Feeding Reduced-Oil DDGS to Pigs and Poultry

<u>Introduction:</u>

Distillers dried grains with soluble (DDGS) and other coproducts from the biofuels industry may be included in diets fed to pigs (20 to 30 % inclusion rate) and poultry (7 to 15 % inclusion rate) in all phases of production. Approximately 70 % of the broiler industry is feeding dried distillers grains with solubles, with an average inclusion rate of 6 %. The concentration of DE and ME in DDGS and in corn germ is similar to corn, but high-protein distillers dried grains (HP-DDG) contains more energy than corn. In contrast, if the oil is removed from DDGS, the product will have a lower energy concentration than corn or conventional DDGS (Table 1).

Conventional DDGS is low in starch (3-11 %), but relatively high in fat (approximately 10 %) and three times greater in ADF, NDF and total fiber than in corn.

Today, the biofuel industry is continuing to expand production and seek alternative profit streams, such as incorporating the removal of oil by solvent extraction, so that the extracted oil can be sold to the human food industry. Thus, new coproducts that are available for animal feed have made the formulation of diets confusing. How and when oil is extracted during the ethanol production process each create a different coproduct with different chemical compositions. For example, if the grain is de-hulled and de-germed prior to fermentation, a high-protein distillers dried grains with solubles may be produced. High protein DDGS has greater crude protein, high amino acid concentration (lysine) and less fat and fiber.

If oil is extracted from the DDGS, a de-oiled DDGS is produced. De-oiled DDGS contains 2 to 4 % oil and therefore, also contains less energy than conventional DDGS. If only the condensed solubles is de-oiled, then semi-de-oiled DDGS containing 5 to 7 % oil is produced. If fiber is removed from the DDGS after production, a coproduct called enhanced DDGS is produced. This product contains approximately 10 % less non-starch polysaccharides than conventional DDGS.

The bottom line is removal of oil may improve the flowability of the coproduct and also address some of the handling issues normally associated with conventional DDGS. Other positives with removal of oil from DDGS for pork production is the pork fat quality issues encountered with feeding a coproduct high in polyunsaturated fats, such as linoleic acid. The type of dietary fat fed to pigs is incorporated into the carcass. A carcass high in unsaturated fat is more likely to cause oxidation, slicing and processing difficulties. Finally, another positive with de-oiled DDGS might be the increased crude protein and other nutrients, but research is inconclusive.

Therefore, the ultimate question is: Does extraction of oil from DDGS affect energy and feeding value in swine diets?

The apparent total tract digestibility (ATTD) of ether extract in DDGS has been reported only from one experiment that showed that the ATTD of oil in DDGS is approximately 70 % (Stein et al., 2006).

The ATTD of energy in most DDGS is lower than in corn because of the greater concentration of fiber in the coproducts than in corn. Researchers have determined that corn DDGS has ATTD of energy of 82.9 % compared to 90.4% in corn (Pedersen et al., 2007).

Research by Kerr et al. (2013) evaluated the impact of reducing oil in DDGS on the metabolizable energy concentration in growing pigs. As expected, the de-oiled DDGS had reduced percent of ether extract and gross energy; however, TDF, CP and ash increased. When evaluating the relationship between percent ether extract and GE, DE and ME, the researchers (Kerr et al., 2013) determined that percentage of ether extract was related to GE ($R^2 = 0.87$) and thus a good predictor. But not a primary factor for predicting DE and ME content ($R^2 = 0.22$ and 0.32, respectively). Ultimately, de-oiled DDGS has a lower concentration of ME than corn (Table 2). It does appear that the remaining oil in de-oiled DDGS is less digestible (52%) than extracted oil (94 %).

<u>Nursery, Growing and Finishing Pig:</u>

Nursery pigs from 2 to 3 wk post-weaning, and growing and finishing pigs may be fed diets containing up to 30 % conventional DDGS without any negative impact on pig growth performance. Recent research has shown that de-oiled corn DDGS can be included in diets fed to weanling pigs in concentrations of up to 30 % (Jacela et al., 2011). This inclusion rate of 30 % de-oiled DDGS had no effect ($P > 0.05$) on the ADG, ADFI, or G:F of nursery pigs weighing 20 to 50 lbs when dietary fat was added to diets to offset the reduced metabolizable energy content.

However, growing and finishing pigs (64 to 266 lbs) fed increasing levels of de-oiled DDGS had linear reduction in ADG and ADFI ($P < 0.01$) especially after 20 %, thus carcass weight and yield were reduced as well ($P < 0.01$). Carcass fat iodine values increased linearly ($P < 0.01$) as pigs fed increasing levels of de-oiled DDGS, but lower than iodine values from pigs fed conventional DDGS. Back fat and percent lean were not affected by the level of de-oiled DDGS fed to growing and finishing pigs (Jacela et al., 2011).

Inclusion of corn HP DDG in diets fed to growing-finishing pigs was reported in one experiment (Widmer et al., 2008). In this experiment, HP DDG replaced all the SBM in the corn-based diets and the overall growth performance was not different for pigs fed the HP DDG containing diets compared to pigs fed corn-SBM control diets.

To date, no research has been completed looking at feeding de-oiled DDGS or HP DDG to gestating or lactating sows. The current recommendation for conventional DDGS is to feed no more than 50 % to gestating sows.

<u>Broiler and Layers:</u>

Broiler chickens fed 10 % de-oiled DDGS for 18d were more efficient than broilers fed 20 % de-oiled DDGS (Guney et al., 2013). Regression analysis determined that the maximum inclusion rates for de-oiled DDGS were between 6.74 and 7.52 %. Whereas the inclusion rate for conventional DDGS was 12.45 %.

Broiler chickens fed high protein corn distillers dried grains (HP-DDG; 54 %) as a 50 % replacement for soybean meal had no effect on bird performance or breast fillet yield at 42 d of age (Applegate et al., 2009).

Feeding 20 % dried distillers grains in hen diets has no effect on egg production or egg quality, but did increase yolk redness (Brunet et al., 2012).

Table 1: Chemical Composition of Corn and Corn Coproducts, as-fed basis (NRC, 2012)

Item	Corn	Corn DDG	Corn DDGS > 10%	Corn DDGS 5 to 9 %	Corn DDGS < 4%	Corn HP DDG
GE, kcal/kg	3933	4919	4849	4710	5098	5173
ME, kcal/kg	3395	3158	3434	3582	3102	3732
NE, kcal/kg	2672	2109	2384	2343	2009	2342
Crude Protein, %	8.24	28.89	27.33	27.36	27.86	45.35
Lysine, total %	0.25	0.87	0.77	0.90	0.68	1.22
Ether extract, %	3.48	8.69	10.43	8.9	3.57	3.54
NDF, %	9.11	41.86	32.50	30.46	33.75	33.63

Table 2: Chemical composition of DDGS from research, as-fed basis (Jacela et al., 2011 and Graham et al., 2013)

	Conv. DDGS	Low Fat DDGS	Low Fat DDGS	Low Fat DDGS	De-Oiled DDGS
Crude Protein, %	**25.2**	**27.4**	**27.1**	**30.1**	**31.2**
Crude Fat, %	9.6	8.1	6.6	7.6	4.0
GE, kcal/kg	5,317	5,293	5,135	4,585	5,098
ME, kcal/kg	**4,250**	**4,100**	**4,150**	**3,153**	**2,858**
NDF, %	28.6	30.7	29.9	36.5	34.6

Table 3: Effect of de-oiled DDGS on nursery and finishing pig growth performance. (Jacela et al., 2011)

Item	0 %	5 %	10 %	20 %	30 %
Nursery					
ADG, lb/d	1.00	1.01	0.994	0.979	0.972
ADFI, lb/d	1.65	1.70	1.67	1.65	1.67
G:F	0.609	0.595	0.594	0.593	0.582
Grow-Finish					
ADG, lb/d	1.99	1.96	1.95	1.95	1.92
ADFI, lb/d	4.75	4.77	4.64	4.64	4.49
G:F	0.420	0.413	0.422	0.421	0.431

Table 4: Effect of medium-oil DDGS on finishing (150 lbs) pig growth performance. (Graham et al., 2013)

Item	0 %	15 %	30 %	45 %
ADG, lb/d	1.92	1.87	1.84	1.79
ADFI, lb/d	6.03	5.96	5.90	5.86
G:F	0.320	0.313	0.313	0.307

References:

Applegate, T.J., T. Johnson, Z. Jiang, and C. Troche. 2009. The nutritional value of high-protein corn distillers dried grains for broilers chickens and its effect on nutrient excretion. Poultry Sci. 88:354-359.

Graham, A.B., R.D. Goodband, M.D. Tokach, S.S. Dritz, J.M. DeRouchey and S. Nitikanchana. 2013. The effects of medium-oil dried distillers grains with solubles on growth performance, carcass traits and nutrient digestibility in growing-finishing pigs. J. Anim. Sci. (on-line)

Guney, A.C., M.Y. Shim, A.B. Batal, N.M. Dale, and G.M. Pesti. 2013. Effect of feeding low-oil distillers dried grains with solubles on the performance of broilers. Poultry Sci. 92:2070-2076.

Jacela, J.Y., J.M. DeRouchey, S.S. Dritz, M.D. Tokach, R.D. Goodband, J.M. Nelssen, R. C. Sulabo, R.C. Thaler, L. Brandts, D.E. Little, and D.J. Prusa. 2011. Amino acid digestibility and energy content of deoiled (solvent-extracted) corn distillers dried grains with solubles for swine and effects on growth performance and carcass characteristics. J. Anim. Sci. 89:1817-1829.

Kerr, B.J., W.A. Dozier III, and G.C. Shurson. 2013. Effects of reduced-oil corn distillers dried grains with solubles composition on digestible and metabolizable energy value and prediction in growing pigs. J. Anim. Sci. 91:3231-3243.

Pedersen, C., M.G. Boersma, and H.H. Stein. 2007. Digestibility of energy and phosphorus in ten samples of distillers dried grains with solubles fed to growing pigs. J. Anim. Sci. 85:1168-1176.

NRC. 2012. Nutrient Requirements of Swine. 11th rev. ed. Natl. Acad. Press, Washington, DC.

Stein, H.H., M.L. Gibson, C. Pedersen, and M.G. Boersma. 2006. Amino acid and energy digestibility in ten samples of distillers dried grains with solubles fed to growing pigs. J. Anim. Sci. 84:853-860.

Widmer, M.R., L.M. McGinnis, D.M. Wulf, and H.H. Stein. 2008. Effects of feeding distillers dried grains with solubles, high-protein distillers dried grains and corn germ to growing-finishing pigs on pig performance, carcass quality and the palatability of pork. J. Anim. Sci. 86:1819-1831.