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PRE-HATCH DEVELOPMENT OF SMALL INTESTINE IN TURKEY

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ABSTRACT

A study was undertaken to illustrate the pre-hatch development of the small intestine in turkey (*Meleagris gallopavo*). Sixty embryos of Beltsville White turkey each from third, fourth, sixth, ninth, twelfth, fifteenth, eighteenth, twenty-first, twenty-fourth and twenty-seventh day of incubation and six-day-old poults were collected. Gross morphological and morphometric studies were conducted on the segments of small intestine in the embryos collected. The morphogenetic differentiation of the small intestine occurred by sixth day of incubation and the morphometric parameters showed progressive increase with age of the embryo.

Keywords: Development, Embryo, Turkey, Small intestine

INTRODUCTION

The rising global demand for turkey and its products necessitates the studies on the growth and feed utilization of birds, which depends on the structural and functional differences of the alimentary tract. Due to the early maturing nature of the digestive system (Moran, 1985), the present study on pre-hatch development of the small intestine was undertaken to illustrate the morphogenesis of small intestine in turkey (*Meleagris gallopavo*).

MATERIALS AND METHODS

The present study was conducted on 66 fertile eggs of Beltsville White turkey with viable embryos, collected from the University Poultry and Duck Farm, Mannuthy, Thrissur. The eggs were then set in incubator at ideal temperature and humidity conditions. Six embryos each were selected from the group, on third, fourth, sixth, ninth, twelfth, fifteenth, eighteenth, twenty-first, twenty-fourth and twenty-seventh day of incubation. Six-day-old poults were also studied.

The embryos of third, fourth, sixth, ninth and twelfth day of incubation were studied using stereozoom microscope. The embryos and poults were then dissected and the small intestines were collected from fifteenth day of incubation to day-old poult stage for morphological and morphometric studies. The tract was divided into duodenum, jejunum and ileum. The weight of the individual components of small intestine (g) were measured using a digital monopan balance. The lengths (cm) and the anterior, middle and posterior widths of different regions (cm) were measured using graduated scale and Vernier caliper. The morphometric data was analysed statistically (Snedecor and Cochran, 1994).

RESULTS AND DISCUSSION

The foregut appeared as the most cephalic part of the primitive gut tube by third day of incubation. Midgut and hindgut appeared by fourth day. Though the foregut and hindgut were closed by sixth day, the midgut was connected to the yolksac with the help of yolk stalk. This stage was characterized by the presence of two loops, *viz.* anterior most duodenal loop and the posterior umbilical loop and the observations were similar to that of Dibner and Richards (2004), in chicken embryo by sixth day of incubation. The umbilical loop began as a slight ventral curvature of the intestine corresponding to the level of the yolk stalk.

The descending and ascending limbs of the duodenal loop with pancreas in between could be recognized during the ninth day of incubation. The umbilical loop that represented the jejunal primordium, formed descending and ascending limbs with number of convolutions outside the body cavity, which might be due to the rapid elongation of the intestinal tract. Except for the continually elongating umbilical loop, the twelfth day embryo did not present much difference from that of the ninth day.

Table 1. Weight and length of segments of small intestine during pre-hatch period in turkey (Mean±S.E)

Age of embryo (days)	Weight (g) (n=6)			Length (cm) (n=6)		
	Duodenum	Jejunum	Ileum	Duodenum	Jejunum	Ileum
15	0.036±0.002	0.082±0.003	0.023±0.003	3.233± 0.143	8.667± 0.180	1.200±0.096
18	0.050±0.002	0.098±0.003	0.032±0.003	4.267± 0.198	9.683± 0.149	1.783±0.135
21	0.065±0.002	0.123±0.003	0.035±0.004	4.350± 0.229	10.500± 0.291	2.383±0.162
24	0.118±0.003	0.328±0.007	0.068±0.003	4.567± 0.163	11.100± 0.548	3.000±0.057
27	0.395±0.008	0.605±0.015	0.175±0.007	6.267± 0.235	16.017± 0.403	3.550±0.138
28 (Day old poult)	0.405±0.013	0.613±0.022	0.178±0.005	6.383± 0.224	16.233± 0.393	3.667±0.223

Table 2. Width of duodenum during pre-hatch period in turkey (Mean±S.E) (n=6)

Age of embryo (days)	Width of duodenum (cm)		
	Anterior	Middle	Posterior
15	0.120^{c}±0.003	0.122^{e}±0.003	0.117^{d}±0.002
18	0.130^{c}±0.004	0.135^{de}±0.004	0.127^{d}±0.002
21	0.133^{c}±0.003	0.143^{d}±0.003	0.125^{d}±0.005
24	0.155^{b}±0.006	0.170^{c}±0.004	0.162^{c}±0.005
27	0.247^{a}±0.006	0.275^{b}±0.008	0.232^{b}±0.005
28 (Day-old poult)	0.263^{a}±0.010	0.305^{a}±0.004	0.247^{a}±0.008
F-value	114.092**	258.879**	137.394**

** Significant (p<0.01), ns- non-significant
Means bearing same letter as superscript within a column do not differ significantly

Table 3. Width of jejunum during pre-hatch period in turkey (Mean±S.E) (n=6)

Age of embryo (days)	Width of jejunum (cm)		
	Anterior	Middle	Posterior
15	0.120^{c}±0.003	0.122^{d}±0.002	0.115^{d}±0.002
18	0.125^{c}±0.004	0.120^{d}±0.004	0.120^{d}±0.004
21	0.127^{c}±0.006	0.125^{d}±0.007	0.122^{d}±0.005
24	0.160^{b}±0.005	0.163^{c}±0.007	0.157^{c}±0.007
27	0.204^{a}±0.007	0.203^{b}±0.006	0.203^{b}±0.156
28 (Day-old poult)	0.242^{a}±0.005	0.222^{a}±0.009	0.220^{a}±0.008
F-value	119.766**	50.026**	74.065**

** Significant (p<0.01), ns- non-significant
Means bearing same letter as superscript within a column do not differ significantly

Table 4. Width of ileum during pre-hatch period in turkey (Mean±S.E) (n=6)

Age of embryo (days)	Width of ileum (cm)		
	Anterior	Middle	Posterior
15	0.110^{c}±0.004	0.107^{c}±0.003	0.113^{c}±0.003
18	0.117^{c}±0.002	0.117^{c}±0.002	0.117^{c}±0.002
21	0.118^{c}±0.004	0.122^{c}±0.005	0.118^{c}±0.005
24	0.147^{b}±0.008	0.148^{b}±0.010	0.145^{b}±0.007
27	0.200^{a}±0.006	0.210^{a}±0.003	0.210^{a}±0.007
28 (Day-old poult)	0.207^{a}±0.011	0.217^{a}±0.006	0.212^{a}±0.005
F-value	44.210**	78.969**	85.211**

** Significant (p<0.01), ns- non-significant
Means bearing same letter as superscript within a column do not differ significantly

Though the morphogenetic differentiation occurred by sixth day of incubation, the segments of small intestine were grossly detectable by fifteenth day of incubation only. The retraction of the umbilical loop into the body cavity was completed by twenty-seventh day of incubation.

The small intestine consisted of duodenum, jejunum and ileum in the present study as reported by Nickel *et al.* (1977).

Duodenum appeared to start from the cranio-dorsal sac of the gizzard. The duodenal flexure forming the U-shaped loop of duodenum divided it into descending and ascending limbs. The duodenal loops overlapped the loops of jejunum and occupied the most ventral part of the intestine by twenty-seventh day of incubation. The jejunum was related to the duodenal loop cranio-ventrally by day-old poult stage and was composed of many loops with lesser diameter compared to that of duodenum. It was the longest of all the segments of small intestine. The remnant of yolk sac, the Meckel's diverticulum was observed at the beginning of distal half of jejunum, on closure of the abdomen by twenty-seventh day of incubation. No clear demarcation was observed between the jejunum and ileum in the present study and therefore, the part of intestine lying in between the two caeca was considered as ileum. It was the shortest segment in all ages among the segments of small intestine. This observation was in accordance with the findings of Nazrin *et al*. (2012).

The mean weight and length of the segments of small intestine increased progressively with age of the embryo (Table 1). The width of anterior, middle and posterior parts of duodenum exhibited significant increase with advancement of age of the embryo (Table 2) which was in agreement with the findings of Kalita *et al*. (2012) in Kadaknath fowl. The anterior, middle and posterior width of jejunum and ileum also increased as age advanced (Tables 3,4).

SUMMARY

The morphogenetic differentiation of the segments of small intestine, *viz*. duodenum, jejunum and ileum, occurred by sixth day of incubation in the present study and the segments were grossly measurable by fifteenth day of incubation. All the segments of the small intestine exhibited progressive increase in the weight, length and width with advancement of the age of embryo.

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Ethics statement: The study was conducted on experimental animals following standard operating protocols of animal handling and sample examination and necessary approval was taken from Institutional Animal Ethics Committee.

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