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Effect of Feeding Different Fiber Levels to Chickens and Ducks on Some Chemical Aspects of the Alimentary Tract

G.A.R. Kamar, H.M. Mourad, M.S. Samy and N.A.H. Ahmed

Departments of Animal Production, Faculty of Agriculture, cairo University and National Research centre, Dokki, Cairo - Egypt.

INVESTIGATION was carried out for determining some chemical aspects for the alimentary tract segment's contents of Fayoumi cockerels and Pekin drakes fed on diets containing different crude fiber levels and sacrificed on different ages. The pH values of segment's contents of the digestive tract in drakes were higher than those in cockerels except in the case of caecum which was nearly similar in both species. Slight increase in pH values was noticed as age increases in both species. The pH of gut contents in both species slightly increases with increasing the crude fiber content of the diets. The volatile fatty acids (VFA's) production in the digestive organs of ducks was higher than that of chickens. The highest values of VFA's concentration were observed in the caecum followed by rectum, jejunum and ilium then dudenum and crop respectively. The crude fiber % on dry matter basis of the different segment's contents influenced by age and feeding diets containing different levels of crude fiber for chickens and ducks. The highest crude fiber was observed in a descending trend in the contents of rectum, crop, jejunum and ilium, caecum then dudenum. The highest dry matter content was observed in the crop, rectum, jejunum and ilium, dudenum and finally caecum for the two species. The crude fiber levels in the diets of chickens and ducks reflected on slight decrease of dry matter content in the digestive tract segments contents.

Feed costs constitute from 50 to 70 percent of total poultry production costs. This emphasizes the reasons for the use of economical and efficient feeds. When small savings in feed cost can be made without reducing the nutritive quality of the ration, such savings can mean a profit rather than a loss. Physiology of digestion studies represent an important role in clearing the basis of poultry nutrition.

The age of chickens had no significant influence on the pH of the digestive tract organs (Herpol, 1966). The volatile fatty acids (VFA' S) are the major final products of fermentation in the alimentary tract of the fowl and that the caeca is one of the major sites of VFA's production (Annison and Kenworthy, 1968). Sturkie (1967) mentioned that there are evidence in favor of the ceaca as the organ of crude fiber digestion and caecatomy decreased its digestion.

Experimental

Numbers 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).

On 4th week 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, digestible crude protein and crude fiber (Table 1). Sawdust was used to achieve the designed level of fiber (Davis and Briggs, 1974).

On 90, 180, 270 and 360 days of age, five birds from each species were slaughtered. Birds were prevented from diet three hr. before sacrificing, digestive systems were removed. Fine threads were used to tie esophagus and crop, proventiculus, gizzard, duedenum, jejunum and ilium, caecum and rectum. Each segment including its contents were separeted. PH was determined for the contents of the crop, dudenum, jejunum and ilium, caecum and rectum. Afterwards, each segment was preserved individually in deep freeze (—18°). Fresh samples were taken from the contents of each mentioned segment for VFA's determinations. The fresh residual was weighed after drying at 60° for 24hr to determine the air dried weight. Crude fiber and VFA's were calculated on the dry matter basis.

pH measurements were done directly using Beckman pH-meter. The methods of Eaide et al. (1967) and A.O.A.C. (1975) were used for determining VFA's, dry matter and fiber respectively.

TABLE 1. **Diets fed to cockerels 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

Result and Discussion

1. *Hydrogen ion concentration (pH)*

Table (2) shows the effect of age and different crude fiber levels in the diet on the digesta-pH in the different parts of the alimentary tract for the chickens and ducks. It is obvious that the pH values of the segments content's of the gut in ducks are higher than those of chickens, except the caecum which is nearly similar in both species. The above mentioned findings are in agreement with that of Farner (1942), Herpol (1966) and Mattocks (1971).

The effect of age on the pH values of the different segments content' s of the gut regardless the crude fiber levels, reflected slight increase in pH values as age increases in both species. The above result is in contrast to that cited by Herpol (1966).

Generally, data in Table (2) showed that the pH values of the alimentary canal content' s in both species increases with increasing the crude fiber content of the rations.

2. *Total volatile fatty acids (VFA' s)*

The effect of age and different crude fiber levels on VFA'S concentration as (m. eq/ 100 g dry matter) in the chickens and ducks digestive tracts is presented in Table (3). For the ducks, it is observed that VFA' s production in the digestive organs was higher than that of chickens.

It can be concluded that VFA 's production in the digestive tract organs of the chickens and ducks can be arranged in a descending order as follows caeca, rectum, jejunum and ilium, dudenum then crop. These results are in agreement with those reported by Beattie and Shrimpton (1958),Annison and Kenworthy (1968) and McNab (1973). In the meantime, Bolton (1965) and Ivorec *et al.* (1976) mentioned that extensive hydrolysis of starch and sugars by microorganisms occurs in the crop. In the present work a low VFA' s concentration was determined in the crop contents. This may be due to the rapid absorption in the chicken' s crop wall (Ivorec *et al.*, 1976). Concerning the effect of age on VFA' s concentration regardless crude fiber levels fed, VFA' s concentration in ducks increased with age up to 9 month and levelled off or declined as observed 9 months of age. The lowest values were observed on 3rd and 12th month. Meanwhile, contradictory results were obtained on chickens, *i.e.*, VFA' s concentration decreased with increasing age specially in the caeca. The results concerning VFA' s in the duck' s gut coincide with that found by Hillerman *et al.* (1953).

3. *Crude fiber content of the digesta*

The data concerning the crude fiber content on dry matter basis of digesta of the different segments of the digestive tract of Fayoumi cockerels and Pekin drakes are presented in Table (4). It is not worthy to compare the two species received crude fiber levels. Generally, for cockerels, the crude fiber varied from segment to another on the dry matter basis, the highest crude fiber percent was present in a descending trend in the contents of rectum, jejunum and ilium, caecum then dudenum. The corresponding arrangement for drakes was rectum jejunum and ilium, crop, caecum then rectum.

TABLE 2. Effect of fiber levels and age on the pH of the different segments contents of the digestive tract in Fayoumi cockerels and Pekin drakes.

Segment	Age (months)	Cockerels, 5% (CF) Drakes, 6% (CF)				Cockerels, 7.5% (CF) Drakes, 9.0% (CF)				Cockerels, 10% (CF) Drakes, 12% (CF)			
		3	6	9	12	3	6	9	12	3	6	9	12
Crop	Cockerels	—	5.1	5.1	5.1	—	4.8	5.4	5.4	—	4.9	5.3	5.4
	Drakes	6.2	5.5	5.6	6.4	5.0	5.5	6.0	6.4	5.5	5.5	6.0	6.4
Duodenum	Cockerels	—	5.8	6.08	6.2	—	6.0	6.4	6.0	—	6.1	6.1	6.3
	Drakes	6.4	6.0	6.4	6.5	6.2	6.0	6.2	6.6	6.2	6.0	6.0	6.5
Jejunum + ilium	Cockerels	—	6.0	6.1	6.0	—	6.1	6.5	6.4	—	6.1	6.1	6.5
	Drakes	6.5	6.3	6.4	6.8	6.6	6.8	6.5	6.8	6.3	6.3	6.3	6.4
Caecum	Cockerels	6.7	6.5	6.8	6.7	6.2	7.5	7.3	6.8	6.6	6.5	7.0	6.8
	Drakes	6.6	6.5	6.5	6.7	6.5	6.3	6.6	7.4	6.6	6.5	6.6	7.1
Rectum	Cockerels	6.0	6.0	6.9	6.8	7.2	6.6	7.4	7.3	6.9	6.7	6.9	7.1
	Drakes	7.0	6.9	7.0	7.1	6.9	8.0	7.5	7.7	7.2	8.0	7.5	7.7

TABLE 3. Effect of fiber levels and age on VFA's concentration (m.eq/100 g dry matter matter) of the digesta of the different segments of the digestive tract in Fayoumi cockerels and Pekin ducks.

Segments	Age (months)	Cocke els, 5% (CF) Drakes, 6% (CF)				Cocke·els, 7.5% (CF) Drakes , 9.0% (CF)				Cockeresl, 10% (CF) Drakes , 12% (CF)			
		3	6	9	12	3	6	9	12	3	6	9	12
Crop	Cockerels	—	9.3	11.0	13.8	—	14.6	13.6	13.7	—	20.3	14.1	17.6
	Drakes	20.3	20.0	17.1	23.3	18.3	19.6	20.7	21.3	20.7	19.3	18.9	17.5
Dudenum	Cockerels	—	14.8	13.6	13.5	—	14.1	15.8	16.4	—	30.7	14.7	26.3
	Drakes	14.5	17.1	22.0	16.3	15.0	24.1	29.2	26.1	18.3	35.5	27.9	22.7
Jejunum + ilium	Cockerels	—	14.4	16.1	20.5	—	20.0	17.4	18.0	—	21.9	16.5	16.3
	Drakes	27.9	34.9	42.1	54.7	27.5	44.9	33.0	40.0	21.6	76.0	35.5	27.8
Caecum	Cockerels	—	133.9	62.2	68.0	—	119.3	69.5	71.9	—	112.5	71.9	72.6
	Drakes	61.3	85.7	120.0	83.9	105.0	113.0	113.0	78.1	111.0	265.0	146.0	85.7
Rectum	Cockerels	—	57.1	36.3	47.6	—	53.2	38.8	39.3	—	37.0	40.8	65.9
	Drakes	44.1	60.2	58.5	58.8	51.5	57.1	32.0	54.1	58.6	57.1	43.0	49.1

The high crude fiber content in the rectum may indicate that the crude fiber is less digestible and / or completely undigestible, this may be explained on the basis that the figures of crude fiber are calculated as percentage and not as amount. In other words, the increased concentration of crude fiber means that the other nutrients are digested and absorped but the crude fiber remain in undigestible form in the rectum until excreted in the droppings (Mangold, 1934, Mass, 1943 and Saito and Kibe, 1957).

The small intestine appears to have no role in crude fiber digestion, that no traces of cellulose to be found in the fowl' s gut (Thornburn and Wilcox, 1965) and the pH of these sites are unable for microbial fermentation. However, the dudenum content of crude fiber was low. This might be due to speed of passage from this part (Hillerman at al., 1953).

The caecal fiber content was observed to be lower (4·5 and 6·4 % for chickens and ducks respectively) than any other parts of the gut. Two assumptions may explain this observation, (1) the crude fiber did not enter the caeca, thereby the caeca did not contribute to the feed utilization by cellulose digestion (Mattocks, 1971). However, in this work, increasing crude fiber of the caecal content was observed by increasing its level in the diet, It might be a reason to reject this assumption, (2) the crude fiber entered the caeca and digested. Many workers ensured this view in vivo and vitro experiments on caecatomy and intact birds (Herpol, 1967, Mangold, 1934, Halnan, 1949, Thornburn and Willcox, 1965 and Sturkie, 1967).

Concerning the main effect of age regardless the effect of fiber level on crude fiber content of the gut, there was no certain trend, indicating that the age had had no effect on crude fiber content of the different parts of the gut in both chickens and ducks.

4· *Dry matter content (DM)*

The data concerning dry matter (DM) content of the different gut's segments are presented in Table (5) . The results showed that the dry matter was higher in the duck' s crop than that in the crop of chickens.

For chickens and ducks, the highest dry matter content was observed in crop followed by rectum then jejunum and ilium, dudenum and finally caecum. there results revealed that the dry matter tended to be higher in the crop, rectum and lower in the small intestine and caeca. It might sustain the role of the small intestine and caecum in water absorption (Thornburn and Wilcox, 1965, Mattocks, 1971 and Sturkie, 1967).

The results concerning the main effect of age regardless the different fiber levels in chickens and ducks showed irregular trend. Generally the increase in crude fiber levels in the diets of chickens and ducks reflected a slight decrease of dry matter content in the digestive organs.

TABLE 4 Crude fiber content on dry matter basis of the digesta of different segments of the digestive tract in Fayoumi cockerels and Pekin drakes.

Segments	Age (months)	Cockerels, 5%(CF) Drakes, 6% (CF)				Cockerels, 7.5% (CF) Drakes, 9.0% (CF)				Cockerels, 10% (CF) Drakes, 12% (CF)			
		3	6	9	12	3	6	9	12	3	6	9	12
Crop	Cockerels	—	7.19	9.61	7.42	—	11.80	10.81	11.69	—	11.72	12.03	12.50
	Drakes	8.72	8.80	8.87	8.45	10.45	9.18	9.87	12.40	10.85	11.79	13.71	13.68
Dudenum	Cockerels	—	3.27	4.21	2.73	—	4.08	4.19	4.74	—	5.12	5.14	5.72
	Drakes	3.40	2.21	5.04	5.29	2.58	4.49	5.47	4.60	3.79	5.48	5.04	7.61
Jejunum + ilium	Cockerels	—	7.51	7.94	7.64	—	8.55	8.55	8.89	—	9.61	8.99	9.17
	Drakes	12.94	11.94	9.66	9.01	14.17	13.81	10.62	9.96	16.25	12.41	9.94	13.07
Caecum	Cockerels	—	3.82	3.41	4.91	—	4.07	5.03	4.39	—	5.22	6.30	5.10
	Drakes	4.75	6.55	5.41	5.44	5.84	6.89	7.09	7.85	6.81	6.14	5.32	8.23
Rectum	Cockerels	—	11.87	11.69	14.40	—	13.61	14.15	13.29	—	18.67	14.47	13.23
	Drakes	14.43	11.35	13.43	15.37	14.59	15.39	18.17	17.56	21.30	16.64	19.28	19.39

TABLE 5. Dry matter content of the digesta of different segments of the digestive tract in Fayoumi cockerels and Pekin drakes.

Segments	(Age (months)	Cockerels, 5% (CF) Drakes, 6% (CF)				Cockerels, 7.5% (CF) Drakes, 9.0% (CF)				Cockerels, 10% (CF) Drakes, 12% (CF)			
		3	6	9	12	3	6	9	12	3	6	9	12
Crop	Cockerels	—	24.1	42.7	35.6	—	23.8	46.1	28.7	—	25.5	43.1	28.3
	Drakes	42.2	37.3	34.8	30.6	32.6	37.7	39.4	30.2	37.5	39.2	35.7	38.3
Dudenum	Cockerels	—	19.4	35.3	18.8	—	18.1	19.5	18.4	—	18.3	20.2	18.6
	Drakes	21.6	21.8	19.2	16.5	18.7	24.3	18.0	25.0	17.1	15.9	20.1	19.1
Jejunum + ilium	Cockerels	—	18.3	30.4	18.8	—	17.8	22.6	22.3	—	19.8	23.7	26.4
	Drakes	22.0	19.8	18.3	20.2	18.6	20.2	18.0	24.6	18.3	17.2	20.7	24.9
Caeca	Cockerels	—	15.7	25.6	13.4	—	16.8	19.0	12.7	—	16.6	21.1	15.2
	Drakes	18.8	19.4	19.2	20.0	13.7	23.2	15.6	21.3	17.5	13.0	18.9	21.8
Rectum	Coakerels	—	21.1	34.3	25.5	—	19.9	20.4	26.2	—	24.2	26.8	19.1
	DrIkes	21.9	22.6	17.8	18.8	17.7	27.8	25.0	26.2	18.7	16.0	26.0	21.4

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تأثير التغذية بمستويات مختلفة من الألياف الخام للدجاج والبط على بعض المدلولات الكيماوية للجهاز الهضمى

محمد جمال الدين قمر ، حمدى محمد مراد ، محمد سعيد سامى ونجوى عبد الهادى أحمد

كلية الزراعة ـ جامعة القاهرة والمركز القومى للبحوث ـ مصر

أجريت هذه الدراسة لتقدير بعض المدلولات الكيماوية لمحتويات أجزاء الجهاز الهضمى للديوك الفيومى وذكور البط البكينى المغذاة على علائق محتوية مستويات مختلفة من الألياف الخام مع ذبح الطيور عند أعمار مختلفة • تبين أن قيم تركيز أيون الايدروجين لمحتويات أجزاء الجهاز الهضمى كانت أعلى فى ذكور البط عنه فى ديوك الدجاج عدا منطقة الاعور حيث كانت القيم متشابهة فى كلا النوعين • لوحظ زيادة طفيفة فى قيم تركيز أيون الايدروجين مع تقدم العمر فى كلا النوعين • تبين زيادة فى تركيز أيون الايدروجين لمحتويات الجهاز الهضمى لكلا النوعين مع زيادة محتوى الألياف فى الغذاء • وجد أن انتاج الأحماض الدهنية الطيارة فى الجهاز الهضمى للبط كان أكثر منه فى الدجاج • ولقد كان أعلى تركيز للاحماض الدهنية الطيارة فى الاعور يليه المستقيم ، الجزء الأوسط والأخير من الأمعاء الدقيقة ، الجزء الأول من الأمعاء الدقيقة وأخيرا الحوصلة • كانت النسبة المئوية للالياف على أساس المادة الجافة فى الأجزاء المختلفة للجهاز الهضمى لكل من الدجاج والبط ذات علاقة بالعمر ومحتوى الألياف فى الغذاء • ولقد كانت النسبة المئوية للالياف أعلاها فى المستقيم يليها الحوصلة ، الجزء الأوسط والأخير من الامعاء الدقيقة ، الاعور وأخيرا فى الجزء الأعلى من الامعاء الدقيقة • وأعلى معدل للمادة الجافة كان فى الحوصلة يليه المستقيم ، الجزء الأوسط والأخير من الأمعاء الدقيقة ، الجزء الأول من الامعاء الدقيقة ، وأخيرا الأعور وذلك لكلا النوعين من الطيور • ولقد كان لمحتوى الألياف الخام فى الأغذية للدجاج والبط تأثيرا مخفضا لمحتوى المادة الجافة فى أجزاء الجهاز الهضمى •