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TABLE OF CONTENT

Archive

Volume 5 (2); March 25, 215

Research Paper

Vegetable peels: a promising feed resource for livestock.

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

Online J. Anim. Feed Res., 5(2): 33-39, 2015; pii: S222877011500006-5

Abstract

The study was undertaken to find out the chemical composition of different vegetable peels available in Rangunia, Chittagong, Bangladesh. Total 10 different vegetable peels i.e., Banana blossom (*Musa sapientum*), Bottle gourd peel (*Lagenaria siceraria*), Brinjal peel (*Solanum melongena*), Gram husk (Cicer arietinum), Green banana peel (*Musa sapieutum*), Green coconut peel (Cocos nucifera), Pea husk (*Pisum sativum*), Potato peel (*Solanum tuberosum*), Pumpkin peel (*Cucurbita maxima*), Ripe banana peel (*Musa sapientum*) were collected from the 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 extracts (NFE), Ether extracts (EE) and Ash. Results indicated that, crude protein content in Banana blossom was 13.8 g/100g, Bottle gourd peel 7.0 g/100g, Brinjal peel 12.3 g/100g, Gram husk 4.5 g/100g, Green banana peel 7.0 g/100g, green coconut peel 4.9 g/100g, pea husk 6.2 g/100g, Potato peel 13 g/100g, Pumpkin peel 16.5 g/100g and Ripe banana peel 6.8g/100g. In addition to crude protein, all samples contained substantial amount of crude fiber, nitrogen free extracts, ether extracts and ash. It could therefore be inferred that, the vegetable peels might be an alternative to conventional feeds for livestock of the developing countries.

Keywords: Ash, Crude Fiber, Crude Protein, Ether Extract, Moisture, Nitrogen Free Extract, Vegetable Peels.

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Research Paper

Nutritive value of water hyacinth (*Eichhornia Crassipes*).

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

Online J. Anim. Feed Res., 5(2): 40-44, 2015; pii: S222877011500007-5

Abstract

The study was undertaken to find out the chemical composition and nutritive value of Water Hyacinth (Eichhornia crassipes) available in Chittagong, Bangladesh. Eichhornia crassipes samples 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. Metabolizable energy (ME) was estimated mathematically for all samples by using standard formula. Results indicated that, there were no significant variations (P>0.05) in the DM, CP, CF, NFE, EE and TA contents of the samples collected from different places. DM content varied from 8.7 to 9.3 g/100g, CP content varied from 10.1 to 11.2 g/100g, CF content varied from 26.1 to 27.4 g/100g, EE content varied from 1.1 to 1.8 g/100g, NFE content varied from 47.2 to 50.2 g/100g and TA content varied from 12.3 to 12.4 g/100g. Similarly, metabolizable energy (ME) content also varied from 1999.7 to 2054.1 Kcal/kg DM. It could therefore be inferred that, the nutrient contents of Eichhornia crassipes does not vary due to variation in geographical location. Nutritionally, Eichhornia crassipes seems sound enough to be utilized as feed for livestock especially during scarcity period.

Keywords: Chemical Composition, Eichhornia crassipes, Metabolizable Energy, Nutritive Value.

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Research Paper

Performance of rabbits on exclusive day and/or night feeding regime in the derived savannah zone of Nigeria.

Ojebiyi O.O, Olarinde O. J., Adepoju A. A., Akinola A. O. and Adetutu O. I.

Online J. Anim. Feed Res., 5(2): 45-49, 2015; pii: S222877011500008-5

Abstract

This study was carried out using Twenty four growing rabbits with an average initial weight of between 667 - 676 g. The rabbits were randomly allocated into three groups of eight rabbits each, with each rabbit serving as a replicate in a completely randomized design experiment. The rabbits were fed conventionally on concentrate (l00g) and fresh forages – Aspilia africana- Tndax procumbens (200g) per animal per day. The first group which served as the control were provided with feed and water ad libitum while the second group (day feeding) were fed once during the day (08:00 hrs) and provided with only water at night. The third group (night feeding) were fed once in the evening (06:30 hrs) and provided with water during the day. The experiment lasted for eight weeks. Parameters recorded were temperature and humidity of the rabbitary, rectal temperature of the rabbits, feed intake and left over, water consumption, weight gain as well as the pulse rate of the rabbits. Rabbits on exclusive night feeding had final weights (1.62 kg) comparable (P>0.05) with the control (1.58 kg) that were fed ad-libitum (day and night) and higher (P<0.05) than the weight of rabbits (1.48 kg) fed exclusively during the day. Feed wastage was much lower (P<0.05) in rabbits fed exclusively at night. The relative organ weights shows that the kidney, spleen, and intestinal weights were not affected (P>0.05) but there were differences (P<0.05) in weights of lungs, heart and liver for the feeding regimes. It can be concluded that feeding rabbits at night is better to take advantage of their nocturnal habit. This will encourage the participation of individuals whose schedules are busy during the day in rabbit meat production thus making more rabbit available for consumption.

Keywords: Concentrate, Feed Intake, Feed Wastage, Forages, Nocturnal Habit, Weight Gain.

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Research Paper

AEffect of feeding different levels of *Moringa oleifera* leaves on performance, haematological, biochemical and some physiological parameters of Sudan Nubian goats.

Babeker E.A. and Abdalbagi Y.M.

Online J. Anim. Feed Res., 5(2): 50-61, 2015; pii: S222877011500009-5

Abstract

The present study was designed to investigate the effects of feeding different levels of *Moringa oleifera* leaves on the performance, haematological, biochemical and some physiological parameters of Sudan Nubian goats on three different levels of *Moringa oleifera*, group A (0%) As control, group B offered (20%) and group C (50%) fed different levels of *Moringa oleifera* leaves. Thirty yearling females of Nubian goats weighted between 16.00 - 24.00 kg and their age was nearly 10 - 12 months were used in this study, the animals were divided according to their live body weight into three groups of ten each, goats were housed in pens of suitable size and were managed as any other commercial goat flock ...read more

Keywords: *Moringa oleifera* Leaves, Performance, Blood Hematology, Blood Biochemical, Physiological Parameters and Nubian Goats.

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Research Paper

A study of management, husbandry practices and production constraints of cross-breed dairy cattle in South Darfur state, Sudan.

Hamza A.E, Eltahir S.S, Hiam M.E. and Makarim A.G.

Online J. Anim. Feed Res., 5(2): 62-67, 2015; pii: S222877011500010-5

Abstract

The present work was prepared to evaluate the management applied, husbandry practices and the constraints facing crossbreed dairy cattle owners in South Darfur state, Sudan. Structured questionnaire was designed to collect the data, and the analysis was performed using frequencies and descriptive statistics. The results showed that graduated persons among dairy farm owners in Mossay district represent the majority (35%) then those of higher secondary certificate (25%) and those passing the intermediate school were (10%) where the rest of the producers were illiterate (5%). It was found that crossbreed dairy farms in Mossay district was established during few last years; (55%) of the producer established their farms in a period more than 10 years, while 40% of the respondent claimed that they started investment in milk production in a period ranging between 3-8 years, only 5% of the herd owners replied that they involved in milk production...read more

Keywords: Management, Husbandry Practice, Constraints, Crossbreed, Dairy Cattle, South Darfur, Sudan.

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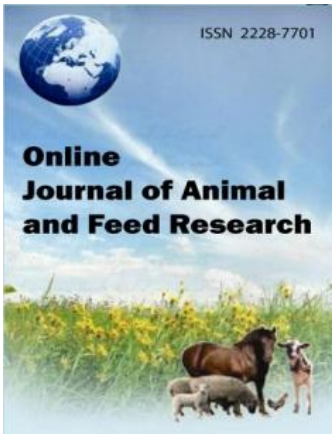

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VEGETABLE PEELS: A PROMISING FEED RESOURCE FOR LIVESTOCK

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

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ABSTRACT: The study was undertaken to find out the chemical composition of different vegetable peels available in Rangunia, Chittagong, Bangladesh. Total 10 different vegetable peels i.e., Banana blossom (*Musa sapientum*), Bottle gourd peel (*Lagenaria siceraria*), Brinjal peel (*Solanum melongena*), Gram husk (*Cicer arietinum*), Green banana peel (*Musa sapieutum*), Green coconut peel (*Cocos nucifera*), Pea husk (*Pisum sativum*), Potato peel (*Solanum tuberosum*), Pumpkin peel (*Cucurbita maxima*), Ripe banana peel (*Musa sapientum*) were collected from the 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 extracts (NFE), Ether extracts (EE) and Ash. Results indicated that, crude protein content in Banana blossom was 13.8 g/100g, Bottle gourd peel 7.0 g/100g, Brinjal peel 12.3 g/100g, Gram husk 4.5 g/100g, Green banana peel 7.0 g/100g, green coconut peel 4.9 g/100g, pea husk 6.2 g/100g, Potato peel 13 g/100g, Pumpkin peel 16.5 g/100g and Ripe banana peel 6.8g/100g. In addition to crude protein, all samples contained substantial amount of crude fiber, nitrogen free extracts, ether extracts and ash. It could therefore be inferred that, the vegetable peels might be an alternative to conventional feeds for livestock of the developing countries.

Keywords: Ash, Crude Fiber, Crude Protein, Ether Extract, Moisture, Nitrogen Free Extract, Vegetable Peels.

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INTRODUCTION

The economy of Bangladesh is mainly based on Agriculture. Livestock plays a crucial role in the agricultural economy. About 36% of the total animal protein comes from the livestock products in our everyday life. Around 25% peoples of the country are directly engaged in livestock sector and 50% peoples are partly associated in livestock production. The contribution of livestock sub-sector to the GDP was 2.95% estimated to be 17.3% of agriculture. The growth of GDP for livestock was 7.2%. Bangladesh has 24 million cattle, out of which 6 million are dairy cattle of local and crossbreds (DLS, 2008).

Dairy animals are the key components of livestock. The majority of the dairy cattle are in the hands of smallholder dairy producers. The country has one of the highest cattle densities of 145 large ruminants/square kilo meter compared with 90 for India, 30 for Ethiopia, and 20 for Brazil (Karim, 1997). The numbers of dairy farms are estimated at about 1.4 million with an average herd size of 1-3 cows (Hemme, 2008). Dairying is a part of the mixed farming systems in Bangladesh (Saadullah, 2001) and a predominant source of income, nutrition and jobs (Miyan, 1996). Dairying is also considered a powerful tool to develop a village micro economy of Bangladesh (Shamsuddin et al., 2007) to improve rural livelihoods and to alleviate rural poverty. Nevertheless, the higher price and acute scarcity of conventional feeds are two major constraints to the profitable livestock production. Replacing traditional feeds to unconventional feeds can be beneficial for the farmer. Using shrub, tree leaves, tender shoots and twigs as fodder is a traditional practice in the villages.

Recently, there has been increasing recognition of the use of shrub and tree fodder as livestock feed (Saadullah, 1989). Therefore, current study was undertaken to find out the chemical composition of different types of vegetable peels that could be used as potential unconventional feeds for livestock.

MATERIAL AND METHODS

Study area

Rangunia is a sub-district of Chittagong. There are lots of small and large dairy farms in Rangunia. Small dairy farm owner mostly practicing the use of unconventional feed particularly vegetable peels. Therefore, Rangunia was selected as the study area for collection of sample.

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Collection of sample

Samples were collected by using simple random sampling technique. Total 10 different types of unconventional feeds were selected randomly. Approximately 2000 grams of each sample was collected. Samples were wrapped up by polythene bag and preserved in the laboratory for chemical analysis.

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 moisture, DM, CP, CF, NFE, EE and ash in the animal nutrition laboratory and PRTC laboratory in Chittagong Veterinary and Animal Sciences University, Chittagong, Bangladesh as per AOAC (2006).

Calculation of ME

Metabolizable energy (ME) was calculated separately for all 10 different samples. Calculation was performed by using the mathematical formula as per Lodhi et al. (1976).

Statistical analysis

Data related to chemical composition of unconventional feeds 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 vegetable peels particularly, moisture, dry matter (DM), crude protein (CP), crude fiber (CF), nitrogen free extract (NFE), ether extract (EE) and total ash contents in different samples have been presented in Table 1.

Table 1 - Chemical composition (g/100gDM) of the vegetable peels available in Rangunia, Chittagong.

English name	Scientific name	ME	DM	CP	CF	NFE	EE	Ash
Banana blossom	Musa sapientum	2185.7	8.9	13.8	27.4	44.7	3.9	10.2
Bottle gourd peel	Lagenaria siceraria	2278.1	6.6	7.0	23.0	58.3	2.1	9.6
Brinjal peel	Solanum melongena	2231.2	10.5	12.3	26.8	52.7	1.6	6.6
Gram husk	Cicer arietinum	1798.9	88.4	4.5	48.3	38.4	5.6	3.2
Green banana peel	Musa sapieutum	2659.5	11.7	7.0	24.1	54.1	6.0	8.8
Green coconut peel	Cocos nucifera	2863.2	12.0	4.9	30.2	56.8	1.8	6.3
Pea husk	Pisum sativum	1350.9	89.2	6.2	48.4	30.5	2.3	12.6
Potato peel	Solanum tuberosum	2594.4	16.3	13.0	12.5	64.6	0.9	9.0
Pumpkin peel	Cucurbita maxima	2704.8	13.3	16.5	14.8	62.2	1.9	4.6
Ripe banana peel	Musa sapientum	2634.8	7.7	6.8	16.8	56.5	7.8	12.1
SEM		148.1	10.4	1.3	4.0	3.4	0.7	1.0
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; NS=Non-significant ($P>0.05$); SEM=Standard error of mean, *=Significant at 5 % level ($P<0.5$); ***=Significant at 0.1 % level ($P<0.001$)

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Banana flower (*Musa sapientum*)

Banana flower (*Musa sapientum*) known as banana blossom or heart, is a wonder looking male, sterile flower of the banana plant. Banana flower, similarly to banana is an excellent source of potassium, vitamins A, C and E. According to research conducted by the Chinese Academy of Tropical Agricultural Sciences, banana flowers have tremendous nutritional values. This is a good source of fiber and protein. The flowers contain a class of phytochemical known as saponins. They also have antioxidant activity to reduce the risk of cardiovascular diseases. Banana flowers are an excellent source of flavonoids. These phytochemicals help prevent damage to DNA cells by neutralizing free radicals. They have cholesterol lowering, anti-inflamation, anticancer and anti-aging activities. In present study, banana flower contained 2185.7 kcal ME/kgDM, 91.1 g/100g moisture, 13.8 g/100g crude protein, 27.4 g/100g crude fibre, 3.9 g/100g ether extract, 44.7 g/100g nitrogen free extracts and 10.2 g/100g ash which is close to the result of Kanchana et al. (2005) who found 88.75 g/100g moisture, 21.01 g/100g crude protein, 20.315 g/100g crude fibre and 8.74 g/100g ash. Therefore, banana flower could be a promising feed resource for livestock.

Bottle gourd peel (*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 much 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 %. Bottle gourd with peel contains more crude fiber, acid detergent fiber, hemicelluloses, iron, phosphorus, zinc then bottle gourd without peel (Milind and Satbir, 2011). Leaves contain cucurbitacin B. Extracts of the plant have shown antibiotic activity (Gorasiya et al., 2011). In present study, bottle gourd peel contained 2278.1 kcal ME/kgDM, 7.0 g/100g crude protein, 23.0 g/100g crude fibre, 2.1 g/100g ether extracts, 58.3 g/100g nitrogen free extracts and 9.6 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 could be an alternative feed source for livestock.

Brinjal peel (*Solanum melongena*)

The *Solanum melongena* is a member of the plant family Solanaceae. The plant bears a fruit of the same name, commonly used in cooking. As a nightshade, it is closely related to the tomato and potato. It was domesticated in India from the species. Cows eating GM brinjal produced significantly (14.3%) more milk, almost as if they were treated by a light hormone in 42 days only. In present study, brinjal peel contained 2231.2 kcal ME/kgDM, 12.3 g/100g crude protein, 26.8 g/100g crude fibre, 1.6 g/100g ether extracts, 52.7 g/100g nitrogen free extracts and 6.6 g/100g ash.

Gram husk (*Cicer arietinum*)

Gram husk (Cicer arietinum) is frequently used in dairy ration because it is not only cheap but also abundant especially in Chittagong region. In present study, gram husk contained 1798.9 kcal ME/kgDM, 11.6 g/100g moisture, 4.5 g/100g crude protein, 48.3 g/100g crude fibre, 5.6 g/100g ether extract, 38.4 g/100g nitrogen free extracts and 3.2 g/100g ash. In another study, Sreerangarajua (2000) found 51.0 g/100g crude protein and 11.0 g/100g ether extracts in gram husk. The proximate composition of Bengal gram (*Cicer arietinum*) husk is

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comparable to that of cereal straw (Sen et al., 1978). It is one of the preferred feed ingredients in the diet of crossbred dairy cows in and around Bangalore, India. It is reported that gram husk contain some anti nutritional factors (Barry, 1989) particularly certain types of tannins. So gram husk can be cautiously used in ruminant ration.

Green banana peel (*Musa sapientum*)

Scientific name is *Musa sapientum*. This is a herbaceous plant of the family Musaceae. It is a fast-growing plant with a 3-5 m high stem and almost every part of it is usable. According to Leslie (1976), it is now cultivated throughout the tropics. The plant is cultivated primarily for its fruits and to a lesser extent for the production of fibre. The peel has been reported to be useful in making banana charcoal, an alternative source of cooking fuel in Kampala. Kudan (1973) reported that the peels in conjunction with other substances create a liniment for reducing acuteness of the arthritis and pains. The proportion of the banana which is wasted as peel is 18-20 % (Dividich et al., 1976). The nutritive value of ripe banana peel was slightly better than the almost ripe and green peel (Tartrakoon et al., 1999). In present study, green banana peel contained 2659.5 kcal ME/kgDM, 7 g/100g crude protein, 24.1 g/100g crude fibre, 6 g/100g ether extracts, 54.1 g/100g nitrogen free extracts and 8.8 g/100g ash.

Green coconut peel (*Cocos nucifera*)

The local name of Green coconut peel is Dab and scientific name is *Cocos nucifera*. Green coconut is one of the most nutritious of all fruits. The whole coconut tree may be utilized, but the main products are obtained from the fruit. Copra and oil, lauric acid, coconut milk, fiber, flour and coconut water are derived from immature fruit which is used in several application. The green coconut is truly one of nature's wonder. Every part of the coconut is used for some purpose. From this tree we can derive everything necessary to sustain life. It is a source of food and drink to nourish the body, medicine to maintain and restore health and materials to build shelter, clothing and tools to provide the necessities of life. That's why, it is called the 'tree of life' (Fife, 2005). Coconut shell-oil is used for external application in eczema, ringworm, chronic skin diseases (Khare, 2004). The coconut oil is also used as an emetic and as a purgative (Trivedi, 2006). It is very rare to use as animal feed in our country. It has good nutritive value. It is highly rich in carbohydrate. In present study it contained 2863.2 kcal ME/kgDM, 12.0 g/100g dry matter, 4.9 g/100g crude protein, 30.2 g/100g crude fiber, 56.8 g/100g nitrogen free extracts, 1.8 g/100g ether extracts and 6.3 g/100g ash (Table 1). A polysaccharide factor isolated from coconut water is found to be immunogenic and oil from coconut shell fiber antimicrobial (Khare, 2004). So, green coconut peel can be used as unconventional feed resource for livestock.

Pea husk (*Pisum sativum*)

Pea husk (*Pisum sativum*) in present study, contained 1350.9 kcal/kg ME, 10.8 g/100g moisture, 6.2 g/100g crude protein, 48.4 g/100g crude fibre, 2.3 g/100g ether extract, 30.5 g/100g nitrogen free extracts and 12.6 g/100g ash which is similar to FAO (2005) where the they found 93.7 g/100g dry matter, 6.7 g/100g crude protein, 38 g/100g crude fibre, EE 0.3 g/100g ether extracts and 5.0 g/100g ash. According to Gowda et al. (2004), pea husk contained 92.3 g/100g dry matter, 6.0 g/100g crude protein, 1.1 g/100g ether extracts, 42.6 g/100g crude fibre, 5.0 g/100g ash and 45.2 g/100g nitrogen free extracts. So, peas husk could be a potential and valuable feed for livestock as it is available throughout the whole country at a reasonable price.

Potato peel (*Solanum tuberosum*)

The potato is starchy, tuberous crop from the perennial *Solanum tuberosum* of the Solanaceae family. Potato plants are herbaceous perennials that grow about 60 cm high. During peeling process, 30 to 40 % of the potatoes

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and vegetables become waste. Waste generated by peeling commonly called peeling. Potato peels contain an array of nutritionally and pharmacologically interesting components such as phenolic compounds, glycoalkaloids, and cell wall polysaccharides, which may be used as natural antioxident, precursors of steroid hormones, and dietary fibre. The utilization of by-products also contributes to reduce amounts of wastes and thus to sustainable production (Schieber et al., 2003). In present study, potato peel contained 2594.4 kcal ME/kgDM, 13 g/100g crude protein, 12.5 g/100g crude fibre, 0.9 g/100g ether extracts, 64.6 g/100g nitrogen free extracts and 9 g/100g ash. The result is in close agreement with Mahmood et al. (1998) who found 14.70 g/100g CP and 7.65 g/100g ash.

Pumpkin peel (*Cucurbita moschata*)

The local name is mistikumra and scientific name is *Cucurbita moschata*. The fruits are edible and eaten as vegetable. Mature fruits of squash gourd are used as a table vegetable for baking in pies and for making jam and also livestock feed. The flesh is usually fine-grained and mild-flavored and thus suitable for baking. Besides these it is a source of Vitamin A and Vitamin C (Rahman et al., 2008). In present study, pumpkin peel contained 2704.8 kcal ME/kgDM, 16.5 g/100g crude protein, 14.8 g/100g crude fibre, 1.9g/100g ether extracts, 62.2 g/100g nitrogen free extracts and 4.6 g/100g ash. So, pumpkin peel is nutritionally sound and may be good feed for livestock.

Ripe banana peel (*Musa sapientum*)

Almost similar to green, ripe banana peel contained 2634.8 kcal ME/kg DM, 6.8 g/100g crude protein, 16.8 g/100g crude fibre, 7.8 g/100g ether extracts, 56.5 g/100g nitrogen free extracts and 12.1 g/100g ash. The result is inconsistent with Tartrakoon et al. (1999) who found 4383 kcal ME/kgDM, 91.62 g/100g DM, 5.19 g/100g CP, 11.58 g/100g CF, 10.66 g/100g EE and 16.30 g/100g ash for green banana peel and 4593 kcal ME/kgDM, 95.66 g/100g DM, 4.77 g/100g CP, 11.95 g/100g CF, 14.56 g/100g EE and 14.58 g/100g ash for ripe banana peel. Thus, properly processed banana peel could be a good source of nutrients for livestock (Anhwange, 2008).

CONCLUSION

Year round supply of sufficient feeds for livestock is the priority area for profitable livestock production. The available feed stuffs in Bangladesh are mainly crop residues, agro-industrial by-products and unconventional feed stuffs. The role of unconventional feeds in ruminant nutrition continues to increase. The utilization of unconventional feeds will not only benefit the milk and beef industry but also increase the economic return. Unconventional feed can also be used during the scarcity of traditional feed.

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NUTRITIVE VALUE OF WATER HYACINTH (*Eichhornia crassipes*)

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ABSTRACT*:* The study was undertaken to find out the chemical composition and nutritive value of Water Hyacinth (*Eichhornia crassipes*) available in Chittagong, Bangladesh. *Eichhornia crassipes* samples 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. Metabolizable energy (ME) was estimated mathematically for all samples by using standard formula. Results indicated that, there were no significant variations (P>0.05) in the DM, CP, CF, NFE, EE and TA contents of the samples collected from different places. DM content varied from 8.7 to 9.3 g/100g, CP content varied from 10.1 to 11.2 g/100g, CF content varied from 26.1 to 27.4 g/100g, EE content varied from 1.1 to 1.8 g/100g, NFE content varied from 47.2 to 50.2 g/100g and TA content varied from 12.3 to 12.4 g/100g. Similarly, metabolizable energy (ME) content also varied from 1999.7 to 2054.1 Kcal/kg DM. It could therefore be inferred that, the nutrient contents of *Eichhornia crassipes* does not vary due to variation in geographical location. Nutritionally, *Eichhornia crassipes* seems sound enough to be utilized as feed for livestock especially during scarcity period.

Keywords: Chemical Composition, *Eichhornia crassipes*, Metabolizable Energy, Nutritive Value.

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INTRODUCTION

Water hyacinth (*Eichhornia crassipes*) is a cosmopolitan invasive aquatic plant which can tolerate a wide range of environmental conditions such as temperature, humidity, illumination, pH, salinity, wind, current and drought. The plant is morphologically plastic with a rapid mode of vegetative propagation that makes it well adapted to a long distance of dispersal and colonization under diverse ecological conditions. It is one of the most prolific aquatic plant which spreads at an alarming rate. It has spikes of light blue flowers and green color roundish leaves with inflated bladder like petioles. The extremely rapid rate of proliferation of *Eichhornia crassipes* results reduced penetration of dissolved oxygen in water body, change in water chemistry, disruption of aquatic flora and increased rate of water loss due to evapotranspiration. Therefore, it is considered as a serious threat to biodiversity and recently massive attention has been given to its harvesting for use as alternative plant protein source for livestock.

In Bangladesh, cattles are fed mainly low quality roughage including natural grazes and agro-industrial by products such as straw, sugarcane by-products and other crop residues. These feeds are deficient in protein, energy, minerals and vitamins. At certain time of the year, quality of grazing deteriorates due to seasonal influence. Thus livestock productivity consequently declines and in this case lactation ceases unless supplements are offered. Availability of livestock feeds are decreasing day by day in Bangladesh due to shortage of grazing area. In such cases, water hyacinth, a very common and locally available unconventional feed may be a good alternative to overcome feed crisis.

In Bangladesh, huge amount of *Eichhornia crassipes* are produced due to large number of rivers, ponds, lakes and other water reservoirs. In many coastal areas of the country, *Eichhornia crassipes* is commonly used as

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forage for cattle either as basal feed resource or supplement to a diet consists of sugarcane, molasses and cereal straws. About 60% or more ponds and rivers are covered by water hyacinth in Chittagong district and almost all of them are being used by the farmers without any nutritional knowledge on it. If the chemical composition and nutritive value of *Eichhornia crassipes* can be explored, the farmers can utilize them as an unconventional feed for their livestock to minimize feed cost and maximize production. Therefore, current study was undertaken to find out the chemical composition and nutritive value of *Eichhornia crassipes* available in Chittagong, Bangladesh.

MATERIAL AND METHODS

Study area

Eichhornia crassipes are available all over Bangladesh. However, the study was carried out in three remote areas i.e., Khulshi, Raozan and Fatikchari of Chittagong district. There were sufficient ponds, water reservoirs and low lands in the study area for collection of *Eichhornia crassipes*.

Collection of sample

Eichhornia crassipes samples were collected from different ponds, water reservoirs and low lands of Khulshi, Raozan and Fatikchari area. Immediate after collection, roots were cut-off and removed, fresh stalks and leaves were collected and packed into air tight polythene sacs and sent to the animal nutrition laboratory, Chittagong Veterinary and Animal Sciences University, Chittagong, Bangladesh for chemical analysis.

Preparation of samples

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 about 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, uniformly ground samples were collected for proximate analysis.

Chemical analyses

Chemical analyses of *Eichhornia crassipes* 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 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, Metabolizable energy (ME) content in all the water hyacinth 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 *Eichhornia crassipes* 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 DISCUSSIONS

Eichhornia crassipes belongs to Kingdom-Plantae, Order-Commelinids, Family-Pontederiaceae, Genus-Eichhoria and Species-crassipes. In present study, *Eichhornia crassipes* contained low DM (9.3%), moderate CP (10.5%) and CF (26.9%) high NFE (48.7%) and TA (12.4%). These observations are in well agreement with other investigators (Aboud et al., 2005; Boyd, 1968; Dada, 2002; Dairo, 1997; Gollamudi et al., 1984; Mako and Babayemi, 2008; Okoye et al., 2002; Reza and Khan, 1981). The level of CP available in *Eichhornia crassipes* may be considered favorable for feeding ruminant and may be considered as a valuable supplement for low quality crop residues (Aboud et al., 2005). Previous reports indicated that, light green leaves and petioles of *Eichhornia crassipes* contained higher percentage of protein than those of the mature plant (Men et al., 2006). The leaf contains more protein than sweet potato leaf (An et al., 2003) while the protein content in entire plant is higher than traditional grasses such as elephant grass (Hong et al., 2003). Therefore, *Eichhornia crassipes* can be supplemented in low quality diets (Khan et al., 2002). Leaf proteins of *Eichhornia crassipes* are rich in glutamine, asparagine and leucine (Virabalin et al., 1993). Chemical composition of *Eichhornia crassipes* is influenced by season, type of habitat (Poddar et al., 1991; Tham, 2012; Tucker and Debusk, 1981) as well as harvesting frequency (Reddy and D'Angelo, 1990). In tropical condition, the plant matures more rapidly (Buxton, 1996) and cell walls become highly lignified (Van Soest, 1988). Crude protein concentration is high in the immature forage but

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declines as maturity advances (Buxton, 1996). Lignin and silica are the most important limiting factors for digestibility of *Eichhornia crassipes* (Van Soest, 1981). Lignin content of *Eichhornia crassipes* varied from 7 to 10% while silica varied from 0.5 to 5% (Abdelhamid and Gabr, 1991; Biswas and Mandal, 1988). *Eichhornia crassipes* grown in sewarage had high crude protein and ash contents (Wolverton and McDonald, 1978) compared with ponds, rivers and lakes. High content of ash in water hyacinth is probably due to accumulation of minerals absorbed from water (Boyd, 1968).

Eichhornia crassipes is very popular recently as animal feed, aqua feed, water purification, fertilizer, biogas production, even food for human and other products (Ogle et al., 2001; Wolverton and McDonald, 1976). Water hyacinth can be used as fresh, ensiled or wilted for feeding animals. Whole plants either, chopped or ground can be used as feedstuffs for both ruminants and monogastrics (Tham, 2012). *Eichhornia crassipes* contains high levels of cellulose and hemicellulose, which could serve as energy sources for ruminants (Mukherjee and Nandi, 2004). Fresh *Eichhornia crassipes* can be utilized as partial replacement of para grass (Brachiaria mutica) in diets of cattle (Biswas and Mandal, 1988; Thu, 2011). Supplementation of wilted *Eichhornia crassipes* in a rice straw-based diet has positive effect on intake and growth of beef cattle (Islam et al., 2009). In a study, daily live weight gain was approximately 500 g when 30% dried *Eichhornia crassipes* was included in the basal diet of wheat straw at a fixed amount of concentrates (Parashar et al., 1999). Since *Eichhornia crassipes* has very low dry matter content, wilting is preferred to reduce silage losses (McDonald et al., 2011). *Eichhornia crassipes* can be ensiled successfully with addition of molasses, rice bran, cassava root as well as organic acids. Silage prepared with *Eichhornia crassipes* has well acceptance by ruminants (Tham, 2012). An ensiled mixture of *Eichhornia crassipes*, rice straw, urea and molasses was fed to dairy cattle and resulted an increase of milk yield (Chakraborty et al., 1991; Tham, 2012). Utilization of both wilted and ensiled *Eichhornia crassipes* as a feed for sheep was reported (Abou-Raya et al., 1980; Baldwin et al., 1975). Although wilted *Eichhornia crassipes* has not been recommended as the sole feed for sheep, however, it could replace up to 50% of the concentrates in complete diets (Abdelhamid and Gabr, 1991). *Eichhornia crassipes* residues, after mechanical extraction of the juice, can be used in the diet of fattening buffalo calves (Borhami et al., 1992). While *Eichhornia crassipes* accounted for 35% of diet, then feed conversion efficiency was higher compared to a similar level of Egyptian clover (Trifolium alexandrinum).

Chemical composition of *Eichhornia crassipes* varies with regard to habitat, density and season (Poddar et al., 1991; Tucker and Debusk, 1981). Highest CP and lowest ADF were obtained in the winter at the time of lowest growth rates. As DM productivity increased in warmer weather, CP levels decreased and ADF content increased (Tucker and Debusk, 1981). In another report, higher concentrations of nitrogen were accumulated in the shoots of *Eichhornia crassipes* than in its roots, whereas nitrogen accumulation was similar in the roots and shoots of water lettuce (Agami and Reddy, 1990; Tham, 2012). It was evident that, roots were supposed to hold more Zn than other parts of *Eichhornia crassipes* (Rupainwar et al., 2004). Insect damage also reduced the concentrations of nitrogen and P in plants growing in high nutrient water (Heard and Winterton, 2000). *Eichhornia crassipes* is a good source of crude fat. Gollamudi et al. (1984) reported that fat in water hyacinth was primarily found in leaves (14.9 g/100g) whereas roots and stalks contained 1.6 and 0.9 g/100g respectively.

The improvement of crude protein intake and digestibility has been seen when increasing levels of fresh *Eichhornia crassipes* was incorporated in cattle diets (Tham, 2012). However, to avoid bloat and low intake of rice straw, the level of fresh water hyacinth in diet should not exceed 30% for growing cattle. Nutrient digestibility increased with increasing level of ensiled water hyacinth offered (Tham, 2012). It seemed likely that ensiled *Eichhornia crassipes* at levels of at least 50% of the diet had the potential to supply enough metabolisable energy for better live weight gains of >300 g/day in cattle.

Table 1 - Chemical composition and nutritive value of Water Hyacinth (*Eichhornia crassipes*) available in Chittagong, Bangladesh

Parameters	Chemical composition (g/100gDM)						
	DM	CP	CF	Ash	EE	NFE	ME (Kcal/kg)
Khulshi area	9.3	10.3	27.4	12.4	1.1	48.8	1999.7
Raozan area	8.7	10.1	26.1	12.3	1.3	50.2	2054.1
Fatikchori area	9.8	11.2	27.4	12.4	1.8	47.2	2028.5
Mean	9.3	10.5	26.9	12.4	1.5	48.7	2032.6
Std. Deviation	0.5	0.5	0.6	0.1	0.3	1.2	22.4
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)

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CONCLUSION

Eichhornia crassipes is available all over the country almost round the year. *Eichhornia crassipes* contains moderate CP, high NFE and TA. It contains adequate mineral that is sufficient for maintenance and production requirement of cattle. These imply that the plant can be utilized as feed for animals especially ruminants. It is also reported that the proximate composition of water hyacinth is almost similar to other perennial grasses available in Bangladesh. *Eichhornia crassipes* naturally absorbs pollutants including toxic chemicals like lead and others as well as some organic compounds believed to be carcinogenic in surrounding water. Therefore, *Eichhornia crassipes* can assist farmers ensuring sustainable production of least cost diets for cattle. The sustainability of the least cost diet is expected eventually for successful management of the weed in water ways for protection of biodiversity. Therefore, more comprehensive studies are recommended to make it low cost, locally available conventional aquatic feed for livestock.

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PERFORMANCE OF RABBITS ON EXCLUSIVE DAY AND/OR NIGHT FEEDING REGIME IN THE DERIVED SAVANNAH ZONE OF NIGERIA

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ABSTRACT*:* This study was carried out using Twenty four growing rabbits with an average initial weight of between 667 - 676 g. The rabbits were randomly allocated into three groups of eight rabbits each, with each rabbit serving as a replicate in a completely randomized design experiment. The rabbits were fed conventionally on concentrate (l00g) and fresh forages –*Aspilia africana- Tndax procumbens* (200g) per animal per day. The first group which served as the control were provided with feed and water *ad libitum* while the second group (day feeding) were fed once during the day (08:00 hrs) and provided with only water at night. The third group (night feeding) were fed once in the evening (06:30 hrs) and provided with water during the day. The experiment lasted for eight weeks. Parameters recorded were temperature and humidity of the rabbitary, rectal temperature of the rabbits, feed intake and left over, water consumption, weight gain as well as the pulse rate of the rabbits. Rabbits on exclusive night feeding had final weights (1.62 kg) comparable (P>0.05) with the control (1.58 kg) that were fed ad-libitum (day and night) and higher (P<0.05) than the weight of rabbits (1.48 kg) fed exclusively during the day. Feed wastage was much lower (P<0.05) in rabbits fed exclusively at night. The relative organ weights shows that the kidney, spleen, and intestinal weights were not affected (P>0.05) but there were differences (P<0.05) in weights of lungs, heart and liver for the feeding regimes. It can be concluded that feeding rabbits at night is better to take advantage of their nocturnal habit. This will encourage the participation of individuals whose schedules are busy during the day in rabbit meat production thus making more rabbit available for consumption.

Keywords: Concentrate, Feed Intake, Feed Wastage, Forages, Nocturnal Habit, Weight Gain.

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INTRODUCTION

Feeding involves a complex series of decisions and depends upon an elaborate array of mental, motor and digestive abilities. The initiation of feeding behavior can be affected by diurnal rhythms and social factors but input from monitors of the body state are of particular importance (Fraser and Broom, 1990). Signals reported to be of importance in several species include visual input, input from taste receptors, inputs resulting from stomach contractions, insulin effects, plasma glucose detector input and fat store monitor inputs (Mogenson and Arnold, 1974). Once food is found, the rate of ingestion will limit intake and this will depend upon oral mechanics and other abilities of the animal; the physical and mechanical properties of the food; the availability of water; the nutrient qualities of the food and the effects of disturbances such as those due to danger of predation, attacks by insects, or competition from other members of the species. It thus appears that the point at which ingestion of meal ceases will depend on gut size and input to the brain from sensory receptors, such as those which signal that the gut is full (Frazer and Broom, 1990). In rabbits the consumption of solid and liquid feed fluctuates over a 24 hour period with much feed consumed in the dark than in the light Lebas et al. (1986).

According to Prud'hon (1975) as a rabbit grows older the nocturnal nature of its feeding habit becomes more pronounced. The number of feeds during light period drops and the morning 'feeding rest' tends to lengthen. Feeding of rabbits can therefore be timed to such periods when intake is high and wastage lower. With increased intake growth performance is enhanced while reduction in feed wastage will ultimately lead to some savings in terms expenditure on feed. This experiment was conducted to compare the effect of two feeding regimes: exclusive day and/or night feeding on the performance of growing rabbits.

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MATERIALS AND METHODS

Experimental site

The experiment was carried out at the Rabbitary unit of the Teaching and Research Farm located within the campus of Ladoke Akintola University of Technology, Ogbomoso, Oyo State, Nigeria. The study site lies between latitudes 8007'N and 8012'N and longitudes 4004'E and 4015'E. According to the University weather station report, the climate condition of Ogbomoso area is between humid and fairly hot sub-humid tropical with marked wet and dry seasons. There is a short period of harmattan in between the two seasons (wet and dry). The mean annual rainfall is 1,400mm with a weekly developed bimodal pattern of distribution, reaching peak around July and September. The air temperature ranged between 25.8°C in August and 30.5°C in March with the mean annual temperature of 27°C. The average relative humidity is 77% with as high as 92.9% and 61.4% in morning and afternoon respectively.

Experimental animals and management

Twenty four growing rabbits of mixed breed (New Zealand white X California white) with an average weight of between 667 ± 23.4 and 676 ± 49.2g were used for the study. They rabbits were randomly divided into three groups of eight rabbits each after weight balancing, each rabbit served as an experimental unit in a completely randomized design. The rabbits were fed conventionally on a mixture of 100g concentrate containing 17% protein and Metabolizable energy of 2500Kcal/kg and a mixture of fresh forages –*Aspilia Africana* (17.3% crude protein, 14.9% crude fibre and 3.89Kcal/g of Gross energy)- *Tridax procumbens* (16.9% crude protein, 15.9% crude fibre and 3.92Kcal/g of Gross energy) -200g per animal per day. The first group which served as control was provided with feed and water ad libitum. While the second group were fed once during the day (08:00hrs) and provided with only water at night. The third group were fed once in the evening (06:30 hrs) and provided with water during the day. The rabbits were housed individually in wood-wire cages with dimensions of 44×34×44cm. The drinking and feeding troughs used (earthen pots re-enforced with cement to prevent tipping off) were removable types for easy cleaning. The experiment lasted for eight weeks. Various parameters such as temperature and humidity of the rabbitary, rectal temperature of the rabbits, feed intake and left over, water consumption, weight gain of the rabbits, and pulse rate of the rabbits were recorded.

Carcass evaluation

After the experiment the five rabbits that had weights close to the mean for the group were selected per treatment for carcass evaluation. They were fasted for twelve hours weighed, stunned, bled, scalded and eviscerated to remove the internal organs. The dressed carcasses were then weighed and used to calculate the dressing percentage.

Data analysis

Data collected were subjected to analysis of variance using the General Linear Model (GLM) of (SAS 2000). Duncan Multiple Range Test of the same statistical package was used for comparing the means.

RESULTS AND DISCUSSION

The Performance of rabbits fed at different periods of the day is presented in Table 1. The Final weights of rabbits on night feeding and ad lib feeding were similar ($P>0.05$) but higher ($P<0.05$) than day feeding. Similar trend was observed for daily weight gain. The final weight of between 1483g and 1621g observed in this study is higher than 1120g to 1415.00g reported by Onimisi et al. (2006). Factors influencing final weight could be inheritance, environment and nutrition. The daily weight gain obtained in this study (between 14.5g-16.9g) are lower than 17.6g to 24.6g reported by Onimisi et al. (2006) but higher than 6.68g to7.30g reported by (Babarinde, (2006). The values obtained fall within the ideal growth rate of rabbits in the tropics which is between 12g to 20g per day as reported by Tegbe et al. (2004). The daily feed intake ranged from 57.9g to 69.0g. The lower daily feed intake of rabbits on ad lib feeding could be as a result of relatively high temperature during the day compared to night temperature. Lebas et al. (1986) reported that high temperature affects growing rabbits negatively resulting in reduced rate of live weight gain caused by reduction in feed intake. He further stated that when rabbits are raised at 18-20°C they can reach a live weight of 3kg by 112 days whereas at 30-51°C they only reach 2.5 kg. This could be improved by night feeding as rabbits would have access to feed in the cooler part of the day and also within their natural feeding regime. It was observed in this study that rabbits on night feeding did not waste feed as the rabbits in other treatments. This observation might be attributed to the nocturnal habit of rabbits and the fact that at night temperatures are normally lower than day.

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Table 1 - Performance characteristics of the experimental Rabbits

Parameters	Ad lib feeding	Day feeding	Night feeding	P value
Initial weight(g)	676±49.15	667±23.4	673±57.3	0.0004
Final weight (kg)	1.58±0.0534[a]	1.48±0.0.0512[b]	1.62±0.0633[a]	0.0001
Daily weight gain (g/rabbit)	16.1±1.03[a]	14.5±0.98[b]	16.9±0.86[a]	0.153
Daily feed intake (concentrate) (g/rabbit)	62.7±0.91[b]	57.9±1.56[b]	69.9±1.81[a]	0.0001
Daily forage intake (g/rabbit)	197±0.22	197±0.32	198±0.15	0.623
Daily water intake (ml)	52.9±1.61[b]	41.8±2.31[c]	63.4±1.95[a]	0.0003
Daily forage waste (g/rabbit)	2.50±0.09[b]	3.00±1.26[a]	1.88±0.62[c]	0.0004
Daily concentrate waste (g/rabbit)	37.4±0.92[b]	41.6±1.45[a]	30.0±1.85[c]	0.0001

abc Means along the same row with similar superscripts are not significantly different (P>0.05)

Table 2 - Physiological responses of the experimental rabbits

Parameters	Ad lib feeding	Day feeding	Night feeding	P - value
Daily atmospheric temperature (OC)	27.5±3.31[a]	26.4±1.21[a]	24.8±1.39[b]	0.0004
Daily relative humidity (%)	77.5±3.31[a]	62.0±0.78[b]	75.1±1.21[a]	0.0001
Daily pulse rate (bpm)	62.7±0.14	62.2±0.53	63.9±0.35	0.546
Daily rectal temperature °C	35.5±0.11	35.9±0.21	36.7±0.42	0.002

[abc] Means along the same row with similar superscripts are not significantly different (P>0.05)

Table 3 - Carcass and relative organ weights of the experimental rabbits

Parameters	Ad lib feeding	Day feeding	Night feeding	*P*value
Live weight (g)	1576±53.4[a]	1483±51.2[b]	1621±63.3[a]	0.0002
Dressed weight (g)	1043±35.32	894±30.3	1083±36.7	0.0003
Dressing percentage (%)	66.2±6.47[a]	60.32±9.42[b]	66.8±3.97[a]	0.546
Organs weights (% of live weight)				
Lung	0.46±0.05[b]	0.43±0.03[b]	0.53±0.07[a]	0.0001
Heart	0.13±0.02[b]	0.16±0.03[a]	0.19±0.02[a]	0.0002
Kidney	0.64±0.18	0.61±0.21	0.66±0.05	0.002
Spleen	0.06±0.01	0.062±0.00	0.05±0.01	0.499
liver	3.34±0.24[a]	2.96±0.21[b]	3.76±0.77[a]	0.0003
Intestine	19.3±2.51	19.0±2.58	20.5±4.31	0.0004

[abc] Means along the same row with similar superscripts are not significantly different (P>0.05)

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There is increased activity, less stress and boredom unlike the experience during the day. When rabbits are bored, they express this by playing and scratching the cage and equipment therein and at times it can result in tipping off of the feeders thus leading to wastage. The daily atmospheric temperature was between 24.9°C and 27.5°C (Table 2). This is within the thermo-comfort zone of rabbits. Nguyen QuangSuc (1985) reported that the suitable ambient environment for rabbit production is a temperature range of 18-28°C. The relative humidity was generally high during the day and night.

The interaction between ambient temperature and relative humidity especially during the day might have an effect on feed intake and weight gain of the rabbits. There was no difference in pulse rate of rabbits on the feeding regime. Pulse rate obtained are ideal for rabbits and indicates that the rabbits were not under any stress. The pulse rate obtained were also lower than 101-147 beats per minute reported by Iyeghe – Erakpotobor et al. (2012) for rabbits raised under sub-humid tropical environment, and 137 cpm reported for Egyptian "Giza" rabbits (Fayez et al., 1994). The normal pulse rate observed also indicates that the interplay between ambient temperature and humidity in the study area did not constitute any form of stress to the rabbits.

Rectal temperature of the rabbits were also not affected (P>0.05) by feeding regime. This is expected because the environment during the study was close to the rabbit's thermo-comfort zone. Rectal temperature of 35.5- 36.7°C obtained in this study are lower than 39.4°C (Fayez et al 1994), 38.4- 39.3oC (Iyeghe-Erakpotoboret al 2012). Peter (1999) reported that at normal rectal temperature (comfort temperature); rabbits ingest approximately twice as much water as feed. This applies to the rabbits fed exclusively at night hours but offered only water during day. This argument is in line with the findings of Reddy (1999) who reported that a continuous supply of fresh, cool and clean water will be beneficial in reducing heat stress and that fresh, cool drinking water around 15°C increased feed intake by 5-10% compared with warm drinking water at around 29°C during heat stress. The observed slightly lower temperature at night which was close to thermo-neutral zone enhanced feed intake and growth of rabbits on night feeding. Feeding of rabbits during the night with supply of water during the day could find good application in areas where the ambient temperatures are high especially during the day by aiding to reduce heat stress through a reduction in heat increment of feeding.

Carcass and organ characteristics of rabbits fed at different period of the day as presented in Table 3 shows that the dressing percentage obtained for rabbits fed during the day (60.3) was lower (P<0.05) than 66.2% and 66.8% for the control and rabbits on night feeding respectively. All the values however compares favourably with 60.0 to 69.9 reported by Amaefule and Ironkwe (2002) and are higher than 52.0-55.5% reported by Iyeghe-Erakpotobor (2006) for rabbits fed concentrate and Stylosanthesverano 52.05-53.36% by Sobayo et al. (2008) on fermented maize gluten and 41.1–49.5% reported by Fayeye et al. (2000) for crossbred rabbits of New Zealand White, California and Chinchilla.

The values obtained for dressing percentage in this study are higher than 50-57% recommended by Aduku and Olukosi (1990) for rabbits under tropical conditions. The range of values reported for the heart (0.17 to 0.19) obtained in this study is lower than the values reported by Aduku and Olukosi (1990). Since the animals were fed the same diet though at different feeding regime in this study, it cannot be said that the differences in relative weights of the hearts is due to any incriminating factor resulting from feed. The relative weights of the liver shows differences between feeding regime with rabbits on the control and night feeding having higher weights (3.34 and 3.76 respectively) than those on day feeding (2.96). Sobayo et al. (2008) observed similar change in percentage liver of rabbits fed fermented maize gluten though there were no differences in heart proportions. Liver size is known to increase in response to several factors, especially deficiencies in protein and amino acids accumulation of fat (Velu *et al.* 1971), or presence of anti-nutritional factors (Aderemi, 2003). The differences observed in relative liver weights in this study however showed the liver to be directly proportional to the body weights of the rabbits. According to Butcher et al (1983), external and internal offal percentages tend to increase as slaughtered weight of the animal increase. This is similar to the report of Adeniji (2004) that the amount of viscera depends on body weight. However, the values obtained for kidney and spleen shows no significant differences.

CONCLUSION

From the results obtained in this study, it can be concluded that rabbits can be fed exclusively at night. This is for convenience as well as serves as encouragement for individuals with busy schedule during the day to keep rabbits. The reduction in feed wastage will lead to some cost savings thus improving the income accruable to the rearers.

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EFFECT OF FEEDING DIFFERENT LEVELS OF *Moringa Oleifera* LEAVES ON PERFORMANCE, HAEMATOLOGICAL, BIOCHEMICAL AND SOME PHYSIOLOGICAL PARAMETERS OF SUDAN NUBIAN GOATS

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ABSTRACT: The present study was designed to investigate the effects of feeding different levels of *Moringa oleifera* leaves on the performance, haematological, biochemical and some physiological parameters of Sudan Nubian goats on three different levels of *Moringa oleifera*, group A (0%) As control, group B offered (20%) and group C (50%) fed different levels of *Moringa oleifera* leaves. Thirty yearling females of Nubian goats weighted between 16.00 - 24.00 kg and their age was nearly 10 - 12 months were used in this study, the animals were divided according to their live body weight into three groups of ten each, goats were housed in pens of suitable size and were managed as any other commercial goat flock. The animals had free access to water. Forage was fed at rate of 1% of live body weight. They were fed for 6 weeks. The results showed a significant increase ($P<0.05$) on body weight in group B than the other two groups. Feed Conversion Ratio (FCR) was increased significantly ($P<0.05$) in group B and group C compared with group A. Whereas feed intake (kg/day) and Water intake (kg/day) were significantly higher ($P<0.05$) in group B than group A and C. There were the Body temperature (Tr), Respiratory Rate (RR) and Pulse rate (Pr) demonstrated significant ($P<0.05$) values in group B. On the Erythrocytes indices showed significant variations among the groups except Mean Corpuscular Hemoglobin Concentration (MCHC) in group B, which recorded high significant ($P<0.05$) in all indices of Erythrocytes when compared with the other two groups. In the other hand leukocytes indices have similar observations for all parameters except total white blood cells count (WBCs) which increased significantly ($P<0.05$) in group B (6.21 ± 0.14) than group C (4.77 ± 0.34) and group A (4.21 ± 0.09). Glucose decreased a significant different ($P<0.05$) in group B when comparable than other two groups, while Total protein and Albumin were recorded high significant different ($P<0.05$) values in group B; (7.71 ± 0.03) and Albumin (2.86 ± 0.10), respectively. When comparable than other two groups. Therefore, the study revealed that the *Moringa oleifera* leaf meal could be used to improve livestock system of small ruminants without any adverse effect on the productive performance and blood indices at the 20% diet inclusion level. However more research is needed to assure these findings.

Keywords: *Moringa oleifera* Leaves, Performance, Blood Hematology, Blood Biochemical, Physiological Parameters and Nubian Goats.

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INTRODUCTION

The livestock sector plays a significant economic role in most developing countries, and is essential for the food security of populations. The productivity of farm animals in most tropical countries is generally low, mainly due to poor quality and inadequacy of available feeds. Moreover, conventional feed resources (grains, cereals, legumes, etc.) for animal production are scarce and highly expensive in many parts of the world. Thus searching for alternative unconventional feed sources that may have valuable components of animal diets is indispensable. For instance, feeding by-products from agricultural and food processing industries to livestock can be one of the solutions (Negesse et al., 2009; Szumacher-Strabel et al., 2011; Zhou et al., 2012). Protein supplementation is often important to improve livestock performance, and this needs to be done with respect to the requirements of the animal in addition to the balance of other nutrients available. However, the prices of these protein sources have been escalating continuously in recent times, whilst availability is often erratic. The problem has been worsened due to the increasing competition between humans and livestock for these protein ingredients as food. According to Odunsi, (2003) the rapid growth of human and livestock population, which is creating increased needs for food and feed in the less developed countries, demand for an alternative feed resources must be identified and evaluated. The use of tree parts as alternative feed resources for ruminant livestock is becoming increasingly important in many parts of the tropics and sub-tropics (Silanikove, 2000; Melesse et al., 2009). Moringa trees are multi-purpose trees of economic importance with several industrial and feeding values.

According to Leng (1997), the poor condition of livestock in the tropics is more likely as a result of inefficient digestion in the rumen and inefficient utilization of the nutrients absorbed from low quality feeds. Several attempts which have been made to improve the nutritive quality of this class of livestock feeds include physical, chemical and biological treatments, use of feed additives as well as supplementation with non-protein nitrogen sources such as urea and molasses (Adegbola 2002). Alkali treatment of fibrous crop residues have been well researched and proven to increase the potential feeding value of crop residues (Preston and Leng, 1997). Moreover, the possibility of using urea as a cheap readily available source of nitrogen in ruminant diets led to the expectation of rapid improvement in ruminant productivity in developing countries. However for various reasons these technologies have

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not been widely adopted as expected and animal productivity is still poor (Owen and Jayasuriya 1989). The tree fodder are important source of high quality feed for grazing ruminants and as supplements to improve the productivity of herbivores on low quantity feeds. The tree fodder from part of the complex interaction between plants, animal and crops. The positive aspects of which help to balance a plant, animal, soil ecosystem and from which there is stable source of feed (Devendra, 1993). Moringa oleifera is a well known tree in West Africa especially in semi-arid areas where it is often cultivated as a living fence around people's gardens. Leaves of the tree are noted for high content of crude protein, essential vitamins, minerals and amino acids (Makkar and Becker 1997; Gidamis et al. 2003). However, according to Akinbamijo et al. (2004), the value of the tree and its benefits as a high-quality supplement to components at low-quality roughages in ruminant feeding systems have not been fully known nor widely exploited.

The use of fodder trees and shrubs to solve the problems of low productivity in small ruminant production has been reported by (Paterson et al., 1999; Makkar and Becker 1996; Aregheore, 2004). Some indigenous and a limited number of introduced species have been selected to serve as supplements to the low quality forage fed to these animals (Pezo et al., 1991). Most of the trials in the Humid Zone of West Africa (HZWA) conducted by the International Institute for Tropical Agriculture (IITA) and the International Livestock Centre for Africa (ILCA) involved Gliricidia sepium and Leucaena leucocephala which have shown benefits to crops production and animal improvement through alley farming and feed gardens. However, these species may have limitations in terms of productivity, palatability, presence of toxic substances and adaptability (Attah – Krah, and Reynolds, 1989; Akinbamijo et al., 2006). Also, the reluctance of smallholder farmers to adopt these tree species as supplements for small ruminant nutrition has necessitated the search for other tree species which may offer additional benefits. Moringa (Moringa oleifera Lamarck) is a slender, deciduous, perennial evergreen tree that originated in India but has spread to other regions of the world (Foidl et al., 2001). It is one of the fastest growing trees in the world with high biomass yield, high crude protein of + 25% and a balance of other nutrients in the leaves (Makkar and Becker, 1996, Foidl et al, 2001; Asaolu et al., 2010). Moringa provides food, medicine, fuel and other uses but it's potential as an important browse plant for small ruminants diet supplementation has not been fully documented (Gutteridge and Shelton, 1993; Anjorin et al., 2010). Moringa can thrive well in any region where the soil is not waterlogged (Asaolu et al., 2009). Its cultivation as human food and livestock feed in the Southern states has not been popular because information on the feeding value is scarce (Asaolu et al., 2010).

One way of utilizing fodder trees is to use them as feed to small ruminants as part of, or along with, Multi Nutrient Blocks (MNBs) (Sansoucy, 1995; Agbede and Aletor, 2004; Aye, 2007). MNBs create an effective ecosystem and increase intake and digestibility of low quality, high fiber grasses usually consumed by the small ruminants (Habib et al., 1991). *Moringa oleifera L*am (syns. Moringa pterygosperm, family Moringaceae), a non-leguminous multi-purpose tree, is one of the fastest growing trees in the world, with high crude protein in the leaves (> 20 %) (Makkar andBecker, 1996). Moringa is native to sub-Himalayan regions of India and is now naturalized in many countries in Africa, Arabia, Southeast Asia, Caribbean Islands and South America (Ramachandran et al., 1980). It offers a good alternative source of protein to humans and ruminants wherever they thrive (Nouala et al., 2006). Laboratory analysis (Makkar & Becker 1997; Asaolu, 2009) showed negligible amounts of tannins (1 to23 g/kg) in all fractions of the Moringa oleifera plant and high levels of sulphur-containing amino acids. There has been an increasing interest in the use of moringa as a protein source for livestock (Makkar & Becker, 1997; Sarwatt et al., 2004; Asaolu et al., 2009). Sarwatt et al. (2004) reported that moringa foliages are a potential inexpensive protein source for livestock feeding. The advantages of using moringa as a protein resource are numerous, and include the fact that it is a perennial plant that can be harvested several times in one growing season and also has the potential to reduce feed cost. Moringa can easily be established in the field, has good coppicing ability, as well as good potential for forage production. It can reach 12 m in height at maturity, yielding up to120 tones/ha/yr when planted very densely for use as forage (Makkar & Becker, 1997). Additionally, it is not affected by ant serious diseases in its native or introduced ranges (Parrotta, 2005).

Evaluation of the blood profile of animals may give some potentials of a dietary treatment to meet the metabolic needs of the animal since according to Church et al. (1984), dietary components have measurable effects on blood constituents such that significant changes in their values can be used to draw inference on the nutritive value of feeds offered to the animals. The assertion of Ikhimoya and Imasuen (2007) that most of the available information on haematological parameters of goats in the humid tropics is based on disease prognosis. The various functions of blood are made possible by the individual and collective actions of its constituents – the biochemical and haematological components. Generally, both the biochemical and haematological blood components are influenced by the quantity and quality of feed and also the level of anti-nutritional elements or factors present in the feed (Akinmutimi, 2004), including elements of toxicity. They can also be used to monitor protein quality of feeds. Haematological components of blood are also valuable in monitoring feed toxicity especially with feed constituents that affect the formation of blood (Oyawoye and Ogunkunle, 1998) and Abu et al. (1988) reported that low level haemoglobin (Hb) of treatment diets could imply that dietary proteins were not of high quality. Diets containing poor protein would usually result in poor transportation of oxygen from the respiratory organs to the peripheral tissues (Roberts et al., 2000). Reduction in the concentration of PCV in the blood usually suggests the presence of a toxic factor (e.g. haemagglutinin) which has adverse effect on blood formation (Oyawoye and Ogunkunle, 1998). High WBC count is usually associated with microbial infection or the presence of foreign body or antigen in the circulating system. The haematological characteristics of livestock suggest their physiological disposition to the plane of nutrition (Madubuike and Ekenyem, 2006). Reductions in packed cell volume and red blood cell values are indicative of low protein intake or mild anemi (Lindsay, 1977). Blood chemistry constituents

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reflect the physiological responsiveness of the animal to its internal and external environments which include feed and feeding (Esonu et al., 2001; Iheukwumere and Okoli, 2002). Blood chemistry studies are usually undertaken to establish the diagnostic baselines of blood characteristics for routine management practices of farm animals (Tambuwal et al., 2002; Onyeyilli et al., 1992.; Aba-Adulugba and Joshua, 1990). The hematopoietic system is an important index of physiological and pathological status in animals and humans (Harper, 1973), since it is the one which becomes exposed to a high concentration of toxic agents first. Total serum protein has been reported as an indication of the protein retained in the animal body (Akinola and Abiola, 1991, Esonu et al., 2001), while total blood protein depend on the quantity and quality of dietary protein (Eggum, 1970). Normal range of blood sugar level indicates that animals are not surviving at the expense of body tissues (Ologhobo et al., 1992). Frandson, (1986) reported that the number of neutrophils in the blood increases rapidly when acute infection is present, hence a blood count showing this increase is useful in diagnosis of infections. He reported further that eosinophils which normally are scarce increase in numbers in certain chronic diseases, such as infection with parasites and also in allergic reactions.

The aims of this study are to evaluate the feed value of *Moringa oleifera* leaves as feed supplements for small ruminant and to evaluate its effects on some physiological parameters, Hematological indices (Erythrocytes and leukocytes indices) and some blood metabolism profile of Nubian goats in White Nile State, Sudan.

MATERIALS AND METHODS

Animals and experimental design

Thirty yearling (10 – 12 month) females of Nubian goats their body weight was from 16.00 to 24.00 kg were used in this study. The animals were purchased from local small ruminant market in Maatog near Eldweem city (Latitudes 130 and 290 North, Longitudes 200 and 320 East); they bear the typical characteristic of the indigenous Nubian breed. They were deep lopping ears and short tapering tail. The coat color was black. The animals were housed in un-shaded goat's pen; at the Faculty of Science, University of Bakht Alruda. For two week to adapt period to the compared of the study.

The animals were dosed with Ivermectin against endoparasite and Ectoparasite animals; 0.2ml per/kg body weight; with drawl period. The animals were then divided at three groups each of ten animals according to their live weight. first groups range was weight 16.44 kg; used as control (zero Moringa leave fed). The second group was 16.90 and the 3rd group was 16.00 kg; they fed different levels of *Moringa oleifera* leaves (0%, 20% and 50%; respectively).The period of this study was 45 days.

Ingredients and Chemical analyses:-

The animals were fed according to relevant standards for the group. The rations were offered add libitum throughout the experimental period. Composition (%) of the Experimental ration fed to Nubian goats different levels of *Moringa oleifera* leaves, where the moringa leaves were modify with sorghum hay as complementary ingredients up to 100 %; as Described below:

Group A: Moringa leaves 0% + Sorghum Hay 54%.

Group B: Moringa leaves 20% + Sorghum Hay 34%.

Group C: Moringa leaves 50% + Sorghum Hay 4%.

The Chemical compositions of ingredients were derived from FAO's Animal Feed Resources Information System (1991-2002) and from Bo Gohl's Tropical Feeds (1976-1982) as shown in table (2).

Experimental feeds procurement and processing:-

Fresh leaves were harvested from available trees regardless of tree age, from the Faculty of Science farm, University of Bakht Alruda on April 2013 in dry season and the leaves were trimmed from its twigs on a plastic sheet. The trimmed leaves were then finally spread thinly on plastic sheet under shade for 72 hrs and mixed regularly to ensure uniform drying for safe storage. The air dried moringa leaves were finally transported to the experimental site, where the mean ambient temperature was raining between 25^{o}C and 39^{o}C.

Feedlot performance:

Body weight

The animals were weighed firstly and weekly until the end of the six week, and weighed at the end of the experiment. The animals were weighed individually by the pan balance.

Feed Intake and water Intake

Feed and water were offered approximately at the same time in the morning (09.00 hr). The food offered was weighed in a single pan balance - to the nearest 100g. The food and water was offered in the fodder basins and the remaining amounts from the previous day were measured, so that the amounts of food and water consumed were determined.

Body temperature, Respiratory Rate and Pulsed rate:

Measurements of rectal temperature (Tr), respiration rate (RR) and pulse rate (Pr) were recorded daily in the morning (09.30 hr) before feeding. Tr was measured to the nearest 0.1 ^{0}C using a clinical thermometer inserted

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into the rectum for 1 min. RR was measured by counting the flank movements for 1min. Pr was measured by hand femoral vein for 1 min.

Blood collection and analyses

Blood was collected from the jugular vein of the experimental animals at the first of study, and at the end of termination of the experiment (At the six week before feeding at 09.30 hr) in a vial containing ethylene diamine tetra-acetic acid (EDTA). 5ml of whole blood was collected aseptically from the jugular vein using disposable needles 2ml of the blood in EDTA containing vacutainer tubes (BDvacutainer, Bell industrial Estate, plymouth, Uk) the remands was placed in plain tube for serum analyses. The EDTA tubes were immediately capped and the content was mixed gently for a period of one minute by repeated inversion or rocking. Blood samples were analyzed immediately after collection for packed cell volume (PCV) and haemoglobin (Hb) concentration as described by Benson et al., (1989) and Jain, (1993). Red Blood Cells (RBCs), White Blood Cells (WBCs) as well as the differential WBC counts were determined using the Neubauer haemocytometer after appropriate dilution (Lamb, 1981). Values for the constants: Mean Corpuscular Haemoglobin Concentration (MCHC), Mean Corpuscular Haemoglobin (MCH) and Mean Corpuscular Volume (MCV) were calculated from RBC, Hb and PCV values as described by (Simon and Casmir 2001).

Serum was obtained by allowing the blood to clot in room temperature for 2 hours, centrifuged, and collected into plain sealed tube and then stored at -20 ^{0}C until analyzed. Serum total protein was determined by the biuret reagent method according to King and Wooton (1965), Albumin was determined as described by Toro and Ackermann (1975). **BCG method:** Plasma Glucose level was determined by Enzymatic, calorimetric, GOD-PAP method according to Trinder, (1969).

Statistical analysis:-

The data obtained from the growth performance and blood samples collected from the Nubian goats fed different levels of *Moringa oleifera* leaves (0%, 20% and 50%), had been subjected to standard methods of statistical analysis was performed using windows based SPSS (Version 16.0, 2007). The analysis of variance (ANOVA) test was used and Statistical significance was considered when $P<0.05$.

RESULTS

Chemical composition of the experimental feeds:-

The chemical composition of feeds used in this experiment is shown in Table 2. The Crude Protein content of *Moringa oleifera* leaves was high (20.9%) compared with Sorghum leaves (7.5%) also Crude fiber was low in *Moringa oleifera* (18.5%) leaves than Sorghum leaves (32.3%). The neutral detergent fiber (NDF) (28.5%) and acid detergent fiber (ADF) (18.1%) contents of *Moringa oleifera* leaves were very low compared as that of Sorghum leaves (68.7%), (44.0%) respectively.

Feedlot performance of Nubian goats fed different levels of *Moringa oleifera* leaves:-

Effects of feeding different levels of *Moringa oleifera* leaves three levels on the performance of Sudan Nubian goats on group A as control (0%) Moringa leaves; group B and group C fed *Moringa oleifera* leaves (20% and 50%, respectively). As shown in Table 3 a significant improvement ($P<0.05$) of body weight was noted at the end of experiment in group B than the other groups and has been observed from week 3 to week 6 as shown in (Figure 1). Total gain (kg) and Average daily gain (kg) increased significantly ($P<0.05$) in group B when compared with group A and C. Feed conversion ratio (FCR) increased significantly ($P<0.05$) in group B than group A and C. Feed intake (kg/day) and Water intake (kg/day) were significantly higher ($P<0.05$) in group B than group A and C.

Body temperature (Tr), Respiratory Rate (RR) and Pulsed rate (Pr) of Nubian goats fed different levels of *Moringa oleifera* leaves:-

Body temperature (Tr), Respiratory Rate (RR) and Pulse rate (Pr) demonstrated high significant ($P<0.05$) values in group B than the control group and group C; (39.18 ± 1.27oc), (18.83 ± 0.14beats/minute) and (78.32 ± 0.27beats/minute), respectively, as shown in Table 4.

Blood constituents of Nubian goats fed different levels of *Moringa oleifera* leaves:-

Blood constituents changes in the composition of Nubian goats fed different levels of Moringa oleifera leaves meal based diet for 6 weeks is presented in Tables 5, 6 and 7.

Erythrocytes indices: All parameters showed significant variations among the groups except Mean Corpuscular Hemoglobin Concentration (MCHC) in group B, which showed high significant ($P<0.05$) when observed with other two groups (Table 5).

Leukocytes indices: Similar observations have been seen in all parameters except total white blood cells count (WBCs) which increased significantly ($P<0.05$) in group B (6.21 ± 0.14) than group C (4.77 ± 034) and group A (4.21 ± 0.09).

Glucose decreased significantly ($P<0.05$) in group B when compared with other two groups (A and B), while T. protein and Albumin recorded higher significant ($P<0.05$) values in group B when compared with group A and C; (7.71 ± 0.03) for T. protein and (2.86 ± 0.10) for Albumin.

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Table 1 - Percentage of the Ingredient compounds of the diets.

Ingredients (%)	Group A (0%)	Group B (20%)	Group C (50%)
Moringa oleifera leaves	0	20	50
Sorghum leaves	54	34	4
Sorghum Grain	5	5	5
Groundnut Cake	20	20	20
Groundnut Hay	20	20	20
Common Salt	1	1	1

Table 2 - Chemical composition of the experimental diets.

Main analysis (% DM)	*Moringa oleifera* leaves	Groundnut Cake	Groundnut Hay	Sorghum Hay	Sorghum Grain
Dry matter (% as fed)	42.7	91.3	89.4	90.0	87.4
Crude protein	20.9	11.2	14.6	7.5	10.8
Crude fiber	18.5	33.6	27.1	32.3	2.8
NDF	28.5	51.8	45.1	68.7	11.0
ADF	18.1	43.8	37.1	44.0	4.3
Lignin	7.0	10.2	6.5	6.2	1.1
Ether extract	3.8	1.6	2.3	1.4	3.4
Ash	10.5	1.1	8.7	8.8	2.1
Gross energy	18.2	10.3	18.4	17.9	74.5
Calcium (g/kg DM)	26.4	11.0	21.7	1.8	0.3
Phosphorus (g/kg DM)	2.6	1.5	4.9	1.7	3.3

The contents of this table are currently derived from FAO's Animal Feed Resources Information System (1991-2002) and from Bo Gohl's Tropical Feeds (1976-1982); Last updated on 24/10/2012; From (http://www.feedipedia.org/content/feeds); DM = dry matter; NDF = neutral detergent fiber; ADF = acid detergent fiber.

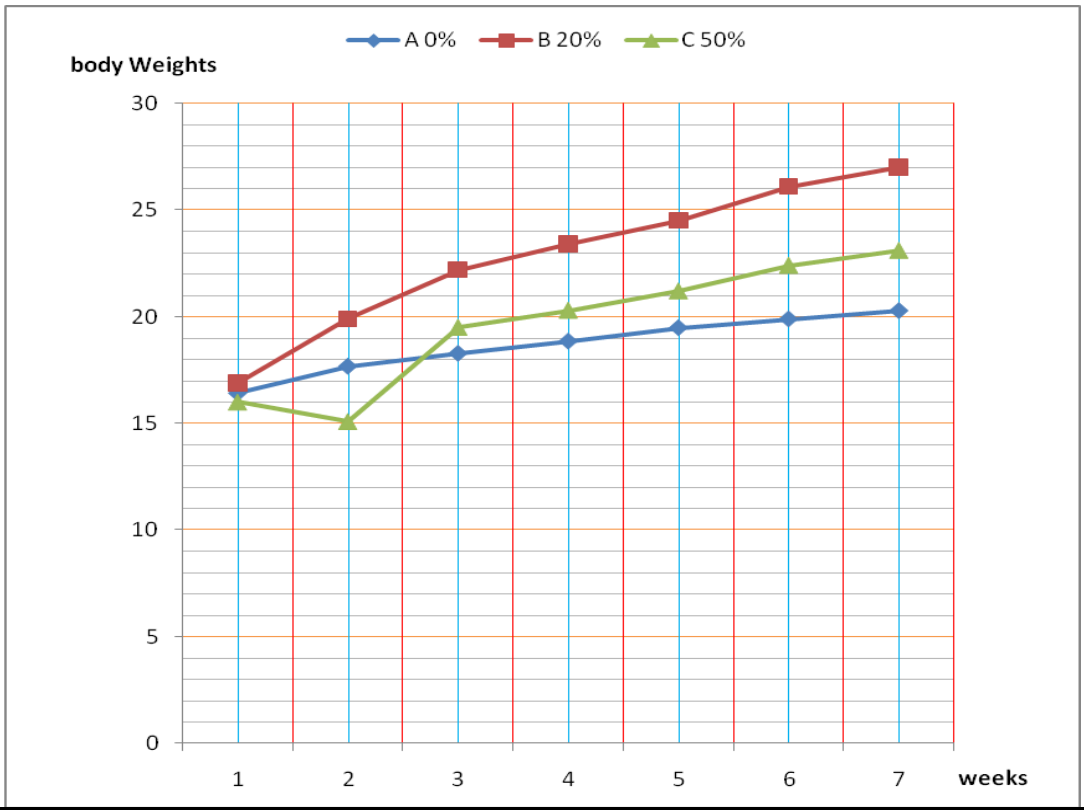

Figure 1 - Indicates the increasing of weekly body weight of Nubian goats fed different levels of *Moringa oleifera* leaves. The body weight has noted the increase significant on the (3,4,5 and 6) weeks in the study in all the groups, where the group (B) recorded high significant difference (P<0.05), compared with the other two groups (A and C).

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Table 3 - Overall performance of Nubian goats as affected by graded levels of Moringa oleifera leaves.

Parameter	Moringa 0%	Moringa 20%	Moringa 50%
Experimental period (days)	45	45	45
Number of animals	10	10	10
Initial weight, kg	16.44 ± 2.06	16.90 ± 0.66	16.00 ± 0.92
Final weight, kg	20.30 ± 2.17 a	27.00 ± 0.78 b	23.10 ± 1.00a
Total gain, kg	3.86 ± 0.17 a	10.10 ± 0.27 b	7.10 ± 0.60 c
Average daily gain, kg	0.08 ± 0.004 a	0.22 ± 0.006 b	0.15 ± 0.014 c
Feed intake(DMI), kg/day	0.30 ± 0.01a	1.58 ± 0.02 b	1.01 ± 0.02c
Feed conversion ratio (FCR)	3.75 ± 0.67 a	7.18 ± 0.24 b	6.73 ± 0.46 b
Water intake, kg/day	1.13 ± 0.02 a	1.46 ± 0.03 b	1.31 ± 0.03c
Kg water intake DMI	0.87 ± 0.01a	0.93 ± 0.02 a	1.30 ± 0.03 b

[a,b,c] means along the same row with different superscripts are significantly different from each other. (P<0.05).

Table 4 - The means and standard errors of some physiological parameters as affected by dietary intake of *Moringa oleifera* leaves.

Parameter	Moringa 0%	Moringa 20%	Moringa 50%
Rectal temperature (Tr) °c	38.59 ± 0.37[a]	39.18 ± 1.27[b]	38.87 ± 0.39[b]
Respiratory rate (RR) beats/minutes	16.38 ± 0.21[a]	18.83 ± 0.14[b]	16.34 ± 0.23[a]
Pulsed rate (Pr) beats/minutes	74.38 ± 0.29[a]	78.32 ± 0.27[b]	75.12 ± 0.29[a]

[a,b] means in the same row with different superscripts are significantly different from each other (P<0.05).

Table 5 - The means and standard errors of Erythrocyte indices as affected by dietary intake of *Moringa oleifera* leaves.

Indices	Moringa 0%	Moringa 20%	Moringa 50%
RBCs. (×10^6/ µL)	11.19 ±0.08[a]	13.33 ± 0.14[b]	11.85 ± 0.16[c]
Hemoglobin (g/dl)	8.32 ± 0.03[a]	10.46 ± 0.09[b]	9.21 ± 0.15[c]
PCV (%)	23.60 ± 0.37[a]	31.50 ± 1.09[b]	26.80 ± 0.77[c]
MCV (fl)	21.14 ± 0.44[a]	23.53 ± 0.67[b]	22.56 ± 0.53[b]
MCH (pg)	7.35 ± 0.07[a]	7.80 ± 0.05[b]	7.64 ± 0.11[b]
MCHC (g/dl)	35.27 ± 0.64	34.21 ± 0.99	34.41 ± 0.64

[a,b,c] means along the same row with different superscripts are significantly different from as before (P<0.05).

Table 6 - The means and standard errors of leukocytes Indices of Nubian goats as affected by dietary intake of Moringa oleifera leaves.

Indices	Moringa 0%	Moringa 20%	Moringa 50%
Total WBCs (×10^3/ µL)	4.21 ± 0.09[a]	6.21 ± 0.14[b]	4.77 ± 034[c]
Lymphocytes (%)	55.40 ± 1.27	55.70 ± 0.78	55.30 ± 0.65
Neutrophils (%)	35.90 ± 1.38	35.80 ± 0.83	36.30 ± 0.62
Monocytes (%)	2.39 ± 0.45	1.80 ± 0.42	2.20 ± 0.47
Eosinophils (%)	5.90 ± 0.28	5.90 ± 0.23	5.80 ± 0.33
Basophils (%)	0.50 ± 0.17	0.70 ± 0.21	0.40 ± 0.16

[a,b,c] means along the same row with different superscripts are significantly different from as before. (P<0.05).

Table 7 - The means and standard errors of some plasma constituents as affected by dietary intake of Moringa oleifera leaves.

Parameter	Moringa 0%	Moringa 20%	Moringa 50%
Glucose (mg/dl)	78.80 ± 1.5[a]	60.60 ± 0.76[b]	75.80 ± 1.69[a]
Total protein (g/dl)	6.57 ± 0.55[a]	7.71 ± 0.03[b]	6.93 ± 0.14[c]
Albumin (g/dl)	2.16 ± 0.30[a]	2.86 ± 0.10[b]	2.53 ± 0.12[c]

[a,b,c] means along the same row with different superscripts are significantly different from each other. (P<0.05).

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DISCUSTION

The tree, *M. oleifera* (Moringaceae), is cultivated widely all over the world (Odee, 1998; Jed and Fahey, 2008) and used for various purposes, one of which is as a feed supplement to livestock (Martin, 2007; Fadiyimu et al., 2010). In this study, Nubian goats were used to test the different levels of *Moringa oleifera* leaves (0%, 20% and 50%) via its effect on the animals' body weights as well as on blood parameters.

Composition (%) of the Experimental ration fed to Nubian goats different levels of *Moringa oleifera* leaves, where the moringa leaves were added with sorghum leaves as a complementary ingredients up to 100 %; the chemical composition of feeds used in this experiment was shown in Table 2. The Crude Protein (CP) content of moringa leaves were high compared to Sorghum Hay and the Crude fiber was low in moringa leaves than Sorghum Hay. The NDF and ADF contents of moringa leaves were very low compared to that of Sorghum Hay. But calcium contents were higher in *M. oleifera* leaves (26.4 g/kg DM) in comparison to the Sorghum leaves (1.8 g/kg DM). As mixing of moringa leaves with other fodders can also contribute towards better livestock performance and good-quality products. It was reported that the mixing of M. stenopetala leaves with grass improved DMI, body weight, and nitrogen retention capacity in male sheep (Gebregiorgis et al., 2012). The crude protein of *Moringa oleifera* has been reported by (Becker, 1995) to be of better quality for ruminants because of its high content of by-pass protein. Higher proportions of by-pass protein have been also reported to result in faster weight gains in livestock (McNeill et al., 1998).

The results on Table 3 showed the dry matter intake as percent (DMI kg/day) of body weight (BWT) were higher for the group B (1.58± 0.02) than groups A (0.30 ± 0.01) and C (1.01± 0.02), respectively. Although, there is significant difference between the three groups, the results were in agreement with the finding of Alan (1988), who noted that for the same breed the DMI% of body weight ranged between 3-5% of BWT. However, the obtained results were higher than that reported by Charray et al. (1992) who mentioned that the DMI% were 2.5% of BWT for Nubian goats. The findings of the weight gain in this study were significantly higher for group B (10.10 ± 0.27g/day) than groups A (3.86 ± 0.17g/day) and C (7.10 ± 0.60g/day), respectively. The highest body weight gain of goats in group B support earlier findings that *M. oleifera* is of a high nutritional value (Ram, 1994; Makkar and Becker, 1996; Anwar et al., 2007). Increase in the body weight of the goats in current study might be due to the fact that *M. oleifera* is rich in amino acids, vitamins and minerals particularly iron (Subadra et al., 1997; Faye, 2011). However, all in best the significant increase of body weight and is captivity, were the energy expenditure is minimal (Fadi et al., 2010).

The feed conversion ratio values was 3.75 for (control) obtained in this study was similar to 2.63- 4.00 reported by earlier researchers in the tropics (Ayers et al., 1996; Okorie, 2003), 7.18 (group B) and 6.73 (group C) - Table 3. Were higher than the 2.63- 4.00 but they were generally better than that of 5.32 – 5.63 as reported by Eustace et al. (2003). Generally poor FCRs obtained were probably due to the relatively low growth rates. Genetic values might have also contributed to the lower FCRs values recorded (Ayers et al., 1996; Okorie, 2003). Murro et al. (2003) reported that *Moringa oleifera* dried leaves 20% of total diet Growing sheep and goats, 20% improvement in growth rate but poorer feed conversion.

The physiological parameters of the Nubian goats are shown in Table 4. The Mean rectal temperature were significantly ($P<0.05$) different from each other in groups. The rectal temperature was constant and fell within the normal range for sheep and goats (32.60 ^{0}C to 39.60 ^{0}C); (Aye, 2007). The mean respiratory values were significantly ($P<0.05$) different from each other in groups. (16.38 ± 0.21) in group A and (18.83 ± 0.14), (16.34 ± 0.23) in group B and C, respectively. The mean pulse rates were significantly ($P<0.05$) different from each other in groups (A, C and B). The pulse rates fall within normal range reported as 70 - 90 pulse/minute for sheep and goats (Kaushish, 2010). The highest values of these physiological parameters was only notes in group B, this could be attributed to that *M. oleifera* is of high and better nutritional value as signs of health and more productive animals (Anwar et al., 2007; Ikhimioya and Imasuen, 2007 and Addass et al., 2010).

Table 5, indicates the Erythrocyte Indices of Nubian goats fed different levels of *Moringa oleifera* leaves. Past reports revealed that haematological constituents are always a reflection of animals responsiveness to their initial and external environment (Isikwenu et al., 2012), hence this constituents are important in diagnosing the functional status of an exposed animal to suspected toxicant. All parameters showed significant variations among the groups except (MCHC) in group B, which they marked high significant ($P<0.05$) in all indices of Erythrocytes when compared to other two groups (A and C). Red Blood Cell (RBCs) counts were also high and followed a trend similar to that observed for Hb; indicating that none of the *Moringa oleifera* leaves supplements has effected on a resulted of hemoglobin, they have been described by Foster and Smith (2011), final higher RBC values, as observed for animals on *Moringa oleifera* leaves supplementation, had been attributed in some earlier studies to a higher plane of nutrition. The highest RBCs recorded in group B corresponded with the highest values of PCV and Hb concentration observed in group B, suggesting their superiority in terms of their capability of supporting high oxygen carrying capacity of the blood, also Foster and Smith (2011) reported that physiological stress free and absence of anemia related diseases which might be due to iron deficiency. The obtained RBC, Hb and PCV values in this study were similar to their values obtained by Okoruwa et al. (2013). West African dwarf bucks fed *pannisetum purpureum* and *unripe plantain* peels. However The obtained Hb values of 8.32, 10.46 and 9.21 g dL-1 for group A, B and C respectively, fell within the normal range values (7.00 to 15. 00 g dL-1) as reported by Tambuwal et al. (2002) for WAD goats and Sudanese goats by (Babeker and Elmansoury, 2013), the increase of Hb in this study would have translated to an advantage in favor of the animals on *Moringa oleifera* leaves supplementation. Such an observation was regarded by Opara et al. (2010) as an advantage in terms of the blood's oxygen-carrying

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capacity. A deficiency of haemoglobin in the red blood cells decreases blood oxygen-carrying capacity, leading to symptoms of anemia (Aaron et al., 2003). The PCV was significantly high (P<0.05) in group B (31.50 ± 1.09) and (23.60 ± 0.37), (26.80 ± 0.77) in groups A and C, respectively. The observed PCV values fell within the range of 21.0-36.9% reported for clinically-healthy WAD goats (Taiwo and Ogunsanmi, 2003; Daramola et al., 2005). It should be noted that only *Moringa oleifera* dried leaves supplementation resulted in a significant (P<0.05) increase in PCV at the end of the study; suggesting that *Moringa oleifera* dried leave offered the grazing animals a better plane of nutrition. Such high PCV values have been regarded (Addass et al., 2010) as signs of healthy and high productive animals. Ikhimioya and Imasuen, (2007), reported that only goats on *Moringa oleifera* dried leaves supplementation could probably have a high tendency for a return of PCV to normal level following an infection through compensatory accelerated production; as they were the only animals with PCV value above 32% documented by Frandson, (1974) to be normal for circulatory system in goats. The mean corpuscular haemoglobin (MCH) and mean corpuscular volume (MCV) was not significantly (P<0.05) different from diet B and C. But diet A was significantly (P<0.05) lower than diets B and C. The mean corpuscular haemoglobin concentration (MCHC) were not significantly different (P<0.05) among all the groups, but the MCV and MCH were significantly (P<0.05), different from groups B and C when comparable with group A, respectively. The MCHC was not significantly (P<0.05) different from each other in groups.

Table (6), represent the leukocyte Indices of Nubian goats fed varying levels of *Moringa oleifera* leaves. The total white blood cells (TWBCs) was significantly (P<0.05) high in diet B (6.21± 0.14 x103/µ) when compared with diet C (4.77± 0.03 x103/µ) and A (4.21± 0.09 x103/µ), respectively. This results means that goats on diets B remained healthy, because the number of TWBC counts on the normal range. Konlan et al., (2012) reported that WBC offer explanation for defense mechanism of animal. Also the obtained WBC values are within earlier reported ranges for WAD goats (Daramola et al., 2005) and Sudanese goats by (Babeker and Elmansoury, 2013). West African Dwarf goats seem to possess protective system, providing a potent and rapid defense against any infectious agent and this is probably the physiological basis for the adaptation of this species to this ecological zone characterized by high prevalence of diseases (Opara et al., 2010). White blood cell differentional, lymphocyte, neutrophils, monocyte, eosinophils and basophils were not significantly different among all groups.

The result on table (7) shows the examination of some biochemical indicators contributes to the knowledge of metabolic profiles in feedlots performance of Nubian goats and their possible disorders, whether of a latent or clinical nature. The concentration of glucose determined in this study was decreased significantly in group B (60.60 ± 0.76 mg/dl) when compared with groups A (78.80 ± 1.50mg/dl) and group C (75.80 ± 1.69 mg/dl), respectively. The present glucose value was in agreement with that and the normal range (50-75mg/dl) of goats, which reported by Dhanotiya (2004). However, they were higher than those obtained by (Babeker and Elmansoury, 2013) 65.20 mg/dl and Turner et al., (2005) 66.3 mg/dl; this difference may be attributed to the difference in breed, age or feed consumed; (Mbass and Poulsen, 1991). Since the levels were within the variation range (50-75mg/dl) indicated for healthy goats (Zubcic, 2001; Dhanotiya, 2004), it thus appears plausible to infer that the observed depressed serum glucose in group B is not due to Moringa leaf meal intoxication, but that the dietary energy was sufficiently utilized for growth and the animals were not surviving at the expense of body tissues (Ologhobo et al., 1992). The low glucose level observed indicates that it is suitable for human diabetic consumption, as the presence of flavonoid also correlates with the reports of (Farooq et al., 2007) who stated that the *M. oleifera* plant is one of the highly potential antidiabetic plants, probably because of the presence of the ability of its compounds and some flavonoids to inhibit a-amlylase activity to regulate the amount of glucose in the blood.

The concentration of the total protein and albumin reported in this study was significantly difference between all the groups. These results were comparable to the normal range of goats (6.4-7g/dl) reported by Dhanotiya (2004). However, the present results were lower than (9.8 g/dl) reported by Ibrahim et al., (2005) and (7.48 g/dl) reported by Zubcic (2001). This is differences may be due to the influence of breed, age or feed of these goats (Mbassa and Poulsen, 1991). Also the results of albumin on the normal range (2.7-3.9g/dl), which reported by Dhanotiya, 2004), (3.3 .5g/dl) reported by Ibrahim et al., (2005) and (3.3 +6.1g/dl) noted by Zubcic; (2001). The superior values obtained for the diet of group B show that the high level of total protein and albumin is safe and beneficial, and not detrimental, because the levels of some chemical composition of moringa leaves are beneficial as they impact some qualities of rumen undegradable protein, thus improving protein availability and utilization (Garg et al., 1992). Moringa leaves are also a good protein source that is a convenient substitute of some meals (soybean and rapeseed) for ruminants, and they are able to improve the microbial protein synthesis in the rumen (Soliva et al., 2005).

Conclusion

Moringa can help small and medium-scale farmers overcome shortages of good quality feeds and therefore sustain and improve their livestock productivity. The results of this study recorded that supplementation of *Moringa oleifera* leaves 20% – based multi nutrient blocks in small ruminants' diet is rapid growth performance and facing death challenges to the animals. Under Tropical Dry season conditions and when phosphorus and potassium are available in the soil, Moringa can maintain high biomass yield over time but this requires nitrogen to be supplied in sufficient amounts to cover that removed at harvest. *Moringa oleifera* leaves supplementation offered grazing Nubian goats a better plane of nutrition relative to the two reference supplements, thereby supporting higher growth rates. The hematological indices indicate that the animals on *Moringa oleifera* leaves supplementation 20% were healthier and with a greater capacity to return to normal health following an infection. An adoption of the *Moringa oleifera* leaves technology by small ruminant keepers in the tropics could therefore be a panacea to the

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nutritional and health hardships faced by the animals during the usually long dry season. Based on the result of this present study most hematological and biochemical values obtained were within the normal range reported for goats. The use of varying levels of *Moringa oleifera* leaves 20% in this study have demonstrated to be potential sources of readily available energy and protein that would go along way infilling feed shortage gaps without any adverse effect on the Nubian goats. The responses in terms of energy utilization and hematological traits by Nubian goats proved to be more effective and efficient in diet B compared to diets A and C.

Recommendations:

1- Research to support improved production techniques of the moringa plant is, however, needed to enable farmers produce the meal at dry season at lower cost for economic use in animal feeding.

2- Moringa leaves meal is non-toxic to goats at least at the level of 20%.

3- Moringa leaf meal could be used to improve daily weight gain, body weight and dry matter intake (DMI) of small ruminants at the 20% diet inclusion level.

4- Moringa leaves meal (MOLM) has the potential to decrease glucose level in goats blood plasma.

5- The results of this study clearly show that supplementation of *Moringa oleifera* –based multi nutrient blocks in small ruminants' diet can enhance better performance and pose no health challenges to the animals. *Moringa oleifera* compares favorably with Groundnut Hay and sorghum Hay nutritionally and can enhance the performance of goats as protein supplements in white Nile state in Sudan.

6- Moringa leaves meal (MOLM) has the potential to evaluate some blood parameters in goats such as haemoglobin, haematocrit, White blood cells and Red blood cells.

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A STUDY OF MANAGEMENT, HUSBANDRY PRACTICES AND PRODUCTION CONSTRAINTS OF CROSS-BREED DAIRY CATTLE IN SOUTH DARFUR STATE, SUDAN

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ABSTRACT*:* The present work was prepared to evaluate the management applied, husbandry practices and the constraints facing crossbreed dairy cattle owners in South Darfur state, Sudan. Structured questionnaire was designed to collect the data, and the analysis was performed using frequencies and descriptive statistics. The results showed that graduated persons among dairy farm owners in Mossay district represent the majority (35%) then those of higher secondary certificate (25%) and those passing the intermediate school were (10%) where the rest of the producers were illiterate (5%). It was found that crossbreed dairy farms in Mossay district was established during few last years; (55%) of the producer established their farms in a period more than 10 years, while 40% of the respondent claimed that they started investment in milk production in a period ranging between 3-8 years, only 5% of the herd owners replied that they involved in milk production. The results revealed that dairy farms in Mossay district were constructed from different materials, but the majority of the dairy farms (55%) were constructed from constant materials (bricks, iron and cement) while (20%) were made of local materials and (5%) prepared from both constant and local materials. Only (50%) of the dairy herd owners replied that they are using records while some (45%) did not keep records. The period extends between (April to June) represents the summit of forage shortage (45%), then the period between March-June (10%). It was noticed that dairy herd owners preparing their rations adding salts from different sources; (60%) add salt in a form of (Sodium chloride + licking stone), (35%) use (licking stone) and 5% add only (sodium chloride). Constraints facing the dairy herd owners in Mossay district found to be varying;(20%) of the respondents mentioned that prevalence of diseases was the major obstacle, (15%) said that feeding cost was the production limiting factors, whereas, (10%) claimed that (insecurity, water and power shortage) were the main constraints. Also, the results indicated that (60%) of the producers had high desire to continue investing in dairy production, some (15%) had a moderate desire however, a few (5%) had a weak desire and intending to change their activities. Concerning the husbandry practices; (25%) of dairy farm owners practiced dehorning, where, (15%) used identification (ear tags), also, (15%) of them practiced (dehorning + hooves care), on the other hand, (5%) of the respondents replied they did not adopt any husbandry practice. Fortunately, (90%) of respondents checked their cattle monthly and only (5%) did not check their animals regularly. According to the present findings, it is clearly ;dairy cattle owners at Mossay district need immediate and intensive extension programs to help them improving herd management and adopting ideal husbandry practices.

Keywords: Management, Husbandry Practice, Constraints, Crossbreed, Dairy Cattle, South Darfur, Sudan.

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INTRODUCTION

Milk plays a major contribution to human diet in many countries worldwide, and cattle are considered as the main producing source (Eltaher, 2010). However, milk not only meets 25% of a pastoral family's caloric requirements in South Darfur, but also has an important exchange value, (Kerven, 1986). According to (MARF, 2012), cattle population in Sudan estimated to be about 29, 84000 heads which produce more than (2,776,000) tons of milk. Generally, in Sudan milk production relay mostly on traditional sector which produces more than 80% of the raw milk, (Elzubier and Mahala, 2011). Moreover, the indigenous cattle breeds in Sudan particularly (Butana and Kenana) provide the majority of milk supply for domestic consumption beside their adaptability and the ability to withstand the inconvenient and adverse environmental conditions and resistance of endemic diseases. Those dairy breeds under improved management at the research stations can produce more than 1500 kg /lactation (El-Habeeb, 1991) and (Musa et al., 2005).

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However, still the milk produced from the indigenous dairy breeds do not fill the gap of raw milk shortage, therefore, efforts have been directed towards increase production(genetic improvement)of indigenous dairy cattle through cross breeding. Nowadays, in South Darfur state (particularly Nyala City) it is a common practice using crosses of local breeds with exotic high milking breeds to meet the continuous milk demand of Nyala city which witnessed heavy migration last decade due to the conflicts and tribal wars. It's well known that these crosses produce and reproduce better than local types, (McDowell, 1985). Really, these dairy farms that concentrated in Mossay district (just 9 kilometer Southern-East to Nyala) have provided more than 90% of total milk demand of the area. Before establishment of these dairy farms; Nyala milk supply comes from the adjacent village herds (Bulbul and Kass, about 60 and 100 kg respectively, Western Nyala) which always associated with some shortcomings such as improper handling and risk of chemical preservatives added to the milk to avoid spoilage during the transportation. Unfortunately, the nutritional system, husbandry practices and the level of management in these dairy farms were not subjected to any sort of evaluation and investigation, therefore, the present study was prepared to study the management and husbandry practice adopted in attempt to suggest solutions to the constraints.

MATERIAL AND METHODS

The present study was conducted in Mossay district, which is located about (9 kilometers Southern-East to Nyala), in South Darfur state-Sudan. This area is a center gathering many dairy farms using high yielding crossbreed dairy cattle. These dairy farms established 20 years ago and contributed effectively in supplying liquid milk demand of Nyala. To collect data concerning the management, husbandry practice and constraints; structured questionnaire was designed and direct interview with dairy farm owners was conducted. Then the collected data were grouped, coded and analyzed using frequencies and descriptive statistics utilizing SPSS (version.11.).

RESULTS AND DISCUSSION

The results showed that age of the majority of dairy farm owners in Mosay district ranges between 30-40 years (45%), then 41-56 years old (40%) and only one respondent was above 60 years old (5%) (Figure 1). Graduated persons among dairy farm owners in Mossay district represent the majority (35%) then those of higher secondary certificate (25%) and those only passing the intermediate school were (10%) where the rest of the producers were received Khalwa education (5%) or illiterate (5%) (Figure 2).

It was found that crossbreed dairy farms in Mossay district was established in few last years; the results revealed that 55% of the producer established their farms in a period more than 10 years, while 40% of the respondent claimed that they started investment in milk production in a period ranging between (3-8 years), only 5% of the herd owners replied that they involved in milk production field recently (before 2 years ago) .It was observed that dairy farms area in Mossay district was limited and small compared to the herd size and future expansion. Only 10% of the dairy farms having more than 5 fedans, 30% possessing farm area between (2-4 fedans) and 5% of the dairy farm owners their farms were less than one fedan. The results revealed that dairy farms in Mossay district were constructed from different materials, but the majority of the dairy farms (55%) were built from constant materials (bricks, iron and cement) while (20%) were made of local materials and (5%) prepared from both constant and local materials. The main types of animal reared in crossbreed dairy farms in Mossay district were cattle and goats (55%) beside, some types which illustrated in fig.3. The phenomena of raising goats beside dairy cattle could be attributed to the reason that goats need least level of management, low feeds cost, short life cycle as well having good demand and high marketing chances. They used goats return to meet the feeding cost of their dairy cows.

No doubt, recording system in dairy farms is considered one of the essential tools of effective management, unfortunately, only 50% of the dairy herd owners replied that they use records when some others (45%) did not keep records. Even those herders whose practice recording they did not register animal data in ideal records form, instead they use paper sheets which are not permanent and liable to loss and damage. It was observed in the dairy farms of Mossay district, a complete absence of animal data and information concerning farm financial analysis, nutritional status and health care. Definitely, these miss-managerial defects could affect the right decisions in the dairy farm. Financial records are useful in analyzing previous performance while keeping health records decrease health hazards and assist in control and treatment of infectious diseases, (Delorenzo and Thomas, 1996) and (Babiker, 2007).

The common source of drinking water in area of study was wells (60%), some had water pipes (25%) and the other producers obtained drinking water from both pipes and wells (10%) (Figure 4).

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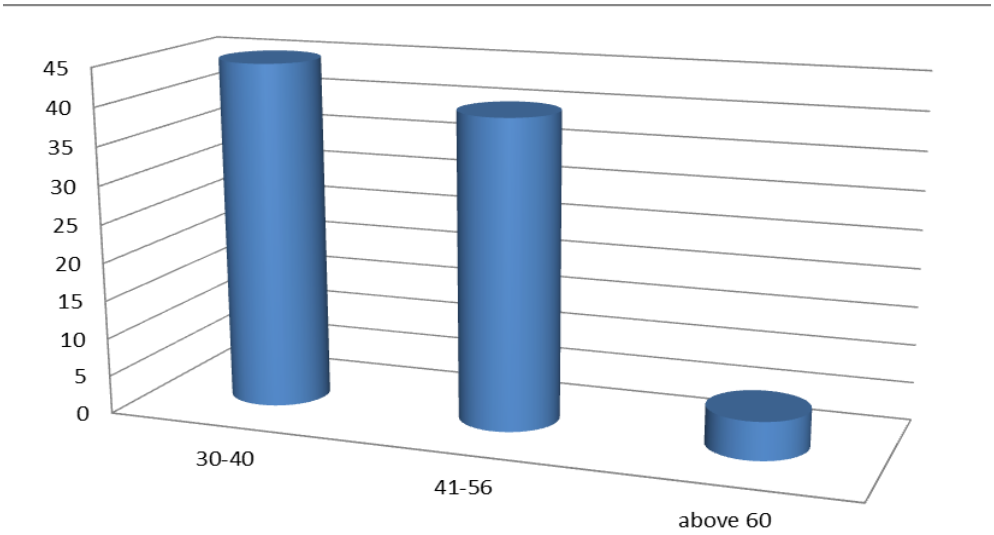

Figure 1. Ages of dairy farm owners in Mossay district

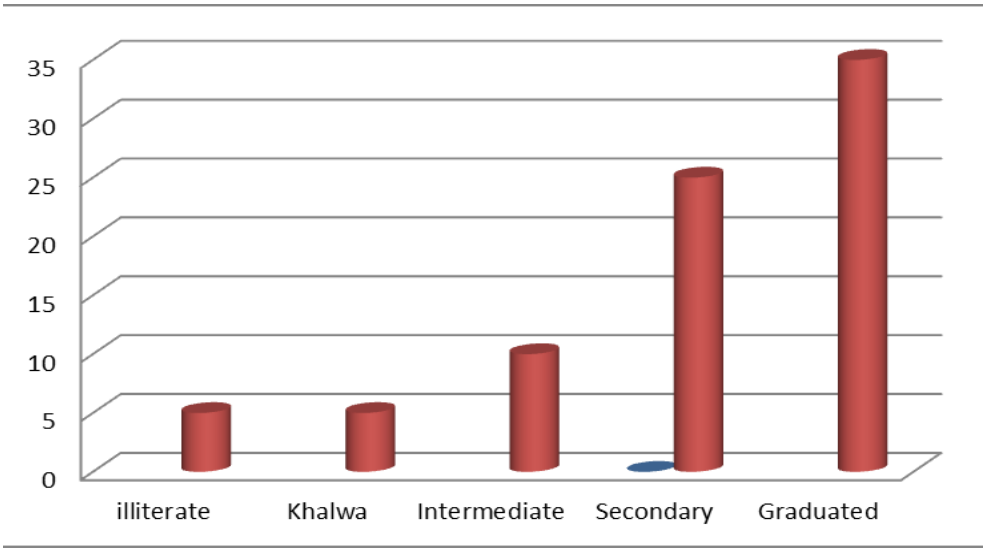

Figure 2. Educational level of responders

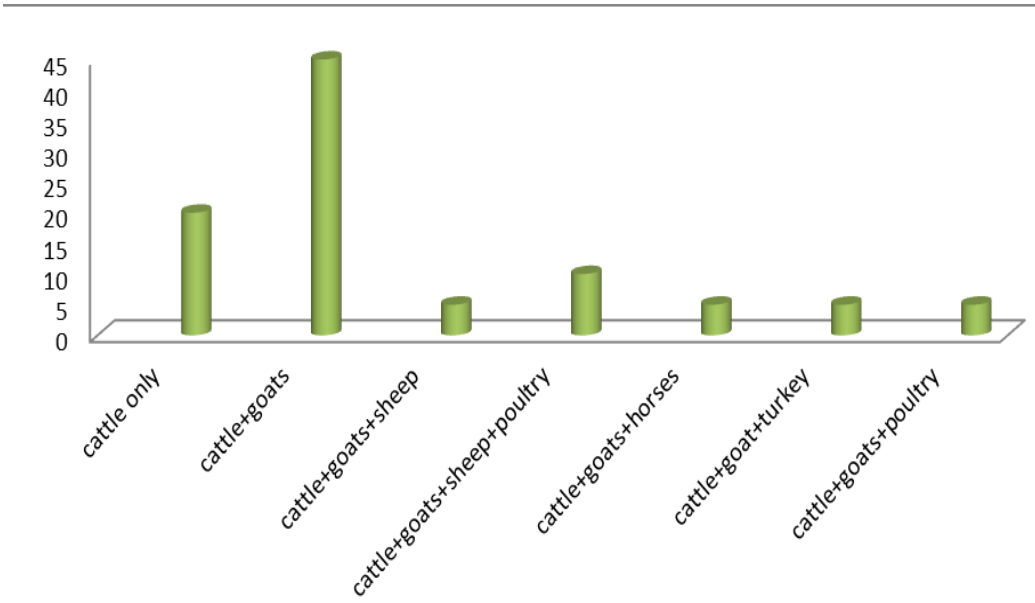

Figure 3. Types of animal kept beside cattle in Mossay area

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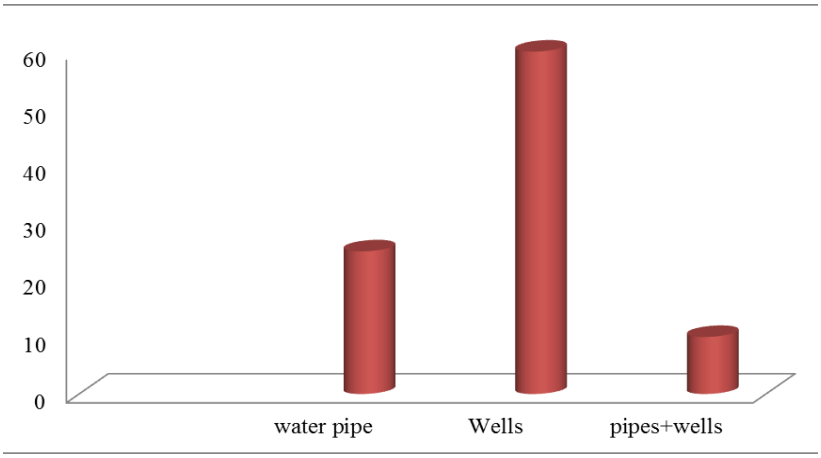

Figure 4. Water sources

All dairy herders kept their cows indoors (100%) and they do not allowed them to graze out sides. Most of the Dairy farm herders at Mossay district feed their cows individually (45%) whereas the others (35%) practiced group feeding. It was found that cows' owners offered concentrates, from various sources; 45% of them prepare the concentrates in the farm using the available raw materials, 30% of the respondents purchase the concentrates while 15% of the producers use both sources (farm prepared and commercial), the same practiced was observed by (Elniema et al., 2011) among herders keeping dairy herds in the pri-Urban regions of Khartoum North province and (Hanyani-Malmbo et al., 1998) in Zimbabwe. Although forages represent a big problem for the dairy cows' owners (for its scarcity and high price); only 45% of them grow forages while, 50% do not grow forages for their herds. Fig.5. shows the forages shortage periods, it was found that period between (April–June) represents the summit of forage shortage (45%), then the period between March-June (10%). Also, respondents were asked how they can overcome the period of forages scarcity, 50% of them answered they succeeded in controlling forage shortage by preserving fodder during abundance, whereas, 25% of them prepare and store feed stock and 15% purchase forage during the scarcity period. Fortunately, the majority of milk producer understood the importance of salt in the herds rations, therefore, it was noticed that they preparing their rations adding salts from different sources; 60% added salt in a form of (Sodium chloride + licking stone), 35% used (licking stone) and 5% added only (Sodium chloride). Moreover, all dairy farm owners milked their cows manually (100%) twice a day (100%). The constraints that facing the dairy herd owners in Mossay district and limit their activities found to be varied, while 20% of the respondents mentioned that prevalence of diseases was the major obstacle, 15% said that feeding cost was the production limiting factors, whereas, 10% claimed that (insecurity +water and power shortage) were the main constraints. Figure 6 demonstrates the major constraints facing dairy farm owners in Mossay district. Although the presence of these obstacles, big number (60%) of producers had high desire to continue investing in dairy production, some (15%) had a moderate desire however, a few (5%) had a weak desire and intending to change their activities.

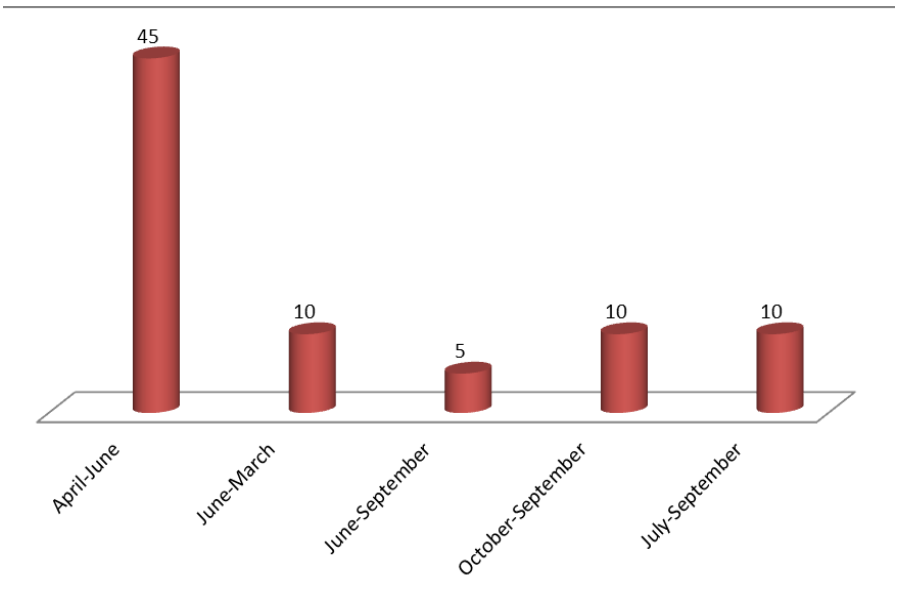

Figure 5. Forage shortage periods

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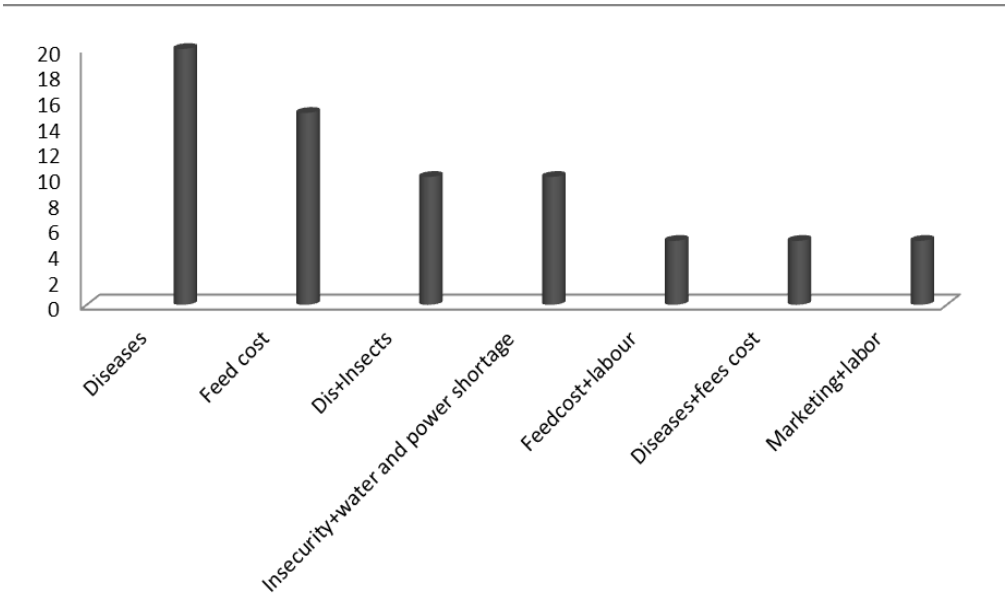

Figure 6. The major constraints of dairy farm owners in Mossay district

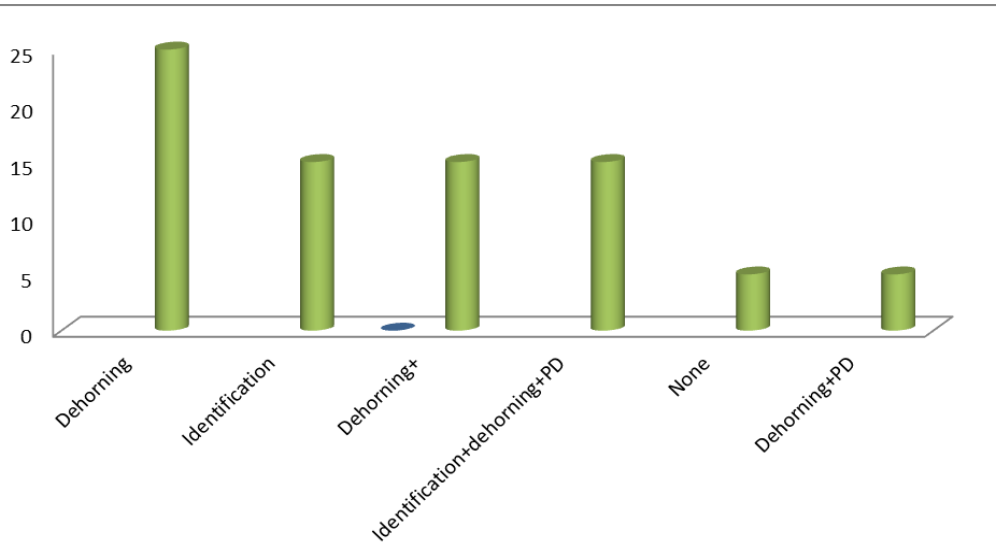

Fig 7. Husbandry prctices

Husbandry practices are considering one of the important components of farm management but, the producers of Mossay dairy farms did not pay much care about the principles of husbandry practices. (25%) of dairy farm owners practiced dehorning, where, 15% used identification (ear tags), also, 15% of them practiced (dehorning + hooves care), on the other hand, 5% of the respondents replied they did not adopt any husbandry practice (Figure 7).

Fortunately, milk producers at Mossay district were very aware of periodic health check of animals; (90%) of them checked their cows monthly and only 5% did not check their animals regularly. This is considered a good practice, because, for maximum benefit of the dairy production healthy cows are required, (Payne and Wilson, 1999). It was clear that management level in crossbreed dairy farms in Mossay district was not proper; also, the husbandry practices were not ideal hence, intensive extension programs are needed to improve management standards, also, training and workshops are essential to enhance dairy farm owners' skills in husbandry practices.

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g. MATERIALS AND METHODS;

h. RESULTS;

i. DISCUSSION;

j. CONCLUSION;

k. Acknowledgements (if there are any);

1. REFERENCES;

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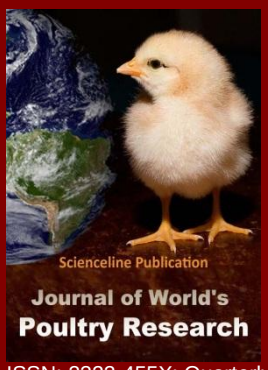

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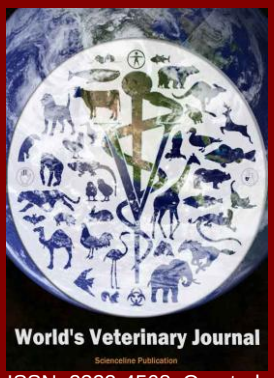

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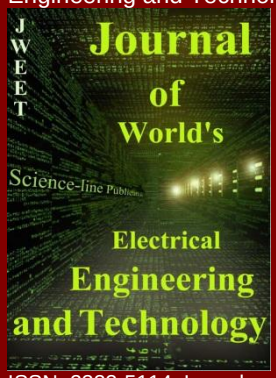

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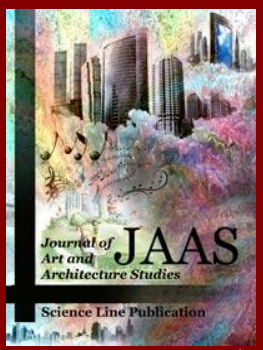

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