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Volume 8 (4); 25 July 2018

Research Paper

Maize cobs and potato hash silage as alternative feed for grower pigs under smallholder production in Gauteng province of South Africa.

Thomas RS, Ncobela C, Mphofu K, Sebothoma P, Tsatsimpe M, Makgoth OGi, and Kanengoni AT.

Online J. Anim. Feed Res., 8(4): 84-89, 2018; pii: S222877011800011-8

Abstract
Maize cobs (MaC) and potato hash (PoH) are readily available and can be incorporated into pig diets to reduce feed costs and minimize nutrient losses to the environment but there is scant information on their utility on farm. A study was designed to evaluate pigs' growth performances when fed three diets; a control diet (CON) and a diet containing maize cob and potato hash silage inoculated with an exogenous feed enzyme (xylanase (Natugrain TS L®)) (MaCPoHES) and (MaCPoHS) without an exogenous feed enzyme on-farm level. The study was conducted at two smallholder pig farms in Gauteng province, South Africa. The three diets were formulated to contain 16 % crude protein (CP)/kg DM (dry matter) and 14 MJ of digestible energy (DE)/kg DM. Sixty large white x landrace cross bred pigs (30±5.0 kg body mass) from each farm were randomly allocated to the three treatment diets in a completely randomized design and fed ad libitum for 56 days. The pigs that were fed MaCPoHES from both farms had a better feed conversion ratio (FCR) compared with pigs that were fed CON and MaCPoHS. In addition, pigs that were fed CON had higher dry matter intake (DMI) than pigs that were fed MaCPoHS diets. There were treatment x farm interactions for average daily gain (ADG) and FCR. In addition, there were no treatment x farm interactions for initial weight (IW), final weight (FW), average daily feed intake (ADFI) and dry matter intake (DMI) in both farms. However, pigs at Zuurbekom farm had a higher ADG, ADFI and DMI than pigs at Winterveld farm. Pigs fed MaCPoHES diet had a better FCR compared to the CON on both farms. This suggests that the use of these agricultural by-products in growing pig diets can help reduce feed costs. More studies need to be carried out to determine the optimum inclusion level of MCPH in pig diets, their impact on carcass quality and the cost benefit.

Keywords: Smallholder farm, Maize cob, Potato hash, Enzyme, Grower pigs

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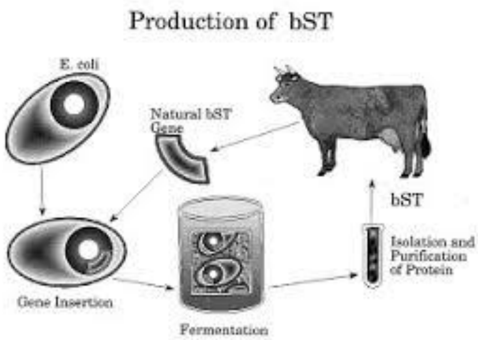
Review



Review on the role of bovine somatotropin hormone for dairying.

Addisu Sh, Tegenaw K, and Tesfa A.

Online J. Anim. Feed Res., 8(4): 90-96, 2018; pii: S222877011800012-8

Abstract
Bovine somatotropin (bST) is a metabolic protein hormone used to increase milk production in dairy cows. This hormone is important for growth, development, and other bodily functions of all animals. The only source of bST is from the pituitary glands of slaughtered cattle. Dairy cows are usually injected subcutaneously the volume of injective of a commonly used formulation is 1.4ml. The injection is typically repeated every 14 days. BST has the potential to increase the efficiency of milk production but there is no a change in milk composition. Potentially 10-15% more milk can be obtained from each cow with a cost of implementation of less than 5%. Good management measures recommended by a product manufacturer to ensure a high response in milk yield to bST administration. It increases the body weight and heat stress of the user animals. However, culling rate is higher in the bST treated animals than the non-treated. This hormone also does not have side effect on the health of human being (it is a treatment of children suffering from hypopituitary dwarfism as well as animas, but it increases the frequency of certain disease conditions such as mastitis and foot problems in cows. Therefore, using bST hormone is an important for developing countries which is food insecure and poor productive dairy cow, because even if it costs and needs good management, will not have said effect on human being, animals as well as environment.

Keywords: Bovine somatotropin hormone, Dairy, Effect, Milk

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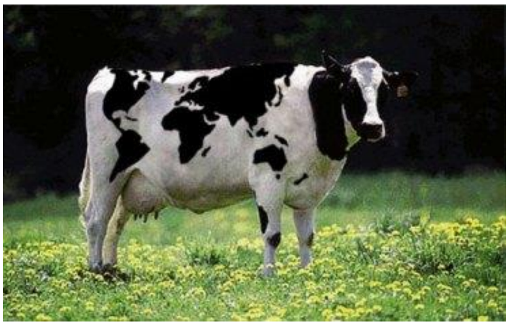
Research Paper

Effects of period of calving, season of calving and parity on milk production performance of Holstein Friesian dairy cows in Alage ATVET college, Ethiopia.www.ojafr.ir



Worku D.

Online J. Anim. Feed Res., 8(4): 97-104, 2018; pii: S222877011800013-8

Abstract

The study was conducted to evaluate milk production performance of Holstein Friesian and associated factors in dairy farms of Alage Agricultural Technical and Vocational Education Training College. The productive traits' data gathered from 1987 to 2015 were analyzed using general linear model procedures of SAS version 9.2. The result revealed that the overall least square means and standard errors for daily milk yield (DMY), 305 days milk yield (305DsMY), lactation milk yield (LMY) and lactation length (LL) were 8.06±0.119 kg, 2473.3±34.78 kg, 2395±61 kg and 323±5.34 days, respectively. Period of calving and parity had significant effect (P < 0.001) on productive traits (DMY, 305 DsMY, LMY, and LL) of Holstein Friesian cows. Whereas, season of calving was not significant on all productive traits of HF cows. The overall value obtained for DMY, 305 DsMY, LMY and LL were very disappointing and below the standard set for commercial dairy farm. Furthermore, the milk production performance of Holstein Friesian found was lower than the milk production performance reported in many tropical regions. Poor management and climatic condition combined with a poor adaptation of Exotic breeds in Ethiopia were the most probable factors accounted for this poor overall value of the breed. Therefore, giving attention to the poor management of the breed and improving the level of genotype by environment (GXE) interaction is required for optimal production performance of Holstein Friesian breed in the area.

Keywords: Alage dairy farm, Productive performance, Holstein Friesian

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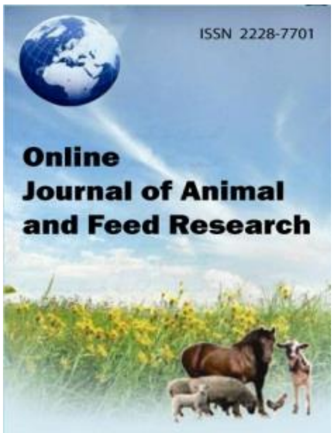

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MAIZE COBS AND POTATO HASH SILAGE AS ALTERNATIVE FEED FOR GROWER PIGS UNDER SMALLHOLDER PRODUCTION IN GAUTENG PROVINCE OF SOUTH AFRICA

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Supporting Information

RESEARCH ARTICLE
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ABSTRACT: Maize cobs (MaC) and potato hash (PoH) are readily available and can be incorporated into pig diets to reduce feed costs and minimize nutrient losses to the environment but there is scant information on their utility on farm. A study was designed to evaluate pigs' growth performances when fed three diets; a control diet (CON) and a diet containing maize cob and potato hash silage inoculated with an exogenous feed enzyme (xylanase, Natugrain TS L®) (MaCPoHES) and or without an exogenous feed enzyme (MaCPoHS) on farm level. The study was conducted at two smallholder pig farms in Gauteng province, South Africa. The three diets were formulated to contain 16% crude protein (CP)/kg DM (dry matter) and 14 MJ of digestible energy (DE)/kg DM. Sixty large white x landrace cross bred pigs (30±5.0 kg body mass) from each farm were randomly allocated to the three treatment diets in a completely randomized design and fed *ad libitum* for 56 days. The pigs that were fed MaCPoHES from both farms had a better-feed conversion ratio (FCR) compared with pigs fed CON and MaCPoHS. In addition, animals fed CON had higher dry matter intake (DMI) than pigs that were fed MaCPoHS diets. There were treatment x farm interactions for average daily gain (ADG) and FCR. In addition, there were no treatment x farm interactions for initial weight (IW), final weight (FW), average daily feed intake (ADFI) and dry matter intake (DMI) in both farms. However, pigs at Zuurbekom farm had a higher ADG, ADFI and DMI than pigs at Winterveld farm. Pigs fed MaCPoHES diet had a better FCR compared to the control animals on both farms. This suggests that the use of these agricultural by-products in growing pig diets can help reduce feed costs. More studies need to be carried out to determine the optimum inclusion level of maize cobs and potato hash (MaCPoH) in pig diets, their impact on carcass quality and the cost benefit.

Keywords: Smallholder farm, Maize cob, Potato hash, Enzyme, Grower pigs

INTRODUCTION

One of the major challenges facing smallholder pig farmers in the Gauteng Province of South Africa is the increased feed costs driven by the high demand for the cereals. Feed costs account for 70 - 80% of pork production costs (Fialho et al., 1995). This has prompted the need to utilize cheaper and local readily available fibrous feeds from the agro-processing industry (Babayemi, 2008; Bindelle et al., 2008; Adeyemi et al., 2009). Success of increasing the inclusion of fibrous ingredients in pig diets is dependent on the impact on performance in relation to viability. Dietary fibre reduces the digestion and rate of absorption of nutrients, thus increasing the metabolic demand for nutrients (Wenk, 2001).

Furthermore, high fibre in grower pig diets increases the rate of feed passage (Fevrier et al., 1992). However, feeding fibrous diets to pigs also presents a range of potential benefits of those fermentable fibrous substrates that can substitute for expensive energy substrates. Maize cobs (MaC) are an underutilized resource for animal feeds and has the potential to reduce pork production costs (Ndindana et al., 2002; Kanengoni et al., 2004) for smallholder pig farmers in Gauteng. Currently in Gauteng Province, MaC are thrown away or burnt. Dietary inclusion of 30% untreated ground MaC reduced growth performance and nutrient digestibility in growing pigs (Ndindana et al., 2002; Kanengoni et al., 2004; Anguita et al., 2006).

To cite this paper: Thomas RS, Ncobela C, Kgopong G, Mphofu K, Sebothoma P, Tsatsimpe M, Muller T, Makgothi G, and Kanengoni AT (2018). Maize cobs and potato hash silage as alternative feed for grower pigs under smallholder production in Gauteng province of South Africa. *Online J. Anim. Feed Res.*, 8(4): 84-89. www.ojafr.ir

Approximately 50 tons of potato hash (by-product produced from the processing of chips) is produced in South Africa per day and is dumped for lack of alternative viable uses (Haigh, 1990; Nkosi et al., 2010; Thomas et al., 2010). Some of the limitations for using potato hash (PoH) in pig nutrition are high moisture content (>85%; Nkosi et al., 2010; Thomas et al., 2010); low water-soluble carbohydrates (WSC) contents 18 g/kg DM (Nkosi et al., 2011) and high fibre 60.5 g/kg^{-1} DM (Thomas et al., 2010). Therefore, ensiling MaC and PoH would be a viable method of preserving high moisture by-products such as PoH (Cao et al., 2009). Ensiling high moisture material such as PoH successfully, it is necessary to add dry resources or absorbents such as MaC to improve its DM content and to improve fermentation.

However, the addition of MaC to PoH will increase the fibre level of silage, making it even less suitable as feed for growing pigs. A potentially sustainable solution could be the addition of exogenous enzymes at ensiling to degrade cell walls and increase the availability of WSC to be consumed by lactic acid bacteria (LAB) (McDonald et al., 1991, Meeske et al., 1999). The benefits of exogenous enzymes is improving nutrient digestion in pigs have been documented (Jones et al., 2010; Kerr and Shurson, 2013). The objective of the study was to evaluate growth performance of grower pigs fed ensiled maize cob and potato hash treated with and without an exogenous xylanase feed enzyme (Natugrain TS L®).

MATERIALS AND METHODS

Maize cobs (920 g/kg DM) were collected from the agricultural research council - animal production fields (ARC-AP, Irene, Gauteng, South Africa), and ground to pass through a 10 mm sieve. Potato hash was collected from Simba (Pty) Ltd (Isando) in Kempton Park South Africa and brought to ARC-AP for chemical analysis and silage making. Potato hash and maize cobs were mixed at a ratio of 70:30 to achieve at least a 400 g/kg DM, pre ensiled composition is shown in table 1 . The mixture was ensiled in 210 L drums for 90 days. Diets treated with or without enzyme were formulated and tested on selected farms to demonstrate the technologies in the farmers' environments.

Ethical approval

The agricultural research council animal ethics committee approved the experiment (reference number: APIEC16/005).

Animals, Treatments and Experimental Design

The study was conducted in two district municipalities of Gauteng province (west rand district - Zuurbekom farm and Tshwane district - Winterveld farm). The farms were considered to have significant pig production activity, namely: management (feeding, cleaning), housing, animal health, farm infrastructure and marketing channels within the smallholder pig sector in Gauteng Province. The diets were formulated with inclusion levels of 200 g/kg maize cob potato hash of silage (as fed) as shown in table 2. The diet was formulated to provide 14 MJ/kg digestible energy (DE), 180 g crude protein (CP)/kg DM and 10.0g lysine/kg. This resulted in three treatments namely; control diet without maize cob and potato hash silage (CON), diets containing 200 g/kg maize cobs potato hash silage/kg diet treated with enzyme (MaCPoHES) or without enzyme (MaCPoHS). Sixty crossbred pigs (large white x landrace) aged 64 days old, ± 30 kg live weight were selected from Winterveld farm and 60 crossbred pigs (large white × landrace) aged 60 days old, ± 28 kg live weight were selected from Zuurbekom farm and used for the experiment. The experimental pigs were randomly allocated to three treatments in a completely randomised design. Pigs were housed in groups of five in 8.94 × 5.6 m pens in environmentally controlled house with the temperature ranging from 22 to 25 °C for eight week.

Measurements

Pigs were weighed individually at the start and weekly for eight week. The pigs had free access to feed and feed intake was measured daily by subtracting refusals from feed offered. Refusals were not analysed but they were visually examined to see if the pigs were selecting against maize cobs. Selection was high in the first week, after which the pigs consumed all feed offered. Average daily gain (ADG), average daily feed intake (ADFI) and feed conversion ratio (FCR) were calculated over the period each group of animals were in the trial from the body weight and feed intake values.

Chemical composition analysis

Diets were analysed in triplicate, in the animal and poultry science laboratory at the University of KwaZulu-Natal, Pietermaritzburg. Dry matter content was determined by oven drying the samples at 65 °C for 48 hours. The ash content was determined after incineration of the sample at 550°C for 4 hours according to method 990.05 (AOAC, 1990). Dry samples were ground through a 1 mm screen (Wiley mill, Standard Model 3, Arthur H. Thomas

To cite this paper: Thomas RS, Ncobela C, Kgopong G, Mphofu K, Sebothoma P, Tsatsimpe M, Muller T, Makgothi G, and Kanengoni AT (2018). Maize cobs and potato hash silage as alternative feed for grower pigs under smallholder production in Gauteng province of South Africa. *Online J. Anim. Feed Res.*, 8(4): 84-89. www.ojafr.ir

Co., Philadelphia, PA, USA) for chemical analyses. The neutral detergent fibre (NDF) and acid detergent fibre (ADF) contents were determined following the procedures of Van Soest et al. (1991) using ANKOM Fibre Analyser (Ankom, Macedon, NY, USA). Separate samples were used for ADF and amylase-treated neutral detergent fibre (aNDF) analyses and both included residual ash. The GE was determined with bomb calorimetry (MS-1000 modular calorimeter, Energy Instrumentation, Centurion, South Africa).

Table 1 - Chemical composition of maize cob and potato hash pre ensiled (n=3)

Nutrient (g/kg dry matter)	MaC	PoH	MaCPoH
Dry matter	963	161	361
Crude protein	27	98	148
aNDF	493	489	456
Acid detergent fiber	896	178	143
pH	–	5.05	6.4
WSC	–	4.35	75

aNDF= amylase-treated neutral detergent fiber; WSC= Water soluble carbohydrates; MaC= Maize cob; PoH= potato hash; MaCPoH= 30:70 fresh weight basis.

Table 2 - Composition of experimental diets fed to growing pigs

Ingredients (%)	Experimental diet[1]		
	Control	MaCPoHS	MaCPoHES
Molasses	1.4	1.2	1.2
Soyabean meal (oilcake)	18.8	20.0	20.0
Wheat Bran	5.0	–	–
Maize	71.0	54.6	54.6
Monocalcium Phosphate	1.3	1.5	1.5
Feed Lime	1.3	1.1	1.1
Lysine	0.4	0.8	0.8
Salt	0.4	0.4	0.4
MaC + PoH	–	20.0	20.0
Vitamin–mineral premix[2]	0.4	0.4	0.4
Calculated composition (%)			
Dry matter	88.2	78.5	78.5
Crude protein	16	15.5	15.5
Crude fibre	4.4	12.6	12.6
DE, MJ/kg	13.5	13.1	13.1
Laboratory composition (%)			
Dry matter	92.34	79.66	77.68
Organic matter	72.89	75.08	72.46
Ether extract	2.50	2.15	2.34
Crude protein	15.92	16.90	17.48
NDF	10.52	12.72	12.48
ADF	3.38	5.39	6.23
GE, MJ/kg	17.03	16.15	16.63

MaCPoH = maize cobs + potato hash, DE= digestible energy, NDF = neutral detergent fiber, ADF= acid detergent fiber, GE MJ/Kg DM = gross energy mega joules/kilogram dry matter

Statistical analyses

The data was analyzed using ANOVA and repeated measures of SAS (2008), testing for differences in each diet over time and between diets. Duncan's multiple range test was used to compare differences among the treatment groups. The data also was tested for normality and homogeneous treatment variances and where necessary suitable adaptation to testing procedure incorporated.

Effects of treatments on growth performance of grower pigs were analysed with the model.

$Y_{ij} = \mu + t_i + \beta_j + \varepsilon_{ij}$

Where

Y_{ij} is the individual observations of the ith treatment and the jth replicate,

μ is the general effect,

t_i is the effect of the ith treatment,

β_j is the effect of the jth replicate,

ε_{ij} is the random variation or experimental error.

To cite this paper: Thomas RS, Ncobela C, Kgopong G, Mphofu K, Sebothoma P, Tsatsimpe M, Muller T, Makgothi G, and Kanengoni AT (2018). Maize cobs and potato hash silage as alternative feed for grower pigs under smallholder production in Gauteng province of South Africa. *Online J. Anim. Feed Res.*, 8(4): 84-89. www.ojafr.ir

RESULTS AND DISCUSSION

Data on table 1 was comparable to 170 g/kg DM in potato pulp reported by Okine et al. (2005) and 956 g/kg DM maize cob reported by Kanengoni et al. (2014). This indicates that is difficult to ensile PoH therefore, a suitable absorbent is needed (Wilkinson, 2005). Therefore, absorbent maize cob was used to improve its DM during ensiling. The DM content of 361 g/kg in MaCPoH in the present study revealed that MaCPoH silage had acceptable moisture content according to the range of 120 and 450 g/kg (McDonald et al., 1991). Growth performance measurements of grower pigs from two different farms in Gauteng province fed diets containing ensiled maize cob and potato hash treated with enzyme (MaCPoHES) or without enzyme (MaCPoHS) are shown in table 3. After 56 days of the feeding trial, there were no differences (P>0.05) in final weight, ADG and ADFI between treatments on both farms. This was different to findings by Frank et al. (1983), Ndindana et al. (2002) and Kanengoni et al. (2004) who reported a reduction in average daily gain when diets containing maize cobs were fed to growing pigs compared to the control diet.

This result also differed with findings by Nkosi et al. (2010) and Thomas et al. (2010) who reported a lower growth performance when growing pigs were fed total ensiled mixed ration of potato hash and ensiled potato hash with or without inoculants compared to the control diet. The differences between these other studies and the current study could be attributed to ensiling both by-products and adding enzyme to the diets. The pigs that were fed MaCPoHES from both farms had a better (P<0.05) FCR compared with pigs that were fed control CON and MCPH. In addition, pigs that were fed CON diet had higher (P<0.05) DMI than pigs that were fed MaCPoHS diets. There were treatment × farm interactions for ADG and FCR. In addition, there were no treatment x farm interactions for final weight, ADFI and DMI in both farms. However, pigs at Zuurbekom farm had a higher (P<0.05) ADG, ADFI and DMI than pigs at Winterveld farm. This could be due to factors such as the different experimental conditions (location of the farm) and the differences in pig genotype. The MaCPoHES treatment had a better FCR (P<0.05) than CON on both farms. This is consistent with the study by Rahnema and Borton (2000) who reported improved gain to feed ratio when pigs were fed different levels of potato chips scraps. Therefore, the results of the current study demonstrate that ensiling of MaC with PoH treated with exogenous enzyme improved intake and growth parameters of the growing pigs under farm conditions.

Table 3 - Growth performance of pigs fed on maize cobs and potato hash diets

Parameter[1]	Location						SEM	Diet	Farm	Diet × farm
	Winterveld			Zuurbekom						
	CON	MaCPoHS	MaCPoHES	CON	MaCPoHS	MaCPoHES				
IW (kg)	30.40	30.36	30.25	27.80	28.98	28.01	5.76	0.99	0.17	0.92
FW (kg)	61.75	60.98	63.57	66.62	64.15	65.59	7.96	0.79	0.31	0.32
ADG (kg)	0.75^{b}	0.73^{b}	0.82^{b}	0.92^{a}	0.80^{b}	0.87^{a}	0.09	0.60	0.0003	0.03
ADFI (kg)	2.79^{b}	2.69^{b}	2.78^{b}	3.16^{a}	2.89^{b}	3.17^{a}	0.03	0.95	<.0001	0.52
DMI (kg)	2.75^{a}	2.36^{bc}	2.25^{c}	2.86^{a}	2.50^{b}	2.57^{b}	0.02	<.0001	<.0001	0.41
FCR	3.46^{a}	3.12^{ab}	3.14^{a}	2.78^{b}	3.05^{ab}	2.97^{b}	0.37	0.0003	0.56	0.02

[a,b] Within a column means with different superscripts differ (P<0.05). CON= Control, MaCPoHS= maize cob potato hash silage, MaCPoHES= maize cob potato hash silage with enzyme, IW= initial weight, FW= final weight, ADG= average daily gain, ADFI= average daily feed intake, DMI= dry matter intake, FCR= feed conversion ratio.

CONCLUSION AND RECOMMENDATION

It was concluded that diets containing MaCPoH treated with or without exogenous enzyme may be an alternative feed source for growing pigs as indicated by higher intake. The MaC and PoH combination at a ratio of 30:70 produced better silage, indicated by an improved performance by the pigs. More studies need to be carried out to determine the optimum inclusion level of MaCPoH in pig diets, their impact on carcass quality and the cost benefit.

DECLARATIONS

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Author's contribution

All authors contributed equally to this work.

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Competing interest

The authors declare that they have no competing interests.

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REVIEW ON THE ROLE OF BOVINE SOMATOTROPIN HORMONE FOR DAIRYING

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REVIEW
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ABSTRACT: Bovine somatotropin (bST) is a metabolic protein hormone used to increase milk production in dairy cows. This hormone is important for growth, development, and other bodily functions of all animals. The only source of bST is from the pituitary glands of slaughtered cattle. Dairy cows are usually injected subcutaneously the volume of injective of a commonly used formulation is 1.4ml. The injection is typically repeated every 14 days. BST has the potential to increase the efficiency of milk production but there is no a change in milk composition. Potentially 10-15% more milk can be obtained from each cow with a cost of implementation of less than 5%. Good management measures recommended by a product manufacturer to ensure a high response in milk yield to bST administration. It increases the body weight and heat stress of the user animals. However, culling rate is higher in the bST treated animals than the non-treated. This hormone also does not have side effect on the health of human being (it is a treatment of children suffering from hypopituitary dwarfism as well as animas, but it increases the frequency of certain disease conditions such as mastitis and foot problems in cows. Therefore, using bST hormone is an important for developing countries which is food insecure and poor productive dairy cow, because even if it costs and needs good management, will not have said effect on human being, animals as well as environment.

Keywords: Bovine somatotropin hormone, Dairy, Effect, Milk

INTRODUCTION

There is a rapid increase in the human population particularly in developing countries. The demand and supply gap for food is increasing with time. To narrow this gap, multi-dimensional approaches are being carried out. Proponents of a new type of technology biotechnology claim that it will supply more food at less cost to meet this growing demand. One of the major agriculture related products of biotechnology research is bovine somatotropin (bST) (Jabbar et al., 2009). Naturally produced by a cow's pituitary gland, bST is one of the hormones involved in normal growth, development of mammary gland and normal milk production (Murphy, 1998). Bovine somatotropin (bST) is naturally occurring protein produced by the pituitary gland in all cattle. Recombinant bovine somatotropins (rbST), which differ from their native form by several amino acids, have been synthesized and manufactured using recombinant DNA techniques to increase milk production in dairy cows. The Food and Drug Administration (FDA) approved rbST product in 1993 after determining that its use would be safe and effective (Soliman, 2014).

It is a metabolic hormone, not a growth hormone like a steroid, which is released from the anterior pituitary gland of cattle and, until recent years, could be produced only by cows (Kohout et al., 2008). Bovine somatotropin (bST) increases milk production in dairy animals. The maximum increase in milk production has been observed up to 41%. Somatotropin did not change milk composition significantly. During short-term application of bST, cows mobilized their body reserves to support the increased milk production. Although DM intake of cows was increased in the long term applications, however, gross efficiency of production was improved due to larger increase in milk production than DM intake. Repartitioning of nutrients in body-tissue was primarily responsible for the increase in milk-production but defining the exact mechanism by which bST exerted its effect still (Sarwar and Tanveer, 2002).

There is no question that bST use increases milk yield and production efficiency. However, there are many factors that affect the magnitude of the milk production response, and study results vary widely. A number of factors have been identified as influencing milk production response in bST research trials: the quality of herd management, including the availability and quality of feed; the dosage of bST; when bST is administered during a cow's lactation, with the largest increases in milk production occurring when bST is administered following the peak

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in the lactation cycle, 63-90 days following calving; the age of the cow, with first lactation cows having a lower response than older cows; and the body condition of the cow prior to the start of treatment, and the cow's initial health before and during treatment (Kohout, 2008).

The genes responsible for production of bST in cattle were identified in bovine tissue cells; they cause the pituitary cells to produce the biological product bST. These genes were isolated and inserted into specific bacteria as part of a plasmid, with gene splicing. As these altered bacteria replicate, the new genes are also replicated and passed along to all new bacteria. The presence of these genes causes the bacterial cell to become a little "manufacturing plant" which produces bST in large quantities. Eventually the bacterial cells are killed and removed, leaving the purified bST. Based on the above facts the main objective of this paper is to review the effect of bovine somatotrophine hormone on dairying cows.

Sources and how to use bST

Commercially produced bST is very similar to naturally occurring bST found in the bovine Pituitary, with only a single amino acid difference or a few amino acid differences according to the manufacturers. Originally, the only source of bovine growth hormone was the pituitary gland of dead cattle. This method, however, produced very little of the hormone. Since those days a process was developed to mass produce bovine growth hormone in amounts previously impossible. Scientists, after determining which gene controls production of bovine growth hormone, were able to insert the gene into the Escherichia coli bacteria (E. coli). This method allowed for larger scale production of bovine growth hormone in a laboratory setting.

Dairy cows are usually injected subcutaneously in the ischiorectal fossa (depression beside the tail head) or behind the shoulder (post scapular). The volume of injective of a commonly used formulation in the U.S.A. is 1.4ml. The injection is typically repeated every 14 days. Feeding bST to cows will not work. Amino acids and peptides are the building blocks of proteins. The hormone bST is a complex protein that is immediately broken down into small, inactive amino acids and peptides and rendered ineffective when it enters a cow's digestive system. How often a cow must be injected with bST will depend on whether a bST product can be developed that releases the hormone gradually over a long period of time.

BST has been used to increase milk production; in this case bST is given from the ninth or tenth week after calving until the end of lactation. In the US the generally claimed responses are from 2.25 litters to 6.6 litter of milk/cow/day (Davis et al., 1988). To extend the lactation of cows that would otherwise be culled because of inability to breed or other health reasons. BST can be used to keep a cow in production for 30 to 100 days extra. The exact details of how bST increases milk production are not known, but it is thought that blood flow to the cows' mammary (milk-producing) gland is increased. The blood carries an increased amount of nutrients available for milk production. More nutrients are extracted from the blood by the mammary gland, which improves efficiency of milk production. Feed efficiency (pounds of milk produced per pound of feed consumed) is improved because more milk is produced and the proportion of feed used for body maintenance is decreased. The actual amount of feed consumed by bST treated cows' increases, helping the cow meet the increased nutrient demands.

Management factors and the use of bST

Quality of management is a major factor determining milk yield response as is the quantity and quality of feed provided. Good management measures recommended by a product manufacturer to ensure a high response in milk yield to bST administration include; cows should not be overcrowded, additional ventilation or cooling systems may be needed if not adequate, flooring should be kept clean and provide adequate traction, feeding areas should be designed to facilitate feeding, adequate water must be provided, cows should be protected from the effects of heat in hot weather and adequate shade should be provided, high quality feed should be available, fly control is imperative (Rock et al., 1989).

It is evident that such measures would improve cow welfare. However, use of bST in the absence of such measures would exacerbate welfare problems. It has been suggested that, if there are adverse effects in cows treated with bST, the farmers are not managing their animals well enough. Hence farmers who do find that their cows have mastitis, foot disorders, reproductive disorders or other problems specified as a potential risk when bovine somatotropin is used may be reluctant to report the occurrences. Any failure of farmers to report problems would affect the results of follow up studies after bST use.

Effect of bST on dairy cow and human health

Milk yield

According to the reviewed paper of Sarwar and Tanveer (2002) effect of bovine somatotropin on the lactational and reproductive performance of lactating dairy cows. Daily administration of exogenous bST derived from the extracts of pituitary glands, or even the growth hormone release factor from the extracts of the hypothalamus of

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slaughtered cows (Enright et al., 1988) or recombinantly derived bST, cause a higher milk-yield without altering the gross composition. Official estimates of the yield response to bST administration have varied from 10-25% (AHI, 1987) to 10-15% (CAST, 1993). However, responses can be variable and may depend on management factors to achieve a maximal response.

In a long-term study with Holstein cows, bST treatment increased the average fat-corrected milk (FCM) yield in a dose- dependent fashion from 23 to 41% over control production (27.9 kg/d) in lactating cows (Bauman et al., 1989). However, increasing increments of bST show less increase. According to the report of Etherton and Bauman (1998), greater increases occur when the management and care of the animals are excellent. This claim might have some validity if it could be shown that high yielding cows prior to bST injection show consistently greater yield responses. In low yielding cattle, dramatic effects on bST have been reported, e.g. a 288% increase in yield in *Bos indicus* cows (Phipps et al., 1991) treated on days 75-95 of lactation, although between days 96 and 120 there was no significant effect on yield.

In addition to the above report the production response increases with increasing dose of bST up to a maximum response at 30-40 mg/day (Bauman, 1992). The commercial preparation in use in the USA is a slow release formulation in which 500 mg are administered every 2 weeks. Although responses to bST are often described as 'smooth' (Bauman, 1992), periodic injections produce an unphysiological lactation curve. Thus, the results of Eppard et al (1991) show that the milk yield curve has a distinctly 'saw-tooth' appearance: during the 2 week period between injections the yield increased approximately 50% in the first 7 days, declining to baseline by day 14, before being sharply stimulated again by the next injection. In the case of 28 day injection cycles a lower than expected milk yield can be obtained in the fourth week (Vernon et al, 1988).

Daily administration of exogenous bST derived from the extracts of pituitary glands, or even the growth hormone release factor from the extracts of the hypothalamus (Enright et al., 1988) of slaughtered cows or recombinant derived bST, cause a higher milk-yield without altering the gross composition. In a long-term study with Holstein cows, bST treatment increased the average fat-corrected milk (FCM) yield in a dose dependent fashion from 23 to 41% over control production (27.9 kg/d) in lactating cows (Bauman et al., 1989). However, increasing increments of bST show less increase. In another experiment, 32% increase of milk-yield was reported in cows treated with 100 IU/day of bST over control (Eppard et al., 1985a); they also found a pattern of diminishing marginal response of milk-yield to increasing hormone dose. Similar results have been reported by other workers (Eisenbeisz et al., 1990; Elvinge et al., 1988; Soderholm et al., 1988). Administration of bST, either by daily injections or in a sustained release vehicle, had no significant differences in milk or solid corrected milk of treated cows (McGuffey et al., 1990). In a previous study it was shown that bST administered by prolonged release formation was effective in improving milk-yield and productive efficiency of cows (Bauman et al., 1989).

Increase in milk production of cows given bST at their peak lactation was less than for those treated at mid to two third of their lactation (McDowell et al., 1987; Richard et al., 1985). The cows receiving 41.2 mg/d of bST in their early lactation reduced 10% more 3.5% than the control group (Schneider et al., 1990). This increase was less than that reported by other workers in the cows treated with bST after their peak lactation (Elvinger et al., 1988; West et al., 1990). This indicated that, even though responses: to exogenous bST did occur, the response was much less than that after peak lactation. One explanation of this was that during early lactation the response might be limited by nutrient availability, because cows were in considerable negative energy balance. The other reason was limited supply of glucose for lactose rather than by the ability of cows to mobilize body-reserves in support of lactation (Richard et al., 1985).

Milk Composition

The complex composition and unique biophysical properties of milk can easily be disturbed by slight deviations in composition. Nevertheless, the cow receiving bST seems to have the ability to produce more milk with the same mammary gland, while retaining normal product composition (Sarwar and Tanveer, 2002). This has probably much to do with the physical limitations for the composition of milk, as mentioned by Walstra and Jenness (1984) which was cited from (Sarwar and Tanveer, 2002) .

Bovine somatotropin does not change the composition of milk in any significant way. The concentration of fat and protein in milk varies due to genetics, stage of lactation, age, diet composition, nutritional status, environment and season (Enright et al., 1988). These factors also affect the composition of milk from BST-supplemented cows. Any minor differences in milk composition from bST supplementation are within the normal range. The variations in the content of fat and protein in milk are of the same magnitude as those usually observed in cows not supplemented with bST (Eppard et al., 1985). Lactose percentage decreased significantly at peak lactation but no change was noted at mid lactation in the milk of bST treated cows (McDowell et al., 1987) however, protein concentration declined in cows with negative energy balance (Asimov et al., 1988). This was in line with that of the report of Eppard et al. (1985) and Escher et al. (1988) that bST supplementation does not alter the proportion of total milk protein represented by whey proteins and caseins.

Milk from cows supplemented with bST does not differ in the quantity of vitamin A, thiamin, riboflavin, pyridoxine, vitamin B-12, pantothenic acid or choline; the content of biotin increases slightly (Eppard et al., 1985; Escher et al., 1987). BST naturally occurs in cows' milk in very small quantities (only 0.000006 % of all the milk protein is bST). Supplemental administration of bST does not affect the quantity of bST found in milk. Another protein hormone found in milk, insulin-like growth factor I (IGF-I), is regulated by bST. Because the biological effects of IGF-I are not species-specific, as they are for bST, some opponents suggested that this poses a safety concern. When bST is administered to dairy cows, the concentration of IGF-I in blood increases about three-fold and the levels of IGF-I in milk can increase up to two-fold (Asimov et al., 1988; Eppard et al., 1985a; Firkins et al., 1989). Nonetheless, IGF-I in milk does not pose a safety risk because it is a protein and is digested like all other dietary proteins (Farries, 1989). Furthermore, IGF-I is present in human breast milk, and at levels as high or higher than the levels in milk from bST-supplemented cows (Gertler et al., 1984)

Nutritional needs of dairy cows

Studies have examined the production responses to bST under a wide variety of feeding programs. Obtaining a response in milk production to bST does not require special diets or unique feed ingredients. It is important that the diet meet the cows' nutrient requirements which are influenced by the milk yield. Cows supplemented with bST increase their feed intake to provide the extra nutrients needed to sustain the increased milk production, but the nutrient composition and density of the diet do not need to be modified. Cows typically adjust their voluntary feed intake upward within a few weeks after initiation of bST supplementation (Davis et al., 1988; Desnouveaux et al., 1988). Thus, to maximize the milk response to bST, dairy farmers must be attentive to management factors that affect food intake. High quality forage is a critical component in obtaining high levels of voluntary intake.

Other important factors that farmers must consider to optimize the response to bST are: adlibitum feeding (free access to feed at all times), unlimited access to clean cool water, nutritionally balanced diet, adequate dietary protein, proper levels of digestible fiber and control of temperature and humidity. If cows consume an insufficient quantity or imbalanced composition of nutrients, the response to bST will decrease according to the extent of the inadequacy (Asimove et al., 1988)

Body condition

The mechanism of action of bST involves a whole range of changes in the metabolism of body tissue so that more nutrients can be used for milk production. These changes involve direct effects on tissue metabolism (e.g., adipose liver). The difference between body condition of treated and control animals varied between 0.2 and 0.5 points (Wells 1995, Chilliard 1988, Phipps 1990). On the other hand, BST treated cows might have an increased voluntary feed intake starting 4 - 6 weeks after the onset of the treatment (FOI 1993, Oldenbroek 1990). The body weight of a BST treated animal has been recorded as approximately 40 kg higher than control animals at the end of the lactation. However, body composition changed and this effect may be largely due to an increase in body water (Oldenbroek, 1990; Wells, 1995; Chilliard, 1991).

Animal health effect

Several studies have focused on the potential adverse effect of the long-term exogenous administration of bST on health aspects of dairy cattle. Not all studies were very informative concerning study design, diagnoses etc. Conclusions such as "no health effects were noted" have been stated regularly (Phipps 1990, Hartnell, 1991, Burton 1994; Oldenbroek 1990). In general health effects are difficult to detect, because symptoms are often non-specific and therefore, the prevalence and incidence of different health diagnoses, based only on visual or physical examinations are of limited value. During BST treatment an increased number of cows experienced periods "off feed" (reduced feed intake) (Monsanto, 1996; Kronfeld, 1994; Cole, 1992; Pell, 1992). There is no indication in the literature that bST treated animals might have an increased incidence of ketosis (Burton, 1994). Several studies showed an increased incidence of bloat, indigestion and diarrhea in bST treated cows (FOT NADA 14-872 1993; Monsanto 1996) In addition, the incidence of left displaced abomasum tended to increase bST treated animals (Monsanto 1996). In general the control animals had more miscellaneous health problems during the pre-treatment period than the bST treated animals. This difference might have influenced the outcome of the study (Monsanto 1996). Several authors have described increases in laboured breathing, body temperature and heart rates in BST treated animals (Cole 1992; Monsanto 1996). One manufacturer of bST warns that udder oedema is more likely in bST treated cows, especially when bST use is commenced in mid-lactation.

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Heat stress

The increased metabolic activity associated with bST induced galactopoietics also involves an increase in heat production by the body, which challenges thermoregulatory processes. The effect can be pronounced, as illustrated by the report that, of 18 cows receiving bST and subjected to heat stress, two cows died and four suffered from ataxia, whereas no such responses were observed in 16 control cows (Elvinger et al., 1992).

Life span (culling)

Concern has been expressed that cows might be metabolically overworked when treated during their lactation with bST. Therefore, life-expectation of the bST treated cows might be reduced. This effect of bST might be visible in an increased percentage of involuntary culling in herds However, the decision to cull dairy cows is complex and affected by many cow and farm factors (Pikus et al., 1989). Only limited information is available on culling rates associated with bST treatment. This is because of the above described reason and the fact that culling was prohibited in several of the studies. PAMP data (1996) showed that more cows had been removed from the bST treated herds than from the control herds. The difference was significant in multifarious cows. Ruegg et al. (1998) focused in their study on the culling practices of 32 herds. In 19 herds cows were BST treated. During the course of the study, 4 farms discontinued or restricted the use of bST and two control herds commenced bST treatment. These farms were excluded from the study. Culling rate was higher in the bST treated herds than in the control herds, although the difference was not significant. In the bST treated herds, more cows were culled because of mastitis and sickness and fewer cows were culled for reason of production or death, than in the control herds. A problem with this study was that the control and bST treated herds appeared to have considerable differences in herd size, milk production levels and age at first calving. Cole et al. (1992) presented a study on health and reproduction of bST treated dairy cows. No culling was conducted during the study and cows were only removed for scheduled necropsies or unscheduled necropsies when a cow died or was declared moribund. Eight cows had unscheduled deaths, and all these animals were bST treated. The following diagnoses were included, four mastitis cases, two pneumonias, one abomasal displacement and one case of Johnes disease. Other studies did not reveal a high culling incidence of bST treated animals compared with control animals (Oldenbroek, 1990).

Causing disease and medicine usage

BST increases the frequency of certain disease conditions such as mastitis and foot problems in cows. These conditions are normally treated using veterinary medicines. Hence bST is leading, on average to the increased use of veterinary medicines. This increased use allows more opportunity for the development of resistance to antimicrobials in pathogens on farms (Pocius et al., 1986). It may also result in increased residues of antibiotics in milk. These residues could result in further resistance to antimicrobials when the milk is fed to calves or other animals.

Human health

Consumers can be reassured of the safety of milk from cows supplemented with rbST based upon the U.S. experience. Milk from rbST-supplemented cows (more than 265 billion liters [70 billion gallons] from more than 30 million cows as of 2009) has been a part of the U.S. food supply since rbST approval in 1993 and its use has not been associated with any scientifically documented detrimental effects on human health (Raymond et al., 2010). This was associated with the report of (Hammond, 1990; Bennett, 1950; Froesch, 1957) in the 1950s, there was interest in giving bovine growth hormone injections to children who were deficient in human growth hormone to help them achieve normal growth. Unfortunately, in these children, it was shown definitively that bovine growth hormone had no effect on growth in humans. This means that even if milk had high concentrations of bovine growth hormone, the hormone would not stimulate human cells to grow. Furthermore, when bovine growth hormone is given orally, it is broken down by digestive enzymes. According to the Office of Biotechnology at Iowa State University, the "biological activity of commercial bST is identical to natural bST." Bovine somatotropin ingested via a human's digestive system has no effect on the human. The digestive system breaks the bST down into amino acids and peptides, which remain inactive. Human growth hormone (or human somatotropin) has different amino acids than bST, which prevents bST from having any effect on humans. Milk produced by bST injected cattle is perfectly safe for human consumption.

CONCLUSION

Generally utilizing of bST hormone can alleviate the demand of milk due to an increment of human population. bST hormone increases milk production in dairy cows while with normal milk composition or with no altering milk composition. It is a metabolic hormone. Cows supplemented with bST increases feed intake. It also increases the treated cow's body weight. It has no any effect on animal health. In addition to this it has no any effect on human health a person who is consuming a milk gained from BST hormone treated cow. Therefore, according to the recommendation of FAO utilizing of bST is an advantages for increment of milk production and full filing the standard milk intake per individual per year of an individual person like for developing countries.

DECLARATIONS

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Author's contribution

MS Kibrnsh Tegenaw and MR Assemu Tesfa have been involved in critically revised the manuscript for important intellectual contents. MR Shewangzaw Addisu wrote the manuscript. All authors read and approved the final manuscript.

Competing interests

The authors declare that they have no competing interests.

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EFFECTS OF PERIOD OF CALVING, SEASON OF CALVING AND PARITY ON MILK PRODUCTION PERFORMANCE OF HOLSTEIN FRIESIAN DAIRY COWS IN ALAGE ATVET COLLEGE, ETHIOPIA

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Supporting Information

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ABSTRACT: The study was conducted to evaluate milk production performance of Holstein Friesian and associated factors in dairy farms of Alage Agricultural Technical and Vocational Education Training College. The productive traits' data gathered from 1987 to 2015 were analyzed using general linear model procedures of SAS version 9.2. The result revealed that the overall least square means and standard errors for daily milk yield (DMY), 305 days milk yield (305DsMY), lactation milk yield (LMY) and lactation length (LL) were 8.06±0.119 kg, 2473.3±34.78 kg, 2395±61 kg and 323±5.34 days, respectively. Period of calving and parity had significant effect (P<0.001) on productive traits (DMY, 305 DsMY, LMY, and LL) of Holstein Friesian cows. Whereas, season of calving was not significant on all productive traits of HF cows. The overall value obtained for DMY, 305 DsMY, LMY and LL were very disappointing and below the standard set for commercial dairy farm. Furthermore, the milk production performance of Holstein Friesian found was lower than the milk production performance reported in many tropical regions. Poor management and climatic condition combined with a poor adaptation of Exotic breeds in Ethiopia were the most probable factors accounted for this poor overall value of the breed. Therefore, giving attention to the poor management of the breed and improving the level of genotype by environment (GXE) interaction is required for optimal production performance of Holstein Friesian breed in the area.

Keywords: Alage dairy farm, Productive performance, Holstein Friesian

INTRODUCTION

Food insecurity is an appearance of famine challenging in many developing countries, especially those found in Sub-Saharan Africa (SSA) and South Asia. Ethiopia is one of sub-Saharan Africa with its huge livestock population and is estimated to have 59.5 heads of cattle, about 98.59% of local cattle breeds; the remaining are hybrid and exotic breeds with 1.22 and 0.19%, respectively (CSA, 2016/17).

In Ethiopia's increasing human population, urbanization trends and rising household incomes are leading to a rapid increase in the demand for milk and milk products, and the demand has been met by increased production (Ranawana, 2008). More effective approach to increase production can be improving environmental condition and management practices coupled with improving genetic potential of dairy animals (Lateef, 2007). At the same time, the government has an ambitious target for improvement in the dairy production environment to increase towards 50% self-sufficiency in milk products by 2020. But, increasing the number of animals is not a desirable proposition as the land resources of the country are very limited and cannot afford to allocate more land under fodder production.

Due to the very important role that the livestock sector plays in the economy of the country, formulation of development plan regarding the sector is indispensable. Furthermore, livestock sector has a significant contribution to the Ethiopian economy, but production per animal is extremely low (Kumar and Tkui, 2014). It is therefore imperative that performance evaluation of dairy cattle should be formulated on the basis of reliable statistical data, and hence, timely and accurate dairy cows data are required for the formulation, implementation, monitoring, and evaluation of performances of dairy cattle in the sector.

In Ethiopia, the genetic improvement of dairy cattle is mainly based on cross-breeding and adoption of improved exotic breeds. Even though there is a concern about the adaptation of pure exotic dairy cattle to the tropical environment (climate, feed and disease challenge), pure Holstein Friesian dairy breeds have been raised by large-scale private and state dairy farms in Ethiopia in general and that of Alage ATVET College in particular. But, the performance of these animals and factors affecting it has not been systematically studied and documented.

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Therefore, the periodical evaluation of factors affecting the productivity of animals is very crucial for future planning and management. Furthermore, comprehensive information on milk production performance of Holstein Friesian dairy cows in Alage ATVET College is limited. Thus, the present study designed to evaluate the milk production performance of Holstein Friesian dairy cattle and factors affecting their performance.

MATERIALS AND METHODS

Description of the Study Area

The current study was conducted at Alage Agricultural Technical Vocational Educational Training (ATVET) College, which is located at 217 km southwest of Addis Ababa, in the vicinity of the Abijata and Shala lakes of the Ethiopian Rift Valley. The farm rests on 4200 ha of land and geographically located at a longitude of 38°30 east and a latitude of 7°30′north, with an altitude of 1600 m.a.s.l. The area has a minimum and maximum temperature ranging from 11 to 32°C and the mean annual rainfall of 800 mm. Based on agro-climatic condition and rainfall pattern, Alage ATVET College has three distinct seasons; a short rainy season (March-May), a long rainy season (June – September) and a dry season (October – February) (NMSA, 2015).

Farm Establishment and breed groups

Alage dairy farm started its dairying activity in 1980 with foundation stock of Holstein Friesian origin brought from the Stella dairy farm, Holetta and individual farms around Addis Ababa. The farm was consisted mainly of Holstein Friesian cattle population to produce milk and milk products to fulfill the ever-increasing demand for milk and milk products in the area.

Herd management

Animals were maintained under an intensive feeding and production systems and herds were managed separately based on sex, age, pregnancy, time of calving and lactation. Animals were stall-fed individually with green fodders and roughages, concentrates were also fed to the animals according to the need for different categories of animals. Heifers and dry cows were mainly fed on green fodder and other roughages throughout the year. During the day of the rainy season, cows were grazed on native pastures from 1:00-3:00 A.M local time. Later on the day, animals were tied and fed with dry and green fodder, concentrates and mineral licks under the shade. Animals were fed according to calculated requirements with concentrate feeds and mineral licks during late pregnancy and lactation. Lactating cows were fed 1 kg concentrates per 2.5 kg of milk produced before each milking. Concentrates are prepared by mixing maize with wheat bran, noug cake (*Guizotia abyssinica*), salt and limestone. Hay produced from various types of annual and perennial plants of *graminaceous* and *leguminous* species were used for feeding animals.

Semen of purebred Holstein Friesian bulls from the National Artificial Insemination Center was used for insemination. Insemination was carried out by artificial insemination (AI) technicians. Detection of estrus was carried out twice a day, early in the morning and late in the afternoon. Pregnant cows were managed separately during the last trimester and calving was in well-constructed calving pens. Lactating cows were hand-milked twice daily, early in the morning (8:00-9:00 A.M) and late in the afternoon (3:00-4:00 P.M) and daily milk yield from individual animals were weighed and recorded. Newborn calves were taken away from their dams shortly after birth and were given colostrums for the first five days of age. Fresh milk was offered twice a day in a bucket until the age of 6 months. They were kept in individual pens. Animals were regularly vaccinated against anthrax, pasteurellosis, blackleg, foot and mouth disease, lumpy skin disease, and contagious bovine pleura pneumonia. Internal and external parasitic infestation were dewormed and sprayed regularly.

Data collection

Data collected from the period 1987-2015 (28 years), from the history sheet kept on each individual animal record book maintained at the farm was used for the study. Records have an identification number, Dam and Sire ID number, sex of animal, date, and reason of exit, dates of birth, calf ID, service date and calving dates, parity number and drying dates. The variables considered were average daily milk yield (DMY), 305 days milk yield (305 DsMY), lactation milk yield (LMY) and lactation length (LL). The compiled record cards were checked for its completeness and unclear and incomplete data were cleaned out.

Data analysis

The data on productive traits (DMY,305DsMY,LMY, and LL) were interred into Microsoft Excel spreadsheet and analyzed using general linear model (GLM) procedures of SAS version 9.2 (SAS, 2008). The model used includes fixed effects of period of calving, season of calving and parity. Based on rainfall distribution, months of the year were classified into three seasons; a short rainy season, which extends from March to May, a long rainy season, which extends from June to September and a dry season that extends from October to February and periods having 4 years each. Only a few numbers of animals completed more than 7 lactations and also the estimated least square means for parity numbers 7 and greater than 7 were almost similar. Therefore, all parities above 7 were pooled together in parity 7^+.

The following statistical model was used to analyze the data.

Yijk= μ + Bi +Sj+ Yk + eijk

where, Yijk = Observation on DMY, 305DsMY, LMY and LL

μ = Overall mean

Bi = Fixed effect of i^{th} season of calving (long rainy, short rainy and dry season)

Sj = Fixed effect of j^{th} period of calving (P1;1990-1993, P2;1998-2001,…P6;2010-2015)

Yk = Fixed effect of k^{th} parity (1, 2, 3 …7)

eijk = Residual random error

RESULTS AND DISCUSSIONS

305 days milk yield (305 DsMY)

In this study, the overall least square mean and standard error of 305 days milk yield of Holstein Friesian dairy cows was estimated to be 2473.3±34.78 kg, which is lower than the least square mean for 305 days milk of 3689±45.0 kg for Holstein Friesian cows in Holleta Bull Dam farm (Ayalew et al., 2015). In contrast, lower 305 days milk yield (1707.25±13.25 kg) was reported for Holstein-Friesian × Deoni-Crossbred cows (Zewdu et al., 2013). Furthermore, the present finding is higher than 2015 kg for Holstein Friesian cows in Zimbabwe as reported by Ngongoni et al. (2006) and lower than 3408 kg for Holstein-Friesian in Turkey as reported by Katok and Yanar (2012). Such variation could be due to differences in a production environment, herd management, quality and quantity of forage and data structure, editing and adjustment procedures.

The overall least square means (LSM±SE) of 305 days milk yield as affected by period of calving, season of calving and parity are given in Table 2, respectively. The statistical analysis revealed that the observed differences of 305 days milk yield due to period of calving and party effect (P<0.001) were significant, while the variations due to season of calving were not significant (Table 1). This concurs well with the report of Zewdu et al. (2013) and Ayalew et al. (2015). But, a study by Ajili et al. (2007) and Katok and Yanar (2012) reported a significant effect of season of calving on 305 days milk yield. The present study revealed that mean 305 days milk yield was significantly (P<0.001) lowest during the earliest period (1990-97), while a dramatic increasing trend was observed from the animals that calved from 1998-2015 (Figure 1); showed progressive improvements in periods. The overall increasing trend of 305 days milk yield over the years might be due to improvements in management, better adaptation of Holstein Friesian breed to climatic, management condition as well as environmental effects. In other cases, mean 305 days milk yield increased from 1^{st} parity to 6^{th} parity, while decreased when the parity of cows goes beyond 7^{th} parity (Table 1). This difference could be due to the fact that cows calving in the first parity were not mature enough to produce more milk due to different physiological conditions like udder development and energy reserve for both body maintenance and milk production.

Lactation milk yield (LMY)

The overall least square mean and standard error of LMY of Holstein Friesian dairy cows was estimated to be 2395±61 kg with a coefficient of variation 39.7% (Table 1). The estimates of LMY found in this study was lower than the reports of several authors, 2704 Kg per lactation of Holstein-Friesian cattle (Krishantan and Sinniah, 2014), 3438±887.19 kg for Holstein-Friesian cattle under subtropical conditions of China (Usman et al., 2012), 3604±38.4 kg for Holstein-Friesian cattle at Holleta Bull Dam farm (Ayalew et al., 2015), 3710±111 kg for Holstein Friesian dairy cows in Ethiopia (Tadesse et al., 2010) and 4097±1491.2 liters for Holstein Friesian at Holleta Bull Dam Station and Genesis Farms (Alewya, 2014), 5519 L of Up-Country Exotic dairy cattle breeds of Sri Lanka (Kollalpitiya et al., 2012). On the other hand, the value obtained in the current study was higher than the Mean±SE of 2149.19±143.8 liter of Holstein Friesian in Hossana town Ethiopia (Haftu, 2015). These lower LMY of Holstein Friesian in the present study might be an indication of poor adaptation of this exotic breed to climatic and management condition in the study area. Furthermore, most of the cattle in tropics have on average an extremely low level of milk production. This is in good agreement that, there are many reasons for lower productivity, notably, these includes unfavorable environmental conditions of climate, low standards of animal husbandry and prevalence of parasites and diseases (Abdel Rahman and Alemam, 2008).

The overall least square mean (LSM±SE) of lactation milk yield for the fixed effects of period of calving, season of calving and parity are summarized in Table 1. The result confirmed that significant effect (P<0.001) of period of

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calving and parity on LMY in agreement with the report of Tadesse et al. (2010), Ayalew et al. (2015), Usman et al. (2012) and Alewya (2014), whereas season of calving did not have significant effect (P > 0.05) on LMY of Holstein-Friesian. Unlike the present study, Zewdu et al. (2013) and Hammoud and Salem (2013) reported season of calving had a significant effect on LMY of Holstein-Friesian. In contrast, Bilal et al. (2008) and Usman et al. (2012) found non-significant effect of season of calving on lactation milk yield. The result in the current study revealed that lactation milk yield was significantly decreased from animals that calved during the period from 1990-1997, while progressively increased during 1998-2005 (Figure 1). However, LMY showed decreasing trend from the animals that were calved during 2006-2015 (Figure 1). Thus, the variation in milk yield observed in different years reflected the level of management as well as environmental effects (Javed et al., 2004). The progressively increasing trend of lactation milk yield over the later period of calving (1998-2015) is an indication of better management, better adaptation of Holstein Friesian breed to climatic and management condition or environment through time or both. Furthermore, lower milk yield at the period from 1990-97 is due to the poor adaptation of Holstein Friesian breed in the country. Cows with 1st parity had lowest milk production, and highest milk production recorded in 3rd parity followed by 6th and 4th parity. However, decreased LMY at the 7th parity concurred well with the findings of Tadesse et al. (2010) and (Alewya, 2014). While, LMY at the 1st, 2nd, and 5th parity was not statistically significant as compared to 3rd, 4th, and 6th parity.

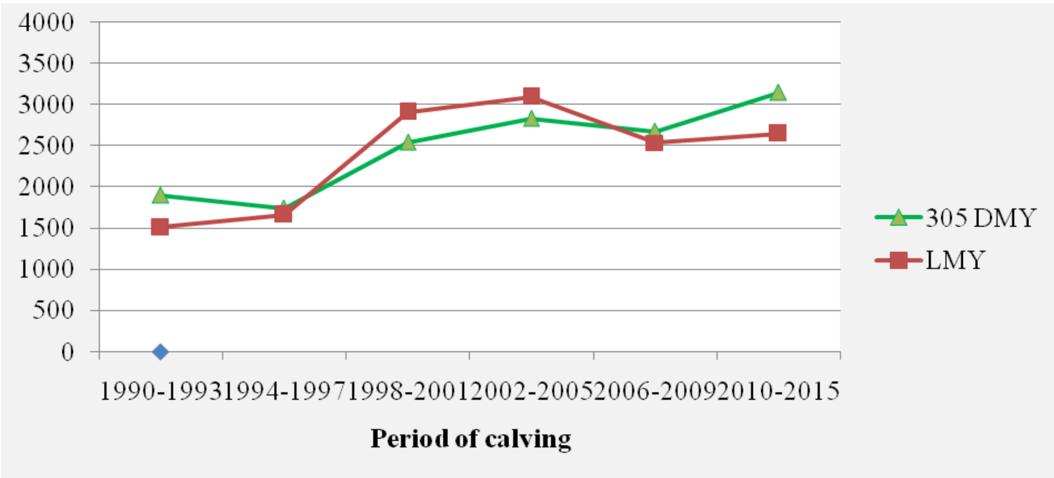

Figure 1 - The trend of 305DsMY and LMY of Holstein-Friesian over period of calving at Alage ATVET College

Table 1. Least square means and standard error of lactation milk yield and 305 days milk yield for the fixed effect of period of calving, season of calving and parity

Source	LMY (kg)		305 days milk yield (kg)	
Overall Mean (LSM±SE)	N	2395±61	N	2473.3±34.78
CV (%)	774	39.7	761	24.4
Period of calving		***		***
1990-1993	77	1511±139c	80	1901.5±77.43d
1994-1997	88	1666±123c	90	1739.88±69.03d
1998-2001	176	2911±96ab	176	2545±54.23c
2002-2005	192	3093±88a	200	2832.24±49.11b
2006-2009	95	2539±117b	96	2675±66.06bc
2010-2015	146	2650±95b	119	3145±58.95a
Season of calving		NS		NS
March-May	180	2498±93	177	2474±53
June - September	214	2308±87	203	2480±50
October-February	380	2378±70	381	2466±40
Parity		**		***
1	236	2465±72ab	237	2040.64±40.6b
2	196	2464±79ab	190	2407.2±45.36ab
3	146	2777±91a	143	2573.79±51.8a
4	98	2558±111a	93	2625.53±64.93a
5	54	2303±149ab	56	2600.15±83.03a
6	23	2443±225a	22	2655.48±129.86a
7+	21	1754±235b	20	2410.25±136.46ab

Means separated by different superscript letters under the same variable in one column are significantly different. *** = significant (P<0.001), ** = (p<0.01), NS=Not significant, N =number of records, LMY= lactation milk yield.

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Average daily milk yield (DMY)

The overall least square mean and standard error of DMY of Holstein Frisian dairy cows was estimated to be 8.06±0.119 kg with a coefficient of variation of 25.8%. The overall value obtained in this study is in close agreement with 8.38±0.47 liters for Holstein-Friesian (Haftu, 2015), 8.52±3.04 liters for Zebu × Holstein-Friesian (Belay et al., 2012) and 8 liters for Holstein-Friesian Ethiopia (Kebede, 2009), respectively. Whereas, the overall value of DMY found in this study was lower than the highest milk production per day (17 L/day) for Up-Country Exotic dairy cattle breeds of Sri Lanka (Kollalpitiya et al., 2012) and 15.8 liters of Cameroon Holstein Friesian dairy cows (Gwaza et al., 2007). While, the overall value of DMY found in this study was higher than 5.65±0.04 kg (Zewdu et al., 2013).

The overall least square means (LSM±SE) of lactation milk yield for the fixed effects of period of calving, season of calving and parity are summarized in Table 2. The result revealed that period of calving and parity had significant effect (P<0.001) on DMY, while season of calving had no significant effect on DMY of Holstein-Friesian dairy cows. Furthermore, period of calving, season of calving and parity showed source of variation for DMY of Holstein-Friesian × Deoni-crossbred cows (Zewdu et al., 2013). In this study, the lowest value of DMY was observed from the period 1990-1997, while increased at the period from 1998-2015 (Figure 2). Interestingly, a progressively increasing trend was observed from the cows that calved from 1997-2015; this might be an indication of improved management combined with a better adaptation of Holstein Friesian dairy cows in the farm. The results of the current finding confirmed that daily milk yield was highest at 4th parity, lowest at 1st parity. Besides, an increasing trend of daily milk yield was observed from 1st parity to 6th parity, while decreased when the cows go beyond 7+ parity (Table 2).

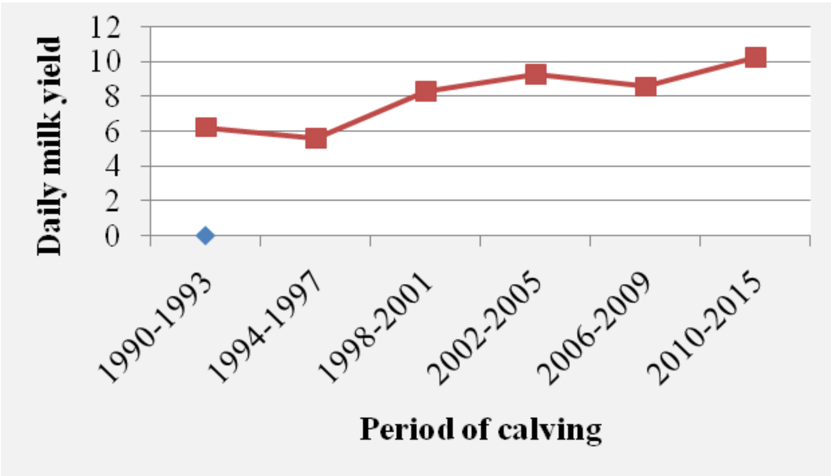

Figure 2 - The trend of daily milk yield of Holstein-Friesian over a period of calving at Alage ATVET College

Lactation Length (LL)

The overall least square means and standard error of lactation length for pure Holstein-Friesian in this study was found to be 323±5.34 days with a coefficient of variation of 24% (Table 2). This is comparable with LL of 319±1.91 days for Holstein-Friesian cattle breeds at Holleta Bull Dam farm (Ayalew et al., 2015), 314 days for Holstein-Friesian in Turkey (Sandhu et al., 2011) and 325 days for Holstein-Friesian in Ethiopia (Niraj et al., 2014). However, the result was longer than the average lactation length of 301±91days at Holleta Bull Dam Station and Genesis Farms (Alewya, 2014), 252.25±5.31 days for Holstein-Friesian at Hossana town (Haftu, 2015), 278.4±90.17 days (Javed et al., 2004), 294 days in Sudan (Abdel et al., 2007) and 291.86±6.55 days for Holstein-Friesian in Pakistan (Sattar et al., 2005), respectively. In contrast, the LL obtained in this study was lower than 342 days lactation length of Holstein-Friesian dairy cows (Krishantan and Sinniah, 2014), 366.5±76.71 days under sub-tropical conditions of China (Usman et al., 2012) and 356.97±76.32 days of Holstein-Friesian (Rameez Raja Kaleri et al., 2017) and 358 days in Mexico (Utrera et al., 2013). In most modern dairy farms, a lactation length of 305 days commonly accepted as a standard. This standard allows for calving of every 12 months with a 60 day dry period and this standard considered as ideal for many years. Therefore, the value of LL reported in the present finding was not advantageous to produce calves each year with a lactation period of about 10 and ½ months. Moreover, longer lactations prolong the calving interval thereby decreasing the number of calves that could be obtained during the life span of a cow.

The least square means and standard error of lactation length for the fixed effects of period of calving, season of calving and parity are summarized in Table 2. The significant effect of period of calving and parity (P<0.001) in agreement with the report of Alewya (2014) on LL of Holstein-Friesian cows. The significant effect of

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parity coincides with the report of Sattar et al. (2005) for Holstein-Friesian cows in Pakistan, Tadesse et al. (2010), Alewya (2014) in Ethiopia and Gader et al. (2007) in Sudan. On the other hand, season of calving did not have a significant effect (P>0.05) on LL of Holstein-Friesian dairy cows. In contrast to this, Lateef et al. (2008) reported a significant effect of season on lactation length of purebred Holstein-Friesian and Jersey cows in a sub-tropical environment of Pakistan. The present study confirmed that comparatively lactation length was longest at the period from 1998-2005, while shortest LL was observed during the period from 2010-2015 (Figure 3). In other cases, the longest LL was observed at 1st parity, while shortest at 7+ parity. The lowest lactation length of Holstein-Friesian in the 7th parity was different from the report of Kaleri et al. (2017).

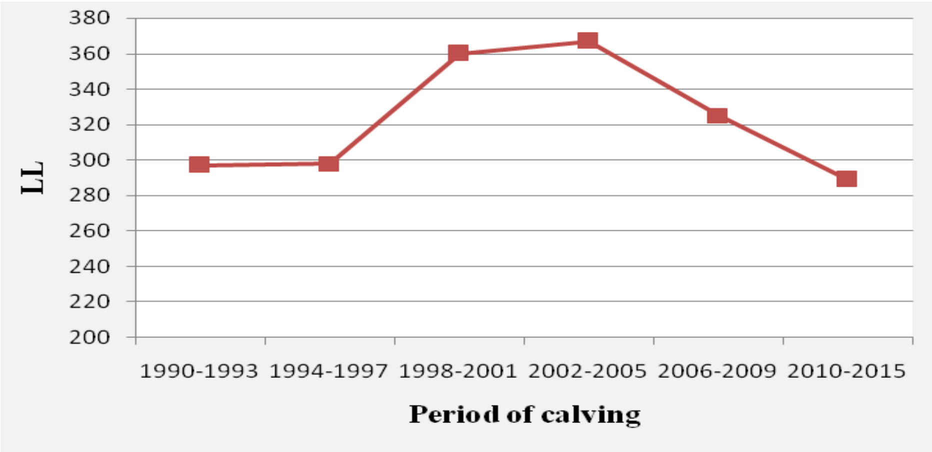

Figure 3 - The trend of lactation length (LL) of Holstein-Friesian over a period of calving at Alage College

Table 2 - Least square means and standard error of daily milk yield and lactation length for the fixed effect of period of calving, season of calving and parity

Source		DMY (kg)		LL (days)
Overall Mean	N	8.06±0.119	N	323±5.34
CV	766	25.8	665	24
Period of calving		***		***
1990-1993	80	6.25±0.26 d	62	297±12bc
1994-1997	92	5.61±0.235d	77	298±11bc
1998-2001	176	8.34±0.186c	161	360±8a
2002-2005	200	9.29±0.169b	159	367±8a
2006-2009	98	8.59±0.225bc	85	325±10b
2010-2015	120	10.28±0.202a	121	289±8c
Season of calving		NS		NS
March-May	178	8.07±0.18	152	319±8
June-September	204	8.1±0.17	174	322±8
Oct-February	384	8±0.13	339	326±6
Parity		***		***
1	237	6.6±0.14c	205	357±6a
2	193	7.76±0.155cb	176	334±7ab
3	143	8.43±0.17ab	126	334±8ab
4	94	8.6±0.22a	84	311±10cb
5	56	8.59±0.28ab	39	329±13cab
6	23	8.54±0.43ab	19	330±20cab
7+	20	7.84±0.47cab	16	263±21c

Means separated by different superscript letters under the same variable in one column are significantly different. *** = significant (p<0.001), NS=Not significant, N =number of records, DMY= daily milk yield, LL= lactation length, CV= coefficient of variation.

CONCLUSIONS AND RECOMMENDATIONS

The overall milk production performance of Holstein Friesian and associated factors in Alage ATVET College, Oromia Ethiopia was stated. Based on that, the results conclude towards the idea that the milk production performance of Holstein-Friesian dairy cows; daily milk yield, 305 days milk yield, lactation milk yield is comparably low and far below their potential, which is lower than the performances reported in the tropics.The productive performance of Holstein-Friesian in Alage ATVET College showed variation among a different period of calving and differences in parity. In all aspects, productive traits were not significantly (P>0.05) influenced by season of calving. The variation in productive traits observed during different periods of calving reflected the level of feeding, climatic condition and management differed between periods. Low milk production of Holstein-Friesian is achieved by paying attention to management factors and adjusting genotype environment interactions. Since the period of calving had shown to influence the performance of the existing breed, great attention should be given to the inconsistent management practice across different periods. The result would, therefore, provide very useful information and assist decision making particularly regarding the level of management at different periods. Poor husbandry and breeding practices and genotype-environmental interactions might be some of the reasons for the results of the lower value of this study.

DECLARATIONS

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Authors' Contribution
D Worku was participated on proposal preparation, data collection, data analysis and gathering all relevant information and writing of the manuscript. The author read and approved the final manuscript.

Conflict of interests
The authors have not declared any conflict of interests.

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e) Books, containing sections written by different authors:

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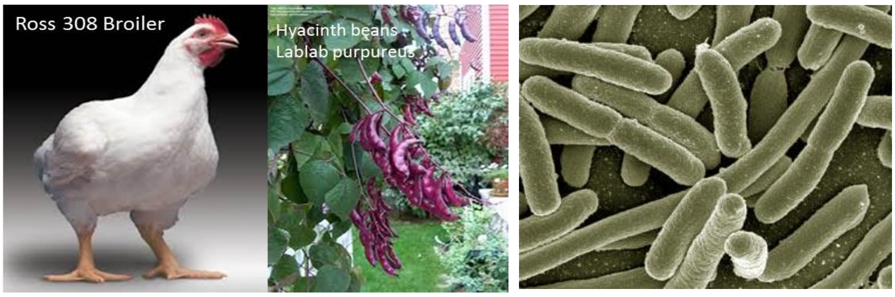

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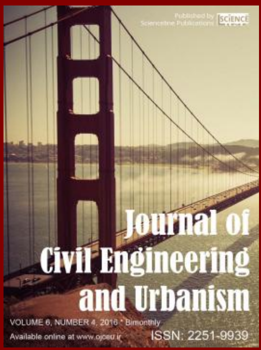

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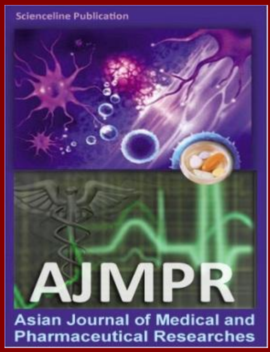

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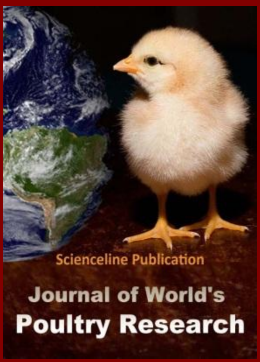

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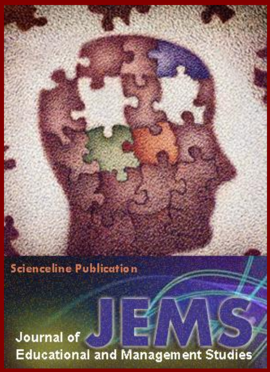

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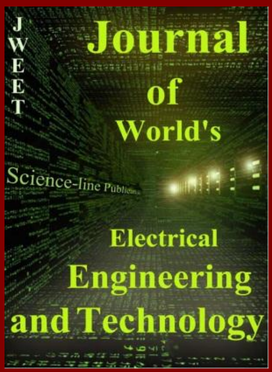

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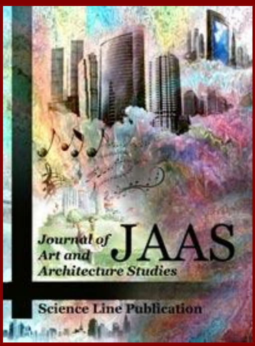

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