RAW MUNG BEANS AS A PROTEIN SOURCE FOR BRED GILTS[1]

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ABSTRACT

A study involving 546 crossbred gilts from six seasons was conducted to evaluate raw mung beans as a partial replacement for soybean meal in diets for gilts during gestation. Gilts were randomly allotted to either a control sorghum grain-soybean meal diet or a diet in which a portion of the soybean meal was replaced with mung beans. In the first three seasons, gilts were fed diets in which the protein supplement was totally soybean meal or 89% mung beans (high level) and 11% soybean meal. In the last three seasons the level of mung beans in the supplemental protein was reduced to 61% mung beans with 39% soybean meal (moderate level). Feeding the high level of mung beans decreased ($P < .05$) weight gain during gestation and reduced ($P < .05$) weight loss during lactation compared with gilts fed the control diet or the moderate level of mung beans. Little difference was noted in litter size at birth, but litter size at 21 d for gilts fed moderate levels of mung beans was less ($P < .05$) than for gilts fed the control diet or the high level of mung beans. Little difference was noted in survival rate to 21 or 42 d or individual and litter weights at birth and 21 d. Pig and litter weights at 42 d, however were reduced in gilts fed the high level of mung beans ($P < .05$ and $P < .10$, respectively) compared with the control diet. This study suggests that diets containing moderate levels of mung beans may decrease litter size at 21 and 42 d and decrease individual pig and litter weights at 42 d.

(Key Words: Pigs, Mung Beans, Reproductive Performance.)

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Introduction

The mung bean is a large-seeded food legume that is an important source of dietary protein for many people in the world. Mung beans are high in protein and lysine with a lysine to crude protein ratio equivalent to that of soybean meal. Availability of undersized or split beans or excess beans during periods of overproduction has stimulated interest in feeding surplus mung beans to swine.

Previous work has shown that raw ground mung beans can be used as a partial replacement for soybean meal (Cannon et al., 1983; Woltmann et al., 1987) or for cottonseed meal (Thompson and Hillier, 1942) in growing-finishing swine rations.

A trypsin inhibitor in mung beans (Borchers and Ackerson, 1947; Gupta and Wagle, 1978) may limit its use in swine diets. However, recent research has shown that raw soybeans, which also contain the trypsin inhibitor, can be fed to gestating gilts as the sole source of supplemental protein (Crenshaw and Danielson, 1985). Feeding high levels of raw mung beans as a protein source for gestating gilts has not been studied previously. The objective of this study was to determine the effect on weight gain and subsequent reproductive performance of replacing a portion of the soybean meal in swine diets during gestation with raw mung beans.

Experimental Procedure

A total of 546 crossbred gilts bred to crossbred boars from six seasons (fall 1983 through

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spring 1986) were allotted randomly at breeding from two lines selected for rapid or slow growth to two dietary treatments. A control sorghum grain-soybean meal diet (Treatment 1) was fed each season (Table 1). The second treatment consisted of a sorghum grain-based gestation diet with a combination of raw ground mung beans and soybean meal providing the supplemental protein. In the first three seasons, mung beans were included at a high level. This was calculated as the level at which tryptophan became limiting and resulted in a protein supplement of 89% mung beans and 11% soybean meal, at which mung beans provided 84% of the supplemental lsyine (high level, Treatment 3). In the last three seasons, mung beans were included in the diet at a lower level to provide only half the supplemental lysine (moderate level, Treatment 2). This resulted in a protein supplement with 61% mung beans and 39% soybean meal.

Gilts were in outside dirtlots during gestation and were fed 2.27 kg of feed per head per day in individual feeding stalls. They had fresh water available at all times. At d 110 of gestation, gilts were weighed and moved to individual farrowing crates; litters were penned separately until weaned at 42 d. Beginning at d 110, all gilts were fed the same lactation diet (Table 1) at a rate of 2.04 kg per head per day until parturition. After parturition, gilts had ad libitum access to this lactation diet for the duration of the 42-d lactation period. All gilts were weighed at breeding, d 110 of gestation and 42 d postpartum. Pig weights and litter size were recorded at birth, 21 and 42 d of age. Pigs had access to creep feed from 21 to 42 d of age.

Statistical analysis was conducted using least squares analysis of variance. Terms in the model included the fixed main effects of season farrowed, selection line and treatment. Differences between treatment mean were tested using Student's t-Test (Steel and Torrie, 1960). Interactions of season x line and treatment x line also were included because they approached significance ($P < .10$) for at least one characteristic. Because the average breeding (pretreatment) weight differed for the various treatment groups, breeding weight was included as a covariate. This analysis procedure effectively combined analyses for two separate experiments. Treatments 2 and 3 were never compared directly in any season of the study. However, because Treatment 1 was fed in each of the six seasons, comparisons of Treatments 2 and 3 could be made indirectly by using the comparison to Treatment 1. This assumed that treatment x season interactions were absent. There is no way to test this assumption across all three treatments, but there was little evidence of a year x treatment interaction in either of the two separate

TABLE 1. COMPOSITION OF EXPERIMENTAL DIETS

	Gestation diets			Lactation diet
		Mung beans		
Ingredient, %	Control (1)	Moderate level (2)	High level (3)	
Ground sorghum grain	81.22	76.63	73.23	77.84
Soybean meal, 44%	14.39	7.30	2.48	17.82
Ground mung beans[a]		11.51	19.80	
Dicalcium phosphate	1.76	1.86	1.91	1.68
Calcium carbonate	1.04	1.01	.99	1.07
Salt	.34	.34	.34	.34
Vitamin-trace mineral mix[b]	.25	.25	.25	.25
Chlorotetracycline[c]	1.00	1.00	1.00	1.00
Calculated analysis				
Protein, %	13.64	13.14	13.03	14.85
Lysine, %	.62	.62	.62	.68

[a]27.0, 1.86, 1.10, .82, .20 and .34% for crude protein, lysine, isoleucine, threonine, tryptophan and methionine + cystine, respectively.

[b]Supplied 1,764,000 IU vitamin A, 176,900 IU vitamin D, 7,480 IU vitamin E, 1.8 g riboflavin, 8.8 g pantothenic acid, 11.9 g niacin, 8.8 mg vitamin B_{12}, 1.5 g menadione sodium bisulfite, 11 g Mn, 40 g Fe, 40 mg Se, 80 mg I, 4 g Cu and 40 g Zn per kg of premix.

[c]Supplied 220 mg of chlorotetracycline per kg of complete feed.

experiments. This technique to combine information from different experiments is similar to that employed by Tyler et al. (1983).

Results and Discussion

Dietary treatment effects on weight change during gestation and lactation and subsequent reproductive performance are shown in Table 2. Gilts fed the high level of mung beans (Treatment 3) averaged 3.4 kg less gestation weight gain ($P < .05$) than gilts fed the control diet (Treatment 1) and 4.8 kg less gain than gilts fed the moderate level of mung beans (Treatment 2). Conversely, gilts fed Treatment 3 lost less weight during lactation than those fed the other two treatments and were different ($P < .05$) from those fed Treatment 1. This may be explained partially by decreased litter weights at weaning for offspring from Treatment 3, indicating that milk production was reduced. Generally, females with lower gestation weight gain have lower weight loss during lactation.

Litter size at birth was similar among dietary treatments, but litter size at 21 and 42 d was reduced for gilts fed Treatment 2 compared with those fed Treatment 1. Differences ($P < .05$) were noted for both litter size at 21 and 42 d between gilts on Treatments 2 and 1. It should be noted that a source of mung beans fed during the first three seasons when Treatment 3 (high level of mung beans) was compared to the control diet was different from the source fed during the last three seasons when Treatment 2 (moderate level of mung beans) was compared to the control diet. It is possible that the decrease in litter size at 21 or 42 d for gilts fed the moderate level of mung beans, but not the high level of mung beans, may be due to variability in source of mung beans. No differences ($P > .10$) were noted among treatments for survival rate from birth to 21 or 42 d. However, pigs from gilts fed the moderate level of mung beans (Treatment 2) tended to have a lower survival rate than those fed either the control diet (Treatment 1) or the high level of mung beans (Treatment 3). Neither pig nor litter weight at birth or 21 d was affected by level of dietary mung beans. However, mean pig weight and litter weights at d 42 were reduced ($P < .05$ and $P < .10$, respectively) for gilts fed the high level of mung beans (Treatment 3) compared with the control diet.

TABLE 2. THE EFFECTS OF FEEDING RAW MUNG BEANS TO GESTATING GILTS ON WEIGHT CHANGE, LITTER SIZE, SURVIVAL RATE AND LITTER WEIGHT

Item	Treatments		
	1	2	3
No. of gilts	289	116	141
Wt at breeding, kg	130.1	128.7	128.2
Gestation gain, kg	55.9 ± .85[a]	57.3 ± 1.58[a]	52.5 ± 1.45[b]
Lactation gain, kg	−15.6 ± 1.51[a]	−15.2 ± 2.81[ab]	−9.9 ± 2.59[b]
Litter size			
Birth	9.60 ± .14	9.24 ± .26	9.56 ± .24
21 d	7.95 ± .14[a]	7.27 ± .25[b]	7.91 ± .24[ab]
42 d	7.72 ± .14[a]	7.15 ± .26[b]	7.72 ± .23[ab]
Survival rate, %			
Birth to 21 d	83.8 ± 1.08	80.1 ± 2.01	84.1 ± 1.85
Birth to 42 d	81.4 ± 1.11	78.9 ± 2.06	82.0 ± 1.91
Pig wt			
Birth, kg	1.52 ± .01	1.51 ± .02	1.48 ± .02
21 d, kg	5.18 ± .05	5.24 ± .10	5.11 ± .09
42 d, kg	10.88 ± .12[a]	11.19 ± .23[a]	10.33 ± .21[b]
Litter wt			
Birth, kg	14.30 ± .19	13.82 ± .36	13.71 ± .33
21 d, kg	40.45 ± .70	38.16 ± 1.30	39.24 ± 1.20
42 d, kg	82.31 ± 1.47[c]	79.90 ± 2.73[cd]	77.62 ± 2.52[d]

[a,b]Means with different superscripts differ ($P < .05$).

[c,d]Means with different superscripts differ ($P < .10$).

The results of this study suggest that mung beans in the diet of bred gilts may decrease litter size at 21 and 42 d and decrease individual pig and litter weights at 42 d. Because trypsin inhibitors have been isolated in raw mung beans (Borchers and Ackerson, 1947; Gupta and Wagle, 1978), interference with protein utilization may be an explanation of the reduced reproductive and lactation performance of gilts fed raw mung beans. Lectins, thought to interfere with growth and protein utilization, also have been identified in small quantities in mung beans by de Mulenaere (1965) but were reported to be nontoxic to rats. Liener (1976) failed to find any lectin (hemagglutinating) activity in mung beans and further reported that heat-treating of mung beans failed to improve weight gain by rats.

Combs et al. (1967) and Yen et al. (1977) suggested that raw soybeans interfere with protein utilization. Myer et al. (1982) observed a similar response when feeding raw red beans, *Phaseolus vulgaris*, to young pigs. It also has been reported (Hooks et al., 1965; Yen et al., 1977; Myer et al., 1982) that pigs do not have an enlargement of the pancreas and increasing compensating pancreatic secretion when they ingest trypsin inhibitors, as has been reported for the rat and chick (Chernick et al., 1948; Booth et al., 1960; Garlich and Nesheim, 1966; Khayambshi and Lyman, 1966). Work by Crenshaw and Danielson (1985) suggests that bred gilts are more resistant than young swine to trypsin inhibitors in raw soybeans.

A borderline tryptophan deficiency is another plausible explanation of the decreased performance of bred gilts fed mung beans. An estimated value of .20% tryptophan (Chatterjee and Abrol, 1975) was used in diet formulation, whereas analyzed values (Table 1) were used for other amino acid levels in mung beans. Of the total dietary tryptophan, .13 and .12% for Treatments 2 and 3, mung beans provided .02 and .04 units. Thus, if tryptophan content of mung beans is lower than .20%, borderline deficiency of tryptophan may have occurred, especially in Treatment 3 (NRC, 1988).

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