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EFFECT OF WHOLE-COTTON SEED SUPPLEMENTATION ON GROWTH PERFORMANCE AND HAEMATOLOGICAL PROPERTIES OF DJALLONKE SHEEP IN THE DRY SEASON

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ABSTRACT: *An 8-week feeding trial was carried out to investigate the effect of whole-cotton seed (WCS) supplementation on the growth performance and some blood constituents of Djallonke sheep fed rice straw. A total of 12 sheep with an initial weight of 13.7 ± 0.20 kg were randomly assigned to one of three treatments (four animals per treatment). The treatments consisted of no supplementation (T0) and supplementation with 200 g /head/d (T1) or 400 g/head/d (T2) on as fed basis. Feed intake, growth performance and some haematogical parameters (haemoglobin [Hb], packed cell volume [PCV], white blood cells [WBC], red blood cells [RBC]) were measured. Differential leukocyte (lymphocytes, neutriphils, eosinophils, monocytes and basophils) counts were also determined. Intake of basal diet was higher (P<0.05) for sheep supplemented with 400 g/head/d than for those receiving 200 g/head/d and WCS intake was higher (P<0.05) for sheep fed T2 than for those fed the T1 diet. Feeding the basal diet only resulted in weight loss and high mortalities. Haemoglobin concentration, PCV, and WBC and RBC counts increased with supplementation but the difference between T1 and T2 for these measurements was not significant (P>0.05). Eosinophilia increased (P>0.05) with increasing level of supplementation. This study suggests that WCS is a good source of rumen degradable protein and can help reduce the decline in growth of sheep especially in the dry season.*

Keywords: *Whole cotton seed, rumen degradable protein, Eosinophiles.*

ORIGINAL ARTICLE

INTRODUCTION

Livestock production makes numerous contributions to the lives of both rural and urban dwellers (FAO, 1991). Among the small ruminants, sheep is of more concern than goat (FAO, 1991). In Ghana, long legged and the dwarf (Djallonke) sheep are the main breeds available (Charray et al., 1992) and are efficient meat producers in the tropics due to their high prolificacy.

Natural forage is the main feed resource for sheep and goats in the tropics. Nutritional quality of natural forages however fluctuates widely between the rainy season when their nutritional value is high and dry season when they become lignified and are lower in nutritional value (Sarnklong et al., 2010). The dry season also favors rampant bush fires that destroy natural grazing lands. Consequently, feed supplementation with crop residues such as rice straw in the dry season has become necessary especially for small ruminants such as sheep. To ensure efficient utilization of such low quality crop residues in the dry season, protein supplementation is necessary to provide rumen degradable protein needed to support rumen microbial growth and improve digestibility.

Rice straw is an abundant crop residue generated from rice cultivation in the Northern region of Ghana. It has the potential to serve as a major source of feed for ruminants in the dry season but its utilization is limited by very low CP content (6%) and therefore cannot support ruminant production as a sole diet. The utilization of rice straw by small ruminants in the dry season may however be improved through protein supplementation to synchronize ruminal energy degradation of forage fiber. Whole Cottonseed (WCS) is a cheap feed resource in many countries of tropical Africa where the crop is grown. It contains 24% CP and can support the nitrogen requirement of rumen microbes fed low quality forage (Luginbuhl et al., 2000). In Ghana, 22,200 to 24,220 metric tons of cotton is

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produced annually (Karbo and Bruce, 2000). Strategic supplementation of rice straw that has lower CP content with WCS that is high in CP could help sustain sheep during dry season. Whole-cotton seed however contains gossypol that is reported to affect some haematological properties of ruminants (Calhoun et al., 1990). Haematological properties are also influenced by the nutrition of the animal (Ekenyem and Madubuike, 2007). Changes in the haematological characteristics could be used as a measure of the nutritional or physiological status of the animal but no studies have examined the effects WCS supplementation on such constituents in this region.

This study was therefore conducted to determine the effects of WSC supplementation on the feed intake, growth performance and haematological indices of Djallonke sheep fed rice straw in the dry season.

MATERIALS AND METHODS

Twelve Djallonke sheep (13.7 ± 0.20 kg) were randomly assigned to one of three treatments (T0, T1 and T2) in a completely randomized design. Animals on T0 were fed only rice straw with no supplement, T1 and T2 received 200 g/head/d and 400 g/head/d of WCS respectively. Whole-cotton seed was obtained from a commercial cotton ginnery (Ghana Cotton Company Ltd., Tamale, Ghana). Rice straw was collected from rice fields after combine harvesting, near the Department of Animal Science Farm of the University for Development Studies (UDS), Nyankpala campus. All animals were offered basal diet of 500 g rice straw separately from the supplement; the rice straw was fed in wooden feed troughs and the WCS were offered in a plastic bowls. Feed and water were offered on *ad libitum* basis. The experiment lasted for 8 weeks. The study was conducted during the dry season (December –January 2009) at the Department of Animal Science Farm of the UDS, Nyankpala campus. There were four animals per treatment and animals were housed intensively and restrained in individual pens (2.5 x 1m) on a concrete floor and fed once daily starting 09:00 in the morning. Weight of feed offered and left over were recorded daily and animals were weighed weekly for determination of feed intake of basal and supplementary diets, and growth performance of sheep respectively. Two animals in the T0 died in the 4th week of the study and the study was terminated after the third mortality occurred in the same group at the 8th week. Post mortem results on the carcass revealed that the animals died of heart water. Table 1 shows the estimated chemical composition of the basal and supplementary diets.

Table 1 - Estimated[1] Chemical composition of untreated rice Straw and whole - crop cotton seed (DM basis)

Item	Untreated rice straw (%)	Whole-cotton seed (%)
Dry Matter	89	92
Crude Protein	3.3	24.0
Crude fiber	29	20.8
Ash	12	5
Lignin	3.72	nd
Silica	15.8	nd
Calcium	0.12	0.15
Phosphorus	0.10	0.64

[1] Avornyo et al. (2007); Luginbuhl et al. (2000); nd = not determined

Blood collection and analysis

The blood samples were collected from the jugular vein of each sheep into heparin-impregnated vacutainer® using a 5 ml disposable syringe. A single blood sample was taken for each animal before the animals were introduced to the treatment diets and after the 8th week of feeding. Samples were stored in vacuum flask and sent immediately to the UDS microbiology laboratory for analysis. Samples were analyzed for haemoglobin (Hb) concentration by the cyanmethaemoglobin colorimetric method as previously described by Cheesbrough (2001). Red blood cells (RBC), white blood cells (WBC) counts, and parked cell volume (PCV) were measured by microhaematocrit and haemocytometry techniques as described by Mukherjee (2005).

Statistical Analysis

The data was analyzed by ANOVA for the effects of supplementation using GenStat® (Discovery Edition 3.0). Significant difference was declared at $P<0.05$ and difference among means were separated using the Standard Error of Differences (SED) of means.

RESULTS

Effect of WCS on intake and weight gain of Djallonke sheep

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Table 2 shows the effect of supplementation on feed intake and growth performance of sheep. Intake of the rice straw was not significantly different (P>0.05) between sheep fed T0 and T1 diets however, sheep on T2 diets had significantly higher (P<0.05) intakes than those on T0 and T1 (Table 2). Thus supplementation with WCS at 200 g/head/d did not increase intake of rice straw relative to sheep that did not receive the supplement. Similarly, sheep supplemented with 400 g/head had greater (P<0.05) intake of the supplementary diet than those receiving 200 g/head/d. The total weight gained and final weight after 8 weeks of feeding were both higher (P<0.05) for supplemented sheep than for non-supplemented ones. The loss of weight in non-supplemented sheep was associated with high mortalities in that group (Table 2).

Table 2 - Effect of WCS on intake (*as fed basis*) and growth performance of Djallonke sheep after 8 weeks of being supplemented with 0 (T0), 200 (T1) or 400 (T2) g/head/d of whole-cotton seed

Item	Treatments			
	T0	T1	T2	SED[1]
Intake of rice straw (g/d)	215[a]	201[a]	304[b]	32.3
Intake of WCS (g/d)	0.0	152.7[a]	305.3[b]	15.36
Initial weight (kg)	13.63	13.95	13.58	0
Final weight (kg)	10.25[a]	15.20[b]	15.25[b]	0.75
Total weight gain (kg)	-3.75[a]	1.25[b]	1.67[b]	0.71
Average daily weight gain (g/day)	-67.0[a]	22.3[b]	22.4[b]	13.48
Mortality	3	0	0	0

[1]Standard error of differences of means; Means in the same row with different superscripts are significantly different (P<0.05)

Effect of WCS on the haematology of Djallonke sheep

The effects of WCS supplementation on some haematological indices of sheep are presented in Table 3. White blood cells and RBC, and differential leukocyte counts of WBC for supplemented animals were within the range for Djallonke sheep kept under semi-intensive management system under similar conditions (Addah and Yakubu, 2008). Animals on the sole rice straw had significantly lower (P<0.05) Hb, PCV, WBC and RBC values. The difference between T1 and T2 was not however significant (P>0.05).

Table 3 - Effect of WCS on the haematology of Djallonke sheep supplemented with 0 (T0), 200 (T1) or 400 (T2) g/head/d of WSC

Items	Treatments			
	T0	T1	T2	SED[1]
Haemoglobin (g/dL)	8.30[a]	9.80[b]	10.65[b]	0.58
Parked cell volume (%)	25.01[a]	29.50[b]	32.00[b]	1.76
White blood cells ($\times 10^9$/L)	2.90[a]	5.95[b]	5.95[b]	0.40
Red blood cells ($\times 10^6$/µl)	3.30[a]	3.80[b]	4.15[b]	0.23
Differential leukocyte count (%)				
Lymphocyte	52.00	56.99	58.00	2.15
Neutrophils	34.50	36.50	37.00	2.69
Eosinophils	5.00[a]	7.50[b]	10.00[c]	0.79
Monocytes	0.00[a]	0.50[ab]	1.00[b]	0.35
Basophils	0.00	0.50	0.50	0.50

[1]Standard error of differences of means; Means in the same row with different superscripts are significantly different (P<0.05)

DISCUSSION

The improved growth performance of sheep fed the supplemented diets could be attributed to the provision of rumen degradable CP. Ruminal fiber utilization in ruminants fed low quality forages such as straws is limited by insufficient rumen degradable N. This decreases microbial protein synthesis and results in poor growth performance as observed in the non-supplemented sheep. The minimum CP required for sustenance of microbial growth is 6-8 % (Van Soest, 1982). A CP of 3.3 % (Table 1) for rice straw is extremely low to support microbial growth hence the loss of weight and mortalities observed for sheep on the basal diet alone. The synchronization of protein and energy in the rumen might account for the superior performance of sheep offered 400 g/head/d compared to those supplemented with 200 g/head/d. Even though cellulolytic bacteria have low maintenance requirements due to their slow growth rate, they have a higher preference for NH_3 than other sources of N. Ruminal production of NH_3 requires sufficient degradable energy. Higher levels of silica in rice straw similarly limit intake and digestibility (Agbagla-Dohnani et al., 2003; Van Soest, 2006).

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The loss of weight and eventual deaths in sheep fed the basal diet only is explained by extensive mobilization of nutrients from body tissues through gluconeogenesis. This study suggests that without protein supplementation in the dry season, farmers could suffer greater losses if animals are raised solely on rice straw. The results are consistent with those of Avornyo et al. (2007) who reported an increase in average daily weight gain when sheep were fed rice straw and supplemented with WCS but are contrary to the findings of Luginbuhl et al. (2000) and Sandra et al. (2007) who both reported a decrease in average daily weight gain of goats when WCS was fed at 30% inclusion level. The relatively poor growth performance reported by Sandra et al. (2007) for animals supplemented with WCS could be due to the high inclusion of soybean meal (17%) in the non-supplemented diet.

The WBC and RBC values for supplemented sheep were indicative of the nutritional status of the animals as those that did not receive protein supplementation consistently had lower values than those that did. The haematological indices observed for supplemented sheep were similar to those of Djallonke sheep raised semi-intensively and supplemented with WSC (Addah and Yakubu, 2008). Increase in eosinophiles levels is associated with stress (Addah et al., 2007) or disease condition (Addah and Yakubu, 2008). Gossypol might have stimulated eosinophilia in supplemented sheep but this did not affect growth performance adversely. The WBC and RBC counts however fell below the values reported by Sandra et al. (2007) who fed goats with 15% and 30% WCS. Sandra et al. (2007) observed a decline in the WBC and RBC when WCS was increased from 15% to 30%. Gossypol content of WCS varies among varieties and high levels have been found to cause fragility of the RBC (Calhoun et al., 1990).

CONCLUSION

This study suggests that WCS is a good source of rumen degradable protein and can help reduce to decline in growth of sheep especially in the dry season. It is recommended that sheep grazing on crop residues such as rice straw be given WCS as a protein supplement to maintain or increase their productivity.

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GROWTH PERFORMANCE AND ECONOMY OF REPLACING MAIZE WITH COMBINATIONS OF BREWERS' GRAINS, JACK BEAN AND CASSAVA ROOT MEAL IN BROILER FINISHER RATIONS

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ABSTRACT: *This study was done to determine the effect of complete replacement of maize with maize/sorghum-based brewers' dried grains (MSBDG), jackbean (JB) and cassava root meal (CRM) on performance of finisher broilers and the feed cost implication of using these test materials as the major energy sources. Four experimental diets T_1, T_2, T_3 and T_4 were formulated to contain maize, MSBDG, JB and CRM in the following proportions 60, 0, 0, 0%; 0, 20, 15, 25%; 0, 20, 20, 20%, and 0, 20, 25, 15% respectively. Other ingredients were the same for the four diets. One hundred and sixty eight (168) 4-week-old Hubbard broilers were divided into 4 treatment groups of 42 birds each; and each group subdivided into 3 replicates of 14 birds per replicate. Each treatment group was randomly assigned to an experimental diet in a completely randomized design (CRD) experiment. The feed intake of T_1, T_2 and T_4 birds were similar ($P>0.05$) but lower ($P<0.05$) than that of T_3 birds. There was no significant ($P>0.05$) difference in daily weight gain between T_1 (1.70g) and T_2 (1.55g) birds. The feed conversion ratio of T_1 birds was better ($P<0.05$) than T_2, T_3 and T_4 birds. The feed cost of N195.58 for T_4 required to produce 1kg meat was lower than the cost of N214.50 required for meat production in T_1. Generally, the MSBDG/JB/CRM feeds produced 1kg meat at costs 6.17%, 3.71% and 8.82% for T_2, T_3 and T_4 lower than the T_1 diet.*

ORIGINAL ARTICLE

Keywords: *Broilers, feed ingredient combinations, performance*

INTRODUCTION

The conventional energy ingredient in poultry ration is maize. Maize and/or guinea corn constitutes over 50% of the diet for the different classes of poultry (Iyayi, 2009). Since intake of other nutrients is controlled by energy intake, it becomes imperative that poultry rations contain ingredients that will supply adequate amount of energy to meet the birds' requirement for production.

Maize is a staple for humans, livestock and poultry, and now fuel. This rising demand for maize for alternative uses has driven the cost of maize upwards (Good, 2006). Nigeria has never produced enough maize to meet the demand for human consumption, the beverage industries and livestock production. Whereas in the United States, maize is grown largely for livestock feeding with about 80 – 90% maize included in the rations for cattle, in Nigeria none of the sectorial units of the nation's industry that use maize hardly get enough. It could be attributed in part to its poor yield. FMWR (2008) has reported that the potential yield of maize is about 8 tons/ha while the actual average yield is about 3.9 tons/ha. Similar pattern was reported for millet, sorghum, rice and some tubers like sweet potato and cassava.

According to Uchegbu et al. (2004), prices of feed ingredients have gone so much high that poultry producers in Nigeria are focusing on unconventional alternatives rather than on conventional ones like maize, soybean and other possible ingredients to achieve reduced cost of production. At present, the astronomical rise in the prices of these conventional ingredients (maize, soybean, groundnut cake and fish meal) has put enormous pressure on the poultry farmer to look for alternatives.

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A brief survey of literature shows that efforts have been made by researchers in Nigeria for over four decades to find alternative sources of feeds from unconventional feed ingredients that are readily available at reasonable prices (Udedibie and Emenalom, 1993; Uchegbu et al., 2004). Each of these researchers has succeeded in reducing the maize component of the diets incompletely. Thus there appeared to be no alternatives as good as maize. Hence there is need for a continued search for an ingredient or combinations of ingredients that would simulate maize in poultry diet. Maize/sorghum brewers' dried grain is the extracted residue of maize and sorghum which resulted from the production of beer. It is a moderate source of energy and contains a high percentage of protein relative to maize (Uchegbu, 1995).

Raw jackbean contains 28.5% crude protein, 7.8% crude fibre, 3.1% ether extract. However, the crude protein content of jackbean has been reported to drop to 25% after boiling or autoclaving (Udedibie, 2003); in an effort to reduce its anti-nutritional contents such as canavanine, concanavalin A, urease, canatoxin, etc. (Udedibie et al., 2004). Cassava root is abundantly produced in Nigeria, especially Eastern Nigeria, and the mature root can be left in the soil for as long as two years (Irvine, 1979), hence it is available throughout the year. Cassava root meal has been reported to be low in protein (2.4%) (Aduku, 1993) and relatively high in energy (3620 kcal/kg ME). Attempts to use cassava as a source of energy in poultry diets as replacement for maize have, however, yielded conflicting results. This is because cassava tuber contains cyanogenic glucoside, linamarin. Linamarin is deglycosylated by the enzyme, linamarase, yielding acetone cyanohydrins, which spontaneously converts to hydrogen cyanide once it is ingested (Sayre, 2007). Methods of detoxifying cassava tubers include sun drying (Odukwe, 1994) cooking, (Okeke et al., 1985), use of additives (Obioha et al., 1984) and fermentation (Udedibie et al., 2004). The price of cassava is low relative to maize, although man also consumes it. Having considered the attributes of brewers' dried grains, jackbean and cassava, it appeared that appropriate combinations of these ingredients could result in product(s) which could serve as a major energy source in complete replacement of maize in finisher broiler ration.

The objective of this study is therefore to evaluate the performance, of finisher broilers fed diets containing combinations of BDG, jackbean and cassava root meal in complete replacement of maize and the cost effectiveness of using such diets in finisher broiler production.

MATERIALS AND METHODS

Experimental Site

This research was carried out in the Poultry unit of the Teaching and Research Farm of the Department of Animal Science and Technology, Federal University of Technology, Owerri, Imo State. Imo state (4°4' - 6°3' N, 6°15' - 8°15' E) is situated in south-eastern agro-ecological zone of Nigeria.

Sources and Processing test ingredients

The maize/sorghum-based brewers dried grains used for this study was obtained from Consolidated Breweries Plc., Awo-Omamma, Imo State, the brewers of '33' Export Larger Beer. It was sundried for 5 day. The brewers dried grains was then run through a hammer mill to break up its lumps before being used in ration formulation. The jackbean used for this experiment was obtained from Jos, Plateau State. The jackbean was cracked, and then soaked in water for 2 days, boiled for 1 hour, then sundried and milled before use in the formulation of the experimental diet. The cassava tubers used for this experiment were produced at Mgbirichi – Ohaji, Imo State. The whole fresh tubers were cut in small slices of about 0.1 – 0.2cm and then spread on a platform under the sun to dry. These slices were completely dried within 5 days. The dried cassava chips were then milled to produce the cassava root meal (CRM). Each of these 3 feedstuffs (MSBDG, JB and CRM) was sent for proximate analysis using standard methods (AOAC, 1995).

Experimental diets, birds and design

Maize/sorghum-based brewers dried grains, jackbean and cassava root meal which were combined at varying proportions to completely replace maize in all the diets except in the control diet as shown in Table 1. One hundred and sixty eight (168) broiler chicks at 4 weeks of age were selected for this trial. The birds were divided into 4 groups of 42 birds each. Each group was subdivided into 3 replicates of 14 birds in a completely randomized design experiment. Each group was randomly assigned to an experimental diet. The experimental diets were weighed daily and fed to the birds at about 8:00 am. Before feeding the birds the following morning, the leftover feeds of the previous day were weighed in order to obtain a record of the daily feed intake. Water was supplied *ad libitum*. However, stale water was changed daily and drinking trough thoroughly cleaned before filling with fresh water every morning. Damp litters were usually removed and replaced with fresh ones.

Data collection

The birds were weighed at the beginning of the experiment and weekly thereafter. Feed intake was determined by the difference between the quantity offered and the leftover the following morning. The experiment lasted for 5 weeks. Data were collected on initial body weight, final body weight, daily weight gain, feed intake, feed conversion ratio, and mortality.

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Data analysis

Data collected on daily weight gain, feed intake and feed conversion ratio were subjected to one-way analysis of variance (ANOVA). Where significant treatment effects were detected from the ANOVA, means were compared using Duncan's new multiple range test as outlined by Steel and Torrie (1980).

Table 1 - The ingredient compositions of experimental diets fed to finisher broilers

Ingredient	Diets (% inclusion levels of test ingredients)			
	T_1	T_2	T_3	T_4
White maize	60.00	-	-	-
MSBDG	-	20.00	20.00	20.00
Jackbean	-	15.00	20.00	25.00
Cassava root meal	-	25.00	20.00	15.00
Calculated nutrient analysis (%)				
Crude protein	19.56	21.75	22.71	23.67
Crude fibre	4.27	6.80	7.05	7.31
Ether extract	4.04	3.46	3.67	3.60
Calcium	1.26	1.38	1.37	1.37
Phosphorus	0.81	0.94	1.06	0.97
ME (Kcal/Kg)	2906.89	2549.95	2532.41	2514.88

Each data contained 14% soybean meal, 10% wheat offal, 4% palm kernel cake, 3% fishmeal, 2% *Alchornea* leaf meal, 3% blood meal, 2% bone meal, 1% oyster shell, 0.25% methionine, 0.25% lysine, 0.25% vitamin / mineral premix, 0.25% common salt. Vitamin / mineral premix contributed the following per kg of feed: vitamin A, 5,000,000 I.U.; vitamin D_3, 1,000,000 I.U.; vitamin E, 16.0g; vitamin K, 1.0g; vitamin B_1, 0.509 mg; Riboflavin, 2 - 4 mg; pyridoxine, 0.35 mg; niacin, 3.5 mg; biotin, 0.005 mg; choline chloride 30.0 mg; folic acid 0.1 mg; vitamin B_{12}, 0.002 mg; vitamin C, 2.50 mg; manganese, 10.0 mg; zinc, 4.5 mg; Copper 0.20 mg; iron 5.0 mg; methionine 2.0 mg; calcium panthothenate 1.0 mg.

RESULTS AND DISCUSSION

The result of the proximate values of maize/sorghum-based brewers' dried grains, jackbean, cassava root meal and maize is shown in Table 2. The crude protein of MSBDG (19.14%) was lower than the crude protein of jackbean (22.84%). The crude protein value of maize (9.0%) was higher than that of CRM (3.59%). The crude fibre values of MSBDG, JB and CRM were 9.45%, 8.80% and 3.70% respectively; and each of these was higher than the crude fibre value of maize (2.8%).

Table 2 - Proximate Composition of Maize/Sorghum-based brewers' dried grains (MSBDG), Jackbean (JB), Cassava Root Meal (CRM) and Maize

Nutrient	MSBDG	JB	CRM	Maize
Moisture content (%)	12.80	13.05	12.25	10.50
Dry matter (%)	87.20	86.95	87.75	89.50
Crude protein (%)	19.14	22.84	3.59	9.0
Crude fibre (%)	9.45	8.80	3.70	2.8
Ether extract (%)	7.08	2.08	0.70	4.2
Ash	4.30	4.00	2.40	1.5
Nitrogen free extract (%)	47.23	49.23	77.36	72.0
HCN (mg / 100g)	-	-	2.81	-

The crude protein content of cracked, soaked and cooked jackbean (22.84%) was lower than 25.5% which is the CP value for jackbean cooked for 1 hour as reported by Udedibie (2003). The cassava root meal is lower than MSBDG and Jackbean in both crude protein and crude fibre but higher in metabolize energy.

The feed intake of the control birds (T_1) was similar ($P>0.05$) to that of the T_4 birds. The feed intake of bird on T_3 was significantly ($P<0.05$) higher than that of T_1 and T_4. There was a general increase in feed intake values arising from the various combinations of MSBDG, JB and CRM, and this reflected the lower energy values of these diets relative to the control – a condition which encouraged increased feed intake to enable the birds meet their energy requirement (Hill and Dansky, 1954). However, the drop in feed intake of the group on T_4 despite its least energy value could be attributed to its high fibre (7.31%) which was quite above the recommended value of 5.5% for finisher broilers (Obioha, 1992).

There was no significant ($P>0.05$) difference in average daily weight gain between T_1 and T_2 birds. The birds on T_3 and T_4 had significantly ($P<0.05$) lower daily weight gain than the control (T_1) (Table 3). The reason for the similarity in the daily weight gain of the birds on T_1 and T_2 could be associated with the fact that the crude fibre content of T_2 was not high enough as to impede feed consumption and utilization; thus the birds were able to compensate for low energy value of the diet by increasing consumption. The feed conversion ratio of T_1 birds was significantly ($P<0.05$) lower and better than that of T_2, T_3 and T_4 birds, which were similar. This agrees with the report of Afolayan et al.

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(2009) that birds on lower energy diet would have poor feed conversion efficiency when compared with high energy diet whether in wet, hot or cold season. Birds on low energy diet and high fibre consume more water than those on high energy diet across the three seasons, thus explaining its lower feed intake, lower metabolizable energy as water is consumed at the expense of feed. The number of birds that died in T_1 and T_4 was 1 each, and no death recorded in T_2 and T_3. The mortality records were quite low and were not ascribed to the experimental diets.

Table 3 - Performance of finisher broiler fed combinations of maize/sorghum-based brewers' dried grains, jackbean and cassava root meal

Parameters	T_1	T_2	T_3	T_4	S.E.M
Mean initial body weight (kg)	0.47	0.47	0.47	0.49	0.012
Mean final body weight (kg)	2.17^a	2.04^{ab}	1.97^b	1.93^b	0.053
Daily body weight gain (kg)	1.70^a	1.55^{ab}	1.50^b	1.45^b	0.054
Daily feed intake (g)	48.57^a	44.29^{ab}	42.86^b	41.42^b	1.547
Feed conversion ratio (g feed/ g wt.)	2.80^b	3.41^a	3.56^a	3.43^a	0.148
Mortality	1	-	-	-	-

^{a,b} Means in the same row bearing different su1perscript are significantly ($P<0.05$) different; S.E.M - Standard error of mean.

In terms of feed cost required to produce one kilogram of meat, T4 diet had the least cost of production of N195.58 per kg meat produced while the T_1 (control) recorded the highest cost of N214.50 per kg meat produced (Table 4). Therefore, based on the cost of feed required to produce 1kg meat, the various combinations of MSBDG, JB and CRM which resulted in diets T_2, T_3 and T_4 produced 1kg broiler meat at rates 6.17%, 3.71% and 8.82% cheaper for T_2, T_3 and T_4 than the maize based diet (T_1).

Table 4 - Feed cost evaluation of various combinations of MSBDG, JB and CRM in broiler finisher diets

Parameters	T_1	T_2	T_3	T_4
Kg feed / kg weight gain	2.89	3.41	3.56	3.43
Cost of feed (US$ / Kg) [1]	0.53	0.42	0.41	0.41
Cost of feed / kg weight gain (US$)	3.42	3.83	3.97	3.84
Cost reduction (%)[2]	0.00	6.17	3.71	8.82

[1] Cost of feed was determined based on prevailing ingredient costs. [2] Relative to the control.

CONCLUSION

This experiment has revealed that maize could be replaced completely with maize/sorghum-based brewers' dried grains, jackbean and cassava root meal at 20 : 15 : 25 for finisher broiler, producing similar growth rate to the control diet. The superiority of maize-based diet (control) over 20 : 15 : 25 as evidenced in lower feed intake and lower feed conversion ratio is compensated for by the lower feed cost required to produce 1kg weight of broiler meat using MSBDG/Jackbean/CRM combination.

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GROUNDNUT OIL IMPROVES TENDERNESS, JUICINESS AND CONSISTENCY OF BEEF SAUSAGES

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ABSTRACT: *This study was conducted to determine the effects of crude groundnut oil (GO) on the storability and sensory characteristics of comminuted beef sausages. Boneless beef was thoroughly trimmed of all visible fatty and connective tissues, minced and freshly prepared GO was added during comminution to formulate sausages at three levels (5%, 10% and 15%) of oil inclusion, and compared with products formulated with only lean beef. Sensory and laboratory analyses were conducted weekly for 3 weeks. The results indicated that the GO products were more tender, juicier and smoother than sausages formulated with only lean beef. The GO products had intense groundnut flavour, no effect on flavour liking but enhanced product acceptability. In addition, the GO increased the unsaturated fatty acid content of the products, had no significant effect on lipid per-oxidation and product stability in storage. It is recommended that groundnut oil is used in beef sausages up to 15% inclusion, on weight basis for improved sensory and acceptability of the products.*

ORIGINAL ARTICLE

Keywords: *Beef sausages, vegetable fats, beef fat, sensory*

INTRODUCTION

Products from meat processing firms are widely accepted by meat consumers due to the increasing demand for convenient meals. Beef products however, have not caught on well with most consumers although such products have limited religious and tribal barriers compared with pork (Teye, 2010). This is because beef cattle in Ghana are sold at their later stages of productivity, making their meat tough and dry with little or no marbling fats. Secondly, the fat of beef is reported to be high in saturated fatty acids, which are believed to be directly related to cardiovascular risk factors (Hongbao, 2006; Sharma et al., 2011). Moreover, when the fat of beef cools, it solidifies and exhibits a "greasy" sensation in the mouth of consumers when such products are consumed (Warriss, 2010). Technologically, the hard fat has high tendency of separating from the muscles to form fat-pockets in the casings of sausages (Teye, 2010); a condition which is aesthetically not appealing.

In view of these, beef products in Ghana are made using only lean beef without fat (Teye, 2010). Meanwhile, fat is reported to play a major role in the texture, juiciness and flavour of comminuted meat products (Crehan et al., 2000). Drewnowski (1992) also reported that the sensory properties of fat make a diet flavourful and rich. Elsewhere, the fats of pork and chicken are used to substitute beef fat in comminuted beef products, as these have lower levels of saturated fatty acids than beef fat (Ambrosiadis et al., 1996). However, religious barrier against the consumption of pork hinders the use of pork fat in beef products especially in northern Ghana, as most meat consumers here are Moslems. Chicken fat is not available in large quantities for use as a substitute for beef fat.

There is therefore the need to find alternative fats which are less saturated and with better sensory characteristics than beef fat, for use in beef sausages to improve the sensory characteristics. One of such with potential for use is groundnut oil (a vegetable fat).

Vegetable fats are relatively higher in unsaturated fatty acids (65%), compared with beef fats (46%) and therefore have fewer health concerns (Paneras and Bloukas, 1994). Groundnut oil is locally extracted by market women in northern Ghana, and is used in most homes on daily basis for the preparation of various meals. The potentials of vegetable oils as fat substitutes were realized when used to substitute pork fat in low-fat frankfurters (Paneras and Bloukas, 1994).

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This work was therefore aimed at investigating the potentials of groundnut oil as fat substitute on the storability, sensory characteristics and overall acceptability of beef sausages.

MATERIALS AND METHODS

The research was conducted at the Meat Processing Unit and Laboratories of the University for Development Studies, Tamale. The Iodine Value (IV) of the fatty acids in the products was determined at the Food Laboratories of the Ghana Standards Board, Accra, Ghana.

Acquisition of vegetable oil

Freshly prepared crude-groundnut oil was obtained from the local market for use. The oil was used to formulate products at three levels T2 (5%), T3 (10%) and T4 (15%) of minced beef on weight basis, and compared with products formulated with only lean beef (T1) as control.

Sausage preparation

The single factor research design was employed in this study. Fresh boneless beef from the hindquarters of mature bulls was obtained from the Meat Processing Unit of the University for Development Studies, thoroughly trimmed of all visible connective tissues and fats, cut into smaller sizes and minced using a 5mm-sieve table top mincer (Talleres Rommon, Spain). The minced meat was divided into groups of 4kg and the oil was randomly assigned to the meats to formulate the products. Each treatment was replicated twice. The minced meat in the T2, T3 and T4 were mixed with the apportioned oils in a 10-litre plastic bowl and allowed to stand for 10 minutes before comminution, to enable the meat to absorb the oil. The following ingredients were also added in equal amounts (g/kg) to the various formulations of sausage meat: 15.0g curing salt, 0.5g red chillies, 1.0g black pepper, 1.0g white pepper and 2.0g "adobo" (pre-formulated spices). Crushed ice (1.0kg) was added during comminution to regulate the temperature, as well as attain desired consistency of meat batter. The mixture was comminuted in a 3-knife bowl chopper (Talleres Rommon, Spain) until a meat-batter temperature of 17°C was attained. The meat batter was immediately stuffed into natural casings, using a hydraulic stuffer (Talleres Rommon, Spain) and manually linked into similar length of about 10cm. The sausages were weighed and then hung on smoking racks and smoked for an hour after which they were scalded to a core temperature of 70°C. The sausages were cooled in cold water and hung on the racks again for excess water to drain. The sausages were packed in transparent polythene bags and vacuum-packed, labelled and stored in a refrigerator at 2°C for sensory and laboratory analyses at later dates.

Sensory evaluation

A total of twenty (20) panellists, comprising staff and students were randomly selected and trained according to the British Standard Institution (BSI, 1993) guidelines to evaluate the products. The sausages were thawed and warmed in an oven (Turbofan, Blue seal, UK), sliced into uniform sizes (about 2cm in length) and wrapped with coded aluminium foils and presented to the panellists. Each panellist was provided with water and pieces of bread to serve as neutralizers between the products. An eight-point category scale, as described by Keeton (1983), was used to rate the sensory characteristics of the products.

Internal colour: 1=extremely pale red; 2=very pale red; 3=moderately pale red; 4=slightly pale red; 5=slightly dark red; 6=moderately dark red; 7=very dark red; 8=extremely dark red

Tenderness: 1=extremely tough; 2=very tough; 3=moderately tough; 4=slightly tough; 5=slightly tender; 6=moderately tender; 7=very tender; 8=extremely tender

Juiciness: 1=extremely juicy; 2=very juicy; 3=moderately juicy; 4=slightly juicy; 5=slightly dry; 6=moderately dry; 7=very dry; 8=extremely dry

Consistency: 1=extremely smooth; 2=Very smooth; 3=moderately smooth; 4=slightly smooth; 5=slightly coarse; 6=moderately coarse; 7=Very coarse; 8=extremely coarse

Groundnut flavour intensity: 1=extremely strong; 2=very strong; 3=moderately strong; 4=slightly strong; 5=slightly weak; 6=moderately weak; 7=very weak; 8=extremely weak

Flavour liking/ acceptability: 1=Like extremely; 2=Like very much; 3=Like moderately; 4=Like slightly; 5=Dislike slightly; 6=Dislike moderately; 7=Dislike very much; 8=Dislike extremely;

Chemical analysis and pH of products

The sausages were analyzed for lipid per-oxidation (peroxide value), moisture, crude protein and fat contents according to the methods of the AOAC (1999). In addition, Iodine Value of the products was determined according to the methods of the ISO (1996). Analyses were conducted in triplicates; all reagents were of analytical grade. For determination of the pH, 10g samples were homogenized with 50 ml distilled water and pH value was measured with a digital pH-meter (CRISON, Basic 20).

The data obtained were analyzed using the General Linear Model (GLM) of Analysis of Variance (ANOVA) of the Minitab Statistical Package, version 15 (MINITAB, 2007). Where significant differences were found, the means were separated using Tukey Pair Wise comparison, at 5% level of significance.

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RESULTS AND DISCUSSION

Sensory evaluation of products

Table 1 - Sensory characteristics of the sausages

Parameters	T1	T2	T3	T4	SED	Sig.
Color	4.35	4.50	4.10	4.30	0.67	Ns
Tenderness	4.25^{b}	4.05^{b}	4.60^{b}	5.85^{a}	0.86	***
Juiciness	4.45^{a}	3.70^{ab}	2.8^{b}	3.40^{b}	0.74	***
Consistency	5.90^{a}	4.55^{b}	3.95^{b}	1.85^{c}	0.66	***
G'nut flavor intensity	6.25^{a}	5.20^{ab}	4.80^{b}	3.95^{c}	0.82	***
Flavor liking	2.70	2.35	2.70	2.50	0.66	ns
Overall Acceptability	3.85^{a}	3.05^{ab}	2.25^{bc}	2.05^{c}	0.85	***

SED= Standard error of difference, ^{abc}Means in the same row with different superscripts are significant ns= not Significant, ***= Significant (P<0.001), G'nut=Groundnut

The products were offered to the panellists for sensory evaluation and the results are presented in Table 1. There were no significant differences (P>0.05) in the color and flavor liking of the products (Table 1). Meat purchasing decisions are influenced more by product appearance than any other quality factor (Lawrie and Ledward, 2006); color and flavor represent perceived freshness and are of vital importance to the meat industry and meat science research (Mancini and Hunt, 2005). The similar color of the products is an indication that the use of GO will not result in beef sausages which are different from the standard products.

The GO resulted in sausages which were tenderer, juicier and with smoother consistency (P<0.001) than those formulated with only lean beef (Table 1). Tenderness is regarded as the most important sensory attribute affecting meat acceptability (Warkup et al., 1995). Tenderness has also been identified as the most critical eating quality characteristics, which determines whether consumers are repeat buyers (Lawrie and Ledward, 2006). Several research works reported an increased juiciness and tenderness with an increase in fat content in meat products (Berry and Wergin, 1993; Troy et al., 1999). Fat in meat products plays a major role in improving water holding capacity and binding properties, forming rheological and structural properties that trap moisture in the products to improve juiciness (Hughes et al., 1997; Pietrasik and Duda, 2000).

Some consumers of beef sausages describe it as tough and dry, hence do not patronize it. The GO improved the tenderness and juiciness of these products. The acceptability of the products with GO products was consequently enhanced (P<0.001).

Proximate compositions of products

Table 2 - Proximate composition of the sausages

Parameters	T1	T2	T3	T4	S.e.d.	Sig.
Moisture	76.91_{a}	75.69_{a}	71.71_{b}	67.98_{c}	0.46	***
Crude protein	20.31_{ab}	22.06_{a}	18.54_{ab}	17.06_{b}	0.96	*
Fat (ether extract)	6.44_{b}	10.37_{a}	10.61_{a}	11.07_{a}	1.49	***

^{abc}Means in the same row with different subscripts are significantly different. S.e.d=standard error of difference, sig=significance, *=significant (P<0.05), ***=significant (P<0.001)

The moisture, crude protein and fat (ether extract) contents of the products are presented in Table 2. There was a reduction in the moisture (P<0.001) and crude protein (P<0.05) contents of the products with an increase in oil inclusion. Serdaroglu and Rmencioglu (2004), observed a significant reduction in moisture content with an increase in fat level in meatballs. Dzudie et al., (2002), also reported a reduction in moisture and protein contents with increasing levels of fat in ground beef formulations.

During the comminution of meat, the muscle proteins form 3-dimensional matrices that trap moisture and fat to minimize their loss (Xiong, 1997; Warriss, 2010). Fat and moisture compete for space in the protein matrices, and therefore a higher fat content in meat will leave few muscle protein-matrices to bind water, and that could have resulted in the lower moisture content of products with GO. However, when some of the moisture is trapped in products with higher fat contents, the fat acts as a barrier to prevent the rapid loss of moisture during product storage (Pietrasik and Duda, 2000). This might have accounted for the higher level of juiciness in the experimental products, although they had lower moisture contents.

The fat levels were significantly increased with increase in oil inclusions (Table 2). The rate of increase however, did not reflect the quantities added during the product formulation. The T3 and T4 products were expected to have fat

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levels exceeding 10 and 15 percent respectively, but these were quite lower than what was expected (Table 2). This might be due to losses during cooking of the products.

Cooking of meat and meat products results in losses of fats from them (Dzudie et al., 2002). Serdaroglu and Rmencioglu (2004) reported a decrease in fat retention with an increase in fat levels in meatballs, and higher fat retentions observed in products with the least fat contents. This is because as fat content increases, the mean free distance between fat droplets decreases, this phenomenon causes fat coalescing and then leaks out from the product (Tornberg et al., 1989).

pH of products

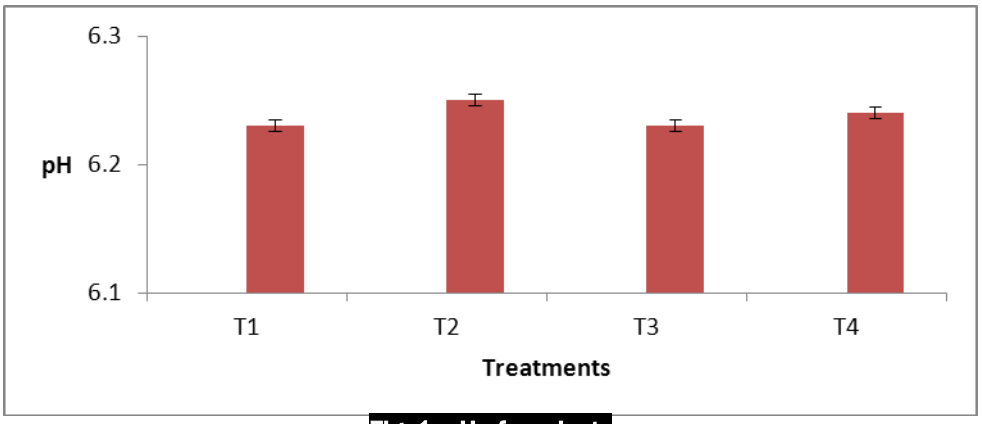

Fig. 1. pH of products

The pH of the products was taken and presented in Fig. 1. The pH of the products was not significantly different ($P>0.05$) at the various levels of GO inclusions (Fig. 1).

Several research works reported the significance of pH on microbial stability of meat products. Higher pH makes meat products susceptible to microbial attack and multiplication (Warriss, 2010). Lower pH of meat is a result of anaerobic glycolysis, where glycogen reserves in the muscles are channelled in to the production of lactic acid in cells of muscles (Incze, 1992; Lawrie and Ledward, 2006). This makes the muscles acidic and hence creates an unfavourable condition for microbial activities, thus improves their storability (Lawrie and Ledward, 2006). Since the pH of the products did not vary considerably, it is not expected that the use of groundnut oil will have an adverse effect on the microbial stability of the products.

Iodine value of fatty acids in the products

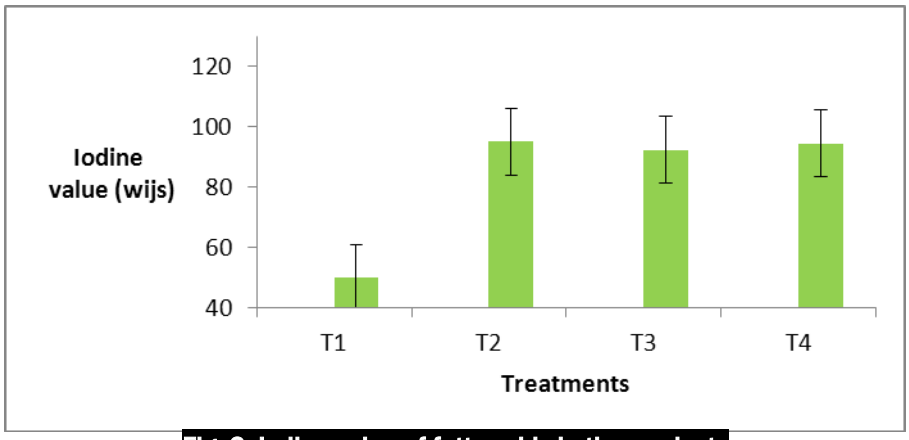

Fig. 2. Iodine value of fatty acids in the products

The iodine value (IV), which is the degree of unsaturation of fatty acids in the fats of the prepared sausages, was analyzed and the results are presented in Fig. 2. The IV of the fatty acids in the GO products was higher ($P<0.05$) than the Control products (Fig. 2). According to Wood (1984), vegetable fats are higher in unsaturated fatty acids than animal fats. The GO therefore increased the level of unsaturated fatty acids in the product.

Excessive intake of dietary saturated fatty acids has been associated with the development of hypertension, cardio-vascular diseases and obesity (Bruhn et al., 1992; Hongbao, 2006). A diet containing fats of the unsaturated fatty acids on the other hand, has been shown to be beneficial in the prevention of atherosclerosis and coronary heart

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disease (Wolfram, 2003; Russo, 2009). Long-term diets containing monounsaturated fatty acids have been shown to reduce platelet aggregation and decrease plasma LDL-cholesterol levels (Smith et al., 2003). Unsaturated fatty acids are also very essential in the body for balancing of hormones, keeping of skin and arteries supple, lubrication of joints as well as forming a component of body cells (Tabas, 2002).

Lipid per-oxidation (Per-oxide value) in the products

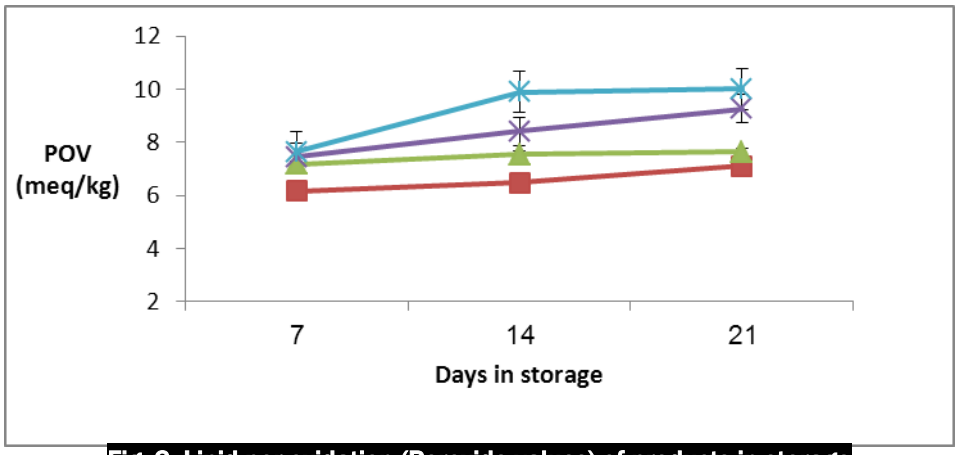

Fig. 3. Lipid per-oxidation (Peroxide values) of products in storage

The peroxide values (POVs) of the products were determined on the 7th, 14th and 21st days of storage, and the results are presented in Fig. 3. The POVs of the products ranged between a minimum of 6.17 and 10.02 mill equivalent/kg products. The POVs increased with an increase in GO inclusion in the products. The values also increased with an increase in the duration of storage.

Lipid per-oxidation in food is of importance, in that it progresses at faster rates in fats rich in unsaturated fatty acids, than those high in saturated fatty acids (Warriss, 2010). The unsaturated and polyunsaturated fatty acids present in these, react with oxygen to form fatty acid hydro-peroxides. Hydro-peroxides are unstable, and breakdown into various compounds which can produce off-flavors; leading to a stale, rancid flavor in foods (Kerler and Grosch, 1996).

Among the products however, the peroxide values were significantly lower than 25 mill equivalent/kg sausage, which is considered as the limit of acceptability in fatty foods (Evranuz, 1993; Narasimhan et al., 1986). The acceptability of the products was also not adversely affected, indicating that rancidity in the products was not pronounced.

CONCLUSIONS

The use of GO in beef sausages resulted in products which were more tender, juicier, smoother and with higher acceptability than those formulated with lean beef. The GO products had higher levels of unsaturated fatty acids, and no adverse effect on the storability of the products. It is recommended that groundnut oil is used in beef sausages up to 15% inclusion for improved product acceptability.

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EFFECT OF REPLACEMENT OF MAIZE WITH CASSAVA ROOT MEAL FORTIFIED WITH PALM OIL ON PERFORMANCE OF STARTER BROILERS

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ABSTRACT: *The effects of replacement of maize with cassava root meal fortified with palm oil on performance of starter broilers were determined in a 28-day feeding trial. Five experimental broiler starter diets were formulated such that diet T_1 (control) contained 60% maize. Diets T_2, T_3, T_4 and T_5 were formulated such that they contained cassava root meal (%), fortified with palm oil (%) in the proportions of 8:2, 16:4, 24:6 and 32:8 respectively, in replacement of maize. The diets were fed to broilers in a completely randomized design experiment replicated thrice. Each replicate contained 10 birds. Birds fed T_2, T_3 and T_4 diets had statistically ($P>0.05$) similar daily feed intake and daily weight gain values with the control group except T_5 birds that had significantly ($P<0.05$) lower daily feed intake and daily weight gain. Feed conversion ratios of the birds on cassava root meal and palm oil diets compared favorably with the control except for the T_5 group which recorded a significantly ($P<0.05$) higher feed conversion ratio. The least cost (US$ 0.85) per kg meat produced was recorded with the birds on T_1 diet and followed by the T_3 (16:4%) birds. It is therefore concluded that maize as a dietary energy source in poultry diet is nutritionally superior to cassava root meal fortified with palm oil.*

ORIGINAL ARTICLE

Key words: *Chicks, cassava root meal, palm oil, performance*

INTRODUCTION

The high cost of maize arising from inadequate maize production and competing use of the available feedstuff for human consumption and animal feed (Okorie, 1982; Ohwofa, 1993; Oyedeji, 2002). This has contributed to the unprecedented increase in feed costs to the point of it constituting over 90% of poultry farm recurrent expenditure (Igboeli, 2001).

One of the major challenges to researchers in the tropics is the provision of alternative feeds for monogastric animals. Maize a conventional feedstuff has remained the major energy source in compounded diets for poultry and other non-ruminants. The various uses to which maize is being committed, such staple food for man, brewing and confectionary, has placed additional cost constraints on its continued use in poultry diets. The solution is to explore the use of alternative feed ingredients, hitherto under exploited by poultry farmers (Udedibie et al., 2004; Durunna et al., 2005). Among the alternative feedstuff which could be used as energy sources for poultry diet even though it is lower in protein and other essential nutrients (Longe and Oluyemi, 1977; Odukwe, 1994).

However, one serious set - back in the use of cassava as feedstuff for monogastric is it content of cyanogenic glucosides, linamarin and lotaustralin, which on hydrolysis inside the animal body produces hydrogen cyanide which is highly toxic (Nartley, 1973; Hill, 1977). Okeke (1980) reported that for cassava root meal to be used in poultry diets, it has to be processed so as to reduce its total cyanide content from 360 mg kg^{-1} to about 15 - 20 mg kg^{-1}. Various methods have been devised for detoxifying cassava root meal. These include cooking (Okeke et al., 1985), soaking in water (Rajaguru, 1975), sun drying (Odukwe, 1994), and use of additive (Obioha et al., 1984; Odukwe, 1994). Tewe et al. (1980) and Formunyam et al. (1980) have reported that sun-drying and the addition of palm oil have been shown to be effective in reducing the rate of hydrolysis of cyanogenic glycosides in cassava to produce hydrogen cyanide.

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However, there is a paucity of information on the effect of replacement of maize with cassava root meal fortified with palm oil on performance of broiler chicks. The objective of the current investigation was to study the effects of replacement of maize with cassava root meal fortified with palm oil on the performance of starter broilers.

MATERIALS AND METHODS

Experimental location

This research was conducted at the Poultry Unit of the Teaching and Research Farm of the Department of Animal Science and Technology, Federal University of Technology, Owerri, Imo State. Owerri is situated in south-eastern agro-ecological zone of Nigeria, and lies between latitude 4°4' and 6°3' N and longitude 6°15' and 8°15' E. The agro-climatic data of Owerri has been reported by MLS (1984).

Procurement and processing of cassava root meal

Fresh cassava tubers were purchased at Umunze in Anambra state, Nigeria. The cassava tubers were sliced into 1cm thick flakes for effective drying. The sliced cassava tubers were sun dried for about nine hours for nine days. The dry cassava flakes were milled using a hammer mill (screen size) to produce cassava root meal before they were incorporated into the rations.

Composition of diets

Five experimental broiler starter diets provided as a mash were formulated such that diet T_1 (control) contained 60% maize. Diets T_2, T_3, T_4 and T_5 were formulated such that they contained cassava root meal, fortified with palm oil (%) in the proportions of 8: 2, 16: 4, 24: 6 and 32: 8 respectively, in replacement of maize. The chemical composition of the cassava root meal and maize are shown in Table 1. In addition, the calculated chemical compositions of the formulated diets are shown in Table 2.

Table 1 - Proximate composition of cassava root meal and maize

Component	Cassava root meal	Maize
Moisture content (%)	14.10	12.00
Crude protein (%)	3.22	8.50
Crude fibre (%)	5.00	2.80
Ether extract (%)	0.50	4.24
Ash (%)	2.65	1.35
Nitrogen free extract (%)	74.53	71.10
HCN (mg/100g)	3.46	-
ME* (kcal/Kg)	2235.40	3001.20

*Determined according to Morgan et al. (1975): HCN - Hydrogen cyanide; ME - Metabolisable energy

Table 2 - Ingredients composition of the experimental diets (%) for broiler starter

Component	Dietary treatment				
	Control (T_1)	T_2	T_3	T_4	T_5
Maize (%)	60.00	50.00	40.00	30.00	20.00
Cassava root meal (%)	-	8.00	16.00	24.00	32.00
Palm oil (%)	-	2.00	4.00	6.00	8.00
Calculated chemical composition					
Crude protein (%)	21.50	21.02	21.11	21.10	21.01
Crude fibre (%)	3.80	4.13	4.47	4.81	5.14
Ether extract (%)	3.86	5.46	7.07	8.65	10.23
Ash (%)	3.32	3.43	3.54	3.67	3.77
ME (Kcal/kg)	2932.31	2931.79	2931.75	2931.52	2931.10

*Each diet contained 24% Soybean bean meal, 2% Palm kernel cake, 3% Wheat offal, 4% fish meal, 3% Blood meal, 2% bone meal, 1% oyster shell, 0.25% lysine, 0.25% Methionine, 0.25% vitamin/mineral premix and 0.25% common salt. ME – Metabolisable energy.

Experimental birds and their management

One hundred and fifty (150) day old unsexed broiler chicks of Hybro strain were procured and weighed. They were randomly allotted to five treatment groups of 30 birds each, with ten birds constituting a replicate, in a completely randomized design (CRD). The birds were raised under identical environmental and management conditions. Feed and water were provided *ad-libitum*. The broilers were weighed individually in all the groups and average weight determined at the beginning of the experiment and weekly thereafter. The experiment lasted for 28 days.

Parameters measured

Initial live weights of the birds were taken. Daily feed intake was determined by the difference between the quantity of feed offered the previous morning and the quantity of leftover the following morning. Weight gain was

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determined by obtaining the difference between initial weight of each group and its final weight on the 28th day of the experiment. Data on feed intake and weight gain were used to calculate the feed conversion ratio. Feed conversion ratios were calculated by dividing the total feed intake per bird by total weight gain. Feed cost per kilogram (kg) was calculated based on the prevailing market prices of ingredients. Data collected were subjected to analysis of variance and Duncan's New Multiple Range Test used to detect differences among means (Steel and Torrie, 1980).

Economic analysis

Cost analysis was carried out at the end of the feeding trial to assess the economic viability of ingredient used. The cost kg^{-1} feed ingredient used and that of the diets were noted. The mean feed intake was used to calculate the mean cost of feed consumed by the birds under each treatment.

RESULTS

The data on effects of replacement of maize with cassava root meal (CRM) fortified with palm on the performance characteristics of starter broilers are presented in Table 3. There were significant ($P<0.05$) reductions in average daily feed intake, average final weight gain and average daily weight gain of starter broilers fed T_5 diet relative to the groups fed T_1, T_2, T_3 and T_4 diets. Feed conversion ratio of birds on T_5 diet was significantly ($P<0.05$) higher than that of the groups fed T_1, T_2 and T_3 diets. However, feed conversion ratio for the birds fed control diet was not different from ($P>0.05$) to birds fed T_2, T_3 and T_4 diet. Similarly, there were no significant differences in cost of feed and cost of feed/kilogram meat produced ($P<0.05$) among the groups.

Table 3 - Effects of replacement of maize with cassava root meal fortified with palm oil on body weight gain feed intake, feed conversion ratio and feed cost analysis of starter broilers

Parameters	Replacement levels of palm oil fortified cassava root meal					SEM
	T_1	T_2	T_3	T_4	T_5	
Avg. initial body wt. (g)	130.35	130.33	130.34	130.31	131.32	0.41
Avg. final body wt. (g)	1279.37[a]	1183.08[a]	1183.08[a]	1135.89[a]	976.38[b]	51.09
Avg. daily wt. gain (g/day)	41.04[a]	37.60[a]	37.60[a]	35.91[a]	30.18[b]	1.83
Avg. daily feed intake (g/d)	87.00[a]	84.00[a]	83.00[a]	83.00[a]	74.00[b]	2.23
Feed conversion ratio	2.12[b]	2.23[b]	2.19[b]	2.31[ab]	2.45[a]	0.06
Cost analysis						
Cost of feed (US$ /Kg)	0.40	0.39	56.80	0.40	0.40	-
Cost of feed / Kg meat (US$)	0.85	0.89	0.87	0.92	0.97	-

[ab]Means within a row with different superscripts are significantly ($P<0.05$) different; SEM- Standard error mean

DISCUSSION

The proximate composition of maize revealed a lower metabolisable energy (3001.20 Kcal/kg) value when compared with the values of 3440 kcal/kg and 3432 Kcal/kg reported by Obioha (1992) and Aduku (1990) respectively. The cassava root meal used in the present study is lower in both crude protein (3.22%) and metabolisable energy (2235 Kcal/Kg), but higher in fibre (5.0%) relative to maize which had 8.50%, 3001.20 Kcal/Kg and 2.80% for crude protein, metabolisable energy and crude fibre respectively. The moisture content values for maize (12.00%) and cassava root meal (14.10%) used in the present study were slightly higher than 12.25% for cassava root meal and 10.50% for maize earlier reported by Uchegbu (2005).

The superiority of T_1 diet over the other is evidence that maize, as an energy source, is nutritionally to palm oil fortified cassava root meal The significant reduction in weight gain of birds fed T_5 diet support the results of (Jensen et al., 1970; Longe and Oluyemi, 1977) that reported linear decrease in weight gain of birds resulting from the increase in the quantity of cassava root meal included in the ration. The residual cyanogenic glucosides present in cassava root meal could not be associated with poor performance of birds fed T_2 – T_5 diets as sun-drying is known to reduce the level of these compounds to the point where they have no negative effect on the animal (Tewe, 1991; IITA, 1994; Akinfala et al., 2002). Synthetic DL - methionine was also included in the diet and this amino acid can help to detoxify the hydrogen cyanide (HCN), through its transformation to the more innocuous thiocyanate (Tewe and Egbunike, 1992; Tewe, 1994)

This depressed performance in birds fed T_5 diets could be connected with the poor protein quality of T_5 diet relative to the control diet (T_1). This is also in agreement with the proximate biochemical compositions of maize (8.5 % CP, 4.24 % EE, 2.8 % CF, 1.35% ash and 3001.20 kcal/kg ME) and cassava root meal (3.22 % CP, 0.5% EE, 5.0 % CF, 2.65 % ash and 2235.40 kcal/kg). Adding palm oil (fat) to poultry feed is normal and acceptable because this addition has been shown usually to increase metabolisable energy of the whole diet beyond that expected from the fat itself (Jensen et al., 1970; Olomu, 1995). The non-significant higher final live weights of birds fed T_2 and T_3 diets as observed in the present study further support the earlier report by Nwoche et al. (2001) that 4% dietary

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inclusion of palm oil as the best inclusion level that will bring about an optimum growth in broilers. The significant value of feed intake of birds fed T_5 diet is an indication of reduction of quantity of feed consumed by the birds. It is therefore likely that on balance the protein provided by the cassava root meal fortified with palm oil was of rather inferior quality compared with that from the maize.

The feed conversion ratio of the control birds was better than that of the groups fed T_5 diet. The cost of starter broiler diet per kilogram ranged from US$ 0.39 to US$ 0.40, the cost being reduced with increasing levels of cassava root meal and palm oil in the diet (Table 3). The significant increase in the feed conversion ratio of starter broilers fed T_5 diet indicated relatively poorer feed utilization. This result shows that 1kg meat is produced cheaper with control diet as it recorded the lowest feed cost (US$ 0.85) for 1 kg broiler meat produced followed by birds fed T_3 diet (US$ 0.87). The highest cost for the group fed T_5 diet (US$ 0.97) could be attributed to the high cost of palm oil in the market as at the time this investigation was carried out.

CONCLUSION

Results from the study suggest that maize as a dietary energy source in poultry diet is nutritionally superior to cassava root meal fortified with palm oil. Nevertheless replacing maize with cassava root meal/palm oil (%) in proportions of 8:2, 16:4 and 24:6 also gave a comparable result to birds fed T_1 diet. The study presented herein has strongly shown that cassava root meal fortified with palm oil has a very bright future as a feed ingredient in broilers. It is therefore suggested that the use of palm oil fortified cassava root meal as a partial replacement for maize in poultry diets be further explored to ascertain the best inclusion level needed for optimal performance.

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CAN SEX INFLUENCE THE EFFECT OF POUNDED *PARKIA BIGLOBOSA* PODS EXTRACT ON STRONGYLE IN SHEEP?

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ABSTRACT: *A study was conducted to examine the influence of sex on the effect of pounded dawadawa pods extract as a sequel to a preliminary work that suggested some efficacy on strongyle in sheep. The study was undertaken from September to November, 2009. Twelve Djallonke sheep (six males and six females) randomly selected were used. The pounded Dawadawa pods extract was soaked (1kg pod/1.5 liter of water) and mixture was allowed to stand for 12 hours. The filtrate was administered orally at 0.5ml/kg and 0.6ml/kg body weight and a control. Faecal samples were taken from the experimental animals 72 hours after each administration. Laboratory analysis was run to identify strongyle ova after which counts were made. Experimental animals were blocked by sex. Ova counts of strongyle were found to have reduced significantly (P<0.01) over the study period for both dosages. However, the 0.6ml/kg body weight gave better results in worm ova counts, producing 97% reduction in ova counts as against 95% reduction in ova counts for 0.5ml/kg dosage. Control animals recorded an increase in ova counts throughout the study period. Worm ova counts were tended to be higher in females compared to that of males for both dosages. The trend was not evident in the control, suggesting some probable confounding effect of sex on the ability of Dawadawa pods extracts to act efficaciously.*

ORIGINAL ARTICLE

Keywords: *Dawadawa pods extract, sex, sheep, strongyle, worm ova counts*

INTRODUCTION

Livestock production makes numerous contributions to the lives of both rural and urban dwellers (FAO, 1991). Among the small ruminants, sheep is of more concern than goat, (FAO, 1991). In Ghana, long legged and the dwarf (Djallonke) sheep are the main breeds available (Charray et al., 1992) and are efficient meat producers in the tropics due to their high prolificacy.

However, worm infestation is one of the setbacks in producing this ruminant. Damage comes mostly from poor growth and unthriftiness (Blakely and Bade, 1994), both under semi intensive and extensive management systems. Charray et al., (1992) estimated that in Africa 97% of small ruminants are carriers of parasites of the digestive system. Helminthes undoubtedly are the most important single group of internal parasite affecting sheep productivity. This is particularly true for the strongyles (roundworms) which are most frequently endemic and usually cause varying degree of stunting rather than death, (Carles, 1983).

Control of these important internal parasites is of great concern to all farmers. However, farmers have relied over the years on orthodox medications which animals have developed immunity over (Schoenian, 2006). They are also becoming more expensive. Ethnoveterinary as an alternative method of treating internal parasites in ruminants have proofed positive in Northern Ghana as reported by Yidana et al., (2006). Iddrisu (2009) recorded substantial and significant ova count reduction in strongyle with the use of pounded *Parkia biglobosa* pods extracts in sheep. A dosage of 4mls/10 kg body weight was used. Notwithstanding the encouraging results the worms were not completely cleared, neither was the sex factor investigated. This study therefore set out to explore whether comparatively higher doses could completely clear the worms and also to examine whether sex could influence the observed effect.

MATERIAL AND METHODS

Study location

The study was undertaken on the livestock production farm of the Animal Science Department of the University for Development Studies at Nyankpala in the Tolon Kunbungu District of Ghana. It started from

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November 2008 to January 2009. The study area lies within the Guinea Savanna Zone, characterized by large areas of low grass land interspersed with trees. The area has a single pattern of rainfall which starts from May and ends in October. Nyankpala lies on altitude 183 m, latitude 09°25˝N and longitude 00°58˝W, with a mean annual rainfall of 1043.60 mm and temperature of 28.30°C. Mean annual day time relative humidity is 54%.

System of management of sheep

The main system of production is semi- intensive where the animals were provided with a well-constructed pen. The flocks were released during the day into the fields around to graze. The sheep were watered and provided with supplementary feed comprising of cassava peels.

Administration of Dawadawa Pods Extract Solution (DPES)

Treatments of the pods were in three phases;

Treatment one (T1): (0.5ml/kg live weight).

Treatment two (T2): (0.6ml/kg live weight).

Treatment three (T0) (Control): animals under this were not given the DPES. The animals were weighed before the administration of the extract and a base line was also taken to know the worm load of the animals. A syringe was used to draw the required quantity of the extract and the animals were drenched with the appropriate dose and treatment.

Faecal samples collection

The field data collected from the sheep was faecal samples. This was done by gently restraining the animal and collecting about 3-5 grams of faecal samples directly taken from the rectum through the anus by the fingers covered with gloves. The first baseline faecal samples were collected at the end of the month of September. Animals were then drenched immediately with the preparation from the pounded Dawadawa pods and after 72 hours of administration (i.e. early October) faecal samples were collected for the month of September. The process was repeated at the end of October, but faecal samples collected in early November for the month of October and similarly for November. After the collection of each sample, the gloves were changed or washed to avoid contamination. The samples were then taken to the University's Laboratory in well- cleaned and labeled plastic containers for analysis. All samples were usually taken within the early hours of 6: 00- 8:00 in the morning.

Storage of samples

In situations where examination was not immediately possible, samples were kept in a refrigerator.

Laboratory procedure for the examination of the faecal samples

The floatation technique of New South Wales Department of Agriculture (2000) for worm egg count was used in the identification of ova.

Floatation method

The modified McMaster procedure specifically used here involved taking three (3) grams of faecal samples and with the aid of the laboratory pestle and mortar; this was well emulsified with 10ml tap water. The emulsion was poured into a labeled test tube and centrifuged for 5 minutes at 3000 rpm. The supernatant was decanted and another fresh tap water was added to wash out debris. A saturated sodium chloride solution made up of 270g of sodium chloride dissolved in one liter tap water was added to sediment and mixed.

The test tubes containing the mixture of sediment and floatation fluid was filled in test tubes up to the top and arranged in the centrifuge and centrifuged for 5 minutes at 3000 rpm to deposit the debris and bring the ova to the surface. A quantity of the supernatant was drawn with a pipette from the surface of the solution to fill a McMaster Counting Chamber and examined using X10 objective lens of microscope and worm ova identified, counted and recorded.

Identification of helminthes eggs

Strongyle ova were identified by the morphology (colour, shape and size) of eggs with the aid of a microscope and with a guide from a helminthological chart.

Interpretation of egg counts

To estimate the total worm egg count in the 1g of faecal sample, the mean worm egg count was determined. The sum total of eggs seen and counted in one chamber of McMaster Counter Chamber was multiplied by a factor of 100. This represented the amount of eggs per gram of faecal samples for the individual animal. This was given as $X = Y \times 100$ (epg) where X is worm egg count per gram of faecal sample and Y is mean worm egg count of the two chambers of the Mc master slide.

Data Analysis

Data was analyzed using GenStat (Edition 3) in one way ANOVA.

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RESULTS AND DISCUSSION

Mean worm ova count during study period

The base mean worm load of 4533 epg for all experimental animals in September reduced to a low of 2026 epg upon administration of T1 (0.5ml/kg) and T2 (0.6ml/kg) (Table 1). After 4 weeks in October this average worm load shot up to 5425 epg but again come down to 3000epg on drenching. A similar trend was observed for the month of November. The fluctuation in ova counts month after month might be due to the development of resistance or exposure of the animals to open grazing where they could pick up more larvae of the worms, offsetting or eroding any meaningful impact of the DPES. Hunter, (1994) said that worms develop resistance to anthelmintics if they are administered regularly at below recommended doses and that in the tropics development of ingested larvae to adults is arrested until suitable environmental condition occur in the dry season and the onset of rains for hatching of worm eggs. The decrease in worm ova count after each administration confirms findings by Iddrisu (2009) of some degree of efficacy of the DPES.

Table 1 - Mean monthly worm ova counts for all experimental animals

Month	September		October		November	
Time of faecal sample collection	Base	72 hours later after 1st adm.	4 weeks later	72 hours after 2nd adm.	8 weeks later	72 hours after 3rd adm.
Mean worm ova count	4533	2026	5425	3000	4808	3317

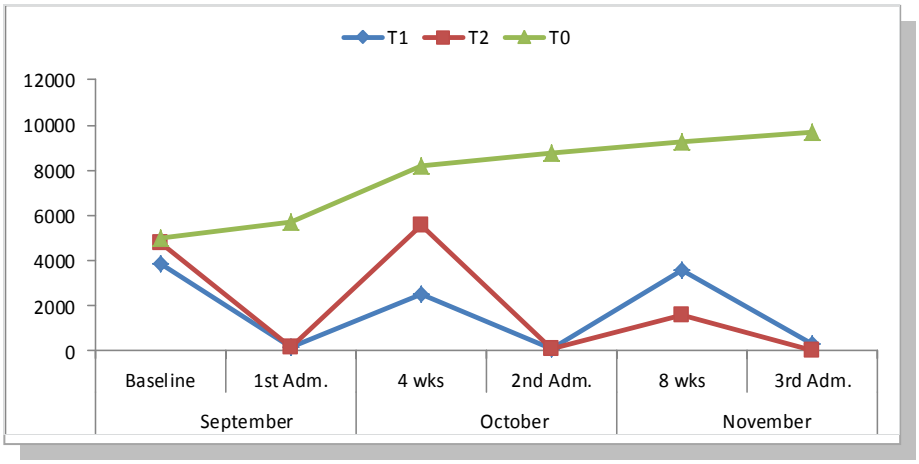

Fig. 1. Mean worm load as affected by dosage of DPES over time. Worm ova count was noted before animals were drenched and after 72 hours ova counts were again noted for the 3 months.

Mean monthly worm ova counts after each administration were significantly different ($P<0.01$) between the control (T0) on the one hand and treatments T1 and T2 on the other hand but not between T1 and T2 (Fig. 1), suggesting that the presence of tannins in the DPES administered were probably in a quantities high enough to be lethal to the worms. The mean worm ova counts however increased in week four again implying that the action of DPES against strongyle is effective for limited period, and that farmers who adopt this product may probably have to use a shorter routine than four weeks, especially under extensive management system. Mean ova counts for treatment T1 and T2 continued to decline after week four, prompting the need to probe for residual effects of DPES. On the contrary that of the control (T0) continued to rise which was to be expected as animal were on open grazing and subject to picking more ova on the pasture (Fig. 1).

Influence of sex on effect of DPES on worm ova counts

Mean worm ova counts tended to be higher in females compared to that of males in September and after administration all ova were cleared in males for T1 and T2 but not for females (Table 2), possibly because of the significant variance between female and male ova counts initially.

Table 2 - Mean Worm Ova Count for the month of September

Period	Treatment	Sex	Before administration	After administration
September	T1	Female	10000	600
		Male	5400	0
	T2	Female	13000	810
		Male	6100	0
	T0	Female	14500	15500
		Male	5400	7400

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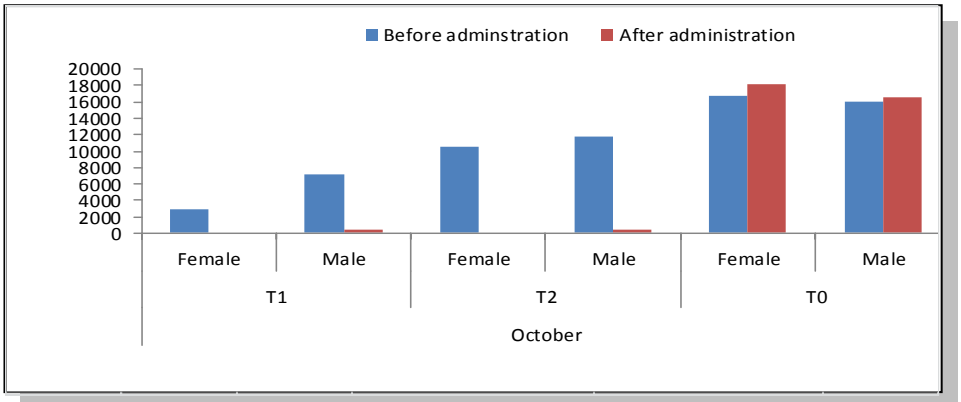

Fig. 2. Mean worm ova counts based on sex of animals

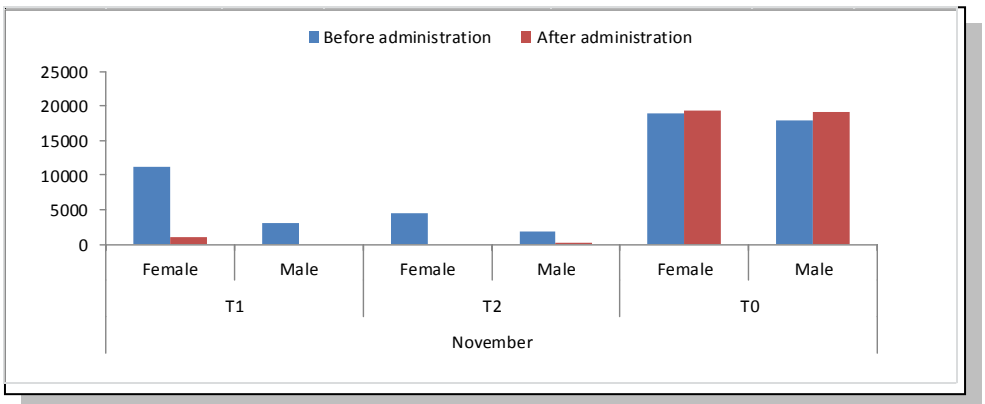

Fig. 3. Mean worm ova counts based on sex of animals after the third administration of DPES

In October, regardless of the variance in mean ova counts between females and males (though those of the males tended to be higher for T1 and T2 before administration) (Fig. 2), all ova were cleared after administration of DPES for both sexes for the two treatments (T1 and T0), except for some traces that were left in the males (Fig. 2). The opposite appeared to have occurred after the third administration of DPES in November, where the females this time round tended to have a higher ova count before treatment and a trace of ova count for T1 only after administration of the DPES (Fig. 3). It thus appears that ova count levels may have a threshold for which the DPES could completely clear worm ova depending upon the sex of the animal.

Treatment one (T1) showed some efficacy (Fig. 2 and 3), but this was not consistent for the females over the study period. Whereas all worm ova were cleared for the males after the third administration in November for T1 and T2 (Fig. 3), this was not the case for the females as some traces were left with the third administration of the lower dose T1 but T2, suggesting that females may probably require a sustained higher dose of T2 to have all their worm ova also cleared by a third administration (Fig. 3).

The higher dose of T2 (6ml/10kg of body weight) over T1 (5ml/10kg of body weight) which was also over and above what Iddrisu (2009) used (i.e. 4ml/10kg body weight) suggests that a consistent use of that dosage in both males and females could be adequate to clear the worm ova in sheep over similar periods and times. It was also noted that the lower dose of T1 (5ml/10 kg of body weight) cleared all worm ova in males by the third administration but not in the females (Fig. 3). Sex and ova count variance interaction before administration appear implicated in the observed differences after treatment and may be attributable to differences in browsing behavior. Max et al., (2003) showed that there is an effect of taniniferous browses meal on faecal egg counts and internal worm burdens with an average of 19%, which are in line with McCorkle's (1999) findings that tannin proved to reduce parasite load in sheep and goats.

Figures in parenthesis indicate an increase rather than a reduction.

It has been suggested that drug resistance could occur once worms can survive a dosage of a drench that would have previously killed them; this could possibly be influenced by sex, too. Outcomes of the second and third drenches of T1 and T2 (except for third T1 drench for the females) (Table 3) fall below Cole's (1986) standards of 500 eggs per gram (epg) being generally considered high enough to require treatment in order to limit pasture contamination and subclinical disease. The second and third T2 drenches thus seem satisfactory for both sexes. However this has to be trodden with caution as Campbell-Platt (1980) has reported that Dawadawa pods contain as much as 27-44% tannins which interact with some sensitive receptors in sheep.

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Table 3 - Percentage reduction in ova count during study period					
Periods	Treatment	Sex	Before administration (Base line)	After administration (at end of study)	Percentage Reduction
September	T1	Female	10000	600	94
		Male	5400	0	100
	T2	Female	13000	810	93
		Male	6100	0	100
	T0	Female	14500	1500	90
		Male	5400	7400	(37)
October	T1	Female	2900	0	100
		Male	7100	400	94
	T2	Female	10600	0	100
		Male	11700	500	96
	T0	Female	16700	18100	(8)
		Male	16100	17000	(6)
November	T1	Female	11300	1100	90
		Male	3100	0	100
	T2	Female	4500	0	100
		Male	1800	100	94
	T0	Female	19000	19200	(1)
		Male	18100	19200	(6)

CONCLUSION

The dosage of 6ml/10kg body weight proved consistently effective against strongyle in both sexes of sheep within a suggested interval of four weeks for subsequent drenches. The effectiveness was noticeable in a relatively shorter period, after 4 weeks for males but longer for females, after 8 weeks.

RECOMMENDATION

A minimum of 4 weeks is suggested for subsequent drenches. Females may therefore be given this higher dose of 6ml/10kg body weight while worm ova count in the males can be contained with the 5ml/10kg body weight.

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HEMATOBIOCHEMICAL DYNAMICS AND BODY WEIGHT GAIN OF BLACK BENGAL GOAT FOLLOWING UREA MOLASSES BLOCK (UMB) SUPPLEMENTATION

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ORIGINAL ARTICLE

ABSTRACT: *Black Bengal goats supplemented with urea molasses block (UMB) resulted in body weight gain and significantly increased (P<0.05) in various hematobiochemical parameters like total erythrocyte count, packed cell volume, hemoglobin concentration, serum glutamic oxaloacetic transaminase (SGOT) and serum glutamic pyruvic transaminase (SGPT) level as compared to controlled group; whereas, erythrocyte sedimentation rate was not varied in either group.*

Keywords: *Black Bengal goat, body weight gain, hematobiochemical, UMB.*

INTRODUCTION

Bangladesh harboring 34.4 millions of goat of which 90% goats are Black Bengal (Husain et al., 1998) and reared for poverty alleviation, self-employment, food supply and increase of skin export (Islam and Huque, 2002). Goats ranked as second most population in aspect of total contribution of livestock, in Bangladesh (FAO, 2002) though they contribute our GDP with poor production both milk and meat due to their poor genetic makeup and improper nutrition. Nutritional status of goat is very poor in Bangladesh due to shortage of feeds and fodder both in quality and quantity (Hossain et al., 2003). Farmer cannot spare land for fodder production for goat. More than 70% of the rural peoples are directly or indirectly engaged in agriculture and goats are generally reared as scavengers in Bangladesh (Huq et al., 1990). Molasses and urea supplementation with available energy and nitrogen may upgrade the energy and ammonia levels in the rumen (Freitas et al., 2003; Mancini et al., 1997). Urea molasses straw supplementation in goat accelerates body weight gain, alterations in hematological values (Drowdy and Matrone, 1968), biochemical parameters like SGOT, SGPT etc. (Tiwari et al., 2010). This study was conducted to reveal such body weight gain and hematobiochemical changes due to UMB supplementation of Black Bengal goats in Bangladesh.

MATERIALS AND METHODS

Animals and Feedings

The study was conducted for 40 days on twenty Black Bengal goats of Government Goat Development Farm, Sylhet; Bangladesh. The laboratory procedures were completed jointly in the laboratory of Dairy and Poultry Science, Sylhet Agricultural University, Sylhet; and Supreme Diagnostic Centre, Dhaka-1207, Bangladesh.

Experimental goats

A total of 20 female goats (*Capra hircus*) were divided equally as A (control) and B (experimental) and the average body weights of these animals were 12-13kg and their ages ranged from 12 to 16 months. Goats were kept in semi-intensive system with grazing and supplied *ad-libitum* clean fresh drinking water throughout the experimental period.

UMB preparation

Composition of Urea Molasses Block (UMB) is given in Table 1. Ingredients for making UMB were purchased from local market at Sylhet town. UMB were prepared according to Sansoucy (1995).

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Urea Molasses Block (UMB) feeding

Experimental goats supplemented with urea molasses block (UMB) orally at the dose of 200gm/head/day as divided into half equally and offered in the morning and in the evening for 42 days along with normal concentrates and grazing status.

Table 1 - Formula for making Urea Molasses blocks (composition in %)

Ingredients	Percentage
Molasses	45
Urea	15
Mineral mixture	10
Quick lime	12
Sodium bentonite	3
Rice polish	10
Common salt	5
Total	100

Performance and Blood determination

Body weight of the animals: The body weight of each of the animal (goat) was measured with the help of balance and weight box at 0 day and every 7 day intervals during the experimental period (42 days). The body weight of the animal was taken before feeding in morning and expressed in kilogram (kg).

Blood collection: For the hematobiochemical examination, blood samples were collected aseptically with sterile syringe and needle from the jugular vein of two groups of animals (goat). Approximately 5ml of blood was collected from each animal and was transferred immediately to a clean, dried test tube containing anticoagulant (EDTA) at a ratio of 1:10 for the hematological studies and were performed within five hours after collection of blood. Approximately another 5ml of blood was collected from each animal and was transferred immediately to a clean, dried test tube which was used to collect of serum for biochemical studies.

Hematological examination: Following the method described by Lamberg and Rothstein (1977) total erythrocyte count (TEC) haemoglobin content (Hb), packed cell volume (PCV), erythrocyte sedimentation rate (ESR).

Biochemical examination: Blood sera biochemical parameters SGOT and SGPT were detected from the goat's serum by the use of specific test kit and analyze in a diagnostic centre.

Statistical analysis

Data obtained from the experiment were calculated and expressed as Mean ± SE on body weight and hematological parameters (e.g. TEC, Hb concentration, PCV and ESR) and biochemical parameters (e.g. AST and ALT) were analyzed statistically using students paired T-test.

RESULTS AND DISCUSSION

Effects of UMB feeding on body weight of goats

The changes observed in the body weight of goats after UMB feeding are presented in Table 2. The goats treated with (UMB) showed increased body weight. Significantly (P<0.05) higher weight gain was recorded in group B on day 21 and significantly (P<0.01) higher weight gain was recorded in group B on day 28 consecutively up to day 42. The increased body weight was highest (14.39Kg) in experimental group B on day 42; on the other hand it was only 13.58kg in controlled group A on the same day.

Table 2 - Effects of UMB on body weight (kg) in goats

Groups	Treated with	Body weight (kg)						
		0 day	7 day	14 day	21 day	28 day	35 day	42 day
A	Controlled (normal grazing)	12.87±0.04	12.95±0.02	13.13±0.02	13.38±0.07	13.49±0.06	13.56±0.02	13.58±0.04
B	UMB normal grazing	12.61±0.02	12.91±0.03	13.30±0.04	13.61*±0.03	13.91**±0.02	13.72±0.49*	14.39±0.01**

The values are expressed as the Mean ± SE of 6 animals in each group; * = Significant at (P<0.05), ** = Significant at (P<0.01).

Effects of UMB feeding on haematological parameters of goats

The observed effects of UMB feeding on hematological parameters are presented in Table 3. TEC was higher in significantly at (P<0.05) in UMB supplemented group compared to the control group. The hemoglobin concentration increased significantly at (P<0.01) and PCV were also increased significantly at (P<0.05) due to UMB supplementation and there was no change in ESR value.

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Table 3 - Hematological parameters of different groups of goats and comparison by Dunnett's test		
Hematological parameters	Mean ± SE in the different treatment groups	
	Group-A (control)	Group-B (experimental)
TEC (million/mm^3)	12.59±0.02	13.08±0.01*
Hb (gm%)	8.49±0.01	10.46±0.01**
PCV (%)	25.75±0.85	27.25±0.48**
ESR (mm in 1st hr)	0	0
The values represent the mean ± SE of 6 animals in each group; * = Significant at p<0.05), ** = Significant at (p<0.01),		

Effects on biochemical parameters

The effect of urea molasses block (UMB) on biochemical parameters was presented in Table 4. From the table, it could be depicted that serum glutamic oxaloacetic transaminase (SGOT) and serum glutamic pyruvic transaminase (SGPT) values increased significantly (P>0.01) in the UMB supplemented goats, compared with those of controlled.

Table 4 - Biochemical parameters of different groups of goats and comparison by Dunnett's test		
Biochemical parameters	Mean ± SE in the different treatment groups	
	Group-A (control)	Group-B (experimental)
SGOT/AST IU/L	112.51±0.91	136.47±0.89**
SGPT/ALT IU/L	52.91±0.90	65.75±0.86**
The values represent the Mean ± SE of 6 animals in each group, ** = Significant at (P<0.01).		

DISCUSSION

UMB supplementation in Black Bengal goats revealed highest body weight gain average (14.39Kg) as compared to untreated goats (13.58 kg) at the end of experiment of 42 days ad this findings are very corroborated with Saddul and Bodoo (2001), where they reported better response in terms of daily live weight gain (56gm) in weaned kids feeding UMB with a daily concentrate (42gm/day) in combination with cotton seed cake showed. The present results also concur with the findings of Vatta et al., (2007); Ali (1992) in goat, who observed an increased body weight by urea feeding. This increased body weight may be related with the improved intake and digestibility of roughages. Leng (1990), Singh et al. (1999) and Kawas et al. (1999) also reported body weight gain improvement in their experiment on goats.

Increase of haematological parameters in present findings resemble to that of Drowdy and Matrone (1968) in sheep who reported that haematological values increased significantly by using urea supplement. Wenzlaf and Erhardt (1991), who reported the increased hemoglobin concentration in lambs treatment with urea. Mburu et al. (1994) reported the increase of hemoglobin by administration of urea in East African goat. Martson et al. (1998), Ali (1992) also reported that the TEC, Hb% and PCV were increased which was similar with the present study.

Increase of hematological parameters in present findings resemble also with that of Tiwari et al. (2010) in goat kids who reported that SGOT and SGPT values increased significantly by using urea molasses mineral block supplement. Significant increase in serum SGOT activity in UMMB treated goats suggests an increased respiratory burst and mitochondrial involvement, as SGOT is chiefly a mitochondrial enzyme resulting from acute and chronic liver injury (Hassanein, 2004). Since SGPT is one of the specific assayable liver enzymes, its elevated level in the study may indicate hepatic damage caused by oral administration of UMB (Sharma, 1996; Tennant, 1997). Although it is difficult to point the damage to any particular organ by UMMB, but increased levels of aminotransferases in buffaloes may be attributed to liver damage (Sihag et al., 2009) as it is the primary organ of biotransformation of UMMB.

Except slight toxicity (resulting increased SGOT and SGPT), use of urea was useful in improving the general health condition of goat if they are supplemented in proper rate and ratio. To minimize the toxicity and get comprehensive result the duration of the experiment should be prolonged more than 6 weeks. Further study should be carried out including more parameters.

CONCLUSION

Urea molasses block (UMB) supplementation in Black Bengal goats in Bangladesh will be the key feeding system for the development of sustainable goat production scheme in Bangladesh during scarce period of feeds. As UMB supplementation enhances the body weight and hematolobiochemical Physiology of Black Bengal goats, so it can be advised to the farmers through the proper authority.

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STUDY ON REPRODUCTIVE TRAITS OF TWO BREEDS OF PARENT STOCK (FEMALE BREEDERS) IN THE HUMID ZONE OF NIGERIA

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ABSTRACT: *This study was carried out to assess the reproductive traits of White Plymouth Rock (WPR) and Barred Plymouth Rock (BPR) parent stock reared under similar housing, management and agro-climatic conditions and the traits considered are fertility and hatchability. Total fertile eggs produced by WPR and BPR are 1,763,322 eggs and 1,732,966 eggs respectively during the observed period (2002-2005). The analyzed data showed that breed has no significant (P>0.05) effect on fertility regardless of the batch of breeder hens. WPR and BPR genotypes recorded 3.84±0.04 eggs and 3.80±0.04 eggs/hen/week respectively and were similar. Batch has highly significant (P<0.01) effect on fertility regardless of breeds' performance. Batch 1 recorded the highest mean values, intermediate in batch 2 and batch 3, being the lowest. There was highly significant (P<0.01) effect of breed on hatchability in layer breeders. BPR genotype recorded the highest mean values in hatchability and was superior to WPR. Similarly, batch has highly significant (P<0.01) effect on hatchability. Batch 1 recorded the highest mean values, intermediate in batch 2 and batch 3, being the lowest. The batch effect implies that reproductive efficiency of breeding stock declines with advancing age. It was revealed in this study that BPR genotype was superior in terms of hatchability rate to WPR. There was no significant (P>0.05) breed x batch interaction effects on fertility and hatchability. It was indicated in this study that both genetic and non-genetic factors affected the reproductive traits of parent stock in Nigeria. Important interventions to meet the increasing demand for commercial chicks in this country include favourable environment, adequate nutrition and a more productive breed of parent stock.*

Key words: *Genotype, hen, chick, fertility, hatchability.*

ORIGINAL ARTICLE

INTRODUCTION

The increasing demand for poultry products such as eggs and meat as a means of bridging protein gap in this country could be met only when the poultry industry is equipped with strains of breeder hens that have superior genetic potentials for the production of good quality chicks. The principal objective of commercial hatcheries is to secure the maximum number of quality day-old chicks from the fertile eggs set for hatching. Fertility and hatchability are the two most important determinants for producing more chicks from given number of breeding stock within a stipulated period (Islam et al., 2002a). Fertility and hatchability of breeding hen according to Warren (1953) depends on a number of factors like genetic, physiological, social and environment. Fairfull (1990) and Fairfull and Gowe (1986) reported that maternal inheritance is important for early growth rate, viability or disease resistance of day-old chicks. While comparing fertility and hatchability using 19,205 eggs of White Leghorn (WL), Rhode Island Red (RIR) and White Rock (WR), Jayarajan (1992) reported that fertility was highest for WL and WR during cold season and for RIR during the summer. Similarly, Islam et al. (2002b) reported significant (P<0.05) effect of breed of cocks on fertility and hatchability. The authors also reported significant (P<0.05) effect of batch on fertility but insignificant (P>0.05) batch effect on hatchability. In addition, Ali et al. (1993) reported no significant (P>0.05) effect of breed on fertility and hatchability in RIR, Fayoumi and Fayoumi x RIR fowls. Previous reports in literature had implicated management and environment as two major non-genetic factors influencing hens' performance such as egg production, fertility and hatchability (Singh et al., 1983; Jayarajan, 1992). Fertility according to Gowe et al. (1993) was a trait of the parents, determined primarily by the gametes. Moreover, French (2000) reported that exposing hatching eggs to high incubation temperature tends to lower the hatchability after a long time due to water loss from the eggs.

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As regards breed effect, Abdel-Rahman (2000) reported that naked neck gene reduced fertility and hatchability significantly than normal genotype. The researcher added that total dead embryos and hatchability differed ($P<0.05$) among the genotypes but no genotype x stress interaction effect was indicated. In addition, Islam et al. (2002a) reported significant ($P<0.05$) breed x batch interaction effect on fertility but the reverse was indicated for hatchability. In view of the importance of the poultry sub-sector in generating income, employment and production of high quality animal proteins and the fact that genetic makeup of any animal determines its productivity, this study was undertaken to:

A. Determine the genetic differences in reproductive traits of two breeds of parent stock
B. Evaluate the effect of non-genetic factor on these traits.

MATERIALS AND METHODS

Site of study

Data for this study were collected from the farm records of Ajanla Farms (CHI Ltd.), Ibadan between 2002 and 2005. Ibadan is situated at an elevation of 200m above sea level and lies about $7^{0}28^{1}$ and $3^{0}54^{1}$. The city enjoys two distinct seasonal periods namely, rain (May-October) and dry season (November-April). The minimum and maximum temperatures on average during the year are 20^{0}C and 30^{0}C, respectively.

Breeds and their management

The exotic parent stocks studied are Barred Plymouth Rock (BPR) and White Plymouth Rock (WPR) hens and were managed on the floor throughout the production period for natural mating at ratio 1male:10females. The cocks were declawed to prevent injury during copulation and were separated from the females during growing (rearing) period until about two weeks to the laying time. This method adopted was to prevent pre-cocious mating and it afforded the cocks an opportunity to reach the prescribed weight and maturity. Management practices on the farm during the observed period were uniform. Cleanliness and bio-security measures were strictly adhered to while vaccinations against viral diseases were administered as and when due. Three batches of each breed of parent stock with a total population of 21,780hens (WPR: 10,974; BPR: 10,806) starting from 5% egg production for 48weeks/batch were used for this study. Batch here refers to a sequential order in the placement of certain number of birds on the farm at a particular time. Fertility percent was determined on the candling (18^{th}) day while hatchability percent was taken on the hatching (21^{st}) day.

Hatchery management

Temperatures and relative humidity during incubation were as follows:

a. Setting temperature- 99.75^{0}F (1-18days)
b. Setting humidity- 83%RH (1-18days)
c. Hatching temperature- 99^{0}F (19-21days)
d. Hatching humidity- 85%RH (19-21days)

Data Analysis

Data collected were subjected to analysis of variance (ANOVA) using the General Linear Model (SAS, 2001) and the significant differences between means of breeds and batches were determined by Duncan New Multiple Range Test of the computer package

The appropriate statistical model used for fertility and hatchability was:

$Yijk = \mu + Gi + Bj + \varepsilon ijk$

Yijk= Observation of the k^{th} population, of the j^{th} batch and i^{th} genotype

μ= common mean

Gi= fixed effect of genotype (i=2)

Bj= fixed effect of batch (j=3)

εijk=random errors assumed to be normally and independently distributed with zero mean and common variance.

RESULTS

Table 1 shows the analysis of variance of the effects of breed and batch on fertility and hatchability of the two breeds of layer breeders. There was no significant ($P>0.05$) effect of breed on fertility but the reverse was the case for hatchability. However, batch of breeder birds has highly significant ($P<0.01$) effect on fertility and hatchability.

DISCUSSION

Effects of breed and batch on fertility

The least square means showing the effect of breed on fertility were presented in Table 2. There was no significant ($P>0.05$) effect of breed on fertility in this flock.

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Table 1 - Analysis of variance showing the effects of breed and batch on fertility and hatchability						
Source	Df		MS		F-Value	
	Fertility	Hatchability	Fertility	Hatchability	Fertility	Hatchability
Breed	1	1	0.09	5.67	0.48	21.37***
Batch	2	2	3.95	3.57	20.59***	13.45***
Breed x batch	2	2	0.14	0.40	0.75	1.50
*** =P<0.001						

The average number of fertile eggs per hen per week recorded for BPR and WPR was 3.80±0.037 and 3.84±0.036, respectively and were similar. The result was in agreement with the findings of Ali et al. (1993) who observed that breed has no significant effect on this trait but contradicted those of Islam et al. (2002a) who reported significant effect of breed on fertility of breeder layers. The obtained result implied that maternal inheritance has little influence on percent fertility but that improved management, balanced nutrition and favourable environment would promote good fertility rate. Fertility as one of the reproductive traits is lowly heritable and largely influenced by environmental factors. Therefore, balanced breeder nutrition and optimum housing conditions will enhance the production of high quality fertile eggs in order to meet the increasing demand for commercial chicks.

Furthermore, the least square means for the effect of batch on fertility were given in Table 2. There was highly significant (P<0.01) effect of batch on fertility. Batch 1 recorded the highest mean (4.03±0.045 eggs) values, intermediate in batch 2 (3.80±0.045 eggs) and batch 3 (3.62±0.045 eggs/hen/week), being the lowest. The result was consistent with the findings of Jayarajan (1992) and Islam et al. (2002b) who reported significant effect of batch on fertility. The positive and significant batch influence on fertility indicates that breeder chicks produced from young grandparent stock are more vigorous, productive and efficient in terms of fertility rate than those from older birds. That is, the first set of chicks produced by grandparent birds are more productive than those produced at later or advanced ages and this might be due to declining reproductive efficiency of breeder hens with advancing age.

Interaction effects

There was no significant (P>0.05) breed x batch interaction effects on fertility in this flock (Table 3) and this was not in agreement with the findings of Islam et al. (2002a) who reported significant breed x batch interaction effect on fertility. This implies that breed and batch acted independently on these reproductive traits.

Table 2 - Least square means showing the effect of breed and batch on fertility			
Factors	N (weeks)	LSQ	SE
Genotype			
BPR	145	3.80	0.037
WPR	149	3.84	0.036
Batch			
1	97	4.03	0.045[a]
2	98	3.80	0.045[b]
3	99	3.62	0.044[c]
[a,b]: means along the column with different superscripts are significantly different; BPR- Barred Plymouth Rock; WPR- White Plymouth Rock			

Effect of breed and batch on hatchability

The least square means showing the effect of breed on hatchability was presented in Table 3. There was highly significant (P<0.01) effect of breed on hatchability. It was found that average number of chicks per hen for BPR and WPR respectively was 2.84±0.043 and 2.54±0.042. The former was however, superior to the latter. The result showed that breed differences exists in hatchability trait among breeds of parent stocks even though management and environment also play some positive and significant roles. The result corroborates the findings of Abdel-Rahman (2000) who reported significant effect of breed on hatchability but contradicted those of Islam et al. (2002b) who reported an insignificant effect of breed on this trait. In addition, the least square means showing the effect of batch on hatchability was given in Table 3. There was highly significant (P<0.01) effect of batch on hatchability. Batch 1 recorded the highest mean (2.88±0.053 chicks) values, intermediate in batch 2 (2.67±0.053 chicks) and batch 3 (2.50±0.052 chicks/batch/week), being the least. The batch's result on hatchability was similar to what was reported for fertility rate and it implies that there was a decline in reproductive efficiency of layer breeders with successive hatches from the same grandparent stock birds. The result was in agreement with the findings of Islam et al. (2002a) who reported significant effect of batch on hatchability and Gowe et al. (1993) who posited that there is usually a decline in fitness traits with advancing age of breeder hens. It was indicated in this study that BPR breed was productive, profitable and had superior genetic potential for this trait since more normal chicks were produced than WPR during the observed period which lasted 144 weeks.

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Interaction effects

There was no significant (P>0.05) breed x batch interaction effects on hatchability in this flock (Table 3) and this agreed with the findings of Islam et al. (2002a) who found no significant strain x batch significant effect on this trait.

Table 3 - Least square means showing the effect of breed and batch on hatchability

Factors	N (weeks)	LSQ	SE
Genotype			
BPR	145	2.83	0.042[a]
WPR	149	2.54	0.043[b]
Batch			
1	97	2.88	0.053[a]
2	98	2.67	0.053[b]
3	99	2.50	0.052[c]

[a,b:] means along the column with different superscripts are significantly different; BPR- Barred Plymouth Rock; WPR- White Plymouth Rock

CONCLUSION

Both genetic and non-genetic factors are important in the productivity of parent stock in this hot environment. There was highly significant (P<0.01) effect of breed on hatchability but the reverse was the case for fertility rate. Batch of breeder birds also significantly (P<0.01) affected both fertility and hatchability. BPR genotype appeared good and possessed genetic superiority over WPR in hatchability trait. It is hereby suggested that to meet the increasing demand for commercial chicks in this country, favourable environment, adequate nutrition and a more productive breed of parent stock should be provided.

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STUDIES ON THE PHYSICAL CHARACTERISTICS OF SOME FEED INGREDIENTS IN NIGERIA 1: PROTEIN SOURCES AND INDUSTRIAL BY-PRODUCTS

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ABSTRACT: *Physical characteristics such as particle size (PS), bulk density (BD), water holding capacity (WHC) and specific gravity (SG) of eight feed raw materials grouped into protein sources (groundnut cake (GNC), soybean meal (SBM), foreign fishmeal (FFM) and local fishmeal (LFM)) and industrial by-products (wheat offal (WO), brewers' dried grains (BDG), palm kernel cake (PKC) and rice husk (RH)) were studied. The effects of different PS (unmodified, ≥1.00 mm and <1.00 mm) on BD, WHC and SG of the experimental materials were studied using a Randomized Completely Block Design (RCBD). Particle size effect was significant for BD, WHC and SG characteristics of the feed ingredients studied. SBM and PKC consistently recorded higher BD values across PS than other feed raw materials in their individual groups. Among the protein sources, decreasing the particle size, (≥1.00 mm and <1.00 mm) increased the BD values of GNC and SBM and then FFM and LFM respectively. SBM proved to hold more water than the other protein feedstuffs across all PS. At <1.00 mm PS, RH had the lowest capacity to absorb water. Again, GNC and SBM SG values increased at ≥1.00 mm PS and subsequently decreased at <1.00 mm PS. FFM and LFM also had increased SG value up to the <1.00 mm PS. Industrial by-products (WO, BDG, PKC and RH) did not follow similar pattern in their PS-SG effects. Type of machines used and processing methods applied on these industrial by-products may be an explanation to that observation.*

Key words: *groundnut cake; soybean meal; rice husk; palm kernel cake; particle size; water holding capacity; bulk density; Specific gravity.*

ORIGINAL ARTICLE

INTRODUCTION

Feed includes any substance, whether processed, semi processed or raw, which is used for animal consumption. It includes, therefore forage crops, manufactured feed and such things as animal and human waste (FAO, 1997). This same report also stated that almost all the feed and feed raw materials ranging from cereals, vegetable proteins, plants with natural toxins (cassava, legumes, etc), fruits and other crop by-products, household and catering waste, animal by-products are at risk of having their quality and safety compromised.

Feeding animals in any intensive livestock enterprise takes up to 70% of the total input of the enterprise (Amir et al., 2001). This fact makes research and discussion of feeds and feeding the vital issues with the prime goal of cutting down huge costs expended on feeding the animals, without compromising the quality of feed or the potential of the animal to efficiently produce at its peak. The goal has led to several studies on novel feedstuffs, some of which have benefited livestock production, while some still require further studies (Udedibie, 2003; Esonu et al., 2002; Esonu et al., 2003; Okoli et al., 2003; Adeola and Olukosi, 2008; Dale, 2008; Iyaye, 2008).

However, very little has been done about the quality of these novel feedstuffs, with the focus being mostly on nutrients they could supply. The influence of physical characteristics of feeds and feedstuffs on the production of livestock in the tropics has particularly received limited attention over the years probably because this is not considered a major factor of influence on livestock productivity (Omede, 2008). Therefore, this neglect of physical characteristics of feed or feedstuff might be one of the hidden reasons why animals eat so much and yet have little yield to the farmer or why some intensively kept animals eat below their productive requirement in the tropics.

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Physical characteristics of feed ingredients used in formulating poultry feeds in Nigeria are not known because these physical characteristics are not popular research issues, contrary to those identified by Omede (2008) in feed quality evaluation. These physical characteristics are not included in the quality scheme for nutritional requirements for poultry by the Standards Organization of Nigeria (Standards Organization of Nigeria, 2003).

Their effects are therefore not known, especially in the use of numerous alternative feedstuffs currently promoted by nutritionists in the country. Lack of such information has led to difficulty in predicting the actual optimal inclusion levels of these alternative feedstuffs in poultry rations. Furthermore, the probable effects of the endogenous physical characteristics of alternative feedstuffs may have been erroneously attributed to the effects of anti-nutritional substances in the feed ingredients. Again, the effects of alterations and processing on these physical characteristics, which are known to influence them have not received research attention especially in locally promoted alternative feedstuffs (Baker and Herrman, 2002; Esonu et al., 2002; Esonu et al., 2003; Udedibie, 2003; Esonu et al., 2004; Amerah et al., 2007).

Similarly, information on the important physical characteristics of feed ingredients utilized in Nigeria livestock industry needed for the development of legal schemes and feed quality regulation framework for the country are lacking. Thus, the impact of poor quality feed ingredients on the poultry industry and information needed for proper intervention and amelioration of the problem are lacking. Therefore, the regulatory agencies are ill equipped to properly enforce standards.

The objective of this study therefore was to determine the physical characteristics (particle size, bulk density, water holding capacity and specific gravity) of some protein sources and industrial by-products utilized in Nigeria and the effect of different particle sizes on the other physical characteristics.

MATERIALS AND METHODS

Experimental site

This research was conducted at the Animal Science Laboratory of the Department of Animal Science and Technology, Federal University of Technology, Owerri, Imo State, Nigeria between September, 2008 and February, 2009.

Experimental materials

Groundnut cake (GNC), soybean meal (SBM), local fishmeal (LFM) and foreign fishmeal (FFM) grouped as protein sources and wheat offal (WO), brewers' dried grains (BDG), palm kernel cake (PKC) and rice husk (RH) grouped as industrial by-products were collected from feed ingredient dealers in Owerri were subjected to various physical characteristics measurements to determine their Particle sizes (PS), Bulk density (BD), Water-holding capacity (WHC) and Specific gravity (SG).

Sample selection and collection

A formal diagnostic survey of feedstuffs used in feed formulation in Owerri was conducted and this led to the selection of the four most utilized protein sources and industrial by-products poultry feed ingredients in Owerri. At the point of collection, about one (1) kilogram of each type of feed ingredient was collected. This was put in cellophane bags, which were appropriately labeled accordingly and later grouped according to feed types as shown in Table 1. Only feedstuffs that had not stayed beyond a week in the store were sampled and collected.

Table 1 - Feedstuffs groups and the various feed raw materials used in the experiment

Feed ingredient group	Feed ingredients			
Protein sources	Groundnut cake	Soybean meal	Local fish meal	Foreign fish meal
Industrial by-products	Wheat offal	Brewers' dried grain	Palm kernel cake	Rice husk

Particle size (PS) measurement

Three particle sizes were determined using sieve analysis (ASAE, 1983; Jillavenkatesa et al., 2001). The first was an unmodified sample of the experimental materials. The sample were then subjected to the laboratory analyses obtain the desired different particle sizes. One kg weight of each experimental sample was measured out, passed through a 1.00 mm mesh sieve to determine coarse and fine particles. Pelleted feeds were crumbled it with a laboratory mortar for 5 minutes before sieving.

The samples under the sieve (<1.00 mm particles) were classified as fine, while the particles left in the sieve (≥1.00 mm particles) were classified as coarse while the original sample was classified as unmodified. These modified samples sizes were further subjected to bulk density, water-holding capacity and specific gravity measurements in four replications as done to the unmodified samples in order to study the effects of particle size on these parameters.

Bulk density (BD) measurement

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The method described by Makinde and Sonaiya (2007) was adopted. To obtain the BD of the experimental materials, a Pyrex glass funnel of known volume (165 cm^3, 75 mm internal diameter) was first weighed with a weighing balance (Silvano, Model BS-2508). The test sample material was then poured into the funnel and leveled off to the brim without pressing. The funnel and its content were weighed again and the initial weight of funnel subtracted from the final weight to obtain the weight of the test material.

The weight of the test material was then divided by the known volume of the funnel. For example, the bulk density of a dry feed sample weighing 50 grams in a 165-cm^3 funnel will be: 50 grams/165 cm3 = 0.3030 g/cm^3 (Makinde and Sonaiya, 2007). This step was replicated four times for each experimental material, both as unmodified and modified samples (<1.00 mm and ≥1.00 mm particles).

Water holding capacity (WHC) measurement

The filtration method described by Makinde and Sonaiya (2007), was adopted with slight modification. A Pyrex glass funnel of known volume (165 cm^3, 75mm internal diameter) lined inside with filter paper (Whatman No. 1, 11 mm diameter) was weighed (Silvano, Model BS-2508). A sample of the test sample material was poured into the funnel and leveled off to the brim without pressing. Another filter paper was placed on the top of the test material. The funnel and its content were weighed again and the difference between both weights determined to obtain the dry weight of the test sample material. The funnel and its content were set-up below a burette filled with water.

Water dropping from the burette (about 70 drops per minute) was allowed through this known volume of test sample material in the Pyrex funnel and at the first drop of water from the funnel, the burette was stopped and the wet sample weighed. The volume of water absorbed by the test sample material was read-off from the burette. The initial weight of the funnel and its content was subtracted from the final weight (weight of the wet set-up) to obtain the weight of water absorbed by the test sample material. The weight of water held by the sample material to the weight of the dry feed was given as the water holding capacity of the sample in g water/g dry feed. It is assumed in all cases that the initial percentage water content of the dry feed raw materials tested ranged between 12 and 14% (Omede, 2004). This step was repeated four times for each sample/experimental material, both as unmodified and modified samples (<1.00 and ≥1.00 mm particles).

Specific gravity (SG) measurement

Specific gravity of a substance is a comparison of the density of that substance relative to a standard value (density of water). The procedure used in determining BD will be repeated to determine BD of test sample material of one kg. This BD value will be used to determine SG of the test sample material. SG is determined as a ratio of the bulk density of known mass of the experimental sample to the density of water for both the unmodified and modified samples (<1.00 and ≥1.00 mm particles). For example, if the BD of a given test sample material is given as 0.5 g/cm^3, the SG of that given test sample material will be given thus:

BD of test sample material/the Density of water (1.0 g/cm^3)

= 0.5 g/cm^3 /1.0 g/cm^3

= 0.5

Statistical analyses of data

Data generated on PS, BD, WHC and SG of feed raw materials were subjected to analysis of variance (ANOVA) and where significant differences were established among means, they were separated using SAS statistical software (SAS, 1999).

RESULTS AND DISCUSSION

The physical characteristics of protein sources and industrial by-products frequently used as feed ingredients in Nigeria in monogastric animal feed manufacturing/compounding were studied. The overall bulk density (BD), water holding capacity (WHC) and specific gravity (SG) of these ingredients materials ranges from 0.24-0.45 (g/cm^3), 0.20-1.46 (g water/g feed) and 0.24-0.45 respectively. From the results obtained in this study, different feed raw materials even within the same group had different physical characteristics. Implication of this is that level of inclusion of each feed raw material in final feed formulation will be influenced by these variations in physical characteristics and would influence the ceiling of inclusion.

The only known study closely related to this area in Nigeria was done by Makinde and Sonaiya (2007), who studied water, blood and rumen fluid absorbencies of some fibrous feedstuffs. Specifically, the physical characteristics of all groups of feed raw materials used in Nigeria are not known. There is currently no standard in this aspect as a vital issue for feed manufacturers (SON, 2003). It is known that the performance of any compounded feed is a summary of the individual contributions from the different raw materials used in producing such feed. This makes it a matter of urgency to consider the quality of feed raw materials not only in terms of their nutritional potential but also of their physical characteristics and quality in the formulation of commercial feeds.

In the case of feed raw materials, what determine their physical characteristics (BD, WHC and SG) are their nature or physical structures i.e. fibrous nature and the kind of NSPs they are made of- soluble or non-soluble

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among other factors listed by De Lange (2000). In protein-source group of feed raw materials (Table 2), GNC was similar (P>0.05) to all other protein sources in their BD and SG, SBM had the highest BD and was at the same time significantly different (P<0.05) from FFM, LLM in BD and SG.

Table 2 - The BD, WHC and SG of protein-source group of feed raw materials

Feed raw Materials	BD (g/cm³)	WHC (g water/g feed)	SG
GNC	0.37^{ab}	0.20^{b}	0.37^{ab}
SBM	0.45^{a}	1.46^{a}	0.45^{a}
FFM	0.32^{b}	0.38^{b}	0.32^{b}
LFM	0.35^{b}	0.28^{b}	0.35^{b}
SEM	0.0278	0.0981	0.0278

GNC = groundnut cake; SBM = soybean meal; FFM = foreign fish meal; LLM = local fish meal; BD =bulk density; WHC = water holding capacity; SG = specific gravity; ^{ab} means within a column with different superscript are significantly (P<0.05) different.

SBM was significantly higher (P<0.05) and different in WHC than other protein sources even though it had the highest BD. This is quite different from the results obtained in the commercial feeds where the negative correlation between BD and WHC was maintained. This is a strong indication that SBM may be containing very high quantity of soluble NSPs than other protein sources, making it to hold more water. Hence in using SBM in compounding commercial feed it is important to consider this particular physical quality of SBM and the effect it will have on the quality of the formulated final feed (Kyriazakis and Emmans, 1995).

In the industrial by-products group of feed raw materials (Table 3), WO and PKC were similar (P>0.05) in their BD and SG but significantly different (P<0.05) from BDG and RH, which were similar (P>0.05) to each other in their BD and SG as well. PKC recording the highest BD value also had the highest and significantly different (P<0.05) WHC from those of WO, BDG and RH. This is expected because the β-mannan in PKC is likely water soluble. However, in comparison with the BD and WHC of palm kernel meal (PKM) (0.57 g/cm³ and 2.93 g water/g feed respectively) recorded by Sundu et al (2006), the BD and WHC values recorded here for PKC were relatively low. However, it should be noted that the methods of processing (PKM is solvent extracted while PKC is mechanical extracted) must have influenced the differences in the results obtained between PKC in this study and PKM in Sundu et al. (2006). This phenomenon indicates that PKC has a potential benefit for poultry provided that if included in the diet consumed by birds can be digested and made available to the birds.

Table 3 - The BD, WHC and SG of industrial by-products feed raw materials group

Feed raw materials	BD (g/cm³)	WHC (g water/g feed)	SG
WO	0.30^{a}	0.50^{b}	0.30^{a}
BDG	0.24^{b}	0.38^{b}	0.24^{b}
PKC	0.36^{a}	1.29^{a}	0.36^{a}
RH	0.26^{b}	0.29^{b}	0.26^{b}
SEM	0.0264	0.2290	0.0264

WO = wheat offal, BDG = brewers' dried grains, PKC = palm kernel cake, RH = rice husk, BD = bulk density, WHC = water holding capacity, SG = specific gravity, ^{ab} means within a column with different superscript are significantly (P<0.05) different.

Particle size (PS) effects on the Physical characteristics (BD, WHC and SG) of protein sources and industrial by-products group of feed ingredients.

In Table 4, GNC, SBM and FFM had significant differences in BD values between ≥1.00 mm PS and <1.00 mm PS. GNC had no significant difference (P>0.05) in their BD values between the unmodified PS and < 1.00 mm PS. Similarly, SBM and FFM had no significant differences (P>0.05) in its BD values between the unmodified PS and ≥ 1.00 mm PS, while LFM showed significant difference in BD values between the same particle sizes. SBM and FFM maintained a consistency in BD between the unmodified PS and ≥1.00 mm PS. The highest BD was recorded by SBM at ≥1.00 mm PS. Protein sources of fish origin were observed to record lower BD values than those of plant origin.

Table 4 - Particle size effects on BD of some protein sources group of feed raw materials

Feed raw materials	BD (g/cm³) at different particle sizes			
	Unmodified PS	≥1.00mm PS	<1.00 mm PS	SEM
GNC	0.37^{b}	0.42^{a}	0.30^{b}	0.0348
SBM	0.45^{a}	0.46^{a}	0.38^{b}	0.0251
FFM	0.32^{b}	0.30^{b}	0.33^{a}	0.0088
LFM	0.35^{a}	0.29^{b}	0.32^{ab}	0.0173

GNC = groundnut cake; SBM = soybean meal; FFM = foreign fish meal; LLM = local fish meal; BD = bulk density; WHC = water holding capacity; SG = specific gravity; ^{ab} means within a column with different superscript are significantly (P<0.05) different.

The results of particle size effects on WHC of some protein sources group of feed raw materials are shown in Table 5. GNC and FFM recorded significantly higher (P<0.05) WHC values in their unmodified PS than in the two

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modified particle sizes, which were similar (P>0.05) to each other. On the reverse, SBM and LFM recorded significantly higher (P<0.05) WHC values in their finer particles (<1.00mm PS) than in the unmodified PS and ≥ 1.00mm PS, which were statistically similar (P>0.05). There seems to be a kind of WHC grouping among protein sources of feed raw materials in that GNC and FFM had similar results, while SBM and LFM had similar results too. By implication, only one combination of a pair these should be selected in feed formulation. This may help to balance WHC characteristics in the final feed, while combining feed raw materials from different pair may result to synergistic effects on WHC.

Table 5 - Particle size effects on WHC of some protein sources group of feed raw materials

Feed raw materials	WHC (g water/g feed) at different particle sizes			
	Unmodified PS	≥1.00mm PS	<1.00 mm PS	SEM
GNC	0.20[a]	0.07 [b]	0.10[b]	0.0392
SBM	1.46[b]	0.98[b]	1.68[a]	0.2066
FFM	0.38[a]	0.13 [b]	0.33[b]	0.0763
LFM	0.28[ab]	0.10[b]	0.30[a]	0.0635

GNC = groundnut cake; SBM = soybean meal; FFM = foreign fish meal; LLM = local fish meal; WHC = water holding capacity; [ab] means within a column with different superscript are significantly (P<0.05) different.

In SBM however, there was an observed skyrocketing rise in WHC as its particle size was reduced to < 1.00mm PS that was more than 5 times the values obtained in other protein sources at the same finer particle size. This implies that SBM is higher in soluble NSPs than other protein sources used in this study. Hence, in using SBM to formulate feeds of a desired WHC, particle size of the SBM must first be put into consideration as the final WHC of the formulated feeds will depend chiefly on the WHC contributed by individual feed raw materials.

Again, all the WHC values decreased as the particle sizes of the feedstuffs decreased to ≥1.00 mm. This reduction was specifically significant in GNC and FFM (P<0.05). At the <1.00 mm PS, the values rose again beyond those recorded for ≥1.00 mm PS in all cases and were particularly significant for SBM and LFM (Table 5). These results indicate that relatively higher proportions of the unmodified feedstuffs were actually made up by the <1.00 mm PS or fine particles.

To obtain relatively uniform particle sizes for a milled feedstuff, there is the need to determine the milling efficiency of the milling machine used. This is critical since a milling machine of low efficiency may produce feedstuff of varied particle sizes even though it was adjusted to a specific size. Modifying the particle sizes of the feed raw materials reduced the WHC of the feed below their original WHC values and this agrees with Choct (1997), who reported that milling the coarse bran to a particle size of 1 mm almost halved the water holding capacity from 6.15 g to 3.54 g of water per g of bran. Among these feeds, the fish meals (foreign and local) were higher in their WHC values than GNC at all levels of particle sizes. This implies that even protein sources of animal origin incorporated into commercial feeds may be contributors to a high WHC value in such feeds.

However, GNC seemed to be the feed raw material in this group with a very low WHC value and may be very suitable as a protein source in producing feeds with low WHC. This does not remove the fact that the method of oil extraction used in producing the GNC may have also contributed to this WHC in GNC.

In Table 6, GNC, SBM and FFM had significant differences in SG their values for ≥1.00mm PS and <1.00mm PS. GNC had no significant difference (P>0.05) in its SG values between the unmodified PS and <1.00mm PS. SBM and FFM had no significant differences (P>0.05) in its SG values between the unmodified PS and ≥1.00mm PS, while LFM had significant difference in SG values between the same particle sizes. SBM and FFM maintained a consistency in SG between the unmodified PS and ≥1.00mm PS. The highest SG was recorded by SBM at ≥1.00 mm PS. Protein sources of fish origin were observed to record lower SG values than those of plant origin.

Table 6 - Particle size effects on SG of some protein sources group of feed raw materials

Feed raw materials	SG at different particle sizes			
	Unmodified PS	≥1.00mm PS	<1.00 mm PS	SEM
GNC	0.37[b]	0.42[a]	0.30[b]	0.0348
SBM	0.45[a]	0.46[a]	0.38[b]	0.0251
FFM	0.32[b]	0.30 [b]	0.33[a]	0.0088
LFM	0.35[a]	0.29[b]	0.32[ab]	0.0173

GNC = groundnut cake, SBM = soybean meal, FFM = foreign fish meal, LLM = local fish meal, SG = specific gravity, [ab] means within a column with different superscript are significantly (P<0.05) different.

BDG, PKC and RH had significantly higher (P<0.05) BD values at the unmodified PS than at ≥ 1.00mm PS (Table 7). In WO however, significant difference was observed in WHC values between unmodified PS and the < 1.00mm PS. All industrial by-products group of feed raw materials had similar (P>0.05) BD at both modified particle sizes. It seems there is much effect on BD as particle sizes reduces further. This may be explained by the fact that these feed raw materials have already undergone several industrial processing that may have changed their physical structure and hence, their physical characteristics. Subjecting these feed raw materials of industrial by-products to further processing such as reduction in particle size may not be advisable as this will result to lower

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BD which has negative effect on poultry performance (Shelton et al., 2005). Again, the fact that there was no significant PS effect on BD between the ≥1.00 mm and <1.00 mm particle sizes indicates relative uniformity of the unmodified feedstuff sample in its particle size.

Table 7- Particle size effects on BD of some Industrial by-products group of feed raw materials

Feed raw materials	BD (g/cm³) at different particle sizes			
	Unmodified PS	≥1.00mm PS	<1.00 mm PS	SEM
WO	0.30[a]	0.24[ab]	0.18[b]	0.0346
BDG	0.24[a]	0.18[b]	0.21[ab]	0.0173
PKC	0.36[a]	0.30 [b]	0.30[b]	0.0200
RH	0.26[a]	0.18[b]	0.24[ab]	0.0240

WO = wheat offal, BDG = brewers' dried grains, PKC = palm kernel cake, RH = rice husk, BD = bulk density, [ab] means within a column with different superscript are significantly (P<0.05) different.

In Table 8, particle size effects on WHC of the industrial by-products group were reported. BDD, PKC and RH recorded significantly different (P<0.05) and higher WHC values at <1.00mm PS than in unmodified PS, while their WHC values at ≥1.00mm PS were similar (P>0.05) to the values obtained at unmodified PS and <1.00mm PS.

Table 8 - Particle size effects on WHC of some Industrial by-products group of feed raw materials

Feed raw materials	WHC (g water/g feed) at different particle sizes			
	Unmodified PS	≥ 1.00mm PS	< 1.00 mm PS	SEM
WO	0.50[b]	1.56[a]	0.67[ab]	0.3286
BDG	0.38[b]	0.67 [ab]	0.73[a]	0.1080
PKC	1.29[b]	1.38 [ab]	1.70[a]	0.1244
RH	0.29[b]	0.33[ab]	0.82[a]	0.1703

WO = wheat offal, BDG = brewers' dried grains, PKC = palm kernel cake, RH = rice husk, WHC = water holding capacity, [ab] means within a column with different superscript are significantly (P<0.05) different.

However, WO recorded significant difference (P<0.05) in WHC values between unmodified PS and ≥1.00mm PS indicating that most of the unmodified WO was in the coarse form. To achieve consistency in WHC in the use of industrial by-products as feed raw materials, it seems particle size should be maintained at ≥1.00mm PS. RH seemed to be the one with the lowest capacity to absorb water. This is expected as RH is mainly fibrous in nature (made of external coating material) than all the rest, however, reducing its particle size to <1.00mm may have provided a larger surface area for maximum absorption of water than WO and BDG at the same PS level. This particle size will give a considerable WHC as it is still observed that apart from WO, other feed raw materials in this group had their WHC increased with decrease in particle size. By assumption, WO may be the most suitable industrial by-product to consider as a feed raw material for feed formulation when WHC is a factor of concern.

From this study, PKC is consistently shown to have the highest natural ability to absorb water. This increased to 1.70 g water/g feed at the <1.00 mm PS. There is the need to study the implication of this in the use of this locally available feedstuff in the sustainable production of commercial poultry diets.

BDG, PKC and RH had significantly higher (P<0.05) SG values at the unmodified PS than at ≥ 1.00mm PS (Table 9). In WO however, significant difference was observed in SG values between unmodified PS and the < 1.00mm PS. All industrial by-products group of feed raw materials had similar (P>0.05) SG at both modified particle sizes.

Table 9 - Particle size effects on SG of some Industrial by-products group of feed raw materials

Feed raw materials	*SG at different particle sizes*			
	Unmodified PS	≥ 1.00mm PS	< 1.00 mm PS	SEM
WO	0.30[a]	0.24[ab]	0.18[b]	0.0346
BDG	0.24[a]	0.18[b]	0.21[ab]	0.0173
PKC	0.36[a]	0.30 [b]	0.30[b]	0.0200
RH	0.26[a]	0.18[b]	0.24[ab]	0.0240

WO = wheat offal, BDG = brewers' dried grains, PKC = palm kernel cake, RH = rice husk, SG = specific gravity, [ab] means within a column with different superscript are significantly (P<0.05) different.

It seems there is much effect on SG as particle sizes reduces further. This may be explained by the fact that these feed raw materials have already undergone several industrial processing that may have changed their physical structure and hence, their physical characteristics. Subjecting these feed raw materials of industrial by-products to further processing such as reduction in particle size may not be advisable as this will result to lower SG which could have negative effect on poultry performance (Bhatti and Firkins, 1995).

CONCLUSION

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There are practically no standard evaluation methods for physical characteristics (particle size, bulk density, water holding capacity and specific gravity) of feed ingredients used in formulating poultry feeds by feed manufacturers in Nigeria. The Standards Organization of Nigeria does not have records of what should be optimal the quality standards for physical characteristics of feed manufactured in Nigeria.

As a result, the physical characteristics of feed ingredients in Nigeria are not known. The relationships existing between these physical characteristics and their influences on formulated feed as well as on poultry performance are not known. From this study, it can be established that there is a negative correlation between bulk density and water holding capacity of feed ingredients. An increase in bulk density in this experiment results to decrease in water holding capacity of feed ingredients studied.

Therefore, there is the need for provision of national feed regulatory program with measures based as much as possible in international standards set by appropriate organization for the animal production sector. There should be an integration of regulatory frame works across the stake holders and sectors (Standards Organisation of Nigeria, National Food and Drugs Administration and Control, Veterinary Council of Nigeria and Nigeria Institute of Animal Science), e.g. having agricultural health laws and regulations and enforcement rather than having varied laws and organizations controlling animal and plant health issues in the country.

Feed quality assurance program in Nigeria should encompass the goals of quality assurance programme, ingredient quality covering all aspects listed by Okoli et al. (2009); Omede (2008), and Okoli et al. (2007a, b), production and processing methods of feeds, finished feed quality. The purchasing agents and end-users of manufactured feed ingredients must request for quality assessment reports from their manufactured or feed raw materials suppliers.

Further studies need to be done to validate or explain further the results obtained in this study and the claims made. There is also the need to conduct a feeding trial using feeds compounded with the feed ingredients studied herein with animals, considering their physical characteristics as obtained herein to ascertain the effects of these physical characteristics on animal performances and productivity level.

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STUDIES ON THE PHYSICAL CHARACTERISTICS OF SOME FEED INGREDIENTS IN NIGERIA 2: ENERGY SOURCES AND NOVEL FEEDSTUFFS

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ABSTRACT: *Physical characteristics such as particle size (PS), bulk density (BD), water holding capacity (WHC) and specific gravity (SG) of six (6) feed raw materials energy sources (maize (MZ), sorghum (SGH) and cassava flour (CF)) and novel feedstuffs (leaf meal from Microdesmis puberula (LEM), poultry dung (PD) and rumen digesta (RD)) were also studied. The effects of different PS (unmodified, ≥1.00 mm and <1.00 mm) on BD, WHC and SG of the experimental materials were studied using a Randomized Completely Block Design (RCBD). Particle size effect was significant for BD, WHC and SG characteristics of the feed ingredients studied. SGH and PD consistently recorded higher BD values across PS than other feed ingredients in their individual groups. In the energy group, SGH, CF and MZ had the highest WHC at unmodified, ≥1.00 mm and <1.00 mm PS respectively. The WHC value of the LEM (5.50 g water/g feed) used in this study was twice higher than values for PD and RD at the <1.00 mm PS suggesting the possibility of a high content of soluble non-starch polysaccharides. Energy group (MZ, SGH, and CF) had reduced SG values as the PS was modified from ≥1.00 mm to <1.00 mm PS. The physical characteristics of feed ingredients studied cannot be concluded to be optimal since the standard values for the country do not exist.*

Keywords: *Maize; sorghum; poultry dung; rumen digesta; particle size; water holding capacity; bulk density; specific gravity.*

ORIGINAL ARTICLE

INTRODUCTION

Feed includes any substance, whether processed, semi processed or raw, which is used for animal consumption. It includes, therefore forage crops, manufactured feed and such things as animal and human waste (FAO, 1997). This same report also stated that almost all the feed and feed raw materials ranging from cereals, vegetable proteins, plants with natural toxins (cassava, legumes, etc), fruits and other crop by-products, household and catering waste, animal by-products are at risk of having their quality and safety compromised.

Feeding animals in any intensive livestock enterprise takes up to 70% of the total input of the enterprise (Amir et al., 2001). This fact makes research and discussion of feeds and feeding the vital issues with the prime goal of cutting down huge costs expended on feeding the animals, without compromising the quality of feed or the potential of the animal to efficiently produce at its peak. The goal has led to several studies on novel feedstuffs, some of which have benefited livestock production, while some still require further studies (Udedibie, 2003; Esonu et al., 2002; Esonu et al., 2003; Adeola and Olukosi, 2008; Dale, 2008; Iyaye, 2008).

However, very little has been done about the quality of these novel feedstuffs, with the focus being mostly on nutrients they could supply. The influence of physical characteristics of feeds and feedstuffs on the production of livestock in the tropics has particularly received limited attention over the years probably because this is not considered a major factor of influence on livestock productivity (Omede, 2008). Therefore, this neglect of physical characteristics of feed or feedstuff might be one of the hidden reasons why animals eat so much and yet have little yield to the farmer or why some intensively kept animals eat below their productive requirement in the tropics.

Physical characteristics of feed ingredients used in formulating poultry feeds in Nigeria are not known because these physical characteristics are not popular research issues, contrary to those identified by Omede (2008), in feed quality evaluation. These physical characteristics are not included in the quality scheme for

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nutritional requirements for poultry by the Standards Organization of Nigeria (Standards Organisation of Nigeria, 2003). Their effects are therefore not known, especially in the use of numerous alternative feedstuffs currently promoted by nutritionists in the country. Lack of such information has led to difficulty in predicting the actual optimal inclusion levels of these alternative feedstuffs in poultry rations. Furthermore, the probable effects of the endogenous physical characteristics of alternative feedstuffs may have been erroneously attributed to the effects of anti-nutritional substances in the feed ingredients. Again, the effects of alterations and processing on these physical characteristics, which are known to influence them have not received research attention especially in locally promoted alternative feedstuffs (Baker and Herrman, 2002; Esonu et al., 2002; Esonu et al., 2003; Udedibie, 2003; Esonu et al., 2004; Amerah et al., 2007).

Similarly, information on the important physical characteristics of feed ingredients utilized in Nigeria livestock industry needed for the development of legal schemes and feed quality regulation framework for the country are lacking. Thus, the impact of poor quality feed ingredients on the poultry industry and information needed for proper intervention and amelioration of the problem are lacking. Therefore, the regulatory agencies are ill equipped to properly enforce standards.

The objective of this study therefore was to determine the physical characteristics (particle size, bulk density, water holding capacity and specific gravity) of some energy sources and novel feedstuffs utilized in Nigeria and the effect of different particle sizes on the other physical characteristics.

MATERIALS AND METHODS

Experimental site

This research was conducted at the Animal Science Laboratory of the Department of Animal Science and Technology, Federal University of Technology, Owerri, Imo State, Nigeria between September, 2008 and February, 2009.

Experimental materials

Maize (MZ), sorghum (SGM), and cassava flour (CF) grouped as energy sources and leaf meal (*Microdesmis puberula*) (LEM), rumen digesta (RD) and poultry dung (PD), grouped as novel feedstuffs used in feed formulation Owerri were subjected to various physical characteristics measurements to determine their Particle sizes (PS), Bulk density (BD), Water-holding capacity (WHC) and Specific gravity (SG).

Sample selection and collection

A formal diagnostic survey of feedstuffs used in feed formulation in Owerri was conducted and this led to the selection of the four most utilized protein sources and industrial by-products poultry feed ingredients in Owerri. At the point of collection, about one (5) kilogram of each type of feed ingredient was collected. This was put in cellophane bags, which were appropriately labeled accordingly and later grouped according to feed types as shown in Table 1. Only feedstuffs that had not stayed beyond a week in the store were sampled and collected. Rumen digesta and poultry dung were collected fresh from the abattoir and poultry houses respectively before further processing.

Table 1 - Feedstuffs groups and the various feed ingredients used in the experiment

Feed ingredient groups	Feed ingredients		
Energy sources	Maize	Sorghum	Cassava flour
Novel feedstuffs	Leaf Meal	Rumen digesta	Poultry dung

Particle size (PS) measurement

Three particle sizes were determined using sieve analysis (ASAE, 1983; Jillavenkatesa et al., 2001). The first was an unmodified sample of the experimental materials. The sample were then subjected to the laboratory analyses obtain the desired different particle sizes. One kg weight of each experimental sample was measured out, passed through a 1.00 mm mesh sieve to determine coarse and fine particles. Pelleted feeds were crumbled it with a laboratory mortar for 5 minutes before sieving.

The samples under the sieve (<1.00 mm particles) were classified as fine, while the particles left in the sieve (≥1.00 mm particles) were classified as course, while the original sample was classified as unmodified. These modified samples sizes were further subjected to bulk density, water-holding capacity and specific gravity measurements in four replications as done to the unmodified samples in order to study the effects of particle size on these parameters.

Bulk density (BD) measurement

The method described by Makinde and Sonaiya (2007), was adopted. To obtain the BD of the experimental materials, a Pyrex glass funnel of known volume (165 cm^3, 75 mm internal diameter) was first weighed with a weighing balance (Silvano, Model BS-2508). The test sample material was then poured into the funnel and leveled

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off to the brim without pressing. The funnel and its content were weighed again and the initial weight of funnel subtracted from the final weight to obtain the weight of the test material.

The weight of the test material was then divided by the known volume of the funnel. For example, the bulk density of a dry feed sample weighing 50 grams in a 165-cm^3 funnel will be: 50 grams/ 165 cm^3 = 0.3030 g/cm^3 (Makinde and Sonaiya, 2007). This step was replicated four times for each experimental material, both as unmodified and modified samples (<1.00 mm and ≥1.00 mm particles).

Water holding capacity (WHC) measurement

The filtration method described by Makinde and Sonaiya (2007), was adopted with slight modification. A Pyrex glass funnel of known volume (165 cm^3, 75mm internal diameter) lined inside with filter paper (Whatman No. 1, 11 mm diameter) was weighed (Silvano, Model BS-2508). A sample of the test sample material was poured into the funnel and leveled off to the brim without pressing. Another filter paper was placed on the top of the test material. The funnel and its content were weighed again and the difference between both weights determined to obtain the dry weight of the test sample material. The funnel and its content were set-up below a burette filled with water.

Water dropping from the burette (about 70 drops per minute) was allowed through this known volume of test sample material in the Pyrex funnel and at the first drop of water from the funnel, the burette was stopped and the wet sample weighed. The volume of water absorbed by the test sample material was read-off from the burette. The initial weight of the funnel and its content was subtracted from the final weight (weight of the wet set-up) to obtain the weight of water absorbed by the test sample material. The weight of water held by the sample material to the weight of the dry feed was given as the water holding capacity of the sample in g water/g dry feed. It is assumed in all cases that the initial percentage water content of the dry feed raw materials tested ranged between 12 and 14% (Omede, 2004). This step was repeated four times for each sample/experimental material, both as unmodified and modified samples (<1.00 and ≥1.00 mm particles).

Specific gravity (SG) measurement

Specific gravity of a substance is a comparison of the density of that substance relative to a standard value (density of water). The procedure used in determining BD will be repeated to determine BD of test sample material of one kg. This BD value will be used to determine SG of the test sample material. SG is determined as a ratio of the bulk density of known mass of the experimental sample to the density of water for both the unmodified and modified samples (<1.00 and ≥1.00 mm particles). For example, if the BD of a given test sample material is given as 0.5 g/cm^3, the SG of that given test sample material will be given thus:

BD of test sample material/the Density of water (1.0 g/cm^3)
= 0.5 g/cm^3 /1.0 g/cm^3
= 0.5

Statistical analyses of data

Data generated on PS, BD, WHC and SG of feed raw materials were subjected to analysis of variance (ANOVA) and where significant differences were established among means, they were separated using SAS statistical software (SAS, 1999).

RESULT AND DISCUSSION

The physical characteristics of energy sources and novel feedstuffs frequently used as feed ingredients in Nigeria in monogastric animal feed manufacturing/compounding were studied. The overall bulk density (BD), water holding capacity (WHC) and specific gravity (SG) of these ingredients ranges from 0.02-0.41 (g/cm^3), 0.35-0.89 (g water/g feed) and 0.02-0.41 respectively. From the results obtained in this study, different feed raw materials even within the same group had different physical characteristics. Implication of this is that level of inclusion of each feed raw material in final feed formulation will be influenced by these variations in physical characteristics and would influence the ceiling of inclusion.

The only known study closely related to this area in Nigeria was done by Makinde and Sonaiya (2007), who studied water, blood and rumen fluid absorbencies of some fibrous feedstuffs. Specifically, the physical characteristics of all groups of feed raw materials used in Nigeria are not known. There is currently no standard in this aspect as a vital issue for feed manufacturers (Standards Organisation of Nigeria, 2003). It is known that the performance of any compounded feed is a summary of the individual contributions from the different raw materials used in producing such feed. This makes it a matter of urgency to consider the quality of feed raw materials not only in terms of their nutritional potential but also of their physical characteristics and quality in the formulation of commercial feeds. De Lange (2000), having studied an overview of the determinants of the nutritional values of feed ingredients made mention of the highlighted the effect of certain physical characteristics of feed ingredients.

In the energy sources group (Table 2), Sorghum, though had the highest BD, was similar (P>0.05) to CF in BD and SG, while MZ had the lowest BD and SG. MZ and SGM had similar (P>0.05) WHC values which were significantly higher (P<0.05) than that of CF. SGM having the highest WHC suggests that it may likely contain higher

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value/quantity of water soluble NSPs than others. MZ having a lower BD than SGM is as expected since it has a higher fibre content than SGM (Aduku, 1993).

Table 2 - The BD, WHC and SG of energy sources used in this experiment

Feed raw materials	BD (g/m³)	WHC (g water/g feed)	SG
MZ	0.33[b]	0.78[a]	0.33[b]
SGM	0.41[a]	0.89[a]	0.41[a]
CF	0.34[a]	0.62[b]	0.34[a]
SEM	0.0251	0.0783	0.0251

MZ = maize, SGM = sorghum; CF = cassava flour (sun dried); BD = bulk density; WHC = water holding capacity; SG = specific gravity; [ab] means within a column with different superscript are significantly (P<0.05) different.

In the Novel feedstuffs (Table 3), LEM was significantly (P<0.05) lower than RD and PD in BD and SG. In their WHC, RD recorded the highest value but was similar (P>0.05) to LEM. LEM seems to have more fibrous matter than the rest of the feed, while PD would have had a very low fibrous content for it to record the highest BD. The poultry dung is a waste product from digestion in poultry and the digestion process must have broken down the fiber in the original feed. RD recorded the highest WHC value. The microbes in the rumen of the animal (cattle) from which RD was obtained may have helped to break down RD the more, having exposed its surfaces for more water absorption. These novel feedstuffs need further study in the area of their physical quality and characteristics since as at now interest is more in researches focusing on their nutritive and replacement values for conventional raw materials of feeds.

Table 3 - The BD, WHC and SG of some Novel feedstuffs used in this experiment

Feed raw materials	BD (g/m³)	WHC (g water/g feed)	SG
LEM	0.02[b]	0.60[ab]	0.02[b]
RD	0.09[a]	0.67[a]	0.09[a]
PD	0.30[a]	0.35[b]	0.30[a]
SEM	0.0841	0.0982	0.0841

LEM = leaf meal (*Microdesmis puberula*); RD = rumen digesta; PD = poultry dung; BD = bulk density; WHC = water holding capacity; SG = specific gravity; [ab] means within a column with different superscript are significantly (P<0.05) different

Particle size (PS) effects on the physical characteristics (BD, WHC and SG) of some cereals and tubers used as feed raw materials.

In Table 4, it was observed that all members of the cereals and tuber group of feed raw materials had significantly different (P<0.05) and higher BD between their unmodified PS and in modified particle sizes with the exception of SGM at the ≥1.00mm PS where there was similar (P>0.05) value with other particle sizes. The BD of these feed raw materials were relatively moderate and uniform when compared with other feed raw materials groups indicating uniform particle size in the original unmodified sample.

Table 4 - Particle size effects on BD of some cereals and tubers used as feed raw materials

Feed raw materials	BD (g/m³) at different particle sizes			
	Unmodified PS	≥1.00mm PS	>1.00mm PS	SEM
MZ	0.33[a]	0.30[b]	0.30[b]	0.0100
SGM	0.41[a]	0.36[ab]	0.32[b]	0.0260
CF	0.34[a]	0.30[b]	0.30[b]	0.0133

MZ = maize; SGM = sorghum; CF = cassava flour (sun dried); BD = bulk density; [ab] means within a column with different superscript are significantly (P<0.05) different.

According to a document by America's Pork Check off Program (2008), low bulk density of feed ingredients will decrease the bulk density of the final diet and that to increase bulk density; the ingredients are often sold in a pelleted form.

In their WHC (Table 5), while MZ and SGM had significant differences (P<0.05) between ≥ 1.00 mm PS and < 1.00mm PS, their values at the modified particle sizes were not significantly different from the WHC values at their unmodified PS. Hence, differences in WHC occurred with change in particle size. However, in CF, significant difference (P<0.05) was only observed in the WHC values between the unmodified PS and the ≥1.00 mm PS, while there was no significant difference (P>0.05) in its WHC when the particle size was reduced. Unexpectedly, the WHC value of MZ at ≥ 1.00 mm particle size was very low compared to what was obtained by Sundu et al. (2005), who reported 1.94 (g water/g feed) for corn, though the value for MZ was closer to this when the particle size reduced to <1.00 mm. Probably, there was more of the <1.00 mm PS in the unmodified PS of maize used in this study. Hence, using any of these in formulating commercial feed for any animal will be dependent on the knowledge of their individual particle size and the desired WHC or any other physical characteristics of interest to the feed manufacturer.

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Table 5 - Particle size effects on WHC of some cereals and tubers used as feed raw materials

Feed raw materials	WHC (g water/g feed) at different particle sizes			
	Unmodified PS	≥1.00mm PS	>1.00mm PS	SEM
MZ	0.78^{ab}	0.10^{b}	1.20^{a}	0.3204
SGM	0.89^{ab}	0.32^{b}	0.98^{a}	0.2066
CF	0.62^{a}	0.48 ^{b}	0.50^{ab}	0.0437

MZ = maize; SGM = sorghum; CF = cassava flour (sun dried); BD = bulk density; ^{ab} means within a column with different superscript are significantly (P<0.05) different.

In Table 6, it was observed that all members of the cereals and tuber group of feed raw materials had significantly different (P<0.05) higher SG between their unmodified PS and modified particle sizes with the exception of SGM at the ≥1.00 mm PS where there was similar (P>0.05) values with other particle sizes.

Table 6 - Particle size effects on SG of some cereals and tubers used as feed raw materials

Feed raw materials	SG at different particle sizes			
	Unmodified PS	≥1.00mm PS	>1.00mm PS	SEM
MZ	0.33^{a}	0.30^{b}	0.30^{b}	0.0100
SGM	0.41^{a}	0.36^{ab}	0.32^{b}	0.0260
CF	0.34^{a}	0.30 ^{b}	0.30^{b}	0.0133

MZ = maize; SGM = sorghum; CF = cassava flour (sun dried); BD = bulk density; ^{ab} means within a column with different superscript are significantly (P 0.05) different.

Particle size (PS) effects on the physical characteristics (BD, WHC and SG) of some novel feedstuffs.

All Novel feedstuffs had significantly higher (P<0.05) BD values in <1.00 mm PS than in ≥ 1.00 mm PS (Table 7). Furthermore, significant difference (P<0.05) in BD was noticed between unmodified PS and ≥1.00 mm PS in RD, while the BD value of PD at the unmodified PS was similar (P>0.05) to the values obtained in the two modified particle sizes. In the case of the novel feedstuffs, increase in BD was recorded with a reduction in particle size in almost all group members. LEM and RD had relatively low BD (0.02-0.09 g/cm^3) when compared with PD (0.26-0.36 g/cm^3). For efficient application in feed formulation, LEM and RD may need to be utilized only in pelleted rations in order to override their natural low BD characteristics.

Table 7 - Particle size effects on BD of some Novel feedstuffs

Feed raw materials	BD (g/m^3) at different particle sizes			
	Unmodified PS	≥1.00mm PS	>1.00mm PS	SEM
LEM	0.02^{b}	0.02^{b}	0.03^{a}	0.0033
RD	0.09^{a}	0.06^{b}	0.09^{a}	0.0100
PD	0.30^{ab}	0.26 ^{b}	0.36^{a}	0.0290

LEM = leaf meal (*Microdesmis puberula*); RD = rumen digesta; PD = poultry dung; BD = bulk density; ^{ab} means within a column with different superscript are significantly (P<0.05) different.

In their WHC, as shown in Table 8, all novel feedstuffs recorded the highest and significantly different (P<0.05) WHC at their <1.00 mm PS, when compared to the values obtained in their unmodified PS and ≥ 1.00 mm PS except for LEM, where the WHC value at the ≥1.00mm PS was similar (P>0.05) to the values in the other two particle sizes. LEM at the <1.00 mm PS was more than twice higher in WHC than the rest of the members of the group. Grinding LEM and RD must have provided more surface area on them. This may have also destroyed the cell walls and the bond that can withstand water. Also, this is an indication of the degree of soluble NSP that may be contained in them. It would seem that the inclusion of fine particles of LEM in the finished feed may influence feed intake to a large extent since the material is capable of swelling 8 times its normal size in the presence of water, thus, affecting satiety.

Table 8 - Particle size effects on WHC of some Novel feedstuffs

Feed raw materials	WHC (g water/g feed) at different particle sizes			
	Unmodified PS	≥1.00mm PS	>1.00mm PS	SEM
LEM	0.61^{b}	0.75^{ab}	5.50^{a}	1.6071
RD	0.67^{b}	1.13^{b}	2.72^{a}	0.4755
PD	0.35^{b}	0.24 ^{b}	0.67^{a}	0.0290

LEM = leaf meal (*Microdesmis puberula*); RD = rumen digesta; PD = poultry dung; BD = bulk density; ^{ab} means within a column with different superscript are significantly (P<0.05) different.

All novel feedstuffs had significantly higher (P<0.05) SG values in < 1.00 mm PS than in ≥ 1.00 mm PS (Table 9). Furthermore, significant difference (P<0.05) in SG was noticed between unmodified PS and ≥ 1.00 mm PS in RD, while the SG value of PD at the unmodified PS was similar (P>0.05) to the values obtained in two modified particle sizes. In the case of the novel feedstuffs, increase in SG was recorded with a reduction in particle size in almost all group members.

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Table 9 - Particle size effects on SG of some Novel feedstuffs				
Feed raw materials	SG at different particle sizes			
	Unmodified PS	≥1.00mm PS	>1.00mm PS	SEM
LEM	0.02[b]	0.02[b]	0.03[a]	0.0033
RD	0.09[a]	0.06[b]	0.09[a]	0.0100
PD	0.30[ab]	0.26 [b]	0.36[a]	0.0290
LEM = leaf meal (*Microdesmis puberula*); RD = rumen digesta; PD = poultry dung; BD = bulk density; [ab] means within a column with different superscript are significantly (P<0.05) different.				

Because SG is a factor correlated directly to BD, in like manner, SGM (energy source), and PD (novel feedstuff) consistently recorded the highest SG values as was observed in their BD when compared to other feed raw materials in their individual groups almost at all particle sizes. Knowing the individual SG values of feed raw materials is very important because the SG of the final feed produced from varying feedstuffs will be determined by the SG values of its individual feed ingredients composition. The floatability of commercial feeds will be affected by the SG of the ingredients they are made of. However, the SG values obtained in this study were very low and may likely float within the GIT of monogastric animals if fed as single diet as none of the feed raw materials had SG value up to 1.2, which was the minimum feed particle SG suggested by Bhatti and Firkins, (1995) and Kaske et al. (1992).

CONCLUSION

There are practically no standard evaluation methods for physical characteristics (particle size, bulk density, water holding capacity and specific gravity) of feed ingredients used in formulating poultry feeds by feed manufacturers in Nigeria. The Standards Organization of Nigeria does not have records of what should be optimal the quality standards for physical characteristics of feed manufactured in Nigeria.

As a result, the physical characteristics of feed ingredients in Nigeria are not known. The relationships existing between these physical characteristics and their influences on formulated feed as well as on poultry performance are not known. From this study, it can be established that there is a negative correlation between bulk density and water holding capacity of feed ingredients. An increase in bulk density in this experiment results to decrease in water holding capacity of feed ingredients studied.

Therefore, there is the need for provision of national feed regulatory program with measures based as much as possible in international standards set by appropriate organization for the animal production sector. There should be an integration of regulatory frame works across the stake holders and sectors (Standards Organization of Nigeria, National Food and Drugs Administration and Control, Veterinary Council of Nigeria and Nigeria Institute of Animal Science), e.g. having agricultural health laws and regulations and enforcement rather than having varied laws and organizations controlling animal and plant health issues in the country.

Feed quality assurance program in Nigeria should encompass the goals of quality assurance programme, ingredient quality covering all aspects listed by Okoli et al. (2009); Omede (2008), and Okoli et al. (2007a, b), production and processing methods of feeds, finished feed quality. The purchasing agents and end-users of manufactured feed ingredients must request for quality assessment reports from their manufactured or feed raw materials suppliers.

Further studies need to be done to validate or explain further the results obtained in this study and the claims made. There is also the need to conduct a feeding trial using feeds compounded with the feed ingredients studied herein with animals, considering their physical characteristics as obtained herein to ascertain the effects of these physical characteristics on animal performances and productivity level.

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A MOLECULAR (PCR) SURVEY ON ABORTIONS CAUSED BY *Campylobacter spp.* IN THE DAIRY CATTLE OF TABRIZ-IRAN

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ABSTRACT: *This study was conducted to determine the prevalence of Campylobacter spp. induced abortions in Tabriz (northwest Iran) dairy herds and also to determine the pathogenic species responsible. A total number of 76 aborted fetuses and related placentas were admitted to the large animal clinic at the University of Tabriz, from May 2008 to August 2010. Tissue samples were collected from several fetal organs including liver, kidney, lung, spleen, heart, stomach fluid and placenta, then separately pulverized under liquid nitrogen and finally stored at -20°C until DNA extraction. DNA extraction from frozen tissues samples was performed using a commercial kit (AccuPrep Genomic DNA Extraction Kit, Bioneer, S. Korea) following the manufacturer's instructions. Of 76 submissions (fetuses, placentas), 3 (3.9%) sample were diagnosed positive to the Campylobacter fetus subsp. Veneralis by the PCR protocol. This is the first report on abortion caused by Campylobacter fetus subsp. Veneralis from the dairy herds of Tabriz-Iran.*

ORIGINAL ARTICLE

Keywords: *Campylobacteriosis, abortion, cattle, PCR, Tabriz*

INTRODUCTION

Abortion in dairy cattle is commonly defined as a loss of the fetus between the age of 42 days and approximately 260 days. Pregnancies lost before 42 days are usually referred to as early embryonic deaths, whereas a calf that is born dead between 260 days and full term is defined a stillbirth. A low rate of abortions is usually observed on farms and 3 to 5 abortions per 100 pregnancies per year is often considered normal (Hovingh, 2009).

Bovine genital campylobacteriosis (also known as bovine venereal campylobacteriosis) is a venereal disease caused by *Campylobacter fetus subsp. venerealis* (*C. fetus veneralis*). In females, *C. fetus* persists in genital secretions and produces temporary infertility, embryonic death and abortion. Infected bulls are subclinical carriers and when a herd infection is established *C. fetus* is more prevalent in older bulls than in young bulls (Eaglesome and Garcia, 1992).

Campylobacter fetus is divided into the two closely related subspecies: *C. fetus* subspecies (*subsp.*) *venerealis* and *C. fetus* subsp. *fetus* (Veron and Chatelain, 1973).

An intermediate biovar of *C. fetus subsp. venerealis* has been described. Whether this variant has specific clinical features is unclear. *Campylobacter fetus subsp. fetus* can be recovered from the intestinal tract of cattle and other animal species (Garcia et al., 1983).

Campylobacter fetus subsp. fetus can be isolated from aborted bovine fetuses showing its clinical relevance in cattle. However, *C. fetus subsp. fetus* is associated with sporadic cases of abortion in bovine whereas *C. fetus subsp. venerealis* is associated with endemic abortion and fertility problems in certain areas.

In dairy cows, the importance of the disease has declined over the past 40 years with the use of artificial insemination, because of bull screening at artificial insemination studs and the use of antibiotics in semen extenders. However, where natural service is used (notably in beef and traditional herds of Iran) its venereal rout of transmission means that campylobacteriosis must always be considered as a potential cause of infertility. It is still a major cause of reproductive disease in many countries. In a 15-year study in Argentina, involving over 11300 bulls, 22% were found to be immunofluorescent (positive) whilst in 400 cows in three dairy herds in California 47% were seropositive for *C. fetus* (Noakes et al., 2001).

Although *C. fetus* is primarily recognized as a veterinary pathogen, *C. fetus* subsp. *fetus* is occasionally diagnosed as an opportunistic emerging pathogen in humans. Infections usually occur in pregnant or immuno-

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compromised individuals and are often systemic with a variety of neurological and vascular complications (Thompson and Blaser, 2000).

The diagnosis of abortions often presents a challenge to the herd owner and the herd veterinarian. Although a gradual increase in the abortion rate in a herd may be noted over a period of many years, a sudden and dramatic increase is more commonly seen. For this reason, prompt and thorough action is required when abortions do occur. While infectious agents are perhaps the most frequently thought of cause of bovine abortion, there are other factors which may cause a proportion of pregnancies to terminate with an abortion.

The objective of this study was to determine the presence of venereal campylobacteriosis among the dairy herds of Tabriz and its effect on the abortion rate of these animals.

MATERIAL AND METHODS

Samples

From May 2008 through August 2010, a total number of 76 aborted fetuses and related placentas were admitted to the Large Animal Clinic, Faculty of Veterinary Medicine at the University of Tabriz. Tissue samples were taken from the several fetal organs including liver, kidney, lung, spleen, heart, stomach fluid and placenta, then separately pulverized under liquid nitrogen and finally stored at -20°C until DNA extraction.

DNA extraction

DNA extraction from frozen tissue samples (fetal tissues and placentas) was performed using a commercial kit (AccuPrep Genomic DNA Extraction Kit, Bioneer, S. Korea) following the manufacturer's instructions. Briefly, 100µL of thawed homogenates of fetal tissues were mixed with 600µL of Nuclei Lysis Solution and homogenized for 10 seconds. Samples were incubated at 65°C for 30 min, followed by the addition of 17.5µL proteinase K (20mg mL^{-1}) and incubation at 60°C for three hours, vortexing every 30 min. Three microliters of RNase A (4mg mL^{-1}) were added, the samples were mixed and incubated at 37°C for 30minutes. After cooling, 200µL of Protein Precipitation Solution were added, followed by vortexing and centrifugation at 13,000 *g* for 4minutes. The supernatant was transferred to a new micro tube with 600µL of isopropanol, mixed, and centrifuged at 13,000 *g* for 3minutes. The supernatant was discarded and the pellet was washed with 600µL of 70% ethanol, followed by a final centrifugation at 13,000 *g* for 3min. Each pellet was dissolved in 100µL of DNA Rehydration Solution by incubating at 65°C for one hour. DNA quality was assessed by spectrophotometry and PCR amplification of an internal control (prolactin gene). Samples that did not yield a prolactin amplicon nor had DNA concentration lower than 100ng μL^{-1} as assessed by spectrophotometry were excluded from further analysis.

PCR

DNA samples were PCR tested for detection of. *C. fetus subsp. venerealis* and *C. fetus subsp. fetus*. PCR reactions were performed using 13µL of a commercial PCR mix (AccuPower PCR preMix, Bioneer, S. Korea), 0.75µL of a 25µM solution of each primer (Table 1), and 1µL of DNA (100 to 500ng per reaction). Parameters used were initial denaturation at 95°C for 5min, followed by denaturation at 95°C for 1min, annealing for 1min, extension at 72°C for 1min and a final extension at 72°C for 7min. The annealing temperatures and number of cycles for each agent are described too. PCR products were resolved by electrophoresis in a 1% agarose gel stained with ethidium bromide. Positive controls included DNA from cultured organisms or infected tissues. Positive and negative controls (in which DNA template was replaced by PCR-grade water) were included in all reactions.

Table 1 - Primer sequences for *Campylobacter fetus subs. Veneralis* (VenSF & VenSR) and *fetus* (MG3F&MG3F)

Product size	Primer sequences	Name
9601bp	5'GGTAGCCGCAGCTGCTAAGAT3'	MG3F
	5'TAGCTACAATAACGACAACT3'	MG4R
142bp	*C. fetus* subsp. *Venerealis* 5'CTTAGCAGTTTGCGATATTGCCATT3'	VenSF
	5'GCTTTTGAGATAACAATAAGAGCTT3'	VenSR

Statistical analysis

Frequencies of positive results were compared between fetal tissues and placentas by the Fisher's exact text, using SPSS software, version 16 (GraphPad Software, California, USA).However statistical difference was not observed between the two samples (fetal tissues and placentas) ($P>0.05$).

RESULTS

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Of 76 submissions (fetuses& placentas), 3 (3.9%) samples were diagnosed positive to *C. fetus subsp. venerealis* by the PCR test and any positive reaction was not found against the *C. fetus subsp. fetus*. In other word, the PCR test results for detection of *C. fetus subsp. Venerealis* either in the fetal tissues or in placentas was the same (3.9%) (Figure 1 and Table 2).

Table 2 - Results of PCR tests for diagnosis of *Campylobacter fetus subs. Veneralis* (CFV) and *Campylobacter fetus subs. fetus*(CFF) in the fetal tissues and related placentas

Sample	Positive	Negative	Total
Fetal tissue	3(3.9%) CFV 0(0%) CFF	73(96.05) CFV 76(100%) CFF	76(100%) CFV 76(100%) CFF
Placenta	3(3.9%) CFV 0(0%) CFF	73(96.05) CFV 76(100%) CFF	76(100%) CFV 76(100%) CFF

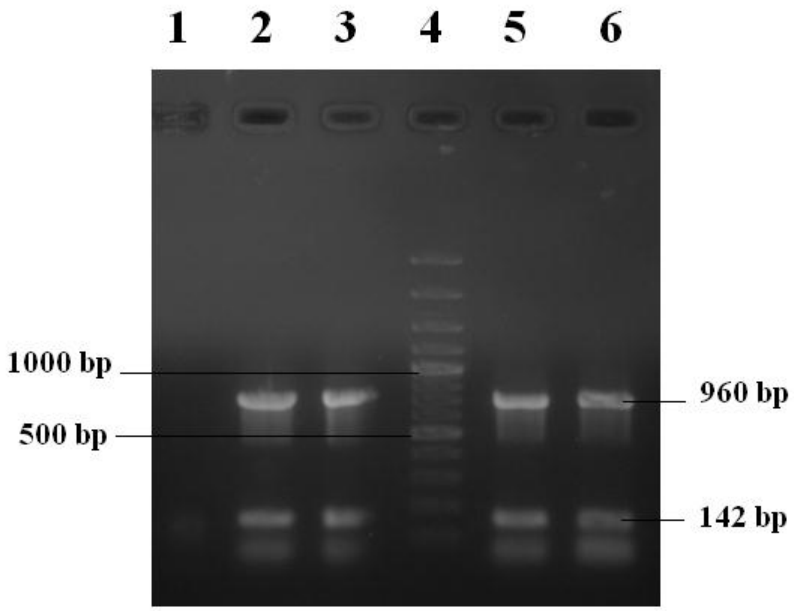

Figure 1 - Representative results of PCR amplification of genomic DNA of *Campylobacter fetus subs. veneralis* in fetal tissues and placenta: Lane1: Non Template Control (NTC); Lane2: positive control; Lane 3: positive sample from placenta; Lane 4: molecular weight marker, 5 and 6: positive samples from aborted fetuses

DISCUSSION

Pregnancy losses caused by a variety of infectious agents produce a severe economic impact on the profitability of the cattle industry worldwide (Anderson et al., 1990; Jamaluddin et al., 1996; Campero, 2000; Campero et al., 2003; Moor et al., 2003).

Bovine venereal campylobacteriosis remains a substantial problem in beef and dairy cattle in many countries including Iran (Garcia et al., 1983; Campero et al., 1987; Hum et al., 1994; Dillon et al. 1995; Caldow and Taylor, 1997; Campero 2002; Cobo et al., 2003).

Campylobacter *fetus subsp. venerealis*, which is regarded exclusively as a venereal pathogen of cattle, is confined to the female reproductive tract and the bull's prepuce. The immunofluorescent antibody test (IFAT) is widely used in some countries for the diagnosis of the disease in preputial samples (Campero et al., 1987; Dillon et al., 1995; Campero, 2000; Cobo et al., 2003).

However, the technique does not differentiate between *C. fetus* subspecies. On the other hand, serological tests are of little or no value, since genital campylobacteriosis does not engender measurable serum antibody levels (Noakes et al., 2001).

A vaginal mucus agglutination test was first described by Kendrick and has been used extensively since. However, it is important not to use the copious mucus of oestrus or mucus contaminated with the uterine discharges (especially after abortion) in which the agglutinins will be affected (Kendrick, 1967).

For above mentioned reasons, in present study PCR protocol was chosen as a superior test for detecting the *Campylobacter spp*. in placentas and internal organs of aborted fetuses. Our results indicated that the rate of abortion caused by *Campylobacter fetus subsp. Veneralis* in the dairy cattle of Tabriz is very low (3.9%) (Table 2). This means that by using the artificial insemination for breeding the animals, the transmission of genital

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campylobacteriosis has been prevented in many areas. Unfortunately in some farms the bulls were kept for treating the repeat-breeder cows, therefore this could be a potential threat for spreading the genital campylobacteriosis. On the other hand, *Campylobacter fetus subsp. fetus* was not detected in fetal tissues or placentas. This means that, this organism has not any role in the cow's abortion in the dairy farms of Tabriz.

CONCLUSION

This is concluded that the serum antibody levels against the *Campylobacter fetus spp*. may be decreased at the time of abortion. Therefore the PCR protocol is the best tool for detecting the abortions caused by *Campylobacter fetus spp*. and differentiating between its tow *subsp*. (*C.F. veneralis* and *C.F. fetus*). On the other hand, placentas of aborted cows have the same value of internal organs of aborted fetuses for detecting the *Campylobacter fetus spp*. by the PCR protocol. However for more accuracy sampling from two sites (placenta &internal fetal organs) for performing PCR protocol strongly recommended.

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EFFECTS OF FEEDING DIFFERENT LEVELS OF *Balanites aegyptiaca* (*HEGLIG*) KERNEL CAKE ON CATTLE RUMEN ENVIROMENT

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ORIGINAL ARTICLE

ABSTRACT: *The present experiment aimed to investigate the effects of replacing groundnut cake with Balanites aegyptiaca kernel cake up to 15% on rumen environment in local kenana cattle. The study was conducted at the experimental unit of Veterinary Medicine and Animal Production College, Sudan University of Science and technology at Hillat Kuku. Traits studied were rumen pH ammonia concentration (NH3), volatile fatty acids concentration (VFAs) and bacterial count (BC). No significance difference was observed for pH, NH3, VFAs and BC between treatments. Generally, NH3 and VFAs was increased with time post feeding. But, BC decreased with time post feeding. It was concluded that incorporation of B. Aegyptiacua kernel cake at 5, 10, 15% to replace equal percentages of groundnut cake did not significantly (P<0.05) affected rumen environment.*

Key words: *Ammonia, Bacteria Balanites aegyptiaca, Cake*

INTRODUCTION

Balanites aegyptiaca is used for firewood, charcoal, poles, timber, utensils, tool handle, food, medicine, fodder, mulch, shade, windbreak and gum (Guinand and Lemessa, 2001). This plant contributes up to 30% of the dry matter intake of goats in the dry season in Burkina Faso (Hall and Walker, 1991). Kernel meal, the residue remains after oil extraction was used for fattening of sheep in Sudan (Elkhidir et al., 1983) and in other animals in Senegal (Vogt, 1995) and as stock feed in Uganda (Katende et al., 1995). In Sudan it is more likely the species with widest natural range (Badi et al., 1989). It makes up to one third of the total tree population in central region of Sudan (NRC, 2008). The rumen is essentially a fermentation chamber in which the resident microbial population helps to digest the diet. Hungate (1975) reported that, in order to sustain constant microbial population, the rumen environment must fulfil certain conditions. Among these conditions are that the rumen must be warm (39-42°C) and anaerobic. He also mentioned that the rumen must have chemical reducing environment and it must be rich in organic matter. Types of microorganisms (Bacteria, protozoa, and fungi) that populate the rumen are severely affected by temperature, reduction potential and PH (Smith and Oldham, 1983). The microbial ecosystem in the rumen varies within animals, with time after feeding and between days in the same animal (Preston and Leng, 1987). They also mentioned that rumen environment is largely affected by type and quality of food eaten. The optimal pH for rumen proteolytic enzyme, range from 5.5 to 7.0 (Kopency and Wallace, 1982). Ruminal acidosis, which is a common digestive disorder reflect imbalance between microbial production, microbial utilization and ruminal absorption of organic acids (Nagaraja and Titgemeyer, 2007). It was observed that when ruminal pH decreases beyond 5.6 volatile fatty acids absorption was enhanced because they became more protonated or undissociated (Bergman, 1990). But this rapid absorption of VFAs is accompanied by shift in rumen microbes in producing more lactic acid which is more readily absorbed and will impair VFAs absorption (Giesecke and Stangassinger, 1980). Microbes in the rumen are plant material fermenters, and to digest straw carbohydrates they need to be supplied quantitatively with many nutrients one of them is ammonia (Hegarty et al., 1996). Rumen NH3 level varies widely throughout the day and its level depends largely on the feeding regime and feed quality (Ciszuk, 1973). Ruminal NH3 concentration is inversely related to carbohydrate availability in the rumen (Russel et al., 1983; Hristov et al., 1997; Heldat et al., 1999). This is so because decreased energy lead microbes to degrade food protein into NH3 and ammonia uptake by microbes will be impaired (Nocek and Russel, 1988; Hristov et al., 1997). Taragi et al. (1964) stated that the highest level of urea in the blood was reached five hours after the rumen

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attained its highest NH3 concentration. Ammonia is combined with hydrogen ions in the rumen fluid to form ammonia ions. This process depends on ruminal pH (Kajanapruthipong and Leng, 1998). Ruminal microbacteria form the key link between the ruminant and its diet because VFA and microbial protein from feed degradation account for the majority of nutrients utilized by the host (Sutton, 1985). The objectives of the present study were to investigate the effects of feeding steers kernel cake of *Balanites aegyptiaca* on rumen cattle ecology.

MATERIAL AND METHODS

Experimental animals

Three castrated local Kenana bulls at 3-3.5 years old were used in this experiment. Animals were fitted with rumen cannulae as described by Brown et al. (1968). Animals were fed twice daily and had free access to clean water and salt licks during the study.

Experimental feeds

Four rations based on sorghum, molasses and wheat bran were formulated in such a way to provide experimental levels of *Balanites aegyptiaca* oil cake (0, 5, 10, and 15 %) as ground nut cake was replaced (Table 1).

Table 1 - Ingredients of experimental rations and chemical composition (DM basis) as %

Ingredients	*Balanites aegyptiaca* kernel cake (%)			
Time	0	5	10	15
Sorghum (feterita)	30.00	30.00	30.00	30.00
Wheat bran	19.00	19.00	19.00	19.00
Molasses	30.00	30.00	30.00	30.00
Groundnut cake	20.00	15.00	10.00	5.00
Salt (NaCl)	01.00	01.00	01.00	01.00
Total	100	100	100	100
Chemical analysis				
DM	87.30	86.90	86.60	86.30
CP	18.20	18.30	18.30	18.40
Crude fiber	5.50	5.40	5.30	5.20
Crude fat	3.10	2.90	1.30	1.10
NFE	60.50	60.30	61.70	61.60
MEMJ/Kg	11.89	11.81	11.51	11.43

*DM: Dry matter, CP: crude protein, NFE: Nitrogen free extract, MEMJ/kg; Metabolizable energy

Experimental design

The trial design was according to Latin square design with four treatments and four experimental periods. Each period lasted seven days. The adaptation period was six days to allow bulls to adapt the experimental diet; this was followed by ten days of sample taking.

Traits Studied

Rumen pH: A sample of about 60 cc of rumen liquor was taken using a 20 cc syringe. Electronic pH meter was used to read the rumen pH

Ammonia determination: Ammonia concentration was determined as described by Conway method (1967) using Conway unit and then NH3 in rumen liquor=T×N×100 (mg/100 ml of sample volume).

T= Titration, N= Normality of acid.

Volatile fatty acids: Volatile fatty acids were determined as described by Kroman et al. (1967).

Bacterial count: Rumen fluid was obtained from the three fistulated calves rumen in calibrated glass syringes following the procedures of menke and Steingass (1988). 10 ml of the collected rumen liquor were shaken to precipitate rumen content and protozoa at the base of the syringe. 1 ml of the upper part of the syringe was taken for bacterial count. One ml of this solution after mixed in formal solution was used for culture in nutrient agar at room temperature. Then after growth the colonies were counted according to Hungate (1969).

Statistical Methods

Data was analyzed by SPSS computer program version 17 (univariate analysis of variance and multiple comparisons) to obtain means, standard deviations and to compare means.

RESULTS AND DISCUSION

Table 2 shows that there was no significant difference ($P<0.05$) in pH value for different rations studied. This is in agreement with Sehgal and Makkar (1994), Narasa et al. (1986) and Tiwari (2001) who stated that there was no difference in rumen pH due to feeding different isonitrogenous diets based on different natural protein sources.

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On the other hand, Kopency and Wallance (1982) reported that the optimum rumen pH for its proteolytic enzymes to be active fall in the range of 5.5 to 7.0. Generally animals fed control diet showed numerically lower values at all post-feeding time.

Table 2 - Rumen pH (means±SD) in different incubation time (0-9 hrs.) for cattle fed different level of *B. aegyptiaca* cake

Treatment	*Balanites aegyptiaca* kernel level (%)				
Time	0	5	10	15	Significant
0 hrs	6.63±0.48	6.30±0.20	6.30±0.32	6.60±0.12	NS
3 hrs	5.73±0.05	6.10±0.15	6.00±0.30	6.10±0.15	NS
6 hrs	5.93±0.06	6.36±0.27	6.16±0.31	6.03±0.16	NS
9 hrs	5.86±0.08	6.00±0.10	5.90±0.12	5.93±0.17	NS

SD= standard deviation; *NS: Non significant at (P<0.05)

Table 3 shows the various ammonia concentrations for rations at different *B. aegyptiaca* cake levels and at different time post-feeding. There was no significant difference (P<0.05) among treatments, this agreed with Sehgal and Makkar (1994) and Tiwari (2001). Generally ammonia concentration increased with time past feeding. It was also noticed that the control diet (0% *B. aegyptiaca*) showed the lowest ammonia concentration, while animals on diet containing 5 and 10 % *B. aegyptiaca* showed the highest concentrations of ammonia.

Table 3 - Rumen ammonia concentration (NH3 mg/100 ml) (means±SD) in different incubation time (0-9 hrs.) for cattle fed different level of *B. aegyptiaca* cake

Treatment	*Balanites aegyptiaca* kernel level (%)				
Time	0	5	10	15	Significant
0 hrs	5.80±2.87	6.00±3.96	5.79±3.25	7.37±5.11	NS
3 hrs	2.69±0.34	3.67±0.83	2.76±0.21	3.85±0.51	NS
6 hrs	4.43±2.13	6.41±3.19	6.30±3.95	5.39±0.85	NS
9 hrs	6.00±3.07	6.99±3.36	6.89±2.59	6.43±4.31	NS

SD= standard deviation; *NS: Non significant at (P<0.05)

Table 4 shows the various volatile fatty acid concentrations for rations at different *B. aegyptiaca* cake levels and at different time post-feeding. There was no significant difference (P<0.05) among treatments. Obtained results agreed with Trei et al. (1970) and Murphy et al. (1994). There was a general trend for volatile fatty acids concentration to increase with time post-feeding.

Table 4 - Rumen volatile fatty acid concentration (VFAs mg/100 ml) (means±SD) in different incubation time (0-9 hrs.) for cattle fed different level of *B. aegyptiaca* cake

Treatment	*Balanites aegyptiaca* kernel level (%)				
Time	0	5	10	15	Significant
0 hrs	0.371±0.072	0.431±0.060	0.455±0.031	0.431±0.060	NS
3 hrs	0.352±0.093	0.364±0.010	0.431±0.010	0.457±0.120	NS
6 hrs	0.470±0.061	0.473±0.080	0.424±0.145	0.480±0.061	NS
9 hrs	0.492±0.061	0.476±0.114	0.411±0.175	0.401±0.021	NS

SD= standard deviation; *NS: Non significant at (P<0.05)

Table 5 shows the various Bacterial counts for rations at different *B. aegyptiaca* cake levels and at different time post-feeding. There was no significant difference (P<0.05) among treatments. In this trial bacterial count seemed to fluctuate (decrease or increase) with time. The bacterial count tends to decrease with time post-feeding. The highest count observed at zero time post- feeding. However, Leedle et al. (1982) found that bacterial numbers to be lowest 2 to 4 hour after feeding and to gradually increase until 16 hours post-feeding. Warner (1966) found that very little fluctuation in the numbers of bacteria in the rumen when sheep were fed every three hours.

Table 5 - Bacterial count (means±SD) in different incubation time (0-9 hrs.) for cattle fed different level of *B. aegyptiaca* cake

Treatment	*Balanites aegyptiaca* kernel level (%)				
Time	0	5	10	15	Significant
0 hrs	$16.77\times10^6\pm282$	$16.14\times10^6\pm190$	$17.93\times10^6\pm371$	$16.93\times10^6\pm141$	NS
3 hrs	$13.45\times10^6\pm500$	$13.75\times10^6\pm350$	$13.15\times10^6\pm355$	$13.87\times10^6\pm288$	NS
6 hrs	$14.02\times10^6\pm183$	$14.90\times10^6\pm322$	$14.57\times10^6\pm252$	$14.67\times10^6\pm131$	NS
9 hrs	$14.53\times10^6\pm735$	$15.73\times10^6\pm241$	$15.29\times10^6\pm333$	$15.03\times10^6\pm196$	NS

SD= standard deviation; *NS: Non significant at (P<0.05)

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CONCLUSION

From the present study it was concluded that incorporation of *Balanites aegyptiaca* kernel cake at levels of 5, 10 and 15% to replace equal quantities of groundnut cake had no adverse significant effects on rumen environment pH NH3, VFAs and bacterial count).

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PREVALENCE OF POULTRY DISEASES AND PARASITES IN BOTSWANA

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ABSTRACT: *This paper reviewed literature on the prevalence of diseases and parasites of poultry in Botswana over a five year period i.e., from 2006 to 2010. Coccidiosis was the most prevalent disease in poultry species except for ostriches which were mainly affected by colisepticaemia. The highest prevalence of diseases and parasites was recorded in 2007 with fowl pox, coccidiosis, salmonellosis and helminthiasis being the main contributors. Fowl pox was prevalent in family chickens which are reared under free range. Poultry diseases were mainly prevalent in Gaborone, Mochudi, Francistown and Molepolole districts with 225, 168, 148 and 135 cases, respectively. Newcastle disease was sporadic throughout the study period. In the present study, the common parasites of poultry were mites, fleas, lice, ticks and helminths, and helminths were the most prevalent followed by mites. Of all species, chickens were affected most by parasites followed by guinea fowl. These results suggest inadequacies in health management, indicating that strict biosecurity measures should be put in place in order to reduce mortalities. There is also a need for extension service to train farmers on health management.*

Key words: *Biosecurity, coccidiosis, diseases, Newcastle disease, parasites, salmonellosis*

REVIEW ARTICLE

INTRODUCTION

The poultry industry in Botswana has grown rapidly since its inception in the 1970s. According to Poultry Annual Report (2010), the industry employs about 4050 people the majority of whom are women. Moreki (2011) reported that Botswana is nearly self-sufficient in chicken meat and table eggs. However, Botswana imports further processed chicken meat, turkey, duck, quail, guinea fowl and pheasants from South Africa. The *per capita* consumption of poultry meat and eggs are estimated to be 42.6 kg meat and 66 eggs per person per year, respectively (Poultry Annual Report, 2010).

World-wide, two main poultry production systems exist and these are free range (also known as village or family poultry) and commercial systems. Family poultry production system uses mainly the indigenous chickens which scavenge around homesteads for food. On the other hand, the commercial system uses imported high yielding bird strains. In family poultry, shelter is seldom provided resulting in birds sleeping in tree tops during the night to prevent predation (Mushi et al., 1999). Furthermore, Mushi et al. (2000) reported that *Tswana* chickens are mainly raised under free range or semi intensive systems where vaccinations against poultry diseases such as Newcastle disease (NCD), Infectious Bursal Disease (IBD) and coccidiosis are not carried out. Instead, traditional herbal remedies were used to treat sick chickens. On the other hand, commercial chickens are provided with housing and adequate nutrition, and are vaccinated against diseases.

Some of the major constraints in the poultry industry in Botswana are limited feed resources and diseases. Modification of the production systems from free range to intensive systems has contributed to the vulnerability of poultry to diseases resulting in poor bird performance including reduced feed intake, feed poor conversion ratios and poor growth rates.

Despite the rapid growth of the industry, there is little documentation of poultry diseases in Botswana. Therefore, this paper reviews the prevalence of poultry diseases in Botswana over a five year period, i.e., from 2006 to 2010. Data used in this review were obtained from the Botswana National Veterinary Laboratory (BNVL) reports and database.

POULTRY DISEASES AND PARASITES

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Figure 1 shows the number of confirmed cases of poultry diseases and parasites in Botswana from 2006 to 2010. These confirmed cases included viral, fungal, bacterial, parasitic and non-specific causes which include *inter alia* nutritional factors, trauma, stress and injuries. According to Figure 1, the cases of diseases and parasites increased from 2006 to 2007 and thereafter declined. In general, diseases and parasites declined over time, indicating improvement in farmers' health management practices.

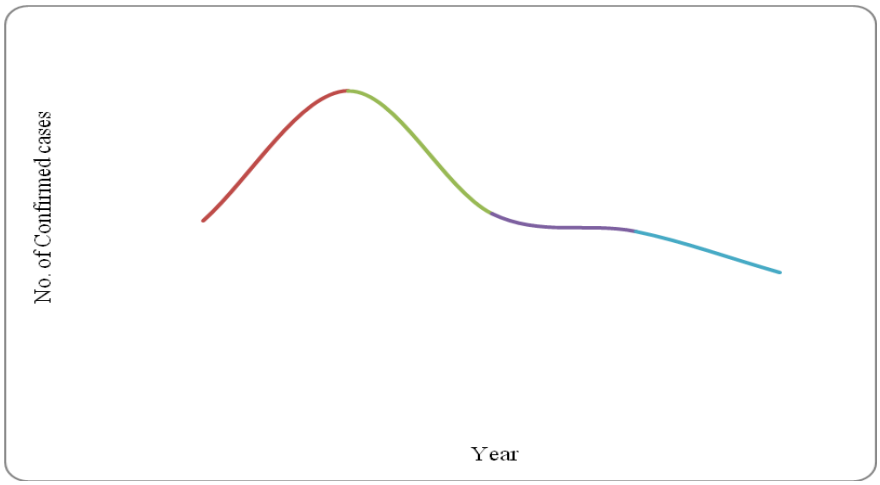

Fig. 1. Number of confirmed cases of poultry diseases and parasites (2006 to 2010)

This current study identified the diseases and parasites of chickens, ostriches, guinea fowl, ducks and turkeys. For this reason, the discussion is centred on diseases and parasites of these five poultry species.

Chickens

Table 1 shows the prevalence of chicken diseases across the districts from 2006 to 2010. It is clear from Table 1 that the highest number of confirmed cases was recorded in Gaborone, Mochudi, Molepolole, Francistown and Mahalapye with 225, 167, 148, 135 and 118 cases, respectively. These five districts are the main producers of poultry in Botswana. As shown in Table 1, the highest number of positive cases was recorded in 2007. Thereafter, a decline in cases was observed, indicating that farmers had adopted sound disease preventative measures.

The common diseases and conditions of chickens are presented in Table 2. It is clear from Table 2 that coccidiosis and fowl pox were the two most prevalent diseases of poultry. Fowl pox occurred mainly in family chickens. Diseases of less prevalence were IBD and NCD. According to Table 2, the highest prevalence was recorded in 2006 and 2007 and the lowest in 2008. During the study period only nine cases of mange were recorded in chickens. According to Office International des Epizootics (OIE) (2008), mange is a contagious skin disease that is characterized by crusty, pruritic dermatitis and hair/feather loss, is caused by a variety of parasitic mites burrowing in or living on the skin. Acaricides are used to control mange.

Table 1 - Positive cases of chicken diseases across the districts

Districts	2006	2007	2008	2009	2010	Total
Francistown	4	38	31	43	19	135
Gaborone	31	53	62	37	42	225
Gantsi	0	6	5	5	2	18
Jwaneng	0	13	4	4	4	25
Kanye	12	23	20	20	19	94
Kasane	0	4	4	4	3	15
Letlhakane	5	32	4	5	1	47
Lobatse	1	40	16	17	16	90
Mahalapye	8	43	31	28	8	118
Maun	0	22	6	3	7	38
Mochudi	32	48	39	31	17	167
Molepolole	27	55	33	20	13	148
Palapye	1	5	14	19	9	48
Selebi Phikwe	0	13	8	12	5	38
Serowe	1	10	7	17	12	47
Tsabong	0	4	2	2	2	10
Total	122	409	286	267	179	1263

Source: BNVL Annual Reports (2006-2010)

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Table 2 - Ten most common chicken diseases in Botswana from 2006 to 2010

Year	Coccidiosis	Newcastle disease	Salmonellosis	Fowl pox	Colisepticaemia	E-coli	Nutritional deficiencies	Avian mycoplasma	Infectious Bursal Disease	Pediculosis	Total
2006	82	6	32	24	0	0	14	19	1	3	181
2007	58	4	28	36	0	27	25	39	0	25	242
2008	64	0	1	29	10	0	3	7	3	2	126
2009	40	2	6	25	40	0	5	2	1	8	131
2010	38	1	7	28	11	7	4	5	5	4	114
Total	282	13	74	142	61	34	51	72	10	42	781

Source: BNVL Annual Reports (2006-2010)

Ostriches

Helminthiasis, trauma, colisepticaemia and salmonellosis cases were recorded in ostriches and helminthiasis was the most prevalent. Like chickens, the highest number of cases (5) of ostrich diseases was observed in 2007 followed by 2009 with four cases. The low prevalence of ostrich diseases in this study could be attributable to low numbers of farmed ostriches in the country, and also to adoption of strict biosecurity measures on farms. Traumatic injuries reported in this study could be attributable mainly to fright, or fighting of birds, especially during the breeding season. No case of NCD was recorded in ostriches in the present study. According to European Commission (2001), the last case of NCD was reported in ostriches in Botswana in 1993.

Guinea fowl

Prevelance of guinea fowl diseases in Botswana is shown in Table 3. Similar to chickens and ostriches, a higher number of confirmed cases (38) of guinea fowl diseases were observed in 2007 followed by 2010 with 25 cases. Of all the diseases, coccidiosis and helminthiasis were the most prevalent. Bonkoungou (2005) in Burkina Faso reported that guinea fowl are more tolerant to common viral and bacterial diseases that occur in poultry but are intolerant to internal and external parasites because of their scavenging behaivour under semi-intensive production systems. In Botswana, guinea are reared mainly under semi-intensive systems.

Table 3 - Number of confirmed cases of guinea fowl diseases (2006 to 2010)

Year	Helminthiasis	Coccidiosis	Hardware disease	Pediculosis	Trauma	Salmonellosis	Colisepticaemia	Total
2006	1	1	0	0	0	0	0	2
2007	17	16	1	1	2	1	0	38
2008	9	10	0	0	0	1	0	20
2009	9	7	0	0	0	1	5	23
2010	8	12	0	1	0	2	2	25
Total	44	46	1	2	2	5	7	108

Source: BNVL Annual Reports (2006-2010)

Ducks

As is the case with turkeys, duck production in Botswana is practiced at subsistence level. The highest number of cases of diseases and parasites of poultry were recorded in 2007. Four diseases of ducks were recorded and these were *Vibrio fluvialis* (5), fowl pox (1), helminthiasis (1) and colisepticaemia (1). It is apparent that *Vibrio fluvialis* was the most prevalent.

Turkeys

In Botswana, turkey production is mainly practiced at subsistence level; hence the low number of cases of disease cases reported in the present study. As in other poultry species, high prevalence of diseases was observed

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in 2007. Coccidiosis and blackhead were the only diseases that affected turkeys, and the most prevalent was coccidiosis.

Parasites and parasitic diseases of poultry

The parasites of chickens, ducks, guinea fowl, ostriches and turkeys are presented in Table 4. It is clear from Table 4 that helminths and mites were the most prevalent parasites of poultry. Helminths were more prevalent in chickens than in other poultry species. This finding points to inadequacies in health management practices, especially in *Tswana* chickens, which do not receive adequate technical support from the extension service. In the present study, only ostriches were not affected by helminths probably indicating that farmers had adopted sound and effective health management programs.

Table 4 - Parasites of chickens, ducks, guinea fowl, ostriches and turkeys

Species	Mites	Fleas	Lice	Ticks	Helminths	Total
Chicken	34	0	3	0	129	166
Ducks	0	3	0	0	1	4
Guinea fowl	35	8	0	0	26	69
Ostriches	0	2	0	2	0	4
Turkeys	0	0	0	0	14	14
Total	69	13	3	2	170	257

Source: BNVL Annual Reports (2006-2010)

CONCLUSION

In this study, the highest prevalence of diseases and parasites was observed in 2007. Coccidiosis was the most prevalent disease in chickens, ducks, guinea fowl and turkeys, and colisepticaemia in ostriches. Fowl pox was prevalent in *Tswana* chickens due to inadequacies in health management. In order to reduce mortalities due to managemental factors such as diseases, it is necessary that strict biosecurity measures should be put in place. In addition, there is need for extension service to intensify farmer training on health management.

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MORPHOMETRIC TRAITS AS INDICATORS FOR BODY WEIGHT IN SUDANESE KENANA CATTLE

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ABSTRACT: *In this study body weight in both sexes was predicted using some morphometric. Traits used were height at withers (HTW), heart girth circumference (HGC), abdominal girth circumference (ABGC) and body length (BL). The overall means of live body weight (WT) and of the studied morphometric traits (HGC, ABGC, BL and HTW), respectively, were 281.814 ± 3.527kg, 150.641 ± 0.447, 190.542 ± 1.177, 87.963 ± 0.512 and 119.023 ± 0.497 cm. The phenotypic correlation coefficients for body weight (BW) with HGC, ABGC, BL and HTW in this experiment were 0.98, 0.78, 0.64 and 0.70 respectively. Prediction equations were obtained for combined sex, males and females. R^2 was high in the three equations (0.97, 0.98 and 0.97 respectively). Obtained prediction equations were tested for their validity by estimating body weights of six males and 25 female Kenana cattle. These animals were weighed by three different methods; the equations, Dalton tape and large ruminant scale, and obtained weights were not significantly different (P≤0.05). It was concluded that prediction equations can be used efficiently to estimate live weight in Kenena cattle when it is difficult to use scales.*

ORIGINAL ARTICLE

Keywords: *Body weight, correlations, Kenana cattle, morphometric traits, Sudan*

INTRODUCTION

A study of linear measurements in Africa is important because most traditional African farmsteads lack a weighing machine and adequate knowledge to understand its manipulation. The use of the calibrated weigh band which is very common in developed countries is not common in the developing world because their calibrations are based on temperate breeds of cattle. But simple linear measuring devices will be easy to handle and will assist in selecting animals to become the parents of the next generations (Essien and Adesope, 2003). Essien and Adesope (2003) also reported that over the years, emphasis has shifted from subjective methods of appraising cattle to more objective methods like the use of linear measurements of different body parts. Information on morphometric traits can be used in assessing growth rate, body weights, and feed utilization and carcass characteristics in farm animals (Brown et al., 1973). They can be taken at a relatively low cost with a reasonable accuracy and consistency and they serve as supplemental information for comprehensive performance testing. Gilbert and Gregory (1952) noted that linear body measurements describe an animal more completely than conventional methods of weighing and grading. Ibe and Ezekwe (1994) reported that morphometric traits have been used to characterize breeds, evaluate breed performance and predict live body weight of animal.

Morphometric traits are less subjected to short-term changes as in body weight and allow comparisons in different parts of the body (Russell, 1975) and their use to predict live body weight of animals is perceived more reliable compared to the use of weighing scales which could introduce biases according to the fullness of the gut (Obike et al., 2010). Alsiddig et al. (2010) and Gunawan and Jakaria (2010) found significantly high correlation coefficient for HG with live weight (>0.80) they also reported that stepwise regression showed that HG was a good estimator of weaning and yearling live weight followed by HTW and BL. Kashoma et al. (2011) reported that the correlation of BW with HG at various ages for Tanzania shorthorn zebu cattle were in the range of 0.65–0.94, whereas R^2 for regression equations were 0.87 and 0.88 for females and males. Caglar and Skerden (1993) declared that the regression equations must be determined for beef breeds for different country and regions. Kenana cattle are considered one of the promising dual purpose cattle, yet information on their morphometric traits and their relation with economical traits such as body weights are limited. Hence, this study was conducted to

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provide essential information on some of these morphometric traits.

MATERIAL AND METHODS

Location of study

Data analyzed in this study was collected by measuring morphometric traits in cattle at Um-Benein Research Station and villages around it. This area, Um-Benein, was located in Sinnar state on the western bank of the Blue Nile about 360 km south of Khartoum and 9 km south of Singa. It lies between latitude 13° 04 N and longitude 33° 56 E and is 435 meters above sea level. There are three distinct seasons in the year based on rain fall and temperature, winter (November - February), hot summer (March - June); and wet summer (July - October), with some showers in May and June. In addition to some herds that were studied in the Gezira State.

Animals and their management

A total of 301 animals (Kenana cattles) were used to estimate morphometric traits, whereas thirty one animals (males and females at different ages) were weighed using weighing machine to compare obtained weights with those calculated from prediction equations and Dalton tape for same animals. All the animals were housed in pens fenced by wood materials, steel pipes and sheds of local materials and corrugated zinc sheets. Water was available all the time in steel troughs.

Statistical analysis

The data were subjected to statistical analysis in the SPSS (1983), using least square fixed model procedure (Harvey, 1977) model one. The model included fixed effects of sex, age, lactation number and herd. The residual mean square was used as the random error term to test the significance of differences among groups.
The general model fits the data was:

$$Y_{ijkl} = \mu + S_i + Aj + H_l + e_{ijkl}$$

Where:

Y_{ijkl} = the trait studied (Live body weight).
μ = the overall mean underlying the trait.
S_i = the effect of ith sex (for i = 1 and 2).
Aj = the effect of j^{th} age (for j = 1...5).
H_l = the effect l^{th} of herd (for l = 1...3).
e_{ijkl}= the random error term (All factors considered fixed except for the random error term).

RESULTS AND DISCUSION

Table1 shows least square means of BW, HG, ABC, BL and HTW. The overall mean for HTW for Kenana cattle were similar to those obtained by Alsiddig et al. (2010) for Sudan Zebu Cattle (Baggara type) and Aamir et al. (2010) for Kenana cattle, but lower than others reported for some Sudanese cattle breeds (FAO, 1995). The increase in estimates of Morphometric traits with age in Kenana cattle in this study was similar to the result reported by Green and Carman (1978) who showed that skeletal development within a population become relatively more uniform with age and with that Aamir (2010) who indicated that these measurements were affected with age and the live weight of the animal.

The results in table 2 shows that there was increase in mean values of morphometric traits and body weight with age, this is similar to the finding reported by Green and Carman (1978).

Information on correlation coefficients between morphometric traits and productive traits were scare. The results in Table 3 showed that a significantly ($P \leq 0.01$) high positive correlation coefficient exist between body weight and heart girth (r = 0.98). This estimate was higher than the results obtained by Alsiddig et al. (2010) in Baggara cattle. However, in early report, Francis et al. (2002) observed a similar trend that body weight was highly correlated ($r \geq 0.90$) with body length, heart girth, height at withers and abdominal girth but particularly so with heart girth (r = 0.96). The results suggested that any of these variables or their combinations would provide a good estimate of predicting live body weight in Kenana cattle. Orheruata (1988) found a similar trend in beef cattle, that high heart girth circumference measurement meant more muscle in the meat.

Different regression equations were also derived to predict live body weights in Kenana cattle. Francis et al. (2002) developed some prediction equation for these traits in Zimbabwe for indigenous, Friesian, Brahman, Red Dane and crossbred cattle.

$Y= -388.438-0.153ABGC-0.419HTW-0.083BL+5.022HGC$ ($R^2=0.97$) (1)
$Y= -377.487+5.483HGC-0.427ABGC-0.883BL-.012HTW$ ($R^2=0.98$) (2)
$Y= -407.830+5.105HGC-0.123ABGC+0.012BL-0.487HTW$ ($R^2=0.97$) (3)

Differences in estimates of morphometric traits reflect useful measures that depict the size and shape of animal.

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Table 1 - Least square means (means±SE) ofmorphometric traits of Kenana cattle according to sex and age groups.

Age	Trait		BW (kg)	HGC(cm)	AGC(cm)	BL(cm)	HTW(cm)
	Sex	No.					
1-2yrs	Male	05	188.00±10.56	129.12 ±1.33	156.43±1.23	77.56±1.33	106.00±2.50
	Female	35	184.24 ± 8.62	128.11±1.38	155.32±1.89	75.66±1.06	104.85±1.19
3-4yrs	Male	07	292.32±12.00	149.00±2.20	161.21±0.34	85.33±1.44	111.03±2.33
	Female	12	284.22 ± 16.29	150.00±2.12	180.47±2.87	86.63±1.62	122.74±2.25
5-7yrs	Male	08	380.33±12.23	153.21±1.22	195.44±1.33	90.00±0.55	125.00±2.33
	Female	45	338.83 ± 11.95	152.83±1.26	193.42±1.72	89.60±0.97	123.35±1.65
8-10yrs	Male	-	-	-	-	-	-
	Female	82	307.28 ± 4.92	155.83±`.01	198.48±1.38	93.06±0.78	122.85±0.68
>10yrs	Male	-	-	-	-	-	-
	Female	103	297.96 ± 19.12	152.83±1.26	198.30±3.18	87.29±192	122.47±2.82
Overall	Male	301	281.81 ± 3.53	150.64 ±0.50	190.54±1.39	87.96±0.51	119.02±0.50
	Female	20	293.90 ± 16.34	130.83±2.24	160.17±3.48	83.33±1.18	112.67±1.07
	Overall	281	282.03 ± 4.98	151.69±1.42	183.63±2.05	95.56±0.70	126.05±0.63

BW= body weight; HGC = Heart girth circumference; AGC = Abdominal girth circumference; BL = Body length and HTW = Height at withers.

Table 3 - Phenotypic correlation coefficients between morphometric traits and some productive traits of Kenana cattle

Trait	HGC (cm)	ABGC (cm)	BL (cm)	HTW (cm)	ACB (kg)	ES (kg)	Age (yrs)
HGC (cm)	1.00	0.82**	0.66**	0.74**	0.92**	0.98**	0.57**
ABGC (cm)		1.00	0.55**	0.66**	0.91**	0.78**	0.66**
BL (cm)			1.00	0.59**	0.48**	0.64**	0.40**
HTW (cm)				1.00	0.58**	0.70**	0.47**
ACB (kg)					1.00	0.92**	0.55**
ES (kg)						1.00	0.53**
Age (yrs)							1.00

** Correlation is significant at (0.01) level (2- tailed); HGC = Heart girth circumference; AGC = Abdominal girth circumference; BL = Body length; HTWs = Height at withers; AC = Actual body weight; ES = Estimated body weights.

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The relatively high accuracy of live body weight prediction obtained in this study suggested that regression equations were sufficient to be use in prediction of body weight from linear body measurements in Kenana cattle. However, more studies are needed to emphasis this statement. This is advantageous, especially in the Sudan, with difficulties in weighing machines

Table 4 - Least square means of estimated body weights (kg) for males and females Kenana cattle obtained using the scale, Dalton weighing band and the derived equation

Method of BW Estimation	Males		Females	
	No.	Weight (M±SE)	No.	Weight (M±SE)
Dalton equation	6	194.00^{a}±5.05	25	274.80^{b}±7.70
Derived equation	6	213.30^{a}±8.08	25	283.80^{b}±10.40
The scale	6	190.33^{a}±6.33	25	283.90^{b}±8.90
Total	18	199.20±4.33	75	280.20±5.10

Means with the same letter were not significantly different ($P > 0.05$). ^{a,b} Different letters denote significant differences at ($P < 0.05$).

CONCLUSION

Information on morphometric is vital and valuable in management and breeding programs and should be well utilized to improve the performance of Sudanese cattle breeds, especially Kenana cattle.

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SURVEY OF CHEMICAL DISINFECTANTS USED BY POULTRY FARMERS IN IMO STATE, NIGERIA

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ABSTRACT: *Pathogen contamination can be prevented with aid of proper health care products such as disinfectants. This study was designed to evaluate the efficacy of common disinfectants and disinfection practice of poultry farmers in Imo State, Nigeria, in order to generate information needed for the proper regulation of disinfectant use in the area. Primary data were generated from structured questionnaires distributed to animal health practitioners and poultry farmers in the State. Results showed that farmers choice of disinfectants were dependent on cost and availability. Z-germicide® 10 (22.27%) and Izal® with 9 (20.45%) are more widely distributed in the various animal health outfits. This was closely followed by Lysol® 6 (13.63%) and Diskol® 6 (13.63%). Morigard® 3 (6.81%), Dettol® and Septol® 3 (6.81%) appeared each in three outfits. Vox® 1 (2.27%) CID 20® 1 (2.27%) a Virkon® 1 (2.27%) occurred once and that is at the Avian influenza desk officer's store. Izal® 140 (58.82) was more widely used by farmers followed by Z-germicide®, both of which are phenolic products. Morigad® with 2 (2.94%) and Lysol® with 91.47%0 are also phenolic products. Altogether 76.47% of disinfectants used in Imo State were of phenolic products. Most poultry farms in the State did not use disinfectant footbath. Those that used them did not insist on workers or visitors dipping their feet in them before entering the farm house. They also did not reconstitute the disinfectants according to the manufacturer's instructions.*

Keywords: *Disinfectants, poultry farms, disease, Nigeria*

ORIGINAL ARTICLE

INTRODUCTION

Intensive poultry farming provides optimum conditions for the concentration of pathogens and transmission. The crowding of thousands of birds in an enclosed warm and dusty environment is highly conducive for the transmission of contagious diseases (Collins, 2007). Furthermore, selection of birds for faster growth rate and higher meat yield has left the birds immune system less able to cope with infections and there is a high degree of genetic uniformity in the population, making spread of disease all the more easy (Delany, 2003). The presence of these diseases has created the need for the control of poultry pathogen in the intensive farming system.

Microbiological contamination can be prevented and controlled using proper management practices and healthcare products such as disinfectants (MSU, 2008). The main purpose of disinfectant action is to reduce the number of pathogen in the environment. By reducing pathogen numbers, the potential for disease occurrence in the poultry farm is reduced (Block, 2001). The mode of action of the disinfectant chemicals is usually to disrupt significant cellular structures or processes in order to kill or eliminate the microorganisms (Allen and White, 2006).

Generally, a commercially available disinfectant will exhibit the ability to reduce microbial contamination by several orders of magnitude in a standard test method in order to be approved for use. In use in farms however, not all disinfectants exhibit the activity that one would expect on standard tests (HACCP Manual, 2008).

According to records from the zonal veterinary Clinic Owerri, Imo State (Chima, personal communication) there are several cases of disease outbreaks in many poultry farms even, when the farmers claimed to have used disinfectants to prevent such disease outbreaks. Farmers may therefore be spending their money on available disinfectants without commensurate results. There may also be inherent problems arising from poor prescription practices of skilled and unskilled animal health practitioners in the area (Okoli et al., 2002). There is therefore the

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need to generate reliable data on the disinfectant use practices of poultry farmer in the study area, since such information will aid formulation of regulatory frameworks for the development of appropriate biosecurity schemes.

The objectives of this study was therefore to determine the types of disinfecting agents prescribed by animal health practitioners, the types utilized by poultry farmer as well as the disinfection practices of farmers in Imo State.

MATERIALS AND METHODS

The study area

The study was carried out in the three geo-political zones of Imo State, which is situated in South-eastern agro-ecological zone of Nigeria. Poultry production in the area has been described by Okoli (2004). The farming operations are distributed over urban, peri-urban and rural sites and have been shown by Okoli (2004) to range from very small operations (50-100), to medium (101 to 1000 birds) and large scale (above 1000 birds).

Identification and selection of animal health outfits/farms

A two-week preliminary field investigation was carried out to identify animal health practice outfits and farms that will be sampled. During this survey, researcher made her self-known to the poultry operators and their managers and discussed the detailed nature of the work with them.

The main study, which, consisted of two phases (survey/evaluation) covered the three geo-political zones of the states, Owerri, Orlu and Okigwe. The urban centers in each zone were purposively included. The study sites selection covered all the animal health practice outfits and some large-scale and small-scale farms in the state. The preliminary field investigation revealed that there were more commercial farms in the Owerri geo-political zone. Based on this information, 40 farms were selected from Owerri zone, 30 farms from Orlu zone, and 20 farms from Okigwe zone. Altogether 90 farms were surveyed. Selection of these farms was based on the membership list of the state branch of the Poultry Association of Nigeria. The list of 227 members was first divided into geo-political zones and thereafter, farms in each zone were grouped according to their scale of operation as stated earlier. The farms were then randomly selected for the survey.

Furthermore, six farms for on-farm disinfection study were randomly selected, (two farms from each zone). Specifically, one large-scale farm and one small-scale farm were selected from each geo-political zone.

The large-scale farm in Owerri zone is located at Naze in Owerri West LGA. It has been in existence for about 20 years and currently stocks about 10,000 birds of different strains and ages, housed in four separate buildings. About 8,000 birds are reared on battery cage, while another 2000 birds are reared on deep litter. The feed for the birds are sourced from commercial feed manufacturers, while a borehole in the farm supplies water for the birds.

The small-scale farm from Owerri zone is located at Egbu Road in Owerri North LGA. It is a demonstration farm belonging to Imo State Livestock Development Project. The farm has been in operation for more than six years and presently stocks about 600 birds, (200 broiler and 400 pullets) in two separate buildings in the farm. The birds are reared on deep litter. The feed for the birds is sourced from commercial feed dealers, while water is supplied from a private borehole in the farm.

In Orlu geo-political zone, the larger-scale farm selected is located at Okwu Abala in Orlu LGA. The farm has been in existence for about five years. The farm houses about 2000 laying birds in two building. Each building is partitioned into four pens with wire gauze. The birds are reared on deep litter. Both feed and water for the birds are sourced from commercial feed and water dealer respectively.

The small-scale farm from Orlu zone is located at Ihioma. It has been in existence for about four years. There are about 800 birds reared on deep litter in a single structure at the back of the operator's house. The structure is divided into four pens, with short wire gauze. Feed and water for the birds are sourced from commercial dealers.

In Okigwe geo-political zone, the large scale farm selected is located at Umulolo along Okigwe-Enugu express road. The farm has been in existence for about ten years, and currently houses about 6500 birds in four separate buildings and reared on deep litter. About 5,000 out of the 6,500 birds in the farm are laying. The farm belongs to an animal health practitioner, who compounds the feed for the birds. Water for the birds is sourced from a private borehole in the farm.

The small-scale farm in Okigwe geo-political zone is located at Ubahu Okigwe. It has a bird population of about 930, housed in one long house divided into five pens with dwarf wall and wire gauze. The bird population is made up of about 120 broilers and 800 laying birds reared on deep litter. Feed is sourced from commercial feed dealer, while their drinking water is from water hawkers and a nearby stream.

Survey of animal health business practitioners

This was carried out with the; objective of determining the types of disinfecting agents sold or prescribed by them. Two visits were made to all the animal health practice outfits in Owerri, Orlu and Okigwe Urban centers. During the first visit, structured questionnaires were distributed to the owners of the outfits that sell disinfectants to the farmers and second visit, the questionnaires. The completed questionnaires were retrieved. The questionnaire responses was collated and analyzed with frequency distribution. A sample of the questionnaire is shown in appendix 1.

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Survey of poultry farmers

A survey of selected poultry farmers to determine the types and volumes of disinfectants utilized by poultry farmers in Imo State and to determine the disinfection practices of poultry farmers in Imo State.

Selection of the study farms was based on the membership list of the state branch of the poultry Association of Nigeria as stated earlier. The 227 membership list was divided into the three geo-political zones and thereafter 40 farms from Owerri, 30 farms from Orlu and 20 farms from Okigwe (totaling 90 farms) were selected. The study farms were randomly selected using the restricted shuffled approach (Schutz and Grimes, 2002). This was done by writing name of each of the farm in each geo-political zone on a single card of similar size and color. The cards were shuffled thoroughly to mix them, and then spread out on a table with their faces downwards. A volunteer was asked to pick one card each from the packs belonging to each geo-political zone. This was repeated until the desired numbers of farms were selected for each zone.

Again, two visits were made to each of the selected farms, first to distribute structure questionnaires and secondly to collect the responses. Responses were collaborated with on-site observation.

Statistical analysis

The questionnaire responses were collated and analyzed using frequency distribution.

RESULTS AND DISCUSSION

The activities of animal health practitioner (AHP) in Imo state

Results of the survey of animal health practitioners in Imo State are highlighted in table 1-4. Table 1 revealed that Z-germicide® 10 (22.27%) and Izal® with 9 (20.45%) are more widely distributed in the various outfits. This was closely followed by Lysol® 6 (13.63%) and Diskol® 6 (13.63%). Morigard® 3 (6.81%), Dettol® and Septol® 3 (6.81%) appeared each in three outfits. Vox® 1 (2.27%) CID 20® 1 (2.27%) a Virkon® 1 (2.27%) occurred once and that is at the Avian influenza desk officer's store.

Table 1 - Types of disinfectant stocked by animal health practitioners in Imo State

Disinfectants	Frequency	Percentage
Z-germicide®	10	22.72
Izal®	9	20.45
Diskol®	6	13.63
Lysol®	6	13.63
Morigard®	3	6.81
Dettol®	3	6.81
Septol®	3	6.81
Trisept®	1	2.27
Vox®	1	2.27
CID 20®	1	2.27
Virkon®	1	2.27
Tota	44	100

Source: Filed data 2009.

This is expected since phenol in the form of carbolic acid is the oldest known chemical disinfectant and has been shown to have many advantages over other type of disinfectants including being readily available, is cheap and easy to dispense among many other properties.

Table 2a showed that demand of a particular disinfectant by the farmers (54.05%) mostly influence disinfectant stocking pattern in the animal health outfits. This was followed by the disinfectant availability (29.72%) and professional choice of disinfectant (16.21%). It is clear from the results that the availability of a particular disinfectant in an animal health outfit in Imo State is driven by the farmer's choice and not the professional's choice of the practitioner. This agrees with the general picture of drug abuse previously reported in the management of antibacterial products in Nigeria and other developing countries (Okeke et al., 1999; Okoli et al., 2002).

Table 2b showed that (66.66%) of animal health practitioners prescribe to farmers disinfectants for use in their farms. Most often, their prescription is based on what is available in their outfit and not in efficacy, as highlighted earlier in table 4.2a. The complication of such poor management of antibacterial drugs is counterproductive and has been complicated in the very high resistance of common microorganisms to available antibacterial in the study environment (Okoli et al., 2002; Okoli, 2004).

Table 3a showed that majority of the poultry farmers (66.66%) accepted the disinfectants prescribed by the animal health practitioners for use in their farms. The (33.33%) non adherence to the prescription of animal health practitioners as observed in this study is of both economic and public health implications since such behaviors have been shown to be a contributory factor to the already stated development of acquired bacterial resistance in Nigeria and other developing countries (Okoli et al., 2002).

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Table 3b revealed that (83.33%) of the interviewed animal health practitioners stated that farmers chose a particular disinfectant for use based on its cost; as against availability and colleague influence (8.3% each). It would seem then that Z-germicide® and Izal® which is phenolic compound are not only the most readily available but also the cheapest in the study areas. The cost may not necessarily be a factor of the disinfectant quality but also that of the nature of packaging and presentation.

Table 2 - Disinfectant stocking determinants and prescription frequency among animal health practitioners

Items	Frequency	Percentage
(a) Disinfectants stocking determinants (n = 37)		
Determinants		
Demand	20	54.05
Availability	11	29.72
Professional choice	6	16.21
Total	37	100
(b) Disinfectant prescription frequency (n = 24)		
Disinfectant Prescription		
AHP that prescribe to farmers	16	66.66
AHP that do not prescribe to farmers	5	20.83
AHP that prescribe sometimes	3	12.50
Total	24	100

Source: Filed data 2009.

Table 3 - Farmers adherence to prescription and determinants of disinfectant choice by farmers

Items	Frequency	Percentage	
(a) Farmers adherence to prescription (n = 24)			
Farmers Adherence			
Farmers that adheres to prescription		16	66.66
Farmers that do not adhere to prescription		8	33.33
Total		24	100
(b) Determinants of farmer's choice of disinfectants (n - 24)			
Determinants			
Cost		20	83.33
Available		2	8.33
Colleague influence		2	8.33
Total		24	100

Source: Filed data 2009.

For example, there may be smaller packs of these products which bring them within the purchasing power of the farmers, who have been shown to be mostly small holders (Anyaegbunam, 2003; Nwaodu, 2005).

Table 4 Revealed that majority of the outfits (70.83%) do not keep records of the volume of each disinfectant sold, while 29.66% kept records of their sales. This result is of grave economic and animal health importance since lack of such information reflects the poor organizational structures of animal health business enterprise in Nigeria.

Table 4 - Availability of sales record on disinfectants in the health practice outfit

Sales record keeping	Frequency	Percentage
Available record	17	70.83
Non Available record	7	29.16
Total	24	100

Source: Filed data 2009.

Over the last decade, significant proportion of veterinarians are in private practice, however, Okoli et al. (2002) showed that out of 158 animal health outfits studies in South Eastern Nigeria, only 48 (30.4%) were manned by skilled veterinarian while a major 69.6% was manned by non-descript traders and non by pharmacists.

In Owerri specifically, the 21.9% recorded was significantly lower than the regional average. It is therefore probable that the preponderance of this group of untrained animal health practitioners in the study area is contributory to the observed poor records keep culture.

The survey of the animal health practice outfits showed that Izal® and Z-germicide®, which are phenolic products, are more widely distributed in the outfits that sell disinfectants. The other products that are next to them in distribution are all phenolic products also, with the exception of Diskol®, which is a glutareldehyde. The least in distribution are Virkon® (Oxidizing agent), Vox® (Halogen product) and CID 20®, which has a mixed active ingredient (quaternary ammonium compound, aldehyde and alcohol).

Virkon®, Vox® and CID 20® were not found in the commercial outfits but were the disinfectants being distributed to the farmers by Federal Livestock Department through the desk officer of Avian Influenza project, Owerri, Imo State. Though the animal health practitioners prescribe to farmers the disinfectant to buy, farmers

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choice of disinfectants still determines what they stock in their outfits. The farmer's choice of disinfectant was over 80% dependent on cost as could be seen from the survey. This explains why they prescribe and sell more of Izal®, which is cheaper than the other disinfectants to farmers.

The activities of poultry farmers in Imo state

Table 5 revealed the socio-cultural characteristics of the farms studied in Owerri, Orlu and Okigwe zones of Imo State. There were more farms at Owerri than Orlu and Okigwe. Sixty percent of the farmers were males and fell within the 41 to 50 years age bracket, with 44 (48.88%) having attended tertiary institutions. Most of these farmers (93.3%) were married.

Table 5 - Social characteristics of farmers (n = 90)

Social Characteristics		Frequency	Percentage
(a)	**Location of farm**		
	Owerri	40	44.44
	Orlu	30	33.33
	Okigwe	20	22.22
	Total	90	100
(a)	**Sex of Farmers**		
	Male	54	60
	Female	36	40
	Total	90	100
(c)	**Age of Farmers**		
	Below 20	0	0.0
	21-30	0	0.0
	31-40	21	23.33
	41-50	42	46.66
	51-60	17	18.88
	Above 60	10	11.11
	Total	90	100
(d)	**Marital Status**		
	Married	84	93.33
	Single	6	6.66
	Total	90	100
(e)	**Educational Qualification**		
	Non formal education	4	4.44
	Primary	8	8.88
	Secondary	34	37.77
	Tertiary	44	48.88
	Total	90	100

Source: Filed data 2009

Anyaegbunam (2003) and Nwaodu (2005) have reported similar results for the different sectors of the livestock industry in Imo State. Usually these smallholder farmers are civil servants, married and having moderately large families of 4-6 persons. They use different forms of livestock farming to augment their incomes (Anyaegbunam, 2003).

Table 6a revealed that 50 (58.55%) of farms were mixed broilers and layer farms. On-site observation showed that the 16 (17.77%) that rear only broilers were mainly small sized farms with birds under five hundred in number, while those that reared only layers were mainly large-sized farms with birds above two thousand in number. Table 6b showed specifically, the small sized and large sized farms were 32 (35.55% each) while the medium sized farms were fewer in number (28.88%).

Table 4.7 revealed (a) the pattern of disinfectant use in farms, (b) presence of disinfectant footbath in farm and (c) availability of disinfectants in the footbath. Table 7a revealed that 68 (75.55%) of the farms surveyed use disinfectants, while 22 (24.44%) were not using disinfectants. On site observation showed that the farms that do not use disinfectants are mainly the small sized farms that keep only broilers and cockerels.

Table 7b revealed that 50 (55.55%) of the farms had footbath at the entrance of poultry pens while 40 (44.44%) did not have footbath in the farm. Table 7a showed that 68 (75.55%) of farms use disinfectants, this indicates that some farms that did not have footbath still use disinfectants for other purposes. On site observation showed that some farms, pour disinfectants in folded sac bags placed at the entrance to the poultry house. This, they use as improvised footbath. Such practices reflect gross ignorance of the actual functions of a disinfectant footbath in a farm (WHO, 1994).

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Table 6 - Types of poultry farms and size distribution of farm		
Items	**Frequency**	**Percentage**
(a) Types of Farm		
Broiler	16	17.77
Mixed (broiler/layer)	50	55.55
Layer	24	26.66
Total	90	100
(b) Farm Size		
Small size (less than 500 in number)	32	35.55
Medium sized farms (500-1000 birds)	32	28.88
Large farms (above 1000 birds)	26	35.55
Total	90	100

Table 7 - Pattern of disinfectant use, presence of disinfectant footbath in farm and availability of disinfectants in the footbath		
Items	**Frequency**	**Percentage**
(a) Use of disinfectant		
Farms that use disinfect	68	75.55
Farms that do not use disinfectant	22	24.44
Total	90	100
(b) Presence of disinfectant footbath		
Farms with disinfectant footbath	50	55.55
Farms without disinfectant footbath	40	44.44
Total	90	100
(c) Availability of disinfectant in the footbath		
Disinfectant always available in the footbath	30	44.11
Disinfectant not always Available in the footbath	38	55.88
Total	68	100
Source: Filed data 2009.		

The presence of a footbath at the entrance of a poultry house may not mean that disinfectants are in them, thus table 4.7c. Table 4.7c showed that only 30 (44.11%) of farmers were constant in their use of disinfectant in the baths, while 38 (55.88%) use disinfectant only when it is available in the farm. On site observation showed that, the farmers that were consistent with disinfectant use were mainly the large sized farms that rear layer.

Table 8 showed that the types and frequency of use of different disinfectant brands in the study area. Izal® 140 (58.82) was more widely used by farmers followed by Z-germicide®, both of which are phenolic products. Morigad® with 2 (2.94%) and Lysol® with 91.47%0 are also phenolic products. Altogether 76.47% of disinfectants used in Imo State were of phenolic products.

Table 8 - Types of disinfectants used in farms		
Disinfectant	**Frequency**	**Percentage**
Izal®	40	58.82
Z-germicide®	9	13.23
Diskol®	6	8.82
CID 20®	3	4.41
Vox®	2	2,92
Virkon®	5	7.35
Morigad®	2	2.94
Lysol®	1	1.47
Total	68	100
Source: Filed data 2009.		

Again Table 9a showed that 40 (58.82%0 of the poultry farmers were using disinfectants that were readily available than those prescribed for them by the animal health practitioner (8.82%). Previous experience with the product and cost also played minor roles (17.64% and 14.70% respectively) in the farmer's choice of the disinfectant.

Table 9b on the other hand showed that the decision on the types of disinfectants to use in farms in the study areas was evenly distributed among farm managers, animal health practitioners and farm owners. This is in agreement with the earlier results in table 4.3b that 66.66% of farmers accept the prescription of the animal health practitioners; it is probable that these are mostly the owners and managers of the larger layers farms.

Table 10a revealed that 40 (58.82%) of farmers reconstituted the disinfectants as desired, while 28 (41.17%) adhered to the instructions given by the manufacturers. On site, observation showed that farm workers, who reconstitute the disinfectants, do not bother to read the instructions before reconstitution of the disinfectant. Similarly, table 4.10b showed that majority (58.82%) of the farms change the reconstituted disinfectant in the

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footbath every other day. From onsite observation, it was discovered that almost all the farms visited change the disinfectant more out of desire than what the manufacturers recommends.

Again table 10c showed that 30 (44.11%) of farms insisted on their workers and visitor's use of footbath, while 38 (55.885%) of farms do not insist on their workers and visitors use of footbath on the farm. These results again highlight the gross ignorance on the part of these farmers on the actual functions of disinfectants on intensive farming of poultry. Different level of such poor use of antibacterial, which leads to antibacterial resistance, has also been reported among skilled and unskilled veterinarians in the study area (Okoli et al., 2002).

Table 9 - Determinants of farmer's choice of disinfectants and decision on the disinfectant to use in the farm

Determinants of farmers choice	Frequency	Percentage
(a) Availability	40	58.82
Prescription	6	8.82
Previous experience	12	17.64
Cost	10	14.70
Total	68	100
(b) Who decides disinfectant to use		
Farm manager	24	35.29
Animal health practitioner	22	32.35
Farm owner	22	32.35
Total	68	100

Source: Filed data 2009.

Table 10 - Reconstitution practice of farmers, frequency of change of reconstituted disinfectants and frequency of use of footbath

Items	Frequency	Percentage
(a) Reconstitution practice of farmers		
As directed by manufacturers	28	41.17
As desired by farmers	40	58.82
Total	68	100
(b) Frequency of disinfectant change		
Daily	8	11.76
Every other day	40	58.82
Weekly	20	29.41
Total	68	100
(c) Frequency of use of footbath		
Farmers that insists on use of footbath		
Farmers that do not insists on	30	44.11
Use of footbath	38	55.88
Total	68	100

Source: Filed data 2009.

Table 11 - General use of disinfectants in farming activities

Items	Frequency	Percentage
(a) Use of disinfectant in washing Feed/water trough		
Yes	26	38.23
No	42	61.26
Total	68	100
(b) Use of disinfectants in washing Farm clothes/footwear		
Yes	14	20.58
No	54	79.41
Total	68	100
(c) Use of disinfectant in cleaning		
Poultry house after each batch of bird was culled		
Yes	58	85.29
No	10	14.70
Total	68	100
(d) Use of disinfectant in washing After handling of birds		
Yes	20	29.41
No	48	70.58
Total	68	100

Source: Filed data 2009.

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While the relationship between antibacterial use, and emergence and spread of resistance may be complex (Piddock, 1996; DZC, 1997), the misuse of anti-bacterial in animal production, has been partly linked with the escalating rates of bacterial resistance in the study area and worldwide (WHO, 1997; Okoli, 2004).

Table 11 highlighted the other general uses of disinfectants in the study farms. The result showed that 58 (85.22%) of farms use disinfectants to wash the poultry pens after the birds have been culled, while less than 30% of farmers use disinfectant in washing farm equipment, cloths or themselves.

These findings indicate that majority of the farms in the study area are not practicing adequate biosecurity measures. Disinfection of poultry house and equipment has become an integral part of modern poultry management and these, is to help in reducing the microbial load to zero or near zero in and around the farm premises (Mrigen, 2006).

The result of the survey of poultry farmers indicates that out of the 90 farms sampled 68 (75.55%) use disinfectants. From the number of farms that use disinfectant only 50 (55.53%) have disinfectant footbath at the entrance of the buildings. However, only 30 (44.11%) had disinfectant always in the footbath.

This study shows that what determines the disinfectant farmers use is availability and not effectiveness. This explains why Izal® and Z-germicide® are most widely used by farmers. From table 4.8 Izal® tops the list of disinfectants used by farmers inspite of the fact that it is not recommend for use in poultry farming by the manufacturers. This survey also showed that 58% of farmers reconstitute the disinfectant as they desired and not as recommended by the manufacturers while 55% of farmers do not insist on the use of footbath in their farms.

CONCLUSION

The survey of animal health practice outfits in Imo State shows that the animal health practitioners stock, prescribe and sell mainly phenolic products. Topping the list of product from this chemical group, which they sell to poultry farms are Z-germicide® and Izal®. The poultry farmers in turn use mostly Izal® and Z-germicide® for disinfection in their farms. This is because they are readily available in all the outfits and are also cheaper than the other disinfectants. These, they use without consideration to their relative efficacy.

Most poultry farms in Imo State do not use disinfectant footbath. Those that use them do not insist on workers or visitors dipping their feet in them before entering the farm house. They also do not reconstitute the disinfectants according to the manufacturer's instructions. This makes the disinfection practice very inadequate when compared to the emphasis attached to biosecurity programs in poultry farming worldwide.

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EFFECT OF ENVIRONMENTAL FACTORS ON BODY CONDITION SCORE OF TAGGAR GOATS UNDER DRY LAND FARMING IN WESTERN SUDAN

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ORIGINAL ARTICLE

ABSTRACT: *Effects of type of supplementation, season of kidding and litter size on body condition score (BCS) at kidding and at weaning time were evaluated in Taggar goats in extensive management under dry land farm. The supplemented groups (2 and 3) had (P<0.05) higher body condition at kidding compared with the control group. Body condition at time of weaning was sharply decreased, but the decline was greatest in control groups. The rainy season kidders showed higher (P<0.05) BCS at kidding and at weaning time compared with dry season kidders. Twin kidders had a tendency (P>0.05) for higher BCS at kidding compared with single and triplet kidders. At weaning time triplets kidder had slightly lower (P<0.05) body condition compared to single and twin kidders.*

Key words: *Tropical, supplementation feeds, productivity, Dalanj, Taggar, Sudan.*

INTRODUCTION

In many parts of the tropics, animal productivity is constrained by regular feed shortages occasioned by dry seasons and droughts. During such periods animals are mainly dependent on poor quality grasses and crop by-products with little or no supplementation, leading to low animal performance.

Body condition score (BCS), measured on a scale of 0–5 (Russel et al., 1969), was reported to be a result of fat accumulation and mobilization. It is generally acknowledged that live weight and body condition are intimately connected to the productivity of domestic ruminants (Robinson, 1990). Cycles of production frequently involve animals storing surplus energy in the form of body fat in times of dietary sufficiency. These reserves are then catabolized when dietary energy intake is inadequate to match the demands of production. Furthermore, there is a good reason to believe that feedback occurs among dietary energy intake, body energy stores and reproductive rate (Lamond, 1970) such as frequency of breeding and litter size reflect the nutritional status of the dam.

Taggar goat breeds of southern Kordofan State, Sudan, frequently inhabit harsh environments where there are marked seasonal constraints in the availability of feed nutrients and water. Observations on the productivity of the Taggar goat have linked live weight and body condition score of the doe to kidding interval and litter size (Ibrahim, 2009). A quantitative assessment of the effects of environmental factors that influence the changes in live weight and body condition of goats in harsh environments is important aiming to improve their productivity. The objective of this research was to study the effects of environmental factors (type of supplementation, season of birth and litter size) on body condition score at kidding and weaning time of Taggar goats under dry farm condition.

MATERIALS AND METHODS

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Study area

The area of study (Dalanj) lies within the medium rain (500 mm) woodland savannah (longitudes 12.02˚ N, Latitudes 29.39˚E). The total area extends over 9300 km² with a population of 250,000 people. The soil types varied from sandy (goz) in north to heavy clays (vertisoil) and the lighter clay (gardoud) in the south. The mean monthly temperature ranged from 31.3 C° in April to 25.8 C° in July. Annual rainfall ranging between 500-800 mm, with peak rain in August (SKDP, 2000).

Experimental animals and housing

Forty- seven pregnant Taggar does with three bucks were acquired by direct purchase from the Dalanj livestock local market. The age of experimental animals varied between 1-4 years. Does and bucks were treated with the necessary medication against endo-and ecto-parasites (AGVET, USA 1.0 ml/50 kg body weight subcutaneously, Ivomec super drench).Vaccination against goat pox, Anthrax and Hemorrhagic Septicemia were carried out. The does were ear tagged, weighed and divided into Groups 1, 2 and 3, consisting of 16, 16 and 15 does respectively. The initial live body weight averaging 19.16±6.53kg, 19.14±4.17kg and 19.17±4.05kg for Groups 1, 2 and 3 respectively. Each group was kept in separate enclosures constructed from iron bars and wire, and equipped with trough feeders and watering. Animals were individually tethered at proper distance from each other and offered supplement type in separate troughs. All does were daily turned out to graze on pasture from 8.00 a.m (before midday) to 6.00 pm (after midday). On their returned from pasture, does in Groups 2 and 3 were offered 350g/day/head of supplement A and B (Table 1), respectively.

Assessment of body condition score

Assessment of body condition score was conducted at weekly intervals for 12 weeks after kidding. Body condition score was assessed using the 5 point scale described by Aumont et al. (1994) and Thompson and Meyer (2002). According to this scale, emaciated goats were given score 1, thin goats score 2, average goats score 3, fat goats score 4 and obese goats score 5. The animals were visually assessed by palpation of the lumber vertebrae area between the back of the ribs and front of the pelvic bones.

Table 1 - Ingredients and chemical composition of types of supplement

Components (%)	Supplement A	Supplement B
Sorghum grains	15	15
Groundnut Cake	45	-
Rosella seeds	-	50
Wheat bran	19	19
Groundnut Hulls	20	15
Common Salt	0.75	0.75

Proximate analysis (DM basis)

Supplement types	DM%	CP%	CF%	E.E%	NFE%	Ash%	ME(MJ/Kg DM)[1]
Supplement A	93.2	20.4	10.3	4.5	58	6.8	12.20
Supplement B	93.9	16.7	17.4	6.6	47.5	11.8	11.57

[1] Metabolizable energy was calculated from Ellis (1981); Me (MJ/kg DM) = 0.12 CP + 0.01 EE + 0.005 CF + 0.014 NFE.

Statistical analysis

Resulting data were analyzed for variance (analysis of variance) according to complete randomized design using Statistical Package for the Social Sciences, software package (SPSS version 10, 1996). Duncan's Multiple Range Tests (DMRT) was used to separate multiple means where appropriate.

RESULTS

The data in (Table 2) revealed that the type of supplement had significant effect on the BCS at kidding and weaning. The BCS of does in the control group at kidding and weaning were significantly lower than that of the supplemented groups.

The BCS at kidding and at weaning in the two seasons of birth, indicated that rainy season kidders maintained (P<0.01) higher score compared to cool dry season kidders (Table 3).

Table 2 - Effect of type of supplement on the body condition score

Animal Group	N	BCS at kidding	BCS at weaning
Group 1	15	2.89±0.11 [b]	2.60±0.11 [b]
Group 2	16	3.53±0.13 [a]	3.13±0.13 [a]
Group 3	15	3.63±0.11 [a]	3.40±0.11 [a]

[ab] Values in the same column with different letters are different at P<0.01 according to Duncan's Multiple Mean Separation.

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Table 3 - Effect of season of birth on the body condition score			
Season of birth	**N**	**BCS at kidding**	**BCS at weaning**
Rainy season	28	3.53±0.10 [a]	3.13±0.10 [a]
Cool dry season	18	3.06±0.09 [b]	2.83±0.09 [b]

[ab]Values in the same column with different letters differ according to Duncan's multiple range mean separation (P<0.01).

On the other hand, there was no effect of litter size on BCS at kidding (Table 4). However, this effect was apparent (P<0.01) at weaning, showing that the highest BCS was maintained by the twin kidders (3.13±0.12) followed by single kidders (3.02±0.08) and the triplet kidders (2.92±0.14) (Table 4).

Table 4 - Effect of type of litter size on the body condition score			
Litter size	**N**	**BCS at kidding**	**BCS at weaning**
Single	32	3.27±0.08	3.02±0.08 [a]
Twin	12	3.42±0.12	3.13±0.12 [a]
Triplet	2	3.00±0.38	2.00±0.36 [b]

[ab] Values in the same column with different letters differ (*P*<0.01) according to Duncan's Multiple Range Separation.

DISCUSSION

Body condition score is a subjective measure of nutrient reserve. The condition presented in this study in supplemented groups was very high. There results were supported by others (Cisse et al. 1994., Okello et al., 1996 and Acero-Camelo et al., 2008) who reported that the level of feeding was found to be an important determinant of goat condition, also in agreement with Santucci (1984) and Branca (1987). The pregnant does recovered their body slightly, this may be related to the increased energy needs in gravid does due to fetal growth which could lead to less lipid deposition or an increase in lipo-mobilisation from supplemented concentration offered to goats. Improved body condition scores in the present study indicates that animals responded to a higher intake of ration feeding during late pregnancy, results similar of that recorded by Morand-Fehr and Sauvant (1978).

The condition score obtained in rainy and cool dry season reflected the effect of seasonal changes in nutritive grazing value, a similar result were reported by Fredricks (1993) and Nsoso et al. (2003) who reported that season affected body condition score with lower scores in the dry season than in the wet season.

Body condition before weaning declined with throughout the entire lactation period, whereas the change in condition in supplemented goats was less pronounced compared with un-supplemented goats, perhaps due to the fact that as does go through an entire lactation, body condition score changes as fat reserves are used for milk production. These results were in agreement with by Susmel and Cuzzit (1988) and Gubartalla et al. (2002).

The change in condition at weaning period for does born in rainy and cool dry seasons was not affected by season of birth. However, all does in both seasons lost condition and could be due to nutritional changes reflecting rangeland condition. Similar results were reported by Cisse et al. (1994) and Nsoso et al. (2003) who reported that goats lost condition with progressive deterioration of pasture in the dry season.

The effect of litter size on body condition score was apparent since does with triplets and twins lost more score compared with does giving birth to single kids. This was likely due to the fact that heavier does tended to produce more milk, results consistent with Awemu et al. (1999) and Ciappesoni et al. (2004).

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EFFECT OF FEEDING DIFFERENT LEVELS OF DECORTICATED SUN FLOWER CAKE (Abad Alshames) (*Helianthus nnuus L.*) ON PERFORMANCE OF SUDAN DESERT GOATS

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ABSTRACT: *This experiment was conducted to study the effects of replacing groundnut cake with sunflower cake in ruminants feed. The replacement was done at three levels, 0%, 15% and 25%, which were incorporated in three isocaloric, isonitrogenous diets A, B, and C, respectively. Nine male kids of Sudan desert goats at 3-4 months of age and average body weight 18.14 kg wee used in this experiment. The kids were randomly assigned to three treatments (3 animals each), then the animals in each treatment was subdivided into three groups of one animal (replicates). The study showed a significant difference (P<0.05) between treatments for average daily weight gain (ADG) and feed conversion rate (FCR), on the other hand, the study showed that there was no significant difference (P>0.05) between treatments for average feed intake, average final body weight gain and average of total gain. According to the results, sunflower cakes meal had no deleterious effects on ruminant's performance; it may be used up to 25% in kids feeding with satisfactory results. Also sunflower cakes meal could be used for growing kids and fattening of mature goats.*

ORIGINAL ARTICLE

Keywords: *Abad Alshames .body weight, kids, feed conversion, Nubian*

INTRODUCTION

Human population in developing countries (Africa, Asia and the Americas) is increasing rapidly (Allen, 1983). Jasiorowski (1975) stated that world demand for animal protein is growing continuously The main reason for the present low per capita consumption of animal protein is the low livestock productivity rather than the low livestock numbers (Jasiorowski, 1975; FAO, 1994).The Sudan is a vast country of great animal wealth in the continent, which estimated at about (140.5), of which 41.84, 52.24, 43 and 4.4 million head of cattle, sheep, goats and camels respectively (MARF, 2008) Goat is one of the most important livestock species in rural areas. In Sudan, Pakistan, Turkey, Egypt and Tunisia researches showed that goat are reared for their meat, milk or both meat and milk (Darcan et al., 2005; Arain et al., 2010; El-Hassan El-Abid et al., 2008; Mousa, 2011; Gaddour et al., 2007). Many authors mentioned that goat meat has received little attention and as a result knowledge of yield and quality of goat meat is limited when compared to sheep and cattle (Warmington and Kirton 1990; Anous and Mourad, 1993). Protein is the most expensive feed ingredient in animal ration and there was always shortage in its supply particularly in developing countries. This shortage is very critical in both human and animal nutrition (Yagoub and Talha, 2009). Traditionally, the farmers have been using cottonseed cakes for feeding their livestock as a source of vegetable protein and its prolonged use can affect the fertility of these animals Zahid et al., 2003). Earlier investigations (Ahmed et al., 2004; Garcia et al., 2004) indicated that sunflower meal was equally good in performance, yet the cost of sunflower meal based rations was the lowest. The nutritional quality of sunflower meal is dependent on the processing method of oil extraction (Mandarino, 1997). Abbas and Yagoub (2008) concluded that sunflower cake can replace up to 100% of groundnut cake in broiler chicks. In Its annual report, CBS (2005) mentioned that sunflower grain output reached 12 thousand tons in, 2004/05 seasons compared with 7 thousand tons in the previous season. The objective of this research was to investigate the effects of replacing sunflower meal with groundnut cake in fattening of goats.

MATERIALS AND METHODS

Site of study

This study was conducted at the Rural Development and Extension Center (RDEC), Faculty of Animal Production–Almanagil-University of Gezira, 76 kilometers west to Wad Medani, Gezira state. The experiment extended for 45 days, it started at 15/4/2010 and ended at 31/5/2010.

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Experimental feed (rations)

The experimental rations were shown in Table 1. Sunflower cake was added at three different levels (0, 15 and 25%). Rations were isonitrogenous and isocaloric and contain, in addition to Sunflower cake, groundnut cake, wheat bran, sorghum grain, molasses, gasses and urea.

Table 1 - Experimental rations formulation

Item	Treatments		
	Ration A 0%	Ration B 15%	Ration C 25%
sunflower cake	0.00	15.00	25
Ground nut cake	20.00	00.00	0.00
Wheat bran	25.00	23.00	23.00
Sorghum gain	30.00	30.00	30.00
Molasses	10.00	12.00	10.00
Ground nut hulls	11.00	16.00	8.00
Oyster shell	2.00	2.00	2.00
NaCl	2.00	2.00	2.00
Total	100.00	100.00	100.00

Experimental animals

Nine male kids of Sudan desert goat were used at 3-4 months of age and their average body weight of 18.14 kg. Animals were vaccinated against anthrax and hemorrhagic septicemia. They were ear tagged, drenched with (ELbendazol -25) to treat internal parasites. Acaricides were applied externally after giving a path to the animals, with soap and water, aiming to remove against external parasites. Oxytetracycline injections were also given to treat subclinical infections. Animals were allowed 14 days as adaptation period. In this period groundnut hay and experimental concentrate rations were given.

Housing

The experimental animals were housed in semi open pens built from corrugated steel sheets supported by bamboo poles and steel bars of about three meters high. The pens were covered with zinc sheet. Each pen was provided with water and feed troughs.

Feeding management

The ration ingredients were mixed manually and left to dry by air and then packed in labeled sacks (A, B and C). Roughage (groundnut hay) was available ad libitum, green fodder (*Cyndon dactylon*) was also offered at week interval at amount of one kg/head as to avoid vitamin "A" deficiency.

Data collection

Feed Intake: The rations were given to the kids daily every morning at 8:00 am and the refusal part was collected in the next morning at 7:00 am, weighed and subtracted from the daily offered amount to calculate the actual feed intake.

Body weight: The experimental animals were weighed weekly using small ruminant's balance (0 – 50 kg capacity), following an overnight fasting. Body weights were used to calculate the daily weight gain and feed conversion ratio (FCR).

Statistical analysis

Data was statistically analyzed by analyses of variance applicable to randomized complete block designs using Minitab Statistics software (Steel and Torrie, 1980). Means were compared at a level of significance equal to 0.05.

RESULTS AND DISCUSSION

Live body weight of kids at 3-4 month of age was found to be 13.90±.06 to 14.43±0.23kg (Table 2). There were no differences ($P<0.05$) between treatments due to differences in the level of dietary sunflower cake. Final body weights in this study (after 45 days) range from 17.00±0.06 to 17.20±0.11 kg. No significant differences ($P<0.05$) were notice between treatments. Entire Kid weights were higher than estimates reported by Kebede et al., (2008) in Ethiopia.

Table 2 shows that the level of sunflower cake did not significantly ($P>0.05$) affected average daily feed intake. Average daily feed intake ranged from 0.82±0.08 to 0.85±0.04kg/ d. This result was higher than that reported by Atay et al. (2011) for Anatolian Black kids in Turkey, but lower than that indicated by Yagoub and Babiker (2009) for Nubian goats in Sudan at 9 month of age. It was clear that feed intake increased as the level of

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substitute cake increased in the diet. This agreed with Beshir (1996), Salih and Abdel-whab (1990) and Bakheit (1993). On the other hand Mohammed and Idris (1991) found opposite situation.

Daily weight gains in this study were 0.06±001, 0.07±01 and 0.08±04 kg/d in treatments A, B and C, respectively. There were significant differences (P<0.05) between treatments, and daily gain increases as the percent of sunflower cake increased. Obtained estimates agreed with the findings of Wildeus et al. (2007) and Johnson et al. (2010), but were higher than results reported by El-Hassan El-Abid et al., 2008) for post weaning daily weight gain of Sudanese kids under traditional pastoralism. These estimates were lower than those reported by Memisi et al. (2009) for post weaning daily gain till six month of age in Serbia.

Feed conversion ratios in this experiment were found to be 14.33±0.18, 11.43±0.15 and 13.33±0.19 Kg DMI/kg gain in the three treatments respectively. There were significant differences (P<0.05) between treatments. These estimates were in agreement with Yagoub and Babiker (2009) who reported 13.36 -7.75 (Kg DMI/kg).

Table 2 - Feedlot performance values (means ± S.E) of experimental Kites fed different levels of sun flower cake

Item	Treatments			L.S
	Ration A 0%	Ration B 15%	Ration C 25%	
Ave. initial body weight, (kg).	14.43±0.23	13.90±.06	14.30±0.04	N.S
Ave. final body weight, (Kg).	17.00±0.06	17.10±.0.28	17.20±0.11	N.S
Ave. total live weight gain, (kg).	2.86±0.36	2.52±0.61	3.25±1.07	N.S
Daily feed intake, kg DM/head/day)	0.82±0.08	0.83±0.04	0.85±0.04	N.S
D Daily weight gain, (g/head/day).	0.06±001a	0.07±01a	0.08±04a	*
Daily weight gain, as (%) of empty body weight.	0.51±0.1a	0.50±0.1a	0.47±.00b	*
Feed conversion ratio, (Kg) DMI/kg gain.	14.33±0.18a	11.43±0.15b	13.33±0.19c	*

*= Means are significantly different (P <0.05); Ration (control), B, C Treatments Containing 0, 15 and 25% sunflower cake.

CONCLUSION

The inclusion or the use of sun flower cake for goat fattening showed a positive effect on the performance as the highest levels of sun flower cake resulted in high daily gain and feed conversion efficiency. Thus sun flower cake may gain solid ground in the future as a supplement for goat and sheep fattening.

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EPIDEMIOLOGY OF HELMINTH PARASITES IN SMALL RUMINANTS OF LADAKH, INDIA

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ABSTRACT: *A study was conducted to determine the prevalence and various risk factors associated with helminth parasitism in small ruminants of Ladakh (India) during 2007-2008. A total of 581 small ruminants including 313 sheep and 268 goats were considered during the study. The gastrointestinal tracts including heart and lungs of the host animals were collected from different slaughtered houses and were subjected for the presence of larvae and adult helminth parasites using standard parasitological methods (Boomker et al, 1968). The study reveals overall prevalence as (69.70%) with (68.37%) and (71.26%) in sheep and goats respectively. A significant difference was observed in prevalence of helminth parasites with respect to season, wherein higher prevalence (76.50%) was observed during the wet season as compared to dry season 58.13%. Similarly an association was observed between sex and age of the host with prevalence of helminth infections. Females and young animals of either of the host species were more infected than their counter partners. Likewise an association was observed between prevalence and agro-ecology of the study area where in higher values (76.50%) were recorded for comparatively lowland (Kargil) areas as compared to highland (Leh) areas (58.13%). Hence, it was concluded that species of the animal, season, sex, age, and agro-ecology are important risk factors associated with helminth parasitism in this area.*

ORIGINAL ARTICLE

Keywords: *Sheep, goats, helminth parasite, prevalence, ladakh*

INTRODUCTION

Helminth parasite infections of ruminants are a major problem throughout the world. These are responsible for a number of economic losses in a variety of ways as: losses through lower fertility, reduced work capacity, involuntary culling, a reduction in food intake, lower weight gains, milk and meat production, treatment costs and mortality in heavily parasitized animals (Carmichael, 1972, Akerejola et al., 1979). Despite of immense progress made to control parasitosis people of Ladakh continue to incur significant losses due to insufficient availability of information and aid regarding with helminthosis. Ruminants are one of the important sources of livelihood in Ladakh and constitute the backbone of economy. Therefore taking care of these animals for better production is one of the important goals. It is known that a prerequisite for the development and implementation of sustainable parasite management programs is to have a taxonomic and epidemiological knowledge of the parasites present in a specific area. The sustainability of helminth control practices also relies on the prevention of resistance and preservation of anthelmintic effectiveness, as well as effective utilization of the locally available food resources. Keeping the same in view the present study was taken into consideration in order to find out various helminth parasites infesting the ruminants of Ladakh and various associated risk factors for an effective management.

MATERIAL AND METHODS

Different slaughter houses of the study area were surveyed randomly and a total of 581 gastrointestinal tracts together with heart and lungs of sheep and goats were collected. The GI tracts were separated anatomically, then each organ was opened separately for examination of parasites and its contents and mucosa were washed in water to remove all parasites. The contents of the abomasum and small intestine were washed through a 90 mesh sieve and of the large intestine through a 250 mesh sieve for the collection of mature and immature parasites. The bile ducts of liver were opened and visible parasites were removed and placed in normal saline. The total content of

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the large intestine was examined in large Petri dishes by the naked eye as well as under microscope. The trachea and bronchi were opened, scrutinized for visible parasites and rinsed in running water over a sieve with 90mm mesh size. The entire lungs were washed and then cut into about 10 mm cubes, for the collection of microscopic parasites. Every nematode recovered from the contents was cleaned with physiologic saline and fixed in hot 70% alcohol. The nematodes were then cleared in lactophenol while as the trematodes and cestodes were fixed in Carnoys fixative and preserved in 70% alcohol. The parasites thus collected were identified on the basis of various morphological and morphometric characters.

RESULTS

Of the 581 small ruminants, examined 405 (69.70%) were found infected with one or more helminth parasite species. The prevalence of these parasites were (68.37%) and (71.26%) in sheep and goats respectively Table 1. The parasites collected during the present study were *Trichuris ovis, Haemonchus contortus, Dictyocalus filaria, Chabertia ovina Fasciola hepatica, Dicrocoelium dendriticum, Moniezia expansa* and *Stilesia globipunctata*. However no acanthocephalan was encountered during the study. There were statistically significant differences in prevalence of parasites with respect to season; it was observed that the infection rate was higher in wet season (76.50) than in the dry season (58.13) in both the host species Table 2. The study also indicated higher prevalence in females (76.28%) and young ones (72.91%) as compared to males (63.05%) and adults (67.44%) in sheep and goats respectively Table 3 and 4. Similarly an association was found between the prevalence and agro-ecology of the study area wherein the prevalence was higher in low land areas (76.50%) as compared to high altitudes (58.13%, Table 5). The study further revealed that health status of the animals has a minor effect on the prevalence of helminth infections where in it was observed that the animals which were healthy had less infection as compared to those which were comparatively weak (Table 6).

Table 1 - Overall prevalence of helminth parasites

Species	N.E	N.P	%
Sheep	313	214	68.37%
Goats	268	191	71.26%
Total	581	405	69.70%

Table 2 - Prevalence of helminth on the basis of Season

Season	N.E	N.P	%
Dry	280	186	58.13
Wet	301	225	76.50
Total	581	405	69.70

Table 3 - Prevalence of helminth on the basis of Sex of the host

Sex	N.E	N.P	%
Male	295	186	63.05
Female	286	219	76.28
Total	581	405	69.70

Table 4 - Prevalence of helminth on the basis of Age of the host

Age	N.E	N.P	%
Young	240	175	72.91
Adult	341	230	67.44
Total	581	405	69.70

Table 5 - Prevalence of helminth on the basis of Agro-ecology

Locality	N.E	N.P	%
Lowland	366	280	76.50
High-altitude	215	125	58.13
Total	581	405	69.70

Table 6 - Prevalence of helminth on the basis of Health status

Health status	N.E	N.P	%
Good	371	225	68.73
Poor	210	150	71.42
Total	581	405	69.70

DISCUSSION

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This study revealed that the helminth infection in ruminants occur throughout the Ladakh. It also disclosed that regardless of the environmental conditions, species, age and the sex of the host, the animals of this region are infected with a variety of the helminth parasites. The various parasites recovered during the present study have also been reported from the other two regions of the same state (J&K), as well as from different parts of the world having the almost same geographical locations and environmental conditions (Bali, 1976; Chishti, 1986; Mazyad et al., 2002; Sissay et al., 2006). The higher prevalence in goats as compared to sheep is in agreement with reports of Fikru et al., 2006. This could be due to slow or less development of immunity in goats to gastrointestinal parasitres compared with the situation in the sheep, the later faced prolonged challenge over generations, but in goats, the less availability of sufficient browsing area and expansion of crop agriculture forced them to graze with the other species that had good resistance. In addition goats in Ladakh are managed under extensive pastoralism in which large number of animals is kept together. This could increase the degree of pasture contamination leading to higher prevalence rate. The higher prevalence of nematodes than trematodes and cestodes is in contest with many reports all over the world, (Fikru et al., 2006; Sissay et al., 2007). The study further revealed that sex of animals show an association with the prevalence of the parasites, the higher prevalence in females than their counter partners may be due to some physiological peculiarities of the female animals, which usually constitute stress factors thus, reducing their immunity to infections, also the females happen to be lactating which leads to weakness/malnutrition. Similar to my results are the reports as reported by (Blood and Radostists, 2000). The significantly higher prevalence in wet season than that of the dry season is in consent with many reports around the world, (Tembely et al., 1997; Moyo et al., 1996; Fritche et al., 1993; Githigia et al., 2005). This could be due to the existence of a direct relationship between prevalence with rainfall, humidity and temperature. The presence of sufficient rainfall and moisture during wet season favored the survival of infective larvae in pasture and higher probability of uptake of the infective larvae leading to higher prevalence rate Sissay et al., 2007. Similarly the higher prevalence recorded in younger animals as compared to the adult ones is in agreement with most literatures (Dunn, 1978; Shah-Fischer and Say, 1989; Kiyyu, 2003; Nwosu et al., 1996, Nganga et al., 2004) from different corners of the world. This could be due to the fact that younger animals are more susceptible to infections than adults. Adult animals may acquire immunity to parasites through frequent challenge and expel the ingested parasites before they establish infectuion; (Dunn, 1978; Shah-Fischer and Say, 1989). The reason for higher prevalence in lowland (Kargil), as compared to high altitude (Leh) could be that these agro-ecological zones are characterized by a hot humid environmental situation that is favorable for the survival of intermediate and infective stages of most of the parasites (Teklye, 1991; Fikru et al., 2006). The possible reason for slightly higher prevalence in weak animals of both the host species could be that these animals usually have a comparatively weak immune system which does not fight with the infections to the same extent as that of a healthy animal's immune system (Kuchai et al., 2008).

CONCLUSION

The present study show that it is beyond the doubt that the sheep and goats of Ladakh are infested by a large number of helminth parasites which could be responsible for economic losses in a variety of ways, therefore efforts should be made to control helminthiasis which requires a detailed knowledge of these parasites and it is believed that the present study will provide some help for the same. The study also show that season, sex, age and geographical location appear to be the major limiting factors for the prevalence of helminth parasites.

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