Multinutrients Feed Block Production Using Agro Industrial By-Products on Acceptability by West African Dwarf Goats

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Abstract
Shea nut cake enriched with urea, soybean cheese waste and *Gliricidia sepium* was made into feed blocks using three binders (cement T1, cassava flour T2 and industrial starch T3). The feed blocks were air dried for 21 days at air temperature of about 28°C to investigate their physical properties and acceptability. Twelve (12) healthy growing West African dwarf (WAD) goats of average weight 8.0 kg were used with *Daniella oleiveri* as basal diet for 14 days in a completely randomized design. Feed blocks using industrial starch as binder was harder and more compact compared to the two other binding agents throughout the drying period. Chemical composition showed that highest content of dry matter was recorded for T3 (96.32%) and lowest in T2 (94.23%). T2 recorded highest crude protein content (32.71%) while T1 had the least (30.18%). Crude fibre content was also highest in T2 (4.50%) and lowest in T3 (4.42%). In addition, highest ash content was observed in T2 (8.82%) and lowest in T1 (6.79%). In terms of physical properties (hardness and compactness), feed block produced using industrial starch as binder is the best. Among the treatments, T3 was most acceptable with coefficient of preference above unity. The cost of production was highest in T3 (N80.25 /kg) and lowest in T1 (N54.00/ kg). Feed block produced using industrial starch as binder is recommended for adoption by farmers as dry season feed supplement in ruminant nutrition due to its properties and acceptance by the animals.

Keywords: Chemical composition, feed block, shea nut cake, WAD goat

Introduction

Shortage of feeds and fodders, in terms of quantity and quality during the dry season is a major problem for developing countries like Nigeria in meeting the nutritional requirement of livestock. Shea nut cake is a by-product that is left after fat extraction from shea nuts (*Vitellaria paradoxa*, Gaertn.). It is available in large quantities in West Africa most especially Nigeria and Ghana. Shea nut cake was reported to have similarities in its nutrient composition to wheat bran (NRC, 1994). Wheat by-products are used extensively in livestock feed in Western Africa. These by-products are often imported and thus can be scarce and expensive. Annongu *et al*. (1996) observed that shea nut cake contains some anti-nutritive factors, particularly tannins that are in the range of 98.7 to 156.4 g/ kg. The tannin concentration is similar to or higher than other high tannin-containing feedstuffs such as sorghum grains (*Sorghum vulgare*) and faba beans (*Vicia faba*). These may not pose a problem to ruminants as they tolerate certain concentration of tannins in their rumen. The importance of the quantity consumed is receiving recognition since tannins in several types of forage can have beneficial effects in moderate amounts (Min *et al.,* 2003).

Makkar, (2007) indicated that the use of solid feed supplementation blocks, i.e. multinutrient blocks, provides the nitrogen, minerals and vitamins deficient in fibrous feeds which are available to this animal during dry season period. Block supplementation with crop-residue-based diets has resulted in increased milk production, with a favourable cost– benefit ratio, varying from 1:2 to 1:5, depending on the purchase price of ingredients and selling price of milk (Makaar, 2007). Increase in lactation length has also been observed. Decreases in inter-calving days and in the age at first calving are additional beneficial effects of feeding the blocks. Feeding of crop residues with UMMBs can sustain a milk yield of up to 4 or 5 litres per day in cattle (Makkar, 2007). Generally, multi-nutrient feed block will bring improvement in livestock productivity, coupled with more efficient utilization of locally available feed resources (especially fibrous feed), and will further lead to economic and social benefits for the local population.

Therefore, this experiment was designed to produce affordable multinutrients feed block using shea nut cake as dry season feed supplement for ruminants.

Materials and Methods

The experiment was conducted in small ruminant section at the Teaching and Research farm, College of Agriculture, Kwara State University, Malete. The cold process was used for the production. The blocks were made by hand (manually) in batches (Sansoucy, 1986). The mixed material was placed into a 16cm x15cm x16cm wooden mold. The mold was lined with plastic sheeting to prevent the block from sticking to the walls and to allow easy removal from the molds (Asaolu, 2012).

Twelve growing West African dwarf goats weighing averagely 8 kg with good body condition were used. The experimental animals were tagged and randomly assigned to the experimental diets. The animals were given prophylactic treatments against parasites and other infections. The experimental animals were provided with feed block every day before eating forages.

Table 1: Composition of experimental diets using different binders (%)

Ingredient	T1 (Cement %)	T2 (Cassava flour %)	T3 (Industrial starch %)
Shea nut cake	30	30	30
Rice bran	5	5	5
Soybean waste	10	10	10
Gliricidia leave	15	15	15
Urea	10	10	10
Binder	10	10	10
Molasses	15	15	15
Bone meal	3	3	3
Premix	1	1	1
Salt	1	1	1
Total	100	100	100

The blocks were monitored and assessed for hardness and compactness at 7 and 21 days respectively by 3 persons independently using a subjective scale: Soft (+) Medium (++) and Good (+++). Hardness was tested by three persons independently by pressing with the thumb in the middle of the block. Compactness was tested by three persons independently by the ease to break the block by hand (Mohammed *et al.,* 2007).

Colour, taste, texture and smell/aroma were determined independently by three persons according to Hadjipanayiotou (1994).

The feeding of the WAD goats to determine relative preference and acceptability lasted 14 days with 7 days adjustment (acclimatization) and 7 days data collection periods respectively and was carried out using the cafeteria method (Ogunbosoye and Otukoya. 2014). Feed block was weighed before giving to the animals. The feed resources preferred was assessed from coefficient of preference (COP) value, calculated from the ratio between the intake of individual feed resource and the average intake of the feed resources. Therefore, feed block was inferred to be relatively acceptable provided the COP was greater than unity. Blocks samples were analyzed for proximate (AOAC, 2000) and fibre fractions (Van Soests *et al*., 1991). The cost analysis of feed block from the different binders was estimated using the prevailing prices of the various ingredients in the Nigerian Naira (N) at the time of the study (Mohammed *et al*., 2007).

Data obtained for all determined parameters were subjected to one-way analysis of variance (ANOVA) procedure using SAS package of (2010). Significant means were separated using the least significant difference (LSD) at 5% probability of the same package.

Results and discussion

The crude protein (CP) contents varied between (30.18%) and (32.71 %), the CP was highest in T2 (32.71%) and the least CP value was obtained from T1 (30.18%). These values were similar when compared to other reports (Asaolu, 2012; Aye, 2015). The high concentration of CP was a reflection of the high presence of urea, soybean cheese waste and probably *Gliricidia sepium*, a leguminous forage the block contained. Onwuka (1999) reported that high CP content of the feed block makes it suitable as a source of concentrated supplementary nitrogen necessary for microbial protein synthesis in the rumen. The crude fibre (CF) content was within the range of 4.26% to 4.50%. These values were similar to the values reported elsewhere (Asaolu, 2012) but at variance with the values obtained by Omoniyi *et al*. (2013). The variations may be due to varietal difference in the binder. Dietary fibre through microbial degradation and synthesis supplies energy to support maintenance, growth, lactation and reproduction (Lu *et al.,* 2005). The NDF ranged from 23.42% to 28.32%. The feed block had low content of fibre. Since the voluntary DM intake and digestibility are dependent on cell wall constituent (fibre), especially NDF, therefore, the feed block is believed to be easily consumed by the animals (Table 2)

Table 2: Nutrient composition (%DM) of feed block (SNC) with different binders

Parameters	T1 (cement)	T2 (cassava flour)	T3 (industrial starch)
Dry matter	96.25	94.23	96.32
Ash	6.79	8.82	8.45
Crude protein	30.18	32.71	31.56
Ether extract	7.35	7.64	7.26

Crude fibre	4.26	4.50	4.42
NFE	44.73	56.51	51.53
NDF	23.43	28.33	27.52

NFE=Nitrogen free extracts, NDF=Neutral detergent fiber

Hardness and compactness of feed blocks has been described by Asaolu (2012) as an important aspect to be considered during block manufacturing. The result of the measurement of hardness and compactness is presented in Table 3. All the formulated feed block, resulted in blocks of comparable hardness and compactness (7 to 21 days) after casting. This is different from what was reported by Chenost and Kayouli (1997) who suggested that the blocks will dry and be ready for use after about (10 days) when dried preferably in the shade as the strong sun can cause cracking in the blocks. Herrera *et al*. (2007) and Asaolu (2012) observed that as block hardness increases, animal intake diminished. It was observed that T3 (industrial starch) produced a good hardness and compactness than T1 (cement) and T2 (cassava flour). This indicates that industrial starch can replace most cement as most animal welfare advocates are against the usage of cement in animal feed preparation.

Table 3: Hardness and compactness of feed blocks 7/21 days after molding

	Days of molding					
	7			21		
Parameters	T1	T2	T3	T1	T⅓	T3
Compactness	+	++	+++	+	++	+++
Hardness	+	+++	++	+	+++	++
Weight (kg)	2.3	2.9	2.7	2.1	2.2	2.2

Soft (+), Medium (++) and Good (+++)

Presented in Table 4 is the coefficient of preference of the feed block among the diet. T3 was highly preferred, this may be because T3 was palatable with good smell of molasses and not too hard to consume by the animal. During the study period, the preference was not affected by the CP, as all the CP is within the range of requirement. T2 was least consumed and least preferred despite the fact that it has the highest CP. Refusal of it might be due to some factors like taste, odour and the hardness of the block (Karbo, 1993). The order of preference is T3> T1>T2 respectively.

Table 4: Coefficient of preference of the feed block

DAY	T1(cement)	T2 (cement)	T3(industrial starch)
DAY 1	0.87^{a}	0.67^{a}	1.10^{a}
DAY 2	0.92^{a}	0.97^{a}	1.11^{a}
DAY 3	1.02^{a}	0.83^{b}	1.19^{a}
DAY 4	1.00^{b}	0.83^{c}	1.22^{a}
DAY 5	0.96^{a}	0.92^{a}	1.17^{a}
DAY 6	0.93^{b}	0.91^{b}	1.25^{a}
DAY 7	0.94^{b}	0.86^{b}	1.24^{a}

abc= Means (average of 3 analyses each) in different columns with the same superscript are not significantly different (p>0.05).

Tables 5 presents the cost of producing the feed blocks. The cost effectiveness of the three formulations was estimated at current price of the feed ingredient in the market in Nigeria currency. The cost of production per 15 kg formulation ranged from ₦975 – ₦1, 284. Highest production cost was recorded in T3 with ₦1, 284 which was as a result of high price of the industrial starch binder. The relatively higher cost of production of a feed block expressed in this experiment was basically due to the type of binder used in the formulation. The cost of production of a 15 kg formulation of the feed blocks in this experiment was generally less than the cost range for feed blocks reported by Ibrahim *et al*., (2011) whose range was ₦2, 522 – ₦2, 835 and this variation is attributed to the type, quantity of the ingredients used in the production process and the cost of ingredient at that time.

Table 5: Number of blocks produced per 15 kg formulation and cost per block in Naira (₦)

Parameters	T1(cement)	T2 (cassava flour)	T3 (industrial starch)
Number of blocks	10	8	8
Cost formulation (₦)	975	1209	1284
Cost/ 2kg block (₦)	108	151.1	160.5
Cost/1kg block (₦)	54	75.55	80.25

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