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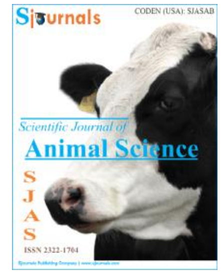

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Original article

Evaluation of supplemented ginger (*Zingiber officinale*) levels on the performance of growing and fattening Uda sheep in semi-arid Nigeria

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ABSTRACT

Two different experiments were conducted using fifteen growing lambs and fifteen fattening rams of Uda breedwith average weight of 17 and 21.4 kg and age of between 11and 20 months respectively to evaluate supplemented ginger levels on performance of the animals. In each experiment, the animals were randomly assigned to three treatment diets containing graded ginger levels in a completely randomized experimental design replicated five times. Ginger was supplemented at graded levels of 2.5 and 5% for treatments T2 and T3 respectively, while treatment T1 (control) had no ginger. Results indicated a significantly lower body weight gain for growing animals (experiment 1) fed diets containing ginger (P<0.05) while feed conversion ratio (FCR) and cost of feed/kg live weight gain was higher. For fattening animals (experiment 2), ginger inclusion above 2.5% had a negative effect on fattening performance (P<0.05). It was concluded that inclusion of ginger in the diet of growing and fattening Uda sheep could not improve performance.

1. Introduction

Spices such as ginger (*Zingiber officinale*) have been reported to possess useful pharmacological potent chemical substances for use in animal nutrition (Akhtar et al., 1984) used to enhance the performance of livestock (Muhammad et al., 2009). They exact anti-oxidative action (prevents cells and tissues from damage from harmful substance), antimicrobial action (capable of destroying or inhibit disease causing organism), impact on palatability, gut function and reduction of methane emission in ruminants. Ginger *(Zingiber officinale)* possesses a mixed composition of zingerone, shogaols and gingerols (Nidaullah et al., 2010). HHH (2011) reported that ginger contains volatile oils like borneol, camphene, citral, eucalyptol, linalool, phenllandrene, zingiberine, zingiberol (gingerol, zingirone and shogaol) and resin. Some gingers' medicinal properties are contained in the chemicals responsible for the taste, the most noteworthy being gingerol and shogaol. A protein digesting enzyme (Zingibain) found in ginger is believed to improve digestion as well as kill parasites and their eggs. It was also reported to enhance antibacterial and anti-inflammatory actions and it is thought to assist other anti-bacterials, such as antibiotics, by up to 50%. The major components of ginger are Zingiberen and Zingerol that can stimulate the digestive systems by controlling the digestive pH and the activity of digestive enzyme and microbial activity. The nutrients found in ginger include carbohydrates, lipids, proteins, minerals and vitamins. Among these, Phosphorus, potassium, riboflavin and vitamin C may be found. Ginger contains about 12 antioxidant constituents, the combined actions of which have been regarded as being more powerful than vitamin C (HHH, 2011).

Many livestock farmers faced with the challenge of improving livestock performance in order to ensure more net return (Pervez, 1992). Currently, there is an increasing interest in using spices in animal nutrition in order to replace the use of antibiotics and ionophore (Barton, 1999; Greathead, 2003). Ginger is used as natural additives to replace chemical additives to improve digestibility, nutritive value, and increase feed utilization, thus improve the performance of growing animals (Banchaar et al., 2008). In addition, feed additives derived from plants, can be included in animal's diet to improve productivity and yield of animal products (Windisch et al., 1999). Among these natural additives, aromatic plants spice have been examined due to their advantages as growth promoters, they are residue free and generally recognized as safe (Cowan, 1999). This study is aimed at evaluating supplemented ginger levels on the performance of growing and fattening Uda sheep.

2. Materials and methods

2.1. Experimental location and climatic condition

The studies were conducted at livestock teaching and research farm of Usmanu Danfodiyo University, Sokoto. The farm is located about 10 kilometers north of Sokoto metropolis in wamako area of Sokoto state, located in Sudan savannah zone extreme northwest part of Nigeria, between latitude 12^0 N 13^0 and 58'N and longitude 4^0N 08'E and 60^0 54'E and an attitude of 300m above sea level (Mamman et al., 2000). Sokoto state is located in North western part of Nigeria, with land area of 28,232.37sq kilometer. Sokoto state is located between longitude 11^0 30'' 13^0 50'' East and latitude 4^0 6'North. It is border to North by Niger republic; Zamfara State to east and Kebbi State to south–west (Anon, 2009). The state falls within the Sahel, Sudan or Guinea savannah vegetation zone. The study area has alternating wet and dry season (SEPP, 1996). Rainfall starts late and ends early with mean annual rainfall ranging between 500-1300mm. The wet season begins in most part of the state in May and last up to September or October, with an annual rainfall peaking in August while the dry season October and last up to April. Annual evaporation is 162mm (Mamman et al., 2000). Sokoto state has an estimated population of 3,696,999 people made up principally of two major groups namely; Hausa and Fulani (NPC, 2006).

2.2. Experimental design, feed sourcing and diet formulation

A complete randomized design (CRD) was used for the two experiments. Fifteen (15) experimental animals each were divided into three (3) dietary treatments replicated five times; each animal serving as replicate. The animals were balanced for weight at the start of the experiments. The ginger was purchased from Kara in Sokoto metropolis market together with other feed ingredients which includes Maize, Cowpea husk, Cowpea hay, Cotton seed cake, and Rice offal, Salt, dried and Premix. Bone meal was purchased from Sokoto central abattoir. Three diets were formulated for each study using supplemented ginger levels. Diet 1 serves as a control (without ginger inclusion) while Diets 2 and 3 were supplemented with 2.5% and 5% ginger respectively. The experimental diets were used to feed the fifteen (15) growing and the fifteen (15) fattening animals for 90 days. The diets were designated as diet 1, 2, and 3 in the experiments. Compositions of the experimental diets are shown in tables 1 and 2 respectively.

Table 1
Composition of Experimental Diets for experiment 1.

	Treatments (ginger supplemented level %)		
Ingredients	**1 (0%)**	**2 (2.5%)**	**3 (5.0%)**
Maize	20.46	20.46	20.46
Cowpea husk	12.25	12.25	12.25
Cotton seed cake (CSC)	15.98	15.98	15.98
Rice offal	12.64	12.64	12.64
Cowpea hay	35.85	35.85	35.85
Salt	0.50	0.50	0.50
Bone meal	2.50	2.50	2.50
Premix	0.50	0.50	0.50
Total	100	100	100
Calculated nutrient contents			
Crude Protein (%)	16.00	16.00	16.00
Energy (kcal ME/kg)	2200.25	2200.25	2200.25
Crude Fibre (%)	21.59	21.59	21.59
Ginger supplementation (%)	0	2.5	5

Table 2
Composition of Experimental Diets for experiment 2.

	Treatments (supplemented ginger level (%)		
Ingredients	**1 (0%)**	**2 (2.5%)**	**3 (5%)**
Maize	38.65	38.65	38.65
Cowpea husk	15.70	15.70	15.70
Rice offal	0.95	0.95	0.95
Cotton seed cake	14.70	14.70	14.70
Cowpea hay	26.50	26.50	26.50
Bone meal	2.50	2.50	2.50
Premix	0.50	0.50	0.50
Salt	0.50	0.50	0.50
Total	100	100	100
Calculated nutrient contents			
Calculated energy (ME Kcal/kg)	2635.07	2635.07	2635.07
Crude protein (%)	12.30	12.30	12.30
Calculated Fiber (%)	20.11	20.11	20.11
Ginger Supplementation (%)	0	2.5	5

2.3. Experimental animals and their management

The animals were quarantined for two weeks before the commencement of experiments. During this period, broad spectrum antibiotics were administered. The animals were also dewormed and housed in pens measuring 1 × 2m. Plastic opened cylindrical feeding troughs were used for efficient feeding and avoidance of feed wastage. Calibrated buckets were used as drinkers. Water and feed were provided *ad libitum*. Sanitary management practice was carried out throughout the trial periods.

2.4. Data collection

In each experiment, Feed and water intakes were calculated on daily basis.Feed intake was recorded by subtracting feed left over from quantity offered the previous day. Live weight changes were recorded on weekly basis after overnight fasting of the animals to avoid error due to gut fill.

2.5. Chemical and statistical analysis

Thoroughly mixed representative samples of the experimental diets were analyzed for proximate components using the procedure of Association of Official Analytical Chemist (AOAC, 1990).The data obtained from two experiments were subjected to analysis of variance (ANOVA) using Statview statistical package (SAS, 2002). Least significant difference was used to separate means.

3. Results and discussion

3.1. Proximate composition of the experimental diets

Table 3
Proximate composition of experimental diets for experiment 1.

	Treatments (ginger supplemented level %)		
Parameter (%)	**1 (control)**	**2 (2.5)**	**3 (5.0)**
Dry matter (DM)	94.55	95.79	95.37
Crude protein (CP)	11.71	12.13	12.10
Crude fiber (CF)	23.65	27.6	29.34
Ether extract (EE)	6.15	5.62	4.98
Nitrogen free extract (NFE)	47.57	44.25	41.76

Result (Table 3) showed that dry matter content of experimental diet varied from 95.37 to 95.79%. Crude protein (CP) content varies from 11.71 to 12.13%. Crude fiber (CF) content increased as the level of ginger increased. Ether extract decreased from treatment 1 to treatment 3 as ginger level increased.

Table 4
Proximate composition of the experimental diets for experiment 2.

	Treatments (ginger supplemented level %)		
Parameter (%)	**1 (Control)**	**2 (2.5)**	**3 (5.0)**
Dry matter (%)	94.67	95.58	95.87
Crude protein (%)	12.92	12.31	12.01
Crude fibre (%)	22.01	25.62	30.33
Ether extracts (%)	6.10	5.32	4.76
NFE (%)	50.55	46.02	41.6

The Dry Matter (DM) content of the experimental diet increases as the level of ginger increased. Crude Protein content decreased slightly as the level of ginger increased. Ether Extract and NFE values decreased from treatment 1 to treatment 3. Crude Fibre content increased as the inclusion level of ginger increased (Table 4).

3.2. Performance of growing Uda sheep fed graded levels of ginger (*Zingiber officinale*)

Results (table 5) showed no significant difference ($p>0.05$) in initial body weight of the growing animals. Total live weight gain and average daily gain were higher ($p< 0.05$) for treatment 1 (control) compared to other treatments. Final weight, feed intake and dry matter as % body weight for treatments 1 and 2 are significantly higher ($p<0.05$). Feed conversion ratio (FCR) is significantly higher ($p< 0.05$) for animals fed diet containing Higher ginger levels (ginger treatment 3).

Table 5
Performance of growing sheep (experiment 1) fed varying levels of ginger.

	Treatments (ginger supplemented level %)			
Parameters	**1 (0%)**	**2 (2.5%)**	**3 (5.0%)**	**SEM**
Initial body weight (kg)	17.60	17.20	16.20	1.23
Final body weight	25.00[a]	19.70[ab]	17.20[b]	2.23
Total live weight gain (kg)	7.80[a]	2.50[b]	1.00[b]	1.54
Average daily gain (kg)	113.00[a]	39.00[b]	34.00[b]	26.31
Feed intake (kg/day)	1.10[a]	0.75[b]	0.53[b]	0.16
Total feed intake (kg)	1126.16[a]	732.44[ab]	570.29[b]	122.01
Feed conversion ratio	6.04[c]	6.54[b]	7.03[a]	0.002
Dry matter intake as %body weight (DMI as %BW)	4.159[a]	3.50[ab]	3.138[b]	0.223

abc means in the same row with different superscripts are significantly different ($p < 0.05$).

3.3. Performance of fattening Uda sheep fed graded levels of ginger (*Zingiber officinale*)

Table 6 indicated no difference ($P > 0.05$) between the treatments in initial weight, final weight and DMI as % BW. Treatments 1 and 2 have significantly higher total weight gain ($P <0.05$) compared to treatment 3. There is no significant difference ($P > 0.05$) in feed intake between treatments 1 and 2.

Table 6
Feed intake, Feed conversion ratio and live weight gain of fattening Uda sheep fed graded levels of ginger.

	Treatments			
Parameter	**1 (Control)**	**2 (2.5g/kg ginger)**	**3 (5g/kg ginger)**	**SEM**
Initial weight (Kg)	21.500	20.200	22.60	2.94
Final weight (Kg)	33.250	30.600	30.000	2.72
Total weight gain (Kg)	11.750[a]	10.400[a]	7.400[b]	0.97
Average daily gain (ADG) (Kg/day)	164.0[a]	146.0[ab]	106.0[b]	19.31
Feed intake (Kg/day)	2.07[a]	1.95[a]	1.75[b]	0.10
Feed conversion ratio	5.90[b]	5.63[b]	7.19[a]	0.84
DMI as %body weight	5.28	5.51	5.08	0.25

3.4. Cost of growing Uda sheep fed graded levels of ginger (*Zingiber officinale*)

Total cost of feed consumed (TCFC) is significantly higher ($P< 0.05$) for animals in treatment 1 (control) compared to those in treatment 3. However, cost of feed/kg live weight kg was lower for the same group of animals (treatment 1).

Table 7
Cost of feed and cost feed/kg live weight of growing sheep fed graded ginger levels

	Treatments (ginger supplemented level %)			
Parameters	**1 (0%)**	**2 (2.5%)**	**3 (5.0%)**	**SEM**
Total cost of feed consumed (₦)	15522.59[a]	9822.35[b]	12074.54[b]	1337.38
Cost of feed/ kg live weight (₦)	568.21[c]	735.09[b]	1391.92[a]	98.72

abc means in the same row with different superscripts are significantly different ($p < 0.05$); 1USD= ₦197.

3.5. Cost of fattening Uda sheep fed graded levels of ginger (*Zingiber officinale*)

Table 8 indicated no significant difference ($P > 0.05$) in Total cost of feed consumed between treatments 2 and 3. Cost of feed/kg live weight is significantly higher for animals fed higher ginger levels.

Table 8
Cost of fattening Uda sheep fed graded levels of ginger.

	Treatments			
Parameter	**1 (Control)**	**2 (2.5g/kg ginger)**	**3 (5g/kg ginger)**	**SEM**
Total cost of feed consumed(TCFC)(₦)	12188.855[b]	15365.249[a]	17229.401[a]	726.5
Cost of feed/kg live weight(₦/ kg)	488.076[c]	903.450[b]	1580.522[a]	155.0

abc means in the same row with different superscripts are significantly different ($p < 0.05$); 1USD= ₦197

3.6. Proximate composition of the experimental diets

Dry matter content of experimental diets for both experimentswas similar to values reported for number of tropical feed stuffs (Payne and Wilson, 1999; Maigandi and Nasiru, 2006). The crude protein content of the diets is within the recommended values to support the optimum microbial need in the rumen. The values are above the 10-12% crude protein requirement for growth of sheep as outlined by Gatenby (2002). The crude fiber contents of the diet were close to the recommended value for sheep (ARC, 1990). Increased crude fiber content from diet 1 to diet 3in both experiments could be due to increased level of ginger. Decreased ether extract and NFE contents might also be associated with increased ginger level.

3.7. Performance of growing sheep fed graded levels of ginger

Decrease in dry matter intake as % body weight with increased level of ginger could be associated with decreased feed intake. Dry matter intake as % body weight observed for treatment 3 was less than the value reported by Bibi- Farouk and Osinowu. (2006) for Yankasa sheep and Muhammad et al. (2008) for Uda sheep. Decrease in feed intake with increased level of ginger might be attributed to palatability of the diet brought about by the pungent properties of the test material. The significantly lower weight gain experienced by animals on treatment 2 and 3 might be due to lower feed intake. It has earlier been reported that the higher the feed intake, the greater the opportunity for increasing body weight gain by farm animals (Honhold et al., 1989). Highest Average daily gain (113g/day) was recorded for treatment 1 while the lowest for treatment 3 due to the intake factor. Higher feed conversion ratio obtained for animals in treatment 3 was due to lower feed intake and live weight gain.

3.8. Performance of fattening sheep fed graded levels of ginger

Slight increase in dry matter intake as % body weight with increased level of ginger could be as a result of decreased feed intake. Dry matter intake as % body weight observed for all the animals are higher than the values reported byAruwayo, et al. (2013) for Udasheep. The difference being attributed to decreased feed intake. The decrease in ADG as a result of decrease in feed intake might be as a result of the ginger's pungent smell and hot nature induced by the nature of phyto-chemicals as observed by Akoachere et al. (2000), Sarica et al. (1995) and Greathead (2003). Decreased weight gain could also be as a result of lower feed intake by animals on treatment 2 and 3. The feed conversion ratio of the animals was lower than the values reported by Yusuf (2009) for fattening Yankasa sheep. These could be attributed to breed and individual animal differences.

3.9. Cost of feed and cost feed/kg live weight of growing and fattening sheep fed graded ginger level

Animals fed 2.5 and 5% levels of ginger in experiments 1had lower cost of feed consumed due to their reduced feed intake. On the contrary, cost of feed per kg live weight gain for these groups (2.5 and 5% ginger supplementation) was higher even in the experiment 2 because the animals had lower live weight gain. Cost of feed per kg live weight gain is an important indicator of economics of sheep production (Maigandi et al., 2002).

4. Conclusion

Feed intake, live weight gain and average daily gain decrease with increasing ginger level. It was concluded that ginger supplementation has negative impact on growth performance of Uda sheep.

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