

*Original Research***Histomorphological Study on Retina of the Adult Surti Buffalo (*Bubalus bubalis*)****Malsawm Kima^{1*}, R. K. Barhaiya², Y. L. Vyas³ and D. M. Bhayani⁴**Department of Veterinary Anatomy and Histology, College of Veterinary Science & Animal Husbandry,
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Abstract

The present study was conducted on 10 pairs of eye balls to study the histomorphological structures of retina. The retina was composed of ten layers such as (i) pigmented epithelium (ii) layer of rods and cones (iii) external limiting membrane (iv) outer nuclear layer (v) outer plexiform layer (vi) inner nuclear layer (vii) inner plexiform layer (viii) ganglion cell layer (ix) nerve fibers layer (x) internal limiting membrane. The mean thickness of the retina in the center of the tunics was $177.56 \pm 10.72 \mu\text{m}$ and that of retina in the peripheral section of the tunics was $120.24 \pm 15.40 \mu\text{m}$.

Key words: Eye Ball, Histomorphology, Micrometry, Retina, Surti Buffalo

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Introduction

Retina is one of the most important components of the eye since it is directly involved in the process of vision. Visual perception is a sensory process initiated at the retina, and completed in the cerebral cortex. The histological study of retina in Indian buffalo has not been done breed wise. So the present study was carried out in the eye ball of surti buffalo irrespective of the sex of animals to establish basic data bank as well as to provide authentic references for future study.

Materials and Method

The samples were collected immediately after slaughtering of animals in local slaughter house, Anand. The eye balls were fixed in Davidson's fixative to prepare the paraffin sections. The histological sections

were stained with Haematoxylin and Eosin Stain (Singh and Sulochana, 1996) for normal routine staining and Masson's trichrome stain (Luna, 1968) for special staining. The micrometrical measurement of the different parameters taken from the center and equator of retina was recorded with the help of graduated eye piece. The data was analyzed statistically (Snedecor and Cochran, 1967).

Results and Discussion

The retina can be divided into two parts, the part which covered the posterior portion of vascular tunic i.e. *pars optica retinae* and the part which covered the anterior portion of vascular tunic i.e. *pars ciliaris retinae* and *pars iridae retinae*. The junction between the two parts of retina is known as *oraciliaris retinae* (Fig. 1).

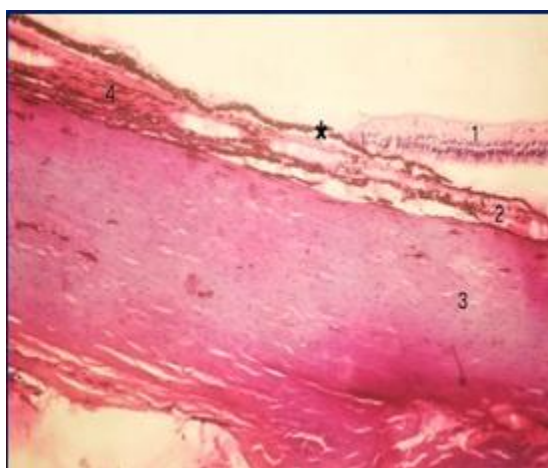


Fig. 1: Photomicrograph of tunics of eye ball of surti buffalo (H&E stain, 75X) showing (1) Retina, (2) Choroid, (3) Sclera, (4) Ciliary body and (*) Oraciliaris retinae.

The retina of surti buffalo was found to be composed of ten layers such as (Fig. 2):

1. Pigmented epithelium
2. Layer of rods and cones
3. External limiting membrane
4. Outer nuclear layer
5. Outer plexiform layer
6. Inner nuclear layer
7. Inner plexiform layer
8. Ganglion cell layer
9. Nerve fibers layer
10. Internal limiting membrane.

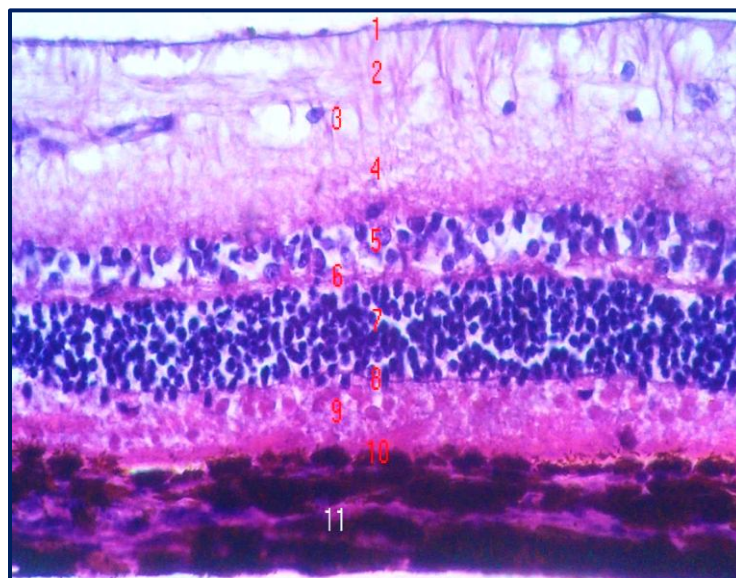


Fig. 2: Photomicrograph of Retina of surti buffalo (H&E stain, 300X magnification) showing (1) Internal limiting membrane, (2) Nerve fibers layer, (3) Ganglion cell layer, (4) Inner plexiform layer, (5) Inner nuclear layer, (6) Outer plexiform layer, (7) Outer nuclear layer, (8) Outer limiting membrane, (9) Layer of rods and cones, (10) Pigmented epithelium and (11) Choroid.

This observation is found to be in concurrence with the observations of Prince *et al.* (1960) in domestic animals, Dellman (1993) in cattle, Khaled (2003) in bovine and Gellat (2007) in domestic animals.

Pigmented Epithelium

This epithelium was simple cuboidal or squamous epithelium with prominent nuclei. It was heavily pigmented but where it was backed by tapetum lucidum it was less pigmented (Fig. 3).

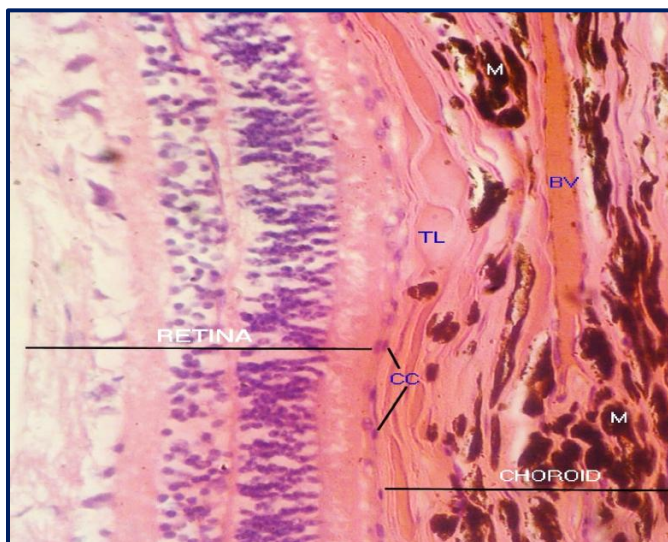


Fig. 3: Photomicrograph of tunics of eye ball of surti buffalo (H&E stain, 300X) showing Retina in which pigmented epithelium is less pigmented where (TL) tapetum is present, Choroid, (CC) Choriocapillary, (M) Melanocytes and (BV) Blood vessel.

Layer of Rods and Cones

The next layer was the layer of rod and cone cells situated between the layers of pigmented epithelium and the external limiting membrane.

External Limiting Membrane

The external limiting membrane was a thin membrane situated between the layer of rods and cones and the layer of outer nuclei.

Outer Nuclear Layer

The layer of outer nuclei was composed of the nuclei of both rods and cones arranged in layers of about 7 to 9 rows.

Outer Plexiform Layer

The outer plexiform layer was situated between the outer nuclear layer and the inner nuclear layer and was observed to be thinner than the inner plexiform layer.

Inner Nuclear Layer

The inner nuclear layer was composed of around 3-4 rows of nuclei and it was found to be thinner than the outer nuclear layer.

Inner Plexiform Layer

The inner plexiform layer was situated between the inner nuclear layer and the ganglion cell layer.

Ganglion Cell Layer

The ganglion cells were usually arranged in a single row and were found to be absent where retinal blood vessels were present.

Nerve Fibers Layer

The nerve fibers layer was present between the ganglion cell layer and the internal limiting membrane. The presence of retinal blood vessels in this part of retina increased the thickness of the retina. The thickness of nerve fiber layer was found to be increased near the optic disc.

Internal Limiting Membrane

The internal limiting membrane was the innermost thin membrane and was in contact with the vitreous body.

The present observations of general histological structures of adult surti buffalo are found to be in agreement with the observations of Prince *et al.* (1960) in domestic animals, Khaled (2003) in bovine and Gelatt (2007) in domestic animals.

Micrometry of Retina

The mean thickness of the retina in the center of the tunics was $177.56 \pm 10.72 \mu\text{m}$ with the range from $155.10 \mu\text{m}$ to $229.67 \mu\text{m}$ and that of retina in the peripheral section of the tunics was $120.24 \pm 15.40 \mu\text{m}$ with the range from $94.57 \mu\text{m}$ to $149.33 \mu\text{m}$. The present observations were lower as compared to the observations of Prince *et al.* (1960) in cattle ($220 \mu\text{m}$) and Gelatt (2007) in domestic animals (central retina of 200 to $240 \mu\text{m}$ and peripheral retina of 100 to $190 \mu\text{m}$). However, the individual thickness of retina near to the optic nerve was as high as $270.20 \mu\text{m}$ in the present study. The mean thickness of the different layers of retina were as below-

- (a) Pigmented epithelium $5.36 \pm 0.35 \mu\text{m}$ (range between 3.30 to $6.60 \mu\text{m}$)
- (b) Layer of rods and cones $25.30 \pm 0.74 \mu\text{m}$ (range between 23.10 to $29.70 \mu\text{m}$)
- (c) Outer nuclear layer $35.20 \pm 0.74 \mu\text{m}$ (range between 30.00 to $39.60 \mu\text{m}$)
- (d) Outer plexiform layer $6.05 \pm 0.23 \mu\text{m}$ (range between 4.95 to $6.60 \mu\text{m}$)
- (e) Inner nuclear layer $22.82 \pm 0.63 \mu\text{m}$ (range between 19.80 to $26.40 \mu\text{m}$)
- (f) Inner plexiform layer $22.27 \pm 0.91 \mu\text{m}$ (range between 16.50 to $26.40 \mu\text{m}$)

The average numbers of rows of nuclei in the outer and inner nuclear layer were 8.16 ± 0.20 and 3.3 ± 0.14 rows respectively. Prince *et al.* (1960) in cattle and Khaled (2003) in bovine reported the thickness of pigmented epithelium as about $10 \mu\text{m}$ and $9 \pm 0.9 \mu\text{m}$ respectively. These values were higher than the mean value of the present observation i.e. $5.36 \pm 0.35 \mu\text{m}$. Prince *et al.* (1960) in cattle mentioned the thickness of outer nuclear layer of retina as $36 \mu\text{m}$. This value was in accordance with the present mean value of the outer nuclear layer i.e. $35.20 \pm 0.74 \mu\text{m}$. However, Khaled (2003) in bovine reported that the mean value of the outer nuclear layer was $30 \pm 1.70 \mu\text{m}$ which was slightly lower than that of the present observation. The present observation of thickness of inner nuclear layer ($22.82 \pm 0.63 \mu\text{m}$) was in agreement with the observation of Prince *et al.* (1960) in cattle ($20 \mu\text{m}$). However, the present observation was found to be higher than the observation of Khaled (2003) in bovine ($9 \pm 1.10 \mu\text{m}$). The present observation of the thickness of outer plexiform layer ($6.05 \pm 0.23 \mu\text{m}$) was found to be lower than the observation of Khaled (2003) in bovine ($11 \pm 0.80 \mu\text{m}$). Khaled (2003) in bovine reported the thickness of inner plexiform layer as $34 \pm 2.10 \mu\text{m}$. In the present study, the thickness of inner plexiform layer was $22.27 \pm 0.91 \mu\text{m}$ which was lower than the observation of Khaled (2003) in bovine. Prince *et al.* (1960) in cattle mentioned the presence of around 10 rows of nuclei and Khaled (2003) in bovine reported the presence of around 6 rows of nuclei in the outer nuclear layer. The present mean value of the number of

nuclei in outer nuclear layer was 8.16 ± 0.20 which was found to be lesser than the observation of Prince *et al.* (1960) in cattle but higher than the observation of Khaled (2003) in bovine.

The present mean value of the number of nuclei in the inner nuclear layer was 3.3 ± 0.14 which was found to be in accordance with the observation of Khaled (2003) in bovine, where he reported the nuclei of inner nuclear layer were arranged in 3 rows. Prince *et al.* (1960) in cattle mentioned the presence of 5-6 rows of inner nuclei in the inner nuclear layer which was found to be slightly higher than that of the present observation. The variations in the values of thickness of different layers of retina may be due to variations in the species of animals or some other factors.

Artifacts of Retina

The present study showed two types of artifacts i.e. retinal detachment and folding of retina. Retina usually detached from the retinal pigmented epithelium and sometimes detached from the choroid due to poor fixation. At the site of retinal detachment, outer segment of the intact photoreceptors and fragment of retinal pigment epithelium were present. Similar findings were reported earlier by Margo and Lee (1995) and Milles (2012). In more than 60-70 % of the samples, it was found that retina took a convex appearance vitreally which was looking like a fold (Fig. 4).

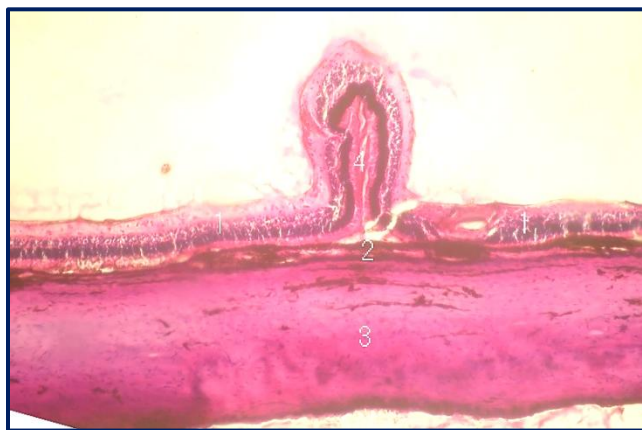


Fig. 4: Photomicrograph of tunics of eye ball of surti buffalo (H&E stain, 75X) showing (1) Retina, (2) Choroid, (3) Sclera and (4) Folding of retina.

It was almost round and oval in shape. The retinal fold was not observed in unfixed enucleated eye. This retinal fold may be due to either artifacts of fixation as earlier described by Milles (2012) or hereditary as reported by Chen and Nathans (2007). The fixative (formalin) causes the shrinkage of fibrous tunic, shortening of the vitreous body and posterior lens zonules that leads to traction of retina and resulting into folding of very delicate and soft layer of nervous tissue i.e. retina. These findings are in accordance with the observations of Margo and Lee (1995) and Milles (2012).

Conclusion

The histological layers of retina of surti buffaloes were arranged in ten layers as in other domestic animals. The mean thickness of the retina in the center of the tunic was non significantly higher than that in the periphery of the tunic. The individual thickness of retina near to the optic nerve was very high due to increased thickness of nerve fibers. The mean thickness of retina in the center of the tunic was $177.56 \pm 10.72 \mu\text{m}$ and that of retina in the peripheral section of the tunic was $120.24 \pm 15.40 \mu\text{m}$. Retina was usually detached from the retinal pigment epithelium or from choroid. This may be due to faulty processing of tissue during preparation of blocks and sectioning.

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