Greener Journal of Agricultural Sciences

ISSN: 2276-7770 ICV: 6.15

Submitted: 12/08/2014
Accepted: 15/09/2014
Published: 14/12/2015

DOI: http://doi.org/10.15580/GJAS.2015.7.081214325

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Research Article (DOI http://doi.org/10.15580/GJAS.2015.7.081214325)

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ABSTRACT

Twelve Desert lambs; six Hamari tribal subtype and similar number of Kabashi subtype) were used in the experiment. Their age was four months with average weight of 25.25 Kg. Six lambs (three from each subtype, received a fattening ration and the other six lambs were kept on natural grazing (control). At the end of the experimental period of 60 days all lambs were slaughtered for studying meat characteristics. Slaughter weight (SWt.), empty body weight (EBW) and hot carcass weight of pen fed lambs had considerably higher values (P <0.01) compared to free grazing animals. In addition, the dressing percentage (D %), *Longissmus dorsi (L. dorsi) muscle* area and the width of tail base followed the same trend. Kabashi lambs showed greater values (P <0.01) for most carcass traits compared with Hamari ones. Also pen fed lambs had higher (P <0.01) percentages of fat and muscle in carcass and a decreased percentage of bone compared to the free grazing animals. Kabashi lambs, especially the pen fed, had higher percentages (P<0.01) for fat and lean whereas Hamari animals on the same feed had the highest (P <0.01) total bone percentage. Subtype and feeding system had significant effects on D %, *L. dorsi* muscle area and tail base. Higher values (P <0.01) for these parameters were noticed in pen fed Kabashi lambs. Also subtype × feeding system interactions had significant (P<0.01) effects on D %, *L. dorsi* muscle area and tail base width.

Key words: Groundnut hay, Carcass, Dressing percentages, *Longissmus dorsi,* Slaughter weight.

INTRODUCTION

Sheep is one of the major agricultural endowments of the Sudan in general and North Kordofan State in particular (Mufarrih, 1991). These animals are raised under traditional systems that depend mainly on natural grazing. Hence sheep suffer serious seasonality in feed supply both in quantity and quality especially during dry summer months when animals could hardly secure enough to maintain themselves (Jadalla,1995). Also feed shortages may be due to drought and desertification which affected the region for several consecutive years, in addition to some passive human activities like fire burnings (El Hag *et al*., 1997) Hamari and Kabashi subtypes are related to Kababish breed which is considered as the model of Sudanese Desert sheep (Mufarih, 1991) There are a lot of similarities between the localities of these subtypes and their management is generally similar (McLeroy, 1961). Their tribal classification is mainly based on coat colours which are variable and are mostly tribal trade mark; Hamari sheep are dominantly red while Kabashi animals are mostly brown, light brown or spotted black or red. In recent years the demand for Sudanese sheep in foreign market increased and production of high quality slaughter lambs has become a very important issue in Sudan. Evaluation and comparison of different feed stuffs and mutton quality as well as different feed supplements are now hot subjects for many researchers. The present work was designed to evaluate the meat production potential of Sudanese Desert sheep (subtypes Hamari and Kabashi) and to test the suitability of groundnut hay as basal feed for fattening Sudanese Desert sheep (Jadalla *et al*., 2014).

MATERIALS AND METHODS

Study area

This study was carried out I North Kordofan State (latitudes 11:15' and 16:30 N and longitudes 27 and 32 E). The highest annual temperatures (40^0 C) are during summer season (April-June) while the lowest values (15^o C) are recorded during winter season (Dec.-Feb.). The rainy season extends from July to October with an average annual rainfall of about 280mm (Khatir, 2012). Animal production is the main economical activity beside growing crops.

Experimental animals and traits

Twelve weaned Desert lambs (6 lambs subtype and Kabashi subtypes) were used in the experiment. Animals aged four months with average live weight of 25.25 Kg. Six lambs (three from each subtype) were kept on free grazing (control) while the remaining animals (three from each subtype) were allotted to experimental ration. The composition and chemical analysis of the diet was given in table 1. The ingredients used in ration formulation were sorghum grains, groundnut seed cake, groundnut shells, oysters and common salt at 48, 35,14 and 2 % . The lambs were individually penned and allowed an adaptation period of 14 days. Each animal was then fed the experimental ration formed of groundnut hay as basal feed and concentrates. Concentrates were given at 250g/ head once in the morning while roughages (groundnut hay) were given *ad libitum.*

Animals slaughtered

The experiment extended for sixty days and by the end all lambs were slaughtered for studying carcass characteristics. The head was removed from the rest of the body at the atlas and the fore and hind feet at the carpal and tarsal joints, respectively. Skinning and evisceration were then carried out and all abdominal and thoracic organs were removed and their weights were recorded. Kidneys and kidney fat were left intact in the carcass and the hot carcass weight was soon determined. The alimentary tract was weighed full and empty and the weight of the contents (fill) was obtained by difference. The fill was subtracted from the slaughter weight to obtain the empty body weight (EBW). The tail base width was measured according to Owen *et al.* (1977) and then removed at its articulation and weighed. Kidneys and the kidney knob channel fat (KKCF) were removed and weighed separately. From each carcass a rib joint ($10 – 12^{th}$) were removed and weighed. The outline of the cross-sectional area of the muscle *longissimus dorsi* (eye muscle) at the 12^{th} rib was traced on a tracing paper and later calculated. Samples of rib joints were then wrapped in polythene bags, frozen and stored for tissue separation later Grygus (2009).

Physical analysis

At the time of dissection the frozen rib joints were thawed under room temperature and weighed. The thickness of subcutaneous fat for the sections was recorded by using a vernia. The subcutaneous fat was removed using scalpel and forceps. The muscles were then separated from bones followed by inter-muscular fat and connective tissues and then had been weighed.

Statistical analysis

Carcass data and chemical composition were statistically analyzed as a 2X2 Factorial experiment (2 subtypes and 2 feed treatments) in a randomized complete block design with three replications (Steel and Torrie, 1980).

RESULTS

The composition and proximate analysis of the experimental ration is given in table (1) and feedlot performance of the experimental lambs is presented in table (2). Mean slaughter and carcass characteristics are shown in table (3) and the effects of ration and subtype on slaughter and carcass characteristics are shown in table (4). It was observed that pen fed lambs recorded heavier slaughter weights (S.Wt.) ($P<0.05$), empty body weights (EBW) ($P<0.01$), hot carcass weights ($P<0.001$) and rib joint weights ($P<0.0001$) compared with the free grazing animals. In addition, the dressing percentage (D %), *L. dorsi* muscle area and the width of the tail base followed the same trend. Kabashi lambs were the best in EBW, rib joint and hot carcass weights and the difference was only significant ($P<0.05$) for the latter trait (table 4). Subtype and feeding system had significant effects on D % ($P<0.0001$), *L. dorsi* muscle area ($P<0.0001$) and tail base width ($P<0.0001$) (table 5). Subtype × feeding system interactions had significant effects

(P<0.01) on D % (on S.Wt. basis), EBW basis (P<0.05), *L. dorsi* muscle area and tail base width (P<0.05).

Carcass composition

Table (6) shows means and percentages of carcass composition of pen and free grazing lambs. Also effect of subtype and feeding on carcass composition is presented in table (7). Subtype had significant main effects on cold rib joint, total fat and lean meat (P<0.0001) and total bone (P<0.05). Similarly, effects of feeding system were clear on cold rib joint, total fat, total bone and lean meat (P<0.0001). Fat thickness over *L. dorsi* muscle area in pen fed lambs was remarkably higher than that of free grazing animals. Pen fed Kabashi lambs had the heaviest (P<0.0001) cold rib joint, total fat and lean meat. Hamari lambs on the same feed had the highest (P<0.05) total bone. There were significant subtype × feeding system interactions on cold rib joint and lean meat (P<0.0001), total fat (P<0.01) and total bone (P<0.05).

DISCUSSION

Pen fed lambs recorded higher values for S. Wt., EBW, hot carcass, D%, *L. dorsi* muscle area and the width of the tail base. This can be explained by the actual tissue growth exhibited by animals fed the experimental ration. These findings agree with El -Tayeb *et al.* (1987) who concluded that lambs fed on high concentrated diets dressed better. This pattern of increase in weight may also demonstrate the value of groundnut hay as a feed ingredient in finishing lambs. The current results are also supported by the findings of Mansour *et al.* (1988b) who found that lambs fed rations containing 45% and 30% groundnut hay gave slaughter weights of 31.5 and 32.1 Kg and hot carcass of 13.3 and 14.0 Kg, respectively. The overall D % (on S.Wt. basis) in pen fed animals was higher than that reported by Mansour *et al.* (1988b) and lower than the findings (48.4%) of Babiker and Abdel Hamid (1988) for adult Hamari sheep. On EBW basis, pen fed lambs in the present study dressed higher than the values reported by Mansour (1987) and Ahmed and Sulieman (1988). Kabashi subtype showed greater values for most carcass traits compared with Hamari lambs. These differences were expected because S.Wt. of Kabashi lambs were higher than that of Hamari. Furthermore, the difference in D % could also be explained by the large gut fill of Hamari lambs, in line with Carles (1983) who stated that D% is greatly affected by gut fill.

Subtype and feeding system have some effects on carcass composition. Lean to bone ratio in the present study was higher than that reported by Babiker and Abdel Hamid (1988), Mansour *et al.* (1988a) and El -Tayeb *et al.* (1987). This may be due to the relatively higher nutritive value of groundnut hay used in the present study as basal feed. Also it may be due to higher feed intake and feed conversion ratio (FCR) in the present work.pen fed lambs had higher percentage of fat and muscle in carcass and a decrease percentage of bone. These results were in line with earlier statement (Kempster, 1982) that during the fattening period fat grows dramatically if extra energy is available. Also Drew and Reid (1975), Gaili and Mahgoub (1981) concluded that the ratio of fat: lean is affected by the plain of nutrition. Total fat in the current study was remarkably higher compared with that reported by Mansour *et al.,* (1988b), where total lean and bone were lower than the above work. Also fat thickness over *L. dorsi* muscle area was remarkably higher in pen fed animals which is in line with the widely accepted belief that the *L. dorsi* and the fat over it are significantly and positively correlated with S. Wt. which in turn affected by the type of nutrition (Macit *et al.,*2002 of Moron-Fuenmayor and Clavero, 1999). Pen fed Kabashi lambs recorded heavier cold rib joint, total fat and lean meat, while Hamari subtype, on the same feed, had the highest total bone. This could be explained on the ground that Kabashi sheep had larger body size, consumes more feed and had relatively better FCR compared with Hamari.

The study concluded that Sudanese Desert sheep, especially Kabashi subtype, had good potential for mutton production due to it's higher growth rates and feed conversion efficiency because these traits are among the factors affecting economical mutton production.

CONCLUSION

The study concluded that Sudanese Desert sheep, especially Kabashi subtype, had good potential for mutton production due to its higher growth rates and feed conversion efficiency because these traits are among the factors affecting economical mutton production.

Table 1. Ingredients and proximate analysis of the experimental diet

i) Ingredients (as fed):	
Sorghum grains (dura)	48%
Groundnut cake	35%
Grinded groundnut hulls (bran)	14%
Oysters	2%
Common salt	1%
ii) Proximate analysis (%) on dry matter basis:	
Crude protein (CP)	23.4
Crude fibre (CF)	16.32
Ether extract (EE)	4.84
Nitrogen- free extract (NFE)	5.00
Ash	5.44

Table 2. Mean performance (±SD) of Hamari and Kabashi lambs during the fattening period in North Kordofan

	Pen fed		Free grazing	
Parameter	Kabashi	Hamari	Hamari	Kabashi
Number of animals	3	3	3	3
Days on feed	60	60	60	60
Initial body weight (Kg)	25.3± 1.99	23.96± 2.38	25.62± 1.63	26.14± 1.46
Final body weight (Kg)	34.4± 1.67	32.60± 2.53	29.52± 1.79	29.16± 1.18
Total body gain (Kg)	9.10± 1.24	8.64± 0.76	3.90± 0.88	3.02± 0.61
Mean daily gain (Kg)	0.152± 0.02	0.144± 0.01	0.065± 0.02	0.05± 0.01
Total feed intake (Kg)	62.65± 7.15	65.08± 5.10	64.00± 6.60	60.82± 2.83
Mean daily feed intake (Kg)	1.04±0.12	1.08± 0.28	1.07± 0.11	1.01± 0.05
Feed conversion ratio (FCR, Kg feed / Kg gain)	6.88± 1.82	7.53± 0.96	16.41± 2.57	20.14± 3.19

Table 3. Mean slaughter and carcass characteristics (±SD) of Hamari and Kabashi lambs in North Kordofan

	Kabashi		Hamari	
Parameter	Pen fed	Free grazing	Pen fed	Free grazing
Number of animals	3	3	3	3
Days on feed	60	60	60	60
Slaughter weight (Kg)	34.00± 1.633	29.10± 1.552	33.17± 1.649	28.50± 0.707
Empty body weight, EBW (Kg)	29.50± 1.388	22.70± 1.226	27.60± 1.438	22.70± 0.648
Gut fill (Kg)	4.54± 0.236	6.41± 0.343	5.50± 0.294	6.17± 0.125
Warm carcass weight (Kg)	16.00± 0.816	11.20± 0.499	13.80± 0.624	10.70± 0.374
Dressing % (on S.Wt. basis)	47.10± 0.12	38.30± 0.445	41.70± 0.216	37.60± 0.544
Dressing % (on EBW basis)	54.20 ± 0.245	49.10± 0.591	50.20± 0.395	47.10± 0.386
L. dorsi muscle area (cm2)	17.27±0.145	8.92± 0.378	16.68± 0.177	8.26± 0.267
Rib joint weight (Kg)	0.592± 0.033	0.377± 0.021	0.528± 0.023	0.367± 0.013
Tail base width (cm)	21.29± 1.025	12.10± 0.464	16.10± 0.784	11.80± 0.478

Table 4. Effects of ration and subtype on slaughter and carcass characteristics of Hamari and Kabashi lambs in North Kordofan

	Parameters (Kg)			
Factor	**S. wt.**	**EBW**	**Hot carcass**	**Rib joint**
Ration:				
1	33.583	28.533	14.917	0.561
2	28.817	22.717	10 933	0.372
SE (ration)	0.7880*	0.6572 **	0.3257 ***	0.0134 ****
Sheep subtype:				
Hamari	30.833	25.133	12.267	0.4470
Kabashi	31.567	26.117	13.583	0.485
SE (subtype)	0.7880 NS	0.657 NS	0.3257 *	0.134 NS
SE (interaction)	0.1144 NS	0.9294 NS	0.4606 NS	0.0190 NS

NS = not significant (P>0.05), * = significant (P<0.05), ** = highly significant (P<0.01), ***= very highly significant (P<0.001) **** = very highly significant (P<0.0001)

Table 5. Analysis of subtype and feeding system effects on some carcass characteristics of Hamari and Kabashi lambs in North Kordofan

Parameter	**Hamari**	**Kabashi**	**Feeding system**	
			Mean	**SE**
Management:	**D % (on S.Wt. basis)**			
Pen feeding	41.70b	47.07a	44.39	0.2114****
Free grazing	37.57c	38.33c	37.95	
Mean (subtype)	39.64	42.70		
SE (subtype)	0.2114***			
SE (interaction)	0.2989**			
Management:	**D % (on EBW basis)**			
Pen feeding	50.23b	54.20a	52.22	0.2348****
Free grazing	47.13c	49.13c	48.13	
Mean (subtype)	48.68	51.67		
SE (subtype)	0.2348***			
SE (interaction)	0.3321*			
Management:	***L. dorsi* muscle area**			
Pen feeding	16.68a	17.27a	16.98	0.1406****
Free grazing	8.26b	8,92b	8.59	
Mean (subtype)	12.47	13.10		
SE (subtype)	0.1406*			
SE (interaction)	0.1988*			
Management:	**Tail base width**			
Pen feeding	16.13b	21.29a	18.71	0.3999****
Free grazing	11.83c	12.13c	11.98	
Mean (subtype)	13.98	16.71		
SE (subtype)	0.3999*			
SE (interaction)	0.5655*			

In the same column or raw, and within a factor, means followed by the same letter do not differ significantly (P>0.05), *= significant (P<0.05) **= highly significant (P<0.01) ***= very highly significant (P<0.001) ****= very highly significant (P<0.0001)

Table 6. Mean carcass analysis (rib joint) of Hamari and Kabashi lambs in North Kordofan

Item	Pen Kabashi %	Fed Hamari %	Free Kabashi %	Grazing Hamari %
Cold rib joint (g)	590	544	341	343
Fat thickness (cm)	0.867	0.757	0.333	0.320
Fat wt. (g)	164	145	37	32
Bone wt. (g)	27.80	26.65	10.85	9.33
Lean wt. (g)	102	110	82	83
Connective T. (g)	17.29	20.22	24.05	24.20
	290	255	195	198
	49.15	46.88	57.18	57.73
	20	20	17	18
	3.39	3.68	4.99	5.25

Table 7. Analysis of the effects of subtype and feeding system on carcass composition of Hamari and Kabashi lambs in North Kordofan

Factor	Hamari	Kabashi	Feeding system Mean	SE
Management:	**Cold rib joint (g)**			
Pen feeding	544.00b	590.00a	567.0	1.1487****
Free grazing	343.00c	341.00c	342.0	
Mean (subtype)	443.50	465.50		
SE (subtype)	1.1487****			
SE (interaction)	1.6245****			
Management:	**Fat weight (g)**			
Pen feeding	145.00b	164.00a	154.5	0.7615****
Free grazing	32.00d	37.00c	34.50	
Mean (subtype)	88.50	100.50		
SE (subtype)	0.7615****			
SE (interaction)	1.0769**			
Management:	**Bone weight (g)**			
Pen feeding	110.00a	102.00b	106.0	0.5401****
Free grazing	83.00c	82.00c	82.50	
Mean (subtype)	96.50	92.00		
SE (subtype)	0.5401*			
SE (interaction)	0.7638*			
Management:	**Lean meat (g)**			
Pen feeding	255.00b	290.00a	272.5	0.5652****
Free grazing	198.00c	195.00d	196.5	
Mean (subtype)	226.50	242.00		
SE (subtype)	0.5652****			
SE (interaction)	0.7993****			

In the same column or raw, and within a factor, means followed by the same letter do not differ significantly (P>0.05). * = significant (P<0.05) ** = highly significant (P<0.01) ***= very highly significant (P<0.001) **** = very highly significant (P<0.0001)

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Cite this Article: Mohamed Ali, M.A., Abdella, H.O., Elimam, M.E., Sulieman, A.H., Tibin, M.A.M, Neama, A.E. and Jadalla, J.B. (2015). The effect of feeding groundnut hay and concentrates on some carcass characteristics of Sudanese Desert lambs (tribal subtypes Hamari and Kabashi) in North Kordofan State, Sudan. Greener Journal of Agricultural Sciences, 5(7): 233-239, http://doi.org/10.15580/GJAS.2015.7.081214325.