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Gross Anatomical and Morphometrical Studies on the Thymus of Vanaraja Chicken

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ABSTRACT

The present study was conducted on the thymus of forty (40) day-old Vanaraja chicks, procured from the Livestock Farm Complex, BVC Patna, and reared up to six months of age. Birds were divided into four age groups: 0, 30, 90, and 180 days. From day one, the thymus appeared as a paired, lobulated organ located on either side of the neck, forming the left and right thymus. Each thymus comprised 4–6 lobes arranged in a chain extending from the mid-cervical to the cranial thoracic region. Lobes were embedded in subdermal connective tissue, irregularly elliptical in shape, with smooth surfaces, and varied in color from pale white to yellowish-white and pale pink. The maximum weight and volume of both thymic lobes were recorded at 30 days of age. Thymic size increased up to day 30, followed by a gradual decline from day 90 onward. Although the right thymus tended to weigh more than the left, the difference was not statistically significant. Significant changes in thymic weight, volume, length, and width were observed across age groups. The largest dimensions were recorded at 30 and 90 days, while significant regression in both lobes was observed by 180 days of age.

Keywords: Gross, Morphometric, Vanaraja Chicken, Thymus

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INTRODUCTION

The chicken is a foundational model for immunological research and continues to be a valuable animal model for insights into immune function. Primary lymphoid organs contain embryonic yolk sac, bursa of Fabricius, thymus and bone marrow. Lymphocytes originated in these primary lymphoid organs immigrate and colonize into the secondary lymphoid organs. Secondary lymphoid organs include spleen, caecal tonsil, mucosa associated lymphoid tissue (MALT), gland of Harder etc. (Glick, 1978). The organized poultry sector accounts for approximately 70% of the total poultry industry output, while the unorganized sector contributes the remaining 30% (Ali, 2015). Indigenous chicken breeds play a significant role in supporting the rural economies of many underdeveloped and developing countries, such as India (Dahariya et al., 2020a; Dahariya et al., 2020b).Numerous studies have examined the lymphoid system in broiler chickens (Khan et al., 2014), domestic chickens (Kannan et al., 2015), Japanese quail (Senapati et al., 2015), and turkeys (Ali, 2016), but there is limited research on the lymphoid system of Vanaraja chickens. The present study focuses on the gross morphological and morphometric development of the thymus in Vanaraja chicken with age

MATERIALS AND METHODS

The present study was carried out on the forty (40) day-old chicks of Vanaraja chicken which were procured from Livestock farm complex BVC Patna and reared up to 6 months of age in the experimental pens (cage system) at LFC, Bihar Veterinary College, Patna. Standard management practice (housing, feeding, vaccination etc.) was followed uniformly for all the birds. All the birds were given ad libitum feed throughout the experimental period. The whole experimental period of study was divided into four (4) groups i.e. 0-day, 30 day, 90, 180 days of age of Vanaraja chicken. The birds were randomly allocated to four (4) groups (Groups I to IV), each containing ten (10) birds of straight run. The birds were sacrificed and a right and left thymus gland was carefully dissected out. Under gross morphometrical study of thymus, the weight (gm) and volume (ml) of left and right thymus along with length and width of cranial, middle and last lobe of each thymus (mm) was recorded in all age group of Vanaraja chicken. The present research work was approved from the Institutional Animal Ethics Committee (IAEC) of Bihar Veterinary College, BASU Patna (IAEC/BVC/20/10). All the data recorded was analysed statistically as per the standard method given by Snedecor and Cochran (1994).

RESULTS AND DISCUSSION

The thymus was a paired, lobulated and located on either side of the neck in all age group of Vanaraja chicken. Each thymus consisted of long chains of lobes in Vanaraja chickens (Fig. 1). The lobes exhibited various colors, ranging from pale white to yellowish white and pale pink. The present finding was in agreement with Rajesh kumar et al. (2001) in chicken, Muthukumaran et al. (2011) in turkeys, Sultana et al. (2011) in ducklings, Lochi et al. (2014) in Aseel chicken and Mahanta

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(2018) in local hill fowl of Uttarakhand and RIR

Fig,1: Gross photograph showing the left thymus in Vanaraja birds of group I.

The lobes had convex dorsal surface and flattened ventral surfaces in all age group of Vanaraja chicken. The present findings were in line with Mahanta (2018) who found similar results in local hill fowl of Uttarakhand and RIR. In all age groups, each thymus showed 4-6 lobes and both the left and right thymus was extended from the mid-cervical region to the cranial thoracic region (Fig. 1 & 2)

Fig, 2: Photograph showing the left thymus in group II Vanaraja birds.

Similar observation was made by Mahanta (2018) who reported that the right and left thymus had 6-7 lobes in local hill fowl of Uttarakhand and 5-7 lobes in Rhode Island Red (RIR) in all age groups. Further, the present findings were in agreement with the reports of King and McLelland (1984) who found 4-7 lobes in the thymus of birds, Gulmez and Aslan (1999) who observed 5-9 and 6-9 lobes in the left and right thymus of native geese respectively and Muthukumaran et al. (2011) who stated 6-8 lobes in the thymus of turkey.

The average weight of left thymus in Vanaraja birds was found to be 0.26±0.1 gm, 1.88±0.02 gm 1.48±0.01 gm and 1±0.04 gm in 0 day, 30 days, 90 days, 180 days of age of Vanaraja chicken respectively (Fig.3 & Table 1).

Fig, 3: Weighing of left thymus of group II Vanaraja chicken

Table 1: Weight and volume of the left thymus and right thymus

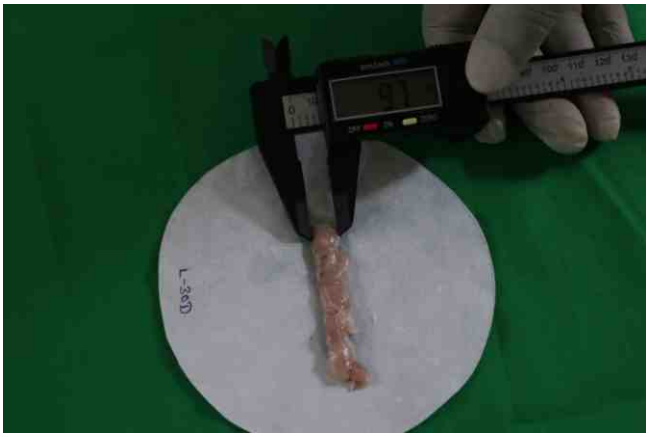
Group	Vanaraja Chicken (Mean ± SE)			
	TWL (gm)	TWR (gm)	TVL (ml)	TVR (ml)
I	0.26±0.1d	0.27±0d	0.91±0.01cA	0.99±0.03c
II	1.88±0.02a	2.45±0.05aA	2.99±0.06aA	2.95±0.12aA
III	1.48±0.01b	1.71±0.02bA	1.22±0.06bA	1.41±0.13bA
IV	1±0.04c	1.02±0.04c	0.88±0.01c	1.01±0.02c
P value	0.001	0.005	0.001	0.001

The average weight of right thymus in Vanaraja birds was found to be 0.27±0 gm, 2.45±0.05gm 1.71±0.02 gm and 1.02±0.04 gm in 0 day, 30 days, 90 days, 180 days of age of Vanaraja chicken respectively (Table 1). Thymic weight and volume was increased up to 30 days and after 90 days onwards gradually decreased. Hashimoto and Sugimura (1977) reported that the maximum weight of the thymus gland was found to be 15.76 g at 17 weeks of age in White Pekin ducks. Muthukumaran et al. (2011) found that the thymus attained its maximum weight at the age of 6 months in both the sexes of turkey and they weighed about 1.42 ± 0.07 gm on right side and 1.25 ±0.02 gm on left side. The mean volume of left thymus in Vanaraja birds was found to be 0.91±0.01 ml, 2.99±0.06 ml 1.22±0.06 ml and 0.88±0.01 ml at 0 day, 30 days, 90 days, 180 days of age respectively (Fig.4 & Table 1). The mean volume of right thymus in Vanaraja birds was found to be 0.99±0.03 ml, 2.95±0.12 ml 1.41±0.13 ml and 1.01±0.02 ml at 0 day, 30 days, 90 days, 180 days of age respectively (Table 1). A significant difference in weight and volume was observed at different age intervals.

Fig, 4: Volume measurement of left thymus of group II Vanaraja chicken

First lobe (Cranial)

The average length of first lobe of left thymus in Vanaraja birds was found to be 4.99±0.06 mm, 12.29±0.26 mm, 10.13±0.11 cm and 8.92±0.05 mm at 0 day, 30 days, 90 days, 180 days of age respectively (Fig.5 & Table 2).



Fig, 5: Measurement of the Left Thymus First Lobe Width in Group II Vanaraja Chickens

Similarly, the average length of first lobe of right thymus in Vanaraja birds was found to be 9.03±0.08 mm, 13.6±0.33 mm, 9.73±0.15mm and 8.03±0.04 mm at 0 day, 30 days, 90 days, 180 days of age respectively (Table 2). The length of thymic lobe in left and right thymus was significantly regressed at 180 days in comparison to 30 and 60 days in Vanaraja chicken. Significantly higher length of thymic lobe in left and right thymus was observed in groups II and III in comparison to group I and IV of Vanaraja chicken. The average middle width of first lobe of left thymus in Vanaraja birds was found to be 5.31±0.13 mm, 9.88±0.11 mm, 7.41±0.14 mm and 6.04±0.06 mm at 0 day, 30 days, 90 days, 180 days of age respectively (Fig. 8 &Table 3). Similarly, the average middle width of first lobe of right thymus in Vanaraja birds was found to be 8.72±0.15 mm, 9.94±0.23 mm, 7.59±0.11 mm and 6.39±0.04 mm at 0 day, 30 days, 90 days, 180 days of age respectively (Table 3).

The width of thymic lobe in left and right thymus was significantly regressed at 180 days in comparisons to 30 and 90 days in Vanaraja chicken. Significantly higher width of left and right lobe of thymus was observed at 30 days in comparison to other age intervals.

Table 2: Length of different lobe of left thymus and right thymus of Vanaraja bird

Group	Vanaraja (Mean ± SE)					
	TLL1(mm)	TLL2 (mm)	TLL3 (mm)	TLR1 (mm)	TLR2 (mm)	TLR3 (mm)
I	4.99±0.06 d	8.13±0.1 b	7.49±0.08 b	9.03±0.08 c	8.51±0.11 c	6.09±0.08 c
II	12.29±0.26 a	10.07±0.1 a	10.4±0.21 a	13.6±0.33 a	8.69±0.14 c	11.07±0.09 a
III	10.13±0.11 b	10±0.1 a	11.18±0.13 a	9.73±0.15 b	10.52±0.08 a	11.4±0.13 a
IV	8.92±0.05 c	8.02±0.09 b	7.99±0.09 b	8.03±0.04 d	10.05±0.06 b	10.58±0.13 b
P value	0.001	0.785	0.015	0.015	0.001	0.309

Second lobe (Middle)

The average length of second lobe of left thymus in Vanaraja birds was found to be 8.13±0.1 mm, 10.07±0.1 mm, 10±0.1 cm and 8.02±0.09 mm at 0 day, 30 days, 90 days, 180 days of age respectively (Table 2). The average length of second lobe of right thymus in Vanaraja birds was found to be 8.51±0.11 mm, 8.69±0.14 mm, 10.52±0.08 mm and 10.05±0.06 mm at 0 day, 30 days, 90 days, 180 days of age respectively (Table 2). The length of thymic lobe in left and right thymus was significantly regressed at 180 days in comparison to 30 and 60 days in both breed of chicken. The average middle width of second lobe of left thymus in Vanaraja birds was found to be 6.54±0.16 mm, 11.97±0.17 mm, 7.16±0.09 mm and 6.14±0.04 mm at 0 day, 30 days, 90 days, 180 days of age respectively (Table 3). The average middle width of second lobe of right thymus in Vanaraja birds was found to be 7.19±0.17 mm, 11.03±0.2 mm, 7.55±0.14 mm and 6.42±0.1 mm at 0 day, 30 days, 90 days, 180 days of age respectively (Table 3). The length of

thymic lobe in left and right thymus was significantly regressed at 180 days in comparison to 30 and 60 days in both breed of chicken.

Third lobe (caudal lobe)

The average length of third lobe of left thymus in Vanaraja birds was found to be 7.49±0.08 mm, 10.4±0.21 mm, 11.18±0.13 mm and 7.99±0.09 mm at 0 day, 30 days, 90 days, 180 days of age respectively (Table 2). The average length of third lobe of right thymus in Vanaraja birds was found to be 6.09±0.08 mm, 11.07±0.09 mm, 11.4±0.13 mm and 10.58±0.13 mm at 0 day, 30 days, 90 days, 180 days of age respectively (Table 2).

The average middle width of third lobe of left thymus in Vanaraja birds was found to be 4.05±0.07 mm, 9.93±0.18 mm, 9.23±0.12 mm and 8.15±0.06 mm at 0 day, 30 days, 90 days, 180 days of age respectively (Table 3). The average middle width of third lobe of right thymus in Vanaraja birds was found to be 6.36±0.16 mm, 11.83±0.15 mm 6.06±0.07 mm and 9.01±0.05 mm at 0 day, 30 days, 90 days, 180 days of age respectively (Table 3).

Hashimoto and Sugimura (1977) reported that the maximum weight of the thymus gland was found to be 15.76 g at 17 weeks of age in White Pekin ducks. Muthukumaran et al. (2011) found that the thymus attained its maximum weight at the age of 6 months in both the sexes of turkey and they weighed about 1.42 ± 0.07 gm on right side and 1.25 ±0.02 gm on left side. Khenenou et al. (2012) observed that the accelerated growth of the thymus started from the first week of age and continued up to the second week (0.007 %) in broiler chicken. The second phase finished on the seventh weeks of age (0.0016 %). The involution of the organ started from the seventh week of age and it was completed by 23rd weeks of age.

Table 3: Width of different lobe of left thymus and right thymus of Vanaraja bird

Group	Vanaraja (Mean ± SE)					
	TWL1 (mm)	TWL2 (mm)	TWL3 (mm)	TWR1 (mm)	TWR2 (mm)	TWR3 (mm)
I	5.31±0.13d	6.54±0.16c	4.05±0.07d	8.72±0.15b	7.19±0.17b	6.36±0.16c
II	9.88±0.11a	11.97±0.17a	9.93±0.18a	9.94±0.23a	11.03±0.2a	11.83±0.15a
III	7.41±0.14b	7.16±0.09b	9.23±0.12b	7.59±0.11c	7.55±0.14b	6.06±0.07c
IV	6.04±0.06c	6.14±0.04c	8.15±0.06c	6.39±0.04d	6.42±0.1c	9.01±0.05b

CONCLUSION

The thymus was fully developed at 0 day to accept the environmental challenges. The gross morphometrical parameters of thymus was gradually increased with the advancement of ages up to 30 days, afterwards gradually decreased due to regression in organ.

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