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Research Paper

FEEDLOT PERFORMANCE AND CARCASS CHARACTERISTICS OF SOME SUDAN DESERT SHEEP ECOTYPES AND THEIR CROSSES

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The present study aimed to evaluate feedlot performance and carcass characteristics of lambs from some pure-bred Sudan Desert sheep ecotypes: Dubasi (DU), Shugor (SH), Watish (WA); and their crosses, Dubasi x Watish (DU x WA), Dubasi x Shugor (DU x SH) and Shugor x Watish (SH x WA). Crossbred lambs (DU x WA, DU x SH, and SH x WA) took a shorter duration to attain the target live weight of 40 kg compared with pure-bred lambs (DU, SH, and WA). Daily gain was greater in SH x WA lambs and was lowest in DU lambs. Dry matter intake was greater in crossbred than pure-bred lambs. Feed conversion efficiency was superior in crossbred than in pure-bred lambs. Hot and cold carcass weights were heaviest in SH lambs and lightest in SH x WA lambs. Crossbred lambs DU x WA and SH x DU had more muscles, SH lambs had more bone and WA lambs had more fat. Fat depots were significantly ($P<0.05$) heavier in WA lambs compared to other lambs types.

Keywords: Sudan desert sheep, Growth, Carcass characteristics

INTRODUCTION

The estimated Sudanese national sheep flock size is 40 million head (MARF, 2015). It has been classified on the basis of morphology and distribution in to: Sudan Desert and Sudan Arid Upland (McLeory, 1961; and Wilson and Clarke, 1976). Sudan Desert sheep are further classified into tribal sub types, e.g., Hamari, Kabashi, in North and West Kordofan States, Shugor, Dubasi and Watish in the Central States (El-Hag *et al.*, 2001). Morethan 82% of sheep in Sudan are of the Sudan Desert type (Sulieman *et al.*, 1990).

Sudan desert sheep is raised by nomadic tribes in the semi-desert zone and the low rainfall wood land savannah belt. Study of genetic characterization of local Sudanese sheep populations showed that the desert sheep has higher values of heterozygosity compared to the Western and Southern populations, including West African, Arid upland and Nilotics sheep populations (Gornas *et al.*, 2011). Sudan Desert

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sheep provide the bulk of lamb and mutton consumed locally or exported and all exported of live sheep, and play an important role in the economics of country.

Shugor ecotype is moderately large sheep ranging in color from light to dark brown. They are found mainly in Butana plains, where they graze on natural pastures and agricultural crops by-products in the nearby irrigated agricultural schemes. Dubasi ecotype is similar in size to the Shugor ecotype, but their thin coat is usually particolored white and black. They are the prototype sheep of the Gezira area, especially the northern part, and are concentrated in the villages of Dubaseen tribes. Watish ecotype is smaller and stockier than either the Shugor or the Dubasi ecotypes. They are hardy sheep and live under high rainfall conditions, mainly along the central and southern parts of the Blue Nile state of the Sudan (Sulieman *et al.*, 1990).

Considerable research studies have been conducted to evaluate the productivity of Sudan desert sheep (Suliman and Amin, 1980; El Hag *et al.*, 1985; El Karim and Owen, 1987; Mansour *et al.*, 1988; El-Hag *et al.*, 2001; Suliman and Babiker, 2007; and Hassan *et al.*, 2013). These previous studies concentrated mainly in effects of nutrition on growth and carcass characteristics among the different ecotypes. Although, crossbreeding is broadly used as an effective method to improve animal productivity (Leymaster, 2002), there is little information on effects of crossing between different Sudan desert sheep breeds on performance and carcass characteristics. The present study was conducted to evaluate feedlot performance and carcass characteristics of lambs of three ecotypes of the Sudan desert sheep and their crosses.

MATERIAL AND METHODS

Experimental Animals, Housing, Feeds and Feeding

A total of forty-eight, 6-month old lambs of Sudan desert sheepecotyped: Dubasi (DU), Shugor (SH), Watish (WA); and their crosses, Dubasi x Watish (DU x WA), Dubasi x Shugor (Du x SH) and Shugor x Watish (SH x WA), with a mean live weight of 25 kg, were used for this study. The animals were provided by El-Huda National Sheep Research Station, Managil, Gezira, Sudan. Prior to the trial, all animals were dewormed (Ivermectin injection 10%), individually weighed, identified with uniquely numbered ear tags, and subjected to an adaptation period of fourteen days to adjust to the housing conditions and diet. At the end of the adaptation period lambs were divided into six groups (eight animals each) according to their type, and kept in pens equipped with watering and feeding facilities.

All groups were fed same diet, which contained a concentrate mixture (45% sorghum gain, 20% cotton seed cake, 33% wheat bran, 1% limestone and 1% salt) and groundnut halum as a roughage source. The diet was formulated to meet the nutrient requirements of growing lambs (NRC, 2007) Concentrate diet and roughage were offered adlibitum. Feed intake was determined daily as the difference between the amounts of feed offered and refusals. Lambs live weight was taken weekly until they attained a target slaughter weight of 40 kg.

Slaughtering

Animals were slaughtered after an overnight fasting in lairage according to the Islamic Halal-method (severing the throat, the jugular veins and arteries without stunning). Following skinning and evisceration, head, skin, feet and visceral organs

were weighed separately. The carcass was weighed hot and after chilling for 24 hours at 4 °C. The kidney and channel fat were removed from the cold carcass and weighed. Subsequently the carcass was split along the midline. The left side was weighed and cut into wholesale cuts according to specification of the Meat and Livestock Commission (1976). Cuts were dissected into muscle, bone and fat and each tissue was weighed separately. The total weight of each tissue was pooled to give totals for the side.

Statistical Analysis

Data were subjected to one-way analysis of variance using the GLM procedure of SAS version 9.1 (SAS, 2003). Least-square means were computed and tested for differences by Duncan multiple range test.

RESULTS

Feedlot Performance

Results related to feedlot performance of DU, SH, WA; and their crosses, DU x WA, DU x SH and SH x WA are shown in Table 1. Crossbred lamb groups (DU x WA, DU x SH, and SH x WA) took shorter times to attain the target live weight of 40 kg compared to the purebred lamb groups. The shortest duration to reach the target weight was scored by SH x WA lambs (56 day), while DU lambs took the longest duration (76 days) to attain the target weight.

Average daily gain was significantly greater in crossbred groups compared to the purebred groups. The SH x WA lambs had the highest daily gain (241 g/day) while the DU lambs had the least (daily gain g 204/day). Dry Matter Intake (DMI) was significantly greater in crossbred than in purebred lambs. The highest DMI was scored by SH x WA lambs while the lowest DMI was recorded in DU lambs. No significantly differences were found in Feed Conversion Ratio (FCR) among the groups; however, crossbred lambs (DU x WA, SH x DU, and SH x WA) showed better FCR than purebred lambs (DU, SH, and WA).

Table 1: Feedlot Performance of Sudan Desert Sheep Ecotypes and Their Crosses

Item	Treatment Groups[1]						S.E	P. level
	SH	DU	WA	Du x Wa	SH x DU	SH x WA		
Initial body weight (kg)	25.25	23.88	24.88	26	27.05	24.9	0.89	NS[2]
Final body weight (kg)	40.2	39.6	40.1	40.2	40.5	40.4	0.29	NS
Feedlot period (days)	69^{b}	76^{a}	66^{b}	60^{c}	58^{c}	56^{c}	3.99	P<0.05
Total live weight gain (kg)	14.33	16	14.5	14.19	13.5	14.17	0.94	NS
Daily live weight gain (g/day)	217^{b}	204^{b}	216^{b}	236^{a}	230^{a}	241^{a}	13.7	P<0.05
DMI (kg/day)	1.32^{b}	1.34^{b}	1.42^{a}	1.41^{a}	1.44^{a}	1.49^{a}	0.4	P<0.05
Feed conversion ratio (feed/kg gain)	6.2	6.5	6.6	6.1	6	6.1	0.41	NS

Note: [1] SH = Shugor, DU = Dubasi, WA = Watish, DU x WA = Dubasi x Watish, SH x Du = Shugor x Dubasi, SH x Wa = Shugor x Watish, [a, b, c] Means in the same row with similar superscripts are not significantly different, [2] NS = not significant.

Slaughter Data and Carcass Characteristics of the Desert Lambs

Table 2 shows the slaughter data of the different experimental groups. No significant differences were found in hot carcass weight, cold carcass weight and dressing percentage among the groups. The hot dressing percentage ranged between 49.77% in WA to 47.94% in SH x WA, and the cold dressing percentage ranged between 47.21% in SH to 46.22% in DU x WA. Also no significant difference was observed in carcass composition (lean, fat, bone, and trims) of the experimental groups. However, SH x DU lambs showed the highest lean percentage (59.20%), WA lambs showed the highest fat percentage (16.30), and SH lambs showed the highest bone percentage (21.99). The lean to bone ratio and lean to fat ratio were not significantly different among the lamb groups.

Table 2: Slaughter Weight and Carcass Characteristics of Sudan Desert Sheep Ecotypes and Their Crosses

Item	Treatment Groups[1]						S.E	P. Level
	SH	DU	WA	DU x Wa	SH x DU	SH x WA		
Slaughter weight (kg)	38.88	39.38	39.5	39.88	39.75	38.5	0.58	NS[2]
Hot carcass weight (kg)	19.4	19.1	19.65	19.15	19.13	18.4	0.42	NS
Cold carcass weight (kg)	18.34	18.5	18.88	18.43	18.45	17.8	0.45	NS
Cold side weight (kg)	9.03	8.6	8.6	8.7	8.38	8.1	0.19	NS
Dressing percentage								
Hot C.W[3]/live wt. base	49.08	48.35	49.77	48.02	48.02	47.94	0.94	NS
Hot C.W/empty body weight base	55.99	55.79	56.31	55.65	55.51	55.94	0.86	NS
Cold C.W/live weight base	47.21	46.95	47.81	46.22	46.47	46.27	1.04	NS
Cold C.W/empty body weight base	53.81	54.15	54.09	53.56	53.48	53.97	0.99	NS
Total muscle %	57.9	55.96	55.08	59.14	59.2	56.55	2.08	NS
Total bone %	21.99	21.28	19.9	20.5	21	20.75	0.61	NS
Total fat %	11.59	15.71	16.3	14.15	14.48	14.38	1.18	NS
Trims %	5.46	5.14	4.95	4.34	4.23	5.25	0.74	NS
Muscle: bone ratio	2.64	2.63	2.86	2.88	2.82	2.73	0.21	NS
Muscle: fat ratio	2.07	3.81	3.49	5.19	4.95	4.15	0.64	NS

Note: [1] SH = Shugor, DU = Dubasi, WA = Watish, DU x WA = Dubasi x Watish, SH x Du = Shugor x Dubasi, SH x Wa = Shugor x Watish, [a, b, c] Means in the same row with similar superscripts are not significantly different. [2] NS = not significant, [3] c.w = carcass weight.

Wholesale cuts expressed as a percentage of half cold carcasses of lamb groups is shown in Table 3. There were no significant differences in the prime cuts between the experimental groups. Crossbred lambs (DU x WA, SH x DU, and SH x WA) yielded significantly heavier leg and chump and single short forequarter cuts than purebred lambs. SH x DU lambs yielded the heaviest leg and chump as well as single short forequarter cuts. Loin cut was heavier in SH x WA followed by SH and least in WA lambs. Best end of neck was significantly (P<0.01) heavier in SH lambs compared to other lamb groups. Low value cuts as breast and neck were generally lighter in crossbred lambs.

Non-carcass component given in Table 3 revealed no significant differences among lambs groups except for kidney knob and channel fat,omentumfat and reproductive organs. The kidney knob and channel fat and omentum fat were significantly (p< 0.05) heavier in WA lambs compared with the other lamb groups.

DISCUSSION

The improvement in growth performance of crossbred lambs compared with purebred lambs could be due to hybrid vigor. The improvement of growth by crossbreeding in sheep was reported previously, i.e., Macit *et al.* (2001), Sauer *et al.* (2013) and Korkmaz and Emsen (2016). SH x

Table 3: Non-Carcass Component of Sudan Desert Sheep Ecotypes and Their Crosses (Percentage of Empty Body Weight)

Item	Treatment Groups[1]						S.E	P. Level
	SH	DU	WA	Du x Wa	SH x DU	SH x WA		
Head	7.08	6.87	6.88	7.28	7	6.95	0.17	NS
Skin	10..50	9.1	9.39	9.68	9.43	9.33	1.62	NS
Four feet	10.47	10.15	9.4	8.3	10.1	9.8	1.12	NS
Heart	0.48	0.43	0.51	0.4	0.44	0.51	0.04	NS
Lung and trachea	2.64	2.55	2.35	2.38	2.68	2.85	0.16	NS
Intestine (empty)	3.5	3.3	3.5	3.9	3.33	4	0.27	NS
Stomach (empty)	3.57	3.36	3.45	3.43	3.5	3.63	0.18	NS
Liver	1.99	2.02	2.05	1.93	2.05	2.07	0.12	NS
Spleen	0.45	0.53	0.32	0.33	0.53	0.42	0.07	NS
Kidneys	0.35	0.33	0.35	0.33	0.38	0.35	0.02	NS
Kidney knob and channel fat	1.14^{b}	1.40^{b}	1.60^{a}	1.13^{b}	1.58^{ab}	1.48^{ab}	0.16	P<0.05
Omentum fat	2.07^{a}	2.14^{a}	2.58^{c}	2.00^{a}	1.58^{b}	2.25^{ab}	0.25	P<0.05
Mesenteric fat	1.06	1.34	1.33	1.35	1.03	1.2	0.13	NS
Reproductive organs	1.13^{c}	1.31^{b}	1.25^{bc}	1.58^{a}	1.60^{a}	1.38^{b}	0.09	P<0.001

Note: [1] SH = Shugor, DU = Dubasi, WA = Watish, DU x WA = Dubasi x Watish, SH x Du = Shugor x Dubasi, SH x Wa = Shugor x Watish, [a, b, c] Means in the same row with similar superscripts are not significantly different, [2] NS = not significant.

Table 4: Yield of Wholesale Cuts of Sudan Desert Sheep Ecotypes and Their Crosses (% of Cold Side Weight)

Joint	Treatment Groups[1]						S.E	P. Level
	SH	DU	WA	DU x Wa	SH x DU	SH x WA		
Leg and chump	32.55^{b}	32.88^{b}	34.50^{a}	35.03^{a}	35.83^{a}	34.78^{a}	0.66	P<0.05
Single short forequarter	32.55^{c}	33.40^{ab}	32.70^{b}	33.90^{b}	35.55^{a}	35.08^{a}	0.42	P<0.01
Loin	11.46	11.45	10.63	10.96	11.45	11.98	0.47	NS[2]
Best end of neck	8.45^{a}	7.90^{ab}	7.90^{ab}	7.20^{b}	7.2	7.30^{b}	0.25	P<0.01
Breast	5.5^{a}	5.1^{b}	5.7^{a}	4.85^{b}	4.95^{bc}	5.2^{ac}	0.18	P<0.05
Neck	8.10^{a}	8.43^{a}	7.95^{a}	8.8^{a}	7.45^{ab}	7.15^{b}	0.31	P<0.05
Tail	2.05	1.7	1.9	1.6	1.6	1.7	0.25	NS

Note: [1] SH = Shugor, DU = Dubasi, WA = Watish, DU x WA = Dubasi x Watish, SH x Du = Shugor x Dubasi, SH x Wa = Shugor x Watish, [a, b, c] Means in the same row with similar superscripts are not significantly different, [2] NS = not significant.

WA lambs spent fewer days in the feedlot than the other lamb groups, and this due to their high growth rate. The high growth rate of this lamb group coincided with their high dry matter intake. Purebred DU lambs grew at a low rate, and that could be a reflection of their low dry matter intake, and to their genetic make-up. The fact that crossbred lambs were more efficient feed converter than purebred lambs could be explained by their higher growth rate over purebred lambs. Increases in food intake have a profound effect on growth and the efficiency of feed utilization (Lawrence *et al.*, 2012).

The decreased empty body weight of SH x WA lambs might be due to the increased gut fill of this lamb group. Hot and cold carcass weights of this crossbred group were the lightest among the different lamb groups, and these could be a consequence of their lighter empty body weight. The greater dressing percentage of WA lambs over the other lamb groups could be attributed to their lighter weight of non-carcass (components head, skin, intestine and rumen) and the increased degree of fatness of this lamb group,as the dressing percentage increased with fatness (Solomon *et al.*, 1980). Difference in carcass composition of these lambs could be explained by differences in their genetic background, reflected in mature size and maturation rate (Lawrence *et al.*, 2012). This could be seen in Table 2 where carcass muscle was greater in SH and DU purebred lambs and that crossing of these two types resulted in the highest carcass muscle. The reduction of carcass fat of this crossbred group is possibly due to the effect of SH blood. SH blood was also found to reduce carcass fat of WA lambs. Highcarcass fat also observed inthe crossed bred of WAparticularly in SH x WA lambs. The fact that carcass bone was least in WA lamb type compared with other lamb groups might be due to the size difference of this lamb type (McLeory, 1961). The highest muscle: bone ratio of WA x DU could be explained by the high muscle proportion of DU and low bone proportion of WA lambs.

CONCLUSION

It can be concluded that crossbred lambs showed better growth performance than purebred lambs and that crossbred took a shorter time to attain the target live weight of 40 kg. Carcass characteristics did not differ significantly between groups. Larger-scale experiments are necessary to confirm the results on growth performance and carcass characteristics of crossbred and purebred Sudan lambs under different conditions.

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