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Biometrical sexual differentiation of fifth cervical vertebra of blue bull (*Boselaphus tragocamelus*)

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Abstract

The present biometrical study was carried out on the fifth cervical vertebra of six specimens of adult Blue bull (*Boselaphus tragocamelus*) of either sex. It was revealed that average length of the body was measured to be 5.33 ± 0.03 cm in females that was significantly lesser ($P < 0.05$) than that of males, where it was found to be 5.60 ± 0.06 cm. The average width of the body at the caudal aspect was measured to be 2.08 ± 0.03 cm in females that was significantly lesser ($P < 0.05$) than that of males, where it was found to be 2.23 ± 0.05 cm. The average vertical diameters of vertebral canal at the cranial and caudal aspects were found to be 1.61 ± 0.04 cm and 2.01 ± 0.04 cm in adult Blue bull respectively. The average height of dorsal supraspinous process was found to be 3.88 ± 0.04 cm, whereas the average width of dorsal spinous process at the summit, middle and base were recorded as 2.73 ± 0.05 cm, 2.14 ± 0.03 cm and 1.48 ± 0.03 cm respectively in adult Blue bull. The present biometrical study would be helpful in identification of the bone and would be useful to the wild life professionals for determination of sex of this animal and solving vetero-legal cases related with this species.

Keywords: Biometry, blue bull, cervical vertebrae

Introduction

The Blue bull (*Boselaphus tragocamelus*) is known to be one of the biggest antelopes in Asia and is widely found in both the forests and adjoining villages with enough green grass [2]. It belongs to the family Bovidae and comes under the genus *Boselaphus* [3-8]. It is quite prevalent in northern and central parts of India especially in the foothills of Himalayas, eastern part of Pakistan and southern part of Nepal, but has vanished from Bangladesh [9-11]. The adult male resembles ox and are seen in day times in the meadow pasture, timberland areas and agricultural land area. It prefers mostly plain or grassy plain and low hilly areas with shrubs, small bushes, scrub forests with scattered trees and does not usually found in dense forest areas, dense compact wood, etc. They are safeguarded beneath the IUCN (2003) and safeguarded as 'Schedule III' animals of the Indian Wildlife Protection Act, 1972 [1]. The places like Gir National Park (Gujarat), Kumbhalgarh Sanctuary (Rajasthan) and Panchamarahi Biosphere Reserve provide protection to the Blue bull in India. The massive body of the Blue bull can be attributed to the large skeleton of the antelope. The skeleton of Blue bull consist massive bones that protects the viscera and provides shape and support to the heavy musculature [12]. The present biometrical study will furnish baseline data on the fifth cervical vertebrae of adult Blue bull that would immensely help the wild life anatomists and Veterinarians in species identification and solving forensic and vetero-legal cases.

Materials and methods

The present biometrical study was carried out on the fifth cervical vertebra of six specimens of adult Blue bulls (*Boselaphus tragocamelus*) of either sex. The permission for the collection of bones was acquired from the Principal Chief Conservator of Forests (PCCF), Government of Rajasthan. The bones were possessed from the Jodhpur Zoo, Rajasthan getting authentic confirmation from the Principal Chief Conservator of Forests (PCCF), Government of Rajasthan. The skeletons were taken out from the burial ground that was located in the premises of the office of the Deputy Conservator of Forest Wildlife (WL), Jodhpur. The collected bones were boiled in an Aluminium container for about an hour and then air dried for two to three days. The gross study was conducted under the supervision of the Zoo Authority, Jodhpur, India. The different biometrical parameters of fifth cervical vertebra of Blue bull

were measured and subjected to routine statistical analysis as per standard technique given by [13] and independent samples t-Test with Systat Software Inc, USA and SPSS 16.0 version software.

Results and Discussion

The fifth cervical vertebra of Blue bull consisted of body, arch and processes (Fig. 1). The biometrical observations revealed that the average weight of C₅ was found to be 244.42±2.86 gm in adult Blue bull. Further, it was measured to be 238.66±1.73 gm in females that was significantly lesser (*P*<0.05) than that of males, where it was found to be 250.18±2.20 gm (Table 1). The average length of the body was found to be 5.47±0.07 cm in adult Blue bull. Further, it was measured to be 5.33±0.03 cm in females that was significantly lesser (*P*<0.05) than that of males, where it was found to be 5.60±0.06 cm. The average width of the body at the cranial aspect was found to be 2.83±0.05 cm in adult Blue bull. Further, it was measured to be 2.75±0.08 cm and 2.90±0.02 cm in females and males respectively. The average width of the body at the middle was found to be 2.61±0.04 cm in adult Blue bull. Further, it was measured to be 2.54±0.04 cm in females that was significantly lesser (*P*<0.05) than that of males, where it was found to be 2.68±0.02 cm. Similarly, the average width of the body at the caudal aspect was found to be 2.15±0.04 cm in adult Blue bull. Further, it was measured to be 2.08±0.03 cm in females that was significantly lesser (*P*<0.05) than that of males, where it was found to be 2.23±0.05 cm.

The average vertical diameter of vertebral canal at the cranial aspect was found to be 1.61±0.04 cm in adult Blue bull. Further, it was measured to be 1.57±0.05 cm and 1.65±0.07

cm in females and males respectively. Similarly, the average vertical diameter of vertebral canal at the caudal aspect was found to be 2.01±0.04 cm in adult Blue bull. Further, it was measured to be 1.93±0.04 cm and 2.08±0.04 cm in females and males respectively. The average transverse diameter of vertebral canal at the cranial aspect was found to be 1.68±0.07 cm in adult Blue bull. Further, it was measured to be 1.55±0.07 cm in females that was significantly lesser (*P*<0.05) than that of males, where it was found to be 1.82±0.05 cm. The average transverse diameter of vertebral canal at the caudal aspect was found to be 2.42±0.03 cm in adult Blue bull. Further, it was measured to be 2.37±0.04 cm and 2.47±0.02 cm in females and males respectively.

The average height of dorsal supraspinous process was found to be 3.88±0.04 cm in adult Blue bull. Further, it was measured to be 3.81±0.02 cm in females that was significantly lesser (*P*<0.05) than that of males, where it was found to be 3.96±0.03 cm. Similarly, the average width of dorsal spinous process at the summit was found to be 2.73±0.05 cm in adult Blue bull. Further, it was measured to be 2.64±0.04 cm in females that was significantly lesser (*P*<0.05) than that of males, where it was found to be 2.83±0.02 cm. The average width of dorsal spinous process at the middle was found to be 2.14±0.03 cm in adult Blue bull. Further, it was measured to be 2.09±0.04 cm and 2.19±0.01 cm in females and males respectively. The average width of dorsal spinous process at the base was found to be 1.48±0.03 cm in adult Blue bull. Further, it was measured to be 1.43±0.02 cm in females that was significantly lesser (*P*<0.05) than that of males, where it was found to be 1.53±0.02 cm.

Table 1: Measurements of fifth cervical vertebra of Blue bull in cm

Parameters		Range	Mean	SD	SE	Female (Mean±SE)	Male (Mean±SE)	
Body	Length	5.3-5.7	5.47	0.16	0.07	5.33*±0.03	5.60±0.06	
	Width	Cranial	2.62-2.94	2.83	0.12	0.05	2.75±0.08	2.90±0.02
		Middle	2.48-2.71	2.61	0.09	0.04	2.54*±0.04	2.68±0.02
Caudal		2.02-2.32	2.15	0.10	0.04	2.08*±0.03	2.23±0.05	
Diameter of vertebral canal	Vertical	Cranial	1.49-1.73	1.61	0.10	0.04	1.57±0.05	1.65±0.07
		Caudal	1.87-2.16	2.01	0.10	0.04	1.93±0.04	2.08±0.04
	Transverse	Cranial	1.42-1.91	1.68	0.17	0.07	1.55*±0.07	1.82±0.05
		Caudal	2.30-2.51	2.42	0.07	0.03	2.37±0.04	2.47±0.02
Distance between the two ventral divisions of transverse processes		4.5-5.1	4.82	0.20	0.08	4.67±0.09	4.97±0.07	
Distance between two cranial articular processes		3.7-4.2	3.93	0.18	0.07	3.83±0.09	4.03±0.09	
Distance between two caudal articular processes		2.4-2.7	2.57	0.12	0.05	2.53±0.09	2.60±0.06	
Dorsal supraspinous process	Height		3.77-4.0	3.88	0.09	0.04	3.81*±0.02	3.96±0.03
	Width	Summit	2.58-2.87	2.73	0.12	0.05	2.64*±0.04	2.83±0.02
		Middle	2.02-2.21	2.14	0.07	0.03	2.09±0.04	2.19±0.01
		Base	1.39-1.57	1.48	0.06	0.03	1.43*±0.02	1.53±0.02
Distance between cranial and caudal articular processes		3.8-4.7	4.18	0.35	0.10	4.05±0.14	4.30±0.14	
Transverse process	Dorsal division	Length	3.5-4.2	3.96	0.31	0.09	3.88±0.13	4.03±0.12
		Width	2.09-2.41	2.22	0.09	0.03	2.16*±0.02	2.28±0.03
	Ventral division	Length	3.3-4.0	3.68	0.24	0.07	3.60±0.10	3.77±0.09
		Width	2.43-2.82	2.67	0.12	0.03	2.60*±0.05	2.75±0.02
Diameter of cranial transverse foramen		Transverse	0.48-1.07	0.86	0.21	0.06	0.79±0.10	0.94±0.06
Diameter of caudal transverse foramen		Transverse	1.28-1.57	1.43	0.10	0.03	1.38*±0.03	1.49±0.04
Diameter of cranial transverse foramen		Transverse	0.39-0.66	0.55	0.09	0.03	0.47*±0.02	0.63±0.01
Diameter of caudal transverse foramen		Vertical	0.95-1.21	1.06	0.08	0.02	1.03±0.02	1.10±0.03
Distance between cranial and caudal transverse foramen			2.3-2.9	2.53	0.27	0.08	2.43±0.10	2.62±0.12
Articular process	Cranial	Length	2.19-2.59	2.43	0.13	0.04	2.33*±0.05	2.52±0.03
		Width	2.11-2.56	2.33	0.14	0.04	2.25±0.06	2.41±0.04
	Caudal	Length	2.43-2.84	2.67	0.11	0.03	2.61*±0.05	2.74±0.03
		Width	2.14-2.63	2.36	0.18	0.05	2.30±0.06	2.43±0.08

Values bearing superscript (*) differ significantly in column *P*<0.05

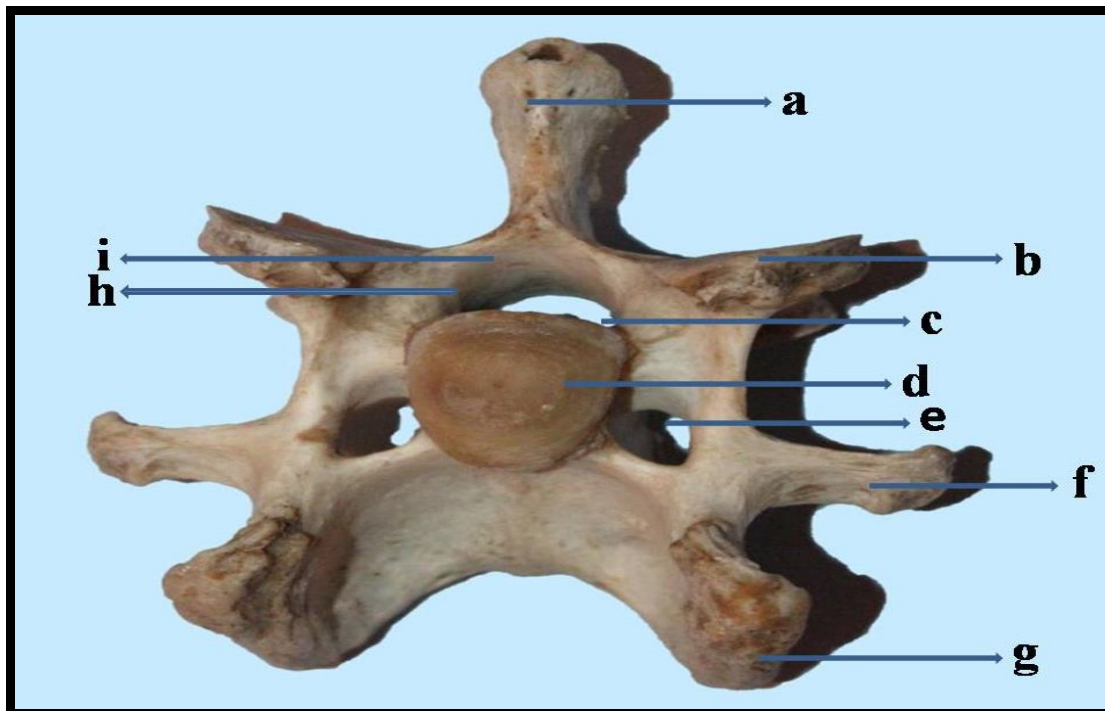


Fig 1: Cranial view of fifth cervical vertebra of adult female Blue bull (*Boselaphus tragocamelus*) showing a) Dorsal supraspinous process, b) Cranial articular process, c) Cervical vertebral foramen, d) Cranial surface of body, e) Transverse foramen, f) Dorsal division of transverse process, g) Ventral division of transverse process, h) Pedicle and i) Laminae

Conclusion

The various biometrical parameters of the fifth cervical vertebra like average length and widths of body, average vertical and transverse diameters of vertebral canal, average height and width of dorsal supraspinous process, average length and width of dorsal and ventral divisions of transverse process, average transverse and vertical diameters of cranial and caudal transverse foramina, average length and width of cranial and caudal articular processes were significantly ($P < 0.05$) more in male than female Blue bull. There is no previous information on these parameters in the fifth cervical vertebra neither of Blue bull, nor in any other domestic animals with which comparisons could be made. We therefore believe that the data presented above would form a baseline for further work and solving forensic and vetero-legal cases.

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