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U.S. Department of Agriculture's Economic Research Service has recently published estimates of world-wide use of soybean meal. The following table provides data for the past three marketing years. One can see that most of the soybean meal is consumed by China, EU-27 countries, United States and the "other" countries which are primarily located in Southeast Asia.

It is interesting that soybean meal consumption in most countries has been relatively stable over the past three years, whereas, meal consumption in China is growing. The importance of the world's economy, a country's population growth, the consumer's demand for meat, milk and eggs, and the profitability of the livestock and poultry operations directly impact these soybean meal use values. Dynamic growth in the world economy should greatly increase the demand for soybean meal and may alter a countries share of the soybean meal market.

## Soybean Meal Use (Million Metric tons)

	2007/2008	2008/2009(*)	2009/2010 (**)	% of Total
United States	30.15	27.89	27.58	17%
Argentina	0.62	0.63	0.68	1%
Brazil	12.26	12.44	12.61	8%
China	30.85	31.67	35.25	22%
India	2.06	2.38	2.85	2%
EU-27	35.17	31.58	31.54	20%
Other Countries	<u>46.13</u>	<u>45.84</u>	<u>48.49</u>	<u>30%</u>
World Totals	157.24	152.43	159.00	100%

**Reference:** USDA, Economic Research Service, *World Agricultural Supply and Demand Estimates*; WASDE-481, April 9, 2010

## Soybean Meal Process/Quality

The objective of this study was to evaluate the nutritional value of expeller soybean meal (ESBM) compared to solvent-extracted soybean meal (SBM). A secondary objective was to determine the effect of SBM's particle size on broiler performance. ESBM is what remains after the oil is mechanically removed from whole soybeans. Expeller-processed ESBM typically has a higher fat and energy content, but lower protein than solvent-extracted meals.

The experiment was a 2 x 2 factorial of SBM type (ESBM and SBM) and particle size (coarse and fine). The fine SBM was produced by grinding the material through a 1.6 mm hammermill screen (390 microns), the coarse treatments were fed as received from the supplier (1,040 microns). A total of 1,024 male day-old broiler chicks were randomly assigned to one of four treatments with 8 replicate pens per treatment and 32 birds per pen. The starter diets were fed in crumbled form and the grower and finisher diets in pelleted form. Commercially available SBM and ESBM were used in the experiments. The SBM was analyzed for moisture, crude protein, and crude fat, which were then used to estimate the ME of the SBM. The estimated ME content of ESBM and SSBM was 2,800 and 2,588 kcal/kg, respectively. Results indicated an interaction between particle size and SBM type for the bird's body weight in the 49-day experiment. The coarse SBM and ESBM and fine SBM resulted in heavier 49 day weight (3,794, 3,803 and 3,762 g respectively) as compared to the fine ground ESBM (3,605 g). The adjusted feed conversion ratio for the birds fed the SBM (1.90) was poorer than birds fed the ESBM (1.77). Birds fed the finely milled SBM had poorer adjusted feed conversion ratios (1.86 vs. 1.80) compared to the regular meal. The results of this experiment indicated that birds performed better when fed the coarse SBM. The difference in adjusted feed conversion ratios indicated that energy value of 2,800 kcal/kg for ESBM was underestimated in the diet formulation.

*Pacheco, W.J. and co-workers. 2010. Evaluation of expeller-produced and solvent-extracted soybean meal at two particle sizes on broiler performance. Abstract M25, 2010 International Poultry Scientific Forum; Georgia World Congress Center, Atlanta, Georgia; January 25–26.*

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## Effect of Glycerol on Pelleting Feeds

Two studies were conducted to evaluate the effects of utilizing glycerol in swine and poultry diets on pelleting performance. In Experiment 1, a corn-soy based swine grower diet containing either 0, 3, 6, and 9% glycerol was pelleted using a California Pellet mill (Master Model HD, Series 2000). Prior to the pellet die, each diet was steam conditioned for 30 seconds to 65, 77 and 88 °C in an atmospheric conditioner. In Experiment 2, the objective was to validate results from the first experiment in a large commercial facility. A corn-soy based turkey grower diet was formulated to contain 3% glycerol. The diet was pelleted using a 500 HP Bliss pellet mill. Energy usage and pellet quality were measured. In the first experiment, there was an interaction between glycerol and conditioning temperature. For all diets containing glycerol, roll skid occurred and the pellet mill plugged as conditioning temperature approached 88 °C. This was consistent across replications. This did not occur when diets were conditioned to 65 and 77 °C. Electrical energy consumption tended to decline as conditioning temperature increased. The addition of glycerol did not significantly influence energy consumption. However, pellet quality increased linearly ( $P < 0.01$ ) with increasing levels of glycerol. Results from the second experiment were consistent with the first experiment, in that there was an interaction between condition temperature and the addition of glycerol. Additionally, the addition of glycerol improved ( $P < 0.05$ ) pellet durability. These studies suggested that addition of glycerol improves pellet quality. However, conditioning temperatures must be reduced in feed formulations containing glycerol.

*Mader, E.F. and co-workers. 2010. Utilizing glycerol in swine and poultry Diets: Feed manufacturing considerations. Abstract M76, 2010 International Poultry Scientific Forum; Georgia World Congress Center, Atlanta, Georgia; January 25–26.*

## Feeding Value of Transgenic Soybeans

An experiment was conducted to evaluate transgenic soybeans containing the *gm-fad2-1* gene fragment and the *gm-hra* gene (event DP-3Ø5423-1). Expression of the *gm-fad2-1* gene fragment suppresses the endogenous FAD2-1 gene and results in an increased level of oleic acid and decreased levels of linoleic acid, linolenic acid, and to a lesser extent, palmitic acid in the soybean seed. The GM-HRA protein, encoded by the *gm-hra* gene, is a modified version of soybean acetolactate synthase that is used as a selectable marker during transformation.

Hy-line leghorn pullets (20 wk of age) were placed in cage lots (7 hens/cage, 2 cages/lot) and were randomly assigned to one of four corn-soybean meal (SBM) dietary treatments (6 lots/treatment) formulated with the following SBMs: non-transgenic near isoline control (control), non-transgenic commercial reference SBM-A (92M72), non-transgenic commercial reference SBM and transgenic SBM-B produced from soybeans containing event DP-3Ø5423-1. Weeks 20-24 were a preconditioning period and the four experimental diets were then fed from 25-36 wk of age. Results indicated body weight, hen-day egg production, egg mass, feed consumption and feed efficiencies for hens fed SBM-B were not significantly different from the respective values for hens fed diets formulated with the near-isoline control SBM. Likewise, egg component weights, Haugh unit measures, and egg weights were similar regardless of the SBM source.

*Mejia, L. and co-workers. 2010. P227 Evaluation of soybean meal with the genetically modified output trait DP-3Ø5423-1 when fed to laying hens. Abstract M227, 2010 International Poultry Scientific Forum; Georgia World Congress Center, Atlanta, Georgia; January 25–26.*

## Feeding Glycerin/Glycerol to Sheep

The objective of this study was to evaluate the effects of crude glycerin on performance and carcass characteristics in finishing wether lambs. Thirty wether lambs weighing  $44.1 \pm 5.6$  kg were individually fed, isocaloric, isonitrogenous dietary treatments containing 0, 5, 10, 15, or 20% crude glycerin (88% pure) on a dry weight basis. Diets were fed once daily for ad libitum consumption and contained 15% chopped hay, approximately 25% dried distiller's grains with solubles, and the specified treatment combination of cracked corn replaced with increasing amounts of crude glycerin. Dry matter intake ( $P = 0.004$ ) and average daily gain ( $P = 0.05$ ) and growth per feed ( $P = 0.06$ ) increased with increasing concentrations of glycerin in the diet during the first 14 days of the feeding period. However, there were no differences among treatments for final body weight, or cumulative dry matter intake, cumulative average daily gain, cumulative growth per feed, or carcass measurements. The researchers concluded that adding up to 15% crude glycerin to finishing wether diets improved feedlot performance, particularly during the first 14 days, without any effect on carcass characteristics.

*Gunn, P.J. 2010. Effects of crude glycerin on performance and carcass characteristics of finishing wether lambs. J. Animal Sci. 88:1771-1776.*

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## Effects of Glycerin/Glycerol on Rumen Fermentation

The objectives of this study were to determine the effects of crude glycerin on apparent total tract digestibility, and to measure diurnal changes in ruminal pH and concentrations of ammonia and VFA.

Nine crossbred steers fitted with ruminal cannulae were used in a replicated, complete block experiment with three treatments consisting of steam flaked corn diets containing 0, 2, and 4% crude glycerin (DM basis). Steers were allowed ad libitum access to finishing diets containing 6% alfalfa hay, and provided 14% crude protein, 3.5% protein equivalent as non-protein nitrogen. Feed dry matter intake was similar among treatments. Apparent total tract digestibilities of DM, OM, starch, CP, and crude fat were similar for cattle fed the different dietary treatments. Apparent total tract digestibilities of NDF were 60.4, 51.8, and 48.1 for cattle fed 0, 2, and 4% glycerin, respectively ( $P < 0.01$ ). Feeding glycerin linearly increased mean ruminal pH from 5.61 in control steers to 5.67 and 5.73 when glycerin was added at 2 and 4 %, respectively ( $P < 0.053$ ). Concentrations of butyrate and valerate decreased and acetate increased as crude glycerin increased in the diet. The researchers concluded that when fed at low levels in finishing diets, glycerin may alter fiber digestion, but has little impact on other components of the diet.

*Parsons, G.L. and J.S. Drouillard. 2010. Effects of crude glycerin on ruminal metabolism and diet digestibility in flaked corn finishing diets. Abstract 96. 43<sup>rd</sup> Midwestern Meeting of Am. Dairy Sci. Assn. and Am. Soc. of Animal Sci., Des Moines, IA., March 15-17.*

## Amino Acid Availability of Soybean Meal for Ducks

The apparent ileal amino acid digestibility of six feedstuffs (corn, wheat, corn distillers dried grains with solubles, canola meal, soybean meal (SBM), and meat and bone meal (MBM)) were determined for White Pekin ducks in a 5-d experiment. The feedstuffs served as the sole source of amino acids in semi-purified diets composed of dextrose, soy oil, Solka Floc, minerals, and vitamins, with the exception of corn and wheat, in which both lacked dextrose. Fourteen day-old ducks were allocated to six dietary treatments and fed to eight replicates (six ducks/replicate) from 14 to 19 day post hatch. Birds were killed on day 19 and digesta from the terminal ileum were collected. Ileal nitrogen digestibility was highest ( $P < 0.01$ ) in SBM (88.3%) and lowest in MBM (72.4%). Ileal digestibility for all of the amino acids was highest in SBM among the feedstuffs. Lysine digestibility was highest ( $P < 0.01$ ) for SBM followed by canola meal, corn, wheat, MBM, and distillers dried grains with soluble; the values were 90.3, 79.0, 78.0, 76.8, 75.6, and 69.2%, respectively. Methionine digestibility in SBM was highest ( $P < 0.01$ ), whereas MBM had the lowest digestibility value for methionine (78.4%). For threonine, SBM (84.0%) had the highest digestibility and corn (61.6%) had the lowest digestibility ( $P < 0.01$ ), but there were no differences among other feedstuffs. Ileal tryptophan digestibility was between 78.9 (MBM) and 93.0% (SBM). The researchers concluded that, based on this study, there were considerable differences among feedstuffs in the digestibility of their amino acids for ducks. Therefore, it is important to take the digestible amino acid content of feedstuffs into account during feed formulation.

*Kong, C. and O. Adeola. 2010. Apparent ileal digestibility of amino acids in feedstuffs for White Pekin ducks. Poultry Sci. 89:545-550.*

## Feeding Excessive Protein to Weanling Pigs

Two experiments were conducted to determine the effects of excess dietary protein in diets for nursery pigs. One hundred and five pigs weighing 10.4 kg were fed a common diet for 14 days post weaning and the experimental treatments for the next 28 days. The treatments were corn-soybean meal-based diets formulated to 22.5, 25.0, and 27.5% crude protein. Overall ADG, ADFI, and G:F were not affected when crude protein was increased from 22.5 to 27.5% . For the second experiment, 105 pigs weighing 10.0 kg were weaned, allotted to pens as in previous experiment and fed a common diet for the first 14 days post weaning. For the next 28 days, the pigs were fed a corn-soybean meal control (23% CP), a diet with 30% DDGS (25% crude protein), and a corn-soybean meal diet formulated to the same crude protein concentration as the DDGS treatment (i.e., 25% crude protein CP). Overall ADG, ADFI, and G:F of pigs fed the control diet were not different than that of pigs fed the high crude protein treatments. However, pigs fed the DDGS treatment had lower G:F than pigs fed the corn-soy diet with the same crude protein content ( $P < 0.04$ ). The conclusion was that based on these results the feeding nursery pigs diets with as much as 27.5% crude protein will not decrease growth performance. Therefore, any loss of growth performance in nursery pigs fed diets with as much as 30% DDGS should not be blamed on an excess of dietary crude protein.

*Williams, S.M. 2010. 166 Effects of excess dietary protein from soybean meal and dried distillers grains with soluble in nursery pigs. Abstract 166, 43<sup>rd</sup> Midwestern Meeting of Am. Dairy Sci. Assn. and Am. Soc. of Animal Sci., Des Moines, IA., March 15-17.*

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## Lysine Requirements of Swine

A total of 1,080 pigs were used in four 28-d experiments to determine the lysine requirements of growing-finishing pigs. Low- and high-lysine diets without added fat were formulated for each experiment by varying amounts of corn, soybean meal, and synthetic amino acids in order to meet or exceed an ideal amino acid pattern. The diets were formulated to six lysine levels. There were six pens with six or eight pigs per pen and an equal number of barrows and gilts in each pen. The diet treatments provided a range of lysine to calorie ratio for each of the experiments. The results of these experiments confirm previous recommendations for pigs of this genotype. The research team found that for pigs weighing 37 to 65 kg, 56 to 86 kg, 87 to 107 kg, and 102 to 129 kg, performance and margin over feed costs were optimized with standard ileal digestibilities of lysine to calorie ratios of 2.69, 2.35, 2.09, and 1.79 g/Mcal metabolizable energy. *(Note-This type of research study becomes increasingly important when pork producers are formulating diets with alternative feed ingredients with lower levels of available lysine compared to the standard soybean meal. Amino acid requirements of the pig must be met for optimum performance. Soybean meal has been thoroughly studied and found to consistently contain relatively high levels of available essential amino acids.)*

*Bergstrom, J.R. and co-workers. 2010. Effects of increasing standardized ileal digestible lysine:calorie ratio on growth performance of growing-finishing pigs. Abstract 193, 43<sup>rd</sup> Midwestern Meeting of Am. Dairy Sci. Assn. and Am. Soc. of Animal Sci., Des Moines, IA., March 15-17.*

## Immune Response to Soybean Meal

A study was conducted to verify the standard ileal digestibility lysine requirement of pigs using carcass growth and feed efficiency as the primary criteria. A second objective was to verify previous work that whole-body growth was promoted equally by low and high dietary SBM levels while carcass growth was constrained by high SBM content. The 2x4 factorial designed experiment was to test four standardized ileal digestible (SID) lysine levels as two levels (high and low) of soybean meal. The experiment took a different turn when pigs were unexpectedly infected with diseases that trigger systemic inflammation. Diagnostic results confirmed pigs as PRRS and PCV2 (circovirus) positive; PCV2 tissue lesions were present. Mortality and morbidity was 6 times normal (12.7%) for 16 weeks. The inflammatory nature of these viruses was evident from the presence of circulating pro-inflammatory cytokines. The main effect of SID lysine was not significant for growth or feed utilization; however, the effect of SBM level was ( $P < 0.05$ ). The pigs fed the higher SBM diet grew faster, were more efficient and had greater carcass gain. The beneficial effect of the high soybean meal diet was evident at each lysine level for growth and feed utilization. The SID lysine requirement for the H-SBM regimen was 0.95% using growth and feed utilization criteria. This estimate was lower for pigs fed L-SBM diets (0.85%). The research team concluded that some component of SBM appeared to modify the impact of high immune stress on feed efficiency and the SID lysine requirement and that the high soybean meal treatment significantly reduced the negative effect of inflammatory diseases on average daily gain and feed use. They indicated while the mechanism was unclear; they suggested that the anti-inflammatory isoflavones in soybean may be involved.

*Johnston, M.E. and co-workers. 2010. Soybean meal level modifies the impact of high immune stress on growth and feed efficiency in pigs. Abstract 174, 43<sup>rd</sup> Midwestern Meeting of Am. Dairy Sci. Assn. and Am. Soc. of Animal Sci., Des Moines, IA., March 15-17.*

## Meat Consumption

U.S. Department of Agriculture recently published estimates for meat consumption in the United States. The table indicated that this year we will be consuming 208.6 pounds of meat per person with about half of the total coming from red meat sources and half from poultry.

These data are important to soybean growers since about 70% of the total meat consumption is from animals and poultry that require diets high in soybean meal. Growing livestock and poultry enterprises mean growing markets for soybean meal.

### US Meat Consumption Per Capita (lbs.)

	2008	2009	2010	% of Total
Beef	62.7	61.2	59.7	28%
Pork	49.4	50.0	47.1	22%
Other Red Meat (*)	1.4	1.5	1.4	1%
Broilers	83.4	79.6	83.3	40%
Turkey	17.6	16.9	15.8	8%
Other Poultry (**)	<u>1.4</u>	<u>1.4</u>	<u>1.3</u>	<u>1%</u>
Total Meat Consumption	215.9	210.5	208.6	100%

(\*) includes veal, lamb and mutton (\*\*) includes mature chickens

**Reference:** USDA, Economic Research Service, *World Agricultural Supply and Demand Estimates; WASDE-481, April 9, 2010*