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## Feeding Value of Alfalfa Leaf Protein Concentrate (ALPC) for Swine

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### Summary

Three feeding trials involving 96 starter pigs, 48 grower pigs and 48 finisher pigs were used to determine the feeding value of alfalfa leaf protein concentrate (ALPC) for swine. ALPC was substituted for 33%, 66% or 100% of dehulled soybean meal (SBM) on an equal-weight basis. Level of ALPC did not affect feed intake or feed efficiency. During the finisher phase, ALPC substituted for 66% or 100% of dehulled SBM, improved daily gain ( $P < .05$ ). For the entire trial, ALPC did not affect feed efficiency; average daily gain was improved by replacing 66% dehulled SBM with ALPC ( $P < .05$ ).

Twelve crossbred barrows averaging 26 lb were used to determine protein and energy digestibilities and nitrogen balance in starter diets where ALPC replaced 0, 66%, or 100% of the dehulled SBM. Digestibilities of protein and energy of ALPC were 83.5% and 77.7% respectively. The digestible energy of ALPC, 4.17 kcal/g, was similar to that of dehulled SBM 4.39 kcal/g. These results suggest that ALPC can replace soybean meal in a corn diet for pigs from 17 lb to 202 lb with no adverse effects on feed efficiency, rate of gain, or carcass characteristics.

### Introduction

Alfalfa's production of protein per acre makes it an important potential protein source for swine. It contains 19% crude protein and 26% crude fiber. A disadvantage of feeding alfalfa to nonruminants is the low digestible energy. The commercial protein alfalfa leaf protein concentrate (ALPC), that we evaluated, contained 55.8% crude protein, 5.4 kcal/g of gross energy.

### Procedures

In the feeding trials, 96 crossbred starter pigs averaging 16.5 lb, 48 grower pigs averaging 60.7 lb, and 48 finisher pigs averaging 136.4 lb were allotted based on sex and initial weight to four dietary treatments in four replications: corn-dehulled SBM (control diet), ALPC substituted for dehulled soybean meal at 33%, 66% or 100% on an equal-weight basis. Compositions of rations used during the starter (17-56 lb), grower (56-136 lb) and finisher (136-202 lb) phases are given in Tables 1, 2, and 3. The digestibilities of protein and energy in ALPC were determined with pigs weighing 22.2 lb initially. Additionally, 24 barrows from the finisher trial averaging 210 lb were used to study the effect of ALPC on carcass characteristics and fat color.

Table 1. Composition of Diets Containing ALPC as a Feed Ingredient for Starter Pigs

ALPC substituted for SBM, % <sup>a</sup>	--	33	66	100
Ground corn	72.3	72.5	72.8	73.0
Soybean meal, dehulled	23.1	15.4	7.7	--
Alfalfa leaf protein concentrate	--	7.7	15.4	23.1
Calcium phosphate, dibasic	1.7	1.7	1.7	1.7
Limestone, grnd	1.4	1.2	0.9	0.7
Premix	1.0	1.0	1.0	1.0
Salt	0.5	0.5	0.5	0.5
Calculated value, %				
Crude protein	17.57	17.72	17.87	18.02
Calcium	0.92	0.93	0.93	0.93
Phosphorus	0.70	0.70	0.70	0.70
Lysine	0.91	0.90	0.89	0.89

<sup>a</sup>ALPC substituted for dehulled soybean meal on an equal-weight basis.

Table 2. Composition of ALPC Diets for Grower Pigs

ALPC substituted for SBM, % <sup>a</sup>	--	33	66	100
Ground corn	78.1	78.3	78.5	78.7
Soybean meal, dehulled	18.0	12.0	6.0	--
Alfalfa leaf protein concentrate	--	6.0	12.0	18.0
Calcium phosphate, dibasic	1.3	1.3	1.3	1.3
Limestone, grnd	1.1	0.9	0.7	0.5
Premix	1.0	1.0	1.0	1.0
Salt	0.5	0.5	0.5	0.5
Calculated value, %				
Crude protein	15.60	15.72	15.84	15.96
Lysine	0.76	0.76	0.75	0.74
Calcium	0.72	0.72	0.72	0.72
Phosphorus	0.60	0.60	0.60	0.60

<sup>a</sup>On an equal-weight basis.

Table 3. Composition of ALPC Diets for Finisher Pigs

ALPC substituted for SBM, % <sup>a</sup>	--	33	66	100
Ground corn	83.1	83.3	83.4	83.5
Soybean meal, dehulled	12.9	8.6	4.3	--
Alfalfa leaf protein concentrate	--	4.3	8.6	12.9
Calcium phosphate, dibasic	1.4	1.4	1.4	1.4
Limestone	1.1	0.9	0.8	0.7
Premix	1.0	1.0	1.0	1.0
Salt	0.5	0.5	0.5	0.5
Calculated value, %				
Crude protein	13.62	13.70	13.79	13.88
Lysine	0.61	0.61	0.60	0.60
Calcium	0.72	0.70	0.71	0.72
Phosphate	0.61	0.61	0.61	0.61

<sup>a</sup>On an equal weight basis.

### Results and Discussion

Performances of pigs for each phase (starter, grower, and finisher) are shown in Table 4. Level of ALPC did not affect feed intake, feed efficiency or number of days to reach 220 lb body weight. Level of ALPC did not affect the daily gain during the starter or grower phases, but ALPC substituted for 66% or 100% of dehulled SBM improved daily gain during the finisher period ( $P < .05$ ). For the entire trial, pigs fed ALPC diets and those on the SBM (control) gained at the same rate with similar feed efficiencies.

The apparent digestibilities of protein and energy (Table 5) decreased as ALPC increased ( $P < .05$ ). Level of ALPC did not affect the nitrogen retention. The digestibilities of protein and energy of ALPC were 83.5% and 77.7%, respectively. ALPC has a digestible energy of 4.17 kcal/g, similar to that of dehulled SBM (4.39 kcal/g).

Level of ALPC did not significantly affect carcass length, backfat thickness, loin eye area, or percentage of carcass in four lean cuts. (Table 6). There was a trend towards increasing the yellowness of backfat as the level of ALPC increased in the diet, but the color change is of little practical importance since it can not be distinguished visually.

These results suggest that ALPC can replace dehulled SBM in corn diets for pigs from 17-210 lb with no adverse effects on feed efficiency, rate of gain, carcass characteristics, or color of fat and muscle.

Table 4. Performance of Pigs Fed Indicated Levels of Alfalfa Leaf Protein Concentrate (ALPC)<sup>a</sup>

ALPC replacing SBM, %	0	33	66	100
<u>Starter phase</u> (7.5-25.2 kg) (16.5-25.2 lb)				
Daily gain, lb	1.14 <sup>b</sup>	1.12 <sup>b</sup>	1.14 <sup>b</sup>	1.03 <sup>b</sup>
Daily feed intake, lb	2.27 <sup>b</sup>	2.16 <sup>b</sup>	2.33 <sup>b</sup>	22.18 <sup>b</sup>
Feed/gain	1.96 <sup>b</sup>	1.92 <sup>b</sup>	2.03 <sup>b</sup>	2.09 <sup>b</sup>
<u>Grower phase</u> (27.6-62 kg) (60.7-136.4 lb)				
Daily gain, lb	1.83 <sup>bc</sup>	1.74 <sup>c</sup>	1.85 <sup>b</sup>	1.80 <sup>bc</sup>
Daily feed intake, lb	4.95 <sup>b</sup>	4.80 <sup>b</sup>	5.21 <sup>b</sup>	4.88 <sup>b</sup>
Feed/gain	2.73 <sup>b</sup>	2.77 <sup>b</sup>	2.82 <sup>b</sup>	2.72 <sup>b</sup>
<u>Finisher phase</u> (62-91.6 kg) (136.4-201.5 lb)				
Daily gain, lb	1.85 <sup>d</sup>	1.83 <sup>d</sup>	2.05 <sup>b</sup>	1.98 <sup>c</sup>
Daily feed intake, lb	6.58 <sup>b</sup>	6.64 <sup>b</sup>	7.11 <sup>b</sup>	6.60 <sup>b</sup>
Feed/gain	3.58 <sup>b</sup>	3.67 <sup>b</sup>	3.50 <sup>b</sup>	3.35 <sup>b</sup>
<u>Entire trial</u> (7.5-91.6 kg) (16.5-201.5 lb)				
Daily gain, lb	1.63 <sup>a</sup>	1.61 <sup>a</sup>	1.72 <sup>b</sup>	1.63 <sup>a</sup>
Daily feed intake, lb	4.66 <sup>a</sup>	4.60 <sup>a</sup>	4.95 <sup>a</sup>	4.62 <sup>a</sup>
Feed/gain	2.91 <sup>a</sup>	2.88 <sup>a</sup>	2.90 <sup>a</sup>	2.83 <sup>a</sup>
Days to 220 lb	173 <sup>a</sup>	174 <sup>a</sup>	168 <sup>a</sup>	170 <sup>a</sup>

<sup>a</sup>Each value is the mean of four pens of three pigs each except for six pigs per pen during the starter phase.

<sup>bcd</sup>Means in a row with different superscripts differ significantly ( $P < .05$ ).

Table 5. Apparent Digestibility and Nitrogen Retention of Pigs Fed Indicated Levels of Alfalfa Leaf Protein Concentration<sup>a</sup>

ALPC replacing SBM, %	0	33	100
Energy digestibility, %	85.8 <sup>d</sup>	82.9 <sup>e</sup>	81.8 <sup>e</sup>
Digestible energy, kcal/g	3.70 <sup>d</sup>	3.69 <sup>d</sup>	3.69 <sup>d</sup>
Protein digestibility, %	83.8 <sup>d</sup>	80.9 <sup>de</sup>	79.9 <sup>e</sup>
Nitrogen retention, g/day	12.3 <sup>d</sup>	12.1 <sup>d</sup>	12.0 <sup>d</sup>
BV <sup>b</sup>	71.0 <sup>d</sup>	72.4 <sup>d</sup>	70.6 <sup>d</sup>

<sup>a</sup>Dry matter basis; each value is the mean of two periods of four pigs each averaging 26 lb.

<sup>b</sup>Biological value is expressed by nitrogen retained as percentage of nitrogen digested.

<sup>de</sup>Means in a row with different superscripts differ significantly ( $P < .05$ ).

Table 6. Effect of ALPC on Carcass Characteristics of Barrows<sup>a</sup>

ALPC replacing SBM, %	0	33	66	100
Slaughter weight, lb	223.3 <sup>c</sup>	214.1 <sup>d</sup>	225.5 <sup>c</sup>	216.5 <sup>cd</sup>
Dressing percent, %	74.9 <sup>d</sup>	73.3 <sup>e</sup>	75.9 <sup>c</sup>	74.7 <sup>d</sup>
Carcass length, in <sup>b</sup>	31.7 <sup>c</sup>	30.8 <sup>d</sup>	31.5 <sup>c</sup>	31.1 <sup>cd</sup>
Backfat thickness, in	1.35 <sup>c</sup>	1.18 <sup>d</sup>	1.38 <sup>c</sup>	1.22 <sup>c</sup>
Loin eye area, sq. in	4.67 <sup>c</sup>	4.25 <sup>c</sup>	4.33 <sup>c</sup>	4.19 <sup>c</sup>
Four lean cuts, % <sup>b</sup>	54.7 <sup>cd</sup>	55.3 <sup>cd</sup>	54.2 <sup>d</sup>	56.3 <sup>c</sup>

<sup>a</sup>Each value is the mean of six pigs except for five pigs on 0% ALPC.

<sup>b</sup>Covariance adjustment was made to a constant slaughter weight.

<sup>cd</sup>Means in a row with different superscripts differ significantly ( $P < .05$ ).