

# Comparative morphological and morphometrical studies on the kidney in broiler chicken and broiler duck

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## ABSTRACT

*The present study was conducted on the kidneys of six each of adult broiler chicken and broiler ducks. The colour of kidney in chicken was reddish brown while in duck it was slightly greyish. In both broiler chicken and broiler duck, each kidney was incompletely divided into three lobes; cranial, middle and caudal of which caudal lobes were the largest. The shapes of kidney lobes in broiler chicken and duck showed some differences. The kidneys of broiler duck were larger than that of broiler chicken. Length of three lobes on both sides in chicken showed significant difference ( $P < 0.01$ ) while in broiler duck, there was no significant difference in the length of cranial and middle lobes. But, the length of both these lobes differed significantly from that of the caudal lobe ( $P < 0.01$ ).*

*Total weight of kidney as well as total weight of right and left kidneys in chicken showed significant correlation with the body weight at 0.05 percent level while these parameters in ducks showed a significant correlation with the body weight at 0.01 percent level. Except in the case of the width, all other parameters like length, width, thickness and weight of right and left kidneys in chicken and duck showed significant difference at 1 percent level.*

**Key Words:** Kidney, Lobes, Morphology, Morphometry.

## INTRODUCTION

Poultry industry in India that includes chicken, duck, Japanese quail, turkey and guinea fowl farming is regarded as the fastest growing agricultural sector. India has made considerable progress in broiler production in the last two decades and ranks as fifth largest producer of poultry broiler in the world. Broiler farming has been given

considerable importance in the national policy and has a good scope for further development in the years to come.

In birds the homeostasis of fluid and ions needs the proper functioning of several organ systems and is a more complex phenomenon than in other vertebrates. Kidneys in birds are very important organs that help to maintain water and electrolyte balance. Literature pertaining to the comparative gross anatomical features of kidney in broiler chicken and ducks are scanty. Hence, the present study was undertaken.

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## MATERIALS AND METHODS

The present programme of study was conducted on the kidneys of six each of adult broiler chicken and broiler ducks. The body weight of each bird slaughtered at the Meat Technology Unit, Mannuthy of Kerala Veterinary and Animal Sciences University was recorded using digital weighing balance.

After opening the abdomen of cadavers, topography, colour, shape and relations of kidney with other visceral organs in broiler chicken and broiler duck were studied and were recorded in a digital camera. Kidney samples from the cadavers of broiler chicken and broiler duck were carefully dissected out of the renal fossa. After separating the kidneys, weight of the whole kidney and different lobes of kidney was measured by using an electronic balance. Length, width and thickness of the whole kidney and individual lobes of kidney were measured by using a Vernier caliper.

Statistical analysis of data obtained was done using Statistical Product and Service Solutions Version 24.0. One way ANOVA was performed to test the difference between various parameters within each species and independent t-test was performed to test the difference between various parameters of chicken and duck. Pearson's correlation coefficient was used to find out the relationship between body weight, weight of kidney and various parameters of kidney in chicken and duck.

## RESULTS AND DISCUSSION

In the present study it was noticed that the kidneys of broiler chicken and broiler

duck were located in the renal fossa on the ventral surface of the pelvic bones as noticed by Nabipour *et al.*, (2009) in rock dove and Abood *et al.*, (2014) in Mallard duck. In male birds, ventral to anterior end of kidneys, testes were seen. Two major branches of abdominal aorta *viz.* external iliac artery and ischiatic arteries crossed the kidney on each side. Each kidney was flattened and elongated and was divided into three lobes *viz.* cranial, middle and caudal similar to the findings of Abood *et al.*, (2014) in the kidneys of Harrier species, chicken and Mallard duck. The present study revealed that caudal lobe was the largest among the three lobes in both broiler chicken and broiler duck similar to the observations made by Nabipour *et al.*, (2009) who observed that the each kidney from Rock dove, collared dove and owl consisted of three divisions *viz.* a large caudal, a small middle and a cranial division somewhat larger than the middle division. Abood *et al.*, (2014) noticed that each kidney of Harrier species, chicken and mallard duck was incompletely divided into three lobes; cranial, middle and caudal of which caudal lobes were the largest.

The present study showed that the kidneys of broiler chicken and duck were morphologically differing in size, shape, and colour (Figs. 1 and 2) similar to the findings of Morild *et al.*, (1985). The kidneys of broiler duck were larger than that of broiler chicken similar to the findings of Abood *et al.*, (2014) who reported that the kidneys of Mallard ducks were larger than that of chicken. In chicken, colour of kidney was reddish brown while in duck it was slightly greyish. The shapes of kidney lobes in broiler chicken and duck showed

some differences. In broiler chicken, cranial lobe was oval shaped; middle lobe was elongated while caudal was triangular in shape. In broiler duck, cranial lobe was oval shaped and middle elongated while caudal was the largest in size and round in shape.

Biometric observations of right and left lobes of kidney in broiler chicken are presented in table 1. Length of three lobes on both sides showed differed significantly ( $P < 0.01$ ). There was no significant difference between the width of cranial and caudal lobes on both sides, but the width

of both cranial and caudal lobes differed significantly from that of the middle lobe on both sides. Thickness of cranial, middle and caudal lobes of kidney on right side differed significantly ( $P < 0.01$ ) whereas on left side, there was no significant difference in thickness between cranial and caudal lobes, but the thickness of both these lobes differed from that of the middle lobe. There was no significant difference in the weight of cranial and middle lobes on both sides. But, the weight of both these lobes on both sides differed significantly from that of the caudal lobe on both sides.

**Table 1. Comparison of right and left cranial, middle and caudal lobes of kidney in chicken, mm (Mean  $\pm$  standard error) (n=6)**

Parameters	Cranial	Middle	Caudal	F value
Length of right lobe	1.8 $\pm$ 0.0577 <sup>a</sup>	1.4 $\pm$ 0.0632 <sup>b</sup>	2.4 $\pm$ 0.0632 <sup>c</sup>	67.059**
Width of right lobe	1.233 $\pm$ 0.0558 <sup>a</sup>	0.917 $\pm$ 0.0477 <sup>b</sup>	1.183 $\pm$ 0.0792 <sup>a</sup>	7.452**
Thickness of right lobe	1.15 $\pm$ 0.0428 <sup>a</sup>	1.417 $\pm$ 0.0654 <sup>b</sup>	0.85 $\pm$ 0.0563 <sup>c</sup>	25.988**
Weight of right lobe	0.91 $\pm$ 0.01915 <sup>a</sup>	1.0267 $\pm$ 0.05619 <sup>a</sup>	2.195 $\pm$ 0.10317 <sup>b</sup>	106.915**
Length of left lobe	1.9 $\pm$ 0.0365 <sup>a</sup>	1.25 $\pm$ 0.0428 <sup>b</sup>	2.217 $\pm$ 0.0601 <sup>c</sup>	107.500**
Width of left lobe	1.217 $\pm$ 0.0307 <sup>a</sup>	0.967 $\pm$ 0.0558 <sup>b</sup>	1.2 $\pm$ 0.0683 <sup>a</sup>	6.720**
Thickness of left lobe	0.95 $\pm$ 0.0428 <sup>a</sup>	1.35 $\pm$ 0.0563 <sup>b</sup>	0.95 $\pm$ 0.0428 <sup>a</sup>	23.415**
Weight of left lobe	0.9 $\pm$ 0.01366 <sup>a</sup>	1.1067 $\pm$ 0.08682 <sup>a</sup>	2.3567 $\pm$ 0.08713 <sup>b</sup>	121.677**

(Means bearing different letters as superscripts differ significantly within a row). (\*\*significant at 1% level, \* significant at 5% level, ns-non significant)

In the case of the right kidney of broiler duck, there was no significant difference in the length of cranial and middle lobes (table 2). But, the length of both these lobes differed significantly from that of the caudal lobe ( $P < 0.01$ ). In the case of left kidney, length of three lobes showed a significant difference at 1% level. The

width of cranial and middle lobes of right kidney did not differ significantly but the width of caudal lobe differed significantly from that of cranial and middle lobes ( $P < 0.01$ ). In the case of left kidney, width of all three lobes showed significant difference at 1 percent level. There was no significant difference in the thickness of right cranial

and middle lobes. But, the thickness of both these lobes differed significantly from that of the caudal lobe ( $P < 0.01$ ). In the case of left kidney, thickness of three lobes showed a significant difference at 1 percent level. On both sides, weight of all three lobes of

kidney differed significantly at 1 percent level. It was observed that except in the case of the width, all other parameters of right and left kidneys in chicken and duck showed significant difference at 1 percent level (table 3).

**Table 2. Comparison of right and left cranial, middle and caudal lobes of kidney in duck, mm (Mean± standard error) (n=6).**

Parameters	Cranial	Middle	Caudal	F value
Length of right lobe	2.150 ± 0.0428 <sup>a</sup>	2.033 ± 0.0494 <sup>a</sup>	3.383 ± 0.0601 <sup>b</sup>	212.782**
Width of right lobe	0.783 ± 0.0477 <sup>a</sup>	0.833 ± 0.0333 <sup>a</sup>	1.550 ± 0.0428 <sup>b</sup>	105.691**
Thickness of right lobe	0.567 ± 0.0333 <sup>a</sup>	0.617 ± 0.0307 <sup>a</sup>	0.783 ± 0.0307 <sup>b</sup>	12.870**
Weight of right lobe	1.1450 ± 0.0480 <sup>a</sup>	2.0417 ± 0.0969 <sup>b</sup>	2.8150 ± 0.07187 <sup>c</sup>	124.144**
Length of left lobe	2 ± 0.0577 <sup>a</sup>	2.050 ± 0.0671 <sup>b</sup>	3.300 ± 0.0730 <sup>c</sup>	123.608**
Width of left lobe	0.783 ± 0.0307 <sup>a</sup>	0.817 ± 0.0307 <sup>b</sup>	1.650 ± 0.0428 <sup>c</sup>	194.328**
Thickness of left lobe	0.483 ± 0.0477 <sup>a</sup>	0.617 ± 0.0477 <sup>b</sup>	0.833 ± 0.0307 <sup>c</sup>	22.626**
Weight of left lobe	1.1750 ± 0.0450 <sup>a</sup>	2.1083 ± 0.1356 <sup>b</sup>	3.0250 ± 0.0430 <sup>c</sup>	115.216**

(Means bearing different letters as superscripts differ significantly within a row). (\*\*significant at 1% level, \* significant at 5% level, ns-non significant).

**Table 3. Morphometric parameters of right and left kidneys in chicken and duck, mm (Mean± standard deviation) (n=6)**

Parameters	Chicken	Duck	t value
Length of right kidney	5.600±0.3406	7.567±0.2875	10.808**
Mean width of right kidney	1.1050±0.12062	1.0533±0.07763	0.882 <sup>ns</sup>
Mean thickness of right kidney	1.1367±0.08406	0.6533±0.04502	12.415**
Weight of right kidney	4.0667±0.37601	6.0033±0.41225	8.502**
Length of left kidney	5.367±0.2733	7.360±0.3146	11.658**
Mean width of left kidney	1.1233±0.08618	1.0817±0.04579	1.046 <sup>ns</sup>
Mean thickness of left kidney	1.0800±0.03633	0.6583±0.08208	11.507**
Weight of left kidney	4.3133±0.20675	6.3083±0.40455	10.756**
Total kidney weight	8.3800±0.54384	12.3117±0.81005	9.87**

(Independent t test \*\*significant at 1% level, \* significant at 5% level, ns-non significant)

Total weight of kidney as well as the total weight of right and left kidneys in chicken showed significant correlation with the body weight at 0.05 percent level (table 4). Pearson's correlation coefficients (r) of kidney parameters revealed that the total weight of kidney in chicken showed

significant correlation with the total weight of right kidney at 0.01% level while the weight of left kidney had 0.05% level significance (table 5). Other parameters of right and left kidneys viz. length, width and thickness did not show any correlation with the body weight and weight of kidney.

**Table 4. Pearson's correlation coefficients (r) of kidney parameters and body weight in duck and chicken.**

Sl. No.	Kidney parameters	Body Weight in duck	Body Weight in chicken
1	Total Kidney weight	0.973**	0.911*
2	Length of right kidney	0.252 <sup>ns</sup>	0.416 <sup>ns</sup>
3	Length of left kidney	0.591 <sup>ns</sup>	0.034 <sup>ns</sup>
4	Mean width of right kidney	0.896*	0.312 <sup>ns</sup>
5	Mean width of left kidney	0.254 <sup>ns</sup>	0.639 <sup>ns</sup>
6	Mean thickness of right kidney	0.617 <sup>ns</sup>	0.701 <sup>ns</sup>
7	Mean thickness of left kidney	0.580 <sup>ns</sup>	0.466 <sup>ns</sup>
8	Weight of right kidney	0.947**	0.886*
9	Weight of left kidney	0.983**	0.784*

(\*\*Correlation significant at 0.01% level, \*Correlation significant at 0.05% level, ns-non significant)

Total weight of kidney as well as the total weight of right and left kidneys in ducks showed a significant correlation with the body weight at 0.01% level (table 4). Pearson's correlation coefficients (r)

of kidney parameters and kidney weight showed that total weight of right and left kidneys had a significant correlation with the total weight of kidney at 0.01% level (table 5).

**Table 5. Pearson's correlation coefficients (r) of kidney parameters and weight of kidney in duck and chicken.**

Sl. No.	Kidney parameters	Kidney weight in duck	Kidney weight in chicken
1	Length of right kidney	0.225 <sup>ns</sup>	0.657 <sup>ns</sup>
2	Length of left kidney	0.583 <sup>ns</sup>	0.295 <sup>ns</sup>
3	Mean width of right kidney	0.805 <sup>ns</sup>	0.578 <sup>ns</sup>
4	Mean width of left kidney	0.456 <sup>ns</sup>	0.663 <sup>ns</sup>
5	Mean thickness of right kidney	0.559 <sup>ns</sup>	0.635 <sup>ns</sup>
6	Mean thickness of left kidney	0.446 <sup>ns</sup>	0.665 <sup>ns</sup>
7	Weight of right kidney	0.992**	0.964**
8	Weight of left kidney	0.992**	0.877*

(\*\*Correlation significant at 0.01% level, \*Correlation significant at 0.05% level, ns-non significant)

The findings of present study would provide a baseline data regarding the contribution of various morphological parameters of kidneys in broiler chicken and duck to their body weight and would form a basis for further functional studies.

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