

A Comparison of Some Morphometric Measurements at Different Ages between Sudanese Fulani and Western Baggara Bulls

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Abstract

The present work was conducted to compare between Sudanese Fulani bulls Morphometric measurements and Western Baggara (Nyalawi ecotype) at different points of age (1 - 2 years, 3 - 4 years, 5 - 6 and above 7 years). A total of 368, (163 Sudanese Fulani and 205 Nyalawi) bulls were used. The Morphometric measurements studied were: live body weight (LBW), body length (BL), heart girth (HG), height at withers (HTW), hip height (HH) and rum width (RW). Relationship between live weight and external body measurements was determined by regression (r). The results revealed that based on live body weight, of Sudanese Fulani bulls at (1 - 2 years, 4 - 5 years and 6 - 7 years) were superior to Nyalawi bulls, but the different was not significant ($P < 0.05$). Also, all the correlation coefficients between live weight and the various body measurements of Sudanese Fulani bulls were significant ($P < 0.01$). A highly positive correlation coefficient was recorded between live weight and chest depth ($r = 0.89$, $P < 0.01$), while the lowest value was found between body weight and height at wither ($r = 0.70$, $P < 0.01$) for Sudanese Fulani bulls. Likewise, a high ($r = 0.78$, 0.56 , 0.76 and 0.74) positive correlation between BW and HG were reported for Nyalawi bulls in all age groups under investigation. Moreover, body measurements of Sudanese Fulani were significantly ($P < 0.05$) higher than those of Nyalawi bulls at all ages. The present findings showed the superiority of Sudanese Fulani bulls on Nyalawi bulls. The results suggest that body measurements and Morphometric measurements should be considered in the genetic improvements of this promised breed.

Keywords: *Sudanese Fulani Bulls; Nyalawi; Phenotypic; Body Measurements*

Introduction

Sudan possess the largest and diverse number of livestock populations and natural resources in Africa, according to [1] cattle population in Sudan estimated at 141 millions, however, after Sudan referendum, livestock number decreased to 103 millions. Although, most of livestock in Sudan are owned by nomadic or semi-nomadic tribes living in the semiarid regions without veterinary care or extension services; cattle still play multifunction roles; domestic, social, political and economic [2]. Beside, western Baggara cattle, Fulani or (Kuri cattle) is an important indigenous beef cattle in South Darfur and Blue Nile which kept by Fellata tribe [3] and also, have many different local names like Mbororo, and Kuri.

This cattle differs in body conformation, behaviour and other phenotypic details from Western Baggara ecotypes in South Darfur. It's distinguished by long lyre-shaped horns reaching between 0.8 and 1.2m in length, the adult male has an average height of between 125 and 140 cm at the withers these features make this breed comparatively unique. Sudanese Fulani cattle is owned mainly by Fulani tribe that found in different parts of Sudan (Darfur and Blue Nile states) and characterized by traditional migratory routes crossing Sudan during the rainy season on June continued to September passing to South-Westward from West, Central Africa and Cameroon at end of dry season. These animals are mostly rely on natural grazing in open range conditions and seasonal migration.

Phenotypic description is a tool of breed characterization which means identifying distinct breed populations and describing their body measurements and production potentialities. Studying Morphometric measurements of a breed is an essential step for designing plans, strategies and establishing programs for genetic improvement, maximizing use of genetic resources and enhancing conservation of indigenous cattle breeds [4,5]. Variation in body measurements of farm animals are most likely due to genetic and environmental factors therefore, determining morphometric measurements of a breed is a sort of differentiating breeds [6]. The current work was initiated to compare between Sudanese Fulani bulls body measurements and Western Baggara (Nyalawi) bulls at different points of age.

Material and Methods

Data collection

Morphometric data

Data on morphological measurements of Fulani and Baggara cattle was collected from El Mawashi local livestock market located in Nyala (South Darfur State-Sudan). Which considered the main livestock market. The animals (163 Fulani and 205 Western Baggara Cattle) were divided into four age groups: Group A (1-2 years), Group B (3 - 4 years), Group C (4 - 5 years) and Group D (over 6 years).

Age was determined using dentition (teeth).

The Morphometric measurements investigated in the present study included: live body weight (LBW), body length (BL), heart girth (HG), height at withers (HTW), hip height (HH) and rum width (RW). Body weight was measured in kilogram (kg) using a mechanical scale (0 - 1000 kg), height at withers and hip height measurements in centimeters (cm) using a measuring stick. The body length, heart girth and rump width measured in centimeters (cm) by a tape ruler. Live animal measurements were taken according to methods described by [7-9] as follow:

- **Body length (BLT):** The distance on the dorsal midline from the top of the head to pin bones.
- **Heart girth (HG):** The narrowest circumference immediately posterior to the front legs.
- **Depth of Chest (DC):** The distance between the top behind the scapular and the flow of the sternum (taken to be the depth of brisket) immediately behind forelegs.
- **Height at withers (HAW):** The vertical distance from the floor beneath the animal to the point of the withers will be measured with a measuring stick.
- **Hip height (HH):** Distance down to the hips from the distance down to the floor with a descending tape placed above the animal.
- **Rump width (RW):** The distance between the most posterior points of pin bones.
- **Rump height (RH):** Measured from hips (*Tuber coxae*) to pins (*Tuber ischii*).
- **Face length (FL):** Distance from between the dorsal surface of the frontal bone to the distal end of the nasal bone.
- **Head width (HW):** Measured as the widest point of the head.
- **Head to shoulder (HS):** The distance from the nose to point of shoulder.
- **Horn length (HLth):** The distance from the tip of the horn to the base of the horn.
- **Ear length (ELT):** The distance from the tip of the ear to the base of the ear.
- **Neck length (NK):** The distance from the dip in the vertebrae (takes practice to find the right dip) between the shoulder blades to just in front of poll.
- **Shoulder to tail drop (STD):** The distance from the point of the shoulder to the pin bones.
- **Tail length (TL):** The distance from the pin bones of the sacrum to the base of the tail switch.
- **Foreleg length (FL):** The distance from the proximal extremity of the olecranon process to the ground.
- **Canon circumference (CC):** The narrowest circumference of the canon bone.

Statistical analysis

The collected data was analyzed using Statistical Package for Social Sciences (SPSS) software version 16.0. Relationship between live weight and external body measurements was determined by regression (r), also, standard deviation (SD), coefficient of variation and (CV) and analysis of variants (ANOVA) were used.

Results and Discussion

Table 1 demonstrates the (Mean ± Standard deviation) live body weights of Sudanese Fulani and Western Baggara (Nyalawi) bulls according to age groups. The results revealed that Sudanese Fulani bulls at (1 - 2 years, 4 - 5 years and 6 - 7 years) were superior to Nyalawi bulls, but the different was not significant. However, at (3 - 4 years); Nyalawi bulls were significantly (p < 0.05) heavier than Sudanese Fulani males. The current results were not in line with those reported by [10] they concluded that Nyalawi sub-type was found to have a significantly (p < 0.01) heavier weight and large frame size at all age points studied.

Age groups	Sudanese Fulani ecotype cattle (n = 163)				Nyalawi ecotype cattle (n = 205)			
	N	Live body weight (Kg)			N	Live body weight (Kg)		
		Min	Max	Mean ± Sd.		Min	Max	Mean ± Sd.
1 - 2 years	40	150	360	244.30 ± 38.84 ^a	55	120	340	226.00 ± 38.16 ^b
3 - 4 years	35	195	410	272.14 ± 43.13 ^b	52	210	395	292.88 ± 50.31 ^a
4 - 5 years	49	240	595	370.04 ± 65.39 ^a	54	240	560	361.67 ± 60.54 ^b
Over 7 years	39	300	500	384.72 ± 58.27 ^a	44	280	495	379.16 ± 66.60 ^a

Table 1: Comparison of live body weight (Kg) between Sudanese Fulani and (Nyalawi ecotype) bulls according to the age group. Mean in the same row with different superscripts are significantly different (p < 0.05). N: Number of Observation; Min: Minimum; Max: Maximum; SD: Standard Deviation.

The correlation coefficients between live weight and the body measurements of Sudanese Fulani and Nyalawi bulls are shown in table 2. The results indicated that all the correlation coefficients between live weight and the various body measurements of Sudanese Fulani bulls were significant (P < 0.01). However, a highly positive correlation coefficient was recorded between live weight and chest depth (r = 0.89, P < 0.01), while the lowest value was found between body weight and height at wither (r = 0.70, P < 0.01). These results were in line with those reported by [11] who studied body measurements heart girth (HG), withers height (WH), body length (BL), shoulder width (SW), hip width (HW), shin circumference (SC), and tail circumference (TC) of male Kamphaengsaen beef cattle as parameters for estimation of live weight and obtained highly (P < 0.0001) significant difference between body weight (BW) and linear body measurements. It is well known that body weight of cattle is highly correlated with heart girth, this finding coincided with those reported by [9,12-14]. On the other hand, the current results were not in line with [15] who obtained a weak correlation between body weight BL, TL and EL (r = 0.25, 0.26 and 0.17) respectively for white Fulani cattle.

Body Measurements	BW	BL	HG	HAW	DC	CC
BW		0.822**	0.847**	0.737**	0.844**	0.827**
BL	0.847**		0.778**	0.735**	0.747**	0.757**
HG	0.866**	0.762**		0.704**	0.848**	0.791**
HAW	0.790**	0.782**	0.789**		0.831**	0.824**
DS	0.893**	0.820**	0.886**	0.835**		0.826**
CC	0.858**	0.762**	0.782**	0.809**	0.817**	

Table 2: Coefficients of correlation between live body weights and linear body measurements of Sudanese Fulani bulls. Correlation coefficients are Significant at (P < 0.01). Upper matrix = Sudanese Fulani cattle. Lower matrix = Nyalawi ecotype cattle.

Correlation of live body weights and linear body measurements of Nyalawi bulls in different age groups is illustrated in table 3. A high ($r = 0.78, 0.56, 0.76$ and 0.74) positive correlation between BW and HG were reported for Nyalawi bulls in all age groups under investigation. The present findings were all most coincided with an early study by [9] who found that carcass heart girth around the hump had the highest correlation coefficient ($r = 0.79, P < 0.001$). But, were slightly lower than those obtained by [9], they reported a highly positive correlation coefficient between live weight and heart girth around the hump ($r = 0.83, P < 0.001$) compared with other body measurements for Baggara (Nyalawi) bulls. Also, our finding is lower than those demonstrated by [10] they found that the heart girth around hump gave significantly ($p < 0.01; r^2 = 0.9$) high correlation coefficient with the live weight in Nyalawi bulls. However, the present results is lower than estimation found by [16] who obtained a significantly ($P \leq 0.01$) high positive correlation coefficient between body weight and heart girth ($r = 0.98$) for Sudanese Kenana Cattle.

Body Measurements	1 - 2 years	3 - 4 years	5 - 6 years	Over 7 years
BL	0.792**	0.762**	0.711**	.0667**
HG	0.782*	0.562**	0.756*	0.740**
HAW	0.700**	0.747**	0.577**	0.641**
DS	0.717**	0.607**	0.730**	0.650**
CC	0.608**	0.658**	0.595**	0.722**

Table 3: Coefficients of correlation of live body weights and linear body measurements of Nyalawi bulls.

Least square means of live body weight and body measurements of Sudanese Fulani and Nyalawi bulls according to age groups is presented in table 4. The results revealed that all body measurements of Sudanese Fulani were significantly ($P < 0.05$) higher than those of Nyalawi bulls at all age groups. Except body length and face length, body measurements for mature (5 - 6 years) Sudanese Fulani were higher than those reported by [17] for Zebu Bororo (Wodaabé) cattle of Niger. They obtained 156.7 for HG and 120 cm for HW, versus 170.88 and 136.00 respectively for Sudanese Fulani. What a surprising! BL and FL of Sudanese Fulani (101.92 and 24.84 cm) were much lower than those reported for Zebu Bororo (Wodaabé cattle of Niger (51 and 134.8), Zebu Mbororo of Burkina Faso (52.5 and 131.8), White Fulani (57.24 and 117.0) and Sokoto Gudali (60.77c and 123.14cm). Likewise, body length obtained for adult (5 - 6 years) Western Baggara (Nyalawi) bulls in the current study (96.65 cm) was far lower than those of Yanbian (122 cm) [18], Sudanese Kenana (123 cm) [19] and Bangladeshi Red Chittagong (125 cm) [20] Cattle respectively. The current findings were in full agreement with those demonstrated by [21] they reported that the Senegalese and White Fulani are much larger than the Sudanese Fulani; these variations might be attributed to influence of the environment and breed adaptation. Moreover, BL length of Nyalawi bulls in the current study (96.65 cm) is comparable with those recorded by [22] for white cattle in Bali (96.58 cm).

Age	Traits (cm)	Sudanese Fulani					Nyalawi				
		N	Min	Max	Mean ± Sd.	CV%	N	Min	Max	Mean ± Sd.	CV%
1 - 2 years	BL	40	70	105	86.70 ± 8.70 ^a	75.65	55	75	102	84.09 ± 5.70 ^b	32.49
	HG	40	110	159	144.35 ± 11.17 ^a	35.05	55	35	158	133.56 ± 15.87 ^b	21.98
	HAW	40	112	137	125.12 ± 5.86 ^a	34.39	55	105	137	115.95 ± 5.45 ^b	29.72
	DC	40	135	193	160.70 ± 7.32 ^a	11.16	55	121	171	141.09 ± 9.52 ^b	90.67
	HH	40	115	152	131.25 ± 11.69 ^a	7.37	55	109	135	123.04 ± 5.25 ^b	27.52
	RH	40	113	139	126.38 ± 5.49 ^a	5.49	55	99	127	115.44 ± 5.63 ^b	31.62
	RW	40	28	46	37.48 ± 4.07 ^a	4.07	55	25	85	31.25 ± 7.87 ^b	61.94
	HL	40	35	48	41.45 ± 2.745 ^a	7.54	55	31	43	36.20 ± 2.76 ^b	7.60
	Hw	40	18	26	21.33 ± 1.54 ^a	2.38	55	15	24	18.69 ± 1.85 ^b	3.33
	HL th	40	21	80	45.02 ± 14.58 ^a	79.56	55	5	29	15.20 ± 5.61 ^b	31.57
	FL	40	19	26	22.72 ± 1.66 ^a	2.77	55	18	24	20.80 ± 1.64 ^a	2.57
CC	40	16	19	17.28 ± .87 ^a	0.77	55	14	19	15.78 ± 1.05 ^a	1.10	

3 - 4 years	BL	35	80	107	91.97 ± 6.492 ^a	42.15	52	80	104	91.00 ± 5.46 ^a	29.88
	HG	35	130	178	154.43 ± 8.12 ^a	66.02	52	124	164	147.13 ± 8.15 ^b	66.47
	HAW	35	117	138	125.49 ± 5.11 ^a	26.13	52	113	138	121.13 ± 4.82 ^b	23.21
	DC	35	122	187	164.23 ± 12.95 ^a	67.70	52	141	177	153.81 ± 8.68 ^b	75.37
	HH	35	122	145	131.74 ± 5.28 ^a	27.96	52	120	139	128.92 ± 4.60 ^b	21.21
	RH	35	121	140	129.23 ± 4.45 ^a	19.83	52	113	129	120.54 ± 3.90 ^b	15.23
	RW	35	25	46	37.94 ± 4.78 ^a	22.88	52	29	38	33.38 ± 2.27 ^b	5.14
	HL	35	34	48	42.29 ± 2.76 ^a	7.62	52	34	41	37.54 ± 2.07 ^b	4.29
	Hw	35	18	26	21.57 ± 1.70 ^a	2.89	52	17	22	19.52 ± 1.46 ^a	2.13
	HL ^h	35	24	72	47.43 ± 11.75 ^a	35	52	8	41	22.79 ± 7.62 ^b	58.13
	FL	35	19	26	22.94 ± 1.43 ^a	35	52	31	25	21.19 ± 1.858 ^a	3.45
CC	35	16	19	17.40 ± 0.95 ^a	0.89	52	15	19	16.87 ± 0.97 ^a	0.942	
5 - 6 years	BL	50	93	117	101.92 ± 6.05 ^a	36.60	54	62	114	96.65 ± 7.37 ^b	54.42
	HG	50	141	201	170.88 ± 12.10 ^a	46.59	54	142	191	161.17 ± 9.42 ^b	88.74
	HAW	50	125	182	136.00 ± 9.02 ^a	81.42	54	118	139	127.39 ± 5.34 ^a	28.58
	DC	50	133	223	179.78 ± 14.64 ^a	45.54	54	141	191	168.96 ± 11.77 ^b	38.71
	HH	50	125	265	142.42 ± 18.66 ^a	134.53	54	124	144	134.15 ± 4.72 ^b	22.31
	RH	50	125	157	136.54 ± 6.89 ^a	47.60	54	118	139	126.41 ± 4.74 ^b	22.51
	RW	50	33	64	45.32 ± 5.50 ^a	30.30	54	31	41	36.28 ± 2.28 ^b	5.22
	HL	50	40	48	44.46 ± 2.24 ^a	5.02	54	35	45	39.89 ± 2.28 ^b	5.23
	Hw	50	17	48	22.86 ± 4.17 ^a	17.38	54	16	33	20.74 ± 2.64 ^b	6.98
	HL ^h	50	32	93	61.44 ± 15.38 ^a	83.53	54	9	42	24.22 ± 8.11 ^b	65.87
	FL	50	20	57	24.82 ± 4.90 ^a	24.06	54	17	26	22.06 ± 1.47 ^b	2.16
CC	50	16	21	19.04 ± .92 ^a	0.856	54	15	20	17.80 ± 1.01 ^a	1.03	
Over 7 years	BL	39	93	116	103.28 ± 6.07 ^a	36.89	44	88	120	99.39 ± 6.53 ^b	42.70
	HG	39	141	195	167.67 ± 11.99 ^a	99.96	44	146	181	162.45 ± 9.58 ^b	91.84
	HAW	39	121	183	135.95 ± 11.31 ^a	61.99	44	116	138	126.93 ± 5.77 ^b	33.32
	DC	39	164	207	184.33 ± 12.56 ^a	60.80	44	135	200	172.36 ± 12.29 ^b	42.12
	HH	39	129	160	140.51 ± 7.73 ^a	59.83	44	122	144	133.89 ± 5.46 ^b	29.83
	RH	39	40	153	133.08 ± 17.46 ^a	55.17	44	116	185	128.07 ± 10.44 ^b	33.99
	RW	39	35	83	44.31 ± 8.50 ^a	72.32	44	33	43	37.64 ± 2.44 ^b	5.95
	HL	39	25	59	43.79 ± 5.50 ^a	39	44	35	47	41.86 ± 3.09 ^b	9.56
	Hw	39	18	28	22.41 ± 1.86 ^a	39	44	15	25	20.18 ± 2.28 ^b	5.22
	HL ^h	39	19	102	54.33 ± 22.44 ^a	78.64	44	12	60	29.57 ± 8.57 ^b	73.46
	FL	39	20	31	24.10 ± 2.26 ^a	39	44	19	27	22.86 ± 1.48 ^b	2.21
CC	39	16	21	18.82 ± 1.21 ^a	1.46	44	16	20	18.20 ± 1.09 ^a	1.19	

Table 4: Least square means of live body weight and body measurements of Sudanese Fulani and Nyalawi bulls according to age groups. Mean in the same row with different superscripts are significantly different ($p < 0.05$). N=Number of Observation; Min: Minimum; Max: Maximum; SD: Standard Deviation; CV: Coefficient of Variation; BW: Body Weight; BL: Body Length; HG: Heart Girth; HAW: Height at Withers; DC: Deep of Chest; HH: Hip Height; RH: Rump Height; RW: Rump Width; HL: Head Length; HL^h: Horn Length; FL: Face Length; CC: Canon Circumference.

Conclusion

- Sudanese Fulani bulls at (1 - 2 years, 4 - 5 years and 6 - 7 years) were superior to Nyalawi bulls.
- All the correlation coefficients between live weight and the various body measurements for both Sudanese Fulani and Nyalawi bulls were significant ($P < 0.01$).
- Body measurements of Sudanese Fulani were significantly ($P < 0.05$) higher than those of Nyalawi bulls at all age points.
- We recommend considering Morphometric and body measurements in genetic improvement of indigenous beef cattle.

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