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Annals of Biological Research, 2015, 6 (4):14-18
(http://scholarsresearchlibrary.com/archive.html)

Annals of Biological Research
Scholars Research Library
ISSN 0976-1233
CODEN (USA): ABRNBW

Nutrient evaluation of total mixed rations used in ruminant feeding using maize bran, cowpea husk, poultry litter and groundnut haulms in a semi-arid environment of Nigeria

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ABSTRACT

This experiment was designed to evaluate the nutrient content of some locally available feed ingredients and to estimate their production cost for their utilization in production of mixed rations for ruminant. The feed ingredients used were Maize bran, Cowpea husk (energy sources), groundnut haulms and poultry litter (protein sources). The formulation was based on the ratio 60:40, energy / protein ratio respectively and ten formulations F1 – F10 were developed. There was significant (P<0.05) variation between the proximate composition of all the rations with no significant (P>0.05) difference in Metabolizable Energy, ME amongst F2, F3, F4, F5 and F7, F8, F9, F10 except F1 that differs (P<0.05) significantly from F2 through to F10. The proximate composition revealed that the mixed rations had a range of 99.8% - 89.6% DM, 15.80% - 4.37% CP, 46.00% - 25.5% CF, 8.00% - 3.00%Fat, 15.00% - 2.00% Ash, and ME 18 – 12.13 GE MJ/Kg.DM). All the formulations recorded above 50% degradability at 48 hours period of incubation. More so, the cost of production for each of the formulation showed that the highest cost of production was ₦ 3920.70 about USD $25.21while the least was ₦3457.80 about $22.30per 100Kg formulation which is moderate and affordable.

Key words: Evaluation, Mixed Rations, Nutrient, Proximate, Ruminants

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INTRODUCTION

Knowledge of the nutritional composition of most commonly available crop residues used in feeding ruminants is a necessary tool in the effective and efficient utilization of these residues in production of mixed rations that will meet the ruminant requirement for production and maintenance in the Semi-arid environment of Nigeria. Food grains are required almost exclusively for human consumption and poor quality roughages form the only part of the diet for ruminants for a considerable part of the year (Preston and Leng, 1987). The poor nutritional status, especially in terms of quality of the feed resources available to ruminants is mostly due to the low plane of nutrition (Doma *et al.*, 1999). In Nigeria, animal feeding depends on the enhanced and efficient utilization of non-conventional resources that cannot be used as food for humans or feed for livestock though there is scarcity and fluctuation in quantity and quality of all year round feed supply is a major constraint to livestock production (Ørskov, 1998; 1999). (Tchinda *et al.*, 1993) reported native pastures and crop residues to be the most widely available low-cost feeds for ruminants in the tropics. Occasionally however, supplementary feeding is provided by way of food processing by-products such

as cassava peels and cereals milling by-products (Okojie, 1999). In the dry season and post harvest periods, these feed resources become the main sources of energy for use by ruminants when poor quality forages prevail (Kibon and Ørskov, 1993). The most widely used method of rumen digestibility study in Nigeria is the in situ incubation of samples in nylon bags into the rumen of animals and this technique has been used for many years to provide estimates of both rate and extent of disappearance of feeds constituents and potential rumen degradability of feedstuffs and feed constituents while incorporating effects of particulate passage from the rumen (Van Soest, 1994). It is therefore necessary to know the quality of different locally available feedstuff mixed to produce rations for ruminants and also quantity that needs to be supplied for optimal production and reproduction through estimate of their nutritive values, ruminal study and also their affordability by local farmers.

MATERIALS AND METHODS

Experimental Site

The experiment was carried out at the University of Maiduguri teaching and research farm. The area is situated at latitude 11o5' north, longitude 30o5' east and at altitude of 354m above sea level. 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).

Samples collection and preparation

The feed ingredients used includes Maize bran, sorghum husk, groundnut haulms were purchased at Maiduguri cattle market while poultry litter was obtained from University of Maiduguri Poultry House.

Mixing of Feed Ingredients to Formulate Rations

Mixing of the ingredients was done manually on a flat floor and approximately 100kg of ingredients were mixed per batch in order to get a homogenous mixture with 60:40 (protein: energy sources) as reported by (Mohammed *et al.*, 2007). It has been found that the order of introduction of the components plays an important role in the mixing process (FAO, 1986).

Chemical Analysis

The samples used for the formulated diets were analyzed for Dry matter, Crude protein, Crude fibre, Ether extract and Ash according to (A.O.A.C., 2000).

Statistical analysis

Data collected were subjected to analysis of variance (Steel and Torrie, 1980). Significant differences between means were tested using LSD.

Cost of producing the formulations

The cost of producing all the ten (10) formulated rations was determined based on the current market prices of the ingredients used in the formulation at the time of production, and when a USD $1 is equivalent to ₦155 Nigerian Naira.

RESULTS AND DISCUSSION

Table 1: Proximate composition of the feed ingredients

Ingredients	Maize bran	Cowpea husk	Poultry litter	Groundnut haulms
Dry matter (%)	90.50	80.70	95.50	91.10
Crude protein (%)	9.50	6.50	14.00	12.00
Crude fibre (%)	6.20	9.40	24.00	31.00
Ash (%)	4.50	9.80	6.00	3.00
Ether extract (%)	9.90	1.40	5.02	2.90
Nitrogen free extract (%)	59.10	50.70	56.50	33.10
ME MJ/Kg DM	13.81	14.89	-	13.81

ME = Metabolizable Energy

Table 1 shows the proximate compositions of ingredients used in the formulations. The Percentage Dry Matter content ranged from 80.70 – 95.50 % DM across the ingredients with highest dry matter content recorded in Poultry

litter (95.50%) followed by groundnut haulms (91.10%DM) and Maize bran (90.5%). The lowest dry matter content was recorded in cowpea husk (80.70%DM). The high dry matter recorded in Groundnut haulms, Maize bran and cowpea husk are in line with the findings of (Mlay *et al.*, 2001) and (Allen, 1982) that used similar ingredients in their formulations and in concord to 80.70% - 98.20% DM reported by (Malgwi and Mohammed, 2015). Crude protein contents ranged from 6.50% - 14.00% across the ingredients with the highest crude protein in poultry litter (14.00%), while the lowest was recorded in cowpea husk (6.5%). In this experiment, the DM and CP recorded for poultry litter are within the range of 85 to 93% DM and 15 to 35% CP reported for broiler litter by many authors (Park *et al.*, 1995) cited in (Jokthan *et al.*, 2013). This variation in crude protein content of the crop residues may have resulted from soil fertility, variety of crops, time of harvest and the uric acid content of the poultry litter. Highest crude fibre content was recorded in Groundnut haulms (31.00% CF) and the lowest was recorded in Maize bran (6.2% CF) while cowpea husk and poultry litter had crude fibre content of 9.40% and 24.00% CF respectively is similar to the 9.40 and 20.00% CF recorded for cowpea husk and poultry litter respectively (Malgwi and Mohammed, 2015). This may be due to the proportion of leaves to the stems or vines in the haulms and the level of maturity of the plants and which in agreement with the findings of (Allen, 1982) who reported a crude fibre content of up to 31.80% CF for groundnut haulms and 33.40% CF for Cowpea husks. The %EE of the ingredients used in the formulation ranged from 1.40% - 9.90%. Nitrogen free extract values were highest in maize bran (59.1% NFE) and least value was recorded in groundnut haulms (33.1%). On the basis of energy content of the various ingredients, it was observed that cowpea husk had the highest Metabolizable energy content (14.89 MJ/Kg.DM).

Table 2: Feed Formulation based on (100Kg)/ Formulation (Kg)

Ingredients	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10	Total
MB	30	40	30	20	40	10	50	20	30	20	290
CH	30	20	30	40	20	50	10	40	30	40	310
PL	30	20	10	20	10	30	10	10	20	30	190
GH	10	20	30	20	30	10	30	30	20	10	210
Total (Kg)	100	100	100	100	100	100	100	100	100	100	1000

MB= Maize Bran, CH=Cowpea Husk, PL= Poultry Litter, GH= Groundnut Haulms

Table 2. Shows the ten experimental rations (F1 – F10) formulated using locally available feed ingredients in a 100kg mixture and the varying proportion of the ingredients. The feed ingredients were Maize bran and Cowpea husk (energy sources) and Poultry litter and Groundnut haulms (protein sources). The formulation was done in the ratio of 60:40 of energy to protein (Mohammed, 2007). Cowpea husk was the major ingredient used in the formulations, having a total of 310kg out of the total 1000Kg of the ten formulations. Its highest percentage of inclusion was recorded in formulation F6 (50%), followed by F4, F8, and F10 (40%), F1, F3, and F9 (30%), F2 and F7 (20%) and F5 (10%). Maize bran was second to Cowpea husk in the formulation, having a total of 290kg of the 1000Kg of the ten formulations. The highest percentage inclusion was recorded in formulation F7 (50%) followed by F2 and F5 (40%), F1, F3, F9 (30%) followed by F4, F8 and F10 (20%), and F6 (10%). Cowpea husk and Maize bran were included in the formulations as energy sources which will increase weight gain in animals. The poultry litter and groundnut haulms were included as major protein sources in all the rations developed for its role when included in ruminant ration in animal well being such as growth, maintenance, hormonal and enzymatic activities (Ademola *et al.*, 2004).

Table 3: Proximate composition of the formulations

Nutrient compositions		Formulations									
	SEM	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10
Dry Matter (%)	0.2376*	99.60^{a}	97.40^{c}	99.70^{a}	94.90^{d}	99.80^{a}	97.70^{c}	89.60^{e}	94.60^{d}	99.64^{a}	98.90^{b}
Crude Protein (%)	0.2293*	13.13^{bc}	12.69^{c}	8.31^{f}	4.37^{g}	13.48^{b}	15.8^{a}	8.45^{f}	10.59^{d}	9.45^{e}	7.96^{f}
Ether Extract (%)	0.2797*	6.00^{c}	5.00^{d}	3.00^{f}	3.00^{f}	5.00^{d}	3.00^{f}	4.00^{e}	7.00^{b}	6.00^{c}	8.00^{a}
Crude Fibre (%)	0.2776*	33.50^{e}	46.00^{a}	28.20^{g}	32.50^{f}	26.50^{h}	44.00^{b}	40.50^{c}	37.00^{d}	25.50^{i}	26.00^{hi}
Ash (%)	0.2475*	3.00^{e}	3.50^{e}	3.00^{e}	9.50^{c}	13.50^{b}	2.00^{f}	15.00^{a}	3.00^{e}	3.00^{e}	8.00^{d}
ME MJ/Kg DM	0.2845*	12.13^{b}	12.30^{ab}	12.47^{ab}	12.55^{ab}	12.88^{ab}	12.97^{a}	13.01^{a}	13.01^{a}	13.01^{a}	13.18^{a}

*GE= Gross Energy, SED = Standard error of difference between two means; abc = ^{abc} Means within same row having different superscripts differ significantly * = (P<0.05); ns = non Significant;*

Table 3 shows the proximate composition of the formulations (F1 – F10). The Dry Datter content, ranged from 89.60 to 99.80 %DM. Highest dry matter content was recorded in F5 (99.80%) while F7 recorded least (89.60%), There is significant difference (P<0.05) in the dry matter content of all the formulations. Thus, the dry matter values

obtained in this study was in agreement with what was reported by (Addass *et al.*, 2011) who recorded 98.29% - 99.30% DM with similar ingredients. The crude protein, crude fiber and ether extract range in this study are 4.37% - 15.80% CP, 25.50% - 46.00%CF and 3.00% - 8.00% EE. However, these findings is in contrast with the work of (Addass *et al.*, 2011) who reported CP, CF and EE range of 10.00% - 11.20% CP, 25.00% - 38.00% CF and 1.90% – 2.60% EE respectively. The CF content of all the formulations is within the range of 40% CF stated for crop residues characterized by high content of fibre reported by (Adegbola, 1998). Since the nutritive value of crop residues varies according to species, varieties, environmental conditions, stage of maturity and methods of harvest, storage, age at harvest (Alhassan et al., 1987), which could attest to the variation and pattern of the nutrient content distribution of the formulations as shown by the proximate analysis of all the mixed rations, it is necessary and of more advantage to combine two or more crop residues in order to step up the nutrient content of a diet while formulating dry season mixed rations for ruminant. The Metabolizable energy content of formulation ranged from 12.13 MJ/Kg DM in F1 to 13.18 MJ/Kg DM in F10. This was not in line with the findings of (Addass *et al.*, 2011) and slightly higher than 3.61–3.94 MJ/kg DM recorded by (Malgwi and Mohammed, 2015) and could be due to the difference in the level of inclusion and qualities of the ingredients used in this experiment. The nature of variation in proximate composition in these crop residues may generally be caused by factors that could be genetic or environmental (Ikram *et al.*, 2010).

Table 4: Cost of production of 100kg of each Formulation (₦)

Formulation	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10	Total
Maize bran	1161.30	1548.40	1161.30	774.20	1935.50	387.10	1548.40	774.40	1161.30	774.20	11225.90
Cowpea husk	1285.80	857.20	7285.50	1714.40	428.60	2143.00	857.20	1714.40	1285.00	1714.40	13286.60
Poultry litter	600.00	400.00	200.00	400.00	200.00	600.00	200.00	200.00	400.00	600.00	3800.00
Groundnut haulms	410.70	821.40	1232.10	821.40	1232.10	410.70	1232.10	1232.10	821.40	410.70	8625.00
Total	3457.80	3627.00	3879.20	3710.00	3796.20	3540.80	3837.70	3920.70	3668.50	3499.30	36937.50

1USD $ is equivalent to N155

Table 4 shows the cost of production of the ten formulations in Naira (₦) per 100kg of each formulation. The cost of production was determined based on the prevailing prices of the different locally available feed ingredients at time of formulation and the prevailing dollar-naira equivalent. F8 ₦3, 920 (equivalent to $25.29) had highest productions cost while F1 ₦3, 457 (equivalent to $22.30) recorded least production cost. These variations in total cost of each formulation were as a result of the different amount of feed ingredients used and their different prices. The cost of production of the mixed rations in this experiment are slightly higher than the cost was incurred by Ibrahim et al., (2011) whose production cost for multi-nutrient block using crop residues ranged from ₦2,522 – ₦2,835 (equivalent to $16.27 - $18.29). This cost differences were as a result of differences in the quantity of feed ingredients used, their levels of inclusion and individual prices as determined based on the prevailing market price at the time of this experiment. Thus, it is revealed that ruminant animals can be conveniently fed with appropriate mixing of crop residues to meet their nutrient requirements from the locally available feed resources with minimum and affordable cost of feeding.

CONCLUSION

The results of this study revealed that commonly used crop residues by local farmers to feed ruminants in the study environment, when mixed in appropriate proportions can be used to meet both production and reproduction requirement of ruminant animals at an affordable cost. Thus, mixing two or more crop residues, can improve poor quality forage diet which normally has low energy, low nitrogen, low intake and poor digestibility especially during the dry season.

Recommendations

Based on the findings of this study, it is recommended that small and large scale farmers and those in the fattening business, should blending two or more residues in appropriate ratios which could increase its utilization by the animals during feeding especially in the semi arid environments for optimum productivity.

Acknowledgement

We gratefully acknowledged the Laboratory Technician, Mal. Shehu Jauro, Department of Animals Science, University of Maiduguri for his time and assistance in the conduct of all laboratory experiments in this work and the Teaching and Research Farm, University of Maiduguri for logistic support to perform this research work.

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