Journal of Animal and Feed Sciences, 6, 1997, 71 – 79

Effect of sex on feed intake, growth and nutrients digestibility in Blackhead sheep fed complete mash rations of crop residues

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(Received 23 November 1996; accepted 6 February 1997)

ABSTRACT

Three complete mash rations formulated with crop residues: groundnut shell (GNS), sunflower heads (SFH) and citrus pulp waste (CPW) were tested using 18, 10-month-old Blackhead sheep (9 ram lambs and 9 ewe lambs) of initial body weight 16.9 ± 0.59 kg in a 2 x 3 factorial randomized complete design. The three rations contained about 13% CP and the parameters tested were feed intake, growth and nutrients digestibility. Sex had no effect ($P > 0.05$) on feed intake of the sheep in any of the rations offered. Final average body weight among sheep in the three rations were not significantly ($P > 0.05$) different from each other, however, within treatments sex had an effect ($P < 0.05$) on final average body weight. Ram lambs had higher ($P < 0.05$) final average body weight than ewes. This was also the case in average daily live weight gains. Among the three rations, rams and ewes on the CPW ration had better ($P < 0.05$) growth rates than those on GNS and SFH. Feed efficiency (kg DMI/kg live weight gain) followed the pattern of growth rate. Nutrients were better ($P < 0.05$) digested by ram lambs than by ewe lambs of the three rations offered. Nutrients digestion was, however, better ($P < 0.05$) in ram and ewe lambs fed the CPW ration.

KEY WORDS: feed intake, growth, digestibility, crop residues, sheep, sex

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INTRODUCTION

The integration of small ruminant production with crop residues remains underappreciated and unexplored among small holder farmers in Zambia (Aregheore, 1994a). Crop residues are a key element in tropical ruminant nutrition (deHaan, 1991), and can meet the nutritional requirements of animals if properly processed. The major draw back in the use of crop residues lies in their low feeding value due to their high fibre and low protein content (Sharma and Rajora, 1971; deHaan, 1991; Aregheore and Chimwano, 1992; Aregheore, 1994b).

However, their importance in ruminant nutrition has been stressed in temperate and tropical countries (Rakes, 1969; Cappock et. al.,1974; Reddy and Reddy, 1981, 1983; Krishnamohan and Charyule, 1983; deHaan, 1991; Ikhatua et. al. 1991; Aregheore, 1994a,b, 1996). The use of crop residues in complete rations has been reported (Rakes 1969; Reddy and Reddy, 1981; Kawalker and Patel, 1978; Aregheore, 1992). Using crop residues in compounding complete rations facilitates total feed intake of all portions of the ration offered, rapid growth of animals so they reach market weight earlier than conventional grazing animals, without supplementary feeding. Rakes (1969) reported that the incorporation of crop residues in balanced complete rations provides uniform consumption to meet daily nutrient requirements of ruminant livestock. This minimizes labour, reduces wastage and optimizes the utilization of waste materials (Reddy and Reddy, 1983; Aregheore, 1992; Aregheore et. al., 1996).

The aim of this experiment was to investigate the effect of the sex of Blackhead sheep in the utilization of complete rations based on crop residues in Zambia.

MATERIAL AND METHODS

Groundnut shells (GNS), sunflower head (SFH) and citrus pulp waste (CPM) were obtained from different areas within Lusaka, Zambia. They were sun-dried to a constant weight and then ground through a 6 mm sieve hammer mill (Turner and Metals, Lusaka). They were later moistened to contain 60% DM, maintained at 21^{0}C for at least 10 days and aerated for 24 h before being used in the preparation of rations. Other ingredients used were maize grain, maize bran, urea (46% N), common salt and mineral + vitamin premix. The feedstuffs were compounded into three rations (mash) to represent each of the crop residues (Tables 1 and 2). The rations were isonitrogenous.

TABLE 1

Chemical composition of the three crop residues

Nutrients, %	Crop residues		
	groundnut shells	sunflower heads	citrus pulp waste
Dry matter	89.88	90.39	89.00
Crude protein	7.96	8.98	7.60
Ash	10.09	9.63	8.46
Ether extract	1.92	2.54	1.45
NDF	63.72	72.00	59.70
ADF	42.63	46.10	38.68
ADL	14.60	18.31	12.78
Hemicellulose	24.09	25.90	21.02
Cellulose	38.09	37.42	34.36
GE MJ kg^{-1} DM	17.78	18.20	16.10

TABLE 2

Ingredients and composition of the complete rations, air dry basis, %

Ingredients	Rations		
	groundnut shells	sunflower heads	citrus pulp waste
Maize	15.50	15.50	15.50
Maize bran	36.10	36.10	36.10
Groundnut shells	45.00	0.00	0.00
Sunflower heads	0.00	45.00	0.00
Citrus pulp waste	0.00	0.00	45.00
Urea (46% N)	2.40	2.40	2.40
Mineral-vitamin mixture	0.50	0.50	0.50
Salt	0.50	0.50	0.50

* mineral-vitamin mix provided the following 500000 IU vit. A, 125000 IU vit. D_3, 1330 mg Co, 250 g Ca, 2257 mg Cu, 41730 mg Fe, 4418 mg Mn, 38220 mg Zn and 113400 mg Mg

Eighteen Blackhead sheep (9 rams and 9 ewes) were used. The sheep were about ten months old with an average initial body weight of 16.9 ± 0.59 kg, and were divided into three groups according to sex so that there were 3 rams and 3 ewes in each treatment. The experiment was a 2 x 3 factorial randomized complete design. The sheep were housed and fed in groups of three, and for each ration there were two group pens. Thus there was a total of six group-pens. The sheep were fed twice daily at 8.00 and 18.00 h, and were allowed free access to fresh clean water. The rations offered were either increased or decreased depending on intake. Average weight at the beginning and at the end of the trial was used to express growth rate and voluntary dry matter intake.

At the end of the growth phase, the sheep were housed individually for digestibility studies. Faeces voided by each sheep during the day were collected and sampled for 7 days using the total faecal collection method. At the end faeces were dried in a forced draught oven at 70°C for 24 h. The faeces for each sheep were bulked and 25% of the total sample was taken, milled and kept in air tight bottles until chemical analysis. The rations fed were also sampled for approximate chemical analysis.

Analytical methods

Approximate chemical analyses of crop residues, rations (Table 3) and faeces were according to the outlined procedures of AOAC (1980). Gross energy values were determined by the ballistic bomb calorimeter using benzoic acid as the standard. Fibre fractions, NDF, ADF and ADL, hemicellulose and cellulose were analyzed using the procedures of Goering and Van Soest (1970).

Analysis of variance for factorial randomized complete design Steel and Torrie (1980) was used to analyze data. Significant differences between means were compared using Bonferroni t-statistics (Gill, 1978). All data between the sexes within treatments were subjected to the Student t-test.

TABLE 3

Proximate composition of the rations, DM basis

Nutrients, %	Rations		
	groundnut shells	sunflower heads	citrus pulp waste
Dry matter	90.89	91.30	90.54
Crude protein	13.10	13.30	12.90
Total ash	3.70	4.10	3.60
Ether extract	5.40	5.70	6.10
NDF	46.49	49.40	42.68
ADF	29.27	31.30	26.89
ADL	6.85	7.24	5.96
Hemicellulose	17.22	18.10	15.79
Cellulose	26.12	28.16	24.53
GE MJ/kg	16.25	16.98	16.16

RESULTS AND DISCUSSION

Data on body weight, dry matter intake and feed efficiency are presented in Table 4. There was no significant difference ($P > 0.05$) among sheep in final average body weight, but within treatments there were significant differences

TABLE 4

Weight gain, dry matter intake and feed efficiency of Blackhead sheep fed the three complete mash ration (40 days)

Parameters	Rations		
	groundnut shells	sunflower heads	citrus pulp waste
Initial average LW, kg			
ram lambs	16.9±0.82	16.9±0.80	16.9±0.14
ewe lambs	15.8±0.32	15.6±0.70	15.8±0.15
mean	16.4±0.57	16.3±0.75	16.4±0.14
Final average LW, kg			
ram lambs	23.8±1.03[a]	24.3±0.98[a]	25.6±0.62[a]
ewe lambs	20.9±0.92[b]	21.0±1.00[b]	22.2±0.50[b]
mean	22.3±0.98	22.7±0.99	23.9±0.56
Live weight gain, kg			
ram lambs	6.9±0.21[1]	7.4±0.18[a12]	8.7±0.48[a1]
ewe lambs	5.0±0.60	5.4±0.30[b]	6.3±0.35[b]
mean	6.0±0.41	6.4±0.24	7.5±0.42
Average daily gain, g/d			
ram lambs	0.174[a]	0.186[a]	0.218[a]
ewe lambs	0.127[b]	0.136[b]	0.158[b]
mean	0.151[1]	0.161[12]	0.188[2]
Average DMI			
ram lambs	1.0±0.06	1.0±0.04	1.0±0.07
ewe lambs	1.0±0.08	1.0±0.06	1.0±0.06
mean	1.0±0.07	1.0±0.05	1.0±0.07
Feed efficiency, kg DMI/kg LW gain			
ram lambs	5.97[a]	5.59[a]	4.72[a]
ewe lambs	8.03[b1]	7.57[b12]	6.52[b2]
mean	7.00	6.58	5.62

a, b, c – means within each treatment for each variable of different superscript differ at $P<0.05$
1, 2, 3 - means within row with different superscript differ at $P<0.05$

($P<0.05$) between rams and ewes. The ewes had lower ($P<0.05$) growth rates than the rams. Also, the growth rate of rams and ewes was better ($P<0.05$) in the CPW than in SFH and GNC, however, within the CPW ration rams also had better growth rates than ewes ($P<0.05$). Shelton and Carpenter (1972) reported that male animals usually have higher gains than females. With sheep, Abouheif et al. (1992) reported higher growth rate for Najdi ram lambs than ewe lambs of the same age. Also, Aregheore (1994b) reported higher growth rate for rams than

ewes of the West African Dwarf goats in Southern Nigeria where course forage was fed in the dry season.

Feed intake did not differ between rams and ewes, or treatments ($P > 0.05$). Results of growth rate and dry matter intake indicated that even when DMI is at the same level between ewes and rams, rams still gained better. This, therefore, confirmed earlier reports that male animals grow better than females of the same age even when they are fed the same ration and/or are subjected to the same environmental conditions (Aregheore, 1994b).

Voluntary DMI were within the same level, even though the fibre fractions of the rations differed. The processing (grinding) of the residues before their incorporation with other ingredients to give the final complete feed mash helped the sheep consume every portion of the rations offered. Due to the even distributions of nutrients in the rations, the sheep could not give preference to a particular portion. Sheep generally are selective in nature, preferring non-fibrous feedstuffs (Leng, 1981; Aregheore, 1996), however, the total mixture made it impossible for them to differentiate the fibrous and non-fibrous portions of the rations offered. The preparation improved the utilization of agricultural wastes and also improved DMI of the rations. The results obtained in improved feed intake are in agreement with Leng et al. (1955), Kawalker and Patle (1978), Reddy and Reddy, (1983), Aregheore et al.(1995). These results are a step forward in matching ruminant livestock production with locally available feed resources in Zambia, a land-locked country. Feed efficiency (kg DMI/kg live weight gain) was influenced by growth rate, thus the rams had better ($P < 0.05$) feed efficiency than the ewes. Among the rations, the sheep on the CPW ration had better ($P < 0.05$) feed efficiency than the others, however, there was no difference between GNS and SFH fed sheep. Aregheore (1994b) with goats observed a similar trend in feed efficiency, where the bucks were better than the female goats.

Nutrients digestibility (Table 5) was on average better in the rams than in the ewes in all the rations offered. With the exception of ADF, which was low in GNS, the digestibility of nutrients was high in both rams and ewes. Among the three rations, nutrients digestibility was higher ($P < 0.05$) in the CPW group (rams and ewes), over the other two rations. However, SFH had almost the same level of the digestibility. The similarities between GNS and SFH rations could be due to the fact that they had almost the same level of fibre. The complete feed mash system used helped to improve the digestibility of the rations. The use of urea-N in the rations may also have contributed to the improvement in nutrients digestibility by the sheep (Loosli and McDonald, 1968).

The results of this trial demonstrated that sex has no influence on DMI, however, sex did influence nutrients digestibility and, subsequently, on the growth rate of sheep.

TABLE 5

Effect of sex on apparent nutrients digestibility of complete mash rations by sheep

Parameters	Rations		
	groundnut shells	sunflower heads	citrus pulp waste
Dry matter			
ram lambs	79.4 ± 0.38^{a}	82.5 ± 0.69^{a}	82.1 ± 0.49^{a}
ewe lambs	68.4 ± 0.42^{b1}	77.0 ± 0.38^{b12}	78.5 ± 0.58^{b2}
mean	73.9 ± 0.40^{1}	79.7 ± 0.54^{2}	80.2 ± 0.54^{2}
Crude protein			
ram lambs	68.4 ± 0.80^{1}	72.5 ± 0.58^{2}	78.9 ± 0.22^{3}
ewe lambs	66.8 ± 1.20^{1}	70.6 ± 0.98^{2}	76.8 ± 1.62^{3}
mean	67.6 ± 1.00^{1}	71.6 ± 0.78^{2}	77.9 ± 0.92^{3}
NDF			
ram lambs	74.6 ± 0.98^{a1}	80.1 ± 0.10^{a2}	81.0 ± 0.93^{2}
ewe lambs	72.1 ± 0.62^{b1}	78.1 ± 0.08^{b2}	79.1 ± 0.72^{2}
mean	73.4 ± 0.80^{1}	79.1 ± 0.09^{2}	80.0 ± 0.83^{2}
ADF			
ram lambs	58.6 ± 0.78^{a1}	67.1 ± 0.80^{a2}	78.0 ± 0.42^{a3}
ewe lambs	53.9 ± 0.72^{a1}	62.3 ± 0.78^{b2}	73.1 ± 0.68^{b3}
mean	56.3 ± 0.75^{1}	64.7 ± 0.79^{2}	75.6 ± 0.55^{3}
Hemicellulose			
ram lambs	82.2 ± 0.36^{a1}	89.1 ± 0.73^{a2}	89.6 ± 0.48^{a2}
ewe lambs	80.1 ± 0.18^{b1}	82.7 ± 0.69^{b12}	87.3 ± 0.92^{b2}
mean	81.1 ± 0.27^{1}	85.8 ± 0.71^{2}	88.5 ± 0.70^{3}
Cellulose			
ram lambs	63.4 ± 0.68^{a1}	78.3 ± 0.89^{a2}	79.7 ± 0.96^{a2}
ewe lambs	58.9 ± 0.94^{b1}	75.7 ± 0.86^{b2}	76.1 ± 0.87^{b2}
mean	61.1 ± 0.81^{1}	77.0 ± 0.88^{2}	77.9 ± 0.92^{2}
GE			
ram lambs	79.4 ± 0.92^{a1}	80.4 ± 0.88^{a12}	83.3 ± 0.96^{a2}
ewe lambs	67.9 ± 0.96^{b1}	78.2 ± 0.58^{b2}	80.4 ± 0.82^{a2}
mean	73.6 ± 0.94^{1}	79.3 ± 0.73^{2}	81.8 ± 0.89^{3}

a, b, c – means within each treatment for each variable of different superscript differ at $P < 0.05$
1, 2, 3 – means within row with different superscript differ at $P < 0.05$

Conclusively, the results demonstrated that complete feed mash can be prepared from locally available crop residues to produce cheap livestock feed, and it was also a means of improving the quality of residues for livestock nutrition in Zambia where they do not have enough feed resources to sustain high level of livestock production.

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STRESZCZENIE

Wpływ płci owiec czarnogłówek na pobranie paszy, wzrost oraz strawność składników pokarmowych dawek pełnoporcjowych zawierających uboczne produkty roślinne

Na 10-cio miesięcznych 18 owcach czarnogłówkach (9 tryczków i 9 jarliczek) o początkowej masie ciała 16,9 ± 0,59 kg, oznaczono wartość pokarmową trzech pełnoporcjowych dawek (około 13% białka ogólnego) zawierających uboczne produkty roślinne: łuski arachidowe (GNS), główki słonecznika (SFH) lub odpady pulpy cytrusowej (CPW), w układzie czynnikowym bloków losowych 2 x 3.

Płeć nie miała wpływu ($P > 0,05$) na ilość pobieranej paszy, natomiast istotnie ($P < 0,05$) wpływała na przyrosty dzienne i końcową masę ciała; lepsze wyniki miały tryczki.

Przyrosty jagniąt otrzymujących dawkę CWP były większe ($P < 0,05$), zaś strawność i wykorzystanie paszy (kg SM/kg przyrostu) lepsze niż z pozostałych grup.