HISTOMORPHOLOGICAL STUDY OF THYMUS GLAND IN THE IRAQI PIN–TAILED SANDGROUSE BIRD "*Pterocles alchata caudarus*"

Hanaa Kareem Ali Alshammary[1,4] Salah Hassan Al-Maliki[2] Eqbal Salman Najem[3]

Khalid Ibrahim Abd Alkazraji[1] Ahmed Abdulla Hussein[1]

[1] Dept. of Anatomy, Histology & Embryology, College of Vet. Med., Univ. of Diyala- Iraq.
[2] Dept. of Anatomy, Histology and Embryology, College of Vet. Med., Baghdad Univ.- Iraq.
[3] Dept. of Pathology and Poultry Diseases, College of Vet. Med., Univ. of Diyala- Iraq.

[4] Corresponding author: hkareem1976@yahoo.com

ABSTRACT

Although avian thymus gland has been studied in several types of birds, but regarding Iraqi Alchata "*Pterocles alchata caudarus*", it is yet not to be done. Thus, the present study has been approved to recognize the histomorphological architecture of it. For this purpose six healthy local Alchata birds of both sexes and different ages were used and divided into two groups anatomical and histological, birds were sacrificed by slaughter with legitimate way. Morphologically thymus gland situated on both sides along the neck, it was a paired gland contain two chains of lobes each of them composed of multi lobes have irregular or flattened shape and pallid-yellowish to pinkish color; while the histological study shows that the thymus gland of alchata was totally covered with a capsule of connective tissue extend from it a number of septa split the gland into several lobules that are partially separated from one another, each of them consist of two areas, inner medulla and outer cortex. Cortex observed dark in color due to its high content of small lymphocytes that was tightly packed in the cortex than the medulla, which was composed of large amount of reticuloepithelial cells of central nuclei and acidophilic cytoplasm with large number lymphocytes of acidophilic cytoplasm, thus, the medulla appear paler.

Key words: Alchata bird, histology of thymus, morphology of thymus.

INTRODUCTION

As it's known, that the lymphatic organs plays a vital role in the defense mechanism (Getty, 1975; Bach, 1978), according to its function and development, it can be classified into primary (central lymphatic organs) (Szenberg, 1976) and secondary (peripheral organs) (Glick, 1978).

The primary lymph organs consider as the creators of lymphocyte precursors which contain thymus and bone marrow in many species of animals and in birds it include the yolk sac and cloacal bursa, in order to centralized the humoral immune responses in these structures mainly and in the thymus in the

young birds (Kendall, 1980). In the other hand, the secondary organs stimulate the maturation lymphatic system cells (Rose, 1979).

Thymus gland in all kinds of vertebrates considered as one of the central lymphoid organs with a main function that play a significant role in the hosting and offering of a suitable microenvironment within which T cells for the development and production of functionally competent T-lymphocytes (Mohammad *et al.*, 2007). The differentiation of T-cells happens during they are developing through a different partitions in the thymus (Bodey *et al.*, 2000 ; Panse, 2006 ; Berrih-Aknin, 2005).

Thymus has a unique component among the lymphatic organs which is the epithelial cells that are well known for its cellular organization (Pearse, 2006), that are seemingly playing an important role in the differentiation of T-lymphocytes (Boyd *et al.*, 1983).

"***Pterocles alchata***" is a bird classified under the pteroclididae family of the order Pteroclidiformes, Sandgrouse is a common name of Pteroclididae, that contain about sixteen species of bird members within which Alchata. A section of them are Asian species and classified as syrrhaptes and the remainder from Africa and Asia and placed in the genus pterocles. This bird is distributed across eastern, northern and southern Africa, the Middle East and India and south to Iran and Pakistan and through to central Asia (De Juana and Boesman, 2013).

Even though thymus gland has been studied in numerous types of birds, but, in the Iraqi Alchata "*Pterocles alchata caudarus*", not yet studied. Therefore, the current research aims to identify the histomorphological structure of it.

MATERIALS AND METHODS

Thymus gland of six healthy birds of the local Alchata of both sexes and different ages were used in this study and divided into two groups anatomical and histological, birds were sacrificed by slaughter with legitimate way, to observe thymus lobes along the two sides of the neck the dissection of the neck was achieved. Then the position, shape, color and boundaries were recorded in the anatomical study. While in the histological study specimens were collected from birds washed by normal saline immediately after slaughtering then fixed in 10% formaldehyde solution followed by dehydration in the series of ascending grade of alcohol (70, 80, 90, 100%) then clearing in xylene, infiltrated and later embedded in melted paraffin and finally cutting by the using of rotary microtome and the resulting sections were stained by routine stain (H & E) followed by examined under the light microscope with different powers (4x, 10x, 20x 40x) and photographed by digital camera (Bancroft *et al.*, 2013).

RESULTS AND DISCUSSION

Anatomical results: The gross morphological study revealed that thymus gland in the local Alchata "*Pterocles alchata caudarus*" situated on both sides along the neck, closely to the esophagus, trachea, common carotid artery, jugular vein, and brachial plexus at the thoracic inlet. It was a paired gland contain two chains of lobes each of them composed of frequent lobes about four to six irregular to flattened in shape lobes of yellowish to pinkish color (Fig. 1), these results comparable to that of Getty (1975); kendall (1980); king and McLeland (1984) in chicken; Sultana *et al.*, (2011) in duck; Tarek *et al.*, (2012) in broiler chicken. The caudal lobe of the thymus located in contact with the thyroid gland (Fig. 2) similar to that mentioned by Hodges (1974) in chicken; Bowden (2005) in toloests; Song *et al.*, (2012) in ostrich.

Histological Results: Thymic sections that stained by Hematoxylin and Eosin stain observed that thymus gland contained many lobes embedded in the adipose tissue and covered completely by a thin capsule of connective tissue (Fig. 3). The capsule sent numerous delicate septa extended from it into the parenchyma of the gland and dividing it into partially separated lobules. Each of these lobules contain two areas without any mark of separation, inner lightly stained medulla and outer darkly stained cortex (Fig. 4), parallel findings was also observed by Treesh *et al*., (2014); Kannan *et al.*, (2012; 2015) in chicken.

The cortex positioned along the periphery of the gland and observed dark in color and more basophilic because of its enriched content with lymphocytes which was numerous and tightly packed in the cortex than in the medulla forming the major cellular population of the parenchyma (Fig. 4 and 7). Another cell type also found in the cortex was the Reticuloepithelial cells (RECs) but in small number and smaller size and lighter color than that of the medulla, (RECs) inside the cortex were stellate in shape with one or two nuclei (Fig. 5 and 6), they thought to be serve as supportive network in the cortical region for lymphocytes and macrophages, similar findings previously mentioned by Song *et al.*, (2012) in ostrich; Dellmann and Brown (1998); Kannan *et al.*, (2015) in chicken.

The inner medulla was the second composition of thymic parenchyma which composed of large amount and bigger size and darker color of reticuloepithelial cells (RECs) which has central nuclei and eosinophillic cytoplasm beside a large number of medium and small lymphocytes of acidophilic cytoplasm, thus, the medulla appear pail in color (Fig. 4,6 and 7),

these results was in agreement with Honjo and Hirota (1993); Khalil *et al.*, (2003); Karim *et al.*, (2005) and Ali (2017) in chicken.

Inside the medulla the reticuloepithelial cells and lymphocytes collected together gradually ending in the formation of Hassall's corpuscles, which have structureless hyalinized center and concentrically arranged reticuloepithelial cells in the peripheral (Fig. 7), and their function not yet known. Also they might be gathered and changing into reticular structures which are abundant in the medulla, they appear as irregular masses of vacuoles of different sizes filled later with eosinophilic homogenous material which thought to be as a result of degenerating reticuloepithelial cells, (Fig. 6 and 7), analogous results were recorded by Bacha and Bacha (2000) in chicken; Sultana *et al.*, (2011) in duck; Elewa (2005); Elzoghby and Attia (2007) in ostrich and Ali (2016) in turkey "*Meleagris gallopavo*".

Fig. 1. Photography of Thymus gland of Alchata (arrows) embedded in the connective tissue closely to a- esophagus, b- trachea, c- jugular vein and brachial plexus at the thoracic inlet

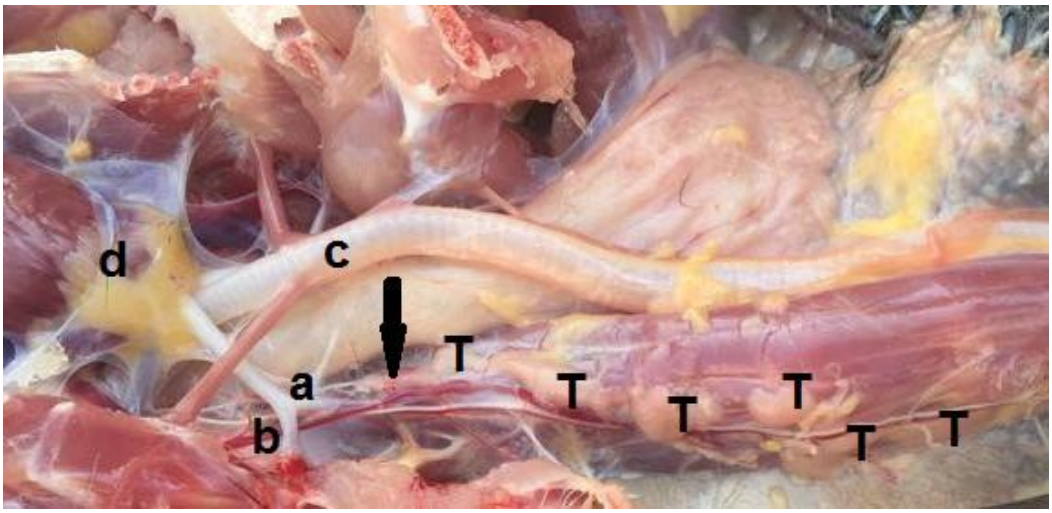

Fig. 2. Photography of Thymus gland of Alchata composed of frequent lobes of yellowish to pinkish color (T). The caudal lobe of the thymus located in contact with the thyroid gland (arrow), a- common carotid artery, b- jugular vein, c- trachea, d- heart

Fig. 3. Histological section of thymus gland showed: a: adipose connective tissue, L: thymic lobes C: capsule (H & E stain, 40 X)

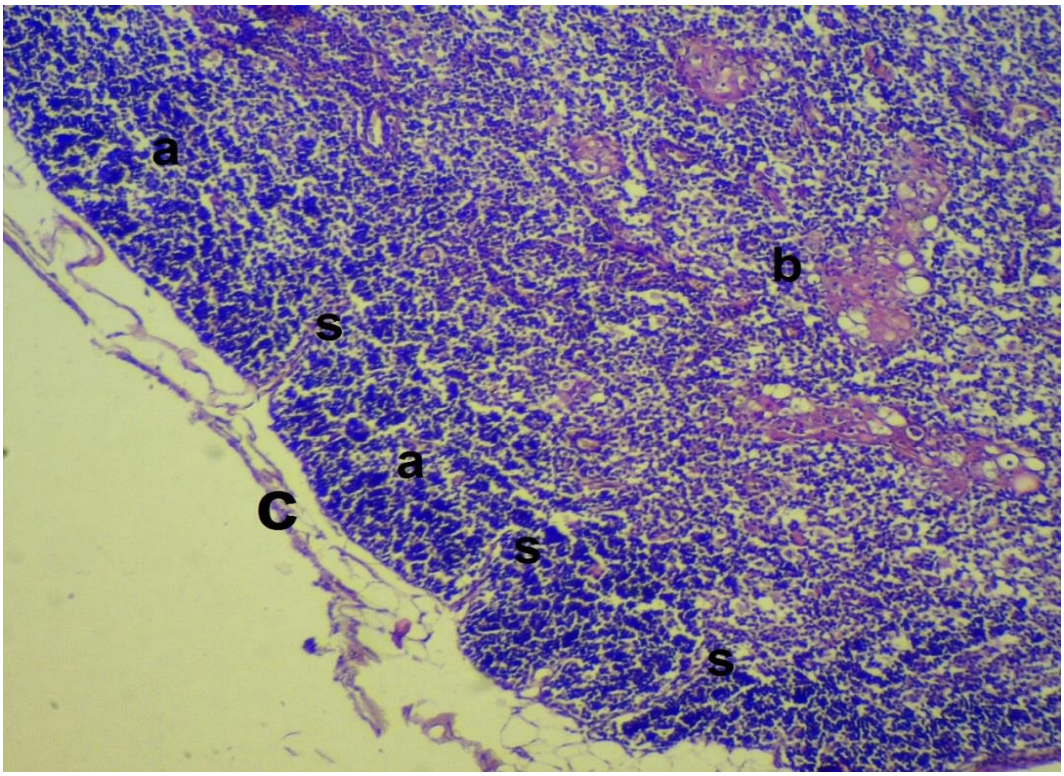

Fig. 4. Histological section of thymus gland showed: a: cortex, b: medulla, c: capsule, s: septa (H & E stain, 100 X)

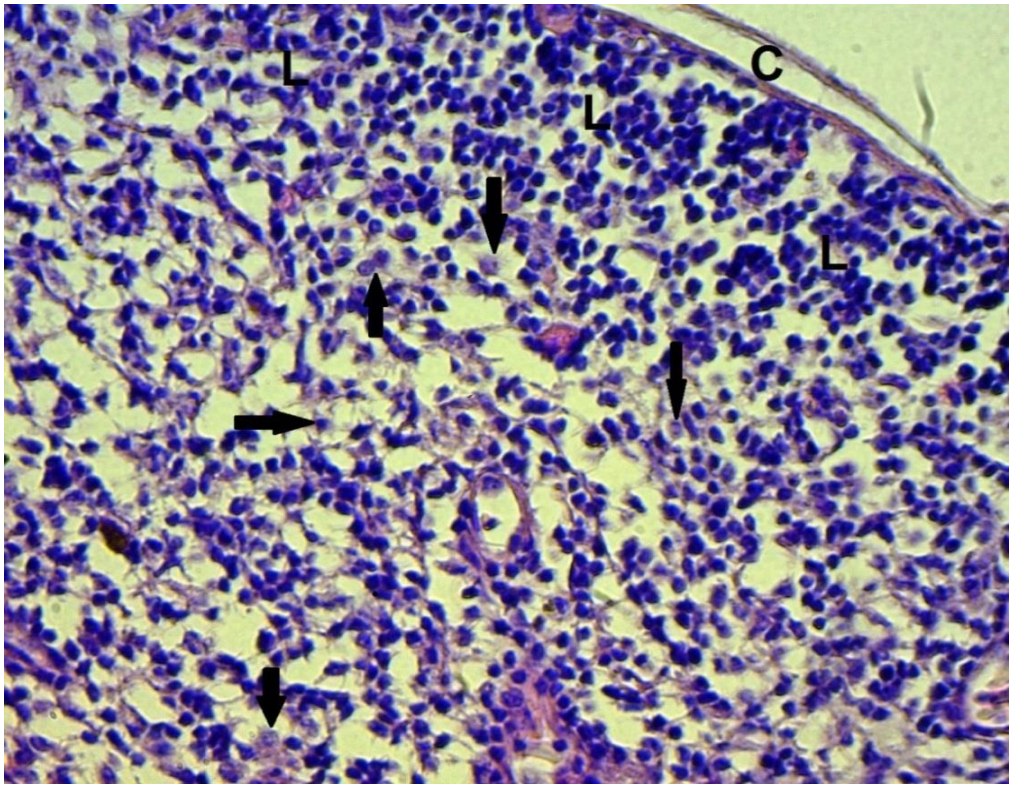

Fig. 5. Histological section showed: c: capsule, L: lymphocytes inside the cortex, RECs: reticuloepithelial cells inside the cortex (arrow heads) (H & E stain, 400 X)

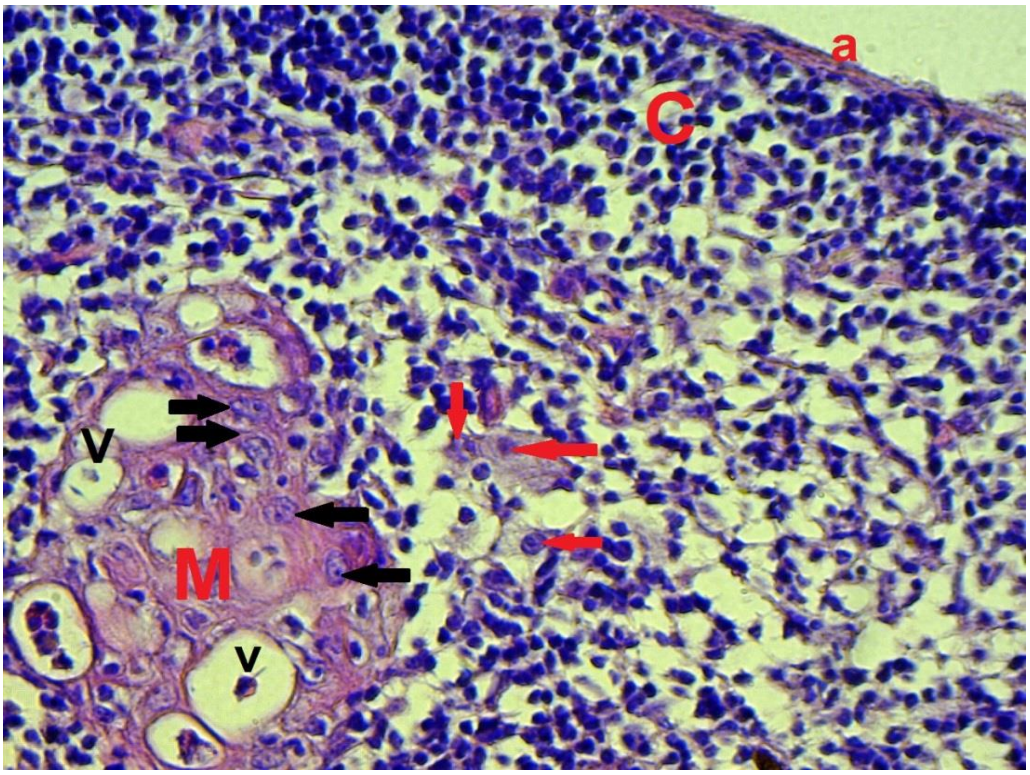

Fig. 6. Histological section showed: a: capsule, C: cortex, RECs in the cortex (red arrow heads), M: medulla, RECs inside the medulla (black arrow heads), v: vacuoles (H & E stain, 400 X)

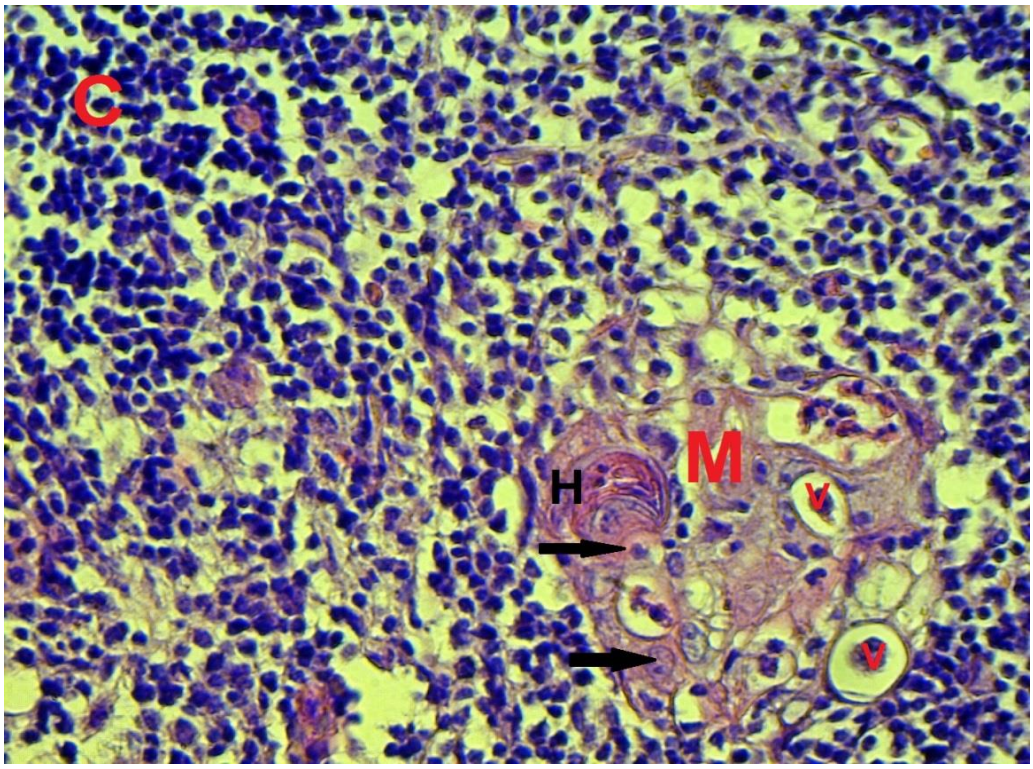

Fig. 7. Histological section of thymus gland showed: C: cortex with dark lymphocytes, M: medulla containing lighter lymphocytes and larger RECs (arrow heads), H: Hassall's corpuscle, v: vacuoles. (H & E stain, 400 X)

REFERENCES

Ali, H. K. 2016. Anatomical and Histological study of thymus gland in the local breed of turkey "*Meleagris gallopavo*" in Iraq. 3rd Scientific Conference - College of Veterinary Medicine - University of Tikrit. 2,3 May: 93-97.

Ali, H. K. 2017. Histomorphological Study of Thymus in Local Chicken "Gallus gallus domesticus". *Diyala journal for pure sciences*, 13(3): 120-132.

Bach, J. F. 1978. Immunology. 5th ed., John Wiley and Sons, New York, USA: 15-35.

Bacha, W. J. and L. M. Bacha. 2000. Color Atlas of Veterinary Histology. Lippincott Williams and Wilkins, London. 2nd ed. Pp: 191-200.

Bancroft, J. D., S. K. Suvarna and C. Layton. 2013. Bancroft's Theory and Practice of Histological Techniques. 7th Ed. Churchill Livingstone Elsevier. Edinburgh. London. Melbourne and New York. Pp: 106-118.

Bodey B., B. J. Bodey, S. E. Siegel and H. E. Kaiser. 2000. The role of the reticulo-epithelial (RE) cell network in the immuno-neuroendocrine regulation of intrathymic lymphopoiesis. Anticancer Res. 20(3A): 1871-88.

Bowden, T. J., P. Cook and J. H. W. M. Rombout. 2005. Development and function of the thymus in teleosts. Fish & Shellfish Immunology. 19: 413-427.

Boyd, R. L., H. A. Ward and H. K. Muller. 1983. The growth of non-lymphoid thymic components *in vitro*: Age related differences during development. *J. Reticuloendothel. Soc*., 34: 371-82.

De Juana, E. and P. Boesman. 2013. Black-bellied Sandgrouse (*Pterocles orientalis*). *In:* del Hoyo, J., Elliott, A., Sargatal, J., Christie, D. A. and de Juana, E. (eds.). 2013. *Handbook of the Birds of the World Alive*. Lynx Edicions, Barcelona.

Dellmann, H. D. and E. M. Brown. 1998. Textbook of Veterinary Histology. 2nd Edn., Lea Fiebiger, Philadelphia: 165-67.

Elewa, Y. H. A. 2005. Some morphological studies on immunological organs in ostrich. M. V. Sc. Thesis. Fac. Of Vet. Med. Zagazig. Univ.

El-Zoghby, I. M. A. and H.F. Attia (2007). Fine structure of the thymus gland in ostrich (Struthio camelus L). The 31th Scientific Conference of the Egyptian Society of Histology and Cytology: 1-16.

Getty, R. 1975. Sission and Grossman's The Anatomy of the Domestic Animal. 5th ed., Vol. 2. W. B. Saunders Co., Philadelphia. London: 2010-2018.

Glick, B. 1978. The immune response in the chicken: Lymphoid development of the bursa of Fabricius and thymus and an immune response role for the gland of Harder. Poultry Science, 57(5): 1441-1444.

Hodges, R. D. 1974. The Histology of The Fowl. Academic Press INC. New York. U.S.A. : 440-458.

Honjo, K. and Y. Hirota. 1993. Immunohistochemical investigations of lymphocytes in the lymphoid organs of cyclophosphamide treated chickens. Journal of Veterinary Medical Science 55: 895-897.

Kannan, T. A., G. Ramesh, S. Ushakumari, S. Venkatesan and S. Vairamuthu. 2015. Light and electronmicroscopic details of Thymic Reticuloepithelial cells in Nandanam Chicken (Gallus domesticus). *International Journal of Advanced Research*, 3(9): 841-846.

Kannan, T. A., G. Ramesh, S. Ushakumary, G. Dhinakarraj and S. Vairamuthu. 2012. Lightmicroscopic studies on Spleen of Chicken *(Gallus domesticus). Haryana Vet.*, 51(12): 114-115.

Karim, M. R., M. Z. I. Khan and Z. Haque. 2005. The dynamics of immunocompetent cells in the major lymphoid organs and mucosa associated lymphoid tissues of chemotherapy treated chickens. *Journal of the Bangladesh Society for Agricultural Science and Technology* 2: 5-8.

Kendall, M. D. 1980. Avian thymus glands: A review. Dev. Comp. ImmunoL, 4: 191-209.

Khali, L. M., Z. I. Islam, M. Khalil and R. Islam. 2003. A prospective study of prenatal and postnatal development of thymus of deshi chicken. *Mymensingh Medical Journal*, 12: 20-24.

Mohammed, M. G., S. Chilmonczyk, D. Birch, S. Aladaileh, D. Raftos and J. Joss. 2007. Anatomy and cytology of the thymus in juvenile Australian lung fish, *Neoceratodus orsteri*. *J. Anat.*, 211: 784-97.

Panse, R. L. and S. Berrih-Aknin. 2005. Thymic myoid cells protect thymocytes from apoptosis and modulate their differentiation: implication of the ERK and Akt signaling pathway. *Cell Death Differ.*, 12(5): 463-472.

Pearse, G. 2006. Normal structure, function and histology of the thymus. Toxicologic Pathology, 34: 504-514.

Rose, E. 1979. The immune system in birds. Journal of the Royal Society of Medicine, 72(9): 701-705.

SONG, H., K. PENG, S. LI, Y. WANG, L. WEI and L. TANG. 2012. Morphological characterization of the immune organs in ostrich chicks. *Turk. J. Vet. Anim. Sci.* 36(2): 89-100.

Sultana, N., M. Z. I., Khan, M. A. Wares and M. A. Masum. 2011. Histomorphological study of the major lymphoid tissues in indigenous ducklings of Bangladesh. *Bangl. J. Vet. Med.* 9(1): 53-58.

Szenberg, A. 1976. Ontogenesis of the immune system in birds. In: MARCHABRIS, J. J. (Ed.) Comparative immunology. Oxford: Blackwell Scientific Publications: 419-431.

Tarek, K., M. Mohamed, B. Omar and B. Hassina. 2012. Morpho-Histological Study of the Thymus of Broiler Chickens During Post-Hashing Age. *International Journal of Poultry Science.* 11(1): 78-80.

Treesh S. A., A. O. Buker and N. S. Khair. 2014. Histological, histochemical and immunohistochemical studies on thymus of chicken. *International Journal of Histology and Cytology*, 1(11): 103-111.

دراسة نسيجية شكلية للغدة الزعترية في طائر القطا العراقي

هناء كريم الشمري[1، 4] صلاح حسن المالكي[2] اقبال سلمان نجم[3]

خالد ابراهيم الخزرجي[1] أحمد عبدالله حسين[1]

[4] المسؤول عن النشر: hkareem1976@yahoo.com

المستخلص

على الرغم من أن الغدة الزعترية قد درست في عدة أنواع من الطيور، ولكنها لم تدرس بالقطا العراقي الى الان، ولذا، خصصت هذه الدراسة للتعريف بالتركيب الشكلي والنسيجي لهذه الغدة. استخدمت لهذا الغرض ستة طيور صحية من القطا المحلي من كلا الجنسين ومختلف الأعمار وقسمت إلى مجموعتين تشريحية ونسيجية، وتم قتل الطيور بطريقة الذبح الحلال.

شكلياً كانت الغدة الزعترية تقع على كلا الجانبين على طول الرقبة، وهي غدة مزدوجة تحتوي على سلسلتين من الفصوص كل منها يتألف من عدة فصوص مفلطحة أو غير منتظمة الشكل ذات لون وردي مصفر، بينما بينت الدراسة النسيجية ان الغدة الزعترية في طائر القطا كانت محاطة كليا بمحفظة من النسيج الضام يمتد منها عدد من الحواجز التي تقسم الغدة الى عدة فصيصات منفصلة عن بعضها جزئيا، وكل منها تتكون من منطقتين هما منطقة داخلية هي اللب واخرى خارجية هي القشرة.

كانت القشرة داكنة اللون بسبب محتواها العالي من الخلايا الليمفاوية الصغيرة والمرصوفة بإحكام في منطقة القشرة اكثر من منطقة اللب، التي تألفت من كمية كبيرة من الخلايا الطلائية الشبكية مركزية النواة والهيولي ذو الصبغة الحامضية مع عدد كبير من الخلايا الليمفاوية ذات الهيولي ذو الصبغة الحامضية، مما يعطي اللب المظهر الشاحب.

الكلمات المفتاحية: طائر القطا، التركيب النسيجي للغدة الزعترية، دراسة شكلية للغدة الزعترية.