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Effect of Feeding Different Fiber Levels to Chickens and Ducks on Some Physiological Aspects of The Alimentary Canal

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PHYSIOLOGICAL volume of the digestive tract in male Pekin ducks was larger than that in Fayoumi cockerels. The highest level of the crude fiber in the ration caused increase in the physiological volume of the total digestive tract in both chickens and ducks, the increase was higher in ducks than in chickens. The differences due to age and treatment were significant. The caecum was affected by the different levels of crude fiber together with the total digestive tract in chickens and ducks for both absolute and relative physiological volume. The volume was higher in the ducks than in the chickens,. The relative physiolcgical volume was higher in the chickens than in the ducks. The empty volume of the total digestive tract was not affected by the bulky ration.

Adequate nutrition is important in maintaining the health, growth and reproduction in poultry. Each of the nutrients must be supplied to birds in proper amounts. If one nutrient is lacking or out of balance with the other nutrients.. inefficient poultry production will result.

The physiological relative volume of the crop in turkeys increased with age, while in chickens it was almost constant at successive ages (Kamar et al., 1978). The relative physiological volume of the turkey's caeca was higher than in chickens at successive ages (Marz et al., 1956 and Ibrahim, 1969). The increase in caeca size increases the ability in digestion of fiber content of the ration (Kamar and Mostageer, 1963).

Material and Methods

Number of 450 Fayoumi cockerels and 489 Pekin drakes were used in this study. From one day to four weeks of age the chickens and ducks were fed on starting rations according to NAS-NRC (1977) and Ash (1976) respectively.

On 4 weeks of age, each of the Fayoumi cockerels and Pekin drakes were divided randomly into three equal groups. The groups were fed rations containing different levels of metabolizable energy, digetible crude protein and crude fiber (Table 1). Sawdust as used to achieve the designed level of fiber (Davis and Briggs, 1947).

On 90, 180, 270, and 360 days of age ,five birds from each species were slaughtered. Birds were prevented from diet three hours before sacrificing, digestive systems were removed. Fine threads were used to tie esophagus and crop, proventiculus, gizzard, duddenum, jejunim and ilium, caecum and rectum. Each including its contents was separated.

The physiological volumes of the crop, proventriculus, duodenum, jejunum and ileum, caeca and rectum 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 the digestive tract.

The data were analysed by the analysis of variance (Steel and Torrie, 1960).

TABLE 1. **Diets fed to cokerels and drakes.**

Items	Cockerels			Drakes		
	A	B	C	A	B	C
Constituents %						
Basal ration	95.0	95.0	92.0	95.0	92.0	89.0
Blood meal	5.0	1.5	2.0	3.0	3.0	3.0
Sawdust	—	3.5	6.0	2.0	5.0	8.0
Nutritive values and fiber content						
ME kcal/kg "Calculated" . . .	2982	2910	2821	2941	2852	2759
Digestible crude protein % . .	17.8	15.1	15.1	16.2	15.8	15.4
Crude fiber %	5.40	7.48	10.04	6.18	9.04	11.92

Results and Discussion

I *Physiological volume*

1. Crop and esophagus.

In chickens, the physiological volume of the crop and esophagus increased with age. The relative physiological volume decreased with age (Table 2). The differences due to treatment and age were significant ($p < 0.01$).

In ducks, the absolute and relative physiological volumes increased with age (Table 3). The differences due to age were significant (P— 0.01 while those due to age were not significant.

TABLE 2. Effect of crude fiber levels and age on the physiological volume of the digestive tract and its segments in fayoumi cockerels.

Segments	Age (months)	Treatments											
		5% Crude fiber				7.5% Crude fiber				10% Crude fiber			
		3	6	9	12	3	6	9	12	3	6	9	12
Crop + Oesphagus	A	—	27.2	28.2	31.4	—	41.6	55.0	58.5	—	42.8	49.8	51.2
	R	—	40.1	33.4	32.3	—	50.1	52.3	42.9	—	55.9	47.9	42.8
Proventriculus	A	—	1.0	1.2	1.8	—	0.6	0.8	1.0	—	1.0	1.4	1.5
	R	—	1.5	1.4	1.9	—	0.7	0.8	0.7	—	1.3	1.4	1.3
Duodenum	A	—	4.5	6.2	6.8	—	5.0	7.0	7.6	—	5.0	5.2	6.6
	R	—	6.6	7.3	7.0	—	6.0	6.7	5.6	—	6.5	5.0	5.5
Jejunum + Ileum	A	—	18.6	27.2	33.8	—	20.0	23.0	41.0	—	11.5	25.8	33.0
	R	—	27.4	32.2	34.8	—	24.1	21.9	30.1	—	15.0	24.8	27.5
Caecum	A	1.5	2.0	3.4	4.3	1.2	2.0	3.2	7.4	1.5	2.6	3.0	4.6
	R	4.3	3.0	4.0	4.4	2.6	2.4	3.0	5.4	4.8	3.4	2.9	3.8
Rectum	A	1.0	2.7	4.3	5.0	1.8	4.8	5.2	5.8	1.7	6.1	6.6	8.0
	R	2.9	4.0	5.1	5.2	3.9	5.8	4.9	4.3	5.5	8.0	6.5	6.7
Giizzard	A	—	11.8	14.0	14.0	—	9.0	11.0	15.0	—	7.6	12.0	15.0
	R	—	17.4	16.6	14.4	—	10.9	10.5	11.0	—	9.9	11.0	12.5
Total digestive tract		35.0	67.8	84.5	97.1	46.0	83.0	105.2	136.3	31.0	76.6	103.9	119.9

A Absolute physiological volume (cm^3). R Relative physiological volume to digestive tract.

The increase in physiological volume was greater in ducks than in chickens. The elasticity of ducks crop seems to be higher than that in chickens. Similar results were obtained by Kicka (1968), Yamani (1964) and Kamar et al. (1978).

2. *Proventriculus*

In chickens, the absolute physiological volume of the proventriculus increased with age, the relative one had no trend (Table 2). The difference due to age and treatment were not significant.

The absolute and relative physiological volumes of duck's proventriculus with age (Table 3). The differences due to treatment and age were not significant.

Generally, the physiological volume increased in both chickens and ducks. the in ducks was higher than that in chickens.

3. *Gizzard*

In chickens, the physiological volume of the gizzard increased with age, the relative one had no trend (Table 2). The differences due treatment and age were not significant.

The physiological volume of duck's gizzard increased slightly with age, while the relative one decreased (Table 3). The differences due to age were not significant, while those due to treatment were significant.

4. *Small intestine*

A. Duodenum. In chickens, the absolute physiological volume of duodenum increased with age (Table 2). The relative one increased until 9 months of age for birds obtained 5 and 7.5 % crude fiber in the rations. For birds received 10 % crude fiber, the relative physiological volume decreased with age. The differences due to age and treatment were not significant.

The absolute and relative physiological volumes of duck's duodenum increased with age (Table 3). The differences due to age and treatment were not significant.

B. Jejunum and ileum. In chickens, the absolute and relative physiological volumes increased with age (Table 2). The differences due to age were significant ($P < 0.01$), while those due to treatment were not significant.

The duck's absolute physiological volume increased with age (Table 3). The differences due to treatment were significant ($P < 0.01$), while those due to age were not significant. In this connection Kamar *et al.* (1978) in chickens and Yamani (1964) in ducks obtained similar results.

TABLE 3. **Effect of crude fiber levels and age on the physiological volume of the digestive tract and its segments in pekin drakes.**

Segments	Age (months)	Treatment											
		6% Crude fiber				9% Crude fiber				12% Crude fiber			
		3	6	9	12	3	6	9	12	3	6	9	12
Crop + Oesphagus	A	91.0	112.0	114.2	117.4	100.0	103.4	107.8	116.0	94.0	103.0	106.0	116.2
	R	50.4	54.5	53.6	52.0	50.7	50.4	50.4	49.0	45.9	46.4	45.6	47.1
Proventriculus	A	4.6	5.4	5.6	7.4	4.6	5.0	5.8	8.4	6.4	8.2	9.6	9.6
	R	2.6	2.6	2.6	3.4	2.3	2.4	2.7	3.6	3.1	3.7	4.1	3.9
Duodenum	A	5.2	7.0	7.6	8.4	7.2	8.0	8.6	10.8	7.0	7.6	8.0	8.0
	R	2.9	3.4	3.6	3.7	3.7	3.9	4.0	4.6	3.4	3.4	3.4	3.3
Jejunum + Ileum	A	54.0	55.0	59.0	62.4	59.0	60.0	62.0	69.0	69.0	70.0	71.6	73.8
	R	29.9	26.8	27.7	27.7	29.9	29.3	29.0	29.2	33.7	31.5	30.8	29.9
Caecum	A	5.2	5.0	5.1	7.6	5.2	6.2	7.2	8.6	6.0	8.6	9.0	9.8
	R	2.9	2.4	2.4	3.3	2.6	3.0	3.4	3.6	2.9	3.9	3.9	4.0
Rectum	A	3.8	4.2	4.6	5.0	4.2	4.4	4.6	5.2	3.6	4.8	7.2	9.0
	R	2.1	2.0	2.2	2.2	2.1	2.2	2.2	2.2	1.8	2.2	3.1	3.7
Gizzard	A	16.6	17.0	17.0	17.4	17.0	18.0	18.0	18.6	19.0	20.0	21.0	20.4
	R	9.2	8.3	8.0	7.7	8.6	8.8	8.4	7.9	9.3	9.0	9.0	8.3
Total digestive tract		180.4	205.6	213.1	225.6	197.2	205.0	214.0	236.6	205.0	222.2	232.4	246.8

5. *Caeca*

The absolute physiological volume of caeca in chickens increased with age in all treatments studied (Table 2). The relative one was high at 3 months of age in the three treatments, it dropped slightly thereafter, followed by a moderate increase up to 12 months of age. The differences due to treatment were not significant, those due to age were significant ($P<0.01$).

In ducks, the absolute physiological volume of caecum increased all over the the ages studied (Table 3). The relative one increased with age in all treatments except birds obtained 6 % crude fiber in the ration (3). The bulky ration affected the physiological volume. The differences due to treatment and age were significant, ($P< 0.01$) and $P<0.05$) respectively.

However, the absolute physiological volume was higher in ducks than in chickens. This may indicate that ducks can tolerate more crude fiber in their rations than chickens. Similar conclusions were obtained by Mraz et al. (1956) and Kamar *et al.* (1978) in chickens.

6. *Rectum*

In chickens, the absolute and relative physiological volumes of the rectum increased with age (Table 2). The differences due to treatment were not significant, those due to age were significant ($P<0.01$).

In ducks, the absolute and relative physiological volumes of rectum increased with age (Table 3). The differences due to age and treatment were not significant.

The physiological volume of the digestive tract of Pekin drakes was larger than that in Fayoumi cockerels. Also, the high crude fiber level in the ration caused increase in the physiological volume in the digestive tract in both chickens and ducks. The increase was higher in ducks than in chickens. These results may indicate that the physiological volume was affected by the bulkiness of the ration. This enables the ducks to digest more fiber than chickens. Similar results were obtained by McNab (1973) and Sturkie (1976).

II. The tissue volume (empty volume)

For chickens and ducks, the empty volume of the total digestive tract was not affected by the bulky rations.

For the two species, the differences due to treatment were not significant, while those due to age were significant ($P<0.01$).

1. *Crop and oesphagus*

The absolute and relative tissue volume of the crop and oesphagus in chickens increased all over the ages studied (Table 4). It can be concluded that the bulky ration increased the elasticity of the crop slightly. The differences due to age and treatment were significant, ($P<0.05$) and ($P<0.01$) respectively.

TABLE 4. Effect of crude fiber levels and age on the empty valume of the digestive tract and its segments in fayoumi cockerels.

Segments	Age (months)	Treatments											
		5% Crude fiber				7.5% Crude fiber				10% Crude fiber			
		3	6	9	12	3	6	9	12	3	6	9	12
Crop + Oesphagus	A	—	6.8	10.8	11.6	—	7.4	12.0	16.5	—	7.2	11.2	12.8
	R	—	8.0	8.5	10.2	—	7.7	10.0	13.5	—	7.3	10.3	11.1
Proventriculus	A	—	2.4	3.5	3.4	—	3.6	3.1	4.6	—	3.5	3.2	4.1
	R	—	2.8	2.8	3.0	—	3.8	2.6	3.8	—	3.5	2.9	3.6
Duodenum	A	—	5.9	14.0	9.6	—	7.4	9.2	11.0	—	7.4	9.3	12.4
	R	—	6.9	11.1	8.4	—	7.1	7.7	9.0	—	7.4	8.5	10.8
Jejunum + Ileum	A	—	18.4	25.8	19.2	—	23.0	21.0	20.0	—	26.5	22.2	21.0
	R	—	21.6	20.4	16.9	—	24.0	17.5	16.3	—	26.6	20.4	18.3
Caecum	A	2.5	3.2	5.6	5.1	2.8	2.8	3.8	4.6	2.6	3.6	4.2	4.6
	R	3.9	3.8	4.4	4.5	4.9	2.9	3.2	3.8	4.1	3.6	3.9	4.0
Rectum	A	2.7	3.6	5.8	6.8	2.7	2.8	6.8	7.0	3.3	5.3	6.0	7.2
	R	4.2	4.2	4.6	6.0	4.7	2.9	5.7	5.7	5.2	5.3	5.5	6.3
Gizzard	A	—	19.4	27.0	24.0	—	21.0	25.0	25.0	—	19.0	23.0	23.0
	R	—	22.8	21.3	21.1	—	21.9	20.9	20.4	—	19.0	21.1	20.0
Liver	A	—	25.4	34.0	34.0	—	28.0	39.0	34.0	—	27.0	30.0	30.0
	R	—	29.8	26.9	29.9	—	29.2	32.5	27.7	—	27.1	27.5	26.1
Total digestive tract		65.0	85.1	126.5	113.7	57.0	96.0	119.9	122.7	63.0	99.5	109.1	115.1

A = Absolute volume (cm^3). R = Relative volume to digestive tract.

TABLE 5. **Effect of crude fiber levels and age on the empty volume of the digestive tract and its segments in pekin drakes.**

Segments	Age (months)	Treatments											
		6% Crude fiber				9% Crude fiber				12% Crude fiber			
		3	6	9	12	3	6	9	12	3	6	9	12
Crop + Oesphagus	A	15.0	13.0	17.8	16.6	13.0	16.6	12.2	10.0	12.0	8.4	11.0	13.8
	R	6.8	6.8	8.6	7.7	6.3	8.3	5.3	5.8	4.9	4.4	6.6	7.6
Proventriculus	A	7.4	7.6	7.6	8.0	5.4	5.4	7.6	4.8	8.6	6.6	6.2	7.2
	R	3.3	4.0	3.7	3.7	2.6	2.7	3.3	2.8	3.5	3.4	3.7	3.9
Duodenum	A	16.8	15.0	14.4	15.2	16.0	13.6	19.8	19.6	20.0	17.0	14.4	12.4
	R	7.6	7.8	7.0	7.0	7.8	6.8	8.6	5.6	8.1	8.9	8.6	6.9
Jejunum + Ileum	A	38.0	30.0	35.0	41.6	35.0	37.0	43.0	34.0	43.0	32.0	27.0	30.2
	R	17.2	15.7	16.9	19.3	17.0	18.4	18.6	19.8	17.4	16.7	16.1	16.5
Caecum	A	5.0	3.8	4.3	4.6	5.0	4.4	5.8	4.2	5.0	4.8	3.8	4.6
	R	2.3	2.0	2.1	2.2	2.4	2.2	2.5	2.5	2.1	2.5	2.3	2.5
Rectum	A	12.0	5.2	5.2	4.0	11.4	4.8	5.2	5.0	9.0	5.2	4.0	5.6
	R	5.4	2.7	2.5	1.9	5.5	2.4	2.3	2.9	3.6	2.7	2.4	3.1
Gizzard	A	64.4	52.0	62.0	63.0	59.0	55.0	76.0	49.0	76.0	54.0	49.0	52.0
	R	29.1	27.1	30.0	29.2	28.7	27.4	32.0	28.6	30.7	28.1	29.3	28.5
Liver	A	62.0	65.0	60.4	63.0	61.0	64.0	62.0	55.0	74.0	64.0	52.0	57.0
	R	28.1	33.9	29.2	29.2	29.6	31.9	26.8	32.1	29.9	33.3	31.1	31.2
Total digestive tract		220.6	191.6	206.7	216.0	205.8	200.8	231.6	171.6	247.6	192.0	167.4	182.8

A = Absolute volume (cm^3). R = Relative volume to digestive tract.

In ducks, the absolute and relative volume did not show certain trend with age (Table 5). The differences due to treatment were significant (>0.01) while, those due to age were not significant.

2. *Proventriculus*

In chickens, the absolute and relative volumes of the proventriculus had no constant trend with age (Table 4). The differences due to treatment were significant ($p<0.01$) while, those due to age were not significant.

In ducks, the absolute and relative volume increased slightly with age in both treatments containing 6 and 9 % crude fiber in the ration (Table 5). For birds received 12 % crude fiber in the ration, the absolute volume decreased with age up to 9 months. The differences due to treatment were significant ($P<0.01$) while, those due to age were not significant.

3. Small intestine

A. Duodenum : In chickens, the absolute and relative volumes of the duodenum showed a fluctuating trend with age in the treatment of 5 % crude fiber while, this segment was increased with the advancement of age in the other treatments. The differences due to treatment were not significant while, those due to age were significant ($P<0.01$).

In ducks, the absolute and relative volumes showed fluctuated trend in both treatments having 6 and 9 % crude fiber in the rations, while, the values of this segment were decreased with age in the third treatment. The differences due to treatment were not significant while, those due to age were significant ($P<0.01$).

B. Jejunum and ileum : In chickens, the absolute and relative volumes had no certain trend with age for birds received 5 % crude fiber level, with a tendency of a decline for the other treatments. The differences due to age and treatment were not significant.

In ducks, the absolute and relativa volumes had no certain trend with age (Table 5). The differences due to age and treatment were not significant.

In general, the bulky ration does not affect the gastrointestinal tract volume in both chickens and ducks. These results were also observed by Hindawy (1976) and Kamar et al . (1978).

4. *Caeca.*

In chickens, the absolute tissue volume increased all over the ages studied (Table 4). The relative volume was high at 3 months of age in all treatments, it dropped thereafter, then increased at 9 and 12 months of age. The differences due to treatment and age were significant, ($p<0.05$) and ($p<0.01$) respectively.

In ducks, the absolute and relative tissue volumes were high at 3 months of age in all treatments (Table 5). These results may indicate that the caecum is an early in maturity part in ducks. Therefore, the ducks may digest more fiber than chickens. The differences due age and treatment were not significant.

Generally, the volume of caecum was higher in ducks than that in chickens. In chickens, the volume was affected slightly by the bulky ration, it was not affected in ducks. Daeder (1972), Hindaway (1976) and Kamar et al. (1978) obtained similar results in Fayoumi chickens.

5. *Rectum*

In chickens, the absolute and relative tissue volume increased with the advancement of age (Table 4). The differences due to treatment were not significant while, those due to age were significant ($p<0.01$).

In ducks, the absolute and relative volume was high at 3 months of age (Table 5). The differences due to treatment were not significant while, those due to age were significant. ($P<0.01$).

6. *Gizzard.*

In chickens, the volume of gizzard increased with age up to 9 months, then decreased in the treatment receiving 5 % crude fiber or stopped in the other treatments (Table 4). The relative volume decreased with the advancement of age. The differences due to treatment were not significant while, those due to age were significant ($P<0.05$).

In ducks, the absolute and relative volume showed fluctuated end with age (Table 5). The differences due to treatment were not significant while, those due to age were significant ($P<0.01$).

References

Ash, W.J. (1976). *Raising Ducks.* Farmers Bulletin No. 2215, USDA.

Daeder, A.H. (1972). The effect of food bulkiness and fiber level on digestive tract of chicks *M.Sc. Thesis,* Ain-Shams University.

Davis, F. and Briggs, G.M. (1947). The growth promoting action of cellulose in purified diet for chicks. *J. Nut.* 34, 295.

Hindaway, M.M. (1976). Comparative studies on the digestive system of pultry and its relationship with the size of the ration using bulky food. *M. Sc. Thesis,* Cairo University

Ibrahim, N.A.M. (1969). Some nutritional studies on the effect of crude fiber in poultry rations with reference to their production. *M. Sc. Thesis,* Cairo University.

Kamar, G.A.R. and Mostageer, A. (1963). The physiological causes of differences in efficiency utilization in chickens. *Egypt. J. Anim. Prod.*, 11 : 385-389.

Kamar, G.A.R., Kicka, M.A. and Darwish, A.A. (1978). Development of the digestive system in chickens and turkeys. *Egypt J. Anim. Prod.*, 18, 121.

Kicka, M.A.M. (1968). The effect of some managerial treatments on egg production in fayoumi fowl. *M. Sc. Thesis*, Cairo University.

McNab, J.M. (1973). The avian cacca. A review. *World's Poultry Sci.*, 3, 251.

Mraz, F.R., Boucher, B.V. and McCartney, M.G. (1956). The influence of dietary productive energy and fiber on growth response in chickens. *Poultry Sci.*, 358, 1335.

National Academy of Sciences — National Research Centre. (1977). "*Nutrient Requirements of Poultry*". Washingtong, D.C. 7*th* rev. ed.

Steel, R.G. and Torrie, J.H. (1960). *Principles and Procedures of Statistics.* McGraw-Hill Book Co., New York.

Sturkie, P.D. (1976). "*Avian Physiology*". 7*th* Ed. Ithaca, N.Y. Cornell Univ.

Yamani, K.A.O. (1964). Developmental Changes in body organs, glands and tissues of ducks *M.Sc. Thesis* Cairo Univ. Fac. Agric.

تأثير التغذية بمستويات مختلفة من الألياف الخام للدجاج على بعض الاعتبارات الفسيولوجية للجهاز الهضمى ٢ ٠ السعة الفسيولوجية والحجم

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كلية الزراعة جامعة القاهرة * والمركز القومى للبحوث ٠ مصر

كانت السعة الفسيولوجية للجهاز الهضمى عالية فى البط أكثر من الدجاج ٠ سببت النسبة العادية من الالياف الخام فى العليقة زيادة فى السعة الفسيولوجية للقناة الهضمية فى كل من الدجاج والبط ، وكانت الفروق نتيجة للعمر والمعاملة معنوية ٠ كان الاتجاه واحد فى كل من الدجاج والبط فى زيادة السعة الفسيولوجية ولكن كانت فى البط أعلى ، بينما بالنسبة للسعة الفسيولوجية النسبية كانت أعلى فى الدجاج عن البط مما يوضح أن البط يتحمل نسبة أعلى من الألياف فى العلائق ٠ لم يتأثر حجم الجهاز الهضمى والاجزاء المختلفة منه كثيرا بحجم العليقة ٠