Increasing the Utilization of Distiller's Dried Grains with Solubles in Livestock and Poultry Production Systems

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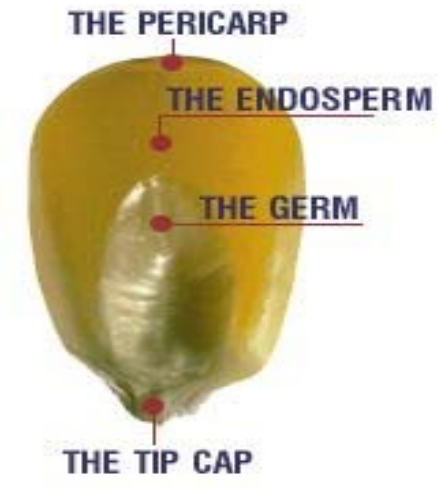
Components of Yellow Dent Corn

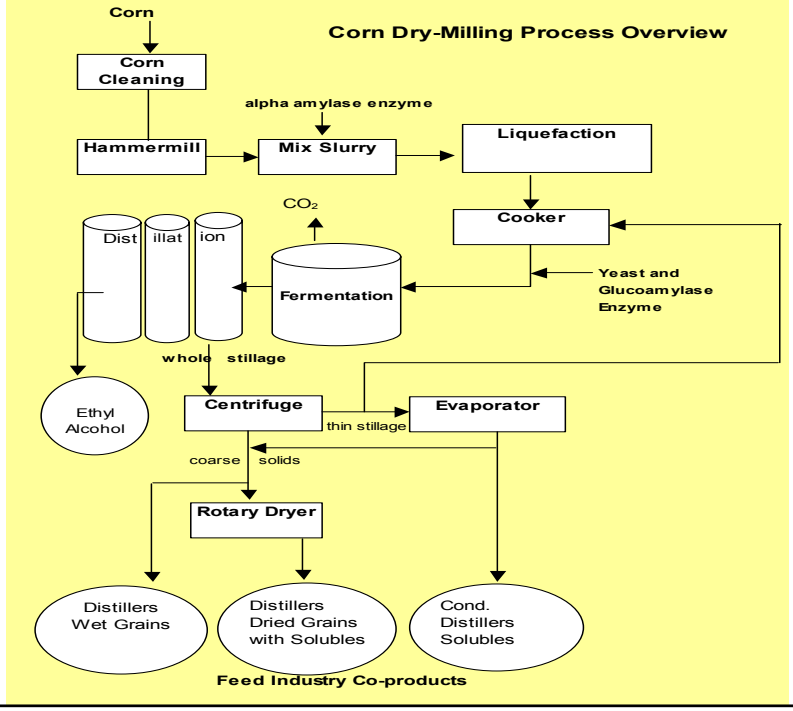
Starch	61.0 %
Corn Oil	3.8 %
Protein	8.0 %
Fiber	11.2 %
Moisture	16.0 %



Slide courtesy of Ms. Kelly Davis, CVEC

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 and blended and dried to produce distiller's dried grains with solubles (DDGS)

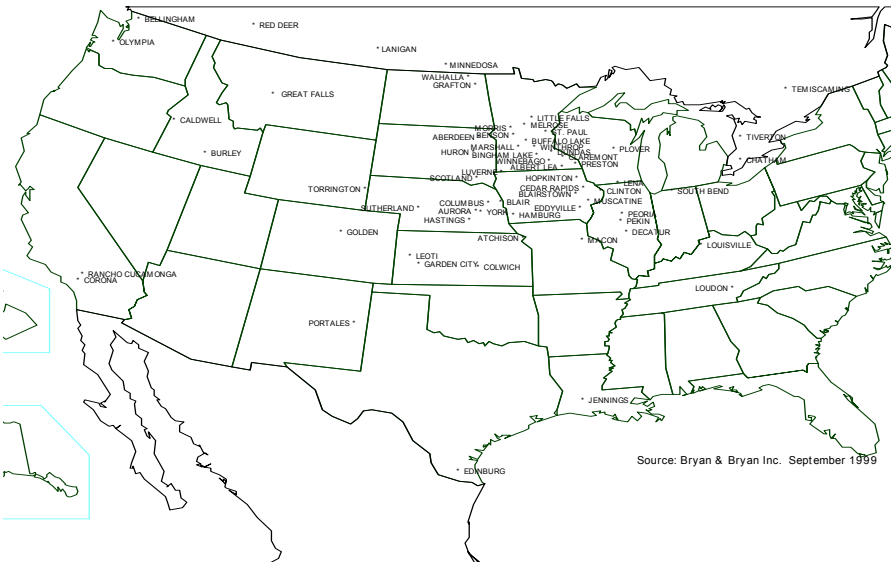


Dry-Milling Average Yield Per Bushel

- Ethanol 2.7 gallons
- DDGS 18 lbs
- CO_2 18 lbs

Slide courtesy of Ms. Kelly Davis, CVEC

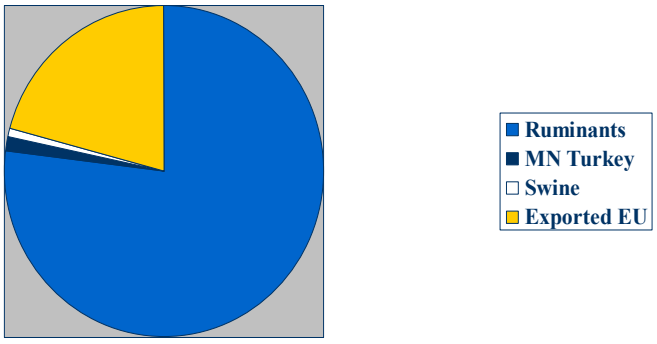
Map of U.S. Ethanol Plants



DDGS Production and Use

- 3.2 to 3.5 million metric tonnes (MT) of DDGS are produced in North America/year
  - ~ 900,000 MT produced in MN-Dakota region
  - ~ 700,000 MT exported to the EU
  - ~ 2.65 million MT fed in U.S. and Canada
    - ~ 2.58 million MT (80%) fed to ruminants
    - ~ 45,000 MT fed in MN turkey industry
    - ~ 27,000 MT used in swine diets

Markets for DDGS Produced in North America



The Minnesota Ethanol Industry

- 145 million bu. of corn is made into ethanol and other products (14% of MN crop)
- 14 plants produce
  - 300 million gallons of ethanol/yr
  - 1.4 million tons of DDGS
- Existing plants have (are expanding) and new plants are being built

WHAT DO WE DO WITH ALL OF THE DDGS THAT WILL BE PRODUCED?

Source: Ralph Groshen, Minnesota Dept. of Agriculture (2000)

Options for Increasing Markets for DDGS

- Domestic use (most feasible)
  - Dairy and beef
    - Some opportunity
  - Swine and poultry
    - Significant opportunity but must be high quality

"Produce it and feed in in our own backyard"

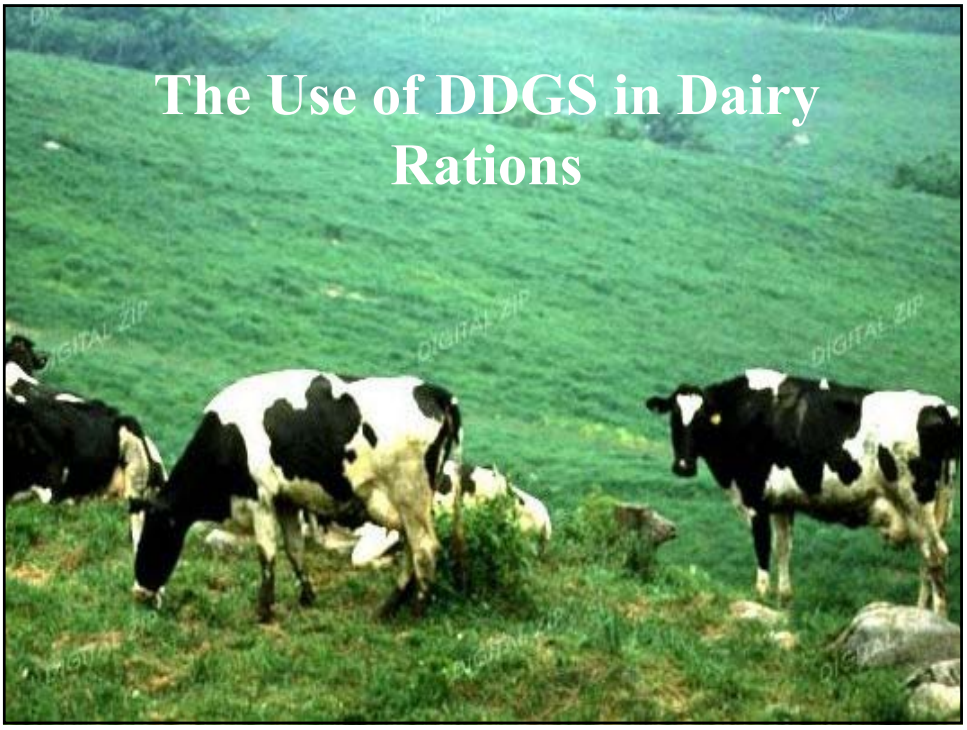
- Exports (some opportunities?)
  - High transportation costs
  - Poor geographical location of plants

Options for Increasing Markets for DDGS

- Value added components of DDGS

  What are the possibilities?

  - High insoluble fiber may improve gut health of pigs and poultry
  - May have advantages for improving on-farm food safety production procedures (e.g. Salmonella reduction)
  - Solubles may contain biologically active compounds that could provide growth and/or reproductive benefits

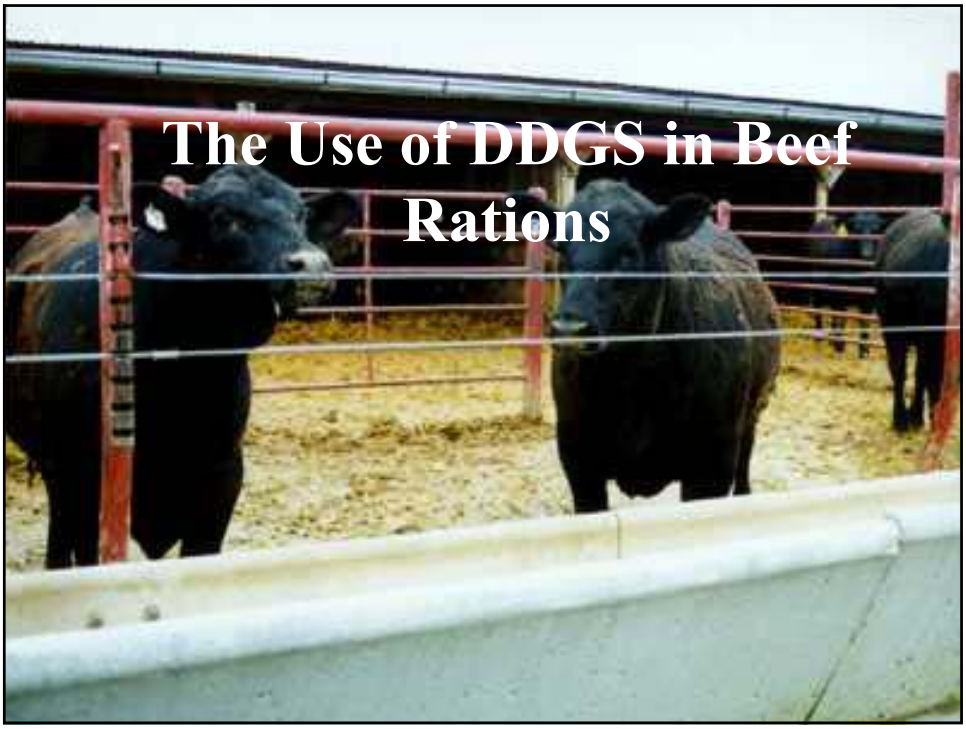


Nutritional Value of DDGS for Dairy Cows

- Excellent protein source (28% crude protein)
- High in by-pass protein
- High in NDF (44%)
- Very palatable – increases dry matter intake
- Effective partial replacement for corn and soybean meal

Recommended Feeding Levels of DDGS for Dairy Cows and Replacements

- Lactating dairy cows
  - Up to 30% DMI under normal feeding conditions
  - > 30% DMI if BST is used
- Calves
  - Up to 20 % DMI
- Replacement heifers
  - Up to 25% DMI



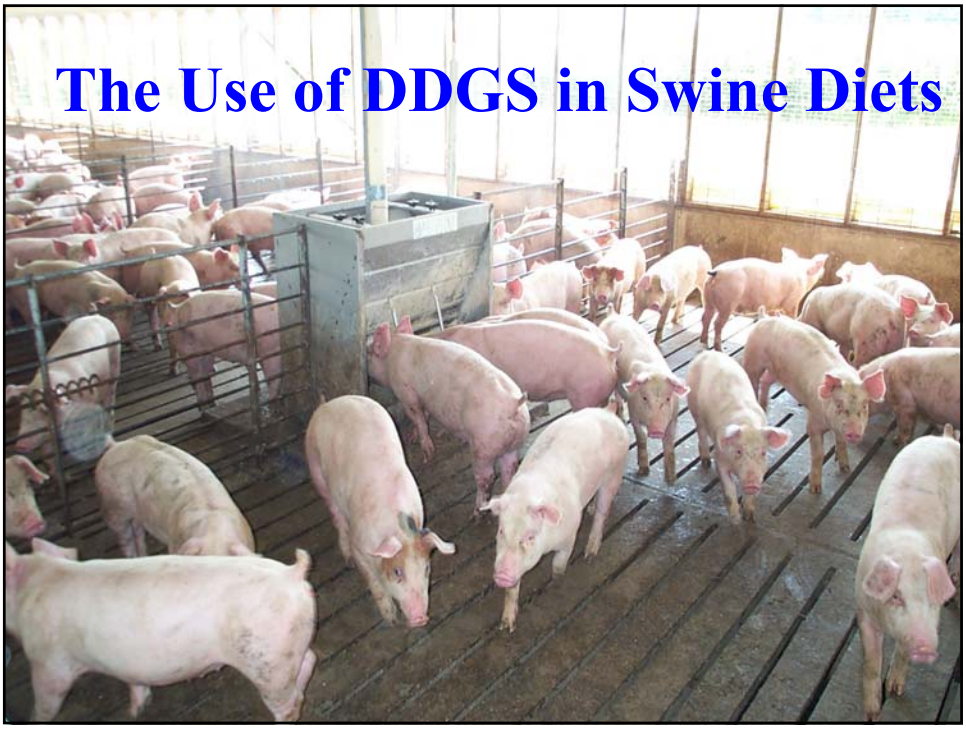
Nutritional Value of DDGS for Beef Cattle

- Excellent protein source (28% crude protein)
- High by-pass protein
- Excellent source of essential minerals (P and K)
- Improves rumen health
- Very palatable
- 1.8 times more value compared to soybean meal

Recommended Feeding Levels of DDGS for Beef Cattle

- Creep feeding
  - Up to 20%
- Feedlot cattle
  - Up to 40 % DMI
- Receiving/starting cattle
  - Up to 20%
- Brood cows
  - Up to 35% of supplement

The Use of DDGS in Swine Diets



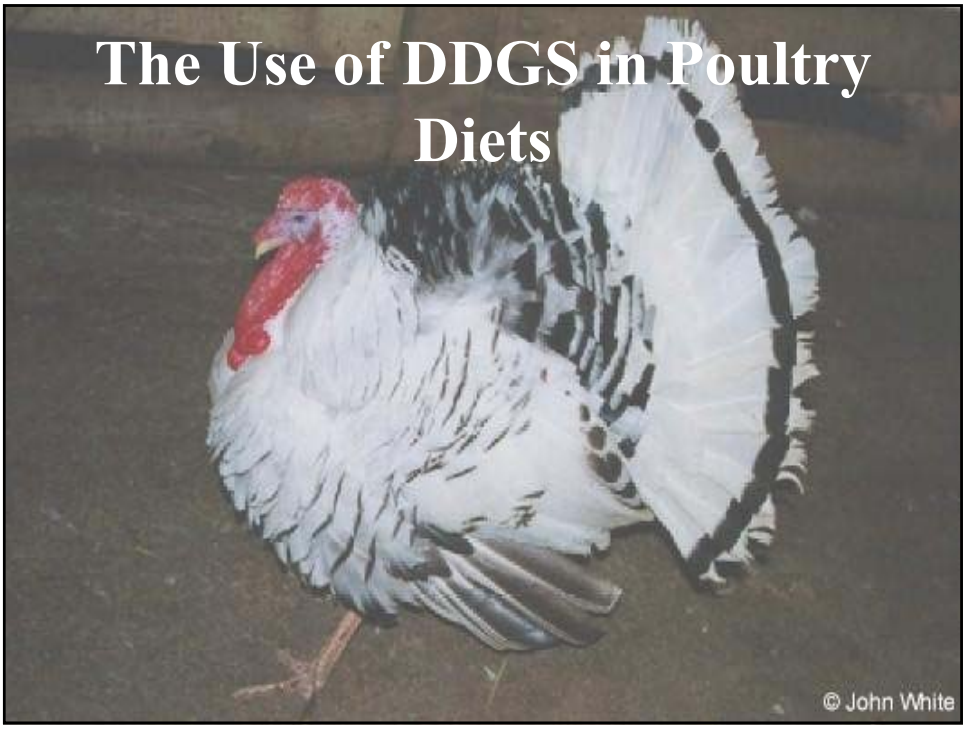
Nutritional Value of DDGS for Swine

- Must use high quality DDGS
  - Light color = high amino acid digestibility
- Excellent energy and available phosphorus source
- Nutritional value higher than previously thought
- May improve gut health (i.e. ileitis, gut edema)
  - Decreased mortality and improved growth performance
- Effective partial replacement for corn and soybean meal

Maximum Recommended Inclusion Rates of DDGS in Swine Diets

- Nursery pigs (>15 lbs)
  - Up to 25 %
- Grow-finish pigs
  - Up to 20% (higher levels reduce pork fat quality)
- Gestating sows
  - Up to 40%
- Lactating sows
  - Up to 20%

The Use of DDGS in Poultry Diets



Nutritional Value of DDGS for Poultry

- Must use high quality DDGS
  - Light color = high amino acid digestibility
- Excellent energy and available phosphorus source
- Nutritional value higher than previously thought
- Unidentified growth factors?
  - 5% DDGS resulted in 17-32% improvement in gain
  - 3% DDGS in turkey breeder hen diets increased egg numbers and hatch
- Effective partial replacement for corn and soybean meal

Recommended Maximum Inclusion Rates of DDGS in Turkey Diets

- Turkey poults
  - Up to 2.5%
- Turkey grow-finish
  - Up to 12%

Recommended Feeding Levels of DDGS for Broilers

- Broiler chicks – up to 2.5%
- Broiler finisher – up to 5.0%

Recommended Maximum Inclusion Rates of DDGS in Layer Diets

- Layers – up to 15%
- Breeders – up to 20%
- Pullets – up to 5%

DDGS Quality is Highly Variable

- Nutritionists want PREDICTABILITY AND CONSISTENCY in feed ingredients.
- The keys for getting maximum value from DDGS are:

"Know what you have (or want)"

And

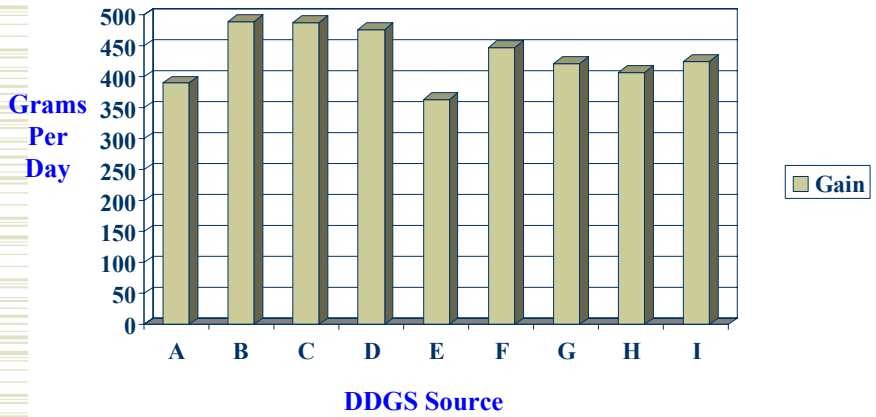
"Know how to use it"

DDGS Quality is Highly Variable

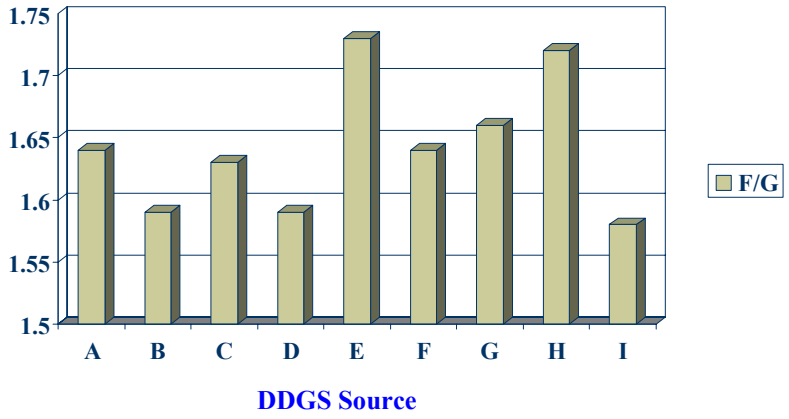
- Color ranges from very light to very dark
- Odor ranges from sweet to smoky or burnt
- Range in concentration in selected nutrients:
  - Dry matter – 87 to 93%
  - Crude protein – 23 to 29%
  - Crude fat – 3 to 12%
  - Ash – 3 to 6%
  - Lysine – 0.59 to 0.89%

Source: Cromwell et al. (1993)

Growth of Chicks Fed Nine Sources of DDGS

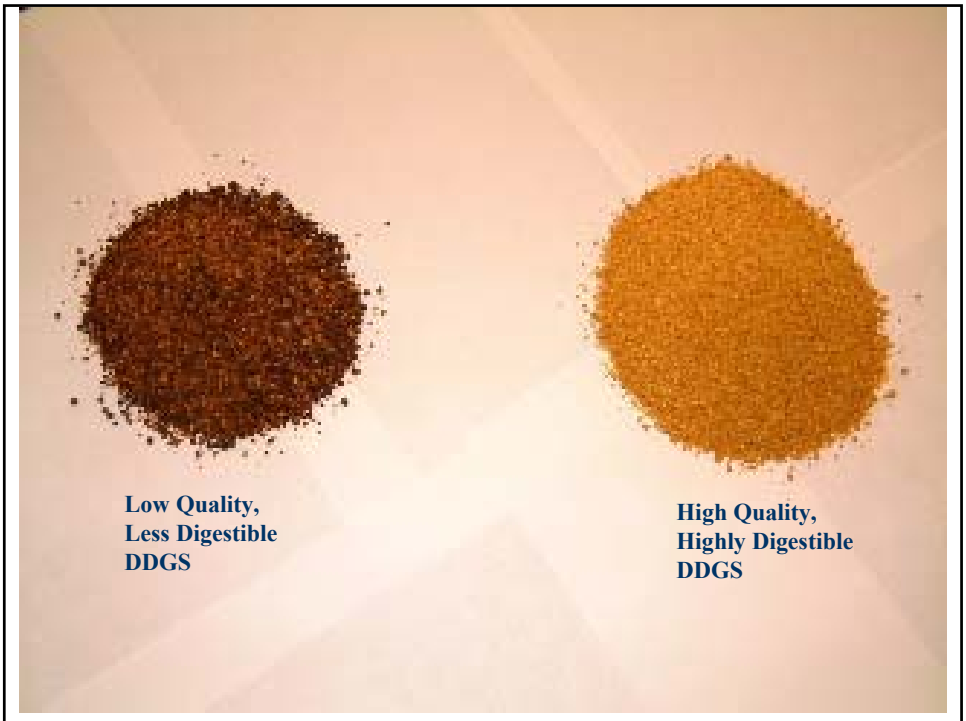


Feed Conversion of Chicks Fed Nine Sources of DDGS



Considerations for Selecting DDGS Sources for Swine and Poultry

- Must be golden color
  - higher amino acid digestibility
- Produced by new Midwestern plants
  - higher nutrient content and digestibility than DDGS from older plants



Quality Considerations for Selecting DDGS Sources for Swine and Poultry

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

Quality Considerations for Selecting DDGS Sources for Swine and Poultry

- 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

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		

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