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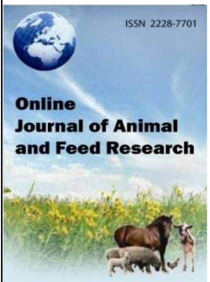

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07.82% Klebsiella spp., 01.73% Psedomonas spp., 03.47% Proteues spp. and 06.08% Enterococci spp. While, the Gram-positive bacteria were 07.82% Micrococcus spp., 05.21% Streptococcus spp. and 28.69% Staphylococcus spp. In conclusion camel milk is a source for many bacteria which may lead to health hazard for man when it is taken raw (as in many rural areas in Arabic countries including the Sudan).

Key words: Raw Camel Milk, Aerobice Bacteria, Fungi.

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CASSAVA (*Manihot esculenta crantz*): AN AFFORDABLE ENERGY SOURCE IN DAIRY RATIONS

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ABSTRACT: *The current paper explores the evidence that exists on the potential use of cassava plant (Manihot esculenta Crantz) as an energy source for dairy cattle. Several studies have proven cassava roots, leaves and processing residues to be an important ruminant animal feed resource. Cassava root chip and meal are a potentially good rumen fermentable energy for dairy cows in the tropics. The vegetative parts of cassava are considered to be wastes since human beings grow cassava for its tubers. Feeding trials with cattle have shown cassava hay to have a dry matter intake levels DMI of around 3.2% of BW) and a digestibility (71%). The hay also contains tannin-protein complexes that may be a good source of rumen un-degradable protein that will be available to the animal post-ruminally. It has also be shown that supplementing 1-2 kg/head/day of cassava to dairy cattle may go a long way in reducing feeding costs and significantly increasing milk quality and quantity produced. Cassava hay was also noted to be anthelminthic and therapeutic since it contains condensed tannins. Condensed tannins have been proven to reduce gastrointestinal nematodes. Use of cassava as a substitute of maize in dairy rations can significantly lower the feed costs in smallholder dairy farms in cassava producing countries like Mozambique. It was concluded that cassava is potentially an affordable substitute for conventional energy source for small scale dairy farmers.*

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Key words: *Cassava, Feed, Commercial Opportunity, Dairy, Cattle*

INTRODUCTION

Availability of animal feed is one of the greatest constraints to the expansion of the livestock industry in developing countries. Apart from the high and fluctuating costs and some of the ingredients used in mixed feeds, notably cereal grains are in high demand for human consumption (Oguntimein, 1988). The cassava products and by-products can be good alternative source of carbohydrate and protein for conventional feed ingredients.

In Mozambique cassava roots and leaves are widely grown mainly as a staple food. The main cassava products are the green leaves used as vegetable; the roots used fresh or dried for flour, roasted as a *gari* or for beer brewing. Cassava supplies roughly 30% of all calories consumed in Mozambique, making it the Country's most important food security crop (Donovan et al., 2011). In northern Mozambique, cassava commercialization centers on trade in dried flour, while in the south a prepared cassava-based convenience food called *rale* accounts for the bulk of marketed cassava product.

Due to the high productivity of cassava, either per unit of land or unit of labor, its products are generally priced lower than most crops. In Mozambique the price of cassava averages at around 55% of the cost of wheat and 60% of the cost of maize (Donovan et al., 2011). The relatively low cost of cassava makes it an attractive crop with a lot of potential in the livestock feed industry. Although there is scientific evidence that support the potential of cassava as an important livestock feed, it use as such is not fully exploited (Anjos, 2007). It is estimated that only 4% of total cassava output is used as a livestock feed resource. The aim of this paper is to explore the potential use of cassava as a substitute for maize in dairy rations.

MATERIALS AND METHODE

Chemical and nutritional composition of cassava

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The crop is an important source of carbohydrate for humans and animals, having higher energy density than other root crops, 610 kJ/100 g fresh weight. Dried cassava root has energy density that is similar to cereals (Bradbury and Holloway, 1988, FAO, 1990). Cassava roots and cassava leaves are both used for animal feed (Buitrago, 1990, Dahniya, 1994). The general chemical composition of cassava roots and leaves is shown in Table 1.

Table 1 - Chemical composition of cassava roots and leaves (Buitrago, 1990)

Nutrient	Storage root		Leaves	
	Fresh weight basis (%)	Dry weight basis (%)	Fresh weight basis (%)	Dry weight basis (%)
Dry matter	35.00	100.00	28.00	100.00
Starch	30.21	85.10	16.23	39.00
Crude protein	1.10	3.10	6.80	24.00
Fat	0.47	1.30	1.80	6.50
Crude fibre	1.10	3.10	5.80	20.60
Ash	0.70	1.90	1.70	6.20
Calcium	0.10	0.33	0.43	1.50
Phosphorus	0.15	0.44	0.08	0.27

Cassava roots are rich in digestible carbohydrates, mainly in starch. Cassava starch granules are composed mainly of two polysaccharides, amylose (20%) and amylopectin (80%) (Sandoval, 2008). Therefore cassava roots are low in protein and fat. Cassava root has less than the recommended minimum limit in almost all essential amino acids, except tryptophan (FAO, 1990). Cassava leaves are much richer in protein than the roots, although the leaf contains a lower proportion of methionine than the root protein. Cassava is good source of dietary fibre, magnesium, sodium, riboflavin, thiamine, nicotinic acid and citrate (Bradbury and Holloway, 1988). Cassava however contains cyanogenic glycosides linamarin and lotaustralin in a ratio of 97:7 in all its tissues except for the seeds (Teles, 1995). Cassava is usually classified by farmers as being bitter or sweet depending on the levels of anti-nutritional factors therein. Cassava varieties with bitter taste are considered toxic (Chiwona-Karltun et al., 2004).

In order to reduce toxicity, improve palatability of cassava various treatment methods are applied. Such methods include, peeling, boiling, steaming, shredding, roasting, fermentation, however the most common practices is drying of the roots after chipping (Garcia and Dale, 1999). The majority of farmers in Southern Africa prefer to grow the bitter varieties of cassava as form of crop protection against pests. It is therefore imperative that cassava must me adequately processed or treated before use as an animal feed ingredient. Most cassava growing farmers in Southern Africa know various processing techniques such as heap fermentation of roots to reduce bitterness (Tivana et al., 2007).This method is useful when preparing cassava roots for use as animal feeds. Cassava roots and leaves can also be ensiled to produce a nutrient dense feed that is low in anti-nutritional factors (Eruvbetine, et al., 2003).

Use of cassava in as livestock feed

Studies from across Africa reveled that cassava could be used as a source of energy and protein for ruminants. In Kenya, Sanda and Methu (1998) evaluated the effect of substitution of maize by cassava in dairy Friesian, Ayrshire and their F1 cross cows reported that cassava products are good energy feed ingredient for dairy cows and it can totally replace maize meal in the concentrate diets for cows producing approximately 12 kg of milk per day. In addition no significant difference in vivo digestibility of either the dry matter or organic matter and the feed cost per ton were reduced.

Cassava roots

Another study on the potential use of cassava as an important livestock feed ingredient evaluated the effect of cassava root chip on milk yield in lactating Holstein-Friesian cows. The cows were fed *ad libitum* a ration consisting of roughage (dried Ruzi grass) and a cassava containing concentrate with inclusion levels ranging from 25 % cassava up to 55 %. The results showed that the levels of cassava root chip containing concentrate compared favorably with a conventional concentrate. There were no significant differences in the total dry matter intake, digestion coefficients of Dry matter and Organic matter, milk yield and milk composition. It was therefore concluded that cassava chips can be used in dairy cattle feeds with inclusion levels as high as 55% (Wachirapakorn et al, 2001).

In another study by Wanapat and Petlum (2001), a supplement ration containing a high level of 85 % cassava root chips was fed to peri-parturient dairy cows (one month before calving up to 13 weeks post-partum). It was concluded that high level of cassava chips in the concentrate resulted in increased milk yield quality yet the cost of the cassava based feed was 60% lower than a typical commercial product. In primiparous lactating Holstein cows, cassava scrapings included at 0, 25, 50, 75 or 100% levels in the diet had no significant effect on dry matter intake (kg, %BW and g/BW $^{kg0.75}$) However, milk yield, milk yield corrected for 3.5% fat, and fat yield decreased linearly by 20, 30 and, 1.15 g/day, respectively, when corn grain was replaced with cassava scrapings (Ramalho et al., 2006).

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Cassava leaves

Cassava leaves have been tested on ruminants either as silage or hay. In Tanzania Kavana *et al* (2005) found out that that dairy cattle fed cassava leaf silage produced more milk than the control group that received standard silage. Cows on the cassava leaf silage produced an average of 9.9 litres/cow/day compared with 7.6 litres/cow/day from cows fed a standard maize silage. Cassava foliage was included in silage at the following graded levels 0, 20, 40 or 60% and its effect on milk production and composition on fat quality of Holstein-Friesian cow milk was evaluated. It was observed that milk quantity and quality including milk urea content decreased linearly with increasing levels of cassava foliage silage in the diet (P <0.05). However, γ-linolenic and palmitic acid concentration in milk increased with increasing proportions of cassava foliage silage in the diet. Cassava leaf silage proved not to have a significant effect on milk fatty acids, pH, density; milk protein, fat, lactose total solids and somatic cell counts (Modesto et al., 2009).

The effect of corn silage (CS) replacement by cassava's foliage silage (CFS) on the production and quality of milk were evaluated. The results indicated that No significant effect (P>0.05) was observed for the levels of replacement of CS with CFS for the variables: dry matter intake (kg/day and %BW), milk yield, 4% fat corrected milk production, fat, protein, lactose, total solids, N-urea, and acidity, which had average values of 25.42 L/day, 24.54 L/day, 3.78%, 3.13%, 4.55%, 13.25%, 18.91 mg/dL, and 1.67, respectively. Nevertheless, a decreasing effect (P<0.02) was observed on milk density with the increase in replacement level (Santos et al., 2009)

Cassava hay

A study was conducted to examine the supplementation level (0, 0.8 and 1.7kg DM/hd/d) of cassava hay in multiparous Holstein – Friesian crossbreds. Concentrate was supplement at the same level while urea-treated (5%) rice straw was offered *ad libitum* basis. The results revealed that supplementation of cassava hay could significantly reduce concentrate use resulting in similar milk yield (12.5, 12.12 and 12.6 kg/hd/d) and significantly enhanced 3, 5% Fat corrected milk (14.21, 15.70, 14.9 kg/day). Moreover, cassava supplementation increased milk fat and milk percentages (Wanapat et al., 2000a). In other study Wanapat et al. (2000b) reported that cassava hay contained high level of protein and minimal level of tannin at 3 months after harvest. According to Wanapat (2001), cassava hay contains 20 to 25% crude protein in the dry matter, and with very minimal HCN content. Feeding trials with cattle revealed high levels of Dry matter intake (3.2% of BW) and high Dry matter digestibility (71%). The hay contains tannin-protein complexes which could act as rumen by-pass protein for digestion in the small intestine. Therefore, supplementation with cassava hay at 1-2 kg/hd/d to dairy cattle could markedly reduce concentrate requirements, and increase milk yield and composition.

Twelve swamp buffaloes and Brahman cattle heifers (6 animals each) were randomly assigned to two treatments, control (grazing only) and supplementation of cassava hay at 1-kg dry matter per head per day (DM/hd/d), in a 2×2 factorial arrangement according to a cross-over design. As a result it was revealed that supplementation of cassava hay at 1-kg DM/hd/d significantly (P<0.05) improved the nutrition of both swamp buffaloes and Brahman cattle in terms of DM, organic matter (OM), protein and energy intake and digestibility, ruminal NH3-N and rumen ecology. Cassava hay CH should be recommended used as a protein source replacement a soybean meal in concentrates for a sustainable dairy production in the tropics (Kavana et al., 2005). The cassava hay had a significant effect on the parasitic infestation, in terms of lower egg counts (Granum et al., 2007)

The effects of cassava feed block

Experiment was conducted to investigate the effect of cassava hay (CH) incorporated in a high-quality feed block (HQFB) on feed intake, digestibility, rumen fermentation, milk production and milk composition in lactating dairy cows. There were three treatments: control (no supplementation of HQFB); HQFB (supplementation of HQFB without CH); and HQFB-CH (supplementation of HQFB with CH). Total dry matter intake and digestion coefficient of dry matter in the HQFB-CH treatment were higher than in the other groups. The concentration of NH_3-N, the pH and the microbial populations in the rumen did not differ between treatments. Milk yield in the two HQFB treatments were higher than in the non-supplemented treatment. Fat-corrected milk (3.5% FCM), percent milk fat and total solids in the HQFB-CH treatment were higher than for the other treatments (Koakhunthod et al., 2001).

Suksombat et al, 2006 evaluated 3 groups of cows fed concentrates containing the respective cassava pulp, 35%, 40%, and 45%. All cows were fed *ad libitum* grass silage and given free access to clean water. Dry matter intake (15.3 vs. 15.8 kg/d), milk yield (14.2 vs. 14.1 kg/d), milk composition and body weight change were unaffected (P>0.05) by the treatments. Their study indicated that 45% cassava pulp can be used in the concentrate for lactating dairy cows.

CONCLUSION

Studies from across Africa have revealed that cassava is a good alternative source of dietary energy for dairy cattle. Various parts of the cassava plant including leaves, stems and roots can be processed to produce a valuable dietary energy source for lactating dairy cows. Cassava has also been noted to be toxic as it contains cyanogenic glucosides, such as linamarin and lotaustralin, it also contains significant levels of tannins and hydrogen cyanide. The content of the aforementioned anti-nutritional factors in cassava is variable with different cassava cultivars. Farmers can however grow the less bitter types for livestock feeds or eliminate the anti-nutritional factors via a variety of processing methods. Cassava root chip and meal are a potentially good rumen fermentable energy for dairy cows. Cassava hay has also been concluded to have to have a dry matter intake and digestibility levels that are comparable to conventional energy sources. It was also concluded that the hay also contains tannin-protein complexes that may be a good source of rumen undegradable protein that will be available to the animal post ruminally. The cheap production cost of cassava therefore makes it a reasonably more cost effective substitute for conventional energy sources such as maize.

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AEROBIC BACTERIA AND FUNGI ASSOCIATED WITH RAW CAMEL'S MILK

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ABSTRACT: *The objective of this study was to determine the aerobic bacteria and fungi associated with raw camel's milk. Samples were collected from farms in Bahri (Khartoun North) area in the Sudan. The isolated aerobic bacteria (one hundred and fifteen isolates) were identified as (85.26 %) Gram–negative, while (14.73 %) were Gram-positive. The Gram-negative bacteria were 39.13% Escherichia coli serotypes, 07.82% Klebsiella spp., 01.73% Psedomonas spp., 03.47% Proteues spp. and 06.08% Enterococci spp. While, the Gram-positive bacteria were 07.82% Micrococcus spp., 05.21% Streptococcus spp. and 28.69% Staphylococcus spp. In conclusion camel milk is a source for many bacteria which may lead to health hazard for man when it is taken raw (as in many rural areas in Arabic countries including the Sudan).*

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INTRODUCTION

The one humped camel is an essential source of food and milk in many parts of the world and especially in developing countries in Africa and Asia. The dromedary plays also economic, social and ecological roles (Warden, 1992; Ouajd and Kamel, 2009).

Milk is an ideal habitat for the growth and multiplication of microorganisms due to its nutritional constitution which contain protein, carbohydrate, mineral and vitamins. All these components support the growth of many forms of bacteria (Omer and Eltinay, 2008).

Raw camel milk may contain microorganisms pathogenic for man and their source may lie either within or outside the udder (Sinell, 1973).

Many epidemiologists reports proved that, non-heat treated milk and raw-milk products represent the major factors responsible for illnesses caused by food borne pathogens (De Buyser et al., 2001)

Ziney and Al- Turk (2007) reported that, approximately 50% of the examined raw camel's milk samples were produced and handled under poor hygienic conditions with high health risk to the consumers.

Omer and Eltinay (2008), reported isolation of 43% gram-positive cocci, 11% gram negative cocci, 30% Gram negative rods, 23% Gram positive rods, 32% for Staphylococcus, 15% for yeast from camel's milk.

The same authors reported that, Sixty eight samples were examined for *Bacillus cereus*, *Salmonella spp., Clostridium perfringens*, and *Listeria monocytogenus*. The results indicated that, all samples tested for pathogenic organims were negative for *Salmonella spp*., *Clostridium perfringens*, and *Listeria monocytogenus,* positive for *Bacillus* cereus, *staphylococcus aureus*, and *Echerichea coli*.

Abeer et al. (2012) reported isolation of 5 *Salmonella spp*., 12 *E. coli* and 2 *Listeria monocytogenes* from a total of 185 camel's milk samples collected from Sinai, Aswan and Sharqia Governorates.

MATERIALS AND METHODS

One hundred and sixty camel's milk samples were collected from camels (apparently healthy) in different farms in Bahrei area in the Sudan, the camels (Camelus dromedarius) are of different ages. Samples were collected in sterile bottles and transported to the laboratory in an insulated ice box. The isolation and identification of the bacteria, fungi and yeast is according to Barrow and Feltham (1993). The purified isolates of bacteria were identified according to the criteria include: Cultural characteristic of isolates; shape, colour, odour, elevation, margin, consistency, growth and size of colonies. The colonial characteristic on the different and selective media and haemolysis of blood agar; Gram's stain reaction; Motility; Aerobic growth; Biochemical tests.

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The fungi were examined by Dilution plating technique, with potato dextrose agar. The plates were incubated at 22°C -25 °C for five days. For isolation of fungi the Sabouraud's agar medium was used and two sets of media were inoculated, with one set incubated at 25°C -30°C and the second set incubated at35±2c°. All cultures were examined at least weekly for fungal growth and should be held for four to six weeks. Examine the plates for fungal colonies exhibiting typical color and morphology. Biochemical tests and serological procedures were performed to confirm findings.

RESULTS

The main Gram-negative bacteria, which isolated were *Escherichia coli* species (39.13%), *Klebsiella* species included *Klebsiella pneumonia* (07.82%), *Proteues* species included *Ptoteues* mirabilis (03.47%), and *Psedomonas* species which included *Pseudomonas aeruiginosa, Psedomonas dimunata* which represented (01.73%) of the total isolates. The main Gram-positive bacteria were the *Staphylococcus spp.* Included *S. sacchrolyticus, S.aureus and S.epidermis* which represented (28.69%) and *Enterococcus faecalis* represented (06.08%) of the total isolates. Other groups were: *Streptococcus* and included *Streptococcus viriddans.*They represented (05.21%) of the total isolates. and *Micrococcus* species which included *Micrococcus luteus*, which represented (07.82%) of the total isolates. The fungi and yeast were not isolated from all the samples of raw camel's milk.

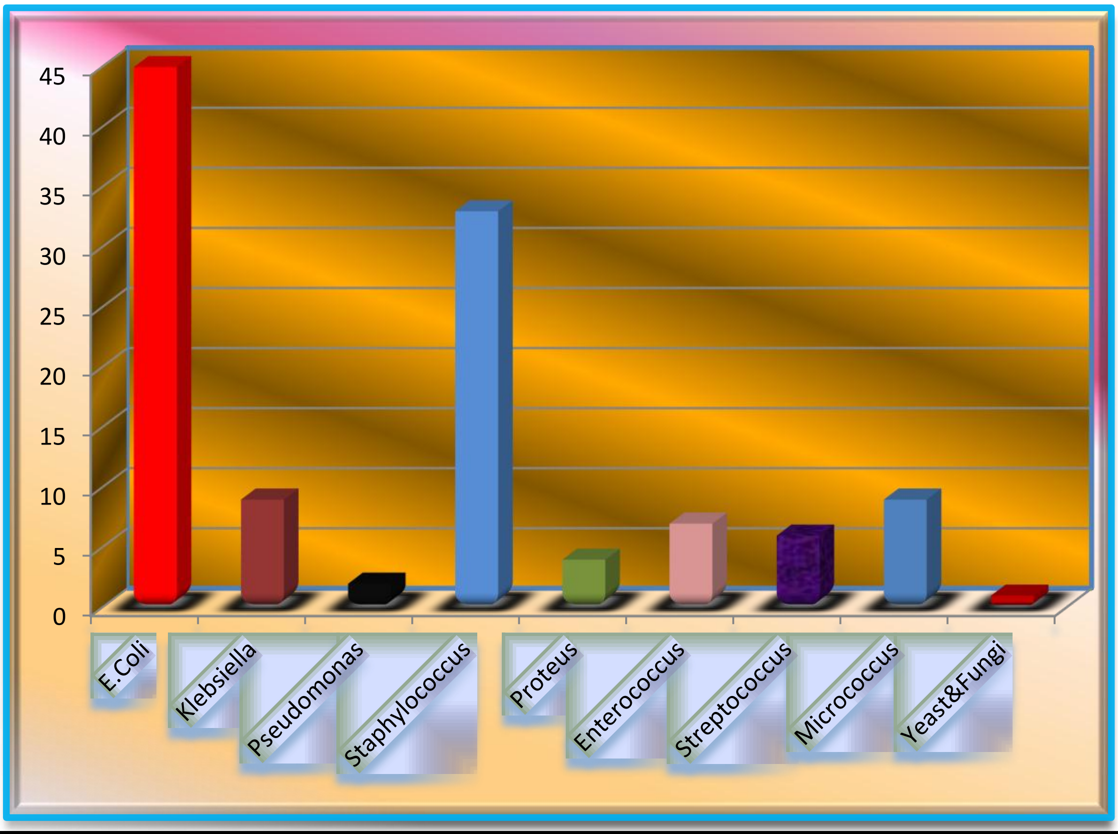

Diagram 1: The total percentage of aerobic microorganisms associated with Raw Camel's Milk.

DISCUSSION

The present study reveals the cross- contamination of camel's milk either from the animal itself or from the workers. The important aim of the present study, were to assess the microbial quality of raw camel's milk. Noreddine (2008) reported the dominance of *enterococci* with *Enterococcus faecalis* as the main representative species. Besides *Enterococcus*, other genera including *Pediococcus* (28.2%), *Streptococcus* (4%), *Lactococcus* (8%) and *Leuconostoc* (1%). In the present study the main representative species included *Escherichia coli species* (39.130%) that may be due to the bad hygiene in small camels' farms in Sudan, or due to un- clean worker's hands or dirty utensils. So it will be recommended that; the raw camel's milk must be pasteurized before direct drinking, the udder should be washed and cleaned before milking, the worker's hands should be healthy and use clean utensils during milking protocol. On the other hand, also we can use milking machine.

These findings support results of Abdullah and Sabry (2009) who reported, E. coli was isolated from 33 (66%) of the 50 raw milk and product samples tested. Also Soomro et al. (2002), Chye et al. (2004) and Aly and Galal (2002) reported that E.coli was found to be the highest percentage of isolates from raw camel milk.

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In the present work the Salmonella species, Listeria monocytogenus, Bacillus cereus, Clostridium *perfringens*, yeast and fungi species were not isolated from all samples of raw camel's milk which has a significant public health implication.

In conclusion, according to the presence of the previously isolated bacteria the camel's milk must be heated and pasteurized before drinking.

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EFFECT OF DIETARY LEVELS OF COWPEA (*Vigna unguiculata*) SEEDS ON BROILER PERFORMANCE AND SOME SERUM BIOCHEMICAL FACTORS

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ABSTRACT: *Effect of inclusion of different levels of untreated cowpea (Vigna unguiculata) seeds (0, 5, 10 and 15%) in broiler diet on performance and some serum biochemical factors was studied. The research was conducted on basis of a completely Randomized Design (CRD). Feed intake, body weight gain, feed conversion ratio, protein intake and protein efficiency ratio were significantly ($P \leq 0.05$) reduced with the inclusion of 15% untreated cowpea seeds. Plasma cholesterol, glucose, albumin, total protein, Ca and K contents were significantly ($P \leq 0.05$) decreased with increasing level of cowpea seeds in diets. Uric acid concentration observed to be higher in birds fed 15% cowpea seed. It is concluded that good performance of broiler chicken is satisfactory maintained with 5 to 10% inclusion of cowpea seeds in balanced diet for broiler.*

ORIGINAL ARTICLE

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Key words: *Cowpea, Untreated, Broiler, Production, Plasma*

INTRODUCTION

There is needed to look for locally available and cheap sources of feed ingredients particularly those that do not attract competition between humans and livestock. Robinson and Singh (2001) reported that there has always been interest in legume grains as protein source in poultry diets. Productive parameters and serum biochemistry assay of livestock suggest the physiological disposition of the animals to their nutrition (Madubuke and Ekendem, 2006). Esonu et al. (2001) had stated that haematological constituents reflect the physiological responsiveness of the animal to its internal and external environments which include feed and feeding. Scientists have found the effects of various feeds on the haematology and serum biochemistry of livestock and concluded that feed ingredients including unconventional sources affect animal physiology. Teguia et al. (2003) observed that inclusion of some legumes in starter broiler chicken such as black bean, bambara groundnut, and/or cowpea seeds induced deteriorating effects on growth rate. Only the birds fed on diet with cowpea meal recorded growth rates and feed intake that were comparable to the control, they also reported that only 6% of either cowpea or bambara groundnut was included in the broiler diets, higher inclusion levels would limit the utilization of legume grains due to the presence of anti-nutritional factors. Emenalom and Udedibie (1998) suggested that up to 10% levels of raw mucuna could be tolerated by broiler. Raw mucuna seeds contain high level of anti-trypsin activity, phytate, cyanide and tannins (Esonu et al., 2001) which limit its use in animal feeding. This statement is supported by previous reports showing that legume seeds may contain variable amounts of the protease inhibitors, trypsin, chymotrypsin and phyto-haemagglutinins (D'Mello, 1995; Wiseman, 1995). The presence of protease inhibitors could be responsible for the depression in growth reported by Teguia et al. (2003) as they interfere with the digestion of proteins. Feeding untreated legume seeds to boiler chickens resulted in poor feed consumption, deteriorating growth rate also affect blood biochemistry. Therefore, the objective of this experiment was to assess the effect of the various dietary levels of cowpea seeds on productive parameters and serum responses of broilers as a guide to optimum production of healthy and safe poultry products.

MATERIAL AND METHODS

Seeds analysis and diets formulation: Samples of cowpea (*Vigna unguiculata*) seeds were analyzed for proximate composition according to the methods outlined in the AOAC methods of analysis (1990). See Table 1. Eight isocaloric and isonitrogenous starter and finisher diets (Table 2) were formulated according to nutrient specifications of the standards recommended by National Research Council (NRC, 1994). Diet (A) was the control with 0% of cowpea seeds, diet (B) 5%, diet (C) 10% and diet (D) 15% untreated cowpea seeds.

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Table 1 - Chemical composition of cowpea (*Vigna unguculata*) seed

Item	Analysis
Crude protein	29.18
Crude fat	2.30
Crude fiber	6.22
Ash	4.60
NFE	51.32

Table 2 - Composition of experimental broiler diets containing dietary levels of cowpea seeds

	Dietary levels of cowpea seeds (%)							
	Starter				Finisher			
	0(A)	5(B)	10(C)	15(D)	0(A)	5(B)	10(C)	15(D)
Sorghum	64.90	64.90	60.66	60.86	64.9	64.9	60.66	60.80
Groundnut meal	15.2	13.48	13.24	15.9	15.2	13.48	13.24	14.9
Sesame meal	13	10	8	-	12.0	9.00	7.00	-
Wheat bran	0.30	-	-	-	1.3	1.00	1.06	1.54
Br. super concentrate*1	5	5	5	5	5	5	5	5
Dicalcium	1.10	1.0	0.80	1.10	1.1	1.01	1.5	1.06
Salt	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Premix	0.25	0.25	0.25	-	0.25	0.25	0.25	0.25
V. oil	0	0.12	1.76	1.75	-	0.11	1.00	1.19
Methionine	-	-	0.04	0.14	-	-	0.04	0.14
Calculated analysis								
ME (Mj/kg)	11.74	12.92	12.54	12.21	12.55	12.60	13.83	12.57
Crude protein	23.71	23.05	23.60	24.58	20.01	19.42	19.25	20.01
Crude fat	4.28	3.40	3.50	3.10	4.28	3.07	4.12	4.66
Crude fiber	4.28	4.37	4.24	4.22	4.60	4.17	3.98	4.09
Calcium	1.01	1.1	1.0	1.07	1.00	1.09	1.1	1.06
Av. Phosphorus	0.51	0.49	0.44	0.47	0.48	0.48	0.46	0.46
Methionine	0.57	0.51	0.46	0.48	0.58	0.56	0.57	0.44
Lysine	1.05	1.90	1.14	1.07	1.05	1.8	1.15	1.14
Determined analysis								
Crude protein	23.45	25.85	25.77	24.69	19.89	19.68	20.44	18.38
Ether extract	7.0	6.40	6.70	5.50	6.8	7.4	6.11	5.89
Crude fiber	6.67	7.01	6.67	6.27	6.51	7.02	6.42	6.55
Nitrogen free extract	52.47	50.77	50.43	51.65	56.96	55.84	56.33	59.37
ME*2 (Mj/kg)	12.76	12.81	12.75	12.76	12.92	12.77	11.81	12.88
Ash	5.74	5.82	6.24	7.34	6.24	5.88	5.93	7.17

*1Super concentrate contains the following: CP 40%, ME 2000 kcal/kg, C. fiber 3%, EE 3% Ash 34%, Ca, 8% Av. P 1.38% Lysine 12%, Methionine 3%, Methionine + cysteine 3.5%, Vitamin A 250000 IU/kg, Vitamin D_3 50000 IU/kg, Vitamin E 500 Mg/kg, Vitamin K_3 6 Mg/kg, Vitamin B_1/thiamin 20 Mg/kg, Vitamin B_2/riboflavin 100 Mg/kg, Lysine 12%, Methionine 3%, Copper 120 Mg/kg, Zinc 1000 Mg/kg, Iodine 6 Mg/kg, Vitamin C 4000 Mg/kg, Folic acid 30 Mg/kg, Iron 800 Mg/kg, Manganese 1400 Mg/kg, Cobalt 12 Mg/kg, Niacin vitamin pp. 600 Mg/kg, Pantothenic acid/vitamin B_3 160 Mg/kg, Vitamin B_6/pyridoxine 40 Mg/kg, Vitamin B_{12} 300 Mcg/kg, Biotin/vitamin H 2000 Mcg/kg, Choline 10000 Mg/kg, Copper 120 Mg/kg, Zinc 1000 Mg/kg, Iodine 6 Mg/kg, Selenium 3 Mg/kg. *2Metabolizable energy is calculated according to the equation of Iodhi et al. (1976).

Birds and treatments

A total of 240 one-day old unsexed broiler chicks (Ross 308) were used in 42-day feeding trial after being vaccinated against Mareks, disease. The chicks were divided into four treatment groups of sixty birds each and randomly allocated to the dietary treatments. Each group was further divided into six replicates of ten birds each. The chicks were reared from one –day-old to six weeks of age in 24 pens (20201) with wood shavings litter. For the first 3 weeks, the chicks were fed starter diets and then they were placed on finisher experimental diets. Feeding and water supply to the bids were ad libitum while other standard management practices were adopted. Feed intake and body weight were determined weekly by weighing the feed and birds. Body weight gain was determined then feed conversion ratio was calculated. Protein intake and protein efficiency ratio were also weekly determined.

Plasma chemical constituents, analysis

At the end of 6th week of age, 3 birds were randomly selected from each replicate making a total of 18 /treatment. Sampled birds were fasted for 8 hours then slaughtered. Blood sample were taken from jugular vein and received in 10 ml test tube. Hemoglobin concentration (Hb) was determined using Haemoglobin –Drabkin kit. Plasma total protein was determined as shown by (King and Wooton, 1965). Plasma albumin, globulin, Na and plasma k were determined by calorimetric method of (Bartholomew and Delaney, 1966). Plasma Ca was determined by calorimetric method described by (Trinder, 1967). Inorganic phosphorus was determined by the method described by (Gomeri, 1942). Plasma glucose and plasma cholesterol were determined by enzymatic calirometric methods using kit GOD-PAP (Radox Labrotary Ltd. Lodon). Plasma uric acid was measured by an enzymatic method using akit (Plasmatic Laboratory Products Ltd., U.K).

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Statistical analysis

The research was conducted on basis of a completely Randomized Design (CRD). Data were subjected to analysis of variance and treatment means compared using the Duncans' Multiple range tests.

RESULTS AND DISCUSSION

Overall performance of broiler chicks as affected by inclusion of different dietary levels of cowpea seeds are shown in Table 3. Feed intake was significantly ($P \leq 0.05$) influenced by dietary treatments. Feed intake of birds fed 15% cowpea seeds were significantly ($P \leq 0.05$) depressed compared to the control. The depression in feed intake is in line with the findings of Lji et al. (2004) and Mahmoud (1997), who reported that feed intake depressed with the increased level of cowpea seeds. This reduction in feed intake may be due to tannin which were complex glycol-proteins with some of the saliva, such complex causes a sensation astringent in the oral cavity, which greatly reduced palatability and hence consumption (Laurena,1984). On the other hand reduction in consumption associated with a lower digestibility (Silivlo, 2007). Body weight gain was significantly ($P \leq 0.05$) depressed at 15% cowpea seeds, these results are in agreement with the finding of Teguia and Beynen (2005) who attributed this to the presence of anti-nutritional factors, this statement was supported by previous reports showing that legume seeds contain variable amount of the protease inhibitors, trypsin, chemotrypsin and phytohaemaggulatinins (D"Mello, 1995; Wiseman, 1995). These findings coincided with that reported by Teguia et al. (2003) who attributed the depression in growth to the presence of protease inhibitors as they interfere with the digestion of protein. Tannin presence reduced utilization of more essential amino acids and reduced the activity of digestive enzyme. Therefore, growth deteriorated. FCR was not significantly ($P \geq 0.05$) influenced by dietary treatments. Protein intake was significantly ($P \leq 0.05$) affected by dietary treatments. It was decreased when the level of cowpea seeds increased. This statement is supported by previous reports showing that legume seeds may contain variable amount of protease inhibitors, trypsin, chemotrypsin (D'Mello, 1995; Wiseman, 1995). This is coincided with the finding of Teguia et al. (2003) who attributed the reduction in protein intake to the presence of protease inhibitors as they interfere with the digestion of protein. PER observed to be the poorest for birds fed on 15% cowpea seeds. This coincided with Tshovhote et al. (2003) finding. He attributed the reduction in PER to the quality of protein which enhanced as a result of the combination of more than one source of protein.

Table 3 - Overall performance of broiler chicks as affected by inclusion of dietary levels of cowpea seeds

Parameters	Dietary levels of cowpea seeds%				± SEM
	0(A)	5(B)	10(C)	15 (D)	
Feed intake (g/bird)	3277.4^{a}	3140.1^{ab}	3015.5^{b}	2635.6^{c}	39.2
Body weight gain (g/bird)	1709.5^{a}	1578.3^{b}	1530.1^{b}	1268.8^{c}	23.13
FCR (g/BWG)	2.00	2.10	1.92	1.98	0.08
Protein intake (g/bird)	794.04^{a}	774.08^{b}	733.87^{b}	649.32^{c}	15.42
PER (BWG/ PI)	2.34^{a}	2.13^{bc}	2.27^{b}	2.14^{bc}	0.06

Values are means of 18 birds/ treatments (3 birds / replicate); Means with different superscripts in the same row were significantly different ($P<0.05$)

Table 4 - Plasma constituents as affected by inclusion of dietary levels of cowpea-seeds

Parameters	Dietary levels of cowpea seeds%				
	0(A)	5(B)	10(C)	15(D)	±SEM
Haemoglobin%	70.06^{a}	68.53^{b}	69.2^{ab}	66.53^{c}	0.36
Camg/dl	9.88^{b}	10.02^{b}	10.9^{ab}	7.29^{c}	0.29
NamEq/L	179.18^{b}	189.3^{a}	180.0^{b}	173.06^{c}	3.11
KmEq/L	5.07^{a}	4.79^{b}	4.7^{b}	3.49^{c}	1.31
Total protein(g/dl)	7.14^{a}	6.75^{a}	5.10^{b}	3.08^{c}	0.22
Albumin(g/dl)	4.79^{a}	4.23^{ab}	4.18^{c}	2.05^{c}	0.20
Globumin(g/dl)	3.07^{a}	2.89^{b}	1.98^{b}	1.92^{c}	0.05
Cholesterol(mg/dl)	216.85^{a}	208.06^{a}	189.6^{b}	168.4^{c}	4.87
Uric acid(mg/dl)	2.91^{b}	2.82^{cb}	2.9^{b}	3.55^{a}	1.20
Glucose(mg/dl)	195.18^{a}	193.42^{a}	180.2^{b}	184.20^{b}	4.32
Total lipids(mg/g)	352.75	349.82	368.02	371.37	14.57
Pi mg/dl	6.06	5.54	5.98	5.72	0.23

Values are means of 18 birds/ treatments (3 birds / replicate); Means with different superscripts in the same row were significantly different ($P< 0.05$).

Results of the effect of the inclusion of different levels of cowpea seeds on plasma constituents are shown in Table 4. Plasma total protein, albumin, globulin, glucose, cholesterol, plasma K, Ca, and Na were significantly ($P \leq 0.05$) depressed as the level of cowpea seeds increased. Reduction in plasma protein was observed when the level of cowpea seeds increased. This is in agreement with Kauramoto et al. (1996) who explained this in part to the direct consequence of the effect of condensed tannins reducing the digestibility of the protein diet. Plasma albumin and globulin decreased as cowpea seeds inclusion increased. This was coincided with the findings of Al-Homidan et al. (2006). Their findings indicate significant reduction in the concentration of plasma albumin as direct

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results of anti-nutritional factors present in diet containing 2% above cowpea seeds. Plasma cholesterol and glucose reduced as the level of cowpea seeds increased. This finding was supported by Meluzzi (1977) who attributed this reduction to the liver disorders. Reduction in plasma electrolytes (Ca, Na, K) was explained by Oberleas et al. (1981) who reported that the absorption of Ca, K, Na and Zn may be unavailable in feed containing high level of phytate. Uric acid concentration increased when level of cowpea seeds increased, these results coincided with Akinola and Abiola (1990) findings. They attributed this increment of serum uric acid to poor dietary protein utilization. Phosphorus and total lipids were not significantly ($P \geq 0.05$) influenced.

From the economic analysis, the profit was calculated as relative percentage from the control diet. The results revealed that 5% level was the most profitable level

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NITROGEN BALANCE AND RUMEN MICROBIAL PROTEIN SYNTHESIS IN GOATS FED DIETS CONTAINING SOAKED AND ROASTED MUCUNA BEAN (*Mucuna Pruriens*)

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ABSTRACT: *The effect of soaking and roasting velvet beans (Mucuna pruriens) on nitrogen utilization and rumen microbial protein synthesis in goats was investigated. Sixteen goats were randomly assigned to four diets in a completely randomized design. Goats were fed a basal diet of Cynodon dactylon hay plus 30% soaked (treatment 1), 30% roasted (treatment 2) and 30% untreated velvet bean (treatment 3). The control diet had 100% hay (treatment 4). Animals were given experimental diets over 14 days following a 7-day adjustment period. Feed, refusals, urine and faecal samples were collected daily from individual goats for determination of nitrogen, nitrogen intake, utilization and allantoin in faeces and urine. Microbial protein yield was estimated from the allantoin. Data were analysed using PROC General Linear Model of Statistical Analysis Software. Goats fed a diet with soaked beans had significantly higher (P<0.05) nitrogen balance than those fed diets with roasted beans although nitrogen balance for the latter was non-significantly different (P>0.05) from that of goats fed untreated beans. Microbial protein synthesis was highest for diets with soaked beans although this was non-significantly different (P>0.05) from diets with roasted and untreated beans. All diets containing velvet beans, processed or not, contributed to significantly higher (P<0.05) microbial protein yield than diets with hay only. In terms of nitrogen balance, soaking can be recommended as an appropriate processing method for velvet beans for goat feeding. However, for microbial protein yield, processing method was not statistically important and the bean could be used untreated producing the same results.*

ORIGINAL ARTICLE

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INTRODUCTION

In Southern Africa, the seasonality of rainfall results in marked seasonal variation in the quantity and quality of feed. Available feeds are of very poor quality during the dry season and there is usually an acute shortage of feed resources characterized by low protein content and high fibre. This leads to slow rates of ruminal degradation, a high rumen load, low rumen fractional outflow rates, poor growth in young stock, loss of body weight and consequent sub-optimal productive and reproductive performance (Mupangwa et al., 2002). Poor quality pastures and crop residues alone are not able to sustain effective animal production and maintenance so there is need to find alternative protein supplements which enhance productivity. Forage legumes such as velvet beans can be used as supplementary feeds during the dry season. Supplementation increases rate of fibre digestion which increases forage intake thereby improving nutrient absorption for enhanced animal production (Tolera et al., 2000).

Velvet bean (*Mucuna pruriens* var *utilis*) is a high yielding herbaceous legume that has been put to various uses worldwide. Because of its high crude protein content of about 27.7% (Belewu et al., 2008), it is potentially a good source of crude protein for use in animals supplementation during the dry and drought season. The legume, however, contains anti-nutritional factors like L-dopa which deter feed intake and hence growth rate. L-dopa levels can be reduced through various processing methods including roasting and soaking (Nyirenda et al., 2003). These processing methods are easy and affordable rendering them appropriate for communal farmers who depend on small ruminant production for a number of benefits. The extent to which these processing methods influence the utilisation of nitrogen in velvet bean and rumen microbial protein production in goats is not known. Such knowledge, when available, will enable communal farmers to make informed decisions on appropriate processing methods for velvet bean before use as a protein supplement for goats, the majority of which are within this group. In Zimbabwe, goats are primarily owned by resource poor smallholder farmers who hold 97% of total national goat population (CSO 2000). Optimization of goat production in this group of farmers, therefore, has the potential to significantly reduce levels of malnutrition and improve livelihoods through income generation. The objective of this

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study was to determine the effects of roasting and soaking velvet beans on nitrogen utilisation and rumen microbial protein production in goats.

MATERIALS AND METHODS

Animals and management

The study was carried out in the University of Zimbabwe Animal Science Bioassay Laboratory with 16 Mashona does weighing on average of 18.5±4 kg. The feeding trial was conducted over a period of 21 days comprising of seven days adaptation period and the remaining fourteen days for sample collection. Animals were housed in individual metabolism cages that allowed separate collection of urine and faeces. Goats were initially offered feed at a rate of 3% of their body weight on dry matter basis. The amount of feed offered was then adjusted accordingly depending on their stable daily intake during the adaptation phase. Weighed amounts of the experimental diets were then offered *ad lib* every morning and water provided through drinking nipples. Feed offered, refusals, faeces and urine were measured and recorded every morning. The goats were offered fresh feed every morning and the metabolism crates were cleaned on a daily basis.

Preparation of treatment diets

The first treatment comprised of velvet beans soaked in water for 24 hours, dried overnight in an oven at 30ºC, ground and mixed with hay at a ratio of 3:7. The second treatment had velvet beans roasted in an oven at 90ºC for 30 minutes, ground and mixed with hay at a ratio of 3:7. The third treatment was 10kg of velvet beans ground raw and mixed with hay at the ratio of 3:7. 100% hay was the negative control treatment. Four goats were randomly assigned to each of these treatments in a completely randomized design.

Refusal, faeces, urine collection and sampling

Feed refusals and faeces were collected and weighed every day. Small samples of the refusals and faeces were stored in a cold room at 3ºC for nitrogen determination. Urine samples were measured, preserved with 25% sulphuric acid and stored in a cold room at 3ºC for nitrogen and allantoin determination.

Proximate analysis

Five replicates of the treatment diets were evaluated for dry matter, crude protein, crude fibre and ash using the A.O.A.C (1990) methodologies for proximate analysis.

Rumen microbial protein synthesis

Urine samples were diluted and analysed for the presence of purine derivatives using the Allantoin technique by Young and Conway (1942). Microbial protein yield (MPY) was calculated using the formula:-

MPY = (G x 70) / (0.83 x 0.116 x 1000)

Where $G = \frac{D}{0.84}$

D is the amount of allantoin excreted in urine

Nitrogen balance

Feed, urine, faecal and refusal samples were analysed for nitrogen content using the Kjeldhal method (AOAC, 1990). Nitrogen balance was calculated using the formula:-

Nitrogen Balance = Nitrogen Intake - (Faecal nitrogen + Urinary Nitrogen)

Statistical analysis

Results from proximate analysis were analysed using the general linear models procedure of SAS Version 9.3 (SAS, 2010). Nitrogen balance and rumen microbial protein production were also analysed with PROC GLM of SAS. Adjusted Tukey's method was used for multiple comparison of means.

The model was:

$Y_{ij} = \mu + T_i + e_{ij}$

where

Y_{ij} was the nutrient composition, nitrogen balance or rumen microbial protein production;

μ was the overall mean due to conditions common to all observations;

T_i was the effect of the i^{th} treatment diets (i=1, 2, 3 and 4); and

E_{ij} were the random residuals.

RESULTS AND DISCUSSION

The nutritional composition of the treatment diets and the effects of the four diets on nitrogen balance and microbial protein yield are summarized in Table 1 and Table 2 respectively. The method of velvet bean treatment did not significantly (P<0.05) influence crude fibre content, crude protein content, ash content, and rumen microbial protein yield of the treatment diets.

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Table 1 - Mean percent dry matter, crude fibre crude protein and ash in soaked, roasted and untreated velvet beans and hay diets				
Diet	**Dry Matter**	**Crude protein**	**Crude fibre**	**Ash**
30% Soaked beans + 70% hay	91.63(0.099)[a]	14.08(0.368)[a]	27.74(0.513)[b]	6.94(0.058)[b]
30% Roasted beans + 70% hay	91.67(0.099)[a]	14.70(0.368)[a]	27.47(0.513)[b]	6.98(0.058)[b]
30% Untreated beans + 70% hay	90.96(0.099)[b]	14.08(0.368)[a]	26.97(0.513)[b]	7.04(0.058)[b]
100% Hay	91.27(0.099)[b]	11.27(0.368)[b]	34.72(0.513)[a]	8.09(0.058)[a]

[ab]Means in same column with different superscripts differ significantly

Table 2 - Mean intake, nitrogen balance and rumen microbial protein yield in goats fed roasted, soaked and untreated velvet beans and hay diets			
Treatment Diets	**Nitrogen intake (g/day)**	**Nitrogen balance (g/day)**	**Microbial Protein Yield (ml)**
30% Soaked beans + 70% hay	1 767.36[a]	358.00[a]	56.69[a]
30% Roasted beans + 70% hay	1 133.97[b]	-243.94[b]	37.65[ab]
30% Untreated beans + 70% hay	1 193.97[b]	41.18[ab]	40.89[ab]
100% Hay	549.94[c]	-221.45[b]	28.13[b]

[abc]Means in same column with different superscripts differ significantly

The inclusion of velvet beans in the diets increased nitrogen intake and more importantly, soaking velvet beans significantly increased intake compared to roasted and untreated velvet beans. Goats fed diets with soaked velvet beans had significantly higher ($P>0.05$) nitrogen balance ($P<0.05$) than those fed roasted, untreatred velvet beans and 100% hay (Figure 1). This was probably because the nitrogen intake of soaked beans was higher than any other treatment. Matenga et al. (2003) reported lower levels of intake when goats were fed untreated velvet beans. This low intake of nitrogen in diets with untreated and roasted velvet beans could be attributed to presence of anti-nutritional factors which lower the nutritional value of grain legumes and subsequently reduce nutrient utilisation by animals (Mugendi et al., 2010). The positive nitrogen balance observed in goats fed diets with soaked beans probably implied that significant amounts of nitrogen were being absorbed and utilised for tissue growth.

The negative nitrogen balance obtained in goats fed diets with roasted velvet beans could be attributed to the low availability of nutrients following the heating process. Roasting and hence heating denatures proteins. Emenalom et al. (2005) concluded that roasting was a less efficient method of processing velvet beans when compared to methods such as boiling. As a treatment procedure, roasting does not reduce L-dopa but reduces the protein quality of velvet beans (Mugendi et al., 2010). From this study, soaking velvet beans before feeding to the goats led to relatively higher nitrogen balance than roasting and feeding untreated. Soaking is easy and less laborious method of processing the beans. This concurs with the observation that soaking is a better method in terms of nitrogen retention than other methods like boiling and leaching (Nyirenda et al., 2003).

There was no significant difference ($P>0.05$) in the microbial protein yield of goats fed diets with soaked, roasted and untreated velvet beans (Table 1). However, the microbial protein yield in goats fed diets with soaked beans was significantly higher ($P<0.05$) than that of goats fed diets with 100% hay as a negative control. Contrary to Matenga et al. (2003)'s assertion that velvet beans contain anti-nutritional factors capable of producing derivatives which suppress microbial activity in the rumen, this study showed that conservative inclusion of untreated velvet beans in goat diets produce comparable amounts of microbial protein to soaked and roasted velvet beans. However, Mugendi et al. (2010) reported that roasting had no significant effect on levels of L-dopa in velvet beans. This could explain the similarity in microbial protein production of roasted diet with untreated beans. Clearly, inclusion of velvet bean, treated or untreated, in goat diets increases rumen microbial protein synthesis.

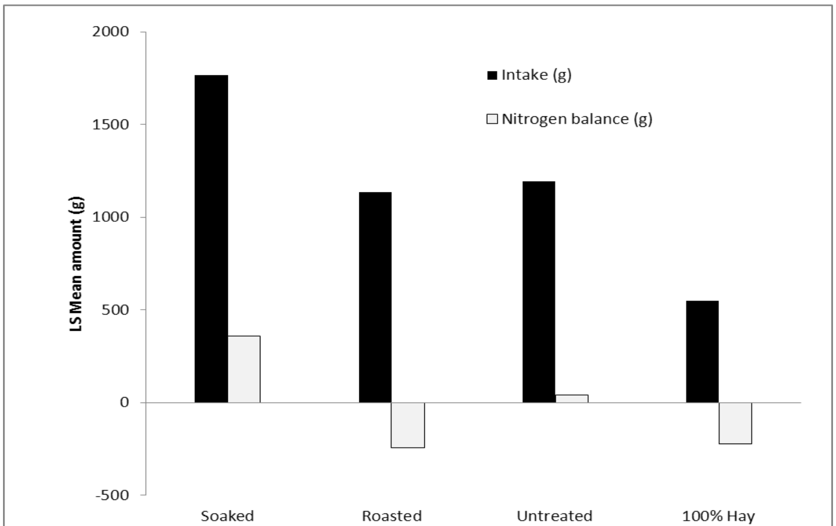

Figure 1 - Effect of treatment method on nitrogen balance and intake in goats fed roasted, soaked and untreated velvet beans and hays diets

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CONCLUSIONS

Soaking velvet beans in water increased nitrogen balance and rumen microbial protein production compared to roasting which had a negative balance and a lower microbial protein yield. Although this study indicated that the velvet beans can be used unprocessed, more studies are required to reinforce this notion.

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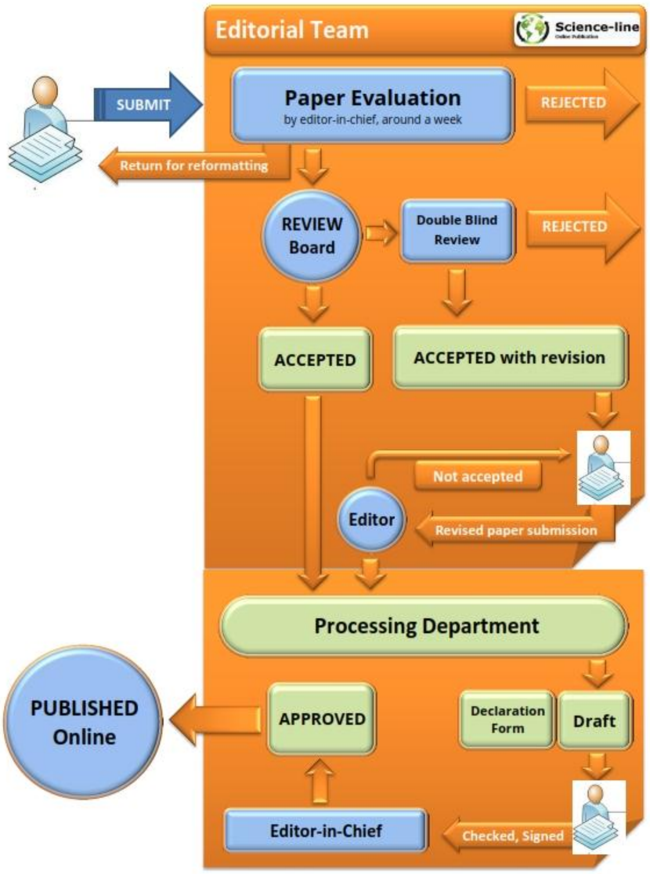

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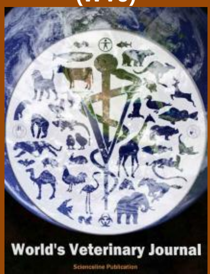

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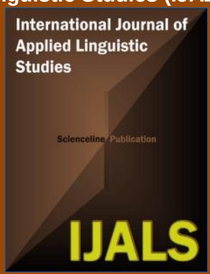

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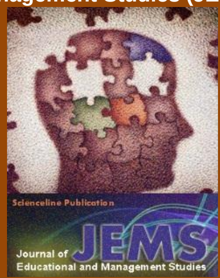

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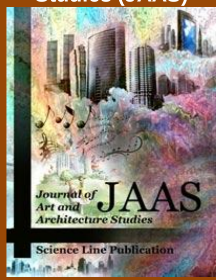

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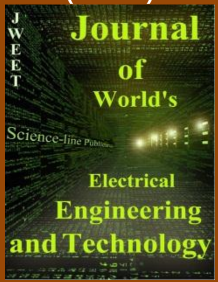

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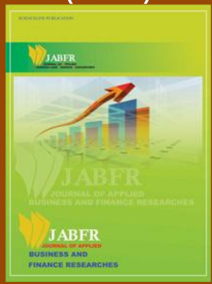

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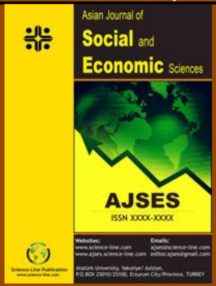

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