



ISSN (E): 2277-7695  
ISSN (P): 2349-8242  
NAAS Rating: 5.23  
TPI 2022; SP-11(7): 3838-3840  
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[www.thepharmajournal.com](http://www.thepharmajournal.com)  
Received: 22-04-2022  
Accepted: 25-05-2022

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## Age dependent gross morphological changes of thymus gland in Turkey (*Meleagris gallopavo*)

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### Abstract

This study was executed to elucidate the gross morphological and age-related changes of thymus from day-old to ten months of age on monthly intervals from broad breasted bronze variety of turkeys. The thymus gland was made up of long chains of 6-8 lobes extended from cervical region to anterior part of thoracic cavity. It appeared as a creamish white coloured and the shape of the lobes was varied from irregular, elongated and oval to flattened structure. Age related morphological changes were apparently observed in the thymus of turkeys throughout the study in both the sexes. The involution was begun at the proximal cervical part which showed smaller sized thin lobes embedded within subdermal adipose tissue and it started to come down towards the distal cervical part with age advancement. The thoracic thymus was noticed as small irregular structure at ten months in hen and eleven months in tom turkeys. The weight of the thymus was gradually increased from day-old and reached its highest total weight of  $5.84 \pm 0.02$  gm in hen and  $7.70 \pm 0.02$  gm in tom turkeys at six months. Afterwards it gradually decreased and completely absent at the age of eleven months in hen and twelve months in tom turkeys.

**Keywords:** Gross anatomy, age-dependent changes, thymus, Turkey

### Introduction

Turkey (*Meleagris gallopavo*) is a large gallinaceous bird of the family Meleagridae, which belongs to North America, domesticated in Europe and are kept only for meat, considered as festive food. They can flourish well in a wide variety of agroclimatic conditions; hence it can be raised easily almost anywhere in the world. The thymus is a primary lymphoid organ in birds which is essential for the development of peripheral lymphoid tissues and their associated adaptive immune functions (Clawson *et al.*, 1967) [4], which also plays a pivotal role in producing precursors of cells involved in specific cell mediated immune responses (T-cells) and these cells co-operate with B - cells in the production of antibodies (Leena *et al.*, 2009) [7]. Though elaborate work has been done on the thymus of birds and scant work in turkeys, information available regarding the age dependent changes in gross morphology and morphometry of the thymus gland in turkeys is quite lesser. Hence, the study was proposed to record the age dependent changes in gross morphology and morphometry of thymus in turkeys.

### Materials and Methods

The thymus gland of Turkey was collected from day-old to ten months of age at monthly intervals from broad breasted bronze variety of turkeys. They were apparently healthy and vaccinated against Newcastle disease. The samples for the study were collected from Turkey farms at in and around the Dharmapuri, Krishnagiri, Salem and Namakkal districts. The study was carried out at the Department of Veterinary Anatomy, Veterinary College and Research Institute, Namakkal. The age, sex and live body weight of birds were recorded immediately after procured from the farms. After the bird was humanely sacrificed, a skin incision was made on mid ventral aspect of neck upto thoracic cavity in order to expose the cervical and thoracic part of thymus respectively. Subsequently, after completing the *in-situ* topographic anatomy of organ, it was carefully dissected and collected. The gross morphological features like location, size, shape, color, number of lobes and age-related changes of the same parameters were studied.

## Result and Discussion

### 1. Topography

In Turkey, the thymus was observed as a lobulated, paired structure, located in the subdermal connective tissue along either side of neck and extended up to the anterior thoracic region as noted by Muthukumaran *et al.*, 2011<sup>[9]</sup> in Turkey. In contrary, Mestanova and Varga, (2016)<sup>[8]</sup> described that the paired thymus was arranged in string like pattern at cervical region of neck close to jugular vein in chicken (Plate 1).

In the neck region, the cervical part of thymus was related to trachea, jugular vein, common carotid artery and vagus nerve on either side. The right thymus also had relation to esophagus along the neck and crop at the level of thoracic inlet. The terminal lobe of thoracic thymus was related to the thyroid gland and brachiocephalic artery on either side. Whereas, Ali, 2016<sup>[1]</sup> in Turkey and Ali, 2017<sup>[2]</sup> in local chicken mentioned that the thymus had relation to jugular vein, common carotid artery, oesophagus and trachea at cervical region, brachial plexus at base of neck and thyroid gland at anterior thoracic region.

### 2. Morphology

The thymus of Turkey was appeared as a creamish white coloured paired gland *viz.*, right and left. Each was made up of long chains of 6-8 lobes extended from cervical region to anterior part of thoracic cavity. The shape of the lobes was varied from irregular, elongated and oval to flattened structure. The adjacent lobes were not clearly separated and were connected to each other throughout its length (Plate 1). Contradicting to this, Muthukumaran *et al.* (2011)<sup>[9]</sup> stated that the pale red to pink coloured thymus constituted by six to eight lobes with irregular elliptical shape in Turkey. Also in contrary, the thymic lobes were elongated to flattened and pale white to yellowish white in colour with five lobes in both right and left thymus in Indigenous ducklings (Sultana *et al.*, 2011)<sup>[10]</sup>, six to eight lobes in each thymus, yellowish to pinkish in colour and shape varied from flat to irregular in Turkey Ali, (2016)<sup>[1]</sup> and five to eight lobes in Sonali chicken (Ayman *et al.*, 2020)<sup>[3]</sup>.

Each thymus was divided into cervical part and thoracic part according to its topographical location. The cervical part of the thymus was constituted by 4- 5 lobes which began at ninth cervical vertebra and extended caudally up to thoracic inlet. But, Ayman *et al.* (2020)<sup>[3]</sup> in Sonali chicken described that the cranial end of thymus was began at third cervical vertebra and caudal end was located at thoracic inlet. The proximal cervical part had relatively smaller sized lobes than distal part. The thoracic part of the thymus was short, continued from the cervical part and consisted of 2 – 3 lobes which extended from thoracic inlet to the anterior thoracic region. No morphological difference was observed between the right and left thymus in both the sexes.

### 3. Age dependent morphological changes

Age related morphological changes were apparently observed in the thymus of turkeys throughout the study in both the sexes.

The shape of thymic lobe was not clearly distinguished and appeared as a thin string of thread like structure in day-old poult. From one month of age, the size of the lobes was persistently increased and observed in varied shapes such as oval and elongated with slight compression on either side. It attained its greatest size at six months of age. It undergone

involutory phase from seven months of age (Plate 2) and completely involuted at the age of eleventh month in hen and twelfth month in tom turkeys. Ayman *et al.*, 2020<sup>[3]</sup> in Sonali chicken also recorded the variations in thymus according to age. The thymic lobes were oval, elongated and irregular shaped with brownish colour at 28 days of age. It was yellowish white at day 42 and maintained up to day 56.

The involution was begun at the proximal cervical part which showed smaller sized thin lobes embedded within subdermal adipose tissue and it started to come down towards the distal cervical part with age advancement. The thoracic thymus was noticed as small irregular structure at ten months in hen and eleven months in tom turkeys. Islam *et al.* (2019)<sup>[5]</sup> in commercial broiler chicken also observed that the thymus was extended from base of the skull to thoracic cavity in day old and it was absent at upper one – fifth of neck in adult.

The weight of the thymus was gradually increased from day-old and reached its highest total weight of  $5.84 \pm 0.02$  gm in hen and  $7.70 \pm 0.02$  gm in tom turkeys at six months. Afterwards it gradually decreased and completely absent at the age of eleven months in hen and twelve months in tom turkeys (Plate 2). The lowest total weight in involutory phase was recorded as  $1.00 \pm 0.02$  gm in hen at ten months and  $1.20 \pm 0.02$  gm in tom at eleven months of age. The weight of right and left thymus numerically showed the difference but statistically no significant difference was noticed in both the sexes. Whereas Muthukumaran *et al.* (2011)<sup>[9]</sup> in Turkey found that the weight was gradually increased with age and reached maximum at sixth month ( $6.39 \pm 0.23$  gm) and showed reduction phase from seven months of age. The lowest mean weight was recorded as  $1.30 \pm 0.07$  gm at ninth month. The weight of right thymus was more than left thymus in both the sexes. Also in contrast, the weight of thymus was increased from first week and reached the maximum of  $6.212 \pm 0.633$  gm at 14<sup>th</sup> week with total regression at 23<sup>rd</sup> week of age in broiler chicken (Khenenou *et al.*, 2012)<sup>[6]</sup>. Ayman *et al.*, 2020<sup>[3]</sup> recorded the mean weight of thymus as  $0.023 \pm 0.006$  gm,  $0.347 \pm 0.026$  gm and  $0.279 \pm 0.05$  gm at day-old, 42 and 56 days of age respectively in Sonali chicken.

Islam *et al.* (2019)<sup>[5]</sup> in commercial broiler chicken observed that the thymus was extended from base of the skull to thoracic cavity in day old and it was absent at upper one – fifth of neck in adult. The size of thymus also increased along with age and maximum growth was attained at 35 days of age.



**Fig 1:** Photograph showing the cervical and thoracic part of thymus (arrows) and its topographical location



**Fig 2:** Photograph showing the growth pattern of thymus from day-old to eleven months of age in tom turkey

### Conclusion

The turkey's thymus was a lobulated, paired structure, located in the subdermal connective tissue along either side of neck and extended up to the anterior thoracic region. The thymus of Turkey was appeared as a creamish white coloured paired gland *viz.*, right and left. Each was made up of long chains of 6-8 lobes extended from cervical region to anterior part of thoracic cavity. The shape of the lobes was varied from irregular, elongated and oval to flattened structure. From one month of age, the size of the lobes was persistently increased attained its greatest size at six months of age and underwent involutory phase from seven months of age and completely involuted at the age of eleventh month in hen and twelfth month in tom turkeys. The weight of the thymus was gradually increased from day-old and reached its highest total weight of  $5.84 \pm 0.02$  gm in hen and  $7.70 \pm 0.02$  gm in tom turkeys at six months. Afterwards it gradually decreased and completely absent at the age of eleven months in hen and twelve months in tom turkeys.

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