

GROWTH AND COMPOSITION OF THE OMANI DHOFARI CATTLE

1. BODY WEIGHT GROWTH AND CARCASS COMPOSITION*

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Summary

A study was conducted which demonstrated that Dhofari cattle responded well to intensive management systems in terms of growth rates and carcass yields. Twenty-four Omani Dhofari bulls and steers (12 of each) were reared from birth until slaughter at 110, 160 or 210 kg body weight (four of each sex at each slaughter weight). Calves were fed *ad libitum* a diet of concentrate (16.5% CP) and Rhodesgrass hay (8.8% CP). Bulls and steers reached the predetermined slaughter weights of 110, 160 and 210 kg at 154 and 164; 219 and 233; 273 and 310 days of age, respectively. Respective mean pre and post-weaning daily body weight gains for bulls and steers were 581 and 530; 796 and 706 g averaging 645 and 596 g over 36 weeks. At 210 kg, the heaviest weight of the study, dressing-out percentage (DO) was 54.5 and 56.9 yielding carcasses of 115.9 and 118.5 kg which contained 60.4 and 61.5% muscle; 11.6 and 11.4% bone and 24.5 and 22.9% fat for bulls and steers, respectively. Proportion of bone in the carcass decreased, that of fat increased, whereas that of muscle remained unchanged between slaughter weights of 110 to 210 kg. That resulted in increased muscle : bone and decreased muscle : fat ratios. At 160 kg body weight, bulls had less fat and more muscle and bone than steers but there were no sex differences in carcass composition at 210 kg slaughter weight.

(Key Words : Omani Dhofari cattle, Body weight growth, Body composition, Non-carcass components)

Introduction

Cattle numbers in Oman have been estimated at 126,000 out of a total of about one million livestock (Anonymous, 1987). Dhofari cattle, which are kept mostly by the Jebali people in the southern region of Oman (Dhofar), constitute about 63% of the total Oman cattle population (Anonymous, 1987). Dhofari cattle is a small-sized breed with a small cervico-thoracic hump, short horns, a narrow body and a tendency towards dark skin colours. They are fed seasonal range grass especially during the monsoon season, Rhodesgrass hay, by-products such as dates, fish, banana stems and household leftovers. Under traditional management systems, the performance of

Dhofari cattle is poor so they contribute only a small proportion of the total national meat requirements. Large amounts of chilled and frozen meat products therefore need to be imported into the country. With improvement of management and control of diseases, Dhofari cattle have enhanced their performance in terms of growth rates (Anonymous, 1978). Further investigation on growth and carcass composition in these animals is needed to evaluate their future role in meat production in Oman. This study aimed to study the performance of Dhofari cattle under improved management.

Materials and Methods

Twenty-four bull and steer Dhofari cattle (12 of each sex) were used. Every second male born was allocated to the steer group by castrating with a burdizzo during the first 4 weeks of life. Four animals of each sex were randomly allocated to be slaughtered at 110, 160 and 210 kg body weights. These slaughter weights were chosen to represent a range at which local animals are traditionally marketed and slaughtered. Calves were fed

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concentrate (16% CP) creep feed from one month of age and weaned at 24 weeks of age. From weaning until slaughter calves were fed on the same pelleted feed *ad libitum* plus Rhodesgrass hay (table 1). Water and salt blocks were provided *ad libitum*. Calves were weighed weekly from birth to slaughter.

TABLE 1. COMPOSITION OF EXPERIMENTAL FEEDS (%) ON DRY MATTER WEIGHT BASIS

Type of feed	Dry matter	Crude protein	Crude fibre	Crude fat	Ash
Concentrate	92.7	16.50	2.26	3.34	5.89
Rhodesgrass hay	93.4	8.83	40.90	1.80	9.38

Animals were slaughtered the Muslim (Halal) way when each animal reached its pre-determined weight in Sultan Qaboos University Farm slaughter house. Carcass and non-carcass components were weighed immediately after slaughter. The liver was weighed with gall bladder. The weight of the four unskinned feet was recorded as feet weight. Carcasses were split along the vertebral column into left and right halves and left half was chilled for 24 hours at 4°C then wrapped in polyethylene bags and stored at -15°C. Weight of gut fill was computed as the difference between a full and empty alimentary tract. Empty body weight (EBW) was computed as the difference between slaughter weight and weight of gut fill. The left half was dissected into muscle, bone, fat and connective tissue.

Experimental data were analysed utilising Statistical Analysis Systems (SAS, 1985) General Linear Models procedures. Least square means were computed and tested for significance using Duncan's Multiple Range Test. Rates of growth of body organs in relation to EBW were evaluated using Huxley's (1932) equation of relative growth in the logarithmic form, $\log Y = \log a + b \log X$, where Y is a body component of X (a whole, e.g. EBW) and b and a are constants.

Results

Body weight growth

The mean birth weight of the male Dhofari cattle in this study was 15.0 kg. They had an overall daily gain range of 596 to 645 g. This enabled them to reach mean weights of 110, 160 and 210 kg at 154 or 164, 219 or 233 and 273 or 310 mean days of age for bulls and steers, respectively (table 3). Entire males grew faster before and

after weaning thus reaching the slaughter weight of 210 kg 37 days earlier than the castrates. By 40 weeks of age the bulls weighed approximately 13 kg (6.6%) more than the steers (table 2 and 3).

TABLE 2. MEAN BODY WEIGHT (KG) AND GROWTH RATES (G) ± SE (STANDARD ERROR OF MEANS) IN DHOFARI BULLS AND STEERS

Item	Bulls	Steers	SE	Effect of castration
Body weight (kg):				
At birth	14.83	15.17	1.67	
At 12 weeks	66.00	60.40	6.12	
At 24 weeks	119.56	109.80	5.50	
At 36 weeks	183.50	168.75	6.50	*
At 40 weeks	206.50	193.67	5.50	*
Daily weight gain (g/d):				
Prewaning (0-24 weeks)	581	530	10	*
Postweaning (24-36 weeks)	796	706	20	*
Overall (0-30 weeks)	645	596	20	*

* Effects of castration are significant ($p < 0.05$).

Body composition

Dressing-out percentage (DO) in Dhofari bulls and steers ranged between 53.2-56.9% (58.9-60.4% on EBW basis) yielding carcasses of 61-62, 85-91 and 116-119 kg at a slaughter weights of 110, 160 and 210 kg, respectively (table 3).

Table 4 shows the weight of a number of non-carcass components as % of body weight of Dhofari bulls and steers at the three slaughter weights. Total offals weighed 26.2-27.6% of slaughter weight with the hide contributing the highest proportion (6.2-7.9%). Gut fill contributed 6.6-7.7% of the slaughter weight. The offals grew at differential rates in relation to EBW. The head, hide, feet, empty alimentary tract, spleen, heart and kidneys grew at a lower rate; liver, lungs and trachea, diaphragm, tail and total offals grew at a similar rate whereas, omental fat, mesenteric fat and genitals, grew with a rate higher than that of EBW.

Over the range of 110-210 kg body weight, proportions of the carcass muscle and bone decreased because of their low rate of growth in relation to EBW. Proportions of fat increased due to its higher rate of growth than EBW (table 5). For both bull and steer

TABLE 3. PERFORMANCE PARAMETERS OF DHOFARI BULLS AND STEERS SLAUGHTERED AT 110, 160 AND 210 kg BODY WEIGHTS

Item	Bulls			Steers			SE
	110 kg	160 kg	210 kg	110 kg	160 kg	210 kg	
Slaughter age (days)	154 ^d	219 ^c	273 ^b	164 ^d	233 ^c	310 ^a	11
Empty body weight (kg)	104.832	143.961	196.303	101.541	150.961	197.012	1.768
Hot carcass weight (kg)	61.975 ^c	84.800 ^b	115.875 ^a	61.175 ^c	91.050 ^b	118.500 ^a	1.638
Dressing Out % ¹	55.1 ^{ab}	53.2 ^b	55.4 ^a	55.6 ^a	56.1 ^a	56.9 ^a	0.9
Dressing Out % ²	59.2	58.9	59.0	60.3	60.3	60.4	0.9

^{ab,c} Means on the same line without or denoted with the same superscripts do not differ (p > 0.05).

¹ DO % on full weight basis.

² DO % on EBW basis.

TABLE 4. WEIGHT OF NON-CARCASS OFFALS (% SLAUGHTER WEIGHT) AND THEIR GROWTH COEFFICIENTS RELATIVE TO EBW OF DHOFARI BULLS AND STEERS SLAUGHTERED AT 110, 160 AND 210 BODY WEIGHTS

Item	Bulls			Steers			SE	SLWT	Growth coefficients	
	110 kg	160 kg	210 kg	110 kg	160 kg	210 kg			<i>b</i>	<i>sb</i>
Head	6.08 ^a	5.52 ^b	5.07 ^c	5.77 ^b	5.11 ^c	4.54 ^d	0.11	***	0.65***	0.05
Hide	7.75 ^a	7.88 ^a	7.21 ^b	7.22 ^b	7.03 ^b	6.29 ^c	0.19	**	0.81*	0.07
Feet	2.20 ^a	1.99 ^b	1.71 ^c	2.28 ^a	1.98 ^b	1.69 ^c	0.06	***	0.54***	0.05
Gut fill	6.84	6.61	6.07	7.70	6.94	5.88	0.92	*	0.65	0.24
Alimentary tract [@]	4.62 ^{ab}	4.79 ^a	4.14 ^b	4.81 ^a	4.83 ^a	4.06 ^b	0.25	*	0.76*	0.10
Liver	1.44	1.47	1.55	1.36	1.47	1.39	0.09		1.03	0.09
Spleen	0.29 ^{ab}	0.26 ^{bc}	0.23 ^c	0.31 ^a	0.27 ^b	0.23 ^c	0.02	***	0.56***	0.08
Heart	0.52 ^a	0.45 ^{bc}	0.39 ^c	0.49 ^{ab}	0.43 ^{bc}	0.41 ^c	0.03	**	0.64**	0.09
Kidneys	0.26 ^a	0.26 ^a	0.22 ^b	0.25 ^a	0.25 ^{ab}	0.23 ^b	0.01	*	0.79*	0.08
Lungs & trachea	1.23	1.23	1.21	1.25	1.26	1.34	0.08		1.00	0.10
Omental fat	1.77 ^c	1.99 ^c	3.15 ^a	1.80 ^c	2.52 ^b	2.99 ^a	0.19	***	1.84***	0.11
Mesenteric fat	0.93 ^d	1.31 ^c	1.87 ^b	0.93 ^d	1.67 ^b	2.52 ^a	0.15	***	2.29***	0.16
Genitals	0.05 ^b	0.07 ^a	0.07 ^a				0.008		1.71*	0.29
Diaphragm	0.68	0.63	0.76	0.72	0.78	0.70	0.06		0.99	0.03
Total offals	27.62 ^a	27.64 ^a	27.40 ^a	27.03 ^{ab}	27.44 ^a	26.25 ^b	0.45		1.02	0.03
Tail	0.30	0.32	0.32	0.30	0.28	0.27	0.02		0.96	0.11
Penis	0.05 ^b	0.07 ^a	0.07 ^a	0.03 ^c	0.04 ^c	0.03 ^c	0.004	*	1.26	0.28

^{ab,c} Means on the same line without or denoted with the same superscripts do not differ significantly (p > 0.05).

b regression coefficient, *, **, *** its value is different (p < 0.05, 0.01, 0.001) from 1.0 and *sb* its standard error.

*, **, *** Effects of slaughter weight (SLWT) are significant (p < 0.05, 0.01, 0.001).

@ Empty.

calves, proportions of these carcass tissues ranged between 60.4-68.1; 11.4-15.0 and 14.1-24.5% of carcass for muscle, bone and fat, respectively. Over this range muscle : bone ratio increased whereas that of muscle : fat decreased (table 5).

As proportions of slaughter weight, bulls had heavier

head, hide and penis than steers at all weights; higher proportions of total offals at 210 kg but lower proportions of omental fat at 160 kg and lower mesenteric fat at 160 and 210 kg (table 4). At 160 kg bulls had higher proportions of muscle and lower proportions of fat in their carcasses than steers (table 5). This resulted in a

significantly higher muscle : fat ratio in bulls than steers. However, there were no significant difference between the two sexes at 210 kg body weight (table 5).

TABLE 5. MEAN WEIGHT OF CARCASS COMPONENTS (% CARCASS WEIGHT) AND THEIR GROWTH COEFFICIENTS RELATIVE TO CARCASS WEIGHT OF DHOFARI BULLS AND STEERS AT 110, 160 AND 210 KG BODY WEIGHTS

Component	Bulls			Steers			SE	Growth coefficients	
	110 kg	160 kg	210 kg	110 kg	160 kg	210 kg		<i>b</i>	<i>sb</i>
Muscle	66.8 ^a	68.1 ^a	60.4 ^c	66.1 ^{ab}	64.0 ^{bc}	61.5 ^c	1.2	0.88*	0.03
Bone	14.9 ^a	13.5 ^b	11.6 ^c	15.0 ^a	12.9 ^b	11.4 ^c	0.4	0.61***	0.04
Total fat	13.9 ^c	14.1 ^c	24.5 ^a	14.2 ^c	18.5 ^b	22.9 ^a	1.4	1.77**	0.12
Muscle : bone	4.51 ^c	5.05 ^{ab}	5.24 ^{ab}	4.42 ^c	4.98 ^b	5.40 ^a	0.15		
Muscle : fat	4.89 ^a	4.88 ^a	2.53 ^c	4.81 ^a	3.57 ^b	2.70 ^{bc}	0.36		

^{ab,c} Means on the same line without or denoted with the same transcripts do not differ significantly ($p > 0.05$).

b is growth coefficient, *, **, *** its value is different ($P < 0.05, 0.01, 0.001$) from 1.0 and *ab* its standard error.

Discussion

Body weight growth

The efficiency of animals to produce meat is measured by their rate of weight gain and carcass yield. Undeveloped tropical beef breeds like the Dhofari are reputed to have low production levels reflected in both low growth rates and carcass yields. In most of these breeds it has not been fully established whether this low productivity is due to their genetic makeup or to poor management. In the present experiment Dhofari cattle had fast pre and post-weaning growth rates which enabled them to reach the slaughter weight of 210 kg at about 9-10 months. Under traditional management systems this weight is achieved by Dhofari cattle at the age of 2 years or more (Anonymous, 1978). This indicates that the breed does respond well to improved management. Growth rates achieved in this study were higher than those of many beef cattle breeds in Arab countries (Anonymous, 1987) and comparable to those of improved tropical breeds (Hill, 1988). Lodge (1989) reported that Dhofari cattle grew well in absolute terms, especially when reared on their dams, and remarkably well in relation to their small initial size or the mature weight of parent stock compared to calves of temperate dairy breeds (Friesian, Jersey and Australian Milking Zebu) raised under similar conditions. Dhofari cattle appear to have good potential for efficient meat production and their small size could be a distinct advantage under husbandry systems in Oman because of limited feed resources. Rearing of beef cattle under intensive systems such as cereal beef reduces slaughter age. For example in the U.K., beef produced from cereals

or arable products reached slaughter weight of about 400 kg, a weight approximately 10 times their birth weight, at 10-12 month of age (Gerrard and Mallion, 1980). Dhofari cattle reached a weight (210 kg) much greater than 10 times their birth weight (15 kg) at an age lower than that reported for these temperate breeds.

The birth weight of 15.0 kg recorded in the present study for male Dhofari cattle is comparable to that reported for the breed elsewhere in Oman (Anonymous, 1978). While a higher birth weight, 24 kg (Anonymous, 1987), has been observed, this appears to be an exception. However, variations in body weights including birth weight are expected for unimproved breeds such as the Dhofari. Birth weight of the Dhofari cattle is also comparable to that of cattle in the Arab World (Anonymous, 1987) and Africa (Wilson, 1987) but low compared to those of temperate improved beef breeds indicating the small adult size of the breed.

Body composition

Accompanying their improved body weight growth performance, Dhofari cattle also had good carcass yields in the form of high dressing-out percentage and weight of offals. This is consistent with the few reports on local cattle when raised under improved management (M. G. El Hag, personal communications 1994). Dressing-out percentage in Dhofari cattle computed on full and empty body basis in this study was comparable to that reported for improved tropical and temperate breeds and their crosses (Hill, 1988; Waddad and Gaili, 1988).

The low rate of growth of most internal organs indicate that their proportion in the slaughter weight will

decrease whereas the high rate of the omental and mesenteric fats increases with increased body weight. This has been reported in domestic animals (Hammond, 1932). Proportions of internal organs in the body of Dhofari cattle were generally similar to those reported for crosses of other Omani cattle (El Hag and Al Shargi, 1993) and to those in tropical breeds (Waddad and Gaili, 1988).

Under intensive management Dhofari cattle produced carcasses of good quality as reflected in its carcass composition. At the weight of 210 kg they had high lean and low bone content. Bone content of the carcass is an important factor in determining its value. Proportion of bone in improved beef cattle carcasses should not exceed 14% (Hill, 1988). Dhofari cattle carcasses in this study contained about 11% bone which is well within this range in contrast with tropical zebu cattle in which bone percentage may reach up to 20% (Hill, 1988). The proportion of bone depends on the degree of finish of the carcass, the higher the fat percentage the lower bone content. Fat content in Dhofari cattle carcasses at 210 kg body weight of 23-25% was higher than that reported for tropical breeds such as the Boran (18%) but less than those reported for improved temperate breeds such as the Hereford (35.7%) and Angus (39.4%) (Hill, 1988). Proportions of carcass fat increased with increased body weight reaching its highest level at 210 kg body weight. When this is combined with the small size of the breed as indicated by its low birth weight and weight at 10 months it suggests the early maturity of the breed. This indicates that Dhofari cattle should be slaughtered at weights lower than those of temperate beef breeds to avoid deposition of excess fat in the carcass.

Effect of castration:

Castration reduced growth rate of Dhofari cattle and prolonged time needed to reach slaughter weight. At 40 weeks of age steers weighed 13 kg less than bulls. This is in line with reports on temperate beef cattle that bulls consistently gain faster, require less feed and produce leaner carcasses than steers (Perry, 1980). Lack of significant differences in composition between bulls and steers at heaviest weights in the present study does not comply with reports in the literature (Berg and Butterfield, 1978). However, it might have resulted from the use of small numbers of animals in the study.

Castration is traditionally practised worldwide in beef cattle for easy management and to improve carcass quality by increasing fat cover and marbling. Older castrates eat more feed thus allow less animals to be kept on available feed. This is of great significance in Oman and other parts of the tropics which has limited animal feed resources. To

exploit Dhofari cattle to their best potential, results of the present study show that entire males will give more efficient meat production.

This study demonstrated that Dhofari cattle show improved performance reflected in higher growth rates and good carcass yield when raised under an intensive management system. Castration reduced body weight gains and resulted in a higher rate of fat deposition at lower body weight.

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