

Effect of High Fiber Ingredients on the Performance, Metabolizable Energy and Digestibility of Broiler and Layer Chicks

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Summary and Implications

An experiment was conducted to evaluate the effects of feeding various fiber ingredients on the performance of chickens bred for egg or meat production from 1 to 21 d of age. The lower fiber diet was based on a traditional corn-soybean meal (SBM) diet and the higher fiber diet was formulated by addition of 60 g/kg of both dried distillers grains with solubles (DDGS) and wheat bran in the first period of feeding and 80 g/kg of both DDGS and wheat bran in the second period of feeding to the corn-SBM base diet. Two lines of male chicks, Ross 308 broiler and Hy-Line W36 layers, were randomly assigned to cages with 11 replicates of 8 chicks for each of the four treatments. The evaluation criteria consisted of average daily gain (ADG), average daily feed intake (ADFI), feed efficiency (FE), nitrogen-corrected apparent metabolizable energy and neutral detergent fiber (NDF) digestibility. The higher dietary fiber diet significantly reduced broiler ADG for the 1-12 d and 1-21 d experimental periods. Neutral detergent fiber digestibility was higher in the layer chicks than in the broiler chicks regardless of the diet, and higher dietary fiber concentration resulted in increased ileal and total NDF across lines. These results suggest that layer chicks are able to better utilize feed ingredients rich in fiber content compared to broiler chicks, possibly due to decreased ADFI and increased fiber utilization

Introduction

The recent increase in the price of corn and oil has led to interest in dietary fiber as a method to reduce feed costs in poultry diets. According to the Renewable Fuels Standard, ethanol production is expected to increase through 2022, with corn based ethanol production capped at about 15 billion gallons by 2015 (Renewable Fuel Standard, 2013). It is important to understand the effects of these alternative dietary feed ingredients on bird performance to

allow for proper formulation into current poultry diets.

Higher fiber in feed ingredients has shown to have negative effects on digestion and absorption of nutrients in chickens. However, inclusion of high fiber ingredients in moderate levels, 60 – 120 g/kg of the diet in both broiler and layer diets does not decrease performance.

There have been several experiments involving use of high dietary fiber ingredients in both broilers and adult laying hens' diets, and the inclusion of up to 120 g/kg and 50-200 g/kg DDGS showed no effects on performance and production of broiler chicks and adult laying hens, respectively. However, there are few reports concerning the use of high fiber ingredients in layer chicks. In this experiment, two high fiber ingredients (DDGS and wheat bran) were included in a traditional corn-soy bean meal. The objective was to evaluate the performance, metabolizable energy (AMEn) and neutral detergent fiber (NDF) digestibility of broiler and layer chicks fed corn-soybean diet or higher corn-soybean-DDGS-wheat bran diet over a 21 d feeding period.

Materials and Methods

A total of 250 male Ross broiler chicks and 250 male Hy-line W36 layer chicks were secured from separate commercial hatcheries. On d 1, chicks were individually weighed, sorted by weight, wing banded and assigned to battery cages within line to minimize differences in mean cage bodyweight at the start of the experiment. Treatment groups were assigned to battery cages in a completely randomized design. Treatments were arranged in a 2x2 factorial with two chicken lines (broiler and layer) and two dietary fiber concentrations (lower fiber and higher fiber). Each of the 4 treatments consisted of 11 experimental units of 8 chicks, resulting in 88 total chicks per treatment. Starter diets for both broiler and layer chicks were formulated to have the same energy level. The higher fiber diet was formulated to contain 60 g/kg of DDGS and 60 g/kg wheat bran from 1 to 12 d and 80 g/kg of both DDGS and wheat bran from 13 to 21 d. Birds had ad libitum access to feed and water throughout the experimental period. Average daily feed intake (ADFI) and average daily gain (ADG) were recorded over 1-12 and 1-21 d periods. Clean excreta sample free of feathers were collected over the 19-21 d periods and all chicks were euthanized by carbon dioxide asphyxiation on d 21 for collection of ileal contents for NDF determination. Results were analyzed using PROC GLM of SAS (SAS Inst. Inc., Cary, NC).

Results and Discussion

Dietary fiber had no effect on ADFI in either line of birds (Table 1). There were significant interactions in ADG over both the 1-12 d and 1-21 d periods as higher dietary fiber resulted in a significant decrease in ADG for the broiler chicks but did not have significant effects on layer chicks. As expected, broilers consumed more feed, grew at a faster rate and converted feed intake to body weight gain more efficiently than layer chicks regardless of dietary treatment. Interestingly, the higher fiber diet supported maximal ADG in the layer chicks, but resulted in reduced ADG in broiler chicks. This response is consistent with previous research in that 125g/kg of DDGS did not alter layer chick weight gain, feed intake or feed efficiency. These results are interesting as there were no significant differences in feed intake in either broiler or layer chicks with the increased dietary fiber. This change in body weight gain without significant alterations in feed intake resulted in the interactions between bird line and dietary fiber content as broiler chick FE is slightly reduced by higher dietary fiber content and layer chick FE is slightly increased by higher fiber content. The explanation for the reduced performance could include higher total intake of high fiber feed ingredients in the broiler chicks resulting in reduced ADG without affecting feed intake.

Increasing dietary fiber significantly increased ileal and total tract NDF disappearance regardless of bird line (Table 2). Layer chicks had a significantly higher total tract NDF disappearance in comparison to broiler chicks. This might be due to a relatively longer intestinal length in layer chicks compared to broiler chicks.

Although there were significant differences in NDF disappearance between both chicken lines and dietary fiber

content, there were no significant differences observed in the AMEn. This is not altogether surprising as diets were balanced with oil to maintain isocaloric content.

In conclusion, feed intake was not altered in either broiler or layer chicks by the inclusion of two high fiber feed ingredients into the dietary formulation. Although feed intake was not different in either chicken line, broiler chicks had reduced ADG with the high fiber ingredients while the layer chicks performed equally well regardless of dietary fiber. The layer chick responses can be attributed to greater fiber digestion and fermentation as layer chicks had increased NDF disappearance and higher fiber diets stimulated NDF disappearance. Although NDF disappearance was altered by line and diet, AMEn was not altered by line or diet in this experiment. Although the mechanism is yet unclear it appears that layer chicks may tolerate higher concentrations of high fiber dietary ingredients in comparison to faster growing broiler chicks.

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Table 1. Effect of high and low fiber diets in broiler and layer chicks from 1 to 12 and 1 to 21 d of age on average daily gain (ADG), average daily feed intake (ADFI) and mortality corrected feed efficiency (FE).¹

Line	Dietary fiber	1-12 d			1-21 d		
		ADG (g/bird)	ADFI (g/bird)	FE (g/kg)	ADG (g/bird)	ADFI (g/pen)	FE (g/kg)
Broiler		18.3	24.1 ^a	760	31.2	46.2 ^a	672
Layer		5.2	11.1 ^b	471	8.0	16.0 ^b	467
SEM ²		0.19	0.39	12.4	0.42	0.51	8.9
	High fiber	11.2	16.9	609	18.7	30.4	565
	Low fiber	12.4	17.7	621	20.0	31.8	573
	SEM ¹	0.19	0.39	12.4	0.42	0.51	8.9
..... P value							
Line		<0.01	<0.01	< 0.01	<0.01	<0.01	<0.01
Dietary fiber		<0.01	0.16	0.47	0.02	0.06	0.49
Line x Dietary fiber		<0.01	0.44	0.04	0.02	0.09	0.06

^{a,b} Values in the same column not sharing a common superscript differ significantly at $P \leq 0.05$.

¹ N=11. Broiler average initial body weight = 40.0 g. Layer average initial body weight = 37.0 g

² Pooled standard error of mean

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Table 2. Effect of increasing dietary fiber from DDGS and wheat bran in broiler and layer chicks fed from 1 to 21 d on nitrogen corrected Apparent Metabolizable Energy (AMEn), Ileal and apparent total tract digestibility.¹

Line	Dietary fiber	AMEn (MJ/kg)	Ileal aNDF	Excreta
				aNDF
Broiler		13.42	0.21	0.19 ^b
Layer		13.41	0.22	0.23 ^a
SEM ²		0.119	0.007	0.010
	High fiber	13.42	0.25 ^a	0.23 ^a
	Low fiber	13.41	0.18 ^b	0.20 ^b
SEM		0.119	0.007	0.010
..... P value				
Line		0.96	0.39	0.01
Dietary fiber		0.99	< 0.01	0.02
Line x Dietary fiber		0.41	0.66	0.75

^{a,b} Values in the same column not sharing a common superscript differ significantly at $P \leq 0.05$.

¹ aNDF disappearance reported as coefficients. N=11. Broiler average initial body weight = 40.0 g. Layer average initial body weight = 37.0 g

² Pooled standard error of mean