

*Research article*

**Determination of Anatomical morphology in proventriculus, proventriculus-gizzard junction, cecum and liver in turkey spp. (*Meleagris gallopavo*) with histomorphological characteristics of liver for post mortem diagnosis**

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ABSTRACT

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The study was aimed to investigate the anatomical (body weight, proventriculus, proventriculus-gizzard junction, liver and cecum) and histological (liver) features of the turkey to identify the gross and histo-morphological characteristics to help post mortem diagnosis of common turkey diseases. The average length, width and diameter of proventriculus, proventriculus-gizzard junction and cecum were measured both in male and female (Table1). Among the 20 turkeys average body weights of male and female were found  $3.55 \pm 0.034$  kg and  $2.75 \pm 0.05$  kg respectively. In the same way the in male average length, width and diameter of proventriculus were  $5.16 \pm 0.033$  cm,  $2.13 \pm 0.044$  cm,  $3.59 \pm 0.027$  cm respectively. Similarly average length, width and diameter of proventriculus-gizzard junction were  $1.81 \pm 0.036$  cm,  $0.87 \pm 0.036$  cm and  $2.32 \pm 0.041$  cm respectively. Likely the average length, width and diameter of cecum were  $22.81 \pm 0.204$  cm,  $1.13 \pm 0.042$  cm and  $3.9 \pm 0.039$  cm respectively in male. On the other hand in female the average length, width and diameter of proventriculus were  $2.76 \pm 0.043$  cm,  $1.87 \pm 0.422$  cm,  $3.25 \pm 0.045$  cm respectively. Also average length, width and diameter of proventriculus-gizzard junction were  $1.22 \pm 0.055$  cm,  $0.91 \pm 0.052$  cm and  $3.23 \pm 0.051$  cm respectively. Furthermore the average length, width and diameter of cecum were  $21.24 \pm 0.047$  cm,  $1.17 \pm 0.042$  cm and  $3.14 \pm 0.052$  cm respectively. Additionally, the internal surface of proventriculus was found reddish in color. Similarly, internal membrane of pair ceca was found greenish and membrane wall was found thick to thin according to the segments of ceca. Moreover, the gross feature of liver in turkey was dark brown in color and the average weight of the liver in male was  $50.66 \pm 0.030$  gm conversely in female was  $59.37 \pm 0.102$  gm. Furthermore, histological features revealed that liver of turkey were consists of parenchyma and stroma under microscope. Hepatocyte, central vein, hepatic sinusoids and portal triad were the main histological features of turkey liver. Overall, these prominent anatomical and histological features of several internal organs of turkey will be helpful for post mortem diagnosis and treatment of turkey disease.

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## 1. INTRODUCTION

Poultry meat alone contributes 37% of the total meat production in Bangladesh (Begum et al., 2011). However, among the livestock sector, the poultry industry (specially, commercial broiler and layer) is in the line to be destroyed due to severity of avian influenza (bird flu) (Jones and Swayne, 2004). Thus, it is crying need to search the alternative protein source to meet up the increasing demand (Asaduzzaman et al., 2017; Owen et al., 2008). Turkey meat may be one of the best options for alternative protein source in Bangladesh. Turkey production is an important and highly profitable agricultural industry with a rising global demand for its products (Yakubu et al., 2013), and they are adaptable to wide range of climatic conditions (Onwumere and Obasi, 2010; Yassin et al., 2013). But turkey production has not been fully explored in Bangladesh including other developing countries despite its huge potential over other poultry species due to lack of some anatomical knowledge which is essential for turkey disease diagnosis by post mortem analysis. Lots of veterinarians are regularly diagnoses the disease of chicken, duck and pigeon based on the basis of post mortem lesions. A large number of papers, books, and other information are available, regarding the normal anatomy of important visceral organs of chicken, duck and pigeon all over the world including Bangladesh (Morrow et al., 2008; Ahmed et al., 2009) on the other hand no such information's are available for turkey spp. in our country and very few all over the world (Marsden, 1940; Malewitz and Calhoun, 1958). Therefore, the study was been aimed to determine the Anatomical morphology of some important visceral organs (Proventriculus, proventriculus-gizzard junction, cecum and liver) in turkey spp. with histomorphological characteristics of liver for post mortem diagnosis of turkey disease.

## 2. MATERIALS AND METHODS

Ten male and ten female bronze turkey (apparently healthy and disease free) about more than six month of age were collected from different market and farm of Chattogram city corporation area in Bangladesh during July 2019 to January 2020. After weighing the live weight and routine slaughtering, important visceral organs (liver, proventriculus, proventriculus-gizzard junction and cecum) were observed properly to see the size, shape, appearance, color, consistency, weight and measurements (length, width, and diameter) at the same time. All the measurements were taken before and after longitudinal sectioning and after internal content removing from visceral organs. All procedures were done with proper hygienic management and a role scale was used for the measurement. In Addition, liver samples were taken immediately into Bouin's solution and finally to 10% formalin and stored for histological study. Therefore, for histological study sections of the liver tissue were fixed in 10% neutral buffered formalin for a period of 72 hours followed by processing and staining with Hematoxylin and Eosin stain according to a standard scientific procedure (Gridley, 1957). Finally, the prepared permanent histological slides were observed with light microscope at (4x, 10x and 20x) magnifications. The measuring data were analyzed using statistical software, STATA/IC-13. T-test was carried out between two groups and  $P$ -value<0.05 was considered as significant for t-test.

## 3. RESULTS

The average body weight of male turkey was  $3.55\pm 0.034$  kg alternatively  $2.75\pm 0.05$  kg in female. Highest body weight was 3.7kg while the lowest was 3.4 kg in male, conversely 3kg and 2.5 kg in female. Results indicate, male body weights were heavier than female. Proventriculus or glandular stomach of turkey was elongated spindle shaped organ. It was extended in male

approximately between levels of fifth thoracic to third lumbo-sacral vertebrae and in female approximately between fourth to seventh thoracic vertebrae. The wall of the glandular stomach was thicker than the esophagus. Internal surface of proventriculus was covered by a thick whitish mucous coat. In the glandular mucosa of proventriculus where a group of longitudinally arranged multi rowed crater like holes contained by deep proventricular glands was present to produce acid and proteolytic gastric juice. The average lengths of proventriculus in male and in female were  $5.16 \pm 0.033$  cm and  $2.76 \pm 0.043$  cm respectively. Highest length of proventriculus was 5.3 cm while the lowest was 5 cm in male alternatively 3cm and 2.6 cm in female. Outcome point out, male proventriculus was longer than female. Besides, average width of proventriculus in male and female were  $2.13 \pm 0.044$  cm and  $1.87 \pm 0.422$  cm. Highest width of proventriculus was 2.4 cm conversely lowest was 2 cm in male on the other hand 2 cm and 1.7 cm in female. In the same way, average diameters of proventriculus in male and in female were  $3.59 \pm 0.027$  cm and  $3.25 \pm 0.045$  cm respectively. Highest diameter of proventriculus was 3.7 cm and the lowest was 3.5cm in male alternatively 3.7 cm and 3 cm in female. It represents that, both width and diameter of proventriculus in male were more than female turkey (Table 1)

The junction between glandular stomach (proventriculus) and muscular stomach (gizzard) was situated caudally to the proventriculus which was a constricted portion and mucosa was light yellow in color, a coat of yellowish mucous were covered the surface. The average length, width and diameter of the proventriculus-gizzard junction were  $1.81 \pm 0.036$  cm,  $0.87 \pm 0.036$  cm and  $2.32 \pm 0.041$  cm in male alternatively  $1.22 \pm 0.055$  cm,  $0.91 \pm 0.052$  cm and  $3.23 \pm 0.051$  cm in female. Highest length, width and diameter of the proventriculus-gizzard junction were 2 cm, 1 cm and 2.5 cm while the lowest were 1.7 cm, 0.7 cm and 2.1 cm in male on the other hand 2 cm, 1.1 cm and 3.5 cm were highest and 1 cm, 0.6 cm and 3 cm were lowest in female. Outcomes specify length, width and diameter of

proventriculus-gizzard in male were higher than female (Table 1).

The liver of turkey was laid ventrally and posterior to the heart. It was dark brown in color in fresh condition and closely associated with proventriculus and spleen. The liver comprised two separate lobes- left and right lobes which were join cranially in the midline. The lobes were situated at the floor of the abdominal cavity. The cranial ends of the lobes were very close to the heart. The left lobe was prism shaped and smaller than the right lobe. The right lobe was somewhat heart shaped. The liver was slightly more caudally situated in the male than in female. The parietal surfaces of liver were convex and visceral surfaces were concave. The gall bladder lied on the right lobe beneath the spleen. The average weight of the liver was  $50.66 \pm 0.030$  gm in female while  $59.37 \pm 0.102$  gm in male. The highest weight of liver in female was 50.8 gm conversely lowest was 50.5 gm. On the contrary, the highest weight of liver was 59.8 gm while lowest was 59.1 gm in male. It represents that the weight of liver in male was heavier than female (Table 1).

Pair cecum was found in turkeys which was the part of large intestine. Each cecum had proximal, middle and distal part. The short light red proximal part had a narrow lumen and a relatively thick wall. The middle part was long, bluish green to gray-green in color, wider and wall was thinner. The short light red distal part was expanded with a pointed extremity. The lumen of each cecum was mostly wider than in other parts of the intestinal tract. The wall of the each cecum was thinner than in other parts of the intestinal tract. The internal surfaces of the cecum were blackish white in color. The wall contained lymphoid tissue mostly at the proximal part that was known as cecal tonsil. The average length, width and diameter of cecum in male were  $22.81 \pm 0.204$  cm,  $1.13 \pm 0.042$  cm and  $3.9 \pm 0.039$  cm while in female  $21.24 \pm 0.047$  cm,  $1.17 \pm 0.042$  cm and  $3.14 \pm 0.052$  cm respectively. The highest length, width and diameter of cecum were 24cm, 1.3cm and 4.1cm in male while the

lowest length, width and diameter of cecum 22cm, 0.9cm and 3.9cm respectively. In Contrast, the highest length, width and diameter of cecum were 21.5cm, 1.4cm and 3.4cm while

the lowest length, width and diameter of cecum 21cm, 1cm and 2.9cm respectively in female. It represents that the length, width and diameter of cecum in male were upper than female (Table 1).

Table 1. Quantitative anatomical measurements of turkey.

Parameter	Sex	Observation	mean±S.E.	P value
Body weight (kg)	M	10	3.55±0.034	S
	F	10	2.75±0.05	
Proventriculus (length) (cm)	M	10	5.16±0.033	
	F	10	2.76±0.043	
Proventriculus (width) (cm)	M	10	2.13±0.044	
	F	10	1.87±0.422	
Proventriculus (diameter) (cm)	M	10	3.59±0.027	
	F	10	3.25±0.045	
Proventriculus-gizzard junction (length) (cm)	M	10	1.87±0.036	
	F	10	1.22±0.055	
Proventriculus-gizzard junction (width) (cm)	M	10	0.87±0.036	
	F	10	0.91±0.052	
Proventriculus-gizzard junction (diameter) (cm)	M	10	2.32±0.041	
	F	10	3.23±0.051	
Liver (weight) (gm)	M	10	59.37±0.102	
	F	10	50.66±0.033	
Cecum (length) (cm)	M	10	22.81±0.204	
	F	10	21.24±0.041	
Cecum (width) (cm)	M	10	1.13±0.042	
	F	10	1.17±0.042	
Cecum (diameter) (cm)	M	10	3.9±0.039	
	F	10	3.14±0.052	

M= male, F= female, S.E. = Standard error, S= Sgnificant

Microscopically, turkey liver is comprised of two major histological components, (1) parenchyma which was represented by hepatocyte and (2) stroma which comprised of connective tissue and contained vessels. The main structural and functional component of liver was hepatocytes (Figure 1). Hepatocytes were polyhedral cells having one or two spherical nuclei with well developed nucleoli. Under microscope, liver lobule was less prominent and not clear hexagonal in shape that formed the structural unit of liver. It had a vein at the centre called central vein (Figure 1). Central veins were lined with thin endothelium, and prominent sinusoids entered into them. The hepatic cells were arranged in cords in a radiating manner from the central vein and hepatic sinusoids traveled between the strips of hepatocytes, draining into the central vein. The irregular spaces between the

hepatic plates were occupied by liver sinusoids which were lined by discontinuous endothelial cells. Some of the endothelial cells were modified to become phagocytic cells called Von kupffer's cells (Figure 1). At the meeting point of three liver lobules portal tract were present. Each portal tract contained three major structures, namely, a portal venule, hepatic arteriole and a small hepatic ductule. These three structures of the portal tracts were referred to as portal triad (Figure 1). Small lymphatics was also seen in some places within portal triad. Dense areolar connective tissue was observed around blood vessels. A thin capsule of glisson was surrounded by the liver.

#### 4. DISCUSSION

The study revealed that, average body weight of male and female turkey was 3.55 kg and 2.75 kg while it was found 2.36 kg and 1.90 kg in a

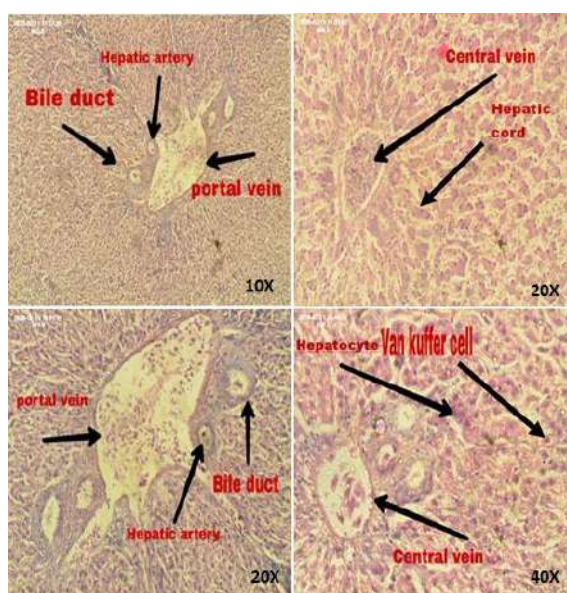


Figure 1. Histological picture of liver of turkey in different focus and magnification.

turkey farm of Tamilnadu, India at the age of 8<sup>th</sup> week (Venkatesakumar et al., 2018). This difference might be due age variation or dietary nutrition variation. The glandular stomach of domestic fowl and turkey has a length of 5cm and a width at its widest part was 1.5cm (McLeod, 1939; Malewitz and Calhoun, 1958). In another study showed glandular stomach has a length of 6.25cm in male and 5.25cm in female turkey (Marsden, 1940). It represents that, present study results found little variation with the previous studies of proventriculus in turkey. In previous study represents most of the internal surface of proventriculus of turkey was reddish in color and contained longitudinally arranged multi-rowed carter like hole containing deep gland in mucosa of proventriculus (Malewitz and Calhoun, 1958) as like as the present study. It can also be a post mortem diagnostic procedure in turkey by observing the normal and abnormal condition of internal surface of proventriculus. The present study findings regarding proventriculus-gizzard junction will be the first study ever in turkey. It was found similarity regarding the surface coat color and internal structure of this area with some previous studies (McLeod, 1939; Malewitz and Calhoun, 1958). In domestic poultry species ceca is divided into left and right as paired and it had also three segments per part like proximal, middle and

distal containing more narrow lumen inside with thin wall, containing bluish green colored mucosa compared with turkey (Malewitz and Calhoun, 1958; Kausar et al., 2016). The present study represents more or less similar results compared with other study regarding ceca of other poultry species. The length of each cecum was 14 cm to 20 cm in some domestic species of poultry (Kausar et al., 2016) which indicate length of turkey ceca was longer than that. The liver was dark brown and weight of the liver was 33.9 gm to 55.5 gm in hatching age to maturity in common domestic species of poultry (Latimer, 1925; Musalrz et al., 2006). The results indicate liver of turkey was larger than other domestic species of poultry. The structures of liver, position of gall bladder were found similarity with previous study (Getty and Sisson, 1975; Ghosh, 1998). Microscopically liver of turkey was less lobulated and interlobular septa was also less distinct than other domesticated animals but structural resemblance was found with other domestic poultry species most importantly with chicken (Madhan and Raju, 2014). The present study results regarding histological structure of liver was analogous with previous finding of turkey liver histology (Malewitz and Calhoun, 1958). The microscopic findings of the present study especially the arrangement pattern of different cells in liver was same as other domesticated fowl (Malewitz and Calhoun, 1958; Eurell and Brian, 2006). The normal architectural details and some time cellular details of liver become destructed in common infectious diseases (Hossain et al., 2006; Lu et al., 2014) of domesticated birds which can be also occur in turkey liver. By comparing normal histology with abnormal structure of liver it will be possible to diagnose infectious diseases of turkey after post mortem analysis.

## 5. CONCLUSIONS

From the study outcome veterinarians will get clear concept about the normal anatomy of some important visceral organs of turkey *spp.* which may help them to diagnose the turkey disease during post mortem examination.

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