Comparative Histomorphological Study of Kidneys in Pigeon (*Columba livia*) and Starling Birds (*Sturnus valguris)*

Suhaib A. H. AL-Taai[1], Riyadh H. Nasif[1]

[1]Lect., Department of Anatomy & Histology, College of Veterinary Medicine / University of Baghdad/Iraq

Abstract

This paper is focused application on the histomorphological and morphometrical differences of the kidneys of two species (*Sturnus valguris* and C*olumba livia*) belong to different orders varied in climate. Our study used 30 birds divided into two equal groups; first was 15 starling birds (*Sturnus valguris*) and the second group consisted of 15 pigeon (*Columba livia*). The current study showed morphological results of kidneys in both birds, where appeared differences between kidneys. In starling's kidney was described square shape with fused left and right kidneys, either pigeon's kidney was divided in to three lobes (cranial, middle and caudal) with elongated-like. The present study was revealed Mean measurements. The study recorded length of starling's kidney was (4.43±0.12cm), while weight and volume were recorded (3.75±0.05g) and (2.28m±0.04cm³) respectively, while in pigeon was kidney length (5**.**45±0.12cm)**,** weight of kidney was (4.85±0.02g) and volume about (2.21±0.06cm³). Microscopic results were included in two species, the renal cortex which made up the majority of the kidney, while small region of kidney called medulla. Our study was different impatience between starling's bird and pigeon kidney about renal corpuscles, where the study showed the bowman's space in starling bird was wide from pigeon. The study observed significant statistics analysis. Mean measurement was (10.64±0.02µm) and (8.65±0.04µm) in bowman's space, while mean of the glomerulus capillaries and renal corpuscles of pigeon was a larger than starling's bird (47.54±0.11µm), (26.60±0.12µm),(56.55±0.12µm) and (37.41±0.11µm) respectively. Also the present work was recorded significant statistics analysis during calculation the number of renal corpuscles in 1 mm² in starling bird kidney was more than that in the kidney of pigeon (20.25 ± 0.23µm) and (16.42 ± 0.01µm).

Key words: *starling, pigeon, bird, kidney, histology, comparison*

Introduction

There are more than (8755) faction of the birds distribution around the world. These are birds different in strain, order and nature of the diet [1]. The starling birds (*Sturnus valguris)* are considered a seasonal birds during winter, while the pigeon (*columba livia*) are domestica birds in Iraq and other countries along year [2]. The kidneys are important organ inside the living organism during mammalians, birds and fish, and which have been many functions for the maintaining of continuance life, the kidneys do not affect nature of external factors such as the environment by providing a balance the body fluids during parts of nephrons, homeostasis, osmolality, ionic content, pH and finally ridding of metabolic waste materials outside the body [3]. The birds are probably affected due to climatic condition for semi desert areas may lead to adaption characteristics of these birds [4]. Anatomically, the kidneys of birds include left and right kidneys which are located symmetrically in pelvic region one on either side of the vertebral column [5]. Generally, the kidneys shape of avian are different from bird to other bird according to kind or strain, there are three lobes division into cranial, middle and caudal during left and right kidney [6 and7]. Histologically, the kidney of birds have been nephrons are dividing into cortical (reptilian) type

Corresponding author:
Suhaib A. H. AL-Taai
dr.suhaibaltaai77@gmail.com

which is a shortest type and locate in renal cortex more numerous, but lack henel's loop, whereas, the second nephrons named medullary (mammalian) type, it has a longest type and has henel's loop, this type of nephrons is less numerous than cortical nephron and extended to medulla [8 and 9]. Always all studies have been published about mammal kidneys, while comparative studies were recorded a few for avian kidneys. The current study is aimed to investigate comparison between two types of birds, first is called starling (*Sturnus valguris)* and other called pigeon (*columba livia)* depending on climate differences of their kidneys.

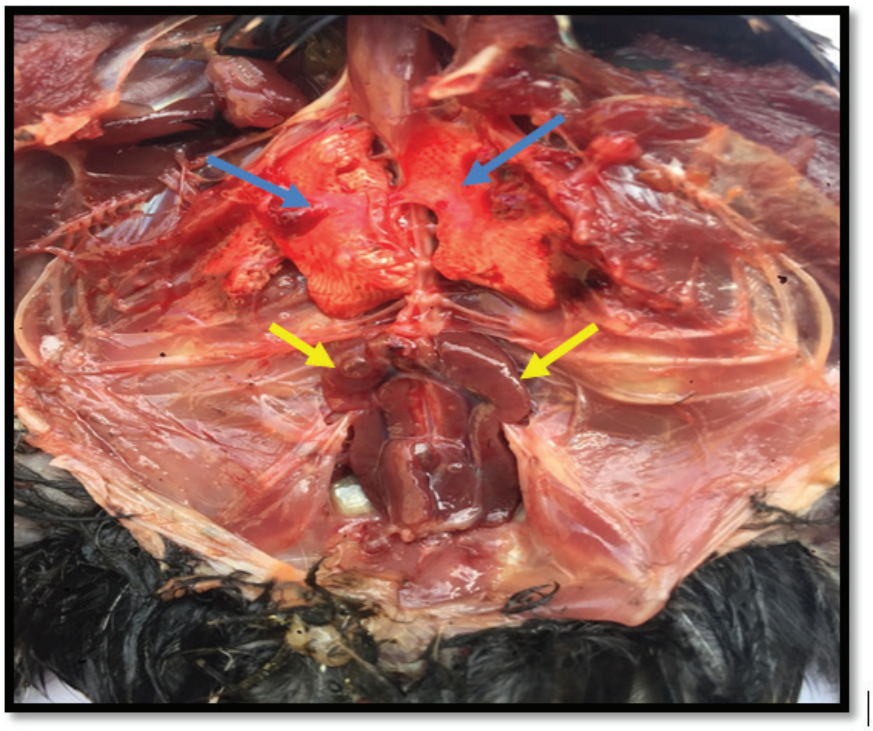
Materials and Methods

Thirty birds were used in our study. These birds were divided into two groups, the first group was included 15 bird of starling species *(Sturnus valguris)* and the second group was 15 pigeon (*Columba livia*). All birds were bought from Ghizzel market of Baghdad. The birds are put inside cages in the animal house in college of veterinary medicine of Baghdad University. The birds and pigeon were sacrificed after give injection sodium pentobarbitone (70 mg/kg) at intra muscularis [10]. We fixed the specimen on dissected board for dissection, and later we are done mid-line incision in abdomen region and after that we washed viscera of bird by distill water for removing the blood and other adheres particle. After that, we removed the internal viscera from the body to clearance of the kidneys organ for the comparison. The study are measured the length, weight and volume of kidneys, the length are taken by digital caliber, but the weights of bird were measured via sensitive electron balance, whereas the volume are measured by using the volumetric cylinder. For histological measurements, the study were used bouin's fixative to keep the kidney samples. Both birds were dissected for histological technique. Slides were stained by Hematoxylin and Eosin for general structure and Periodic Acid Sschhiff [11].

Results and Discussion

In morphological results of kidneys in both birds, the macroscopic sections were appeared differences between starling's kidney(*Sturnus valguris*) and pigeon's kidney (*columba livia*), where the study described starling's kidney square in shape and fused left and right side (fig.1). Whereas in pigeon was elongated–like and divided into left and right kidney with subdivided lobes. These lobes were included cranial, middle and caudal divisions (fig. 2). This result was parallel with [12 and 13]. whom said that the kidneys of quail and sparrows consisted of a large caudal, a small middle and a cranial part and conflicted with kidney's starling in our study. The study was revealed macroscopic measurements, mean length of starling's kidney, weight and volume were recorded (4.43±0.12cm), (3.75±0.05g) and (2.28m±0.04cm³) respectively, while in pigeon, mean of length was (5**.**45±0.12cm**),** weight of kidney was (4.85±0.02g) and volume about (2.21±0.06cm³). In histological cross sections, the study showed renal that kidneys of birds included the renal cortex which made up the majority of the kidney, while small region of kidney was called medulla (fig.3 and 4). These results were accepted with [7]. The renal cortex has the reptilian (cortical) nephrons without henel's loope while in medulla contain the mammalian type of nephrons with loop of henle (fig.5). These results were not corresponding with that [14] whom reported that fish no have henel's loop, subsequently that fish kidney included reptilian nephrons only. Our study was proved the differences between starling's bird and pigeon about renal corpuscles, where the study recorded the bowman space of renal corpuscle in starling bird was wide from pigeon, while the glomerulus capillaries of pigeon was a large than starling's glomerulus capillarie. This result was aimed to nature of bird life and seasonal condition. These results accepted with whom that [4] and different with that said in [3]. Also the present work was appeared that the renal corpuscles of two species of birds contain on an outer and inner layer of Bowman's capsule separated by Bowman's space from a centrally located glomerulus and podocytes which boundaries in inner layer of bowman's capsule, so the study showed during magnifying macula densa was prominent cells which appeared nearly between proximal and distal convoluted tubules as shown in the results. The current study showed renal tubules (proximal, distal and collecting) and collecting duct during cortex and medulla (fig.6). These results were accepted with whom said that [15] which described renal tubules and collecting duct in Quail and Green- Winged Teal. Our work recorded significant statistics analysis during calculation the number of renal corpuscles in 1 mm² in starling bird kidney was more than that in the kidney of pigeon (20.25 ± 0.23µm) and (16.42±0.01µm) respectively. Mean measurement

of renal corpuscles was (37.41±0.11µm)in starling, (56.55±0.12µm) in pigeon, but glomeruli capillaries were (26.60±0.12µm) in starling and (47.54±0.11µm) in pigeon. Also the study recorded significant analysis during mean measurement of bowman's space in two species, where was (10.64±0.02µm) in starling kidney and (8.65±0.04µm) in pigeon kidney.



Fiqure (1) : ventral view of the starling bird shows fused kidneys (yellow arrow) and lungs (blue arrow) .

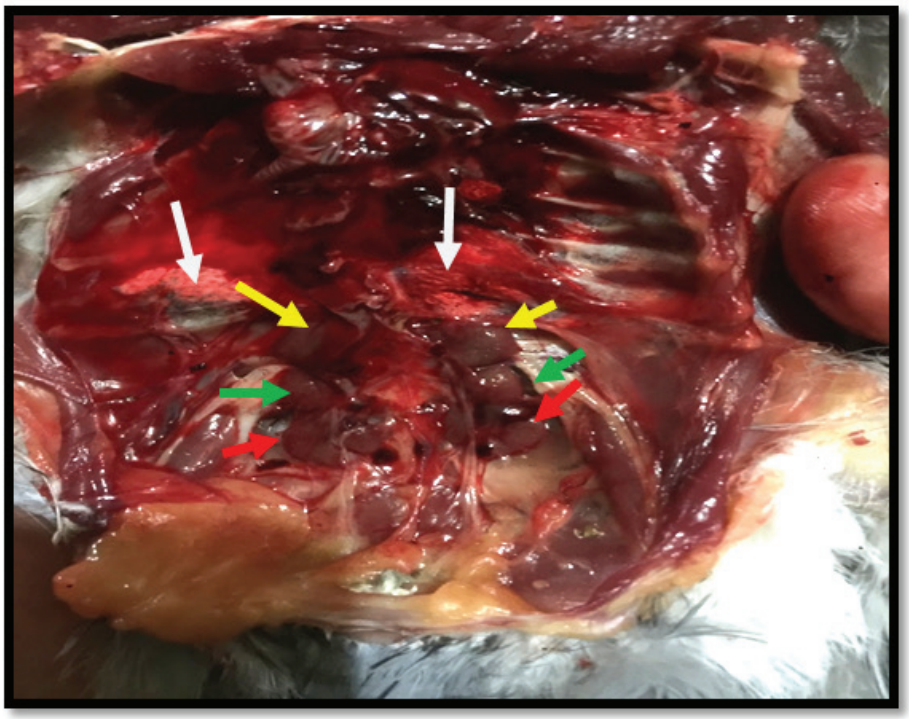


Figure (2) : ventral view of the pigeon shows the right & left kidneys divided into :cranial lobe (yellow arrow), middle lobe (green arrow),caudal lobe (red arrow)and lungs (white arrow).

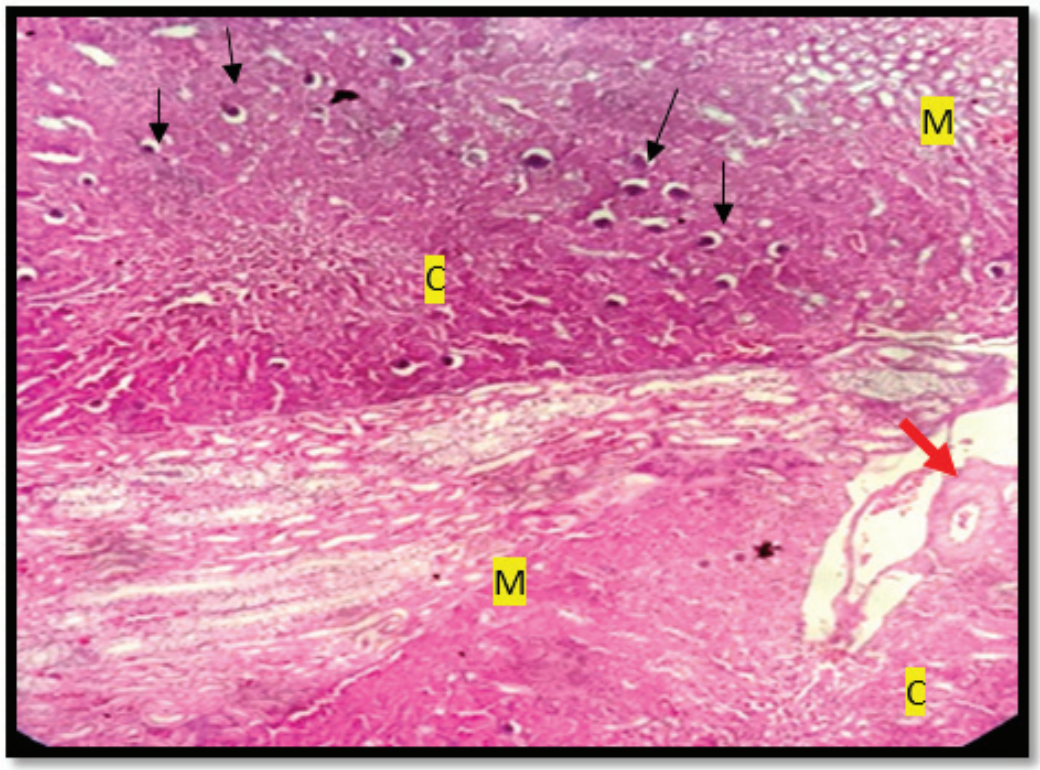
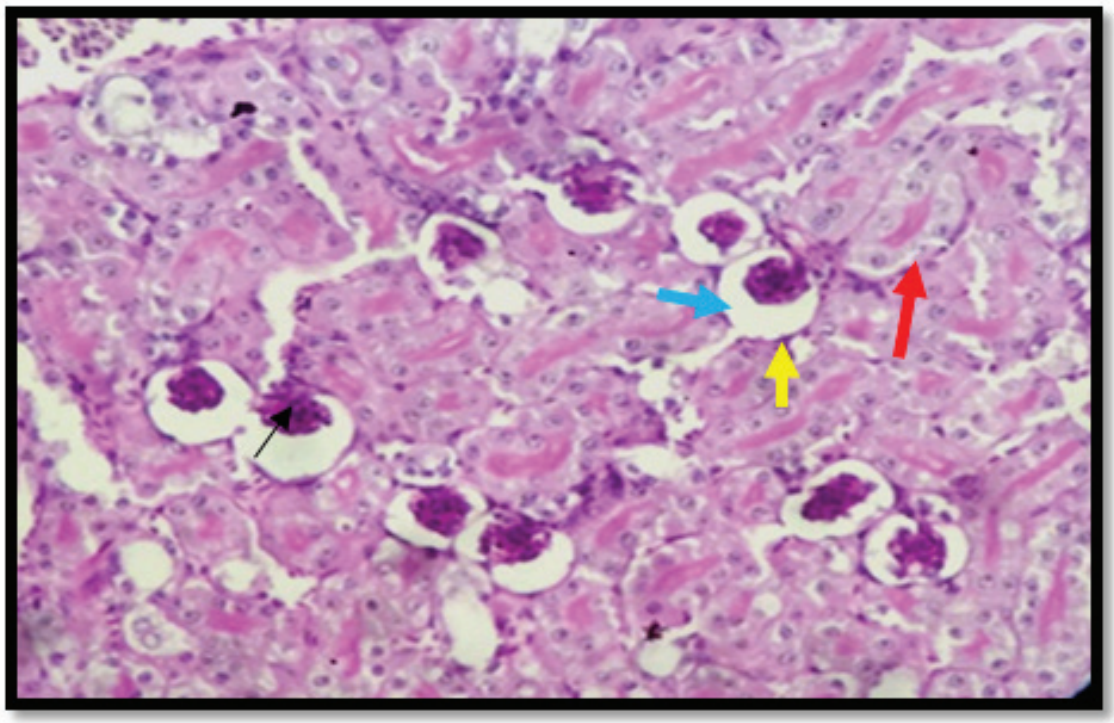


Figure (3): histological section of pigeon kidney shows renal cortex (C),medullary cone (M), renal corpuscles (small black arrow) and inter lobular blood vessel (red arrow) ,H&E 100x stain



Figure(4):Histological section of starling bird renal cortex shows renal corpuscles, bowman capsule(yellow arrow), glomeruli capillaries(black arrow),wide bowman space(blue arrow)and proximal renal tubules(redarrow), PAS 400x stain.

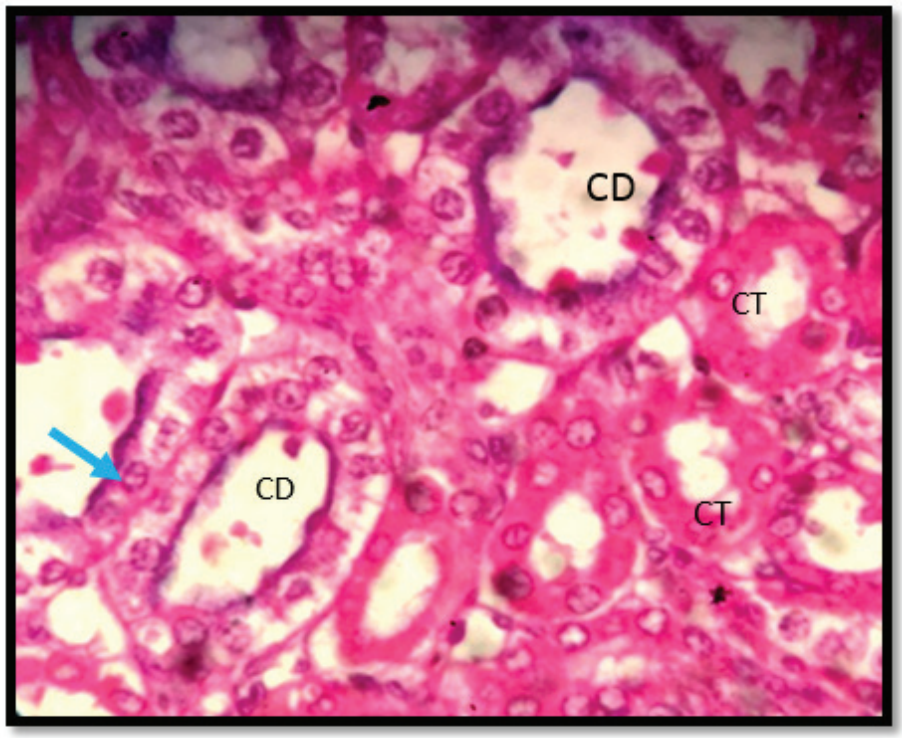
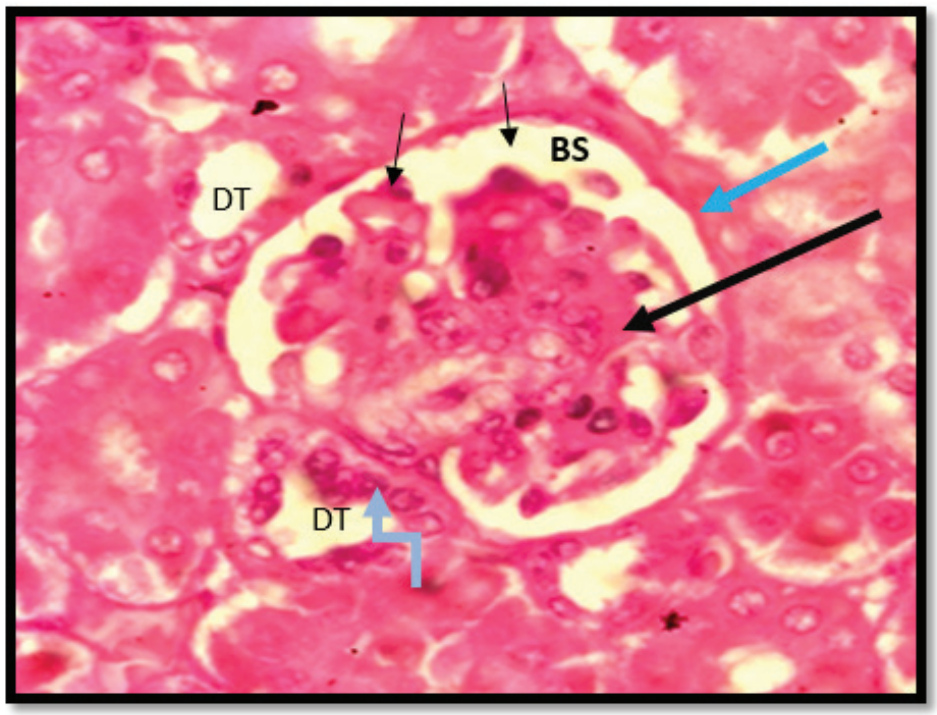


Figure (5): histological section of pigeon kidney medulla shows collecting ducts (CD)with lining simple cuboidal epithelium (blue arrow)& Collecting tubules (CT) with lining simple cuboidal epithelium, H&E 1000x stain



Figure(6): histological section of pigeon's kidney cortex shows renal corpuscle (Bowman's capsule) (blue arrow), glomerulus capillaries(large black arrow), narrow Bowman's space(BS), Podocytes(small black arrows), distal convulated tubules(DT) &Macula densa (curved arrows) H&E 1000x stain.

Conclusions

1. Pigeon's kidney had good developed nephrons represent from renal corpuscles (glomerulus ,bowman's capsule and bowman's space).

2. Starling's bird had less capacity of the kidney than pigeon due to seasonal condition of their birds.

3. Pigeon were more adaption than starling birds therefore that pigeon can live in any climate.

Ethical Clearance: The Research Ethical Committee at scientific research by ethical approval of both MOH and MOHSER in Iraq

Conflict of Interest: Non.

Funding: Self-funding

References

1. King,A. S. and Mclelland, J.: Outline of Avian Anatomy,1st edition Bailliere, Tindall, London. 1975; 33-39.

2. Gorman, K.."Bird lady of Haslet helps to elevate occasions". Star Telegram. Archived from the original on 2 April 2019. Retrieved 25 June 2008.

3. Hall L W .Kidney function. In: Veterinary Nephrology 1st ed. , BAS printers limited. Girton College, University of Cambridge. 27 – 56.

4. Dawson TJ,Herd RM. Digestion in the emu: low energy and nitrogen requirements of this large ratite bird. Comp Biochem Physiol . 1983; 41–45.

5. Hodges R. D. The renal system. In the histology of the fowl. 2nd ed. Academic press. London and New York. 1974; 489 -524.

6. MICHAŁEK,K, SZCZERBIŃSKA,D, GRABOWSKA,M , MAJEWSKA,D, LASZCZYŃSKA, M (2016): Department of Physiology, Cytobiology, and Proteomics, Faculty of Biotechnology and Animal Husbandry, West Pomeranian University of Technology in Szczecin, Szczecin, Poland 2 Department of Poultry and Ornamental Bird Breeding, West Pomeranian University of Technology in Szczecin, Szczecin, Poland 3 Department of Histology and Developmental Biology, Pomeranian Medical University, Szczecin, Poland. Turk J Zool (2016) 40: 314-319 © TÜBİTAK doi:10.3906/zoo-1506-21.

7. Batah, A L . MORPHOLOGICAL AND HISTOLOGICAL STUDY FOR THE KIDNEYS OF COOT BIRD (Fulica atra) Department of anatomy, college of veterinary medicine, university of Basrah,Basrah,Iraq (Received 24April 2012,Accepted 3June 2012).

8. Bacha.W,J.and Wood,G.L.M. Avian urinary system in color atlas of Veterinary histology.William and Wilkins.Waverlly company . Hong Kong. 1990.164-174.

9. Abood, D. Reshag, A; Azhar, S. K. and Myson, A. Department of Anatomy,Histology and Embryology, College of Veterinary Medicine University of Baghdad, Iraq. Comparative anatomical and histological features of the kidney in Harrier (Circus aueroginosus), Chicken (Gallus domesticus) and Mallard duck (Anas platyrhynchos), The Iraqi Journal of Veterinary Medicine, 2014; 38(1): 017 – 003.

10. Mitchell, M.A., Smith, M.W. The effects of genetic selection for increased growth rate on mucosal and muscle weights in the different regions of the small intestine of the Domestic fowl (Gallus Domesticus). Comp. Biochem. Physiol. 1991; 99A: 251-258.

11. Luna, L.G. Manual of histologic staining method of armed forces institute of pathology 3ed. New York, U.S.A. 1968:123.

12. Braun,E.J and Dartzler,W.H. functional of mammalian-type and Reptilian-type nephrons in kidneys of desert quail.Am.J.physiol. 1972. 617-629.

13. Casotti,G.and Braun,E.J. Renal Anatomy in Sparrows from Different Enviroments.J.morphol. 2000;24 (3): 283-291.

14. AL- Taai, S A. Seasonal morphohistological study of gills and kidneys in common male carp fish (Cyprinus carpio L.), A thesis Submitted to the Council of Veterinary Medicine College – University of Baghdad in Partial Fulfillment of the Requirements for the Degree of Doctor of Philosophy in Veterinary Medicine – Anatomy and Histology.2015.

15. Baragoth, A F. Histomorphological and

morphometrical comparative study of the kidney between Quail (Conturnix coturni) and Green-winged Teal (Anas crecca) according to their environment type, Coll. of Vet. Med. Univ. of Wasit (Received 2 April 2014, Accepted 25 September 2014)