BENSON HILL®

Results of a Collaborative Feeding Trial

Advancing Broiler Efficiency and Carcass Quality with **Benson Hill's Ultra-High Protein, Low-Oligosaccharide Soybean Meal**

Integrator **Two**

ABSTRACT

A 42-day feeding trial was conducted in collaboration between Benson Hill, Inc. and a large broiler integrator, to evaluate the impact of soybean meal (SBM) derived from Benson Hill's Ultra-High Protein, Low Oligosaccharide (UHP-LO) soybean varieties on broiler performance. The study compared two dietary treatments, each incorporating either UHP-LO SBM or conventional SBM. Results demonstrated that broilers fed with UHP-LO SBM exhibited improvements in final body weight and feed conversion ratio (FCR), as well as performed equally or better on carcass traits. These outcomes highlight the potential of Benson Hill's UHP-LO SBM to improve feed efficiency, lower production costs in broiler diets, and maximize economic returns for poultry producers.

INTRODUCTION

Feed costs account for more than 65% of expenses in broiler production. Soybean meal is a key ingredient, regularly used in broiler diets as a source of crude protein and essential amino acids. Although it is widely recognized as a premier protein source for monogastric diets, soybean meal also contains anti-nutritional factors. These are mostly oligosaccharides which are complex carbohydrates known to cause gut irritation in monogastric animals (Teague et al. 2020). Moreover, while soybean yields have been increasing, protein levels have steadily declined, leading to a conundrum of lower quality soybean meals (Ciampitti et al. 2021). Benson Hill's advanced soybean breeding technology has achieved an Ultra-High Protein, Low Oligosaccharide soy variety class that creates an UHP-LO SBM that brings more value to the poultry industry. These soybean varieties have been shown to have 14% higher crude protein content than conventional soybeans and a >90% reduction in the oligosaccharides raffinose and stachyose. UHP-LO SBM has demonstrated significant potential in both academic and commercial trials, offering a promising solution for broiler producers and nutritionists. Therefore, a large 42-day commercial trial was completed to evaluate the performance and carcass characteristics of broilers fed with UHP-LO SBM as a complete replacement of conventional SBM. The positive outcomes of the study present a real opportunity for the poultry industry by offering a more economical and efficient ingredient to use for broiler feed formulation.

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 improve bird performance and reduce feed costs.

METHODS

A randomized, complete-block-design trial was conducted with 5,760 mixed gender broiler birds placed into 96 pens arranged into 6 randomized blocks. Pens were top-dressed over used litter. The feeding program was a four-phase corn and SBM-based diet, with feeding changes occurring at 10, 21 and 35 days of age. All diets were non-medicated and included a phytase enzyme as well as xylanase/NSP enzymes (Table 1). Broilers were vaccinated with Advent®, along with the standard hatchery vaccines. Each diet was fed to 48 pens of 60 broilers per pen.

Table 1.1: Starter Diet

Starter Diet in pounds	Benson Hill UHP-LO	Commodity SBM
Corn	1227.65	1166.57
Soybean Meal		727.75
Animal fat	5.00	25.03
Other ingredients	95.80	80.60
Benson Hill UHP-LO SBM	645.16	
Ingredient Total	2000.0	2000.0

Table 1.2: Grower Diet

Grower Diet in pounds	Benson Hill UHP-LO	Commodity SBM
Corn	1331.58	1272.19
Soybean Meal		628.17
Animal fat	5.00	27.84
Other ingredients	97.90	73.40
Benson Hill UHP-LO SBM	565.43	
Ingredient Total	2000.0	2000.0

Table 1.3: Finisher 1 Diet

Finisher 1 Diet in pounds	Benson Hill UHP-LO	Commodity SBM
Corn	1435.41	1378.35
Soybean Meal		526.66
Animal fat	5.00	26.11
Other ingredients	54.50	67.00
Benson Hill UHP-LO SBM	485.78	
Ingredient Total	2000.0	2000.0

Table 1.4: Finisher 2 Diet

Finisher 2 Diet in pounds	Benson Hill UHP-LO	Commodity SBM
Corn	1480.80	1411.47
Soybean Meal		496.20
Animal fat	5.00	33.85
Other ingredients	54.50	58.40
Benson Hill UHP-LO SBM	459.60	
Ingredient Total	2000.0	2000.0

The feeding trial included two treatments to compare Benson Hill UHP-LO with a control SBM diet. In a commercial broiler trial conducted in 2020, UHP-LO was formulated with an energy credit of 65 kcal/lb. Bird performance in this trial was on par with the control, suggesting that UHP-LO soybean meal has at least this additional amount of energy. In a more recent commercial trial in 2024, using a more advanced generation of product, UHP-LO was credited with an 80 kcal/lb higher energy value than conventional SBM, based on evidence of increased energy digestibility due to its higher protein content, lower antinutritional factor content and higher sucrose levels (Dozier and Perryman, 2010). This same approach was applied in the current trial, assigning UHP-LO SBM an energy credit of 80 kcal/lb in diet formulation. Treatments were as follows: conventional SBM (Conventional SBM), and UHP-LO SBM supplying 100 percent of the SBM, using increased energy relative to control (80 kcals per pound more energy) (BH UHP-LO).

Recommended nutritional specifications for UHP-LO SBM can be found in Table 2. Mortality and mortality weight were recorded daily. Bird weights and feed consumption were measured and used to calculate feed efficiency. At the end of the trial, birds were processed, and carcass traits were evaluated using 4 birds per pen (2 males and 2 females). Response variables were analyzed using a general linear mixed model to evaluate the effect of diet (commodity SBM vs. Benson Hill UHP-LO SBM). For growth performance, block was included as a covariate, while both gender and block were included as covariates when modeling carcass traits. Significance was determined at a p-value of less than 0.01.

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

	Unit	Soybean Meal BH UHP-LO
Moisture	%	9.633
Crude Protein	%	55.187
Metabolizable Energy Poultry	Kcal/lb	1,120 kcal/lb vs 1,040 kcal/lb on the conventional SBM
Crude Fat	%	1.700
Crude Fiber	%	2.727
Ash	%	6.440
Calcium	%	0.261
Phosphorus - Available	%	0.266
Phosphorus – Total	%	0.650
Lysine Total	%	3.37
Methionine Total	%	0.757
Methionine + Cystine	%	1.534
Arginine	%	4.088
Tryptophan	%	0.62
Valine	%	2.67
Glycine	%	2.24
Histidine	%	1.47
Phenylalanine	%	2.82
Threonine	%	2.05
Leucine	%	4.17
Isoleucine	%	2.58
Choline	%	1250
Sodium	%	0.030
Potassium	%	2.070
Linoleic Acid	%	0.400
Dry Matter	%	90.367
Sulfur	%	0.432
Choline	%	0.050
Sodium	%	0.400
Potassium	%	0.813
Linoleic Acid	%	60.149
dLys-P	%	3.465
dMet-P	%	0.757
dM+C-P	%	1.533
dArg-P	%	4.088
dTrp-P	%	0.633
dVal-P	%	2.737
dHis-P	%	1.505
dPhn-P	%	2.893
dThr-P	%	2.110
dLeu-P	%	4.280
dIso-P	%	2.652
dCys-P	%	0.777

RESULTS AND DISCUSSION

Broiler weights, feed conversions, and mortality results are summarized in Table 3. Broilers were initially weighed at placement and then after the 42-day feeding trial. Results showed that broiler chickens fed BH UHP-LO SBM had significantly higher body weights compared to those fed conventional SBM. Additionally, both Feed Conversion Ratio (FCR) and mortality-adjusted FCR were significantly improved in birds receiving the BH UHP-LO SBM diet. Although this difference was not statistically significant, a numerical trend towards improved livability was also observed in broilers fed the BH UHP-LO SBM diet. These findings indicate the potential benefits of BH UHP-LO SBM in enhancing broiler performance metrics.

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

	Final Body Weight Adjusted by Mortality	FCR	Mortality Adjusted FCR	Livability
Commodity SBM	5.18 a	1.57 b	1.56 b	96.06 a
BH UHP-LO	5.46 b	1.52 a	1.51 a	96.91 a

a,b Means in the same row that do not have a common superscript differ ($P < 0.01$).

Table 4. Carcass Yield (% of Live Weight)

	Carcass Weight without Giblets	Carcass Weight Front and Hind	Carcass Hind Weight
Commodity SBM	74.43 a	73.5 a	28.4 a
BH UHP-LO	75.04 b	74.1 b	28.8 b

a,b Means in the same row that do not have a common superscript differ ($P < 0.01$).

Table 5. Tender and Breast Yield (% of Live Weight)

	Tenders	Breast and Back	Breast
Commodity SBM	4.45 a	45.01 a	21.45 a
BH UHP-LO	4.40 a	45.30 a	21.43 a

a,b Means in the same row that do not have a common superscript differ ($P < 0.01$).

The results for carcass weight and carcass composition as a percentage of live weight are presented in Tables 4 and 5, respectively. Birds fed BH UHP-LO SBM had significantly higher percent carcass weight without giblets, as well as increased front, back, and hind carcass weights as a percent of live weight, compared to birds fed conventional SBM. However, no significant differences were found in the yield of tenders, combined breast and back, or breast yield across the different dietary treatments. These findings align with previous research by Perryman et al. (2013), which reported that diets formulated with Low-Oligosaccharide and Ultra-Low Oligosaccharide SBM required approximately 45% less supplemental fat and showed no adverse effects meat yields compared to diets containing conventional SBM (Perryman et al. 2013). Findings from this study suggest that BH UHP-LO SBM can enhance carcass yield without negatively impacting specific meat cut yields.

Table 6. Increased Revenue Per Pound of Carcass Without Giblets (WOG) (prices of Jan. 6, 2025)

	$ per lb of WOG	Income/1M birds
Conventional SBM	5.06	0.00
BH UHP-LO	5.38	$318,227.48

Table 7. Revenue Per Pound of Breast (prices of Jan. 6, 2025)

	$ per lb of breast	Income/1M birds
Conventional SBM	1.64	0.00
BH UHP-LO	1.73	$87,160.60

Revenue per pound of carcass without giblets (WOG) and breast meat is summarized in Tables 6 and 7, respectively. Using January 6, 2025, pricing data from the USDA Monthly National Chicken Report, we evaluated the economic impact of the significant improvements in carcass yield and the numerical breast yield improvement observed in this trial. With WOG priced at $1.3136 per pound and breast meat (boneless and skinless) 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 translates to an additional $318,227.48 in revenue for WOG and $87,160.60 for breast meat when using BH UHP-LO diets over conventional SBM diets. These results underline the economic advantages of Benson Hill UHP-LO soybeans, which improves growth performance and enhance carcass yield and high-value traits like breast meat, offering both cost efficiency and profitability for broiler producers.

CONCLUSIONS

The substitution of Benson Hill UHP-LO soybean meal (SBM) for conventional SBM demonstrated significant improvements in broiler growth performance, feed efficiency, and carcass yield. Results from this trial reinforce the value of Benson Hill's Ultra High-Protein, Low-Oligosaccharide SBM, which offers an additional energy advantage of 80 kcal per pound. This increased energy density, along with higher crude protein content, supports enhanced growth with similar feed intake, improving feed efficiency and affirming BH UHP-LO SBM as an energy- and protein-rich alternative to conventional SBM. Furthermore, the reduced antinutritional factors in UHP-LO, such as lower oligosaccharide levels, may also contribute to the improved efficiency and performance observed. These findings validate UHP-LO SBM's potential to optimize broiler production and support superior poultry performance. With its enhanced nutritional profile and proven impact on productivity, Benson Hill UHP-LO SBM presents a compelling, high-efficiency, and cost-effective alternative for producers seeking to maximize growth and feed efficiency in broiler production.

REFERENCES

1. Ciampitti, I., Naeve, S., Reis, A. F. B., & Rosso, L. M. (2021). Soybean seed composition: Changes in protein and amino acids over four decades. K-State Research and Extension. Kansas State University. https://bookstore.ksre.ksu.edu/pubs/soybean-seed-composition-changes-in-protein-and-amino-acids-over-four-decades_MF3552.pdf

2. 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

3. Perryman, K. R., Olanrewaju, H., & Dozier, W. A. III. (2013). Growth performance and meat yields of broiler chickens fed diets containing low and ultra-low oligosaccharide soybean meals during a 6-week production period. Poultry Science, 92(5), 1292–1304. https://doi.org/10.3382/ps.2012-02723

4. Teague, K. D., Tellez-Isaias, G., Chai, J., Petrone-Garcia, V., Vuong, C. N., Blanch, A., Rasmussen, S. H., Brown, K., Zhao, J., & Rochell, S. J. (2020). Dietary soy galactooligosaccharides affect the performance, intestinal function, and gut microbiota composition of growing chicks. Poultry Science, 99(8), 4275–4285. https://doi.org/10.1016/j.psj.2022.102440

NOTES:

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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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