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## Morphology and Morphometry of Rhinencephalon of Brain of Surti Buffalo (*Bubalus bubalis*)

Alka Suman\*, Sweta Pandya and Vanila Shukla

Department of Veterinary Anatomy and Histology

College of Veterinary Science and AH, Anand Agriculture University, Anand, 388001

Corresponding Author: dralkasuman@gmail.com

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### Abstract

The morphological and morphometrical study of brain of Surti buffaloes was conducted on all the structures of the rhinencephalon which were located on the ventral surface of the cerebral hemispheres. The structures included paired olfactory bulb, olfactory tract, lateral and medial olfactory striae and pyriform lobe. The olfactory bulbs were oval, hollow structures which continued caudally with the olfactory tract. The overall mean length and width of right bulb were  $3.45 \pm 0.06$  and  $1.46 \pm 0.03$  cm, while those of left bulb were  $3.42 \pm 0.06$  and  $1.43 \pm 0.03$  cm, respectively. The olfactory tracts were short, wide and flat bands which divided caudally into two lateral and medial striae. The pyriform lobes were two pear shaped structures.

**Key Words:** Buffalo, Rhinencephalon, Morphometry, Olfactory bulb, Pyriform lobe.

### Introduction

The buffaloes are true even-toed mammals that belong to the family Bovidae. The Surti buffaloes are found in Charotar tract of Gujarat. Buffalo/Bison have quite poor eyesight, but their hearing and sense of smell is very good. They are able to detect another animal by smell at a distance of 3 kilometers (Yasuda, 2017). Olfaction is a chemoreception that forms the sense of smell. Sniffing and licking the female's genitalia are the most frequent patterns, suggesting an important function of chemical communication through olfaction (Fraser and Broom, 1990). The present study was conducted on olfactory brain of 12 adult Surti buffaloes as the structures of olfactory brain are mainly involved in olfaction.

### Materials & Methods

The study was carried out at the department of Veterinary Anatomy & Histology, College of Veterinary Science and Animal Husbandry, AAU, Anand, Gujarat. The materials required for the study were collected from normal healthy adult Surti buffaloes immediately after slaughter from the abattoir of Ahmedabad Municipal Corporation. The samples were preserved in 10 % neutral buffered formalin at least for 24 hours. The measurements like length and width of various structures of rhinencephalon of brain were taken with the digital Vernier callipers, non-stretchable thread and scale. The means, standard errors and coefficients of variance were worked out and the differences

between right and left side measurements were compared by using student's paired 't' test (Snedcor and Cochran, 1994).

## Results and Discussion

The rhinencephalon or olfactory brain comprised the olfactory bulbs, tracts, lateral and medial olfactory striae, the trigonumolfactorium, and the pyriform lobes. These structures are shown in Figure 1 and their biometry in Table 1.

### Olfactory Bulb

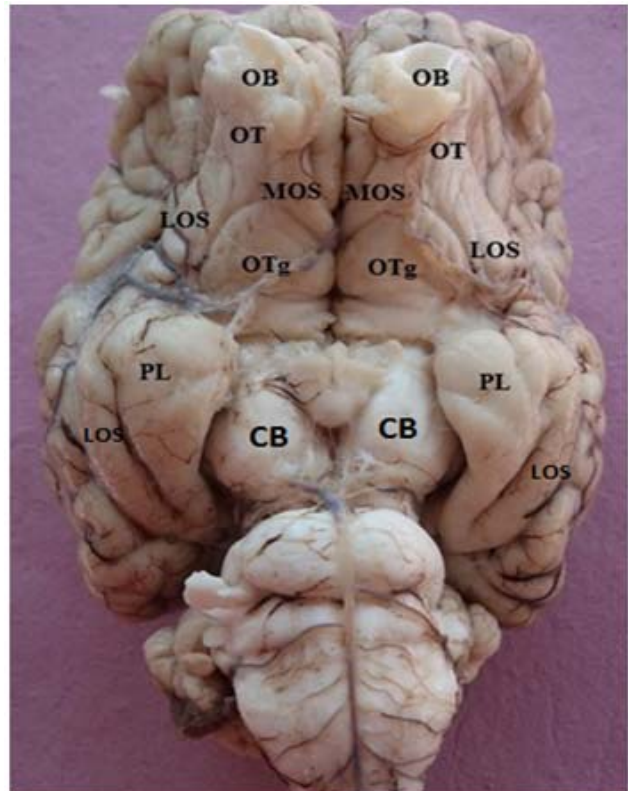
The paired olfactory bulbs were oval shaped, hollow structures placed on ventral aspect of anterior pole of cerebral hemisphere. Its convex face fit into the ethmoidal fossa and received numerous olfactory nerve-fibers. Caudally it continued with the olfactory tract. The anterior horn of lateral ventricles was present in the olfactory bulbs. These observations are in line with the Trotter and Lumb (1962) in bovine, ICAR (1964) in ox, Getty (1975) in horse, and Konig *et al.* (2009) in domestic mammals.

The mean length of olfactory bulb of right side was 3.45 cm (range 2.98 to 3.60), whereas that of the left olfactory bulb was 3.42 cm (range 2.94 to 3.56). The mean width of olfactory bulb of right side was 1.46 cm (range 1.27 to 1.68), whereas that of the left olfactory bulb was 1.43 cm (range 1.25 to 1.65). Harper and Maser (1975) reported the length and width of right and left olfactory bulb as 3.67 and 3.89, and 1.75 and 1.58 cm, respectively in American plain buffalo, which is little higher than the present findings, while Tiwari and Prakash (1990) reported the corresponding values as 3.12 and 3.10, and 1.49 and 1.53 cm, respectively, in buffalo where the length is lower while the width is at par with present observation.

### Olfactory Tract

The olfactory tract was short, wide, hollow and flat band. Cranially it was attached with olfactory bulb, while caudally it divided into two lateral and medial olfactory striae. It contained a canal which connected the ventricle of the bulb with the lateral ventricle. These observations are in accordance with the Trotter and Lumb (1962) in bovines, ICAR (1964) in ox and Getty (1975) in horse. They mentioned that the olfactory tract is a short, wide, flat band from the lower extremity of the bulb which turns backward on the ventral surface of the cerebral hemisphere and divides into medial and lateral olfactory striae.

The mean length of right olfactory tract was 1.64 cm (range 1.53 to 1.72), whereas that of the left olfactory tract, it was 1.65 cm (range 1.57 to 1.74). The mean width of olfactory tract of right side was 1.46 cm (range 1.27 to 1.68), whereas that of the left olfactory tract it was 1.43 cm (range 1.25 to 1.65). Chen *et al.* (2009) reported that the olfactory tract of camel consisted of the lateral



Photograph of Ventral Surface of Brain showing structures of Rhinencephalon

OB-Olfactory Bulb, OT-Olfactory Tract, LOS-Lateral Olfactory Stria, MOS-Medial Olfactory Stria, OTg-Olfactory Trigonium, PL-Piriform Lobe, CB-Cerebral Peduncles

and medial branches which were 0.40 and 0.18 cm in width, respectively. However, in present study we did not observe any lateral and medial branches of olfactory tract in buffalo.

### Olfactory Striae

Each olfactory tract was caudally divided into two olfactory striae; the lateral stria and the medial stria. The medial stria was shorter and passed medially of the medial surface of the cerebral hemisphere, while the lateral stria was longer and wider and passed backwardly along the lateral border of cerebral hemisphere parallel to rhinal sulcus. At the end it joined the pyriform lobe. These observations are in agreement with Trotter and Lumb (1962) in bovine, ICAR (1964) in ox and Getty (1975) in horse. They observed the two olfactory striae, medial stria was short passed backward and inward to the median fissure of cerebral hemispheres. The lateral one was larger and longer passed inward and backward external to pyriform lobe and entered in hippocampus convolutions. The small but prominent gray area observed between medial and lateral olfactory stria was trigonium olfactorium.

The mean length of right lateral olfactory stria was 9.36 cm (range 8.00 to 10.70), whereas that of left lateral olfactory stria was 9.67 cm (range 8.60 to 11.15). The mean width of right lateral olfactory stria was 1.13 cm (range 1.02 to 1.30), whereas that of left lateral olfactory stria was 1.11 cm (range 1.00 to 1.21). The mean length of right medial olfactory stria was 1.77 cm (range 1.30

**Table 1: Morphometric measurements of structures of rhinencephalon**

Sr. No.	Parameters	Right			Left			't' value
		Range	Mean±SE	CV%	Range	Mean±SE	CV%	
<b>1</b>	<b>Olfactory Bulb</b>							
	Length (cm)	2.98-3.60	3.45±0.06	5.51	2.94-3.56	3.42±0.06	5.56	0.43
	Width (cm)	1.27-1.68	1.46±0.03	8.22	1.25-1.65	1.43±0.03	8.33	0.56
<b>2</b>	<b>Olfactory Tract</b>							
	Length (cm)	1.53-1.72	1.64±0.02	3.66	1.57-1.74	1.65±0.02	3.03	0.48
	Width (cm)	1.35-1.45	1.41±0.01	2.21	1.30-1.50	1.40±0.01	3.57	0.48
<b>3</b>	<b>Lateral Olfactory Stria</b>							
	Length (cm)	8.00-10.70	9.36±0.21	7.59	8.60-11.15	9.67±0.20	7.24	1.06
	Width (cm)	1.02-1.30	1.13±0.02	7.08	1.00-1.21	1.11±0.02	7.21	0.55
<b>4</b>	<b>Medial Olfactory Stria</b>							
	Length (cm)	1.30-2.05	1.77±0.07	14.12	1.10-2.05	1.63±0.08	17.18	1.25
	Width (cm)	0.30-0.70	0.54±0.03	20.37	0.40-0.80	0.62±0.04	22.58	1.48
<b>5</b>	<b>Pyriform Lobe</b>							
	Length (cm)	4.10-6.20	5.40±0.19	11.85	3.90-6.20	5.13±0.22	14.81	0.97
	Width (cm)	1.60-2.40	1.96±0.08	14.28	1.55-2.40	1.93±0.07	13.47	0.29

None of the measurements differed significantly between right and left side by 't' test.

to 2.05), whereas that of left medial olfactory stria was 1.63 cm (range 1.10 to 2.05). The mean width of right medial olfactory stria was 0.54cm (range 0.30 to 0.70), whereas that of left medial olfactory stria was 0.62 cm (range 0.40 to 0.80).

### **Pyriform Lobe**

Two pear shaped structures were located on ventral surface of cerebral hemisphere just lateral to the optic tract and cerebral peduncles. It had two surfaces and two borders, the ventral surface was convex while the dorsal surface was concave, and placed below the fornix and hippocampus. The lateral border was attached with lateral olfactory striae and the medial border was near the lateral border of cerebral peduncles. Trotter and Lumb (1962) in bovine, Getty (1975) in horse, and Konig *et al.* (2009) in domestic animals mentioned that the pyriform lobe is large pear shaped eminence lateral to the cerebral peduncle from which it is separated by the lateral fissure and present on ventral surface of the cerebral hemisphere. The present findings are in accordance with these authors.

The mean length of right pyriform lobe was 5.4 cm (range 4.10 to 6.20), whereas that of left pyriform lobe was 5.13 cm (range 3.90 to 6.20). The mean width of right pyriform lobe was 1.96 cm (range 1.60 to 2.40), whereas that of left lateral pyriform lobe was 1.93 cm (range 1.55 to 2.40).

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**Conflict of Interest:** All authors declare no conflict of interest.

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