ONLINE JOURNAL OF ANIMAL AND FEED RESEARCH

An International Peer-Reviewed Journal which Publishes in Electronic Format

Volume 6, Issue 1, January 2016

ISSN 2228-7701

Online Journal of Animal and Feed Research

An international peer-reviewed journal which publishes in electronic format (online)

Online J. Anim. Feed Res., 6 (1): January 25, 2016

Behzad Shokati
PhD student, Department of Agronomy and Plant Breeding, Faculty of Agriculture, University of Maragheh, IRAN (Email: behzad_sh1987@yahoo.com)
Agriculture: Environment, Nutritive value and utilization of feeds
Ekrem LAÇİN
PhD, Professor, Dept. Animal Science and Production, Facult. Vet. Med., Atatürk University, TURKEY (Email: ekremlacin@hotmail.com)
Nutrition - Non-Ruminants
Fazul Nabi Shar
PhD, Lecturer, Faculty of Veterinary & Animal Sciences, Lasbela University of Agriculture Water & Marine Sciences, Uthal Balochistan, Pakistan (Email: fazulnabishar@yahoo.com)
Clinical Veterinary Medicine, Poultry & Animal Husbandry
Fikret Çelebi
PhD, Prof., Dep. Physiology, Facult. Vet. Med., Atatürk University, Erzurum, TURKEY (Website; Email: fncelebi@atauni.edu.tr)
Physiology and Functional Biology of Systems
Firew Tegegn
Bahir Dar University, ETHIOPIA (Email: firewtegegne@yahoo.co.uk)
Animal Nutritionist
Ferdaus Mohd. Altaf Hossain
DVM, Sylhet Agricultural University, Bangladesh; not shah Jalal University of Science & Technology, BANGLADESH (Email: ferdaus.dps@sau.ac.bd)
Microbiology, Immunology, Poultry Science, and Public Health
Hamid Mohammadzadeh
PhD, Assistant Prof., Department of Animal Science, Faculty of Agriculture, University of Tabriz, IRAN (Email: hamidmhz@ag.iut.ac.ir)
Nutrition - Ruminants
Hazim Jabbar Al-Daraji
PhD, Professor, University of Baghdad, College of Agriculture, Abu-Ghraib, Baghdad, IRAQ (Email: prof.hazimaldaraji@yahoo.com)
Avian Reproduction and Physiology
John Cassius Moreki
PhD, Department of Animal Science and Production, Botswana College of Agriculture, Gaborone, BOTSWANA (Email: jcmoreki@gmail.com)
Nutrition - Non-Ruminants, Breeders, Livestock management
Manish Kumar
Prof. Dr., Society of Education (SOE), INDIA (Email: manishzoology06@gmail.com)
Pharmacology, Ethnomedicine
Megiste Taye
PhD, Seoul National University, SOUTH KOREA (Email: mengistietaye@yahoo.com)
Comparative genomics and bioinformatics
Mohammed Yousuf Kurtu
Associate Prof., Animal Sciences Department, Haramaya University, Dire-Dawa, ETHIOPIA (Email: mkurtu2002@yahoo.com)
Animal Science, Nutrition
Muhammad Saeed
PhD candidate, Northwest A&F University, Yangling, 712100, CHINA (Email: muhammad.saeed@nwsuaf.edu.cn)
Nutrition - Ruminants
Naser Maheri Sis
PhD, Assistant Prof., Dept. Anim. Sci., I.A.U.-Shabestar, IRAN (Website; Emails: maherisis@iaushab.ac.ir; nama1349@gmail.com)
Nutrition - Ruminants, Nutritive Value, Utilization of Feeds
Nilüfer SABUNCUOĞLU ÇOBAN
PhD, Professor, Department of Animal Science and Production, Faculty of Veterinary Medicine, Atatürk University, TURKEY (Website; Email: ncoban@atauni.edu.tr)
Animal Hygiene, Physiology, Animal Welfare
Ömer ÇOBAN
PhD, Professor, Department of Animal Science and Production, Atatürk University, TURKEY (Website; ocoban@atauni.edu.tr)
Nutrition - Ruminants
Paola Roncada
PhD, Associate Professor, Veterinary Pharmacology and Toxicology, University of Bologna, ITALY (Email: paola.roncada@unibo.it)
Pharmacokinetics
Raga Mohamed Elzaki Ali
PhD, Assistant Prof., Department of Rural Economics and Development,University of Gezira, SUDAN (Email: ragaelzaki@yahoo.co.uk)
Animal-feed interactions, Nutritive value
Saeid Chekani Azar
PhD, Dept. Anim. Sci., Facult. Vet. Med., Atatürk University, TURKEY (Emails: saeid.azar@atauni.edu.tr; schekani@gmail.com)
Physiology, Product Quality, Human Health and Well-Being,
Shahin Eghbal-Saeid
PhD, Assiociate Prof., Dep. Anim. Sci., I.A.U., Khorasgan (Isfahan), IRAN (Email: shahin.eghbal@khuisf.ac.ir)
Animal Genetics and Breeding
Shahin Hassanpour
Dept. Physiology, Facult. Vet. Med., I.A.U., Shabestar, IRAN (Email: shahin.hassanpour@yahoo.com)
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Volume 6 (1); 25 January 2016

Research Paper

Hilly grasses and leaves: a promising unconventional feed resource for livestock.

Hossain M.E., Karim M.H., Ahmed M.I. and Sultana S.A.

Online J. Anim. Feed Res., 6(1): 01-07, 2016; pii: S222877011600001-6

Abstract

The study was undertaken to find out the chemical composition of different hilly grasses and leaves available in Bandarban areas of Bangladesh. Total 10 different hilly grasses and leaves such as Bottle gourd leaf (*Lagenaria siceraria*), Castor bean leaf (*Ricinus communis*), Cogon grass (*Imperata cylindrica*), Dhol kolmi (*Ipomoea carnea*), Giant reed leaf (*Arundo donax*), Hilly grass (*Cynodon dactylon*), Pithraj leaf (*Aphanamixis polystachya*), Sal leaf (*Shorea robusta*), Shegun leaf (*Tectona grandis*) and Tiger's claw (*Erythrina variegata*) leaf were collected from study areas. Samples were collected, chopped and tested immediately for moisture content and remaining samples were sun-dried and processed using standard procedure. Chemical analyses of the samples were carried out in triplicate for Dry matter (DM), Crude protein (CP), Crude fiber (CF), Nitrogen free extract (NFE), Ether extract (EE) and Ash. Metabolizable energy (ME) was calculated mathematically for all samples by using standard formula. Results indicated that, crude protein content in Bottle gourd leaf was 33.6 g/100g, Castor bean leaf 21.0 g/100g, Cogon grass 8.4 g/100g, Dhol kolmi 26.3 g/100g, Giant reed leaf 8.6 g/100g, Hilly grass 6.8 g/100g, Pithraj leaf 15.3 g/100g, Sal leaf 16.3 g/100g, Shegun leaf 11.9 g/100g and Tiger's claw leaf 18.4 g/100g. In addition to crude protein, all samples contained substantial amount of crude fibre, nitrogen free extracts, ether extracts and ash. It could therefore, be inferred that, the hilly grasses and leaves might be used as an alternative to conventional feeds for livestock particularly during scarcity period.

Keywords: Hilly Grasses And Leaves, Metabolizable Energy, Moisture, Dry Matter, Crude Protein, Crude Fiber, Nitrogen Free Extracts, Ether Extracts, Ash.

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Research Paper

The effect of ground-nut (*Arachis hypogaea, L.*) seed cake supplementation on performance of desert sheep under dry land conditions in North Kordofan, Sudan.

Fadul B.A., Abdalla M.Kh., Mohamed A-EL, Nour I, Idris A* and Eltaher H.

Online J. Anim. Feed Res., 6(1): 08-13, 2016; pii: S222877011600002-6

Abstract

This study was conducted in north Kordofan state-Sudan to evaluate the effects of feeding ground-nut cake supplement on lambs body weight changes and body measurements as an alternative to ground-nut hay plus natural grazing. Twenty four heads of lambs were used (16 males and 8 females) with 6 animals in each group (4 males and 2 females). All the groups were left to graze on natural pasture, and then supplemented by ground-nut hay and ground-nut cakes. Experimental animals allowed drinking water every two days. Groups (1 and 3) were supplemented with ground-nut cake at the rate of 150 g per head /day. The body weights and body measurements were recorded weekly. Range grasses were sampled and analyzed for proximate chemical analysis and for in vitro digestibility trails. The results indicated that the body weight, height at withers, heart girth and body length in males were higher, also the animals supplemented with ground nut cake during autumn season recorded higher values. In vitro digestibility coefficient for ground-nut seed cake was 65.7% and 62.7% for range grasses which were significantly ($P < 0.05$) higher than the ground-nut hay (49.8%) at 72 hrs. It was recommended that the supplementary feeding is the best strategy to improve lambs performance on the natural pastures during the dry season.

Keywords: Supplementary Ground-Nut Cake, Lambs, Body Measurements, Sudan

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Research Paper

Nutritive value of fish meal.

Hossain M.E., Akter K. and Das G.B.

Online J. Anim. Feed Res., 6(1): 14-19, 2016; pii: S222877011600003-6

Abstract

The study was undertaken to find out the variations in the chemical composition of different types of fish meal available in the metropolitan areas of Chittagong, Bangladesh. Fifteen different types of fish meal samples were collected from study areas. Chemical analyses of the samples were carried out in triplicate for dry matter (DM), crude protein (CP), crude fiber (CF), nitrogen free extract (NFE), ether extract (EE) and total ash (TA) in the animal nutrition and poultry research and training centre (PRTC) laboratory, Chittagong Veterinary and Animal Sciences University, Chittagong, Bangladesh. Metabolizable energy (ME) was estimated mathematically for all samples by using standard formula. Results indicated that, DM, CP, NFE, EE, TA and ME content significantly differed ($P<0.01$) from one sample to another. However, no significant ($P>0.05$) variation was found in the CF contents of the samples. DM content varied from 86.7 to 96.7%, CP content varied from 31.3 to 61.2%, EE content varied from 0.8 to 23.5%, NFE content varied from 0.6 to 14.6%, Ash content varied from 13.3 to 36.7% and ME content varied from 1788.4 to 3478.8 kcal/kg. It could therefore be inferred that, the chemical composition of fish meal available in the local market are widely variable. Therefore, every sample

needs to be analyzed before use for ration formulation.
Keywords: Chemical Composition, Fish Meal, Metabolizable Energy, Nutritive Value.
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Research Paper

Nutritive value of Helencha (*Enhydra Fluctuans*).

HHossain M.E., Sarma S.M., Sikder H. and Kabir M.H.

Online J. Anim. Feed Res., 6(1): 20-23, 2016; pii: S222877011600004-6

Abstract

The study was undertaken to find out the chemical composition and nutritive value of Helencha (*Enhydra fluctuans*) available in Chittagong, Bangladesh. *Enhydra fluctuans* were collected from three different remote places of the study area. Chemical analyses of the samples were carried out in triplicate for dry matter (DM), crude protein (CP), crude fiber (CF), nitrogen free extracts (NFE), ether extracts (EE) and total ash (TA) in the animal nutrition and poultry research and training centre (PRTC) laboratory, Chittagong Veterinary and Animal Sciences University, Chittagong, Bangladesh. Results indicated that, there were no significant variations (P>0.05) in the DM, CP, CF, NFE, EE and TA and ME contents of the samples collected from different places. DM content varied from 86.5 to 87.4%, CP content varied from 20.7 to 23.8%, CF content varied from 20.1 to 21.6%, EE content varied from 0.1 to 0.2%, NFE content varied from 28.3 to 34.4% and TA content varied from 10.4 to 13.5%. Similar to proximate components, metabolizable energy (ME) content also varied from 1991.9 to 2073.4 Kcal/kg DM. It could therefore be inferred that, the nutrient contents of *Enhydra fluctuans* does not vary due to variation in places. Results also indicated that, the nutritive value of *Enhydra fluctuans* is comparable with other available grasses in Bangladesh. Therefore, *Enhydra fluctuans* could be a promising unconventional feed resource for livestock.

Keywords: Chemical Composition, Enhydra Fluctuans, Helencha, Metabolizable Energy, Nutritive Value.

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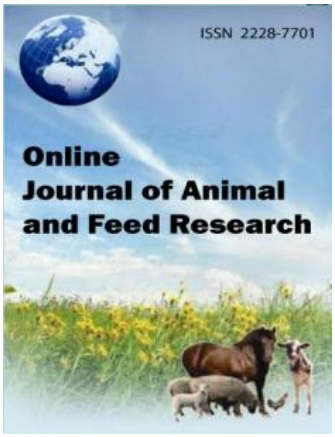

ISSN: 2228-7701

Frequency: Bimonthly

Current Issue: 2016, Vol: 6, Issue: 1 (January)

Publisher: SCIENCELINE

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Homepage: www.science-line.com
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Emails:
administrator@science-line.com
saeid.azar@atauni.edu.tr

Online Journal of Animal and Feed Research

Volume 6, Issue 1: 01-07; Jan 30, 2016 ISSN 2228-7701

HILLY GRASSES AND LEAVES: A PROMISING UNCONVENTIONAL FEED RESOURCE FOR LIVESTOCK

Md. Emran HOSSAIN*[1], Mohammad Hasanul KARIM[2], Mohammad Imran AHMED[2] and Syeda Ayesha SULTANA[2]

[1]*Department of Animal Science and Nutrition, Chittagong Veterinary and Animal Sciences University, Khulshi, Chittagong-4225, Bangladesh*
[2]*UG student, Chittagong Veterinary and Animal Sciences University, Khulshi, Chittagong-4225, Bangladesh*
*Email: emrancvasu@yahoo.com

ABSTRACT*:* The study was undertaken to find out the chemical composition of different hilly grasses and leaves available in Bandarban areas of Bangladesh. Total 10 different hilly grasses and leaves such as Bottle gourd leaf (*Lagenaria siceraria*), Castor bean leaf (*Ricinus communis*), Cogon grass (*Imperata cylindrica*), Dhol kolmi (*Ipomoea carnea*), Giant reed leaf (*Arundo donax*), Hilly grass (*Cynodon dactylon*), Pithraj leaf (*Aphanamixis polystachya*), Sal leaf (*Shorea robusta*), Shegun leaf (*Tectona grandis*) and Tiger's claw (*Erythrina variegata*) leaf were collected from study areas. Samples were collected, chopped and tested immediately for moisture content and remaining samples were sun-dried and processed using standard procedure. Chemical analyses of the samples were carried out in triplicate for Dry matter (DM), Crude protein (CP), Crude fiber (CF), Nitrogen free extract (NFE), Ether extract (EE) and Ash. Metabolizable energy (ME) was calculated mathematically for all samples by using standard formula. Results indicated that, crude protein content in Bottle gourd leaf was 33.6 g/100g, Castor bean leaf 21.0 g/100g, Cogon grass 8.4 g/100g, Dhol kolmi 26.3 g/100g, Giant reed leaf 8.6 g/100g, Hilly grass 6.8 g/100g, Pithraj leaf 15.3 g/100g, Sal leaf 16.3 g/100g, Shegun leaf 11.9 g/100g and Tiger's claw leaf 18.4 g/100g. In addition to crude protein, all samples contained substantial amount of crude fibre, nitrogen free extracts, ether extracts and ash. It could therefore, be inferred that, the hilly grasses and leaves might be used as an alternative to conventional feeds for livestock particularly during scarcity period.

Keywords: Hilly Grasses And Leaves, Metabolizable Energy, Moisture, Dry Matter, Crude Protein, Crude Fiber, Nitrogen Free Extracts, Ether Extracts, Ash.

ORIGINAL ARTICLE
pii: S222877011600001-6
Received 28 Apr. 2015
Revised 08 Aug. 2015
Accepted 23 Oct. 2015

INTRODUCTION

Livestock is an integral part of the farm economics of Bangladesh. Bangladesh has a very high density of population considering the total land mass and the cultivable land. Livestock production depends upon several factors, such as health care management, breeding, nutrition etc. However, it is considered that the most important constraint to livestock development in Bangladesh is the shortage of feed and fodder (Rahman, 2011).

Bridging the gap between teeming population and food production is one of the important tasks of developing countries like Bangladesh. Expensive staple foods and policy constraints on food imports are the major factors worsening the food situation in developing countries (Weaver, 1994). Protein-energy deficiency has been recognized as the most common form of malnutrition in regions where people depend mainly on starch-based diets (Michaelsen and Henrik, 1998; Weaver, 1994). Livestock production, animal husbandry and maintenance of soil fertility play important role in rural development and in turn the economy of developing countries. Livestock nutrition is also one of the critical constraints to increase animal productivity in developing countries (ILRI, 1995) and perpetual gap persists between the demand and supply of digestible crude protein and total digestible nutrients to livestock in Asian continent (Singh et al., 1997).

Providing adequate good-quality feed to livestock to raise and maintain their productivity is and will be a major challenge to agricultural scientists and policy makers all over the world. Increase in population and rapid growth in world economies will lead to increase in demand for animal products. An increase of approximately 30 % in both meat and milk production is expected in the coming 20 years. At the same time, the demand for food crops will also increase. Future hopes of feeding the millions and safeguarding their food security will depend on the enhanced and efficient utilization of unconventional resources that cannot be used as food for humans, rather as feed for livestock.

The higher price and acute scarcity of conventional feed ingredients create problems to the profitable commercial dairy and poultry farming in Bangladesh. Therefore, attention is gradually being focused on cheaper alternative feeds, especially, those are available in our country but people are unknown to them. Therefore, present study was aimed to find out the nutritive values of hilly grasses and leaves that could be used as an alternative to conventional feeds for livestock particularly during scarcity period.

To cite this paper: Hossain M.E., Karim M.H., Ahmed M.I. and Sultana S.A. 2016. Hilly grasses and leaves: a promising unconventional feed resource for livestock. *Online J. Anim. Feed Res*., 6(1): 01-07.
Scienceline/Journal homepages: http://www.science-line.com/index/; http://www.ojafr.ir

MATERIAL AND METHODS

Study area

Most of the hilly grasses and leaves are available in the hills of Bandarban. Therefore, the current study was undertaken in hilly areas of Bandarban district.

Collection of sample

Samples were collected from the hills of Bandarban. Approximately 2000 grams of each sample was collected. Samples were wrapped up by polythene bag and sent to the Animal Nutrition Laboratory, Chittagong Veterinary and Animal Sciences University, Chittagong.

Preparation of sample

Fresh samples were cut into the smaller pieces of 1 cm sieve size and placed into the hot air oven for proper drying. The dried samples were subjected to grinding to make it homogenous powder. Later on, it was mixed properly and exposed to shade to cool down for sampling. Individual samples were kept in air tight polythene bag and identified by marker. Later on it was subjected to chemical analyses.

Analysis of sample

Chemical analyses of the samples were carried out in triplicate for dry matter (DM), crude protein (CP), crude fiber (CF), nitrogen free extract (NFE), ether extract (EE) and ash in the animal nutrition laboratory, Chittagong Veterinary and Animal Sciences University, Chittagong, Bangladesh as per AOAC (2006).

Calculation of ME

Metabolizable Energy (ME) was calculated from proximate components by using a standard mathematical formula as per Lodhi et al. (1976).

Statistical analysis

Data related to chemical composition of the hilly grasses and leaves were compiled by using Microsoft Excel 2007. Chi-square (χ^2) test was performed to analyze the data by using SPSS 16.0. Statistical significance was accepted at 5 % level ($P<0.05$).

RESULTS AND DISCUSSION

Chemical composition of the hilly grasses and leaves particularly Bottle gourd leaf, Castor bean leaf, Cogon grass, Dhol kolmi, Giant reed leaf, Hilly grass, Pithraj leaf, Sal leaf, Shegun leaf and Tiger's claw leaf for moisture, dry matter (DM), Crude protein (CP), Crude fiber (CF), Nitrogen free extracts (NFE), Ether extracts (EE) and ash have been presented in Table 1.

Table 1 - Chemical composition (g/100g DM) of the hilly grasses and leaves available in the hilly areas of Bandar ban, Chittagong

English name	Scientific name	ME	DM	CP	CF	NFE	EE	Ash
Bottle gourd leaf	*Lagenaria siceraria*	2470.1	8.1	33.6	11.2	32.8	4.2	18.2
Castor bean leaf	*Ricinus communis*	2201.8	24.2	21.0	25.0	43.1	1.6	9.3
Cogon grass	*Imperata cylindrica*	1591.1	32.0	8.4	41.2	42.3	1.1	7.0
Dhol kolmi	*Ipomoea carnea*	2493.4	19.3	26.3	13.0	49.8	0.2	10.7
Giant reed leaf	*Arundo donax*	2054.9	34.0	8.6	29.5	49.3	2.4	10.2
Hilly grass	*Cynodon dactylon*	1741.0	33.4	6.8	40.2	43.9	1.3	7.8
Pithraj leaf	*Aphanamixis polystachya*	2879.5	64.0	15.3	18.5	48.0	11.1	7.1
Sal leaf	*Shorea robusta*	2764.1	64.1	16.3	14.2	58.8	4.3	6.4
Shegun leaf	*Tectona grandis*	2323.8	34.6	11.9	26.2	49.5	4.3	8.1
Tiger's claw leaf	*Erythrina variegata*	2715.5	71.6	18.4	16.1	51.4	6.0	8.1
SEM	–	136.3	6.7	2.7	3.4	2.2	1.0	1.1
Level of sig.	–	***	***	***	***	NS	**	NS

ME=Metabolizable energy (kcal/kgDM); DM=Dry matter; CP=Crude protein; CF=Crude fibre; NFE=Nitrogen free extract; EE=Ether extract; SEM=Standard error of the mean; NS=Non-significant ($P>0.05$); **=Significant at 1% level ($P<0.01$); ***Significant at 0.1% level ($P<0.001$)

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Bottle gourd leaf (*Lagenaria siceraria*)

The local name of bottle gourd is Pani Lau and scientific name is *Lagenaria siceraria*. It is cultivated throughout our country. The fruits are eaten as vegetable. The fruits are cool and very useful to human health in summer season. Decoction of leaves mixed with sugar is given in jaundice. Warm juice of tender stem relieves earache (Vashista, 1974). The edible portion of immature fruit is about 84.0 g/100g. Bottle gourd with peel is good source of crude fiber, acid detergent fiber, hemicelluloses, iron, phosphorus, zinc than bottle gourd without peel (Milind and Satbir, 2011). Leaves contain cucurbitacin and extracts of the plant have shown antibiotic activity (Gorasiya et al., 2011). In present study, bottle gourd leaf contained 2470.1 kcal ME/kgDM, 33.6 g/100g crude protein, 11.2 g/100g crude fibre, 4.2 g/100g ether extracts, 32.8 g/100g nitrogen free extracts and 18.2 g/100g ash (Table 1). However, the result of the current study is contradictory with Gopalan et al. (2004) who found DM 12.0 g/100g, CP 2.0 g/100g, CF 1.0 g/100g, EE 6.0 g/100g, ash 2.0 g/100g. Thus bottle guard leaves and their wastes could be an alternative feed resource for livestock.

Castor bean leaf (*Ricinus communis*)

Castor bean (*Ricinus communis*) has been cultivated for centuries for the oil produced by its seeds. The Egyptians used to burn castor oil in their lamps more than 4000 years ago. Castor bean is cultivated all over the world on commercial scale including some advanced countries. Among these, India, China, Brazil, Ethiopia, Paraguay, Vietnam and Thailand are the major castor growing countries and account for 97.0% of the world's production (FAO, 2008). In present study, castor bean contained 2201.8 kcal ME/kgDM, 24.2 g/100g dry matter, 21.0 g/100g crude protein, 25.0 g/100g crude fibre, 1.6 g/100g ether extract, 43.1 g/100g nitrogen free extracts and 9.3 g/100g ash. The castor beans grown in India for castor oil production has high leaf-protein content but has not been processed because, although the immature leaves are safe to consume, a poisonous alkaloid 'ricin' combined with protein forms in the mature leaf. The nutritional values of leaf proteins have been investigated by different researchers (Waterlow, 1962; Duckworth and Woodham, 1961; Gerloff et al., 1965 and Rau et al., 1969). Similarly, leaf amino acid compositions have been studied by Gerloff et al. (1965) and Byers (1971).

Cogon grass (*Imperata cylindrica*)

The local name of cogon grass is Shon and scientific name is *Imperata cylindrica*. Cogon grass is a perennial, rhizomatous grass that grows from 2 to 4 feet in height. The leaves are about 1 inch wide, have a prominent white midrib, and end in a sharp point. Leaf margins are finely toothed and are embedded with silica crystals. The upper surface of the leaf blade is hairy near the base. The undersurface is usually hairless. The flowers are arranged in a silvery, cylindrical, branching structure, or panicle, about 3-11 inches long and 1½ inches wide. It is used for thatching the roofs of traditional homes throughout south-east Asia. It is planted extensively for ground cover and soil stabilization near beach areas and other areas subject to erosion. Other uses include paper-making, thatching and weaving into mats and bags. However, it's most common usefulness may be seen in its medicinal properties which include astringent, antipyretic, diuretic, tonic and styptic actions. It is used in traditional Chinese medicine. A number of cultivars have been selected for garden as ornamental plants. Young inflorescences and shoots may be eaten cooked, and the roots contain starch and sugars and are therefore easy to chew. Cogon grass is a valuable feed for cattle, goat and sheep. In present study, cogon grass contained 1591.1 kcal ME/kg DM, 32.0 g/100g dry

To cite this paper: Hossain M.E., Karim M.H., Ahmed M.I. and Sultana S.A. 2016. Hilly grasses and leaves: a promising unconventional feed resource for livestock. *Online J. Anim. Feed Res*., 6(1): 01-07.
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matter, 8.4 g/100g crude protein, 41.2 g/100g crude fiber, 42.3 g/100g nitrogen free extracts, 1.1 g/100g ether extracts and 7.0 g/100g ash (Table 1). As an unconventional feed, cogon grass can be used as alternative feed resource for livestock in scarcity of traditional feeds.

Dhol kolmi (*Ipomoea carnea*)

Dhol kolmi (*Ipomoea carnea*) is herbaceous aquatic or semi-aquatic perennial plant of the tropics or subtropics. Leaves are flat and vary in shape depending on variety, from heart-shaped to long, narrow and arrow-shaped. Narrow leaves are 1-2.5 cm wide and 20-30 cm long. Broad leaves are up to 5 cm wide and 15-25 cm long. The leaves are very low in cholesterol. It is also a good source of protein, dietary fiber, phosphorus, vitamin A, vitamin C, riboflavin, niacin, vitamin B6, folate, calcium, iron, magnesium, potassium and manganese. Dhol kolmi is an excellent source of Vitamin A and Vitamin C. In many developing countries, the largest contribution of vitamin A intake comes from the provitamin a carotenoids in plant foods, which may contribute up to 82 g/100g of the total vitamin A intake, whereas the contribution from fish and meat is of minor importance, because these foods are expensive and/or are not accessible (Berg et al., 2000). Malaysians mostly consume green vegetables such as Chinese mustard leaves, Chinese kale, lettuce, spinach and swamp cabbage (Amin and Cheah 2003; Wen et al., 2010). In present study, Dhol kolmi contained 2493.4 kcal ME/kg DM, 80.7 g/100g moisture, 26.3 g/100g crude protein, 13.0 g/100g crude fibre, 0.2 g/100g ether extract, 49.8 g/100g nitrogen free extracts and ash 10.7 g/100g.

Giant reed leaf (*Arundo donax*)

Giant reed (Arundo donax) is a perennial rhizomatous grass which is widely diffused in subtropical and warm temperate regions. From its native area, probably Eastern Asia, it has been dispersed all over the world by humans who use it for multiple purposes such as roof thatching, reeds in woodwind instruments, sweeping materials, fishing rods etc. Its spontaneous and rapid growth allows A. donax to be considered as an invasive weed (Pilu et al., 2012). It is an erect, perennial, bamboo-like grass. In traditional medicine, it is utilized as a diuretic, sudorific and for dropsy treatment (Shamel, 1917; Gucel, 2010; Guarrera, 2007). A. donax has been used industrially to produce cellulose, paper and rayon. Giant reed leaf is abundantly available in the hilly areas of Bandarban. From the nutritional analysis, it contained 2054.9 kcal ME/kgDM, 34.0 g/100g dry matter, 8.6 g/100g crude protein, 29.5 g/100g crude fiber, 49.3 g/100g nitrogen free extracts, 2.4 g/100g ether extracts and 10.2 g/100g ash (Table 1). Only the hilly people use this leaf as feed for their domestic animals. It is a good source of protein. Thus giant reed leaf may be used as an alternative protein source for livestock.

Hilly grass (*Cynodon dactylon*)

Hilly grass is a kind of herb that contains fibers. It grows enormously in the hilly areas of Bandarban district. Generally local people of that region use it as feed for their domestic animals. In present study, hilly grass contained 1741.0 kcal ME/kg DM, 33.4 g/100g dry matter, 6.8 g/100g crude protein, 40.2 g/100g crude fiber, 43.9 g/100g nitrogen free extracts, 1.3 g/100g ether extracts and 7.8 g/100g ash (Table 1). It is a good source of vitamins and minerals. This grass is widely available in hilly areas, so this grass can be used as unconventional feed for livestock.

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

Pithraj leaf (*Aphanamixis polystachya*)

It belongs to Meliaceae family. Scientific name is *Aphanamixis polystachya*. This is a large tree with bunches of rounded lobular fruits and glossy deep brown seeds, grows wild and planted in forests and roadsides all over the country (Ghani, 2003). The plant is extensively used in traditional system of medicine for various ailments in different Asian countries like spleen and liver complications, tumors, rheumatism. The plant is reported to possess antitumor (Rabi and Gupta, 1995), hepatoprotective (Gole and Dasgupta, 2002), insecticidal (Talukder and Howse, 1993), antibacterial, antifungal and immunosuppressive (Ghani, 2003) activities. Leaves contain diterpene alcohol and beta-sitosterol. Seeds yield polystachin, an alkaloid, a glycoside and a saponin (Ghani, 2003). In present study, the pitraj leaf contained 2879.5 kcal ME/kg DM, 15.3 g/100g crude protein, 18.5 g/100g crude fibre, 11.1 g/100g ether extracts, 48.0 g/100g nitrogen free extracts and 7.1 g/100g ash.

Sal leaf (*Shorea robusta*)

The sal (*Shorea robusta*) is one of the dominant tree species in tropical deciduous forests. The sal tree is a hardwood timber tree up to 30-35 m tall. The crown is spreading and spherical. Leaves are 20 cm long, simple, shiny and glabrous, delicate green, broadly oval at the base. Fruits are 1-1.5 cm large and ovoid (Orwa et al., 2009). Sal seed leaves are used as roughage of medium to poor quality (Orwa et al., 2009). The used leaves/plates are readily eaten by goats and cattle that roam the streets freely. In present study, Sal leaf contained 2764.1 kcal ME/kgDM, 16.3 g/100g crude protein, 14.2 g/100g crude fibre, 4.3 g/100g ether extracts, 58.8 g/100g nitrogen free extracts and 6.4 g/100g ash which is contradictory with the other investigators (Makkar et al., 1998; Sen, 1938) who found 11.3 g/100g CP, 27.4 g/100g CF, 3.2 g/100 EE, 3.9 g/100g NFE and 6.4 MJME/kg sal leaf.

Shegun leaf (*Tectona grandis*)

Shegun is the common name for the tropical hardwood tree. The English name of shegun leaf is teak leaf and scientific name is *Tectona grandis*. It is native to south and south east Asia, mainly Bangladesh, India, Indonesia, Malaysia, and Burma, but is naturalized and cultivated in many countries, including those in Africa and the Caribbean. Myanmar accounts for nearly one third of the world's total teak production. Teak is a large, deciduous tree that is used for animal feed. It has small, fragrant white flowers and papery leaves that are often hairy on the lower surface.

Teak leaves are four-sided branchlets; bear the very large leaves which are shield for three to four months during the latter half of the dry season. The leaves are shiny above and hairy below with vein network clear about 30 x 20 cm but young leaves up to 1.0 m long. The leaves yield the dye which is used to colour clothes. Teak is probably the best protected commercial species in the world. It was found that, 1g of teak leaf powder could remove 86.73% of cadmimum (II) from 50 ml aqueous solution (Acton, 2011). So it has antitoxic properties. In Indonesia, teak leaves are also used for producing mold starter culture (Lusas et al., 1989; Applewhite, 1989). In present study, teak leaf contained 2323.8 kcal ME/kgDM, 34.6 g/100g dry matter, 11.9 g/100g crude protein, 26.2 g/100g crude fiber, 49.5 g/100g nitrogen free extracts, 4.3 g/100g ether extracts and 8.1 g/100g ash (Table 1). It a good source of minerals and protein. Thus teak leaf may be an alternative feed resource for animals.

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Tiger's claw leaf (*Erythrina variegata*)

The foliage of *Erythrina variegata* makes an excellent feed for most livestock. A tree of average size, pruned three or four times a year, produces from 15 to 50 kg of green fodder annually depending on growing conditions. Legume trees offer a renewable and cheap source of feed protein for ruminant animals in smallholder farms in tropical regions. Erythrina species belong to a legume family that can be found throughout the tropics. The juice of fresh leaves from some Erythrina species is used in traditional medicine, where it is considered to be a sedative and an analgesic (Ratnasooriya and Dharmasiri, 1999; Deb et al., 2009). *Erythrina variegata* foliage has high crude protein content, 19 to 22 g/100g in dry matter (DM), and can be an excellent feed for most livestock (Kibria et al., 1994; Aregheore and Perera, 2004; Kongmanila and Ledin, 2009). Tiger's claw leaf contained 2715.5 kcal ME/kgDM, 18.4 g/100g crude protein, 16.1 g/100g crude fibre, 6.0 g/100g ether extracts, 51.4 g/100g nitrogen free extracts and 8.1 g/100g ash. The result is almost similar to (Kibria et al., 1994) who found CP ranged from 19-22 g/100g. Leaves normally contain 16 to 18 g/100g crude protein and have an IVDMD of 50 g/100g. The leaves have no known toxicity for cattle.

CONCLUSION

The results of this study indicated that the hilly grasses and leaves are good sources of carbohydrates, protein and energy. From review it was also evident that, the hilly leaves are a good source of Iron, Copper, Potassium and Manganese which may meet the recommended daily allowance. Adequate consumption of these plant leaves and grasses may help in preventing adverse effects of dietary deficiencies. Moreover, feeding these unconventional feeds may reduce pressure on the conventional feeds which will ultimately minimize production cost of livestock and their products and by-products.

Acknowledgement

The author is grateful to UGC for financial support through "Development of Database for Feeding Systems in Dairy Farms at Peri-Urban and Urban Areas of Chittagong, Bangladesh" project. The author is also grateful to Animal Nutrition laboratory, PRTC laboratory and Food Science and Nutrition laboratory, CVASU for providing technical support particularly for use of Kjeltec, Fibetec and Soxtec for feed analysis.

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To cite this paper: Hossain M.E., Karim M.H., Ahmed M.I. and Sultana S.A. 2016. Hilly grasses and leaves: a promising unconventional feed resource for livestock. *Online J. Anim. Feed Res*., 6(1): 01-07.
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To cite this paper: Hossain M.E., Karim M.H., Ahmed M.I. and Sultana S.A. 2016. Hilly grasses and leaves: a promising unconventional feed resource for livestock. *Online J. Anim. Feed Res*., 6(1): 01-07.
Scienceline/Journal homepages: http://www.science-line.com/index/; http://www.ojafr.ir

Online Journal of Animal and Feed Research

Volume 6, Issue 1: 08-13; Jan 30, 2016 ISSN 2228-7701

THE EFFECT OF GROUND-NUT (*Arachis Hypogaea, L.*) SEED CAKE SUPPLEMENTATION ON PERFORMANCE OF DESERT SHEEP UNDER DRY LAND CONDITIONS IN NORTH KORDOFAN, SUDAN

Basheer Adam FADUL[1], Mohammed Khair ABDALLA[2], Abd-ELnasir MOHAMED[2], Ikhlas NOUR[2], Ahmed IDRIS[1]✉ and Hamza ELTAHER[3]

[1] Faculty of Natural Resources and Environmental Studies, Peace University, P.O. Box 20, El Fulla, Sudan
[2] University of Khartoum, Faculty of Animal Production, Sudan
[3] Nyala University, Animal Production, Sudan

ABSTRACT: This study was conducted in north Kordofan state-Sudan to evaluate the effects of feeding ground-nut cake supplement on lambs body weight changes and body measurements as an alternative to ground-nut hay plus natural grazing. Twenty four heads of lambs were used (16 males and 8 females) with 6 animals in each group (4 males and 2 females). All the groups were left to graze on natural pasture, and then supplemented by ground-nut hay and ground-nut cakes. Experimental animals allowed drinking water every two days. Groups (1 and 3) were supplemented with ground-nut cake at the rate of 150 g per head /day. The body weights and body measurements were recorded weekly. Range grasses were sampled and analyzed for proximate chemical analysis and for in vitro digestibility trails. The results indicated that the body weight, height at withers, heart girth and body length in males were higher, also the animals supplemented with ground nut cake during autumn season recorded higher values. In vitro digestibility coefficient for ground-nut seed cake was 65.7% and 62.7% for range grasses which were significantly ($P < 0.05$) higher than the ground-nut hay (49.8%) at 72 hrs. It was recommended that the supplementary feeding is the best strategy to improve lambs performance on the natural pastures during the dry season.

Keywords: Supplementary Ground-Nut Cake, Lambs, Body Measurements, Sudan

ORIGINAL ARTICLE
pii: S222877011600002-6
Received 18 Dec. 2015
Accepted 10 Jan. 2016

INTRODUCTION

The Sudan national sheep flock is estimated to be 50.9 million heads (FAO 2009). More than 65% of the sheep in Sudan are of the Sudan desert type, they are kept mainly in the northern parts where they are maintained under rangeland conditions.

Sheep population in Sudan has an annual growth rate of about 3% (MARF, 2007). The share of livestock in the national income is about 22.3%, constituting about 18.2% of total exports and about 38% of agricultural exports. In spite of the importance of sheep they are still raised under nomadic conditions using traditional methods of management and natural grazing. Sheep flocks in north Kordofan are raised on rangelands under traditional agro-pastoral systems. One of the major constraints under rangelands conditions in the tropics is the lack of good quality grazing resources on a year-round basis, where animals face a prolonged dry season (February-June). This induced the seasonality of production, high mortality rates in both young and mature animals and low reproductive performance (El-Hag et al., 2001). The low levels of protein in natural range lands under tropical conditions is the dominance of annual grasses, this is reflected in the ruminant animals raised on such range lands do not ingest sufficient nutrients necessary for good performance (El-Wakeel and Abu Sabah, 1993). Therefore, this research work was prepared to evaluate the effects of feeding ground-nut cake supplement on lambs body weight changes and body measurements as an alternative to ground-nut hay plus natural grazing.

MATERIAL AND METHODS

The Study Area

The study was conducted in north Kordofan State, Sudan. This lies within latitudes 11.5-13.75 N° and longitudes 27-29.5 E°. Average annual rainfall is 300 mm in the north and about 400 mm in the southern parts. The dominant vegetation is a variable mixture of mainly annual grasses, the dominant grasses species in the area include Dactyloctinium aegyptiun (Abu-Asabi), Cenchrus biflorus (Haskaneet), Echnochloa colonum (Difra), Eragrostis tremula (Banu), Andropogon gayanus (Abu Rakhies), Zornia glockidata (Shiline), and Ipomea cordiosepala (Tabar), as described by Yehia (2002).

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

Experimental procedures

Twenty four (16 males +8 females) 6 months old desert lambs were selected. The animals were randomly divided into four groups (treatments) of six each (4males+2females) matching in age and weight. The experimental animals were given access to water every two days. The four groups were allowed to graze natural grasses available on pasture. However, the other two groups were supplemented with additional concentrates, consisting of ground-nut seed cake; each animal in these two groups was individually fed 150g concentrates at 8:00 daily commenced with short adaptation period for two weeks. During this period, the animals were injected with Ivomec subcutaneously against external and internal parasites. Moreover; Albendazole was drenched orally for de worming.

Range grasses, ground-nut cake and ground-nut hay were collected in gunny bags then milled through a 2.0mm screen for in-vivo digestibility, and a sub sample taken and milled further through 1.0mm screen for use in gas production trial, mineral assay and proximate analysis.

In-vitro gas production

The gas production technique was used in the in-vitro gas production assessment. The net gas volumes data was then fitted in the following equation as described by (Ørskov and McDonald, 1979):

$G = a + b\ (1 - e^{-c\ t})$

Where:

G = the volume of gas produced (ml) at time t,

a = the gas production from the immediately soluble fraction (ml),

b = the gas production from the insoluble but degradable fraction (ml),

a + b = the potential gas production (ml),

c = the rate constant of gas production (fraction/h)

OMD48= organic matter digestibility at 48 hours.

In-vitro organic matter digestibility calculated from the equation: OMD (%) = 18.53 + 0. 9239 gas production (at 48hrs) + 0.0540 CP, (Menke and Steingass 1988).

Data Collection

Body weight and body measurements

The animals were weighed and body measurements were taken at the beginning of experiment after the adaptation period. Measurements were taken for two seasons on lambs, animal body weights were recorded every week and body measurements were taken using a measuring tape according to (Owen et al., 1977). The body condition score (BCS) was determined according to 1 to 5 scale (Russel, 1991).

Statistical analysis:

The data were analyzed using a completely randomized block design (CRBD). In treatments were arranged factorials (statistix 8) and LSD test was used for mean separation. The results of gas volume recordings were fitted to the exponential equation $P = a + b\ (1 - e^{-c\ t})$, where p is the gas volume at time t and a, b, and c are constants describing gas production with time: the constants 99 are based on gas volume recordings at 3, 6, 12, 24, 48, 72 and 96 h. Significant differences between means with respect to gas volume readings were tested using Duncan's multiple range test (Duncan, 1955).

RESULTS AND DISCUSSION

The results of chemical composition and digestibility coefficients of the supplements are presented in Table 1. The results revealed that the ground-nut cake, ground-nut hay and natural grasses have higher nutrient contents and digestibility coefficients compared to dry season grasses crude protein. Their respective energy and digestibility estimates were 11.8, 9.4 and 9.8 (ME, MJ/kg DM) and 56.3, 58.6 and 62.5 % for ground-nut cake, hulls and grasses-residue. One of the most important constraints to livestock production under rangeland conditions is the scarcity of nutritious grazing on a year-round basis (Cook and Fadlalla, 1987; El-Hag, 1992). The situation is particularly critical during the long dry season that extends from February to June. Rangelands grasses quality drops sharply during this time of the year. However, protein is considered the most affected nutrient (Van Soest, 1982); one of the major causes for low levels of protein in natural rangelands under tropical conditions is the dominance of annual grasses and absence of perennials (El-Wakeel and Abu Sabah, 1993). Consequently, ruminant animals raised on such rangelands do not ingest sufficient nutrients necessary for good performance. It is therefore, imperative, that other feed sources such as cakes should be used to supplement the deficient nutrients.

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The gas production methods of estimating nutritive value of experimental ingredients have been used to assess the rumen fermentation of ingredients. The total gas production (ml/200mg DM) at 48 hrs as shown in table 2 indicates variations in the grasses, ground-nut cake and ground-nut hay. The results showed that ground-nut cake reflected the greater ($P<0.05$) gas volume at different time intervals. However, the grasses showed the lowest gas volume during incubation time, this may be reflecting the presence of more anti-nutritional factors. These findings are in complete agreement with (Ahmed and El-Hag, 2004, Bahatta et al., 2002 and Idris, 2011).

As shown in Table 3, male lambs scored significantly ($P<0.05$) higher body weight gain compared to the female lambs. Also, it was found that sex of lamb had a significant effect on birth weight. Males were heavier than females (Idris et al., 2011). In contrast, Arther and Ahunu (1989) indicated that differences in breed, type and sex of lambs were not significant.

Analla et al., (1998) reported that the sex had significant ($P< 0.05$) effect on birth weight and lamb survival. It was noted that male lambs were heavier than females in lamb survival age, birth weight. Similarly, (Idris et al., 2011) reported that male lambs were significantly ($P<0.05$) heavier than females at birth, weaning and 6 months of age. The same traits were reported by (Boujenane and Kansari, 2002) to be significant to 70 days of age. On the other hand, (Rastogi, 2001) reported that sex of lamb was not a significant source of variation, also (Hassen et al., 2002) found that male and female lambs had similar weights at birth and until 30-60 days of age, then after that they differed.

Like-wise, (Suleiman, 1976) studied the weaning weight of Sudanese desert sheep and found that the weaning weights were (24.75 and 21.9 kg) for the male and female lambs respectively. It is well documented that sex of lamb had direct effect on weaning weight and male lambs were heavier at weaning than female lambs (Alama, 1987). Desert sheep gain more body weight during autumn season compared with those during summer; this might be attributed to the declaiming of the pasture herbage in term of quality and quantity with the onset the dry season. Mohamed and Salih (1991) have demonstrated that sheep grazed during the dry season on low rain woodland savannah pasture lost body weight, they have also stated that the inability of dry season grazing to sustain livestock production was a result of a decline in intake of dry matter and inadequate digestible nutrients. As expected, animals supplemented with ground-nut cake were higher ($P<0.05$) weight compared to unsupplemented animals. The same results were reported by (Lutfi, 1983) he found that the average daily gain was 126.31 g/day and the feed conversion ratio was 7.6.

Effects of supplementation, seasons and sex on lambs body measurements

Sex of lambs had significantly affected height at wither, heart girth, body length, head length, ear length and neck length (tables 3 and 4) .The results shown that, male lambs scored higher ($P<0.05$) values compared with female lambs. Animals during autumn season were recorded better body measurements compared with those during summer. Height at wither, heart girth, ear length, tail length and body condition score of animals supplemented with ground-nut seed cake were had high values compared with unsupplemented animals. The interaction (sex x seasons) was significantly affected body heart girth and body length (table 3). The subclass male x autumn recorded the higher ($P<0.05$) heart girth and body length followed by the other subclasses.

Table1. Chemical composition (%DM-basis) and in vitro digestibility coefficients (%) of ground-nut cake, ground-nut hay and natural grasses and calculated energy content.

Ingredients [Nutrient (g/kg DM)]	Ground nut cake	Ground nut hay	Grasses
Dry matter	93.7	92.6	95.3
Crude protein	44.2	11.2	6.4
Crude fibre	6.6	29.3	45.9
Crude fat	6.3	1.8	0.79
Ash	6.7	12.9	7.3
Energy density (ME, MJ/kg DM)*	11.77	9.35	9.76
In vitro OM digestibility (%)	56.25	58.61	62.48

*ME: Metabolizable Energy was calculated from literature values.

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Table 2 - Gas production (mean ± S.E) ml per200 mg dry sample from incubation of natural grazing, ground-nut cake and ground-nut hay at different time intervals.

Natural grazing, ground-nut cake and ground nut hay	Incubation time(h)							Constants*			
	3	6	12	24	48	72	96	a	b	C	a+ b
Grasses	3.7±0.17	5.5±0.29	9.0±0.29	19.3±0.33	52.7±0.33	62.7±0.33	67.5±0.58	-4.16	96.02	0.02	91.86
Ground-nut cake	12.3±2.40	21.8±2.67	35.3±3.57	39.3±2.12	43.8±1.10	65.7± 1.10	87.6±1.10	-5.7504	48.16	0.1565	42.4096
Ground-nut hay	10.3±033	15.0±0.33	29.8±0.33	43.2±0.17	47.7±0.44	49.8±0.17	49.8±0.33	-1.88	51.70	0.08	49.82

*a, b a, b and c represents constants in equation $P = a + b\ (1 - e^{-ct})$ describing gas production with time: the constants are based on gas volume recordings at 3, 6, 12, 24, 48, 72 and 96 hour.

Table 3 - Effect of sex, seasons, GNC supplementation and interactions sex x season, sex x supplementation on lambs body weight, weight gain and body measurements (mean± S.E).

Factors	Treatments and subclasses	Body weight Kg	Weight gain Kg	Height at withers Cm	Heart girth Cm	Body length Cm	Head length Cm
Sex	Male	35.00 ±0.34	18.26 ± 2.62	73.60 ±0.21	74.84 ±0.24	61.92 ±0.23	29.90 ±0.12
	Female	30.28 ±0.48	8.40 ± 3.64	72.40 ±0.30	72.15 ±0.34	59.88 ±0.33	28.80 ±0.17
Seasons	Autumn	35.83 ±0.36	31.95 ± 2.70	75.77 ±0.23	76.48 ±0.26	63.14 ±0.25	30.08 ±0.13
	Summer	29.45 ±0.43	-5.28 ± 3.46	70.23 ±0.27	70.51 ±0.30	58.65 ±0.29	28.62 ±0.15
Ground-nut seed cake	GNC	33.87 ±0.39	32.54 ± 3.02	73.82 ±0.25	74.65 ±0.28	61.06 ±0.27	29.53 ±0.14
	No GNC	31.41 ±0.39	-5.87 ± 3.00	72.18 ±0.25	72.34 ±0.28	60.73 ±0.27	29.17 ±0.14
Sex × Seasons	Male autumn	38.83 [a] ±0.44	40.35 ± 3.31	76.51 ±0.28	78.22 [a] ±0.31	64.56 [a] ±0.30	30.78 ±0.15
	Female autumn	32.83 [b] ±0.63	23.54 ± 4.65	75.02 ±0.40	74.74 [b] ±0.45	61.72 [b] ±0.43	29.38 ±0.22
	Male summer	31.17 [c] ±0.52	-3.82 ± 4.29	70.69 ±0.33	71.46 [c] ±0.37	59.27 [c] ±0.36	29.02 ±0.18
	Female summer	27.74 [d] ±0.74	-6.73 ± 5.84	69.77 ±0.47	69.56 [d] ±0.53	58.03 [d] ±0.51	28.23 ±0.26

[a b c d]: Means with different superscript within the same column and same factor are significant different (P<0.05); **No GNC** = not supplemented with ground-nut cake; **GNC** = supplemented with ground-nut cake

To cite this paper: Fadul B.A., Abdalla M.Kh., Mohamed A-EL, Nour I, Idris A and Eltaher H. 2016. The effect of ground-nut (*Arachis hypogaea, L.)* seed cake supplementation on performance of desert sheep under dry land conditions in North Kordofan, Sudan. *Online J. Anim. Feed Res*., 6(1): 08-13.
Scienceline/Journal homepages: http://www.science-line.com/index/; http://www.ojafr.ir

Table 4. Effect of sex, seasons, GNC supplementation and their interactions on lambs body measurements (mean± S.E).

Factors	Treatments and subclasses	Ear length Cm	Neck length Cm	Tail length Cm	Body condition score
Sex	Male	17.24 ±0.04	25.17 ±0.09	60.01 ±0.27	3.49 ±0.01
	Female	16.91 ±0.05	24.76 ±0.13	60.09 ±0.39	3.42 ±0.02
Seasons	Autumn	17.19 ±0.04	25.32 ±0.10	62.34 ±0.29	3.80 ±0.02
	Summer	16.96 ±0.05	24.61 ±0.11	57.76 ±0.34	3.12 ±0.02
Ground-nut seed cake	GNC	17.19 ±0.04	25.02 ±0.10	61.25 ±0.32	3.56 ±0.02
	No GNC	16.96 ±0.04	24.91 ±0.10	58.85 ±0.32	3.35 ±0.02
Sex × Seasons	Male autumn	17.32 ±0.05	25.54 ±0.12	62.60 ±0.36	3.87 ±0.02
	Female autumn	17.06 ±0.07	25.11 ±0.17	62.08 ±0.51	3.72 ±0.03
	Male summer	17.15 ±0.06	24.80 ±0.14	57.43 ±0.42	3.11 ±0.02
	Female summer	16.76 ±0.09	24.42 ±0.20	58.09 ±0.60	3.12 ±0.04
Sex × Ground-nut seedcake	Male GNC	17.28 ±0.05	25.32 ±0.13	61.43 ±0.39	3.67 ±0.02
	Male No GNC	17.19 ±0.05	25.02 ±0.13	58.60 ±0.39	3.30 ±0.02
	Female GNC	17.10 ±0.08	24.72 ±0.18	61.08 ±0.55	3.45 ±0.03
	Female No GNC	16.73 ±0.08	24.81 ±0.18	59.09 ±0.55	3.39 ±0.03

[a b c d]: Means with different superscript within the same column and same factor are significant different (P<0.05); **No GNC** = not supplemented with ground-nut cake

CONCLUSION

The final body weights and body measurements of lambs supplemented with ground-nut seed cake revealed better performance compared to those un-supplemented. Furthermore, male lambs found to be heavier than female lambs and animals' body condition during autumn was better compared to it during summer.

Competing interests

The authors declare that they have no competing interests.

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To cite this paper: Fadul B.A., Abdalla M.Kh., Mohamed A-EL, Nour I, Idris A and Eltaher H. 2016. The effect of ground-nut (*Arachis hypogaea, L.)* seed cake supplementation on performance of desert sheep under dry land conditions in North Kordofan, Sudan. *Online J. Anim. Feed Res*., 6(1): 08-13.
Scienceline/Journal homepages: http://www.science-line.com/index/; http://www.ojafr.ir

Online Journal of Animal and Feed Research

Volume 6, Issue 1: 14-19; Jan 30, 2016 *ISSN 2228-7701*

NUTRITIVE VALUE OF FISH MEAL

Md. Emran HOSSAIN[1]✉, Khodeja AKTER[2] and Goutam BUDDHA DAS[1]

[1]*Department of Animal Science and Nutrition, Chittagong Veterinary and Animal Sciences University, Khulshi, Chittagong-4225, Bangladesh*
[2]*UG student, Faculty of Veterinary Medicine, Chittagong Veterinary and Animal Sciences University, Khulshi, Chittagong-4225, Bangladesh*

ABSTRACT*:* The study was undertaken to find out the variations in the chemical composition of different types of fish meal available in the metropolitan areas of Chittagong, Bangladesh. Fifteen different types of fish meal samples were collected from study areas. Chemical analyses of the samples were carried out in triplicate for dry matter (DM), crude protein (CP), crude fiber (CF), nitrogen free extract (NFE), ether extract (EE) and total ash (TA) in the animal nutrition and poultry research and training centre (PRTC) laboratory, Chittagong Veterinary and Animal Sciences University, Chittagong, Bangladesh. Metabolizable energy (ME) was estimated mathematically for all samples by using standard formula. Results indicated that, DM, CP, NFE, EE, TA and ME content significantly differed (P<0.01) from one sample to another. However, no significant (P>0.05) variation was found in the CF contents of the samples. DM content varied from 86.7 to 96.7%, CP content varied from 31.3 to 61.2%, EE content varied from 0.8 to 23.5%, NFE content varied from 0.6 to 14.6%, Ash content varied from 13.3 to 36.7% and ME content varied from 1788.4 to 3478.8 kcal/kg. It could therefore be inferred that, the chemical composition of fish meal available in the local market are widely variable. Therefore, every sample needs to be analyzed before use for ration formulation.

Keywords: Chemical Composition, Fish Meal, Metabolizable Energy, Nutritive Value.

ORIGINAL ARTICLE
pii: S2228770116000003-6
Received 28 Apr. 2015
Revised 09 Aug. 2015
Accepted 28 Oct. 2015

INTRODUCTION

Poultry industry is an emerging agribusiness started during eighties in Bangladesh. Poultry farming is an important sector which provides a large share to the increasing demand for animal protein, cash income and employment opportunities. However, the high price and non-availability of feed ingredients are two major constraints to the growth of commercial poultry enterprises. In Bangladesh, feed cost alone accounts 60-70% of the total production cost (Bulbul and Hossain, 1989). Therefore, it is important to explore quality feedstuff to enhance optimum productivity. About 80% feed stuffs used in poultry ration are imported from different countries. As a result, the cost of feed prepared for poultry using those grains are always high.

Fish meal is a ground solid product that may be obtained by removing most of the water and some of the oil from fish and fish waste (Ruiter, 1995). The main constituents of fish vary little as regards to protein and inorganic matter. Oil and water contents which make up 72-78% of the fish are highly variable in fish meal (Ruiter, 1995). Fish meal is an excellent source of protein. It is considered to be one of the best ingredients for broiler and layer ration since it enhances feed consumption, feed efficiency and egg production (Solangi et al*.,* 2002; Naulia and Singh, 1998). The increasing demand for high quality artificial feed for various farming such as aquaculture, poultry, pig, etc. can be satisfied with fish meal production since this is a source of good quality protein (Hardy and Masumoto, 1990). The nutrient composition of fish meal always vary depending on the type and species of fish, the freshness of the fish before processing and the processing methods. According to NRC (1994), protein content of fish meal varies from 60.0 to 72.3% due to type of fish and its method of preparation. In Asian countries, fish meal is prepared from mixture of trash fish and byproducts of the canning industry resulting in a product of variable composition (Limcangco-Lopez, 1985).

Despite many advantages, the quality of fish meal is often questioned due to variation in preparation and adulteration with cheap diluents such as sand, stone, soil, fine sawdust, horns and hooves, blood meal, animal oil, prawn, poultry byproducts and wastes of tannery (Hossain et al*.,* 2003). This unusual variation in the composition of

To cite this paper: Hossain M.E., Akter K. and Das G.B. 2016. Nutritive value of fish meal. *Online J. Anim. Feed Res*., 6(1): 14-19.
Scienceline/Journal homepages: http://www.science-line.com/index/; http://www.ojafr.ir

fish meal makes a complex situation for the formulation of practical ration. Therefore, current study was conducted to find out the variations in nutrient content of fish meal available in local market.

MATERIAL AND METHODS

Study area

The study was carried out in the peri-urban and urban areas of Chittagong, Bangladesh. The study area has a latitude of 22°21'N, longitude 91°49'E and elevation of 29 m. The area is fairly hot with annual average temperature of 25.1 °C. The variation of daily average temperature is 8.8 °C. Mean monthly temperature has a variation of 9 °C. The hottest month is May having a mean temperature of 28 °C. The coolest month is January which has a mean temperature of 19 °C. The average annual relative humidity of the area is 73.7% and average monthly relative humidity ranges from 58% in January to 86% in August. The area has an average of 2735 mm rainfall per year. There are 135 days per year with more than 0.1 mm of rainfall. The driest weather is in January when an average of 6 mm of rainfall. The wettest weather is in July when there occurs an average of 598 mm of rainfall. The longest day of the year is 13:22 hour long and the shortest day is 10:37 hour long. The current study was carried out during October to November 2013. Livestock and poultry feeds are mostly available in Pahartali, Khatungonja and Karnaphuli markets of Chittagong metropolitan areas. Almost all metropolitan farmers collect their livestock feeds from these three markets. Therefore, these three markets were selected as the study area for collection of sample.

Baseline survey

A baseline survey was conducted in the study area to find out the feasibility for availability of a wide range of fish meal samples. Different types of fish meal sample were identified in the baseline survey. Later on, they were collected in a systematic procedure for study purposes.

Collection of sample

Samples were collected by using simple random sampling technique. Fifteen feed shops were selected randomly having completely different types of fish meal. Approximately 500 grams of each fish meal was purchased from each shop. Samples were wrapped up by polythene bag and preserved in the laboratory for chemical analysis.

Preparation of sample

Samples were chopped uniformly and dried in the sun. Dried samples were subjected to grinding to make it homogenous powder. Later on, it was mixed properly and exposed to shade to cool down for sampling.

Analysis of sample

Chemical analyses of the samples were carried out in triplicate DM, CP, CF, NFE, EE and TA in the animal nutrition laboratory, Chittagong Veterinary and Animal Sciences University, Chittagong, Bangladesh as per AOAC (2000).

Calculation of ME

All samples were subjected to proximate analysis in triplicate. Later on, Metabolizable energy (ME) available in all the fish meal samples was calculated by using a standard mathematical formula as ME (kcal/kg) = 32.95 (% crude protein + % ether extract × 2.25 + % available carbohydrate)-29.20 as per Lodhi et al. (1976).

Data analysis

Data related to chemical composition of fish meal were compiled by using Microsoft Excel 2007. Chi-square (χ^2) test was performed to analyze the data by using SPSS (2007). Statistical significance was accepted at 5% level ($P<0.05$).

RESULTS AND DISCUSSION

Chemical composition of fish meal particularly, DM, CP, CF, NFE, EE and TA contents in different fish meal samples have been presented in Table 1. Throughout the world, fish meal has been used as poultry feed for many years. It is popular because of its high nutritional value. Fish meal is an excellent source of highly digestible protein, long chain omega-3 fatty acids (EPA and DHA) and essential vitamins and minerals. It contains all the essential

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amino acids in adequate quantities required for poultry (Sing and Panda, 1990). It has high levels of essential amino acids such as lysine which is often deficient in grain products that are the typical base for most animal feeds (Hall, 1992). It also contains vitamins such as B_{12}, choline, niacin, pantothenic acid and riboflavin and is a good source of calcium (Ca), copper (Cu), iron (Fe), phosphorous (P) and other trace minerals.

Fish meal is low in fiber and easy to produce (Hall, 1992). Fish meal has high methionine and cysteine content and a high digestibility and biological value (Keller, 1990). Fish meal has ten times more available Se than soybean meal or maize (Miller et al., 1972). The balanced amino acid profile and high palatability of fish meal provides synergistic effects with vegetable proteins in the other animal diet to promote fast growth and reduce feeding cost (Hardy, 2000; Oliva and Goncalves, 2001).

Dry matter (DM)

The average DM content of fish meal estimated in this study was 92.6 % (Table 2). The maximum and minimum DM percent obtained in current study were 96.7% and 86.7% respectively. The result is in close agreement with earlier studies where it was 92.06% (Rostagno et al., 2011), 92% (Larbier and Leclercq, 1994; NRC, 1994), 91.8% (Gohl, 1980) 91.7% (Kifer et al., 1968). However, the result slightly differs with the findings of other investigators (Table 3) who reported it 94.5% (Moghaddam et al., 2007), 90.7% (Devendra, 1979), 90.0% (Verma 2006; Leeson and Summers, 2008; Ruiter 1995, Preston, 2012), 88% (Reddy et al., 2001), 86.0% (Heuser, 1946), 85.1% (McDonald et al., 1995).

Crude protein (CP)

The average CP content of fish meal estimated in this study was 49.2% (Table 2). The maximum and minimum CP percent obtained in current study were 61.2% and 31.3% respectively. The result is in line with earlier studies where it was 55.0% (Verma, 2006), 54.6% (Rostagno et al., 2011), 54.7% (Devendra, 1979), 54.0% (Reddy et al., 2001). However, the result differs with the findings of other investigators who reported it 73.0% (McDonald et al.,1995), 72.0% (Ruiter,1995; Labier and Leclercq,1994), 70.5% (Gohl, 1980), 66.0% (Preston, 2012), 65.0% (North and Bell,1990), 64.2% (NRC,1994), 62.0% (Kifer et al., 1968), 60.0% (Leeson & Summers, 2008; Hesuer, 1994), 59.1%, (Moghaddam et al., 2007).

Crude fiber (CF)

The average CF content of fish meal estimated in this study was 5.3% (Table 2). The maximum and minimum CF obtained in current study was 10.0% and 5.0% respectively. The result is in close agreement with earlier studies where it was 4.1% (Devendra, 1979). However, the result differs with the findings of other investigators who reported it 1.1% (Gohl, 1980), 1.0% (Preston, 2012; NRC, 1994), 0.9% (Reddy et al., 2001), 0.62% (Moghaddam *et al*., 2007), 0.5% (North and Bell, 1990).

Ether extract (EE)

The average EE content of fish meal estimated in this study was 10.7% (Table 2). The maximum and minimum EE percent obtained in current study were 23.5% and 0.8% respectively. The result is in close agreement with earlier studies where it was 12.0% (Ruiter, 1995), 10.2% (Kifer et al., 1968). However, the result differs with the findings of other investigators who reported it 22.9% (Moghaddam et al., 2007), 9.0% (Preston, 2012), 7.5% (Rostagno et al., 2011), 7.0% (Reddy et al., 2001; Donald et al., 1995), 5.3% (Devendra, 1979), 5.2% (Gohl, 1980), 5.0% (Heuser, 1946; NRC, 1994), 2.0% (Leeson and Summer, 2008).

Nitrogen free extract (NFE)

The average NFE content of fish meal estimated in this study was 4.9% (Table 2). The maximum and minimum NFE percent obtained in current study were 14.6% and 0.6% respectively (Table 2). The result is in close agreement with earlier studies where it was investigators who reported it, 6.0% (Devendra, 1979), 4.4% (Reddy et al., 2001). However, the result differs with the findings of other 6.4% (Gohl, 1980).

Total ash (TA)

Fish meal has a high biological value in poultry not only as a protein source but also as source of minerals such as Ca and P and trace elements such as Se or I. The average Ash content of fish meal estimated in this study was 21.8% (Table 2). The maximum and minimum TA percent obtained in current study were 36.7% and 3.3% respectively. The result is in close agreement with earlier studies where it was 22.74% (Rostagno et al., 2011), 21.9% (Reddy et al., 2001), 20.0% (Preston, 2012). However, the result differs with the findings of other investigators who reported it 29.8% (Devendra, 1979), 18% (Kifer et al., 1968), 17.0% (Labier and Leclercq, 1994).

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

16.8% (Gohl, 1980), 14.0 % (Ruiter, 1995), 13.2% (Moghaddam et al., 2007), 10.0% (North and Bell, 1990), 7.4% (NRC, 1994), 5.0% (Heuser, 1946), 2.5% (Verma, 2006).

Table 1 - Chemical composition (%) of individual fish meal

Sample no.	Proximate components (%)						
	DM	ME	CP	CF	NFE	EE	TA
1	86.7	1788.4	36.2	5.0	0.6	8.1	36.7
2	86.7	2228.0	48.2	5.0	2.0	8.1	23.3
3	96.7	2563.6	54.1	5.0	6.0	8.3	23.3
4	90.0	1853.7	36.1	5.0	11.2	4.4	33.3
5	96.7	2161.6	31.3	5.0	14.5	9.2	36.7
6	90.0	2409.1	55.6	5.0	2.2	7.2	20.0
7	96.7	3410.0	50.9	5.0	0.6	23.5	16.7
8	96.7	3478.8	46.6	5.0	9.3	22.5	13.3
9	90.0	2090.5	61.2	10.0	1.3	0.8	16.7
10	90.0	2557.1	58.6	5.0	1.6	8.1	16.7
11	96.7	2436.3	55.8	5.0	1.3	7.9	26.7
12	90.0	2208.8	46.7	5.0	9.9	5.0	23.3
13	96.7	2082.6	52.8	5.0	0.9	4.6	33.3
14	90.0	2730.6	53.9	5.0	8.1	9.7	13.3
15	95.6	2739.8	50.2	5.0	3.6	13.4	23.4

ME=Metabolizable energy (kcal/kg); DM=Dry matter; CP=Crude protein; CF=Crude fibre; NFE=Nitrogen free extract; EE=Ether extract; TA=Total ash

Table 2 - Analytical values for chemical composition (%) of fish meal

Parameter	Statistical range				Sig.
	Maximum	Minimum	Mean	SEM	
DM (%)	96.7	86.7	92.6	1.0	**
CP (%)	61.2	31.3	49.2	2.2	*
CF (%)	10.0	5.0	5.3	0.3	NS
EE (%)	23.5	0.8	10.7	2.4	**
NFE (%)	14.6	0.6	4.9	1.2	**
Ash (%)	36.7	13.3	21.8	2.8	**
ME (kcal/kg)	3478.8	1788.4	2449.3	22.2	***

ME=Metabolizable energy (kcal/kgDM); DM=Dry matter; CP=Crude protein; CF=Crude fibre; NFE=Nitrogen free extract; EE=Ether extract; SEM=Standard error of the mean; NS=Non-significant ($P>0.05$); **=Significant at 1% level ($P<0.01$); **=Significant at 0.1% level ($P<0.001$)

Table 3 - Chemical composition of fish meal found elsewhere in the world

Investigators	Proximate components (%)					
	DM	CP	CF	NFE	EE	TA
Devendra (1979)	90.7	54.7	4.1	6.0	5.3	29.8
Gohl (1980)	91.8	70.5	1.1	6.4	5.2	16.8
Heuser (1946)	86.0	60.0	-	-	5.0	5.0
Kifer et al. (1968)	91.7	62.0	-	-	10.2	18.0
Labier and Leclercq (1994)	92.0	72.0	-	-	-	17.0
Leeson and Summers (2008)	90.0	60.0	-	-	2.0	-
McDonald et al. (1995)	85.1	73.0	-	-	7.0	-
Moghaddam et al. (2007)	94.5	59.1	0.6	-	22.9	13.2
North and Bell (1990)	-	65.0	0.5	-	-	10.0
NRC (1994)	92.0	64.2	1.0	-	5.0	7.5
Preston (2012)	90.0	66.0	1.0	-	9.0	20.0
Reddy et al. (2001)	88.0	54.0	0.9	4.4	7.0	21.9
Rostagno et al. (2011)	92.1	54.6	-	-	7.5	22.7
Ruiter (1995)	90.0	72.0	-	-	12.0	14.0
Verma (2006)	90.0	55.0	-	-	-	2.5

DM=Dry matter; CP=Crude protein; CF=Crude fibre; NFE=Nitrogen free extract; EE=Ether extract; TA=Total ash

To cite this paper: Hossain M.E., Akter K. and Das G.B. 2016. Nutritive value of fish meal. *Online J. Anim. Feed Res.*, 6(1): 14-19.
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CONCLUSION

Fish meal is a vital component of the traditional maize soybean based broiler and layer ration. There is no doubt that, inclusion of fish meal in livestock ration will substantially enhance production of livestock and poultry. However, current study indicates that the quality of fish meal is variable. Therefore, to formulate least cost balanced ration, if aimed to incorporate, fish meal must be analyzed in the laboratory and then include it into the ration.

Competing interests

The authors declare that they have no competing interests.

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To cite this paper: Hossain M.E., Akter K. and Das G.B. 2016. Nutritive value of fish meal. *Online J. Anim. Feed Res*., 6(1): 14-19.
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Online Journal of Animal and Feed Research

Volume 6, Issue 1: 20-23; Jan 30, 2016 *ISSN 2228-7701*

NUTRITIVE VALUE OF HELENCHA (*Enhydra fluctuans*)

Md. Emran HOSSAIN[1]✉, Sabuj Manohar SARMA[2], Hillol SIKDER[2] and Md. Hossain KABIR[2]

[1]*Department of Animal Science and Nutrition, Chittagong Veterinary and Animal Sciences University, Khulshi, Chittagong-4225, Bangladesh*
[2]*UG student, Faculty of Veterinary Medicine, Chittagong Veterinary and Animal Sciences University Khulshi, Chittagong-4225, Bangladesh*

ABSTRACT*:* The study was undertaken to find out the chemical composition and nutritive value of Helencha (*Enhydra fluctuans*) available in Chittagong, Bangladesh. *Enhydra fluctuans* were collected from three different remote places of the study area. Chemical analyses of the samples were carried out in triplicate for dry matter (DM), crude protein (CP), crude fiber (CF), nitrogen free extracts (NFE), ether extracts (EE) and total ash (TA) in the animal nutrition and poultry research and training centre (PRTC) laboratory, Chittagong Veterinary and Animal Sciences University, Chittagong, Bangladesh. Results indicated that, there were no significant variations (P>0.05) in the DM, CP, CF, NFE, EE and TA and ME contents of the samples collected from different places. DM content varied from 86.5 to 87.4%, CP content varied from 20.7 to 23.8%, CF content varied from 20.1 to 21.6%, EE content varied from 0.1 to 0.2%, NFE content varied from 28.3 to 34.4% and TA content varied from 10.4 to 13.5%. Similar to proximate components, metabolizable energy (ME) content also varied from 1991.9 to 2073.4 Kcal/kg DM. It could therefore be inferred that, the nutrient contents of *Enhydra fluctuans* does not vary due to variation in places. Results also indicated that, the nutritive value of *Enhydra fluctuans* is comparable with other available grasses in Bangladesh. Therefore, *Enhydra fluctuans* could be a promising unconventional feed resource for livestock.

Keywords: Chemical Composition, Enhydra Fluctuans, Helencha, Metabolizable Energy, Nutritive Value.

ORIGINAL ARTICLE
pii: S222877011600004-6
Received 30 Apr. 2015
Revised 15 Aug. 2015
Accepted 15 Nov. 2015

INTRODUCTION

Helencha (*Enhydra fluctuans*) is commonly grown perennial forage in Bangladesh. It is popularly known as Helencha shak. It is used for feeding cattle, buffalo, goats, sheep, horses and pigs. It is one of the most persistent forage adapted to wet soils of coastal areas, low lands, ponds and lakes. Mature *Enhydra fluctuans* is nutritious like other grasses and a good source of crude protein. It has several advantages including higher biomass yield in spring, winter and fall when temperatures are cooler and higher digestibility even at maturity. It is palatable and easy for digestion. It keeps the animal in good health and improves reproductive efficiency. It has cooling effect on the body. It is mild laxative, hence prevents constipation. In Bangladesh, high scarcity of fodder is observed during winter. Due to the shortage of forage in winter, production performance of cattle becomes decreased. However, this situation may be overcome by adding *Enhydra fluctuans* as it has higher digestibility and higher productivity in spring, winter and fall. So, if *Enhydra fluctuans* can be used as cattle feed in scarcity period it will minimize the shortage of feed especially forage and improve production performance of cattle. Therefore, present study was undertaken to find out the chemical composition and nutritive value of *Enhydra fluctuans* available in Chittagong, Bangladesh.

MATERIAL AND METHODS

Study area

Enhydra fluctuans is well adapted to poorly drained clay soils where standing water is common during wet weather. In Bangladesh, *Enhydra fluctuans* is available in almost all the low lands and aquatic areas. Therefore, three different remote places, such as, Raozan, Fatikchari and Khulshi areas were selected for study purposes.

To cite this paper: Hossain M.E., Sarma S.M., Sikder H. and Kabir M.H. 2016. Nutritive value of Helencha (*Enhydra Fluctuans*). *Online J. Anim. Feed Res*., 6(1): 20-23.
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Collection of sample

Enhydra fluctuans were collected from three different places i.e., Raozan, Fatikchari and Khulshi area. Immediate after collection, samples were packed into the air tight polythene sacs and sent to the animal nutrition laboratory, Chittagong Veterinary and Animal Sciences University, Chittagong, Bangladesh for chemical analysis.

Preparation of sample

Fresh samples were chopped to 3.0 cm in length and mixed uniformly. Mixed samples were subjected to hot air oven for estimation of dry matter. The remaining samples were sundried for 7 days at an environmental temperature of 22.8-33.8°C and relative humidity of 54.0 - 96.0%. Approximately 500 g of dried samples were collected, chopped and ground uniformly for proximate analysis.

Chemical analysis

Chemical analyses of *Enhydra fluctuans* samples were carried in triplicate for DM, CP, CF, NFE, EE and TA in the Animal Nutrition laboratory, Chittagong Veterinary and Animal Sciences University, Chittagong as per AOAC (2006).

Estimation of ME

All samples were subjected to proximate analysis in triplicate. Later on, ME available in all *Enhydra fluctuans* samples was estimated by using a standard mathematical formula as per Lodhi et al. (1976).

Data analysis

Data related to chemical composition and nutritive value of *Enhydra fluctuans* were compiled by using Microsoft Excel 2007. Chi-square (χ^2) test was performed to analyze the data by using SPSS 16.0 (Winer et al., 1991). Statistical significance was accepted at 5% level ($P<0.05$).

RESULTS AND DISCUSSION

Helencha belongs to Kingdom-Plantae, Phylum-Magnoliophyta, Class-Magnoliospida, Order-Asterales, Family-Asteraceae, Genus-Enhydra, Species-*Enhydra fluctuans*. This is a Perennial herb that grows in the swampy ground of coastal areas, low lands, ponds and lakes. The leaves of are somewhat bitter and eaten as a salad or vegetable in several tropical countries. The stems are fleshy, 30 centimeters or more in length, branched, rooting at the lower nodes and somewhat hairy. The leaves are stalkless, linear, oblong, 3 to 5 centimeters in length, pointed or blunt at the tip and usually truncate at the base, somewhat toothed at the margins. Flowers are white to greenish white in color.

Enhydra fluctuans originated from tropical Indian subcontinent and now found in most tropical and subtropical wetlands, along with river banks, seasonally flooded areas, swamps and lakes of Southern Europe, Africa, Southern Asia and South-east Asia. It grows in soils of any texture, provided moisture is adequate. It tolerates acid soils down to pH 4.5 but is best between 5.5 and 6.5. It can withstand short, seasonal dry periods, but does not tolerate long droughts. The range of temperature for proper growth of *Enhydra fluctuans* is 16-27°C. The optimum temperature for growth is 31-35°C. However, growth rate gradually declines above 38°C.

Table 1 - Seasonal variation in the chemical composition of Helencha (*Enhydra fluctuans*)

Month of harvest	DM (%)	CP (%)	Ash (%)	Ca (%)	P (%)
February	4.7	25.3	18.3	0.7	0.7
March	9.7	27.9	15.4	0.6	0.6
April	9.6	32.6	14.2	0.4	0.5
May	13.5	25.8	15.6	0.5	0.6
June	9.9	26	13.7	0.7	0.6
July	8.2	29.8	14.8	0.6	0.7

Reference: Dewanji and Banik (1992)

Wide variations between seasons were observed in the crude protein content of the plant which could be related to seasonal differences in their growth rates. Crude protein is the component that is reported to exhibit most drastic variation both between sites and with the stage of maturity. *Enhydra fluctuans* contained 25.3% CP in February and 32.6% in April. The average DM content of *Enhydra fluctuans* was 87.0 % (Table 2) in present study

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which is similar to most of the perennial grasses available in Bangladesh. The average CP content was 22.5%. This observation is in well agreement with Dewanji et al. (1992) who observed 25.9% CP in Enhydra fluctuans. The CF content was 24.0% which is almost similar as most of the perennial grasses available in Bangladesh. The CF content of *Enhydra fluctuans* in this study was almost similar with the findings of Dewanji et al. (1992) who found 22.9% CF in Enhydra fluctuans.

Table 2 - Chemical composition and nutritive value of Helencha (*Enhydra fluctuans)* available in Chittagong, Bangladesh

Parameters	Chemical composition (g/100g Air DM)						
	DM	CP	CF	Ash	EE	NFE	ME (Kcal/kg)
Raozan area	86.5	23.9	24.3	12.0	0.1	39.7	2073.4
Fatikchori area	87.4	27.2	24.7	15.4	0.2	32.4	1951.9
Metropoliton area	87.1	26.3	23.1	15.0	0.2	35.4	2019.3
Mean	87.0	25.9	24.0	14.1	0.1	35.9	2013.1
Std. Deviation	0.4	1.4	0.7	1.5	0.1	3.0	49.7
Sig.	NS	NS	NS	NS	NS	NS	NS

DM=Dry matter; CP=Crude protein, CF=Crude fibre, NFE=Nitrogen free extract, EE=Ether extract; NS=Non-Significant (P>0.05)

The TA content of *Enhydra fluctuans* was 14.1% which is similar to the available perennial grasses in Bangladesh. The TA content of *Enhydra fluctuans* in this study was positively supported by Dewanji et al. (1992) where they reported 15.7% TA in Enhydra fluctuans. The EE content in present study was 0.1%. This observation is contrasting with TA contents in most of the perennial grasses available in Bangladesh. However, EE content in this study was in line with Dewanji et al. (1992) where EE was reported to be 0.7%. The ME content of *Enhydra fluctuans* varied from 1991.9 to 2073.4 Kcal/kg according to this study. The NFE content of *Enhydra fluctuans* was 35.9%. The NFE content in this study was closely related with Dewanji et al. (1992) where NFE was reported to be 36.3%.

CONCLUSION

Enhydra fluctuans is a tropical aquatic plant adapted to wide range of poorly drained high moisture area. The plant is highly productive when well fertilized and competes well with broadleaf and grassy weeds. The proximate components of the plant are satisfactory. This is good source of crude protein. As a result, *Enhydra fluctuans* may be supplemented for animals fed straw based protein deficient diet.

Competing interests

The authors declare that they have no competing interests.

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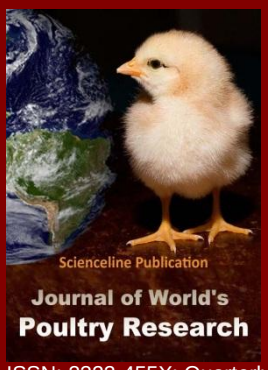

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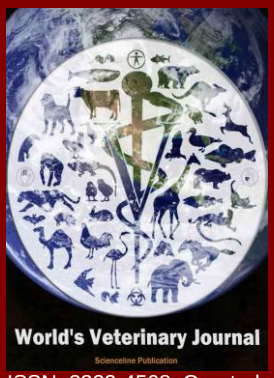

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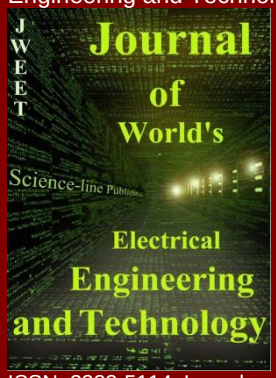

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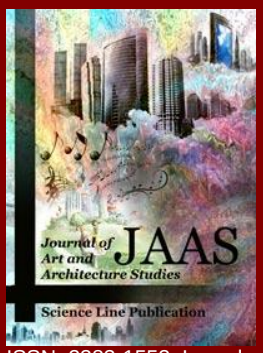

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