

RESEARCH ARTICLE

Effect of Graded Levels of Fiber from Alfalfa Meal on Nutrient Digestibility and Flow of Fattening Pigs

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Abstract

The fiber level and composition have an important effect on nutrient digestibility of swine diets. Little information is known about the effects of fiber level and composition from alfalfa meal on nutrient digestibility of fattening pigs fed a corn-soybean meal-based diet. The objective of this experiment was to determine the effects of alfalfa fiber on the growth performance, intestinal nutrient flow and apparent total tract digestibility (ATTD) of nutrients in fattening pigs. 24 barrows (Duroc×(Large White×Landrace), body weight=(60.6±0.7) kg) were randomly allotted to 4 treatments with 6 replicates of 1 pig per replicate. The pigs were provided a control diet or a diet containing 5, 10 or 20% of alfalfa meal during a 14-d experiment period. Average daily gain (ADG) and the ATTD of dry matter (DM), organic matter (OM), crude protein (CP), neutral detergent fiber (NDF), acid detergent fiber (ADF) and gross energy (GE) reduced linearly as the level of alfalfa meal in the diet increased ($P<0.01$). The total tract flow of DM, OM, CP, NDF, ADF, and GE increased with the increase in dietary alfalfa (linear, $P<0.05$). Growth performance and nutrient digestion were not affected by inclusion of 5% alfalfa meal in the diet ($P>0.05$). A multiple linear regression analysis, taking into account both soluble and insoluble fiber intake, explained approximately 70% of the variation in the ATTD of DM, OM, NDF, and GE ($P<0.01$). In conclusion, alfalfa meal should be limited to less than 5% of the diet in fattening pigs to maximize growth performance and nutrient digestion. Soluble and insoluble fiber from alfalfa meal has the differential roles in nutrient digestion, which may help explain the main variation observed in nutrient digestibility. These findings suggest that knowledge of specific fiber components is necessary to accurately predict the effects of dietary fiber on nutrient digestibility.

Key words: alfalfa, digestibility, fiber, flow, nutrient, pig

INTRODUCTION

Addition of fiber in swine diets is not a common practice in China. Most swine diets in China are based on corn and soybean meal, because these two feed ingredients have the great digestibility and complementary nutrient composition (Renteria-Flores *et al.* 2008a). The increasing usage of fiber by-products in recent years, however, has also led to an increase in fiber concen-

tration of diets.

Alfalfa is one of the most popular forage crops for its high content of crude protein (CP) and minerals but also for its high content of fiber (National Research Council 1998), and it ranks behind only corn, soybean and wheat in terms of economic value (Thacker and Haq 2008). This reason for the usage of alfalfa meal in a diet fed to finishing pigs is that alfalfa fiber can reduce ammonia emission. Inclusion of 10% alfalfa meal in a finishing diet can effectively reduce urinary urea excretion (Yen 2004). Reducing urea excretion can decrease ammonia

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emission by swine operations (Panetta *et al.* 2006). In addition, the bioavailability of phosphorus in alfalfa is reported to be 100% (National Research Council 1998), which could potentially minimize the environmental effect of intensive swine operations.

In contrast to its beneficial effects, increasing alfalfa meal intake reduces nutrient digestibility (Kass *et al.* 1980; Lindberg and Cortova 1995). Thacker and Haq (2008) also reports the apparent total tract digestibility (ATTD) of energy and CP reduces as the level of alfalfa meal increases in a barley-soybean meal-diet fed to growing-finishing pigs. Except the negative effect of fiber level on nutrient digestibility, the impact of fiber composition on nutrient digestibility should be considered when fibrous ingredient is included in a swine diet (Renteria-Flores *et al.* 2008a, b).

Analyzing soluble fiber (SF) and insoluble fiber (ISF) can help improve our understanding of nutrient characteristics of fiber in a diet (Dégen *et al.* 2007). Because SF and ISF have different characteristics for a number of properties, such as fermentability (Guillon *et al.* 2007), water holding capacity (Johansen *et al.* 1996), and the rate of passage (Wilfart *et al.* 2007).

However, there are little data on the effects of fiber level and composition from alfalfa meal on nutrient digestibility of a corn-soybean meal-based diet fed to fattening pig. The first objective of this experiment was to determine the effects of varying levels of alfalfa meal on growth performance, nutrient digestibility and the intestinal nutrient flow. The second objective was to evaluate the interrelation between fiber composition and nutrient digestibility in fattening pigs. The results presented here would provide the important information for fiber level and composition related to nutrient digestibility, and the interrelation can be considered when a fibrous ingredient is formulated in a swine diet.

RESULTS

Growth performance, fiber intake and fecal excretion

Average daily gain (ADG) reduced linearly by increasing the level of alfalfa meal ($P<0.01$, Table 1). Fiber intake and fecal excretion increased as the content of alfalfa meal increased (linear, $P<0.05$). The ADG and ratio of gain to feed (G/F) was not affected by inclusion of 5% alfalfa meal in the diet ($P>0.05$).

Apparent nutrient digestibility

The ATTD of dry matter (DM), organic matter (OM), CP, neutral detergent fiber (NDF), acid detergent fiber (ADF) and gross energy (GE) reduced linearly as the amount of alfalfa meal in the diet increased ($P<0.01$, Table 2). The digestible energy (DE) also decreased by increasing the level of dietary alfalfa meal (linear, $P<0.01$). The diet containing 5% of alfalfa meal did not affect the ATTD of DM, OM, CP, NDF, ADF, and GE ($P>0.05$).

The total tract flow of nutrients

The total tract flow of DM, OM, CP, NDF, ADF, and GE increased linearly with the increase in the content of dietary alfalfa meal ($P<0.01$, Table 3). The total tract flow of CP also increased as the level of dietary alfalfa meal increased (linear, $P<0.05$). There were no differences in the total tract flow of DM, OM, CP, ADF, and GE between the 5% alfalfa meal diet and the control diet ($P>0.05$).

Table 1 Growth performance, fiber intake and fecal excretion in fattening pigs

Item ¹⁾	Level of alfalfa meal (%)				SEM	P-value	
	0	5	10	20		Linear	Quadratic
ADG (g)	986.4 a	1051.5 a	780.7 b	704.5 b	43.3	<0.01	0.84
G/F (%)	41.1 a	41.4 a	35.5 a	36.4 a	1.3	0.37	0.43
TF intake (g dry matter d ⁻¹)	270.7 d	322.1 c	370.6 b	474.0 a	15.7	<0.01	<0.01
SF intake (g dry matter d ⁻¹)	41.0 d	44.0 c	46.7 b	52.9 a	0.9	<0.01	<0.01
ISF intake (g dry matter d ⁻¹)	229.7 d	278.1 c	323.9 b	421.1 a	14.8	<0.01	<0.01
Fecal excretion (g wet weight d ⁻¹)	922.6 b	1060.0 ab	1175.0 a	1205.1 a	40.1	<0.01	0.26
Fecal excretion (g dry matter d ⁻¹)	261.8 b	294.8 a	299.0 a	315.3 a	7.8	<0.04	0.54

¹⁾ ADG, average daily gain; G/F, the ratio of gain to feed; TF, total fiber; SF, soluble fiber; and ISF, insoluble fiber. The same as below.

Data were presented as means, n=6 per group; means in the same row with different small letters differ significantly ($P<0.05$). The same as below.

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