

# Okara: A Possible High Protein Feedstuff For Organic Pig Diets

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### Summary and Implications

A potential alternative organic protein source is okara. Okara is the residue left from ground soybeans after extraction of the water portion used to produce soy milk and tofu. Satisfying the high protein requirements of young pigs presents a production challenge to organic pork producers. The effect of dietary supplementation of okara was evaluated on the growth performance of young pigs. In four replicates, weaned pigs ( $21 \pm 2$  d of age) were allotted to one of three pens. Each pen received one dietary treatment. Treatments were control diet (composed of corn, soybean meal, oats, and essential vitamins and minerals), 2) okara 25% (25% of total diet), 3) okara 50% (50% of total diet). Pigs and feed were weighed at d 0 and at 7 d intervals until completion of each 18 d trial. Average daily gain (ADG), average daily feed intake (ADFI), and gain:feed ratio (G:F) were calculated. Data were analyzed using fixed effect models with repeated measures. Feeding dietary okara to young pigs had no effect on ADG, ADFI, or G:F ratio when compared to control treatment. Diets supplemented with 25% okara increased ADG 14% when compared to diets supplemented with 50% okara. Okara fed at 25% of the diet increased G:F ratio 17% when compared to okara fed at 50% of the diet. Under the conditions of our study dietary okara is a potential high protein organic feedstuff. Inclusion levels of dietary okara up to 25% of the diet could be used with no reduction in ADG, ADFI, or G:F ratio.

### Introduction

Increasing consumer demand for organic pork prompted United States Department of Agriculture (USDA) organic regulations. United States Department of Agricultural organic pork regulations prohibit the use of antibiotics, growth hormones, and dietary animal by-products (1). Animals must be fed organically grown feedstuffs (1). These regulations restrict commonly fed animal based, high quality proteinaceous feedstuff. Satisfying the high protein requirements of your pigs presents a production challenge to organic pork producers. Organic feedstuffs are often four times the price of conventional feedstuffs and availability is limited (2). Alternative protein sources could increase the availability of organic feedstuffs and help meet organic production demands. A potential alternative organic protein source is okara. Okara is the residue left from ground soybeans after extraction of the water portion used to produce soy milk and tofu (3). Large quantities of okara are produced worldwide

creating disposal problems (3). Work with okara as an alternative feedstuff is limited (4). We know of no published studies involving okara as an alternative swine feedstuff. Therefore our objective was to determine the effect of dietary okara on growth performance of young pigs.

### Materials and Methods

#### Animals

Four replicate trials involving a total of 48 pigs (average initial body weight of 13.23 kg) were conducted at the Iowa State University Swine Nutrition Farm, Ames, IA. All pigs were farrowed and reared at the Iowa State University Swine Nutrition Farm, Ames, IA. The protocol was approved by the Iowa State University Committee on Animal Care (Log No. 8-2-5231-S). In each trial, 12 pigs ( $21 \pm 2$  d of age) were allotted to balance for pig weight and litter origin, to one of three pens. Each pen received one dietary treatment. Treatments were: 1) control diet (composed of corn, soybean meal, oats, and essential vitamins and minerals), 2) okara 25% (25% of total diet), 3) okara 50% (50% of total diet). Diets were isolysin and isocaloric based on calculated analysis. Feed consumption and body weights were collected at 7 d intervals until the completion of each 18 d trial. Average daily gain (ADG), average daily feed intake (ADFI), and gain:feed ratio (G:F) were calculated.

#### Experimental diets

The dietary treatments fed (one per pen) were identical except for the treatment additives containing okara added to the diets at 25 and 50% levels by weight. Each diet met or exceeded NRC nutritional requirements (5). Animals were given *ad libitum* access to feed and water.

#### Data analysis

Data were analyzed by using fixed effect models with repeated measures using MANOVA of JMP (SAS Inst. Inc., 1993 Cary, NC). The interaction of treatment  $\times$  time was examined for statistical significance. Higher level interactions were not statistically significant and lower level terms were tested. The pen was considered the experimental unit. Data were reported as least square means. Significance level of less than 0.10 was required as the minimum acceptable P-value.

### Results and Discussion

#### Growth

No dietary treatment  $\times$  time interaction ( $P = 0.39$ ) was observed for growth performance and data was averaged across days (Table 3). Feeding dietary okara to young pigs had no effect ( $P > 0.10$ ) on ADG, ADFI, or G:F ratio when compared with control treatment (Table 3). Diets supplemented with 25% okara had an increased ADG when

compared with diets supplemented with 50% okara ( $P = 0.06$ ). Okara fed at 25% of the diet increased ( $P = 0.04$ ) G:F ratio when compared with okara fed at 50% of the diet. No differences ( $P > 0.10$ ) were observed in ADFI between okara supplementation at 25% vs. 50%.

funds. Mention of company or product names is for presentation clarity and does not imply endorsement by the authors or Iowa State University, nor exclusion of any other products that may also be suitable for application. The authors thank the employees at the swine nutrition farm, and Sally Medford, Pat Horton, and Linda Mosman.

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**Table 1. Basal diet composition and calculated analysis (as-fed basis).**

Item Composition	Dietary Treatment		
	Control	Okara 25%	Okara 50%
Okara	0.00	25.00	50.00
Ground corn	52.31	39.90	27.67
Dehulled soybean meal	34.35	22.10	9.50
Ground oats	10.00	10.00	10.00
Dicalcium phosphate	1.67	1.50	1.52
Calcium carbonate	0.83	0.80	0.62
Vitamin premix	0.09 <sup>a</sup>	0.09	0.09
Mineral premix <sup>d</sup>	0.17	0.17	0.17
Salt	0.45	0.45	0.45
Total	100	100	100
Calculated Analysis			
CP, %	21.7	22.5	23.4
Lysine, %	1.22	1.22	1.22
ME, kcal/kg	3210	3210	3210

<sup>a</sup> Contributed per kilogram of diet: 13,200 IU of vitamin A; 3,300 IU of vitamin D<sub>3</sub>; 66 IU of vitamin E; 19.8 g of riboflavin; 52 mg of d-pantothenic acid; 100 mg of niacin; 60 µg of vitamin B<sub>12</sub>.

<sup>d</sup> Contributed in part per million of diet: Zn, 150.0; Fe, 175.0; Mn, 60; Cu, 17.6; I, 2.0.

Pelleted certified organic soy protein (okara) meal feed (Thorpac, Thorvin, Inc., New Castic, VA) was used in this study. Determination of typical analysis of okara (Table 2) was provided by Thorvin, Inc. Okara, oats, and corn were ground and all diets fed in meal form.

**Table 2. Typical analysis of okara.**

ME, kcal/kg	3388
Protein, %	30.9
Lysine, %	1.63
Methionine, %	0.42
Threonine, %	1.15
Tryptophan, %	0.35

**Table 3. Growth performance of young pigs fed dietary okara.**

Item	Dietary treatment <sup>abcd</sup>			SEM	P-value
	Control	Okara 25%	Okara 50%		
Total ADG, g	484 <sub>xy</sub>	511 <sub>x</sub>	450 <sub>y</sub>	0.01	0.06
Total ADFI, g	787	761	786	0.02	0.75
Total G:F, g/kg	616 <sub>xy</sub>	674 <sub>x</sub>	575 <sub>y</sub>	0.02	0.04

<sup>a</sup>Values are least square means.

<sup>b</sup>Control = basal diet; Okara 25% = basal diet + Okara at 25% of total (as-fed basis); Okara 50% = basal diet + Okara 50% of total (as-fed basis).

<sup>c</sup>No diet x time ( $P = 0.39$  for ADG, ADFI, and G:F ratio) interactions were observed and data were analyzed across time.

<sup>d</sup>Values with differing subscripts differ ( $P < 0.10$ ).

<sub>xy</sub> Value in the same row with the same subscripts do not differ ( $P > .10$ ).