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Degradation Characteristics of Some Dry Season Supplemental Rations for Ruminants in Semi-Arid Region of Nigeria

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Abstract: *The six (6) must feed resources (sorghum husk, cowpea husk, Cottonseed cake, wheat offal, commercial bran and poultry litter) in used for ruminants feeding in Borno State and environments were studied. Variation in nutrient values of the local ingredients necessitates the combination of two or more of the feed ingredients to optimize the quality and quantity of feed for the teaming ruminant population in the study area. Ten diets were formulated based on measurement of the six feed resources mixing up to 100kg for each formulation. A total of 1 ton of feed was formulated. Formulation five (F_5) with 3.8% CP, 13.0%CF, and 31.5% mean degradation at six hours, 80.0% mean degradation at 72hours of incubation had total cost of production N 12/kg only. Formulation four (F_4) with 4.12%CP, 24.0%CF, 50.0% mean degradation at 12hours and 76.5 mean degradation at 72hours of incubation cost N 19/kg only for formulation. The highest crude protein was recorded at formulation three (F_3) but had highest cost of production per hundred kilograms of feed. It was depicted from this work that mixing two or more feed resources with different protein and energy content can yield a good feed of higher and balance percentages.*

Key words:*degradation, ration, ruminants, supplements,*

I. Introduction

Nutrition plays a major role in the productive performance of livestock Fialho et al., (1995). This is important among animals managed on range lands or natural pastures, since quantity and quality of roughages in the tropics is determined by the seasonal pattern of rainfall. Animals that depend on natural vegetations for their nutrition suffer heavy losses during the dry season which coincides with their productive performance Diaville et al., (1994). Most of the crop residues used for grazing during the dry season is low in digestibility and in nitrogen content for maintenance and growth. Weight losses under this condition have been recorded (Miller et al, 1984). A typical sample of dry season pasture harvested in February had a crude protein of 1.5%, void of carotene and phosphorus Miller et al., (1984). The low protein content of ruminant rations is accompanied by low apparent digestibility and in the semi arid regions, poor quality roughages are the major sources of feed used for feeding ruminants animals for a considerable part of the year Preston and Levy, (1987). The effects of unbalanced nutrients supply on ruminants, in particular fermentable nitrogen and protein include low calving, low birth weight, high calving mortality, and low weaning weight and reduced milk production (Preston and Leng 1987).The principal substances determining the nutritive value of forages are protein, soluble carbohydrates and lipids. Intake of tropical grass may decline remarkably when the crude protein percentage falls below 7% Babber et al., (1988). During the dry season a further decrease in digestibility of grasses may occur as a result of increase in lignin content and decrease in mineral, energy and protein contents of the feed. This leads to lower intake, low digestibility and consequently losses in body weight and milk yield in grazing animals therefore the need for supplementation with a balanced ration that will meet the nutritional requirement of these animals. Thus, the objective of this research is to develop feed rations formulated using locally available feed ingredients in the research area, determine the degradability of the feeds formulated so as to come up with feed combinations that could be used to supplement ruminants feeding during feed scarcity and provide ways of reducing competition between man and livestock in the area of research.

II. Materials And Methods

Experimental Site/Location

The experiment was carried out at the University of Maiduguri teaching and research farm. It falls in the Sahelian Region (Semi-Arid Zone) of West Africa, which is characterized by short duration of 3 – 4 month of rainfall. Rainfall varies from 300 – 500 mm; ambient temperatures are higher by April and May, which ranges from 35 – 45% (Alaku,1983).

Sample Collection and Preparation
The materials used in the experiment include: Forceps, nylon bags, disinfectants (detol), cotton wool, thread, samples. Materials used in the laboratory include: weighing scale, Petri dishes, crucibles, hot air oven, muffle furnace, hot plate, test tubes, beakers, digestion flask, measuring cylinder, digestion chamber, distillation chamber, retort stand, burette, pipette, filter paper, spatula, etc.Ingredients used for the feed formulation were purchased at the Maiduguri cattle market and poultry litter was collected later at the University of Maiduguri Teaching and Research Farm. The samples were collected from the farm, weighed and prepared at the animal science laboratory for analysis. 10g of each sample was collected into a Petri dish, and placed into an oven for oven drying until constant weights were attained.

Feed Formulation
A total of 10 rations were formulated using sorghum husk, cowpea husk, wheat offal and bran (a mixture of maize bran, millet bran and sorghum bran) as energy source while cottonseed cake and poultry litter were used as protein source. The formulation was done based on the energy to protein ratio of 60:40.Ingredients used were weighted separately and then mixed up on a clean floor using shovel to turn and mixed thoroughly until homogenously mixed together. One hundred (100) kilograms each of ten different diets were formulated.

Washing Loss
Soluble portion of the feed was determined by weighing 5 g of the feed samples into nylon bags in replicates. It was soaked in warm water at 40 °C for one hour, removed and washed under a running tap for 15 minutes in two circles till clear water was obtained. The bags were oven dried at 60 °C for 48 hours to constant weight (Orskovet al., 1980).

Chemical Analysis
Feed samples were analyzed for Dry Matter (DM), Crude Protein (CP), Crude Fiber (CF) and Ash using the methods of AOAC (2000).

Statistical Analysis
Results from the proximate analysis were subjected to analysis of variance (ANOVA) as described by Steel and Torrie (1980).

Cost of Producing the Formulations
The cost of producing the five formulations was calculated using current prices of feedingredients at the Maiduguri Cattle Market in Naira (N) and the quantities used.

Rumen Degradation Study
This is an in vitro digestibility involving the insertion of nylon bags with feed inside into the rumen and monitoring the digestibility over a specified period of time usually between 0-120 hours (church, 1977). The nylon bag (in vitro) technique for determination of the degradation of feedstuff in the rumen at various incubation periods can be used to screen feeds at initial stages of assessing their nutritive value (Taun et al., 1996). The balance of nutrients potentially made available from and the digestibility of the dry matter in the rumen are the most important criteria of the potential of a basal diet. Digestibility primarily establishes the intake of the basal diet (feed once nutrient deficiencies for the rumen microbes have been corrected (Minson, 1982). However intake is affected by climate and a range of other factors.

III. Results and Discussion
IV.

TABLE 1: Proximate composition of the formulation

	Diets									
Parameters (%)	F_1	F_2	F_3	F_4	F_5	F_6	F_7	F_8	F_9	F_{10}
Dry matter (DM)	96.5	96.5	97.2	97.4	96.2	97.8	98.0	97.7	96.4	97.2
Crude protein (CP)	3.6	4.4	4.5	4.2	3.9	3.5	3.7	4.1	4.3	2.8
Crude fiber (CF)	39.0	31.0	22.0	24.0	13.0	21.0	23.0	36.0	29.0	30.0
Crude Fat (CF)	5 .0	1.0	10. 0	2.0	2.0	1.0	1.0	1.0	4.0	4.0
Ash	2.0	2.0	3.0	4.0	4.0	2.0	1.0	7.0	5.0	5.0
ME (MJ/kg DM)	3.9	3.6	3.6	3.6	3.7	3.8	3.6	3.4	3.5	3.7

Proximate composition of the formulated diets is presented in Table 1. From the tables we can see that formulation threeF_3(5%CP) had the highest crude protein content, followed by F_2 (4.4%CP), F_9 (4.3%CP), F_4 (4.1%CP) and F_8 (4.0%CP) respectively. Formulation F_3 had the highest protein content (4.5%CP) because of the high CP content of cottonseed cake (41.0%CP). Formulation F_{10} had the lowest crude protein content of 2.8%CP. This was as a result of the low crude protein content of the ingredients used in this formulation.Formulation F_1 had highestmetabolizable energy (ME) 3.9 MJ/kg DM while F_8 had the lowest of 3.46MJ/kg DM. The high metabolizableenergy content of most of the formulations is as a result of the varied proportions of the different ingredients in the ration such that a high energy content ingredient: cowpea husk and sorghum (60%) in F_1 and commercial Bran (60%) in F_6.Crude fiber (CF) ranges from 13.0 -39.0%. Highest CF was recorded in F_1, with39.0% CFwhere as F_6 had the lowest 13.0% CFthis could be due to the fibrous nature of most of the crop residues and their level of inclusion. This high crude fiber contents accounts for the lower degradability of most of the formulations.

Table 2: Percentage Dry Matter Degradability

	Diets										
Hours	F_1	F_2	F_3	F_4	F_5	F_6	F_7	F_8	F_9	F_{10}	SEM
6	24.5^{bcd}	18.0^{e}	27.0^{abcd}	29.5^{ab}	31.5^{a}	28.0^{abc}	31.0^{a}	26.5^{abcd}	22.5^{cde}	21.5^{de}	1.59*
12	26.5	34.5	33.5	50. 0	34.5	31.5	34.0	37.0	34.0	33.0	8.01^{ns}
18	38.5	30.5	39.5	38.0	38.5	41.0	41. 0	30.5	38.5	36.0	4.06^{ns}
24	44.5	38.5	42.5	42. 0	43.0	46.0	65.5	52.0	70.0	67.5	8.68^{ns}
36	67.5^{b}	70.5^{ab}	69.5^{ab}	70.5^{ab}	71.5^{ab}	66.5^{ab}	71.5^{ab}	69.5^{ab}	72.0^{ab}	75.0^{a}	1.63*
48	72.0^{b}	74.5^{ab}	73.0^{ab}	72.0^{b}	76.5^{ab}	76.5^{ab}	75.5^{ab}	78.5^{ab}	75.0^{ab}	77.5^{ab}	1.45*
72	75.5^{cd}	76.5^{bcd}	76.0^{bcd}	76.5^{bcd}	80.0^{ab}	78.5^{abcd}	81.5^{a}	79.0^{abc}	74.5^{d}	79.5^{abc}	1.07*

*significant difference among means in the same row
Ns: Not significantly different
SEM: Standard error of mean, a, b, c, d, e: Means with the same alphabets do not differ from each other at P<0.05

Table 2 shows the results of mean degradability pattern of each of the formulations at 6, 12, 18, 24, 36, 48 and 72 hours of incubation.At 6, 12 and 18 hours of incubation, all the formulations recorded lower degradability percentages and statistically not significantly (P<0.05) different at 12 and 18 hours. However, Highest degradability at 24 and 36 hours was recorded in formulations F9 (70.00 %) and F10 (75.00 %) respectively, while lowest were recorded at F2 (36.50 %) and F6 (66.50 %) at 24 and 36 hours respectively. This lower degradability pattern of the formulations could be attributed to increase in lignin and fiber content of the ingredients used in the formulations Baber et al., (1988) and thus will require a longer resident time in the rumen for their degradation. At 48 and 72 hours of incubation, F8 (78.50 %) and F5 (80.00 %) recorded highest degradability respectively. Since all the formulated rations recorded slightly higher degradability (above 50%) between 36 and 48 hours, they may be considered for appropriate for ruminant feeding and this is in concord with the 40 – 50% degradability range recommended by FAO (1986) and theminimum of 60% recommended by Smith et al. (1988). Furthermore, the degradability pattern of all the formulations attained a minimum of 70% degradability at 48 and 72 hours of incubation. It can be deduced from the degradability pattern of the formulated rations in this experiment that longer resident time of feeds in rumen of animals tend to increase their degradability significantly, especially when utilizing a fibrous and high protein ingredient in theformulation of ruminant diets.

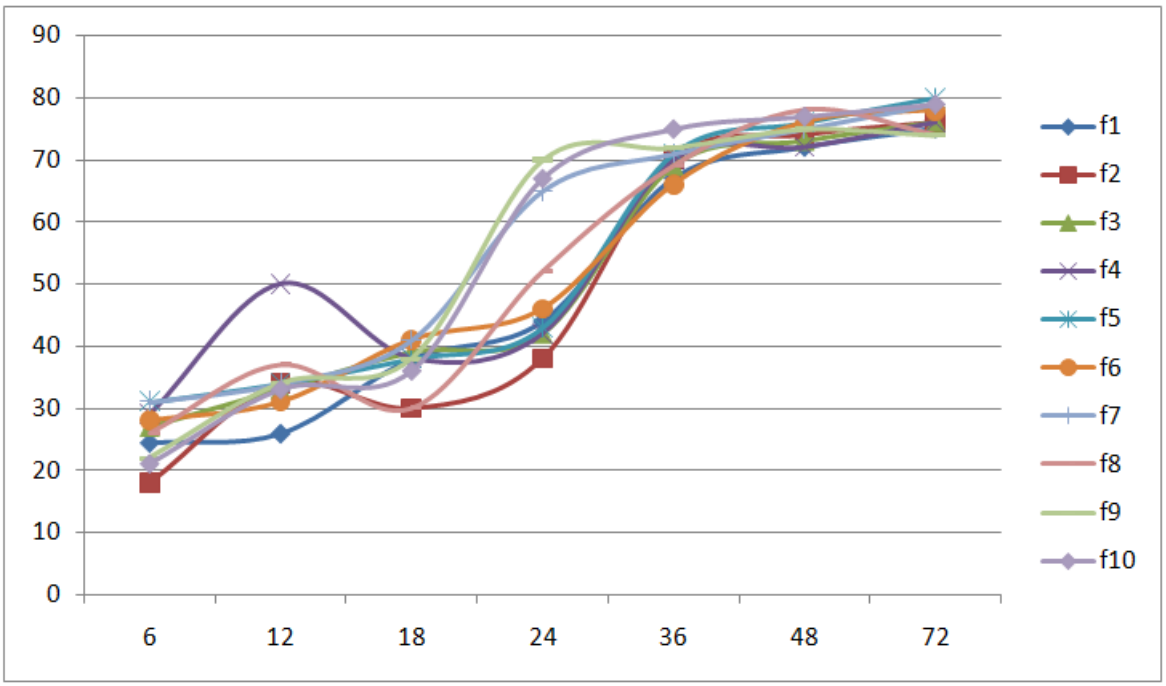

Figure 1.Graphical pattern of Mean degradation for all the formulations.

Table 3: Cost of producing the formulations (N)

	Diets									
Ingredients	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10
Sorghum husk	774	516	516	774	-	-	-	516	516	387
Cowpea husk	824	824	549	412	-	-	-	-	549	412
Wheat offal	-	387	775	518	-	-	-	-	518	387
Bran	-	-	-	-	1,024	1,024	1,024	819	102	409
Cotton Seed Cake	-	2,683	670	-	2,683	670	-	-	2,683	-
Poultry litter	-	180	-	136	180	-	136	180	180	-
Total Cost (N)/Kg	4,281	1,907	4,523	2,510	1,204	3,707	1,830	1,515	1,865	4,278

NB: $1 is equivalent to ₦155.

From Table 3, cost of each ingredient (determined in Nigerian Naira, ₦) differsignificantly from one formulation to the other and these variations depend on the inclusion level of each ingredient used in the formulations. Protein sources of feed are generally higher in price than the energy sources.F5 had lowest production cost of about₦1, 204 ($7.76) per Kg, F3 recorded highest₦4, 523 ($21.18). Most of the formulations had high production cost as a result of high cost and inclusion level of some of the ingredients which a generally expensive. These costs were similar to the cost incurred by Ibrahim et. al., (2011). Nevertheless, it can be said that the nutritive value of feed ingredient used is the major determinant of their price and the final price of the formulation. This was also in line with the report of Mohammed et al., (2006) who in his work used 50-60% cottonseed cake and recorded higher cost of formulation and concluded that, the high price was due to the high market price of cottonseed cake.

V. Conclusion

This study revealed that locally available feed resource can significantly contribute to the nutrient requirement of ruminants. It was depicted from this work that mixing two or more feed resources with different protein and energy content can yield a good feed of higher quality that can meet ruminant requirements for optimal production at a very minimal and affordable cost. However, combination of two or more different feed of protein sources can yield a better result than feeding single to the teaming ruminants in the area of the study.

VI. Recommendations

From the study conducted recommendations can be made as follows:

i. Cereal crop residues should be mixed with leguminous crop residues in feeding ruminants preferably in the ratio of 60:40 cereals to legume.
ii. Mixing of two or more feed ingredients gives higher economic return at minimum cost of production than feeding single ingredient.

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