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飼料內 纖維素 水準이 브로일러의 消化器 발달과 腸內容物의 通過 시간에 미치는 영향

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The Effect of Dietary Fiber Levels on the Size of Brolier's Gut and Chromium Turnover Time in Each Segment

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摘 要

3週齡 부로일러형 병아리를 암수 混合하여 12處理에 battery 當 10마리씩 2反覆의 4x 3x 2형 요인 實驗設計에 依하여 實驗을 實施하였다. 試驗飼料는 0, 10 그리고 20% 의 밀기울 添加區와 20% 밀기울에 0.008%의 cellulase를 添加하여 利用하였다. 5주간 사양이 끝난 후 위의 4가지 다른 比率로 밀기울이 混合된 飼料에 1%의 chromic oxide를 배합하여 하루 100 g씩 給與하였다. 2日間의 豫備期間을 거친 후 다음 2일동안 飼料給與後 2時間, 4時間, 8時間 마다 하루 3번씩 분을 取採하여 다음 分析을 위하여 빙점 이하에서 보관하였다. 2일동안의 분 採取를 끝낸후 각 battery에서 임으로 5마리씩 採取하여 도살후 곧 소화기 전부(식도 첫 부분에서 항문 까지)를 蒐集하여 각 부위별로(근위, 십이지장과 공장, 회장, 맹장, 직장) 묶은 다음 각 부위의 길이를 測定하였으며 근위는 내용물을 제거한 후 무게를 測定하였다.

試驗結果에 依하면 밀기울 添加 水準이 다른 구와 cellulase를 添加한 구들간에 소화기의 길이는 차이를 보이지 않았다. 그러나 對照區에서 각 부위에서 근위의 무게는 현저히 ($P<0.05$) 가벼웠으며 소화기 각 부위에서 chromium이 머무는 시간은 밀기울 處理水準에 따라 차이가 나타나지 않았다.

I. Introduction

Variations in gut size associated with variations in diet have been found among different populations and in different seasons of the year within species. The guts of California quail are longer in winter when the diet is more fibrous and less digestible than in summer (Lewin, 1963) and the guts of wild red grouse, eating mainly heather, are longer than those of captive grouse fed on a concentrated pelleted diet (Moss, 1972). Savory and Gentle (1976) also showed that gut size was larger in brids fed on a high-fiber diet, in females and in older birds. In swine, organ weight, when expressed as a percentage of body weight, was increased for total gastrointestinal tract (GIT), small intestine, cecum and colon as dietary alfalfa increased (Kass et al., 1980).

Similarly, the rate of feed passage through the gastrointestinal (GI) tract of the fowl has been investigated (Cherry and Siegel, 1981). However, they did not consider the relationship between the

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retention time of the different levels of the fiber diet in each segment and chromium as a marker in the rate of passage studies.

The experiments described in this report were conducted to obtain information on the differences of gut size and on the chromium turn over time in each segment and the entire GI tract of chickens fed diets of different fiber contents.

Ⅱ. Materials and Methods

Three-week-old, broiler-type, mixed sex chicks were used in a study conducted for five weeks. The four experimental diets for this study were: 1) an 18% (15% from 7 weeks of age) protein corn-soy control diet, 2) control diet plus 10% wheat bran, 3) control diet plus 20% wheat bran, 4) control diet plus 20% wheat bran plus 0.008% cellulase. Chicks were assigned to 24 groups of 10 chicks for two replicates of 12 treatments. A completely randomized experiment with a 4x3x2 factorial arrangement was used.

After a five-week experimental period without a marker a 24-pen battery of the four diets were supplemented with 1% chromic oxide and fed 100g per bird daily. The diets containing chromic oxide were fed for a 2-day preliminary period and for a 2-day collection period. Feces were collected three times daily from each diet group for two days at 2, 4 or 8 hours after feeding. At the end of 4 days, within each diet group, birds were randomly selected for slaughter at 2, 4 or 8 hours after feeding and the entire gastrointestinal tract was removed and ligated to form five compartments: the gizzard; the proximal small intestine, which is the duodenum and jejunum; the distal small intestine, which is the ileum; the cecum and the rectum. The lengths of the proximal small intestine, the distal small intestine, the cecum and the rectum were measured after straightening, and the gizzard was emptied and weighed. The digesta from each compartment was removed for analysis and immediately weighed, placed in aluminum pans and freeze dried. The dried samples were ground using a 1 mm mesh Udy mill. Samples of dried feed, feces and gastrointestinal contents were stored in air-tight glass bottles until analyzed.

Samples were analyzed for chromic oxide content by the Bolin procedure (Bolin et al., 1952). Chromium turnover time in each segment and in total GI tract was calculated as described by Uden (1978). A computer program (Barr et al., 1982) was used to compare treatment effects. Duncan's Multiple Range Test was used to determine treatment differences when the F-test was significant ($P < 0.05$).

Ⅲ. Results and Discussion

The effects of level of wheat bran on gut dimensions are shown in Table 1.

Adding wheat bran to the basal diet increased gizzard weight. The group fed on the high-energy basal diet had the lowest gizzard weight ($P < 0.05$). The main reason for the longer guts of birds fed on high-fiber diets appears to be their greater food intake (Savory and Gentle, 1976). They also said that gut size was larger in birds fed on high-fiber diets, in females and in older birds. But Fenna and Boag (1974) found no differences in food intake or gut size between quail fed on a low-fiber diet and those fed on the same diet containing 300g cellulose/kg. However, this supports the idea that gut size is more closely related to food intake than to intrinsic properties of fiber.

Cellulase supplementation showed no effect on gizzard weight. There were no significant effects of diet on gut dimensions of the small intestine, cecum and rectum (Table 1).

Presumably the gut of birds fed 20% wheat bran plus cellulase in this research did not have to accommodate more material at a time or pro-

Table 1. Effect of dietary wheat bran level on gastrointestinal tract measurements of chicks.

Diet	Gizzard	Prox. Small Intestine	Dist. Small Intestine	Cecum	Rectum
	% Body Wt.	cm	cm	cm	cm
0% Wheat bran	1.28[a)]	76.52	51.48	16.20	7.01
10% Wheat bran	1.50[b)]	76.16	51.24	16.42	6.82
20% Wheat bran	1.53[b)]	74.49	50.11	16.00	6.83
20% Wheat bran +Enzyme	1.51[b)]	75.27	50.63	16.01	7.20

a-b) Mean values not having a common superscript are significantly different at the 5% level of probability.

vide greater areas for absorption than that of those receiving the control 20% wheat bran diets. Hesselman et al. (1982) also found that there were no significant differences in the weight of ceca expressed as a percentage of body weight between their enzyme treatment group and a non-enzyme treatment group.

The rate of passage of digesta through the gizzard, proximal small intestine, distal small intestine, cecum and rectum and entire GIT of chicks fasted for 2, 4 or 8 hours as estimated by chromium turnover time (total chromium in segment/total intake in 24 hours) are summarized in Table 2.

Table 2. Chromium turnover time[(a)] (Turnover time by diet) in gizzard, proximal small intestine, distal small intestine, cecum, rectum and entire gut of chicken fed 0, 10, 20 or 20% wheat bran plus enzyme.

Diet	Gizzard	Prox. small Intestine	Dist. small Intestine	Cecum	Rectum	Total
	min.	min.	min.	min.	min.	min.
0% wheat bran	61.43	121.55	45.40	11.67	21.50	271.15
10% wheat bran	50.77	104.40	53.35	8.83	17.65	234.30
20% wheat bran	50.13	87.25	59.35	8.17	16.45	226.25
20% puls enzyme	56.83	100.15	61.25	11.77	16.45	241.00

(a) Chromium turnover time=Total chromium in segment/total chromium intake in 24hrs.

Chromium turnover time (minutes) in the gizzard, proximal small intestine, distal small intestine, cecum, rectum and entire GIT of chicks tended to decrease as the level of wheat bran increased, but the differences were not significant. Addition of cellulase apparently showed longer retention time but there were no significant differences. Castle and Castle (1956) and Kass et al. (1980) reported that the length of time digesta remain in GIT, where it is exposed to digestive enzymes and microfloral action, is greater when cell wall content in the diet is reduced.

The passage rate is affected by various factors. Hillerman et al. (1953) said that laying and non-laying hens had about the same rate; 3 hours and 45 minutes, and 3 hours and 50 minutes respecti-

vely. They also showed that food passes through th alimentary canal of laying turkey hens in 3 hours and 13 minutes and through non-layers in 4 hours and 16 minutes. According to Fedorovskii (1951), the first food entering the crop passes directly across the dorsal portion, through the proventriculus, and into the gizzard within 2 minutes. Thus using starved birds should result in the minimum food passage time. A 2 to 5 hour spread in food passage time was observed in similar birds in these tests.

Nakahiro et al. (1974) reported that the ratio of chromic oxide to crude fiber showed almost the same tendency as to the crude fiber content, and both the crude fiber content and the rates were remarkably lower in the cecum than those in the lower ileum and the rectum. They suggested that this fact may indicate that a portion of intestinal ingesta was selectively introduced into the ceca. Jensen et al. (1957) followed the passage of meal supplemented with chromic oxide through chicks fed *ad libitum* and found that peak excretion of the marker occurred five hours after the meal with small quantities being excreted through ten hours after withdrawal of the marked feed. McRae (1974) said that chromic oxide has a density of 5.25 and an extremely fine particle size and is probably not moving with the same speed as the solid digesta, especially not in herbivoras.

It seemed possible that some of the variation in the mean retention time might be a function of differences between marker and diet. Consequently, chromic oxide is not fully represntative of the diet. This could introduce an error. The method, described by Uden (1978), appears to have several advantages over more conventional procedures, but its limitations should be recognized.

Ⅳ. Summary

Three-week-old, broiler-type, mixed sex chicks were divided into replicate groups of 10 birds each and fed for 5 weeks. The wheat bran was defatted and added at 0, 10 and 20% levels. A fourth group received the 20% wheat bran plus a cellulase enzyme added at the level of 0.008%. After a five-week experimental period without a marker a 24-pen battery on the four diets were supplemented with 1% chromic oxide and fed 100g daily. After a 2-day preliminary period, feces were collected three times daily from each diet group for two days at 2, 4 or 8 hours after feeding. At the end of 4 days, within each diet group, birds were randomly selected for slaughter at 2, 4 or 8 hours after feeding and the entire gastrointestinal tract was removed and ligated to form five compartments. The lengths of each segment were measured after straightening, and the gizzard was emptied and weighed.

The summarized data showed that the group fed on the high-energy basal diet had the lowest gizzard weight ($P < 0.05$). Chromium turnover time (minutes) in the each segment and entire GI tract of chicks was not influenced by the high fiber diet or cellulase.

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