BENSON HILL®

Results of a Collaborative Feeding Trial

Benson Hill's Ultra-High Protein, Low Oligosaccharide Soybean Meal Delivers Equal Broiler Performance and **Reduces Feed Costs**

Integrator **Three:** **Tyson Foods**

ABSTRACT

A 42-day broiler feeding trial was conducted in collaboration between Benson Hill, Inc. and Tyson Foods [a large broiler integrator] at Colorado Quality Research, Inc., a commercial research facility in Wellington, Colorado. The study aimed to evaluate the impact of Benson Hill's Ultra-High Protein, Low Oligosaccharide (UHP-LO) soybean meal (SBM) on broiler performance and carcass traits in isocaloric and isonitrogenous broiler diets. Three dietary treatments, incorporating varying soybean meal components, were tested to assess the effects of UHP-LO SBM. Results demonstrated that replacing commodity SBM with Benson Hill's UHP-LO SBM is possible without compromising broiler performance and potentially lowering cost of production. Birds fed UHP-LO demonstrated equal final body weight, feed conversion ratio, and carcass traits as birds fed conventional SBM. These findings confirm the enhanced metabolizable energy and crude protein content of UHP-LO SBM and validate its potential in broiler diet formulations to maximize nutritional value and economic returns for poultry producers.

INTRODUCTION

Minimizing feed costs while maintaining optimal broiler performance is a primary objective in animal nutrition. As a key protein source, soybean meal (SBM) plays a crucial role in broiler diet formulation. Efficient utilization of SBM is essential, given that feed represents the largest expense in broiler production. Benson Hill's Ultra-High Protein, Low Oligosaccharide (UHP-LO) SBM has shown potential to improve broiler performance and reduce diet costs in previous commercial trials. Benson Hill's UHP-LO SBM offers enhanced amino acid content and reduced anti-nutritional factors, with 14% higher crude protein content and a >90% reduction in the oligosaccharides raffinose and stachyose compared to conventional SBM. Due to a combination of these factors, as well as increased sucrose levels, UHP-LO SBM also offers higher levels of metabolizable energy compared to conventional SBM. To further validate the nutritional benefits of UHP-LO SBM in broiler chickens, a large-scale 42-day pen trial was conducted in association with Tyson Foods [a large broiler integrator] to assess whether feeding UHP-LO SBM as a complete replacement for conventional SBM could deliver feed cost savings while maintaining equal broiler performance and carcass characteristics. The positive outcomes of the study present a real opportunity for broiler nutritionists and the poultry industry by demonstrating the potential of UHP-LO SBM to improve the nutritional and economic efficiency of broiler diets while maintaining overall performance.

OBJECTIVE OF THE TRIAL

Determination of Benson Hill Ultra-High Protein, Low Oligosaccharide (UHP-LO) soybean bean meal as a complete replacement of conventional SBM to reduce diet costs while maintaining broiler performance.

METHODS

The trial involved 816 male broiler birds housed on top-dressed used litter. A three-phase feeding program based on corn and soybean meal (SBM) was used, with diet changes taking place at 14 and 28 days of age. Isocaloric and isonitrogenous diets were fed as crumbles for the first 14 days, followed by pellets through the trial's conclusion. Diets included a non-antibiotic anticoccidial (Zoashield®, Elanco Animal Health), and a phytase enzyme, but excluded xylanase and non-starch polysaccharide (NSP) enzymes (Table 1). Each dietary treatment was assigned to 16 pens, with 17 birds per pen.

The UHP-LO SBM was formulated with an energy level 80 kcal per pound higher than the control SBM, based on evidence of increased energy digestibility due to its higher protein content, lower antinutritional factor content and higher sucrose levels (Perryman and Dozier, 2012).

Treatments were as follows: Conventional SBM, BH UHP-LO where the UHP-LO SBM provides 100% of the SBM, with a metabolizable energy level of 80 kcal per pound higher metabolizable energy than the control SBM, and BH UHP-LO no energy credit providing 100% of the SBM as UHP-LO, with no energy level credit.

Table 1.1: Starter Diet

Starter Diet	Conventional SBM	BH UHP-LO	BH UHP-LO no energy credit
Corn	1138.87	1313.06	1286.95
Soybean Meal	743.59		
Animal/Vegetable fat	60.30	10.00	33.58
Other ingredients	57.24	59.41	61.94
Benson Hill UHP-LO SBM		617.53	617.53
Ingredient Total	2000.0	2000.0	2000.0

Table 1.2: Finisher Diet

Starter Diet	Conventional SBM	BH UHP-LO	BH UHP-LO no energy credit
Corn	1255.07	1406.17	1384.95
Soybean Meal	639.47		
Animal/Vegetable fat	53.71	10.00	31.25
Other ingredients	51.76	53.65	53.60
Benson Hill UHP-LO SBM		530.18	530.20
Ingredient Total	2000.0	2000.0	2000.0

Table 1.3: Withdrawal Diet

Starter Diet	Conventional SBM	BH UHP-LO	BH UHP-LO no energy credit
Corn	1342.15	1475.16	1456.25
Soybean Meal	559.11		
Animal/Vegetable fat	51.23	12.51	31.49
Other ingredients	47.52	49.16	49.13
Benson Hill UHP-LO SBM		463.18	463.12
Ingredient Total	2000.0	2000.0	2000.0

Recommended nutritional specifications for UHP-LO SBM can be found in Table 2.

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

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

Mortality and mortality weights were recorded daily. Feed consumption and body weights were measured to calculate feed efficiency. At the conclusion of the trial (day 42), all birds from 8 pens per treatment were tagged, processed, and carcass traits were measured. Response variables were analyzed using a general linear mixed model to evaluate the effect of diet (conventional SBM vs. Benson Hill UHP-LO SBM). For growth performance, block was included as a random effect, while both pen and block were included as random effects when modeling carcass traits. Significance was determined at a p-value of less than 0.05.

RESULTS AND DISCUSSION

Broiler weights, feed conversion ratios (FCR), and livability results are shown in Table 3. Birds were weighed at placement and again after the 42-day feeding trial. No significant differences were observed in average final body weights, or mortality-adjusted FCR between broilers fed diets containing conventional soybean meal (SBM), BH UHP-LO SBM formulated with the 80 Kcal/lb energy credit, or BH UHP-LO SBM formulated at conventional SBM energy levels. Similarly, bird livability was unaffected by diet. These findings highlight the viability of incorporating BH UHP-LO SBM as a high-protein, energy-dense ingredient in broiler diet formulations while maintaining equal growth performance and survivability.

Table 3: Broiler Final Weight, Feed Conversion Ratio, Feed Conversion Adjusted for Mortality and Livability

	Final body weight adjusted by mortality (lbs)	Mortality adjusted FCR	Livability (%)
BH UHP-LO	6.94	1.445	95.4
BH UHP-LO no energy credit	6.86	1.437	96.7
Conventional SBM	6.96	1.441	95.6

All differences among treatments were found non-significant ($P > 0.05$)

Table 4. Carcass Yield

	Hot carcass weight (lbs)	Mortality adjusted FCR
BH UHP-LO	5.11	73.74
BH UHP-LO no energy credit	5.10	73.70
Conventional SBM	5.10	73.32

All differences among treatments were found non-significant (P > 0.05)

Table 5. Tender and Breast Yield

	Breast weight (lbs)	Breast (% of live weight)
BH UHP-LO	1.65	32.4
BH UHP-LO no energy credit	1.63	32.1
Conventional SBM	1.63	31.9

All differences among treatments were found non-significant (P > 0.05)

Table 6. Intestine Weight

	Intestine weight (g)	Liver weight (g)	Spleen weight (g)	Pancreas weight (g)
BH UHP-LO	83.0 a	48.0	2.37	0.40
BH UHP-LO no energy credit	83.0 a	47.0	2.22	0.45
Conventional SBM	89.0 b	49.0	2.42	0.56

All differences among treatments were found non-significant (P > 0.05)

Carcass and breast weights and yield are summarized in Table 4 and 5. No significant differences were observed in hot carcass weight (lbs) or as a percentage of live weight among treatments. Similarly, breast yield did not differ significantly among the treatment groups. However, broilers fed BH UHP-LO SBM formulated with increased energy levels exhibited a non-significant numerical improvement of 1.2% in breast mass weight and 1.7% as a percentage of hot carcass weight compared to those fed conventional SBM.

Organ weights are presented in Table 6. No significant differences were observed in liver, spleen weights, or pancreas weights. However, feeding UHP-LO SBM, with or without the 80 Kcal/lb energy credit, resulted in a significant reduction in intestinal weight. Although not definitive, previous research has suggested that anti-nutritional factors, such as oligosaccharides, can negatively impact cecal microbial diversity, impair water reabsorption, and influence intestinal health in broilers (Bedford, 1995; Blanch, 2020). Based on these findings, we hypothesize that the reduced oligosaccharide content in Benson Hill UHP-LO SBM may benefit gut health by reducing intestinal inflammation.

These results highlight the potential advantages of BH UHP-LO SBM, which combines higher energy content with lower levels of anti-nutritional factors. This combined benefit may improve breast yield and reduce intestinal weights, contributing to increased revenue from premium meat cuts, but also promote improved gut health in broiler chickens.

Table 7. Feed Cost per Ton ($)

	Conventional SBM	BH UHP-LO With $90/ton premium
Starter	284.97	281.26
Grower	268.45	264.96
Finisher	249.68	246.37
Weighted Totals	259.63	256.22

Table 8. Feed Cost per Pound

	¢ per live lb bird	$ per 6.5 lb bird	Savings/ 1M birds
Conventional SBM	18.71	1.22	0.00
BH UHP-LO With $90/ton premium	18.51	1.20	$12,640.83

Table 9. Revenue per Pound of Breast (prices of Jan. 6, 2025)

	$ per live lb of breast	Income/1M birds
Conventional SBM	2.41	0.00
BH UHP-LO	2.44	$29,327.83

Feed cost per ton and feed cost per pound of bird are presented in Table 7 and 8. The following ingredient prices were used: corn $160/ton; conventional soybean meal $360/ton; Benson Hill UHP-LO $450/ton; and Fat $900/ton. Therefore, even using a $90 per ton premium for Benson Hill-sourced soybean meal (SBM) over conventional SBM, feed costs were reduced with the full replacement of conventional SBM by UHP-LO SBM, attributed to its higher crude protein, amino acid content, and energy density. Revenue per pound of breast meat is summarized in Table 9. Using January 6, 2025, pricing data from the USDA Monthly National Chicken Report, we evaluated the economic impact of the numerical improved breast yield observed in this trial. With breast meat (boneless and skinless) priced at $1.4781 per pound, feeding broilers BH UHP-LO SBM formulated with increased energy density yielded the highest returns compared to conventional SBM. On a production scale of one million birds, this equates to an additional $29,327.83 in revenue for BH UHP-LO diets over diets containing conventional SBM. These results highlight the economic advantages of using SBM derived from Benson Hill UHP-LO soybeans, which lowers feed costs and enhances the yield of high-value carcass traits such as breast meat, providing both cost efficiency and profitability for broiler producers.

CONCLUSIONS

The findings from this study demonstrate the value of Benson Hill's UHP-LO SBM as a superior ingredient in broiler diets. The higher crude protein, amino acid content, energy density, and reduced levels of anti-nutritional factors in BH UHP-LO create value through optimized feed formulations. The inclusion of UHP-LO SBM was shown to reduce feed costs per ton, enhance yields of high-value meat cuts such as breast meat, and maintain growth performance and livability comparable to conventional SBM. Furthermore, the reduced intestinal weights observed in broilers fed UHP-LO SBM suggest potential benefits for gut health, likely attributable to its lower oligosaccharide content. These results confirm its suitability as a premium feed ingredient capable of driving both profitability and production efficiency in the poultry industry.

REFERENCES

1. Bedford, M. R. (1995). Mechanism of action and potential environmental benefits from the use of feed enzymes. Animal Feed Science and Technology, 53(2), 145–155. https://doi.org/10.1016/0377-8401(95)02018-U

2. Blanch, A. (2020). Soy oligosaccharides and beta-conglycinin: Behind gut inflammations, wet droppings, and footpad dermatitis in chickens. The Poultry Site. https://www.thepoultrysite.com/articles/soy-oligosaccharides-and-beta-conglycinin-behind-gut-inflammations-wet-droppings-and-footpad-dermatitis--n-chickens

3. Perryman, K. R., & Dozier, W. A. III. (2012). Apparent metabolizable energy and apparent ileal amino acid digestibility of low and ultra-low oligosaccharide soybean meals fed to broiler chickens. Poultry Science, 91(11), 2556–2563. https://doi.org/10.3382/ps.2012-02379

NOTES:

BENSON HILL®

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.

bensonhill.com