Der Tropenlandwirt, Zeitschrift für die Landwirtschaft in den Tropen und Subtropen
91. Jahrgang. Oktober 1990, S. 119 – 132

Body Measurements of Buffalo and Cow Calves as Affected by Weaning, Calving Season and Sex and Their Relation to Body Weight and Carcass Traits

Beeinflussung der Körpermessungen durch Aufzuchtverfahren, Abkalbesaison und Geschlecht sowie ihre Beziehung zum Körpergewicht und Schlachtkörperwert beim Büffel und Rind

by F.M.R. El-Feel[1], M.T. Sallam[1], E.S. Tawfik[2] and A.A. Abdel-Ghani[1]

1 Introduction

Body dimensions have been considered as qualitative growth indicators that reflect the conformational changes occurring during the life span of the animal. They have their value in estimating the potentialities and suitability of animals especially for meat production, when the measurement of the main traits is not possible.

The objective of this study is to investigate the effect of the weaning system, season of calving and sex on body measurements and their relation to body weight and carcass traits of buffalo and cow calves.

2 Materials and Methods

This study was carried out at the farm of the Department of Animal Production, Faculty of Agriculture, Minia University, Egypt. Sixty-four buffalo calves (35 males + 29 females) and 52 cow calves (22 males + 30 females) from highly graded Friesian with local Egyptian Baladi cows were used. The following weaning systems were followed for buffalo calves, while the first three systems were followed with cow calves:

1 Late weaning (90 days) + starter diet during the suckling period (LW + St.).

[1] Dr. F.M.R. El-Feel, Dr. M.T. Sallam and Dr. A.A. Abdel-Ghani; Faculty of Agriculture, Minia University, Minia, Egypt
[2] Prof. Dr. E.S. Tawfik; Faculty of International Agriculture, Kassel University, Witzenhausen, West Germany

2 Late weaning (90 days) + co-operative feed mixture which is normally used as a concentrate for animals (LW + Co-op).

3 Skim milk solution is offered at the beginning of the 2nd month of age. Calves suckle their mothers naturally during the first month of age, then skim milk solution is offered up to 90 days of age along with the starter diet (SM + St.).

4 Foster mother system where buffalo calves were allowed to suckle cow mothers in addition to the starter diet up to 90 days of age (FM + St.).

All animals were fed after weaning on the commercial cubed diet (co-op feed) plus Egyptian clover (*Trifolium alexandrinum*) during winter or drawa (green maize) during summer. Rice straw was used as roughage representing 30 % of the requirements. Animals were fed individually according to TOMMI standards (1963). They were weighed and body measurements were recorded bi-weekly in the morning before drinking and feeding. The recorded measurements were height at withers (H.W.), body length (B.L.), heart girth (H.G.), chest depth (Ch.D.), abdomen depth (Ab.D.), width at hooks (W.H.), cannon length (C.L.) and cannon girth (C.G.). Male calves were slaughtered at two years of age while females remained on the farm.

Data of body measurements were analyzed by the least squares means method (HARVEY 1987). Tukey test (JOHN et al. 1985) was used to test the differences between means. The following statistical model was assumed:

$y_{ijkn} = \mu + s_i + x_j + w_k + e_{ijkn}$ where:

y_{ijkn} = the observation on the n^{th} animal born in the i^{th} season of the j^{th} sex in the k^{th} weaning system.

μ = the overall mean,

s_1 = fixed effect of the i th season of calving (1 = summer, 2 = winter)

x_j = fixed effect of the j th sex (1 = male, 2 = female)

w_k = fixed effect of k^{th} weaning system (k = 1, 2, 3 for both buffalo and cow calves and the 4^{th} system was for buffalo calves only).

e_{ijkn}= the random error

Partial regression and correlation coefficients of live body weight for all animals (males and females) or carcass traits for slaughtered males were calculated within the main effects.

Table I: Least square constants for various factors affecting linear body measurements of buffalo and cow calves at different ages

Source	Buffaloes								Cows							
	Height/ wither	Body length	Heart girth	Chest depth	Abdom. depth	Width/ hooks	Cannon girth	Cannon length	Height/ wither	Body length	Heart girth	Chest depth	Abdom. depth	Width/ hooks	Cannon girth	Cannon length
24 weeks of age																
Overall mean:	101.2	78.7	114.0	45.7	47.8	26.0	14.8	21.8	92.6	82.2	110.4	43.3	48.2	23.6	13.6	21.5
	±0.7	±0.7	±0.9	±0.4	±0.4	±0.3	±0.1	±0.2	±0.6	±0.9	±0.8	±0.3	±0.6	±0.4	±0.1	±0.2
Weaning system	NS	NS	NS	NS	NS	NS	NS	**	*	**	**	**	**	**	**	NS
LW+st	-1.9	-1.0	-0.9	-0.6	-0.7	0.4	-0.1	-0.6a	2.0a	1.3ab	5.4a	1.7a	2.8a	1.0a	0.6a	0.0
LW+co-op.	-1.0	2.2	-0.6	-0.5	-1.1	-0.4	-0.3	-0.3a	-2.3b	-4.3a	-5.3b	-2.0b	-2.8b	-2.7b	-0.6b	-0.4
SM+st	0.7	0.0	0.0	0.5	0.6	-0.2	-0.3	0.8b	0.3ab	3.0b	-0.1ab	0.3a	0.0ab	1.7a	0.0ab	0.4
FM+st	2.2	-1.2	1.5	0.6	1.2	0.2	0.1	0.1ab	—	—	—	—	—	—	—	—
Season of calving	*	NS	**	*	NS	NS	*	**	NS	NS	*	NS	NS	NS	NS	NS
Summer	1.5	0.5	2.2	0.7	0.6	0.3	0.3	0.4	0.3	-2.1	-2.0	-0.5	-0.9	-0.1	0.0	0.2
Winter	-1.5	-0.5	-2.2	-0.7	-0.6	-0.3	-0.3	-0.4	-0.3	2.1	2.0	0.5	0.9	0.1	0.0	-0.2
Sex	NS	NS	NS	NS	NS	NS	*	NS	NS	NS	NS	NS	NS	NS	*	NS
Male	0.7	-0.2	0.4	0.1	0.3	0.0	0.2	0.0	0.1	-0.2	-0.5	0.6	0.5	-0.1	0.3	0.2
Female	-0.7	0.2	-0.4	-0.1	-0.3	0.0	-0.2	0.0	-0.1	0.2	0.5	-0.6	-0.5	0.1	-0.3	-0.2
52 weeks of age																
Overall mean:	118.2	96.2	143.3	57.2	58.0	34.6	17.1	24.1	109.0	105.4	142.1	56.0	60.4	33.1	16.4	24.4
	±0.8	±0.9	±1.3	±0.5	±0.5	±0.4	±0.2	±0.2	±0.6	±0.6	±0.9	±0.3	±0.5	±0.3	±0.1	±0.2
Weaning system	NS	NS	NS	NS	NS	NS	NS	NS	NS	**	**	**	**	**	**	*
LW+st	0.6	1.1	1.8	0.8	1.6	0.6	0.6	-0.3	1.7	2.8a	5.9a	1.5a	3.1a	1.6a	0.8a	0.1ab
LW+co-op.	-2.3	-0.9	-4.8	-1.5	-1.4	-1.4	-0.5	-0.4	-1.1	-4.1b	-5.1b	-1.9b	-3.0b	-2.6b	-0.6b	-0.5a
SM+st	0.4	0.7	0.3	0.5	-0.1	0.3	0.5	0.1	-0.4	1.3a	-0.8ab	0.4ab	-0.1ab	1.0a	-0.2b	0.4b
FM+st	1.3	-0.9	2.7	0.2	-0.1	0.5	-0.6	0.6	—	—	—	—	—	—	—	—

Season of calving	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Summer	1.0	0.4	1.6	0.5	0.1	0.3	0.0	0.1	0.5	-0.8	-1.4	-0.6	-0.6	-0.6	-0.2	0.0
Winter	-1.0	-0.4	-1.6	-0.5	-0.1	-0.3	0.0	-0.1	-0.5	0.8	1.4	0.6	0.6	0.6	0.2	0.0
Sex	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	**	NS	NS	**	NS
Male	1.0	1.2	0.7	0.3	0.6	0.0	0.3	0.2	0.9	0.4	1.6	0.8	0.3	-0.1	0.7	0.3
Female	-1.0	-1.2	-0.7	-0.3	-0.6	0.0	-0.3	-0.2	-0.9	-0.4	-1.6	-0.8	-0.3	0.1	-0.7	-0.3
76 weeks of age																
Overall mean:	128.6	109.0	165.0	65.7	64.4	40.8	19.4	24.9	118.9	117.9	162.9	63.2	66.3	38.3	18.1	25.9
	±0.9	±0.8	±1.3	±0.6	±0.6	±0.5	±0.3	±0.2	±0.8	±0.6	±0.8	±0.3	±1.5	±0.3	±0.2	±0.2
Weaning system	NS	*	NS	NS	NS	NS	**	NS	NS	**	**	**	NS	*	**	NS
LW+st	0.1	1.9a	3.8	1.4	0.6	1.4	0.8a	-0.5	0.7	3.1ab	5.3a	1.6a	1.2	1.7a	0.7a	0.2
LW+co-op.	-1.2	-1.2ab	-1.0	-0.8	-0.5	-0.4	0.0b	-0.1	-1.0	-1.5b	-1.8b	-1.8b	-4.4	-1.7b	-0.4b	-0.6
SM+st	0.2	-3.1b	-3.5	-1.2	-1.1	-0.9	-0.6b	0.2	0.3	-1.6b	-3.5b	0.2ab	3.2	0.0	-0.3ab	0.4
FM+st	0.8	2.4a	0.7	0.6	1.0	-0.1	-0.2b	0.4	—	—	—	—	—	—	—	—
Season of calving	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Summer	0.6	-0.2	0.7	0.4	0.4	0.1	-0.2	0.4	-0.5	-0.3	-1.1	-0.7	0.5	-0.4	-0.2	-0.2
Winter	-0.6	0.2	-0.7	-0.4	-0.4	-0.1	0.2	-0.4	0.5	0.3	1.1	0.7	-0.5	0.4	0.2	0.2
Sex	NS	*	NS	NS	NS	NS	**	NS	*	**	**	**	NS	**	**	NS
Male	1.5	1.9	1.3	0.6	0.3	-0.1	0.7	0.4	1.7	2.2	2.8	1.0	2.6	-0.6	1.1	0.5
Female	-1.5	-1.9	-1.3	-0.6	-0.3	0.1	-0.7	-0.4	-1.7	-2.2	-2.8	-1.0	-2.6	0.6	-1.1	-0.5
104 weeks of age																
Overall mean:	136.7	131.6	180.9	74.5	71.4	47.2	21.1	26.2	126.2	128.6	177.6	70.1	73.2	43.5	19.3	27.0
	±0.9	±1.0	±1.4	±0.6	±0.7	±0.5	±0.2	±0.2	±0.7	±0.7	±0.9	±0.4	±0.6	±0.3	±0.2	±0.2
Weaning system	NS	**	NS	NS	NS	NS	NS	NS	NS	*	**	**	**	**	**	*
LW+st	-0.5	2.2a	2.0	-0.5	-2.1	0.1	0.6	-0.1	-0.3	1.1a	3.2a	0.2a	1.3a	0.3ab	0.5a	-0.7a
LW+co-op.	-0.2	0.2ab	-0.3	1.4	0.8	0.1	-0.1	-0.6	-1.3	-3.0b	-3.6b	-2.5b	-4.1b	-2.1a	-0.6b	-0.1a
SM+st	0.0	-3.9b	-2.3	-1.4	0.8	-0.6	-0.1	0.2	1.6	1.9a	0.4ab	2.3a	2.8a	1.8b	0.1ab	0.8b
FM+st	0.7	1.5a	0.6	0.5	0.5	0.4	-0.4	0.5	—	—	—	—	—	—	—	—

Season of calving	NS	NS	NS	NS	NS	NS	NS	NS	NS	*	*	*	*	*	*	NS
Summer	0.9	0.8	0.2	0.2	0.5	-0.6	0.1	0.2	0.2	-2.3	-2.8	-1.3	-1.9	-1.0	-0.4	-0.0
Winter	-0.9	-0.8	-0.2	-0.2	-0.5	-0.6	-0.1	-0.2	-0.2	2.3	2.8	1.3	1.9.	1.0.	0.4	0.0
Sex	NS	**	NS	NS	NS	NS	**	NS	**	*	**	**	NS	NS	**	NS
Male	1.4	2.1	3.2	0.3	0.5	-0.1	1.2	0.4	3.2	1.8	3.8	1.9	0.8	-0.5	1.2	0.3
Female	-1.4	-2.1	-3.2	-0.3	-0.5	0.1	-1.2	-0.4	-3.2	-1.8	-3.8	-1.9	-0.8	0.5	-1.2	-0.3

NS = not significant * = Significant (P<0.05)* * = Significant (P<0.01)

Means with the same column having different letters are significantly different (P<0.05)

3 Results and Discussion

3.1 Factors affecting body measurements

Data in Table 1 show the least square constants for various factors affecting linear body measurements of buffalo and cow calves at different ages.

3.1.1 Effect of weaning system

The results in Table 1 revealed that the weaning system in buffalo calves had a significant effect on body length at 76 ($P<0.05$) and 104 ($P<0.01$) weeks of age in favour of (FM + St.) and (LW + St.) groups which had higher values than the other two groups. Also the weaning system had a significant effect ($P<0.01$) on cannon length at 24 weeks of age in favour of (SM + St.) group and cannon girth ($P<0.01$) at 76 weeks of age in favour of (LW + St.) group of buffalo calves. However, weaning system had no significant effect on all body measurements of buffalo calves at 12 months of age. EL-BARBARY (1966) stated that differences between comparable measurements of early and late weaned buffalo calves at similar ages were very small and not significant. SOKOL (1974) showed that body measurements of early weaned calves at 6 months of age were not significantly lower than those of the controls. However, SAIKIA et al. (1987) observed that body length, body height and heart girth were affected by diet (whole milk to 90, 60 and 30 days of age).

In cows, the weaning system was found to have a significant effect ($P<0.05$ or $P<0.01$) on all body measurements at different ages, except height at wither (at 52, 76 and 104 weeks of age), cannon length (at 24 and 76 weeks of age) and abdomen depth at 76 weeks of age. EL-FEEL (1984) reported that the weaning system was found to have a significant effect on most body measurements of buffalo and cow calves at different periods of age.

3.1.2 Effect of calving season

Season of calving had no significant effect on all body measurements of buffalo calves at 52, 76 and 104 weeks of age while there was a significant effect ($P<0.05$ or $P<0.01$) on height at withers, chest depth, cannot girth, heart girth and cannon length in favour of summer buffalo calvers at 24 weeks of age, (Table 1). EL-BARBARY (1966), MOSTAGEER et al. (1981) and EL-FEEL (1984) observed seasonal effect on most body measurements of Egyptian buffalo.

The season of calving in cow calves had no significant effect on all body measurement at 24, 52 and 76 weeks of age except heart girth at 24 weeks of age which varied significantly ($P<0.05$) in favour of winter calves. Also winter cow calvers had significantly ($P<0.05$) higher values for body length, heart girth, chest depth, abdomen depth, width at hooks and cannon girth than those of summer cow calvers at 2 years of age.

3.1.3 Effect of Sex

Male buffaloes exceeded significantly ($P<0.05$ or $P< 0.01$) females in cannon girth (at 24, 76 and 104 weeks of age) and body length at 76 and 104 weeks of age (Table 1). However, the

sex of calf had no significant effect on all body measurements at 52 weeks of age. MOSTAGEER et al. (1981) reported that sex had no significant effect on height at withers and abdomen height at 6 and 12 months of age and on body length, heart girth, height at withers, chest depth and abdomen height at 18 months of age.

Male cow calves had significantly ($P<0.05$ or $P<0.01$) higher values of height at withers, body length, heart girth, chest depth and cannon girth (at 76 and l04 weeks old), chest depth and cannon girth (at 52 weeks old) and cannon girth at 24 weeks of age than females (Table 1). On the contrary, male cow calves had significantly ($P<0.01$) lower value of width at hooks at 76 weeks of age than those of females. ABDEL-AZIZ (1960) stated that sex had a significant effect on body length and height at withers at one year old. MOSTAGEER (1978) reported that at six months of age all measurements were affected by sex of calf except abdomen height and maximum width of abdomen. AL-AMIN (1979) reported that sex had a significant effect on body length, heart girth and height at withers; males were superior to females. HEINRICHS and HARGROVE (1987) found that height at withers for Friesian heifers at 6, 12, 18 and 24 months of age was 101.0, 117,6, 127.4 and 132.7 cm respectively.

3.1.4 Differences between buffaloes and cows

It could be noticed from data in (Table 1) that buffalo calves had higher values of height at withers, heart girth, chest depth, width at hooks and cannon girth than cow calves at all ages studied. However, they showed lower values of body length, abdomen depth and cannon length than those of cow calves at most ages. Similar results were reported by EL-FEEL (1984). KALEFF (1942) reported that body measurements in buffalo were wider and deeper than in cattle.

3.2 Relationship between body weight and body measurements

Partial regression coefficients (b) of live body weight on body measurements and determination coefficients (R^2) at different age intervals in buffalo and cow calves are presented in Table 2. It could be noticed that in buffaloes, body weight showed a significant positive relationship with chest depth ($P<0.05$) at 24 weeks of age, body length ($P<0.01$) at 76 weeks of age and with height at withers and width at hooks ($P<0.05$) at 2 years of age. Coefficient of determination (R^2) ranged between 0.59 – 0.83 which means that body weight of buffalo calves at diffeent ages of study could be accurately predicted by involving body measurements in predicting equation. RASHEED (1977) and SAINI and GILL (1987) reported that there were significant relationships between most body measurements and body weight in buffalo calves.

Table 2. Partial regression coefficients of live body weight on body measurements of buffalo and cow calves at different periods of age

Age in weeks	Dep. variable x±SE[2]	Independent variables									
		Intercept	Height/ wither	Body length	Heart girth	Chest depth	Abdom. depth	Width/ hooks	Cannon girth	Cannon lenth	R^{2} [1]
Buffaloes											
24	118.24 ±2.35	–159.36	0.06	0.28	0.17	2.75[3]	1.12	0.82	1.85	0.66	0.81
52	218.85 ±4.10	–256.88	0.98	1.05	0.76	0.83	1.54	–0.25	–0.44	1.19	0.82
76	315.21 ±5.12	–337.04	0.16	2.10[4]	1.22	0.80	0.89	1.25	0.62	2.79	0.83
104	409.70 ±6.02	–316.26	3.21[3]	0.07	0.35	1.25	–0.16	4.37[3]	3.21	–5.34	0.59
Cows											
24	123.11 ±2.14	–94.72	0.99	–0.15	1.42[4]	–2.45	1.28	0.89	3.01	–1.69	0.73
52	248.02 ±3.09	–226.43	0.95	1.20	0.61	–0.97	1.79	0.75	8.06	–2.11	0.75
76	315.70 ±3.05	–311.00	0.89	0.38	1.34	–0.17	0.88	3.21[3]	6.50[4]	–0.13	0.69
104	431.12 ±4.70	–235.12	0.95	1.51	3.37	–1.66	–0.50	1.25	2.61	–7.30	0.71

1 R^2 = determination coefficient
2 Live body weight (kg)
3 significant P<0.05
4 significant P<0.01

The results in Table 2 showed that body weight in cow calves had significant (P<0.05 or P<0.01) and positive relationships with heart girth at 24 and 104 weeks of age, width at hooks and cannon girth at 76 weeks of age. However body weight showed insignificant and negative relationships with chest depth and cannon length at all ages studied. Values of (R^2) which ranged between 0.69 to 0.75 gave the evidence that body weight of cow calves during the first two years of age could be accurately predicted by using body measurements in appropriated prediction equation. JACTAB and KALE (1987) reported that there was a highly significant regression of body length, height at wither and chest girth on body weight.

3.3 Relationship between carcass traits and body measurements

Partial regression coefficients of carcass traits on body measurements and coefficients of determination (R^2) at 2 years of age (slaughter age) in buffalo and cow male calves are presented in Tables (3 and 4).

Table 3: Partial regression coefficients of carcass traits on live body measurements (cm) at slaughter of male buffalo calves

	Dependent variables	Independent variables											Determ. coeff. R2
	X±SE	Intersept	Height/ wither	Body length	Heart girth	Chest depth	Abdom. depth	Width/ hooks	Cannon girth	Cannon length	Dist. bet. eyes	Head length	
Fasting weight (Kg)	421.10±7.62	-633.01	0.71	1.36	1.36	1.99	1.00	1.92	6.02	4.48	-0.95	-0.02	0.73
Carcass weight (Kg)	225.60±3.10	-248.58	-1.17	2.93[2]	0.54	-1.29	1.65	-0.17	5.89	2.68	-0.55	-0.33	0.68
Boneless carcass (Kg)	184.40±2.77	-206.34	-1.09	2.51[2]	0.74	-1.88	1.34	0.27	2.08	4.27	0.64	-0.55	0.68
Meat/bone ratio	4.50±0.06	5.91	-0.04	0.02	0.02	-0.06	0.04	0.03	-0.03	-0.02	0.10[1]	-0.06	0.50
Boneless meat (%)	81.70±0.31	77.91	-0.05	0.04	0.13	-0.34	0.00	0.18	-0.23	-0.03	0.49[1]	-0.13	0.63
Fast dressing (%)	53.90±0.73	74.01	-0.37	0.52[2]	-0.04	-0.56	0.28	-0.26	0.68	0.07	0.00	0.15	0.42
Empty dressing (%)	56.00±0.90	77.17	-0.46	0.67[2]	-0.24	-0.02	0.51	-0.52	0.28	0.12	0.06	-0.21	0.40
Primal cuts (Kg)	162.40±3.8	-68.88	-1.06	2.36	0.53	-3.07	0.94	0.08	3.73	2.48	-0.02	0.18	0.60
%primal cuts/carcass	71.97±0.52	116.47	-0.07	0.08	0.07	-0.89[1]	-0.15	0.09	-0.25	0.26	0.19	0.18	0.44
Non prim. cuts (Kg)	63.19±0.91	-178.78	-0.10	0.57	0.01	1.78	0.70	-0.24	2.16	0.20	-0.54	-0.51	0.64
%non primal cuts/carcass	28.03±0.52	-116.47	0.07	-0.08	-0.07	0.89[1]	0.15	-0.09	0.25	-0.26	-0.19	-0.18	0.44
Eye musc. area (cm)	115.14±2.04	-23.54	0.30	0.54	-1.27	1.63	2.16	-0.56	2.38	-0.06	2.69	-1.80	0.45
Forequarters (Kg)	116.80±1.65	-155.80	-0.36	1.58[2]	0.21	0.05	0.58	-0.65	3.12	0.70	-0.69	0.17	0.74
%forequart./carcass	51.85±0.25	39.56	0.10	0.04	-0.03	0.30	-0.11	-0.25	0.01	-0.32	-0.18	0.15	0.50
Hindquarters (Kg)	108.25±1.65	-55.09	-0.52	1.05	0.52	-0.33	1.03	0.37	3.18	1.65	0.32	-0.52	0.58
%hindquart./carcass	48.15±0.25	75.84	0.01	-0.16	0.10	-0.71[2]	0.10	0.21	0.16	0.18	0.26	-0.16	0.53

1 = significance P<0.05

2 = significance P<0.01

Table 4: Partial regression coefficients of carcass traits on live body measurements (cm) at slaughter of male cow calves

	Dependent variables	Independent variables										Determ. coeff. R2
	X±SE	Intersept/Height wither	Body length	Heart girth	Chest depth	Abdom. depth	Width/ hooks	Cannon girth	Cannon length	Dist. bet. eyes	Head length	
Fasting weight (Kg)	440.80±6.25	–306.03	–1.11	2.23[1]	3.57	–2.50	–1.80	3.18	1.50	0.44	–0.85	2.28	0.89
Carcass weight (Kg)	254.30±2.88	–384.57	1.26	1.15	4.24[1]	–1.30	–2.82[1]	2.10	–3.33	–0.72	–1.74	–2.21	0.81
Boneless carcass (Kg)	212.00±3.10	–297.00	1.30	0.38	4.46[1]	–1.43	–3.19[1]	2.55	–4.54	–1.39	–1.82	–2.54	0.78
Meat/bone ratio	5.05±0.12	10.03	0.04	–0.09[2]	0.12[1]	–0.05	–0.12[2]	0.10	–0.20	–0.12	–0.03	–0.09	0.76
Boneless meat (%)	83.30±1.85	–148.78	–0.37	0.40	0.29	0.33	0.51	2.55	–3.08	2.71	0.75	–0.48	0.37
Fast dressing (%)	57.70±2.11	–15.18	0.70	–0.02	0.60	0.60	–0.28	–1.14	0.84	–0.17	–1.67	1.54	0.39
Empty dressing (%)	64.20±0.51	36.47	0.14	–0.09	0.19	0.41[1]	0.31[2]	–0.41	0.63	–0.11	0.01	–0.12	0.92
Primal cuts (Kg)	180.17±2.19	–354.35	0.63	0.91	3.70[1]	–1.40	2.26[1]	2.37	–3.78	–0.21	–2.20	–1.37	0.84
%primal cuts/carcass	70.82±0.39	32.65	–0.07	0.04	0.29	–0.08	–0.09	0.45	–0.77	0.15	–0.37	0.04	0.58
Non prim. cuts (Kg)	74.15±1.34	–29.23	0.62	0.24	0.53	–0.25	–0.56	–0.30	0.47	–0.52	0.16	–0.83	0.53
%non primal cuts/carcass	29.18±0.39	67.35	0.07	–0.04	–0.29	0.08	–0.09	–0.45	0.77	–0.15	0.37	–0.04	0.58
Eye musc. area (cm)	130.40±1.08	–58.50	–0.25	0.13	0.76	–0.61	0.04	–1.51	1.11	2.64	2.09	1.60	0.82
Forequarters (Kg)	137.60±1.19	–300.79	0.97	1.11	2.19	–0.45	–1.01	0.78	3.14	0.59	–0.70	–1.89	0.79
%forequart./carcass	54.10±0.29	16.70	0.12	0.19[1]	–0.04	0.09	0.21[1]	–0.13	–0.56	0.40	0.11	–0.29	0.73
Hindquarters (Kg)	116.75±1.19	–83.39	0.29	0.04	2.05	–0.85	–1.80[2]	1.31	–0.18	–1.31	1.04	–0.32	0.83
%hindquart./carcass	45.90±0.29	83.44	–0.12	–0.19[1]	0.04	–0.09	0.21[1]	0.13	0.56	–0.40	–0.11	0.29	0.73

1 = significance P<0.05

2 = significance P<0.01

The results in Table 3 revealed that carcass weight, boneless carcass weight, empty dressing percentage, primal cuts weight and forequarters weight had a significant ($P<0.01$) and positive regression coefficients with body length. While significant ($P<0.05$ or <0.01) and negative regression coefficient values were estimated between either percentages of primal cuts weight or hindquarters weight related to carcass and chest depth. Also meat/bone ratio and boneless meat percentage showed a positive relationship ($P<0.05$ and $P<0.01$) respectively with the distance between eyes. It could be concluded that most carcass traits of buffalo male calves which have $R^2= 0.50$ and more such as fasting body weight, carcass weight, boneless meat, meat/bone ratio, boneless meat percentage, primal and non-primal cuts weight, fore and hindquarters weight could be predicted accurately by using body and head measurements.

Fasting body weight and percentage of forequarter/carcass of male cow calves had a positive ($P<0.05$) regression coefficient with body length, but both meat/bone ratio and percentage of hindquarter/carcass had a negative ($P<0.01$ and <0.05) relationship with body length (Table 4). Carcass weight, carcass boneless meat, meat/bone ratio and primal cuts weight were positively related ($P<0.05$) with heart girth and negatively related ($P<0.05$ and <0.01) with abdomen depth. Also hindquarters weight and their percentage to carcass were negatively ($P<0.05$ or $P<0.01$) related with abdomen depth. Empty dressing percentage was positively related ($P<0.05$) with chest depth and negatively related ($P<0.01$) with abdomen depth (Table 4). It could be concluded that all carcass traits of cow male calves under study except both boneless meat percentage and fast dressing percentage could be predicted accurately by using body and head measurements as their R^2 ranged between 0.53 to 0.92.

Finally using body measurements in prediction equation for most carcass traits of buffalo and cow male calves seems to be possible by reasonable level of accuracy.

YAO et al. (1953) observed a positive correlation between width, depth and circumference measurements with carcass grade and dressing percentage. MCMEEKAN (1956) reported that dressing percentage decreased with increasing circumference of cannon bone. ROMITA and BORGHESE (1976) showed that proportion of prime cuts was best estimated from carcass weight while cannon bone and head gave the best estimate for bone. RASHEED (1977) working on male Egyptian buffaloes found a significant correlation between heart girth and dressing percentage. MOSTAGEER et al. (1981) showed that body weight at slaughter and dressed carcass weight were highly significantly correlated with each other and with height at withers, body length, chest depth and chest girth. Dressing percentage was highly significantly correlated with chest girth. The correlations of the various body measurements with rib eye area were low.

4 Summary

The effect of four weaning systems on the body measurements of buffalo and cow calves up to two years of age was compared. Some body measurements were affected by SM + St (skim milk + starter) or LW + St (late weaning + starter) during the first year of age in buffalo calves. In cows, the weaning system showed a significant effect on all body measurements at

different ages studied except, height at withers at 24 and 76 weeks of age and abdomen depth at 76 weeks of age which were not affected significantly by weaning system. Season of calving affected (P<0.01) body measurements at 6 months of age in buffalo calves where summer calvers recorded higher figures than calves born during winter. There was no significant effect at 1, 1.5 or 2 years of age on all body measurements. In cows, season of calving had no significant effect on all body measurements at 24, 52 and 76 weeks of age except heart girth at 24 weeks old which was affected significantly in favour of winter calvers. Also winter calvers had significantly (P<0.05) higher values of most body measurements than those of summer cow calvers at 104 weeks of age.

Sex had a significant effect on cannon girth (at 24, 76 and l04 weeks old) and body length (P<0.05) at 76 weeks old and (P<0.01) at 104 weeks old in favour of male buffalo calves. In cows, male calves had significantly higher values of height at withers, body length, heart girth, chest depth and cannon girth at 76 and 104 weeks old, chest depth and cannon girth at 52 weeks old and cannon girth at 24 weeks old and had significantly (P<0.0l) lower value of width at hooks (at 76 weeks old) than those of female cow calves.

Buffalo calves had higher values of height at withers, heart girth, chest depth, width at hooks and cannon girth and had lower values of body length, abdomen depth and cannon length than those of cow calves at comparable ages.

Live body weight of buffalo calves showed a significant positive relationship with chest depth (P<0.05) at 24 weeks old, body length at 76 weeks old and with height at withers and width at hooks (P<0.05) at 104 weeks old. In cows, live body weight showed a positive and significant relationship with heart girth (P<0.01) at 24 weeks old, width at hooks (P<0.05) and cannon girth (P<0.01) at 76 weeks old and with heart girth (P<0.01) at 104 weeks old. But live body weight showed insignificant negative relationship with chest depth and cannon length at 24, 52, 76 and 104 weeks of age.

Using body measurements (at slaughter), in prediction equation for most carcass traits of buffalo and cow male calves, is possible by reasonable level of accuracy.

Zusammenfassung

Beeinflussung der Körpermessungen durch Aufzuchtverfahren, Abkalbesaison und Geschlecht sowie ihre Beziehung zum Körpergewicht und Schlachtkörperwert beim Büffel und Rind

Der Einfluß verschiedener Aufzuchtverfahren sowie der Abkalbesaison und des Geschlechtes auf Körpermessungen wurden an Kälbern beim Büffel und Rind bis zum Alter von 2 Jahren untersucht. Weiterhin wurde die Bedeutung von Hilfsmerkmalen für die Beurteilung der Körpergröße und des Schlachtkörperwertes an Hand der Beziehungen untersucht. Die Aufzuchtverfahren SM + St (Magermilch + Starter) beeinflußten einige Körpermessungen der Büffelkälber während des ersten Jahres. Beim Rind übte das Aufzuchtverfahren signifikanten Einfluß auf die Körpermessungen in den meisten untersuchten Altersstufen aus. Bezüglich des

Saisoneinflusses zeigten die Büffelkälber im Alter von 24 Wochen höhere Werte im Sommer als im Winter. In verschiedenen Altersstufen wurden Unterschiede zwischen den Geschlechtern sowohl beim Büffel als auch beim Rind zugunsten der männlichen Tiere festgestellt.

Die Berechnung der Beziehungen zu den Körpermessungen zeigte einige Abhängigkeiten, so daß die Abschätzung einiger Kriterien des Schlachtkörperwertes durch Hilfsmerkmale, unter der Voraussetzung einer hohen Meßgenauigkeit, erfolgen kann.

References

1. Abdel-Aziz, A.S., 1960: The growth of Friesian cattle and cross under different rearing levels. M.Sc. Thesis, Faculty of Agriculture, Cairo University Egypt
2. Al-Amin, S.K., 1979: A genetic study on growth and carcass characteristics in Friesian cattle. Ph.D. Thesis, Faculty of Agriculture, Cairo University Egypt
3. El-Barbary, A.S.A., 1966: Some economical characters in the buffalo. M.Sc. Thesis, Faculty of Agriculture, Alexandria University, Egypt
4. El-Feel, F.M.R., 1984: Special studies on the Egyptian cattle under Minia environmental conditions. Ph.D. Thesis. Faculty of Agriculture, Minia University, Egypt
5. Harvey, W.R., 1987: User's guide for LSML 76 mixed model least squares and maximum likelihood computer program. The Ohio State University, Columbs (Mimeo).
6. Heinrichs, A.J. and G.L. Hargrove, 1987: Standards of weight and height for Holstein heifers. J. of dairy sci. 70 (3): 653
7. Jactab, D.Z. and K.M. Kale, 1987: Production of body weight from body measurements in Gir Crosses. Indian J. of Anim. prod. and management 3 (4): 177
8. John, N., W. William and H.K. Michael, 1985: Applied linear statistical models. Second (Ed.), Richard, D., Irwin, Inc. Home Wood, Illinois 60430, pp. 779.
9. Kaleff, B., 1942: The breeding biology of the domestic buffalo compared with that of cattle. Anim. Breed. Abst. 10: 148
10. McMeekan, C.P., 1956: Good rearing of dairy stock. N.Z. Dept. Agric. Bull, 228 (Cited from Indian J. dairy sci. 18:96)
11. Mostageer, A., 1978: Annual report. Academy of Science and Technology, Cairo, Egypt
12. Mostageer, A., M.A. Morsy and R.R. Sadek, 1981: The production characteristics of a herd of Egyptian buffaloes. Sonderdruck aus Zeitschrift für Tierzüchtung und Züchtungsbiologie, 98:220
13. Rasheed, A.A., 1977: A preliminary investigation on the relationship between some linear body measurements and both live and dressed carcass weights of male buffalo vealers raised in Egypt. The Libyan J. of Agric. vol. (6), part (2): 269
14. Romita, A., and A. Borghese, 1976: Production of Friesian calves, 6 months old. 1. growth, carcass yield and composition. Nut.Abst. and Rev. 46 (7): 570
15. Siakia, T.H., K.S. Patel, S. Parnerker and A.D. Dave, 1987: Body weight gain in weaned Kankrej x Jersey and Kankrej x Holstein-Friesian calves. Indian J. of Anim. Sci. 57 (2): 131
16. Saini, A.L. and R.S. Gill, 1987: Relationship among different physical characteristics in Murrah type heifers and dry buffaloes. Indian J. of Anim. prod. and management 3 (4): 193

17. SOKOL, J., 1974: Early weaning of calves. Anim. Breed. Abst. 42 (11): 44

18. TOMMI, Y., 1963: Allowances and rations for farm animals. pp. 71 Sel. Khoshidat-Moscow

19. YAO, T.S., W.M. DAWSON and A.C. COOK, 1953: Relationship between meat production characters and body measurments in beef and milking shorthorn steers. J. Anim. Sci. 12: 775