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RENDERED BY-PRODUCTS AS SOYBEAN MEAL REPLACEMENT IN TURKEY RATIONS

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Primary Audience: Nutritionists, Feed Manufacturers, Turkey Researchers, Turkey Industry Personnel

SUMMARY

A study was conducted with 1600 toms to determine the efficacy of animal by-products (BP) as a replacement for soybean meal (SBM) in turkey rations. Feather meal, meat and bone meal, poultry BP meal, and blood meal were the BP utilized. Starter diets (0–4 wk) consisted of a control diet with 50% soy (0% BP meal) and SBM reduced in 10% increments (40, 30, 20% SBM), with BP meal as a protein replacement. All diets were formulated on an equal digestible amino acid basis. After the starter period, the birds were assigned to either a corn-SBM diet or a diet with 25% protein from BP. Toms displayed no significant differences in performance with any dietary treatments to 18 wk. BP treatments reduced growth slightly after this period.

Key words: Animal by-product meal, oligosaccharide, protein, soybean meal, turkey
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DESCRIPTION OF PROBLEM

Soybean meal (SBM) is currently the protein source of choice for rations in the turkey industry. In general, soybean protein is inexpensive, of high quality, and readily available; additionally, SBM does not vary in nutrient content as much as some other protein sources. Although a literature search on use of rendered by-product (BP) vs. SBM in starter rations found little information, industry use of rendered products as a replacement for soybean protein in turkey rations has been widespread for several years. The popularity of rendered products is probably attributable to SBM's oligosaccharide content, which may reduce metabolizable energy values [1, 2] and is thought to yield excreta that can contribute to foot problems in young poults [3, 4, 5]. Use of rendered BP may eliminate some of these problems and in the proper blend may be a more suitable protein source for starting turkeys.

Use of BP may also reduce the cost of the ration. The possible cost savings would justify some level of BP in the ration, provided similar performance could be maintained. The objective of this study was to determine whether animal by-product proteins may be used for starting turkeys and whether a feed including BP can maintain performance throughout the growing cycle.

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Materials and Methods

A floor pen trial was conducted in a three-phase building system with 1600 Nicholas toms from a commercial hatchery raised from hatch to 18 wk of age (June 1995 to October 1995). The birds were randomly assigned to 32 pens of 50 poults per pen. Each pen provided 1, 2, and 4 ft^2 per tom in brooder, intermediate, and finishing areas, respectively. From 0–4 wk the study used four treatments. A corn-SBM control starter ration containing 50% SBM was compared to diets with SBM reduced in 10% increments (40, 30, 20% SBM) with BP meals as a protein replacement. Feather meal, meat and bone meal, poultry BP meal, and blood meal replaced SBM. After the starter phase (0–4 wk), each pen was assigned to either a corn-SBM diet or a diet containing 25% protein from rendered product blends, for a total of eight dietary treatments. Treatments include one of four starter diets: 50, 40, 30, and 20% SBM; followed by one of two finisher diets: either corn-SBM or 25% BP fed to market weight.

All diets were formulated with least-cost formulation software. Diets were formulated on a digestible amino acid basis. Amino acid digestibility values determined for turkeys [6, 7] were entered into the computer for all feedstuffs utilized and were based on amino acid analyses of feedstuffs used in this trial. Amino acid requirements were expressed on a digestible basis. All BP listed above were in the formulation matrix and came in at varying levels as SBM was limited in the diet. Treatments used fat additions to make diets isocaloric (Tables 1 and 2). Diets were changed at 4, 8, 12, and 16 wk of age.

Toms were weighed at 4, 8, 12, 16, and 18 wk of age. Body weight, feed:gain, and mortality were measured. Feed:gain was adjusted for mortality by adding the weight of dead birds back to the weight of the pen. All data were analyzed by one-way analysis of variance (ANOVA) for the 0–4 wk period. A two-way ANOVA was used for the remainder of the time points with starter and finisher levels of BP as the main effects.

Results and Discussion

Table 3 shows the effects of diets on body weight and feed:gain. Toms fed diets with or without BP additions had similar body weights at 4 and 8 wk. No significant differences ($P > .05$) were observed in mortality among treatments in the experiment. Body weight of the BP toms was depressed by 0.44, 0.79, and 1.01 lb at 12, 16, and 18 wk respectively. Feed:gain at 4 wk approached significance ($P < .08$), with the 30% SBM diet providing the best efficiency. No differences were noted at 8 and 12 wk. At 16 and 18 wk the BP treatment improved feed:gain by 4.1 and 3.4% respectively. These data suggest that when diets are formulated to provide similar digestible amino acid levels relatively high amounts of BP in both the starter and finisher diets will yield only minor adverse effects on performance. Many studies have reported the limiting amino acids in SBM [8, 9, 10, 11, 12, 13, 14] and the variable digestibility of amino acids in feedstuffs [6, 7, 15]. However, formulating on a digestible amino acid basis may overcome these limitations and may enable producers to increase dietary BP.

Starting turkeys on animal protein blends as partial SBM replacement could eliminate some problems caused by anti-nutritive factors such as the oligosaccharides in SBM. Coon *et al.* [1] speculated that the α-galactosidase family of oligosaccharides is the cause of reduced TME_n, fiber digestion, and transit time of SBM in chickens. Further work showed that more than 80% of the stachyose must be removed from soy protein sources to achieve maximum TME_n for chickens [2]. Chickens do not have the ability to metabolize α-galactosides in the small intestine since they lack α-1,6 galactosidase activity in their intestinal mucosa [16].

Additionally, feedstuffs high in oligosaccharide content yield sticky excreta that can lead to hock problems and consequent breast damage of birds [3, 4]. High levels of dietary SBM and foot pad dermatitis were first correlated by Jensen *et al.* in 1970 [17]. Additional research to determine the causes of foot pad dermatitis tested various hypotheses, including methionine deficiencies, biotin deficiencies, and wet litter as factors contributing to the condition [18, 19, 20, 21, 22, 23, 24, 25, 26]. These studies arrived at various conclusions. Our study did not include scores of foot pad conditions. Other researchers, however, have recommended that SBM be limited in the

diets of young turkeys because it increases the occurrence of foot pad lesions. Research suggests that these lesions are due to undigested material from SBM [5].

TABLE 1. Composition of diets fed to toms from 0–4 wk of age (digestible AA basis)

INGREDIENT	20% SBM	30% SBM	40% SBM	CONTROL
Soybean meal	20.00	30.00	40.00	49.95
Ground corn	51.37	47.68	42.67	42.10
Meat and bone meal	0.20	6.85	1.75	–
Feather meal	4.50	3.95	4.15	–
Poultry by-product	15.00	3.00	3.00	–
Blood meal	3.10	3.50	1.35	–
Methionine MHA	0.127	0.143	0.138	0.306
Choline chloride	0.035	0.086	0.064	0.061
Fat	2.00	2.70	3.30	3.37
Dicalcium phosphate	2.95	1.50	2.20	2.41
Limestone	–	–	0.80	1.20
Salt	0.30	0.30	0.30	0.30
Vitamin premix[A]	0.075	0.075	0.075	0.075
Mineral premix[B]	0.10	0.10	0.10	0.10
Selenium premix[B]	0.03	0.03	0.03	0.03
Lysine HCl	0.134	0.018	–	0.015
Coban 60	0.075	0.075	0.075	0.075
BMD 50	0.05	0.05	0.05	0.05
CALCULATED ANALYSIS				
Crude Protein, %	29.9	30.4	30.5	28.1
ME, kcal/kg	3120	3120	3101	3099
Calcium, %	1.30	1.30	1.27	1.21
Avail. Phosphorus, %	0.65	0.63	0.60	0.60
Methionine, %	0.50	0.50	0.50	0.63
Met + Cys, %	1.01	1.00	1.00	0.99
Lysine, %	1.48	1.48	1.48	1.48
Na	0.215	0.212	0.172	0.161
K	0.660	0.862	0.977	1.12
Cl	0.293	0.290	0.247	0.207

[A]Vitamin premix supplied the following amounts per kg of diet: vitamin A, 11,550 IU; vitamin D_3, 4125 IU; vitamin E, 16.5 IU; niacin, 66 mg; d-pantothenic acid, 19.8 mg; riboflavin, 8.25 mg; vitamin B_6, 3.3 mg; menadione, 2.5 mg; folic acid, 1.65 mg; thiamine, 1.65 mg; biotin, 0.165 mg; vitamin B_{12}, 13.2 μg; ethoxyquin, 124 mg.

[B]Mineral mixes provided the following per kg of diet: manganese, 110 mg; zinc, 110 mg; iron, 60 mg; iodine, 2 mg; magnesium, 27 mg; selenium, 0.18 mg; copper, 9 mg; calcium as carrier, 280 mg.

TABLE 2. Composition of diets fed to toms from 4–18 wk of age (digestible AA basis)

INGREDIENT	4–8 WK		8–12 WK		12–16 WK		16–18 WK	
	CS[A]	BP[A]	CS	BP	CS	BP	CS	BP
	%							
Soybean meal	45.03	33.75	34.83	26.12	27.89	20.92	21.93	16.45
Ground corn	45.62	50.42	56.33	56.54	63.16	67.20	68.67	71.95
Meat and bone meal	–	1.65	–	6.70	–	1.40	–	1.75
Feather meal	–	4.40	–	2.65	–	1.00	–	–
Poultry by-product	–	1.00	–	1.00	–	1.00	–	1.00
Blood meal	–	1.00	–	1.00	–	1.00	–	1.00
Methionine MHA	0.232	0.215	0.167	0.060	0.072	0.041	0.027	0.023
Choline chloride	0.047	0.071	–	0.003	0.024	0.035	0.029	0.034
Fat	5.53	4.43	5.44	4.75	6.09	5.08	6.92	5.98
Dical. phosph.	1.93	1.73	1.58	0.44	1.42	0.23	1.20	0.93
Limestone	0.98	0.60	0.87	–	0.76	0.46	0.67	0.32
Salt	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30
Vitamin premix[B]	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075
Mineral premix[C]	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
Selenium premix	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03
Lysine HCl	0.054	0.172	0.158	0.109	0.033	0.083	0.0016	0.015
Coban 60	0.05	0.05	0.075	0.075	–	–	–	–
BMD 50	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
CALCULATED ANALYSIS								
Crude Protein, %	26.0	27.0	22.00	23.25	19.00	19.00	16.5	16.5
ME, kcal/kg	3100	3100	3200	3201	3300	3300	3400	3400
Calcium, %	1.00	1.00	0.85	0.87	0.75	0.75	0.65	0.65
Avail. Phos., %	0.50	0.50	0.42	0.42	0.38	0.38	0.33	0.33
Methionine, %	0.55	0.52	0.45	0.42	0.34	0.30	0.27	0.27
Met + Cys, %	0.88	0.99	0.74	0.80	0.60	0.60	0.51	0.51
Lysine, %	1.38	1.38	1.20	1.30	0.92	0.92	0.74	0.74
Na	0.151	0.184	0.136	0.206	0.136	0.159	0.136	0.154
Cl	0.233	0.267	0.220	0.278	0.225	0.247	0.226	0.238
K	1.032	0.864	0.861	0.790	0.743	0.646	0.642	0.555

[A]CS = Corn-Soybean meal; BP = By-product.

[B]Vitamin premix supplied the following per kg of diet: vitamin A, 11,550 IU; vitamin D_3, 4125 IU; vitamin E, 16.5 IU; niacin, 66 mg; d-pantothenic acid, 19.8 mg; riboflavin, 8.25 mg; vitamin B_6, 3.3 mg; menadione, 2.5 mg; folic acid, 1.65 mg; thiamine, 1.65 mg; biotin, 0.165 mg; vitamin B_{12}, 13.2 μg, ethoxyquin, 124 mg.

[C]Mineral mixes provided the following per kg of diet: manganese, 110 mg; zinc, 110 mg; iron, 60 mg; iodine, 2 mg; magnesium, 27 mg; selenium, 0.18 mg; copper, 9 mg; calcium as carrier, 280 mg.

TABLE 3. Effect of different levels of soybean meal (CS) vs. by-products (BP) in starter tom diets followed by corn-soy or by-product additions

TREATMENT	4 WK[A]		8 WK		12 WK		16 WK		18 WK	
	Weight in Lb									
	BW	F:G	BW	F:G	BW	F:G	BW	F:G	BW	F:G
20% CS	1.80	1.56	7.37	1.66	17.06	2.00	23.30	2.47	29.28	2.59
30% CS	1.77	1.51	7.44	1.71	16.93	2.04	23.39	2.54	27.99	2.80
40% CS	1.77	1.61	7.07	1.76	16.48	2.04	22.56	2.54	28.00	2.71
CTRL-CS	1.84	1.71	7.47	1.64	16.43	2.00	23.30	2.51	27.95	2.80
Mean of CS Treatments			7.34	1.69	16.72	2.02	23.13	2.51	28.30	2.72
20% BP			7.31	1.71	16.76	2.02	22.71	2.46	27.83	2.69
30% BP			7.14	1.69	15.88	2.02	21.93	2.49	26.89	2.67
40% BP			7.26	1.64	15.93	1.93	22.42	2.31	26.95	2.54
CTRL-BP			7.16	1.83	16.55	2.05	22.43	2.38	27.50	2.61
Mean of BP Treatments			7.21	1.71	16.28	2.00	22.37	2.41	27.29	2.62
Pooled SEM	0.04	0.07	0.18	0.05	0.31	0.03	0.52	0.07	0.53	0.06
Effects										
Starter Diet	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Finisher Diet	–	–	NS	NS	P<.05	P<.05	P<.05	P<.05		
Interaction	–	–	NS	NS	NS	NS	NS	NS	NS	NS

[A]Treatments split at 4 wk of age to corn-soy or with by-product addition beyond this point. Please see text for complete explanation.

CONCLUSIONS AND APPLICATIONS

1. Toms receiving starter diets with only 20% SBM and finisher diets containing animal BP showed a reduction in weight gain of 3% or less. Maintaining optimum digestible amino acid content is important in formulating such diets.
2. Results from this study indicate that BP can partially replace SBM as a protein source in diets formulated on a digestible amino acid basis.

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