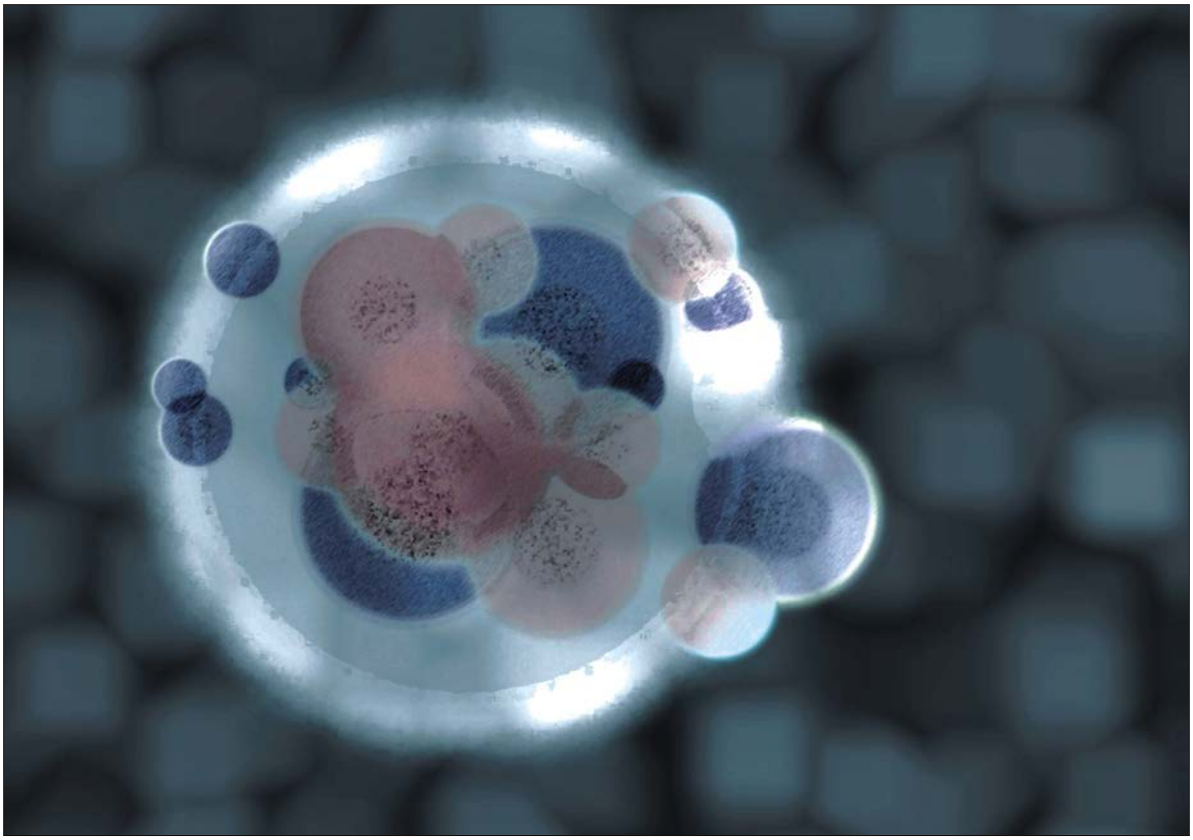

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Multi-nutrient Blocks I: Formulation and Production under a Semi-arid Environment of North East Nigeria

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Abstract: A study on the formulation and production of multi-nutrient blocks for feeding ruminants using local feed ingredients was conducted at the University of Maiduguri Teaching and Research Farm in October, 2004. Two formulations (Fl and F2) were developed where Fl had molasses while F2 had no molasses. Other feed ingredients used included salt 5%; Urea 5%; cement 15%; poultry litter 25%; cotton seed cake 15% while wheat offal was 25 and 35%, respectively. Molasses was 10% in F_1 and zero percent in F_2. Composition of feed ingredients for dry matter ranges from 94.50 to 95.20% in wheat offal; crude protein ranged from 2.90% in molasses to 17.00% in cotton seed cake. Ether extract values ranged from 4.00% in wheat offal to 6.00% in cotton seed cake. Crude fibre ranged from 13.00% in wheat offal to 20.00% in poultry litter. Nitrogen free extract ranged from 23.00% in molasses to 64.20% in wheat offal. Ash values ranged from 3.00% in wheat offal to 6.00% in poultry litter. Calcium values ranged from 0.14% in wheat offal to 2.50% in poultry litter. Sodium was 39.34% in salt; chlorine was 60.00% in salt; nitrogen was 46.00% in urea; iron was 21.45 ppm in cement; manganese was 179 ppm in cement; magnesium 13000 ppm in cement, respectively. Formulation Fl had higher values and this might be due to the presence of molasses which improved the nutrient value, compactness and hardness. The cost effectiveness of the two formulations showed N 43:00 and N 21:00 for a 1.30 kg block this amount could be able afforded by farmers to purchase the blocks and supplement their animals to improve livestock production in the semi-arid region of Nigeria.

Key words: Blocks, formulation, multi-nutrient, Nigeria, production, semi-arid,

INTRODUCTION

The principles for improving the use of poor quality roughages by ruminants include supplementation of fermentable nitrogen and minerals which could by pass the rumen and this could be in form of multi-nutrient blocks formulated. The technique consists of mixing the required feed ingredients in a container and pouring the mixture into moulds and leaving to solidify into blocks(Bheekhee *et al*., 1999). The block should contain nutrients that by pass rumen and such materials include molasses and urea (Liu *et al*., 1995; Leng, 1986; Waruiru, 2004). The blocks could be made from a variety of component feed ingredients depending on their availability locally, nutritive value, price, existing facilities for their use and their influence on the quality of blocks The use of multi-nutrient blocks as a supplement to basal poor quality forage diets for ruminants in Nigeria is new. The aim of this study was to formulate, produce and estimate cost effectiveness of multi-nutrient blocks using local feed ingredients under a semi-arid environment of north east Nigeria.

MATERIALS AND METHODS

Experimental Site/Location: The experiment was carried out at the University of Maiduguri, Teaching and Research Livestock Farm in September 2005. The area is situated on latitude 11°51' North, longitude 30° 05' East and at altitude of 354 m above sea level. It falls within the Sahelian region (semi-arid zone) of West Africa, which is characterised by short duration of 3-4 months of rainfall. Rainfall varies from 300-500 mm, ambient temperatures are highest by April and May and is in the range of 35-40°C while relative humidity ranges from 45-50% as reported by Kellou (2005).

Sample collection and preparation: Feed ingredients Molasses, wheat offal, cotton seed cake, Salt, urea

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fertilizer and cement were all sourced locally and were all processed by grinding using a milling/grinding machine. Poultry litter was collected and sun dried for a period of six weeks to eliminate pathogens (Kellou, 2005).

Mixing of feed ingredients: Mixing of the ingredients was done by hand in a 200 L drum cut to a height of 25 cm. Approximately 20 kg of ingredients were mixed per batch in order to get a homogenous mixture. The mixing procedure was as outlined by Aarts *et al.* (1990). The urea fertilizer was dissolved completely for about 20-30 min. The binder was dissolved in another bucket and after being mixed together and were later all poured into the drum which already contained the dissolved molasses. The whole solution was stirred and mixed properly to obtain a homogenous mixture. Other ingredients were added as follows; dried poultry litter, cotton seed cake and finally wheat offal. Each ingredient was added only after a homogenous mixture of other ingredients was attained.

Moulding of blocks: The homogenous mixture was placed in wooden container moulds measuring 15×15×10 cm (Allen, 1992). The material block was pressed manually using hand. The surface of the wooden mould was covered with polythene sheet to facilitate de-moulding and cleaning of the surface. Blocks formed were removed immediately from the moulds and all blocks were sun dried in the open air under shade.

Block assessment and curing: Hardness (H) and compactness (C) of the blocks were tested four days after de-moulding (Leng, 1992) but was found soft and contained moisture. Second test was made after 10-20 days by three persons independently by assessing, hardness on the scales: Soft (S), Medium (M) and Good (G). Hardness was determined by pressing with the thumb in the middle of the block and compactness by the ease to break by hand. Efforts were geared towards obtaining blocks which set well and could be transported without consequent breakage.

Chemical and cost-effectiveness analysis: All feed ingredients used together with samples from moulded blocks produced were chemically analysed for Dry Matter (DM), Crude Protein (CP), Crude Fibre (CF), Ether Extract (EE), ash and Nitrogen Free Extract (NFE) using AOAC (1990) method. Cost effectiveness of block production for the two formulations was calculated using the current prices of feed ingredients used.

RESULTS AND DISCUSSION

Formulation and mixing: Two formulations were used (Fl and F2) using locally available feed ingredients, one with molasses while the other one without molasses (Table 1). The proportion of ingredients in the two formulations were 5, 5, 15, 25 and 15% for urea, salt, cement, poultry litter and cotton seed cake, respectively. The proportion of wheat offal used were 25% in Fl and 35% in F2, while molasses was only used in Fl at 10% level. The proportions of feed ingredients used in this study are similar to those used in Syria by Hadjipanayiotou *et al.* (1993) with and without molasses using different formulae. Cement at 15% level served as a binder in this study. This level of cement gave a good compactness and hardness of the blocks. However this is a higher level to 10% cement as used by Hadjipanayiotou *et al.* (1993a) which served as a binder and gave compactness and hardness null and soft, respectively. The formulations and order of mixing ingredients, techniques gave compactness and hardness indicated in Table 1. This agrees with what was recommended (Aarts *et al.*, 1990; Leng, 1995; Hadijipanayiotou, 1996). The technique and formulation were simple and could be carried out by smallholder farmer in the study area. The multi-nutrient blocks in this study had high moisture content and took 3-4 weeks after formulation before becoming dried with desired compactness and hardness. This is different from what was recorded by Leng (1995) who reported test for hardness and compactness for multi-nutrient blocks four days after drying. Proportion of water used in the mixing of feed ingredients using 20 kg of mixture were 28 L for Fl and 24 L for F2, respectively. The 24 L of water in F2 was found to give a better homogenous mixture and this improved the compactness of the blocks. This also did not show leaking of water from blocks during moulding when pressure was applied. These characteristics were different from those reported by Hadjipanayiotou (1996)

Table 1: Proportions of feed ingredients in formulations%

	Formulations	
Feed ingredients	F_1	F_2
Urea	5.00	5.00
Salt	5.00	5.00
Molasses	10.00	10.00
Cement	15.00	15.00
Poultry litter	25.00	25.00
Wheat offals	25.00	25.00
Cotton seed cake	15.00	15.00
Water (litres/20 kg mixture)	24.00	24.00
Compactness	0	0
Hardness	0	0

G = Compactness and hardness are good

Table 2: Proximate composition of feed ingredients

	Feed ingredient						
Parameters	Wheat offals	Poultry litter	Cotton seed cake	Molasses	Cement	Salt	Urea
Dry matter (%)	96.20	95.50	94.50	-	-	-	-
Crude protein	12.00	14.00	17.00	2.90-	-	-	
Ether extract (%)	4.00	5.00	6.00	-	-	-	-
Crude fibre (%)	13.00	20.00	14.00	-	-	-	-
Nitrogen free extract (%)	64.20	50.50	52.50	23.10	-	-	-
Ash (%)	3.00	6.00	5.00	3.10	-	-	-
Calcium (ppm)	0.14	2.50		0.82	-	25.00	-
Sodium (ppm)	-	-	-	-	-	-	-
Chlorine (ppm)	-	-	-	-	-	66.66	-
Nitrogen (ppm)	-	-	-	-	-	-	46.00
Iron (ppm)	-	-	-	-	21.45	-	-
Manganese (ppm)	-	-	-	-	179.00	-	-
Magnesium (ppm)	-	-	-	-	130.00	-	-

ppm = Parts Per Million

who used larger quantity of water 40-60 L for every 100 kg of mixture used. This could be supported by the fact that when mixing is done manually by hand, more water is required for a thorough mixing without ant lumps or balls being produced in the mixture. Aarts *et al.* (1990) reported that the order of introduction of the ingredients plays important roles in obtaining a homogenous mixture. In this study, introducing the ingredients in the order; molasses, urea, salt, wheat offal, cotton seed cake, poultry litter and cement lastly as a binder showed that the order of mixing is not critical as has been recommended previously. Once the formulation has proved to provide good quality blocks without lumps or balls, mixing procedure could be altered in order to find the easiest and quickest way of producing the blocks. The standard recommended order of mixing is molasses, urea, salt, binder and wheat offal (Hadjipanayiotou *et al.*, 1996).

Proximate composition of feed ingredients: Proximate composition of individual feed ingredients used in the two formulations are shown in Table 2. The dry matter contents of the ingredients ranged from 94.50 to 96.20% for wheat offal, cotton seed cake and poultry litter. Crude protein content of the cotton seed cake was relatively high 17%, poultry litter 14%, wheat offal 12% and molasses 2.90%. Values were higher than those reported by Ramchuru and Raggoo (2000) 24.20 and 25% Lanyasunya *et al.* (2006). Crude fibre values were 20% poultry litter, 14% cotton seed cake and 13% in wheat offal. Ether extract values were cotton seed cake 6, poultry litter 5 and 4% in wheat offal, respectively. Ash values were 4, 5, 3 and 3.10% for poultry litter, cotton seed cake, wheat offal and molasses, respectively. The remaining ingredients were substances already prepared in the factory, they are cement which had mineral element 25% Calcium, 21.45 ppm Iron, 1790.00 ppm Manganese, 130.00 ppm Magnesium. Salt had mineral elements 39.34%

Table 3: Proximate composition of the formulation

Nutrients	F1 (%)	F2 (%)
Dry matter	95.00	92.90
Crude protein	11.00	13.00
Crude fibre	11.00	13.00
Ether extract	10.00	7.00
Ash	7.00	8.00
Nitrogen free extract	61.00	59.00

Table 4: Cost effectiveness of the formulation

Nutrients	Cost of F_1, N	Cost of F_2, N
Urea	24.00	24.90
Salt	26.00	26.00
Molasses	363.60	0.00
Cement	66.00	66.00
Poultry	37.50	37.00
Wheat offals	91.60	128.30
Cotton seed cake	36.00	36.00
Total	644.70	317.80

NB N142 is equivalent to US$1

Sodium and 60.65% Chlorine and finally urea fertilizer contained 46% nitrogen all values are different from those reported by (Beehkee *et al.*, 1999).

Proximate composition of formulations (blocks): The proximate composition of the two formulations (blocks) are shown in Table 3. The dry matter content was 95 and 92% for formulations Fl and F2, respectively. The high values obtained showed that the blocks have dried very well for the period used in drying (3-4 weeks), thus all moisture has been lost during this period. This also gave the fairly good compactness and hardness for the blocks. Both crude protein and crude fibre values were high 13% for Fl and F2, respectively. The ash content was 7 and 8% for Fl and F2, while the nitrogen free extract was 61% Fl and 59% F2.

Cost effectiveness of formulations: The cost effectiveness of the two formulations is shown in Table 4. Using the current price of feed ingredients used in producing the two formulations, the cost effectiveness of producing 20 kg mixture which gives 15 blocks was N644: 70 for Fl and 317: 80 for F2. Cost of producing 1. 3 kg block of 15×15×10 cm size was N43: 00 for Fl and N21: 00 for F2, respectively. The nutrient composition of the blocks in this study (Table 2) have higher levels compared to those reported by Hadijipanayiotou *et al.* (1996). This nutritional quality is high and could meet requirement of nutrients. Molasses and urea used will provide energy and protein that creates adequate and efficient ecosystem for fermentable digestion of fiber in the rumen (Lang, 1995).

CONCLUSION

This study showed that it is possible to produce multi-nutrient blocks, using locally available feed ingredients that is of good hardness and compactness at cost effective rate of N43: 00 and N21: 00 per block of 1.3 kg weight. These formulations could provide the fermentable nitrogen required by ruminants and thus could replace the conventional method of feeding concentrates and bulky crop residues as practiced by farmers in the semi-arid region of north east Nigeria.

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