Supplementation of Dry Brewer's Grain to Lower Quality Forage Diet for Growing Lambs in Southeast Nigeria**

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ABSTRACT : Twenty yearling lambs of Southeast Nigeria dwarf, liveweight (18±1.9 kg) were grouped into 5 treatments. Dry brewer's grain was substituted for maize offal in the experiment diets namely A to E at 0%, 15%, 30%, 45% and 60% respectively, as supplement to low quality, dry season cassava leaf top and Andropogan gayanus hay at 1:1 ratio that lasted for 56 days. After which 5 of the lambs (average bodyweight=24.3±1.5 kg) were transferred to metabolism crates to determine the digestibility and nitrogen/protein balance studies. While the mean group intakes were (945.9, 996.1, 1,040.5, 1,148.5 and 1,037.7 g conc. DM/day), the growth rates were (115.1, 124.1, 152.5, 168.5 and 123.1 g liveweight gain/day), respectively. There was a recorded decline in both intake (p>0.05) and growth rate (p<0.05) as the level of dry brewer's grain was increased beyond 45% of the supplement. Similar trend was observed on the protein and organic matter efficiency ratios (p>0.05) together with the organic matter intake. The urine nitrogen output was also significant (p>0.05). The work further revealed that, at a certain critical level of intake, dry brewer's grain is able to support growth rates measurable to or better than those noted when feeding maize offal to lambs, and went on to prove dry brewer's grain as an attractive supplementary feed for the drier months of the year, in the Southeast of Nigeria. ***(Asian-Aust. J. Anim. Sci. 2003. Vol 16, No. 3 : 384-388)***

Key Words : dBG, Lower Quality Forage Diet, Growing Lambs

INTRODUCTION

In Nigeria, the need to improve the indigenous ruminant livestock productivity has been emphasized based on the demand for animal protein in the diet of the rapidly growing population. However, there is a need for study into the use of cheap and alternative feedstuffs to sustain and improve the ruminant husbandry. Therefore, this can be achieved from renewable resources, which do not need to compete with feedstuffs suitable for monogastric animals and man (Biedenbach and Porter, 1990; Older et al., 1991). The industrial by-products as brewer's grain are abundant in the Southeast of the country all the year round and constitute a disposal problem. It represents an important potential source for ruminant ration. The use of the dry brewer's grain as the major source of feed has been less successful owing to their palability which can be attributed to poor processing approach used to convert it into feed (Multon, 1988; Kenelly and Ha, 1990). Nevertheless, they have been included for pigs as revealed by Gohl (1981). Brewer's grain is a bulky feed, low in energy and is therefore seldom used for intensive fattening ruminant animals. However, it is used in the feed lot rations for beef cattle in countries where it is uneconomical to feed maize or other grains (Herrera-Saldana et al., 1990; Morgan et al., 1991) and so, the objective of the present study was to determine the level of inclusion of dry brewer's grain in the diets of growing lambs which would support optimum growth.

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MATERIALS AND METHODS

Experimental design and procedure:

Twenty yearling lambs of Southeast Nigeria Dwarf were grouped according to their initial liveweight (18±1.9 kg). Each of the 4 lambs was assigned to the experimental diet A to E, using a randomized complete blocked design. The study was carried out at Igbariam, with the help of Anambra State-Agriculture Development Programme (AS-ADP) staffs and supported by the Helens Agricultural Resources and Bio-Technological Center. Every group was given basal diet of 0.5 kg/head of a mixture of cassava leaf top and grass (Andropogen gayanus) hay at the ratio of 1.1, and a concentrate diet containing maize offal (a by-product of flour industry) at (70%), poultry waste (10%), palm kernel cake (10%), molasses (7%), bone meal (2%), oyster shell (0.5%) and mineral salt (0.5%). The dry brewer's grain represented maize offal in the diets A, B, C, D and E at 0%, 15%, 30%, 45% and 60%, respectively. The diet was provided to the experimental lambs *ad libitum*.

Before the commencement of the 10 days pre-trial period of adaptation to the experimental diets, the lambs were weighed individually and then grouped. In order to avoid selective ration consumption, the concentrate and the hay were weighed daily and given separately at 08:00 h and 17:00 h respectively. Refusals were collected and weighed before the next feeding and samples of each ration were taken and bulked over 56 days for chemical analysis. Fresh water was provided *ad libitum* throughout the experiment trial. 5 lambs of average body weight of 24.3±1.5 kg were placed in individual metabolism crates, and faeces and urine collected separately. The experiment diet were each weighed and offered to the individual lamb in a 5×5 Latin square designed. with a 10 day period of adaptation followed by 5 day period of collection. Where the experiment diet and the refusals were sampled daily and bulked over each 5 day collection period, for chemical analysis. Daily urine and faeces output were recorded and sample taken; while the faeces were frozen and urine stored at 5°C until analysed. Weighs of the individual lambs were taken at the beginning and at the end of each collection period.

Chemical and statistical analysis

The feed samples and faeces were dried to a constant weight under laboratory condition (Amen and Hesselmen. 1984) and were ground to pass through a 2 mm screen as revealed by Wu et al. (1994) and Luhalee et al. (1996). The standard AOAC (1990) procedures were used to determined dry matter (DM), organic matter (OM). crude protein (CP), nitrogen free extract (NFE) and ash contents respectively as applied by Majula and John (1991). MacGregor and Fincher (1993) and Hassan and El Tinay (1995). Data collected from the experiment trials were analysed using the analysis of variance procedures for a randomized complete block design. respectively (Snedecor and Cochran, 1987; SAS Institute, 1995). While the significance of differences among means was determined by Duncan's multiple range test (Duncan. 1955), as applied by Hintze (1987). The mean value and standard deviation were calculated using the Statistical Procedure of Agricultural Research of Gomez and Gomez (1984) and SAS Institute (1995).

RESULTS

The chemical composition of the dry brewer's grain. roughage and concentrate rations offered to the lambs is shown in Table 1 and 2. The crude protein, either extract and crude fiber contents of the rations increased as the level of dry brewer's grain rose, though the levels of ash and nitrogen free extract correspondingly declined. The nitrogen content of dry brewer's grain was unexpected high at 3.12%. and considerably greater than the value of 2.72% reported by Gohl (1981).

The result of the growth trial is summarized in Table 3. Although there was no statistical significant ($p>0.05$) difference in intake. and growth rate was significant ($p<0.05$) registered. There was a general tendency for concentrate intakes to increase as the feeding trial progressed (Sword. 1994; Pettersson et al.. 1998). and for intakes and growth rate to increase as dry brewer's grain replaced up to 45% of maize offal in the concentrate diet. The best growth rates were recorded on diets containing levels of 30% and 45% dry brewer's grain, which supported daily gains of 152.5 and 168.5 g/day, respectively. When the level of dry brewer's grain in the diet was increased to 60%. which resulted to the daily dry matter intake of dry brewer's grain in excess, intakes and growth rate started to decline. The daily intake of the basal forage (hay) diet remain constant at about 0.45 kg/head during the experimental period as noted by Older et al. (1991). and Visser (1993).

Table 1. Nutrient composition of the feeding materials expressed on the dry matter basis (N=3) (%)

Feeding material	Dry matter	Organic matter	Crude fiber	Crude protein	Nitrogen free extract	Ether extract	Ash	Nitrogen
Hay	89.5	81.3	29.0	10.8	45.5	7.0	8.2	1.73
Brewer's grain (BG) (dried)	91.8	87.4	18.4	19.5	52.6	5.1	4.4	3.12

Table 2. Nutrient composition of the diets expressed on dry matter basis (N=3) (%)

Treatment diets	Levels (%) of BG	DM	OM	CE	CP	NFE	EE	ASH	N
A	0	88.14	82.89	7.99	10.8	61.10	4.05	5.25	1.73
B	15	88.74	83.68	9.07	17.2	58.09	4.34	5.06	2.75
C	30	89.33	84.54	10.15	15.15	55.07	4.64	4.79	2.42
D	45	89.93	85.37	11.24	17.33	52.06	4.93	4.56	2.77
E	60	90.52	86.20	12.32	19.5	49.04	5.22	4.32	3.12
Statistical analysis									
MV		89.332	84.536	10.154	15.996	55.072	4.636	4.796	2.558
±SD		-	0.087	0.05	-	-	-	-	0.158

DM=Dry matter, OM=Organic matter, CF=Crude fiber, CP=Crude protein, NFE=Nitrogen free extract, EE=Ether extract, Ash=Crude ash, N=Nitrogen. MV=Mean value and ±SD=Standard deviation.

Table 3. Data on mean daily liveweight gains and intakes of lambs fed diets with different levels of dried brewer's grain for a period of 56 days (N=4)

	Diets					Statistical analysis	
	A	B	C	D	E	MV	±SD
Levels of BG (%)	0	15	30	45	60		
Liveweight gains (g/day)	115.1[a]	124.1[b]	152.5[c]	168.5[c]	123.1[b]	136.66	10.70
Concentrate intake (kg DM/day)	945.9	996.1	1,040.5	1,148.5	1,037.7	1,033.74	32.01
Total conc. intake (kg DM/day)	53.0	55.8	58.3	64.3	58.1	57.86	1.86
Intake of BG (g DM/day)	-	149.4	312.2	516.8	622.6	320.20	-
Nitrogen intake (g/day)	16.4[c]	27.4[b]	25.2[b]	31.8[a]	32.4[a]	26.64	-
Protein intake (g/day)	102.2[a]	171.3[b]	157.6[b]	199.0[c]	202.4[c]	166.50	-
Protein efficiency ratio	1.13	0.73	0.97	0.85	0.61	0.86	-
Organic matter efficiency ratio	0.15	0.15	0.17	0.17	0.14	0.16	0.004
Organic matter intake (g/day)	784.1	833.5	879.6	980.5	894.5	874.44	21.45

Means on the same row with different letters are significantly different ($p<0.05$).

The apparent digestibility trial of dry matter (Table 4) was small on all the diets at about 70.23% mean value. There was a higher apparent digestibility ($p>0.05$) among animals fed diets C and D based on organic matter than those receiving either 0% or 60% dry brewer's grain (3.18 g and 4.66 g, respectively). The urine's nitrogen output was also higher ($p<0.05$) on the D diet, containing 45% dry brewer's grain.

DISCUSSION

The analysis of the dry brewer's grain used in this trial is in close agreement with the study of Gohl (1981) and Aduku (1993), while the relative high crude protein content of 19.5% is similar to that reported by Ranjhan (1993). Though Barnes and Qrekov (1982), Multon (1988), Kenelly and Ha (1990), pointed out that, the nitrogen content of the industrial wastes is generally influenced by variety of the crop used, processing and storage conditions, and predictably the nitrogen content of the diets improved with brewer's grain (2.75% diet B to 3.12% diet E). The poorer nitrogen (1.73%), and higher fiber (29.0%) composition of the hay confirmed that, the basal diet was a mature, low quality forage (Holms, 1989; Older et al., 1991; Belotti and Spurndy, 1992).

The rate of growth difference as revealed in this study over the 5 treatments on levels of dry brewer's grain, may be interpreted by the fact that, voluntary feed intake (VFI) was generally low (Forbes, 1995; Pettersson et al., 1998), but increased to maximum on the diet D. While the digestibility of the organic matter, crude fiber and crude protein followed a similar trend; generally the intake of digestible nutrients, a good example is that of the protein which is essential of growth, increase as the level of

Table 4. Mean intake and diet digestibility of the diets containing levels of brewer's grain. Observation collections were made over a 5-day period following a 10-day adaptation (n=5)

	Diets					Statistical analysis	
	A	B	C	D	E	MV	±SD
Levels of BG (%)	0	15	30	45	60		
Conc. intake (g DM/day)	545.7	472.6	483.0	566.3	497.9	513.1	16.70
Apparent digestibility coefficients (%)							
DM	69.86	69.62	70.22	71.67	69.80	70.23	0.58
OM	70.57	68.90	75.78	75.90	68.77	73.68	-
CF	59.49[b]	63.53[b]	86.69a	95.36[a]	97.49[a]	80.51	-
CP	76.38	82.18	83.44	87.60	78.40	81.60	0.75
NFE	59.99	71.76	81.85	81.85	69.41	72.97	-
EE	99.03	94.13	96.00	98.01	91.12	95.66	-
Nitrogen balance (g/day)							
Intake	9.44[d]	13.00[b]	11.69[c]	15.69[a]	15.54[a]	13.07	-
Faeces	1.72[d]	2.56[c]	1.65[d]	3.15[b]	4.66[a]	2.75	0.61
Urine	5.03[c]	7.51[b]	6.95[b]	8.87[a]	8.50[a]	7.37	-
Retained	2.69[b]	2.96[b]	3.18[b]	3.64[a]	2.38[c]	2.95	0.43
Protein balance (g/day)							
Intake	1.51[d]	2.08[b]	1.87[c]	2.51[a]	2.49[a]	2.09	-
Retained	0.43[b]	0.47[b]	0.50[b]	0.58[a]	0.38[c]	0.47	0.06
Percentage P or N retention	28.50	22.77	26.52	23.20	15.32	23.26	-

Means on the same row with different letters are significantly different ($p<0.05$).

inclusion of dry brewer's grain in the diet rose, note Herrera-Saldana et al. (1990), Huhtanen (1991), Pettersson and Martinsson (1994), in similar studies using grains and their by products. The highest growth rate of 168.5 g/day that was observed on diet D was poorer than expected. Based on the revelation of AFRC (1980), Ranjahan (1993) recommendations, which concluded that a daily allowance of 25 g tissue protein will support a liveweight gain of 100 g/day in the sheep. Poorer growth rate was also noted by Akpa et al. (1994), who fed sheep diets of plan of nutrition, calculated to support good daily rate gain as recommended by AFRC (1980), but which only achieved a gain of 66.8 g to 89.0 g/day.

The difference as found in the study between observed and expected growth rates may be because, the dry brewer's grain is a bulky feed, low in energy and is therefore seldom used for intensive fattening of ruminants (Multon, 1988; Huhtanen, 1991; Morgan et al., 1991). Gohl (1981), recommended normal level of dry brewer's grain to supplement concentrates for cattle to be 10-25%; by the fact that it swells in the stomach and causes digestive disorder, thereby rendering the nutrients unavailable to the animal. The faecal nitrogen outputs on diets D and E (3.18 and 4.66 g/day respectively) support this suggestion, as does the reduction in the overall digestibility of dry matter and crude protein in the diet E (69.80% and 78.40%) over those in diet D (71.67% and 87.60%), respectively (Belotti and Sporndly, 1992; Visser, 1993). The poor voluntary feed intake as noted in diet E was associated with reduced organic matter digestibility, which may have been influenced by the unfavourable olfactory properties of the diet (Barnes and Qrskow, 1982; Pehrson and Donielsson, 1997). These become apparent because of the increased level of the dry brewer's grain in the diet, despite the incorporation of molasses, which were used to enhance palatability (Kennelly and Ha, 1990; Biedendach and Porter, 1990; Sward, 1994). Multon (1988), Gipson (1988) and Older et al. (1991), have noted poor processing/storage to deter and restrict feed intake in some species.

CONCLUSION

In conclusion, it is possible that rations containing dry brewer's grain can improve growth rates in lambs, similar to or greater than those, which are obtained through feeding maize offal. The maximum level of inclusion is however identified, beyond which the swelling stomach and unfavourable olfactory property in dry brewer's grain limit production. Although, the effects of anti-nutritional factors are thoroughly investigated, there are not always economically justified. The use of dry brewer's grain reduced the cost of diets in this study (diet D was 36% cheaper than diet A), which makes it an attractive alternative as a supplement to low quality roughage for sheep and one which in no way imprings upon potential supplies of food for man.

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