The Effects of Fiber Source and Level Upon Chick Growth

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Story in Brief

Two experiments were conducted utilizing 300 chicks to evaluate the effects of dietary fiber source and level on feed intake, weight gain, body shrink, starch digestibility, rate of digesta passage and intestinal tract size. In the first experiment three semi-purified fiber sources (mucilose flakes, polyethylene and wood cellulose) were added by weight on top of the basal diet. Chicks increased feed intake and maintained weight gain with the increasing levels of polyethylene. However, with wood cellulose, feed intake increased only slightly and weight gain was depressed. Including mucilose flakes in the diet decreased feed intake and severly depressed body weight gain. Dietary fiber addition tended to reduce digesta retention time but had only a minimal effect upon percent body shrink with fasting, starch digestibility and intestinal tract size. These results demonstrate that fiber source and level can have a quite varied impact upon poultry productivity. In the second experiment, eight natural fiber sources varying in composition and digestibility were added to the basal ration at the 30 percent level. As in the first experiment, fiber source influenced weight gain, feed intake and feed efficiency. The additional of fiber had little effect on starch digestion indicating that fibers under normal conditions have little impact upon starch utilization in poultry rations.

Introduction

The question of utilizing non-traditional high fiber feed sources in least cost ration formulation is being increasingly raised due to their availability and cost advantage in certain regions of the world. These feed sources such as tomato seeds and turf grass clippings are often high in fiber, but nonetheless contain useful amino acids, energy, vitamins and minerals. Characteristically, by-product feeds vary widely in fiber composition which posses no problem if one can assume that composition of indigestible bulk plays little role in influencing poultry productivity. The following experiments were conducted to evaluate this assumption.

Materials and Methods

In the first experiment, 14-day-old, New Hamp x Columbian chicks were allotted to treatment groups. Treatments were formed by the addition of the following fiber sources to the semi-purified basal diet (Table 1): mucilose flakes,

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Table 1. Composition of the basal diet.

Ingredient	% of Diet
Casein	21.00
Dried egg solids	13.00
Cornstarch	53.35
Arginine	.90
Dl methionine	.50
Glumatic acid	5.26
Glysine	.12
Mineral mix	5.37
Vitamin mix	.40
Chromic oxide	.10
	100.00

a semi-purified source of hemicellulose; solka floc, a purified source of wood cellulose; and finely ground plyethylene. The mucilose flakes were evaluated at the 5, 10, 15 and 20 percent levels, while the solka floc and polyethylene treatments were added at 10, 20, 30, 40, 50 and 60 percent levels. Treatments were replicated twice and consisted of two pens with six birds each. Birds were fed their respective ration for a 7-day feeding period with feces being collected continuously so that ration and starch digestibility could be estimated.

At the conclusion of the feeding period birds, were weighed, fasted for 12 hours and reweighed so that body weight gain independent of gut contents could be determined. The percent shrink (fasted body weight ÷ body weight prior to fasting x 100) was calculated and used to define true weight gain.

Digesta retention time was estimated by withdrawing feed for 2 hours to synchronize appetite and feeding rations containing 1 percent ferric oxide as a colored marker. The number of colored droppings occurring every 15 minutes thereafter was recorded and retention time calculated as the time required for the appearance of 6 red droppings.

To evaluate the effects of fiber on gastrointestinal tract size, 4 birds from each treatment were sacrificed and their tracts bisected at the crop, proventiculus, gizzard, small intestine, cecum, colon and cloaca. The tissue and digesta contents of each segment was determined.

In the second experiment, the influence of alfalfa, amaranth, beet pulp, corn bran, rice bran, wheat straw, sugar cane residue and wheat bran upon body weight gain, feed efficiency, ration digestibility and starch digestibility were evaluated as in the first experiment.

Results and Discussion

The influence of dietary fiber upon feed intake and body weight gain is shown in Figures 1 and 2. Birds responded to polethylene by increasing feed intake above the basal compensating for the reduced nutrient density. Hense, body weight gain was not influenced by polyethylene addition. With the addition of solka floc feed intake declined slightly and weight gain declined markedly since total nutrient intake was not maintained. When mucilose flakes were added to the basal ration, a large reduction in intake occurred, and body weight gains

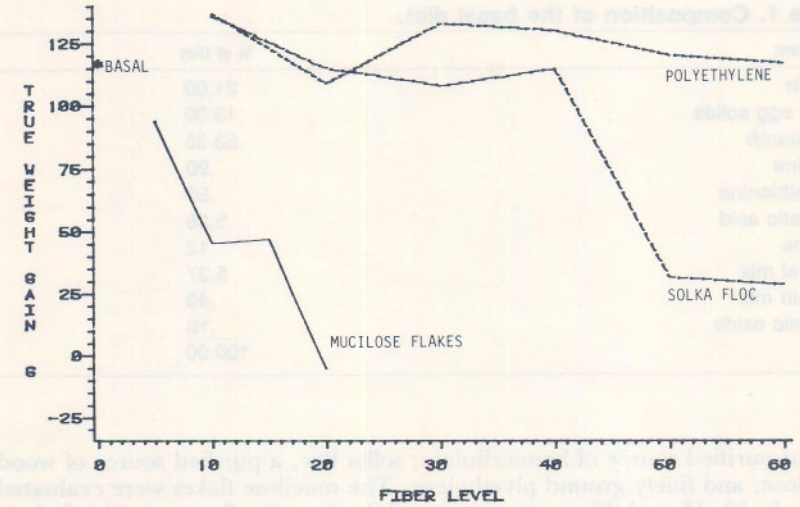

Figure 1. Influence of fiber source and level(%) on true weight gain(grams)

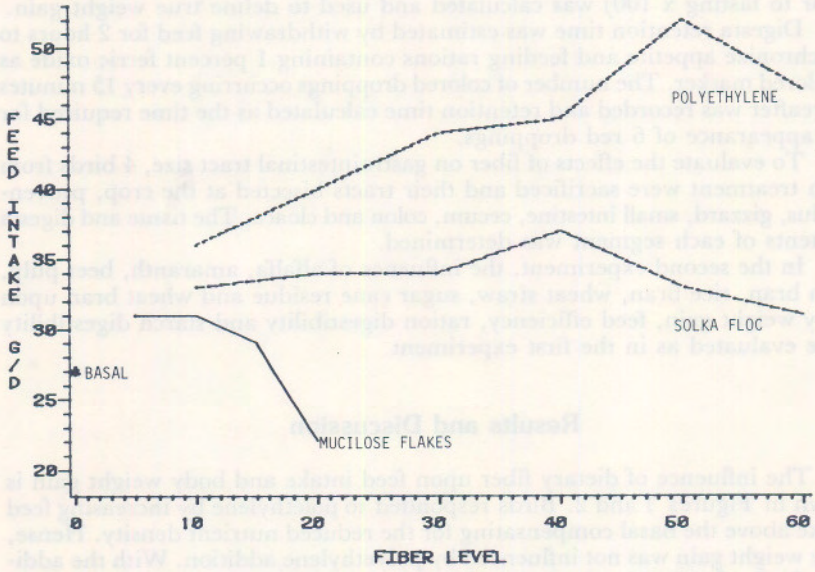

Figure 2. Influence of fiber source and level(%) on feed intake(grams/day)

declined 86 percent. This demonstrates that level and composition of dietary bulk can have a significant effect upon feed intake and weight gain.

In an effort to explain fiber effects, several physiological measurements were made. Retention time averaged 240 ± 15 minutes for birds receiving the basal ration and 192 ± 20 minutes with the fiber addition. Reduced retention time could limit digestion and animal efficiency if time is a limitation for digestive processes. However, in these studies, starch digestion was nearly complete indicating that time was not limiting for starch, the nutrient of greatest dietary concentration, though it could be for other nutrients. Reduced retention time should allow the animal to consume greater quantities of feed as more feed units would be able to pass through the animal each day. Physiological adjustment to increase tract size could also permit greater feed consumption. Measurements of empty tract weight after adjustment for body weight, in this experiment, indicated no significant effects of fiber on tract size or dry matter content. Indeed, body shrink averaged 16 percent and was not significantly different between rations. Therefore, passage rate modification may constitute the only physiological response available to broilers exhibiting increased feed intake. A passage rate ceiling evidently exists as birds fed mucilose were not able to elevate rate of passage enough to compensate for the 230 percent enhancement in digesta water content. The greater digesta water content observed with mucilose inclusion apparently distended the gastrointestinal tract to the point that bulk fill (water fill) limited feed consumption. Fiber water binding capacity may be associated with fiber bulk effects.

The productivity of chicks fed 30 percent natural fiber sources are shown in Table 2. With the exceptions of an increase in gain with wheat bran and a decrease with wheat straw, fiber source did not signficantly effect weight gain, feed intake or feed/gain ratio compared to the basal ration. The percent ration digestibility (Table 3) varied with fiber source suggesting differences in fiber utilization. Starch digestion ranged from 95-99 percent and was not affected by the addition of fiber. This indicates that starch utilization is not influenced by the fiber sources examined although mucilose flakes constituted one exception and starch digestibility was reduced to 89 percent.

This study provides documentation that the level and composition of dietary fibers can have a significant effect upon poultry feed intake and productivity.

Table 2. Performance of chicks.

Treatment	True Gain	Feed Intake	Feed/Gain
	lb/100 birds/day		
Basal	3.68	5.60	1.52
Alfalfa	3.39	7.05	2.08
Amaranth	3.55	7.20	2.12
Beet pulp	2.60	7.11	2.73
Corn bran	4.18	8.99	2.15
Rice hulls	3.74	8.41	2.25
Sugar cane residue	3.21	6.74	2.10
Wheat bran	4.87	8.50	1.74
Wheat straw	2.22	7.60	3.42

Table 3. Percent ration digestibility.

Source	% Digestibility
Basal	86
Amaranth	82
Wheat bran	78
Alfalfa hay	75
Rice hulls	73
Corn bran	73
Beet pump	73
Sugar cane R	72
W straw	72