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Analysis of correlations among biometrical traits and coefficients of adaptability of Deoni cattle

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Abstract

This study was carried on total 168 Deoni cattle from Livestock Farm Complex, College of Veterinary and Animal Sciences, Udgir, Dist. Latur (Maharashtra) during 5 consecutive years and Deoni cattle were divided age wise into 3 groups (calf 0-1 year, heifer 1-3 year and adult-above 3 year age). Biometrical measurements and physiological responses were recorded to study different biometrical traits and coefficients of adaptability of Deoni cattle in their breeding tract in Marathwada region of Maharashtra State. Analysis of biometrical measurements were represented as medium sized body of Deoni cattle and body length (BL), chest girth (CG), height at withers (HW), body surface area (BSA) and body weight (BW) were proportionate according to their age. However, as compared to calves and heifers, the adult Deoni cattle well adapted in their native and biometrical traits like body length, height at wither had positive correlations with other biometrical traits and negative correlation with coefficients of adaptability. It was concluded that, Deoni cattle body was medium sized, low body weight and adapted well in their native breeding tract in Marathwada region of Maharashtra State and biometrical traits like body length and height at wither can be considered while selecting Deoni cattle for breeding purpose.

Keywords: Adaptability, Biometrical traits, Deoni cattle

1. Introduction

Deoni cow is a dual-purpose indigenous breed of cattle that evolved in Deoni tehsil of Latur district in Marathwada region of Maharashtra state and is called locally Dongari cow (means hilly). Deoni breed of cattle was evolved due to crossing of local sturdy Dongari breed of cow that was in Deoni tehsil of Latur district with the Gir and Dangi breeds during the migration of people due to heavy draught in Gujarat State (Joshi and Phillips, 1953) ^[1]. Deoni breed of cattle is medium sized, moderately developed body and symmetrical muscles with three colour variant strains such as, Wannera, Balankya and Shevera. Coat colour in Wannera and Balankya strains is clear white, whereas black colour spots are present on the white coat colour in Shevera strain of Deoni cattle. Milk fat and solid not fat (SNF) is 4.3 and 9.69%, respectively, with an average 950 litter milk yield in a lactation etc. (Singh *et al.*, 2006) ^[2] are some productive characteristics of Deoni cattle. Though the Deoni cow is a moderate milker, the farmers of Latur, Dharashiv, Beed and Parbhani districts are popularly rearing Deoni cattle mainly for agricultural operations due to their sturdiness.

Body growth of farm animals is based on different biometrical measurements or traits like body weight (BW), body length (BL), height at withers (HW) and chest girth (CG) and however, dairy animal's growth and performance are dependent on different factors including environmental conditions. Long term exposure of animals to harsh environmental conditions caused significant morphometrical, physio-biochemical, hormonal and metabolic changes and animal productivity was decreased (Singh *et al.*, 2018) ^[3], however, dairy animals adapted by altering some morphological and biometrical characteristics in due course of time. Farm animal adaptability is principally dependent on physiological responses like core body temperature and respiration rate and these physiological responses can be measured periodically to judge dairy animal welfare. Hence, thermo-adaptability or heat tolerance indices studies of farm animals are pre-requisites to alter management practices during hot climatic conditions and scientifically suggested management practices can maximize their productivity and working ability.

As per our knowledge, very scanty reports are available with regards to different biometrical traits and coefficients of adaptability in Deoni cattle and their correlations. Therefore, this study was planned to study biometrical traits of Deoni cattle and their sustainability in hot and dry climatic conditions in Marathwada region of Maharashtra state.

2. Materials and Methods

Total 168 Deoni cattle from Livestock Farm Complex, College of Veterinary and Animal Sciences, Udgir, Dist. Latur (Maharashtra, India) were selected and divided accordingly age-wise into calf (0-1 year, n=53), heifer (1-3 years, n=47) and adult (above 3 years, n=68) and biometrical and physiological parameters were recorded monthly during 5 consecutive years. Biometrical measurements like body length (BL), chest girth (CG) or chest circumference (CC) and height at withers (HW) were recorded and the body weight (BW) was estimated by Lambourne formula (body weight in kg = CC² x BL/10840). Body surface area (BSA) was calculated by Brody's (1945) [4] equation and physiological responses (respiration rate and rectal temperature) were recorded to determine the coefficient of adaptability by two heat tolerance indices, i.e., Benzra's Coefficient of Adaptability (BCA) (Benzra, 1954) [5] and Iberia Heat Tolerance Coefficient (IHTC) (Rhoad, 1944) [6]. Recorded

data was statistically analysed (Snedecor and Cochran, 1994) [7] and is presented as means ± standard errors.

3. Results and Discussion

All biometrical traits and coefficients of adaptability values of Deoni cattle are presented in Table 1. Biometrical traits of Deoni cattle like BL, CG, HW, BSA and BW were proportionate with increasing age and BL, CG and HW were similar to earlier findings reported by Kuralkar *et al.* (2015) [8] in Deoni cattle of different age groups (calf, heifer and adult). BL, HW and CG measurements were closely similar with earlier reports of indigenous breeds of cattle like Kankrej (Pundir *et al.*, 2007^a [9]; Pundir *et al.*, 2011 [10]), Red Sindhi (Pundir *et al.*, 2007^b) [11] and Hallikar (Singh *et al.*, 2008) [12]. However, biometrical traits like BL, HW and CG in all age groups (0-1, 1-3 and above 3 year age) in Kosali cattle of Chhattisgarh (Jain *et al.*, 2018) [13] and Kathani cattle of eastern Maharashtra (Chavhan *et al.*, 2022) [14] were lower as compared to Deoni cattle which is not similar with present study findings. In this study, it was observed that, the body of Deoni cattle was medium sized and proportionate according to their age, slow growth rate (up to 3 years age) and body weight of adult Deoni cattle was lower as compared with some indigenous cattle breeds like Gir (Gaur *et al.*, 2003) [15] and Sahiwal (Manoj *et al.*, 2012) [16].

Table 1: Age wise biometrical traits and adaptability profile of Deoni cattle (n=60)

Sr. No.	Parameters	Age groups		
		Calves (0-1 year)	Heifer (1-3 year)	Adult (> 3 year)
1	Body length (cm)	87.80±0.36	114.30±0.61	137.60±0.83
2	Chest girth (cm)	99.40±0.16	136.80±0.13	164.40±0.40
3	Height at wither (cm)	90.20±0.47	116.90±0.90	132.10±0.60
4	Body surface area (m ²)	1.67±0.02	2.86±0.04	3.98±0.01
5	Body weight (kg)	80.30±0.70	198.00±0.30	342.50±0.20
6	BCA values	1.40±0.00	1.40±0.00	1.30±0.00
7	IHTC values	101.10±0.32	100.40±0.80	99.20±0.20

Coefficients of adaptability (heat tolerance indices) of farm animals are based on physiological responses like respiration rate and rectal temperature. Whenever environmental temperature increases, respiration rate and rectal temperature are increased and animals dissipate heat quickly, therefore, increased respiration rate is the most critical and easily notable physiological response to poor adaptability of farm animals (Mandal *et al.*, 2021) [17]. Adaptability values in all age groups of Deoni cattle by BCA and IHTC methods were less than 2 and nearer to 100, respectively, which showed better adaptability of Deoni cattle and these findings concurred with our previous observations in native Marathwadi buffaloes (Vaidya *et al.*, 2022; Dhenge *et al.*, 2023) [18, 19]. In present study, it was observed that, the adaptability of Deoni cattle increased with increase in their age. The well adapted dairy animals during adverse climatic conditions are able to reduce their metabolic requirements, conserve energy and sustain their productivity which was previously justified in indigenous breeds of cattle like Tharparkar, Nagori and Sahiwal (Singh *et al.*, 2018) [3].

Likewise, Deoni breed of cattle adapted in their native breeding tract of Marathwada region which has a hot and dry climate during summer. However, biometrical traits might be considered while selecting Deoni cattle and especially in summer months, proper thermal protective and nutritional provisions are essential for enhancing their productivity. Coefficients of correlation among different biometrical traits and coefficient of adaptability of calves, heifer and adults Deoni cattle are presented in Tables 2, 3 and 4 respectively. Biometrical traits as HW, CG and BW of Deoni calves had significantly (*p*<0.05) negative correlation with coefficients of adaptability (IHTC and BCA) (Table 2). It was observed that, Deoni heifer BL and HW had negative and significant (*p*<0.05) correlations with IHTC whereas, CG and BW had significantly (*p*<0.05) positive correlations with BSA and BCA (Table 3). However, significant (*p*<0.05) and positive correlation was observed between biometrical traits (CG and BW) of Deoni heifer (Table 3). Deoni adult cattle biometrical trait like BW had significant (*p*<0.05) and positive correlation with BSA (Table 4).

Table 2: Coefficients of correlations among biometrical traits and coefficient of adaptability in Deoni calves *(*p*<0.05)

Biometrical traits	BL	HW	CG	BW	BSA	BCA	IHTC
BL	1.000	0.730	-0.398	0.248	0.528	0.135	-0.873
HW	0.730	1.000	-0.395	0.097	0.078	0.358	-0.894*
CG	-0.398	-0.395	1.000	0.785	0.478	-0.939*	0.682
BW	0.248	0.097	0.785	1.000	0.863	-0.888*	0.127
BSA	0.528	0.078	0.478	0.863	1.000	-0.727	-0.071
BCA	0.135	0.358	-0.939*	-0.888*	-0.727	1.000	-0.540
IHTC	-0.873	-0.894*	0.682	0.127	-0.071	-0.540	1.000

Table 3: Coefficients of correlations among biometrical traits and coefficient of adaptability in Deoni heifer *($P < 0.05$)

Biometrical traits	BL	HW	CG	BW	BSA	BCA	IHTC
BL	1.000	0.782	-0.856	-0.645	-0.808	-0.668	-0.932*
HW	0.782	1.000	-0.373	-0.069	-0.363	-0.070	-0.949*
CG	-0.856	-0.373	1.000	0.944*	0.954*	0.885*	0.627
BW	-0.645	-0.069	0.944	1.000	0.932*	0.890*	0.344
BSA	-0.808	-0.363	0.954	0.932	1.000	0.808	0.573
BCA	-0.668	-0.070	0.885	0.890	0.808	1.000	0.367
IHTC	-0.932	-0.949	0.627	0.344	0.573	0.367	1.000

Table 4: Coefficients of correlations among biometrical traits and adaptability in Deoni adult Cattle *($p < 0.05$)

Biometrical traits	BL	HW	CG	BW	BSA	BCA	IHTC
BL	1.000	0.683	-0.406	0.593	0.201	-0.659	0.138
HW	0.683	1.000	-0.376	0.314	0.118	-0.746	-0.372
CG	-0.406	-0.376	1.000	0.485	0.806	0.808	0.422
BW	0.593	0.314	0.485	1.000	0.882*	0.035	0.416
BSA	0.201	0.118	0.806	0.882*	1.000	0.420	0.500
BCA	-0.659	-0.746	0.808	0.035	0.420	1.000	0.609
IHTC	0.138	-0.372	0.422	0.416	0.500	0.609	1.000

In this study, it was observed that, BL of all groups Deoni cattle (calves, heifer and adult) had positive correlation with the HW, BW and BSA like earlier study in Kankrej cattle (Pundir *et al.* 2011) ^[10]. BW had a significant ($p < 0.01$) positive correlation with CG and HW in adult Nguni cattle of North Africa (Tyasi *et al.*, 2020) ^[20] which is in agreement with this study findings in adults and it showed that, growth of Deoni cattle occurred proportionately. However, CG of all groups of Deoni cattle was negatively correlated with BL and HW which indicated as inverse relation of CG with BL and HW. The coefficient of adaptability (BCA as well as IHTC) was positively correlated with CG, BW and BSA whereas, it was negatively correlated with BL and HW in heifer and adult groups of Deoni cattle. Positive correlations of BL and HW with different biometrical traits in Deoni cows are in agreement with the earlier findings of indigenous species of farm animals such as Gojri buffalo of North India (Vohra *et al.*, 2015) ^[21] and Chhattisgarhi buffalo of Chhattisgarh (Vohra *et al.*, 2017) ^[22]. In this study, the negative correlation of coefficients of adaptability with biometrical traits like BL and HW showed that, adaptability of Deoni cattle might be dependent on body length and height rather than weight and surface area, as the values less than or nearer to 2 and 100 are considered as well adaptability of animals estimated by BCA and IHTC methods, respectively. However, farm animal adaptability is dependent on capability to maintain their core body temperature and respiration rate within normal range by dissipating heat quickly during hot period of day and therefore, medium sized and well proportionate body of Deoni cattle might be helpful for their adaptation in their native breeding tract.

4. Conclusion

The present findings showed that biometrical measurements were represented as medium sized and proportionate body of Deoni cattle and these cattle adapted in their native breeding tract in Marathwada region of Maharashtra State. Biometrical traits like body length, height at wither had positive correlations with other biometrical traits and negative correlation with coefficients of adaptability which specified high predictability and therefore, biometrical traits like body length and height at wither can be considered while selecting Deoni cattle.

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6. Conflict of interest: Authors have no conflict of interest.

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