COMPARATIVE EVALUATION OF BAMBARA NUT WASTE AND DRY BREWERS SPENT GRAIN AS DRY SEASON FEED SUPPLEMENTS FOR WEST AFRICAN DWARF SHEEP

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ABSTRACT: A feeding trial was conducted to investigate the effects of dry season supplementation of bambara nut waste or dry brewers spent grain on growth performance and blood metabolites (blood plasma ammonia and blood plasma urea) of West African dwarf sheep. A total of nine sheep (six females and three males) were randomly divided into three treatment groups of three sheep per treatment with one sheep serving as a replicate. The first group (control) was only allowed to graze. They were herded out at 08:00hours and brought back at 17:00hours. The second and third groups were given 500g of dry brewers spent grain or bambara nut waste at 8:00hours and at 11:00 hours, thereafter they grazed for the rest of the day. Feed intake and body weights of the animals were recorded. The animals were allowed a pre-experimental period of 3weeks while the feeding trial itself lasted for ten weeks (December – February). At tenth week blood was collected from the animals for 4 days to determine the blood metabolites. The experiment was carried out using a completely randomized design (CRD). The supplement intake for the experiment, the cost implication of using the two supplements and the proximate composition were compared using t-test. Sheep on treatments 2 and 3 had similar ($p > 0.05$) average final body weight, average daily weight gain, average body weight change, blood plasma ammonia concentration, blood plasma urea concentration and economics of production of feeding the two supplements, and these were significantly ($p < 0.05$) higher than those of treatment 1, while sheep on treatment 3 had higher ($p<0.05$) feed intake treatment 1 had the least. Based on the results obtained from the present study, it was concluded that any of the supplements can be used in dry season feeding of sheep for their improved growth performance.

Key words: Bambara nut waste, dry brewers spent grain, dry season, feed supplements, west African dwarf sheep.

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INTRODUCTION

The demand for animal protein in Nigeria has been on the increase because of the rise in human population. Proteins are very essential for the continued existence of man and animal protein products such as meat, egg and milk are very crucial to man. This is because of the ability of these products to furnish the body with excellent balance of essential amino acids necessary for normal growth and development. The proteins of animal origin are good sources of lysine and sulphur amino acids, which are low in proteins of plant origin (Omole, 1991). The intake of animal protein in Nigeria stands at 3.5g/caput/day. This is still far less than the 35g /caput/day as recommended by Word Health Organization (WHO) cited by Ironkwe and Amefule (2008). The task facing any animal scientist in

Nigeria is to increase the production of livestock in Nigeria and to make animal products available to our people.

Nutrition is by far the most important environmental factor affecting livestock production and feed cost represents 75% or more of the total cost of animal production (Cordiez *et al.*, 2001). Good nutrition is required if healthy animals are to give maximum yield of meat and milk. Well nourished animals are better able to withstand the incidence of diseases which may claim up to 50% of the flock (Devandra, 2003). Forages supply approximately 80% of the yearly nutrient requirement of sheep. During the grazing season sheep are able to meet their nutrient requirement from pasture, salt and mineral supplement. McDonald *et al.* (2002) observed that the growth performance of an animal depended on its level of feeding among other things. In Nigeria as in most developing countries, the inadequate supply of feed to ruminant livestock is a major cause of low level of productivity in the animal industry. The rainfall seasonality and poor distribution pose serious forage management and animal feeding problems during the dry season (Hagger, 1998).

According to Obioha and Ndukwe (1992), there is a general decline in crude protein, ether extract and ash, and a progressive increase in crude fibre, N-free extract and dry matter content of forage from the onset of the dry season in early November to the first rain in March of the next season. The effect of this on the animal is a general set back in performance, and specifically, the loss of weight gained during the wet season. The seasonality of these conventional ruminant feed has made it imperative to exploit alternative and cheap sources of feed for ruminants especially during dry season. The alternative feedstuffs being investigated in this study are bambara nut waste and dry brewers spent grain.

Bambara nut waste is the portion discarded as waste after the processing of bambara nut. Bambara groundnut waste, a byproduct of bambara nut milling industry contains 18.30% crude protein, 20% crude fibre, 5.36% ether extract, 41.64% nitrogen-free extact, 10.2% moisture and 16.74 MJ of gross energy (Ani and Omeje, 2007). It has been estimated that Nigeria produces about 100,000 tonnes of the crop annually (Amaefule and Ironkwe, 2007). This accounts for the availability of its waste throughout the year and very cheap since the waste are discarded after obtaining the flour and could constitute environmental hazard if no use is found for it. Brewers spent grain is the material that is remaining after grains have fermented during the beer making process. The nutritional content of the material varies from plant to plant and depending upon the type of substrate used (barley, wheat, corn, etc.), proportions fermented and fermentative process used. Lysine is normally the most limiting amino acid but it is a good source of water soluble vitamins. The present study was therefore conducted to determine the growth and physiological response of sheep fed forage with or without supplementary Bambara nut waste or Brewers spent grain. The result will help to alleviate the loss of weight of sheep during the dry season and also

assist in providing animal protein to feed the increasing population in the developing countries especially the rural populace.

MATERIALS AND METHODS

The study was carried out at the Sheep and Goat Unit of the Department of Animal Science Teaching and Research Farm, University of Nigeria, Nsukka, Enugu State, Nigeria. A total of nine West African dwarf sheep with an average weight of 10.15kg were used for the study.

EXPERIMENTAL PROCEDURE AND DATA COLLECTION

The study was carried out using nine sheep (six females and three males). The animals were allowed a pre-experimental period of 3 weeks in order to adapt to the supplements. The animals were tagged and divided randomly into three treatment groups in a completely randomized design. Each group was made up of three sheep (two females and one male) with one sheep serving as a replicate. The first group was the control group and the group was only allowed to graze. They were herded out every morning (at 8:00hrs) and brought back in the evening (at 17:00hours). In the second and third groups the animals were respectively given 500g each of brewer's spent grain or bambara nut waste in the morning (at 8:00 hours) and at 11:00 hours, the animals were released to graze for the rest of the day. The animals in groups two and three had access to the supplements after grazing. The left over feed was measured the following morning so as to determine the feed intake by each animal. All the animals were housed individually in pens and the initial weights of the animals were measured. Water was supplied to the animals *ad libitum*. The weights of the animals were measured weekly at 8:00hours in the morning before herding them out for grazing throughout the experimental period of ten weeks.

At week ten blood was collected from the sheep for four days to determine the blood metabolites (blood plasma ammonia and blood plasma urea).. Sampling was done between 9:00hours and 11:00 hours after which the animals were released to graze. In the group of animals receiving feed supplements, blood collection was done two hours after feeding them with the supplements. About 5mls of blood was collected from the jugular vein of each animal using sterile disposable syringe. This was emptied into sterile sample bottles for laboratory analysis.

Blood Plasma ammonia Determination

The level of ammonia in the blood was determined by spectrophotometric method.

Blood Plasma urea determination

The level of urea in the blood plasma was determined using RANDOX kit as described by Fawcett and Scott (1960).

PROXIMATE AND STATISTICAL ANALYSIS

Feed samples (bambara nut waste and dried brewer's spent grain) were assayed for proximate composition by the method of AOAC (1990). Data collected were subjected to analysis of variance

(ANOVA) in a completely randomized design (CRD) as described by Steel and Torrie (1980). Significantly different means were separated using Duncan's New Multiple Range Test (Duncan, 1955). The supplement intake for the experiment, the cost implication of using the two supplements and the proximate composition were subjected to t-test as basis for comparison.

RESULT

Proximate compositions of Brewers spent grain and Bambara nut waste used as dry season supplements

Table 1 shows the proximate compositions of brewers spent grain and bambara nut waste used as dry season supplements during the study.

Table 1: Proximate compositions of Brewers spent grain and Bambara nut waste

Nutrient	Composition (Brewers spent grain)	Composition (Bambara nut waste)	t- statistic	P value
Dry matter (%)	89.70	90.20	-1.581	.255
Crude protein (%)	12.38^{b}	16.99^{a}	-5.522	.031
Crude fibre (%)	16.35^{a}	10.29^{b}	5.358	.033
Ash (%)	6.40	4.33	3.171	.087
Ether extract (%)	3.30	4.85	-3.085	.091
N-free extractive (%)	51.27	53.74	-2.430	1.38
Gross energy(MJ/Kg)	12.85^{b}	14.75^{a}	-4.749	.04

a,b- means on the same row with different superscripts are significant at 5%

While there were no significant ($p > 0.05$) differences between the two supplements in dry matter, ash, ether extract and nitrogen-free extract contents, significant ($p < 0.05$) differences existed between the two supplements in crude protein, crude fibre and gross energy contents. The crude protein value (16.99%) of bambara nut waste was significantly ($p < 0.05$) higher than that (12.38%) of brewers spent grain. The crude fibre content (16.35%) of brewers spent grain was significantly ($p < 0.05$) higher than that (10.29%) of bambaranut waste. The gross energy content (14.75 MJ/Kg) of bambara nut waste was significantly ($p< 0.05$) higher than that (12.85 MJ/Kg) of brewers spent grain.

Effect of dry season supplementation of bambara nut waste and dried brewer's spent grain on growth performance of West African Dwarf Sheep

The effect of dry season supplementation of bambara nut waste or dried brewer's spent grain on growth performance of West African Dwarf Sheep is presented in Table 2.

Table 2: Effects of brewers spent grain and bambara nut waste on growth performance of sheep.

	Treatment			
Parameter	**T1**	**T2(BSG)**	**T3(BNW)**	**SEM**
Average Initial body weight (kg)	10.28	9.98	10.20	0.33
Average final body weight (kg)	6.02[b]	12.92[a]	13.56[a]	3.23
Average change in weight (kg)	-4.26[b]	2.94[a]	3.36[a]	1.24
Average daily weight gain (kg)	-0.06[a]	0.04[b]	0.05[b]	0.02
Average daily intake Of supplement (g)	0.00[c]	300.76[b]	405.81[a]	5.87
Blood plasma ammonia conc. (mg/100ml)	0.33[b]	0.46[a]	0.41[a]	0.02

Blood plasma urea conc. (mg/100ml)	7.07[b]	9.63[a]	8.90[a]	0.40

BSG= Brewers spent grain; BNW= Bambara nut waste

Average final body weight

There were significant differences ($p < 0.05$) among treatments in average final body weight. The average final body weight value (13.56kg) of sheep on treatment 3 (group fed bambara nut waste) and that (12.92kg) of sheep on treatment 2 (group fed brewers spent grain) were comparable ($p > 0.05$) but these were significantly ($p < 0.05$) higher than the final body weight value (6.02kg) of sheep on treatment 1 (control).

Average daily weight gain

There were significant differences ($p < 0.05$) among treatments in daily weight gain. Sheep on treatment 3 (group fed bambara nut waste) had similar ($p > 0.05$) average daily weight gain with sheep on treatment 2 (group fed brewers spent grain). Average daily weight loss was observed in sheep on treatment 1(control).

Average body weight change

There were significant differences ($p < 0.05$) among treatments in average body weight change. The average body weight change values of sheep on treatments 2 and 3 (2.94kg and 3.36kg, respectively) were similar and these were significantly higher than that (-4.26kg) of sheep on treatment 1.

Average daily feed intake

There were significant ($p < 0.05$) differences amongst treatments in average daily feed (supplements) intake. Sheep on treatment 3 (group fed bambara nut waste as supplement) had significantly ($p < 0.05$) higher feed intake than sheep on treatments 1(control) and 2 (group fed brewers' spent grain as supplement). Sheep on treatment 2 had significantly ($p < 0.05$) higher feed intake than sheep on treatment 1(control).

Plasma ammonia concentration

There were significant differences ($p < 0.05$) among treatments in plasma ammonia concentration. The plasma ammonia concentration values of sheep on treatments 2 and 3 (0.46mg/100ml and 0.41mg/100ml, respectively) were similar but these were significantly higher than that (0.33mg/100ml)) of sheep on treatment 1.

Plasma urea concentration

There were significant differences ($p < 0.05$) among treatments in plasma urea concentration. The plasma urea concentration values of sheep on treatments 2 and 3(9.63mg/100ml and 8.90mg/100ml, respectively) were similar but these were significantly ($p < 0.05$) higher than that (7.07mg/100ml) of sheep on treatment 1.

Cost implication of feeding sheep with brewers spent grain and bambara nut waste supplements

Table 3 shows the cost implication of feeding brewers spent grain and bambara nut waste supplements to sheep. The estimated gain per sheep because of the supplements were ₦ 1448.25 and ₦ 1476.21 for brewers spent grain and bambara nut waste, respectively. However there was no significant ($p > 0.05$) difference between these values.

Table 3: The economics of production of feeding brewers spent grain and bambara nut waste supplements to sheep.

	BSG	BNW
Cost of supplement in the market / kg(₦)	10	16
Transportation cost/kg (₦)	5	3
Total cost/kg(₦)	15	19
Quantity consumed/sheep during the period of study(kg)	21.05	28.41
Cost of total supplement intake/sheep during the period of study(₦)	21.05x15 =315.75	28.41 x 19 =539.79
Weight gained by sheep during the period of study(kg)	2.94	3.36
Value of 1kg live weight of sheep = ₦ 600		
Revenue due to extra weight added/sheep as a result of the supplement during the period of study(₦)	2.94 x 600 =1764	3.36 x600 =2016

Estimated gain/sheep because of the supplement (₦)	1764-315.75 =1448.25	2016-539.79 =1476.21

t-statistic (-105)

p value .921

BSG= Brewers spent grain; BNW= Bambara nut waste

DISCUSSION

Proximate composition of supplements used as dry season supplements.

As shown in Table 1while Bambara nut waste had 16.99% crude protein, the crude protein content of brewers dry grain was 12.38%. Considering the fact that the potential value of a feed for supplying a particular nutrient can be determined by chemical analysis and that feed protein content is often considered a good determinant of quality Van Saun (2006), the higher crude protein content of BNW tends to suggest that it has higher nutritive value than BSG. Similarly the higher crude fibre content of brewers spent grain tends to suggest that BSG may have lower feed value than BNW. Earlier reported (Obioha,1992) had indicated that although two feeds may have identical energy, protein and mineral content yet one may be superior to the other if it contains less fibre. However, chemical analysis alone of any feeding stuff is a very imperfect standard to judge its nutritive value. The value of a feed does not entirely depend upon the amount of nutrients it contains but also upon the amount of nutrient the animal can digest and use economics of production. Only that portion which is soluble or is rendered soluble by hydrolysis or some other chemical or physical change can be taken up into circulation and assist in supplying the animal body materials for building and repair of tissue or supplying energy necessary for body functions(Maynard and Loosli,2000; Rhajan, 2000; McDonald *et al*., 2002). It implies that although BNW has higher crude protein than BSG, BNW may not be superior to BSG nutritionally on account of crude protein alone since dietary proteins are hydrolyzed to peptide and amino acids by rumen micro-organisms. Some of the amino acids produced are further degraded to organic acids, ammonia and carbon dioxide. The ammonia produced, together with some peptides and free amino acids, are utilized by the rumen micro-organisms to synthesize microbial proteins (Mac Donald *et al*., 2002). A substantial portion of the microbial protein formed is utilized by the host animal. This is of a great advantage because these bacteria in the rumen are capable of synthesizing indispensable as well as dispensable amino acids, thus rendering their host independent of dietary supplies of the former (Mac Donald *et al*., 2002).

Effect of dry season supplementation of bambara nut waste and dried brewers spent grain on growth performance of West African Dwarf Sheep

While the sheep on treatments 2 and 3 (treatments with brewers spent grain and bambara nut waste as supplements, respectively) gained weight on daily basis, those on treatment 1 (those not fed supplements) lost weight. The observed weight gain in groups fed supplementary brewers spent grain or bambara nut waste could be as a result of additional nutrients supplied by the supplements. Under natural grazing ruminants suffer serious seasonality in feed supply both in quality and quantity and this pose animal feeding problem during the dry season (Hagger, 1998). According to Obioha and Ndukwe (1992), there is general decline in crude protein, ether extract and ash and a progressive increase in crude fibre, nitrogen-free extract and dry matter content of forage from the onset of dry season in early November to the first rain of March of the next season. The effect of this on the animal is a general set back in performance and specifically, the loss of weight gained during the wet season (Hagger, 1998). Otchera *et al*. (1995) had earlier reported that sheep which received supplementary feeds in the dry season were able to maintain their weight.

The average daily intake of bambara nut waste was higher than that of brewers spent grain. It could be as a result of the palatability of bambara nut waste. High palatability of a feed will act as a positive factor in combination with other factors which control feed intake and sometimes results in increase in intake (Forbes *et al*., 1999). However, the observed higher feed intake did not influence the average daily weight gain and final body weight of the animals that consumed the bambara nut waste or brewers spent grain as evidenced by the similarity between these values (Table 2).

It was observed (Table 2) that plasma ammonia concentration and plasma urea concentration values of sheep on treatments 2 and 3 were higher than that of sheep on treatment 1(control). This could be attributed to higher plane of nutrition of animals on treatments 2 and 3 as a result of intake of supplements. Blood plasma urea, ammonia and amino acids are indicative of the nutritional status of the animal (Pfander *et al*., 1992). However, the levels of ammonia observed in animals in the treatment groups (0.33mg/100ml, 0 .46mg/100ml and 0 .41mg/100ml for treatments 1, 2 and 3, respectively) were below the toxic level reported by Oltgen *et al*. (1997). Besides, sheep used by Oltgen *et al*. (1997) died when blood ammonia was about 1mg/100ml. Lewis (2003) observed symptoms of ammonia toxicity at levels of 0.5 and1mg/100ml.The levels of blood plasma urea observed in treatment 1, 2 and 3 were 7.07mg/100ml, 9.63mg/100ml and 8.90mg/100ml, respectively. Harrop and Philipson (2000), working with 1-3 year old sheep obtained highest plasma urea levels of 16.9mg/100ml. Offer *et al*. (1996), obtained 20.4 mg/100ml plasma urea level when urea treated diet which supplied 7.2g/day of the non protein nitrogen (NPN) was fed to sheep weighing 30kg. Breed difference, age and sex of animals may affect blood plasma urea levels (Adegbola *et al*., 1999).

Economics of production of feeding sheep with Brewers spent grain and Bambara nut waste supplements

As shown in Table 3, the average supplement intake of sheep on treatment 2 (sheep fed BSG) was 21.05kg, while the average feed supplement intake of sheep on treatment 3 (sheep fed BNW) was 28.41kg during the trial period. Extra weight added by each sheep after being fed with brewers spent grain and bambara nut waste supplements were 2.94kg and 3.36kg, respectively on the average. The estimated cost of 1kg of brewers spent grain was ₦ 15, while the cost of 1kg of bambara nut waste was ₦ 19. One kg weight of the animal was valued at ₦ 600. At the end of the study it was found that the gains derived from feeding the sheep with brewers spent grain and bambara nut waste supplements were ₦1448.25 and ₦ 1476.21, respectively. Based on the fact that there was no significant difference between treatments in the cost of supplements any of the supplements can be used in dry season feeding of sheep. Results also showed that it was cost effective to use either Brewers spent grain or Bambara nut as dry season supplement. The results obtained in the present study therefore tend to suggest that the use of Brewers spent grain or Bambara nut as dry season feed supplements can be beneficial to farmers.

CONCLUSION

Based on the results obtained in the present study, any of the supplements (brewers spent grain or bambara nut waste) can be used in dry season feeding of sheep for improved growth performance.

REFERENCES

Adegbola, T. A.; Mba A.U. and Olubanjo F.O. (1999). Studies on West African Dwarf sheep fed basal hay or hay plus concentrates of varying protein content 1. Dry matter and crude protein digestion and utilization. *Tropical Agriculture (Trinidad)* 54;235-243.

Amaefule, K. U. and Ironkwe, M. O. (2007). Response of weaner rabbits fed graded levels of raw bambara groundnut offal diet. Proc. 32nd Ann. Conf. NSAP. March 18-21. Unical, Calabar, Nigeria. Pp 273-8

Ani, A.O. and Omeje, O. D. (2007). Effects of supplementation with enzyme on growth performance of chicks fed diets containing raw bambara nut (Voundezia subterranea L) waste. Proc. 32nd Ann. Conf. NSAP. March 18-21. Unical, Calabar, Nigeria. Pp 278-281.

AOAC (1990). Official Methods of Analysis. 15th Ed. Association of Official Analytical Chemists, Washington D.C. 2330.

Cordiez, E. O; Lambot, J. N; Bientait, A; pondant, C. and Van E. N. (2001). Saving grain in beef production by feeding aried sugar beet pulp. Wld Anim. Rev. (FAO) No. 50 : 18-23.

Devandra, C. (2003). Goat and Sheep production potentials in the Asian region. Wld Anim. Rev. (FAO) No 32: 33-41.

Duncan, D.B.(1955). Duncan New Multiple Range Test. Biometrics, 11: 1-42.

Forbes, T. J.; Irwin, J. H. D. and Ravern, A. M. (1999). The use of coarsely chopped Barley straw in high concentrate diets for beef cattle. *J. Anim. Agric. Sci. Comb.* **73**: 347-354.

Hagger, R. J. (1998). The intake and digestibility of low quality Andropogon gayanus hay, supplemented with various nitrogenous feed, as recorded by sheep. Nigerian Agric. J.20:70-75.

Fawcett, J.K. and Scott, J.E. (1960). A rapid precise method for rapid determination of urea. *J. Clinical Pathol*. **13**:156-159.

Lewis, D. (2003). Ammonia toxicity in ruminants. *J. Agric. Sci*. **55** (1):111-117.

Maynard, L. A. and Loosli, J. K. (2002). Animal Nutrition 11th edition. McGraw Hill Book Co. New York. Pp 542

McDonald, P; Edwards, R. A; Greenhalgh, J. F. D and Morgan, C. A. (2002). Animal Nutrition. (6th Ed.) Pearson Education (Singapore) Press Ltd New Delhi, India. Pp 693

Obioha, F.C. (1992). Guidelines to increased animal production in Nigeria. *J. Anim. Sci*. **40**:205-210

Obioha, F. C. and Ndukwe, N. (1992). Changes in yield and chemical composition of standing and conserved forage during the dry season in East Central Nigeria. Nig. *J. Anim. Prod*. **3** (2) Pp 252.

Offer, N.w.; Evans, R.A. and Axford, R.F. (1996). A comparative study of Non Protein Nitrogen supplement for sheep. *J. Agric. Sci*. **87**:567Oloyede, O. B.; Odutuga, A. A.; Minari, J. B.; Amballi, A. A.(2007). Assesment of Some serum metabolites and enzymes of broiler-chickens fed raw and processed Bambara groundnut. Int. *J. Poult. Sci.*, **6**(9): 647-650

Omole, T. A. (1991). Processing Technology for Nigerian feed stuffs. Document prepared for the presidential task force on Alternative Feed Formulation for Nigeria. Pp183

Otchera, E.O., Dazie, C.B. and Ayebo, D.B. (1995). Response of sheep to rice straw or cassavs peels fortified with urea and molasses as supplemental feeds to grazing. *Ghana Jnl. Agric. Sci*. **10**:61-66.

Pfander, W. H.;Grebig, S. E. and Price, C. M. (1992). Use of plasma urea nitrogen to vary protein allowances of lambs. *J Anim. Sci*. **44** : 647-653.

Rhajan, S.K. (2000). Absorption of Amino acids and ammonia in the rumen. In: Animal Nutrition in the tropics. Vikas Pub. House Ltd India.pp. 70

Steel, R.G.D. and J.H. Torrie (1980). Principles and Procedures of Statistics. McGraw-Hill Book Co. Inc. New York. Pp633.

Van Saun, R.J (2006). Determining forage quality: Understanding feed analysis. Lamalink.com. 3(8): 18-19,22-26.