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Results of a Collaborative Feeding Trial

Improving Broiler Performance Through the Use of Benson Hill Ultra-High Protein, Low Oligosaccharide Soybean Meal in Comparison to Conventional Soybean Meal

Integrator **One**

ABSTRACT

This study was a 42-day feeding trial conducted with a large broiler integrator, Perdue Farms, at its research facility in Westover, Maryland. The trial was designed to compare the performance of broilers fed with Benson Hill Ultra-High Protein, Low Oligosaccharide (UHP-LO) soybean meal (SBM) relative to conventionally available commodity-sourced soybean meal. Four treatments were used, each with varying soybean meal components to test the results of feeding UHP-LO SBM. The trial results indicated that the use of Benson Hill soy improved feed cost, broiler weights, and feed conversions, leading to significant economic returns by lowering cost of production in all-veg broiler diets. These findings suggest that feeding SBM derived from Benson Hill's improved genetics provides value in broiler feed by reducing poultry producer costs and improving performance.

INTRODUCTION

The poultry industry is constantly searching for ways to improve production efficiency while managing costs. Benson Hill proposes that animal nutrition can change the basis of the fundamental formulation through improved soybean technology. The proposed approach is to explore alternative ingredients for broiler diets with SBM from improved soybeans. Benson Hill UHP-LO SBM is one such ingredient that has shown promise in previous academic and commercial studies. In this study, the hypothesis was that exchanging UHP-LO SBM for other protein components in the broiler diet would result in improved feed conversion ratio (FCR) and a reduction in foot pad dermatitis (FPD) in commercial conditions. To test this hypothesis, a 42-day feeding trial was conducted with a large broiler integrator, Perdue Farms. The trial aimed to compare the performance of broilers fed with UHP-LO SBM relative to conventional SBM. The results of this study could have significant implications for the poultry industry by providing a cost-effective and efficient alternative for broiler feed formulation.

METHODS

The trial was conducted with 2,760 Ross 708 broiler males placed on top-dressed used litter at a density of approximately 1.1 square foot per bird. The feeding program was a simple three-phase corn and SBM-based program formulated to Aviagen's Ross 708 nutritional recommendations, with feeding changes occurring at 14 and 28 days of age. Isocaloric diets were fed as crumbles for the first 14 days, followed by pellets through the end of trial. Diets were all-veg, non-medicated, and contained a phytase enzyme, but no xylanase/NSP enzymes, Table 1. Broilers were vaccinated with Coccivac® B52 at the hatchery, along with the standard hatchery vaccines. Each diet was fed to 16 pens of 46 broilers, apart from treatment 4, which was fed to 12 pens of 46 broilers.

Table 1.1: Starter Diet

Starter Diet	Treatment 1	Treatment 2	Treatment 3	Treatment 4
Corn	1060.9	1184.6	1279.4	1256
Soybean Meal	748.9	325	0	0
Vegetable Oil	61.5	33	11.1	31.3
Other Ingredients	128.7	127.9	127.3	127.2
Benson Hill UHP-LO SBM (Alt TME)	0	0	0	585.5
Benson Hill UHP-LO SBM	0	329.4	582.1	0
Ingredient Total:	2000	2000	2000	2000
Total Cost ($/Ton)	358.89	346.76	337.46	346.93

The feeding trial had four treatments with varying SBM components to test Benson Hill UHP-LO relative to key controls. Following previous work published in 2010 by Dozier and Perryman[2] that verified 80 kcals per pound greater energy availability, UHP-LO was formulated with an extra 80 kcals per pound relative to conventional SBM. These extra calories are likely contributed by the higher digestibility due to lower oligosaccharide content and higher sucrose content in improved soybean varieties from Benson Hill.

Treatments were as follows: conventional SBM (T1), conventional SBM supplying approximately half the soy protein and the other half being supplied by UHP-LO SBM (T2), UHP-LO SBM supplying 100% of the soy protein (T3), and UHP-LO SBM supplying 100 percent of the SBM, using conventional SBM's energy value (80 kcals per pound less energy) (T4). Ingredient cost utilized in the formulation of the diets were: corn at $5 per bushel, vegetable oil at $0.60 per pound, conventional soybean meal at $480 per ton, and UHP-LO SBM at $570 per ton*.

Table 1.2: Grower Diet

Grower Diet	Treatment 1	Treatment 2	Treatment 3	Treatment 4
Corn	1199.2	1301.4	1382.6	1362.9
Soybean Meal	629.5	275	0	0
Vegetable Oil	56.3	32.8	14	31.1
Other Ingredients	115	113.9	113.5	113.5
Benson Hill UHP-LO SBM (Alt TME)	0	0	0	492.5
Benson Hill UHP-LO SBM	0	276.9	489.8	0
Ingredient Total:	2000	2000	2000	2000
Total Cost ($/Ton)	335.92	324.83	316.8	324.77

Table 1.3: Finisher Diet

Finisher Diet	Treatment 1	Treatment 2	Treatment 3	Treatment 4
Corn	1333.1	1428.6	1494.5	1477.9
Soybean Meal	562.9	231	0	0
Vegetable Oil	54.8	32.6	17.3	32.3
Other Ingredients	49.2	307.7	47.1	47.1
Benson Hill UHP-LO SBM (Alt TME)	0			442.7
Benson Hill UHP-LO SBM	0	260	441.2	0
Ingredient Total:	2000	2000	2000	2000
Total Cost ($/Ton)	312.25	302.21	296.44	302.77

Recommended nutritional specification for UHP-LO SBM can be found in Table 2. Mortality and mortality weight were recorded daily. Birds were weighed at feed changes as well as feed consumption calculated by period. Litter samples were also taken at feed changes to determine litter moisture and paw grading was conducted at processing.

Table 2: Recommended Nutrient Specification for Benson Hill UHP-LO

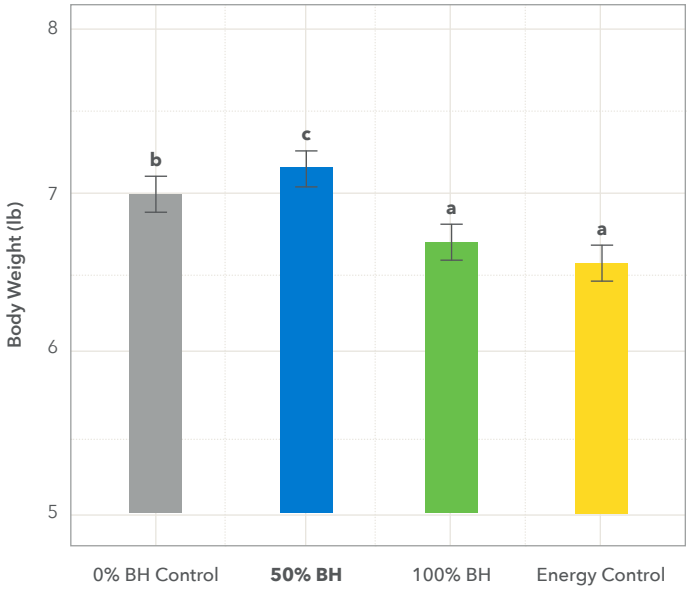
	Unit	Soybean Meal BH UHP-LO
Moisture	Pct	12.000
Crude Protein	Pct	52.931
Metabolized Energy Poultry	kcal/lb	80 kcals higher than control soy
Crude Fat	Pct	1.200
Crude Fiber	Pct	3.500
Ash	Pct	6.570
Calcium	Pct	0.261
Phosphorus - Available	Pct	0.266
Phosphorus - Total	Pct	0.650
Lysine Total	Pct	3.596
Methionine Total	Pct	0.813
Methionine + Cystine	Pct	1.626
Arginine	Pct	3.808
Tryptophan	Pct	0.802
Valine	Pct	2.641
Glycine	Pct	1.943
Histidine	Pct	1.403
Phenylalanine	Pct	2.747
Threonine	Pct	2.087
Leucine	Pct	4.173
Isoleucine	Pct	2.558
Choline	mg/lb	1250.
Sodium	Pct	0.030
Potassium	Pct	2.070
Linoleic Acid	Pct	0.400
Dry Matter	Pct	88.000
Sulfur	Pct	0.432
Chloride	Pct	0.050
Linoleic	Pct	0.400
Cystine	Pct	0.813
DM Protein	Pct	60.149
dLys-P	Pct	3.200
dMet-P	Pct	0.732
dM+C-P	Pct	1.366
dArg-P	Pct	3.465
dTrp-P	Pct	0.714
dVal-P	Pct	2.271
dHis-P	Pct	1.249
dPhn-P	Pct	2.417
dThr-P	Pct	1.732
dLeu-P	Pct	3.631
dIso-p	Pct	2.226
dCys-p	Pct	0.634

RESULTS AND DISCUSSION:

Broiler weights, feed conversions, and mortality can be seen in Tables 3, 4, and 5 , respectively. Broilers were initially weighed at placement. Treatment 2 was significantly heavier than treatments 3 and 4, but not significantly different from treatment 1. At 28 days, treatment 2 was significantly heavier than all treatments, with treatment 1 being intermediate and significantly greater than treatments 3 and 4. This trend continued throughout the trial, with the final broiler weight for treatment 2 being significantly heavier than any other treatment. This indicates that UHP-LO SBM showed improved performance in a blended diet over conventional SBM.

Table 3: Broiler Weights (in lbs.)

	14 days		28 days		42 days	
Treatment 1	0.858	ab	3.410	b	7.012	b
Treatment 2	0.891	a	3.534	a	7.176	a
Treatment 3	0.826	bc	3.248	c	6.668	c
Treatment 4	0.796	c	3.213	c	6.630	c



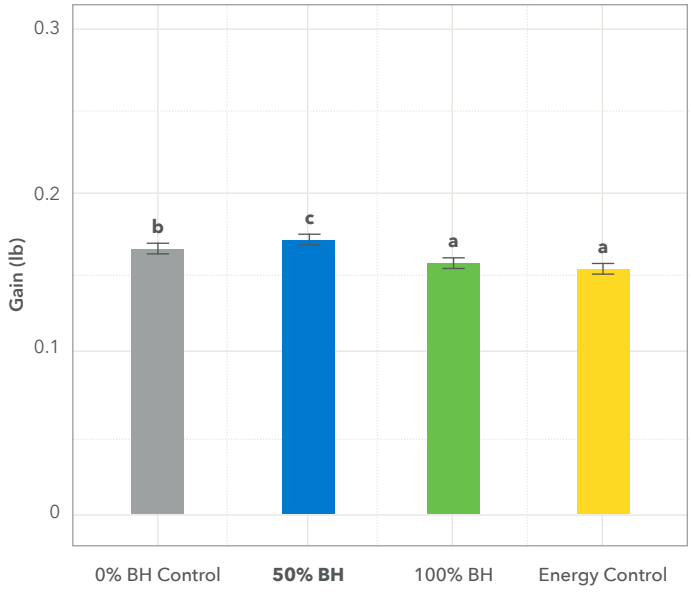
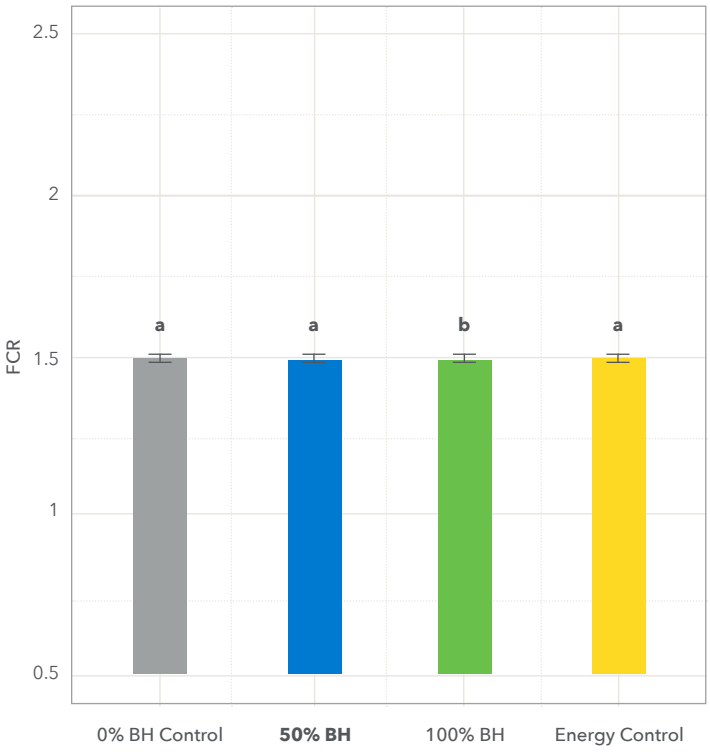


Table 4: Feed Conversion Adjusted for Mortality

	14 days		28 days		42 days		42 days**	
Treatment 1	1.127	a	1.405	a	1.484	a	1.473	a
Treatment 2	1.149	ab	1.418	a	1.486	a	1.458	a
Treatment 3	1.177	b	1.439	b	1.506	b	1.530	b
Treatment 4	1.108	b	1.418	a	1.487	a	1.514	b

**adjusted for mortality and weight



As a result of significant differences in weight for treatments 3 and 4 at 14 days, amino acid and sugar analyses were conducted on the starter feed to confirm UHP-LO SBM sources were utilized in the manufacturing of feeds in treatments 3 and 4.

Low raffinose and stachyose levels in treatments 2, 3, and 4 confirmed that the correct sources of SBM were utilized, however, it was noted that the protein and lysine levels were higher than expected in treatments 1 and 2 in relation to the higher protein levels from the commodity SBM Table 8, which likely account for the differences seen in growth. Feed conversions adjusted for mortality and weight reveal that treatments 1 and 2 are significantly lower than treatments 3 and 4. Many published broiler studies have shown that increasing protein and lysine levels in the starter period will improve weight gain, feed consumption and feed efficiency (1).

Table 5: Broiler Mortality

	14 days		28 days		42 days	
Treatment 1	0.995	-	2.396	b	2.732	ab
Treatment 2	0.162	-	0.572	a	1.404	a
Treatment 3	2.021	-	3.449	b	4.307	b
Treatment 4	1.009	-	1.980	b	2.371	ab

Comparing treatments 1 and 2, there was no evidence for differences in feed conversions when adjusting for mortality and weight, which indicates that UHP-LO SBM can be successfully substituted for commodity SBM. There was also no evidence for differences in adjusted feed conversions between treatments 3 and 4, therefore, the 80 kcals/pound higher energy given to UHP-LO SBM verses commodity soybean meal appears to be a reasonable estimate. There were significant differences in mortality among treatments, however mortality of all treatments was comparable to commercial mortality levels. Even though treatment 2 had lower mortality, other treatments were within industry norm and any difference is not thought to be directly associated with diet or soybean meal source.

Table 6: Feed Cost per Ton

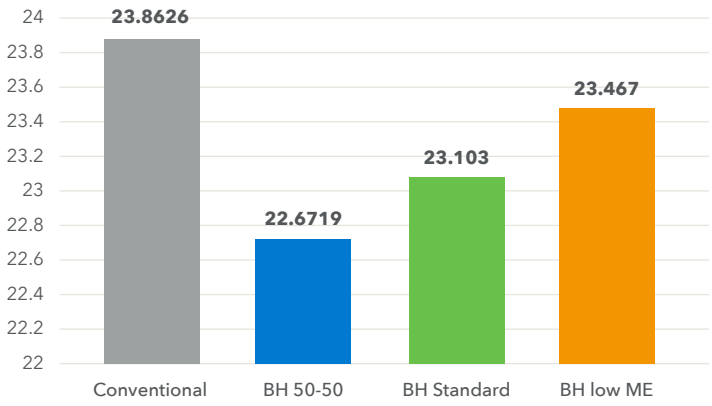
$/ton feed

	Treatment 1	Treatment 2	Treatment 3	Treatment 4
Starter	359	347	337	347
Grower	336	325	316	325
Finisher	312	302	296	303
Total	**$324**	**$311**	**$302**	**$310**

Table 7: Feed Cost per Live Pound

Feed Cost Adjusted for Weight

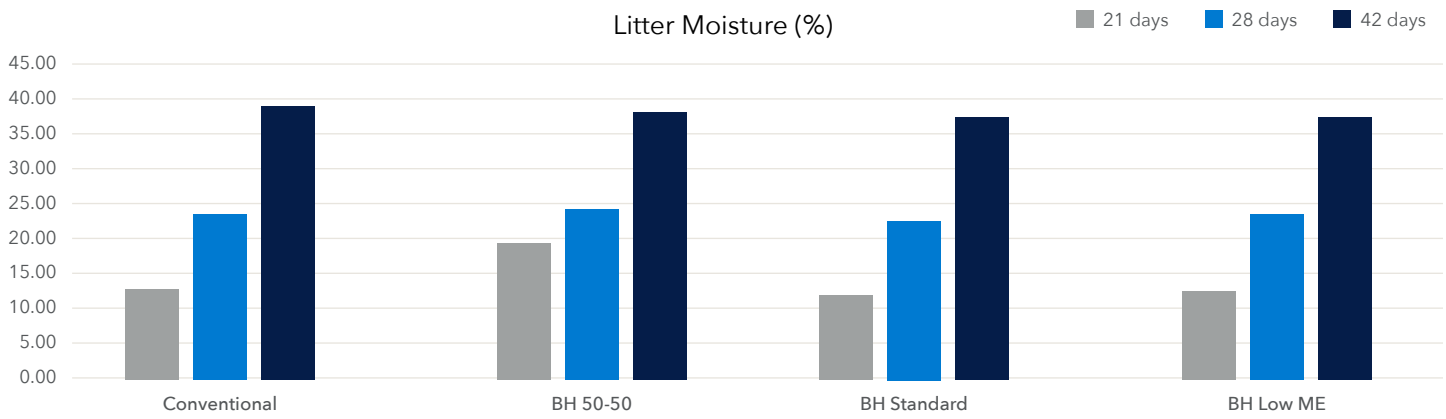
	¢ per live lb	$ per 6.5 lb bird	Savings/1,000,000 birds
Treatment 1	23.863	1.551	0.00
Treatment 2	22.672	1.474	$77,395.50
Treatment 3	23.103	1.502	$49,374.00
Treatment 4	23.467	1.525	$25,714.00



Feed cost per ton is reported in Table 6. With a $90 per ton premium attributed to the Benson Hill sourced SBM over conventional SBM, feed costs per ton were lower with the addition and substitution of UHP-LO SBM due to the higher level of crude protein, amino acids and energy it contained. Feed cost per live pound or per bird was also reduced when adding or substituting UHP-LO SBM for conventional SBM. Treatment 2 had the greatest feed cost savings over the conventional soybean treatment 1, however treatments 3 and 4 also had an advantage in feed cost savings over the conventional SBM treatment 1, as seen in Table 7. These results indicate that SBM derived from Benson Hill UHP-LO soybeans provides value in the context of broiler feed by lowering producer costs.

Litter moisture, Graph 1 , and paw scores were also determined during the trial. Treatment 2 had a significantly higher moisture level at 21 days, however by the end of the trial, there were no significant differences in litter moisture. Paw grading conducted at the end of the trial revealed that all treatments produced high quality paws and that litter moisture was not an issue. The birds in this trial were placed at about 1.1 square foot per bird, resulting in approximately 6.4 pounds per square foot final stocking density. The National Chicken Council recommends less than 8.5 pounds per square foot final stocking density for broilers of this size. The low density utilized in this trial likely accounts for the litter quality and high-quality paws.

Graph 1: Litter Moisture



CONCLUSIONS

The addition and substitution of SBM derived from Benson Hill UHP-LO soybeans for conventional SBM shows a significant economic return in cost of production in this trial . Moreover, its addition to a conventional SBM diet improves final body weight and maintains the feed conversion ratio. It is difficult to draw performance conclusions about the 100% Benson Hill UHP-LO SBM relative to conventional SBM due to the difference in protein content in the starter feed, but this trial confirmed that the 80 kcals per pound energy benefit associated with SBM from Benson Hill UHP-LO soybeans is an accurate estimate.

NOTES:

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Note: Different letters in tables and graphs, ie: a,b,c, ab indicate significance of P<0.05 in specific treatment comparisons as displayed.

* Commodity meal price of $390 per ton plus $90 per ton local basis.

1. June 2024M. Rezaei , H. Nassiri Moghaddam , J. Pour Reza and H. Kermanshahi, International Journal of Poultry Science 3 (2): 148-152, 2004 © Asian Network for Scientific Information 2004 148 The Effects of Dietary Protein and Lysine Levels on Broiler Performance, Carcass Characteristics and N Excretion 1 1 2 1 Department of Animal Science, College of Agriculture, Ferdowsi University, Mashhad, Iran 1 Department of Animal Science, College of Agriculture, Technical University, Isfahan, Iran 2 E-mail: mrezaei2000@yahoo.com

2. Perryman, K. R., and W. A. Dozier III. 2012. Apparent metabolizable energy and apparent ileal amino acid digestibility of low and ultra-low oligosaccharide soybean meals fed to broiler chickens. Poult. Sci. 91:2556–2563.

About Benson Hill

Benson Hill is a seed innovation company that unlocks nature's genetic diversity in soy quality traits through a combination of proprietary genetics, its AI-driven CropOS® technology platform, and its Crop Accelerator. Benson Hill collaborates with strategic partners to create value throughout the agribusiness supply chain to meet the demand for better feed, food and fuel. More information can be found at bensonhill.com or on X, formerly known as Twitter at @bensonhillinc.

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