Dried Distiller's Grains with Solubles on Lactating Sow Performance.

Sam K. Baidoo and Minho Song
Department of Animal Science, Southern Research and Outreach Center
University of Minnesota, Waseca, MN

Introduction

The demand for alternative fuel has increased ethanol production from the conversion of cereal starch into ethyl alcohol by distillation process. Grain distilling traditionally uses corn, wheat, sorghum and other potential grains. Suitable residues for use in animal feed are produced at all stages of the distilling process, from the initial screening of cereal grains to the liquid remaining after the alcohol has been distilled of.

The solid residues are primarily the fibrous portion of the cereal grain extracted after fermentation and distillation processes. The liquid residue contains disrupted yeast cells and substances solubilized from cereal grains and concentrated by evaporation. Much of this liquid is dried to produce a fine, mildly hygroscopic meal known as dried distillers solubles (DDS). The DDS is mixed back with the solid residues and dried to produce dried distillers grains with solubles (DDGS). Increased in ethanol production has resulted in high usage of corn for the distillation process and accumulation of this by-product – DDGS.

Recent studies at the University of Minnesota have shown that recent DDGS from corn contains higher levels of metabolizable energy, digestible amino acids and available phosphorus compared to DDGS produced from older ethanol plants. The comparison of nutrients between old and new generations of DDGS is presented in Table 1. The improved nutrient composition of recent DDGS makes it a cost effective partial replacement for corn, soybean meal, oil and di-calcium phosphate in swine feeding programs.

Table 1. Comparison of old and new generations of DDGS

Item	**Generation of DDGS**	
	New	**Old**
ME, kcal/Ib	1739.5	1600.4
AID Lysine, %	0.44	0.00
AID Threonine, %	0.62	0.36
Available P, %	0.80	0.35

(Shurson et. al 2003)

Inclusion of DDGS in Sow Diets

A summary by Reese (1997) indicates negative responses occurred when alfalfa meal and distillers grains were evaluated (Table 2). The quality of DDGS (nutrient availability) used in that evaluation might have been different from the current new generation DDG

Table 2: Influence of source of fiber fed to the sow during gestation on litter size.

Fiber source	Daily NDF intake, (Ib)		No. pigs born alive	No. pigs weaned	No. litter
	Control	Fiber			
Alfalfa meal	0.58	0.84	- 0.4	- 0.7	269
Alfalfa hay/ haylage	0.54	1.58	+ 0.5	+ 0.8	647
Corn gluten feed	0.36	1.75	+ 0.7	+ 0.4	229
Distillers grains	0.30	0.92	- 0.3	- 0.4	118
Oat hulls/oats	0.57	2.68	+ 1.8	+ 0.7	96
Wheat straw	0.33	0.82	+ 0.5	+ 0.7	699

Adapted from Reese (1997)

Despite the improved nutrient content in new generation DDGS, there is variability in nutrients between plants (Table 3). There is about 30% variation in crude protein and 47% variation in lysine. Frequent nutrient analysis of DDGS batches will therefore be required before using DDGS in feed formulations for swine.

Table 3: Composition of recent DDGS samples

Item	Average	Range
Gross energy, kcal/Ib	2377	2217- 2458
Crude protein, %	30.74	24.6 – 33.7
Ether extract , %	10.20	8.60 – 12.6
ADF, %	13.9	8.6 – 16.2
Starch, %	6.38	2.66 – 10.33
Phosphorus, %	0.76	0.59 – 0.94
Lysine, %	0.88	0.61 – 1.15

There is limited research investigating the dietary effects of DDGS on sow performance during lactation. However, current research studies suggest inclusion rates of DDGS in sow diets from 15 to 30 % (Table 4) without any effect on sow or litter performance.

Table 4: Suggested inclusion rates of DDGS in sow lactation diets

Reference	Suggested inclusion rates in sow lactation diets
University of Minnesota, 2003	20
University of Minnesota, 2006	30

A study by Wilson (2003) at the University of Minnesota with sows fed diets containing 0 or 50% DDGS during gestation and 0 or 20% in lactation through first and second reproductive cycles reported no dietary effect on litter size weaned after the first reproductive cycle. Sows fed diets with DDGS weaned more pigs per litter during the second reproductive cycle compared to the con-soybean meal diets (Table 5).

Table 5. Effect of DDGS gestation diet on sow performance during two reproductive cycles

Criteria	**First Reproductive Cycle**		**Second Reproductive Cycle**	
	Control	**DDGS**	**Control**	**DDGS**
Number of sows	43	48	23	26
Total pigs born/litter	9.9	10.3	10.5	11.6
Litter birth weight, Ib	33.4	35.0	35.6	37.9
Avg. pig birth weight, Ib	3.5	3.5	3.5	3.3

(Wilson, 2003)

Recently, Song et al. (unpublished) fed diets containing 0, 10, 20 and 30% DDGS to lactating sows. Diets containing DDGS were introduced to the sows on day 109 of gestation. Dietary levels of DDGS did not influence sow and litter performance (Table 6). There was a trend for sows fed DDGS during lactation to wean heavier piglets after 18-d lactation.

Table 6. Effect of DDGS in lactation diets on sow and litter performance

Criteria	**Treatments**					**SEM**	**Pvalue**
	Control	**10% DDGS**	**20% DDGS**	**30% DDGS**	**30% DDGS HP**		
No. of sows	60	61	63	61	62		
Average daily feed intake, Ib/d	14.2	14.4	15.4	14.6	14.2	0.35	0.10
Sow's weight change, Ib/lactation period	11.9	9.2	1.4	5.3	-1.38	3.1	0.02
Sow's backfat change, mm/lactation period	-0.55	-0.64	-0.95	-0.59	-1.09	0.20	0.21
Wean to estrus interval, day	4.93	5.00	5.12	5.02	5.25	0.11	0.35
Piglet pre-weaning mortality, %	10.26	8.37	8.48	8.48	7.97	1.25	0.71
Litter weight gain, Ib/sow/lactation period	100.1	103.0	102.8	100.1	101.4	1.96	0.67
Average daily piglet gain, Ib/d	0.56	0.56	0.59	0.57	0.57	0.01	0.07

(University of Minnesota, 2006)

Economics of Adding DDGS to Lactation Diets:

Three factors will influence the economics of adding DDGS to lactating sow diets:

1. Price of feed ingredients
2. Cost of substitution
3. Impact on biological performance.

Energy and nutrients composition of corn, SBM and DDGS is presented in Table 7. The crude protein, lysine, energy and phosphorus content in DDGS are higher than in corn but lower than SBM.

Table 7: Energy and nutrient content in ingredients and lactation diet

Item	Corn	DDGS	SBM	Lactation
Energy, kcal ME/Ib	1554	1281	1536	1484
Crude protein, %	8.8	26.9	47.5	18.8
SID lysine, %	0.20	0.55	2.72	0.90
ATTD P, %	0.04	0.44	0.16	0.35
ADF, %	2.90	16.45	5.4	
NDF, %	10.15	34.96	8.9	

Addition of DDGS to sow diets reduces the inclusion rates of corn, SBM, dicalcium phosphate and oil but increases the addition of limestone and lysine as presented in Table 8 for various levels of DDGS. At 30% inclusion rate, corn and SBM decreased by 11 and 17% respectively and increase in addition of synthetic lysine by 0.48% if formulated on ideal protein basis. Formulation of DDGS on high protein basis will require the addition of less synthetic lysine.

Table 8. Percent substitutions of DDGS in lactation diets

Item	**Levels of DDGS in the Diet (%)**			
	10	**20**	**30**	**30+[1]**
Corn	↓ 3.86	↓ 7.39	↓ 11.28	↓ 18.5
SBM, 47.5%	↓ 5.65	↓ 11.53	↓ 17.07	↓ 9.26
Di-calcium phosphate	↓ 0.24	↓ 0.51	↓ 0.79	↓ 0.86
Oil	↓ 0.58	↓ 0.59	↓ 1.88	↓ 2.09
Limestone	*↑ 0.18*	*↑ 0.36*	*↑ 0.54*	*↑ 0.53*
L-Lysine, HCL	*↑ 0.15*	*↑ 0.32*	*↑ 0.48*	*↑ 0.18*

[1] DDGS formulated on protein basis

The addition of DDGS to lactating sow diets will decrease feed cost from $6.25 per tonne to $19.24 per tonne (Table 9). Recent studies at the University of Minnesota reported no difference in performance between sows fed a control corn-SBM diet and diets substituted with 10, 20 or 30% DDGS. The quality of the new DDGS has improved and is more acceptable by lactating sows.

Table 9: Cost ($) of substitution of DDGS in lactation diets.

Item	Levels of DDGS in the Diet (%)			
	10	**20**	**30**	**30+**
Corn	↓ 0.382	↓ 0.731	↓ 1.116	↓ 1.831
SBM, 47.5%	↓ 1.028	↓ 2.098	↓ 3.106	↓ 1.685
Di-calcium phosphate	↓ 0.086	↓ 0.183	↓ 0.284	↓ 0.310
Oil	↓ 0.277	↓ 0.597	↓ 0.898	↓ 0.999
Limestone	*↑ 0.016*	*↑ 0.032*	*↑ 0.048*	*↑0.047*
L-Lysine, HCL	*↑ 0.303*	*↑ 0.646*	*↑ 0.969*	*↑ 0.363*
Total cost ($)	***↓ 0.625***	***↓ 1.272***	***↓ 1.898***	***↓ 1.924***

Inclusion of DDGS in lactating sow diets increased the margin over feed cost (MOFC) for sows fed diets with 20 and 30% DDGS. In a recent study at the University of Minnesota, the inclusion of 20% DDGS increased MOFC of $6.6 per sow (Table 10).

Table 10. Economic analysis of adding DDGS to lactating sow diets.

Criteria	Level of DDGS in lactating sow diets (%)					SEM
	0	10	20	30	30+	
No. of sows	60	61	63	61	62	
Average gestation feed intake, Ib	527.6	527.6	527.6	527.6	527.6	
Feed cost/sow/gestation period, $	32.0	32.0	32.0	32.0	32.0	
Average lactation feed intake, Ib	258.1	271.9	281.7	268.7	266.7	6.9
Feed cost/sow/lactation period, $	16.2	16.3	16.1	14.6	14.4	0.4
No. of pigs weaned /sow	9.7	9.6	9.7	9.7	9.6	0.1
Average piglet weaning weight, Ib	13.4	14.2	14.1	13.6	13.8	0.2
Revenue / sow, $	348.4	348.4	354.5	349.4	357.6	3.2
Total gestation-lactation feed cost/sow, $	48.2	48.3	48.1	46.6	46.4	0.4
Margin over feed cost / sow, $	300.0	300.1	306.6	303.1	3055	3.24

(University of Minnesota, 2006)

Conclusion:

Improvements in the processing of DDGS as livestock feed has improved with the construction of new ethanol producing plants. This improvement has increased the inclusion levels of DDGS in lactating sow diets. DDGS in lactating sow diets reduces feed cost and increases the economic returns per sow. Based on studies at the University of Minnesota, inclusion of 20% DDGS in lactating sow diets improves performance and increases the economic return per sow.

Literature Cited:

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