Performance of weaner sheep fed wheat straw ensiled with caged layer waste

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Abstract

The performance of weaner lambs fed for 90 days Rhodes grass hay alone (A) or supplemented with silages containing 0, 20 or 40% (B, C, D) caged layer waste (CLW) was examined. Weaver sheep on the diet of hay supplemented with 40% CLW silage had higher total DMI ($P<0.01$) and average daily gain (ADG) than sheep on the other treatments. Mean DMI/kg $W^{0.75}$ and ADG were 59.4, 58.7, 60.0 and 65.0 g/day and 15.0, 20.5, 17.6 and 33.2 g/day for treatments A, B, C and D, respectively. Carcass composition did not ($P>0.05$) differ between treatments except that kidney fat was lower ($P<0.05$) for sheep on the B silage diet. Dressing percentage, % lean, % fat were: 30.4, 31.4, 32.1 and 33.5, 58.0, 59.0, 58.9 and 58:5, 8.3, 7.2, 8.2 and 8.9% for treatments A, B, C and D, respectively. The study showed that CLW was a suitable protein supplement for sheep when processed by ensilage for 42 days at a level of 40% inclusion with wheat straw.

Introduction

The human population in Africa is expanding at an estimated rate of 4% per annum, thereby increasing the demand for protein from animal sources which calls for increased research into alternative sources of feed for livestock. Crop residues provide a source of roughage but their potential is limited by high fibre, low protein, mineral and vitamin content. Chemical treatment of crop residues has been found technically feasible but is of limited application in tropical Africa due to the high cost of the chemicals and insufficient know-how on the use of chemicals by small-scale farmers. The most practical and feasible method of improving the nutritive value of crop residues is through supplementation with energy and/or protein sources.

Caged layer waste is a rich source of protein ranging between 25�30% CP of which 40�50% is true protein. Poultry waste is available in urban and peri-urban areas of Kenya and has been successfully fed to lactating cows (Kayongo and Irungu 1986), beef steers (Odhuba et al 1986) and lactating goats (Nyakalo 1991). In the present study the nutritive value of caged layer waste ensiled with wheat straw and its suitability as a protein supplement for growing sheep were assessed.

Materials and methods

Caged layer waste was collected from 300 layer chickens of the Shavers type, aged 40 weeks and fed on Layers Mash. The waste which was composed of chicken faeces, spilled feed, broken eggs and feathers was collected every three days from a polythene sheet placed below the cages that housed the layers. Wheat straw was chopped in lengths of 2.5�5 cm, put in containers mixed with tap water at a rate of 1:1 by weight and left to stand overnight. Silos measuring 4 m �2 m � 0.6 m were lined with 500 gauge polythene sheet on all sides and bottom. The moistened wheat straw was emptied into each silo in quantities of 100 kg fresh weight to which 3 kg molasses diluted with 31 of water was added. Caged layer waste was added at rates of 0, 20 and 40% by weight. All silos were opened after 42 days by uncovering a small portion (about 30 cm^2) to allow removal of the required quantity of silage.

Thirty-two entire Corriedale weaver lambs six to eight months old of age and weighing 14.9�25.0 kg liveweight were used in the study. They were weighed at the start of the study and thereafter once weekly before feeding. After an adaptation period of four weeks, during which the sheep were individually fed Rhodes grass *(Chloris gayana)* hay and 200 g of commercial Dairy Meal per sheep per day, they were divided into four blocks with two animals per block. The blocks were assigned at random to four treatments in a complete block randomised design. The sheep were fed for 90 days on Rhodes grass hay alone or supplemented with silage containing 0, 20 or 40% CLW silage (treatments A, B, C and D), respectively. Water and Maclick mineral lick were offered *ad libitum*. Proximate analysis was carried out following AOAC (1984) procedures. *In vitro* digestibility of OM and DM of the feeds was determined by the two-stage procedure of Tilley and Terry (1963).

After 90 days four sheep from each treatment were slaughtered to determine carcass quality. The procedure followed was as described by Mafwere and Mtenga (1992). The dressed carcasses were chilled for 24 hours and the cold carcasses sawn down through the centre of the vertebral column. The left side of the carcass was separated into the fore and hind quarters and the l0th rib. Each cut was weighed and dissected into butcher's bone, muscle (lean) and fat.

Carcass analysis was performed to determined carcass weight, per cent tissue on the left-hand side (LHS) of the carcass; kidney fat weight; 10th rib weight and tissue composition. Data obtained were analysed using Harvey's Least Squares analysis programme (Harvey 1990). Differences between treatment means were tested with orthogonal contrasts.

Results and discussion

The chemical composition of hay and silage fed to the wearer sheep is shown in Table 1. Hay showed low crude protein (4.8%) and DM and OM *in vitro* digestibilities of 35 and 39.5%, respectively, and a high crude fibre content (40.8%). The composition of hay used in the present study compared favourably to that fed to beef steers by Odhuba et al (1986). However, it was poorer than that fed to wearer sheep by Mafwere and Mtenga (1992) which contained 5.9% CP and 38.0% CF. The hay used in the study was purchased commercially and its quality varied considerably because of source, stage of growth at harvest. Crude protein of silage was 3.6, 5.8

and 7.7% for silage containing 0, 20 and 40% CLW, respectively. The corresponding CF values of the silage were 48.2, 43.9 ad 41.6%. The 40% CLW-silage had 53.2% more CP and 15.9% less CF than silage alone. All the silage had low IVDMD and IVOMD, though the 40% CLW-silage had the highest values. This was expected since wheat straw has a high fibre content whereas supplementation with CLW would reduce this component and increase CP content of the mixture.

Table 1. *Chemical composition and* in vitro *digestibility of hay and silage fed to sheep.*

		Silage-CLW inclusion (%)		
Diet	Hay	0	20	40
Dry matter	89.0	24.5	24.0	25.3
Composition of dry matter,%				
Crude protein	4.8	3.6	5.8	7.7
Crude fibre	40.8	48.2	43.9	41.6
Ether extract	2.2	2.2	2.4	2.5
Ash	8.7	10.3	12.0	14.3
Organic matter	91.1	90.3	88.8	86.1
Nitrogen-free extract	43.5	35.7	35.9	33.9
In vitro digestibility,				
Dry matter	35.0	29.7	31.7	36.5
Organic matter	39.5	36.0	40.2	41.8

The composition of the silage was in agreement with the findings of Economides (1986) who reported that roughages ensiled with poultry litter had higher CP content compared to those without. Ensiling is reported to conserve the CP in CLW and some of the uric acid in the CLW is converted to true protein during the fermentation process (Economides 1986). The relative increase in digestibility with increasing level of CLW inclusion indicated an improvement in the nutritive value of the crop residues and is in agreement with the findings by Daniels et al (1983).

The results of feed intake and utilisation by the wearer lambs are shown in Table 2. Sheep on the control diet consumed 25% more (P<0.01) hay than those on silage diets. Sheep on the 40% CLW consumed (8�10%) more DM/kg $^{0.75}$ than sheep on the other treatments. dry matter intake increased as the level of CLW in the silage increased and this was accounted for by the increase in CP and decrease in CF content. These changes could have increased digestibility which in turn have led to increased rate of passage of the silage feeds through the gut. Ensiling has also been shown to reduce the objectionable odour associated with raw CLW and this could have improved its acceptability to wearer sheep (Okeke and Oji 1991). The reduced hay dry matter intake with increasing silage dry matter intake suggested that silage depressed intake of hay probably because of a substitution effect. The observations from the present study were in agreement with those reported by Ariel et al (1991) who observed that animals fed on crop residues ensiled with poultry litter had higher DM intake than those fed crop residues ensiled alone.

Table 2. *Least square means of performance parameters of weaver sheep fed silage diets.*

Parameter	Hay	Silage + % CLW			SEM
	0 (A)	0 (B)	20 (C)	40 (D)	
Daily dry matter intake, kg/day	0.6^a	0.6^a	0.6^a	0.7^b	0.01
Hay intake/day, kg	0.4^b	0.3^a	0.3^a	0.3^a	0.01
Hay + silage intake/day, kg	0.4^a	0.4^a	0.4^a	0.5^b	0.01
Silage intake/day, kg	�	0.1^a	0.1^a	0.2^b	0.01
Dry matter intake, g/kg Lwt	27.6^a	27.4^a	28.2^a	29.8^b	0.32
Hay intake, g/kg Lwt	19.2^b	13.3^a	13.5^a	14.5^a	0.30
Hay + silage intake g/kg Lwt	19.2^a	18.8^a	19.3^a	21.8^b	0.34
DM intake, g/kg $W^{0.75}$	59.4^a	58.7^a	60.0^a	65.0^b	0.72
Hay intake, g/kg $W^{0.75}$	41.6^a	28.6^a	28.9^a	31.8^a	0.67
Hay + silage intake, g/kg $W^{0.75}$	41.6^a	40.2^a	41.1^a	47.5^b	0.76
Initial body weight, kg	20.9	20.0	19.6	21.0	0.29
Final body weight, kg	21.8^a	21.2^a	20.6^a	22.7^b	0.17
Average daily gain, g/day	15.0^a	20.5^a	17.6^a	33.2^b	5.52
Feed intake/kg Lwt gain	5.0	4.9	7.4	7.2	2.80

ab Means bearing similar superscript within a row are not different (P>0.05).

Average daily gain (ADG) of sheep on 40% CLW silage was significantly (P<0.01) higher than that of sheep on the other treatments (Table 2). These higher liveweight gain and final liveweight of sheep on the 40% CLW silage suggested that CLW improved the nutritive value of wheat straw. This could be accounted for by the higher crude protein content and *in vitro* digestibility of that diet compared to the other diets (Table 1). The relatively better performance of sheep on the control than those on the 0 and 20% CLW level indicated that this diet was superior to the unsupplemented wheat straw. This was expected since the hay was higher in nutritional value than the wheat straw (Table 1).

The observations in the present study are in agreement with those reported by McClure and Fontenot (1987) who fed yearling steers either on maize grain (1 body weight) or maize forage ensiled with 30% (DM basis) of turkey or broiler manure. However, the results of the present study differed from those reported by Economides (1986) and Rodrigues et al (1987) who did not record any superior performance by animals fed crop residues ensiled with CLW. The discrepancies between these results could be attributed to the use of poultry waste containing litter by those workers as opposed to uncontaminated CLW used in the present study.

The level of CLW inclusion in the silage did not (P<0.05) affect feed conversion ratios (Table 2). This observation suggested that wheat straw/caged layer waste silage gave a poor feed conversion. This was attributed to the low dry matter content of the silage coupled with the high ash content of CLW which would lower the DE of the silage. The results of the present study were in agreement with those reported by Rodrigues et al (1987) who showed that feed required per unit of gain was increased in animals fed rations containing poultry waste.

The level of CLW inclusion had no ($P<0.05$) effect on slaughter characteristics of the sheep, except kidney fat which was lowest in sheep fed the unsupplemented wheat straw (Table 3). Dressing percentage was highest for the sheep on treatment D and lowest for those on the control. Hot carcasses from sheep on treatment D were 10.3, 15.5 and 7.7% heavier than those on treatment A, B and C, respectively. Total lean, total fat and total bone did not ($P>0.05$) differ among treatment means. Nonetheless, sheep on the 40% CLW silage had 10.9, 17.4 and 6.5% more lean and 37.5, 37.5 and 25% more fat than sheep on treatments A, B and C, respectively. The 10th rib weight increased marginally ($P>0.05$) with higher levels of CLW inclusion. The higher kidney fat of sheep on treatment D was consistent with the higher tissue fat content of the sheep on that treatment. The correlation between kidney fat and carcass fat was high and significant ($r = 0.61$). The rather low dressing percentage of the sheep could be attributed to the age of the animals, and this was consistent with the low fat content of the carcasses.

Table 3. *Slaughter characteristics and carcass composition* of *weaner sheep fed silage.*

	Hay	Silage +%CLW			
Parameter	(A)	0 (B)	20 (C)	40 (D)	SEM
Liveweight, kg	22.3[a]	20.98[a]	22.4[a]	23.2[b]	0.17
Hot carcass weight, kg	7.0	6.6	7.2	7.8	0.33
Dressing percentage	30.4	31.4	32.1	33.5	0.88
Tissue in carcass, kg					
Total lean	4.1	3.8	4.3	4.6	0.27
Total fat	0.5	0.5	0.6	0.7	0.06
Total bone	2.5	2.2	2.4	2.5	0.13
Tissue in LHS,					
Lean	58.0	59.0	58.9	58.5	1.57
Fat	8.3	7.2	8.2	8.9	1.18
Bone	33.1	32.6	32.5	31.5	1.41
Composition of LHS, %					
Forequarters	48.4	50.1	49.6	49.4	1.95
Hindquarters	46.9	48.2	48.4	49.0	0.68
10th rib, g	60.7	58.7	62.0	63.7	3.15
Tissue in 10th rib%					
Lean	64.1	67.0	64.3	64.3	5.49
Fat	4.5	2.7	3.3	3.3	1.06

Bone	32.6	28.9	30.6	32.2	2.55
Kidney fat, g	86.5[a]	53.5[b]	85.7[a]	96.2[a]	8.44
Tissue ratios in carcass					
Lean:fat	7.9	7.4	6.9	5.9	0.82
Lean:bone	1.6	1.8	1.7	1.9	1.09
Lean + fat:bone	2.1	2.4	2.4	2.5	0.13

ab Means bearing similar superscript within a row are not significantly different (P>(1.05).

Nonetheless, the findings of the study concurred with those reported by Odhuba et al (1986) and by McClure and Fontenot (1987) on beef steers and on wearer calves, respectively, fed poultry litter enriched silage diets. Similar results were recorded by Rodrigues et al (1987) on sheep fed a control diet or those fed diets containing 10, 20 or 30% poultry litter.

Conclusions

The results showed that caged layer waste was a suitable supplement for growing sheep when ensiled with wheat straw at a level of 40% inclusion and fermented for 42 days. There was significant increase in DMI and ADG, whereas carcass composition was not adversely affected.

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