

Age Related Gross Anatomical Changes in the Pancreas of Post-Hatched Ducks

Anil Kumar Safi, Manoj Kumar Sinha*, Avnish Kumar Gautam, Nirbhay Kumar Singh

ABSTRACT

The experiment was carried out on 40 ducks obtained from the registered duck farm of Muzaffarpur in Bihar. The ducks were divided into four groups, each containing 10 ducks, according to their age as post-hatched (Gr-I), one month (Gr-II), 3 months (Gr-III) and 6 months (Gr-IV) of age. The study examined the pancreas of ducks at different ages, focusing on its location ventrally posteriorly on the right side of the median plane inside the abdominal cavity. The pancreas initially appeared light pink but turned creamy white by six months of age. The dorsal, ventral, and splenic lobes emerged from the pancreas the day after hatching and extended longitudinally parallel to the duodenum's limbs. The pancreatic ventral lobe was positioned between the duodenum's loops in group I ducks and persisted throughout group IV ducks. The weight of the entire body of ducks increased significantly from group I to IV, with the total pancreas weight also increasing as the ducks aged. The length and width of the entire pancreas were found to increase as the ducks' age increased.

Key words: Age, Duck, Gross anatomy, Pancreas, Post-hatched to 6 months.

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INTRODUCTION

Ducks are the second most important alternative poultry species after chickens in terms of production of eggs and meat. This species does not depend on the use of a specialized or high-tech agricultural technique, which is extremely beneficial to low-income farmers. The important characteristics like long production years, large eggs, early morning egg laying, disease resistance, suitability for integrated farming and various rearing systems, including backyard farming, ability to survive in damp land, ease of taming, maintenance under minimum input system of management, etc. are some of the benefits of duck production over chicken production (Meulen and Dikken 2004). Even unlike chickens, ducks do not require a pukka home since they are more resilient and resistant to common avian diseases.

As a new emerging poultry product for human consumption, ducks are being researched for their structural characteristics. The goal of the current investigation was to uncover the histological and gross characteristics of the main element - pancreas - of this intricate system. The organ is unique in digestion; it is ensconced in a small, tightly closed loop of small intestine and plays a significant part in both digestion and the body's overall metabolism of carbohydrates. Because of the organ's high level of evolution and well-defined tasks, it is essential to examine the anatomical specifics of each pancreatic lobe. Severe morbid changes in physiological function can result from very minor harm to pancreas. Hence, this study was aimed to understand the various pancreatic lobes in terms of gross morphology and biometry in ducks from post-hatched to 6 months of age.

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MATERIALS AND METHODS

The present study was conducted on the samples of pancreas of 40 ducks of different age groups, irrespective of sex. The ducks in the experiment were divided into four groups, *i.e.*, Group-I comprised of ten post-hatched ducks, Group-II comprised of ten ducks of one month, Group-III comprised of ten ducks of three months and Group-IV comprised of ten ducks of six months of age. The pancreas along with different lobes and intestinal loops were carefully separated out, and were cleaned in normal saline solution for gross anatomical study and morphometry. Gross measurements were done with the help of digital Vernier calliper and measuring scale. All recorded data were analyzed statistically as per the standard method given by Snedecor and Cochran (1994).

RESULTS AND DISCUSSION

The pancreas of duck was situated on the right side of the median plane, posterior ventral aspect of the abdominal

cavity as earlier reported by Mobini (2011), Deprem *et al.* (2015) and Beheiry *et al.* (2018) in geese. The colour of the pancreas was found to be light pink in group I, while it gradually changed into light pink to creamy white in colour at the age of six month (Fig. 1, 2). These observations had partial harmony with Yadav *et al.* (2018) in Chabro chicken and Patki *et al.* (2019) in Kuttanad duck. Current findings agreed with those of Mahmood *et al.* (2022), who observed the pancreas of adult duck (*Anas platyrhynchos*) as light pinkish in colour. In earlier studies also, the pancreas was described as a pale pinkish organ by Kadhim *et al.* (2010) in red jungle

fowls, Faris (2012) in pigeons, Agele and Mohammed (2012) in golden eagles, and Sharoot (2016) and Beheiry *et al.* (2018) in goose. The pancreas of all age groups of duck was found to be long and narrow structure as described by Hodges (1974) in domestic fowl and Das *et al.* (2003) in duck. In contrast to this, Suresh (2018) noticed it as elongated, ribbon shaped organ in Japanese quail.

Under the current gross observation the pancreas was separated into three separate morphological lobes day after hatching: dorsal, ventral, and splenic lobes and these divisions were persisted across all age groups (Fig. 3). These

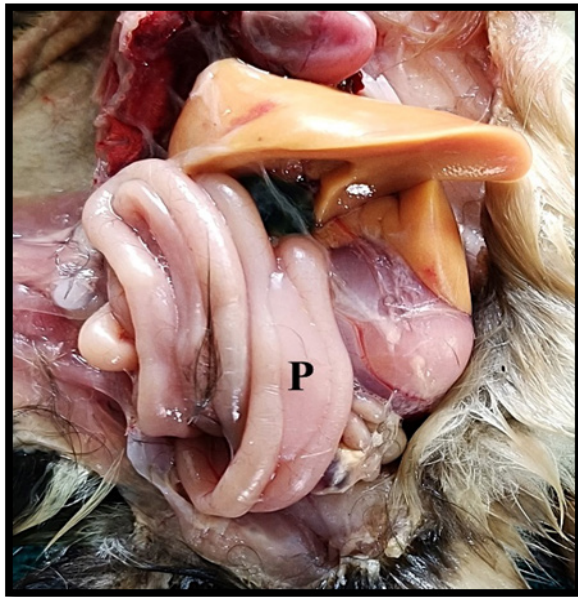


Fig. 1: Gross photograph showing light pink colour of pancreas (P) in duck of group I.



Fig. 2: Gross photograph showing light pink to creamy white colour of pancreas (arrow) in duck of group IV.

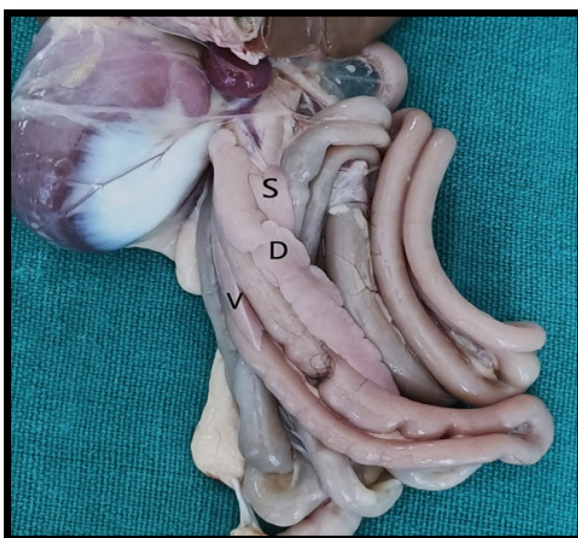


Fig. 3: Gross photograph showing dorsal (D), ventral (V), and splenic lobe (S) of pancreas in ducks.

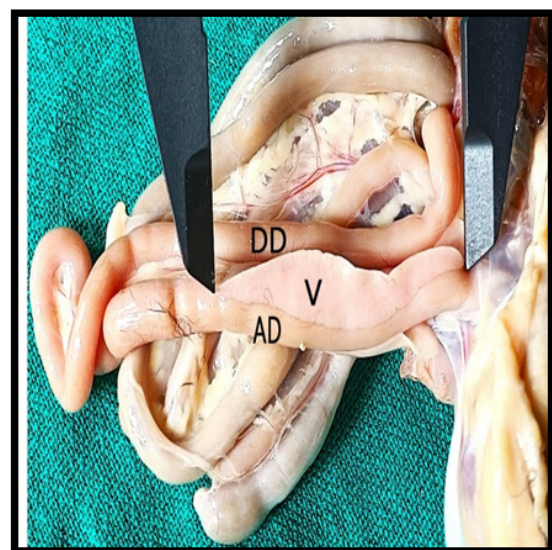


Fig. 4: Gross photograph showing position of ventral lobe (V) of pancreas in between descending (DD) and ascending (AD) loop of duodenum in ducks.

results were consistent with the descriptions of Nickel *et al.* (1977) in domestic birds, Das *et al.* (2003) in ducks, Gulmez (2003) in geese, Saadatfar and Asadian (2009) in mynah, and Patki *et al.* (2019) in Kuttanad duck.

Contrary to our study, splenic lobe was absent in adult Caspian gull (Basir and Abdi, 2015). The present observation regarding lobes of pancreas gland disagree with the findings of Hamodi *et al.* (2013) in adult guinea fowl and common gull, wherein only dorsal and ventral pancreatic lobes were present. From the beginning of the experiment, the dorsal, ventral, and splenic lobes were found to extend longitudinally parallel to the ascending and descending limbs of the duodenum in all age groups of duck. These observations supported the findings of Patki *et al.* (2019) in Kuttanad duck and Das (2003) in ducks. In group I duck the ventral lobe of pancreas was positioned in between the descending and ascending loop of duodenum which was maintained upto group IV of experimental ducks (Fig. 4).

The duodenal loop extended well beyond the end of the pancreas. The gap was present between the distal end of ventral lobe of pancreas and duodenum loop of intestine. Similar results were found by Al-Sharoot (2016) in early-hatched goose, Beheiry *et al.* (2018) in geese, Al-Haaik (2019) in kestrel, Patki *et al.* (2019) in Kuttanad duck, and Al-Khakani *et al.* (2019) in white-eared bulbul. In contrast, entire length of the duodenal loop was occupied in Chabro chicken (Yadav *et al.*, 2018) and almost completely filled the gap of duodenal loops in fowl and pigeon (Hodges, 1974; Nickel *et al.*, 1977). Suresh (2018) in Japanese quail reported similar position about ventral lobe, which was lying in between descending and ascending loop of duodenum.

The dorsal and ventral lobes of the duck were the biggest of these three lobes, while the splenic lobe was the smallest one (Table 2). These findings were in accordance with the description of Nickel *et al.* (1977) in domestic birds, Gulmez

(2003) in goose, Das *et al.* (2003) in ducks, and Saadatfar and Asadian (2009) in mynah. In the current investigation, the splenic lobe of the duck pancreas was linked to the dorsal lobe in all age groups by a separate thin parenchymal band. The ventral lobe, on the other hand, was not linked to any other pancreatic lobes in any age group. The findings had harmony with Patki *et al.* (2019) in Kuttanad duck, Al-Agele and Mohammed (2012) in golden eagle, Beheiry *et al.* (2018) in goose, and Yadav *et al.* (2018) in Chabro chicken.

The live body weight of the duck was recorded in different experimental groups. For groups I, II, III, and IV, the average duck body weight was 38.59 ± 0.64 gm, 343.25 ± 25.54 gm, 1023.72 ± 43.06 gm, and 1155.196 ± 27.78 gm, respectively (Table 1). According to the results, the body weights of ducks increased with age, and the difference was statistically significant across all groups ($p < 0.05$). Ducks pancreas weights in groups I, II, III, and IV were noted as 0.272 ± 0.02 gm, 0.559 ± 0.01 gm, 1.04 ± 0.03 gm, and 1.57 ± 0.07 gm, respectively (Table 1). It was noticed that, the weight of pancreas was also increased as the age of ducks advanced which was statistically significant ($p < 0.05$).

Dorsal Lobe

In all the age groups of ducks, the dorsal lobe of the pancreas was dorsocranial to the ventral lobe and caudal to the splenic lobe. It lays parallel to the longitudinal axis of the duodenal loop (Fig. 5). These findings were in accordance with the description of Patki *et al.* (2019) in Kuttanad duck. The experiment revealed three surfaces, three boundaries, and two extremities at the macroscopic level. The proximal extremity was wider than the distal extremity in all age groups and overlapped cranially with the pancreatic splenic lobe. Bifid nature towards the proximal extremities was seen in the current experiment; the appearance became more noticeable with age. However, in all groups of ducks, the distal

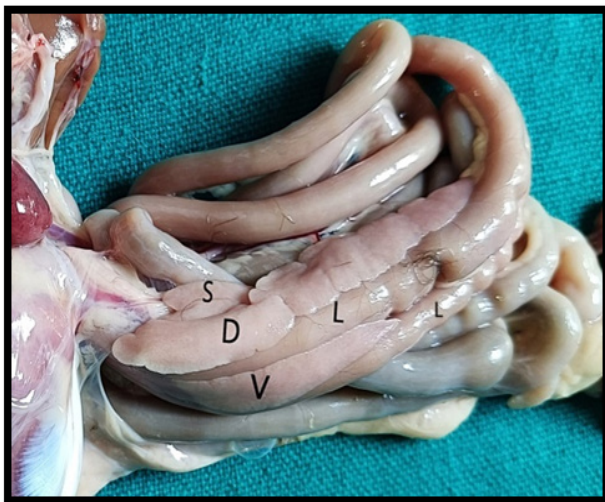


Fig. 5: Gross photograph showing dorsal lobe (D) lay parallel to the longitudinal axis of the duodenal loop (L) loop of duodenum in ducks along with splenic (S) and ventral lobe (V).

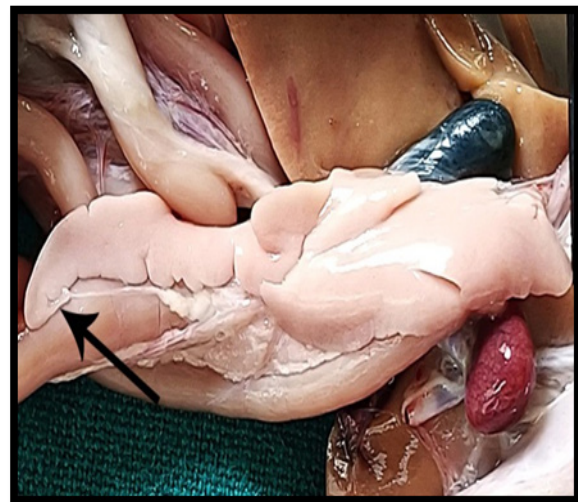


Fig. 6: Gross photograph showing hook-like appearance (arrow) towards distal extremity of dorsal lobe of pancreas in ducks.

tip of the dorsal lobe was bent and produced a noticeable hook-like feature (Fig. 6). These findings agreed with Indu *et al.* (2001) in White Pekin ducks and Patki *et al.* (2019) in Kuttanad ducks. Experimental ducks exhibited an undulating pattern towards the lateral and medial boundaries of the pancreatic dorsal lobe in all age groups under observation (Fig. 7).

In groups I, II, III, and IV of ducks, the mean length of the pancreatic dorsal lobe was 21.06 ± 0.59 mm, 49.70 ± 0.59 mm, 53.14 ± 0.593 mm, and 55.16 ± 0.59 mm, respectively (Table 2). The corresponding mean width of the pancreatic dorsal lobe was 4.02 ± 0.16 mm, 7.76 ± 0.16 mm, 8.35 ± 0.16 mm, and 9.42 ± 0.16 mm (Table 3). According to the observation, groups I, II and III had significant changed mean length, however in group III and IV non-significant change was observed. The mean width of the pancreatic dorsal lobe experienced a gradual change in which group II and III had no significant changes and group I, II and IV showed significant changes ($p < 0.05$).

Ventral Lobe

The pancreatic ventral lobe was fusiform in all age groups of ducks. In all age groups, the macroscopic features of the pancreatic ventral lobe were seen to include two extremities (proximal and dorsal), four surfaces (dorsal, ventral, medial,

and lateral), and four boundaries (dorsomedial, ventromedial, dorsolateral, and ventrolateral). Current findings were consistent with Patki *et al.* (2019) in Kuttanad ducks. Across all age groups, the proximal and distal extremities were tapered and bulged towards the centre, giving the pancreatic ventral lobe a prismatic look. Both Nickel *et al.* (1977) and Patki *et al.* (2019) found similar appearances in birds and Kuttanad ducks, respectively. The current study found that in all age groups of ducks, the proximal and distal extremities were freely positioned in the duodenum’s limbs and were not connected to the duodenal loop (Fig. 8).

In all age groups, it was observed that the ventromedial and ventrolateral boundaries were thin and consistently acute along their length, whereas the dorsomedial and dorsolateral borders were thick and uneven. These results were consistent with what Patki *et al.* (2019) observed in Kuttanad ducks. The ducks of groups I, II, III, and IV had mean ventral lobe lengths of 14.19 ± 0.59 mm, 38.77 ± 0.59 mm, 42.230 ± 0.59 mm, and 44.28 ± 0.59 mm, respectively and the mean width 3.39 ± 0.16 mm, 6.49 ± 0.16 mm, 7.08 ± 0.16 mm, and 7.37 ± 0.16 mm (Table 3). The mean length and width of pancreas in ventral lobe gradually increased according to age in which groups I,

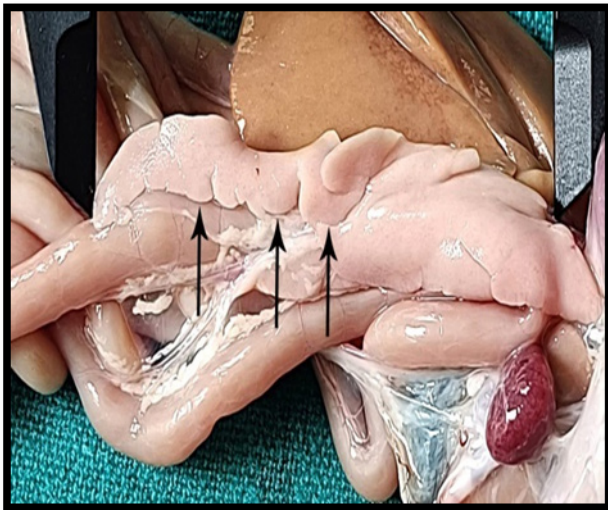


Fig. 7: Gross photograph showing undulating pattern (arrow) and dentate boundaries towards the lateral and medial boundaries of the dorsal lobe.

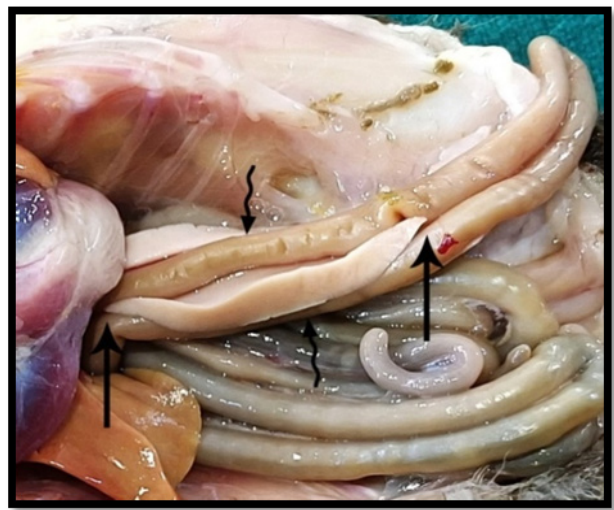


Fig. 8: Gross photograph showing the proximal and distal extremities (arrow) and prismatic appearance of ventral lobe were freely positioned in the loop of duodenum (zigzag arrow).

Table 1: Mean body weight of duck and weight of pancreas (gm)

Group	Body weight of duck (gm)		Weight of whole pancreas (gm)	
	Mean ± SE	Range	Mean ± SE	Range
I	38.59 ± 0.64^a	35.68 - 41.35	0.27 ± 0.02^a	0.15 - 0.39
II	343.25 ± 25.54^b	250.25 - 490.65	0.55 ± 0.01^b	0.51 - 0.62
III	1023.72 ± 43.06^c	890.68 - 1285.25	1.04 ± 0.03^c	0.87 - 1.23
IV	1155.19 ± 27.78^d	1034.87 - 1299.57	1.57 ± 0.07^d	1.25 - 1.98
p-value	$p < 0.05$	--	$p < 0.05$	--

^{abcd} Values with different superscripts in column differ significantly ($p < 0.05$).



II and III showed significant changes ($p < 0.05$), whereas group III and IV revealed no significant change.

Splenic Lobe

It was situated cranial to the dorsal lobe of the pancreas and was evident throughout all age groups (Fig. 9). These findings partially agreed with observations of Al-Sharoot (2016) in early hatched goose, Yadav *et al.* (2018) in Chabro chicken, and Patki *et al.* (2019) in Kuttanad ducks. In contrast, the pancreatic splenic lobe in 16-18-month-old ostriches was only visible under a microscope (Stornelli *et al.*, 2006). It may be due to species diversity. The splenic lobes of the pancreas of ducks were generally extended and irregular in

form in group I, but eventually altered to a roughly leaf-like appearance in group IV under study (Fig. 10).

These findings were partially in accordance with those of Das *et al.* (2003) and Patki *et al.* (2019) in duck. According to current observations, the splenic lobe of the pancreas in ducks had two surfaces (dorsal and ventral), two boundaries (medial and lateral), and two extremities (proximal and distal). The dorsal surface appeared to be fairly convex, whereas the ventral surface was somewhat concave (Fig. 10). The medial boundary was thick, generally straight, and connected to the proximal extremity of pancreatic dorsal lobe. However, in all age groups of ducks, the lateral border was thin and showed no connection. A thin band-like structure that extended

Table 2: Mean length of dorsal, ventral and splenic lobe of pancreas in duck (mm)

Group	Dorsal lobe (mm)		Ventral lobe (mm)		Splenic lobe (mm)	
	Mean \pm SE	Range	Mean \pm SE	Range	Mean \pm SE	Range
I	21.06 \pm 0.44 ^a	18.41-22.63	14.19 \pm 0.16 ^a	13.26-15.10	12.67 \pm 0.19 ^a	11.86-13.96
II	49.70 \pm 0.90 ^b	45.33-53.68	38.77 \pm 0.53 ^b	36.48-41.86	31.91 \pm 0.52 ^b	29.89-34.70
III	53.14 \pm 0.64 ^c	49.63-55.36	42.23 \pm 0.34 ^c	40.84-44.20	33.54 \pm 0.37 ^b	31.83-35.62
IV	55.16 \pm 0.95 ^c	50.96-59.47	44.27 \pm 0.85 ^c	40.87-49.36	36.22 \pm 0.52 ^c	33.96-38.96
p-value	$p < 0.05$	--	$p < 0.05$	--	$p < 0.05$	--

^{abc} Values with different superscripts in column differ significantly ($p < 0.05$)

Table 3: Mean width of dorsal, ventral and splenic lobe of pancreas in duck (mm)

Group	Dorsal width (mm)		Ventral width (mm)		Splenic width (mm)	
	Mean \pm SE	Range	Mean \pm SE	Range	Mean \pm SE	Range
I	4.02 \pm 0.19 ^a	3.20-5.20	3.39 \pm 0.14 ^a	2.77-4.12	2.85 \pm 0.17 ^a	2.12-3.63
II	7.76 \pm 0.05 ^b	7.43-8.01	6.49 \pm 0.08 ^b	6.01-6.91	4.41 \pm 0.07 ^b	4.01-4.86
III	8.35 \pm 0.22 ^b	7.10-9.24	7.08 \pm 0.12 ^c	6.49-7.86	5.35 \pm 0.15 ^c	4.93-6.44
IV	9.42 \pm 0.26 ^c	8.14-10.35	7.37 \pm 0.19 ^c	6.54-8.19	5.98 \pm 0.16 ^d	5.23-6.87
p-value	$p < 0.05$	--	$p < 0.05$	--	$p < 0.05$	--

^{abc} Values with different superscripts in column differ significantly ($p < 0.05$).



Fig. 9: Gross photograph showing splenic lobe (arrow) along with dentate appearance of pancreas.

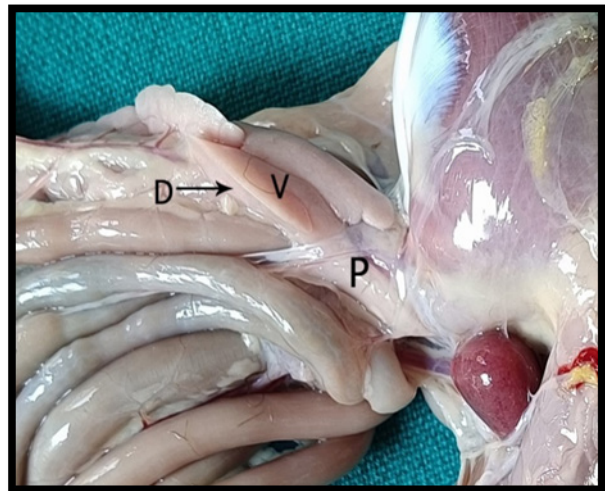


Fig. 10: Gross photograph showing leaf like splenic lobe along with dorsal surface (D), ventral surface (V) and proximal extremity (P).

cranially was seen in the proximal extremity of the splenic lobe in ducks of all ages (Fig. 11).

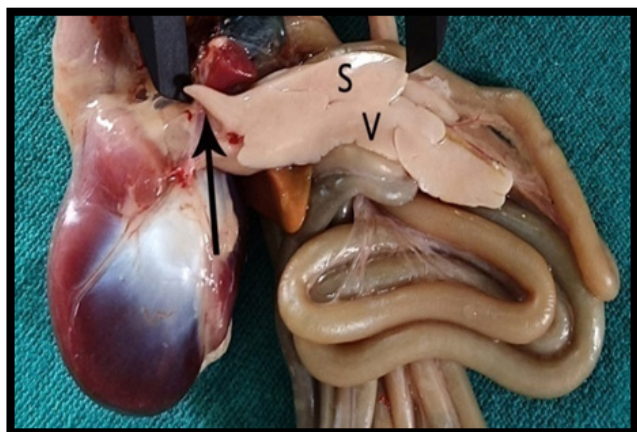


Fig. 11: Gross photograph showing thin band-like structure (arrow) that extended cranially towards proximal extremity of the splenic lobe (S) along with ventral lobe (V).

The distal tip of splenic lobe, however, was blunt, consistent with the observations made by Patki *et al.* (2019) in the Kuttanad duck. The extended splenic lobe towards the spleen in all age groups seen was also in accordance with the studies of Kadhim *et al.* (2010) in red jungle fowls, and Gulmez *et al.* (2004), Al-Sharoot (2016) and Deprem *et al.* (2015) in goose. The mean lengths of splenic lobe of pancreas in groups I, II, III, and IV were 12.67 ± 0.59 mm, 31.91 ± 0.59 mm, 33.54 ± 0.59 mm, and 36.22 ± 0.59 mm, respectively and the mean width 2.85 ± 0.16 mm, 4.41 ± 0.16 mm, 5.35 ± 0.16 mm, and 5.98 ± 0.16 mm, respectively (Table 2, 3). It was found that the mean length significantly changed in group I, II and IV, whereas group II and III showed no significant changes. However, the change in mean width of splenic lobe of pancreas was significant across all groups of experimental ducks ($p < 0.05$).

CONCLUSION

The study examined the pancreas in ducks of different ages (post-hatched to 6 months), focusing on the dorsal, ventral, and splenic lobes. The splenic lobe was the smallest, while the dorsal and ventral lobes were the largest. The weight of the total pancreas increased as the ducks grew, with the proximal extremity overlapping with the splenic lobe and wider than the distal extremity. The ventral lobes had a fusiform appearance, while the splenic lobe was the smallest. The splenic lobe was cranial to the pancreatic dorsal lobe and was typically long and asymmetrical in post-hatched ducks. In 6 months old ducks, they gradually changed to resemble a leaf-like structure. The proximal extremity of the splenic lobe showed a narrow band-like feature that extended cranially, while the distal tip was blunt. The study found that the splenic lobe's weight increased as the ducks grew, with the splenic lobe being the smallest.

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