MORPHOLOGICAL CHANGES IN GASTROINTESTINAL TRACT OF POST- HATCH BROILER CHICKEN

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ABSTRACT

The present study was conducted on "Vencob" broiler chickens reared during post-hatch period from day 1 up to day 48. Birds were sacrificed at weekly interval and carefully dissected to examine thoroughly different segments of gastrointestinal tract from esophagus to cloaca. The gross morphometrical parameters (length, weight) for each and every gut segment were recorded. The relative length and relative weight were calculated. All the morphometrical parameters showed a gradual increase from day 1 till the end of the experimental period. However, duodenal and jejunal length increased more rapidly up to day 8 post- hatch, followed by a gradual increase thereafter. Except the duodenum (till 8th day), all other segments revealed a declining trend in relative length and relative weight. Rate of increase in these biometrical values was comparatively less during the later part of experimental period. In general, with age all the gut segments increased in length and weight parallel to the body growth of the birds.

KEY WORDS : Morphometry, Gastrointestinal tract, Broiler chicken, Post- hatch period

INTRODUCTION

The anatomy of avian alimentary tract is unique that it is highly modified in comparison to the mammals. At hatching, the gastro- intestinal tract undergoes morphological changes in respect of increase in intestinal length, villous height and density along with simultaneous physiological changes (Yadav et al., 2010). During the post- hatch period, weight of the small intestine increases at a faster rate than the body weight (Katanbaf et al.,1988;Sell et al., 1991; Sklan, 2001). Adaptation to oral ingestion of food is associated with a rapid increase in the weight of gastrointestinal (G.I.) tract and in the activity of digestive enzymes during the first 7 - 10 days post- hatch (Trampel and Duke, 2004).It is reported that immediate feeding after hatching accelerates the morphological development of small intestine (Noy and Sklan,1998). Most of the research works on broiler chicken are directed towards its body growth and nutrition. However, the anatomical aspects specifically the detailed morphological changes of G.I. tract in broiler breed post- hatch (up to marketable age) are not reported thoroughly and systematically. The present study was undertaken to explore the same.

MATERIALS AND METHODS

For the present investigation, sixty "Vencob" day- old broiler chicks were procured from Eastern Hatcheries Ltd., Bhubaneswar, Orissa. The chicks were reared in deep litter system in the Experimental Pens, Department of Anatomy and Histology. Standard management practices were followed uniformly for all birds. All the chicks were given feed (starter diet up to 3 weeks and the grower feed thereafter) and water *ad libitum* throughout the experimental period (up to 48 days). Routine vaccination schedule was followed. The body weight of all the day- old chicks were recorded with the help of an electronic weighing balance. Thereafter the body weight of birds were measured weekly. For the gross anatomical study of G.I. tract, the birds were sacrificed by cervical dislocation. Then each bird was carefully dissected to collect the whole intact G.I. tract starting from esophagus to cloaca. Each segment of G.I. tract was identified grossly, followed by recording of length (in cm)

Table 1: Mean ± SE of length (in cm) of different segments of gastro-intestinal tract on different days.

Table 2 : Mean ± SE of weight (in gm) of different segments of gastro-intestinal tract on different days.

***and ** indicate significant changes between two successive values in a column at 5% and 1% level respectively. NS indicates non- significant changes. PV = Proventriculus, Rt = Right, Lt = Left**

with the help of a tape. The weight of each G.I. segment was also measured (in gm) after gently removing its luminal contents by digital pressure and flushing of the same under tap water. The relative length and weight of G.I. segments were calculated per 100 gm body weight. All the data obtained from different biometrical parameters of the present study were subjected to standard statistical analysis, i.e. Paired t - Test (Snedecor and Cochran, 1989).

RESULTS AND DISCUSSION

Different biometrical parameters , i.e. length and weight were recorded for different gut segments throughout the experimental period (up to day 48). The relative length and weight of gut segments were calculated. The biometrical data (length and weight) are presented in Table 1 and Table 2.

Esophagus : The length of esophagus increased gradually from day 1 to day 8, followed by a marked increase up to day 16. Thereafter this trend was steady. There was concomitant increase in weight of this G.I. segment during this post- hatch period. The relative length showed a sharp decrease from day 1(9.47 ± 0.14) to day 8(4.45 ± 0.04), but it slowed down gradually thereafter up to day 40 (1.03 ± 0.2) with a slight increase (1.30 ± 0.03) towards the end of the experimental period. The trend in the change of relative weight (values ranging from 4.14 ± 0.03 to 0.46 ± 0.03) was followed almost similar pattern. All the changes were significant ($p \leq 0.05$).

Crop : The size (data for its diameter not shown) and weight of crop showed a gradual and significant (p? 0.05) increase during post- hatch period . The relative weight of this part, however, decreased significantly from day1 (6.42 ± 0.03) up to day 24(1.22 ± 0.03) and thereafter the changes were non significant.

Proventriculus : The length (except day 8 and 24) and weight of this segment(glandular stomach) revealed a gradual, significant ($p \leq 0.05$) increase throughout post- hatch period under study. There was significant decrease in relative length from day1 (3.22 ± 0.14) up to day 32 (0.22 ± 0.02).Similar trend was observed for relative weight, from day one (6.76 ± 0.03) upto day 32 (0.55 ± 0.03) respectively. Then the change was non significant, i.e. almost constant towards the end of the experiment.

Gizzard : The size(data for its diameter not shown) and weight of the gizzard, the muscular stomach revealed significant ($p \leq 0.05$) gain till day 48. Then the growth was slowed down. The relative weight also showed a decreasing trend with age of the birds, i.e. (15.86 ± 0.02) on day1 and (2.37 ± 0.02) on day32.Then the change was non significant.

Duodenum : The elongation of duodenum was highly significant on day 8, followed by a steady and gradual increase. The relative length slightly increased from day 1(18.35 ± 0.14) to day 8(19.14 ± 0.05), but declined progressively till the end (2.33 ± 0.02). However, the relative weight slowed down (values ranging from 8.8 ± 0.46 on day1 to 0.73 ± 0.3 on day 48) with the age. All these parameters significantly ($p \leq 0.05$) varied with the advancement of age.

Jejunum : There was steep increase in jejunal length and weight up to day 8. It increased consistently thereafter. Both the relative values declined sharply after day 8 post- hatch (Relative length: 43.11 ± 0.7 on day 8,12.33 ±0.02 on day 16, 5.49 ±0.04 on day 48; Relative weight: 9.64 ±0.7 on day 8, 2.71 ±0.06 on day 16, 1.24 ±0.05 on day 48). The changes were significant ($p \leq 0.05$).

Ileum : The length and weight of this intestinal segment steadily increased up to day 16 and after that the change was gradual ($p \leq 0.05$). There was sharp decrease in the values of relative measures from day 16 onward (13.96 ±0.4 to 1.41 ±0.01 and 2.17 ±0.11 to 0.23 ±0.01 respectively) and non significant changes were seen during later part of the experimental period.

Caecum : Caecal length and weight were almost double on day 8 as compared to those of day - old chicks. Then these values gradually ($p \leq 0.05$) increased with age of the birds. There was

slight difference in values of these parameters between right and left caecum. The relative measures markedly decreased from day 16(Right-1.77 ±0.04 and 0.36 ±0.03, left- 1.8 ±0.04 and 0.34 ±0.04 respectively) and it became stable towards the end of the experimental period.

Colo- rectum : The length of this gut segment increased significantly ($p \leq 0.05$) from 3.5 ±0.03 cm on day 1 to 10.5 ± 0.35 cm on day 48. There was consequent increase in its weight. The relative length and weight gradually decreased from day1 (5.28 ± 0.01 and 1.06 ± 0.06 respectively) up to day 24(0.75 ± 0.04 and 0.18± 0.003 respectively). Thereafter these values were more or less constant.

Cloaca : The biometry of the last gut segment revealed a gradual ($p \leq 0.05$) increase with age. This change was stabilized from day 32 onward. The relative length (1.53 ± 0.05 to 0.14 ± 0.01) and weight (0.91 ± 0.02 to 0.08 ± 0.003) slowly declined and seemed almost constant during the later part of the experimental period.

From the present findings it is evident that the length of duodenum, jejunum and caeca became almost double (2 times) or so on day 8 as compared to day 1. The weight of these segments showed a similar trend during this period. The rate of increase in these parameters was maximum during the same period. Kadhim et al.(2010a) also reported great increase in absolute length of intestinal segments during first 10 days post - hatch in broiler breed. The significant increase in absolute length and weight of each intestinal segment in the present study is in agreement with the finding of Kadhim et al. (2010b) in young Red Jungle fowl. More or less similar biometrical values (gizzard weight, small and large intestinal length) were shown in male Ross 308 broiler chickens by Celik et al. (2008) and Sturkie and Whittow (2000) in grown- up broiler birds. This indicates very early maturation and development of the gut segments as a result of feeding the chicks immediately after hatching. The present finding on the intestinal length is also in consonance with those observed by Mitjans et al. (1997) in Leghorn chickens. Geyra et al. (2001) reported accelerated intestinal morphogenesis and enterocyte proliferation as a result of immediate post-hatch feeding to the chicks. Aptekmann et al. (2001) attributed the early maturation of gut to the physiological development of birds which is directly related to digestion and absorption in the small intestine. Early feed supplementation was reported to improve the digestive system that is ultimately reflected in increased body weight (Noy and Sklan, 1999). All the morphometrical values in the present investigation became higher with advancement of age of the birds. Similarly, Handerson et al. (2008) reported that early nutritional supplementation immediately after hatching helps development of digestive system that evokes the nutrient utilization, growth and overall development of chicks. Kadhim et al. (2010a) observed a marked decline in the length of intestinal segments relative to body weight (relative length) during first 20 days post - hatch and a gradual decrease thereafter in broiler birds. This is in conformity with the present finding. The slight increase in relative length of duodenum on day 8 is indicative of the fact that elongation of duodenum during this period was comparatively much greater than the growth of the whole body. Uni et al. (1995) noticed an early rapid growth of duodenum than jejunum or ileum. According to the findings of Sell et al. (1991) , the weight of small intestine increased more rapidly than body weight until 6 days after hatching and after that the growth seemed to be parallel with the body weight. Otherwise, the relative measures of the present study showed a decreasing trend throughout the experimental period, which reflects much greater body growth than the G.I. segments. The increase in length and weight of G.I. segments is actually due to post- hatch morphogenesis and histogenesis, specifically gain in mucosal and muscular components. Even selection process done in case of broilers for feed efficiency affects the total size of gastro- intestinal tract. Similar views were given Kadhim et al. (2010b) and Lilja et al. (1985). So, the balanced supplementation (starter feed) to the post- hatch chicks and thereafter (grower feed) has a significant impact on gut health and morphogenesis that results in overall efficient growth and performance in broiler chicken.

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