

Development of the Digestive System in Chickens and Turkeys

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TWENTY Five Fayoumi cockerels and twenty five Bronze, poults were used in the experiments. Birds used were reared alike until 270 days of age. The ration used for chickens and turkeys was composed of 50% maize and 50% mash. The birds from each species were slaughtered at hatch, 30, 90, 180 and 270 days of age. The digestive system were removed and absolute, and relative physiological volume, length and weight of different segments of the digestive system were determined. The absolute volume, length and weight of different segments of the digestive system increased with age in both species. The relative values for volume and length were nearly constant after 30 days of age. The relative weights slightly decreased after 30 days of age in both species. From the development point of view the digestive system could be considered as an early mature system.

All the absolute measurements, each of the total alimentary canal of for each part showed progressive increase all over the age studied by Calhoun (1933), Harria (1967) and Marsden (1940). Female measurements are shorter than males all over the species and ages studied. The relative length of the caeca ($\text{length of two caecum} \div \text{length of intestine} \times 100$) is almost constant since 2 days of age until 21 weeks of age (0.19%) indicating early maturing phenomenon (Kersten, 1912). The rapid increase in duodernal length coincide with simultaneous increase in duode = mal diameter (Hinni and Watterson, 1963 and Stocum, 1966).

Incomplete picture can be observed for the weight of the digestive system due to lack of literature. Proventriculus percentage from body weights is higher in young chick than in older ones, (O' Dell *et al.*, 1959). Intestine thickness (ratio of weight to length) is constant in adult female chickens at different ages (0.2) (Harris, 1967). Liver percentage to body weight decrease significantly with advanced age in both males and females from 1 to 8 weeks. The females have higher percentage as than males at different ages (Deaton *et al.*, 1969). Relatively, the pancreas weight increased more rapidly than total body weight for the first 30 days, from 30 to 300 days the pancreas: body ratio decreased slowly. No correlation of pancreas weight and body weight was observed in birds of the same age and sex (Marsden, 1940).

Material and Methods

Twenty five Fayoumi cookerls and twenty five Bronze poultls were used in the experiments. The different ages were collected during the period from April to December. Birds used were reared alike until 270 days of age. The ration used during the experimental period for chickens and turkeys was composed of 50% crashed maize and 50% mash. During the first period (1-90 days) the mash ingredients for chickens were 15% wheat bran, 15% rice bran, 15% decorticated cotton - seed meal and 5% fish meal, but for turkeys was 5% wheat bran, 5% rice bran, 20% decorticated cottonseed meal and 10% fish meal. During the second period (91-270 days) the mash ingredients for chickens were 15% wheat bran, 20% rice bran, 10% decorticated cottonseed meal and 5% fish meal, while for turkeys it composed of 10% wheat bran, 12% rice bran, 20% decorticated cotton-seed meal and 8% fish meal. Half percent salt (sodium chloride), 9% limestone and 1% Vitamine A+D₃ were added as feed supplement during the first and second periods for the two species. The digestive system were obtained after slaughtering. Three birds from each species were slaughter at hatch, 30, 90, 180 and 270 days of age. Fine thread were used to tie esophagus, crop, proventriculus, gizzard, duodenum, jejunum and ileum, caeca and return, to cut of each segment including its content. The physiological volume of the crop, duodenum, jejunum and ileum and caeca were determined by the difference between the volume of each segment when full and empty. The relative physiological volume was calculated by dividing the physiological volume of each segment on the total physiological volume of digestive tract. The total length of digestive tract included the length of esophagus, proventriculus, duodenum, jejunum and ileum and rectum without caeca. The relative length was estimated by dividing the length of each segment on total length of digestive tract. The tissue weight was evaluated by weighing the total cleaned fresh tissue of the digestive system and each segment and part. The relative weight of digestive tract and each segment were estimated by dividing the weight of each segment by body weight and by the total weight of empty digestive tract. The calculated volume of crop, gizzard, duodenum, jejunum and ileum and caeca were estimated mathematically from their length and average diameter. The average diameter was obtained after measuring the circumferences of each segment. The segment was open flat to measure its internal circumference. Analysis of variance was carried out according to Snedecor (1959)

Results and Discussion

A. Physiological volume

1. *Crop* : The physiological volume of the crop increased with age in both chickens and turkeys (Table 1). The increased volume in turkeys was greater than chickens (Table 1). The elasticity of turkeys crop seems to be higher than chickens crop. In turkeys, the relative volume increased with age while in chickens it was almost constant at successive ages (Table 1). Chickens crop seems to be an early developing organ than turkeys crop. This may be due to the early sexual maturity in chickens (6 months) compared with turkeys (8.5 moth (Jull, 1947 and Kicka, 1968).

TABLE 1. Absolute and relative volume, length and weights and calculated volume of esophagus and crop of chickens (C) and turkeys (T) at different ages.

Items	Age (days)											
	1		30		90		180		270			
	C	T	C	T	C	T	C	T	C	T		
I. Esophagus												
Absolute length(cm)	4.73 ±0.37	6.23 ±0.09	7.67 ±0.33	12.67 ±0.00	11.73 ±0.23	26.33 ±0.88	20.00 ±1.53	29.67 ±2.40	20.00 ±0.33	34.00 ±1.53		
Relative length ± S.E	10.17 ±0.87	10.79 ±0.48	8.03 ±0.54	9.62 ±0.18	16.76 ±0.42	12.09 ±0.25	10.29 ±0.64	11.34 ±0.96	10.39 ±0.65	14.69 ±0.99		
Absolute weight (g) ± S.E	0.47 ±0.07	0.43 ±0.10	1.26 ±0.18	1.60 ±0.13	2.83 ±1.77	9.47 ±0.77	5.53 ±0.55	20.32 ±1.16	5.86 ±1.21	88.00 ±2.67		
Rel.wt.to body wt. ± S.E	1.73 ±0.28	0.73 ±0.21	1.07 ±0.13	0.60 ±0.04	0.62 ±0.09	0.69 ±0.06	0.43 ±0.01	0.59 ±0.08	0.42 ±0.04	0.56 ±0.07		
Rel.wt. to GIT wt. ± S.E	8.55 ±1.14	7.86 ±1.50	77.26 ±0.48	5.23 ±0.45	5.52 ±0.65	5.99 ±0.48	5.60 ±0.20	7.04 ±0.49	5.29 ±0.49	7.56 ±0.74		
II. Crop												
Physiological volume (cm ³) ± S.E	1.73 ±0.17	3.47 ±0.34	6.50 ±1.06	18.73 ±1.56	21.67 ±0.88	68.87 ±0.15	41.33 ±5.55	96.00 ±14.3	46.00 ±3.79	117.0 ±15.1		
Calculated volume (cm ³) Relative volume ± S.E	1.25 ±4.62 ±4.76	2.17 ±30.51 ±1.05	5.80 ±4.14 ±4.78	65.96 ±42.71 ±10.3	75.80 ±48.17 ±2.29	329.2 ±45.12 ±4.51	116.2 ±48.67 ±4.06	506.6 ±49.56 ±4.08	215.4 ±46.04 ±6.14	20.62 ±49.18 ±6.36		
Absolute weight (g) ± S.E	0.43 ±0.09	0.47 ±0.03	1.33 ±0.20	1.87 ±0.18	3.40 ±0.37	8.53 ±1.44	6.17 ±0.60	24.67 ±0.88	7.13 ±1.87	36.33 ±2.33		
Rel.wt. to body wt. ± S.E	1.58 ±0.33	0.80 ±0.07	1.18 ±0.24	0.62 ±0.06	0.74 ±0.04	0.60 ±0.14	0.44 ±0.03	0.72 ±0.08	0.51 ±0.02	0.53 ±0.03		
Rel.wt. to GIT wt. ± S.E	7.82 ±1.45	8.59 ±0.15	7.44 ±1.42	6.11 ±0.44	6.44 ±0.61	6.03 ±0.67	6.24 ±0.34	8.85 ±0.48	6.51 ±0.89	9.81 ±0.40		

*GIT = Gastro-intestinal Tract

TABLE 2. Absolute and relative volume length and weight, and calculated volume of proventriculus and gizzard of chickens (C) and turkeys (T) at different ages.

Items	Age (Days)											
	1		30		90		180		270			
	C	T	C	T	C	T	C	T	C	T	C	T
I. Proventriculus												
Absolute length (cm) ± S.E.	1.07 ±0.03	1.10 ±0.07	2.13 ±0.00	2.80 ±0.15	3.57 ±0.15	4.67 ±0.44	3.57 ±0.23	5.50 ±0.29	3.17 ±0.17	5.17 ±0.17	3.17 ±0.17	5.50 ±0.29
Relative length ± S.E.	2.30 ±0.22	2.26 ±0.19	2.23 ±0.16	2.13 ±0.10	2.08 ±0.10	2.14 ±0.25	1.84 ±0.10	2.10 ±0.20	1.69 ±0.03	2.04 ±0.16	1.69 ±0.03	2.10 ±0.20
Absolute weight (g) ± S.E.	0.50 ±0.06	0.40 ±0.03	1.60 ±0.35	2.13 ±0.13	2.93 ±0.39	5.10 ±0.24	5.33 ±0.20	11.33 ±1.53	5.67 ±0.47	11.33 ±1.53	5.67 ±0.47	11.33 ±1.53
Rel. wt. to body wt. ± S.E.	1.84 ±0.19	0.68 ±0.08	1.42 ±0.27	0.42 ±0.07	0.64 ±0.04	0.50 ±0.02	0.41 ±0.01	0.33 ±0.03	0.41 ±0.02	0.23 ±0.01	0.41 ±0.02	0.33 ±0.03
Rel. wt. to GIT. wt. ± S.E.	9.09 ±0.59	7.31 ±0.44	9.68 ±1.23	6.96 ±0.50	5.72 ±0.45	3.60 ±0.17	5.39 ±0.26	3.94 ±0.20	5.18 ±0.31	3.06 ±0.16	5.18 ±0.31	3.94 ±0.20
II. Gizzard												
Physiological vol. (cm ³) ± S.E.	0.50 ±0.33	2.87 ±0.13	3.17 ±1.17	8.83 ±0.60	6.00 ±1.00	17.33 ±3.33	9.33 ±0.67	25.20 ±3.06	11.00 ±1.45	35.00 ±6.65	11.00 ±1.45	25.20 ±3.06
Calculate volume (cm ³) Relative volume ± S.E.	6.06 ±1.06	7.57 ±1.81	14.50 ±1.50	25.32 ±2.17	59.85 ±1.73	127.3 ±1.67	104.3 ±0.34	330.3 ±1.70	204.6 ±0.67	583.6 ±4.66	204.6 ±0.67	330.3 ±1.70
Absolute weight (g) ± S.E.	7.46 ±0.03	3.53 ±0.09	5.23 ±0.68	5.07 ±0.31	4.04 ±0.93	4.62 ±3.54	2.26 ±7.86	2.97 ±5.24	2.45 ±1.89	2.42 ±7.62	2.45 ±1.89	2.97 ±5.24
Rel. wt. to body wt. ± S.E.	35.09 ±0.38	37.84 ±0.85	35.58 ±1.43	44.44 ±0.59	36.05 ±1.02	39.67 ±2.74	29.16 ±2.64	34.98 ±1.42	39.98 ±4.14	32.39 ±1.80	39.98 ±4.14	34.98 ±1.42

* GIT = Gastro-intestinal tract.

TABLE 3. Absolute volume, length, calculated volume and relative volume, length and weight of duodenum of chickens (C) and turkeys (T) at different ages.

Items	Age (Days)											
	1		30		90		180		270			
	C	T	C	T	C	T	C	T	C	T		
Physiological Vol. (cm ³) ± S.E	0.53 ± 0.06	1.60 ± 0.21	1.00 ± 0.44	3.40 ± 0.33	2.00 ± 0.33	8.43 ± 1.03	4.67 ± 1.67	13.21 ± 1.67	4.67 ± 1.20	14.67 ± 2.25		
Calculate Vol. (cm ³)	0.47	0.53	6.10	18.38	34.33	68.14	46.80	101.86	48.81	137.7		
Relative volume ± S.E	12.57 ± 0.62	14.49 ± 0.58	6.79 ± 1.75	7.75 ± 0.61	6.45 ± 1.34	7.44 ± 1.79	5.24 ± 1.71	6.81 ± 1.33	6.82 ± 1.20	6.17 ± 1.73		
Absolute length (cm) ± S.E	7.73 ± 0.27	6.87 ± 0.73	16.13 ± 1.33	20.83 ± 1.92	29.50 ± 3.25	35.33 ± 3.71	31.33 ± 1.17	47.67 ± 3.53	31.10 ± 0.73	44.33 ± 1.67		
Relative length ± S.E	16.62 ± 1.18	14.11 ± 1.11	16.90 ± 1.55	15.82 ± 1.69	16.40 ± 1.08	16.16 ± 1.10	16.13 ± 0.65	16.22 ± 1.36	16.12 ± 0.52	17.49 ± 1.52		
Absolute weight (g) ± S.E	0.60 ± 0.10	0.53 ± 0.09	2.27 ± 0.18	2.60 ± 0.37	5.87 ± 0.47	5.87 ± 0.31	9.40 ± 2.43	32.67 ± 2.33	10.20 ± 1.16	34.33 ± 6.36		
Rel. wt. to body wt. ± S.E	2.21 ± 0.86	0.90 ± 0.76	2.02 ± 0.78	0.97 ± 0.11	1.28 ± 0.54	1.22 ± 0.05	0.74 ± 0.32	0.95 ± 0.07	0.73 ± 0.05	0.69 ± 0.07		
Rel. wt. to, GIT. wt. ± S.E	10.91 ± 1.43	9.47 ± 1.33	13.72 ± 1.89	9.50 ± 1.27	11.44 ± 0.94	10.46 ± 0.24	9.52 ± 2.06	11.24 ± 0.59	9.31 ± 0.59	9.27 ± 1.49		

* GIT = Gastro — intestinal tract.

2. Gizzard

The physiological volume of the gizzard enormously increased with age in chickens and turkeys (Table 2). The calculated volume was higher than the actual one in all ages (Table 2). In chickens, the relative volume of gizzard increased until 30 days of age and then almost the same values were observed (Table 2). The increased at 30 days was about 18% higher than that at one day. In turkeys, gizzard relative volume was the highest at hatch then drop to almost a constant value in the other ages (Table 2). This indicate that the gizzard is an early maturing segment in both species. The relative volume of turkeys gizzard was higher than that of chickens.

3. Small intestine

A. duodenum

Actual and calculated volume of duodenum increase in both species progressively in all the studied ages (Table 5). At hatch, the highest relative in turkeys and chickens were observed. The percentages volume afterwards were almost the same, indicating that this organ mature as early as one day old (Table 3). The relative volumes in turkeys were higher than those of chickens indicating higher digestive capacity than chickens (Table 3).

B. Jejunum and ileum

Jejunum and ileum values showed the same trend of variations like the previous segments. The physiological volume of jejunum and iluem showed the same increase with advanced age in chickens and turkeys at successive ages (Table 4).

In chickens, the relative volume of jejunum and ileum was high at one day of age, then dropped slightly at 30 days of age and followed by constant volume from 30 to 270 days of age (Table 4). While in turkeys, the relative volume of jejunum and ileum increased until 90 of age and then became constant (Table 4). Also, this indicates that these two segments are early maturing parts.

4. Caeca

The absolute physiological volume of caeca at hatching was almost the same in both two species. Afterwards, this volume increased up to 270 days of age (Table 5). The calculated physiological volume at one day was low, this indicated that the level of fibers in rations should be low at the early stages of life. Afterwards, this volume increased to enable the bird to consume more fiber. The relative volume of caeca was higher at one day in chickens than in turkeys that enables the chickens to eat more fiber contents than turkeys. In chickens, at 30 days of age the relative volume of caeca dropped slightly then followed by moderate increase up to 270 days of age (Table 5). While in turkey, the relative volume of caeca increased up to 30 days of age and then became constant (Table 5). The relative volume in turkeys was higher than in chickens at successive ages. Mraz *et al.* (1956) and Ibrahim (1969), stated that chickens can tolerate more fibers in the ratio than turkeys.

TABLE 4. Absolute volume, length and weight, calculated volume and relative volume, length and weight of jejunum and ileum of chickens (C) and turkeys (T) at different ages.

Items	Age (days)											
	1		30		90		180		270			
	C	T	C	T	C	T	C	T	C	T		
Physiological vol. (cm ³) ± S.E	1.00 ±0.00	2.60 ±0.33	3.17 ±0.93	10.63 ±0.67	12.00 ±1.00	27.67 ±3.53	23.00 ±2.91	42.33 ±5.60	26.00 ±2.85	50.00 ±6.00		
Calculate volume (cm ³) Relative volume ± S.E	0.27 ±1.06	0.75 ±1.07	31.73 ±2.92	35.23 ±1.20	88.56 ±2.09	159.2 ±2.19	133.7 ±2.70	203.4 ±2.63	162.9 ±3.79	651.7 ±3.27		
Absolute length (cm) ± S.E	29.87 ±2.79	29.93 ±1.16	62.00 ±5.88	85.67 ±4.33	111.2 ±5.34	146.7 ±2.31	129.7 ±2.85	159.7 ±9.62	124.0 ±11.7	156.0 ±11.8		
Relative length ± S.E	64.23 ±1.40	61.29 ±0.94	64.97 ±1.40	65.09 ±2.14	64.46 ±1.20	67.08 ±1.29	65.74 ±1.32	61.02 ±1.18	64.47 ±4.32	61.58 ±2.74		
Absolute weight (g) ± S.E	0.73 ±0.07	0.60 ±0.09	2.87 ±0.49	4.67 ±0.24	11.46 ±0.13	30.40 ±2.64	34.20 ±2.63	59.33 ±2.67	38.87 ±4.92	88.00 ±5.86		
Rel. wt. to body wt. ± S.E	2.68 ±0.24	1.02 ±0.15	2.56 ±0.24	1.74 ±0.35	2.49 ±0.11	1.72 ±0.40	2.68 ±0.18	1.75 ±0.08	2.78 ±0.47	1.73 ±0.23		
Rel. wt. to. GIT. wt. ± S.E	14.00 ±1.15	10.97 ±1.31	17.36 ±1.11	15.26 ±2.62	22.15 ±0.21	21.48 ±3.86	34.63 ±2.58	22.46 ±0.55	35.47 ±2.17	23.76 ±2.07		

GIT = Gastro-intestinal tract.

TABLE 5. Absolute volume, length and weight, calculated volume and relative volume, length and weight of caeca and rectume of chickens (C) and turkey (T) at different ages.

Items	Age (days)											
	1		30		90		180		270			
	C	T	C	T	C	T	C	T	C	T		
I. <i>Caeca</i>												
Absolute volume(cm ³)	0.30	0.30	1.00	2.00	2.67	10.40	6.13	22.23	6.80	22.33		
±S.E.	±0.00	±0.00	±0.17	±0.00	±0.67	±1.00	±0.58	±2.01	±1.53	±1.05		
Calculate volume (cm ³)	1.10	0.51	0.90	0.82	0.56	0.85	0.49	0.65	0.49	0.65		
Relative volume (cm ³)	6.21	5.47	6.01	8.83	7.38	8.67	8.75	8.77	8.56	8.93		
±S.E.	±0.53	±0.68	±1.43	±0.15	±1.06	±0.62	±0.64	±2.11	±0.86	±0.77		
Absolute length(cm)	2.83	4.40	6.50	13.33	13.87	22.73	16.37	16.37	21.33	27.87		
±S.E.	±0.48	±0.44	±0.33	±0.33	±0.40	±0.67	±0.95	±2.03	±0.73	±1.20		
Relative length	15.05	21.19	16.64	23.97	19.86	24.98	20.34	26.36	27.52	26.87		
±S.E.	±1.19	±1.11	±0.57	±1.30	±1.72	±0.28	±1.67	±1.85	±1.58	±0.54		
Absolute weight(g)	0.30	0.30	1.00	2.00	2.67	10.40	6.13	22.33	6.80	32.33		
±S.E.	±0.09	±0.02	±0.00	±0.07	±0.24	±0.69	±0.37	±1.20	±0.87	±2.85		
Rel.wt to body wt.	1.10	0.51	0.90	0.82	0.56	0.85	0.49	0.65	0.49	0.65		
±S.E.	±0.33	±0.08	±0.03	±0.04	±0.07	±0.07	±0.02	±0.03	±0.02	±0.09		
Rel.wt.toGIT wt.	5.45	5.48	6.05	6.54	6.21	7.35	6.21	7.70	6.20	8.73		
±S.E.	±1.60	±0.44	±0.52	±0.28	±0.55	±0.27	±0.22	±0.32	±0.55	±0.81		

II. <i>Rectum</i>													
Absolute length(cm)	2.90 ±0.27	3.74 ±0.31	4.50 ±0.33	7.17 ±0.00	7.27 ±0.44	12.50 ±0.33	9.67 ±0.67	15.57 ±0.67	8.67 ±0.76	15.50 ±1.01			
Relative length ±S.E.	6.24 ±0.38	7.33 ±0.48	4.72 ±0.10	5.45 ±0.11	4.18 ±0.02	5.77 ±0.23	4.97 ±0.27	5.99 ±0.14	4.51 ±0.21	6.12 ±0.74			
Absolute weight(g) ±S.E.	0.43 ±0.07	0.43 ±0.03	1.07 ±0.20	1.87 ±0.20	1.67 ±0.77	8.40 ±0.44	3.70 ±0.66	17.00 ±0.58	44.00 ±0.41	19.67 ±1.30			
Rel. wt. to body wt.* ±S.E.	1.58 ±0.24	0.73 ±0.08	0.90 ±0.10	0.70 ±0.07	0.80 ±0.17	0.69 ±0.04	0.29 ±0.06	0.40 ±0.01	0.29 ±0.02	0.40 ±0.06			
Rel. wt. to dig tr. wt. ± S.E.	±7.82 1.11	7.86 ±0.44	7.47 ±1.14	6.11 ±0.80	7.16 ±1.33	5.23 ±0.27	3.74 ±0.71	5.86 ±0.32	3.75 ±0.41	5.86 ±0.84			

* Relative weight to body weight.
 ** Relative weight to empty digestive tract weight.

TABLE 6. Absolute and relative weight of liver and pancreas of chickens (C) and turkeys (T) at different ages.

Items	Age (days)									
	1		30		90		180		270	
	C	T	C	T	C	T	C	T	C	T
<i>Liver</i>										
Absolute weight(g)	1.20	1.90	3.80	9.40	14.07	36.13	34.80	67.00	35.13	97.33
± S.E.	±0.07	±0.13	±0.59	±0.73	±0.81	±2.63	±1.89	±1.53	±2.17	±10.0
Relative weight	4.41	3.24	3.38	3.13	3.08	2.98	2.73	1.92	2.53	1.96
± S.E.	±0.19	±0.21	±0.40	0.29 ±	±0.19	±0.09	±0.04	±0.10	±0.24	±0.02
<i>Pancreas</i>										
Absolute weight (g)	0.10	0.17	1.07	1.27	2.60	4.20	3.00	7.33	3.07	10.67
± S.E.	±0.03	±0.06	±0.20	±0.24	±0.46	±0.46	±0.67	±0.67	±0.18	±0.67
Relative weight	0.37	0.29	0.95	0.47	0.57	0.34	0.23	0.24	0.22	0.22
± S.E.	±0.12	±0.09	±0.12	±0.09	±0.08	±0.04	±0.05	±0.03	±0.02	±0.01

*The length**I. Esophagus*

In chickens, absolute length did not increase after 180 days, while that of the turkeys continued its increase until the end of the experiment (Table 3). Growth rate of esophagus length does not take any persistent trends in both species (Table 1). Relative length of the esophagus in both species showed no increase after hatching indicating that this segment is an early maturing part (Table 1).

2. Proventriculus

The length of proventriculus was almost the same at one day of age in both species (Table 2). It seems that the growth rate of proventriculus length during incubation period was higher in chickens than in turkeys although the incubation period in turkeys was longer than chickens. Relative length of proventriculus was almost the same after hatching in both species (Table 4). This proves that the proventriculus was an early developing part.

*3. Small intestine**A. Duodenum*

With advanced age the increasing in the length of duodenum was moderate in chickens, while it was largely increased in turkeys (Table 3). Relative length of duodenum was almost the same at the successive ages in chickens, while in turkeys it increased continuously with age (Table 3).

B. Jejunum and ileum

The length of jejunum and ileum in chickens and turkeys were nearly the same at one day of age (Table 4). This may indicate that the growth rate of jejunum and ileum during incubation period was lower in turkeys than in chickens. Absolute length increased enormously with age in both two species up to 180 days of age and decreased slightly at 270 days of age (Table 4). Generally, the relative length of jejunum and ileum in chickens and turkeys were almost the same after hatch indicating that these are early maturing segments.

4. Rectum

The trend of increase in absolute length of rectum with age was progressive in the two species (Table 5). At 270 days of age, however, slight decrease occurred in both species (Table 5). This may be due to the decrease of the total length of digestive tract at 270 days of age. Like the other segments of the intestine, relative length of rectum was high at one day of age then became nearly constant up to 270 days of age in both two species (Table 5). Relative length of rectum was higher in turkeys than in chickens in all ages studied.

5. Caeca

The absolute length of caeca increased with age in the two species (Table 5). Also relative length of caeca to the length of small intestine increased with age in the two species (Table 5). Kerston (1912) showed that the relative length of caeca to the small intestine was almost constant since 2 days of age until 21 weeks of ages in chickens.

The relative length of caeca in turkeys was almost higher than chickens in all ages (Table 5). However, the relative physiological volume of caeca was higher in turkeys than in chickens (Table 7).

Tissue weight

1. Esophagus

In general, the absolute tissue weight of the esophagus of the two species increased gradually with ages (Table 1). The increase was slight in chickens while in turkeys it was enormous due to its large size. At one day of age the absolute tissue weight of esophagus was nearly the same in the two species. Esophagus relative weights was higher in chickens at the early ages than in turkeys (Table 1). The values of turkeys retained some increase in older ages as turkeys are late maturing birds.

2. Crop

Crop weight increased in chickens and turkeys all over the ages studied (Table 1).

In chickens, the relative crop weights decreased with ages up to 180 days of age, due to its importance at the early stages of life (Table 3). In turkeys, the relative crop weights were almost constant during the whole stages of life (Table 3).

3. Proventriculus

At one day of age, the absolute weight of proventriculus was higher in chickens than in turkeys, while at the other ages the absolute weight was higher in turkeys than chickens (Table 2).

The relative weights of proventriculus in the two species decreased with age (Table 2). The same results were obtained by O'Dell *et al.* (1959). In all ages, the relative weights of proventriculus in chickens were higher than in turkeys (Table 4). Chickens may be able, due to that, to digest at early stages of life more than turkeys. Also, turkeys require more palatable feed than in chickens. These results are in agreement with the observations obtained by Yamani (1964) in ducks.

4. Gizzard

In general there was a gradual increase in the gizzard weight in chickens and turkeys with age (Table 2). At one day of age the absolute weight of gizzard was nearly the same in chickens and turkeys. After that, the increase

in the absolute gizzard weight was moderate in chickens while it was enormous in turkeys (Table 2). In chickens, the relative gizzard weights decreased with age (Table 2). In turkeys, the relative gizzard weights fluctuated with no trend showing that this part matured as early as one day old (Table 2).

5. *Small intestine.*

A. *Duodenum*

At one day of age, the absolute weight of duodenum was higher in chickens than in turkeys. Afterwards, progressive increase was observed in the two species (Table 3). In chickens, the relative duodenum weights were high at the early ages and also higher than turkeys (Table 3). This indicates the ability of chickens to digest the food more at their early stages of life and compete with the turkeys also in this character. This suggests that turkeys must have palatable feed at their early stage of life than chickens (Table 3).

B. *Jejunum and ileum*

These two segments showed similar trends like that observed in duodenum with respect to the characters studied (Table 4).

6. *Rectum*

Like the other segments of small intestine, the increase in absolute weight of rectum was moderate in chickens and enormous in turkeys with age (Table 5). In chickens and turkeys, the relative weights of rectum decreased with age (Table 5). Comparing between the two species, the relative weight of rectum to body weight again was higher in chickens than in turkeys to the same causes discussed (Table 5). However, turkeys retained the same increase in relative weight of rectum at the early ages.

7. *Caeca*

At one day of age, the absolute weight of caeca was the same in two species. After this age, the increase in absolute caeca weight was slight in chickens and enormous in turkeys (Table 5).

The relative caeca weight to body weight was high at the early ages of chickens and also was higher than that in turkeys, which enables them to digest more fibers at early ages than turkeys (Table 5).

8. *Liver*

In general, absolute weight of liver increased with age in chickens and turkeys (Table 6). In two species the percentage of liver to body weight decreased with age (Table 6). The same results were obtained by Francis and Roberson (1967) and Deaton *et al.* (1969). Comparing between chickens and turkeys, the relative liver weight was higher in chickens than in turkeys (Table 6).

9. *Pancreas*

In the two species there were a gradual increase in pancreas weight with age (Table 6). This results agreed with Marsden (1940), Hafez (1955) and Nestor and Jaap (1963).

In the two species, the relative pancreas weight did not show any clear trend (Table 6).

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تطوير الجهاز الهضمي في الدجاج الرومي

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استخدم في هذه التجربة خمسة وعشرون ديك فيومي وكذلك خمسة وعشرون ديك رومي من عمر يوم الى عمر ٢٧٠ يوم في خلال الفترة من ابريل حتى ديسمبر * وغذيت هذه الطيور من عليقة تتكون من ٥٠٪ ذرة ، ٥٠٪ مخلوط ناعم وأثناء فترة التجربة منعت الاعلاف الخضراء عن الطيور حتى لا تؤثر على الحجم الطبيعي للفتاة الهضمية * كذلك حصنت الكتاكيت ضد مرض النيوكاسل *

وقد ذبح خمسة ديوك من كل نوع عند الأعمار التالية عند الفقس ، ٣٠ ، ٩٠ ، ١٨٠ ، ٢٧٠ يوم وبعد الذبح جوفت لاستخراج الجهاز الهضمي وبعد استخراجة استخدم خيط رفيع للربط بين الاجزاء المختلفة ثم حسب بعد ذلك الحجم الفسيولوجي - الطول - الوزن المطلق وكذلك النسبي للاجزاء المختلفة للجهاز الهضمي ، كذلك حسب الحجم ورياضيا مقارنة بالحجم المطلق ثم أجرى التحليل الاحصائي لمقارنة النتائج ببعضها وكانت أهم النتائج هي :

(١) الحجم - الطول الوزن المطلق للاجزاء المختلفة للجهاز الهضمي تزيد مع تقدم العمر في الفيومي والرومي ولو ان هذه الزيادة كانت أعلى بالرومي عن الدجاج

(٢) الحجم والطول النسبي يحدث لها ثبات تقريبا بعد عمر ٣٠ يوم بينما نجد ان الوزن النسبي يحدث به نقص بمعدل بسيط بعد هذا العمر ٥٠ .

(٣) لذلك نستطيع القول من وجهة نظر التطور أن الجهاز الهضمي يعتبر من الأجهزة المبكرة النضج *