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UTILIZATION OF RENDERED BY-PRODUCTS AS SOYBEAN MEAL REPLACEMENT IN STARTER TURKEY RATIONS

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Industry Summary

INTRODUCTION

The turkey industry has utilized soybean meal as the protein source of choice for its rations. In general, soy protein is inexpensive, of high quality for the bird, readily available and does not vary in nutrient content as much as some other protein sources. Although a literature search on use of rendered by-products versus soybean meal in starter rations found little information, there have been anecdotal reports of rendered product use as a replacement for soy protein in turkey rations for several years. This is probably justified based on the oligosaccharide content of soybean meal which may reduce metabolizable energy values and is thought to yield an excreta which is hard on the feet of young poults. Use of rendered by-products may eliminate some of these problems and in the proper blend may be a more suitable protein source for starting turkeys.

Use of by-products in starter turkey rations has the potential to improve utilization of rendered products. Using by-products as a sole protein source in starter rations for turkeys could involve more than 150,000 tons of product each year. Each increment of soy protein replacement would use an appreciable amount of rendered product. While the cost of the mix may be slightly higher than a comparable soy protein diet, the starter period of turkeys uses relatively little feed when compared to the entire growth period. Thus, if any improvement in performance could be found, it would probably be worth the additional cost to get the poults started off right

Objectives: The objective of this study was to determine if a blended protein may be used for starting turkeys (hens and toms) and if so, can performance be maintained throughout the growing cycle.

Industry summary:

Hens fed starter diets with additions of by-products tended to have slightly reduced body weights during the starter period. However, feed:gain was improved. Growth rate depressions were compensated for by 12 weeks of age when no treatment effects were observed. The addition of by-products in the finishing diets caused slight depressions in gain overall by the conclusion of the trial (14 weeks) but no differences in feed:gain occurred. No differences were observed when birds received 20% soybean meal compared to a control diet, followed by a corn-SBM diet in the finishing stages. This indicates that a by-product blend can be fed with as little as 20% soybean meal in the starter phase and finished on a corn-SBM diet with no detrimental effects on performance.

Toms fed starter diets with or without by-product additions did not differ from one another. No significant differences were observed in body weight or feed:gain among treatments in any of the finishing diets, regardless of corn-soy or by-product diets. These data support that by-products can be utilized in both the starter and finishing diets in what would be considered high amounts with no adverse effects on performance. Utilization in diets for toms alone at the levels included in this could result in over 700 million lbs of by-product use.

INTRODUCTION

The turkey industry has utilized soybean meal (SBM) as the primary protein source for its rations. Great quantities are utilized in a typical commercial corn-SBM diet due to the high protein requirement of turkeys. Therefore, turkeys are more sensitive to any adverse effects caused by SBM. In general, soy protein is inexpensive, of high quality for the bird, readily available and does not vary in nutrient content as much as some other protein sources. Although some by-product meals contain high protein levels, their inclusion in diets is often limited due to variability from source to source. A literature search on use of rendered by-products versus soybean meal in starter rations found little information, however, there have been anecdotal reports of rendered product use as a replacement for soy protein in turkey rations for several years. This likely due to some antinutritive factors such as the oligosaccharide content of soybean meal, therefore, it may be advantageous to start turkeys on animal protein blends as partial or total soy replacement if adverse problems could be eliminated

Coon, *et al.*,(1990) have speculated that the α-galactosidase family of oligosaccharides is the cause of reduced TMEn, 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 TMEn for chickens (Leske, *et al.*, 1993). Chickens do not have the ability to metabolize the α-galactosides in the small intestine since they lack α-1,6

galactosidase activity in their intestinal mucosa (Gitzelmann and Auricchio, 1965). Additionally, feedstuffs high in oligosaccharide content yield a sticky excreta that can lead to hock problems and consequent breast damage of birds (Halpin *et al.*, 1936, Chesson, 1993). It has been recommended that SBM be limited in young turkeys due to foot pad lesions and has been suggested that the lesions are due to undigested material from SBM (Leeson and Summers, 1991).

Utilizing by-products in starter turkey rations has the potential to improve use of rendered products and also provides an alternative to SBM extraction. By-products as a sole protein source in starter turkey rations could involve more than 150,000 tons of product each year. Each increment of soy protein replacement would use an appreciable amount of rendered product. Although the cost of by-product use may be slightly higher than a comparable soy protein diet, turkeys eat relatively little amounts in the starter period when compared to the entire growth period. Thus, if any improvement in performance can be found, it may be worth the additional cost to start the birds right.

The objective of these experiments was to determine if a blended protein may be used for starting turkeys and if so, can performance be maintained throughout the growing cycle.

ABSTRACT

Two trials were conducted to determine the efficacy of animal by-products as a replacement for soybean meal in turkey rations. Sixteen hundred hens and 1600 toms were randomly assigned to eight dietary treatments. Turkey starter diets (0-4 weeks) consisted of a control diet with 50% soy (0% by-product meal), and soybean meal reduced in 10% increments (40, 30, 20% soy), with by-product meal as a protein replacement. Feather meal, meat and bone meal, poultry by-product meal and blood meal were the by-products utilized. Fish meal was also used in the hen trial. The tom diets were formulated on a digestible basis, whereas the hen diets were not. After the starter period, the birds were assigned to either a corn-soybean meal diet or a diet with 25% of the protein source replaced with by-products. Hens receiving as low as 20% soybean meal, followed by a corn-SBM diet displayed no detrimental effects, although some significant differences were observed in performance amongst treatments. Toms displayed no significant differences ($p > .05$) in performance with any dietary treatments, indicating that soybean meal can be reduced to 20% in the starter diet, with by-product meals in the finishing diets. Replacing soybean meal in starter diets would increase utilization of rendered products and may reduce the oligosaccharide content of the diet, thereby reducing the incidence of foot problems in young poults. Additionally, these results demonstrate the advantage of formulating diets on a digestible basis.

Key words: turkey, animal by-product meal, oligosaccharide, soybean meal, protein

MATERIALS AND METHODS

Two floor pen trials were conducted in a three phase building system with turkeys obtained from a commercial hatchery. Sixteen hundred Hybrid hens were reared from 0-14 weeks of age (August 1994 to November 1994) and 1600 Nicholas toms from 0-18 weeks of age (June 1995 to October 1995). The birds were randomly assigned to eight dietary treatments with 50 poults per treatment. Each pen provided a finisher space of 2.5 and 4.0 square feet per hen or tom respectively. A corn-soy control starter ration containing 50% SBM (CTRL) was compared to diets with soybean meal reduced in 10% increments (40, 30, 20% soy), with by-product meal as a replacement. Feather meal, meat and bone meal, poultry by-product meal and blood meal replaced soybean meal. After the starter phase (0-4 weeks), each pen was assigned to either a corn-soy diet or a diet containing 25% of the protein from rendered product blends, for a total of 8 dietary treatments. Treatments include: starter diets with varying amounts of SBM followed by a corn-SBM diet in the finishing stage: (i.e. 20% SBM + by product meal in the starter stage followed by corn-SBM diets in the finishing stages (20% CS)), 30% CS, 40% CS, CTRL-CS; and starter diets followed by diets containing by-product meals in the finishing stages: 20% BP, 30% BP, 40% BP and CTRL-BP.

All diets were formulated with least-cost diet formulation software. Tom diets were formulated on a digestible basis, whereas the hen diets were not. This was due to digestibility values not being available until after the hen trial was complete. All by-products listed above were in the formulation matrix and

came in at varying levels as SBM was limited in the diet. Treatments were made isocaloric with fat additions (tables 1-4). Diets were changed at 4, 8, 12 and 16 week intervals.

Hens were weighed at 4, 8, 12 and 14 weeks of age and toms were weighed at 4, 8, 12, 16 and 18 weeks 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 was analyzed by analysis of variance and means separated by Least Significant Difference where appropriate.

RESULTS AND DISCUSSION

Body weight and feed/gain results for the hens are shown in table 5. Hens fed starter diets with additions of by-products tended to have slightly reduced body weights during the starter period. However, feed:gain was improved. Growth rate depressions were compensated for by 12 weeks of age when no treatment effects were observed. The addition of by-products in the finishing diets caused slight depressions in gain overall by the conclusion of the trial but no differences in feed:gain occurred. No differences were observed when birds received 20% SBM compared to a CTRL diet, followed by a corn-SBM diet. This indicates that a by-product blend can be fed with as little as 20% SBM in the starter phase and finished on a corn-SBM diet with no detrimental effects on performance. No differences in mortality were observed among any treatments throughout the trial.

Results from the tom trial are shown in table 6. Toms fed starter diets with or without by-product additions did not differ

from one another. No significant differences ($p > .05$) were observed in body weight, feed:gain or mortality among treatments in any of the finishing diets, regardless of corn-SBM or by-product diets. These data support that by-products can be utilized in both the starter and finishing diets in what would be considered high amounts with no adverse effects on performance. By-product utilization may be an alternative until enzyme preparations are available to treat soybean meal.

Conclusions

1. Hens can receive as low as 20% soybean meal in the starter diets, followed with corn-soybean meal diets in the finishing stages with no detrimental effects.

2. Toms can receive as low as 20% soybean meal in the starter diets, followed with by-product diets in the finishing stages with no detrimental effects.

3. Results from this study indicate that by-product utilization could be increased by replacing soybean meal as a protein source.

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Table 1.
Composition of diets fed to hens from 0-4 weeks of age

INGREDIENT	20% SBM	30% SBM	40%SBM	CTRL
		(%)		
Soybean Meal	20.00	30.00	40.00	50.19
Ground Corn	56.60	50.61	44.98	39.17
Meat & Bone Meal	6.00	5.34	1.50	-----
Fish Meal	2.00	2.00	1.50	-----
Feather Meal	2.85	2.33	0.68	-----
Poultry By-Product	3.60	2.00	1.50	-----
Blood Meal	4.92	2.00	1.50	-----
Methionine MHA	0.18	0.16	0.20	0.22
Choline Chloride	0.09	0.08	0.06	0.05
Fat	2.18	3.64	4.86	6.33
Dicalcium Phosphate	1.08	1.12	1.92	2.33
Limestone	0.00	0.22	0.81	1.22
Salt	0.30	0.30	0.30	0.30
Vitamin Premix[1]	0.05	0.05	0.05	0.05
Mineral Premix[2]	0.10	0.10	0.10	0.10
Selenium Premix[2]	0.05	0.05	0.05	0.05
CALCULATED ANALYSIS				
Crude Protein (%)	28.0	28.0	28.0	28.0
ME, kcal/kg	3075	3075	3075	3075
Calcium (%)	1.20	1.20	1.20	1.20
Avail. Phosphorous (%)	0.60	0.60	0.60	0.60
Methionine (%)	0.58	0.58	0.62	0.62
Met + Cys (%)	1.05	1.05	1.05	1.05
Lysine (%)	1.63	1.61	1.69	1.69

[1] Vitamin Premix supplied the following amounts per kilogram of diet: vitamin A, 7700 IU; vitamin D3, 2750 IU; vitamin E, 11 IU; niacin, 44 mg; d-pantothenic acid, 13.2 mg; riboflavin, 5.5 mg; vitamin B6, 2.2 mg; menadione, 1.65 mg; folic acid, 1.1 mg; thiamine, 1.1 mg; biotin, 0.11 mg; vitamin B12, 8.8 µg.

[2]Mineral mixes provided the following per kilogram of diet: manganese, 110 mg; zinc, 110 mg; iron, 60 mg; iodine, 2 mg; magnesium, 27 mg; selenium, 0.18 mg

Table 2.
Composition of diets fed to hens from 4-14 weeks of age

INGREDIENT	4-8 WKS		8-12 WKS		12-14 WKS	
	CS	BP	CS	BP	CS	BP
	(%)					
Soybean Meal	45.04	32.29	34.8	23.70	30.80	19.20
Ground Corn	46.11	51.70	56.78	60.91	60.03	67.96
Meat & Bone Meal	-----	3.00	-----	4.80	-----	2.65
Fish Meal	-----	-----	-----	-----	-----	-----
Feather Meal	-----	1.97	-----	2.00	-----	1.30
Poultry By-Product	-----	2.00	-----	2.00	-----	1.00
Blood Meal	-----	2.00	-----	2.00	-----	1.00
Methionine MHA	0.099	0.057	0.116	0.068	-----	-----
Choline Chloride	0.014	0.032	-----	-----	-----	0.012
Fat	5.37	4.15	5.28	3.84	6.43	4.83
Dicalcium Phosphate	1.83	1.31	1.55	-----	1.47	1.58
Limestone	1.04	0.99	0.90	-----	0.80	-----
Salt	0.30	0.30	0.30	0.30	0.30	0.30
Vitamin Premix[1]	0.05	0.05	0.05	0.05	0.05	0.05
Mineral Premix[2]	0.10	0.10	0.05	0.05	0.05	0.05
Selenium Premix[2]	0.05	0.05	0.03	0.03	0.02	0.02
Lysine HCL	-----	-----	0.10	0.20	-----	-----
Coban 60	-----	-----	0.05	0.05	0.05	0.05
CALCULATED ANALYSIS						
Crude Protein (%)	26.0	26.4	22.00	23.25	19.73	18.99
ME, kcal/kg	3100	3100	3199	3201	3300	3300
Calcium (%)	1.00	1.20	0.86	0.87	0.75	0.75
Avail. Phosphorous(%)	0.50	0.50	0.42	0.42	0.38	0.38
Methionine (%)	0.50	0.45	0.46	0.42	0.31	0.30
Met + Cys (%)	0.90	0.90	0.80	0.80	0.57	0.65
Lysine (%)	1.54	1.50	1.31	1.30	1.07	0.95

[1] Vitamin Premix supplied the following amounts per kilogram of diet: vitamin A, 7700 IU; vitamin D3, 2750 IU; vitamin E, 11 IU; niacin, 44 mg; d-pantothenic acid, 13.2 mg; riboflavin, 5.5 mg; vitamin B6, 2.2 mg; menadione, 1.65 mg; folic acid, 1.1 mg; thiamine, 1.1 mg; biotin, 0.11 mg; vitamin B12, 8.8 µg.

[2]Mineral mixes provided the following per kilogram of diet: manganese, 110 mg; zinc, 110 mg; iron, 60 mg; iodine, 2 mg; magnesium, 27 mg; selenium, 0.18 mg

Table 3.
Composition of diets fed to toms from 0-4 weeks of age

INGREDIENT	20%	30%	40%	CTRL
	(%)			
Soybean Meal	20.00	30.00	40.00	49.95
Ground Corn	51.37	47.68	42.67	42.10
Meat & 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	0.25	0.25	0.25	0.25
Vitamin Premix[1]	0.075	0.075	0.075	0.075
Mineral Premix[2]	0.10	0.10	0.10	0.10
Selenium Premix[2]	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. Phosphorous (%)	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

[1] Vitamin Premix supplied the following amounts per kilogram of diet: vitamin A, 7700 IU; vitamin D3, 2750 IU; vitamin E, 11 IU; niacin, 44 mg; d-pantothenic acid, 13.2 mg; riboflavin, 5.5 mg; vitamin B6, 2.2 mg; menadione, 1.65 mg; folic acid, 1.1 mg; thiamine, 1.1 mg; biotin, 0.11 mg; vitamin B12, 8.8 µg.

[2]Mineral mixes provided the following per kilogram of diet: manganese, 110 mg; zinc, 110 mg; iron, 60 mg; iodine, 2 mg; magnesium, 27 mg; selenium, 0.18 mg

Table 4.
Composition of diets fed to toms from 4-18 weeks of age (digestible basis)

INGREDIENT	4-8 WKS		8-12 WKS		12-16 WKS		16-18 WKS	
	CS	BP	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 & Bone	-----	1.65	-----	6.70	-----	1.40	-----	1.75
Feather Meal	-----	4.40	-----	2.65	-----	1.00	-----	-----
Poultry By-Prod	-----	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 Chlor.	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	1.23	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[1]	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075
Mineral Premix[2]	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. Phosph.(%)	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

[1] Vitamin Premix supplied the following amounts per kilogram of diet: vitamin A, 7700 IU; vitamin D3, 2750 IU; vitamin E, 11 IU; niacin, 44 mg; d-pantothenic acid, 13.2 mg; riboflavin, 5.5 mg; vitamin B6, 2.2 mg; menadione, 1.65 mg; folic acid, 1.1 mg; thiamine, 1.1 mg; biotin, 0.11 mg; vitamin B12, 8.8 µg.

[2]Mineral mixes provided the following per kilogram of diet: manganese, 110 mg; zinc, 110 mg; iron, 60 mg; iodine, 2 mg; magnesium, 27 mg; selenium, 0.18 mg

Table 5.

Effects of different levels of soybean meal vs by-products in starter hen diets followed by corn-soy or by-product additions

Treatment	**4wks		8wks		12wks		14wks	
	(Weight in pounds)							
	BW	F:G	BW	F:G	BW	F:G	BW	F:G
20% CS	1.61[a]	1.72[a]	5.78[a]	2.15	13.30	2.58	15.69[bc]	2.80
30% CS	1.74[b]	1.79[a]	6.58[b]	1.92	13.33	2.50	15.76[bc]	2.73
40% CS	1.82[c]	1.72[a]	6.45[b]	2.08	12.98	2.53	15.71[bc]	2.69
CTRL-CS	1.86[c]	1.90[b]	6.63[b]	2.08	12.96	2.61	15.88[c]	2.65
20% BP			6.06[a]	2.08	13.09	2.55	15.61[abc]	2.76
30% BP			6.04[a]	2.04	13.13	2.60	15.26[ab]	2.64
40% BP			5.87[a]	2.07	13.32	2.54	15.32[ab]	2.77
CTRL-BP			5.96[a]	2.25	12.87	2.56	15.12[a]	2.76

Means with different letters are significantly different.
**Treatments split at 4 wks of age to corn-soy or with by-product addition beyond this point. Please see text for complete explanation.

Table 6.

Effects of different levels of soybean meal vs by-products in starter tom diets followed by corn-soy or by-product additions*

Treatment	**4wks		8wks		12wks		16wks		18 wks	
	(Weight in pounds)									
	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
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

Means with different letters are significantly different.

*.In this trial, there were no significant differences observed among any treatments for BW or F:G

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