atmosphere is cooled during this period. Diurnal AT range and mean AT were lowest (24.0 – 27.8 ^{o}C and 25.46 ± 0.27 ^{o}C, respectively) during the time period following the nocturnal period (06:00 – 09:00 hrs) reflecting the effects of heat loss during the nocturnal period while nocturnal AT range and mean AT were highest (24.8 – 28.3 ^{o}C and 25.89 ± 0.19 ^{o}C, respectively) during the time period following the diurnal period (18:00 – 21:00 hrs) reflecting the effects of heat gain from solar radiation during the diurnal period. Thus mean minimum and maximum ATs were expectedly higher for the diurnal period compared to the nocturnal period (25.46 ± 0.27 ^{o}C vs 23.80 ± 0.19 and 30.52 ± 0.27 vs 25.89 ± 0.19, respectively). These higher diurnal ATs mean that rabbits reared intensively in the tropics are exposed to ATs above their thermoneutral zone (TNZ) (Marai and Rashwan, 2004) especially during the diurnal period and are therefore thermally stressed. The lower ATs of the nocturnal period offer opportunity to loose substantial body heat and to cope with the high tropical ATs.

The insignificant (P > 0.05) breed and sex effects (Table 2) and breed x sex interaction effects (not shown) on the parameters studied was not surprising. The three breeds of rabbits used in the present study are the commonest exotic breeds reared in Nigeria and these breeds may have adapted substantially to the tropical environment. Marai et al. (1991) reported that animals routinely kept under high ATs develop metabolic mechanisms to adapt to heat stress and that in the tropics; New Zealand White rabbits are successfully raised under conditions in which the AT is consistently in the range 32.2 – 35.0 ^{o}C. The highly significant (P < 0.01) differences between nocturnal and diurnal durations of water intake, standing and lying down postures are consequences of the AT differences between these test periods as well as the natural (nocturnal) behavioural inclination of rabbits. Expectedly, DWI was shorter during the nocturnal period as the rabbits needed less water during the low temperature regimens characteristic of this period. Again, domesticated and intensively reared nocturnal animals become less nocturnal overtime and hence sleep/rest for most of the night periods. Duration of standing was significantly (P ≤ 0.05) higher during the nocturnal period probably in response to the more benign AT regimen of this period and/or due to the natural inclination for nocturnal exploration. The shorter time spent standing during the diurnal period was hence in response to the generally higher diurnal ATs as well as the need for some other more important activities like feed and water intakes and lying down to rest and/or loose heat in order to regulate body temperature. Marai and Rashwan (2004) reported that in warm environment (37.2 – 42. 2 ^{o}C), bunnies 5 – 10 weeks lie spread on their sides on the floor to loose body heat. Older rabbits exhibit similar behaviour at a lower AT range of 25 – 30 ^{o}C. Daily feed intake did not differ significantly between test periods probably because rabbits equally utilize the nocturnal and diurnal time periods for feeding. Ruminant livestock exhibit increased grazing activities towards dusk and just before dawn in response to more benign ATs.

The significantly (P ≤ 0.05) higher duration of feed intake (Fig. 1a) and by extension the quantity of feed consumed at AT range of 26 – 28 ^{o}C which was recorded between 18:00 and 21:00 hrs (nocturnal period) and 06:00 – 12:00 hrs (diurnal period) (Table 1) indicates that this temperature range probably corresponds to or is close to the thermoneutral zone (TNZ) of the rabbits used in the present study or that the above time periods were the peak periods for feed intake in rabbits reared in our environment or that a positive interaction effect exists between ambient temperature and time period in this instance. Thermal comfort zone for any animal is a function of the climatic and weather variables of its environment (Marai et al., 1991). Thus animals reared in the hot humid tropical environment acquire overtime the capacity to tolerate higher heat threshold than their counterparts reared in the temperate environments (Finzi, et al., 1988; Marai et al., 1991; Mayer and Bucklin, 2009). Consequently, tropically adapted breeds have higher TNZ than their temperate counterparts (Hansen, 2004; Mayer and Bucklin, 2009). The shorter duration of feed intake at AT range of 22 – 24 ^{o}C (nocturnal period: 00:00 – 03:00 hrs) indicate low feeding activity in the rabbits within this time period in spite of the lower and probably more comfortable thermal environment. The steep decline in time spent feeding as AT rose to 30 ^{o}C and above (diurnal period: 12:00 – 18:00 hrs) indicate the adverse effect of high AT on nutrient ingestion. Animals eat to generate energy for body functions and other activities. The excess is lost to the environment through sensible and insensible heat loss mechanisms (Gates et al., 2001; Marai et al., 2002; Hansen, 2004; Marai et al., 2008; Hansen, 2009). Inability to dissipate excess body heat due to high ATs triggers a series of coping or homeostatic strategies (Horowitz, 2002; Bernabucci et al., 2010) involving hormonally mediated feed-back mechanisms which depress feed intake, increase water intake, reduce the rate of body metabolic activities and hence internal heat production (Marai and Rashwan, 2004; Svotwa et al., 2007; Villalobos et al., 2008; Bernabucci *et al.,* 2010; Marai and Nardone, 2010).

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The adverse effects of high environmental temperatures on duration of grazing in ruminants and feed intake in other livestock species have been extensively studied (Silanikove, 2000; Marai et al., 2008; Bernabucci et al., 2010). The significant ($P \leq 0.05$) rise in DWI with rise in AT (Fig. 1b) was expected. The rise in the time spent drinking was very sharp as AT rose to 28 °C from 26 °C (diurnal period: 09:00 – 12:00 hrs) probably due to more severe thermal stress and the greater need by the rabbits to cool their body. Water serves as a heat sink in the body and enhances insensible (evaporative) heat loss. The temporary drop in time spent drinking observed between 28 – 30 °C AT (diurnal period: 12:00 – 15:00 hrs) could arise from the animals adopting the lying down posture to cool the body via heat conduction, convection and radiation from the body surfaces. However, as AT rose from 30 °C to 32 °C, DWI increased again signifying increasing need for evaporative heat loss. Rabbits have few functional sweat glands (Marai et al., 1991) and fur bearing animals in general loose little heat through their skin due to the covering of fur (Marai et al., 1991). Consequently, evaporative heat loss constitutes the major source of heat dissipation for this class of animal under severe heat stress (Marai et al., 1991; Marai and Rashwan, 2004).

The decline in the time spent standing with rise in AT from 28 °C (Fig. 2a) was sequel to increased thermal stress and the greater tendency to lie down and to drink water. Thus, both the time spent in lying down (Fig. 2b) and drinking water (Fig. 1b) increased sharply with rise in AT to 30 °C and above. Sevi et al. (2002) observed that greater percentage of experimental time was allocated to lying down compared to feeding in lactating ewes under low ventilation regimen (higher thermal stress) compared to moderate and programmed ventilation regimens. Duration of standing was less sensitive to changes in AT probably because the standing posture does not significantly enhance body heat loss under severe thermal stress. It has however been reported that in the absence of shade, an animal will change its posture to the vertical position in respect to the sun in order to reduce the effective area for heat gain from solar radiation during periods of high AT (Silanikove, 2000; Hansen, 2004). Sheep and goats tend to crowd, and to stand intimately side by side for the same purpose (Silanikove, 2000).

The significantly longer DWI due to interaction effect of test period x ambient temperature (Table 3) confirm the dependent nature of this trait on AT within each test period. Within the nocturnal period, water intake was not observed within AT range of 21 – 23 °C probably due to inactivity within the time period and/or lack of a need of water for normal physiological processes (e,g. thermoregulation) consequent upon the low AT. DWI was longer at AT range of 27 – 29 °C as was observed in the early nocturnal period (18:00 – 21:00 hrs) (Table 1) sequel to the higher AT and greater thermal stress. The significantly longer duration of lying down at AT range of 21 – 23 °C coincided with the hours of rest and inactivity and lowest AT. The short duration spent lying down at AT range of 27 – 29 °C (early nocturnal period) is explained by the need to drink water to cool the body hence DWI was longest at this AT range. For the diurnal period, all traits except DS differed significantly with AT indicating that the diurnal AT regimen impacted more on the behavioural traits. Duration of feed intake was least at AT ranges of 23 – 25 °C (early diurnal period) and 31 – 32 °C (late diurnal period). For early diurnal period (23 – 25 °C), it could be that the rabbits have just transitioned from the nocturnal period and are still awaiting for fresh supplies of feed or had lesser need for feed at this early diurnal period while for the late diurnal period, the short DFI was sequel to the high AT and cumulative effects of heat stress which discouraged feeding within this period and AT. Moderate ATs (ATs close to the TNZ) are therefore, the best thermal conditions for feed intake in rabbits. The increasing trend observed for DWI following increasing diurnal AT reflect the positive and linear relationship between AT and water intake. Duration of lying down was similar to the trend observed for the nocturnal AT ranges being longest at low and high ATs and lowest at moderate ATs. It does appear that at temperatures close to the TNZ, rabbits lie down only sparingly. However, the need to feed and/or drink at certain time periods may have influenced the durations of some of the behavioural traits.

The significantly positive correlation between DFI and DS, DWI and DS and DWI and AT (Table 4) arose because rabbits generally stand or squat to feed or drink and because water intake increases with AT. Duration of standing and DLD were significantly negatively correlated since both behaviours are mutually exclusive. Duration of lying down was significantly negatively correlated with AT indicating that as AT increases, the tendency to lie down decreases which could arise from the need to stand to drink water to cool the body.

CONCLUSION

Feed and water intakes impact on welfare and performance of rabbits. The present study revealed that AT affects duration of nutrient ingestion and by extension, the amount of total nutrient consumed by rabbits. High ATs discouraged feed intake for most of the diurnal period and rabbits utilized early nocturnal period for feeding. Therefore, rabbits should be provided with feed during the diurnal period as well as for the nocturnal period contrary to the current practice in most rabbit holdings where nocturnal feeding is not seriously considered. Rabbits spend longer time drinking during the diurnal period consequent upon the higher ATs during this period. Therefore intensively reared rabbits should be provided with cool clean water at all times but especially during the diurnal period. Again, to enhance normal activities of rabbits, temperatures within their comfort zone should be ensured.

REFERENCES

Anna M and Lance J (2005). The rabbit. Royal (Dick) School of Veterinary Studies, University of Edimburgh. Available online at www.rabbitcare.com.

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Scienceline/Journal homepages: http://www.science-line.com/index/; http://www.ojafr.ir

Armstrong DV (1994). Heat stress interaction with shade and cooling. Journal of Dairy Science 77: 2044-2050.
Batchelor GR (1991). Group housing on floor pens and environmental enrichment in sandy Lop rabbits. Journal of the Institute of Animal Technology, Sussex 42 (2): 109-120.
Bernabucci U, Lacetera N, Baumgard LH, Rhoads RP, Ronchi B and Nardone A (2010). Metabolic and hormonal acclimation to heat stress in domesticated ruminants. Animal 4(7): 1167-1183.
Carey HV, Andrews MT and Martins SL (2003). Mammalian hibernation: cellular and molecular responses to depressed metabolism and low temperature. Physiological Review 83: 1153-1181.
Dosenbery DB (2009). Living at microscale. Harvard University Press, Cambridge, mass. 448pp.
Fayez MM and Alnaimy MH (2000). Thermoregulation in rabbits. Egyptian J. Anim. Prod. 11: 120- 122.
Finzi A, Morera P and Kuzminsky G (1988). Acclimation and repeatability of thermo tolerance parameters in rabbits. Proceedings of the 4th Congress of the World Rabbit Science Association. Budapest, Hungary, 419-424.
Gates RS, Zulovich JM, Tuner L, Wurm J, Johnson MFG (2001). Potential for heat stress relief using desicant systems in swine breeding facilities. 7th Int. IBPSA Conference Rio de Janeiro, Brazil, August 13-15. pp 789-796.
Hansen PJ (2004). Physiological and cellular adaptations of Zebu cattle to thermal stress. Animal Reproduction Science 82-83: 349-360.
Hansen PJ (2009). Effects of heat stress on mammalian reproduction. Philosophical Transactions of the Royal Society B. 364: 3341-3350.
Horowitz M (2002). From molecular and cellular to integrative heat defence during exposure to chronic heat. Comparative Biochemistry and Physiology Part A 131: 475-483.
James AL and Kim H (2010). Group housing rabbits. Canadian Council on Animal Care publications. Available online at http://www.awionline.org.
Krohn TC, Ritskes-Hoitinga J and Svenden P (2000). The effects of feeding and housing on the behaviour of the laboratory rabbit. J. Royal Society of Medical Laboratory Animal 33: 101-107.
Manteuffel G (2002). Central nervous regulation of the hypothalamic-pituitary-adrenal axis and its impact on fertility, immunity, metabolism and animal welfare – a review. Arch. Tierz., Dummerstorf 45 (6): 575-595.
Marai IFM and Rashwan AA (2004). Rabbits behavioural response to climate and managerial conditions - a review. Arch. Tierz Dummerstorf 47 (5): 469-482.
Marai IFM, Abdel-Samee AM and El-Gafaary MN (1991). Criteria of response and adaptation to high temperature for reproductive and growth traits in rabbits. Options Mediterraneennes 17: 127-134.
Marai IFM, El-Darawany AA, Fadiel A, Abdel-Hafez MAM (2008). Reproductive performance traits as affected by heat stress and its alleviation in Sheep. Tropical and Sibtropical Agroecosystems 8 (3): 209-234.
Marai IFM, Habeeb AAM and Gad AE (2002a). Rabbits' productive, reproductive and physiological performance traits as affected by heat stress – a review. Livestock Production Science 78: 71-90.
Marai S and Nardone A (2010). Dynamics of the temperature – humidity index in the Mediterranean basin. Int. Journal of Biometeorology Doi: 10.1007/s00484-010-03313.
Mathur R (2005). Introduction and Significance of study of Animal Behaviour. In: Mathur R. (ed.). Animal Behaviour 3rd edition: 1-18.
Mayer R and Bucklin R (2009). Influence of hot-humid environment on growth performance and reproduction of swine. Dept. Anim. Sci. Series An 107, University of Florida (IFAS Extension). http://edis.ifas.ufl.edu.
Nedergard J, Cannon B and Jaenicke R (1990). Mammalian Hibernation (and Discussion). Philosophical Transactions of the Royal Society of London. Series B, Biological Sciences 326 (1237), Life and Low temperatures: 669-686.
Ogunjimi LAO, Oseni SO and Lasisi F (2008). Influence of temperature-humidity Interaction on heat and moisture production in rabbits. Management and Economy 9th World Rabbit Congress-June 10-13, 2008-Verona-Italy: 1579-1584.
Sevi A, Albenzio M, Annicchiarico G, Caroprese M, Marino R and Taibi L (2002). Effects of ventilation regimen on the welfare and performance of lactating ewes in summer. Journal of Animal Science 80: 2349-2361.
Silanikove N (2000). Effects of heat stress on the welfare of extensively managed domestic ruminants. Livestock Production Science 67: 1-18.
Svotwa, E, Makarau A and Hamudikuwanda H (2007). Heat tolerance of Mashona, Brahma and Simental cattle breeds under warm humid summer conditions of Natural region 11 area of Zimbabwe. Electronic Journal of Environment, Agriculture and Food Chemistry 6 (4): 1934-1944.
Villalobos O, Guillen O and Garcia J (2008). Effect of density on performance of Fattening rabbits under heat stress. Management and Economy 9th World Rabbit Congress June 10-13, Verona-Italy: 1631-1636.

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NUTRIENT DIGESTIBILITY, CARCASS CHARACTERISTICS AND PLASMA METABOLITES IN KIDS FED DIETS SUPPLEMENTED WITH CHROMIUM METHIONINE

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ABSTRACT: *This study was carried out to evaluate the effects of different levels of chromium methionine (CrMet) on nutrient digestibility, carcass characteristics and plasma metabolites of male kids. Thirty-two male Mahabadi goat kids (average initial body weight (BW) = 22±2 kg, 4 months) were allocated in a completely randomized design with four treatments: 1) control (without Cr), 2) 0.5, 3) 1 and 4) 1.5 mg Cr as Cr-Met/animal/day. Diets were same (ratio of forage: concentrate was 30:70) except for top-dress addition of Cr-Met and fed in two equal meals (08.00 and 16.00h), Also orts collected before morning meal. Animals were kept in individual pens for 100 days. Kids were slaughtered at the end of the experiment and carcass characteristics determined. The results showed that dressing percentage was not affected by treatment, but, Cr supplementation reduced 10th rib back fat thickness by 30.30% (P<0.01), and tended to increase longissimus muscle area (P<0.09). Supplemental Cr increased percentage of neck (P<0.05) and proximal pelvic limb (P<0.08). Addition of different levels of Cr-Met failed to significantly effect on (P>0.01) the post-prandial changes in plasma levels of cholesterol, urea N, total protein, triglyceride and albumin, However, post-prandial of plasma glucose decreased by Cr (P<0.05). NDF and organic matter digestibility increased in the kids fed added dietary Cr compared with the control group. it was concluded that diet supplementation with chromium methionine could be improved nutrient digestibility, carcass characteristics and peripheral glucose utilization in goat kids.*

Key words: *Chromium-methionine, Mahabadi goat kid, Digestibility, Plasma metabolites, Glocuse*

ORIGINAL ARTICLE

INTRODUCTION

Trivalent chromium (Cr) is a structural component of a glucose tolerance factor (GTF) which potentiates the action of insulin; it is also an essential trace element for normal metabolism of carbohydrate, lipids, protein, and nucleic acids in humans and laboratory animals (Anderson et al., 1987; Abraham et al., 1991; Mertz, 1993). Dietary recommendation for Cr is not listed for most livestock species including goats. Nevertheless, supplementation of Cr in livestock diets may improve animal metabolism and enhance production performance and the quality of animal products (Spears, 1999). There is evidence to suggest that adequate absorption of Cr occurs only when the trace element is associated with a specific organic molecule (Evans, 1982). Consequently, many types of organic mineral complex have been developed and introduced to the market. Chromium methionine chelate is a newly developed organic mineral which is able to directly cross the intestinal cell membrane and be metabolized without any prior digestion since it was chelated with amino acid. Therefore, bioavailability of chromium methionine chelate is proposed to be higher than those of other organic chromium (Ohh and Lee, 2005). Research conducted with pigs showed that organic Cr supplementation increased loin eye area and decreased fat thickness (Page et al., 1993; Lindemann et al., 1995) as well as increasing the rate of lean and decreasing the rate of fat deposition (Boleman et al., 1995; Mooney and Cromwell, 1995). Kitchalong et al. (1995) reported Cr decrease fat thickness over the 10th rib in wether lambs. Bunting et al. (1994) reported lower plasma total cholesterol and higher glucose clearance rates in Holstein calves fed diet supplemented with CrPic. Studies of CrMet supplementation in goat kid are rare. Additionally, the dietary requirement and the exact level of supplementation of Cr need to be defined for livestock which are not exposed to any physical stress per se. In the present investigation, Mahabadi goat kids were supplemented with trivalent Cr as chromium methionine (CrMet) for 90 days. The objective of experiment was to determine the effect of adding different levels of organic Cr on nutrient digestibility, carcass characteristics and plasma concentrations of metabolites in growing goat kids.

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MATERIAL AND METHOD

Animals and dietary treatments

This study was done in Experimental Farm of Agriculture and Natural Resource Collage, university of Tehran, Karaj, Iran. Thirty-two male Mahabadi goat kids (initial age 4 months) were allocated by stratified randomization on the basis of body weight (22±2 kg) into four equal groups. Kids were individually penned and measurements were made on each kid. Kids were allowed ad libitum access to water and offered feed twice daily at approximately 0800 and 1700h for 100 days. Gradual adjustment to forage: concentrate ratio of 30:70 in TMR form. Diet took place over the 10 d quarantine period, and then kids were randomly assigned to one of four dietary treatments (n=8 per group) receiving supplementation of 0, 0.5, 1.0, and 1.5 mg Cr as Cr-Met [10% Cr and 90% Met (wt/wt); MicroPlex 1000, Zinpro, Inc., Eden Prairie, MN] once daily, top dressed with 50 g of ground barley for 90days. The basal diet (Table 1) was formulated for maximum growth and met or exceeded the requirements recommended by NRC (1985). The range of Cr levels was selected based on previous studies with goat (Haldar et al., 2009).

Table 1 - Ingredients and chemical composition of diet

Nutrient	% of DM	Chemical components		Macro mineral and micro mineral	
Alfalfa hay	16.49	DM (%)	80.78	Calcium (%)	0.89
Corn silage	8.32	NEL, Mcal/kg	2.41	Phosphorus (%)	0.48
Ground barley grain	50.65	CP (%)	13.5	Magnesium (%)	0.27
Soybean meal	2.21	NDF (%)	36.6	Sulfur (%)	0.28
Canola meal	4.55	Ether extract (%)	2.6	Zn (mg/kg dm)	219
Wheat bran	9.09	Ash (%)	9	Fe (mg/kg dm)	368
Wheat straw	5.19			I (mg/kg dm)	3
Carbonate Calcium	1.3			Mn (mg/kg dm)	216
Sodium bicarbonate	0.78			Cu (mg/kg dm)	54
Salt	0.52			Co (mg/kg dm)	1
Mineral-Vitamin Premix[1]	0.91			Cr (mg/kg dm)	0.83

[1]Containing vitamin A (250,000 IU/kg), vitamin D (50,000 IU/kg), and vitamin E (1,500 IU/kg), manganese (2.25 g/kg), calcium (120 g/kg), zinc (7.7 g/kg), phosphorus (20 g/kg), magnesium (20.5 g/kg), sodium (186 g/kg), iron (1.25 g/kg), sulfur (3 g/kg), copper (1.25 g/kg), cobalt (14 mg/kg), iodine (56 mg/kg), and selenium (10 mg/kg).

Metabolic challenge and sample analyses

A feeding challenge test was performed on day 75. The pre-feeding blood samples were collected from the jugular vein by jugular vein puncture into evacuated collection tubes containing sodium heparin at 0800 h after an overnight fast and then stored immediately on ice. The kids were fed and bled again 3h after feeding. Plasma samples were harvested by centrifuging at 3000 × g for 15 min and were stored at -20°C until analysis. Plasma samples were analyzed for glucose, triglyceride, total cholesterol, Urea N, total protein and albumin concentration using enzymatic method and appropriate kits (Pars-azmon Co., Tehran, Iran) and Clima Plus Analyzer (RAL, Madrid, Spain). The change (%) in the concentration of the serum metabolites over the basal value at 3 h post prandial was determined as well.

Carcass evaluation

At the termination of the trial, all of the lambs in each treatment group were weighed after 16 h of feed deprivation and slaughtered by Iranian traditional procedure (Nik-Khah, 1984) at the Meat Processing Facility of the Animal Sciences Department, University of Tehran. At slaughter, the head, hair and viscera were removed from carcass, hot carcass (for determination of dressing proportion) was collected, and the right and left halves of the carcasses were separated. Measurements of back fat depth and *longissmus* muscle area were made from right carcass tracings taken at the 10th rib. Carcass dressing proportion was calculated by the following formula: hot carcass weight divided by final live weight ×100. From the carcass, wholesale cuts including neck, proximal thoracic limb, proximal pelvic limb, steak-lumbar, and brisket-abdominal region were separated and weighed (Nik-Khah, 1984).

Diet and fecal samples collection and chemical analyses

Samples of the diet (TMR) and the orts were collected weekly in polyethylene sachets and pooled at monthly intervals. During the last 7 days of the experiment, fecal samples were collected every morning around feeding time. Faecal samples were pooled for each kids at the end of the collection period. Diet and fecal samples were analyzed for DM, organic matter (OM), crude protein (Kjeldahl N *6.25), ether extract, ash, and AIA content in accordance with the Association of Official Agricultural Chemists protocols (AOAC, 1990). All samples were analyzed for neutral detergent fiber (NDF) and acid detergent fiber (ADF) content according to procedures described by Van Soest et al. (1991) . AIA content was used as an internal marker to determine the apparent digestibility of Nutrient digestibility as reported by Van Keulen and Young (1977).

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Statistical Analysis

Data were analyzed as a completely randomized design using the General Linear Model (GLM) procedure of the statistical analysis software package (SAS Institute, 2002). Least-square means were computed and tested for differences by the Tukey's test. Differences of least squared means were considered to be significant at P <0.05, and that of (P <0. 01) was described as a trend.

RESULTS AND DISCUSSION

The effects of supplemental Cr on characteristics and percentage of wholesale cuts of the carcass are presented in Table 2. There is no significant effect of Cr on dressing proportion (%) compared to the control group (P>0.05) but, longissimus muscle area (LMA) had a trend to increased (LMA were 12.65, 13.96, 14.57, 15.24 control to 4, respectively; P= 0.09). Dietary CrMet supplementation reduced 10th rib back fat thickness by 30.30% (P<0.01). Among percentage of wholesale cuts of the carcass, neck (%) increased by addition of Cr to the diet (P < 0.05), whereas the percentage of brisket abdominal, steak-lumbar, Proximal thoracic limb and proximal pelvic limb were not affected by Cr supplementation (P>0.05; Table 4). kids fed 1.5 mg Cr tended to have higher proximal pelvic limb percentage (P=0.08). Our data indicate that Cr additives did affect lipid deposition and LMA. These results supported the findings of Lindemann et al. (1995), who observed that the addition of 200 ppb Cr reduced back fat and increased LMA of growing-finishing swine, and similar effects of Cr were also observed in pigs (Mooney and Cromwell, 1995; Wang and Xu, 2004; Wang et al., 2009). Kitchalong et al. (1995) reported a decrease in fat thickness over the 10th rib in wether lambs fed organic Cr, and no differences were detected for loin-eye area. On the contrary, Evock-Clover et al. (1993) indicated that Cr did not affect back fat or LMA in growing pigs, Yan et al. (2008) and Gentry et al. (1999) did not show any effect of Cr on dressing percentage, back fat and LMA in lambs. As the cofactor of insulin, Cr acts on carcass traits mainly by influencing insulin sensitivity, which closely relates to carbohydrate and protein metabolism (Anderson, 1998). The results of our research suggest that the chromium content in the test diet could not meet the requirements of fattening kids. Reports of carcass cuts in Cr supplementation studies have been rare. Mooney and Cromwell (1997) observed no differences in ham weight of pigs fed supplemental Cr (200g/kg) as CrPic, whereas Anderson et al. (1989) and Hossain et al. (1998) reported increase of breast yield in poultry fed supplemental Cr as CrCl3 (25 to 200 mg/kg) or high-Cr yeast (400g/kg). In the present study, among the wholesale cuts, percentage of neck and pelvic limbs increased by supplemental Cr. These results can be related to Cr effects on improving insulin sensitivity or cellular protein synthesis (Roginski and Mertz, 1969; Okada et al., 1982). Mostafa-Tehrani et al. (2006) reported supplemental Cr from CrNic or CrCl3 increased weights of proximal thoracic and pelvic fat-tailed ram limbs.

Table 2 - Effects of chromium methionine (CrMet) supplementation on carcass characteristics and percentage of wholesale cuts of the carcass in Mahabadi goat kids.

Item	Treatments*				SEM	Significance (p value)
	1	2	3	4		
Loin eye area (LMA,cm2)	12.65	13.96	14.57	15.24	0.70	*
Dressing percentage	41	39	43	39	1.30	NS
Fat thickness over 10th rib, (mm)	3.30^{a}	2.88^{a}	2.63^{ab}	2.3^{b}	0.19	***
Neck (%)	9.66^{b}	10.07^{a}	11.17^{a}	9.96^{a}	0.35	**
Proximal thoracic limb (%)	22.97	22.47	21.92	21.66	0.44	NS
Proximal pelvic limb (%)	29.17	30.50	29.89	30.87	0.47	*
Steaks-lumbar (%)	21.58	20.99	20.78	21.61	0.56	NS
Brisket-abdominal region (%)	16.33	15.83	16.23	16.03	0.37	NS

*1= 0(control), 2= 0.5, 3= 1 and 4= 1.5 mg Cr/day/animal as chromium methionine (CrMet). Means in the same row with different superscripts differ significantly (p<0.05). *P < 0.1; ** P < 0.05; *** P < 0.01; NS = not significant.

Mean plasma glucose, triglyceride, total cholesterol, urea N, total protein and albumin at 0 and 3 h postprandial are shown in Table 3. Dietary Cr supplementation improved post-prandial utilization of glucose (P=0.026). Overall mean plasma glucose concentrations were lower (P<0.05) in the CrMet-fed kids than in those fed control (plasma glucose were 63.38, 58.11, 53.55and 51.81 mg/dL in 1m (control) to 4, respectively). All kids had higher (P<0.01) plasma triglyceride concentrations 3 h after feeding than after 16 h of feed deprivation. Following 16 h of feed deprivation, plasma triglyceride tended to decrease in kids fed 1 mg Cr day (P<0.01). Dietary treatment had no effect (P>0.01) on the post-prandial changes in plasma levels of cholesterol, urea N, total protein, triglyceride and albumin, but overall mean plasma cholesterol (P<0.06) and triglyceride (P<0.04) decreased, whereas urea N increased by CrMet (P=0.06). The 0 and 3 h, post-prandial plasma metabolite concentrations did not reveal any effect of Cr supplementation, and this was in partial agreement with the earlier findings (Kitchalong et al., 1995; Gentry et al., 1999). Haldar et al. (2007) observed that post-prandial serum levels of glucose and cholesterol decreased by dietary Cr supplementation from Cr chloride and Cr yeast in adult castrated male black Bengal goats. The 3 h postprandial plasma glucose indicated a better utilization of glucose after feeding. Overall mean plasma cholesterol and triglyceride levels revealed significant effect of Cr on lipid metabolism as did earlier workers (Bunting, et al. 1994; Kitchalong, et al. 1995; DePew et al., 1996; Subiyatno et al., 1996). Results from this study, therefore, support the suggestion that Cr supplementation has the potential to alter lipid metabolism (Riales and Albrink, 1981). The lower serum triglyceride at 0 h in agreement with the results of Page et al. (1993)

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and Wang et al. (2009), but different by several earlier works reporting little or no effect of supplemental Cr on serum triacylglycerol level (DePew et al., 1996; Besong et al., 2001).

Table 3 - plasma metabolite concentrations at 0 and 3 h post prandial in goat kids supplemented with different levels of chromium methionine (CrMet)

Measurements	Treatment 1				SEM	Significance (p value)		
	1	2	3	4		Diet	time	Diet*Time
Glucose(mg/dL)								
0 h	60.03	56.50	56.33	49.04	3.59	NS	NS	NS
3 h	66.72a	59.71ab	50.78b	54.58b	3.40	**	NS	NS
% change over 0 h value	11.16	8.64	-8.36	13.35	9.85	NS	NS	NS
Total cholesterol (mg/dL)								
0 h	71.06	54.94	69.79	59.90	7.86	NS	NS	NS
3 h	73.24	60.58	67.46	69.37	8.06	NS	NS	NS
% change over 0 h value	25.00	17.32	-0.40	28.36	10.01	NS	NS	NS
TG (mg/dL)								
0 h	36.25	39.04	32.52	36.70	1.34	*	***	NS
3 h	38.53	40.85	36.61	38.81	1.44	NS	NS	NS
% change over 0 h value	6.33b	5.33c	12.82a	5.71bc	0.35	***	NS	NS
Albumin,(g/dL)								
0 h	5.72	5.78	4.98	4.44	0.39	NS	*	NS
3 h	4.63	3.80	4.74	4.84	0.52	NS	NS	NS
% change over 0 h value	-18.17	-32.66	-3.46	12.38	13.12	NS	NS	NS
Urea N, (mmol/l)								
0 h	5.43	6.63	5.62	7.55	0.82	NS	NS	NS
3 h	5.51	5.53	6.18	6.96	0.39	NS	NS	NS
% change over 0 h value	7.45	-8.70	12.26	-4.01	8.47	NS	NS	NS
Total protein,(g/dL)								
0 h	7.32	7.19	6.23	7.44	0.45	NS	NS	NS
3 h	7.89	6.13	6.74	6.49	0.8	NS	NS	NS
% change over 0 h value	10.14	-22.04	7.25	-12.73	10.02	NS	NS	NS

[1]1= 0(control), 2= 0.5, 3= 1 and 4= 1.5 mg Cr /day/animal as chromium methionine (CrMet). Means in the same row with different superscripts differ significantly (p<0.05). For glucose: over all diet effect P = 0.02, For cholesterol: over all diet effect P = 0.06, For protein: over all diet effect P = 0.53. For triglyceride: over all diet effect P = 0.04, For albomin: over all diet effect P = 0.63, For Urea N: over all diet effect P = 0.06. *P < 0.1; ** P < 0.05; *** P < 0.01; NS = not significant

Table 4 - Effects of chromium methionine (CrMet) supplementation on DMI and apparent digestibility of nutrients diet in Mahabadi goat kids

Item	Treatments*				SEM	Significance (p value)
	1	2	3	4		
DMI kg/d	1.00	1.00	1.02	1.06	0.04	NS
Digestibility coefficients (%)						
DM	67.45	69.05	71.09	66.62	1.47	NS
OM	64.50	64.25	67.40	63.21	1.07	*
CP	59.42	57.72	61.19	57.12	1.74	NS
EE	48.14	57.21	61.06	57.44	3.25	NS
NDF	45.81b	46.50b	53.84a	48.46ab	1.58	***
ADF	67.31	64.53	70.50	67.49	1.86	NS

*1= 0(control), 2= 0.5, 3= 1 and 4) 1.5 mg Cr /day/animal as chromium methionine (CrMet). Means in the same row with different superscripts differ significantly (p<0.05). *P < 0.1; ** P < 0.05; *** P < 0.01; NS = not significant

Table 4 shows the effects of Cr supplementation on apparent digestibility of nutrients and dry matter intake (DMI). DMI were not affected (P>0.05) by Cr supplementation. This is consistent with research with pigs (Page et al., 1993; Amoikon et al., 1995; Lindemann et al., 1995), lambs (Samsell and Spears, 1989; Kitchalong et al., 1995; Forbes et al., 1998), and calves (Bunting et al., 1994; Mathison and Engstrom, 1995). In contrast, Moonsie-Shageer and Mowat (1993) did show improved DMI in calves supplemented with high-Cr yeast in a corn-silage diet, whereas Boleman et al. (1995) reported reduced DMI in pigs fed Cr tripicolinate from the growing to the finishing phase.

In the present study, dietary supplementation of CrMet had no effect on the digestibility coefficients of DM, CP, EE and ADF (P>0.05), whereas the apparent digestion rate of NDF was significantly improved in treated animals as compared with control (P<0.01). Kids fed 1 mg Cr tended to have higher OM digestibility (P = 0.06). Cr

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supplementation reportedly increased OM, DM and CP digestibility in Bengal goats (Haldar et al., 2009) and, Kornegay et al. (1997) reported improved DM digestibility in growing-finishing pigs fed chromium picolinate. In contrast, Kraidees et al. (2009) found that supplemental chromium levels from a Cr-yeast source had no effect on digestibility of nutrients in lambs.

CONCLUTON

The results of this experiment suggest that supplemental organically chelated chromium may decrease fat deposition and alter carcass quality in goat kids. Chromium supplementation as CrMet may be beneficial in improving some wholesale cuts such as neck or proximal pelvic limbs, and moreover CrMet may be a useful tool for improving digestion rate of nutrition and glucose utilization in animals even in a non-stressed management regime.

REFERENCE

Abraham A, Brooks B and Eylath U (1991). Chromium and cholesterol-induced atherosclerosis in rabbits. Annals of nutrition and metabolism. 35: 203-207.

Amoikon E, Fernandez J, Southern L, Thompson D, Ward JrT and Olcott B (1995). Effect of chromium tripicolinate on growth, glucose tolerance, insulin sensitivity, plasma metabolites, and growth hormone in pigs. Journal of Animal Science. 73: 1123-1130.

Anderson RA (1998). Chromium, glucose intolerance and diabetes. Journal of the American College of Nutrition. 17: 548-555.

Anderson RA, Bryden NA, Polansky MM and Richards MP (1989). Chromium supplementation of turkeys: Effects on tissue chromium. Journal of agricultural and food chemistry. 37: 131-134.

Anderson RA, Polansky MM, Bryden NA, Bhathena SJ and Canary JJ (1987). Effects of supplemental chromium on patients with symptoms of reactive hypoglycemia. Metabolism. 36: 351-355.

Besong S, Jackson J, Trammell D and Akay V (2001). Influence of supplemental chromium on concentrations of liver triglyceride, blood metabolites and rumen vfa profile in steers fed a moderately high fat diet. Journal of Dairy Science. 84: 1679-1685.

AOAC (1990). Official methods of analysis, 15th ed. Association of Official Analytical Chemists. Washington, DC, pp. 69–90.

Boleman S, Boleman S, Bidner T, Southern L, Ward T, Pontif J and Pike M (1995). Effect of chromium picolinate on growth, body composition, and tissue accretion in pigs. Journal of Animal Science. 73: 2033-2042.

Bunting L Fernandez J Thompson DJr and Southern L (1994).Influenceof chromium picolinate on glucose usage and metabolic criteria in growing Holstein calves. Journal of Animal Science. 72: 1591-1599.

DePew C, Bunting L, Thompson D and Grant D (1996). Chromium picolinate does not alter intake or lipid metabolism in lambs fed standard or high-fat diets. J Dairy Sci. 79: 140.

Evans G W (1982). The role of picolinic acid in metal metabolism. Life Chemistry. Rep. 1:57.

Evock-Clover CM, Polansky MM, Anderson RA and Steele NC (1993). Dietary chromium supplementation with or without somatotropin treatment alters serum hormones and metabolites in growing pigs without affecting growth performance. The Journal of Nutrition. 123: 1504-1512.

Forbes C, Fernandez J, Bunting L, Southern L, Thompson DJr, Gentry L and Chapa A (1998). Growth and metabolic characteristics of suffolk and gulf coast native yearling ewes supplemented with chromium tripicolinate. Small Ruminant Research. 28: 149-160.

Gentry L, Fernandez J, Ward T, White T, Southern L, Bidner T, Thompson DJr, Horohov D, Chapa A and Sahlu T (1999). Dietary protein and chromium tripicolinate in suffolk wether lambs: Effects on production characteristics, metabolic and hormonal responses, and immune status. Journal of Animal Science. 77: 1284-1294.

Haldar S, Mondal S, Samanta S and Ghosh T (2009). Effects of dietary chromium supplementation on glucose tolerance and primary antibody response against peste des petits ruminants in dwarf-bengal goats (capra hircus). Animal. 3: 209-217.

Haldar S, Samanta S, Banarjee R, Sharma B and Ghosh T (2007). Glucose tolerance and serum concentrations of hormones and metabolites in goats (capra hircus) fed diets supplemented with inorganic and organic chromium salts. Animal. 1: 347-356.

Hossain SM, Barreto SL and Silva CG (1998). Growth performance and carcass composition of broilers fed supplemental chromium from chromium yeast. Animal feed science and technology. 71: 217-228.

Kitchalong L, Fernandez J, Bunting L, Southern L and Bidner T (1995). Influence of chromium on tripicolinate glucose metabolism and nutrient partitioning in growing lambs. Journal of Animal Science. 73: 2694-2705.

Kornegay EZ Wang C Wood and M Lindemann (1997). Supplemental chromium picolinate influences nitrogen balance, dry matter digestibility, and carcass traits in growing-finishing pigs. Journal of Animal Science. 75: 1319-1323.

Kraidees M, Al-Haidary I, Mufarrej S, Al-Saiady M, Metwally H and Hussein M (2009). Effect of supplemental chromium levels on performance, digestibility and carcass characteristics of transport-stressed lambs. Asian-Aust J Anim Sci. 22: 1124-1132.
Lindemann M, Wood C, Harper A, Kornegay E and Anderson R (1995). Dietary chromium picolinate additions improve gain: Feed and carcass characteristics in growing-finishing pigs and increase litter size in reproducing sows. Journal of Animal Science. 73: 457-465.
Mathison G and Engstrom D (1995). Chromium and protein supplements for growing-finishing beef steers fed barley-based diets. Canadian Journal of Animal Science. 75: 549-558.
Mertz W (1993). Chromium in human nutrition: A review.
Mooney K and Cromwell G (1995). Effects of dietary chromium picolinate supplementation on growth, carcass characteristics, and accretion rates of carcass tissues in growing-finishing swine. Journal of Animal Science. 73: 3351-3357.
Mooney K and G Cromwell (1997). Efficacy of chromium picolinate and chromium chloride as potential carcass modifiers in swine. Journal of Animal Science. 75: 2661-2671.
Moonsie-Shageer S and Mowat DN (1993). Effect of level of supplemental chromium on performance, serum constituents, and immune status of stressed feeder calves. Journal of Animal Science. 71: 232-238.
Mostafa-Tehrani A, Ghorbani G, Zare-Shahneh A and Mirhadi S (2006). Non-carcass components and wholesale cuts of iranian fat-tailed lambs fed chromium nicotinate or chromium chloride. Small Ruminant Research. 63: 12-19.
Nik-Khah (1984). The growth and carcass quality of Afshari, Turkey and Mehraban lambs on different diets. Australian Society of Animal Production 15: 498–499.
NRC, (1985). Nutrient requirements of sheep, sixth revised ed. National Academy Press, Washington, DC, pp. 45–53.
Ohh SJ and Lee JY (2005). Dietary chromium-methionine chelate supplementation and animal performance. Asian–Australasian Journal of Animal Sciences. 18: 898-907.
Okada S, Taniyama M and Ohba H (1982). Mode of enhancement in ribonucleic acid synthesis directed by chromium (iii)-bound deoxyribonucleic acid. Journal of Inorganic Biochemistry. 17: 41-49.
Page T, Southern L, Ward T and Thompson DJr (1993). Effect of chromium picolinate on growth and serum and carcass traits of growing-finishing pigs. Journal of Animal Science. 71: 656-662.
Riales R and Albrink MJ (1981). Effect of chromium chloride supplementation on glucose tolerance and serum lipids including high-density lipoprotein of adult men. The American journal of clinical nutrition. 34: 2670-2678.
Roginski EE and Mertz W (1969). Effects of chromium (iii) supplementation on glucose and amino acid metabolism in rats fed a low protein diet. The Journal of nutrition. 97: 525-530.
Samsell LJ and Spears JW (1989). Chromium supplementation effects on blood constituents in lambs fed high or low fiber diets. Nutrition Research. 9: 889-899.
SAS Institute. (2002). User's Guide: Statistics. Version 9.1 Ed. SAS Inst. Inc., Cary, NC.
Spears J (1999). Reevaluation of the metabolic essentiality of the minerals. Asian Australasian Journal of Animal Sciences. 12: 1002-1008.
Subiyatno A, Mowat D and Yang W (1996). Metabolite and hormonal responses to glucose or propionate infusions in periparturient dairy cows supplemented with chromium. Journal of dairy science. 79: 1436-1445.
Van Keulen J and Young B (1977). Evaluation of acid-insoluble ash as a natural marker in ruminant digestibility studies. Journal of Animal Science. 44: 282-287.
Van Soest PJ, Robertson J and Lewis B (1991). Methods for dietary fiber, neutral detergent fiber, and nonstarch polysaccharides in relation to animal nutrition. Journal of dairy science. 74: 3583-3597.
Wang M, He Y, Lindemann M and Jiang Z (2009). Efficacy of cr (iii) supplementation on growth, carcass composition, blood metabolites, and endocrine parameters in finishing pigs. Asian-Australasian Journal of Animal Sciences. 22: 1414-1419.
Wang M and Xu Z (2004). Effect of chromium nanoparticle on growth performance, carcass characteristics, pork quality and tissue chromium in finishing pigs. Asian Australasian Journal of Animal Sciences. 17: 1118-1122.
Yan X, Zhang W, Cheng J, Wang R, Kleemann DO, Zhu X and Jia Z (2008). Effects of chromium yeast on performance, insulin activity, and lipid metabolism in lambs fed different dietary protein levels. Asian Australasian Journal of Animal Sciences. 21: 853.

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LEVEL OF ADOPTION AND CONSTRAINTS OF SCIENTIFIC BACKYARD POULTRY REARING PRACTICES IN RURAL TRIBAL AREAS OF SIKKIM, INDIA

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ABSTRACT: *A study was conducted on level of adoption and constraints of backyard poultry rearing practices in rural tribal areas of Sikkim. The data were collected from 125 respondents of Dzongu area, North Sikkim through personal interview with the help of questionnaire. From the present study it was found that 64.8% respondents were medium level adopters followed by high level (19.2%) and low level (16%) adopters. Housing (43.2%) were highly adopted followed by feeding and watering (41.6%), marketing (40.0%), general management (39.2%), health care practices (36.8%) and breeding practice (33.6%). The overall adoption of different backyard poultry rearing practices showed medium level adoption. Non availability of backyard poultry chicks, non-availability of medicine, high incidence of diseases, lack of knowledge about scientific practices, lack of market, attack of predators etc. were the major constraints faced by backyard poultry farmers. The study also pointed some suggestions for solving the constraints regarding backyard poultry rearing practices in Dzongu, North Sikkim.*

ORIGINAL ARTICLE

Key words: *Adoption, Backyard poultry, Farming practice, Constraint, Scientific*

INTRODUCTION

Backyard poultry is an important source of supplementary income and nutrition security for a large number of poor households across the country. Even with proliferation of the industrial poultry on a large scale, backyard poultry constitutes a significant proportion of the total poultry population at the national level. The demand of eggs and meat of rural areas is fulfilled by rearing of backyard poultry (Nandi et al., 2007; Panda et al., 2008). Village chickens provide cheap, readily harvestable protein-enriched white meat and eggs with high quality, digestible protein for immediate home consumption and sale for income generation(Dolberg and Petersen, 2000; Mapiye and Sibanda, 2005; Miao, 2005). There is need to understand the perceptions of the farmers on the functions of backyard poultry and the value of their products under the existing production systems in order to improve backyard poultry productivity and sustainability in rural areas. Therefore assessing the monetary value of chicken and eggs is important and estimate their contribution to household income and food security. Backyard poultry rearing also finds an important role to fulfill the need of stress free and harmful residues free birds (Mandal et al., 2006). There is no reliable information on performance levels, constraints and opportunities of backyard poultry in North Sikkim. This makes it difficult to design and implement village chicken-based developmental programmes that benefit rural livelihoods (Pedersen, 2002; Muchadeyi et al., 2005). The present study was undertaken to investigate the adoption of scientific poultry rearing practices by the backyard poultry farmers.

MATERIALS AND METHODS

Study area

The present study was conducted at Dzongu area, North Sikkim located in the North-Eastern part of India. Sikkim, the second smallest state of India is situated in the Eastern Himalayas. North Sikkim with a total geographical area of 4226 sq. km is the largest district of Sikkim but the least populated with population of 38352 (as per the 2001 census) which are scattered in an altitude range of 4800 feet to 15000 feet. Dzongu area of North

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Sikkim specifically lying between 27^{0}28" to 27^{0}38" North latitude and 88^{0}23" to 88^{0}38" East longitude and is mostly inhabited by Lepcha (Tribal) people. In summer, the temperature during the daytime ranges from 15^0 C to 28^0 C, while during the winter the minimum temperature is as low as 5-6^0 C. The rainfall varies from 3000-4000 mm. The relative humidity is high in monsoon month that is about 90%.

Collection and analysis of data

Samples of 125 backyard poultry farmers were selected randomly from five Gram Panchayat Unit (GPU) of Dzongu area of North Sikkim namely Tingvong, Passingdang, Lingdong, Hee-Gyathang and Gor. The data were collected through questionnaire and respondent's personal interviews were also employed. The score one was assigned for the adoption of the improved practices while score zero was for non adoption. Data were collected, tabulated and analyzed for meaningful conclusion. Statistical analysis was done with the help of Microsoft Excel (2007) and Statistical Analysis System (2001).

RESULTS AND DISCUSSION

Age, gender, education standard and flock size of backyard poultry production

Age, gender of the farmers, education and the scale of poultry production in Dzongu area are presented in Table 1. Majority (46.4%) of the poultry farmers were old which was followed by middle (27.2%) and young (22.4%) farmers.

Table 1 - Age, gender, education and flock size of poultry among the poultry farmers in the study area (n= 125)

Criterion	Percentage
Age	
Young (15-20 Years)	22.4
Middle(21-30 Years)	31.2
Old(Above 30 Years)	46.4
Gender	
Male	27.2
Female	72.8
Education	
Never Attended	12
Primary	76
Secondary	10.4
Tertiary	1.6
Flock Size	
Large (11 And Above Birds)	13.6
Medium (6-10 Birds)	65.6
Small (1-5 Birds)	20.8

n= Total nos. of respondent

The study showed that majority (72.8%) of the poultry farmers in Dzongu area were females. The number of females participated in terms of rural poultry production is always higher than males (Nielsen et al., 2003; Okitoi et al., 2007; Ogunlade and Adebayo, 2009). Among the respondents, 76% were primary educated followed by uneducated (12%) and secondary educated (10.4%).

Performance of backyard poultry

The information regarding the productive performance of poultry birds of Dzongu area are presented in Table 2. In native birds, the average body weight at 6 weeks, average age at first laying, average egg weight at 40 weeks, average yearly egg production and survivability % (up to 6 weeks) were recorded 240- 400 g, 221 days, 32-40 g, 45-50 nos. and 78 respectively.

Table 2 - Performance of different poultry birds rearing in Dzongu area

Economic trait	Result	
	Local /Desi	Broiler
Body weight at six weeks	240-400 g	-
Average age at first laying	221 days	-
Average egg weight at 40 weeks	32-40 g	-
Average egg laying (1 yr.)	45-55 nos.	-
Survivability, % (up to 6 weeks)	78	-
Average body weight at 42 days of age	-	1.75 kg

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Adoption of backyard poultry

In the present study it was found that majority of the respondents (64.8%) were found to be medium adopters followed by high (19.2%) and low (16.0%) adopters (Table 3). This could be due to low annual income, poor knowledge and less utilization of information sources. The similar findings were reported by Ahire et al. (2007), Sasidhar et al. (2008), Khandait et al. (2011).

Practice wise adoption level of farmers about backyard poultry rearing practices are given in Table 4.

Table 3 - Numbers of backyard poultry owners according to their levels of adoption of backyard poultry rearing practices N = 125

Category	Percentage
Low (Score up to 17)	16
Medium (Score 18-34)	64.8
High (Score 35 & above)	19.2
(*mean 25.28, SD 7.669*)	

Table 4 - Adoption level of backyard poultry rearing practices in Dzongu, North Sikkim (N=125)

Practices	Percentage
Housing	
Provision of night shelter	100
Provision of separate house	80.8
Litter material provide	0
Feeders/ Waterer provide	72
Feeding	
Feeding material available in scavenging	100
Kitchen waste	71.2
Additional feed provision(Maize, rice bran)	91.2
Provision for adequate clean water supplement	70.4
Breeding	
Purchased from local market	74.4
Purchased from Govt./Pvt. Hatchery	1.36
Hatching of eggs naturally at home	100
Desi(Local) birds reared	100
Improved backyard poultry breeds reared	5.6
Management practices	
Brooding of chicks naturally	100
Care from predators	60.8
Care of laying hen	67.2
Provision of laying box with dry bedding	75.2
Health care	
Vaccination	7.2
Control of parasites	49.6
Self-treatment of birds	46.4
Treatment of birds by Veterinary doctor	8.8
Marketing	
Sale of eggs and birds in village market	100
Selling at own doorstep	100
Selling of birds when attain a specific wt. gain/age of birds	82.4

Housing practice

Proper housing must not only provide microenvironment or meso-environment that moderate environmental impact but must provide adequate ventilation for birds to lay eggs in nest boxes, as well as to feed and sleep in comfort and security (Kusina and Kusina, 1999).

During the present study, it was found that all the farmer's rear backyard poultry in extensive system where they provide night shelter to their birds. Among them 80.8% per cent respondents constructed a separate house with wooden floor about 1 to 1.5 feet over the ground level made of locally available material *viz*. wooden material, tin/plastic sheet, wire net etc. The rest of the farmers kept their birds in a temporary box like structure made of wood. The well ventilated shelter was provided by a small number of farmers. Majority of them used small plastic/ aluminum pot as feeding trough and water trough and are kept inside poultry houses. The temperature maintaining in poultry house is necessary as there is low temperature in winter season in the study area. But only a few farmers supplied electricity in poultry houses. The similar findings were also reported by Khandait et al. (2011).

Feeding and watering practice

Timing and frequency of feeding, what, how to feed and quantity to feed are important aspects to consider in developing strategies to improve nutrition of village chickens (Mapiye and Sibanda, 2005). The backyard poultry

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farmers kept their bird's free whole day in the backyard to find their own feed. The birds ate insects, earthworms, grains, crop residue and vegetable. There was limited scavenging area for backyard poultry in the study area. In addition to the material available in scavenging, 91.2% and 71.2% of respondents provided cereals (maize, rice bran) and kitchen left over, respectively. The practice of supplementary feeding to the birds with locally produced feed to bridge the fluctuating feed supply gap (Mapiye and Sibanda, 2005). About 70.4% of backyard poultry farmers provided adequate and clean water to the birds. These observations are in confirmation with the observations reported by Mandal et al. (2006).

Breeding practice

Crossbreeding of local strains with some imported strains can increase productivity of flocks (Pedersen, 2002) but should be coordinated to avoid replacement of indigenous stock (Mhlanga et al., 1999). Li et al. (2006) reported that development efforts in Africa and Asia are more focused on introduction of exotic high yielding breeds than understanding the production potential of indigenous chickens. In the study it was found that all the farmers allowed eggs to hatch at home under broody hen naturally for chicks and also made use of other source for procurement of chicks. The cent percent of farmers rear desi birds whereas only 5.6% farmers adopted improved backyard poultry breeds (*i.e.* Vanaraja, Gramapriya etc). Majority (74.4%) of them purchase poultry chicks from the local market and 1.36% purchased from Govt/ private hatchery.

General management practice

Chicks are the most vulnerable and mortalities of chick recorded up to 60% (Pedersen, 2002; Muchadeyi et al., 2005). Farmers are encouraged to provide extra care to their chicks by the use of locally made Hay-box brooder to reduce chick mortality. The cares of chicks were taken by majority of respondents in the study area and 60.8% farmers were protecting their chicks from predators. Around 75.2% of the respondents made provision of laying box with dry bedding materials in shallow and roomy bamboo basket kept in the corner of house. Half of the farmers collected egg frequently. Majority of respondents' brood chicks naturally in sun rays whereas a small number of respondents used chick guards for protection from predators and for natural brooding.

Health care practice

Poor health management resulting in high mortality rates and compromised productive performance characterize most smallholder chicken production systems (Kusina et al., 2001; Pedersen, 2002). Majority of respondents were cleaned the poultry houses daily. The controls of ectoparasite were practiced by 49.6% respondents. During the time of disease infection, 46.4% were involved in self medication to the birds and some of them approached local expert for treatment. Only 8.8% respondents were taking help from veterinary doctors for treating the birds. A small number of backyard poultry farmers practiced deworming and vaccination of birds. It was because of non availability of vaccines and medicines as well as the lack of extension worker expert in veterinary practices. Development of chicken health programmes is required to give reliable information on the epidemiology of diseases and the possibilities of reducing outbreaks (Miao, 2005).

Marketing

The success of a poultry production enterprise is judged by the quantity and quality of products sold (number of chickens and eggs) and consequently, the amount of profit gained. In areas where markets are a problem, farmers are forced to keep the birds longer and this increases the costs of production by increasing the amount of feed required to keep the birds alive (Pedersen, 2002). The backyard poultry owners of Dzongu area were selling their birds at their own doorstep, village market when the birds attain a specific weight gain of 1.5 to 2 kg. The birds were being sold on specific occasion, on demand of customers, on religious function and requirement of money. The respondents expressed that the care of backyard poultry was taken by female. The farmers used poultry manure in agriculture as well as horticulture crops.

The overall adoptions of different backyard poultry rearing practices were presented in Table 5. From the table it was found that the overall adoption of backyard poultry was 39.06%. The practices wise adoption showed that housing (43.2%) was highly adopted followed by feeding and watering (41.6%), marketing (40.0%), general management (39.2%), health care practices (36.8%) and breeds (33.6%).This is because of low level of knowledge of respondents, few sources utilized for acquiring information, low level of education and income. The adoption rates in different practices are almost similar with the findings of Sasidhar et al. (2008) and Khandait et al. (2011).

Table 5 - Overall adoption of backyard poultry rearing practices (Total No. =125)

Area	Percentage
Housing	43.2
Feeding and Watering	41.6
Breed/ Breeding	33.6
General Management	39.2
Health Care	36.8
Marketing	40.0
Overall Adoption	39.06

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Correlates of adoption behavior

The adoptions of scientific poultry farming also depend on farmers' personal as well as social and economic condition. Correlation coefficients of six independent variables were presented in Table 6. These indicated the relationship between variables of poultry farmers with adoption behavior. Age had a significant relationship with adoption level. It gave an idea that young generation might be try to adopt new technologies in their farms. But, Rahman (2007) got negative correlation between age and farmers. Education was negatively and significantly associated with adoption level. It indicates that educated persons had less interest to do farming than other Govt job. The present finding was opposite to the findings of Motamed and Singh (2003) and Rahman (2007). Flock size of poultry had a positive and significant relationship with adoption level. It indicates that farmers having large number of poultry in their farms adopted improved technologies in their farms. Training received showed a positive and significant correlation with the adoption level of the respondents. Training might have given knowledge to the farmers to know the scientific poultry rearing practices. Financial help received was positively and significantly associated with adoption level. It indicated that those who received financial help either from government or financial institution adopted new technologies in their farms. This was similar with the findings of Rahman (2007).

Table 6 - Correlations of adoption of improved poultry rearing practices with independent variables

Sl.no.	Variables	Coefficient of correlation (r)
1	Age	0.547**
2	Education Level	-0.309**
3	Flock Size	0.668**
4	Income from poultry	0.936**
5	Training received	0.475**
6	Credit facility	0.227*

** Correlation is significant at the 0.05 level; ** Correlation is significant at the 0.01 level*

Constraint of backyard poultry rearing practices in the study area

In the study it was observed that majority of the backyard poultry farmers faced problem like non-availability of high yielding breed of poultry chicks, mortality of day old chicks/young birds, high rate of morbidity, inability to diagnose sick birds in Dzongu area. Non-availability of medicines and vaccines at Dzongu resulted in the devastation of the poultry flock by diseases mainly by Ranikhet disease (New Castle disease). Contacts between flocks of different households and the livestock shandies are the important sources of disease transmission. It is therefore, necessary that government and other external agency should take necessary steps for regular supply of vaccines, medicines and other health care services so that the minimum required vaccination should be completed before chicks reach 6 weeks of age i.e. in nursery period. Lack of market for birds and eggs, loss of birds and eggs due to predators etc. were the other important constraint for poultry farmers. Due to lack of proper market in local area poultry farmers of the study area could not able to get their actual benefit as one third of their benefit were spent for high transportation cost. These constraints were also documented by McAinsh et al. (2004) and Omonona and Oni (2004).

Suggestions to improve backyard poultry in Dzongu, North Sikkim

Availability of good germ-plasm: There should be available of high yielding varieties of backyard poultry chicks.

Availability of feed: The improved backyard chicken varieties could not sustain only on scavenging. A small quantity of compounded layer feed should be provided to the birds.

Veterinary and health services: Availability of veterinary aid and skilled persons for vaccination is important. Threat from Newcastle disease is persistent. Supply of immunized birds to backyard is important.

Predators: This is highly devastating factor to the village poultry. As chick stage is most vulnerable, so care should be taken at this stage.

Marketing: A proper market should be established so that the poultry farmers can get proper benefit from poultry and poultry products. To aggregate the produce, farmer's co-operative societies need to be facilitated at village or higher level.

CONCLUSIONS

Backyard poultry rearing is playing an important role in increasing socio-economic status of rural community and employment in rural areas. It was realized that the poor can gain from the opportunities in poultry sector if small-holder poultry which is technologically similar to industrial poultry is taken up. Focus should be on augmenting the advantages of smaller decentralized units in terms of better efficiency, faster and better disease control. There are certainly some production technology advantages for poor; in terms of adaptability for scaling down and the significant labour component. It is important to conserve the indigenous gene pool, and there should be check on introducing high yielding breeds of backyard poultry. It is necessary for an effective disease surveillance mechanism and quick response system to overcome related problems. There is also need for more information to update and validate existing constraints and opportunities in light of the land redistribution process

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and current economic challenges in North Sikkim. The present study viewed that introduction of high yielding dual purpose birds and providing basic health care facilities can bring a significant improvement in sustainable backyard poultry production in Dzongu, North Sikkim.

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REFERENCES

Ahire MC, Birari D and Kamble DK (2007). Adoption of poultry management practices in Solapur, India. The Asian Journal of Animal Science. 2(1/2): 55-58.

Dolberg F and Petersen PH (2000). Poultry as a tool in Poverty eradication and promotion of gender equality. Proceedings of a workshop, March 22-26, 1999, Tune Landboskole, Denmark.

Khandait VN, Gawande SH, Lohakare AC and Dhenge SA (2011). Adoption Level and Constraints in Backyard Poultry Rearing Practices at Bhandara District of Maharashtra (India). Research Journal of Agricultural Sciences, 2(1): 110-113.

Kusina JF, Kusina NT and Mhlanga F (2001). A survey on Village chicken losses: Causes and solutions as perceived by farmers (Ed. R. G. Alders and P. B Spradbrow), Proceedings of SADC planning workshop on Newcastle disease control in village chickens, Maputo, Mozambique, 6-9 March 2000, Australian Center for International Agricultural Research. Canberra Proceedings 103: 148-155.

Li CC, Li J, Mo DL, Xu RF, Chen GH, Qiangba YZ, Ji SL, Tang XH, Fan B, Zhu MJ, Xiong TA, Guan X and Liu B (2006). Polymorphism of ghrelin gene in twelve Chinese indigenous chicken breeds and its relationship with chicken growth traits. Asian-Aust. J. Anim. Sci. 19(2): 153-159.

Mandal MK, Khandekar N and Khandekar P (2006). Backyard poultry farming in Bareilly district of Uttar Pradesh, India: An analysis. Livestock Research for Rural Development, 18(7), http://www.lrrd.org/lrrd18/7/mand18101.htm.

Mapiye C and Sibanda S (2005). Constraints and opportunities of village chicken production systems in the smallholder sector of Rushinga District of Zimbabwe. Livestock Research for Rural Development 17 (10), http://www.lrrd.org/lrrd17/10/mapi17115.htm.

McAinsh CV, Kusina J, Madsen J and Nyoni O (2004). Traditional Chicken Production in Zimbabwe. World's Sci. J., 60: 233-246.

Mhlanga FN, Khombe CT and Makuza SM (1999). Evaluation of indigenous livestock in Zimbabwe. A report prepared for the Department of Animal Science, University of Zimbabwe.

Miao ZH, Glatz PC and Ru YJ (2005). Free-range poultry production - A review. Asian Aust. J. Anim. Sci. 18(1): 113- 132.

Motamed M-K and Singh B (2003). Correlation of Adoption of Improved Sericulture Practices. Indian Journal of Extension Education XXXIX (1 and 2): 51-57.

Muchadeyi FC, Sibanda S, Kusina NT, Kusina JF and Makuza S (2005). Village chicken flock dynamics and the contribution of chickens to household livelihoods in a smallholder farming area in Zimbabwe. Trop. Anim. Health Prod. 37(4): 333-334.

Nandi S, Sharma K, Pawan Kumar and Nandi D (2007). Poultry farming: A rapidly growing profitable business. Poultry Line, 7(12): 19-20.

Nielsen H, Roos N and Thilsted SH (2003). The impact of semi-scavenging poultry production on the consumption of animal source food by women and girls in Bangladesh. J. Nutr., 133, 4027S- 4030S.

Ogunlade I and Adebayo S.A (2009). Socio-economic status of women in rural poultry production in selected areas of Kwara State, Nigeria. Int. J. Poult. Sci., 8: 55-59.

Okitoi LO, Ondwasy HO, Obali MP and Murekefu F (2007). Gender issues in poultry production in rural household of Western Kenya. Livestock Research for Rural Development, 19(2), http:// www.lrrd.org/lrrd19/2/okit19017.htm.

Omonona BT and Oni OA (2004). Economics of Table Egg Production in Ibadan Metropolis, Oyo State, Nigeria. Trop. J. Anim. Sci., 7 (2): 67-73.

Panda AK, Raju MVLN and RamaRao SV (2008). Poultry Production in India: Opportunities and Challenges Ahead. Poultry Line, 8(1): 11-14.

Pedersen CV (2002). Production of semi-scavenging chickens in Zimbabwe. PhD Thesis. The Royal Veterinary and Agricultural University, Copenhagen, Denmark.

Rahman S (2007). Adoption of improved technologies by the pig farmers of Aizawl district of Mizoram, India. Livestock Research for Rural Development. 19(1), http:// www.lrrd.org/lrrd19/19/1/rahm19005.htm.

Sasidhar PVK, Semmaran M, Majumdar S, Chander MA and Tripathi H (2008). Factors Influencing Adoption of Backyard Poultry by Farmers in India. World Poultry Science Journal 2: 315.

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EFFECTS OF DIFFERENT SILAGE PRESERVATIVES ON SILAGE QUALITY OF *Pennesitum purpureum* HARVESTED AT DIFFERENT HARVESTING PERIODS

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ABSTRACT: *The study was conducted to determine the effects of preservatives on the chemical composition of elephant grass (P. purpureum Bana cv.) harvested from N-fertilized and unfertilized treatments at different periods (3, 6 and 9 months). The plants were grown on 1st November 2008 and harvested every 3 months until July 2009. The grass was chopped and a 500 g sample obtained and was mixed with 4% molasses, 4% molasses+0.25% urea and 2.5% dicalcium phosphate, respectively with plain silage as a control. The samples were ensiled with respective preservative in duplicates and were analyzed for pH and proximate after 30 days of ensiling. Molasses added silage had a higher (P<0.05) DM at 3 months on both N-fertilized and unfertilized treatments, whereas molasses added silage prepared from unfertilized treatment harvested at 3 months of growth, had lowest (P<0.05) pH and was highly (P<0.05) digestible but digestibility declined as the plant matured.*

ORIGINAL ARTICLE

Key words: *Elephant grass, Harvesting periods, Silage preservatives, Silage quality.*

INTRODUCTION

Elephant grass is tall growing perennial grass which is indigenous to tropical and subtropical climates. Since *Pennesitum purpureum Bana cv.* yield high biomass it can be used for silage production which will ensure sufficient availability of feed on farm throughout the year. Nisa et al. (2008) stated that uneven and insufficient supply of quality forage is the most critical constraint for profitable livestock production in developing countries. Ensiling is the process of preserving a forage crop and its nutrients to feed later on. According to Kung et al. (2000), the primary purpose of making silage is to maximize the preservation of original nutrients in the forage crop for feeding at a later date.

Botswana is one of the countries that are susceptible to drought and this shows the need to address shortage of feed during drought periods. During summer the quantity and nutritive composition of grasses is high while in winter the quality decline and availability is scanty. Higashiyama and Hirata (2006) emphasized that during the dry season herbage quality declines and it forms the main diet of ruminants in the semi-arid grasslands in the tropics for several months of the year. Therefore, preserving feed can help to sustain livestock industry during drought and dry seasons.

Seglar (2003) confirmed that quality of silage is a major concern, especially in dairy farming and that cows should be fed the highest quality ensiled forages possible for maximum milk production. This indicates that silage quality is important to dairy profitability. Yunus et al. (2000) stated that the quality of silage made from tropical herbages are generally of low fermentation quality as silage do not contain large amount of lactic acid but considerable acetic acid. Elephant grass silage has a low fermentation quality leading to reduced intake and digestibility. Masturi (2004) confirmed that good quality silage requires production of lactic acid to rapidly reduce the pH fermentation which requires sufficient fermentable carbohydrates. The faster the fermentation is completed, the more nutrients will be retained in the silage. Kung (2000) reported that a quick reduction in silage pH will help to limit the breakdown of protein in the silo by inactivating plant proteases. In addition, a rapid decrease in pH will inhibit the growth of undesirable anaerobic microorganisms such as enterobacteria and clostridia. Preservatives can be used to improve silage quality. Therefore, the purpose of this study is to determine the effects of harvesting stage and additives on quality of elephant grass silage.

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MATERIALS AND METHODS

Elephant grass Bana cv. was harvested at different periods: 3, 6 and 9 months, respectively from 5 plots of N-fertilized and unfertilized treatments. The whole plants were chopped at length of 2 cm which is a suitable length that allows firmer packaging, easy handling and have less separation of coarse and fine material. Even distribution of this material facilitated good packing. The length of forage material that Mühlbach (2001) used to make silage was 2.5 cm pieces and was opened after 45 days. Chopped grass of 500 g was thoroughly mixed with preservatives and staffed in the temporary plastic bag silo. This experiment had 4 treatments where different preservatives were added in order to determine effects of different silage preservatives on quality of elephant grass silage. Treatments included control (no preservative added), molasses 4%, urea (0.25%) + molasses 4% and 2.5% of dicalcium phosphate and were done in duplicates. The material was physically and effectively compressed with hands to remove excess air to create anaerobic environment. These silages were opened after 30 days, which was adequate enough to the fermentation phases of silage. Jurgens (2002) indicated that normal fermentation process lasts for 21 days and that there will not be any change unless air is allowed in since silage can stay unspoilt for a long time under anaerobic conditions. The samples were taken for laboratory analysis for pH and proximate analysis. Silages were opened for laboratory analysis on 2nd March 2009, 30th May 2009 and 30th August 2009, respectively. Ensiled elephant grass was analyzed for pH by weighing 20 g of silage which was placed in a blender jar then diluted with 200 g of deionized distilled water and blended for 30 seconds in a high-speed blender. The diluted samples were filtered through four layers of cheese cloth, and pH measured immediately with a pH meter (Contreras-Govea et al. 2009).

Split-plot in Completely Randomized Block Design model was used in analysis. Analysis of Variance was performed on data collected using General Linear Model (PROC GLM) procedure of (SAS 2000-2003). Means were tested for significance using Duncan Multiple Range Test.

RESULTS

Effects of different preservatives on chemical composition of *P. purpureum* harvested on N-fertilized and unfertilized treatments harvested at 3 months

The preservatives resulted in silages with different pH (Table 1). The pH level of molasses added silages from N-fertilized and unfertilized treatment were the lowest (P<0.05) followed by that of plain silage which was also lower (P<0.05) than pH of silage added urea+ molasses and dicalcium phosphate which had similar pH. Molasses added silage had a pH of 4.61 while for plain silage it was 5.57, urea+ molasses was 6.44 and dicalcium phosphate was 6.02 prepared grass harvested at 3 months from unfertilized treatment while on N-fertilized treatment it was 4.78, 5.58, 6.7 and 5.67, respectively.

The dry matter (DM) level of plain silage was similar to that of urea+molasses and dicalcium phosphate added silages (Table 1). The DM level of these three silages were higher (P<0.05) than that of molasses added silage from both N-fertilized and unfertilized treatments. In this study, preservatives did not lead to change in cell wall content of silages, as neutral detergent fibre (NDF) and acid detergent fibre (ADF) content of silages were numerically different. Acid detergent lignin of plain and silage added molasses were similar but lower (P<0.05) than that of urea+ molasses and dicalcium phosphate that were similar on unfertilized treatment. The *in vitro* true dry matter digestibility (INVTDMD) of plain, molasses and urea+ molasses silage was the same but higher (P<0.05) than that of dicalcium phosphate added silage.

Effects of different preservatives on chemical composition of *P. purpureum* harvested at 6 months period

Different silage preservatives had different effects on the chemical composition of silage of *P. purpureum* prepared from six months harvested grass. Molasses resulted in lower (P<0.05) pH on both N-fertilized and unfertilized treatments, when compared to pH of plain, silage added urea + molasses and dicalcium phosphate that had similar pH (Table 2). The DM of silage added dicalcium phosphate was the highest (P<0.05) than that of other silages on unfertilized treatment, while it was similar on N-fertilized treatment. The NDF of plain and dicalcium phosphate silages was the same but higher (P<0.05) than that of molasses and urea+ molasses on both N-fertilized and unfertilized treatments. Acid detergent fibre of plain silage was higher (P<0.05) than that of other silages with preservatives but was similar to that of dicalcium phosphate on N-fertilized treatment. Table 2 shows that acid detergent lignin (ADL) and INVTDMD of all silages from N-fertilized and unfertilized treatments harvested at different periods were the same.

Effects of different preservatives on chemical composition of *P. purpureum* harvested after nine months harvesting period

Data of silage prepared from nine month aged *P. purpureum* and mixed with different preservatives are presented in Table 3. Molasses silage made from N-fertilized and unfertilized treatments had lowest (P<0.05) pH. The pH of silage added molasses was 4.71 while plain silage, urea+ molasses silage and dicalcium phosphate added silage had a pH of 7.35, 7.53 and 7.58, respectively on unfertilized treatment, while it was 6.3, 7.3, 7.2 and 7.65 respectively, on N-fertilized treatment.

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The DM and INVTDMD of different silages prepared from unfertilized and N-fertilized treatment were similar. Neutral detergent fibre of molasses and urea+ molasses silage were the same but lower (P<0.05) than that from silage added dicalcium phosphate while NDF of plain was similar to that of all preservatives on unfertilized treatment. On N-fertilized treatment, NDF of plain silage was higher (P<0.05) than that of molasses added silage but numerically higher than other silages which were similar to molasses silage. The ADF and ADL of the silages with different preservatives from unfertilized treatment were similar. The ADF of urea+ molasses silage from N-fertilized treatment was lower (P<0.05) than that of plain and dicalcium phosphate silage but similar to ADF of molasses added silage prepared from N-fertilized treatment. The ADL content of plain, molasses and dicalcium phosphate silages were numerically different but ADL of silage added urea+ molasses was lower (P<0.05) than that of plain silage.

DISCUSSION

Effects of silage preservatives on pH

The present results showed that different preservatives had different effects on the acidity of the silage prepared from both N-fertilized and unfertilized treatments harvested at different periods. This is in line with Yunus et al. (2000) who explained that high pH level of plain silage could be due to the fact that elephant grass contains low level of water soluble and fermentable carbohydrate. The pH level increased with increasing period of harvesting. Seglar (2003) observed that, maturity had effect on the quality of silage, as grasses often do not completely ferment to decrease pH into a desirable range because not enough substrate is available to complete fermentation. Kunkle et al. (2009) confirmed that forages that are too high in DM may not ensile well and this could be the reason for high silage pH at 6 and 9 months elephant grass silage. At plant maturity, non-structural sugar becomes structural and this reduces fermentable sugar of the silage; hence high pH on plants harvested at 6 and 9 months. Kunkle et al. (2009) observed that though mature grass is chopped, it does not easily pack and compress resulting in trapping air that hinders proper fermentation.

The pH of silage prepared from 3 months age grass suggests that the plain silage was dominated by acetic acid. Schroeder (2004) observed that acetic acid-producing bacteria ferment soluble carbohydrates and produce acetic acid which leads to silage pH decreasing from about 6.0 to 5.0. This pH will not alter rumen environment as most of rumen microbes strive under neutral pH (Russell and Wilson 1996). Acetic acid production is one of the desirable organic acids because ruminants can utilize it as a source of energy. It is produced when cellulolytic and hemicellulolytic bacteria degrade the cell wall material.

In the present study, molasses led to a lower (P<0.05) pH compared to other preservatives that were used. The pH readings of silage prepared from *P. purpureum* harvested from unfertilized treatment at 3, 6 and 9 months were 4.61, 4.66 and 4.71, respectively. Silage prepared from N-fertilized treatment with molasses also had lowest (P<0.05) pH of 4.78, 4.44 and 6.3 harvested at 3, 6 and 9 months, respectively. This is in line with Yunus et al. (2000) who reported a significant variation between molasses and urea silage as molasses reduced (P<0.05) silage pH. Homofermentative bacteria (lactic-acid bacteria) convert water-soluble carbohydrate to lactic acid and proper silage with proper lactic acid production in grasses has pH around 4.2. Previous study of Yokota et al. (1998) reported a pH of 3.85 on elephant grass silage mixed with molasses which contained the highest amount of lactic acid. Molasses is a source of readily available energy, thus sugars which have helped in rapid fermentation of elephant grass as under anaerobic condition lactic acid bacteria ferment sugars and produce organic acids (lactic acid) which lower the pH to about 4.2. Schroeder (2004) observed that when the silage pH drops below 5.6, acetic acid-producing bacteria begin to decline in numbers, while lactic acid-producing bacteria begin to thrive and rapidly reduce the pH. Furthermore, Schroeder (2004) reported that quality silage is achieved when lactic acid is the predominant acid produced, as it is the most efficient fermentation acid which will lead to rapid decline of the pH of the silage. Seglar (2003) observed that the faster the fermentation is completed, the more nutrients are retained in the silage. When silage is consumed, it lowers the rumen pH which affects rumen microbiota. According to Russell and Wilson (1996), ruminant animals depend on cellulolytic ruminal bacteria to digest cellulose, but these bacteria cannot resist the low ruminal pH that modern feeding practices can create. Since the cellulolytic bacteria cannot grow on cellobiose at low pH, pH sensitivity is a general aspect of growth and not just a limitation of the cellulases *per se*. The rumen will be dominated by lactic acid utilizing microbes such as *Megasphaera elsdenii.*

Previous study of Counotte et al. (1983) reported that *Megasphaera elsdenii* convert more than 80% of the DL-lactate fermented to volatile fatty acids (VFA). Bergman (1990) indicated that propionate was removed by the liver but was largely converted to glucose. Propionate is converted to succinyl-coenzyme A, which enter tricarboxylic acid cycle and is converted to malate, when malate is transported to the cytosol where it is converted to oxaloacetate. During this process, malate releases energy yielding molecule Nicotinamide Adenine Dehydroxynade (NADH) that enter Electron Transport Chain (ETC) in mitochondrion to produce three moles of Adenosine Triphosphate (ATP). Oxaloacetate is then converted to phosphoenolpyruvate in gluconeogenesis which will help to yield net of 34 moles of ATP.

Accumulation of lactic acid in the rumen may lead to lactic acidosis. Therefore, the silage containing high concentrations of lactic acid and easily fermentable sugars may be harmful to the ruminant, causing lactic acidosis and digestive disorders. According to Seglar (2003), it is crucial that lactic dominated silage is fed to cattle that need more energy such as dairy cows to ensure that they rapidly utilize lactic acid produced to produce milk.

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Table 1 - Effects of preservatives on Silage prepared from *P. purpureum* harvested at three months at Notwane Farm

Parameters / Treatments	pH			DM			NDF			ADF			ADL			INVTDMD		
	Unfert	Fert	SEM	Unfert	Fert	SEM	Unfert	Fert	SEM	Unfert	Fert	SEM	Unfert	Fert	SEM	Unfert	Fert	SEM
Plain silage	5.57^{by}	5.58^{by}	0.20	14.44^{bz}	18.21^{by}	1.29	69.36^{ay}	68.51^{ay}	5.85	38.22$^{a\,y}$	35.71^{ay}	1.76	3.27^{by}	3.96^{ay}	0.43	74.39^{ay}	66.8^{ay}	5.91
Silage+ molasses	4.61^{cy}	4.78^{cy}	0.13	19.35^{az}	24.21^{ay}	0.82	68.84^{ay}	65.32^{ay}	3.93	37.01^{ay}	35.96^{ay}	1.45	3.28^{by}	3.95^{ay}	0.41	70.79^{aby}	61.68^{az}	2.78
Silage + urea + molasses	6.44^{ay}	6.7^{ay}	0.64	14.90^{by}	16.92^{by}	2.04	72.74$^{a\,y}$	67.36^{ay}	4.86	35.67^{ay}	36.48^{ay}	1.92	4.56^{ay}	4.34^{ay}	0.62	77.04^{ay}	65.51^{az}	4.12
$DiCaPO_4$	6.02b^{ay}	5.67^{by}	0.23	14.48^{by}	15.9^{by}	1.64	71.74^{ay}	66.88^{ay}	4.65	35.37^{ay}	34.30^{ay}	2.13	4.57^{ay}	4.49^{ay}	0.51	61.86^{by}	65.66^{ay}	5.35
SEM	0.20	0.13		1.29	0.82		5.85	3.93		1.76	1.45		0.43	0.41		5.91	2.78	

^{abc}Means on the same column with different superscripts are significantly (P< 0.05) different; ^{yz}Means of the same row with different superscripts are significantly (P<0.05) different. Unfert=unfertilized plot, fert= N-fertilized plot. SEM=Standard error of the mean. $DiCaPO_4$=dicalcium phosphate added silage, DM=Dry matter, NDF=Neutral detergent fibre, ADF=Acid detergent fibre, ADL=Acid detergent lignin, INVTDMD=In Vitro True Dry matter digestibility.

Table 2 - Effects of preservatives on Silage prepared from *P. purpureum* harvested at six months of growth at Notwane Farm

Parameters / Treatments	pH			DM			NDF			ADF			ADL			INVTDMD		
	Unfert	Fert	SEM	Unfert	Fert	SEM	Unfert	Fert	SEM	Unfert	Fert	SEM	Unfert	Fert	SEM	Unfert	Fert	SEM
Plain silage	6.66^{ay}	6.06^{ay}	4.05	71.73^{by}	68.03^{ay}	0.84	74.55^{ay}	73.73^{aby}	1.38	51.77^{ay}	50.4^{ay}	1.51	10.77^{ay}	13.33^{ay}	1.96	33.24^{ay}	33.24^{ay}	8.11
Silage+molasses	4.66^{by}	4.44^{by}	0.89	72.55^{by}	73.51^{ay}	0.16	70.65^{by}	71.66^{by}	1.48	47.11^{by}	47.64^{by}	1.59	8.67^{ay}	11.79^{ay}	2.12	41.47$^{a\,y}$	41.47^{ay}	7.38
Urea+Molasses silage	7.29^{ay}	6.96^{ay}	1.63	71.40^{by}	71.8^{ay}	0.38	70.73^{by}	70.61^{by}	0.96	45.98$^{b\,y}$	44.83^{by}	1.21	9.84^{ay}	9.56^{ay}	1.23	36.82^{ay}	36.82^{ay}	7.09
Silage+ $DiCaPO_4$	6.01^{ay}	6.57^{ay}	0.87	74.32^{ay}	71.74^{ay}	0.85	74.44^{ay}	74.35^{ay}	1.11	47.57^{by}	49.06^{ay}	0.57	9.54^{ay}	9.11^{ay}	1.03	44.31^{ay}	44.31^{ay}	9.00
SEM	0.64	0.23		4.86	1.64		4.86	4.65		1.92	2.13		0.62	0.51		4.12	5.35	

^{abc}Means on the same column with different superscripts are significantly (P<0.05) different. ^{yz}Means of the same row with different superscripts are significantly (P<0.05) different. Unfert=unfertilized treatment, fert= N-fertilized treatment. SEM=Standard error of the mean. $DiCaPO_4$=dicalcium phosphate added silage, DM=Dry matter, NDF=Neutral detergent fibre, ADF=Acid detergent fibre, ADL=Acid detergent lignin, INVTDMD= *In vitro* True Dry matter digestibility

Table 3 - Effects of preservatives on Silage prepared from *P. purpureum* harvested at nine months of growth at Notwane Farm

Parameters / Treatments	pH			DM			NDF			ADF			ADL			INVTDMD		
	Unfert	Fert	SEM	Unfert	Fert	SEM	Unfert	Fert	SEM	Unfert	Fert	SEM	Unfert	Fert	SEM	Unfert	Fert	SEM
Plain silage	7.35^{az}	7.3^{ay}	0.87	69.33$^{a\,y}$	69.89^{ay}	0.84	79.07^{aby}	79.88^{ay}	1.10	56.78^{az}	57.13^{aby}	0.56	13.66^{ay}	14.5^{ay}	1.03	40.43^{ay}	40.6^{ay}	8.69
Silage+molasses	4.71^{by}	6.3^{ay}	0.63	68.11^{ay}	67.56^{ay}	2.04	77.26^{by}	73.70^{by}	0.85	56.15^{ay}	55.49^{aby}	1.14	13.91^{ay}	12.32^{aby}	1.40	46.66^{ay}	47.96^{ay}	4.32
Urea+ molasses	7.53^{ay}	7.2^{az}	0.72	65.50^{ay}	67.84^{ay}	2.72	77.20^{by}	76.82^{aby}	3.44	54.64$^{a\,y}$	53.20^{ay}	1.54	14.21^{ay}	8.86^{ay}	1.32	43.25^{ay}	45.8^{ay}	2.80
$DiCaPO_4$	7.58^{ay}	7.65^{ay}	0.57	68.29^{ay}	66.91^{ay}	1.88	80.16^{ay}	78.37^{aby}	1.23	78.63^{ay}	57.39^{ay}	1.00	16.53^{ay}	10.31^{abz}	2.85	38.20^{ay}	40.32^{ay}	4.32
SEM	4.05	0.89		0.84	0.16		1.38	1.48		1.51	1.59		1.96	2.12		8.11	7.38	

^{abc}Means on the same column with different superscripts are significantly (P< 0.05) different. ^{yz}Means of the same row with different superscripts are significantly (P<0.05) different . Unfert=unfertilized treatment, fert= N-fertilized treatment. SEM=Standard error of the mean. $DiCaPO_4$=Dicalcium phosphate added silage, DM=Dry matter, NDF=Neutral detergent fibre, ADF=Acid detergent fibre, ADL=Acid detergent lignin, DMD=Dry matter digestibility

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Beauchemin (2007) observed that absorption of VFA from the rumen occurs passively through papillae, which are finger-like projections located on the rumen wall. The papillae increase gradually in length when cows are fed a close-up diet or a lactation diet that contains more grain than the dry cow diet. Increased surface area and absorptive capacity of the rumen protects the cow from accumulation of VFA in the rumen which is the main driver of rumen pH depression.

The pH level for urea+molasses added silage in this study was numerically higher than dicalcium phosphate pH but was higher ($P<0.05$) than other silages on both N-fertilized and unfertilized treatments. The level of this silage was neutral and will not change rumen environment. Orthophosphates and non-protein nitrogen (urea) are buffering agents (Seglar, 2003). Yunus et al. (2000) indicated that urea decreases the fermentation quality of the silage by raising the pH.

Effects of silage preservatives on dry matter, cell wall components and dry matter digestibility of elephant grass at different stages of growth

Molasses added silage prepared from both N-fertilized and unfertilized treatments had high ($P<0.05$) DM. This finding is in agreement with Yunus et al. (2000) who observed that molasses increases the DM content of the silage. Yokota et al. (1998) also observed that the DM of Napier grass was 8.62% while the DM of silage added molasses was 13.44%. This could have been due to the fact that cellulolytic microbes could not strive under acidic condition resulting in no microbes reducing DM. Table 1 shows that DM of plain, urea+molasses and dicalcium-phosphate added silages were similar. Yokota et al. (1998) observed that the inclusion of urea-molasses increases the DM percentage.

Preservatives led to numerical reduction of NDF and ADF at different harvesting periods on both N-fertilized and control treatment, except for dicalcium phosphate. Masturi (2004) reported that inclusion of legumes on dwarf Napier silage led to reduction of NDF from 69.1% to 61.6%. In the present study, study urea+ molasses decreased ($P<0.05$) NDF from 74.55% of plain silage to 70.73% and 79.07 to 77.2% at 6 and 9 months harvesting periods, respectively on unfertilized treatment. In agreement with current result, Masturi (2004) further reported that inclusion of legume on the dwarf Napier grass silage reduced ADF and ADL content. The INVTDMD of silage with preservatives prepared from grass harvested after 6 and 9 months periods was higher than for plain silage. This could be due to low NDF, ADF and ADL on these silages. Yunus et al. (2000) reported that addition of molasses and urea+molasses to elephant grass prepared from grass harvested at different heights, led to reduction of NDF, ADF and ADL while the INVTDMD increased when compared to plain silage.

CONCLUSION

It can be concluded that different silage preservatives have different effects on the chemical composition of elephant grass silage prepared from the grass harvested at different periods. N-fertilized treatment had no effects on the quality of the silage. Silage prepared from elephant grass harvested at three months from unfertilized treatment, with molasses as a preservative had a lowest pH. It also had a higher INVTDMD while its cell wall contents were low, indicating that the animal will get more nutrients in a day since the silage is digestible. So, *P. purpureum* silage with molasses as a preservative will be ideal for maximum production of lactic acid and preservation of nutrients in feeding ruminants.

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REFERENCES

Association of Official Analytical Chemists Official Methods of Analysis (AOAC) (1996). 17th Edition, Arlington, Virginia, USA.

Beauchemin KA (2007). Ruminal Acidosis in Dairy Cows: Balancing Physically Effective Fiber with Starch Availability, Florida Ruminant Nutrition Symposium, Canada.

Bergman EN (1990). Energy contributions of volatile fatty acids from the gastrointestinal tract in various species, Physiological Reviews, 70: 567-590.

Contreras-Govea FE, Muck RE, Armstrong KL and Albrecht KA (2009). Nutritive value of corn silage in mixture with climbing beans, Journal of Animal Feed Science and Technology, 150: 1–8.

Counotte GHM, Lankhorst A and Prins RA (1983). Role of DL-Lactic Acid as an Intermediate in Rumen Metabolism of Dairy Cows. Journal of Animal Science, 56:1222-1235.

Higashiyama M and Hirata M (2006). Analysis of a Japanese Black Cattle-rearing system utilizing a bahiagrass (Paspalum notatum Flügge) pasture: 3. Intake from pasture. Grassland Science, 52: 117–126.

To cite this paper: Sebolai TM, Aganga AA, Nsinamwa M and Moreki JC. 2012. Effects of different silage preservatives on silage quality of *Pennesitum Purpureum* harvested at different harvesting periods. *Online J. Anim. Feed Res.*, 2(2): 139-144.
Scienceline/Journal homepages: http://www.science-line.com/index/; http://www.ojafr.ir

Jurgens MH (2002). Animal feeding and nutrition, 9th edition, Kendall / Hunt Publishing Company, Iowa
Kung J, Robinson LJR and Pesek, JD (2000). Microbial populations, fermentation end-products and aerobic stability of corn silage treated with ammonia or a propionic acid based preservative. *Journal of Dairy Science,* 83: 1479-1486.
Kunkle WE, Chambliss CG, Adesogan AT and Adjei MB (2009). Silage Harvesting, Storing, and Feeding, Livestock Science, 122: 24-29.
Masturi S (2004). Effects of legume, molasses and urea inclusion on the quality of Dwarf Napier and King Grass silages. Retrieved 12/03/2010 from http://www.psasir.upm.edu.my/304/1/549539_T_FP_2004_28.pdf.
Mühlbach PRF (2000). Additives to improve the silage making process with tropical forages. In: Silage Making in The Tropics with Particular Emphasis on Smallholders. Ed. t'Mannetje, L., Proc. FAO Electronic Conference on Tropical Silage. 1 September to 15 December 1999. FAO Plant Production and Protection Paper 161, Food and Agricultural Organization of the United Nations, Rome, Italy.
Neiva JNM, Ferreira ACH and Teixeira M (2005). Use of dehydrated sugar cane (*Saccharum officinarum*) as an additive to Napier grass (*Pennisetum purpureum*) ensilage, FAO Corporate DocRep, http://www.fao.org/docrep/005/x8486e/x8486e12.htmdownloaded 18/06/2008.
Nisa M, Shahzad MA, Sarwar M and Tauqair NA (2008). Influence of Additives and Fermentation Periods on Silage Characteristics, Chemical Composition, and In Situ Digestion Kinetics of Jambo Silage and Its Fodder in Nili Buffalo Bulls, Turkish Journal of Veterinary Animal Science, 32: 67-72.
Russell JB and Wilson DB (1996). Why Are Ruminal Cellulolytic Bacteria Unable to Digest Cellulose at Low pH? *Journal of Dairy Science,* 79: 1503-1509.
SAS (2002-2003). Statistical Analysis Software Version 9.1.
Schroeder JW (2004). Silage Fermentation and Preservation, ANGUS Journal, 56, http://www.ag.ndsu.edu/pubs/ansci/dairy/as 1254w.htm, downloaded on 20/02/2010.
Seglar B (2003). Fermentation Analysis and Silage Quality Testing, Proceedings of the Minnesota Dairy Health Conference, Small Ruminant Research, 69: 83-87.
Yokota, H., Fujii, Y. and Ohshima, M. 1998. Nutritional Quality of Napier Grass (*Pennisetum purpureum* Schum.) Silage Supplemented with Molasses and Rice Bran by Goats. *Asian Journal of Animal Science*, 11: 697-701.
Yoldas F, Ceylan S, Yagmur B and Mordogan B (2008). Effects of Nitrogen Fertilizer on Yield Quality and Nutrient Content in Broccoli. Journal of Plant Nutrition, 31: 1333-1343.
Yunus M, Ohba N, Shimojo M, Furuse M and Masuda Y (2000). Effects of adding Urea and Molasses on Napier grass Silage Quality. Asian-Australasian Journal Animal Science, 13: 1542-1547.

To cite this paper: Sebolai TM, Aganga AA, Nsinamwa M and Moreki JC. 2012. Effects of different silage preservatives on silage quality of *Pennesitum Purpureum* harvested at different harvesting periods. *Online J. Anim. Feed Res.*, 2(2): 139-144.
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CHARACTERISTICS AND CONSTRAINTS OF PIG PRODUCTION UNDER RURAL CONDITION IN SIKKIM

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ABSTRACT: *The present study was undertaken to know the production and management practices followed by the farmers and the common constraint of pig production in rural area of Sikkim. The data were collected from 100 respondents through personal interview with the help of questionnaire on different aspects namely housing, breeding, feeding, health care, management practices, economics and the common problems for pig production. In the present study it was observed that 95% farmers constructed their pigsty with locally available wood/bamboo with traditional system. Majority (60%) of the farmers reared cross-bred pigs and offered kitchen waste to their pigs while only 5% of them offered concentrate feeds. Vaccination and deworming was followed by 30 per cent and 35 per cent of farmers respectively. Daily cleaning of pigsty was followed by 50 percent of the farmers and castration and weaning was to be practiced by majority of farmers. Special attention to the pregnant sows and care after farrowing was followed by 69 and 75 per cent respectively. Farmers market their pigs at the age of 1 year or above when they attained the body weight of 85-90 kg or more. Lack of adequate credit facilities, inadequate scientific knowledge on pig farming, lack of veterinary facility, lack of breeding and lack of marketing facilities were observed to be the major constraints perceived by the farmers. The study revealed that the development of pig production is necessary in this area as it will not only fulfill the demand but also help to uplift the economic status of farmers.*

ORIGINAL ARTICLE

Key words: *Production, Constraint, Pig, Breeding, Economic, Feeding, Health, Housing, Sikkim*

INTRODUCTION

Sikkim with its small total geographic area of 7096 km^2, lying within 270 04' to 280 07' 48" N latitude and 880 00' 58" to 880 55' 25" E longitudes, is administratively divided in to four districts *viz.* North, East, West and South. Due to increase in population and the limited availability of land in the state there is already great pressure on the cultivable land, forest and on the environment as well. Livestock farming which requires minimal use of land, labour and capital would be ideal sustainable model for development in such difficult mountainous terrain. The development of livestock would not only provide supplementary source of income but would provide high protein rich food items such as milk, eggs, meat and organic manure for crop production.

Amongst the livestock, pig is most important and every family rear pig as backyard venture in rural area of Sikkim. There is huge demand of pig as people of the state prefer pork than that of other meat. In order to fill the gap of demand and supply of pork, piggery may be encouraged in rural areas. The requirement of piglets under various programmes in the tribal rural area of Sikkim is substantial. In the past piggery had gained momentum as an important economic activity in the state but because of problems related to diseases, and transportation the pace gained has subsided to some extent. Therefore, the present study was undertaken to understand the prevailing production and management practices followed by the farmers and the common problem during pig production in rural tribal area of Sikkim.

MATERIALS AND METHODS

The study area Dzongu, is one of the remotest area of the state lies in the North District is reserved for only Lepcha (Tribal) people. A total of five villages of Dzongu area *viz.* Gor, Hee-Gyathang, Lingdong, Passingdang and Tingvong were selected for the study. Selection of farmers/respondents was done on the basis of Simple Random Technique. In this way 20 farmers from each village were selected so that the total study sample consisted of 100

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respondents from the entire five selected villages. The data were collected from each respondent through personal interview with the help of pre tested questionnaire and self-observation methods were employed. The production and management practices were studied in respect of housing system, breeding, feeding, health care, management and economics and the common problems faced by the farmers during pig production was also studied. The data collected were compiled, tabulated and analyzed to draw meaningful conclusion.

RESULTS AND DISCUSSION

Production and management practices

The production and management practices followed by the farmers of Dzongu area, North Sikkim are presented in Table1. In housing practices, it was observed that 95% of the pig farmers constructed their pigsty with locally available wood/bamboo with tin roofing and wooden flooring above 2-3 feet from the ground. The floor space per adult was found to be inadequate (average 3x4 sq.ft) in majority (95%) of the farms. The raising of floor is above ground level to prevent entering of rats, mice and other small wild predators. Besides these, all farmers have their opinion that raising the floor above ground level help for easy to clean and prevented dampening of floor due to rain. The farm equipments included mainly cut piece of woods as feeding and water trough. Farmers depend on pipe line water for supplying water and no electricity facility is used in the farms.

Breeding is important to improve the productivity of the animals. The majority (60%) farmers were reared cross-bred pigs in their farm. Farmers preferred to rear cross-bred pigs as crossbred pigs have better growth performance and larger litter size. The farmers preferred Hampshire, Large Black, Saddle Back and White York Shire breed of pig. No artificial insemination practice for breeding is found in this area. Only 20 percent farmers were reared breeding boars. The average litter size at birth was 7 while that for weaning was 6. Kumar et al. (2002) and Rahman et al. (2008) reported that the average litter size at birth was 6-8.

The production of pigs mostly depends on feeding practices in the farm. Majority (95%) of the farmers feed kitchen wastes along with cooked mixture comprising of maize bhusa, mustard oil cake, pseudo-stem of banana, tuber, stem and leaves of *Canna indica*. Some of the farmers (70%) boiled the feed before given to pig. Pandey (2000) reported that farmers of Haryana supplied hotel wastes to pig for feeding. Kitchen and rice fermented waste increased the growth performance of pigs and reduced the cost of feeding (Kumar et al, 2010). Varma et al. (1982) and Kumar et al. (2002) reported that most of the farmers of North-Eastern region boiled the feeds before giving to pigs. Feed supplement like mineral mixture, vitamins etc were added to the feeds by 5 percent of the farmers. Majority (93%) of the farmers offered feed thrice daily, in morning, noon and evening.

In health care practices, all farmers did not give attention to the health of their pigs. Majority (60%) of the farmers approached local Veterinarian or Para Veterinarian for consultation on treating ailing animals and rest(40%) farmers applied traditional knowledge for treatment of animals. Vaccination and deworming was followed by 30 per cent and 35 per cent of the farmers respectively. Only 2 per cent of the respondents were given iron injection to the piglets to prevent piglet anemia whereas 39 per cent of the farmers used drugs for skin diseases and ectoparasite control.

The management practices like cleaning of pigsty, cutting of needle teeth, castration, weaning, care of pregnant sow, care after farrowing etc are studied and observed in the area. The study revealed that no farmer used to practice cutting of needle teeth of the piglets to prevent infection of wounds from fighting or causing injuries to the teat of the mother. Castration and weaning was to be practiced by 68% and 70% farmers respectively. The farmers had the opinion that growths of the castrated pigs were more than non-castrated ones. Kumar et al. (2002) also found that the practice of castration of pigs was very common.

It was found that 69 per cent of the respondents took proper care of their pregnant sows and 75 per cent of them took special care of their sows after farrowing. Majority of the farmers (85%) never treated the non-conceiving/repeat breeding sows and preferred to slaughter them. The reason cited by the farmers was that the treatment was too costly. Half of the farmers cleaned their pigsty daily and majority (90%) of the farmers used pig wastes in agriculture crops. Economics is important for livestock production. No farmer will take up piggery unless it is economically viable (Bujarbaruah, 2005). In the study it was observed that 70% farmers got benefit of Rs 15000-25000/year from pig production. Majority (90%) of the farmers market their pigs at the age of 1 year or above when they reached the body weight of 85 kg or above. In Dzongu, the market price of pork was Rs.100 at the time of study.

Common constraint in pig production:

The common constraints in pig production and their rank in Dzongu, North Sikkim are given in Table 2. The overall analysis of the study area revealed that lack of credit facility as the major constraint during pig production ranked 1st. For this reason, majority of farmers reared pig without properly constructed pig shed. Inadequate knowledge of pig production and management and lack of veterinary facilities were the 2nd and 3rd major constraints respectively. The high cost of balanced concentrate feed as the 4th constraint. A technical constraint reported repeatedly by farmers was the lack of quality breeding stock and the absence of systematic breeding programs.

Singh (2000) identified that the breeding was the foremost constraints for the tribal pig farming. Lack of marketing facilities was a common constraint by the pig farmers in Dzongu, since in hilly region; the road and other marketing facilities were limited.

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Table 1 - Production and management practices as followed by respondents		
Sl. No.	**Production and Management practice**	**Percentage (N=100)**
A)	**Housing practices**	
1.	*Construction of pigsty with*	
	i woods/bamboos	95
	ii Others	5
2.	*Feeding/ water trough*	
	i.Woods, iron vessels etc	95
	ii. Others	5
3.	*Water storage facility*	
	i. Present	90
	ii. Not Present	10
B)	**Breeding practices**	
1.	*Types of pig in the farm*	
	i. Cross-bred	60
	ii. Local	40
2.	*Service of sow*	
	i. Natural service with boars	100
	ii. Artificial insemination	0
3.	*Rearing of boars for breeding purpose*	
	i. Reared	20
	ii. Not reared	80
4.	*Litter size at birth and at weaning*	
	i. 5 or below and 4 or below	10
	ii. 6-8 and 5-7	60
	iii. Above 8 and Above 7	30
C)	**Feeding practices**	
1.	*Types of ration used*	
	i. Kitchen waste	95
	ii. Concentrated feed only	0
	iii.Kitchen waste with concentrated feed	5
2.	*Boiling of feeds*	
	i. Boiled	70
	ii. Not boiled	30
3.	*Time of feeds supplied to pigs*	
	i. Once in a day	2
	ii. Twice i.e. Morning and Evening	5
	iii.Thrice i.e. Morning , Noon and Evening	93
D)	**Health care practices**	
1.	*Use of antibiotic*	
	i. Used	25
	ii.Not used	75
2.	*Iron injection to prevent piglet anaemia*	
	i.Practiced	2
	ii.Not practiced	98
3.	*Vaccine against Swine fever/FMD*	
	i. Practiced	30
	ii. Not Practiced	70
4.	*Deworming of pigs*	
	i. Used	35
	ii. Not used	65
E)	**Management practices**	
1.	*Clean of pigsty*	
	i.Daily	50
	ii.2 days interval	40
	iii. Once in a week	10
2.	*Castration of Male piglets*	
	i. Practiced	68
	ii. Not practiced	32
3.	*Weaning of piglets within 2 months*	
	i. Practiced	70
	ii. Not practiced	30
4.	*Cutting of needle teeth of piglets*	
	i.Practiced	0
	ii. Not practiced	100
5.	*Treatment of repeat breeding sows*	
	i. Treated	15
	ii. Not treated	85
F)	**Economics**	
1.	*From pig farming get benefit(Rs/year)*	
	i. less than 15000	20
	ii.15000-25000	70
	iii.above 25000	10
2.	*Market the pig when they are*	
	i. 1 year or below/ 80 kg or below	40
	ii.above1 year /85kg or above 85 kg body weight	60

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Table 2 - Common constraints in pig production and their rank in Dzongu area

Sl. No	Constraints / Problems	N	Percentage (%)	Rank
1	Lack of credit facility	90	90	I
2	Non availability of breeding stock	77	77	V
3	High cost of balance feed ration	81	81	IV
4	Lack of breeding program (Artificial insemination)	65	65	VIII
5	Lack of veterinary facility	83	83	III
6	Improper knowledge of pig production and management	87	87	II
7	High medicine/vaccine cost	64	64	IX
8	High disease susceptibility	63	63	X
9	Lack of market facility	69	69	VII
10	High transportation cost for marketing	59	59	XI
11	Poor Government support	70	70	VI

CONCLUSIONS

It was concluded from the study that majority of the farmers had medium socio-economic status as well as medium knowledge about the production and management of pig concerned. Most of the farmers faced inputs and technical as a problem during pig production. It is necessary to identify the constraints, evaluating options to resolve the constraints and assessing the benefits increases the capacity of the pig farmers to improve their production. The development of pig production is necessary in this area as it will not only fulfill the demand but also help to uplift the economic status of farmers. The study reveals that there is good scope for improving pig production since farmers are eager to learn and aware of the benefits from pig production and management.

REFERENCES

Bujarbaruah KM (2005). Step Towards Increasing Livestock Production in North Eastern Region. ICAR Research Complex for North-Eastern Hill Region, Umiam, Meghalaya, India. Research Bulletin No. 45: 16.

Kumar S, Sinha AP, Thakur S, Singh RN and Singh SK (2010). Growth performance of indigenous pigs reared on kitchen waste. Animal Nutrition and Feed Technology, 10: 139-142.

Kumar R, Pal PP, Prasad K and Prakash N (2002). Modernizing Tribal Piggery A Delineated Approach. Division of Agricultural Extension, ICAR Research Complex for North-Eastern Hill Region, Umiam, Meghalaya, India. Research Bulletin No. 47: 22-29.

Pandey UK (2000). Livestock in the household economy. Proceedings of viiith Annual Conference of the Agricultural Economic Association on Livestock in Different Farming Systems held at Tamil Nadu Veterinary and Animal Sciences University, Chennai, India, November 2000.Pp. 1–13.

Rahman S, Barthakur S and Kalita G (2008). Pig production and management system in Aizawl District of Mizoram, India, Livestock Research for Rural Development, 20(9): www.lrrd.org/lrrd20/9/rahm20139.htm.

Singh JP (2000). An econometric analysis of factors influencing milk production and supply response of milk to change in price at the producer's level: A study in Ranga Reddy district, Andhra Pradesh. Manage Extension Research Review, 1(1): 112-118.

Varma A, Yadav BPS, Sampath KT and Roy DJ (1982). Livestock feeds feeding habits in north eastern hill of India. Division of Animal Nutrition, ICAR Research Complex for North Eastern Hill Region, Umiam, Meghalaya, India. Research Bulletin No. 17: 22-29.

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PREDICTION OF CORRECTED IN SITU FORAGE PROTEIN DEGRADABILITY BY THE CORNELL METHOD

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ABSTRACT: *An experiment was conducted on eight fibrous feeds to compare the Cornell rumen degradable protein values with those of the in situ method that have been corrected for microbial contamination. Samples of hay, sugarbeet pulp, dried lucerne, maize silage, peahaulm silage, fermented whole crop wheat and two different grass silages were used for the Cornell method. A corresponding in situ experiment was carried out on the same samples to estimate their rumen degradable protein values. Regression was used to relate the Cornell rumen degradable protein to that of the in situ technique. Rumen degradable protein estimates observed using the Cornell method were, on average, 0.06 and 0.16 lower than their corresponding in situ uncorrected and corrected values, respectively, with the latter being statistically significant (P<0.01). However, regression analysis between the Cornell and the in situ uncorrected rumen degradable protein, using all eight feeds, was statistically significant (r^2 0.59; P<0.05). The relationship did not improve when the Cornell values were compared with the in situ corrected values for the eight feeds (r^2 0.55; P<0.05). On the basis of inadequate preparation of the peahaulm silage sample for the in situ experiment, it was removed from the data set and the ensuing equation accounted for 0.89 of the variability in the in situ uncorrected rumen degradable protein (P<0.01). A better agreement was observed between the Cornell and the in situ corrected rumen degradable protein (r^2 0.95; P<0.001). The Cornell method therefore significantly correlated with the in situ technique for fibrous feeds. Correlation between the methods could improve if microbial contamination was removed from the analysis. The in situ rumen degradable protein values appeared to be bigger than the associated Cornell values. The Cornell adopted rates of degradation therefore need to be evaluated.*

ORIGINAL ARTICLE

Key words: *Cornell, In situ, Protein, Forages, Degradability, Feeds*

INTRODUCTION

Experiments and data have been analyzed to evaluate the Cornell model against the in situ system for degradability (Shannak et al., 2000; Gosselink et al., 2004). For concentrates and by-products, estimates of protein degradability obtained using the Cornell model correlated well with the corresponding in situ estimates (Shannak et al., 2000). A lack of agreement between forages was observed and might be due to the narrow range of their degradability values and to the fact that nominally similar, rather than the same forages, were compared (Avornyo, 1999). In addition, the in situ values for forages may be affected by microbial contamination of bag residues (Shannak et al., 2000), which significantly reduces the apparent degradability (Alexandrov, 1997; Rodriguez and Gonzalez, 2006; Milis et al., 2007). Further studies may be needed to ascertain if the Cornell and the in situ methods disagree on their forage protein degradability estimates.

Experiments were conducted on eight fibrous feeds to compare the Cornell rumen degradable protein (RDP) values with the analogous in situ estimates that have been corrected for microbial contamination.

MATERIALS AND METHODS

The Cornell method

Samples of hay, sugarbeet pulp (SBP), dried lucerne (DL), maize silage (MS), peahaulm silage (PHS), fermented whole crop wheat (FWCW) and two samples of grass silage (Cambridge University Dairy Unit (DUGS), and a private farm (PFGS)) were weighed on dry matter basis. Wet samples were therefore oven-dried at 55^{0}C to steady state, and all samples milled through 1 mm dry sieve were used for the Cornell in vitro technique (Licitra et al., 1996).

The degradation rates applied to the fibrous feeds were those of the Cornell databank. A common rate of passage of feed of 0.05%/h was adopted for the study.

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The in situ method

A corresponding in situ experiment was carried out on hay, SBP, DL, MS, FWCW, PHS, DUGS and PFGS to estimate their protein degradability values.

The method provided by the AFRC Technical Committee (1992) for estimating protein loss from in situ bags was followed. It involved the use of a monofilamentous polyester cloth of 40-50 μ pore size. Dried lucerne pellets were crushed to achieve 4 mm size and sieved across 45 μm sieve. The rest of the samples were chopped to about 1 cm length. The few peas in PHS were therefore not crushed. Each bag contained approximately 5 g dry matter of sample.

Ruminal infusion of ^{35}S

A stock solution of 20 μCi/ml (^{35}S) containing 100 μg/ml anhydrous Na_2SO_4 was made. Some of the stock solution was further diluted with water in a large bottle to supply 190 μCi/sheep/day. Dosing of sheep with ^{35}S was enabled at 480 ml per sheep per day through tubes with the help of a peristaltic pump. Microbial protein formed in the rumen of sheep was marked with ^{35}S by continuous intra-ruminal infusion of $Na_2{}^{35}SO_4$ for a total of 28 days.

Preparation of solid associated microbes

The method of Whitehouse et al. (1994) was used to isolate solid associated microbes (SAM) for subsequent computation of the proportion of microbial non-ammonia nitrogen (NAN) in bag residual NAN.

Calculations and statistical analyses of data

The estimated in situ RDP, uncorrected and corrected using ^{35}S, were obtained for each feed. Regression was used to relate the Cornell RDP values of the eight feeds to the in situ RDP of the same feeds.

RESULTS

Chemical composition of experimental feeds

Table 1 shows the chemical composition of the experimental feeds.

Table 1 - Chemical composition[a] of the fibrous feeds[b]

Feed	DM, fr. of AR	OM, fr. of DM	CP, fr. of DM	NDF, fr. of DM	ADF, fr. of DM	ADIL, fr. of DM
Hay	0.88	0.91	0.21	0.62	0.24	-
SBP	0.85	0.90	0.12	0.40	0.12	-
DL	0.90	0.90	0.19	0.49	0.37	0.09
MS	0.40	0.95	0.09	0.35	0.18	0.02
DUGS	0.41	0.91	0.20	0.54	0.32	0.02
PFGS	0.30	0.90	0.18	0.54	0.33	0.03
PHS	0.56	0.93	0.17	0.51	0.38	0.07
FWCW	0.53	0.95	0.12	0.33	0.20	0.03

[a]DM, dry matter; fr., fraction; AR, as received; OM, organic matter; CP, crude protein; NDF, neutral detergent fibre; ADF, acid detergent fibre; ADIL, acid detergent insoluble lignin; -, not determined. [b]SBP, sugarbeet pulp; DL, dried lucerne; MS, maize silage; DUGS, dairy unit grass silage; PFGS, private farm grass silage; PHS, peahaulm silage; FWCW, fermented whole crop wheat.

Cornell protein fractions and degradability

The fractions shown in Table 2 were determined from the Cornell method of protein partitioning. Fraction A was higher in the fermented feeds. Conversely, the dry feeds contained greater amounts of fractions B2 and B3. All feeds had lower than 0.1 of CP in the form of fraction C.

Table 2 - Cornell chemical protein fractions[a]

Feed[b]	A	B1	B2	B3	C
Hay	0.25	0.03	0.27	0.43	0.03
Sugarbeet pulp	0.44	0.03	0.12	0.36	0.06
Dried Lucerne	0.32	0.04	0.42	0.16	0.07
Maize silage	0.52	0.05	0.33	0.05	0.05
DUGS	0.59	0.02	0.16	0.18	0.05
PFGS	0.67	0.03	0.19	0.07	0.04
Peahaulm silage	0.33	0.08	0.37	0.16	0.06
FWCW	0.68	0.06	0.16	0.04	0.06

[a]A, soluble non-protein nitrogen; B1, quickly degradable true protein; B2, true protein of intermediate rate of degradability; B3, slowly degradable true protein; C, Undegradable protein. [b]SBP, sugarbeet pulp; DL, dried lucerne; MS, maize silage; DUGS, dairy unit grass silage; PFGS, private farm grass silage; PHS, peahaulm silage; FWCW, fermented whole crop wheat.

Cornell versus in situ method of protein degradability

The Cornell RDP ranged from 0.47 in hay to 0.86 of total crude protein in PFGS. Figures for the fermented feeds were high; 0.73, 0.76, 0.80, 0.85 and 0.86 for PHS, DUGS, MS, FWCW and PFGS, respectively. Sugarbeet pulp and DL degraded by 0.57 and 0.65, respectively. In situ RDP also varied, ranging from 0.62 in hay to 0.85 in

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PFGS for the uncorrected values. The fermented feeds, excluding PHS, recorded bigger RDP compared to the dry feeds (Table 3). Regarding RDP corrected for microbial contamination, the values varied from 0.72 in PHS to 0.94 of total protein in PFGS.

Table 3: Estimations of Cornell, in situ uncorrected and ^{35}S corrected protein effective degradabilities[a]

Feed[b]	Cornell RDP	Uncorrected in situ RDP	^{35}S corrected in situ RDP
Hay	0.47	0.62	0.75
Sugarbeet pulp	0.57	0.73	0.81
Dried Lucerne	0.65	0.74	0.81
Maize silage	0.80	0.77	0.93
DUGS	0.76	0.81	0.90
PFGS	0.86	0.85	0.93
Peahaulm silage	0.73	0.63	0.72
FWCW	0.85	0.84	0.93

[a]RDP, rumen degradable protein. [b]SBP, sugarbeet pulp; DL, dried lucerne; MS, maize silage; DUGS, dairy unit grass silage; PFGS, private farm grass silage; PHS, peahaulm silage; FWCW, fermented whole crop wheat.

Estimates observed using the Cornell method were, on average, 0.06 and 0.16 lower than their corresponding in situ uncorrected and corrected values, respectively, with the latter being statistically significant (P<0.01). However, regression analysis between the Cornell and the in situ uncorrected RDP, using all eight feeds, indicated statistical significance (Figure 1). The relationship did not improve when the Cornell was compared with the in situ corrected RDP for the eight feeds (Figure 2). There were a few whole peas in the peahaulm silage sample (chopped to approximately 1 cm length) for the in situ incubations, and none of them was degraded even after 72 hours of incubation. In contrast, the peahaulm silage samples and the peas in them were all ground through 1 mm sieve for the Cornell tests. Vanzant et al. (1998) have reiterated the importance of the influence of sample preparation on the in situ method. Mehrez and Orskov (1977) noted during their in situ incubations of barley that the barley samples, contained in in situ bags, which had more whole grains gave a lower DM degradability compared to those samples that contained fewer grains. On the basis of a few but variable amounts of intact peas in the in situ residues, the peahaulm silage was removed from the data set and the ensuing equation accounted for 0.89 of the variability in the in situ uncorrected RDP (Figure 3). In Figure 4, a better agreement is observed between the Cornell and the in situ corrected RDP for the feeds excluding PHS.

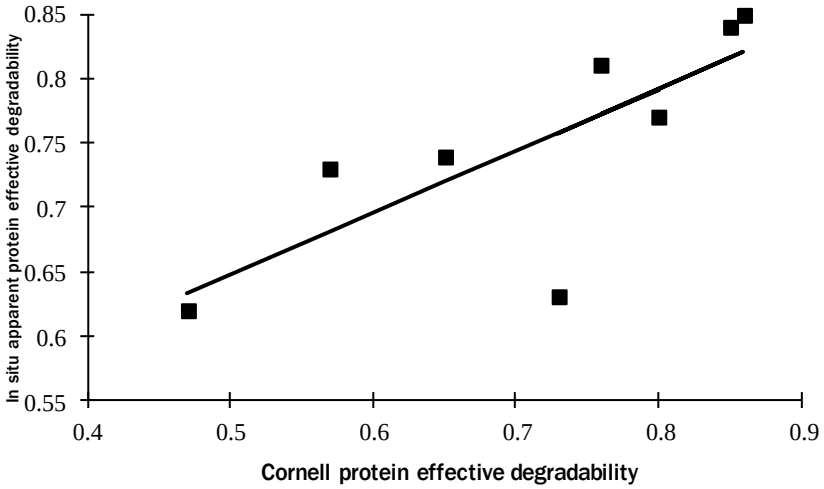

Figure 1 - The relationship between the in situ apparent and the Cornell protein degradabilities of eight fibrous feeds.
[in situ = 0.49 (s.e.=0.17)* × Cornell + 0.40 (s.e.=0.12)*; P<0.05; r^2 = 0.59; MSE = 0.06; n = 8; s.e., standard error of estimate; *, significant at P<0.05; MSE, mean square error.]

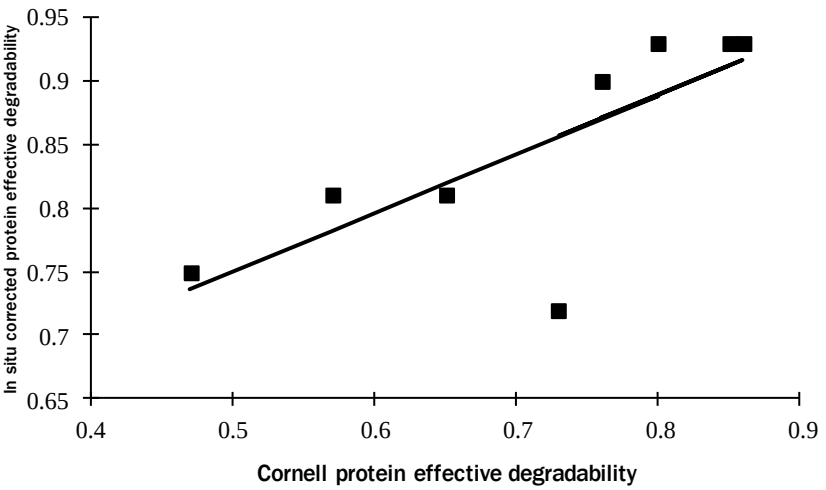

Figure 2 - Prediction of the in situ corrected protein effective degradability, with ^{35}S, by the Cornell protein effective degradability using eight fibrous feeds.
[in situ = 0.47(s.e.=0.17)* × Cornell + 0.51(s.e.=0.12)**; P<0.05; r^2 = 0.55; MSE = 0.06; n = 8; s.e., standard error of estimate; *, significant at P<0.05; **, significant at P<0.01; MSE, mean square error]

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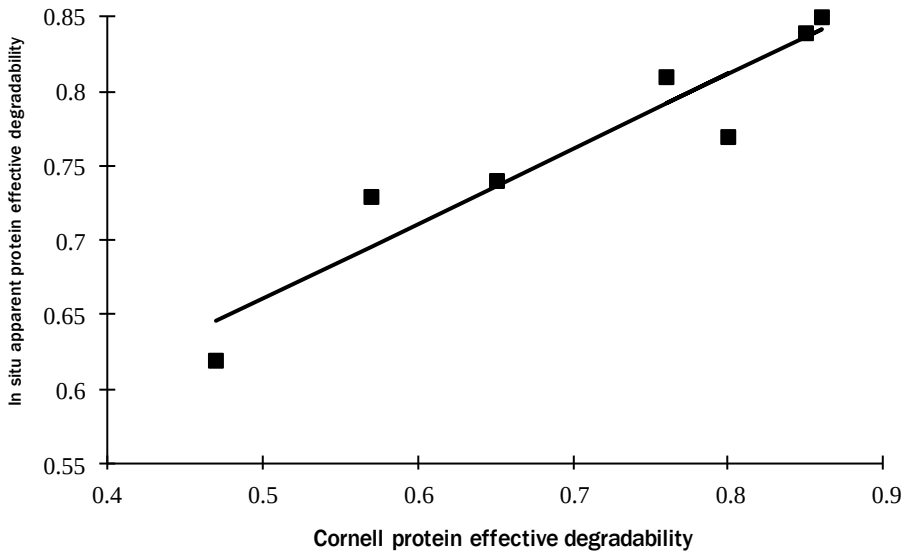

Figure 3 - The relationship between the in situ apparent and the Cornell protein degradabilities of the fibrous feeds excluding peahaulm silage.

[in situ = 0.51(s.e.=0.08)** × Cornell + 0.41(s.e.=0.06)***; P<0.01; r^2 = 0.89; MSE = 0.03; n = 7; s.e., standard error of estimate; **, significant at P<0.01; ***, significant at P<0.001; MSE, mean square error]

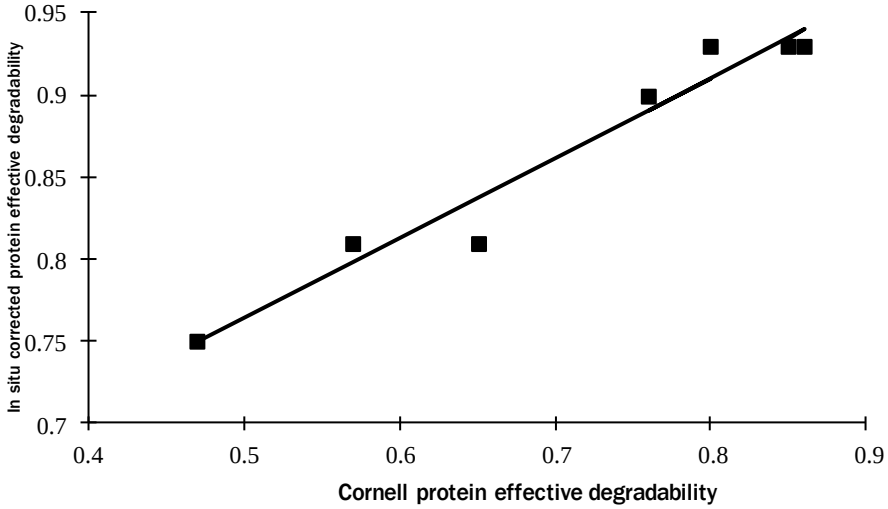

Figure 4 - Prediction of the in situ corrected, with ^{35}S, by the Cornell protein effective degradability of seven fibrous feeds, excluding peahaulm silage.

[in situ = 0.49(s.e.=0.05)*** × Cornell + 0.52(s.e.=0.03)**; P<0.001; r^2 = 0.95; MSE = 0.02; n = 7; s.e., standard error of estimate; **, significant at P<0.01; ***, significant at P<0.001; MSE, mean square error]

DISCUSSION

Cornell protein fractions and degradability

Ensiling of forage allows fermentation bacteria to degrade insoluble protein to non-protein nitrogen (NPN). In the experiment, the fermented forages contained a high amount of soluble protein (SP), much of which was NPN. Pichard and Van Soest (1977) also found that SP in silages and cut forages existed essentially as NPN. Fermentation of protein pools during ensiling would elevate A and C fractions while reducing true protein B. Therefore in damaged silage, nitrogen (N) would be present mainly as NPN and unavailable N. Since lowering of B fraction would be associated with damaged silages, DUGS appeared to be of good quality because of its higher true protein content, compared to the PFGS.

The observation that MS, PFGS and FWCW (Table 2) had a low amount of fraction B3 contrasts with the claim that forages contain significant amounts of pool B3 (Krishnamoorthy et al., 1982). Three reasons may account for this observation:

- variations in neutral detergent insoluble protein (NDIP) occur depending on the method of neutral detergent fibre (NDF) followed. There are about 14 published variations of NDF procedures (Mascarenhas-Ferreira et al., 1983; Van Soest et al., 1991),
- sometimes, neutral detergent solution degrades components that are precipitable in acid detergent solution and vice versa (Krishnamoorthy et al., 1982),
- the feeds mentioned have suffered substantial heat damage or are of poorer quality. However, the NDIP assay revealed very little indigestible N in the feeds analyzed.

Cornell versus in situ estimates

Soluble N estimated by the in situ method tended to be higher than the corresponding Cornell SP value (P<0.01). Lindberg and Varvikko (1982) observed that regardless of bag pore size, the quantity of feed residue left in the bag was about equal if incubation was long. It implied that undegraded feed particles flowing through the

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pores were potentially degradable. In addition to escape of fine particles, instantaneous solubility of some fraction B2 protein in in situ bags could be responsible for the higher in situ values. Pichard and Van Soest (1977) reported a rapidly degraded true protein with a half-life of 10 min, but which was not pool B1.

Peahaulm silage in situ RDP was comparatively low. Preparation of PHS sample for in situ incubation involved chopping only the peahaulm to 1 cm length and leaving the peas whole. Hydrolysable nutrients were confined as rumen actions failed to render the peas degradable. From the figures, it can be deduced that disparity between Cornell and in situ results could be due to major differences in the preparation of sample material (Trujillo et al., 2010). In their paper, Mehrez and Orskov (1977) reported that bags which contained more whole grains of barley yielded a lower DM loss, and vice versa.

Protein degradability in situ tended to be higher than the analogous Cornell value for the same feed. Undegraded fine particle loss from in situ bags has been associated with observed higher in situ values (Ghoorchi and Arbabi, 2010). Alternatively, lower degradation rates applied to Cornell pools would exaggerate the difference (Lanzas et al., 2008).

An agreement was affirmed between the Cornell and the in situ for forage protein degradability (Shannak et al., 2000). It was however noticed that if an abnormal value was included in the regression data (Shannak et al., 2000; Trujillo et al., 2010), in this case in situ PHS effective degradability value, correlation coefficient appreciably decreased. Correction for microbial contamination by the ^{35}S method would further improve the relationship between the Cornell and the in situ estimations.

CONCLUSION

The Cornell method significantly correlated with the in situ technique for fibrous feeds. Correlation between the methods could improve if microbial contamination was removed from the analysis. Method of preparation of feed for incubation would affect the correlation coefficient. The in situ protein effective degradability appeared to be bigger than the associated Cornell values. The Cornell adopted rates of degradation therefore need to be evaluated.

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REFERENCES

Agricultural and Food Research Council (1992). Technical committee on responses to nutrients: nutritive requirements of ruminant. Nutrition Abstracts Reviews (Series B) (Report No. 9), pp: 65-71.

Alexandrov AN (1997). Effect of ruminal exposure and subsequent microbial contamination on dry matter and protein degradability of various feedstuffs. Animal Feed Science and Technology, 71: 99-107.

Avornyo FK (1999). Estimation of degradability of feed protein in the rumen. Unpublished PhD dissertation, University of Cambridge, UK.

Ghoorchi T and Arbabi S (2010). Study of protein characteristics of five feeds by CNCPS model. Asian Journal of Animal and Veterinary Advances, 5:584-591.

Gosselink JMJ, Dulphy JP, Poncet C, Aufrere J, Tamminga S and Cone JW (2004). Rumen escape nitrogen from forages in sheep: comparison of in situ and in vitro techniques using in vivo data. Animal Feed Science and Technology, 166: 35-51.

Krishnamoorthy UC, Muscato TV, Sniffen CJ and Van Soest PJ (1982). Nitrogen fractions in selected feeds. Journal of Dairy Science, 65: 217-225.

Lanzas C, Broderick GA, Fox DG, 2008. Improved feed protein fractionation schemes for formulating rations with the Cornell Net Carbohydrate and Protein System. Journal of Dairy Science, 91: 4881-4891.

Licitra G, Hernandez TM and Van Soest PJ (1996). Standardization of procedures for nitrogen fractionation of ruminant feeds. Animal Feed Science and Technology, 57(4): 347-358.

Lindberg JE and Varvikko T (1982). Effect of bag pore size on the ruminal degradation of dry matter, nitrogenous compounds and cell walls in nylon bags. Swedish Journal of Agricultural Research, 12: 163-171.

Mascarenhas-Ferreira A, Kerstens J and Gast CH (1983). The study of several modifications of the neutral-detergent fibre procedure. Animal Feed Science and. Technology, 9: 19-28.

Mehrez AZ and Orskov ER (1977). A study of the artificial fibre bag technique for determining the digestibility of feeds in the rumen. Journal of Agricultural Science Cambridge, 88: 645-650.

Milis Ch, Liamadis D, Karatzias Ch and Abas Z (2007). Nitrogen in vivo digestibility and in situ degradability data for estimation of lower tract nitrogen digestibility with or without correction for microbial contamination. Small Ruminant Research, 71: 205-214.

Pichard G and Van Soest PJ (1977). Protein solubility in ruminant feeds. In the Proceedings of the 1977 Cornell Nutrition Conference, pp: 91-98.

Rodriguez CA and Gonzalez J (2006). In situ study of the relevance of bacterial adherence to feed particles for the contamination and accuracy of rumen degradability estimates for feeds of vegetable origin. British Journal of Nutrition, 96: 316-325.
Shannak S, Sudekum KH and Susenbeth A (2000). Estimating ruminal crude protein degradation with in situ and chemical fractionation procedures. Animal Feed Science and Technology, 85: 195-214.
Trujillo AI, Marichal M de J, Carriquiry M (2010). Comparison of dry matter and neutral detergent fibre degradation of fibrous feedstuffs as determined with in situ and in vitro gravimetric procedures. Animal Feed Science and Technology, 161:49-57.
Van Soest PJ, Robertson JB and Lewis BA (1991). Methods for dietary fibre, neutral-detergent fibre and nonstarch polysaccharides in relation to animal nutrition. Journal of Dairy Science, 74: 3583-3597.
Vanzant ES, Cochran RC and Titgemeyer EC (1998). Standardization of in situ techniques for ruminant feedstuff evaluation. Journal of Animal Science, 76: 2717-2729.
Whitehouse NL, Olson VM, Schwab CG, Chesbro WR, Cunningham KD and Lykos T (1994). Improved techniques for dissociating particle-associated mixed ruminal microorganisms from rumen digesta solids. Journal of Animal Science, 72: 1335-1343.

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REARING OF FRY TO FINGERLING OF SAUL (*Channa Striatus*) ON ARTIFICIAL DIETS

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ABSTRACT: *Three diets (F1, F2 and F3) containing protein levels of 38.60 to 38.98 % crude protein were used to assess the growth performances of Channa striatus fry (weight 0.52±0.0 to 0.53±0.02 g) in a completely randomized experiment design in five replicate set for 12 weeks. The fry were reared in 15 FRP tanks at a stocking density of 100 fry m^3 and fed ad libitum. The diets F1 and F3 showed significantly (P<0.05) low survival levels of 74±1.2% and 76±4.4% in comparison to diets F2 (82±3.1%) 84th day of rearing. The net biomass gain %, length gain %, SGR, PER and per day weight gain were found significantly (P<0.05) higher and FCR low with diet F2 in comparison to diets F1 and F3. The proximate analysis of carcass showed that the fishes fed diets F2 had significantly (P<0.5) higher deposition of crude protein and lipids in the tissue. The study revealed that the growth performance of C. striatus fry is better in feed F2 and the fry could be reared to fingerling size on formulated diets.*

ORIGINAL ARTICLE

Key words: *Channa striatus*, *Survival, Growth*

INTRODUCTION

Snakehead, *Channa striatus* (Bloch.), a carnivorous air - breather, is a valuable food fish in Asia (Wee, 1982). Snakehead can survive in harsh environments with low dissolved oxygen and high ammonia (Ng and Lim, 1990; Qin et al., 1997a) and therefore, are often cultured in fingerling ponds at densities of 40 – 80 fish. m^{-2}, with annual yields ranging from 7 to 156 tonne.ha^{-1} (Wee, 1982).

The snakehead *Channa striatus* has for long been commercially cultured in many countries for its good taste, market value, and medicinal qualities (Marimuthu and Haniffa, 2004). Snakehead *Channa striatus* is an air-breathing fish highly regarded as a food in Asia because its flesh is claimed to be rejuvenating, particularly for those recuperating from a serious illness. The early post -larvae, late post - larvae, fry and fingerlings of the different size groups of *Channa striatus* were reared from hatchling stage (Haniffa et al., 1999). A protocol was developed for weaning larval snakehead from live *Artemia* to formulated feed, but fingerling performance with formulated feed was not evaluated for this variety of murrel (Qin et al., 1997b). Haniffa et al. (2002a) reported the digestibility of lipid by the stripped murrel *Channa striatus* (0.6±0.12 g) was assessed by feeding six formulated feeds containing 7.54-22.3% lipid and energy varying between 3.54-4.38 kcal/g were prepared. The feeding experiments revealed that apparent protein digestibility (APD) was relatively higher in the diet 3 and 4 (90.24% and 90.60%) whereas; the apparent fat digestibility (AFD) was more in diet 5 and 6 (99.30% and 99.38%) respectively. Effects of feed application rates on growth, survival, and feed conversion of juvenile snakehead murrel, *Channa striatus* have been reported and it was recorded that growth, survival and feed conversion ratio of juvenile snakehead murrel (*Channa striatus*) were evaluated when fed a dry formulated feed with 50% crude protein (Qin et al., 1996b). In *Channa striatus* size and feed dependent cannibalism with juveniles were reported by Qin et al. (1996a).

Mass breeding of *Channa striatus* in an earthen pond have been reported with synthetic hormone 'ovaprim' injection was resorted to (Francis et al., 2000). The mass induced breeding technique is simple and advantageous, as it does not require expensive components like plastic pools, aquaria and hapa (Haniffa et al., 2002b). Marimuthu et al. (2001) reported a simple and low-cost breeding technology for breeding the striped murrel, *Channa striatus* in hapas in ponds was developed in India however, and the impact of dietary nutrients on breeding performance is not demonstrated and/or evaluated. The growth of intensive aquaculture production has led to a growing interest in providing fishes with dietary lipid contents to give higher energy through diet and simultaneously reduce the nitrogen load in the pond system by reducing the protein contents by supplementing the lipid contents. Because the carnivore fishes requires relatively higher levels of dietary animal protein and/or higher dietary energy for rapid

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growth and better survival (Mishra and Mukhopadhyay, 1996) the dietary protein/energy level has to be more. Suitable alternative energy nutrients such as oilseed by-products are the most promising sources of lipid and energy for aqua-feed in the future (Hardy, 2000). There was a significant increase in carcass protein and a significant decrease in ash content with progressive dietary protein substitution. Fry fed with high protein diets tended to have lower carcass lipid contents and higher moisture contents (Mohanty and Samantaray, 1996).

The present study was conducted to assess the feasibility of the development of feed for this premium commodity for the aquaculture.

MATERIALS AND METHODS

Physico – chemical parameters of water

The physico-chemical parameters of water of the NBFGR farm site recorded as (Temp., 26±1°C; pH, 7.4 -7.5; DO, 6.5-8.0 ppm) following the protocols from APHA (1998). Hatchery water temperature, pH, total alkalinity and dissolved oxygen ranged from 26±2°C, 6.9–7.3, 127–132 ppm and 6.4–7.6 ppm, respectively during the entire rearing period.

The hatchery bred spawn were acclimatized and after resorption of yolk sac fry were fed with, *Artemia* nauplii, followed by laboratory made egg custard feed (Table 1). The ingredients were mixed to prepare semi-moist dough (37.5% moisture). The feed was further grated and sieved to get desired size (150-200 µ) before feeding to fish. The healthy fish were separated to conduct feeding experiment.

Table 1 - Feed compositions used during rearing of fry of *Channa striatus*

Ingredients	Percentage
Hen egg with yolk	17.3
Lactogen powder	30.7
Fishmeal powder	50.0
Vitamin & Mineral Mix*	2.0
Vitamin and Mineral composition (Per 100 g) [1]	
Vitamin A (IU)	70000
Vitamin D_3 (IU)	7000
Vitamin E (mg)	25
Nicotinamide (mg)	100
Cobalt (mg)	15
Copper (mg)	120
Iodine (mg)	32.5
Iron (mg)	150
Magnesium (mg)	600
Manganese (mg)	150
Potassium (mg)	10
Selenium (mg)	1
Sodium (mg)	0.59
Sulphur (%)	0.72
Zinc (mg)	960
Calcium (%)	25.50
Phosphorus (%)	12.75

[1] From Agrivet Farm Care Division, GlaxoSmithKline Pharmaceuticals Limited (Mfg. by Sunder chemicals Pvt. Ltd., Chennai).

Feed preparation and feeding

During the acclimation the fishes were fed *ad libitum* with the moist feed containing Goat intestine, Wheat flour, Soybean meal and vitamin and mineral mix mixed in a ratio of 45 : 15 : 5 : 1 w/w (Table 2) for further weaning and rearing on artificial feed. After seven days various economical feeds with gross protein as 38.60 – 38.98% (Table 3) were formulated and growth study was carried out for 12 week rearing period for the fingerlings of *Channa striatus* with different feeds and the growth performances was recorded (Table 4).

Protein contents in ingredients and feed:

Protein** contents in feed and ingredients are given below -
Protein in mustard cake(MOC) was = 32.0 %
Potato Starch = 2.0 %
Protein in fish meal (FM) = 60.0 %
Protein in Prawn head meal = 50.0 %
Average protein contents in prepared feed ranged between 38.60 – 38.98% from F-1 to F-3 (F-1 Crude Protein, 38.60%; F-2 Crude Protein, 38.64%; F-3 Crude Protein, 38.98%. ** Protein estimated using N x 6.25.

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Analytical methods and analysis of data

For the experimentation of *Channa striatus* fingerlings were kept in separate tanks/pools with five replicates per feed totalling fifteen pools and were fed *ad libitum* with different feeds in these fifteen pools (300 l capacity) arranged in Random Block Designing. The performance of the feeds, in terms of the weight gain (%), Specific growth rate (SGR), feed conversion ratio (FCR), Protein efficiency ratio (PER). The growth in length and weight and the survival data were analysed using One-way ANOVA. Duncan's multiple Range test was used to determine which treatment means differed significantly ($P<0.05$) using SPSS version 16.0.

Weight Gain (%) = {(Final body weight) – (Initial body weight)/ (Initial body weight)} x 100
Specific Growth Rate (SGR; % day $^{-1}$) = {(Final body weight) - (Initial body weight) / (experimental days)} x 100
Survival (%) = 100 x (No. of total fish - No. of dead fish)/Number of total fish
Biomass = Final average weight x Total no. of fish

The results were recorded in terms of specific growth (SGR), protein efficiency ratio (PER), per day increment (PI) and feed conversion ratio/efficiency (FCR) (Tables 4, 5). The survival was recorded at the end of the 4th, 8th and 12th week (Tables 6, 7).

Biochemical Analysis

Proximate compositions of feeds and fish carcass were analyzed following methods. All samples were analysed in triplicate. Dry matter was estimated after drying in oven at 105°C for 24 hours; crude protein (N x 6.25) by the Kjeldahl method after acid digestion; Crude lipid by di-ethyl ether extraction method using Soxhlet apparatus. Proximate analysis study was carried out for the reared Fingerlings of *Channa striatus*, fed with different feeds was analysed for body composition (Table 6). The body tissue, feed of the experiments were analysed for dry matter (DM), crude protein (CP), lipid and total ash according to AOAC (1990). The organic matter (OM) was calculated by subtracting the total ash from dry matter (DM).

Table 2 - Feed composition used during acclimatization of grow-out of *Channa striatus*

Ingredients	Percentage
Goat intestine	45.0
Wheat Flour	15.0
Soybean meal	5.0
Vitamin & Mineral Mix[1]	1.0
Composition:	
Protein	47.04
Carbohydrate	16.54
Fat	14.18
Ash	10.34
Fiber	3.55
Gross Energy (k Cal/ 100g)	434.10
Vitamin and Mineral composition (Per 100 g) [1]	
Vitamin A (IU)	70000
Vitamin D_3 (IU)	7000
Vitamin E (mg)	25
Nicotinamide (mg)	100
Cobalt (mg)	15
Copper (mg)	120
Iodine (mg)	32.5
Iron (mg)	150
Magnesium (mg)	600
Manganese (mg)	150
Potassium (mg)	10
Selenium (mg)	1
Sodium (mg)	0.59
Sulphur (%)	0.72
Zinc (mg)	960
Calcium (%)	25.50
Phosphorus (%)	12.75

[1] From Agrivet Farm Care Division, GlaxoSmithKline Pharmaceuticals Limited (Mfg. by Sunder chemicals Pvt. Ltd., Chennai).

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Table 3 - Feeds compositions used during rearing of grow-out of *Channa striatus*						
Feed	**Mustard Oil Cake (%)**	**Potato Starch (%)**	**Fish Meal (%)**	**Prawn Head meal (%)**	**Vitamin Mineral* (%)**	**Gross protein (%)**
F-1	56	6	30	5	3	38.60
F-2	32	17	40	8	3	38.64
F-3	9	27	50	11	3	38.98
Vitamin and Mineral composition (Per 100 g) [1]						
Vitamin A (IU)						70000
Vitamin D_3 (IU)						7000
Vitamin E (mg)						25
Nicotinamide (mg)						100
Cobalt (mg)						15
Copper (mg)						120
Iodine (mg)						32.5
Iron (mg)						150
Magnesium (mg)						600
Manganese (mg)						150
Potassium (mg)						10
Selenium (mg)						1
Sodium (mg)						0.59
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RESULTS AND DISCUSSION

The growth performances, survival and proximate composition of *Channa striatus* are depicted in Tables 4, 5, 6, 7 and 8. The survival ranged between 74±1.2 to 82±3.1% and F1 and F3 diets were significantly different from F2 diet (P<0.05).

Table 4 - The growth performance of the fingerlings of *Channa striatus*							
Feed	**Initial weight (g)**	**Final weight (g) 4th week**	**Final weight (g) 8th week**	**Final weight (g) 12th week**	**Specific growth rate (SGR) after 12 weeks**	**Survival (%)**	**FCR**
F-1	0.52±0.0^{a}	2.6±0.2^{a}	4.2^{a}±0.1^{a}	6.22±0.02^{a}	6.79^{a}	74±1.2^{a}	3.45±0.12^{b}
F-2	0.53±0.01^{a}	3.8±0.3^{*,c}	6.4^{a}±0.2^{c}	8.35±0.12^{c}	9.31^{c,**}	82±3.1^{b}	2.55±0.19^{a}
F-3	0.53±0.02^{a}	3.4±0.1^{b}	5.5^{b}±0.2^{b}	7.18±0.10^{b}	7.92^{b}	76±4.4^{a}	2.87±0.15^{a,**}

Same alphabet in superscript in a column represents no significant difference in weight gain. * = P<0.01; **= p< 0.05. The results are of five replicates of feeding trial.

Table 5 - Initial and final weights and lengths, weight gain and percent weight gain of the *C. striatus* fingerling different treatments during 12 week experimental period								
Feed	**In length (cm)**	**Fn length (cm)**	**In weight (g)**	**Fn weight (g)**	**Length gain (cm)**	**% Length gain**	**Weight gain (g)**	**% Weight gain**
F1	4.2±0.1^{a}	11.20±0.20^{b}	0.52±0.01^{a}	6.22±0.02^{a}	7.0^{a}	166.7^{a}	5.7^{a}	1096.2^{a}
F2	4.4±0.4^{a}	13.38±0.03^{a}	0.53±0.01^{a}	8.35±0.12^{c}	9.0^{c}	204.1^{c}	7.82^{c}	1475.5^{c}
F3	4.1±0.3^{a}	11.88±0.28^{b}	0.53±0.02^{a}	7.18±0.10^{b}	7.8^{b}	189.8^{b}	6.65^{b}	1254.7^{b}

Means in a given column having the same letter superscript are not significantly different at (P<0.05) by ANOVA and Duncan multiple range test.

Table 6 - Average initial and final weight, specific growth rate (SGR), food conversion ratio (FCR), protein efficiency ratio (PER), per day increment (PI) and survival rate (%) of *C. striatus* fingerlings fed various experimental diets for 12 weeks.							
Feed	**In weight (g)**	**Fn weight (g)**	**SGR %/day**	**FCR**	**PER**	**PI (mg)**	**Survival (%)**
F1	0.52±0.01^{a}	6.22±0.02^{a}	6.79^{a}	3.45±0.12^{b}	1.37±0.02^{a}	74.0^{a}	74±1.2^{a}
F2	0.53±0.01^{a}	8.35±0.12^{c}	9.31^{c,**}	2.55±0.19^{a}	1.52±0.03^{b}	99.4^{c}	82±3.1^{b}
F3	0.53±0.02^{a}	7.18±0.10^{b}	7.92^{b}	2.87±0.15^{a,**}	1.45±0.05^{b}	85.5^{b}	76±4.4^{a}

Means in a given column having the same letter superscript are not significantly different at (P<0.05) by ANOVA and Duncan multiple range test

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Table 7. Survival percentage of *Channa striatus* on every 4th week				
Feed	**Stocking Nos. (N=100 X 5 replicates)**	**4th Week (%)**	**8th Week (%)**	**12th Week (%)**
F-1	500	90±2.1 [a]	81±2.9[a]	74±1.2[a]
F-2	500	92±3.5 [a]	77±4.3[b,*]	82±3.1[b,**]
F-3	500	88±2.8 [a]	80±5.2[a,*]	76 ±4.4[a]

Same alphabet in superscript in a column represents no significant difference in survival. * = P<0.01; **= P<0.05. The results are of five replicates of feeding trial.

Table 8 - Whole body composition of *Channa striatus*					
Feed	**Dry Matter (%)**	**Crude Protein (%)[1]**	**Lipid (%)[1]**	**Ash (%)[1]**	**Organic Matter[1] (%)**
F-1	24.2±0.88[b]	63.1±3.4[b]	7.5±0.4[a]	15.3±0.2[a]	84.1±2.0[a]
F-2	25.6±0.56[b]	65.2±1.9[b]	8.8±0.7[b]	14.7±0.6[a]	84.2±1.9[a]
F-3	22.1±0.45[a]	60.4±1.6[a]	7.7±0.1[a]	14.5±0.3[a]	84.7±1.6[a]

Different alphabet in superscript in a column differ significantly (p< 0.05). The results are of five replicates of feeding trial. [1] Dry matter basis

It is well known that Snakeheads observed great amount of cannibalism at all stages of life and it is one of the major reasons of low survival during their culture (Ng and Lim 1990). In the process of cannibalism although shooters are able to prey on fish measuring 2/3 in length (Diana et al., 1985) or 63-80% (Qin and Fast 1996a) to predator size in case of *C. striatus*, no information as to predator-prey ratio is available for *C. marulius* though the species is known to be more predatory and cannibalistic in nature in comparison to *C. striatus*. *C. striatus* in the process of cannibalism ingested comparatively smaller numbers (more than 10%) of prey and large numbers of them die due to injury, shock and spread of diseases (Qin and Fast, 1996b). Qin and Fast (1998) have also revealed that when snakehead begin feeding on formulated feed, the progressive size variation as fish grow does not necessarily provoke cannibalism when an adequate amount of suitable food is available.

The growth performance was higher in F2 than F1 and F3. This was well corroborated with the work of Mohanty and Samantaray (1996) who obtained highest growth performances in *C. striata* fry fed formulated diet containing 550 g kg^{-1} protein (energy 4320 kcal kg^{-1}) fed at the rate of 10% bw . day^{-1}. Similar observations have also been made in case of juvenile *C. striata* (Wee, 1986), *C. micropeltes* (Wee and Tacon 1982), *Chanos chanos* (Lim et al., 1979), *Epinephelus tauvina* (Teng et al., 1978), *Cyprinus carpio* (Ogino & Saito 1970), *Ictalurus punctatus* (Prather and Lovell, 1973) and *Sarotherodon mossambicus* (Jauncey 1982). The diet containing 49.72% protein and 13.54% fat in the feed were well suited for better growth of *C. striatus*. Growth and survival of larval snakehead (*Channa striatus*) fed different diets has been reported by Qin et al. (1997c). They reported the culture performance of larval snakehead (*Channa striatus*) and they have also examined in a three-phase feeding experiment. During Phase - I, diet treatments included: no food; formulated feed only; live *Artemia* nauplii and decapsulated *Artemia* cysts; decapsulated *Artemia* cysts only; formulated feed plus live *Artemia* nauplii; and formulated feed with *Artemia* cysts.

Protein efficiency studies on snakehead body tissue have been performed in good number of cases both from capture and culture stocks (Aliyu-Paiko et al., 2010; Gam et al., 2006; Mohanty and Samantaray 1996; Yang, 1980; Zuraini et al., 2006). Barring the study of Zuraini et al. (2006), the level of protein in body tissues in case of *C. striatus* has been reported to be 230 g kg^{-1} (Zuraini et al., 2006) to 449.0 g kg^{-1} (Gam et al., 2006) in natural stocks whereas in experimental culture, protein level as high up to 713 g kg^{-1} has been reported when fish fed dietary protein level 450 g kg^{-1} along with a lipid level of 65 g kg^{-1} (Aliyu-Paiko et al., 2010). The later, therefore support the present findings in which protein levels in body carcass of *C. striatus.* The availability of protein in body carcass greatly depends on species, size, age, season, protein quality, dietary level of energy, water quality and presence of natural food and culture management (Gam et al., 2006; NRC, 1993).

Protein efficiency in *C. striatus* was found almost directly proportional to the dietary protein levels as all treatments had significantly (P<*0*.05) different carcass protein with highest protein in diet F2 (Table 8). These results were similar to the work of Aliyu-Paiko et al. (2010) and Mohanty and Samantray (1996). Therefore, on the basis of survival, growth and protein efficiency indices recorded in the present study, the growth of *C. striatus* fry was assessed best in F2 diet. However, this needs to be confirmed with other natural feed ingredients in future studies to reduce the cost of formulated diets.

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REFERENCES

Aliyu-Paiko M, Hashim R and Shu-Chien AC (2010). Influence of dietary lipid/protein ratio on survival, growth, body indices and digestive lipase activity in snakehead (*Channa striatus*, Bloch 1793) fry reared in re-circulating water system. Aquacult. Nutr., 16: 466-474.

AOAC (Association of Official Analytical Chemists) (1990). In: *Official Methods of Analysis of the Association of Official Analytical Chemists*, 15th edn (ed. by K. Helrich), p. 1298, Association of Official Analytical Chemists, Arlington, Virginia.

APHA (1998). Standard Methods for the Examination of Water and Wastewater (ed. by L.S. Clesceri, A.E. Greenberg & A.D. Eaton), 20th edn. American Public Health Association, American Water Works Association, Water Environment Federation, Washington, DC, USA.

Diana JS, Chang WYB, Ottey DR and Chuapoehuk W (1985). Production systems for commonly cultured freshwater fishes of Southeast Asia. Pages 75-79 in International Program Report, number 7, Great Lake and Marine Water Center, University of Michigan, Ann Arbor, Michigan, USA.

Francis T, Ramanathan N, Athithan S and Cheryl HF (2000). Induced breeding of Murrel, *Channa striatus* using various inducing agents. Fishing chimes., 19 (10-11): 119-121.

Gam, Lay-Harn, Leow, Chiuan-Yee & Baie, Saringat (2006) Proteomic analysis of snakehead fish (*Channa striata*) muscle tissue. Malaysian Journal of Biochemistry and Molecular Biology, 14:25-32.

Haniffa MA, Raj AJA. and Sridhar S (1999). Weaning diet for striped murrel *Channa striatus*. Fish. Technol. Soc. Fish. Technol. (India). 36 (2): 116-119.

Haniffa, MA Arockiaraj, AJ, Sethuramalingam, TA and Sridhar S (2002a). Digestibility of lipid in different feeds by stripped murrel *Channa striatus*. Journal of Aquaculture in the Tropics 17(3) : 185-191.

Haniffa MA, Marimuthu K and Muruganandam M (2002b). Mass breeding of the striped murrel induced through 'ovaprim'. Fishing chimes, 21(10-11): 53-54.

Hardy R.W. (2000). New developments in aquatic feed ingredients, and potential of enzyme supplements. In: Avancesen Nutricion AcuicolaV.Memorias delV Simposium Internacional de Nutricion Acuicola, Merida,Yucatan, Mexico, 19-22 November (ed. by L.E. Cruz-Suarez, D. Ricque-Marie, M. Tapia-Salazar, M.A. Olvera-Novoa & R. Civera-Cerecedo), pp. 216-226.

Jauncey K (1982). The effect of varying dietary protein level on the growth, food conversion, protein utilization and body composition of juvenile tilapia *Sarotherodon mossambicus*. Aquaculture, 27: 43-54.

Lim C, Sukhawongs S and Pascual FP (1979). A preliminary study on the protein requirement of *Chanos chaonos* (Forskal) fry in a controlled environment. Aquaculture, 17:195-201.

Marimuthu K and Haniffa MA (2004). Seed production and culture of snakehead. Infofish International, 2: 16-18.

Marimuthu K, Haniffa MA, Muruganandam M and Arockia Raj AJ (2001). Low cost murrel seed production technique for fish farmers, Naga., 24(1-2): 21-22.

Mishra S and Mukhopadhyay PK (1996). Effect of some formulated diets on growth, feed utilization and essential amino acid deposition in *Clarias batrachus* fry. Indian Journal of Fisheries, 43: 333-339.

Mohanty SS and Samantaray K (1996). Effect of varying level of dietary protein on the growth performance and feed conversion efficiency of snakehead, *Channa striatus*. *Aquaculture Nutrition* **2**: 89–94.

Ng PK and Lim KKP (1990). Snakeheads (Pisces: Channidae): Natural history, biology and economic importance. In: C.L. Ming and P.K.L. Ng (Editors), Essays in Zoology. Papers commemorating the 40th Anniversary of the Department of Zoology, National University of Singapore, pp.127-152.

NRC (National Research Council) (1993). Nutrient requirements of warm water fishes. National Academy of Sciences, Washington, DC. 114pp.

Ogino C and Saito K (1970). Protein nutrition in fish. I. The utilization of dietary protein by young carp. Bull. Jap. Soc. Scient. Fish. 36:250-254.

Prather EB and Lovell RT (1973). Responses of intensively fed channel catfish to diets containing various protein energy ratios. Proc. South East Assoc. Game Fish Comm., 27: 455-459.

Qin J and Fast AW (1996a). Size and feed dependent cannibalism with juvenile snakehead *Channa striatus.* Aquaculture, 144: 313–320.

Qin J, Fast AW and Kai AT (1997a). Tolerance of snakehead *Channa striatus* to ammonia at different pH. Journal of the World Aquaculture Society, 28, 87–90.

Qin J, Fast AW, DeAnda D and Weidenbach RP (1997b). Growth and survival of larval snakehead, *Channa striatus*, fed different diets. Aquaculture, 148: 105–113.

Qin J and Fast AW (1998). Effects of temperature, size and density on culture performance of snakehead, *Channa striatus* (Bloch). fed formulated feed. Aquacult. Res., 29 (4): 299–303.

Qin J and Fast AW (1996b). Effects of feed application rates on growth, survival, and feed conversion of juvenile snakehead *Channa striatus*. J. World Aquacult. Soc. 27 (1): 52-56.

Qin J and Fast AW (1996a). Size and feed dependent cannibalism with juvenile snakehead *Channa striatus*. *Aquaculture*,114: 313-320.

Qin J, Fast AW, DeAnda D and Weidenbach RP (1997c). Growth and survival of larval snakehead (*Channa striatus*) fed different diets. Aquaculture. 148(2-3): 105-113.

Teng SK, Chua TE and Lim PE (1978) Preliminary observation on the dietary protein requirement of estuary grouper, *Epinephelus salmoides* Maxwell, cultured in floating net cages. Aquaculture, 15:257-289.
Wee KL and Tacon AGJ (1982). A preliminary study on the dietary protein requirement of juvenile snakehead. Bull. Jap. Soc. Scient. Fish., 48, 1463-1468.
Wee KL (1982) The biology and culture of snakeheads. Recent Advances in Aquaculture, pp 180-211 J.F. Muir and R.J. Roberts, eds, Westview Press, Boulder, Colorado.
Wee KL (1986). A preliminary study on the dietary protein requirements of juvenile snakehead. In: Proc. Int. Conf. Dev. Managet. Trop. Living Aquat. Resources, Serdang, Malaysia. 2-5 Aug; 1983, pp 131-136.
Yang Syng-Taek and Lee Eung-Ho (1980) Taste compounds of Korean snakehead meat. In: Taste compounds of fresh-water fishes. Bull. Korean Fish. Soc., 13 (3):115-119.
Zuraini A, Somchit MN, Solihah MH, Goh YM, Arifah AK, Zakaria MS, Somchit N, Rajion MA, Zakaria ZA and Jais AM Mat (2006). Fatty acid and amino acid composition of three local Malaysian *Channa* spp. Fish. Food Chemistry, 97(4): 674-678.

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VITAMIN D_3 INDUCED HYPERCALCEMIC RESPONSE IN THREATENED BRONZE FEATHER BACK (*Notopterus notopterus,* PALLAS)

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ABSTRACT: *Vitamin D_3 (0.0 IU.100 g body weight (BW)$^{-1}$.day^{-1}, 100 IU.100 g BW^{-1}.day^{-1}, 500 IU.100 g BW^{-1}.day^{-1} and 1000 IU.100 g BW^{-1}.day^{-1}) was administered intra-peritoneally (ip) to the freshwater threatened Bronze Featherback, Notopterus notopterus kept in freshwater for 9 days. Analyses of serum calcium levels were performed at 0, 6 hr. and 1, 2, 3, 5 and 9 days (four grow-out Notopterus notopterus from each group of ip doses at each interval). Administration of vitamin D_3 elevated the maximum serum calcium elevation occurred at day 2 freshwater in 500 IU.100 g BW^{-1}.day^{-1} (11.2±0.92 mg.dL^{-1}) and in 1000 IU.100 g BW^{-1}.day^{-1} (12.0±0.46 mg.dL^{-1}) of the fish maintained in the fresh water. There was gradual decrease in calcium levels from day 3 and became normocalcemia on day 9. Out of the three concentrations of ip Vitamin D_3 (100 IU.100 g BW^{-1}.day^{-1}, 500 IU.100 g BW^{-1}.day^{-1} and 1000 IU.100 g BW^{-1}.day^{-1}) the sharp elevation of serum calcium recorded in both 500 IU.100 g BW^{-1}.day^{-1} and 1000 IU.100 g BW^{-1}.day^{-1}. The control (0.0 IU.100 g BW^{-1}.day^{-1}) fish serum calcium behaves like normocalcemia (8.25±0.21 mg.dL^{-1}) in every sampling up to day 2. Results demonstrated that ip Vitamin D_3 exerted a dose-dependent and pronounced hypercalcemic effect in freshwater threatened Bronze Featherback, Notopterus notopterus.*

ORIGINAL ARTICLE

Key words: *Notopterus notopterus*, *Threatened fish, Vitamin D_3, Hypercalcemia*

INTRODUCTION

The physiological and cellular impact of vitamin D_3 and its metabolites have been recently under studies in lower vertebrates including fish. Numerous studies were made to study the physiological role of vitamin D_3 in teleostean fishes (Avioli et al., 1981; Marcocci et al., 1982; Hayes et al., 1986; Takeuchi et al., 1986, 1987; Rao and Raghuramulu, 1995) and changes in the blood calcium and phosphate contents of fish after administration of vitamin D_3 and/or its metabolites (Swarup and Srivastav, 1982; Srivastav, 1983; Swarup et al., 1984; Fenwick et al., 1984; Srivastav and Srivastav, 1988; Srivastav and Singh, 1992; Sundell et al., 1993; Fenwick et al., 1994). Teleost bone may or may not contain osteocytes and has been considered by some investigators to be metabolically inert and unable to contribute to calcium homeostasis. On this basis, we designed the present experiment to determine whether vitamin D_3 affects the serum calcium concentration of the featherback, *Notopterus notopterus,* when the external sources of calcium (environmental and dietary) are eliminated. For comparison, the effect of vitamin D_3 was also tested in this fish in control and experimental conditions.

MATERIALS AND METHODS

A total of 112 adult specimens of *Notopterus notopterus* of both sexes weighing 180-230 g were collected locally during the resting phase and acclimated to the laboratory under conditions of natural photoperiod and temperature (25± 2°C) for two weeks in plastic pools (300L). The fish were fed live feed during acclimatization. For the experiments, the fishes were kept in identical plastic pool. After acclimatization, the fishes were divided into four groups of 24 animals each and submitted to the following treatments:

Group 1: Injected *ip* with vehicle (0.1 ml Arachis oil 100 g BW^{-1} day^{-1}) and kept in freshwater;
Group 2: Injected *ip* with 100 IU of vitamin D_3 100 g BW^{-1} day^{-1} and kept freshwater;
Group 3: Injected *ip* with 500 IU of vitamin D_3 100 g BW^{-1} day^{-1}) and kept in freshwater;
Group 4: Injected *ip* with 1000 IU of vitamin D_3 100 g BW-I day-I and kept in freshwater.

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Vitamin D_3 (Arachitol, duphar - Interfran), administered to groups 2, 3 and 4 was dissolved in Arachis oil. The fish were not fed 24 h before and during the experiment. Blood samples were taken by sectioning the caudal peduncle 4 h after the injection on days 0, 6 hr, 1, 2, 3, 5 and 9 after treatment. The sera were separated and analyzed for calcium level according to the method of Trinder (1960). Data are reported for four specimens and the DMRT was used to determine statistical significance.

RESULTS

Group -1

The serum calcium levels exhibited almost no change throughout the experiment (Table 1, Figure 1). No change was observed in serum calcium level on day 0.0, 6 hr, day 1 following vitamin D_3 treatment. After 3rd day the insignificant increase was recorded on day 5 and 9 ($P>0.05$).

Group -2

The serum calcium levels of vitamin D_3 (100 IU of vitamin D_3 100 g BW^{-1} . day^{-1}) decreased progressively from day 1 to day 2 (Table 1, Figure 1), and decrease thereafter from day 2 to the end of the experiment. The serum calcium level decrease progressively from day 2 until day 9 ($P>0.05$).

Group -3

The serum calcium level of vitamin D_3 (500 IU of vitamin D_3 100 g . BW^{-1} day^{-1}) was moderately increased on day 1, and progressively increases till day 2 (Figure 1). The level decreased progressively from day 2 to day 9. The levels exhibited a significant increase from the control and remain above than the control until day 9 (Table 1, Figure 1).

Group -4

The serum calcium level of vitamin D_3 (1000 IU of vitamin D_3 100 g BW^{-1} . day^{-1}) was highly elevated on day 2 increased on day 1, and progressively increase till day 2 (Figure 1). The level decreased progressively from day 2 to day 9. The levels exhibited a significant increase from the 100 IU and 500 IU treatment and remain above than the control until day 9 (Table 1, Figure 1).

Table 1 - Serum calcium level in *Notopterus notopterus*

Concentrations of calcium	Time					
	6hr	1 day	2 day	3 day	5 day	9 day
Control	8.1±0.11	8.2±0.21	8.2±0.21^a	8.4±0.18^b	8.4±0.43^b	8.6±0.22^b
100 IU	9.3±0.08	9.6±0.23	10±0.14^b	9.8±0.17^b	9.3±0.19^b	8.6±0.10^a
500 IU	9.3±0.07	9.7±0.21	11.2±0.92^b	10.1±0.56^b	9.8±0.72^b	9.1±0.09^a
1000 IU	9.4±0.41	9.7±0.27	12±0.46^b	10.3±0.13^a	9.8±0.17^a	9.6±0.23^a

Means in a row having the same letter superscript are not significantly different at ($p<0.05$) by ANOVA and Duncan multiple range test

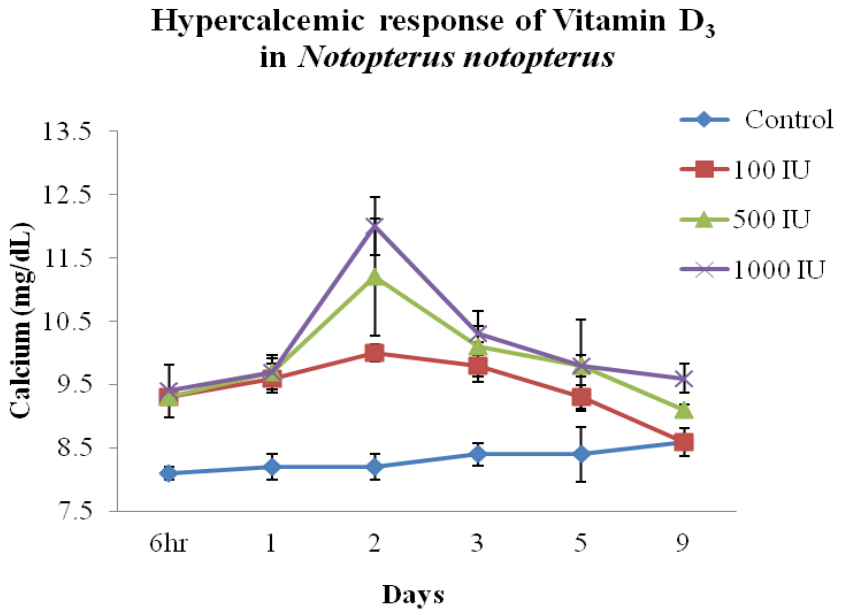

Figure 1 - Vitamin D_3 induced Hypercalcemic response in *Notopterus notopterus*

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DISCUSSION

In *N. notopterus* vitamin D_3 acted as an inducer of hypercalcemia when the fish were kept in freshwater. Earlier investigators working on sharks, rays and cyclostomes (Urist, 1962) and on lungfish (Urist et al., 1972) have reported that administration of vitamin D_3 fails to affect blood calcium contents. Lopez et al. (1977) injected 1,25 $(OH)_2D_3$ into *Anguilla anguilla* and found that the plasma calcium concentrations were not affected by the administration of the metabolite. Mac Intyre et al. (1976) noticed among eels treated with 1,25 $(OH)_2D_3$ but no change in calcium levels. The observed hypercalcemic effects of vitamin D_3 in *N. notopterus* are in good agreement with earlier reports of similar responses after vitamin D and/or maintenance of the fish in a freshwater environment (Swarup and Srivastav, 1982; Srivastav, 1983; Swarup et al., 1984; Fenwick et al., 1984; Srivastav and Srivastav, 1988; Srivastav and Singh, 1992). The present study also agrees with the reports of other investigators who have noticed hypercalcemia (Swarup et al., 1984; Fenwick et al., 1984; Srivastav and Srivastav, 1988) after administration of 1,25 $(OH)_2D_3$. A pronounced hypercalcemia has also been recorded after injecting the American eel *Anguilla rostrata* with calcium chloride solution (Fenwick et al., 1991). These studies support the hypercalcemia observed here in *N. notopterus* maintained in freshwater. In the present study vitamin D_3 treatment resulted in hypercalcemia a fact possibly explained by increased resorption of bone and/or mobilization of calcium from soft tissues.

There was a decline in the serum calcium level of *N. notopterus* maintained in freshwater. Wendelaar Bonga et al. (1984) also noticed significant hypocalcemia in tilapia after 5 days of transfer to a low-calcium environment, which they attributed to the increased efflux of this ion through the gill. The hypocalcemia observed in *N. notopterus* maintained in freshwater also confirms data reported by Wendelaar Bonga and van der Meij (1981) who noticed increased permeability at low-ambient Ca^{2+}. The low-ambient Ca^{2+} the increased water uptake may increase urine production which leads to extra Ca^{2+} loss from the body (Fenwick, 1981).

In D_3 injected *N. notopterus* kept freshwater, the serum calcium level was increased up to day 2 and was slightly reducing up to last day. This restoration of plasma calcium is most probably mediated by an enhanced production of prolactin, as previously suggested by Wendelaar Bonga et al. (1984). Flik et al. (1986) reported, prolactin stimulates Ca^{2+} uptake from the water in tilapia. In the present study, there was calcium available to the featherback from the surrounding medium; therefore, the restoration of calcium can be attributed to water source, bone demineralization and increased mobilization from soft tissues.

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REFERENCES

Avioli LV, Sonn Y, Jo D, Nahon TH,Haussler MR and Chandler JS (1981). 1,25-dihydroxyvitamin D_3 in male, non-spawning female and spawning female trout. Proceedings of the Society for Experimental Biology and Medicine, 166: 291-293.

Fenwick JC and Gilles Brasseur J (1991). Effects of Stanniectomy and experimental hypercalcemia on plasma calcium levels and calcium influx in American eels, *Anguilla rostrata* Le Sueur. General and Comparative Endocrinology, 82: 459-465.

Fenwick JC (1981). The renal handling of calcium and renal $Ca^{2+}(Mg^{2+})$-activated adenosinetriphosphatase activity in freshwater and seawater-acclimated North American eels (*Anguilla rostrata* Le Sueur). Canadian Journal of Zoology, 59: 478-485.

Fenwick JC, Davidson W and Forster ME (1994). *In vivo* calcitropic effect of some vitamin D compounds in the marine Antarctic teleost,*Pagothenia bernacchii*. Fish Physiology and Biochemistry, 12: 479-484.

Fenwick JC, Smith K, Smith J and Flik G (1984). Effect of various vitamin D analogs on plasma calcium and phosphorus and intestinal calcium absorption in fed and unfed American eels, *Anguilla rostrata*. General and Comparative Endocrinology, 55: 398-404.

Flik G, Fenwick JC, Kolar Z, Mayer-Gostan N and Wendelaar Bonga SE (1986). Effects of ovine prolactin on calcium uptake and distribution in the freshwater chichlid teleost, *Oreochromis mossambicus*. American Journal of Physiology, 250: 161-166.

Hayes ME, Guilland-Cumming DF, Russell, RGG and Henderson IW (1986). Metabolism of 25-hydroxycholecalciferol in a teleost fish, the rainbow trout (*Salmo gairdneri*). General and Comparative Endocrinology, 64: 143-150.

Lopez E, Peignoux-Deville J, Lallier F,Colston KW and MacIntyre I (1977). Response of bone metabolism in the eel *Anguilla anguilla* to injections of 1,25-di-hydroxyvitamin D. Calcified Tissue Research, 22 (Suppl): 19-23.

Mac Intyre I, Colston KW, Evans IMA,Lopez E, Macauley SJ, Peignoux-Deville J, Spanos E and Szelke M (1976). Regulation of vitamin D: an evolutionary view. Clinical Endocrinology, 5 (Suppl): 85-95.

Marcocci C, Freake HC, Iwaski J, Lopez E and MacIntyre I (1982). Demonstration and organ binding of the 1,25-dihydroxyvita-min D_3-binding protein in fish (*A. anguilla*). Endocrinology, 110: 1347-1351.

Rao DS and Raghuramulu N (1995). Vitamin D and its related parameters in freshwater wild fishes. Comparative Biochemistry and Physiology, 111A: 191-198.

Srivastav Ajai K and Singh S (1992). Effects of vitamin D_3 administration on the serum calcium and inorganic phosphate levels of the freshwater catfish, *Heteropneustes fossilis* maintained in artificial freshwater, calcium-rich freshwater and calcium-deficient freshwater. General and Comparative Endocrinology, 87: 63-70.

Srivastav Ajai K and Srivastav SP (1988). Corpuscles of Stannius of *Clarias batrachus* in response to 1,25-dihydroxyvitamin D_3 administration. Zoological Science, 5: 197-200.

Srivastav Ajai K (1983). Calcemic responses in the freshwater mud eel, *Notopterus notopterus* to vitamin D_3 administration. Journal of Fish Biology, 23: 301-303.

Sundell K, Norman AW and Bjornsson BTH (1993). $1,25(OH)_2D_3$ increases ionized plasma calcium concentrations in the immature Atlantic cod, *Gadus morhua*. General and Comparative Endocrinology, 91:344-351.

Swarup K and Srivastav SP (1982). Vitamin D_3 induced hypercalcemia in male catfish, *Clarias batrachus*. General and Comparative Endocrinology, 46: 271-274.

Swarup K, Norman AW, Srivastav Ajai K and Srivastav SP (1984). Dose-dependent vitamin D_3 and 1,25-dihydroxycholecalciferol induced hypercalcemia and hyperphosphatemia in male catfish *Clarias batrachus*. Comparative Biochemistry and Physiology, 78: 553-555.

Takeuchi A, Okano T, Sayamoto M,Sawamura S, Kobayashi T, Motosugi M and Yamakawa T (1986). Tissue distribution of 7-dehydrocholesterol, vitamin D_3 and 25-hydroxyvitamin D_3 in several species of fishes. *Journal of Nutritional Science and* Vitaminology, 32: 13-22.

Takeuchi A, Okano T, Torii M, Hatanaka Y and Kobayashi T (1987). Comparative studies on the contents of vitamin D_3, 25-hydroxyvitamin D_3 and 7-dehydrocholesterol in fish liver. Comparative Biochemistry and Physiology, 88B: 569-573.

Trinder P (1960). Colorimetric microdetermination of calcium in serum.Analyst, 85: 889-894.

Urist MR (1962). The bone-body fluid continuum: calcium and phosphorus in the skeleton and blood of extinct and living vertebrates. Perspectives in Biology and Medicine, 6: 75-115.

Urist MR, Uyeno S, King E, Okada M and Applegate E (1972). Calcium and phosphorus in the skeleton and blood of the lungfish, *Lepidosiren paradoxa*, with comment on humoral factors in calcium homeostasis in the osteichthyes. Comparative Biochemistry and Physiology, 42A: 393-408.

Wendelaar Bonga SE and van der Meij JCA (1981). Effect of ambient osmolarity and calcium on prolactin cell activity and osmotic water permeability of the gills in the teleost *Sarotherodon mossambicus*. General and Comparative Endocrinology, 43: 432-442.

Wendelaar Bonga SE, Flik G and Fenwick JC (1984). Prolactin and calcium metabolism in fish: effects on plasma calcium and high-affinity Ca2+-ATPase in gills. In: Cohn DV, Potts Jr JT & Fujita T (Editors), Endocrine Control of Bone and Calcium Metabolism. Elsevier Science Publishers, Amsterdam, 188-190.

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COMPARISON OF THREE APPROACHES OF ESTIMATING PROTEIN B2 AND B3 DEGRADATION RATES IN THE RUMEN OF SHEEP

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ABSTRACT: *A method that involved the gravimetric measurement of the amounts of feed protein B2 (feed protein that is insoluble in borate phosphate buffer but soluble in neutral detergent solution) and protein B3 (feed protein that is insoluble in neutral detergent solution but soluble in acid detergent solution) that remain after each in situ incubation period, was used to obtain the degradation rates of these protein pools in six different feeds. These degradation rates were then compared with degradation rates provided by the Cornell Net Carbohydrate and Protein System for nominally similar feeds in order to establish the extent of agreement between these sets of data. Curve peeling technique was also used on the in situ results of this experiment to generate degradation rates for comparison with the gravimetric and the Cornell values. The study showed that the gravimetric, the curve peeling and the Cornell values were not statistically different for the degradation rates of protein B2 even though the gravimetric estimates were the highest followed by curve peeling and then the Cornell values. For protein B3, the degradation rate estimated with the gravimetric method was highest followed by the curve peeling method and then the Cornell values (P<0.01). The degradation rates assigned to protein B3 in the Cornell databank needs re-examination. There is a need for further application of the gravimetric technique to establish if it gives higher estimates of the degradation rates of proteins B2 and B3 in a range of feedstuffs.*

ORIGINAL ARTICLE

Keywords: *Gravimetric method, Cornell, In situ, Degradation rate, Curve peeling*

INTRODUCTION

Many systems, including the UK system of protein evaluation depend on the in situ method to estimate the rumen degradable protein (RDP) (Van Duinkerken et al., 2010). An alternative method, the Cornell model, adopted in the USA has a sub-model that proposes the subdivision of the soluble protein into A and B1 fractions, and the insoluble protein into B2, B3 and C fractions (Lanzas et al., 2008).

For a variety of ruminant feedstuffs, statistically significant correlations between the Cornell and the in situ techniques for estimating RDP have been observed (Avornyo, 1999; Shannak et al., 2000). However, RDP estimated by the Cornell method tended to be lower than the analogous in situ value for ordinary feeds and vice versa for protected feeds. The lack of consistency with Cornell and in situ RDPs for protected and unprotected feeds may be partly due to the cumbrousness of the in situ procedure (Mathis et al., 2001) but may be also due to the degradation rates adopted by the Cornell databank, which can be verified (Lanzas et al., 2008).

The Cornell group utilized in situ and enzymatic data followed by a curve-peeling technique to estimate the degradation rates of protein pools (Sniffen et al., 1992). The use of curve peeling on in situ data introduces an element of subjectivity in the measurement of the rates of degradation, and may affect the accuracy of the results. A way to overcome these problems is to measure the amount of each protein fraction that remains in the in situ residue at each incubation period. A plot of the fraction disappearance against time will generate a curve whose rate will be that of the fraction. This method can however only be applied to protein fractions that are insoluble but degradable over time. These are proteins B2 and B3 since proteins A and B1 are assumed to disappear almost instantly. Protein C on the other hand cannot be degraded and hence has zero degradation rate (Gosselink et al., 2004).

The study therefore aimed to estimate the in situ rates of degradation of protein B2 and B3 fractions gravimetrically and by curve-peeling using six fibrous feeds whose degradability values had been corrected for microbial contamination by the ^{35}S technique.

MATERIALS AND METHODS

Samples

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The samples analyzed in this experiment were the original samples and the in situ residues of dried lucerne (DL; code D 1576, commercial product), maize silage (MS; code D 1578, variety Hudson from a private farm, not wilted, clamp; additive: Bibby maize sil.), peahaulm silage (PHS; code D 1582, from IGER, Aberystwyth, UK), fermented whole crop wheat (FWCW; code D 1583, variety Riband, clamp with additives: salts and inoculants, from Cambridge University Dairy Unit, UK) and two grass silages (Cambridge University Dairy Unit grass silage (DUGS; code D 1579, perennial rye grass wilted, clamp) and a private farm grass silage (PFGS; code D 1580, mainly perennial rye grass, wilted, tower silage, no additive)).

Feed Analyses

The Cornell method: Samples of DL, MS, PHS, FWCW, DUGS and PFGS were taken. The wet samples among them were first oven-dried at 55^0C to steady state. Then all the samples were milled through a 1 mm sieve and analyzed in triplicate. The Cornell fractions were determined with the method proposed by Licitra et al. (1996).

The in situ method: A corresponding in situ experiment was carried out on DL, MS, PHS, FWCW, DUGS and PFGS to estimate the degradation rates of proteins B2 and B3. The method provided by the AFRC Technical Committee (1992) for estimating protein loss from in situ bags was followed. Monofilament polyester bag (20 x 9 cm) with a pore size of 41 μ was used. Each bag contained approximately 5 g dry matter of sample.

Ruminal infusion of ^{35}S: A stock solution with a concentration of 20 μCi/ml (^{35}S in the form of $Na_2{}^{35}SO_4$) containing 100 μg/ml anhydrous Na_2SO_4 was made. Some of the stock solution was further diluted with water in a large bottle to supply 190 μCi/sheep/day. Dosing of sheep with the 190 μCi of ^{35}S was continuous at 480 ml of water per sheep per day through tubes with the help of a peristaltic pump. Microbial protein formed in the rumen of sheep was marked with ^{35}S by the continuous intra-ruminal infusion of $Na_2{}^{35}SO_4$ for a total of two periods of 14 days each. The method used to obtain solid-associated microbes was originally reported by Whitehouse et al., (1994).

The incubation procedure: Two bags were staggered on each semi-rigid stalk and wetted before placing in the rumen of sheep. Bags were inserted simultaneously into all three sheep. Incubation times were 0, 2, 5, 8, 16, 24, 48 and 72 h. Zero hour disappearance values were obtained by subjecting duplicate bags containing sample material to 24 min of machine washing with the continuous flow of cold water. There were six replicates (3 sheep x 2 trials) of each feed for each incubation time. When removed, the bags were machine-washed and rinsed with cold water in a wash cycle similar to the zero hour determinations. Bags containing the feed residues were then stored frozen at -20^0C followed by freeze drying. All residues, in bags, prior to analysis were vacuum-dried at 70^0C for 1h. On drying, the bags were placed in a dessicator and weighed. After weighing, the samples were allowed to air-equilibrate before grinding to 1 mm to ensure homogeneity, and analyzed for dry matter by the Association of Official Analytical Chemists (AOAC) method, crude protein (Kjeldahl) and microbial contamination.

^{35}S:NAN ratio: Estimation of the extent of microbial contamination of in situ bag residues used a method similar to that described by Mathers and Aitchison (1981). The ^{35}S:N (disintegrations/min per mg N) was computed for both microbe and residue. The proportion of microbial N in residual N was calculated as: ^{35}S:N (residue)/^{35}S:N (microbial).

The Gravimetric Method

Protein B2 pool by the gravimetric method: Estimation of the protein B2 pool by the gravimetric method was done on zero h in situ residues. About 0.3 g of zero h residues were boiled in neutral detergent (ND) solution following the recommended method of Licitra et al. (1996) for the estimation of the neutral detergent insoluble protein (NDIP) content of a feed. The pool size of protein B2 was estimated using the following equation:

$$PB2_{0\ h\ residue}\ (g) = CP_{0\ h\ residue}\ (g) - NDIP_{0\ h\ residue}\ (g), \quad (1)$$

where:

$PB2_{0\ h\ residue}$ was the estimated protein B2 content of the feed, by the gravimetric method.

$CP_{0\ h\ residue}$ was the crude protein content of the zero h residue, and

$NDIP_{0\ h\ residue}$ was the neutral detergent insoluble protein content of the zero h residue.

Degradation rate of protein B2: About 0.3 g samples of in situ residues, of known CP concentrations, obtained at the various incubation times were boiled separately in neutral detergent solution to dissolve any remaining protein B2. In terms of equation, the amount of protein B2 remaining in the in situ residue at any incubation time was given by:

$$PB2_{residue}\ (g) = CP_{residue}\ (g) - NDIP_{residue}\ (g) - MN_{residueNDS}\ (g), \quad (2)$$

where:

$PB2_{residue}$ was the protein B2 remaining in the residue,

$CP_{residue}$ was the protein content of the residue,

$NDIP_{residue}$ was the neutral detergent insoluble protein content of the residue, and

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$MN_{residueNDS}$ was the microbial protein solubilized by the ND method, which was found to be 0.975 of the microbial protein associated with the residue (Avornyo, 1999).

The protein B2 disappearing at any incubation period was given by:

$$PB2_{lost}\,(g) = PB2_{feed}\,(g) - PB2_{residue}\,(g), \quad (3)$$

where:

$PB2_{lost}$ was the protein B2 lost during the incubation,

$PB2_{feed}$ was the protein B2 content of the original feed before incubation, determined by the Cornell chemical analysis, and

$PB2_{residue}$ was the protein B2 remaining in the residue.

Protein B3 pool by the gravimetric method: Estimation of the size of protein B3 by the gravimetric method was done on the zero h in situ residues. About 1 g samples of the zero h residues were boiled in acid detergent (AD) solution using the procedure described by Licitra et al. (1996) for the estimation of acid detergent insoluble protein (ADIP). The amount of protein B3 was given by:

$$PB3_{0\ h\ residue}\,(g) = NDIP_{0\ h\ residue}\,(g) - ADIP_{0\ h\ residue}\,(g), \quad (4)$$

where:

$PB3_{0\ h\ residue}$ was the estimated protein B3 content of the feed, by the gravimetric method.

$NDIP_{0\ h\ residue}$ was the neutral detergent insoluble protein content of the zero h residue.

$ADIP_{0\ h\ residue}$ was the acid detergent insoluble protein content of the zero h residue.

Degradation rate of protein B3: About 1 g residue samples obtained at all the incubation time points were boiled individually in acid detergent solution and the indigestible protein C content estimated. In terms of equation, the amount of protein B3 remaining in the in situ residue at any incubation time was given by:

$$PB3_{residue}\,(g) = NDIP_{residue}\,(g) - ADIP_{residue}\,(g) - MN_{residueNDI}\,(g), \quad (5)$$

where:

$PB3_{residue}$ was the protein B3 remaining in the residue,

$NDIP_{residue}$ was the neutral detergent insoluble protein content of the residue,

$ADIP_{residue}$ was the acid detergent insoluble protein content of the residue, and

$MN_{residueNDI}$ was the microbial protein insoluble in the ND method, that is, 0.025 of the microbial protein associated with the residue.

The protein B3 disappearing at any incubation period was given by:

$$PB3_{lost}\,(g) = PB3_{feed}\,(g) - PB3_{residue}\,(g), \quad (6)$$

where:

$PB3_{lost}$ was the protein B3 lost during incubation,

$PB3_{feed}$ was the protein B3 content of the original feed before incubation, determined by the Cornell chemical analysis, and

$PB3_{residue}$ was the protein B3 remaining in the residue.

Curve peeling: The curve peeling technique described by Nocek and English (1986) was employed. The equation for describing the constants of each linear component of the curve was:

$$R = -kt + R_0 \quad (7)$$

where:

R was the natural logarithm of percent available protein of the feed protein that is present in the residue at time t,

k was the degradation rate constant of the protein fraction,

t was the incubation time,

R_0 was the natural logarithm of percent available protein of the feed protein that is present at incubation time zero.

Calculations and statistical analyses

The cumulative disappearance of each feed protein B2 and B3 fractions were regressed against time.

Two-way Analysis of Variance (ANOVA) was used to remove the effect due to feed (block) and compare the means due to the method (treatment) of estimating the feed protein fraction. The GLM procedure of SAS (1990) was used to compare the means from the degradation rate data.

RESULTS

The disappearance curves

Feed protein fraction disappearance after correcting for microbial contamination by ^{35}S is shown in Figures 1 and 2. Information is given on those fractions in which a regression of their disappearance on time was statistically significant. Protein B2 loss at zero hour incubation ranged from 0.17 in FWCW to 0.69 of total protein B2 in MS (Figure 1b). As incubation progressed, the cumulative fractional protein B2 degradation tended to exceed unity. A slow protein B2 disappearance was observed for PHS.

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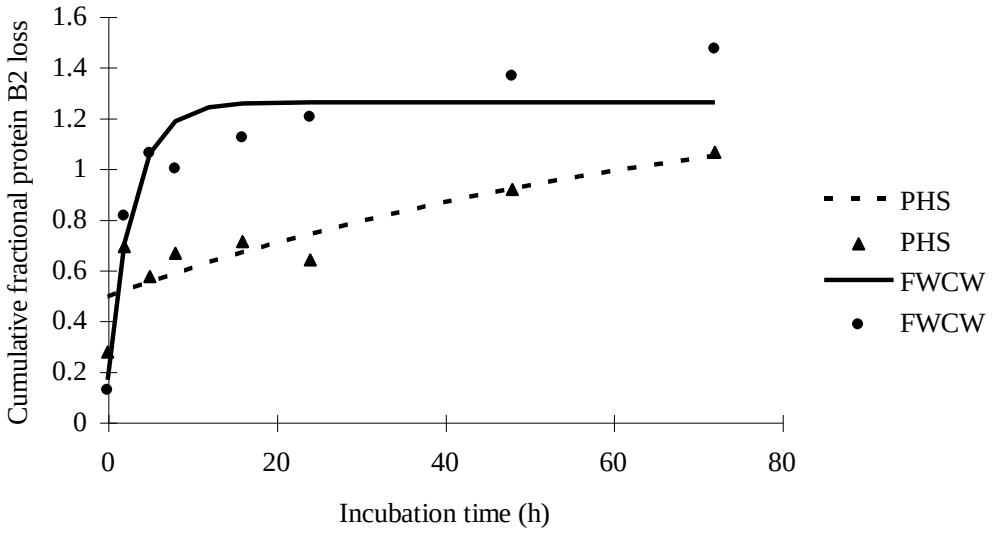

Figure 1a - Protein B2 disappearance in peahaulm silage (PHS) and fermented whole crop wheat (FWCW) after correction for microbial contamination of in situ residues by the ^{35}S technique

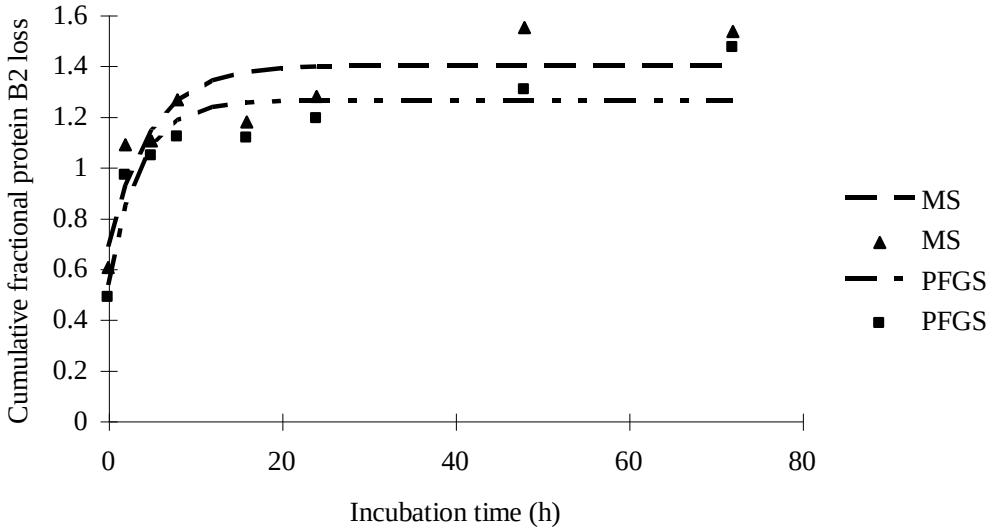

Figure 1b - Protein B2 disappearance in maize silage (MS) and private farm grass silage (PFGS) after correction for microbial contamination of in situ residues by the ^{35}S technique

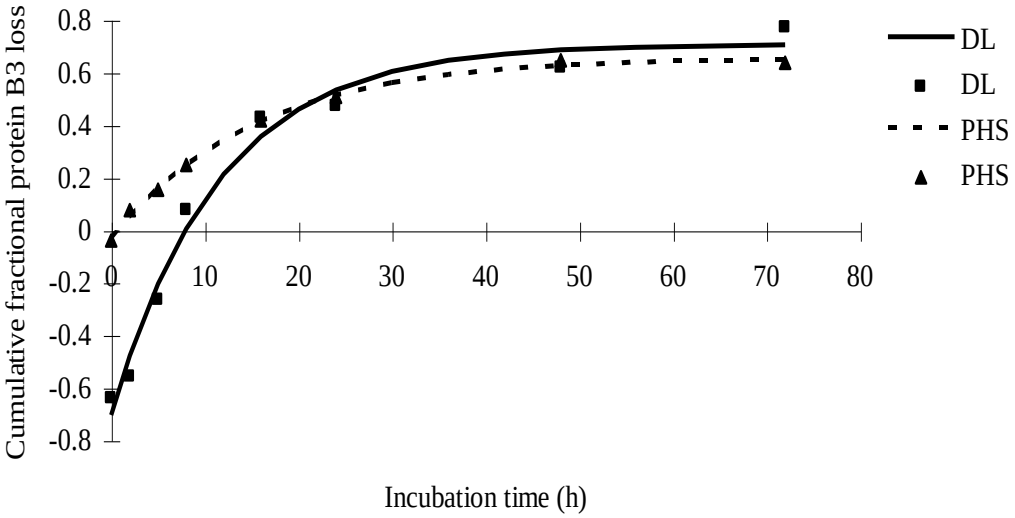

Figure 2a. Protein B3 disappearance in dried lucerne (DL) and peahaulm silage (PHS) after correction for microbial contamination of in situ residues by the ^{35}S technique

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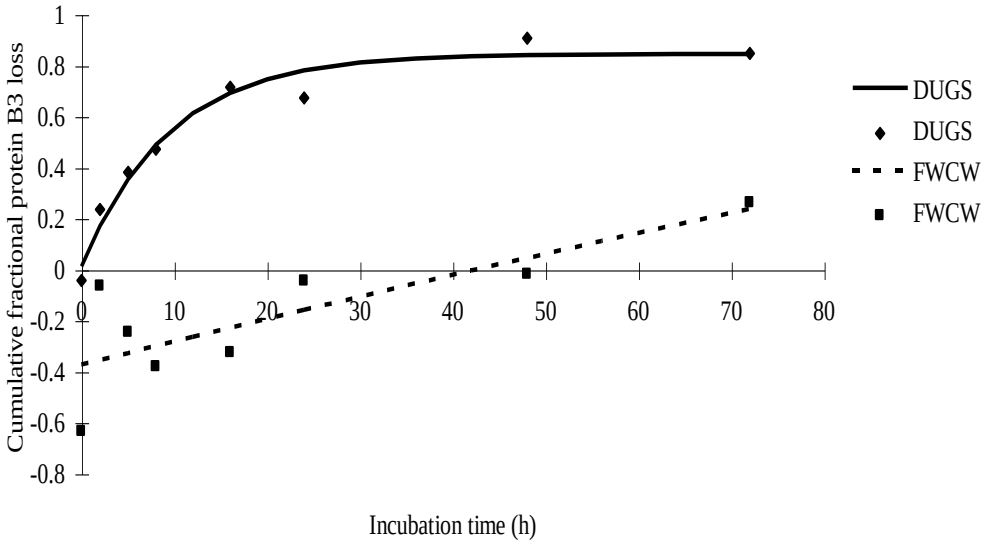

Figure 2b - Protein B3 disappearance in dairy unit grass silage (DUGS) and fermented whole crop wheat (FWCW) after correction for microbial contamination of in situ residues by the ^{35}S technique

The washing loss of protein B3 of DL and FWCW were negative values (Figures 2a and 2b) and the asymptotes of the curves were below one.

Feed fractions

Soluble crude protein determined with borate phosphate buffer was compared with that estimated as the quickly degradable protein "a" in the in situ procedure (Table 1). While the values by the two methods correlated (r^2 0.80; P<0.05), protein solubility in borate buffer was considerably lower than that estimated by the in situ method (P<0.01).

Table 1 - Protein soluble in borate phosphate buffer (Cornell) and the in situ soluble crude protein ("a") obtained by fitting ^{35}S corrected nitrogen disappearance data to the exponential equation of Mehrez and Orskov (1977) for the test feeds[a], fraction of total protein

	Feed							
Method	**DL**	**MS**	**PHS**	**DUGS**	**PFGS**	**FWCW**	**Mean**	**P**
Cornell	0.35	0.56	0.41	0.61	0.70	0.74	0.56	
In situ	0.57	0.73	0.58	0.74	0.86	0.74	0.70	0.022; P<0.01

[a]Feed: DL, dried Lucerne; MS, maize silage; PHS, peahaulm silage; DUGS, dairy unit grass silage; PFGS, private farm grass silage; FWCW, fermented whole crop wheat

The protein B2 pools by the gravimetric method were compared with those by the Cornell chemical method and by the curve peeling method (Table 2). There was largely no correlation between the values produced by the methods. The results of the Cornell chemical method were higher than the equivalent gravimetric and curve peeling methods (P<0.01). The data sets produced by the gravimetric and curve peeling did not differ significantly.

Table 2 - The protein B2 and B3 (fraction of total protein) pools, of the analyzed feeds[a], estimated by the Cornell chemical method, the gravimetric method and the curve peeling method

	Protein B2			Protein B3		
Feed	**Gravimetric**	**Curve peeling**	**Cornell**	**Gravimetric**	**Curve peeling**	**Cornell**
DL	0.12	0.21	0.42	0.26	0.14	0.16
MS	0.13	0.05	0.33	0.13	0.14	0.05
PHS[b]	0.26	0.04	0.37	0.17	0.41	0.16
DUGS	0.10	0.05	0.16	0.19	0.16	0.18
PFGS	0.10	0.10	0.19	0.01	0.05	0.07
FWCW	0.14	0.14	0.16	0.07	0.02	0.04
Mean	0.14	0.10	0.27	0.14	0.15	0.11
s.e.m.; P[c]		0.032; P<0.01			0.029; P=0.58	
[d]r^2		0.12	0.21		0.23	0.59
P[e]		*P*=0.51	*P*=0.36		*P*=0.34	*P*=0.07

Feed: DL, dried lucerne; MS, maize silage; PHS, peahaulm silage; DUGS, dairy unit grass silage; PFGS, private farm grass silage; FWCW fermented whole crop wheat. [b]peas in the sample were not crushed before the in situ analysis. [c]P was the level of significance of the difference between the means. [d]r^2 was obtained by relating the gravimetric values to the other values. [e]*P* was the corresponding significance of the r^2 values.

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Protein B3 sizes by the three methods did not reveal significant difference although curve peeling was the highest followed by the gravimetric and then the Cornell estimates.

Degradation rates

The rates of degradation of the protein B2 pools determined gravimetrically, with the exception of PHS and MS, tended to be higher than those given in the Cornell data bank, and determined by curve peeling (Table 3). The protein B2 rates of degradation were not significantly correlated between the methods. However, when the three methods were compared again with regard to their estimation of the degradation rate of protein B3, a real difference (P<0.01) was revealed with the gravimetric values being the highest followed by curve peeling before the Cornell data bank values.

Table 3 - The degradation rates (per hour) of the feed[a] proteins B2 and B3 fractions estimated by the Cornell[b] chemical method, the gravimetric method and the curve peeling method

Feed	Protein B2			Protein B3		
	Gravimetric	Curve peeling	Cornell	Gravimetric	Curve peeling	Cornell
DL	NE	0.20	0.09	0.09	0.04	0.01
MS	0.20	0.26	0.12	NE	0.06	0.002
PHS[c]	0.01	0.21	0.14	0.07	0.02	0.02
DUGS	NE	0.11	0.15	0.10	0.04	0.01
PFGS	0.30	0.08	0.15	NE	0.03	0.01
FWCW	0.30	0.05	0.10	0.002	0.01	0.002
Mean	0.20	0.15	0.13	0.07	0.03	0.01
(±)s.e.m.	0.051	0.042	0.042	0.010	0.009	0.009
P[d]		P=0.53			P<0.01	
[e]r^2		0.47	0.10		0.85	0.32
P[f]		*P*=0.31	*P*=0.68		*P*=0.09	*P*=0.43

Feed: DL, dried lucerne; MS, maize silage; PHS, peahulm silage; DUGS, dairy unit grass silage; PFGS, private farm grass silage; FWCW fermented whole crop wheat. [b]The Cornell values were taken from their data bank that has been installed on a computer in the Nutrition Laboratory, 307 Huntingdon Road, Cambridge, UK. [c]peas in the sample were not crushed before the in situ analysis. NE, not estimated. [d]P was the level of significance of the difference between the means. [e]r^2 was obtained by relating the gravimetric values to the other values. [f]*P* was the corresponding significance of the r^2 value.

Table 4 - A comparison of the amounts of protein B2 and B3 measured in the original feed sample and in its zero h in situ (gravimetric determination) residue. Values are fraction of total feed protein

Feed[b]	Protein fractions[a]					
	PB2 in original feed	PB2 in zero h residue	PB3 in original feed	PB3 in zero h residue	B2+B3 in original feed	B2+B3 in zero h residue
DL	0.42	0.11	0.16	0.26	0.58	0.37
MS	0.33	0.13	0.05	0.14	0.38	0.27
PHS	0.37	0.26	0.16	0.16	0.53	0.42
DUGS	0.16	0.09	0.18	0.19	0.34	0.28
PFGS	0.19	0.10	0.07	0.01	0.26	0.11
FWCW	0.16	0.14	0.04	0.06	0.20	0.20
Mean	0.27	0.14	0.11	0.14	0.38	0.28
s.e.m; P	0.030; P<0.05		0.017; P=0.28		0.021; P<0.05	

Feed: DL, dried lucerne; MS, maize silage; PHS, peahulm silage; DUGS, dairy unit grass silage; PFGS, private farm grass silage; FWCW fermented whole crop wheat. [a]Protein fractions: PB2, protein B2; PB3, protein B3.

DISCUSSION

The gravimetric method quantitatively measured feed protein fraction disappearance over time. In the process, many variables such as dry matter (DM), crude protein (CP), NDIP, ADIP and microbial contamination were estimated on the in situ residue, each with its associated error. Therefore feeds with a low amount of proteins B2 and B3, for example, PFGS with only 0.07 and MS with only 0.05, of CP as protein B3, did not produce meaningful curves for these fractions.

The in situ prediction of the immediately soluble and completely degradable protein "a" was higher when compared to the protein soluble in borate buffer. An examination of the measured zero h residue indicated that apart from a suggestion of fine particle loss, there was probably a redistribution of the protein B2 fraction. Some amount of protein B2 probably became soluble and was lost during the machine washing, which explains the bigger in situ "a" than the Cornell soluble crude protein (Table 1). Table 4 also shows a lower value for protein B2+B3 in the zero h residue compared to that in the original feed. This was in spite of the apparently bigger values for protein B3 in the zero h residues compared to that in the original feed. Hence there was a bigger loss of protein B2 in the zero h residue than could be offset by the increase in protein B3 in the zero h residue. Pichard and Van Soest (1977) have noticed the presence of a very rapidly degradable insoluble protein fraction with a half-life of about 10 min. After only machine washing of the feeds to determine the zero h incubation, the protein B2 of the resulting residue was found to be lower (P<0.05) than that measured in the feed while the protein B3 appeared to be higher than that determined in the feed. It is likely that the in situ process had affected protein B2 to render a portion

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resistant to solubility in neutral detergent solution. Lanzas et al. (2008) arrived at a conclusion that in order to improve upon the Cornell protein model, protein fractions B2 and B3 should be merged because they were convinced that B3 was degraded at a faster rate than given in the Cornell model. The new rates they assumed were still found to be too slow for prediction of undegraded B3 flow at the omasum. Their new B3 degradation rates still seem to be lower than the rates determined by the gravimetric method.

Summation of the B2 and B3s of the feeds studied was 0.10 less in the zero h residue than the original feed (Table 4). This means varying amounts of protein B2 were also probably lost during machine washing.

The separate comparisons of the protein B2 and B3 sizes obtained by curve peeling in this study, and those reported in Mansbridge (1996) also indicated a lower protein B2 and a higher protein B3 than estimated by the Cornell chemical method. The method of curve peeling may be less accurate because at shorter incubation time points, substantial amounts of protein B2 would have disappeared from in situ bags. The rate of degradation of protein B2 is therefore likely to be underestimated by the curve peeling method. Suggestively higher degradation rates were estimated by the gravimetric method that calls for an evaluation of the Cornell data bank values. The lack of a good correlation between the rates estimated by the gravimetric method and by curve peeling or from the Cornell data bank may be because the Cornell degradation rates were those of feeds which were only nominally similar to the ones studied, and would have different physical and chemical characteristics.

CONCLUSION

The gravimetric method gave higher rates of degradation of protein B2 and B3 ($P<0.01$) of the feeds, when compared to those listed in the Cornell data bank and those determined by curve peeling. Further testing of the gravimetric technique may be needed to ascertain its usefulness.

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REFERENCES

Agricultural and Food Research Council (1992). Technical Committee on responses to nutrients: Nutritive requirements of ruminant animals: protein. Nutr. Abtrs. Revs. (Series B) (Report No. 9), pp. 65-71.

Avornyo FK (1999). Estimation of degradability of feed protein in the rumen. Unpublished PhD dissertation, University of Cambridge, UK.

Gosselink JMJ, Dulphy JP, Poncet C, Aufrere J, Tamminga S and Cone JW (2004). Rumen escape nitrogen from forages in sheep: comparison of in situ and in vitro techniques using in vivo data. Animal Feed Science and Technology, 166: 35-51.

Lanzas C, Broderick GA, Fox DG (2008). Improved feed protein fractionation schemes for formulating rations with the Cornell Net Carbohydrate and Protein System. Journal of Dairy Science, 91: 4881-4891.

Licitra G, Hernandez TM, Van Soest PJ, 1996. Standardization of procedures for nitrogen fractionation of ruminant feeds. Anim. Feed Sci. Technol., 57(4): 347-358.

Mansbridge R (1996). To establish a database of UK forages and raw materials for the Cornell Net Carbohydrate and Protein System (CNCPS). Report authorized and supervised by Dr. Bridget Drew. Centre Manager. ADAS Bridgets, Martyr Worthy, Winchester, Hampshire, SO21 1AP, UK.

Mathers JC, Aitchison EM (1981). Direct estimation of the extent of contamination of food residues by microbial matter after incubation within synthetic fibre bags in the rumen. J. agric. Sci., Camb. 96: 691-693.

Mathis CP, Cochran RC, Vanzant ES, Abdelgadir IEO, Heldt JS, Olson KC, Johnson DE, Cato, J, Faulkner D, Horn G, Paisley S, Mass R, Moore K, Halgerson J (2001). A collaborative study comparing an in situ protocol with single time-point enzyme assays for estimating ruminal protein degradability of different forages. Animal Feed Science and Technology, 93: 31-42.

Mehrez AZ, Orskov ER (1977). A study of the artificial fibre bag technique for determining the digestibility of feeds in the rumen. J. Agric. Sci. Camb. 88: 645-650.

Nocek JE, English JE (1986). In situ degradation kinetics: Evaluation of rate determination procedure. J. Dairy Sci. 69: 77-87.

Pichard G, Van Soest PJ, (1977). Protein solubility in ruminant feeds. Proc. Cornell Nutr. Conf. 91-98.

SAS Institute Inc., (1990). SAS/STAT User's Guide, Version 6, 4th Edition, 1, Cary, NC.

Shannak S, Sudekum KH and Susenbeth A (2000). Estimating ruminal crude protein degradation with in situ and chemical fractionation procedures. Animal Feed Science and Technology, 85: 195-214.

Sniffen CJ, O'Connor JD, Van Soest PJ, Fox DG, Russell JB (1992). A Net Carbohydrate and Protein System for evaluating cattle diets: II. Carbohydrate and protein availability. J. Anim. Sci. 70: 3562-3577.

Van Duinkerken G, Blok MC, Bannink A, Cone JW, Dijkstra J, Van Vuuren AM and Tamminga S (2010). Update of the Dutch protein evaluation system for ruminants: the DVE/OEB$_{2010}$ system. Journal of Agricultural Science: 1-17.

Whitehouse NL, Olson VM, Schwab CG, Chesbro WR, Cunningham KD, Lykos T (1994). Improved techniques for dissociating particle-associated mixed ruminal microorganisms from ruminal digesta solids. J. Anim. Sci. 72: 1335-1343.

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COMPARATIVE STUDY OF WLR OF *Channa striatus* OF FRY-FINGERLING, GROW-OUTS AND ADULTS OF GANGETIC PLAINS

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ABSTRACT: *In the present study the Weight – Length relationships (WLR) are described for the three stages of life of the Snakehead, Saul, Channa striatus, collected from the districts of Barabanki, Lucknow and Unnao in Uttar Pradesh in 2008-09. Method used for analysis of fisheries data on the WLR is ($W=aL^b$) and this study reports the parameters 'a' and 'b' of the length–weight relationships for one hundred numbers of fry/ fingerlings, thirty-seven grow-out fishes and eighty-nine number of adult fishes collected from the same geographical area. The weight and total length of fry/ fingerlings ranged from 340 to 650 mg and 35 to 45 mm respectively ($a=W/L^3$, 0.0060 to 0.0088; log W=log a + b*(log L), 3.92821 to 4.72919; b=(log W-log a)/log L, 3.89643 to 4.11143). The recorded weight and total length of the grow-outs ranged between 9 to 93g and 10.9 to 25.4 cm respectively ($a=W/L^3$, 0.0082 to 0.0146; log W=log a + b*(log L), 0.95424 to 1.96848; b= (log W-log a)/log L, 3.0). In case of adults the weight and total length recorded ranged between 74 to 476g and 22.9 to 42.4 cm respectively ($a=W/L^3$, 0.0054 to 0.0121; log W=log a + b*(log L), 2.39029 to 4.17039; b=(log W-log a)/log L, 3.40747 to 3.95845). Since fishes were collected during the months of April - May, 2008 and November, 2009, the parameters estimated in this study are considered only for these seasons, because WLR are not constant over the entire year and vary according to factors such as temperature, food availability, feeding rate, gonadal development and spawning period. The result suggests that these fishes grow in a pattern from early life stage to adult if grown in the same environmental conditions.*

ORIGINAL ARTICLE

Key words: *Weight-Length, Channa striatus, Fry, Fingerlings, Grow-outs, Adults, Gangetic plains*

INTRODUCTION

Snakeheads (genus *Channa*) are one of the best known and most successful freshwater food fish in Southeast Asia (Ng and Lim, 1990). The Snakehead, *Channa striatus*, a carnivorous, air-breathing fish, belonging to family Channidae. It is one of the valuable food fish, found in rivers, canals, lakes, swamps, marshes and rice fields. The values of the parameter b mostly remained within the expected range of 2.5–3.5. Length (L)–weight (W) relationship parameters (a, b) are important in stock assessment studies (Moutopoulos and Stergiou, 2002) for conversion of length observations into weight estimates to provide some measurements of biomass (Froese, 1998), for between-region comparisons of growth of fish species (Petrakis and Stergiou, 1995), and as a practical index of the fish condition (Barros et al., 2001).

The L–W relationship is usually fitted to the potential equation ($W = aL^b$), where a represents the nutritional condition of the fish (Anderson and Neumann, 1996), and varies according to the geographical regions and gonadic development phases (Barros et al., 2001). Weight-length relationship (WLR) is an important tool in fish biology, physiology, ecology and fisheries assessment (Oscoz et al., 2005). Parameter b is an expression of the type of growth and usually falls between 2.5 and 3.5 (Prager et al., 1989). The obtained coefficients were analyzed with ANOVA.

Studies on length–weight relationships of commercially important fishes are highly significant for management and conservation of populations in natural water-bodies. Scanty reports are available in the literature on the biological aspects, especially length–weight relationships, of *Channa striatus* from different pond

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populations. Aim of the study was, therefore, to investigate certain biometric characters with special reference to length–weight relationship in three different stages of life.

MATERIAL AND METHODS

Fishes were collected by using different fishing gear. Fisheries management and research often require the use of biometric relationships in order to transform data collected the field into appropriate index (Anderson and Gutreuter, 1983; Ecoutin and Albert, 2003). One of the most commonly used in any analysis of fisheries data is the WLR ($W=aL^b$).

The WLR was calculated using the equation $W = aL^b$, where W is the total weight in g and L is the total length in cm, while 'a' and 'b' are constants and 'a' is a coefficient related to body form and 'b' is an exponent indicating isometric growth when equal to 3. The parameters a, and b were estimated by linear regression of the transformed equation: log W = log a + b x log L. Additionally, the statistical significance level of r^2 was estimated (Ricker, 1975) and the b-value for each species was tested by t-test. The exponent b often has a value close to 3, but varies between 2 and 4 and a value of 3 indicates that the fish grows isometrically; values other than 3 indicate allometric growth (Tesch, 1971).

RESULTS AND DISCUSSION

The weight and total length of fry/ fingerlings ranged from 340 to 650 mg and 35 to 45 mm respectively ($a=W/L^3$, 0.0060 to 0.0088; log W=log a + b*(logL), 3.92821 to 4.72919; b=(log W-log a)/logL, 3.89643 to 4.11143). The recorded weight and total length of the grow-outs ranged between 9 to 93g and 10.9 to 25.4 cm respectively ($a=W/L^3$, 0.0082 to 0.0146; log W=log a + b*(logL), 0.95424 to 1.96848; b= (log W-log a)/logL, 3.0). In case of adults the weight and total length recorded ranged between 74 to 476g and 22.9 to 42.4 cm respectively ($a=W/L^3$, 0.0054 to 0.0121; log W=log a + b*(logL), 2.39029 to 4.17039; b=(log W-log a)/log L, 3.40747 to 3.95845). The patterns of length and weight relation are shown in Figures 1, 2 and 3. The r^2 of fry-fingerling, grow-out and adult are 0.805922, 0.891838 and 0.933348 of the captured fish from wild-stock.

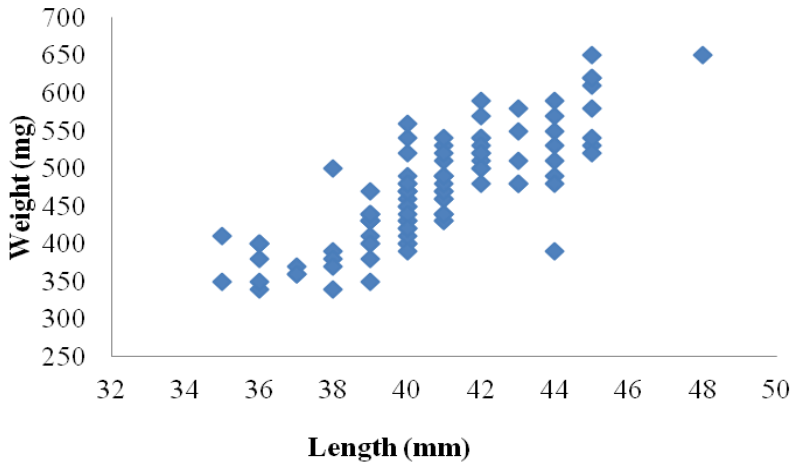

Figure 1 - Pattern of growth in terms of length and weight in fry/fingerlings of *Channa striatus*

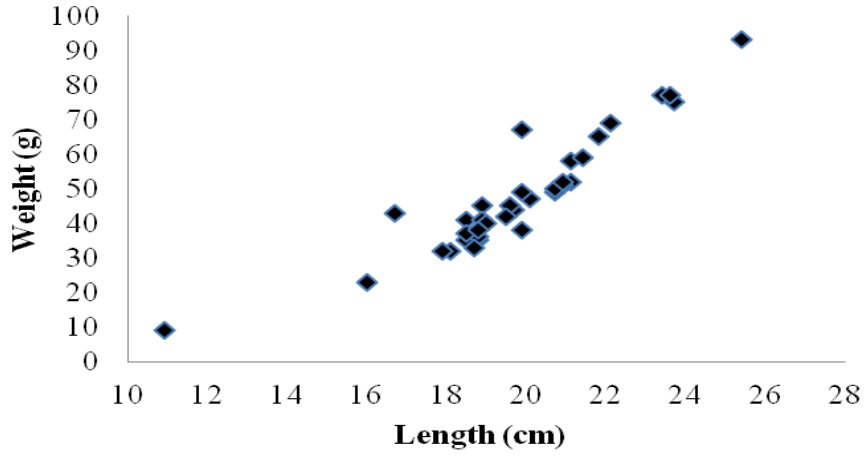

Figure 2 - Pattern of growth in terms of length and weight in grow-outs of *Channa striatus*

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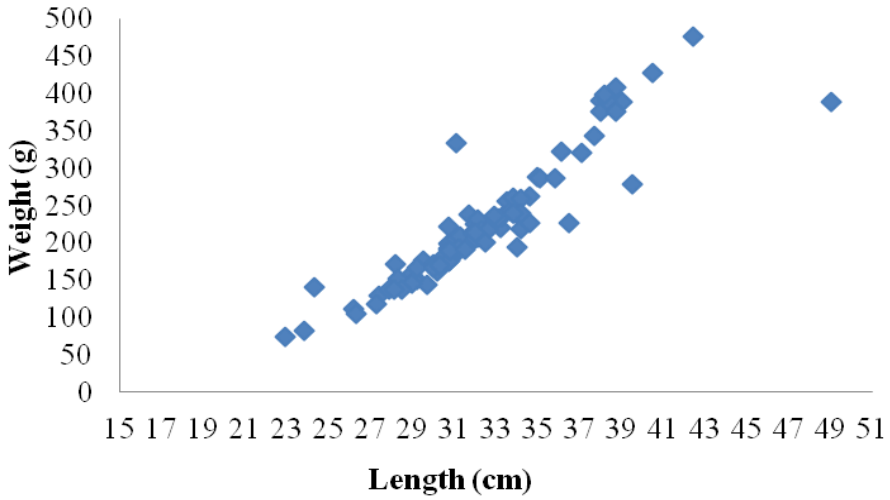

Figure 3 - Pattern of growth in terms of length and weight in Adults of *Channa striatus*

Since fish were captured in summer, the parameters estimated in this study should be considered only for this season, because WLR are not constant over the entire year and vary according to factors such as food availability, feeding rate, gonad development and spawning period (Bagenal and Tesch, 1978). The results of the length–weight analysis of all the fishes of same species are given in Table 1. This study reports the parameters 'a' and 'b' of the length–weight relationships for 89 number of adult fishes, 37 grow-out fishes and 100 numbers of fry and fingerlings captured from the adjoining districts of the same environment.

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REFERENCES

Anderson RO and Neumann RM (1996). Length, weight and associated structural indices. In: Fisheries techniques, 2nd edn. B.R; Murphy, Willis, D.W. (Eds.). American Fisheries Society, Besthesda Maryland, USA, pp. 447– 482.

Anderson R and Gutreuter S (1983). Length, weight, and associated structural indices. In: Fisheries Techniques. L. Nielsen and D. Johnson (Eds). American Fisheries Society, Bethesda, MD, USA, pp. 283–300.

Bagenal TB and Tesch FW (1978). Age and growth. *In*: Methods for assessment of fish production in freshwaters. 3rd edn. T. Bagenal (Ed.). IBP Handbook No. 3. Blackwell Scientific Publications, Oxford, UK, pp. 101–136.

Barros SE and Mosa SG, Regidor HA, Su¨ hring SS (2001). Relaciones longitud-peso en peces del embalse Cabra Corral, Salta, Argentina. Bol. Soc. Biol. Concepcio´ n, Chile 72: 25–30.

Ecoutin JM and Albaret JJ (2003). Length-weight relationship of 52 fish species from West African estuaries and lagoons. Cybium 27: 3–9.

Froese R (1998). Length-weight relationships for 18 less-studied fish species. J. Appl. Ichthyol. 14: 117–118.

Moutopoulos DK and Stergiou KI (2002). Length-weight relationship of fishes from the Aegean Sea (Greece). J. Appl. Ichthyol. 18: 200–203.

Ng PKL and Lim KKP (1990): Snakeheads (Pisces: Channidae): Natural history, biology and economic importance. Essays in Zoology: papers commemorating the 40th Anniversary of the Department of Zoology, National University of Singapore, pp 127-152.

Oscoz J, Escala MC and Campos F (2005). Weight–length relationships of some fish species of the Iberian Peninsula. J. Appl. Ichthyol 21: 73–74.

Petrakis G and Stegiou K I (1995). Weight –length relationships for 33 fish species in Greek waters. Fish. Res. 21: 465-469.

Prager MH, Saila SB and Recksiek CW (1989). FISHPARM: a microcomputer program for parameter estimation of non-linear models in fishery science. Univ. Ocean. Tech. Rep. 1: 87-90.

Ricker WE (1975). Computation and interpretation of biological statistic of fish populations. Department of the Environment, Fisheries, and Marine Service, Ottawa, pp. 382.

Tesch FW (1971). Age and growth. In: Methods for Assessment of Fish Production in Fresh Waters. W. E. Ricker (Ed). Blackwell Scientific Publications, Oxford. pp. 98–130.

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CURRENT STATUS, CHALLENGES AND OPPORTUNITIES OF RABBIT PRODUCTION IN BOTSWANA

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ABSTRACT: *This review highlights the current status of rabbit production, challenges facing the industry and opportunities available. Rabbit farming in Botswana is in its infancy and the rabbit population is estimated to be less than 1000. However, this value is a gross underestimate due to poor monitoring by government extension services. In Botswana, rabbits are mainly kept in the backyards, indicating that intensive systems have not yet been developed. Rabbits have small body size, short gestation period, high reproductive potential, rapid growth rate and ability to utilize forages. Compared to beef, chicken, mutton, chevon and chicken, rabbit meat has low cholesterol, high protein and low fat contents. Rabbit production can be integrated into small farming systems, with the rabbits being fed on crop residues, weeds, poultry droppings, and kitchen and garden wastes. The manure can be used to fertilize soils. The major challenges in rabbit production are inadequacy of breeding stock, inadequate rabbit feeds, poor management (feeding, housing and health care), lack of research support, lack of technical support from extension services, lack of access to credit and inadequate supply of equipment. The major opportunity available to the rearers is that the market is vast due to the small rabbit population in the country. The attributes of rabbits suggest that rabbit farming is likely to play an important role in nutrition, poverty alleviation and food security, especially in countries with higher unemployment levels and HIV/AIDS prevalence rates such as Botswana.*

REVIEW ARTICLE

Key words: *Botswana, Challenges, Cholesterol, Manure, Opportunities, Rabbits*

INTRODUCTION

Domestic rabbits (*Oryctolagus cuniculus*) are ubiquitous, providing protein, fibre, research models, and companionship. Rabbits have high reproductive potentials and fast growth rate (Hassan et al., 2012), utilize low grain and high roughage diets and breed all year-round (Irlbeck, 2001). Other attributes are short gestation period, early sexual maturity, ability to rebreed shortly after kindling and short generation interval (Hassan et al., 2012). These qualities confer on rabbits a potential to bridge the shortage of animal protein in developing countries, where grain can only be justified for human use (Irlbeck, 2001; Hassan et al., 2012).

Rabbit farming is in its infancy in Botswana with an estimated population of less than 1000 (Tjetjoo, 2011). However, this value (1000) is a gross underestimate resulting from poor monitoring of projects by the extension agents who may not be interested in rabbits due to lack of technical expertise. In agreement with Owen (1979) who stated that in developing countries, the vast majority of meat rabbits are produced under small-scale or backyard systems, nearly all rabbit farmers in Botswana operate at subsistence level due to a number of factors including religious taboos and lack of knowledge on rabbit husbandry such as diseases and parasites (Moreki et al., 2011). For example, in the Old Testament the consumption of rabbit meat is prohibited. On the contrary, Schiere (2004) contended that there are few religious or other taboos on rabbit meat, except in vegetarian cultures. Islam does not prohibit consumption of rabbit meat.

Rabbit production plays an important role in improving livelihoods of resource-poor households. Lukefahr (2007) reported that in Bangladesh and India income earnings obtained from sale of rabbits from smallholder rabbitries contributed to women owning milk cows, bullocks and/or buffaloes, purchasing their own land, living in better homes, eating higher quality foods, sending their children to school, and depositing money safely in banks. This indicates that rabbit rearing could be a stepping stone to farmers owning large stock such as cattle and buffaloes, which are associated with status.

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To maximize food production in developing countries, all reasonable options must be considered and evaluated. Among these is the use of livestock species such as rabbits that for one reason or another have not played a major role in animal agriculture in most countries. Rabbit production can be integrated into small farming systems, with the rabbits being fed crop residues, weeds, waste fruits and vegetables (Cheeke 1986), whereas the manure can be used as a fertilizer for crops and gardens (Cheeke 1986; Schiere, 2004). Rabbit manure does not have strong smell, and rabbits do not make much noise therefore the neighbours will not complain (Schiere, 2004). According to Lukefahr (2007), a sustainable system of rabbit production involves the use of renewable on-farm resources, such as local breeds, feedstuffs from forage or garden plots, local materials for hutches and other equipment, and family labour.

There is little information on rabbit production in Botswana (Ramodisa, 2007). Therefore, this paper discusses the current status of rabbit production in Botswana, challenges faced by the industry and opportunities available.

Advantages of keeping rabbits

Small livestock such as rabbits have a number of characteristics that might be advantageous in the smallholder, subsistence-type integrated farming and gardening food production systems in developing countries (Cheeke, 2007). The advantages of keeping rabbits over other livestock are manifold. Schiere (2004) stated that starting a rabbit project requires minimal initial capital outlay. Additionally, a rabbit can be easily sold when a small amount of money is needed to meet immediate family needs.

Rabbits are characterized by small body size, short gestation period, high reproductive potential, rapid growth rate, genetic diversity, their ability to utilize forages (Mailafia et al., 2010) and disease tolerance (Begensel, 2008). In addition, rabbits require small amounts of feed and use inexpensive, easily constructed housing (Cheeke, 1986). Furthermore, rabbits do not compete with humans for grains as strongly as chickens (Price and Regier, 1982; van Dijk, 2003; Moreki, 2007a). Rabbits compliment well with vegetable production as garden wastes are fed to rabbits, whereas the manure is used to fertilize the soil (Price and Regier, 1982). Unlike poultry manure, rabbit manure will not burn the plants and can be applied directly to the plant or its roots. In the opinion of Schiere (2004), rabbit farming exposes children to learning to tend for and appreciate animals. Additionally, rabbits can relief stress and tension when they are watched jumping and vibrating noses or by touching their smooth furs (Ramodisa, 2007). Unlike bigger animals such as cattle, rabbits can be tended by women, children or men as they do not need force to be restrained (Schiere, 2004).

The small body size of a rabbit provides a small carcass that can be consumed by a family in one meal, eliminating the need for meat storage and refrigeration. The meat is stored on the live animal until needed resulting in rabbits being referred to as "biological refrigerators" (Cheeke, 1986). Rabbit meat is of high quality, being high in protein and low in fat content (Mailafia et al., 2010). Lane (1999) also stated that rabbit meat has less cholesterol, fewer calories, and a lower percentage of fat than beef, pork, chicken or lamb, and higher protein content. Table 1 gives the nutritional values of rabbit, chicken, veal, beef, pork and lamb.

Table 1. Nutritional values of meat products

Animal	Protein (%)	Fat (%)	Moisture (%)	Calories/lb
Rabbit	20.8	10.2	67.8	795
Chicken	20	11	37.6	810
Veal	19.1	12	68	840
Beef	16.3	28	55	1440
Pork	11.9	45	42	2050
Lamb	16.7	27.7	55.8	1420

Source: Lane (1999)

Breeds of rabbits in Botswana

According to Begensel (2008), the breeds of rabbits found in Botswana include American chinchilla, Flemish giant, Rex, California white and New Zealand white and black. However, it is not clear which of these breeds predominates and/or is doing well under Botswana's harsh climatic conditions. The breeding programme followed by farmers is unknown leading to the belief that inbreeding could be common.

Housing and equipment

Housing which serves to protect rabbits from inclement weather and predation may be simple or sophisticated. According to Shaeffer and Harper (2008), the rabbitry should be an enclosed building that has proper ventilation, lighting, heating, and cooling systems. Heating and ventilation are crucial because rabbits do not tolerate temperature extremes very well.

In Botswana, rabbit shelter is usually constructed using locally available materials. It must be endeavoured to make the house rat-proof to prevent litter from being preyed upon. Those producers who keep rabbits in the peri-urban and urban areas may design and develop multi-tier cages in order to be economical on the available space. Owen (1979) suggested that information on the design of housing using locally made and designed equipment is an area in which the exchange of information between countries would be beneficial. This implies that benching with African countries that have succeeded in establishing a commercial rabbit industry is crucial.

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Feeding and nutrition

Feeding rabbits can be very cheap or expensive. Although supplementation with concentrate or grain is sometimes necessary and will enhance growth rates, roadside grass, kitchen and garden wastes (especially leaves) can provide the main feed at almost no cost (Schiere, 2004). Products of the processing plants such as tomato pomace form feed resource for rabbits. Sayed and Abdel-azeem (2009) showed that dried tomato pomace can be utilized efficiently and safely in the rabbit diets up to level 20% without any adverse effect on the performance and carcass traits.

In Botswana, rabbits are usually fed mainly on garden waste (*e.g.*, cabbage leaves, carrots, bananas) and kitchen waste which may or may not be supplemented with complete diets. Kitchen wastes may be generated from the producers' home or from nearby restaurants. Schiere (2004) cautions the producers that feed their rabbits on garden wastes to watch out for herbicide/pesticide residues.

Rabbits require fresh, clean water daily. Automatic watering systems offer a continuous water supply while reducing waste and contamination. A doe and her litter need 3.79 litres of water a day in warm weather (Shaeffer and Harper (2008). In most smallholder rabbit operations in Botswana, water is given in various implements varying from old tins to modern drinkers.

Health Management

In order of prevalence, nutritional deficiencies followed by pneumonia and focalo granulomatous hepatitis are the most prevalent diseases in Botswana, whereas psoroptic mange (ear canker) is the most prevalent parasitic infection followed by *Moraxella spp*. (Moreki et al. 2011). Similarly, Begensel (2008) reported ear canker to be the most parasitic infection in Botswana. Moreki et al. (2011) attributed the high prevalence of nutritional deficiencies in rabbits to feeding of poor quality diets. Ear canker is caused by poor hygiene and mite attack, whereas pneumonia results from exposure of young rabbits to draft, indicating that construction of proper housing for rabbits is of paramount importance.

Marketing

Rabbits are raised not only for meat, laboratory use, breeding stock, and Angora wool but also for their skins and for youth programmes (Shaeffer and Harper, 2008). According to Moreki (2007b), rabbits reach market at about 8 weeks of age or less and they may be sold live or dressed. Usually, they are sold to individuals who keep them as pets or those starting backyard rabbitries. In addition, rabbits are sold to institutions such as schools for educational purposes (Ramodisa, 2007). It appears that in Botswana rabbits are kept mainly as pets.

In Botswana, market is vast (Begensel, 2008) due to the small number of rabbits in the country. A four months breeder rabbit sells for P500 (equivalent to USD67.66), which is almost the price of a goat. In Nigeria, Ozor and Madukwe (2005) reported marketing constraints in small-scale rabbit production, which were derived from the difficulty in transporting rabbits to the markets, poor acceptability of rabbit meat, low prices of rabbit meat and its products and minimum sources of ready markets for rabbits and its products.

Challenges

The main challenges in rabbit production in Botswana include:

- Unavailability of rabbit feeds (Begensel, 2008). Due to the small number of rabbits raised by smallholder farmers, rabbit feeds are not produced locally but are imported, usually at high prices and in adequate amounts. Ozor and Madukwe (2005) also reported nutrition and housing as some of the constraining factors in the adoption of improved rabbit technologies by small-scale farmers. Similar observations were made by Oseni et al. (2008) in Western Nigeria.
- Poor housing. As rabbits are not yet commercialized, they are not accorded proper housing resulting in poor animal performance. Generally, housing is basic and is constructed using locally available material. Ozor and Madukwe (2005) also reported housing as one the major challenges in small-scale rabbit production.
- Lack of technical knowledge in rabbit farming by farmers and advisors (Ramodisa, 2007). Oseni et al. (2008) also cited lack of access to information on rabbit management under smallholder units as one of the major challenges in rabbit production.
- Lack of research support (Ramodisa, 2007). Testik (1992) in Turkey reported insufficient incentive supporting measures and scientific knowledge in rabbit production to be one of the challenges in rabbit production.
- Inadequate technical support. Lukefahr and Cheeke (1990) noted that extension methodologies relevant to rabbit project development are generally lacking and are paramount to rabbit projects' success.
- Lack of access to credit. As rabbit farming is relatively new in Botswana, it is not easy to attract funding compared to other livestock such as chickens and smallstock (sheep and goats). However, this may not be the case for youth who can access small funding through Youth and Culture funding source.
- Lack of government support. Unlike cattle, chickens and smallstock, rabbits do not receive government support under Livestock Management and Infrastructure Development (LIMID) support scheme. For rabbit farming to grow and play a significant role in supplying high quality protein in both rural and urban areas there is need for increased government support.

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- Health care inadequacies. As rabbit farming is in its infancy, diseases and parasites of rabbits are not known to the extension agents who are not adequately equipped to impart knowledge and skills to rabbit producers. Ozor and Madukwe (2005) reported health care challenges in small-scale rabbit production in Nigeria. The health care challenges included difficulty of rabbit producers to procure specific drugs for specific treatments of rabbit illnesses, inability to promptly isolate sick animals and difficulty of access to veterinary services.
- Inadequate supply of equipment. Rabbit equipment such as cages, drinkers and feeders are difficult to find in Botswana. Testik (1992) noted that difficulties in acquiring equipment (cages, feeders, drinkers and other equipment) was also one of the major challenges in smallholder rabbit production.
- Inadequate breeding stock. There are no known rabbit breeders in the country and this contributes to the industry not growing. Oseni et al. (2008) found the principal challenges facing the smallholder rabbit production to be difficulties in getting reliable and stable sources for foundation/replacement stock and theft. According to Testik (1992), other challenges include breeders' difficulties to find good quality animal material, insufficient technique and practical knowledge of breeders, modern production techniques are not applied, insufficient advertisement and marketing problems and insufficient integration and organization.
- There is no culture of eating rabbit meat in the country. Similarly, Testik (1992) also reported that Turkish people were not used to eating rabbit meat.
- Lack of defined rearing system. Lukefahr and Cheeke (1991) identified raising rabbits under confinement as one of the common traditional hindrance in rabbit production. This challenge can be eliminated by effective farmer demonstrations.

Opportunities

1. Market is available (Begensel, 2008) and broad (Ramodisa, 2007). Although the national requirements of rabbit meat have not been determined, it is probable significant quantities of rabbit meat could be consumed in the country.
2. Rabbit industry in Botswana is small and evolving, indicating that opportunities exist to start new operations or to expand the existing ones.
3. Backyard gardening, which is supported by government as a poverty eradication strategy provides an opportunity for rabbit farming to be integrated into the farming system to enable utilization of garden wastes. Rabbits are efficient in turning garden and kitchen wastes into high quality protein. Additionally, rabbit manure can be used as a fertilizer in gardens and orchards.

Recommendations

1. To address the issue of inadequacy of breeding stock, Government should set up the National Rabbit Breeding Centre with an objective of making available breeding stock to the producers countrywide. The Centre could also be used to train staff and farmers. In Mozambique, Gaspari (1979) mentioned that a National Centre and Provincial Centres were established to provide housing designs, breeding stock and training facilities as a way of facilitating the growth of the industry.
2. The extension service should encourage formation of rabbit association(s) that will in consultation with government promote and facilitate the growth of the rabbit industry.
3. Extension agents should be trained in rabbit production to enable them to effectively impart knowledge and skills to the rabbit producers.
4. There is a need to undertake survey research in order to investigate the characteristics of the rabbit industry and also to estimate rabbit population in Botswana

CONCLUSION

1. Rabbit producers do not receive government support to start rabbit rearing. For the benefits of rabbit production to accrue to the producers, the support of government and Non-governmental organizations is crucial.
2. Efforts should be made by extension agents to organize training for rabbit producers through seminars, workshops and agricultural shows.
3. Government poverty eradication strategies including LIMID and backyard gardening should consider including rabbit farming.
4. Technical support to the rabbit producers is inadequate as extension agents are poorly equipped to advice producers on general rabbit husbandry management.

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REFERENCES

Begensel F (2008). Rabbit production gives Mahomed a new lease of life. Agrinews Magazine, 39(4): 6.
Cheeke PR (1986). Potentials of rabbit production in tropical in and subtropical agricultural systems. Journal of Animal Science, 63:1581-1586.

Gaspari D (1979). Rabbit breeding and production. Tropical Animal Production, 4(3): 293. www.utafoundation.org/UTAINFO1/TAP/TAP43/4_3_13.pdf
Hassan HE, Elamin KM, Yousif IA, Musa AM and Elkhairey MA (2012). Evaluation of body weight and some morphometric traits at various ages in local rabbits of Sudan. Journal of Animal Science Advances, 2(4): 407-415.
Irlbeck NA (2001). How to feed the rabbit (*Oryctolagus cuniculus*) gastrointestinal tract. Journal of Animal Science, 79(E. Suppl.): 343–346.
Lane TJ (1999). Rabbit Production in Florida. Fact Sheet VM-51. Cooperative Extension Service, University of Florida. http://hammock.ifas.ufl.edu
Lukefahr SD and Cheeke PR (1990). Rabbit project strategies in subsistence farming systems (1) Practical considerations. World Animal Review, 68(3): 60-70.
Lukefahr SD and Cheeke PR (1990). Rabbit project planning strategies for developing countries. (1) Practical considerations. Livestock Research for Rural Development, 2(2). Retrieved on 16 May 2012 from http://www.lrrd.org/lrrd2/3/cheeke1.htm
Lukefahr SD (2007). Strategies for the development of small- and medium-scale rabbit farming in South-East Asia. Livestock Research for Rural Development, 19(9). Retrieved on 16 May 2012 from http://www.lrrd.org/lrrd19/9/luke19138.htm
Lungu JP (1979). Rabbit production in Zambia. Tropical Animal Production, 4(3): 294. www.utafoundation.org/UTAINFO1/TAP/TAP43/4_3_13.pdf
Mailafia S, Onakpa MM and Owoleke OE (2010). Problems and prospects of rabbit production in Nigeria – A review. Bayero Journal of Pure and Applied Sciences, 3(2): 20–25.
Moreki JC (2007a). Commercial rabbit production. Agrinews Magazine, 38(10): 2-12.
Moreki JC (2007b). Commercial rabbit production. Agrinews Magazine, 38(10): 11.
Moreki JC, Sentle MM, Chiripasi SC, Seabo D and Bagwasi N (2011). Prevalence of diseases and parasites of rabbits in Botswana. Research Opinions in Animal and Veterinary Research, 1(9): 556-559.
Oseni SO, Ajayi BA, Komolafe SO, Siyanbola O, Ishola M and Madamidola G (2008). Smallholder rabbit production in Southwestern Nigeria: Current status, emerging issues and ways forward. 9th World Rabbit Congress – June 10-13, 2008 – Verona – Italy. 1597-1601.
Owen JE (1979). Rabbit production in tropical countries. Tropical Animal Production, 4(3): 294. www.utafoundation.org/UTAINFO1/TAP/TAP43/4_3_13.pdf
Ozor N and Madukwe MC (2005). Obstacles to the adoption of improved rabbit technologies by small-scale farmers in Nsukka Local Government Area of Enugu State. Journal of Agriculture, Food, Environment and Extension, 4(1): 70-73.
Price ML and Regier F (1982). Rabbit production in the tropics. Echo Technical Note.
Ramodisa J (2007). Rabbit production. Agrinews Magazine, 38(2): 11.
Sayed Abdel-baset N and Abdel-azeem Ali M (2009). Evaluation of dried tomato pomace as feedstuff in the diets of growing rabbits. International Journal of Agro Veterinary and Medical Sciences, 3: 12-18.
Schiere JB (2004). Agrodok 20 Backyard rabbit farming in the tropics (4th Edition). Agromisa Foundation, Wageningen, The Netherlands. 71 pp.
Shaeffer R and Harper JK (2008). Rabbit production. Agricultural Alternatives. The Pennsylvania State University. http://www.agalternatives.aers.psu.edu
Testik A (1992). Rabbit production and breeding in Turkey. *Options Méditerranéennes* - Série Séminaires - no. 17. 33-34. www.ressources.ciheam.org/om/pdf/a17/92605159.pdf
van Dijk L (2003). Rabbit production guidelines for the Malawi Prison Service. Penal Reform International. Lilongwe, Malawi.

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USE OF *STYLOSANTHES HAMATA* AND *SIDA ACUTA* AS SOLE FEEDS FOR RABBITS *(Oryctolagus cuniculus)*

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ABSTRACT: *A 42-day feeding trial was conducted to determine whether Stylosanthes hamata and Sida acuta could be used as sole feeds for local weaner rabbits. The experimental diets had three treatments with three replicates each in a Completely Randomized Design. The experimental diets were T1 (100% Stylosanthes hamata), T2 (50% Stylosanthes hamata 50% Sida acuta) and T3 (100% Sida acuta). The growth parameters measured/calculated were mean weekly and total feed intake (g), mean weekly and total weight gain (g) and final weight (g). Blood parameters considered included haemoglobin (Hb), packed cell volume (PCV), red blood cells (RBC), mean corpuscular volume (MCV), mean corpuscular haemoglobin (MCH), mean corpuscular haemoglobin concentration (MCHC) and white blood cell (WBC) differential counts (neutrophils, lymphocytes, eosinophils, and monocytes). Additionally, meat colour, juiciness, tenderness and flavour were also noted after animals were sacrificed. Data was analyzed using ANOVA in GenStat (Discovery Edition). There were significant differences (P<0.05) in mean weekly feed intake, total feed intake, mean weekly weight gain, total weight gain and final weight between treatments. T3 animals consumed the highest feed yet T2 animals had the heaviest weight gain at the end of the experiment. Whereas there were no significant differences (P>0.05) between treatments for MCHC and WBC differential counts like neutrophils lymphocytes and eosinophils, significant differences (P<0.05) were observed between treatments for PCV, RBC, MCV and monocytes. The sole Stylosanthes hamata feed significantly (P<0.05) improved meat colour and juiciness, whiles tenderness and flavour, did not record any significant differences (P>0.05) between treatments. The results suggest that Stylosanthes hamata and Sida acuta may have a potential to enhance rabbit growth as a combined feed. Any negative effect on rabbit health either when fed individually or in combination was inconclusive and Stylosanthes in particular as sole feed could improve colour and juiciness of rabbit meat.*

Key words: *Blood indicators, Growth performance, Meat quality, Sida spp., Stylosanthes spp.*

ORIGINAL ARTICLE

INTRODUCTION

World production of rabbits (*Oryctolagus cuniculus*) has been estimated by Lebas and Colin (1992) to be of the order of 1200,000 tonnes per annum. Rabbits are prolific breeders, producing large quantities of tasty meat for home consumption and have a faster rate of production than pigs, goats and sheep. If properly managed, a doe can produce more than 15 times her own weight of offspring in a year (Adjare, 1985). Uses to which the rabbit is put by man include; the supply of food (the most extensive of all the uses), the supply of a very high grade wool, as a source of miscellaneous products, assists in laboratory and experimental work, can be used in educational work of varied sorts and could be kept as pet or companion animal.

Animal protein intake in developing countries is still far below the required standards (FAO, 1998). To close up this gap, several strategies have been advocated notably among them is to encourage the developing countries to research and improve the productive potentials of local breeds rather than depend on exotic breeds which are usually not well adapted to the environment and management conditions in those countries (FAO, 1992). Nutrition is one of the factors that could limit productivity (Lukefahr et al., 1983) and nutrients available in forages can be used to replace grain in rabbit diet and therefore reduce concentrate need for rabbit production (Aduku et al., 1986). Good nutrition translates into good hematological characteristics such as erythrocytes, leucocytes and haemoglobin among others which are good indicators of physiological status of animals (Hawkney and Dennet, 1989). Again meat colour of animals fed concentrate is quite white which makes it not very attractive to the consumer, so the diet that the animals consume is very important (Nguyen and Brian, 2008). Most green feed are of quality and high in carotene and xanthophylls, which are important in giving a deep yellow colour to egg and meat quality (Nguyen and Brian, 2008).

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Although the rabbit is regarded as an herbivorous animal, many rabbit farmers feed their animals with poultry feed (Adjare, 1985). This practice impedes the quick growth of the animals. Domestication has also led to low reproductive performance as well as poor growth rate (Adu et al., 1999). *Stylosanthes* is naturally distributed throughout the tropical and subtropical region in America, Africa, and South Asia (Mannetje, 1984). *Stylosanthes* species may also be used as cover crops, manure and fallow crops, and may be cut and fed fresh or used as hay (Mannetje and Jones, 1990). *Stylosanthes* was introduced into a number of communities in the northern and coastal savanna of Ghana in 1994. It is estimated that about 5,000 ha of natural pastures have been oversown with the legume in almost 300 communities in the Savannah zones since 1994 (Oppong- Anane, 1999). Empirical observation indicates that this forage is readily available and some farmers use it as a sole feed or in combination with *Sida acuta.* This study therefore set out to simulate the farmer scenario of feeding rabbits with *Stylosanthes hamata* as a sole feed or in combination with other forages so as to investigate how this practice impacts on growth, health and the meat quality of rabbits.

MATERIALS AND METHODS

Study area

The experiment was conducted at the livestock farm of the Animal Science Department of the University for Development Studies, Nyankpala campus, Tamale, Ghana. Nyankpala is approximately 16km West of Tamale. It has unimodal rainfall pattern. The area lies on latitude 09°25"N and longitude 00°58"W with an altitude of 183m above sea level. The mean annual rainfall and temperature are 1043mm and 28.3°C respectively. The rainy season is usually between April and October with the dry season from November to March. The mean annual day time humidity is 54% (Kasei, 1990).

Experimental animals

Nine local weaner rabbits about five to six weeks old were used. The mean weights of the animals were 482g, 510g and 550g for T_1, T_2 and T_3 (control) respectively.

Experimental diets and feeding

The experimental diets used were *Stylosanthes hamata* and *Sida acuta*. Animals in T_1 were fed 100% *Stylosanthes*. T_2 and T_3 were given 50% *Stylosanthes* 50% *Sida* and 100% *Sida* respectively. Animals were fed 500g of feed daily between 6:00 am and 4:00 pm. Water was provided *ad lib*. Empty polythene was placed under each cage to collect left over feed and faeces. Any leftover feed was discarded the following morning.

Housing management

Experimental animals were managed intensively in a hutch made of nine separated cages. The wood-frame and wire hutch type was used. The flooring, sides and top were all welded mesh to ensure proper sanitation as well as observation and inspection. The dimensions of the hutch were 64cm × 64cm × 64cm (for length, breadth and height respectively).

Experimental design

Completely Randomised Design (CRD) was used for the experiment. The animals were weighed initially and randomly allotted in equal numbers over the three treatments. There were three replicates per treatment.

Duration

The study lasted for six weeks. The adaptation period was seven days with the treatment diets before the start of the experiment.

Data collection for growth parameters

The parameters studied were: weekly feed intake, and live weight gain. Body weights of experimental animals were recorded weekly. Feed was weight each time before being offered. Leftover feed was collected every morning before feeding and weighed, after sorting out faeces from leftovers.

Experimental Procedure for blood parameters

Samples of blood were collected from each rabbit using the Standard Operating Procedure for Rabbit Immunization and Blood Collection (SOPRIBC, 2006). And each blood sample put into test tubes containing ethylenediaminetetraacetic acid (EDTA). Parameters measured were haemoglobin (Hb), packed cell volume (PCV), red blood cell (RBC), mean corpuscular volume (MCV), mean corpuscular haemoglobin (MCH), mean corpuscular haemoglobin concentration (MCHC) and white blood cell (WBC) differential count (neutrophils, eosinophils, lymphocytes and monocytes).

Packed Cell Volume (PCV)

Heparinised capillary tubes were filled with the blood from the weaner rabbits and sealed using cristaseal. The filled capillary tubes were placed in haematocrit centrifuge (CENTROLIT 11) and spinned at 10,000 rpm for five

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minutes. These ensured maximal packing of the red cells. PCV was subsequently determined by measuring the height of the red cells column using haematocrit reader (Barker and Silverton, 1976).

Haemoglobin (Hb)

The haemoglobin levels were estimated by adding 20 ul of blood sample to 5 mls of Drabkins solution. This mixture was allowed to rest for 5-10 minutes. Drabkins solution haemolysis the red blood cells, releasing haemoglobin pigment into the solution and then Hb was estimated using spectrophotometer (CECILCE 1011) at 540 nm. This was calculated as, Hb=PCV/3 and expressed in grams per decilitre (g/dl)

Estimation of Red Blood Cell (RBC)

RBC was calculated as; PCV×0.13 and expressed in millions micro per litre (10^6 µl).

MCH, MCHC and MCV

The following indices: mean corpuscular hemoglobin (MCH), mean corpuscular hemoglobin concentration (MCHC) and mean corpuscular volume (MCV) was calculated according to Seiverd (1964). The MCHC utilizes only the PCV and Hb measurements. Both of these tests are associated with a greater degree of precision than the RBC count. Therefore, of the three indices, MCHC is most accurate (Sirosi, 1995)

White Blood Cell (WBC) Differential Count

A total white blood cell count is not necessarily indicative of the severity of a disease, since some serious ailments may show a low white cell count. For this reason, a differential white cell count is usually better and that is what was performed in this case. A blood smear was prepared and air dried. It was then stained using Leishman's stain and the slide placed on the microscope stage and examined under ×10 objective lens was moved out and a drop of oil laced on the slide. The ×10 objective lens was moved into a position making contact with the drop of oil. It was carefully focused on the selected field using the fine adjustment knob. The numbers of each cell type counted was recorded and then percentages calculated. Suppose you counted 72 neutrophils among 100 cells, then the percentage of neutrophils in the blood is 72/100 = 72% (Victoria, 2003).

Estimation of Packed Cell Volume (PCV)

Heparinised capillary tubes were filled with the sampled blood of the weaner rabbits and sealed using cristaseal. The filled capillary tubes were placed in a micro haematocrit centrifuge (CENTROLIT 11) and span at 10000 rpm for 5 minutes. This ensured maximal packing of the red cells. The PCV was subsequently determined by measuring the height of the red cells column using haematocrit reader (Barker and Silverton, 1976).

Slaughtering

After the experimental period of 42 days, the rabbits were taken to the University for Development Studies Animal Science Department meat processing unit to be slaughtered. Animals were bled and dressed by scalding. Immediately after scalding, evisceration was done to remove the viscera. The carcasses of the individual animals of the various treatments were subjected to sensory analysis after cooking.

Sensory analysis

Consumption quality was assessed by forming a tasting panel consisting of ten members. They evaluated the intensity of the following characteristics; tenderness, juiciness, colour, and flavour. The carcasses were sliced according to the individual treatment into fifteen pieces of the size of about 2cm and cooked at the same temperature using a regulated electrical stove. During the cooking, the slices were turned over every 10 minutes and the cooking was done for a period of 45 minutes.

After the cooking, the slices were each wrapped in tissue paper based on the individual treatment and placed on a tray and presented to the assessors for the taste evaluation. Bread and water was used as a neutralizer which the assessors took after tasting each slice from each treatment. Assessors scored the attributes of the meat according to Table 1 below.

Table 1 - Score table used to record the results of the evaluation

Meat attribute	Score				
	1	2	3	4	5
Meat colour	Very Light	Light	Intermediate	Dark	Very Dark
Juiciness	Very Juicy	Juicy	Intermediate	Dry	Very Dry
Tenderness	Very Tender	Tender	Intermediate	Tough	Very Tough
Flavour	Very Weak	Weak	Intermediate	Strong	Very Strong

Statistical analysis

The data was analysed using the analysis of variance (ANOVA) in GenStat (Discovery Edition) for growth and blood parameters while the general linear model using diet as factor was used for the sensory analysis.

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RESULTS AND DISCUSSION

The final weights of rabbits in this study for similar ages were comparable to findings by Ansah et al. (2012) who used rabbits in a similar environment that were fed false yam leaves but lower than those of other researchers elsewhere in Africa like Oluremi and Nwosu (2002) in Nigeria and Elamin and Yousif (2011) in Sudan, apparently because of differences in breed, initial weights and unequal duration of experimental period. The overall mean feed intake and average weight gains per rabbit per week was significantly different (P<0.05) between treatments (Table 2). Cook and Gray (2003) and Yarrow and Yarrow (2005) have noted that to reach optimum body size and full antler growth, white-tailed deer require at least 16% protein in the plants they consume, a scenario in which the rabbit may be said to be no exception.

A number of research works have noted that the protein levels of *Stylosanthes hamata* and *Sida acuta* are around 16% or more (Changjun et al., 2004; Skerman et al., 1988; Williams et al., 2012). Changjun et al. (2004) have further observed that metabolisable energy (ME) contents of some S*tylosanthes* spp. are between 1730 and 1815 kcal/kg which though lower than growing rabbits requirement of about 2.5MJ/kg DE (Ibrahim *et al*., 2009), some reasonable gains in weight was made possibly because there was sufficient but not necessarily adequate energy in the experimental diets, given that Ibrahim et al. (2009) have observed that rabbits fed on diet containing 90% energy requirement with or without supplementation showed high values of total revenue, net revenue, economical efficiency and relative economic efficiency, while recorded the low value of feed cost/kg live body weight. Reasonably reduced energy content of diet may not therefore necessarily be a limiting factor to growth. Rabbits on T2 probably gained the highest weight because the mixture of S*tylosanthes hamata* and S*ida acuta* might have provided higher protein content. Furthermore significant differences (P<0.05) were observed in total weight gain and final weight across all treatments (Table 2). Although T3 rabbits consumed the most feed at the end of the study, T2 animals recorded the highest weight, suggesting some possible positive interaction between the legume (*Stylosanthes)* and forage (*Sida)*. Bamikola and Ezenwa (2001) observed a higher growth rate when a mixture of *Stylosanthes* and Guinea grass was used to feed goats in Nigeria. In an experiment with grower goats in Nigeria, the daily live weight gain increased with 30% inclusion level of *Stylosanthes hamata* as compared to the control (100% *Panicum maximum*). An inclusion level above 50% did not however show any significant difference in terms of weight gain (Bamikola, 1999).

Table 2 - Growth performance of rabbits

Parameters	Trt 1	Trt 2	Trt 3	S.e.d.	Sig.
Ave. weekly feed intake(g)	1967^{a}	2008^{b}	2116^{c}	5.94	***
Total feed intake(g)	11802^{a}	12048^{b}	12696^{c}	1.53	***
Ave. weekly weight gain(g)	28^{a}	41^{c}	36.6^{b}	2.00	**
Total weight gain(g)	168^{a}	246^{c}	220^{b}	2.45	***
Final weight (g)	650^{a}	756^{c}	670^{b}	4.49	***

S.e.d- standard error of difference, Trt-Treatment, Sig.= significance, different superscripts ^{abc}= in a row imply significant differences (P<0.001or 0.01) between treatments, ***= significant at P<0.001 and **= significant at P<0.01

Some hematological characteristics

The PCV values (35.3 to 39%) obtained in this study were within the normal range (38 to 45%) as reported by Swenson and Reece (1993) for T1 and T3 but slightly below for only T2 animals. The values (11.8 to 12.7 g/100 ml) for haemoglobin concentration (Hb) obtained in this study again were within the normal range (12.9 to 13.85 g/100 ml) reported by Schalm et al. (1975) for T1 and T3 but slightly below for only T2 animals. The RBC values (4.6 to 5.1 x 106/mm3 of blood) were slightly lower than the values (6 to 11 x 106/mm3 of blood) reported by Olomu *et al*. (2003), but higher than the values (3.10 to 4.67 x 106/mm3 of blood) reported by Taiwo *et al*. (2006). There were no significant (P>0.05) differences among the dietary treatments with respect to the erythrocytic index MCH, but were significantly different (P<0.01) for MCV. The MCV and MCH values obtained here were slightly higher to reference values of 60 to 73 fl, 16 to 23pg by Anon (1980). MCHC values (33.0-33.3%) in this study though slightly significant (P<0.05) between the treatments, fell within the normal range of 26 to 34% as reported by Anon (1980). It would thus appear from PCV and Hb values that over time, feeding *Stylosanthes hamata* with *Sida acuta* could probably lead to anemic conditions. This will require further investigation as RBCs counts were not greatly affected (Table 3).

Table 3 - Effect of diet on hematological characteristics of rabbits

Parameters	Trt 1	Trt 2	Trt 3	S.e.d	Sig.
PCV (%)	38.000^{b}	35.300^{a}	39.000^{b}	0.678	**
Hb (g/100ml)	12.675	11.775	12.650	0.229	ns
RBC (x 10^{6}µL)	5.000^{b}	4.625^{a}	5.125^{b}	0.096	**
MCV (fl)	76.150^{a}	76.650^{b}	76.500^{b}	0.108	**
MCH (Pg)	25.375	25.550	25.300	0.145	ns
MCHC (%)	33.075^{a}	33.325^{b}	33.025^{a}	0.118	*

S.e.d- standard error of difference, Trt-Treatment, Sig.= significance, ^{abc}= in a row imply significant differences (P<0.05) between treatments for different superscripts, ***= significant at P<0.001 and **= significant at P<0.01, ns= non significant

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With regard to WBC differential counts, there were no significant differences (P>0.05) in the MCH, neutrophils, lymphocytes and eosinophils except for monocytes (Table 4). Not a single differential count was recorded for basophils in all treatments. High WBCs in blood tend to suggest subclinical or clinical conditions. It therefore appeared the treatments in the present study did appear to pose any observable health problems and especially so when no basophils counts could be made at all. Recent data have revealed the role of basophils in the initiation of the T helper cell 2 (Th2)-mediated immune response. Not only do basophils guide the Th1-Th2 balance by providing an early source of crucial Th2-skewing cytokines, interleukin (IL)-4 and thymic stromal lymphopoietin, but recent findings have also illustrated their capacity to function as antigen-presenting cells (Sokol and Medzhitov, 2010). Additionally, basophils, eosinophils, and Th2 lymphocytes are recruited to the site of inflammation during late-phase reactions (LPRs) (Falcone et al., 2000), suggesting the probable inflammatory-free condition of animals during the study.

Table 4 - Effect of diet on WBC differential counts of rabbits

WBC differential counts (%)	Trt1	Trt2	Trt3	s.e.d	Sig.
Neutrophils	36.000	36.500	38.000	2.750	ns
Lymphocytes	58.000	60.550	54.150	2.308	ns
Eosinophils	6.000	6.000	5.750	1.643	ns
Monocytes	0.000^{a}	0.500^{b}	0.000^{a}	0.204	*

S.e.d- standard error of difference, Trt-Treatment, Sig.= significance, different superscripts ^{abc}= in a row imply significant differences (P<0.05) between treatments, *= significant at P<0.05, ns= non significant.

Eating quality of rabbit meat

Stylosanthes hamata significantly improved colour and juiciness of the meat of the rabbits (P<0.05) (Table 5). This improvement was however diluted a little when fed in combination with *Sida acuta* for colour but not for juiciness (Table 5). On the other hand, tenderness and flavour did not show any significant differences (P>0.05) between treatments. Priolo and Vasta (2007) hypothesized that tannins are responsible for the differences found in meat colour. Changjun et al. (2004) in their nutritional analysis of some *Stylosanthes* leaf meal found that there were some tannins which may be implicated in this study. Again Guodao et al. (2004) have found that some species of *Stylosanthes* contain β-carotene. Carotene has been noted by Yang et al. (2000) to have effect on the meat colour. Since most forages contain vitamins which improve meat colour as alluded to by Arnold *et al.* (1993) who stated that supplementing grain-fed cattle with supra-nutritional level of vitamin E (a-tocophery acetate) improved meat colour and lipid stability, it is reasonable to assume vitamins in the forages that were fed may have enhanced the meat colour, too. Post-slaughter handling such as keeping the dead animal for some time before dressing being a contributing factor to the meat colour in this study cannot be overruled because Warris (2001) stated that acidity affects colour and water holding capacity after death. On juiciness, significant differences (P<0.05) were recorded between treatments. Factors that influence juiciness include: the animal's age at slaughter, the amount of fat and collagen (connective tissue) contained in particular cuts, and, to a small degree, brining (The Accidental Scientist, 2011). Upon slaughter no reasonable fat was noticed so since a number of research works have reported an increased juiciness and tenderness with an increase in fat content in meat products (Berry and Wergin, 1993; Troy et al., 1999) and given that this fat plays a major role in improving water holding capacity and binding properties, forming rheological and structural properties that trap moisture in the products to improve juiciness (Hughes et al., 1997; Pietrasik and Duda, 2000), the significant differences observed in juiciness may be attributable not to fat but possibly to differences in cuts and finer details in the cooking procedure. No significant differences in tenderness of the meat (P>0.05) was observed. The animals used for this study were not fully matured and were also of the same age. Forrest (2009) confirms that maturity is a factor which has the largest effect on meat tenderness. Flavour did not also record any significant differences (P>0.05) between treatments, possibly because no spices were added during cooking.

Table 5 - Effect of diet on eating quality of rabbit meat (5 point category of scale)

Sensory attribute	Trt1	Trt2	Trt3	S.e.d	Sig.
Colour	1.80^{a}	2.20^{ab}	2.80^{b}	0.373	*
Juiciness	1.50^{a}	1.90^{a}	2.80^{b}	0.375	**
Tenderness	2.00	2.50	2.30	0.427	ns
Flavour	2.80	3.30	3.70	0.383	ns

S.e.d- standard error of difference, P- probability, Trt-Treatment, Sig.= significance, different superscripts imply significant differences (P<0.05) between treatments. **= significant at P<0.00 and *= significant at P<0.05, ns= non significant.

CONCLUSION

Feeding local rabbits with *Stylosanthes hamata* in combination with *Sida acuta* can lead to improved weight gains in them but must be done with a good eye on the health of the rabbits. *Stylosanthes hamata* as a sole can also improve the colour and juiciness of the meat of local rabbits. *Sida acuta* as a sole feed could also bring about improved weight gains however the meat colour would be a bit darker. Given that these two forages are readily available in the locality, it is recommended that farmers use 50% *Stylosanthes hamata* and 50% *Sida acuta*, in feeding so as to improve the weight gains of their local rabbits.

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REFERERENCES

Adjare SO (1985). Try the Rabbit. A practical Guide.

Adu EK, Alhassan WS and Nelson FS (1999). Small holder farming of the greater cane rat (Thryonomys swinderianus, Temminck) in southern Ghana: A baseline survey of management practice. In: Tropical Animal Health and Production 31: 223-232.

Aduku AO, Okoh PN, Njoku PC, Orjichie EA, Aganga AA and Dim NI (1986). Evaluation of cowpea and peanut haulms as feedstuffs for weaning rabbit in tropical environment (Nigeria). Journal of Applied Rabbit Research, 9: 178-179.

Anon J (1980). Guide to the care and use of experimental animals. Vol.-1. Canadian Council on Animal Care, Ottawa, Ontario, Canada. pp. 85-90.

Ansah T, Emelia AA, Deku G, Karikari PK (2012). Evaluation of false yam (*Icacina oliviformis*) leaves on the growth performance of weaner rabbits (*oryctolagus cuniculus*). Online Journal of Animal and Feed Research. 2(1): 76-79

Arnold RN, Arp SC, Scheller KK, Williams SN and Schaefer DM (1993). Tissue equilibration and subcellular distribution of vitamin E relative to myoglobin and lipid oxidation in displayed beef. Journal of Animal Science, 71: 105-118

Baker FJ and Silverton RE (1976). Introduction to Medical Laboratory Technology. Butterworth London UK pp736

Bamikola MA (1999). Performance of goats fed *Panicum maximum* and *Stylosanthes hamata* mixture. Ph. D. Thesis, University of Ibadan, Nigeria.

Bamikola MN and Ezenwa AO (2001). Performance of West African dwarf goats fed Guinea grass and *Stylosanthes hamata* mixture. Small Ruminant Research, 39: 145-152.

Berry BW and Wergin WP (1993). Modified pre-gelatinized potato starch in low fat ground beef patties. Journal of Muscle Foods, 4: 305–320

Changjun B, Guodao L, Dongjun W, Krishna D, Qudratullah S, Prasad VLK, Rao SVR, Rao PP, Ramesh CR, Balagopal R, and Gopalan A. (2004). Stylosanthes leaf for animal industries in China and India. In: High-yielding anthracnose-resistant Stylosanthes for agricultural systems. S Chakraborty(ed). Chapter 24. Australian Centre for International Agricultural Research (ACIAR). p 247

Cook C and Gray B (2003). Biology and Management of White-tailed Deer in Alabama. Alabama Department of Conservation and Natural Resources, Division of Wildlife and Freshwater Fisheries. 175 p.

Elamin KM and Yousif IA. (2011). Evaluation of litter traits in Sudanese rabbits. Livestock Research for Rural Development, 23(9): 2011

Enkenyem BV and Madubuike FN (2007). Haematology and Serum Biochemistry of Grower pigs fed with varying of *Ipomoea asarifolia* Leaf Meal. Pakistan Journal of nutrition6 (6). Pp. 603-606 and Department of Animal Science/Fisheries, Imo State University, P.M.B.2000, Oweni, Nigeria.

Falcone Franco H, Haas H and Gibbs Bernhard F (2000).The human basophil: a new appreciation of its role in immune responses. The American Society of Hematology, Dec. 2000. 96: 4028-4038

FAO (1992). Meat and meat products in animal nutrtion in developing countries. Food and Nutrition Paper 53, Food and Agric. Organisation, Rome.

FAO (1998). Statistical database. http:www.Faostat.org/default.html.

Forrest J (2009). Purdue University Animal Science Department. Meat Quality and Safty.

Guodao L, Changjun B, Dongjun W, Ramesh CR, and Rao PP (2004). Leaf meal production from Stylosanthes in China and India. In: High-yielding anthracnose-resistant Stylosanthes for agricultural systems. S Chakraborty(ed). Chapter 25. Australian Centre for International Agricultural Research (ACIAR). p 256

Hawkney CN and Dennett A (1989). A colour atlas of Comparative Veterinary haematology. Wolfe Medical Publication, England. Pp. 192.

Hughes E, Cofrades S and Troy DJ (1997). Effects of fat level, oat fiber and carrageenan on frankfurters formulated with 5%, 12% and 30% fat. Meat Science, 45(3): 273–281.

Ibrahim ShAM, Abedo AA, Omer HAA and Ali FAF (2009). Response of Growing New Zealand White Rabbits to Diets Containing Different Levels of Energy and Mixture of Some Medicinal Plants. World Journal of Agricultural Sciences 5(5): 544-551.

Kasei CN (1990). A synopsis on the climate of the North of Ghana. In proceedings of the 2nd workshop on Improving Farming System in the Savannah Zone of Ghana, Nyankpala Agriculture College, Tamale from 24th – 26th April. Pp. 4.

Lebas F and Colin J (1992). Proceedings of the 5th World Rabbit Science Association (WRSA) Congress, Oregon. State University.
Lukefahr SD, Hohenboken WD, Cheeke PR and Patton NM (1983). Doe reproduction and preweaning litter performance of straight bred and crossbred rabbits. J. Anim. Sci., 57, 1090-1099.
Mannetje L.t' (1984). Considerations on the taxonomy of the genus. Stylosanthes. In Stace, H.M. & Edye, L.A. (eds) The Biology and agronomy of *Stylosanthes*. Academic Press North Ryde, Australia.Pp. 1 -22
Mannetje L't and Jones RM (1990). Pasture and animal productivity of buffel grass with siratro or Nitrogen fertilizer. Tropical grassland, 24: 269–281.
Nguyen TT and Brian O (2008). The supplementing different green feeds (water spinach, sweet potato leaves, and duckweed) to broken rice based diet on performance, meat and egg yolk colour of huong chicken. College of Agriculture, Can Tho University Can Tho Vietnam, Department of Animal Science and Management, Swedish University of Life Science.
Olomu JM, Ezieshi VE and Orheruata AM (2003). Comparative physiological, haematological, reproductive and physical characteristics of grass-cutter,rabbit and . In: Grass cutter Production in Nigeria:Principles and Practice. A Jachem Publication, p. 46.
Oluremi OIA and Nwosu A (2002). The Effect of soaked Cassava Peels on Weaning Rabbits. The Journal of Food Technology in Africa. Vol. 7 No.1
Oppong-Anane K (1999). Country Pasture/Forage Resource Profiles: Ghana. Found at http://www.fao.org/ag/AGP/AGPC/doc/Counprof/ghana/Ghana.htm. Accessed 17/4/12.
Priolo A and Vasta V (2007). Effects of tannin-containing diets on small ruminant. Vol.6 (SUPPL. 1) 527-530.
Pietrasik Z and Duda Z (2000). Effect of fat content and soy protein/carragenan mix on the quality characteristics of comminuted, scalded sausages. Meat Science, 56: 181–188.
Schalm OW, Jain N and Corroll EJ (1975). Veterinary Hemathology. 3rd ed. Lea and Febiger, Philadelphia. pp. 220-221.
Seiverd CE (1964). Haematology for Medical Technologists. Lea and Febiger, Philadelphia, p. 946.
Sirosi M (1995). Veterinary clinical laboratory procedures Mosby's Fundamentals of Veterinary Technology. 160pp.
Skerman PJ, Cameron DG and Riveros F (1988). Tropical forage legume, 2nd edition, pp. 391–445. FAO (Food and Agricultural Organization of the United Nations): Rome, Italy.
Sokol CL, Medzhitov R (2010). Emerging functions of basophils in protective and allergic immune responses. Journal of PubMed 2010 Mar; 3(2): 129-37
Standard Operating Procedure for Rabbit Immunization and Blood Collection (SOPRIBC)(2006) Comparative medicine laboratory animal facilities. Division of Comparative medicine laboratory animal facilities . University at Buffalo. New York. http://www.research.buffalo.edu/laf/resources/sop/2.a.3_rabbit_immunization.cfm . Retrieved 13/4/2011.
Swenson MJ and Reece WO (1993). Dukes Physiology of Domestic Animals. 11th ed. Cornel University Press. New York, pp. 30-32.
Taiwo AA, Adejuyigbe AO, Talabi EO, Okumakuma GO and Adebowale EA (2006). Effect of raw and cooked Mucuna seed meal based diets on the performance, nutrient digestibility and haematology of weaned rabbits. Nig. J. Anim. Prod.33 (2): 209-215.
The Accidental Scientist (2011). The Science of Cooking: What makes meat juicy and tender? Found at http://www.exploratorium.edu/cooking/meat/INT-what-makes-juicy.html. Accessed 17/4/12.
Troy DJ, Desmond EM and Buckley DJ (1999). Eating quality of low-fat burgers containing fat replacing functional blends. Journal of Food Science and Agriculture, 79: 507–516.
Warris PW (2001). Post mortem changes in muscles and its conversion into meat In: Meat Science, Introductory Test CABI-Pp 100-105.156, 156-161,189.
Williams R, Baxley T and Minogue P (2012). A Native Growing Season Forage for Wildlife - Teaweed,*Sida acuta Burm. f.* University of Florida IFAS Extension Solutions for Your Life. Publication #FOR114.
Yang A, Brenster MJ, Lanari MC and Tume RK (2000). Food science, Australia,Bribane laboratory.
Yarrow GK and Yarrow DT (2005). Managing Wildlife on Private Lands in Alabama and the Southeast edited by Dan Dumont. Alabama Wildlife Federation. Sweetwater Press. Birmingham, AL. 588 p.

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NUTRITIVE PROFILES IN DIFFERENT SIZE GROUPS AND BODY PARTS OF COMMON WHELK *Hemifuses pugilinus* (BORN, 1778) FROM PAZHAYAR, SOUTHEAST COAST OF INDIA

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ABSTRACT: *The aim of this study was to determine instead of levels of protein, fat, carbohydrates (proximate composition) and essential fatty acids of different body parts as well as male and female of extensive marine whelk H. pugilinus on dry weight basis. There was a significant difference in protein, lipid, carbohydrate and water contents between various size groups as well as sex (P<0.05). Total protein content was found to be varying from 30.58±0.75 (digestive diverticula) to 57.23±1.48% (Gonads) in size group II of the female body parts respectively, the carbohydrate 3.66±0.28 to 10.35±0.14 whereas the lipid 10.18±0.04 to 14.67±0.35. The water content varied from 58±1.41 minimum digestive diverticula and maximum in 85±1.41 other body tissues. There was considerably 17 fatty acid composition were identified belongs to ten in saturated fatty acids four were monounsaturated fatty acid and 3 were polyunsaturated fatty acid among these, C16:0 (22.62%) and C18:0 (14.45%) were the major components saturated fatty acids and C18: 1 (5.3%) and C20:4n6 (8.66%) were found major mono and poly unsaturated fatty acids. All groups have good source of the nutritive value particularly the size group II (80-100 mm) is effectual results for the present findings and it's symptomatic of their high nutritional quality for human consumption.*

ORIGINAL ARTICLE

Key words: *Common whelk, Fatty acids, Mollusc, Nutritional composition, Pazhayar*

INTRODUCTION

From the beginning of the 20th century the world population is exploding tremendously great impact on the availability of food. The seafood is a rich source of protein and many varieties of seafood are also low in sodium and cholesterol, but it's nutritious as well. It's a delightful addition to any meal and is an excellent, low-calorie source of many essential nutrients. Nutrition plays a vital role on the development, growth, maintenance of normal body functions, physical activity and length. Nutrients must be obtained through a judicious choice and combinations of variety of foods such as carbohydrate, fats, protein are macronutrients, vitamins and minerals are micronutrients which are necessary for physiological and biochemical process by which the human body acquires, assimilates and utilizes food to maintain health.

Nutritive compositions are ensuring the adequate immune competence and cognitive development of the human metabolisms (Ramakrishnan and Rao, 1995). Due to increasing the populations, new nutritional resources have to be exploited and distributed properly from the land and the sea (Chernysheld, 1977). Hence, recent researches are much focused on the nutritional sources from the marine environment. Marine organisms generally possess varying degrees of exogenous fatty acid components. For e.g. poly unsaturated fatty acid that is typical of certain primary producers (algae and microorganisms) is known to be essential FAs in marine invertebrates (Ermelinda Prato et al. 2009).Whelks are the predatory marine gastropods that are extremely favored for their high protein (Xavier Ramesh and Ayyakkannu, 1992). However, the proximate compositions are widely varied depending on species size. Even though the biochemical composition of bivalves was studied extensively, only limited studies were conducted on gastropods. However, efforts have been made to study the major biochemical composition of gastropods such as *Thais* spp. (Sundaram, 1974).

H. Pugilinus is a marine prosobranch gastropod distributed all over the southeast coast of India which is inhabited at a depth of 3 to 13 fathoms in sandy mud substratum. The species is edible in Hon Shu Islands in Japan (Kira, 1962); in India (Anandakumar et al., 1986) reported. Even they are used for ornamental purposes; lime making industries are exploited in large quantities for its shell. To overcome, the purpose of the present study was to the availability of the compositions and biochemical variations in tissues of *H. pugilinus* in different size groups.

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MATERIALS AND METHODS

Sample Collection and Processing

The study animal were sourced from trawl net operation of by - catch resources at fish landing centre of Pazhayar (Lat 11º 21'22" N; long 79º 50'55" E) the selection of this harbor is one important landing center among the three minor fishing harbor in Tamil Nadu. More then 200 samples were segregate in to three different size groups ranging from 50 to 130 cm and washed thoroughly with tap water and subsequently with distilled water to remove the surface soil and dust. The outer shells were carefully removed and dissected out and identified the male and female were separated to various parts of body such as foot, mantle, gonad and other body tissues (remain part of the animal) could be dried in hot air oven at 60°C for 24 h. The dried material was powdered, sieved and used for further analysis in triplicate to analyze total protein, carbohydrate, lipid and water content. The whole body tissues of both sexes were pooled together and analyzed for the fatty acid profile.

Estimation of total protein: The folin – Ciocalteu phenol method (Lowry et al. 1953) was adopted for the estimation of total proteins in the different body parts of the dried samples.

Estimation of carbohydrate: For the estimation of carbohydrate content, using the procedure of phenol-sulphuric acid (Dubois et al. 1956) method.

Estimation of lipid: The chloroform – methanol extraction procedure (Folch et al. 1956) methods was used for the extracting lipid from the various body parts.

The water content was estimated by subtracting the dry weight of the sample from the known wet weight of the sample dried in a hot air oven and then calculated in percentage to estimate the water content.

Estimation of fatty acid: Fatty acids in the sample were analyzed by converting them in to FAME and analyzed by Gas Chromatography (Sasser et al. 2005). The purified methyl esters were analyzed by gas chromatography (Agilent- GC 6890N) equipped with flame ionization detector. Capillary column- HP Ultra 2 with 2m long and 0.2mm inner diameter coated with 5% phenyl methyl silaxane and 0.33µm thickness was used. The rate of hydrogen carrier gas flow was maintained at 30ml/min. FAMEs were identified by MIDI calibration standard software.

RESULTS

Sea food is the important constituent of the human diet, nowadays the protein efficiency increasing in developing countries. It has stimulating exploration of non – traditional resources (Woodcock and Benkendorff, 2008). The proximate composition of the male meat of marine gastropod in various body parts and size groups were showed (Figures 1, 2 and 3) and the female body parts were shown (Figures 4, 5 and 6) the mean values of protein, carbohydrate, lipid, water content and fatty acids were showed. The percentage biochemical compositions of various body parts of male and female *H. pugilinus* were analyzed and represented, the protein, carbohydrate, lipid and water content varied significant ($P<0.05$). The level of composition was higher in gonad in case of both male and female in all the size groups.

In the present investigations SGII is more significant value compare to the SG I and SG III. The protein content varied from the SG I foot of female 44.9±1.34 - 48.4±1.88 in gonad respectively SG II 47.1±1.47 - 57.2±1.48, SG III 30.5±0.75 - 35.6±1.69.The maximum in gonads (57.2±1.48) in SG II and least amount in 30.5±0.75 in SG III. In order the protein content varied from 40.3±0.14 - 46.1±0.05, 46.4±0.05 - 56.3±0.09 and 29.1±0.14 - 35.8±0.11 the maximum (56.3±0.09) SG II and least amount in 29.58±0.75 in SG III.

Carbohydrate level ranged from the female 5.48±0.28 - 8.13±0.04 in SG I, SG II 6.9±0.14- 10.3±0.14, SG III 3.66±0.28 - 5.46±0.37.Carbohydrate higher in gonad (10.3±0.14) SG II and lower amount in foot (3.66±0.28) SG III. In order the male 8.12±0.14 - 11.2±0.12, 7.82±0.09- 9.88±0.08 and 3.90±0.07 - 5.16±0.12 the maximum (11.2±0.12) in SGI and least amount in 3.90±0.07in SG III. In female, the lipid content varied from 12.59±0.48-15.95±0.07 (SG I) 10.37±0.21 - 14.6±0.35 (SG II) 10.1±0.04 - 13.1±0.07 (SG III). Amount of lipid maximum in (15.9±0.07) gonad SG I and minimum in foot (10.8±0.04) SG I, respectively male 5.83± 0.08 - 12.5±0.14, 8.92±0.10 - 14.8±0.04 and 10.2±0.18 - 13.2±0.19 higher in gonads (15.9±0.07) SI and lower in foot (10.1±0.04) SG II. In the present study, the lipid formed only a less percentage of the total biochemical constituent and it was found to be high in gonad (15.9±0.07 SG II) followed by other body tissues (15.1±0.09 SG I), Digestive diverticula (14.6±0.35SG II) and foot (12.5±0.48 SG I) in *H. pugilinus*. Whereas in the case of *Meretrix meretrix* lipid content was higher in mantle (4.38%) (Palpandi et al. 2008), visceral mass (3.94%) and mantle (3.5%) in *Katelysia opima* (Soma Saha, 2004) and digestive diverticula (8.3%) in gonad and foot (Rajan, 1987). The differences in lipid content of tissues are partially due to the gradual transference of lipids of gonads as reported in *C. Tehuelcha* (De Moreno et al. 1976).

In the present findings, the water content in male ranged from 86±1.41 - 83±1.41 and which was high in other body tissues of SG II and minimum in digestive diverticula of SG II. In female, water content varied between 85±1.41 - 79.5±0.70 maximum in other body tissues of SG III and minimum in digestive diverticula in SG III. Totally 17 different fatty acids were identified 10 were saturated fatty acids (SFA), four were monounsaturated fatty acids and 2 polyunsaturated fatty acids (PUFA), among SFAs, and C16:0 and C18 : 0 were the major acids. In MUFA C18:1 and in PUFA C20:4ω6C were the major acids found in *H.pugilinus.*

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Table 1 - Fatty acid profile for *H. pugilinus*			
Position of carbon atom	**Percentage (%)**		
	SG I	**SGII**	**SGIII**
Saturated Fatty acids (SFA)			
C10:0	-	0.05	-
C12:0	0.71	0.16	0.86
C13:0	0.08	0.1	-
C14:0	3.98	3.89	2.67
C15:0	1.83	1.74	0.67
C16:0	22.62	22.48	11.11
C17:0	4.9	4.65	3.26
C18:0	12.86	14.45	13.41
C19:0	0.58	0.75	0.89
C20:0	0.92	1.61	0.57
	48.48%	49.88%	33.44%
Mono Unsaturated Fatty acids (MUFA)			
C16:1n-5	0.17	0.17	-
C17:1n-8	0.67	0.65	0.47
C18:1n-9	4.15	5.3	4.61
C20:1n-7	1.94	1.81	0.71
	6.93%	7.93%	5.32%
Poly Unsaturated Fatty acids (PUFA)			
C18:3n -6	0.36	0.38	-
C20:4n-6	8.66	6.93	4.68
C20:4n-12	-	-	10.96
	9.02%	7.31%	15.64%
* Percentage composition of fatty acid profile			

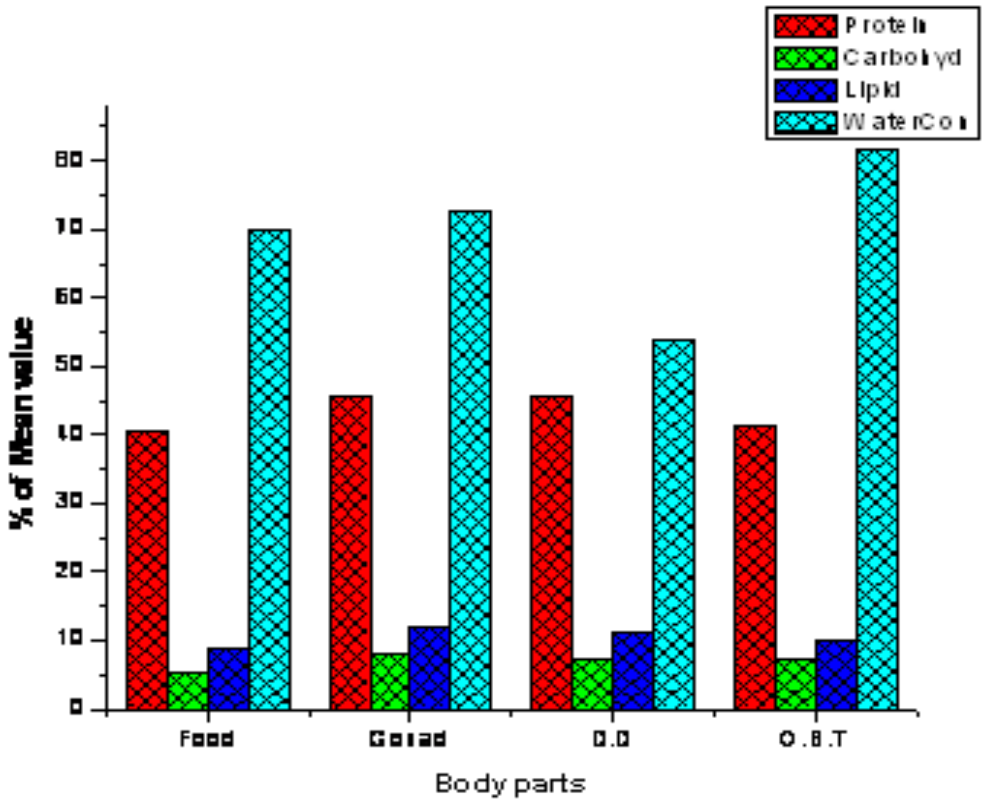

Figure 1. Proximate composition in male *H. pugilinus* body parts; * - Size group I (50 - 70 cm)

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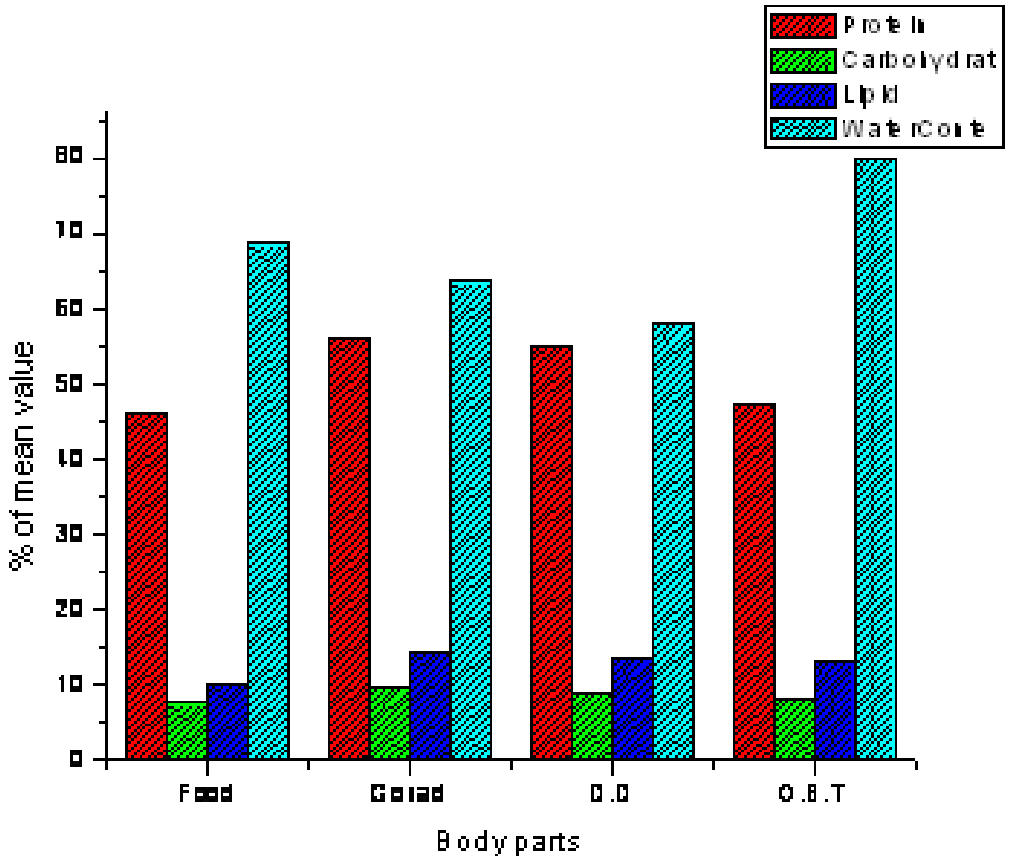

Figure.2. Proximate composition in male *H. pugilinus* body parts; * - Size group II (80 - 100 cm)

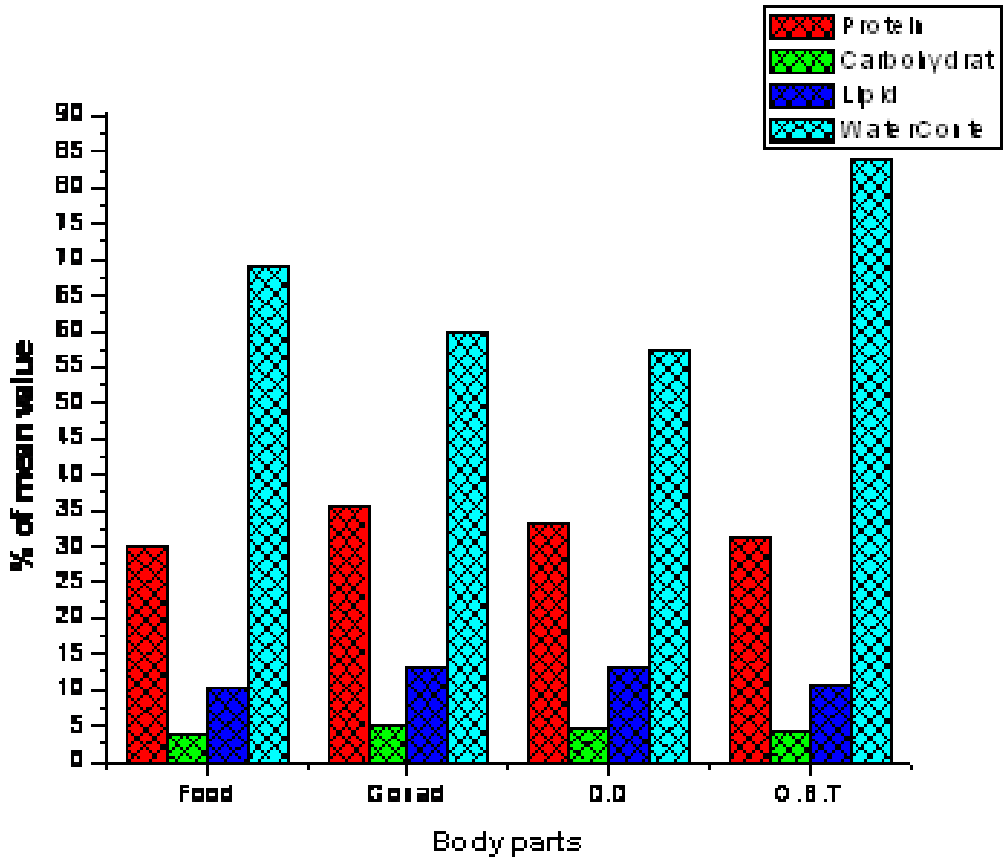

Figure 3. Proximate composition in male *H. pugilinus* body parts; * - Size group II (110 - 130 cm)

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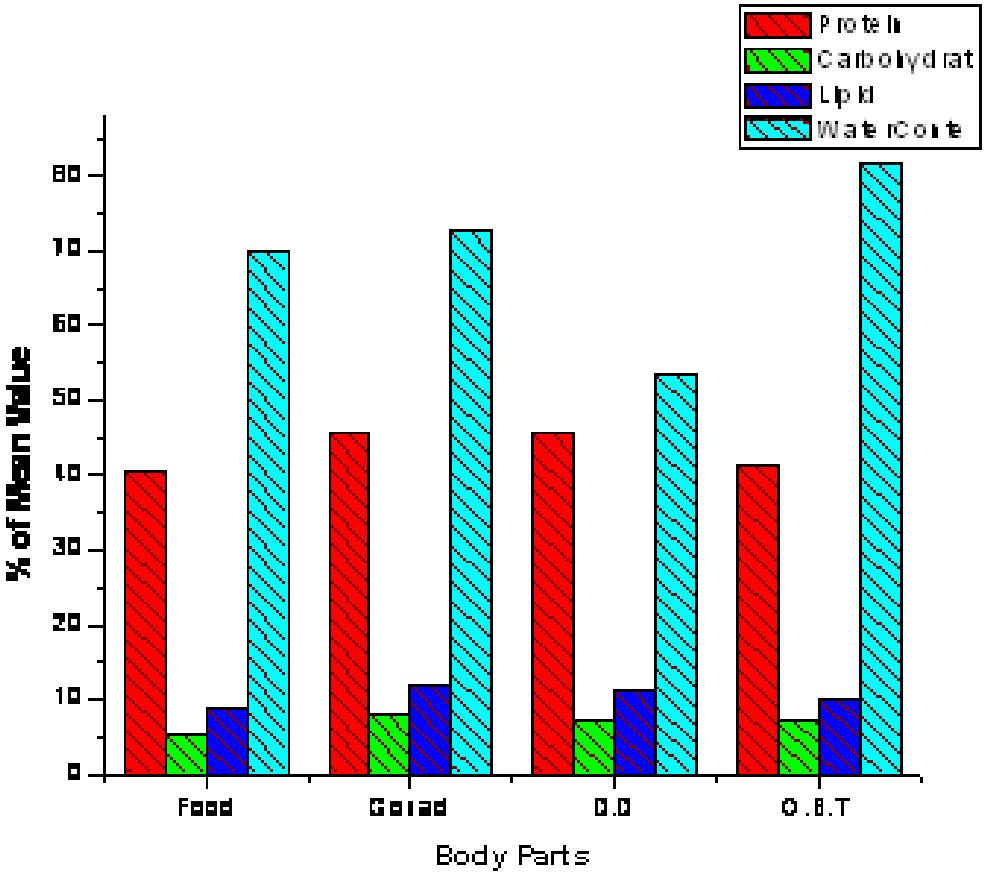

Figure 4. Proximate composition in female *H. pugilinus* body parts; * - Size group I (50 - 70 cm)

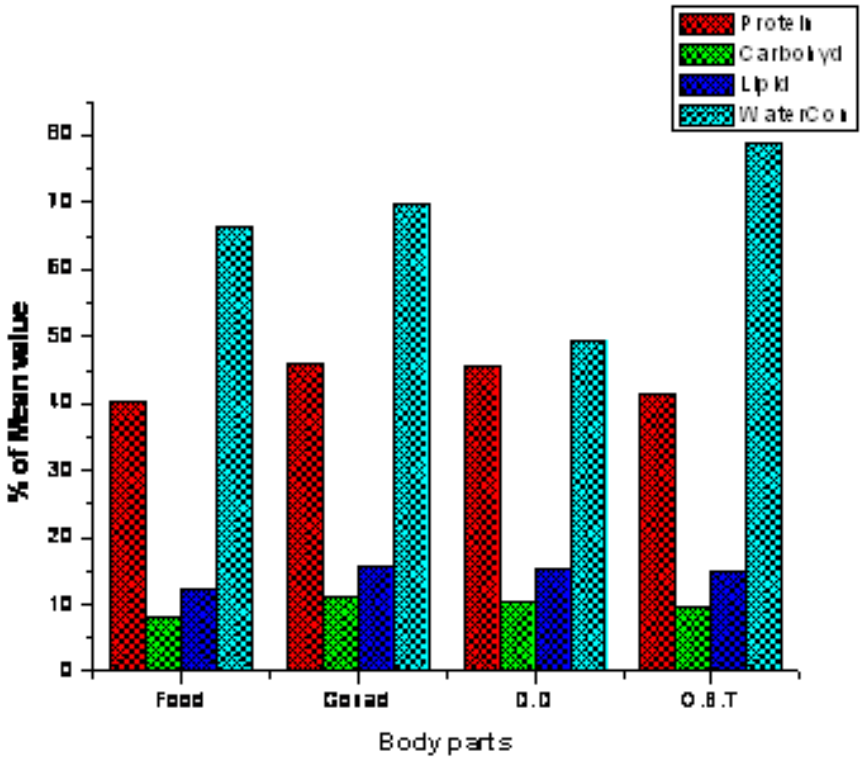

Figure 5. Proximate composition in female *H. pugilinus* body parts of Size group II (80 - 100 cm); * - Size group II (80 - 100 cm)

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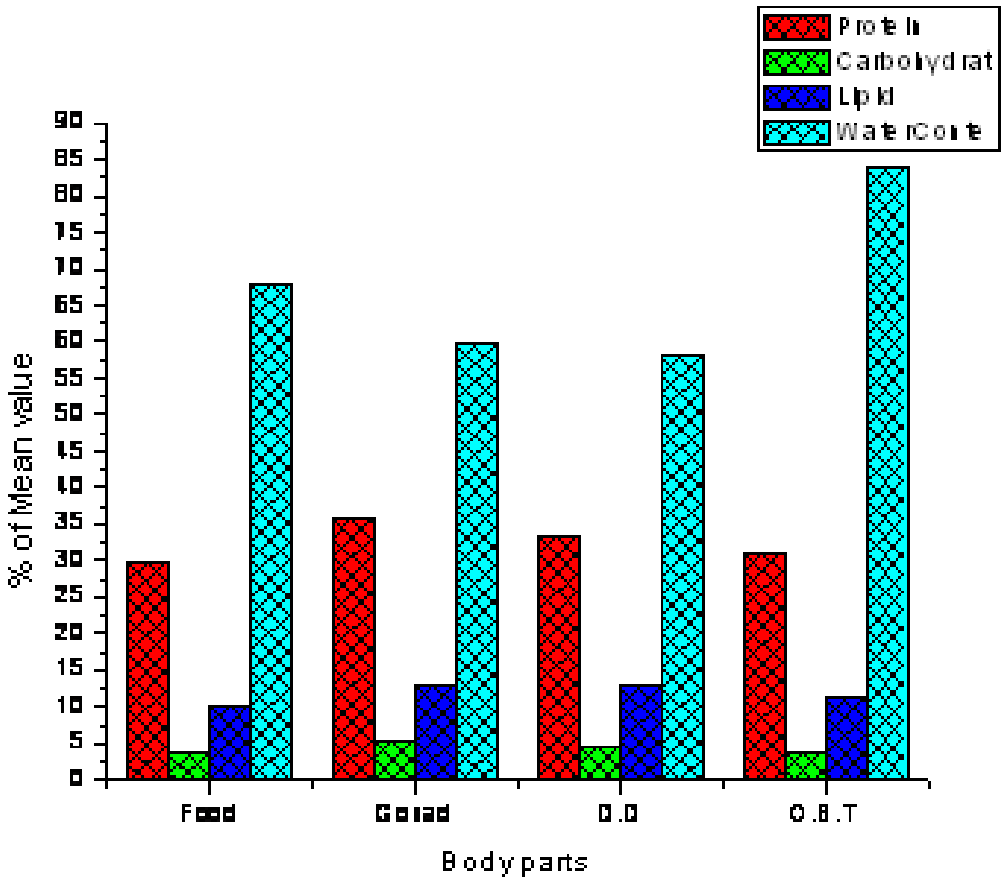

Figure 5. The Proximate composition in female *H. pugilinus* body parts of Size group III (110 - 130 cm); * - Size group III (110 - 130 cm)

DISCUSSIONS

The protein is essential for the sustenance of life and accordingly exists in large quantity of all nutrients in human body. The protein content varies from animal to animal, one body part to another and also season to season (Kunusaki, 2000). The variations in the biochemical constituents like protein, carbohydrate and lipid are mainly influenced by the reproductive cycle, feeding and age of the organisms concerned (Giese and Hart, 1967). Very well agreeing with the above facts, in the present study protein and carbohydrate were found to be higher in gonad (56.3±0.09) of SG II and SG I (48.4±1.88) respectively and it is due to the attainment of sexual maturity and consequent maturation of gonads. The reason for the maximum protein content recorded in the gonad than that of the other analyzed edible portions viz., foot, digestive diverticula and other body tissues of the *H. pugilinus* might be stated that the gonad part acts as a storage organ. In contrast to this view it was stated that the digestive gland acts as a storage site in most of the tropical molluscs (Owen, 1966; Jayabal and Kalyani, 1986; Rajkumar, 1995). The protein content values of the present study were found to be lying more with the protein values of 23.6 to 43.0% in the mantle of *Rapana rapiformis* (Rajkumar, 1995) and 15.71 to 29.8% in the whole body tissue of *Pythia plicata* (Shanmugam, 1991). But the protein was reported more or less equal to the present observation in *Babyloniya spirata* (Shanmugam et al., 2006) in which the adductor muscle, mantle and siphon mixture showed the maximum protein content of 51% and minimum of 43.87%; whereas protein in the foot muscle was 62.13% in male and 64.44% in female of *Chicorus virgineus* and 60.78% and 60.43% of the male and female samples of *R. rapiformis* respectively (Xavier Ramesh and Ayyakkannu, 1992), *Thais bufo* (46.8% in males and 49.8% in females), *T. bisserialis* (42.4% males and 43.4% in females) (Tagore, 1990). Thivakaran (1988) recorded *L. quadricentus* (35.94%) and *N. pyramidalis* (35.63%).

The carbohydrate level in the present study ranged from 10.35±0.14of SG II and to 8.13±0.04 SG I, whereas adductor muscle, mantle and siphon mixture was maximum of 6.8% and minimum of 6.5% in *B. spirata* (Shanmugam et al., 2006). More carbohydrate in the gonad and digestive gland mixture than that of viscera and foot observed in *Morula granulata* suggested that it may be used during the reproductive physiological needs or may be converted to the gonadial lipids (Umadevi et al., 1985; Rajkumar, 1995) concluded that carbohydrate was higher in foot followed by digestive diverticula, mantle and gonad in *R. rapiformis*. Ansell et al. (1973) reported that, in molluscs, generally the carbohydrate reserves may be utilized under unfavourable conditions and the great variation found in tissues indicates that the level of mobilizable carbohydrate reserves may fluctuate widely and

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rapidly in response to fluctuation in condition affecting the position of the animal. Water content in *H. pugilinus* was high in other body tissues of (85±1.41%) SG III and low in digestive diverticula of (50 %) SG I. Similar observation on the variation in water content and dry weight (Ansell et al., 1964) in *Venus mercenaria* and *Tivela stultorum* (Giese et al., 1967) which was due to the maturation and spawning.

The availability of SFAs content was 48.48 % (SG I) 49.88 % (SG II), and 33.44 % (SG III). The value of MUFA and PUFA are given in Table 1. Marine animals are the richest sources of PUFA it accounts about 31.97% of the total fatty acids, where 20:5 and 22:6 acids together accounted for about 90% of the total PUFA (Nair and Mathew, 2000). Among 17 different fatty acids were identified, 10 belong to saturated fatty acid (SFA), 4 were Mono Unsaturated fatty acids (MUFA) and three were polyunsaturated fatty acid (PUFA). The percentage availability of SFA was 48.48% (Size group - I), 49.88 % (Size group – II) and 33.44 % (Size group -III),whereas MUFA was 6.93% (Size group - I), 7.93% (Size group – II) and 5.32% (Size group -III) and PUFA was 9.02% (Size group - I), 7.31% (Size group – II) and 15.64% (Size group -III). Whereas fatty acid contents of *Perna viridis* and *Crassostera madrasensis* accounted 44.06 and 48.4%, 33.74 and 24.04%, 20.47 and 22.15% of SFA, PUFA and MUFA respectively (AjayaBhaskar, 2002).

In the present study arachidonic acid was found in all size groups which was 8.66% (Size group - I), 6.93% (Size group – II) and 4.68% (Size group -III). However, arachidonic acid has been proved effective in improving egg quality (Sargent et al. 1999) and survival at the early life stages of fish (Castell et al., 1994, Bessonart et al., 1999 and Koven et al., 2001). The variation in the SFA level in various size groups can be attributed to seasonal variations, diets and adaptation to habitat changes (AjayaBhaskar, 2002). The saturated fatty acids were the next most common fatty acids 26% in the FD and 25% in the frozen Green ripped mussels of *Perna canaliculus* (Murphy et al., 2001).

In stearic and palmitic acids were commonly high in nature in different species of limpets (Sonia Brazao et al., 2003). In this study the both acids were recorded 14.45% and 22.62% respectively. The water soluble esters of Stearic acid and of palmitic acid (Tween 20 - polyoxyethylene sorbitan monolaurate), and (Tween 40 - PSM) exhibited appreciable bacteriostatic and bactericidal activity against tubercle bacilli in concentrations of 0.01 to 0.001%, but esters of stearic and oleic acid (Tween 60 - PSM) and (Tween 80-PSM) were found inhibitory only at higher concentrations (Dubos, 1947). In the present study, *H. pugilinus* showed dominance of 16:0 and 18:0 fatty acids which constituted 22.62 and 12.86% (SGI) respectively, Therefore *H. pugilinus* would be better alternative sources since it contains both palmitic and lauric acid. Thus present study confirmed that biochemical composition was higher in the foot of various size groups and clearly indicated that they are potential source of nutrition for the currently famished world population.

CONCLUSION

In present study, variation in biochemical composition seems to be governed by different size group and different body parts. The study on proximate composition of *H. pugilinus* revealed that protein and lipid content were high. Fatty acids study depicted that, saturated fatty acids observed were ranging from 16.8 to 22.5% and Stearic acid and Palmitic acid were found to be dominant. This study clearly indicates that the mollusc *H. pugilinus* was the potential source for nutritive value and it is strongly recommended for human consumption.

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REFERENCES

Ajaya Bhaskar D (2002). Nutritional evaluation of molluscan seafood. Ph.D. Thesis. Annamalai University, India.

Anandakumar S, Amutharani G, Gladys Chandraleela A and Pragatheswaran V (1986). Biochemical studies on a little known marine gastropod *Hemifusus pugilinus* Born (Volemidae), Journal of the Marine Biological Association of India, 28: 1-2.

Ansell AD, Sivadas P and Narayanan B (1973). The ecology of two sandy beaches in southwest India. IV. The biochemical composition of four common invertebrates, Marine Biological Association of India, 333-348.

Bessonart M, Izquierdo MS, Sahu M, Hernandez Cruz CM, Gonzalez MM and Fernandez Palacios H (1999). Effect of dietary arachidonic acid levels on growth and survival of gilthead sea bream *Sparus aurala* larvae, Aquaculture, 179: 265-275.

Brazao S, Morais S Boaventura D Re P Narciso L and Hawkins S.J (2003). Spatial and temporal variation of the fatty acid composition of *Patella* sp. (Gastropoda:Prosobranchia) soft bodies and gonads, Comparative Biochemistry and Physiology, 13(6): 425- 441.

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Scienceline/Journal homepages: http://www.science-line.com/index/; http://www.ojafr.ir

Castell JD, Bell JG, Tocher DR and Sargent JR (1994). Effects of purified diets containing different combinations of arachidonic and docosahaexaenoic acid on survival growth and fatty acid composition of juvenile turbot *Scopthalmus maximus,* Aquaculture, 128: 315-333.

Chernyshev M (1977). Can the seas feed Mankind; Seafood, Export Journal, 9(7): 25-26.

De Moreno JEA, Moreno VJ and Brenner RR (1976). Lipid metabolism of the yellow clam *Mesodesma mactroides*: Composition of the lipids, Lipids, 11: 334-340.

Dubois M, Gillas J, Hamilton Rebus RA and Smith F (1956). Colorimetric method for determination of sugars, Analytical Chemistry, 28: 350-356.

Dubos RJ (1947). The effect of lipids and serum albumin on bacterial growth. J. Exptl. Med, 85: 9-22.

Ermelinda P, Antonio D, Michele M and Francesca B (2009). Lipid and fatty acid Compositions of *Mytilus galloprovincialis* cultured in the Margrande of Taranto (Southern Italy): Feeding Strategies and Trophic Relationships, Zoological Studies, 49(2): 211-219.

Folch JM, Lees GH and Stanely S (1956). A simple method for the isolation and purification of total lipids from animal tissues, Journal Biological Chemistry, 226:497-509.

Giese AC, Smith MA and Cheung MA (1967). Seasonal changes in body component indices and chemical composition in the pismo clam *Tivela stultorum,* Comp. Biochem. Physiol, 22: 549- 561.

Giese AC and Hart (1967). Seasonal changes in component indices and chemical composition in *Mytilus edulis,* J. exp. Mar. Biol. Ecol, 1: 34-46.

Jayabal R and Kalyani M (1986). Biochemical studies in the hard clam *Meretrix meretrix* from Vellar estuary, East coast of India, Indian J Mar. Sci, 15: 63-64.

Kira T (1962). Shells of the Western Pacific in color, Hoikusha, Osaka, 224: 72.

Koven W, Barr Y, Lutzky S, Ben Atia I, Weis R, Harel M, Behrens P and Tandler (2001). The effect of dietary arachidonic acid 20:4n-6 on growth, survival and resistance to handling stress in gilthead bream *Sparus aurata* larvae, Aquaculture, 193: 1007-1022.

Kunusaki N (2000). Nutritional properties of Squid and cuttlefish; Nutritional and functional properties of squid and cuttlefish by Masayo Okuzumi and TateoFujii.*35th* Anniversary commemorative publication, 22-59.

Murphy KJNJ, Mann AJ and Sinclair (2001). Fatty acid and sterol composition of frozen and freeze-dried New Zealand green lipped mussel *Perna canaliculus* from three sites in New Zealand, Asian Pacific Journal of Clinical Nutrition, 12(1): 50-60.

Nair PG and Mathew S (2000). Biochemical composition of fish and shell fish, CIFT technology advisory series, pp.14.

Owen G (1966). Digestion in physiology of mollusk; Acsdemic press, New York, 53–69.

Rajkumar T (1995). Studies on biology of *Rapana rapiformis* (Born) (Mollusca: Gastropoda: Rapanidae) from Parangipettai. Ph.D.thesis; Annamalai University, India.

Ramakrishnan S and Venkat Rao S (1995). Nutrional biochemistry, T.R.Publication Pvt.Ltd. Madras, India.

Raymont JEG, Austine A and Lingfold E (1964). Biochemical studies on marine zooplankton. The biochemical composition of *Neonysis interger,* J. Cons. Int. Explor. Mer, 28:354-563.

Sargent J, Bell G, McEnroy L, Tocher D and EstevezA (1999). Recent development in essential fatty acids nutrition of fish, Aquaculture, 177: 191–199.

Sasser M, Kunitsky C, Jackoway G, Ezzell JW, Teska JD, Harper Parker S, Barden D and Blair H (2005). Identification of Bacillus anthracis from culture using gas chromatographic analysis of fatty acid methyl esters, J. AOAC Int, 88: 178-181.

Shanmugam A (1991). Variation in the major biochemical constituents in a salt marsh snail, *Pythia plicata* (Grey) in relation to its reproductive cycle, Mahasagar, 24(2): 113–118.

Shanmugam A, Bhuvaneswari T, Arumugam M, Nazeer RA and Sambasivam S (2006). Tissue chemistry of *Babylonia spirata* (Linnaeus), Indian J. Fish, 53(1) 33-39.

Saha.S (2004). Tissue chemistry of inflated clam *Katelysia opima* M.Sc. Dissertation, Annamalai University, India, pp 20 – 25.

Sundram KS (1974). Edible Gastropods the commercial molluscs of India; CMFRI Bull, Cochin, 25.

Tagore J (1989). Studies on the *Thaisidsthais biserialis* and *Thais bufo* (gastropoda: prosobranchia: thaisidae) from the tranquebar rocky shore south-east coast of India; Ph.D thesis, Annamalai University, India.

Thivakaran GA (1988). Studies on Littorinids *Littorina quadricentus* (Philippi *and Nodilittorina pyramidalis* Guoy and GaiMord, (Gastropoda: Prosobranchia from Tranquebar rocky shore, southeast coast of India. Ph.D. thesis, Annamalai University, India.

Umadevi V, Prabhakara rao Y and Prasada rao DGV (1985). Seasonal changes in the biochemical composition of a tropical intertidal prosobranch *Morula granulate,* Journal of Molluscan Studies, 51(3): 248–256.

Woodcock.S.H and Benkendorff.K (2008). The impact of diet on the growth and proximate composition of juvenile whelks, Dicathais orbita (Gastropoda:Mollusca), Aquaculture, 276: 162–170.

Xavier Ramesh M and Ayyakkannu K (1992). Nutritive value of *Chicoreus ramosus* – A status report, Phuket mar. Biol. Cent, 1(10): 33-34.

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BIOCHEMICAL EFFECT OF GINGER ON SOME BLOOD AND LIVER PARAMETERS IN MALE NEWZELAND RABBITS

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ABSTRACT: *The aim of the present study was to investigate the effects of different ginger rhizome treatments on hepatic oxidative stress markers and antioxidant status. Also, the study was extended to show the serum lipid profile, liver and kidney functions and serum glucose. Forty male New Zealand rabbits were allocated into four groups (10 rabbits in each); control, ginger powder, hot extract of ginger and cold extract of ginger. The results revealed that administration of ginger in its different forms significantly reduced malondialdehyde (MDA) level, glutathione peroxidase (GPX) and glutathione-S-transferase (GST) activities, meanwhile, the reduced glutathione (GSH) was significantly increased in liver. Moreover, ginger treatment depleted serum triacylglycerol (TAG), total cholesterol and low density lipoprotein-cholesterol (LDL-c) while the high density lipoprotein-cholesterol (HDL-c) was increased. Ginger administration improved liver functions but unfortunately, the serum creatinine and glucose levels were increased. We concluded that ginger especially hot extract maintain the antioxidant activities, improve liver functions and reduce lipid peroxidation.*

ORIGINAL ARTICLE

Key words: *Ginger, Cholesterol, Malondialdehyde, Glutathione*

INTRODUCTION

Plants have been the major source of drugs for the treatment of various diseases in many ancient systems of medicine in the world. Ginger is an underground rhizomes of plant Zingiber officinale belonging to the family Zingiberaceae which is widely consumed as spice for the flavoring of foods (Ajith et al., 2007). It has been reported that ginger and its extracts possess some pharmacological activities including hypoglycemic, insulinotropic and hypolipidemic in human (Huang et al., 2004) and in experimental animals (Kondeit et al., 2005). The anti-inflammatory and antioxidant properties in ginger help to relieve various inflammatory disorders like gout, osteoarthritis and rheumatoid arthritis (Habib et al., 2008). The antioxidants in ginger include gingerols, shogaols, monoterpenes, sequiterpenes, some phenolic derivatives and other phytochemicals which are responsible for their pharmacological activities (Li et al., 2001). Ginger acts as a hypolipidemic agent in cholesterol fed rabbits. Also, Akhani et al. (2004) reported that ginger treatment significantly decreased both serum cholesterol and triacylglycerol. In addition, Fuhrman et al. (2000) reported that ginger decreased LDL-cholesterol and triacylglycerol in apolipoprotein-E deficient mice. Many previous studies investigated the hepatoprotective effects of ginger extract against liver toxicity induced by ethanol, carbon tetrachloride, bromobenzene and acetaminophen with significant decrease in the level of ALT and AST (Mallikarjuna et al., 2008; El-Sharaky et al., 2009).

The present work was conducted to study the effect of ginger on liver antioxidant enzymes and glutathione content, serum lipid profiles and aminotransferases, urea, creatinine and serum glucose.

MATERIALS AND METHODS

Animals: Forty male New Zealand rabbits of 30±2 days old weighing 1800±250g were kept in clean and disinfected metal cages. Food and water were available *ad libidum*. All animals kept on basal ration composed of 16.3% crude protein, 11.7% crude fiber, 0.4% calcium, 0.32% phosphorus, 1.359% magnesium and of 2580 kcal digestible energy/kg ration. The animals were allowed to acclimatize for a period of two weeks before the commencement of the experiment.

Medicinal plant: Ginger *(Zingiber Officinale Roscoea)* was purchased from the market of the herbs in Alexandria and mixed with the basal diet along the period of experiment.

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Preparation of ginger extract:

2% Hot extract; 20 g of ginger powder was weighed then dissolved in 1 L of water and boiled, sieved, cooled and presented for animals each day freshly.

2% Cold extract; 20 g of ginger powder was weighed then soaked in 1 L of water for 10 hours, sieved and presented animals each day freshly.

Experimental design: All animals were allocated into four groups 10 rabbits/each as follow;

Group (1): control group kept on basal diet.

Group (2): ginger powder group received 2% ginger powder in basal diet.

Group (3): cold extract group received 2% cold extract of ginger in drinking water.

Group (4): hot extract group received 2% hot extract of ginger in drinking water.

The experiment was extended for one month.

Sampling: Blood samples were collected from ear vein of all animals under the experiment. Samples were centrifuged at 3000 rpm/15 min. the obtained clear, non-hemolyzed sera were kept at -20ºC until the time of analysis. The rabbits were slaughtered; eviscerated and liver tissues were harvested from the carcass and washed by normal saline, dried and weighed. The collected livers of each group were kept frozen at -20 ºC until the time of analysis.

Biochemical analysis

The determination of liver lipid peroxide as Malondialdehyde were measured spectrophotometrically after the reaction with thiobarbituric acid according to Placer et al. (1966); liver Glutathione peroxidase was determined chemically using cummene hydroperoxide as substrate according to Chiu et al. (1976); Glutathione-S-transferase activity was measured spectrophotometrically at room temperature as a rate of GSH conjugation of CDNB according to Habig et al. (1974); Glutathione was assayed by spectrophotometric technique according to Sedlack and Lindsay (1968).

The serum triacylglycerol was determined according to Fossati (1982); serum total cholesterol according to Thomas (1992); high density lipoprotein cholesterol according to Assmann (1979); serum low density lipoprotein cholesterol according to Bauer (1982); serum Alanine aminotransferase activity and serum Aspartate aminotransferase activity were determined according to Reitman and Frankel (1957); serum alkaline phosphatase activity according to Kind and King (1954); serum gamma glutamyl transferase activity according to Szasz and Persijn (1974); serum glucose according to Kaplan (1984); serum urea according to Tabacco et al. (1979); serum creatinine according to Henry (1984); serum testosterone concentration according to Demetriou (1987).

Statistical analysis

The data of biochemical parameters were compared among groups within periods using the GLM procedure of the Statistical analysis System computer package SAS, (1987). Means were compared by the LSMEAN of the same program. Data obtained were expressed in Mean ± SEM.

RESULTS

The liver lipid peroxidation (Malondialdehyde) content, glutathione peroxidase and glutathione-S-transferase and reduced glutathione concentration in rabbits fed basal diet supplemented with 2% ginger powder and ginger extract; hot and cold for 30 days are given in Table 1. All treated groups showed significant decrease of MDA concentration, and GST activity. The 2% hot extract of ginger treated group showed significant decrease of GPx activity, the ginger cold extract treated group showed also, significant decrease of GPx activity while, GSH concentration significantly increased as compared to control group.

Table 1 - Effect of ginger powder, hot and cold extract on liver lipid peroxidation (nmol/g wet tissue), antioxidant enzymes activity (IU/g wet tissue) and Glutathione levels (µmol/g wet tissue) in rabbits liver

	MDA	GPx	GST	GSH
Control group	62.2 ±1.73 ^{a}	8.26 ±0.66 ^{a}	137.67±19.4 ^{a}	28.6 ±0.11 ^{c}
Ginger powder 2%	39.5 ±2.67 ^{b}	9.12 ±0.65 ^{a}	25.11 ±1.99 ^{d}	37.99±0.86 ^{b}
Ginger hot extract 2%	31.6 ±2.49 ^{c}	5.17 ±0.66 ^{b}	60.36 ±5.47 ^{c}	41.37±0.84 ^{a}
Ginger cold extract 2%	38.4 ±3.44 ^{b}	4.32 ±0.53 ^{b}	98.84 ±4.57 ^{b}	37.62±1.15 ^{b}

Values are means ± standard errors. Means in a column without a common small letter differ significantly (P<0.05).

The serum lipid profile in rabbits fed basal diet supplemented with 2% ginger powder and ginger extract; hot and cold for 30 days are given in Table 2. The 2% ginger powder treated group showed significant decrease of triglycerides and total cholesterol while HDL-c significantly increased as compared to control group. The 2% hot extract ginger treated group showed highly significant increase of HDL-c and high decrease of LDL-c as compared to control group. The 2% cold extract of ginger treated group showed significant decrease of TAG and increase of LDL-c as compared to control group.

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Table 2 - Effect of ginger powder, hot and cold extract on serum lipid profile (mg/dl) in rabbits					
	TAG	Chol	HDLc	LDLc	VLDLc
Control group	91.3± 6.72 a	77.0±0.93 [a]	38.2±1.05 [c]	20.5±2.13 [b]	18.26±1.04 [a]
Ginger powder 2%	72.0±3.31 [b]	71.0±0.89 [b]	40.7±0.88 [b]	16.0±1.98 [b]	14.4±1.12 [b]
Ginger hot extract 2%	68.0±2.31 [b]	70.0±1.15 [b]	43.2±0.48 [a]	16.2±1.68 [b]	13.6±1.06 [b]
Ginger cold extract 2%	88.0±3.46 [a]	79.0±1.65 [a]	37.0±0.73 [c]	28.4±0.95 [a]	17.6±1.15 [a]

Values are means ± standard errors. Means in a column without a common small letter differ significantly (P<0.05).

The serum enzyme activities in rabbits fed basal diet for 30 days supplemented with 2% ginger powder and ginger extract; hot and cold for 30 days are given in Table 3. All treated groups showed significant decrease of serum aspartate and alanine aminotransferase, gamma glutamyl transferase and alkaline transferase activities as compared with control group.

Table 3 - Effect of ginger powder, hot and cold extract on serum enzyme activity (u/l) in rabbits				
	AST	ALT	ALP	GGT
Control group	62.2 ±1.73 [a]	8.26 ±0.66 [a]	137.67±19.4[a]	28.6 ±0.11 [c]
Ginger powder 2%	39.5 ±2.67 [b]	9.12 ±0.65 [a]	25.11 ±1.99 [d]	37.99±0.86 [b]
Ginger hot extract 2%	31.6 ±2.49 [c]	5.17 ±0.66 [b]	60.36 ±5.47 [c]	41.37±0.84 [a]
Ginger cold extract 2%	38.4 ±3.44 [b]	4.32 ±0.53 [b]	98.84 ±4.57 [b]	37.62±1.15 [b]

Values are means ± standard errors. Means in a column without a common small letter differ significantly (P<0.05).

The serum glucose, urea, creatinine and testosterone hormone concentration in rabbits fed basal diet supplemented with 2% ginger powder and ginger extract; hot and cold for 30 days are given in Table 4. The serum glucose and creatinine concentration were significantly increased, while the serum testosterone concentration was significantly decreased in all ginger-treated groups as compared to control one. The serum urea concentration only significantly decreased in 2% ginger powder treated group as compared to control one.

Table 4 - Effect of ginger powder, hot and cold extract on serum glucose, urea and creatinine concentration (mg/dl) and serum testosterone concentration (mg/dl) in rabbits				
	Glucose	Urea	Creatinine	Testosterone
Control group	65.0±1.34 [c]	38.3±0.88 [a]	0.99±0.03 [b]	4.72±0.17 [a]
Ginger powder 2%	80.0±1.83 [a]	33.3±0.99 [b]	1.21±0.03 [a]	1.51±0.19 [c]
Ginger hot extract 2%	72.2±2.32 [b]	30.2±1.01 [b]	1.14±0.01 [a]	2.72± 0.35 [b]
Ginger cold extract 2%	82.7±1.74 [a]	38.8±1.05 [a]	1.22±0.04 [a]	0.72±0.08 [d]

Values are means ± standard errors. Means in a column without a common small letter differ significantly (P<0.05).

DISCUSSION

The present study demonstrated that ginger treatment for thirty days significantly decreased the MDA concentration, GPx and GST activities and significantly increased concentration of GSH as compared to control group. Decreasing lipid peroxidation by ginger treatment may be attributed to its antioxidant activity as it contains many phenolic compounds which have inhibitory effect on lipid peroxidation, these phenolic antioxidants may conserve the antioxidant enzymes but increase SH- containing compounds including glutathione. This explanation was agreed with Ahmed et al. (2000) who reported that ginger significantly lowered lipid peroxidation by ameliorating the activities of the antioxidant enzymes; superoxide dismutase (SOD), catalase and glutathione peroxidase in rats. Moreover, Sujatha and Srinivas (1995) revealed that the aqueous extract of ginger inhibited lipid peroxidation and formation of diene, triene and tetraene conjugates in human erythrocyte membrane. Supplementation with ginger can reduce free radical mediated oxidative stress to the cells, the crude gingerol extract was found to have antioxidant activity (Asnani and Verma, 2009). Also, these results were in harmony with Liu et al., (2003) who recorded that administration of either 2% ginger or 5% ginger containing diets to hyperlipidemic rats showed increased GSH and decreased plasma lipid peroxide levels. The depletion of antioxidant enzymes may be explained as ginger offered protection to cells against oxidative stress by scavenging free radicals (Guo et al., 1997). This may be due to the presence of many antioxidative compounds like gingerols, shogaols, phenolic ketone derivatives, volatile oils and flavonoids in ginger, these antioxidant compounds may modulate spare the antioxidant enzymes (Young et al., 2005).

The hypolipidemic effect of ginger may be attributed to stimulation of the conversion of cholesterol to bile acids, an important pathway of elimination of cholesterol from the body by ginger. The activity of hepatic cholesterol-7-α-hydrolase, the rate limiting enzyme of bile acid biosynthesis from cholesterol was significantly elevated in ginger treated animals (Heeba and Abd-Elghany, 2010). Also, the hypocholesterolemic effects of ginger may be due to the inhibition of cellular cholesterol synthesis, since, ((E)-8 beta,17-epoxyllabed-12-ene-15,16 dial) compound was isolated from ginger and interfered with cholesterol biosynthesis in liver homogenate in hypercholesterolemic mice causing its reduction (Tanabe et al., 1993). Our results were in agreement with

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Bhandari et al. (2005) who demonstrated that the ethanolic extract of ginger significantly reduced serum total cholesterol and triglycerides and increased the HDL-c levels, also the extract can protect tissues from lipid peroxidation and exhibit lipid lowering activity in diabetic rats. However, our results were disagree with Rong et al. (2009) who reported that treatment of male and female rats with ginger powder up to 2000mg/ kg for 35 days did not affect serum total cholesterol and triglyceride levels. These differences may be attributed to different dose and sex used in the two experiments.

Administration of ginger improved liver function s as it reduced liver enzymatic activities. These results were in accordance with that of Mallikarjuna et al. (2008) who showed that administration of ginger ethanolic extract (200 mg/kg) orally from day 15 to day 21 along with country-made Liquor (CML) produced significant lowering of AST, ALT, ALP and tissue lipid peroxide levels.

Treatment of ginger significantly decreased serum urea and increased serum creatinine concentration since, ginger contain polyphenols and flavonoids that influence removing certain waste products from plasma. These results agree with Ajith et al., (2007) who reported that the presence of polyphenols and flavonoids in ginger extract might be responsible for the antioxidant nephroprotective activities and the reduction of serum urea and creatinine levels. Creatinine is an organic base formed during muscle protein metabolism as a degradation product of Creatine phosphate. Like many other organic bases, creatinine is filtered at the glomerulus and eliminated from plasma by the kidney. It means that creatinine is filtered only but is not reabsorbed; therefore ginger might have little influence on its excretion, whereas urea is filtered and reabsorbed partly in the nephron. In addition the relation of urea to the water reabsorption may cause extra cellular contraction, which consequently resulted higher concentration of substances such as creatinine in plasma (Mehrdad et al., 2007); this may be the reason for higher significant level of creatinine in rabbits receiving 2% ginger. However, Dias et al. (2006) found that serum creatinine levels were not modified by ginger treatment.

Serum testosterone level significantly decreased, since ginger at higher doses may reduce testicular mass due to feedback reaction while serum glucose level was significantly increased. Our results concerning testosterone were agree with Rong et al. (2009) that oral administration of ginger powder at 2000mg/kg for 35 days slightly but significantly decreased the weight of testes in rats. Also, Morakinyo et al. (2010) reported significant decrease in the weight of testes and serum testosterone concentration in rats given oral aqueous ginger extract (500mg/kg body weight) for 30 days. The decrease in the level of testosterone may be contributed to decrease level of cholesterol as observed in our results which is a precursor of steroid hormone biosynthesis. However, our results were disagree with that of Mallikarjuna et al., (2008) who recorded that aqueous ginger extract administered orally over 8 days significantly increased the weight of testis and the serum testosterone levels in rats. Moreover, Khaki et al., (2009) who reported that serum testosterone level increased significantly in rats received 100 mg/kg body weight for 8 weeks. These discrepancies in the results may be attributed to the dose and the duration of experiment.

Unfortunately, our results regarding blood glucose were disagree with, Sakr, (2007) who reported that Ginger was found to decrease blood glucose in adult male rats. Also, Supplementation with ginger oil significantly reduced the level of blood glucose (9.38%) in non-diabetic rats (Al-Attar and Zari, 2007). However, Weidner and Sigwart, (2000) failed to reproduce the hypoglycemic effect of ginger extract with doses 25, 50 and 100 mg/kg in rats and rabbits. Also Bordia et al. (1997) demonstrated that no effect on blood glucose sugar was observed in healthy human and patients with coronary arterial disease when given 4 gm of ginger daily for 3 months. Even administration of ginger powder to rats up to 2000mg/kg for 35days and 1%, 2%/kg diet for 30 days did not affect serum glucose that suggested that ginger not interfere with glucose metabolism under physiological status (Shanmugam et al., 2011).

CONCLUSION

The use of ginger was beneficial in lowering lipid profiles and lipid peroxidation and has hepatoprotective and nephroprotective effects, but its effect on serum sugar and testosterone levels need further more studies.

REFFERENCE

Ahmed RS, Seth, V and Banerjee, BD (2000). Influence of dietary ginger (Zingiber officinales Rose) on antioxidant defense system in rat: comparison with ascorbic acid. Indian J. Exp. Biol., 38: 604–606.

Ajith TA, Nivitha V and Usha S (2007). Zingiber officinale Roscoe alone and in combination with alpha-tocopherol protect the kidney against cisplatin-induced acute renal failure. Food. Chem. Toxicol., 45(6): 921-927.

Akhani SP, Vishwakarma, SL and Goyal, RK (2004). Anti-diabetic activity of Zingiber officinale in streptocin-induced type I diabetic rats. Journal of Pharmacy and pharmacology, 56: 101-105.

Al-Attar, AM and Zari, TA (2007). Modulatory effects of ginger and clove oils on physiological responses in streptozin-Induced diabetic rats. International Journal of Pharmacology, 3 (1): 34-40.

Asnani VM and Verma RJ (2009). Ameliorative effects of ginger extract on paraben-induced lipid peroxidation in the liver of mice. Acta Poloniae Pharmaceutica. Drug Research, 66(3): 225-228.

Assmann G (1979). Determination of high density lipoprotein cholesterol. Internist., 20: 559.

Bauer, JD (1982). Clinical Laboratory Methods. 9th Ed., The C.V. Company, Westline Industrial Missouri 63116. Chapter 33: Pp. 555.

Bhandari U, Kanojia R and Pillai KK (2005). Effect of ethanolic extract of Zingiber officinale on dyslipidemia in diabetic rats. J. Ethnopharmacol., 97: 227-230.

Bordia A, Verma, SK and Srivastava KC (1997). Effect of ginger (Zingiber officinale Rosc.) and fenugreek (Trigonella foenumgraecum L.) on blood lipids, blood sugar and platelet aggregation in patients with coronary artery disease. Prostaglandins Leukot. Essent. Fat. Acids, 56: 379–84.

Chiu D, Fredrick H and Tappel AL (1976). Purification and properties of rat Lung soluble glutathione peroxidase. Biochemica et Biophysica Acta, 445: 558-566.

Demetriou, JA (1987). Testosterone in methods. In Clinial Chemistry TECH, A.G. and Kaplan, L.A.(eds)2nd Ed. CVMosby Co., pp. 268.

Dias MC, Spinardi-Barbisan ALT, Rodrigues MAM, De Camargo JLV, Tera´n E and Barbisan LF (2006). Lack of chemopreventive effects of ginger on colon carcinogenesis induced by 1,2-dimethylhydrazine in rats. Food and Chemical Toxicology, 44: 877–884.

El-Sharaky AS, Newairy AA, Kamal MA and Eweda SM (2009). Protective effect of ginger extract against bromobenzene-induced hepatotoxicity in male rats. Food Chem. Toxicol., 47: 1584-1590.

Fossati P (1982). Enzymatic colorimetric determination of triglycerides. Principle, L. Clin. Chem., 28:2077.

Fuhrman B, Rosenblat M, Hayek T, Coleman R and Aviram M (2000). Ginger extract consumption reduces plasma cholesterol, inhibits LDL oxidation and attenuates development of atherosclerosis in atherosclerotic, apolipoprotein E-deficient mice. J. Nutr., 130(5): 1124–1231.

Habib SHM, Makpol S, Hamid NA, Das S, Zurinah W, Ngah W and Yusof YAM (2008). Ginger extract (Zingiber officinale) has anti-cancer and anti-inflammatory effects on ethionine-induced hepatoma rats. Clinics, 63: 807-813.

Habig WH, Pabst MJ and Jakoby WB (1974). Glutathione S-transferases: the first enzymatic step in mercapturic acid formation. J. Biol. Chem., 249: 7130-7139.

Heeha GH and Abd-Elghany MI (2010). Effect of combined administration of ginger (Zingiber officinale Roscoe) and atrovastatin on liver of rats. Phytomedicine, 111: 654-659.

Henry JB (1984). Clinical diagnosis and management, 17th edition, Saunder Publisher.

Huang CN, Horng JS and Yin MC (2004).Antioxidative and antiglycative effects of six organosulfur compounds in low density lipoprotein and plasma. J. Agric. Food Chem.52 (11): 3674-3678.

Kaplan LA (1984). Glucose. Clin Chem. The C. V. Mosby Co. st Louis. Toronto. Princeton; 1032-1036.

Katiyar SK, Agrawal R and Mukhtar H (1996). Inhibition of tumor promotion in SENCAR mouse skin by ethanol extract of Zingiber officinale rhizome. Cancer Res. 56: 1023-1030.

Kind P and King E (1954). Estimation of plasma phosphate by determination of hydrolysed phenol with aminoantipyrine. J. Clin. Pathol., 7:322.

Khaki A, Fathiazad F, Nouri M, Khaki AA, Ozanci CC, Ghafari-Novin M and Hamadeh M (2009). The effects of ginger on spermatogenesis and sperm parameters of rat. Iranian J. Reproduc. Med., 7(1): 7-12.

Kondeti RS, Korivi M, Kesireddy N, Kuo CH and Kiesireddy SR (2011). Protective effect of dietary ginger on antioxidant enzymes and oxidative damage in experimental diabetic rat tissues. Food Chem. 124 (4): 1436-1442.

Li WG, Zhang XY and Wu, Y (2001). Anti-inflammatory effect and mechanism of proanthocyanidine from grape seeds. Acta Pharmacologic sinica, 22:1117-1120.

Liu N, Huo, G, Zhang, L and Zhang, X (2003). Effect of Zingiber officinale_Rosc on Lipid peroxidation in hyperlipidemic rats. Wei Sheng Yan Jiu, 32:22-23.

Mallikarjuna, K, Sahitya Chetan, P, Sathyavelu Reddy, K and Rajendra, W (2008). Ethanol toxicity: Rehabilitation of hepatic antioxidant defense system with dietary ginger. Fitoterapie, 79:174-178.

Mehrdad, M, Messripour, M and Ghobadipour, M (2007). The effect of ginger extract on blood urea nitrogen and creatinine in mice. Pakistan J. Biol. Sci., 10 (170: 2968-2971.

Morakinyo, AO, Achema, PU and Adegoke, OA (2010). Effect of Zingiber Officinale (ginger) on sodium arsenite-induced reproductive toxicity in male rats. Afr. J. Biomed. Res. 13: 39-45.

Placer ZA, Crushman L and John Son BC (1966). Estimation of product of lipid peroxidation (malondialdehyde) in biochemical systems. Anal Biochem., 16: 359-364.

Reitman S and Frankel S (1957). A colorimetric method for determination of glutamic pyruvic transaminase. Am. J. Clin. Pathol., 25: 56.

Rong X, Peng G, Suzuki T, Yang Q, Yamahara J and Li Y (2009). A 35-day gavage safety assessment of ginger in rats. Regulatory Toxicology and Pharmacology, 54: 118-123.

SAS (1987). Statistical Analysis System. User Guide: Statistics. SAS Institute Cary, North Carolina.

Sakr SA (2007). Ameliorative effect of ginger (*Zingiber officinale*) on mancozeb fungicide Induced liver injury in albino rats. Aust. J. of Basic and Appl. Sci., 1(4): 650-656.

Sakr SA, Okdah YA and El-Adly EK (2009). Effect of ginger (Zingiber officinale) on mancozeb fungicide-induced testicular damage in albino rats. Aust. J. Basic and Appl. Sci., 3(2): 1328-1333.

To cite this paper: Lebda MA, Taha NM, Korshom MA, Mandour AEIA, El-Morshedy AM. 2012. Biochemical effect of ginger on some blood and liver parameters in male Newzeland rabbits. *Online J. Anim. Feed Res.*, 2(2): 197-202.
Scienceline/Journal homepages: http://www.science-line.com/index/; http://www.ojafr.ir

Sedlack J and Lindsay RH (1968). Estimation of total protein bound and non protein sulfhydryl groups in tissues with Ellman reagent. Anal. Biochem., 86: 271-278.
Shanmugam KR, Mallikarjuna K, Nishanth K, Kuo CH and Reddy KS (2011). Protective effect of dietary ginger on antioxidant enzymes and oxidative damage in experimental diabetic rat tissues. Food Chemistry, 124: 1436-1442.
Sharma SS and Gupta YK (1998). Effect of ginger (Zingiber officinale) against cisplatin induced delay in gastric emptying in rats. J. Ethnopharmacology 62: 49-55.
Sujatha R and Srinivas L (1995). Toxicol. In Vitro, 9: 231.
Tabacco A, Meiathini F, Moda E and Tarli P (1979). Simplified enzymic/colorimetric serum urea nitrogen determination. Clin Chem 25:336-337.
Tanabe M, Chen YD, Saito K and Kano Y (1993). Cholesterol biosynthesis inhibitory component from Zingiber officinale Roscoe. Chem. Pharm. Bull., (Tokyo) 41: 710–713.
Thomas L (1992). Enzymatic colorimetric determination of cholesterol. Labor ND Diagnose. 4th Ed.
Weidner MS and Sigwart K (2001). Investigation of the teratogenic potential of a Zingiber officinale extract in the rat. Reprod. Toxicol., 1575–1580.
Young HY, Luo YL, Cheng HY, Hsieh WC, Liao JC and Peng WH (2005). Analgesic and anti-inflammatory activities of (6) gingerol. J. Ethnopharmacology 96 (1-2): 207-210.

To cite this paper: Lebda MA, Taha NM, Korshom MA, Mandour AEIA, El-Morshedy AM. 2012. Biochemical effect of ginger on some blood and liver parameters in male Newzeland rabbits. *Online J. Anim. Feed Res.*, 2(2): 197-202.
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EFFECT OF GROWTH STAGES AND RANGE SYSTEMS ON VEGETATION ATTRIBUTES, CARRYING CAPACITY, STOCKING RATE AND FORAGE PRODUCTIVITY, NORTH KORDOFAN, SUDAN

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ABSTRACT: *The range vegetation attributes, carrying capacity, stocking rates and forage productivity were studied in close and open range systems at the flowering and seed setting stages during the September and November 2010, respectively, in El Rosa (El-khuwei locality). Sampling was done by locating 2Km² in close and open range systems in a radiating manner from the centre of each site. Completely Randomized Design (CRD) was used to analyses treatments. Biomass production of plants and plant cover at the flowering stage in the close range system were significantly (P<0.0001) higher than that at the seed setting stage in the open range system. The plant density was significant (P<0.05) higher in the close rang system at the flowering stage and lower at the seed setting stage in the open range system. Bare soil and litter was significantly higher (P<0.0001) in the open range system during the seed setting stage and lower in the close range system during the flowering stage. Forage productivity of plants and shrubs browse kg/ha on rangeland was significantly higher (P<0.05) in the close range system during the flowering stage and lower in open range system at the seed setting stage. Carrying capacity was significantly higher (P<0.0001) in the close range system at the seed setting stage and lower in the open range at the flowering stage. Stoking rates in open range system during the seed setting stage was significantly higher (P<0.0001) and lower in the close range system during the seed setting stage. The frequencies of Huskneet (Cenchrus biflorus), Bano, (Eragrostis tremula), Difra (Echinocloa colonum), leflef Luffa aegyptiaca, Gaw (Aristida sp), Shuleny Zornia glochidiata and Aborakhus* Andropogon gayanus were higher in close system during the two stages of growth. Plants such as *Abodaib Ceraotheca sesamoid, Bigual Blepharis linarifolia, Tmrfar (Oldenlandia senegalensis), Rabaa (Zalea sp), Himeira* Hymerocardia, *Diresa (Tribulus terrestris) and Huntot Merremia pinnata recorded higher frequencies in close range system during the flowering stage than in the open range system during the seed setting stage. The Nuida Sida cordofolia had highest frequency in the open range system* during the two stages of growth.

Key words: *Biomass, Cover, Density, Bare Soil, Litter and Frequency, Forage Productivity, Carrying Capacity, Stoking Rates*

ORIGINAL ARTICLE

INTRODUCTION

Natural grasslands generally occur in climates that are either too dry or too cold for forest to persist, for example arid or semi-arid areas, monsoonal tropics with a long dry season, mountainous areas above the tree line (Alps) or tundra's in the arctic regions. Therefore, there are generally no natural grasslands in equatorial or temperate lowlands with humid or sub-humid climates. Grasslands are also more likely to occur on heavy-texture soils or in areas that are regularly burnt (Moore, 1964). In humid and sub-humid climates most grasslands are induced (man made), because the climate lacks the conditions needed for natural grasslands. Generally speaking, land is used for animal production from grassland only when other more profitable land useful systems are not possible. Thus, even natural grasslands, such as the prairies in North America, pampas in Argentina, llanos in Colombia, cerrados in Brazil, downs in Australia, steppe in Russia and pusta in Eastern Europe, have been converted to croplands when soil conditions and rainfall were sufficiently favorable for cereal production (Moore, 1964). The species composition of rangeland varies depending on topography, climate and soil types (Skerman,

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1977). Different grasslands contain diverse types of grasses, legumes, and other herbaceous species. The botanical composition of plant community can also change due to factors like altitude, grazing practices, burning, drought, and temperature effects, pest, and erosion. Therefore, due to, the productivity of an area in terms of its capacity to support livestock may change. Change in plant composition results as a result of the adaptability of the plant species to these influences over a period of time Skerman (1977).

The area of North Kordofan is about 25 million ha which is 14.5 million ha are rangeland (AFRICOVER, 2004) it is considered among the leading regions of Sudan in terms of animal and range resources, where more than 13 million heads of sheep, goats, camels and cattle are present (RPA, 2005). Animal production in the North Kordofan is mainly practiced under traditional extensive systems, depending on natural rangeland (Cook and Fadlalla, 1987). Cattle dominate the southern part of the State, while sheep, goats and camels are present in larger numbers in the northern drier part (El-Hag, 1993). Feed resources about 90% of livestock are from traditional pastoral systems, mainly in the western parts of Kordofan and Darfur states and in the southern states. The long term average annual rainfall is about 300-mm, consisting of storms of short duration between July and September with the highest rainfall generally occurring in August. The main objective of this paper was to investigate the effects of range system on vegetation attributes, carrying capacity and stocking rate, North Kordofan, Sudan.

MATERIALS AND METHODS

Study area

This study was conducted at El-khuwei locality (El Rosa). It lies between longitudes 28˚:33' and 28˚:30'N and latitudes 12˚:14' and 14˚:12'E, about 105 Km west of El Obeid town. North Kordofan State lies between latitudes 11˚:20' and 16˚:36'N and longitudes 27˚:13' and 32˚:24'E. The close range system was established in 2007 in an area of about 500 ha, at El-khuwei locality which is a large export market of animals (Hamari sheep) in western Sudan according to (MAR, 2009). The long term average annual rainfall is about 300-mm, consisting of storms of short duration between July and September with the highest rainfall generally occurring in August. The average monthly temperature according to Nimer (2000) is during l987-2002 in El Obeid town (34.6°C) and the coldest months are December and January with mean temperatures of 14.l°C and 13.5°C, respectively. The hottest months are April, May and June with an average mean temperature exceeding 30°C. The soil of the site lies within the sand dune area locally known as "Goz" soil. The site is naturally dominated by grasses namely Huskneet (*Cenchrus biflorus),* Shilini (*Zornia glochidiata*), Bigail (*Blepharis linarifolia*) and Aborakhus (*Andropogon gayanus*). The trees included Humied (*Sclerocarya birrea*), Higlig (*Balanites aegyptiaca*) and Sider (*Zizuphus spina- Christi).* The Shrubs include Kursan (*Boscia senegalensis*), Usher (*Calotropis*), Mereikh (*Leptadenia pyrotechnica*) and Arad (*Leptadenia pyrotechnica)* according to MAR (2009).

Layout of the experiment

Sampling was done by locating 2Km^2 in the closed and open range system at two different growth stages flowering and seed setting was used to compare vegetation attributes, carrying capacity, stocking rate and forage productivity at each site eight transects of 500m length were located in a radiating manner from the center of the sample site according to Fadlalla and Cook, (1985).

Measurements of Vegetation Attributes

Measuring cover: The traditional loop method was used to measure cover, litter and bare soil according to Parker and Harris (1959). Within the selected plots, 16 transects readings were made, each transect was 100m long. The measurements were taken along each transect using a 100m plastic tape. All parameter were recorded at ten-meter interval, using 3/4'' loop to obtain 100 observations. The data was recorded in specified sheets.

Biomass productivity of plants: The double sampling procedure (Wilm et al., 1944) was used to measure biomass production of plants. Samples selected in close and open quadrates within eight transect 500m long were taken in a radiating mater. At each transect 10 quadrates of 1m^2 were placed at 50m intervals. The three observers' together estimated the weight of the 10 quadrates in the plot, only the 3rd, 7th and 10th estimated first and then cut and weighed. The cut samples were oven dried at 80^{o}C for 24 hours and their dry weights recorded and determine the actual weight of available plants in quadrates and calculated that by average weight in closed and open rangeland.

Density and frequency of pasture: Density and frequency readings were obtained from the same quadrates used in double sampling procedure. Samples selected in close 80 and open 80 quadrates within eight transect 500m long were taken in a radiating mater were at each transect 10 quadrates of 1m^2 were placed at 50m intervals selected samples. Density was determined by counting the number of plants rooted within each quadrate. Frequencies was determined by counting the number of quadrates that containing the species and divide that number by the total number of quadrate used as a percentage individual of a given species according to Morrison et al. (1995) and Kira et al. (1953).

Available browse productivity of shrubs

The Adelaide technique (Andrew et al., 1979) was used to obtain the productivity of shrubs. In this technique, three observers were involved in the simply. Five calibration or standard shrubs were selected at different height classes not exceeding 1.5m. These shrubs were tagged with masking tap. Hand- held production unit for each shrub

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was used to estimate the unit equivalent in each selected shrubs, and then available shrubs production units were visually estimated. Then twigs of 2mm in diameter were cut, oven dried at 105˚C to determine the actual weight of available browse.

Assessment of Carrying Capacity and Stocking Rates

Carrying capacity: Carrying capacity can be used equation:

$$\text{Carrying capacity} = \frac{\text{Annual forage consumption}}{\text{Available forage productivity (kg/ha)}}$$

Carrying capacity calculated by using the following:

Forage productivity (kg/ha)

1- Forage requirement per animal unit/ month/ year
2- Proper use factor % to obtain available forage for proper use 50%
3- Duration of grazing month or year

Stocking rate: For stocking rate in this case is gussets use carrying capacity and area of the range system in the closed and open range and used the following equation AUM/ year:

$$\text{Stocking rate} = \frac{\text{Area (close and open)}}{\text{Carrying capacity}}$$

Statistical Analysis

CRPD and Duncan Multiple Range test was used for mean separation (Steel and Torrie, 1960). SPSS (Statistical Package for Social Sciences) was used for the statistical analyses.

RESULTS AND DISCUSSION

Biomass productivity of plants

Biomass productivity of plants in the close range system at flowering stage was significantly ($P<0.0001$) higher than in open range system at seed setting stage (Table 1). Highly significant ($P<0.0001$) system x growth stage interaction effects was found for biomass productivity. Biomass yield was higher at the flowering and seed stage in the close system and lower in the open range system. These differences in biomass production could mainly due to, the erratic and inadequate rainfall in the rangeland leads to lower forage biomass productivity. These differences in biomass production could mainly be because grazing negatively affects plant communities sometimes, when not at time or the proper stocking rate (HTS, 1975). Dry materials grazing causes relatively little damage to growth in the following season, and grazing during the seed setting stage, causes potentially permanent damage and reduces forage production (HTS, 1975). According to Jerry and Holechek (1989), the amount of rangeland in the world is expected to decline substantially in the next 30 years, and large areas of rangelands in Africa and South America have already been converted to farmland. The main problem of Africa rangelands is the expansion of agriculture into grazing areas (Garcia, 1981). Laca et al. (2001) indicated that at too low or too high levels of plant biomass, rates of nutrient intake are reduced. Intake is influenced by three factors: bite size, bite rate, and grazing time (intake = bite size x bite rate x grazing time). Intake rate is most sensitive to bite size – too little or too much plant biomass diminishes bite size, and either increases (too little forage) or decreases (too much forage) bite rate and grazing time, all of which can diminish animal performance.

Plant density

The plant density was significantly ($P<0.05$) higher in the close range than in open range system (Table 1). At flowering stage plant density was significantly higher ($P<0.0001$) than at seed setting stage. A significant range system x growth stage interaction for plant density was detected, were at flowering stage in the close range, plant density highest density was higher. Ministry of Forests wills, (1994) reported that controlling seasonal drift use among forage types or protecting choice grazing areas for selective use, and protecting critical sites from grazing where required. Livestock grazing patterns should be observed prior to new fence construction, prefer to spend their time on grasslands rather than in forested sites. Because many grassland sites on the protected area are being encroached by forest, livestock distribution is being impacted. Control of forest encroachment will improve livestock distribution and overall forage production.

Plant cover

Plant cover was significantly ($P<0.0001$) higher in close range than in open range (Table 1). At flowering stage plant cover was significantly higher ($P<0.05$) than at seed setting. Range system x growth stage interaction for plant cover was highly significant. Plant cover at the flowering in the close system was the highest; while at seed setting stage in the open range system was lowest. Frequent occurrence of droughts in 1967/84, 1990/91 and the Sahel drought further accentuated rangeland deterioration. Overstocking and sever intermittent and prolonged droughts further exacerbate the low forage availability decreased animal production (RPA, 1993). Ministry of Forests wills, (1994) reported that fencing is an excellent management tools for controlling plant cover, animal and confirming them to a particular grazing area for an appropriate time.

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Bare soil

Bare soil was significantly higher (P<0.0001) in the open range system that in the close range system (Table 1). At seed setting stage, bare soil was significantly higher than in flowering stage. Range system x growth stage interaction for bare soil was significant. The higher bare soil was found in open range at seed setting stage, while the lowest value was found in close range at flowering stage. This situation is related to the main problems associated with rangeland management and over-stocking leads to progressive reduction in biomass production and plant cover, in arid and semi-arid areas over stock leads to soil degradation (Strang, 1980). Norton (1991) found that the contribution of plant litter to the soil surface enriched organic matter content and concentrated nutrient extracted from deeper horizons. He presumed low level of competition between the species and under storey grasses due to different rooting behavior and suggested that water penetration is improved under the plant canopy.

Litter

The litter was significantly higher (P<0.001) in the open range system than in the close system (Table 1). The effect of growth stage on litter was not significant. Range system x growth stage interaction for litter was significant. Higher litter was found in open range system at seed setting stage. The close range system was protected by fancies; however in the open range system, animals allowed to graze in large numbers, so small litter cover is found. Skerman (1966) stated that replacement of perennials by annuals in arid and semi-arid region was attributed to the removal of litter and ground cover by continuous overgrazing and over cultivation.

Available browse of shrubs and forage productivity

Available browse of shrubs and forage productivity kg/ha on rangeland was significantly higher (P<0.05) in the close range system at the flowering stage than in the open range system and lower at seed setting stage (Table 2). Harrison and Jackson (1958) reported that decrease in the productivity of shrubs browse and forage productivity as affected by degradation and desertification, for the Semi Desert in the North Kordofan and Darfur and low rainfall savannah on sand soil area. In most of the grasslands under seasonal rainfall areas, shrubs make considerable contribution to stock feed especially in the dry season. Goats, cattle and to a lesser extent sheep may all obtain an appreciable proportion of their feed from leaves, flowers, pods, twigs, seeds and even the bark of a large number of species. Wilson (1959) stated that in many places it is a normal practice for native herdsmen to lop branches of certain trees and throw them on the ground for their animals to eat during the dry season. In Africa, probably about 75% of the trees and shrubs are browsed to greater or lesser extent by domestic animals (Webster and Wilson, 1966).

Carrying capacity

Carrying capacity was significantly higher (P<0.0001) in the close range system at the seed setting stage than in flowering stage and lower in the open range system at flowering stage (Table 2). Coppock (1994) reported that the degradation of rangeland is generally caused by poor management of rangeland resources. Louis (1989) defined the major problem of the pastoral regions as over-stocking leading to certain ecological disaster, too little lands, the local rangeland could not carry an increased cattle population and that beside localized problems, and the quality of the environment is deteriorating. At times of drought, pressure on grazing land and water resources is leading to marked deterioration in range productivity (Pears, 1970).

Stoking rates

Stoking rates in open range system during the seed setting stage was significantly higher (P<0.0001) and lower in the close range system during the flowering stage (Table 2). The high similarity indices in the late-dry period were expected because warm-season species had not yet begun rapid growth and the least amount of forage was available. With higher forage availability (late-wet period) the similarity index was low, reflecting the effect of stocking density. Low overlap during wet times occurred when goats on the lightly stocked site concentrated more on forbs than goats on the heavily stocked site Walker et al. (1994). Perhaps the main factor determining stocking rate is the density of the plants infestation and the palatability of the plant. Sparse infestations of relatively nutritious, palatable plants like spotted knapweed may be best controlled with light stocking rates of sheep that can take advantage of the animal's preference for the plant. More dense infestations or less palatable weeds may require a heavy stocking rate to force a more even utilization of forage. In extremely dense infestations, animals are often "mob stocked" to facilitate complete removal of all forage (Hanselka and Paschal, 1992).

Species frequencies

Plant frequencies were higher in close range system during the two growth stages than in open range system (Table 3). Higher frequencies on the Huskneet, Bano, Difra, Leflef, Gaw, Shilini and Aborakhus, wily Fresha was lower frequency. However Abodaib, Bigual, Tmrfar, Rabaa, Himeira, Diresa and Hantoot recoded frequencies only in close range system at the flowering stage. Nuida were higher frequencies in open range system at the two stages. Indirect relevance to animal production; because the relations between yield and frequency, number or area will differ between species, their role is mainly to describe and quantify the population of plants in the pasture (Mannetje, Jones and Stobbs, 1976). Range condition is based on density and production of native, palatable,

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perennial grasses (Holechek, 1984). A better criterion might be the diversity of palatable forage species (Holechek, 1984). It might be desirable if up to 20% of yearly forage production is composed of palatable annuals. Annual forbs are important in nutrition of cattle, sheep, and pronghorn diets and reduce pressure on palatable perennial grasses during the growing season. The greater the forage selection provide to domestic or wild ungulates, the more likely it would meet their nutrient (Holechek, 1984).

Table 1 - Effect of growth stages and range systems on vegetation attributes and biomass of plants at El Rosa, North Kordofan State, Sudan

Parameter	Biomass (kg/ ha)	Density (p/ m²)	Cover (%)	Bare soil (%)	Litter (%)
System					
Close	2028.9	34.86	75.27	14.84	9.89
Open	1205.3	26.58	65.01	22.87	12.20
Mean	1617.1	32.45	70.14	18.85	11.04
SE±	74.5***	1.775*	0.58***	0.49***	0.35**
Season					
Flowering	1922.6	35.381	73.61	16.05	10.47
Seed setting	1311.6	27.19	66.67	21.65	11.62
Mean	1617.1	32.45	70.14	18.85	11.04
SE ±	74.5***	1.77 ***	0.58***	0.49***	0.35
Season x system					
Flowering x close	2261.2a	39.562a	78.14a	11.86d	10.00c
Flowering x open	1584.1b	30.16b	69.08b	20.24b	10.94b
Seed x close	1796.7c	27.52c	72.41c	17.81c	9.77d
Seed x open	826.4d	26.58d	60.94d	25.49a	13.46a
Mean	1617.1	32.45	70.14	18.85	11.04
SE ±	74.5***	1.77 ***	0.58***	0.49***	0.35*

Means in the same column under the same factor with different letters are significantly different. * = significant (P < 0.05), ** = high significant (P < 0.001) and *** = highly significant. (P < 0.0001). a, b, c = marginal mean.

Table 2 - Shrubs browse, forage productivity, carrying capacity and stocking rates in close and open range at the flowering and seed stage in El Rosa, North Kordofan State, Sudan

System	Plants (kg/ha)	Browse (kg/ha)	Forage (kg/ha)	CC (AU/ha/year)	S R (AUM/year)
Close	202.9	190.0	203.1	0.750	36.000
Open	120.5	140.0	120.7	0.450	60.000
Flowering	192.3	0.800	192.3	0.710	38.030
Seed setting	131.2	0.500	131.2	0.480	56.250
Mean	161.7	115.0	161.8	0.597	47.570

* = significant (P < 0.05), ** = high significant (P < 0.001) and *** = highly significant (P < 0.0001).

Table 3 - Species frequencies % in close and open range systems during the flowering and seed setting stages in El Rosa, North Kordofan State, Sudan

Plant species		Flowering stage		Seed stage	
Latin names	**local name**	**Close**	**Open**	**Close**	**Open**
Cenchrus biflorus	Huskneet	27.02	18.82	25.97	23.96
Eragrostis tremula	Bano	18.09	15.93	16.95	14.95
Echinocloa colonum	Difra	11.45	11.93	10.91	10.06
Luffa aegyptiaca	leflef	10.23	10.11	9.94	9.50
Aristida sp	Gaw	9.06	8.98	8.99	7.93
Zornia glochidiata	Shuleny	7.53	6.84	6.97	6.82
Andropogon gayanus	Aborakhus	7.13	6.94	6.75	6.84
Ceraotheca sesamoid	Abodaib	2.41	-	2.33	-
Blepharis linarifolia	Bigual	2.37	-	2.00	-
Oldenlandia senegalensis	Tmrfar	2.33	-	1.83	-
Zalea sp	Rabaa	2.06	-	1.71	-
Hymenocardia acida	Himeira	2.00	-	1.45	-
Tribulus terrestris	Diresa	1.46	-	1.02	-
Merremia pinnata	Hantoot	1.44	-	1.00	-
Tephrosia sp	Fresha	1.38	1.07	1.00	1.00
Sida cordofolia	Nuida	1.37	19.38	1.00	18.94

CONCLUSIONS

+ All vegetation attributes and forage productivity were higher in close range system.
+ Bare soil and litter were higher in open range system.
+ Carrying capacity was higher in the close range system at the seed setting stage.
+ Stoking rates was higher in close range system during the flowering stage.

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RECOMMENDATIONS

In addition to it is therefore could be recommended that increase vegetation attributes and forage productivity a significant in the open range needed more management and improvement.

REFERENCES

Africover (2004). *Sudan Spatial Aggregated Map, Afrikaner Project, FAO, Rome, Italy.*

Andrew MH, Noble IR and Lange RT (1979). *Anon-Destructive method for estimating the weight of forage on shrubs*. Aust. Range, I.J.I:225-231.

Cook RH and Fadlalla A (1987). *Seasonal Variation in plasma phosphorus Level* of transhumant sheep in Kordofan, Sudan. Trop. prod. 19: 57-62.

Coppock DL (1994). The Borana plateau of southern Ethiopia: *synthesis of pastoral research, development and change,* 1980-1991. *ILCA (International livestock Center for Africa),* Addis Ababa.

El-Hag FM (1993). *Conserved range grasses for dry Season feeding goats In shiekan province,* North Kordofan, Sudan, El Obied Agricultural Research Station, 1:1-2.

Fadlella B and Cook RH (1985). Design and implementation of in-herd/on-range trials: use of sentinel herds. In: *Research methodologies for livestock on-farm trials.*

Garica VR (1981). Drought and man. The 1974. Case history: *nature pleads not guilty. Vol. 1 Pergamum*.

Hanselka CW and Paschal JC (1992). *Brush utilization on the Rio Grande Plains. Rangelands.* 14: 169-171.

Harrison N and Jackson TK (1958). *Ecological Classification of the Vegetation* of Sudan.

Holechek J L (1984). Comparative contribution of grasses, forbs, and shrubs to the nutrition of range ungulates. Rangelands 6, 245-248.

HTS (Hunting Technical Services) (1975*).* Livestock and range investigation Ghazala Gawazt. Savannah development project phase.

Jerry Land Holechok Rex (1989). *Range Management Principal and Practices*. Prentice Hall. Inc. England cliff, New Jersey.

Kira T, Ogawa H and Shinozaki K (1953). Inter- a specific composition among higher plants. Competition–density–yield inter-Relationships in regularly *Journal of the Institute of Polytechnology*, Osaka City University Series D 4, 1-16.

Laca E, Shipley LA and Reid ED (2001). *Structural anti-quality characteristics of range and pasture plants*. J. Range Manage. 54:413-419.

Louis FM (1989). Peasant official view of range land in Botswana. Land uses policy July. P. 197-202.

MAR (2009). Ministry of Animal Resource and Fisher, report. North Kordofan, Sudan.

Mannetje LT, Jones RJ and Stobbs TH (1976). Pasture evaluation by grazing Experiments. In: N.H. Shaw & W.W. Bryan (Eds). Tropical Pasture Research. *Principles & methods.* Bull. 51. Commonwealth Agricultural Bureaux. Farnham Royal.Bucks.England. 222-234.

MFW (1994). The Ministry of Forests will prepare a report that identifies these authorized AUM levels*. "(page37, CCLUP 90 Day Implementation Report).*

Morrison A, Le Brocque AF and Clarke PJ (1995). An assessment of improved. *Techniques for estimating the abundance (frequency) of sedentary organisms. Vegetation* 120, 131-145.

Moore CWE (1964). *Distribution of grasslands s. In: Barnar , C. (e .) Grasses and Grassland s.* Macmillan, Melbourne, pp. 182–205.

Nimer AM (2000). Effect of *Acacia Senegal* (L.) willd.on Sandy Soils and Assessment of its foliage Nutrients: Case Study of Demokeya Forest, Northern Kordofan. M.Sc Thesis, University of Khartoum, Sudan.

Norton B E (1991). *Function and productivity of range land ecosystem,* Isr. J. Bot 28-19.

RPA (1993). Range and Pasture Administration. *Annual report. Ministry of Agriculture and Animal Wealth.* South Darfur, Sudan.

RPA (2005). Range and Pasture Admin, North Kordofan State. *Annual Range Survey Report. of measuring understory vegetation.* Proc. Of a symposium at Tifton, Georgia.

Parker KW and Harris RW (1959). *The 3-steps method for measuring condition and trend of forest ranges: a resume of its history, development and use*. In: Techniques' and methods.

Pears CK, Owen E, Mtenga LA, Penning PD,and Mayes RW (1970). Range Deterioration in the Middle East. Proc. 11th int. *Grassland Cong. Australia,* p. 26.

Skerman PI (1966). *Pasture and Livestock of Studies* in Kordofan. Special Fund Project area Sudan.

Skerman PJ (1977). Tropical Forage Legumes, FAO, *plant production and protection series,* No.2, FAO, Rome.574p.

Strang C R N (1980). *African pasture lands Ecology*. Food and Agricultural Organization (FAO) of the UN Rome- Italy.

Steel RCD and Torrie JH (1960). Principles and Procedures of Statistics. McGraw, Hill Book Co. New York (Ends) 454 pp.

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Scienceline/Journal homepages: http://www.science-line.com/index/; http://www.ojafr.ir

Walker JW SL, Kronberg SL. Al-Rowdily and West NE, (1994). *Managing noxious weeds with livestock*: Studies on leafy spurge. Sheep Research Progress Rep. No. 3, USDA-ARS 1994-4 pgs 125-135.
Webster CC and Willson PN (1966). Agriculture in the tropics. Long man group limited, London.
Willson PN (1959). Studies of the browsing and reproductive behavior of the east Africa dwarf goat, E. Af. Agric. For J. 23-138-47. *Report. Unite Nations Educational, Scientific and Cultural Organization, Unite Nations Environmental Programmer, Food and Agriculture Organization, Paris*, 655 pp.
Wilm HG and Costtello DF (1944). *Estimating forage by double sampling methods*. Amer. Soc. Argon 36:194-203.

To cite this paper: Abdel Moniem M, El hag A, hassabo AA, Bushara I, Ishag IA, Eisa MO. 2012. Effect of growth stages and range systems on vegetation attributes, carrying capacity, stocking rate and forage productivity, North Kordofan, Sudan. *Online J. Anim. Feed Res.*, 2(2): 203-209.
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THE EFFECTS OF PARITY NUMBER, SEASON AND YEAR OF CALVING OF SUDANESE ZEBU CATTLE (BUTANA) ON THE LACTATION CURVE AND MILK YIELD

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ABSTRACT: *The present study was conducted to investigate the effects of parity number, season and year of calving of Sudanese Zebu cattle (Butana) on the lactation curve and milk yield. A Wood's model (1967) was adopted for the description of the curve, it is a gamma function utilized for regression of milk yield on time lapse post-partum. The regression equation is presented by* $[Y_{(n)} = an^b e^{-cn}]$*; where:* $Y_{(n)}$ *is the total milk yield for* n^{th} *week, a, is the initial milk yield and is considered as a factor which could influence the height of the curve across time but has no effect on the curve. b is the rate of increase of milk yield pre-peak and is considered as the linear constant that measures the average slope of the curve during the increase phase. c is the rate of decrease of milk post-peak, a linear constant that describes the rate of change of the slope of the curve during the decline phase and determines the slope of the curve during this phase. Records of 178 cows were taken from the fifth days of lactation till 30 weeks from the year 1994 – 2001. The records were grouped according to parity (till eight parities), season of calving (dry and wet summer and winter) and year of calving. The results revealed that effect of parity on initial milk yield, although significant, but variable. The peak week, persistency and rate of increase of milk pre-peak were the highest (P<0.01) in parity 1 compared to other parities. However, rate of decrease post-peak was not affected by parity number. Peak yield and total yield increased steadily from parity one to parity 6 then decreased. Calving weight increased significantly (P<0.01) from 1 to 8. Season of calving was shown to have a significant effect on initial milk yield, a, peak week and persistency where, a, was the highest (P<0.01) in wet summer than winter and dry summer and hence was increased to the maximum peak during wet summer with shorter persistency around the peak compared to dry summer and winter. Year of calving significantly affected the rate of decrease post-peak, c, peak yield, weekly and total milk yields. It was shown that cows that calved in year 1997 and 2000 had the lowest (P<0.01) rate of decrease in milk yield, weekly and total yields.*

Key words: *Butana, Parity Number, Season of Calving, Lactation Curve, Milk Yield*

ORIGINAL ARTICLE

INTRODUCTION

Sudan is a well-known country for its animal wealth. Cattle alone were estimated to amount to 132.5 million heads (MARF, 2002). Cattle have served and continue to serve as a valuable role in sustainable agricultural systems. Among cattle in Sudan, Kenana and Butana Zebu breeds proved to be relatively the highest milk producers. In the area of study (eastern Sudan), Butana makes an important social contribution in the area. A dairy farm was established in the mid of the seventies with the objective of improving Butana breed through a selective breeding programme.

The lactation curve is found to be affected by many factors; mainly parity number, season and year of calving. Furthermore, the various components that define the curve are also affected in various ways. Milk yield was found to rise to its maximum to about 5th calving (Vij et al., 1992), although other workers indicated small increases after the 3rd parity (Hammond et al., 1976). The rate of increase of milk pre- or rate of decrease pot-peak with advancement of parity was related to the efficiency of the use of body reserves in mature cows and heifers (O'Connor and Oltenacu, 1988). Season has an obvious effect on the lactation curve because each season is characterized by specific climatic factors such as, temperature, relative humidity, wind movement, solar radiation, light intensity (Peters et al., 1981) and light durations which significantly alters animal's physiological behavior (Phillips and

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Schofield, 1989). The main effects of these factors are the upsetting of the balance between heat production and heat loss causing either hyperthermia or hypothermia which in turn causes decrease in milk yield (Esmay, 1978). Also the effect of season of calving is exerted through the availability of good quality pasture and adequate energy intake (Emery, 1988). In addition of thermoregulatory demands (Madalena et al., 1979). However, supply of and energy intake rather than direct climate are found to affect peak yield and persistency (Yadav and Rathi, 1992). The effect of year of calving on the lactation curve is generally related to differences in nutrition, managerial practices and change in the genetic make-up over the years (Garcha and Tiwana, 1980).

MATERIALS AND METHODS

Anima housing

A dairy research station was established on an area of 5.88 ha in the River Nile Province (northern Sudan). The area lies within the latitude 17° 42' and longitude 33° 58' at 345 meters above sea level and characterized by semi-arid environment; maximum temperature 47.4°C during summer and minimum of 15°C during winter with rainfall between 70 – 100 mm and relative humidity 32.5%..

The animal housing was constructed to accommodate 80 animals. The ceiling was made from local insulated materials and corrugated galvanized metal sheets. An open yard of 15 X 20 m was used for animal exercise. Animals were grouped according to their physiological status (lactating, late pregnancy and dry cows). Cows used in this study were a pure Zebu type (Butana). The animal has a thin neck, light brisket shoulders, but broad hind quarters. Bones, dewlap and hump are small but udder is quite large with high rear attachment with teats about 2 inches. Color is solid red. Average body weight at 1 year is 140 kg (Madani, 1996) and average milk production 1389 kg in 267 days. (Gotbi, 1968) and average age at first calving is 44 months (Alim, 1962) with calving interval 416 – 485 days (Madani, 1996).

Husbandry practices

Cows were identified by names, dehorning of calves was done at two months of age. Hoof trimming was done when required, usually during autumn, culling was done according to productivity or age. The herd was allowed to graze freely in an open area of 3.78 ha that belonged to the research station and which is cultivated with different fodders according to season. The grazing hours are extended to five hours in the afternoon. For the milking cows cut fodders are given at a rate of 2.3 kg for each 100 kg body weight and a concentrate mixture (Table 1) to each cow; 2 kg in the morning and 2 kg in the evening during hand milking time. The present study utilized records of 178 cows for 8 years (1994 - 2001). The data focused on lactation curves of these cows up to 30 weeks following five days of calving as well as body weights.

Table 1 - Ingredients and proximate analysis of concentrate mixer fed to Butana cows in the research station

Ingredients	%
Cotton Seed Cake	34.5
Wheat Bran	34.5
Sorghum Grain	30.0
Salt	01.0
Total	100
Chemical Composition (On Dry Matter Basis)	
Moisture	04.0
Ether Extract	05.0
Crude Protein	22.9
Crude Fiber	14.0
Nitrogen Free Extract	47.7
Ash	0.60
Total	100

RESULTS

Effect of parity

Effect of parity on the different components that defined the lactation curve is shown in Table 2. Significant ($P<0.01$) increases in initial milk yield, a, weekly and total yields started from parity 2 and nearly maintained afterwards up to the 8th parity. While significant ($P<0.01$) decreases in the rate of increase pre-peak ,b, peak week (n-max) and persistency were observed from parity 2 which was maintained up to parity 8. Calving weight increase significantly ($P<0.01$) and progressively from parity 1 to 8, whereas the rate of decrease post-peak, c, was not affected by parity.

Effect of season

Data were pooled to investigate the effect of season irrespective of parity. As shown in Table 3, and n-max were significantly ($P<0.01$) higher in wet summer than both dry summer and winter, whereas persistency was the lowest ($P<0.01$) in wet summer compared to dry summer only.

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Table 2 - Effect of parity number (means ±SE) on different variables of the lactation curve of Butana cows

Variable / Parities	No. cows	a1 Kg	b2 Kg/week	c3 Kg/week	Peak week (n-max)	Peak yield (Kg)	persistency	Weekly yield (Kg/week)	Total yield (Kg/week)	Calving weight (Kg)
1	23	15.38±9.3^{C}	0.63 ±0.4^{A}	0.06 ±0.03	10.5 ±4.5^{A}	33.5 ±10.3^{D}	4.71 ±0.6^{A}	26.5 ±7.7^{C}	795.1±230^{C}	52.3 ±8.4^{H}
2	24	24.71±12.4^{B}	0.41±0.3^{B}	0.06±0.03	7.66±3.8^{B}	36.13±14.1^{CD}	4.25±0.5^{B}	28.32±11.3^{BC}	849.59±338^{BC}	66.54±9.9^{G}
3	21	30.36±12.1^{AB}	0.37±0.2^{B}	0.05±0.03	6.66±3.4^{B}	41.83±12.6B^{C}	4.13±0.6^{B}	32.83±11.1^{AB}	984.8±333^{AB}	84..75±14.9^{F}
4	19	29.44±10.1^{AB}	0.38±0.2^{B}	0.05±0.03	7.46±3.4^{B}	41.46±7.4B^{C}	4.11±0.5^{B}	32.62±7.0^{AB}	978.48±211^{AB}	94.61±13.8^{E}
5	26	35.38±15.3^{A}	0.38±0.2^{B}	0.06±0.02	6.08±2.8^{B}	48.56±14.6^{AB}	3.97±0.4^{B}	37.13±12.0^{A}	1113.96±360^{A}	103.6±11.0^{D}
6	25	32.21±10.4^{AB}	0.47±0.2^{B}	0.07±0.04	7.08±4.3^{B}	50.27±9.9^{A}	4.04±0.5^{B}	37.09±8.0^{A}	1112.66±240^{A}	116.08±12.4^{C}
7	20	37.35±17.5^{A}	0.34±0.3^{B}	0.05±0.04	6.67±3.0^{B}	48.20±15.1^{AB}	4.05±0.6^{B}	36.83±9.5^{A}	1104±285^{A}	123.59 ±12.5^{B}
8	18	32.16±11.7^{AB}	0.43±0.3^{B}	0.06±0.03	7.16±2.9^{B}	47.64±11.9AB	4.14±0.6B	36.01±10.3^{A}	1080.23±264^{A}	135.81 ±12.1^{A}

^{ABCDEFGH}Values within the same column bearing different superscripts vary significantly at P < 0.01. a1: initial milk yield, b2: average slope of the curve during the increase phase pre-peak, c3: average slope of the curve during the decrease phase post-peak.

Table 3 - Effect of season of calving (means ±SE) on different variables of the lactation curve of Butana cows

Variable / Season of calving	No. cows	a1 Kg	b2 Kg/week	c3 Kg/week	Peak week (n-max)	Peak yield (Kg)	persistency	Weekly yield (Kg/week)	Total yield (Kg/week)	Calving weight (Kg)
Wet summer	40	35.19±13.9^{A}	0.43±0.3	0.07±0.04	6.20±2.8^{b}	47.66±12.1	3.83±0.5^{B}	33.70±8.8	1011.04±263	103.02±25.5
Dry summer	60	26.86±13.6^{B}	0.16±0.3	0.06±0.03	8.30±4.2 ^{a}	41.83±13.4	4.30±0.6^{A}	33.03±10.6	990.95±318	92.03±27.9
winter	76	28.63±14.1^{B}	0.41±0.3	0.05±0.02	7.60±3.6 ^{a}	42.44±13.9	4.25±0.5^{AB}	33.50±10.9	1004.85±326	95.35±31.1

^{ABCDEFGH}Values within the same column bearing different superscripts vary significantly at P < 0.01. a1: initial milk yield, b2: average slope of the curve during the increase phase pre-peak, c3: average slope of the curve during the decrease phase post-peak.

Table 4 - Effect of year of calving (means ±SE) for 8 years (1994 – 2002) on different variables of the lactation curves of Butana cows

Variable / Year of calving	No. cows	a1 Kg	b2 Kg/week	c3 Kg/week	Peak week (n-max)	Peak yield (Kg)	persistency	Weekly yield (Kg/week)	Total yield (Kg/week)	Calving weight (Kg)
1994	35	32.89±14.1	0.44 ±0.2	0.06 ±0.03^{A}	7.79±3.7	49.22±14.7^{a}	4.17 ±0.5	37.84±11.5^{A}	1135.0±345^{A}	95.0±27.2
1995	23	32.98±13.9	0.47±0.3	0.07±0.04^{A}	6.48±2.4	47.48±12.4^{a}	3.92±0.5	34.40±8.9^{A}	1032.0±369^{A}	107.6±24.4
1996	30	27.8±12.6	0.44±0.3	0.06±0.02^{A}	7.20±3.7	41.42±11.3^{a}	4.12±0.6	31.50±8.4^{A}	945±251^{A}	97.3±30.4
1997	19	25.65±15.6	0.40±0.3	0.05±0.02^{BC}	8.06±3.2	37.71±13.6^{a}	4.42±0.5	31.15±11.7^{A}	934±350^{A}	91.9±27.7
1998	24	28.99±11.9	0.47±0.4	0.06±0.04^{AB}	8.00±2.9	44.24±8.9^{a}	4.30±0.6	35.20±7.6^{A}	1055.8±228^{A}	95.5±31.1
1999	26	30.72±15.4	0.43±0.3	0.06±0.02^{AB}	6.70±4.0	44.98±12.9^{a}	4.05±0.6	33.38±10.2^{A}	1001±305^{A}	93.9±33.2
2001	16	24.12±14.1	0.29±0.2	0.04±0.03^{C}	7.94±6.2	30.72±11.3^{b}	4.41±0.7	26.26±11.5^{B}	787.8±285^{B}	92.5±27.2
2002	05	25.53±16.0	0.52±0.03	0.06±0.02^{AB}	7.78±3.4	40.33±8.9^{ab}	4.24±0.6	31.66±8.3^{AB}	945.7±254^{AB}	78.7±26.2

^{ABCDEFGH}Values within the same column bearing different superscripts vary significantly at P < 0.01; lower case letters at P <0.05. a1: initial milk yield, b2: average slope of the curve during the increase phase pre-peak, c3: average slope of the curve during the decrease phase post-peak.

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Effect of year of calving

Milk yield (weekly and total yields) and rate of decrease of milk post-calving, c, were the only parameters affected by year of calving (Table 4). Weekly and total yields were the lowest ($P<0.01$) in year 2000, although significant differences could not are detected between years 2000 and 2001. Also, c, was the lowest ($P<0.01$) in year 2000, although significant differences could not be detected between years 2000 and 1997.

DISCUSSION

Effect of parity

The gradual increase in initial milk yield with advancement in parity could be related to more alveolar cells added to each successive lactation (Jakopovic, 1993; Dhangar et al., 1991). The initial milk yield obtained by Sudanese Butana Zebu breed under the current study was lower than that obtained by Holstein-Frisian (Madalena et al., 1976). The highest yield were observed in parities 5 and 7 with productions comparable to those obtained by Vij et al (1992) but different from those obtained by Kellogg et al. (1977). The present study showed that higher rates of increase of milk yield pre-peak ,b, with first parity, whereas other studies showed little or no effect of parity on ,b,values (Ahuno and Kabuga, 1994; Mehto et al., 1980). In lines with some studies rate of decrease of milk production post-peak, c, was not affected with parity (Jakopric, 1993).

Time spent to attain peak week (n-max) was the longest with the first parity. This was inconsistent with other studies (Biradar, 1990). Peak yield was observed to increase with advancement of parity, the highest value was observed in parity 6. Similar observations were obtained in Frisian X Sahiwal (Romachandraiah et al., 1990). Persistency around the peak was the longest with the first parity with gradual decreases towards advancement of parity. Similar trends were observed by other workers in European breeds and buffaloes (Garcha and Tiwana, 1980). However, longer persistency was obtained in the 3rd parity in both Holstein-Frisian (Mehto et al., 1980) and Frisian X White Fulani (Ibeauchi and Okoro, 1980).

The effect of parity on persistency could be due to the fact that, older animals which started lactation at higher levels had a rapid rate of decline, also the regression of alveolar cells increases with advancing age which means a decline in udder productivity.

In the present study, weekly and total milk yields increased with the increase in parity number. Similar results were obtained by other authors (De-Loss and Menedez, 1987). Milk production reached the highest yield with the 5th lactation then declined. Similar results were in Sudanese Kenana cows (El Amin, 1969) and in Frisian cows (Abdelgani and Fahmi, 1966).

The significant steady increase in cows' weights with advancement of parity was in line with the results obtained by Paul (1995). However, a decrease in body weight was observed in Holstein cows with the increase in parity number (Hooven et al., 1968), whereas no relationship was obtained between body weight and parity number in buffaloes (Swanson, 1967). Generally changes in body weights with different lactations are largely due to management programmes and are mostly environmentally determined.

Effect of season of calving

In this study, season of calving was shown to have a significant effect on the initial milk yield, where the wet summer calvers had the highest yield compared to dry summer and winter. Other studies had also observed higher milk yields during the rainy season in Holstein-Frisian X Gir (Madalena et al., 1979) which was related to the availability of good quality forage. n-max was also significantly affected by season where wet summer calvers took the shortest time to reach peak production. These results were in agreement with those obtained in Ghana (Ahunu and Kabuga, 1994) and in USA (Perera et al., 1986) with Holstein-Frisian. At other locations, winter calvers showed shorter durations to reach the peak as with Jersey and Frisian heifers in Germany (Romachandraiah et al., 1990). Persistency around the peak was also significantly influenced by season of calving; shorter persistency was depicted by the wet summer calvers. Weekly and total milk yields increased from summer to winter but no significant differences could be detected. Similar results were obtained by some workers (Udebibe et al., 1985). However, other could detect the significant effect of season (Singh and Gopal, 1982).

Effect of year of calving

In the current study, the rates of increase of milk pre-peak or rate of decrease post-peak were found to be significantly affected by the year of calving, where years 1998 and 2001 showed the highest rates in increase of milk, whereas years 1997 and 2000 showed the lowest rates of decrease. In line with this study, the significant increase in the rate of milk was obtained by some authors (Ahunu and Kabuga, 1994; Duraes et al., 1992) and rate of decrease (Duraes et al., 1992; Madalena et al., 1979). Other studies could not detect the significant effect of year on milk rates of production (Bhutia and Pandy, 1982).

In this study, initial milk yield, weekly and total yields as well as peak yields were significantly affected by the year of calving where years 1994, 1995 and 1999 showed the highest initial yields. Lowest values for weekly, total and peak yields were detected in the year 2000. Similar effects for the year of calving on initial milk yield was obtained by Duraes et al. (1992) and Madalena et al. (1979). Also for the weekly and total yields significant effects were obtained by Queiroz et al. (1987). According to Garcha and Tiwana (1980), the significant effect of year of calving could be related to differences in nutrition and management practices as well as changes in the genetic constitution of the herd.

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Scienceline/Journal homepages: http://www.science-line.com/index/; http://www.ojafr.ir

REFERENCES

Abdel-Gani W and Fahmi SK (1966). Productivity of Frisian and its crosses in USA. Agric. Res. Rev., 44(4): 37 - 42.

Ahunu BK and Kabuga JD (1994). A study of the gamma functions for describing Friesian lactation in Ghana. Bull. Anim. Hlth. Prod. Afri., 42: 147 -152.

Alim KA (1962). Environmental and genetic factors affecting milk production of Butana cattle in the Sudan. J. Dairy. Sci., 45: 242 – 247.

Bhutia ST and Pandey RS (1990). Factors affecting rate and magnitude of milk flow in early part of lactation in dairy cattle. Indian. J. Anim. Sci., 60 (6): 728– 729.

Birader US (1990). Factors affecting peak yield and days to attain peak yield in Surti buffaloes. Indian. J. Dairy. Sci., 43 (1): 10 – 20.

De-Loss RA and Menendez BA (1987). Effect of lactation number, age at calving and service period on production of Holstein-Friesian cows. Revista – Cubana de Reprod. Anim. 13 (1): 63 – 67.

Dhanger MR and Patel JM (1991). Factors affecting lactation milk yield in intermated Jersey X Kankrej cows. Indian. J. Anim., Prod. Management. (3): 151 -154.

Duraes MC, TeixeriaNM and Freitas AFD (1992). Lactation curve of Holstein cows housed under feedlot conditions. Anim. Breeding. Abstracts., 60 (10).

El-Amin FM (1969). Environmental and genetic factors influencing reproduction and milk production of Sudanese indigenous cattle., MVSc Thesis. University of Khartoum-Sudan.

Emery RS (1988). Feed intake and change in body composition of lactating mammals., Dairy Sci Abstr 1990. 52: (1)

Esmay ML (1978). Principles of Animal Environment., AVI publishing Company, Connecticut, USA. 33pp.

Hammond JJ, Mason IL and Robinson TJ (1979). Hammond's Farm Animals (Butler and Turner Ltd) Rome, London, Edward and Arnold Ltd. 69– 71.

Garcha DS and Tiwana MS (1980). Effect of some environmental and physiological factors on persistency of milk yield in buffaloes., Indian. J. Anim. Sci. 16: 34 – 40.

Gotbi OAB (1968). Butana cows as milk producers., Sudan. J. Vet. Sci., Anim. Husb. 9 (1): 270.

Hooven NW., Jr RH, Miller M and Plowman RD (1968). Genetic and environmental relationships among efficiency, yield, consumption and weight of Holstein cows., J. Dairy. Sci. 51: 1409.

Ibeauchi JA and Okoro HAN (1980). Comparison of performance of imported Holstein cattle with indigenous Zebu (White Fulani) cattle in Vom, Nigeria., J. Dairy. Sci. 63 (1): 157.

Jakopovic I (1993). Lactation curves and factors influencing its shape., Anim. Breeding Abstr. 61(2).

Kellogg DW, Urquhart NS and Ortega AJ (1977). Estimating Holstein lactation curves with gamma curve., J. Dairy. Sci. 60: 1308 – 1315.

Madalena FE, Martinez ML and Freitas AF (1979). Lactation curve of Holstein-Friesian and Holstein X Gir cows., Anim. Prod. 20: 10 -17.

Madani MA (1996). Livestock and Animal Production in the Sudan. Khartoum Press. Sudan., 170pp.

Mehto L, kausik SN and Koul GL (1980). Influence of various factors on components of gamma type function of a lactation curve in Hariana cross-bred. Indian., J. Anim. Sci. 50 (7): 538 – 541.

MARF (2002). Ministry of Animal Resources and Fisheries. Estimation of livestock population. Animal Resources Economic Administration.

O'Connor JJ.Jr and Oltenacu PA (1988). Determination of optimum drying off time for dairy cows using dissection analysis and computer simulation., J. Dairy.Sci. 71: 3080– 3091.

Paul D (1995). Body conditions of the cows., Vee. Pro. Holland. 23: 12 – 13.

Perera KS, Gwazdouskas FC, Pearson RE and Brumback Jr TB (1986). Effect of season and stage of lactation performance on Holsteins., J. Dairy. Sci. 69: 228– 236.

Peters RR, Chapin, LT, Emery RS and Tucker HA (1981). Milk yield, feed, prolactin, growth hormone and glucocoricoid response of cows to supplemental light., J. Dairy. Sci. 64: 1671.

Phillips CJC and Schofield SA (1989). The effect of supplementary light on the production and behavior of dairy cows., Anim. Prod. 48: 293 – 303.

Queiroz SA, de Giannani MA, Ramosa A and Tonhati H (1987). Environmental effects on variation of productive traits in Holstein-Friesian X Zebu cross bred cattle in the region of Saocarlos, State of Sapaulo, Brazil. 1. Milk yield. Ravesta Brasileira de Genetica., 10: 63 – 73.

Romachandraiah K, Kumar KS, Sreemannarayanan O and Reddy GPA (1990). Peak yield in pure Jersey cows., Indian. J. Dairy. Sci. 43 (3): 274 – 277.

Swanson EW (1967). Optimum growth patterns for dairy cattle., J. Dairy. Sci. 50: 244– 252.

Singh RP and Gopal R (1982). Lactation curve analysis of buffaloes maintained under village conditions. Indian., J. Anim. Sci. 52: 1157–1160.

Udebibe ABI, Umo I and Shaibu I (1985). Effect of lactation number and season of calving on lactation characteristics of imported Friesian cows., J. Anim. Prod. Res. 5 (1): 31 – 44.

Vij PK, Nivsarkar AE., Balain DS and Raj D (1992). Factors affecting production performance of Tharparkar cattle., Indian. J. Anim. Sci. 62 (8): 772– 774.

Yadav AS and Rathi SS (1992). Factors influencing some performance traits in Hariana cattle. Indian., J. Dairy. Sci. 45 (10): 511 – 516.

To cite this paper: Ahmed MMM, Ariek KDA, Bushara I, A/Wabab KA. 2012. The effects of parity number, season and year of calving of Sudanese Zebu cattle (Butana) on the lactation curve and milk yield. *Online J. Anim. Feed Res.*, 2(2): 210-214.

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EFFECT OF PARITY ON LIVE BODY WEIGHT, DAILY MILK YIELD AND LACTATION LENGTH OF SUDANESE KENANA CATTLE

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ABSTRACT: *Effect of parity (PA) on live body weight, daily milk yield and lactation length of Sudanese Kenana cattle breed were investigated using a surveyed random sample comprised of (200) animals on different numbers of parities, animals were reared on natural pastures. All parameters were determinated by standard statistical analysis models with multivariate ANOVA when daily milk yield (DMY), Live body weight (LBwt) and lactation length (LL) as response and parity numbers (PA_1, PA_2, PA_3 and PA_4) as independent ($P \leq 0.05$). The results revealed that parities had a significant effect on all quantitative parameters that investigated. These differences between observed means were separated using Duncan multiple range tests with equal variances assumed. This suggests that parities could be used as independent factor for estimation of quantitative parameters with relatively high accuracy in Sudanese Kenana cattle breed.*

ORIGINAL ARTICLE

Key words: *Parity, Live body weight, Daily Milk Yield, Lactation length, Kenana Cattle, Sudan*

INTRODUCTION

On a worldwide basis cattle population in Sudan comprise one of the most important livestock species and play a major role in the livelihood of large amount of protein of small farmers and nomadic, the population was estimated to be 38.3 million (FAO, 2002), they well adapted to local environment conditions. Among the Sudanese cattle population Kenana is promising indigenous milk breed. Significances of parity and parameters of economic importance in dairy cattle have been studied by a number of researchers. Oravacová et al. (2006) reported a significant effect of parity on daily milk yield. The aim of the present research was to investigate the effect of parity on daily milk yield, live body weight and lactation length in Sudanese Kenana cattle breeds.

MATERIALS AND METHODS

Research Site

The animals included in this present research were located at Sennar and Blue Nile States on the east and west banks of the Blue Nile. These areas are inhibited by different tribes who raise this local breed.

Research Animals

Animals used in this research were divided into four groups according to parities (1-4). Data for all parameters investigated were collected and taken from (N=200) cows from different householders in one visit surveillance.

Management of Animals

All the animals were managed under a traditional system, the animals were led out to graze freely on the natural pastures during the day and return to pens from local materials in the evening where their feeding was supplemented with whole grained and dry grass forage. Fresh water was given *ad libitum*.

Parameters Measured

The parameters investigated include Daily milk yield (DMY, kg), Live body weight (LBwt, kg) estimated by weighing tape and lactation length (LL, days).

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Statistical Analysis

Data collected in this research with respect to parity and some quantitative parameters were subjected to various Statistical analysis tools in General linear Model (GLM) procedures, Univariate analysis of variance when the quantitative parameters were response and parity (1, 2, 3 and 4) as independent systematic effects was used and coefficients of variation (CV) were obtained using Statistical Packages for Social Sciences (SPSS) release 15.0 (2006) software to evaluate the effect of parity number on all parameters studied. The model used for all variables was $Y = \mu + \text{cow (parity)}_i + \text{error}$, where: Y is quantitative traits studied, cow $(\text{parity})_i$ is effect of i^{th} parities (for i = 1, 2, 3, and 4) and the random error term (All factors considered systematic except for the random error term). For all quantitative parameters, model effects were declared significant at ($P \leq 0.05$) unless otherwise stated.

RESULTS AND DISCUSSION

Milk yield is defined as the amount of milk that is obtained over certain period which may be a day, a week, a month or a lactation period; it is the most important economical trait in dairy cattle (Musa, 2006). Least square means and standard errors of daily milk yield according to parity number is presented in Table 1, the overall mean daily milk yield was 4.97 kg/day for the 1st through the 4th parity. The mean of daily milk yield increased gradually from the first 4.35 kg/day, up to third 5.76 kg/day, which was reached the peak then persisted and decreased. Similar observations have been made by Likewise Licitra et al. (1990) reported that the milk yield of Modicana and Holstein cows increased with parity. The results of this research also confirms the earlier findings of Malau-Aduli et al. (1996) who analyzed on the dairy performance of animals of the same herds.

Live body weight of Animals is an important factor associated with several management practices including selection for slaughter and breeding, determining feeding levels and also it is a good indicators of animal condition (Ulutas et al., 2001). Body weight is a frequently recorded variable in animal research; it is the measurements most used to evaluate growth (Otte et al., 1992). The results demonstrated that the overall mean for live body weight (kg), was 304.33. Parity had effect on live body weight, but not as constant rate. Thus reduction was seen in the second parity due to advances in both parity and age, so demand for maintenance and milk production increases. Thus reduction may be found in live body weight after calving in order to resume cycle, the cow must " overcome" the negative effect of suckling and for law nutrients intake, the results in this present research similar to that reported by John Hall, (2004) for cattle. The increase of live body weight through parities 3rd and 4th may be found due to high nutrients intake.

Lactation length is defined as the period between two consecutive calving during which cows are capable of producing milk or lactating (Musa, 2006). There was a great deal of variation in lactation length of different breeds of cattle in the tropics.

Table 1 - Least square(means ± SE) of quantitative parameters in Sudanese Kenana cattle breed by parities

Parities	Quantitative Parameters			
	N	Daily milk yield(kg)	Live body weight(kg)	Lactation length(days)
PA_1	40	4.35 ± 0.40^{b}	311.40 ± 7.25^{a}	233.50 ± 6.78^{b}
PA_2	65	5.06 ± 0.39^{ab}	289.39 ± 7.16^{b}	248.56 ± 6.70^{ab}
PA_3	41	5.76 ± 0.35^{a}	305.85 ± 6.23^{ab}	258.59 ± 5.84^{a}
PA_4	54	4.64 ± 0.32^{b}	309.98 ± 5.68^{a}	250.08 ± 5.32^{ab}
Overall	200	4.95±0.18	304.33±3.31	247.68±3.09

The differences between means of quantitative parameters are marked by various letters in the same columns are significant ($P \leq 0.05$).

In tropical cattle, restricting the lactation records to 305-days would have less effect, as few cows produce milk for more than 305-days (Musa, 2006). A shorter interval would be more effective, but would penalize high persistency (Syrsted, 1993). Least square means and standard errors were presented according to parities Table-2, the overall mean lactation length was 247.68 days which was lower than that reported by Abdalla et al. (1990) 283.00 days for the same breed at Um-Benen Livestock Research Station.

Coefficients of variation for quantitative parameters according to parities were tabulated in Table-3. These coefficients evaluate and rank the quantitative parameters among their overall rank of CV.

Table 2- Coefficient of variation(CV%) of quantitative parameters in Sudanese Kenana cattle breed by paritie

Parities	Quantitative Parameters			
	N	Daily milk yield(kg)	Live body weight(kg)	Lactation length(days)
PA_1	40	44.36	17.58	16.27
PA_2	65	63.04	15.59	21.47
PA_3	41	46.18	12.43	15.82
PA_4	54	50.22	14.89	15.93
Overall	200	112.46	15.15	17.53

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CONCLUSION

Kenana cattle daily milk yield, live body weight and lactation length were relatively changed by parity, further researches on this topic are required using larger number of animals. Nevertheless, our findings indicate that all parameters investigated have linked to parity number may also depend on different factors such as physiological and metabolic status in cattle of varying parities. At least, this present research was necessary step in validity the use of parity as independent factors assist dairy producers and breeders especially in Sudan.

REFERENCES

Abdalla EA, M. Khalafalla AM and Shafei SA (1990). The influence of age on lactation length and milk yield in Kenana and Butana cows. Sudan Journal of Animal, 3: 93-100

FAO (Food and Agriculture Organization) (2002). FAO data base 2002.

John Hall (2004). The cow calf Manager Livestock Update, February Extension Animal Scientists, Beef, VA Tech. 20 proceeding 2004 Florida Dairy Reproduction Road Show.

Licitra G, Oltenacu PA, Blake RW, Lanza A and D'Urso G (1990). Season of calving and parity effects on milk yield and reproduction of Modicana and Holstein cows in Sicily. Journal of Dairy Science, 73: 224.

Malau-Auli AEO, Abubakar BY, Ehoche OW and Dim NI (1996). Studies on milk production and growth of Friesina × Bunaji crosses. 1 Dairy performance. Asian-Aus. Journal of Animal Science, 9: 503-508.

Musa, AM (2006). Linear body measurements as an indicator of Kenana cattle weight and milk production. M.A.Sc. Thesis, University of Gezira, Sudan.

Orvacová M, Margetīn M, Peškovičová D, Daňo J, Milerski M, Hetēnyi L, Polák P (2006). Factors effecting milk yield and ewe's lactation curves estimated with Test-day model. Gezch journal of Animal Science, 51: 483-490.

Otte MJ, Woods AJ and Abuabara Y (1992). Live weight estimation of cattle by scale and tape- A method comparison study. Tropic. Anim. Health Prod, 24: 109-114.

SPSS (2006). Statistical Packages for Social Sciences Inc. (2006), SPSS user's guide.

Ultuas Z, Saactci M, Ozluturk A (2001). Prediction of body weights from body measurements in East Anatolian Red calves. J Agri Collage of Ataturk University, 32: 61-5.

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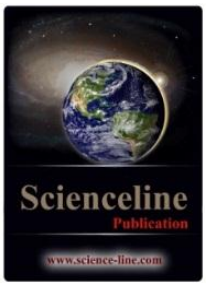

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		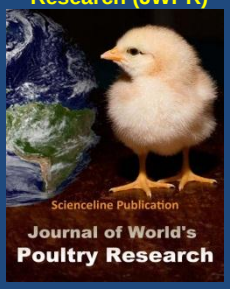	
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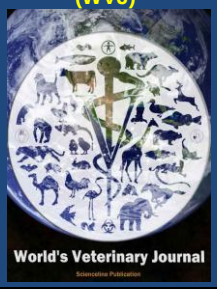		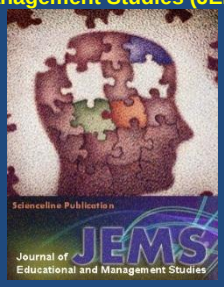	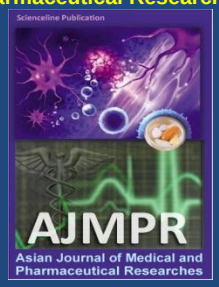
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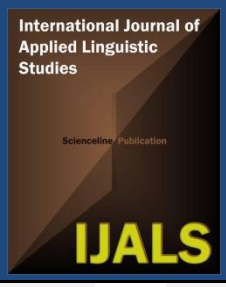			

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