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EFFECTS OF WHOLE COTTON SEED SUPPLEMENTATION ON CARCASS AND MEAT QUALITIES OF THE DJALLONKE SHEEP RAISED ON STATION

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ORIGINAL ARTICLE

ABSTRACT: *This on-station study evaluated the effects of whole cotton seed supplementation on the carcass and meat qualities of Djallonke sheep. Twelve sheep of similar age and weight were randomly selected and supplemented with whole cotton seed (WCS) for fifteen weeks in a completely randomized design. Three treatment levels of 0 g, 200 g and 400 g were offered with four replicates. Supplementation had no adverse effect on carcass quality but significantly (P<0.001) improved juiciness and overall liking of the meat. The results suggest that whole cotton seed could be used as a supplementary feed with 200 g being enough to ensure the survival and to improve the productivity and meat quality of the Djallonke sheep.*

Keywords: Djallonke sheep, cotton seed, carcass

INTRODUCTION

In Northern Ghana, small ruminants can be found in almost every household in the communities. They feed on low quality food particularly, fibrous vegetation which cannot be consumed by humans and non-ruminant animals such as pigs and poultry (Ruth, 1991). They produce the bulk of meat for households (Salifu and Teye, 2006). However, dry-season feeding is difficult due to scarcity and /or poor quality of feed resources. Productivity of animals decrease as a result of scarce and or poor quality feed resources (Danso-Meriku, 2005). The natural vegetation which is the main feed resource is often completely burnt in the dry season and this result in virtually nothing for the animals to graze. Supplementary feeding is therefore a requirement for maintenance or higher turnover in livestock production.

The consumption of meat and its value depends on carcass and meat qualities. Components of carcass and meat qualities are yield and composition, appearance, eating quality, technological characteristics, palatability, wholesomeness and ethical quality (Warriss, 2001). The most important aspect of eating quality is the combined effects of tenderness, juiciness and flavour (Jones, 1995). Tenderness of meat tends to be higher when animals grow rapidly, particularly just before slaughter (Lauorngholz and Ballet, 1997).

Cotton seed is known for its high nutritive value, which includes 25% crude protein, 20.8% crude fibre, 17.5% ether extract, 16% calcium and 5% ash (Calhoun et al., 1995). It was estimated that about 22,200 – 24,220 metric tonnes of cotton seed is produced annually in Northern Ghana (Karbo and Bruce, 2000). An on-farm experiment with cotton seed supplementation indicated that eating qualities were positively affected (Kwarteng, 2009). It is against this background that this experiment was carried out on-station to validate the effect of whole cotton seed supplementation on carcass and meat qualities of the Djallonke sheep.

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MATERIALS AND METHODS

Location and experimental design

The study was conducted on-station at the Nyankpala campus of the University for Development Studies. A total of twelve (12) Djallonke rams of similar age group and an average initial weight of 14 kg were randomly allocated to three (3) treatments with four (4) replicates. The supplemented groups were confined and fed with cotton seeds daily in the morning by 6:00 am before being released to join the other flock on the range. The treatment levels were as follows: Control: 0 gram whole cotton seed supplementation (WCS), T1:200 g WCS and T2:400 g WCS. The experiment lasted for fifteen weeks.

Slaughtering and Sampling

At the end of the feeding trial, the animals were taken to the University for Development Studies Meat Processing Laboratory. The final live weights of the animals were recorded before slaughtering. The animals were each stunned and bled by severing the carotid arteries in the jugular furrow close to the head. Singing was done by the use of firewood and knives to scrape off the hair on the skin. Evisceration was done immediately after singing and washing according to standard procedures.

Experimental parameters measured

Carcass and meat qualities evaluation: immediately after evisceration, the hot carcass weights were taken using a digital scale. The carcasses were then chilled overnight and cold carcass weights were taken 24 hours after slaughtering using the same scale. The weights of the primal cuts; the thigh, shoulder, and the *Longissimus dorsi* (LD) muscle were taken. The weights of empty rumen, intestine and other visceral were also taken.

Drip loss: Fifty grams of the left LD was hanged from a nylon thread in a transparent polythene bag, the ends of the bag fastened and hang in a refrigerator at +2 ^{o}C for a period of 72 hours. After which the weights were re-taken to determine the drip loss.

Fat (ether extract) extraction: crude fat content of samples was determined by the ether extraction method (AOAC 2003; method 991.36) using a Soxtec system (Foss, UK). Three grams of each sample was dried at 100 ^{o}C in an oven (J.P. Selecta, S.A) for three hours. The samples were then ground into fine powder with a ceramic laboratory mortar for the fat extraction.

Moisture determination: empty crucibles were initially weighed and approximately 3 g of each sample was put into the crucible and re-weighed. The weights of the samples plus crucibles were noted using a digital scale (Sartarious A.G. Gottingen, Germany) and noted "W_1". The samples plus the crucibles were put in an oven (J.P. Selecta, S.A) and the oven set at 105 ^{o}C for three (3) hours. The crucibles with the samples were put in a desiccator to cool. The samples plus crucibles were weighed using the same digital scale and was noted "W_2". Estimation of the moisture content was done using the formula "W_1-W_2"

Estimation of crude protein by digestion method: Weighed samples were put into digestion tubes. Two Kjeltabs were added to each tube and 15 ml of concentrated sulphuric acid was added to each tube and gently mixed to wet filter paper. The samples were then loaded onto the digestion block which was set at 420 ^{o}C for 30 minutes. All samples were distilled using automated/manual Kjeldahl distillation systems (Pro-Nitro II).The digested samples were placed into the Pro-Nitro II after the addition of 50 ml of 40% NaOH and distilled for nine (9) minutes. The distillates were collected into receiver solution (4% Boric Acid) and the crude protein estimated.

Sensory analysis

Eating quality was assessed by a fifteen (15) taste panellist who evaluated the intensity of these characteristics: tenderness, juiciness, colour and flavour. The LD musle was thawed at room temperature. The thawed LD was sliced into five chops of 3.5 cm thickness and griddled to a core temperature of 70 ^{o}C (using turbofan blue sealed oven, UK). During the cooking period/ the chops were turned over every five minutes. Chops were then trimmed of all adhering fats. Three rectangular samples were cut from each chop, wrapped in pieces of labelled foil and presented to the assessors. Bread was used as a neutralizer alongside water. Assessors used a five-point category scale to evaluate sample: tenderness (1 very tender, 5 very tough), juiciness; (1 very juicy, 5 very dry), lamb flavour; (1 very strong, 5- very weak), and overall liking; (1 – like very much, 5 – dislike very much).

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Statistical analysis

The data obtained was analysed using the general linear model of analysis of variance (ANOVA) of Minitab version 15.0 (Minitab, PA USA).

RESULTS AND DISCUSSION

Effect of whole cotton seed on live, warm and cold carcass, thigh, shoulder and *Longissimus dorsi* (LD) muscle weights

The effects of supplementation and non-supplementation of whole cotton seed on live, warm and cold carcass, thigh, shoulder and *Longissimus dorsi* (LD) muscle weights are present in Table 1. Live and warm carcass weights tended to be higher for T1 and T2 compared to the control group. The thigh and LD muscle tended to favour the control group.

However, supplementation did not have any significant effect (P>0.05) on live, warm and cold carcass weights for the various treatments (Table 1). Similarly, there was no significant difference (P>0.05) in weights among the various treatments for thigh, shoulder and LD muscle, a reflection of the non-significance live and carcass weights (Table1).

The insignificant differences observed in weights for warm and cold carcass, thigh, shoulder and *LD* muscle are an indication that whole cotton seed has no adverse effect on growth and development of the animal hence, similar carcass yields. This suggests that cotton seed has a potential for use as a supplement for sheep. This result is in agreement with a previous report that, there is a potential for increased carcass yield when sheep and goats are supplemented with cotton seed (Kwarteng, 2009).

Table1- Live weights, weights of warm and cold carcass, thigh, shoulder and LD muscle

Weights (kg)	Control	T1	T 2	SED*	P-value
Live	11.50	14.50	15.50	4.858	0.70
Warm carcass	7.83	8.34	8.75	2.860	0.96
Cold carcass	6.95	5.63	6.00	2.154	0.79
Thigh	0.59	0.55	0.54	0.220	0.97
Shoulder	0.36	0.37	0.36	0.147	0.99
LD Muscle	0.55	0.48	0.48	0.211	0.85

*Standard error of difference

Effect of whole cotton seed on crude protein, ether extract, percentage moisture and drip loss in the *Longissimus dorsi* (LD)

There was no significant difference (P > 0.05) observed for the various treatments on crude protein, ether extract, and percentage moisture (Table 2). However, drip loss was significantly (P<0.05) reduced in the supplemented groups. An indication that cotton seed supplementation did not have any adverse effect on crude protein level, ether extract and percentage moisture but improved moisture retention in the meat. Thus supplementation with whole cotton seed positively improved crude protein level and percentage moisture, and relatively reduced ether extracts and drip loss in the LD muscle.

There was relatively high moisture content in the supplemented groups than the control, and a corresponding less drip loss from the supplemented groups which might have contributed to its juiciness and tenderness of the LD muscle. Muscles with better water holding capacity have an advantage for further processing. Water holding capacity (WHC) is the ability of meat to retain its water during application of external forces such as heating, cutting, mincing and processing (Boles, 2003).

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Table- 2 Crude protein, ether extract, percentage moisture and drip loss of LD muscle					
	Control	Trt 1	Trt 2	SED*	P-value
Crude protein (%)	50.31	53.51	53.45	4.421	0.70
Ether extract (%)	1.96	1.66	1.57	0.360	0.54
Moisture content (%)	53.40	57.38	57.31	5.242	0.67
Drip loss (mg)	3.5^{b}	2.2^{a}	2.5^{a}	0.480	0.05

*Standard error of difference; means in the same row with similar superscripts are not significantly different (P>0.05)

Eating qualities of *Longissimus dorsi* (LD) muscle

There were significant differences (P<0.001) between the various treatments for juiciness and overall liking (Table 3). There was also a significant difference (P≤0.05) in tenderness between the various treatments. There were no significant differences (P>0.05) in colour and flavour. *Longissimus dorsi* (LD) muscles from supplemented groups retained more moisture, making these muscles juicier, tender and likened more compared to the control. Lawrie (2006) reported that increase in water holding capacity improves tenderness of the flesh when cooked. Kwarteng (2009) also reported that there was no adverse effect on meat quality of small ruminants when supplemented with cotton seed and that a positive eating attributes of juiciness was as a result of the better water holding capacity induced as a result of cotton seed supplementation. Their reports are in agreement with our findings. Our study may also suggest that, most Ghanaians prefer meats that are moderately red, more tender and juicy, with high lamb flavour.

Table- 3 Eating qualities of the LD muscle					
Attributes	Control	Trt 1	Trt 2	*Sed	P-value
Color	1.73	1.67	1.53	0.241	0.70
Tenderness	2.80^{a}	2.10^{b}	2.67^{ab}	0.310	0.05
Juiciness	3.20^{a}	1.70^{b}	2.40^{ab}	0.280	0.00
Lamb flavor	1.67	1.93	1.45	0.252	0.19
Overall liking	2.90^{a}	1.6^{b}	2.50^{ab}	0.243	0.00

*Standard error of difference; means in the same row with similar superscripts are not significantly different (P>0.05)

CONCLUSION

The result of this present study suggest that supplementation of whole cotton seed at a level of 200 g produced animals with the most favourable nutritional, and eating qualities of *Longissimus dorsi* (LD) muscles. In general feeding of whole cotton seed up to 400 g in the diets of sheep have no adverse effects on the meat quality. Therefore the readily available cheap feed (whole cotton seed) produce in excess in the Northern part of Ghana especially in can be stored and used to feed sheep during the dry season when animal feed is scare.

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