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Histological Observation of Thyroid Gland at Prepubertal, Pubertal and Castrated Black Bengal Goat

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Abstract: The present study was conducted in the Department of Anatomy and Histology with an aim to observe the histological architecture of thyroid gland at prepubertal, pubertal and castrated Black Bengal goat with Hematoxylin and Eosin stain. The thyroid gland was covered by a three-layered capsule, an outer, the middle and an inner layer. The connective tissue capsule was rich in blood vessels, some times accompanied with lymphocytic infiltration also some fibroblasts. From the capsule, connective tissue septa penetrated the gland parenchyma forming indistinct lobe and lobules of the gland. The thyroid gland was consisted of numerous follicles with interfollicular stroma. The follicle consisted of follicular epithelium and intrafollicular substances. Usually, small sizes follicle were near the capsule and active, whereas, large sizes follicle were towards the center of the gland. The thyroid follicles were lined by cuboidal epithelium in prepubertal Black Bengal goats, cuboidal to columnar in pubertal group. Follicular epithelium becomes squamous or flattened in castrated group. The thyroid follicle contained amber-colored homogenous, solid, lightly eosinophilic colloid material. In the active follicle the colloid was thinner and less in amount, whereas, in inactive follicle it was thicker and more quantity. The colloid materials mostly cracked at castrated group but cracked colloidal materials were found in few large follicles or absent in prepubertal and pubertal group of Black Bengal goats. Parafollicular cells or interfollicular cells were arranged singly or grouped within the basal lamina or interfollicular space. The parafollicular cells were significantly decreased in the adult castrated Black Bengal goats than prepubertal and pubertal group. The inetrfollicular spaces were significantly decreased in castrated Black Bengal goats when compared to prepubertal and pubertal group. Thus it can be assumed that histoarchitectures of the thyroid gland of Black Bengal goat changed at different stages with their activity.

Key words: Histology, thyroid gland, prepubertal, pubertal and castrated Black Bengal goat

Introduction

The histology of the thyroid gland in different animals were studied by Agrawal and Bhattacharya (1981) in Barbari goat; Baishya *et al.* (1986) in Assam goat; Das *et al.* (1965) in bull and the bullock; Mathur (1964) and Roy and Yadava (1975) in Indian buffalo; Mathur (1971) in Asiatic Water-buffalo; Roy (1971) in buffalo; Roy and Saigal (1987) in sheep; Roy *et al.* (1978) in goat; Sanap *et al.* (1998) in cattle. As there is no available literature regarding the histological structure of Black Bengal goat in Bangladesh, the present piece of work will provide valuable information histological structure of thyroid gland at different stages with its activity in detail.

Materials and Methods

Twelve male Black Bengal goats were used in the present study that were grouped as three of which 4 goats at prepubertal stage, 4 goats at pubertal stage and another 4 goats were castrated adult. Thyroid glands from

castrated goats were collected from local market of Bangladesh Agricultural University Mymensingh, immediately after slaughter. Prepubertal and pubertal thyroid glands were collected from butcher shop immediately after slaughter by determining the age of the goat. Before sampling prepubertal group were selected below 4 months of age and pubertal group were selected after 6 months of age whereas the castrated group were selected after 6 months of age which were castrated at earlier of prepubertal life. Left and right lobes of thyroid were collected at a time in different container immediately after slaughter. Thyroid glands were taken in "Bouin's fluid". Each tissue samples was trimmed to about 1 cm² before putting into fixative. Standard histological techniques were adopted for processing of tissues. Paraffin sections were cut at 6 microns thickness using a rotary microtome. Statistical analysis recorded by SPSS program. Figs. and Plates/photographs from selected specimens were prepared and placed in the article for better illustrations.

Results and Discussions

Capsule: The thyroid gland was covered by a thick capsule. In Black Bengal goat, the capsule was consisted of three layers an outer, a middle and an inner layer (Plate 1). The outer layer was consisted of dense collagen fibres with a few reticular and elastic fibres. The middle layer of capsule was consisted of adipose tissue, which arranged in 2-10 layers in some animals (Plate 1). But in few animals such adipose tissue was absent. The inner layer of capsule was related to the follicle and consisted of mainly collagen and elastic fibres (Plate 1).

Prepubertal group: The average thickness of prepubertal capsule was $252.43 \pm 58.95 \mu$ (Table 1). Adipose tissue was in the middle layer of the capsule. Lymphocytic infiltration was observed in 2 animal. Fibroblast cells were remarkably observed in the connective tissue capsule.

Pubertal group: The average thickness of the pubertal capsule was $263.21 \pm 46.67 \mu$ (Table 1). Lymphocytic infiltrations were present in the capsule of 1 animal of this group.

Castrated group: The average thickness of the castrated capsule was $321.46 \pm 34.18 \mu$ (Table 1). Castrated group of Black Bengal goat showed the presence of fat globule in the capsule of the thyroid gland. It was common in four animals in both left and right lobe of thyroid. Adipose tissues were seen in the middle layer of the capsule. One castrated goat showed 2-10 layers of adipose tissue in different place of capsule. Another 3 goats showed one to three layers of fatty tissue in the capsule in some place. The connective tissue capsule was rich in blood vessels. From the capsule, the connective tissue septa penetrated the gland parenchyma forming indistinct lobe and lobules of the gland as described by Roy (1971) in Indian buffalo. This observation regarding prepubertal, pubertal and castrated group of animals was similar to the findings of Roy and Yadava (1975) in Indian buffalo. But present observation was not agreement with the observation of Ham and Carmack (1979) in human and Baishya *et al.* (1986) in Assam Barbari goat. Ham and Carmack (1979) noted the human thyroid gland was covered with two capsules the outer and the inner true capsule. Baishya *et al.* (1986) observed that the gland was probably double layered in Assam barbari goat. In addition, Das *et al.* (1965) noted the presence of smooth muscle fibres in the capsule of thyroid gland in the bull and bullocks. In the present study, the cellular component of the stroma was scanty in castrated Black Bengal goats than prepubertal and pubertal group.

Table 1: Thickness (in micron) of capsule at prepubertal, pubertal and castrated Black Bengal goats. [Animal (n) = 12]

No. of Animals	Prepubertal stage	Pubertal stage	Castrated stage
1	345.2	233.01	345.2
2	258.9	207.12	362.46
3	215.75	284.79	302.05
4	189.89	327.94	276.16
Mean \pm SD	$252.43 \pm 58.95 \mu$	$263.21 \pm 46.67 \mu$	$321.46 \pm 34.18 \mu$

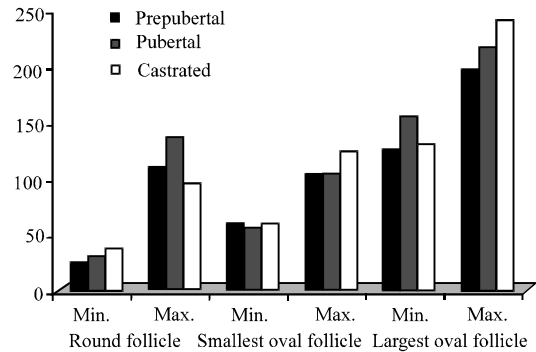


Fig. 1: Showing minimum and maximum diameters in micron of different types of follicles of thyroid gland at prepubertal, pubertal and castrated goats

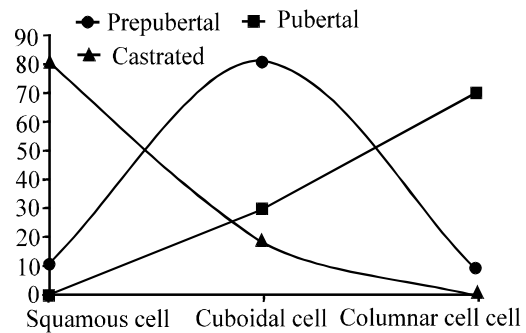


Fig. 2: Showing different types of follicular epithelial cells at every 100 epithelial cells at prepubertal, pubertal and castrated thyroid glands of Black Bengal goats

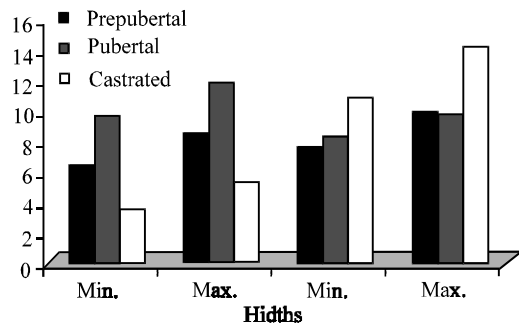


Fig. 3: Showing heights and widths of the follicular epithelium (in micron) at prepubertal, pubertal and castrated thyroid glands of black Bangal goats

Table 2: Minimum (mini.) and maximum (maxi.) diameter (in micron) of different types of follicles at prepubertal, pubertal and castrated groups (n = 12)

		Follicular size (μ)					
		Round follicle		Smallest oval follicle		Largest oval follicle	
Animal group	No. of animal	Min. diameter	Max. diameter	Min. diameter	Max. diameter	Min. diameter	Max. diameter
Prepubertal stage	1	25.8	103.56	51.78	94.93	112.19	163.97
	2	34.52	129.45	77.67	120.82	138.08	189.86
	3	17.26	94.93	69.04	103.56	146.71	241.64
	4	25.8	112.19	43.15	94.93	103.56	189.86
	Mean±SD	25.85± 6.10 μ	110.03± 12.76 μ	60.41± 13.65 μ	103.56± 10.56 μ	125.14± 17.79 μ	196.33± 28.21 μ
Pubertal stage	1	17.2	129.45	43.15	103.56	129.45	172.6
	2	43.15	155.34	60.41	103.56	198.49	258.9
	3	25.89	86.3	69.04	129.45	155.34	189.86
	4	34.52	172.6	51.78	77.67	138.08	241.64
	Mean±SD	30.19± 9.69 μ	135.92± 32.50 μ	56.09± 9.69 μ	103.56± 18.30 μ	155.34± 26.59 μ	215.75± 35.58 μ
Castrated group	1	25.8	103.56	60.41	129.45	155.34	215.75
	2	25.8	86.10	51.78	103.56	120.82	233.01
	3	34.52	112.19	43.15	94.93	129.45	258.9
	4	60.41	77.67	77.67	163.97	112.91	250.27
	Mean±SD	36.63± 14.18 μ	94.88± 13.67 μ	58.25± 12.76 μ	122.97± 26.86 μ	129.45± 16.14 μ	239.48± 16.57 μ

Table 3: Number of different types of follicular epithelial cells at every 100 epithelial cells at different group

	Prepubertal stage			Pubertal stage			Castrated group		
No. of animal	Sq. cell	Cu. Cell	Col. Cell	Sq. cell	Cu. Cell	Col. Cell	Sq. cell	Cu. Cell	Col. Cell
1	15	78	7	2	42	56	78	19	3
2	8	73	19	0	30	70	79	21	0
3	12	82	6	0	20	80	83	17	0
4	6	89	5	0	27	73	81	17	2
Mean ± S.D	10.25±3.49	80.5±5.85	9.25±5.67	-	29.75±7.94	69.75±8.72	80.25±1.92	18.5±1.65	-

(Sq. = Squamous, Cu. = Cuboidal, Col. = Columnar)

Table 4: Height and width of the follicular epithelium (in micron) at prepubertal, pubertal and castrated Balck Bengal goat. (n = 12)

		Prepubertal stage		Pubertal stage		Castrated group							
		Height		Width		Height		Width		Height		Width	
No. of animal		Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
1		6.47	8.63	8.63	10.78	8.63	12.94	8.19	9.92	4.31	6.47	9.06	12.94
2		7.55	8.63	7.33	9.70	9.78	11.86	8.84	10.57	3.23	5.39	11.0	15.10
3		6.47	9.78	8.19	10.35	10.78	11.86	8.41	10.14	4.31	6.47	12.72	14.02
4		5.39	7.55	6.47	9.06	9.78	10.78	7.98	8.45	2.15	5.39	10.57	14.64
Mean±S.D		6.47±0.76	8.64±0.78	7.66±0.89	9.97±0.65	9.74±0.76	11.86±0.76	8.36±0.39	9.77±0.78	3.50±0.89	5.39±0.54	10.83±1.3	14.17±0.80

(Mini. = Minimum, Maxi. = Maximum)

Follicles: The thyroid gland was consisted of numerous follicles with interfollicular stroma. The follicle consisted of follicular epithelium and intrafollicular colloid substances. Follicles were various sizes and shapes. Usually, small sizes follicle were nearer to the capsule and large follicles were towards the centre of the gland (Plate 1) with few exception. This was in accordance with the observations of Sanap *et al.* (1998) in cattle, Baishya *et al.* (1986) in Assam barbari goats, Das *et al.* (1965) in bull and bullocks, Roy (1971) in Indian buffalo. Shapes of the follicles were seen round, oval and irregular with various sizes. Follicles contained colloid in the intrafollicular spaces. Some follicles filled up, with colloid, some follicles contained small amount of colloid in the centre of the intrafollicular space, even few follicles were completely empty at prepubertal, pubertal and castrated Black Bengal goats in this present study (Plate 1, 2, 3).

Usually, the larger follicles were inactive and the smaller follicles were active.

Prepuertal group: In this group, some follicles were smaller and some were larger. Larger follicles were fewer in number located at the centre of the gland. Lymphocytic infiltrations were seen in the interfollicular space. Most of the follicles were oval to spherical (Plate 1, 2) in shape that was similar to the results obtained by Sanap *et al.* (1998) in cattle and few follicles were irregular in shape. In prepubertal Black Bengal goats, the diameter of round follicles varied from 25.85± 6.10 to 110.03± 12.76 μ. In smallest oval follicle, the minimum and maximum diameters were 60.41± 13.65 and 103.56± 10.56 μ respectively. The largest oval follicle, minimum and maximum diameters were 125.14± 17.79 and 196.33± 28.21 μ respectively (Table 2, Fig. 1).

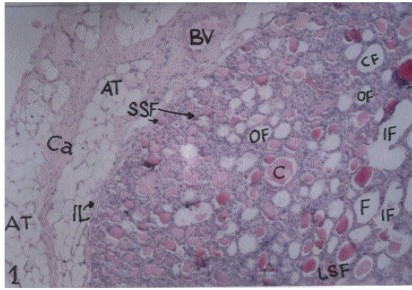


Plate 1: Prepubertal thyroid gland of Black Bengal goat, showing outer layer (O), middle (M) and inner layer (IL) of the capsule (Ca), adipose tissue (AT), colloid free follicle (CF), irregular shape follicle (IF), small sizes follicle (SSF) near the capsule, large sizes follicle (LSF) towards the centre of the gland, Blood vessels in the capsule (BV), oval follicle (OF) and colloid © material in the follicle (F). H and E stain $\times 82.5$.

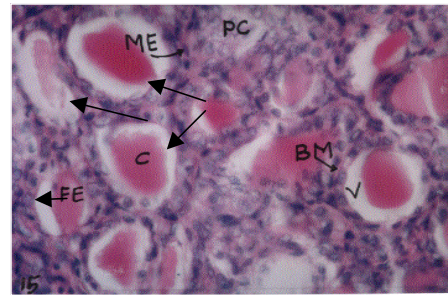


Plate 4: Pubertal thyroid gland of Black Bengal goats, showing myoepithelium cell (ME), colloid materials © with the vacuolation (V), parafollicular cell (PC), Basement membrane (BM), oval to circular follicle (OC) and cuboidal type (CU) follicular epithelium (FE). H and E stain $\times 330$

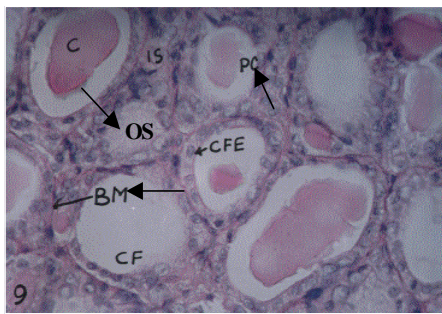


Plate 2: Prepubertal thyroid gland of Black Bengal goat, showing cuboidal follicular epithelium (CFE), colloid material (C), basement membrane (BM), parafollicular cell (PC), interfollicular space (IS), colloid free (CF) follicle and oval shaped follicle (OS). H and E stain $\times 330$.



Plate 5: Castrated thyroid gland of Black Bengal goat, showing flattened follicular epithelium (FFE), colloid material (C), parafollicular cell (PC), blood capillary (BC) and interfollicular space (IS). H and E Stain $\times 330$

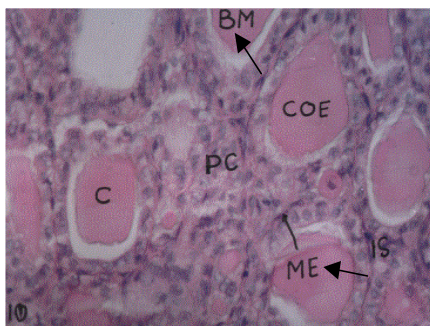


Plate 3: Pubertal thyroid gland of Black Bengal goat, showing columnar follicle epithelium (COE), colloid materials (C), basement membrane (BM), myoepithelial cell (ME), parafollicular cell (PC), interfollicular space (IS). H and E Stain $\times 330$

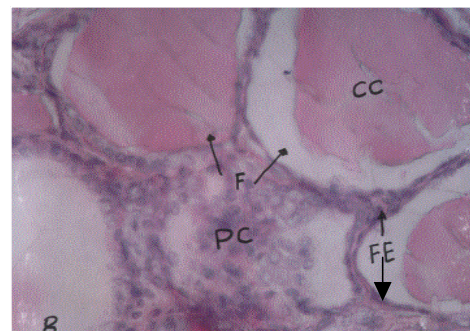


Plate 6: Castrated thyroid gland of Black Bengal goat, showing cracked colloid (CC), material within the follicle (F), flattened follicular epithelium (FE) detached from the colloid and parafollicular cells (PC). H and E Stain $\times 330$

Pubertal group: In this group, 2 animals showed large lymphocytic mass in the centre of the gland in the present study. Most of the follicles were smaller, and were oval to circular (Plate 4) in shape that was similar to the results obtained by Sanap *et al.* (1998) in cattle and few were irregular in shapes. Usually, the smaller follicles were present towards the periphery and larger follicles were towards the centre of the gland. Although some larger follicles were seen near to the periphery which were not seen yet in prepubertal group. In pubertal Black Bengal goats, the diameters of round follicles varied from 30.19 ± 9.69 to 135.92 ± 32.50 μ . In smallest oval follicle, the minimum and maximum diameters were 56.09 ± 9.69 and 103.56 ± 18.30 μ , respectively. In largest oval follicle, the minimum and maximum diameters were 155.34 ± 26.59 and 215.75 ± 35.58 μ , respectively (Table 2, Fig. 1).

Castrated group: Most of the follicles were larger and elongated with round to irregular in shape (Plate 6) that was similar to the results obtained by Sanap *et al.* (1998) in cattle. In castrated Black Bengal goats, the diameters of round follicle varied from 36.63 ± 14.18 to 94.88 ± 13.67 μ . In smallest oval follicle, the minimum and maximum diameters were 58.25 ± 12.76 and 122.97 ± 26.86 μ respectively. In largest follicle, the minimum and maximum diameters were 129.45 ± 16.14 and 239.48 ± 16.57 μ respectively (Table 2, Fig 1).

In prepubertal and pubertal group of Black Bengal goats, the follicles were smaller than those of castrated goats, in the present study. The smaller follicles were active in all groups of goats, which was in accordance with Roy and Yadava (1975) in buffalo. In the present study the each follicle was surrounded by a basement membrane, however there were apertures in the basement membrane, of the adjacent follicles were in contact, which was similar to Ham and Carmack (1979) in human.

Follicular epithelium

Prepubertal group: In Black Bengal goat, the thyroid follicles were lined by cuboidal epithelium (Plate 2). The large rounded nuclei of the epithelial cells were situated towards the base of the cell. Lining epithelium of some follicles were columnar, cuboidal and even squamous cells. The squamous cell percentage were 10.25 ± 3.49 , cuboidal cell percentage were 80.5 ± 5.85 and columnar cell percentage were 9.25 ± 5.67 (Table 3, Fig. 2). In prepubertal Black Bengal goats, the average minimum and maximum height of the follicular epithelium were measured 6.47 ± 0.76 and 8.64 ± 0.78 μ , respectively, whereas, the average minimum and maximum width were 7.66 ± 0.89 and 9.97 ± 0.65 μ , respectively (Table 4, Fig. 3).

Pubertal group: In the pubertal group, the follicular epithelium were lined by cuboidal to columnar epithelium (Plate 3) with large spherical nuclei located at the centre of the cell. Both cuboidal and columnar cells were observed in some follicle at pubertal stage. The cuboidal cell percentage was 29.75 ± 7.94 and columnar cell percentage was 69.75 ± 8.72 (Table 3, Fig. 2). In pubertal Black Bengal goats, the average minimum and maximum heights of the follicular epithelium were 9.74 ± 0.76 and 11.86 ± 0.76 μ respectively, whereas, the minimum and maximum widths of the follicular epithelium in average were 8.36 ± 0.39 and 9.77 ± 0.78 μ respectively (Table 4, Fig. 3).

Castrated group: The height of the follicular epithelium tends to be reduced at castrated group of Black Bengal goat. The follicular epithelium become flattened or simple squamous epithelium with elongated nucleus (Plate 5). The epithelium of follicles of castrated groups was mainly of cuboidal and squamous cells. The squamous epithelium and cuboidal epithelial percentage were 80.25 ± 1.92 and 18.5 ± 1.65 respectively (Table 3, Fig. 2). In castrated Black Bengal goats, the average minimum and maximum height of the follicular epithelium was 3.50 ± 0.89 and 5.39 ± 0.54 μ respectively, whereas, minimum and maximum width of the follicular epithelium in average was 10.83 ± 1.30 and 14.17 ± 0.80 μ , respectively (Table 4, Fig. 3). The present research work revealed that the thyroid follicles were lined by cuboidal epithelium with large rounded nucleus situated at the base of the cell in prepubertal group. But pubertal follicles were lined by cuboidal to columnar epithelium. Whereas, in castrated group of Black Bengal goats, the follicles were lined mainly by the squamous epithelium with elongated nucleus. This observation was similar at prepubertal and castrated cattle (Sanap *et al.*, 1998). Although, it was dissimilar at pubertal stage in cattle by Sanap *et al.* (1998). They stated that the follicular epithelium was low cuboidal with large spherical nuclei located in the centre of the cell. This observation regarding all age groups of the experimental animals (Table 4, Fig. 3) were mostly in accordance with the Baishya *et al.* (1986) in Assam barbari goats, Agrawal and Bhattacharya (1981) in goats and also by Mathur (1964, 1971) in buffalo calves. The height of the follicular epithelium being increased from prepubertal and pubertal group and decreased at castrated group due to advancement of age which was possibly due to the increased functional activity of the gland similar to the observation made by Agrawal and Bhattacharya (1981) in goat.

In the present research revealed that pubertal follicular epithelium was mostly active. The follicular epithelium was uniformly arranged and regular in pubertal group,

similar to the observation of Ronald and Thomas (1961) in human. Whereas, the follicular epithelium were not uniformly arranged and irregular in prepubertal and castrated groups of Black Bengal goats. Even some follicles showed the presence of cuboidal and squamous epithelium, in this study.

Colloid: Colloid is the secretory product of the follicular epithelium that is amber-colored homogenous, solid, lightly eosinophilic material. Sometimes dead or degenerating follicular epithelium observed in the colloid. It was probably due to the sloughing off follicular epithelium.

Prepubertal group: The colloid materials in the lumen of the follicles were solid, eosinophilic presented large number of vacuoles was observed in some follicles. The colloid appeared in the centre of the follicular lumen (Plate 2). Colloid free or follicles with less colloid appeared due to lesser activity of the gland. In few large follicles the colloid material were seen in cracked form that appeared lighter in large follicle indicated that those were inactive follicles.

Pubertal group: In this group, the colloid material was comparatively densely eosinophilic, solid than prepubertal group. Cracking of colloid material was rare or absent in large follicles. Vacuoles were observed in active large follicle, which detached the colloid from the follicular epithelium. Vacuoles were seen in active follicles (Plate 4), in accordance with the observations made by Das *et al.* (1965) in bull and bullocks, Roy and Yadava (1975) in Indian buffalo. Most of the follicles were active. In the present study, colloid of the active follicle was predominately eosinophilic by H & E stain and the inactive follicles showed the colloid material of various degree of acidophilia. This observation was similar to Das *et al.* (1965) in bull and bullocks, Roy and Yadava (1975) in buffalo. In the present research, the desquamated follicular cells were seen in the colloid. In the active follicle the colloid was thinner and less in amount. Whereas, in inactive follicle it was thicker and more quantity. In the present study, prepubertal and pubertal group showed that the thyroid follicles were mostly active, whereas, few were inactive or colloidless.

Castrated group: The colloid material appeared lightly to be eosinophilic and solid materials. The colloid materials were also appeared shrunken and detached from follicular wall, which indicated the lesser follicular activity of the thyroid gland. This was in accordance with the Sanap *et al.* (1998) which indicated that the lesser follicular activity of the thyroid. Few large follicles were completely colloid

free due to decreased activity of this group of Black Bengal goats. Further, the colloid material appeared as cracked form into the follicular lumen, which was common in castrated group (Plate 6). Cracking of the colloid materials was due to the advancement of age and was due to decrease activity indicated for inactive follicles. This observation was not found in available literatures.

Parafollicular cell or interfollicular cell: The cells, which were located beneath the basal lamina of the follicle instead of the follicular epithelium or in the interfollicular space, called parafollicular cell or interfollicular cell. The cells were arranged singly or grouped within the basal lamina or interfollicular space (Plate 2, 3, 4, 5 and 6). They secrete calcitonin. This observation was in agreement with the Dellmann and Eurell (1998) in dog. Light cells were oval or polyhedral and larger than follicular studies (Pearse, 1967).

Prepubertal group: In the interfollicular space, parafollicular cells were observed to be distributed in groups or singly all over the gland (Plate 2). The light cells or clear cells were seen singly or grouped in the interfollicular space. Interfollicular spaces were larger in prepubertal group of Black Bengal goat.

Pubertal group: In this group, interfollicular spaces were comparatively less with less number of parafollicular cell than prepubertal group of Black Bengal goat (Plate 3) with few exception.

Castrated group: In this group, Parafollicular or interfollicular cells very less in number than the pubertal and prepubertal group of Black Bengal goats (Plate 5, 6). The similar observations were reported by Sanap *et al.* (1998) in castrated cattle. Interfollicular spaces were also lesser than both of prepubertal and pubertal group. This was in accordance to Roy and Yadava (1975) in Indian buffalo.

This present study lead to the following conclusion

- Histoarchitectures can be changed at different stages of thyroid gland of Black Bengal goat.
- Activity of the thyroid gland changes the histoarchitectures.
- Activity of the thyroid gland being increased from prepubertal to pubertal stage and being decreased at adult castrated goats.

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