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Gross observations on the kidney of Pratapdhan bird

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Abstract

A total of 20 pairs of Pratapdhan bird kidneys were collected from local meat shop and transported to the laboratory on ice for further examination. These kidneys exhibited a reddish-brown color, a dorso-ventrally flattened shape, and were located retroperitoneally. They were unilaterally positioned along the vertebral column within the synsacrum and iliac fossa depression. On the dorsal surface, lumbosacral masses were present, while the ventral surface was divided into cranial, middle, and caudal sections by an oblique groove. The cranial part was the smallest, extending with the caudal segment of the lungs, while the caudal segment was the largest, reaching the caudal end of the synsacrum. Measurements using a Vernier caliper revealed the maximum length and width of the right and left kidneys as follows: 56.30 ± 1.31 mm and 54.41 ± 1.29 mm for length, and 11.31 ± 0.50 mm and 12.01 ± 0.17 mm for width, respectively. The weight and volume of the right and left kidneys were also recorded: 6.26 ± 0.12 gm and 5.26 ± 0.10 gm for weight, and 5.89 ± 0.19 ml and 4.97 ± 0.17 ml for volume, respectively.

Keywords: Kidney, Pratapdhan bird, gross, analysis, retroperitoneally

1. Introduction

The Pratapdhan bird is a rural chicken variety that was developed by the All India Coordinated Research Project on Poultry Breeding at Maharana Pratap University of Agriculture and Technology, Udaipur. It is a dual-purpose bird that can produce both meat and eggs. It has a multicolored plumage that resembles the local birds of Rajasthan. It has a higher egg production of 161 eggs per year, which is much more than the local native birds (Weblink) ^[12].

The Pratapdhan bird has a unique anatomy of its kidneys, which are located retroperitoneally, between the synsacrum and the iliac fossa. The kidneys are slender, red-brown organs with a flattened dorsal side. They have three sections: cranial, middle and caudal, separated by slanted grooves. The dorsal side has lumpy projections that fit into the lumbosacral cavities, while the ventral side has grooves that accommodate the external iliac arteries. The cranial part is the smallest and lies next to the caudal end of the lungs. The caudal part is the largest. In males, the ventral side of the cranial part is connected to the testis, while the middle and caudal parts are linked to the gizzard, intestine, ureter, vas deferens and oviduct. The size and shape of the kidney lobes vary among different bird species as per Singh *et al.* (2021) ^[10].

The kidneys play a vital role in eliminating nitrogenous wastes, excess water, inorganic salts, and toxic substances that are byproducts of the body's metabolic processes. They also contribute to hormone production and help maintain the optimal osmotic balance of bodily fluids. The urinary system of the Pratapdhan bird comprises two elongated kidneys and two ureters, without a urinary bladder. Consequently, each ureter opens into the urodeum of the cloaca, serving as the passage for urine to exit the body as suggested by Al-Agele (2012), Bacha and Bacha (2012) ^[1, 2]. These were situated retroperitoneally on both sides of the vertebral column, within the synsacrum and iliac fossa depressions, these kidneys exhibit dorsal and ventral surfaces. Structurally, they consist of three components: cranial, middle, and caudal. Notably, an oblique groove present on the ventral aspect of each kidney leads to the bifurcation of these components as observed by Inoue (1953), Khadim and Dauod (2014), Singh *et al.* (2021) ^[5, 6, 10]. Extensive documentation exists on the physiology of avian kidneys, highlighting their roles in conserving water, filtering blood, metabolizing waste, and reabsorbing recyclable materials.

Consequently, a morphological investigation has been undertaken to validate existing studies and discover novel research findings concerning the kidney of the Pratapdhan bird at a macroscopic level.

2. Materials and Methods

The gross features of the Pratapdhan bird's kidneys were studied at the Department of Anatomy and Histology, College of Veterinary and Animal Science, Navania, Vallabh Nagar, Udaipur. Twenty pairs of Pratapdhan bird kidney samples were obtained from different meat shops near Udaipur City. The samples were fresh and unfixed, and they were transported to the laboratory on ice to maintain their macroscopic features. A Digital Vernier Caliper (0-150 mm) was used to measure the dimensions, a digital weighing machine was used to measure the weight, and a measuring cylinder was used to measure the volume of each kidney. The measurement data were then statistically analyzed to find the mean, standard deviation, and standard error Snedecor and Cochran (1989) [11].

3. Results and Discussion

The Pratapdhan bird was specifically bred as a rural chicken variety adapted to the agro-climatic conditions of Rajasthan. It exhibited better performance in terms of egg production and body weight compared to local native birds, which could enhance the income and livelihood of rural poultry keepers (Weblink) [12].

The Pratapdhan bird exhibits notable anatomical features in its kidneys. They were positioned retroperitoneally, located between the synsacrum (a fusion of lumbar and sacrum vertebrae in birds) and the iliac fossa (a concave surface in the pelvis) (Fig.1). Their slender shape and reddish-brown color, along with a flattened dorsal surface, contribute to their distinct appearance. The kidneys of the Pratapdhan bird are divided into three sections: cranial, middle, and caudal, which are demarcated by slanted grooves. This division allows for compartmentalization and specialization of renal functions. The cranial section, adjacent to the lungs, is the smallest portion, while the caudal section, corresponding to the rear of the kidneys, is the largest (Fig. 2). These variations in size and shape of kidney lobes can be attributed to the different adaptations and requirements of bird species based on their habitat, diet, and physiological needs as observed by various researchers Dhyaa *et al.* (2014) in harrier, chicken and mallard duck, Khadim and Daoud (2014) in barn owl, Michalek *et al.* (2016) in breeding Emu, Reshag *et al.* (2016) in Great flamingo and Singh *et al.* (2021) in Guinea fowl [4, 6, 7, 9, 10].

On the dorsal side of the Pratapdhan bird's kidneys, there are noticeable protruding small lumps that fit into the lumbosacral cavities, which contribute to the stability and positioning of the kidneys within the body (Fig. 3), while as per Singh *et al.* (2021) suggested that in guinea fowl lumbosacral masses were larger and deeper. Conversely, the ventral side of the kidneys features grooves that accommodate the external iliac arteries, ensuring proper blood supply to the organ as suggested by Batah (2012) in Coot bird Pervenetskaya *et al.* (2018) in Haysex white breed chicken and Singh *et al.* (2021) in Guinea fowl [3, 8, 10].

In male Pratapdhan birds, the ventral side of the cranial part of the kidneys is connected to the testis, while the middle and caudal parts are linked to other abdominal organs such as the gizzard, intestine, ureter, vas deferens, and oviduct. These connections reflect the intricate interplay between the urinary

and reproductive systems in avian anatomy as suggested by Singh *et al.* (2021) in Guinea fowl [10]. The urinary system of the Pratapdhan bird consists of two elongated kidneys and two ureters, with the absence of a urinary bladder. As a result, each ureter opens into the urodeum of the cloaca, serving as the outlet for urine elimination. This unique anatomical configuration of the urinary system has likely evolved to suit the specific physiological demands of the Pratapdhan bird.

The detailed morphological description of the Pratapdhan bird's kidneys provides a valuable foundation for further research in understanding the physiological functions and potential pathologies associated with this avian species. By studying the intricate structures of the kidneys, researchers can gain insights into the mechanisms of urine formation, regulation of electrolyte balance, and potential renal adaptations to the unique agro-climatic conditions in which the Pratapdhan bird thrives.

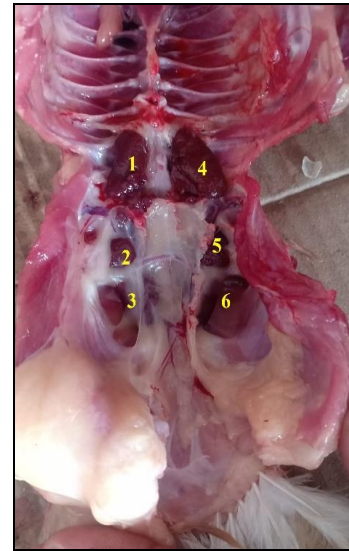


Fig 1: Showing the different structural components of Pratapdhan kidney. viz. 1- Right cranial lobe, 2- Right Middle Lobe, 3- Right Caudal Lobe, 4- Left Cranial Lobe, 5- Left Middle Lobe, 6- Left Caudal Lobe.

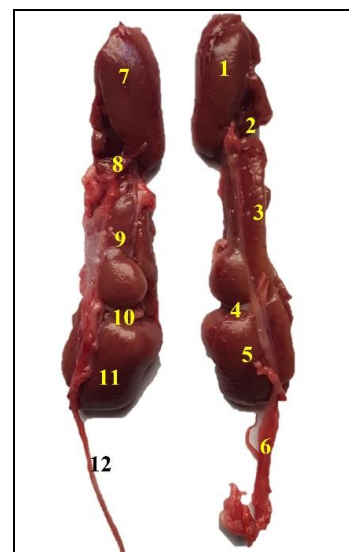


Fig 2: Photograph Showing the different components of Pratapdhan kidney (ventral view). viz. 1- Right cranial lobe, 2- Cranial oblique groove, 3- Right Middle lobe, 4- Cranial oblique groove, 5- Right caudal Lobe, 6- Right ureter, 7-Left Cranial Lobe, 8- Cranial oblique groove, 9- Left Middle Lobe, 10- Caudal oblique groove 11- Left Caudal Lobe, 12- Left ureter.

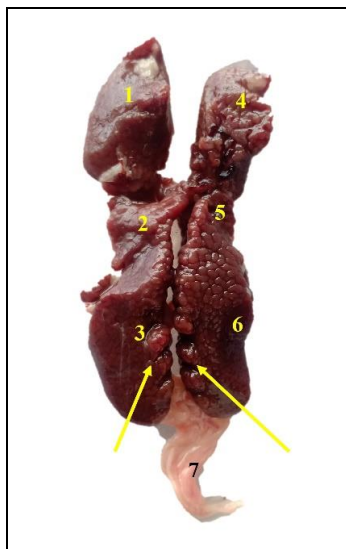


Fig 3: Showing the different structural components in dorsal view of Prapatdhan kidney. viz. 1- Right Cranial Lobe, 2- Right Middle Lobe, 3- Right Caudal Lobe, 4- Left Cranial Lobe, 5- Left Middle Lobe, 6- Left Caudal Lobe, 7- Ureter and Yellow arrow- Lumbosacral masses.

4. Conclusion

In conclusion, the Prapatdhan bird's kidneys exhibit distinct anatomical features that contribute to its unique appearance and functionality. The retroperitoneal positioning of the kidneys, between the synsacrum and iliac fossa, along with their slender shape and reddish-brown color, distinguishes them. The kidneys are divided into cranial, middle, and caudal sections, allowing for compartmentalization and specialized renal functions. These variations in size and shape of kidney lobes are influenced by the bird's habitat, diet, and physiological needs. The dorsal side of the kidneys contains protruding lumps that fit into the lumbosacral cavities, ensuring stability. The ventral side features grooves accommodating the external iliac arteries for proper blood supply. In male Prapatdhan birds, the kidneys are connected to the reproductive organs, indicating the interplay between the urinary and reproductive systems. The urinary system lacks a bladder, and urine elimination occurs through the urodeum of the cloaca.

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