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**DEVELOPMENTAL PATTERN AND AMYLASE
ACTIVITY OF PANCREAS AND CROP
IN MALE BROILER CHICKS***

(With 5 Figures)

By

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SUMMARY

In this study 224 male broiler chicks were used. We aimed to investigate the developmental patterns and the variations in the relative α -amylase activities of both the pancreas and crop related with age in broiler chicks. Body weight, weights and relative weights of pancreas and crop, body weight gain, allometric growth of pancreas and crop, and relative α -amylase activities of crop content and pancreas were measured with 3 day intervals from hatching till 42 days of age. Although the body weight increases regularly throughout the age in broiler chicks, the body weight gain was found to be higher on days 9, 12 and 15 compared to the other days. Although the pancreas and crop weights increase related with age, it has been observed that, relative weights of these organs started to decrease gradually after the 6 day of age. Maximal allometric growth of pancreas and crop were determined on day 36. It has been observed that the growth of pancreas and crop was 2,5 and 4,5 folds more than the growth of body on day 36. Relative α -amylase activity of pancreas peaked on day 12 (P 0.01), then it decreased until the end of pancreas peaked on day 12 (P0.01), then it decreased until the end of the experiment. The highest value of crop content's relative α -amylase activity was recorded on day 3 (P 0.01), and it has been observed that it decreased by age.

Key Words: *Broiler chick, Crop, Pancreas, Amylase activity.*

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and crop weight were obtained from the doctoral thesis of the former author.

INTRODUCTION

Researches about the growth in poultry concentrate on the gastrointestinal tract which plays an important role in food intake, food conversion efficiency and body weight gain (Lilja *et al.*, 1983, Sell *et al.*, 1991, O'Sullivan *et al.*, 1992). This subject is more interesting in broiler chicks that are aimed to be attained the slaughtering weight in the short period of time.

Nitsan *et al.* (1991) reported that there are some changes in the gastrointestinal tract after hatching and the ability to digest food increases by age morphological alterations in the digestive tract and quantitative and qualitative changes in digestive enzymes have effect on this increase Nitsan *et al.* (1991) and Uni *et al.* (1995) found that the digestive enzymes affect the alterations in gastrointestinal tract. Food utilization is greatly affected by these alterations as recorded by Turk (1982).

The changes observed in the digestive tract after hatching are considered as an important growth indicator (Sell *et al.*, 1991). Developmental patterns of gastrointestinal segments change according to species (Krogdahl *et al.*, 1989, King *et al.*, 2000) and race (Nitsan *et al.*, 1991), and it has been suggested that growth characteristic of the gastrointestinal segments must be one of the criteria in selections for the yield (Nir *et al.*, 1993).

Although there are many publications about proventriculus, gizzard and small intestine's developmental patterns, researches about crop are limited. This study was planned to investigate developmental patterns of two important components of the chick's digestive tract (crop and pancreas), and the changes in the α -amylase activity in both during the growth.

MATERIALS and METHODS

In this study 224 male broiler chicks obtained from a commercial hatchery were used. Chicks were fed on commercial starter diet from 1 to 18 days of age, and then changed to grower diet till the end of the experiment. Food and water were supplied ad libitum.

Along the experimental period, at 3 days intervals, 16 chicks were randomly selected. Chicks were weighed and killed by shedding

their blood. The pancreas and crop were removed immediately. Crops were cut with scissors and crop contents were obtained. The crop content could not be taken from the birds whose crops were empty. The pancreas, crop and crop contents were weighted, and pancreas and crop contents were placed into plastic bags and stored at -20C until further analyses (Shapiro et al., 1997).

Tissue and contents were homogenized in 20 volumes of ice cold distilled water (Osman, 1982) and centrifuged 70 000 x g for 20 min at 4°C (Gertler and Nitsan, 1970). Amylase activity was determined by the method of Bernfield (1955) after being modified by Gertler and Nitsan (1970). Activities of α -amylase were expressed as units, one unit was defined as an increase in 1 x 10² of extinction at 550 nm within 3 min.

Amylase units were multiplied by 20 because of dilution and it was expressed as unit/g (U/g). Relative α -amylase activity were calculated according to the equation: (U/g) x (tissue or contents weight) x 100/body weight. Relative weight, body weight gain and allometric growth was calculated as follows: Relative weight: tissue or organ weight x 100/body weight (Sell et al., 1991), Body weight gain: [(body weight/previous sampling day's body weight) -1 x 100]. Allometric Growth: (organ weight /organ weight at first sampling day)/(body weight/body weight at first sampling day) (Nir, et al., 1993). The mean values of weights and relative weights of pancreas and crop, body weight (BW), relative α -amylase activity of pancreas and crop content, and standard error of the means (SEM) were calculated. The changes related to age were determined by variance analyse (Snedecor, 1976).

RESULTS

Data about the weight increases in broiler chicks are shown in Figure 1. It has been observed that body weight and weights of the pancreas and crop increased regularly with age and reached its maximum level on day 42(P<0.01). Body weight development of broiler chicks is illustrated in Fig. 2. On the 6th day of the experiment, the body weight gain was approximately 30 % of the 3rd day, and it was 70%, 60% and 77% of the previous sample day on day 9, 12 and 15 respectively. Body weight gain ranged between 10 % and 35% after the 18th day of the experiment.

The findings about the relative weights of the pancreas and crop are given in Figure 3. It was determined that the relative pancreas weight was 0.5 g / 100g BW on day 3 after hatching, gradually decreased after reaching its peak on day 6 ($P \leq 0.01$) and decreased to 0.2 g/100g BW at the end of the experiment. It was found that while the crop relative weight was approximately 1g/100g BW until the day 6, it was 0.6 g/100g BW on the day 9 ($P \leq 0.01$) and reached its lowest value 0.2 g/100g BW on day 21 and no statistically significant changes were observed after the 21st day.

Allometric growths of the pancreas and crop are shown in Fig. 4. The pancreas growth rate which was 0.7 fold of the body growth rate on day 6, gradually increased to be 2.5 fold at the 36th day then decreased until the end of the experiment. The increase related with age was observed in the allometric growth of both crop and pancreas. The crop growth rate which was approximately 1 fold of the body weight on day 6, determined as 4.5 fold of the body growth rate on day 36.

Data about the relative α -amylase activities in pancreas and crop content are shown in Fig. 5. Although there wasn't any statistically significant changes in relative α -amylase activity of the pancreas till day 6, on day 12 it peaked ($P \leq 0.01$) and it decreased until the end of the experiment. The decreases after day 18 were considered statistically significant compared with day 12 on which the highest level was determined. The crop relative α -amylase activity which was at the maximum level at the 3rd day after hatching, significantly decreased on day 6 ($P \leq 0.01$). Although some fluctuations were determined, yet it decreased with age development.

DISCUSSION

In this study, increases in body weight, pancreas and crop weights throughout the age came in agreement with literatures (Nitsan *et al.*, 1991, O' Sullivan *et al.*, 1992, Nir *et al.*, 1993). It is shown that the maximal body weight gains were on day 9,12,15 compared with the previous sampling days (Figure 2). In spite of the continuous growth of the birds during the trial period, the weight gains percentages decreased after day 12. This finding matches with Gyles's (1989) declaration which

emphasis on the importance of 15 days growth and development period, 1/3 of the live period of the chickens.

If the development in the pancreas and the crop reckoned as the organ weight per 100g body-weight, it is observed that the pancreas relative weight increases till day 6 and then decreases till the end of the experiment (Fig. 3). This finding is similar to the results of the studies which were carried out on chicks by Palo *et al.* (1995) and on turkeys by Kroghdahl and Sell (1989) who demonstrated that the pancreatic growth rate is high at first and second weeks then it decreased on the following weeks. Figure (3) shows the changes in the crop relative weight is very similar to the pancreas's. Nitsan *et al.* (1991) determined that the crop's relative growth decreases in 15 days period. The rapid growth observed rather early in the pancreas and the crops considered as an adaptation mechanism which is necessary for transition from endogen feed, utilised during embryonic life to exogen feed, taken after hatching. As a matter of fact Nitsan *et al.* (1991) expresses the adaptation to exogen feed to progression of the digestive tract and the digestive enzymes.

Regarding the allometric growth which was measured to compare the percentage of the body weight increase to the organ weight increase percentage, it was found that the pancreas's allometric growth was slower than the body growth rate until day 12 and on the following days the pancreas grows more rapidly to reach 2.5-fold more than the body on day 36 (Fig. 4). Nir *et al.* (1993) pointed out that the allometric growth of broiler chicks during 15 days period increases throughout the age. It is found out that the crop growth is slower than the body growth until day 9 and then followed the same manner as pancreas, the crop grows more rapidly than the body and on day 36 it's growth rate was 4.5-fold more than the body's (Fig. 4). Sell *et al.* (1991) found that weights of all segments of digestive tract in turkey increased faster than the body weight.

Nitsan *et al.* (1991) stated that the pancreatic α -amylase relative activity increases in broiler chicks during first 8 days and Pinchasov *et al.* (1990) stated that it decreases after day 20 of age. The obtained results are matched with both of two researches. The relative α -amylase reached its highest activities at 9th, 12th and 15th days which of the highest body weight gain's and this make us consider that the pancreatic

important factor for the body weight increase as Nitsan *et al.* (1990) expressed.

The changes in crop content's relative α -amylase activity related with age could not be discussed due to the fact that no literature concerning this subject could be found. The decrease of relative α -amylase activity in the crop content related with age demonstrates that the activity in crop content retard the body growth.

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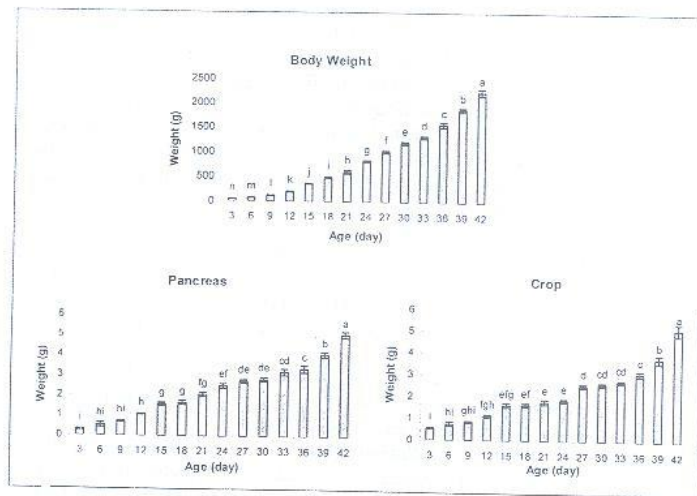


Figure 1: Mean \pm SEM of body weights, pancreas, and crop weights of broiler chicks (n=16). Vertical bars represent SE; when not shown the SE is smaller than the symbol. The differences between the means which don't have the same letter are significant ($P \leq 0.01$).

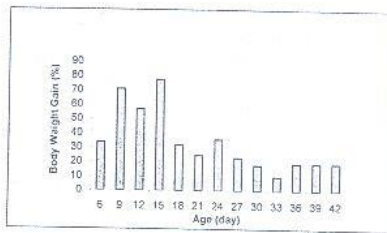


Figure 2: Body weight gain of broiler chicks.

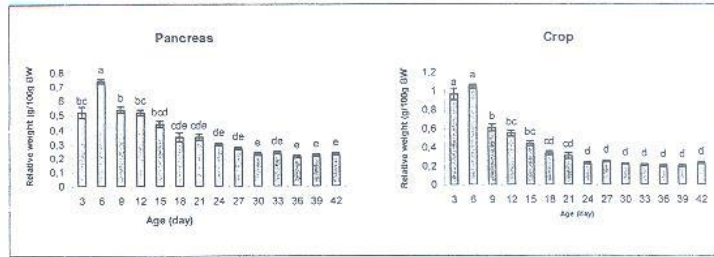


Figure 3: Mean \pm SEM of relative weight of pancreas and crop of broiler chicks (n=16). Vertical bars represent SE; when not shown the SE is smaller than the symbol. The differences between the means which don't have the same letter are significant ($P \leq 0.01$).

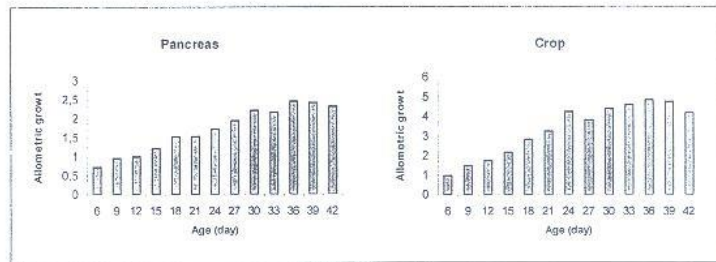


Figure 4: Allometric growth of pancreas and crop of broiler chicks.

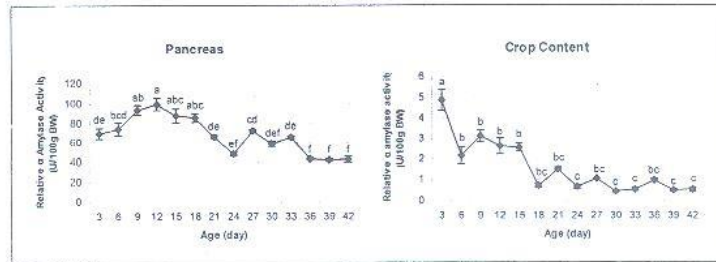


Figure 5: Mean \pm SEM of relative α -amylase activities of pancreas and crop of broiler chicks. In pancreas figure n=16. In crop content Figure n=14 on days 15, 18, 21, 27 and n=15 on days 30, 31 (n=16) and n=16 on the other days. Vertical bars represent SE; when not shown the SE is smaller than the symbol. The differences between the means which don't have the same letter are significant ($P \leq 0.01$).