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Characterisation of meat goat management systems in three districts of central Uganda

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Abstract

A survey of goat production farms was carried out using a structured questionnaire in 70 randomly selected households in Kiboga, Mpigi and Sembabule districts of central Uganda. The objective of the study was to determine the goat production systems and their characteristics. Indigenous goats of the Mubende and Small East African breeds and their crosses are reared. In Mpigi Mubende-boer crossbreds are also reared. Goats are kept for cash from direct sale and slaughter for festivities. Gifts, manure production and dowry were also mentioned among the purposes for which goats are reared. Herds are housed in roofed shelters, kitchens, and on verandas. Tethering was the predominant feeding system followed by open grazing and zero grazing. The average herd size was between 10 and 30 goats. Most farmers provided salt and water though with no clear routine, while a few farmers supplemented feeding with crop residues and tree fodder. The average age of does at first service was 11, 9 and 11.5 months in Kiboga, Mpigi and Sembabule respectively, while the mean kidding intervals for the respective districts were 9, 7 and 9 months.

Key words: Grazing, herds, Mubende-boer crossbreds, tethering

Introduction

The importance of goats in Uganda's economy has long been recognised. Goats along with sheep form the second most important livestock in the agricultural production systems in Uganda (Kiwuwa, 1996). Livestock contributes 17% of the Ugandan agricultural GDP (MFPED, 2000). The livestock population has been rising consistently and was estimated at 5.7, 1.0, 5.1 and 1.4 million goats, sheep, cattle and pigs, respectively (MAAIF, 1996). Goats have the potential to meet the high meat demand of Uganda basing on their being very prolific and having a good reproductive capacity. The acceptability of goat products is high since they have no underlying religious, cultural or social taboos resulting into high prices for meat and live goats. The annual average total meat production of 106.8 tons in Uganda is contributed by beef (64.8%), goat and mutton (21.0%), pork (6.0%) and chicken (8.2%) (Saamanya and Kajura, 2001). Little reliable information is available on the performance of indigenous Ugandan goats as a major component of most Ugandan farming systems. The small goat herds that predominate the goat keeping households in Kiboga, Sembabule and Mpigi districts have hardly been studied.

Materials and methods

A survey was conducted in Mulaji, Nsangi and Lwebitakuli sub-counties of Kiboga, Mpigi and Sembabule districts, respectively. Thirty goat farmers were selected randomly from three villages of Mulaji, twenty from two villages of Nsangi and twenty others from Lwebitakuli. The villages of Kiboga and Sembabule were considered rural setting while villages in Nsangi were considered peri-urban. Primary data was collected between September 2000 and March 2001 through interviews with

the aid of structured questionnaires. Information on several aspects of crop-livestock farming was collected as well as other socio-economic variables. Data were analysed using SPSS package and descriptive statistics obtained are presented.

Results and discussion

Household and farm Profiles

The average number of household members in the study areas was between six and ten. In Kiboga, 90% of the household membership was between 6 - 10 while in Mpigi and Sembabule, 95% were between one and ten. Approximately 100, 90 and 80% of the households in Kiboga, Mpigi and Sembabule, respectively were male headed and on average were aged 35 years or over. Christianity was predominant in all the three districts followed by Islam. Over 36.6% of Kiboga respondents had above five acres of land, while majority of Mpigi and Sembabule farmers owned between 3-5 acres. Most of this land is customarily owned except in Mpigi where 40% of the farmers had titles to their land. Some of the land was being hired on seasonal basis. Labour used for small ruminants is mainly from women though men were found to play a significant role in Kiboga and Sembabule.

Kiboga and Mpigi belong to the Banana-coffee production system with varying degrees of small holder livestock keeping while Sembabule is predominantly agro-pastoral (MAAIF, 1996). Results showed that all the respondents in Kiboga and Sembabule kept indigenous stock of the Mubende and Small East African breeds and their crosses. In Mpigi, 15% of the farmers were keeping a combination of Mubende and Mubende-boer crossbreds.

Goats were kept for various uses. All respondents in Mpigi and Sembabule, and 93.3% of those in Kiboga ranked cash from direct sale and slaughter of goats for festivities highest. Gifts, manure production and dowry or fines were ranked low in Mpigi (15%), Sembabule (35%) and Kiboga (50%), respectively. Contrary to common belief, no respondent ranked prestige among the roles.

Flock housing and feeding

A few farmers of Kiboga (Table 1) reported housing of kids in special kid pens. The majority of goat keepers of Mpigi and Sembabule kept the kids in the kitchen or store, usually covered by a porous basket. Most of the farmers interviewed in Kiboga, 45% in Mpigi and 35% in Sembabule reported that they housed the kids with the rest of the herd.

Over half of Kiboga and Mpigi farmers housed adult goats in roofed shelters, while the rest either used the kitchen and store, or left the animals under trees, on verandahs or in open overnight kraals (Table 1). Tethering was the sole system of goat feeding in Kiboga, predominated in Mpigi and contributed 45% in Sembabule. Zero grazing contributed 25% of feeding system in Mpigi. The most important feed for goats in all the three districts was pasture, though a significant 35% was from crop residues in Mpigi. Table 1 shows a variety of feed supplements in the surveyed areas. In Kiboga, 58.3% of respondents use tree fodder such as *Ficus spp.* while majority in Sembabule reported that they use crop residues and tree fodder in certain times of the year. Results further show that 20, 40 and 50% of farmers in Kiboga, Sembabule and Mpigi district, respectively did not provide water to goats. Also, 40, 33 and 50% of the same farmers provided salt though the provision was done without quantification or specified routine.

Herd structure

Most of the goat herds in Kiboga and Sembabule numbered between 9 and 20, while those in Mpigi were smaller (Table 2). All the farms visited had kids in their herds in different numbers, predominantly

between one and five while many of the farmers did not have weaners. Most Kiboga and Mpigi herds had less than five does while in Sembabule, 70% of the farms had over five does each.

Reproductive parameters and breeding systems

The age of does at first service was found to range between 7-12, 8-12 and 10-12 months in Kiboga, Mpigi and Sembabule, with the overall herd averages at 11, 9 and 11.5 months, respectively. Kidding intervals of 8-11 months ($\mu = 9$), 6.5-8 months ($\mu = 7$) and 6-12 months ($\mu = 9$), were found in Kiboga,

Table 1. Goat housing and feeding practices.

Characteristic		District		
		Kiboga (%)	Mpigi (%)	Sembabule (%)
Housing of kids:	Kid pens	6.7	-	-
	Kitchen or store	26.7	55.0	65:0
	With rest of herd	66.7	45.0	35.0
		(n = 30)	(n = 19)	(n = 20)
Adult herd housing:	Roofed shelters	50.0	55.0	35.0
	Kitchen / store	40.0	45.0	45.0
	Verandah	3.3	-	15.0
	Others	6.7	-	5.0
	(n = 30)	(n = 20)	(n = 20)	
Goat feeding systems:	Grazing	-	-	
	Tethering	100.0	75.0	45.0
	Zero grazing	-	25.0	5.0
	(n = 30)	(n = 20)	(n = 20)	
Type of diet supplement:	Tree fodder (TF)	58.3	-	-
	Crop residues (CR)	41.7	35.0	10.0
	Leguminous MPT's	-	22.2	-
	CR and TF	-	9.8	85.0
	CR and MPT's	-	33.0	5.0
		n = 30)	(n = 20)	(n = 20)

Table 2. Distribution of different categories of goats among households.

Characteristic		District		
		Kiboga (%)	Mpigi (%)	Sembabule (%)
Number of does:	1 - 5	70.0	85.0	30.0
	6 - 10	25.0	15.0	60.0
	> 10	5.0	-	10.0
	(n = 30)	(n = 20)	(n = 20)	
Number of bucks:	0	20.0	5.0	-
	1 - 2	65.0	75.0	100.0
	> 2	15.0	20.0	-
		(n = 30)	(n = 20)	(n = 19)
Total herd size:	1 - 9	6.7	60.0	20.0
	10 -19	70.0	40.0	60.0
	20 - 29	23.3	-	10.0
	> 30	-	-	10.0
		(n = 30)	(n = 20)	(n = 20)

Mpigi and Sembabule, respectively. Litter sizes were between 1-3 in Kiboga though triplets were rare. Most does in Mpigi and Sembabule produced either singles or twins. There were no specific kidding seasons reported.

In Kiboga, 80% of the farmers kept their own bucks, those without used the neighbours' at no cost. Only 5% of the Mpigi respondents did not have bucks though those who have their own sometimes opted for improved bucks within the village, for which they paid Ug. Shs. 2,000. Farmers in Sembabule used own bucks but because of the pastoral systems practiced by most of them, mating is not controlled.

Conclusion

Small holder goat herds numbering between nine and twenty goats predominated the goat keeping households of central Uganda. These herds were mainly composed of Mubende and Small East African breeds, though boer and their crosses existed in a few areas. Goats were housed in roofed shelters and kitchens but in some homes, they were left on verandas. Open grazing and tethering were the common feeding systems with zero grazing limited in extent. Some farmers supplemented the pasture with crop residues and tree fodder. Breeding of does starts before one year of age and the mean kidding interval for the three districts was eight months. The greatest handicaps leading to low growth rates and resultant reduced off-take of goats in the three districts were inadequate nutrition, prevalence of diseases and parasites, poor housing, poor management practices, reproductive wastage and limited market outlets.

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Effect of wood ash extract treatment on the feeding value of sorghum (cv. *Sekedo*) for broiler chicks

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Abstract

Two feeding experiments were conducted to investigate the effects of treating sorghum *(Sorghum bicolor)*, cv. *Sekedo* (S) with wood ash extract on its feeding value for broiler chicks. *Sekedo* was either soaked in water and germinated (WG), soaked in wood ash extract (AS), germinated after soaking in ash extract (AG) or left untreated (UT). The grain constituted 50% of the experimental diets. Treatment of S reduced its tannin content. In the first feeding trial (Experiment 1), significant improvements in growth rate and feed efficiency were realized only for the AG diet. There was no significant difference ($P>0.05$) between diets in feed intake. Ileal digestibility of dietary protein and fat were significantly ($P<0.05$) higher for the AS and AG diets. When maize was replaced with sorghum (Experiment 2), chicks that were fed the maize-based diet grew faster ($P<0.05$) than those on the sorghum-based diets. The UT diet caused a significant ($P<0.05$) depression in growth. Feed efficiency was similar across the four dietary treatments. Ileal digestibility dry matter and crude protein for the UT diet was inferior ($P<0.05$) to that of the AS and AG diets. Generally, treatment of S with wood ash extract improved its feeding value. Germination following wood ash treatment caused a further reduction in tannin content thereby improving the feeding value of the grain.

Key words: Ileal digestibility, nutritional value, *Sorghum bicolor*, tannins

Introduction

The major varieties of sorghum that have been developed in Uganda include *Serena, Lulu* and *Sekedo* - released from Serere Research station in 1966, 1972 and 1995, respectively (Esele, 1995). These varieties apart from *Lulu* contain tannins and are widely used in the formulation of broiler feeds. However, very little work has been done to assess and enhance their nutritional value. The Uganda Seed Project is promoting seed multiplication and distribution of *Sekedo* sorghum, and there is need to explore possibilities of enhancing its feeding value for broiler chicks. Preliminary investigations have shown that the tannin content of *Sekedo* is over 4% catechin equivalents (CE) and diets based on this variety depressed chick growth by 43% when compared to a maize-based diet (Kyarisiima *et al.*, 2001).

High tannin sorghum cannot advantageously replace maize in broiler diets. This is based on the reported negative effects of tannins, with regard to depressed growth rate and reduced feed efficiency in comparison with maize (Mitaru *et al.*, 1983; Elkin *et al.*, 1990; Jacob *et al.*, 1996a) and reduced nutrient digestibility (Mohammed and Ali, 1988).

Several methods have been employed to detoxify and improve the nutritional value of high tannin sorghum. Among these are dehulling, germination, reconstitution and treatment with alkalis. Most of the methods suggested are laborious, expensive or ineffective. The method used to detoxify the grain needs to be simple, inexpensive and easy to adopt both at a domestic and commercial level. The use of conventional alkalis is quite simple and has been shown to be effective in detoxifying high tannin

sorghum (Price *et al.*, 1979; Banda-Nyirenda, 1990) but these chemicals are expensive. Magadi soda, an alkaline salt naturally occurring in Kenya, has also been shown to improve the nutritive value of high tannin sorghum (Muindi and Thomke, 1981; Nyachoti *et al.*, 1998). Mohammed and Ali (1988) demonstrated the potential of wood ash in the detoxification of high tannin sorghum. Wood ash is an alkaline material that is readily available and cheap. Local communities in the southwestern highlands of Uganda use this material to treat the high tannin sorghum grown in that area (Mukuru *et al.*, 1992). This local method of detoxifying high tannin sorghum grain is effective in reducing tannin level but the treated grain contains ash residues and hydrocyanic acid. The treatment also results in about 20% loss of dry matter. A study was therefore conducted to assess the effect of wood ash extract treatment and germination on the feeding value of *Sekedo* sorghum for broiler chicks.

Materials and methods

The local method of treating high tannin sorghum involves soaking the grain in wood ash slurry and then allowing it to germinate for a period of about 4 days. A modified method of this local technology was adopted in order to reduce its negative effects. Wood ash extract was used instead of ash slurry. A weak ash extract solution, at a 1:20 (w/v) ratio, was used as the soaking medium to avoid a reduction in protein quality and availability. The ash-water mixtures were thoroughly stirred for 5 minutes and then left to stand for 15 hours to allow maximum leaching to take place (Etiegni and Campbell, 1991). The resulting supernatant was then filtered with cotton cloth and used to soak sorghum grain. The pH of the extract was 11.5.

Soaking lasted 15 hours and thereafter the grain was sun dried to a moisture content of 11%. For the treatment involving germination, the grain was soaked for 15 hours, drained and spread on freshly cut banana leaves in a room at 26°C. The grain was covered with a layer of fresh banana leaves to preserve moisture. Germination was stopped 26 hours later by spreading the grain in the sun to dry. *Sekedo* sorghum grain was subjected to 3 treatments: (i) Soaked in tap water overnight (15 hours) then allowed to germinate over a period of 26 hours (WG); (ii)Soaked in wood ash extract overnight (AS), or (iii) Soaked in wood ash extract overnight, then allowed to germinate over a period of 26 hours, (AG). Untreated *Sekedo* (UT) sorghum was used as a negative control.

Day-old broiler chicks were obtained from a local commercial hatchery, Ugachick Poultry Breeders Limited. Chicks were randomly distributed into sixteen electrically heated cages measuring 1.0 m x 0.5 m x 0.45 m. The brooder room received 24 hour lighting. Vaccination against newcastle disease (Paramycovirus) and infectious bursal disease (Birnavirus) were done. Chicks were fed on the experimental diets for a period of 4 weeks.

The grain constituted 50% of the experimental diets. Roasted full fat soybean was used as the main protein supplement. In experiment 1, diet 1 was based on grain that was germinated after being soaked in wood ash extract (AG), diet 2 on grain that was soaked in wood ash extract (AS), diet 3 on grain that was germinated after soaking in water (WG), and diet 4 on untreated grain (UT). In experiment, 2 three broiler starter diets based on *Sekedo* grain subjected to AG, AS and UT treatments above were compared with a maize-based diet. The composition of the experimental diets is shown in Tables 1 and 2.

Samples of the major feedstuffs were ground through a 1 mm sieve and analysed for dry matter, ash, crude fat, crude protein (Kjedahl N x 6.25) and crude fibre using standard methods (AOAC, 1990).

Tannins in the sorghum grain were determined using the modified Vanillin assay (Price *et al.*, 1978). The grain was hand cleaned to remove all glumes and broken grain, then ground in a laboratory mill to pass through a 0.5 mm sieve. Two hundred milligrams of the ground grain was placed in a 100ml conical flask and 10 ml of acidified methanol added. The flasks were covered with parafilm and shaken on a reciprocating shaker (Precision Scientific Inc., Illinois, USA) for 20 minutes at room temperature. The extract was carefully poured into test tubes and centrifuged at 3000 rpm for 20 minutes. The clear supernatant was transferred to fresh tubes. Three 1ml aliquots for each extract sample were pipetted

Table 1. Composition of diets used in Experiment 1.

Ingredient (%)	Diets[1]			
Sorghum grain	50	50	50	50
Soybean seed (38%CP)	40.9	40.9	40.9	40.9
Fish (55%CP)	5	5	5	5
DL-Methionine	0.1	0.1	0.1	0.1
Lake shells	2.5	2.5	2.5	2.5
Bone ash	0.7	0.7	0.7	0.7
Salt	0.3	0.3	0.3	0.3
Commercial vitamin premix[2]	0.5	0.5	0.5	0.5
	100	100	100	100
Calculated composition (percent unless otherwise stated)				
Dry matter	91.09	91.40	91.03	90.85
Metabolizable energy (kcal kg^{-1})	3199	3199	3199	3199
Crude protein	22.90	22.97	22.97	23.07
Methionine	0.48	0.48	0.47	0.49
Methionine + cystine	0.87	0.88	0.85	0.89
Lysine	1.12	1.12	1.12	1.12
Calcium	0.98	1.03	0.97	0.97
Total Phosphorus	0.69	0.71	0.65	0.69

[1] Treatments given to the sorghum grain: AG= soaked in ash extract and germinated; AS= soaked in ash extract; WG= soaked in water and germinated; UT= untreated grain.
[2]Provided per kg diet: Vitamin A 12,500 I.U.; Vitamin D_3 2,500 I.U.; Vitamin E 20 I.U.; K_3 3.0 mg; B_1 1.0 mg; B2 5.0 mg; B_6 1.0 mg; B_{12} 0.05 mg; Nicotinic acid 11.25 mg; Calcium pantothenate 6 mg; Choline 0.1 mg; Manganese 75 mg; Iron 37.5 mg; Zinc 62 mg; Copper 6 mg; Iodine 1.0 mg; Selenium 0.12 mg. Source: Frank Wright Ltd, BASF Group, U.K.; distributed by Cooper Uganda Ltd.

Table 2. Composition of experimental diets for Experiment 2.

Ingredient (%)	Maize	AG	AS	UT
Sorghum grain	50	50	50	50
Soybean seed (37%CP)	40.8	40.8	40.8	40.8
Fish (55%CP)	5	5	5	5
DL-Methionine	0.2	0.2	0.2	0.2
Lake shells	2.5	2.5	2.5	2.5
Bone ash	0.7	0.7	0.7	0.7
Salt	0.3	0.3	0.3	0.3
Commercial vitamin premix[2]	0.5	0.5	0.5	0.5
	100	100	100	100
Calculated composition (percent unless otherwise stated)				
Dry matter (determined)	90.93	91.09	91.4	90.85
Metabolizable energy (kcal kg^{-1})	3198	3150	3150	3150
Crude protein (determined)	24.00	23.80	23.76	24.05
Methionine	0.54	0.54	0.54	0.54
Methionine + cystine	0.98	0.98	0.98	0.99
Lysine	1.12	1.12	1.12	1.12
Calcium	0.85	0.95	1.02	0.90
Total Phosphorus	0.56	0.58	0.58	0.59

[1] Treatments given to the sorghum grain: AG= soaked in ash extract and germinated; AS= soaked in ash extract; UT= untreated grain.
[2] Provided per kg diet: Vitamin A 12,500 I.U.; Vitamin D_3 2,500 I.U.; Vitamin E 20 I.U.; K_3 3.0 mg; B_1 1.0 mg; B2 5.0 mg; B_6 1.0 mg; B_{12} 0.05 mg; Nicotinic acid 11.25 mg; Calcium pantothenate 6 mg; Choline 0.1 mg; Manganese 75 mg; Iron 37.5 mg; Zinc 62 mg; Copper 6 mg; Iodine 1.0 mg; Selenium 0.12 mg.
Source: Frank Wright Ltd, BASF Group, U.K.; distributed by Cooper Uganda Ltd.

into 10-ml test tubes. Five ml of 1% vanillin/methanol-8% concentrated HCl/methanol was added to two of the tubes. To the third tube, used as a blank to correct for the background grain colour, 5 ml of 4% concentrated HCl/methanol were added. The catechin standard curve was prepared using catechin/methanol concentrations of 0 to 0.30 mg ml^{-1}. All tubes were incubated in a water bath at 30°C. After 20 minutes of incubation, the optical density (500 nm) of the solutions was read on a Jenway model 6105 spectrophotometer.

A completely randomised design was adopted with four replicates. Each replicate had twelve chicks. Feed and water were provided *ad libitum*. Chicks were individually weighed at the start of the experiment and at the end of each week. All the feed provided was weighed. Feed consumption for each replicate was determined weekly. Mortality was recorded as it occurred. At the end of the feeding trial, birds were killed for the collection of ileal digesta.

In the last week of each feeding experiment, diets were marked with 5 g titanium dioxide per kg of feed. At the end of the feeding experiment, five birds per cage were killed by cervical dislocation and ileal content, from Meckel's diverticulum to the ileo-caeco-colic junction, collected for the analysis of dry matter, crude protein, fat and starch. Determination of titanium dioxide was done according to the method of Short *et al.* (1996).

Data on body weight gain, feed intake and feed efficiency and nutrient digestibility coefficients were subjected to analysis of variance using the procedures of the Statistical Analysis System (SAS, 1990). Treatment means were compared using the least significant differences at a probability level of 5%.

Results and discussion

The results of the responses of chicks to diets based on treated and untreated sorghum grain (Experiment 1) are shown in Table 3. Significant ($P<0.05$) improvements in growth rate and feed efficiency were realized only for chicks fed on the AG diet. There was no significant difference, between diets, in feed intake. Digestibility coefficients of crude protein and crude fat were significantly ($P<0.05$) higher for the AG diet and least in the case of the UT diet. No significant differences were detected in starch digestibility for the four diets. Germination of the grain following treatment with wood ash extract was clearly advantageous. This could be attributed to the 62% decrease in tannin content and improved nutrient digestibility resulting from this treatment. The 40% reduction in tannins caused by soaking the grain in wood ash extract alone did not result in a significant response in the performance of chicks. It is not clear why the high level of dietary tannins hardly had any effects on chick performance.

Table 3. Responses of broiler chicks to diets based on untreated and treated Sekedo sorghum grain.

Parameter	Diets[1]					
	AG	AS	WG	UT	LSD (P<0.05)	P value
Growth responses						
Weight gain (g)	474	401	401	404	33.14	0.0001
Feed intake (g)	940	879	877	899	74.43	0.273
Feed efficiency	1.98	2.20	2.19	2.23	0.180	0.044
Ileal digestibility (%)						
Dry matter	65.70	65.42	66.62	65.91	1.076	0.149
Starch	95.83	95.71	95.67	95.35	0.745	0.556
Crude protein	70.70	64.80	67.26	63.51	2.561	0.001
Crude fat	78.63	75.61	75.11	69.34	1.942	0.0001

[1] Treatments given to the sorghum grain: AG= soaked in ash extract and germinated; AS= soaked in ash extract; WG= soaked in water and germinated; UT= untreated grain.

In Experiment 2, chick growth responses were similar for the AG and AS diets (Table 4). Chicks that were fed the maize-based diet grew faster ($P<0.05$) than those fed on sorghum based diets. The UT diet caused a significant ($P<0.05$) depression in growth. Feed intake and feed efficiency were similar ($P>0.05$) across the four diets. There were no mortalities.

Ileal digestibility of dry matter for the maize based diet and that of the AG and AS diets was similar. Digestibility of dry matter for the UT diet was inferior ($P<0.05$) to that of the AG and AS diets. There was no significant difference ($P>0.05$) in the digestibility of starch. Digestibility of crude protein for the UT diet was significantly ($P<0.05$) lower than that of the diets that were based on the treated grain.

Differences in sorghum varieties and dietary tannins in various reports make it difficult to compare results in these studies. Most researchers have reported growth depression in chicks fed diets that are based on high tannin sorghum but in some studies; no significant effects on growth rates were reported when diets containing high tannin sorghum were fed to broilers (Jacob *et al.*, 1996b). Whereas some studies have reported significant depression in feed intake when chicks were fed diets based on high tannin sorghum (Mohammed and Ali, 1988), other studies have found no such effects (Jacob *et al.*, 1996b). On the other hand, Nyachoti *et al.* (1998) reported increased feed consumption by chicks that were fed on high sorghum diets. In the present study, a reduction of the tannin content of the grain had no significant effect on feed intake.

The poor feed efficiency due to high levels of dietary tannins is consistent with many other reports (Banda-Nyirenda and Vohra, 1990; Elkin *et al.*, 1990). The improved feed efficiency may be explained by higher ileal digestibility of crude protein and fat corresponding to the reduced dietary tannins. Similarly, reduced nitrogen and amino acid digestibilities, in chicks, due to high dietary sorghum tannins have been reported by other researchers (Mitaru *et al.*, 1985).

The reduced weight gain for the sorghum-based diets is in agreement with the results reported by several other researchers (Elkin *et al.*, 1990; Jacob *et al.*, 1996a). The improvements in weight gain and feed intake with wood ash treatment are likely to be due to the reduced tannin content. For *Sekedo* sorghum, the AS and AG treatments caused a reduction in tannin content of 45% and 69%, respectively. Mohammed and Ali (1988) reported an 81% reduction in tannin content when sorghum grain was soaked in wood ash extract that was prepared by mixing one part ash to 5 parts water. The improved weight gain with the AS diets was also consistent with the findings of Mohammed and Ali (1988). In a study by Jacob *et al.* (1996b) dietary tannin content of 1.3% CE (on a dry matter basis) had no significant effect on growth rate or feed efficiency in young broiler chicks, whereas in another study (Jacob *et al.*, 1996b) broilers receiving starter diets with tannin content of 2.5% CE had significantly lower body weights. In the current study, it is only the AG diet that contained 1% CE but even with that level its feeding value was inferior to that of the maize-based diet.

Table 4. Effect of replacing maize with treated or untreated Sekedo sorghum on the performance of broiler chicks.

Parameter	Diets[1]					
	AG	AS	WG	UT	LSD (P<0.05)	P value
Growth responses						
Weight gain (g)	772	759	764	720	49.85	0.1272
Feed intake (g)	1293	1275	1316	1272	98.71	0.8509
Feed efficiency	1.67	1.68	1.78	1.77	0.114	0.2456
Ileal digestibility (%)						
Dry matter	66.96	68.61	68.16	64.19	2.544	0.0150
Starch	96.55	97.05	95.54	95.73	1.581	0.1323
Crude protein	66.73	64.79	69.17	61.77	2.605	0.0009

[1] Treatments given to the sorghum grain: AG= soaked in ash extract and germinated; AS= soaked in ash extract; UT= untreated grain.

Conclusion

Treatment of S with wood ash extract greatly improves its feeding value for broiler chicks. Germination of the grain following ash treatment further reduces tannin content of the grain and improves its feeding value.

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