

The Value and Use of Corn Gluten Feed and Meal and DDGS in Swine Diets

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Corn Wet Milling

- ◆ **Corn is soaked (steeped) to soften the kernel**
 - **germ is separated - oil extracted and germ meal is produced**
 - **hulls are removed**
 - **remaining fraction is centrifuged to remove starch from gluten**
- ◆ **Corn starch and oil (human consumption)**
- ◆ **Corn gluten feed is a blend of hulls, evaporated steep water, and germ meal (animal feeds)**
- ◆ **Corn gluten meal is 40% (blend of 60% meal and corn gluten feed) or 60% protein.**

Products of Corn Wet Milling

- ◆ Corn starch - 67.2%
- ◆ Corn gluten feed - 19.6%
- ◆ Corn gluten meal (60%) - 5.7%
- ◆ Corn germ (50% oil) - 7.5%

Nutrient Profile of Corn Gluten Feed and Corn Gluten Meal

Nutrient	Corn Gluten Feed	Corn Gluten Meal (60%)	Corn
Dry matter, %	90	90	89
Crude protein, %	21.5	60.2	8.3
Fat, %	3.0	2.9	3.9
Fiber, %	10	2.0	1.9
Calcium, %	0.22	0.05	0.03
Phosphorus, %	0.83	0.44	0.28
P availability, %	59	15	14
DE, kcal/kg	2990	4225	3525
ME, kcal/kg	2605	3830	3420
Lys, %	0.63	1.02	0.26
App. Dig. Lys, %	0.32	0.77	0.17
Met, %	0.35	1.43	0.17
App. Dig. Met, %	0.28	0.21	0.15
Thr, %	0.74	2.08	0.29
App. Dig. Thr, %	0.42	1.66	0.20
Trp, %	0.07	0.31	0.06
App. Dig Trp, %	0.03	0.25	0.04

Limitations of Using Corn Gluten Feed

- ◆ Low DE and ME and high fiber
- ◆ Corn gluten feed has 74% of NE of corn
- ◆ Low total lysine and tryptophan levels
- ◆ Low app. ileal digestible tryptophan (32%)
- ◆ Not recommended for pigs < 20 kg
- ◆ Decreased dressing percentage of slaughter pigs

Limitations of Using Corn Gluten Meal

- ◆ Low digestible methionine
- ◆ Cost relative to corn, soybean meal and dicalcium phosphate

Maximizing the Value of Corn Gluten Feed in Swine Diets

- ◆ Best use is in gestation and late finisher diets due to low energy, high fiber content
- ◆ High fiber content appears to increase litter size by .5 pigs/litter vs corn-SBM control diet when fed during gestation over three parities (Honeyman and Zimmerman, 1987).
- ◆ Supplement corn gluten feed diets with ingredients that compensate for deficiencies in energy (fat), and digestible amino acids (lysine and tryptophan).
- ◆ Formulate diets on a digestible amino acid and available P basis.

Maximizing the Value of Corn Gluten Meal in Swine Diets

- ◆ Best used in early grower and lactation diets due to high energy and digestible amino acid content.
- ◆ Supplemental methionine may be required at high inclusion rates for proper amino acid balance.
- ◆ Formulate diets on a digestible amino acid and available P basis.

Recommended Maximum Inclusion Rates for Corn Gluten Feed in Swine Diets

- ◆ Gestation - 50%
- ◆ Lactation - 5%
- ◆ Late starter - 0%
- ◆ Grower – 0%
- ◆ Finisher – 20%

Recommended Maximum Inclusion Rates for Corn Gluten Meal in Swine Diets

- ◆ Gestation - 20%
- ◆ Lactation – 20 %
- ◆ Late starter - 5%
- ◆ Grow-finish - 20%

Example Gestation Diet with Corn Gluten Feed

Ingredient	%	Nutrient Composition	
Corn gluten feed	50.00	Crude protein, %	16.74
Corn	42.30	App. Dig. Lysine, %	0.42
Soybean meal, 48.5%	4.93	App. Dig. M + C, %	0.50
Dicalcium phosphate	0.82	App. Dig. Thr., %	0.46
Limestone	1.00	App. Dig. Trp, %	0.09
Salt	0.50	ME, kcal/kg	2915
Vitamin premix	0.30	Ca, %	0.75
TM premix	0.15	P, %	0.71
Total	100.00		

Example Late Finisher Diet with Corn Gluten Feed

Ingredient	%	Nutrient Composition	
Corn gluten feed	20.00	Crude protein, %	11.95
Corn	75.97	App. Dig. Lysine, %	0.44
Soybean meal, 48.5%	2.17	App. Dig. M + C, %	0.49
Dicalcium phosphate	0.04	App. Dig. Thr., %	0.47
Limestone	0.92	App. Dig. Trp, %	0.09
Salt	0.30	ME, kcal/kg	3192
Vitamin premix	0.30	Ca, %	0.45
TM premix	0.15	P, %	0.40
L-lysine HCL	0.15		
Total	100.00		

Example Lactation Diet with Corn Gluten Meal

Ingredient	%	Nutrient Composition	
Corn	60.70	Crude protein, %	24.1
Corn gluten meal, 60%	20.00	App. Dig. Lysine, %	0.75
Soybean meal, 48.5%	14.27	App. Dig. M + C, %	0.87
Dicalcium phosphate	2.49	App. Dig. Thr., %	0.82
Animal fat	0.97	App. Dig. Trp, %	0.20
Limestone	0.82	ME, kcal/kg	3400
Salt	0.30	Ca, %	1.05
Vitamin premix	0.30	P, %	0.80
TM premix	0.15		

Example Swine Early Grower Diet with Corn Gluten Meal

Ingredient	%	Nutrient Composition	
Corn	60.62	Crude protein, %	22.85
Corn gluten meal, 60%	20.00	App. Dig. Lysine, %	0.80
Soybean meal, 48.5%	9.91	App. Dig. M + C, %	0.96
Dicalcium phosphate	0.95	App. Dig. Thr., %	0.88
Animal fat	0.89	App. Dig. Trp, %	0.19
Limestone	0.73	ME, kcal/kg	3400
Vitamin premix	0.30	Ca, %	0.59
Salt	0.30	P, %	0.51
TM premix	0.15	Avail. P, %	0.27
L-lysine HCl	0.15		
Total	100.00		

Calculating the Value of Corn Gluten Feed in Swine Diets

Additions/1000 kg diet

+ 200 kg CGF	x	cost/kg	= \$
+ 2.91 kg limestone	x	cost/kg	= \$
+ 0.09 kg L-lysine HCl	x	cost/kg	= \$
TOTAL ADDITIONS (A)			= \$

Subtractions/1000 kg diet

- 151.49 kg corn	x	cost/kg	= \$
- 46.48 kg SBM (48.5 %)	x	cost/kg	= \$
- 5.03 kg dicalcium phosphate	x	cost/kg	= \$
TOTAL SUBTRACTIONS (S)			= \$

S - A = Opportunity cost for CGF/200 kg

Calculating the Value of Corn Gluten Meal in Swine Diets

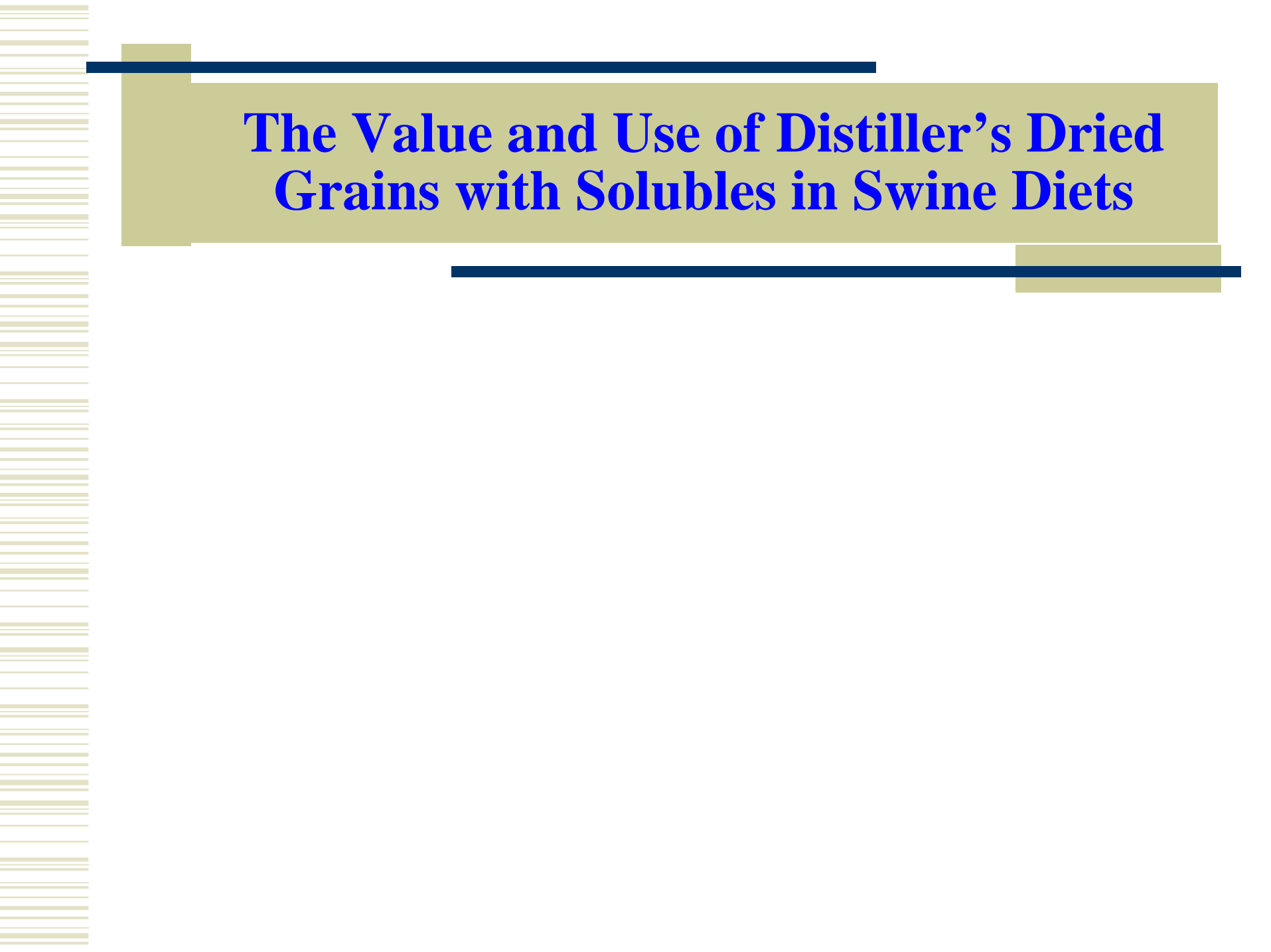
Additions/1000 kg diet

+ 200 kg CGM	x	cost/kg	= \$
+ 0.58 kg limestone	x	cost/kg	= \$
+ 1.08 kg dicalcium phos	x	cost/kg	= \$
TOTAL ADDITIONS (A)			= \$

Subtractions/1000 kg diet

- 76.86 kg corn	x	cost/kg	= \$
- 117.28 kg SBM (48.5 %)	x	cost/kg	= \$
- 7.52 kg animal fat	x	cost/kg	= \$
TOTAL SUBTRACTIONS (S)			= \$

S - A = Opportunity cost for CGM/200 kg



The Value and Use of Distiller's Dried Grains with Solubles in Swine Diets

Production of DDGS

- ◆ Yeasts and enzymes are used to ferment the starch fraction of corn
- ◆ Ethanol and carbon dioxide are produced
- ◆ Distiller's grain and distiller's solubles are the residues remaining after fermentation
- ◆ These fractions are blended and dried to produce distiller's dried grains with solubles (DDGS)

Quality Considerations for Selecting DDGS Sources

- ◆ Golden color DDGS is much better suited for swine diets than darker colored DDGS due to higher amino acid digestibility
- ◆ DDGS produced by new Midwestern plants is higher in nutrient content and digestibility than DDGS from older plants

Quality Considerations for Selecting DDGS Sources

- ◆ Nutrient Specifications
 - Moisture – maximum 12%
 - Protein – minimum 26.5%
 - Fat – minimum 10%
 - Fiber – maximum 7.5%

Quality Considerations for Selecting DDGS Sources

- ◆ Physical characteristics
 - Bulk density – .44 to .48 kg/cubic meter
 - Particle size:
 - maximum coarse particles - 10% on 2000 screen
 - maximum fine particles - 15% on 600 screen & in pan
 - Smell – fresh, fermented
 - Color – goldenrod

Nutrient Profile of Corn Distiller's Dried Grains with Solubles

Nutrient	MW DDGS	Low Quality DDGS	NRC (1998)
Dry matter, %	88.9	88.3	93.0
Crude protein, %	30.2	28.1	29.8
Fat, %	10.9	8.2	9.0
Fiber, %	8.8	7.1	4.8
Calcium, %	0.06	0.44	0.22
Phosphorus, %	0.89	0.90	0.83
P availability, %	90.0	?	79.0
DE, kcal/kg	3965	3874	3449
ME, kcal/kg	3592	3521	3038
Lys, %	0.83	0.53	0.67
App. Dig. Lys, %	0.44	0.00	
Met, %	0.55	0.50	0.54
App. Dig. Met, %	0.32	0.24	
Thr, %	1.13	0.98	1.01
App. Dig. Met, %	0.62	0.36	
Trp, %	0.24	0.19	0.27
App. Dig Trp, %	0.15	0.15	

Limitations of Using DDGS in Swine Diets

- ◆ Must be golden color and highly digestible
- ◆ High fiber limits its use in starter diets
- ◆ Excess nitrogen can be minimized by using synthetic amino acids
- ◆ High oil content limits maximum inclusion rates in grow-finish diets due to pork fat quality

Maximizing the Value of Corn DDGS in Swine Diets

- ◆ Formulate diets using digestible amino acid values
- ◆ High available P reduces the level of dietary P supplementation
- ◆ Adding 5 to 10% DDGS to grow-finish diets appears to reduce mortality due to ileitis and gut edema

Recommended Maximum Inclusion Rates for DDGS in Swine Diets

- ◆ Gestation - 50%
- ◆ Lactation - 20%
- ◆ Late starter - 5%
- ◆ Grow-finish - 20%

Example Swine Grower Diet with Containing 20% DDGS

Ingredient	%	Nutrient Composition	
Corn	60.05	Crude protein, %	19.07
DDGS	20.00	App. Dig. Lysine, %	0.74
Soybean meal, 46%	17.70	App. Dig. M + C, %	0.51
Dicalcium phosphate	0.60	App. Dig. Thr., %	0.48
Limestone	1.05	App. Dig. Trp, %	0.15
Salt	0.30	ME, kcal/kg	3309
Vitamin-TM premix	0.15	Ca, %	0.60
L-lysine HCl	0.15	P, %	0.53
Total	100.00	Avail. P, %	0.30

Example Swine Grower Diet with Containing 20% DDGS and 100 FTU/kg Phytase

Ingredient	%	Nutrient Composition	
Corn	60.70	Crude protein, %	19.10
DDGS	20.00	App. Dig. Lysine, %	0.74
Soybean meal, 46%	17.65	App. Dig. M + C, %	0.51
Dicalcium phosphate	0.05	App. Dig. Thr., %	0.48
Limestone	0.95	App. Dig. Trp, %	0.15
Salt	0.30	ME, kcal/kg	3330
Vitamin-TM premix	0.15	Ca, %	0.44
L-lysine HCl	0.15	P, %	0.43
Phytase - 1000	0.05	Avail. P, %	0.20
Total	100.00		

Example Swine Gestation Diet Containing 50% DDGS

Ingredient	%	Nutrient Composition	
DDGS	50.00	Crude protein, %	20.94
Corn	36.97	App. Dig. Lysine, %	0.47
Soybean meal, 44%	8.68	App. Dig. M + C, %	0.49
Dicalcium phosphate	0.82	App. Dig. Thr., %	0.48
Limestone	2.58	App. Dig. Trp, %	0.13
Salt	0.50	ME, kcal/kg	3254
Vitamin premix	0.30	Ca, %	1.28
TM premix	0.15	P, %	0.73
Total	100.00	Avail. P, %	0.57

Example Swine Lactation Diet Containing 20% DDGS

Ingredient	%	Nutrient Composition	
Corn	52.82	Crude protein, %	19.27
DDGS	20.00	App. Dig. Lysine, %	0.79
Soybean meal, 48.5%	20.55	App. Dig. M + C, %	0.49
Dicalcium phosphate	1.72	App. Dig. Thr., %	0.51
Animal fat	2.50	App. Dig. Trp, %	0.16
Limestone	1.31	ME, kcal/kg	3346
Salt	0.50	Ca, %	1.06
Vitamin premix	0.30	P, %	0.76
TM premix	0.15	Avail. P, %	0.54
L-lysine HCl	0.15		
Total	100.00		

Calculating the Value of DDGS in Swine Diets Using Soybean Meal 44%

Additions/1000 kg diet

+ 100 kg DDGS	x	cost/kg	= \$
+ 1.5 kg limestone	x	cost/kg	= \$
TOTAL ADDITIONS (A)			= \$

Subtractions/1000 kg diet

- 88.5 kg corn	x	cost/kg	= \$
- 10 kg SBM (44%)	x	cost/kg	= \$
- 3 kg dicalcium phosphate	x	cost/kg	= \$
TOTAL SUBTRACTIONS (S)			= \$

S - A = Opportunity cost for DDGS/100 kg

Calculating the Value of DDGS in Swine Diets Using Soybean Meal 46%

Additions/1000 kg diet

+ 100 kg DDGS	x	cost/kg	= \$
+ 1.5 kg limestone	x	cost/kg	= \$
TOTAL ADDITIONS (A)			= \$

Subtractions/1000 kg diet

- 89 kg corn	x	cost/kg	= \$
- 9.5 kg SBM (46%)	x	cost/kg	= \$
- 3 kg dicalcium phosphate	x	cost/kg	= \$
TOTAL SUBTRACTIONS (S)			= \$

S - A = Opportunity cost for DDGS/100 kg

U of M DDGS Web Site

We have developed a DDGS web site featuring:

- * research summaries (swine, poultry, dairy, & beef)
- * presentations given
- * links to other DDGS related web sites

Visit this web site at:

www.ddgs.umn.edu