Journal of Agricultural Technology 2012 Vol. 8(4): 1277-1284
Available online http://www.ijat-aatsea.com
ISSN 1686-9141

Intake and digestibility of dietary maize processing waste by West African dwarf (wad) sheep

Okah, U.[1*], Okeke, C.N.[1] and Anya, M.I.[2]

[1]College of Animal Science and Animal Production, Michael Okpara University of Agriculture, Umudike P.M.B.7267, Umuahia, Abia State, Nigeria, [2]Department of Animal Science, Faculty of Agriculture, University of Calabar, Calabar, Cross River State, Nigeria

Okah, U., Okeke, C.N. and Anya, M.I. (2012) Intake and digestibility of dietary maize processing waste by West African dwarf (wad) sheep. Journal of Agricultural Technology 8(4): 1277-1284.

A study was conducted to evaluate the nutrient intake and digestibility by WAD sheep fed dietary maize processing waste (MPW). Four diets were formulated to contain maize processing waste at 0, 10, 20 and 39%, designated A, B, and D respectively. Nutrient intake, digestibility and nitrogen balance were measured. Dry matter intake (DMI), CP intake were significantly (P<0.05) higher at the 20%, but the 10% and 30% did not differ (P>0.05) from the control (0%). Nitrogen absorption and nitrogen balance followed the same pattern as the DMI and CP intake. Coefficient of digestibility was better at the 20% MPW, but DMD and CFD were similar (P>0.05) for the control (0%), 10% and 30% levels of MPW. Nitrogen free extract and TDN were better at the 30%MPW. The results of the study therefore indicated that 30% MPW could be included in the diet of sheep for improved nutrients utilization. It is however, recommended that further studies be conducted with higher levels of MPW to establish the optimal inclusion level for sheep.

Key words: Maize, processing, waste, diet, digestibility, nutrient

Introduction

Sheep are ruminant animals that have a modified gut that allow them to digest cellulose. West African Dwarf sheep is one of the breeds of sheep that are mainly found in the forest zones of West Africa. They are tolerant to stress under conditions of high relative humidity, are prolific and disease resistant especially to trypanosomiasis (NRC, 1991). Sheep are known to be good grazers and they have the ability to utilize the poorer quality feedstuffs which has led to its importance in the World Agriculture (Gaten, 1991).Sheep feeding in sub-Saharan Africa is often based on natural pastures, hay or crop residues which have poor digestibility, and low content of soluble carbohydrates and

* Corresponding author: Okah, U; e-mail: okahuc@yahoo.co.uk

protein (Njidda and Kibon, 2004). Sheep are important domestic animals in tropical livestock production system, accounting for approximately 34% of the total production of World's grazing ruminants. Sheep are multipurpose animals, but they are primarily kept for the production of meat (mutton), and this accounts for about 11% of the total meat supply in Nigeria. The inclusion of animals slaughtered in the rural areas outside the slaughter houses would have made this figure higher (Njidda and Kibon, 2004). Mutton is widely consumed in all parts of the country as there is no taboo on its consumption. The most immediate stimulus to fatten sheep is the pressure to sacrifice a ram during the major festivals like the Islamic Id-El-Kabir. During this period the prices of rams rise to double or even triple its normal. Nutrition is one of the major problems of intensive production of small ruminants in Nigeria because of seasonal variation in the availability and nutritional value of native pasture and natural grassland (Obua, 2005). Poor nutrition especially during long dry season is one of the major factors militating against livestock production in Nigeria. The dry season results in a rapid decline in the quality and quantity of forages leading to lower forage intake and digestibility with resultant poor animal performance. Dry matter intake is an important factor in the utilization of feed for ruminant livestock (Devendra and Burn, 1983). One of the factors affecting apparent digestibility is the chemical composition of the diets (Mc Donald *et al.,*1987*)*.The higher the percentage of crude fibre in the forage, the lower the digestibility of other nutrients (Schneider and Flatt, 1975). Among the myriad of problems associated with livestock feeding, the most challenging is that of inadequate supply or scarcity of feedstuffs.

Alternative feeding stuffs that can provide the nutrient requirement of ruminant animals are required in their feeding because of inadequate supply of conventional feedstuffs occasioned by competitive demand for the available ones. Such alternative feedstuffs should be far removed from human and industrial interest (Okah, 2004). Maize as a conventional feedstuff has suffered much competition existing between human and animals for its use over the years. In order to reduce this competition, several workers have carried out studies on the use of maize processing waste (residue from pap production) in feeding poultry. However, there is still paucity of research information on its use for ruminant animals, although the rural dwellers use it to feed their sheep and goats during the season of forage scarcity. The objective of this study was therefore to evaluate the nutrient intake and digestibility of dietary maize processing waste in sheep.

Materials and methods

Location of the experiment

The study was carried out at the sheep and goat unit of the teaching and research farm of the Michael Okpara University of Agriculture, Umudike, geographically located on latitude 05^{o} 28′ North and longitude 07^{o} 31′ East and lies at an altitude of 122 meters above sea level. It is situated within the tropical rainforest zone and witnesses an annual rainfall of about 2177mm in 148-155 rain days. Ambient temperature ranged between 22 and 29^{0}C, and relative humidity ranged between 76 and 87% (NRCRI, 2004).

Experimental diets

Four diets were formulated to contain maize processing waste at 0, 10, 20 and 30% designated diets A, B, C and D respectively (Table 1).

Experimental animals, design and management

Four mature rams selected from the university teaching and research farm were used in this study. The animals were first dewormed and also bathed with acaricide against external parasites, using Ferbendazole and Pfizona respectively. They were then housed separately in previously disinfected metabolism cages. Each of the animals was assigned to one of the experimental diets in a 4 x 4 Latin square design experiment.

During the first phase of 28 days, each animal received 1kg of one the experimental diets. Potable water was offered *ad libitum* to each animal daily. Daily voluntary feed intake was determined by weighing the quantity offered and the refusal. Total faeces and urine voided by the experimental animals were collected during the last 7days of the 28days period. In phases 2 to 4, each animal was offered each of the remaining 3 experimental diets in rotational periods of 28days each. The last 7days was used for total faecal and urine collection. The faecal and urine collection were done at about 8.00am on each collection day before feeding and giving water to the animals. The urine was collected using graduated transparent plastic container placed under each cage, and to which 5ml of 25% H_2SO_4 had been added daily to reduce volatilization of ammonia from the urine.

Analytical Procedure

All the feeds and dry samples of the faeces were analysed for proximate composition according (AOAC, 2000).

Statistical Analysis

The data collected and generated from this study were subjected to analysis of variance (ANOVA) as applicable to Latin square design experiment (Steel and Torrie, 1980). Differences between treatment means were separated using Duncan's multiple range tests (SAS, 1999).

Results and discussion

The composition of the experimental diets is presented in Table 1, while Table 2 represents the analysed chemical composition of the diet. The intake, nitrogen balance and nutrient utilization are presented in Table 3, and the apparent digestibility coefficients are shown in Table 4. The dry matter content of the diets (Table 2) was similar (P>0.05) for diets A, B and D, but was significantly (P<0.05) lower in diet C than in diets A, B and D. The crude protein content of diets varied significantly (P<0.05). Diet B contained significantly (P<0.05) higher crude protein than diets A, C and D. However, the crude protein content of all the diets which ranged from 7.43 -8.65% were within the minimum of 7% recommended for small ruminants. The crude fibre content followed the same pattern as the crude protein, except that diet B now had significantly (P<0.05) lower crude fibre. Ether extract was significantly (P<0.05) higher in diets A and D than diets B and C. The ash content of diet B was significantly (P<0.05) higher than the values obtained in diets A, C and D.

Nitrogen free extract was significantly (P<0.05) higher in diet C than in diets A, B and D. The values for dry matter and NFE were inversely related. Body weight (kg) was not affected by the diets (Table 3). Dry matter intake was significant (P<0.05) higher for animals fed diet C than for those fed diets A, B and D. The diet C which had lower DM content, recorded higher DMI. This probably suggests that lower DM in feed promotes dry matter intake by animals. Diet C recorded significantly (P<0.05) higher DMI as percentage of body weight following the higher DMI by animals fed it. However, the animals fed the various diets showed positive DM status as they consumed between 3.50 and 4.38% of their body weight, a little higher than the 3% requirement for small ruminants reared in the tropics (Devendra and McLeroy, 1982). The crude protein intake (g /d) was also significantly (P<0.05) higher for the diet C group than for the groups on diets A, B and D. This agrees with the reports elsewhere (Rajpool *et al.,* 1981; Ahamefule, 2005) that nitrogen intake is positively correlated to DMI. It follows therefore, that higher DMI also promoted higher CP intake. Total nitrogen, faecal nitrogen and urinary nitrogen (g/d) were not influenced significantly (P>0.05) by the diets. The non-significant (P>0.05) differences in faecal nitrogen agrees with the earlier reports by Black *et al.* (1978), Ahamefule (2005) and Okah (2006) who observed that faecal nitrogen was not significantly affected by nitrogen intake.

This might suggest that one single factor like nitrogen intake, protein quality or nutrient relationship could not adequately serve as an index for faecal nitrogen, but the interaction of these factors as earlier reported by Okah (2006). The group on diet C absorbed significantly (P<0.05) more nitrogen (g/d) than the groups on diets A, Band D. Nitrogen balance (g/d) also followed the same pattern as the absorbed nitrogen. The higher absorbed nitrogen and nitrogen balance by the group fed diet C seem to suggest that nitrogen intake affects nitrogen utilization positively. Apparent nitrogen digestibility was similar (P>0.05) for all the diets. However, the positive nitrogen balance for all the treatments indicated that the maintenance requirements of the experimental animals were adequately met by the diets they consumed (Ahamefule, 2005; Okah, 2006).The dry matter digestibility was similar (P>0.05) for animals fed diets A, B and D, but significantly (P<0.05) lower for the animals on diet C.

This report agrees with the reports elsewhere (Mc Donald *et al*., 1995 and Okah, 2006) that DMD is negatively correlated with DMI. The crude protein digestibility (CPD) was similar (P>0.05) for diets A, B and C, but significantly (P<0.05) lower for diet D. The crude fibre digestibility was significantly (P<0.05) lower for diet C than for diets A, B and D. This agrees with the reports by Ash (1990), Fasae *et al.* (2005) and Okah (2006) that crude fibre digestibility decreases with decrease in dietary protein. The crude fibre digestibility followed the same pattern as the dietary ether extract. This seems to suggest that the dietary crude fat (ether extract) is positively correlated with ether extract digestibility. The NFE digestibility was significantly (P<0.05) affected by the NFE content of the diet. Higher NFE in diets resulted in lower NFE digestibility. Maize processing waste (MPW) in diets seem to have significantly (P<0.05) promoted total digestible nutrients (TDN). Diets which had higher CPD had lower total digestible nutrient. However, higher DMD seems to promote higher TDN. It appears therefore that the inclusion of maize processing waste (maize sievate) in maize- based diets enhanced nutrient utilization especially the fermentable carbohydrates in sheep.

Table 1. Composition of experimental diets

Ingredients	0%	10%	20%	30%
Maize	53.50	43.00	33.50	23.50
MPW	-	10.00	20.00	30.00
CPM	20.00	20.00	20.00	20.00
PKC	25.00	25.00	25.00	25.00
Bone meal	1.00	1.00	1.00	1.00
Common salt	0.50	0.50	0.50	0.50
Total	100.00	100.00	100.00	100.00

MPW = Maize Processing Waste
CPM = Cassava Peel Meal

Table 2. Analysed chemical composition of experimental diets

Nutrients (%)	A	B	C	D	SEM
Dry matter	90.25^{a}	90.45^{a}	89.85^{b}	90.73^{a}	0.19
Crude protein	$7.43b^{c}$	8.65^{a}	7.44^{bc}	8.25^{ac}	0.31
Crude fibre	9.32^{a}	9.27^{b}	9.31^{a}	9.33^{a}	0.01
Ether extract	2.38^{ab}	1.88^{b}	1.84^{b}	2.73a	0.21
Ash	17.41^{ab}	19.39^{a}	16.08^{b}	16.64^{b}	0.50
NFE	53.75^{b}	53.27^{b}	55.18^{a}	53.77^{b}	0.41

[a,b] Mean within the same row with different superscript differ significantly ($P<0.05$)

Table 3. Dry matter intake, Nitrogen balance and utilization by WAD sheep fed dietary maize pap processing waste

Parameters	A	B	C	D	SEM
Body weight (kg)	9.31	9.25	9.14	8.37	0.54
Body weight (kg)$W^{0.75}$	5.32	5.30	5.25	4.92	0.62
DMI (g/day)	327.43^{b}	349.98^{b}	395.18^{a}	334.17^{b}	12.76
DMI (g/day)$W^{0.75}$	79.89^{b}	80.88^{b}	88.61^{a}	77.40^{b}	2.61
DMI as % BW	3.50^{b}	3.79^{b}	4.38^{a}	4.01^{b}	0.91
CP intake (g/day)	26.04^{b}	27.77^{b}	31.46^{a}	26.54^{b}	1.23
Total N-intake (g/day)	4.08	4.77	4.67	4.34	0.52
Faecal N (g/day)	0.42	0.50	0.52	0.53	0.73
Urinary N (g/day)	0.57	0.59	0.49	0.49	0.54
Absorbed N (g/day)	3.73^{b}	3.93^{b}	4.51^{a}	3.61^{b}	0.51
Absorbed N (g/day)$W^{0.75}$	2.68^{b}	2.79^{b}	3.09^{a}	2.62^{b}	0.81
Nitrogen balance (g/day)	3.17^{b}	3.34^{b}	4.02^{a}	3.13^{b}	0.61
Nitrogen balance (g/day)$W^{0.75}$	2.36^{b}	2.46^{b}	2.83^{a}	2.35^{b}	0.09
Nitrogen intake (g/day)$W^{0.75}$	1.00	1.26	1.59	2.54	0.97
Apparent N-Digestibility (%)	58.13	57.45	57.89	55.22	1.68

a, b Means within the same row with different superscripts differ significantly ($P<0.05$)

Table 4. Apparent digestibility coefficient (%) of WAD sheep fed graded levels of dietary maize pap processing waste

Nutrients	A	B	C	D	SEM
Dry matter	52.85[a]	52.40[ab]	51.65[b]	52.73[a]	0.27
Crude protein	57.83[a]	57.83[a]	57.16[a]	54.96[b]	0.68
Crude fibre	61.23[a]	62.40[a]	58.72 [b]	61.95[a]	0.82
Ether extract	56.41[b]	55.38 [b]	57.24 [ab]	58.54[a]	0.67
Nitrogen free extract	61.40[b]	60.64 [b]	60.88 [b]	62.83[a]	0.37
TDN	46.03[b]	45.44 [b]	45.68 [b]	47.70[a]	0.51

a, b Means within the same row with different superscripts differ significantly ($P<0.05$)

Conclusion

It was observed in this study that the DMD and CFD of the 30% maize processing waste (maize sievate) diets were similar to those of the maize-based diet (control). The ether extract, nitrogen free extract digestibility and the total digestible nutrients for the animals fed 30% maize processing waste diet improved compared with the maize-based diet. These therefore suggest that maize processing waste (MPW) can be included in the diet sheep up to 30% with improved nutrient utilization. However, there is need to conduct further studies on this material to establish the optimal inclusion level for small ruminants (sheep).

References

Ahamefule, F.O. (2005). Evaluatio of pigeon pea-cassava peel-based diets for goat production in South Eastern Nigeria Ph. D Thesis. Michael Okpara University of Agriculture, Umudke.

AOAC (2000). Association of Official Analytical Chemists. Official Methods of Analysis, 17th ed. Published by Association of Official Analytical Chemists, Washington, DC.

Ash, A.J. (1990). The effect of supplementation with leaves from the leguminous trees *Sesbania gradifolia, Albezia chinensis* and *Gliricidia septum* on intake and digestibility of Guinea grass hay by goats. Anim Fd. Sci. Tech. 28:225-232.

Black, J.L. Pearce, G.R. and Tribe, D.E. (1978). Protein requirement of growing lambs. J. Nutr. 30: 45-60.

Devendra, C. and Burns, M. (1983). Feed and nutrition, In: Goat production in the tropics. CAB (Commonwealth Agricultural Bureaux). Farnharn Royal, Slough, UK, pp.90-115.

Devendra, C. and McLeroy, G.B. (1982). Goat and sheep production in the tropics. International Tropical Agricultural Series. Longman Publishers. Limited London, New York, pp. 209-210.

Fasae, O.A., Alokan, J.A. and Onibi, G.E. (2005). Feed intake and digestibility in Yankasa sheep fed diets containing varying levels of *Leucaena leucocephala* leaf residue. Nig. J. Anim. Prod. 32(1): 88-93.

Gaten, R.M. (1991). Tropical Agriculture- Sheep. Mac millan Education Ltd., London and Basingstoke.
Mc Donald, P., Edwards, R.A. e Greenhalgh, J.F.D. (1987). Animal Nutrition 4th ed. Longman Scientific and Technical Co. England, pp.154-176.
Mc Donald, P., Edwards, R.A. and Greenhalgh, J.F.D. (1995). Animal Nutrition 5th ed. Longman group Ltd.London.
Njidda, A.A. and Kibbon, A. (2004). Effects of graded levels of cane molasses on the performance of growing Balami sheep in the sub-sahelian zone of Borno State, Nigeria. Proc. 9th Ann. Conf. Anim. Sci. Ass. of Nig. (ASAN). September 13th-16th, 2004. Ebonyi State University, Abakaliki, Nigeria. Ppp. 111-114.
NRC (1991). National Research Council. Micro livestock litter known small ruminants with promising Economic Future, National Academy Press, Washington, DC.
NRCRI (2004). Agro-Meteorology Unit. National Root Crop Research Institute, Umudike, Nigeria.
Obua, B.E. (2005). Forage Conservation in Nigeria. Concave Publishers, Owerri, Nigeria.
Okah, U. (2004). Effect of dietary replacement of maize with maize processing waste on the performance of starter broiler chicks. Proc. 9th Ann. Conf. Anim.Sci. Ass. of Nig. (ASAN). September 13th-16th, 2004. Ebonyi State University, Abakaliki,Nigeria. pp. 2-5.
Okah, U. (2006). Performance of sheep fed varying levels of pigeon pea *(Cajanus cajan*) seeds in concentrate diet. Ph. D. Dissertation. Michael Okpara University of Agriculture, Umudike, Nigeria.
Rajpool, R.L., Sengar, O.P.S. and Singh, S.N. (1981). Energy and protein in goat nutrition. In: Proc. Int. Symp. on Nutrition and systems of goat feeding. Vol.I, edited by P. Mecraid-Fehr; A. Bourhouse and M. De Simane 12-15 May, 1981. Tours, France. ITOVIC-INRA, pp. 191-124.
SAS (1999). Statistical Analysis System User's guide: Statistics, SAS Institute Inc. Cary, NC 27513 USA.
Schneider, B.H. and Flstt, W.P. (1975). The evaluation of feed through digestibility experiment. Univ. of Georgian Press, Athens. USA.
Steel, R.G.D. and Torrie, J.H. (1980). Principle and Procedures of Statistics 2nd .ed. Mc Graw-Hill Inc. Tokyo, Japan, 633 pp.

(Published in July 2012)