# Energy From Agriculture:

## New Technologies, Innovative Programs & Success Stories

*December 14-15, 2005* *St. Louis, Missouri*

Farm Foundation

USDA's Office of Energy Policy and New Uses

NRCS

Rural Development

# Feed and Alternative Uses for DDGS

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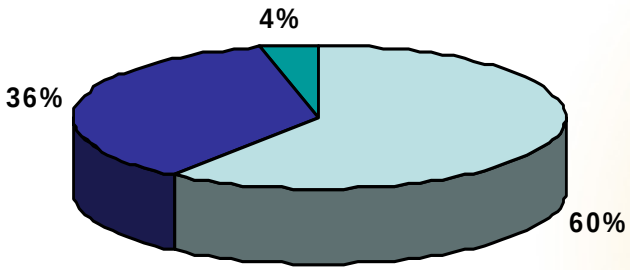
# Rapid Growth of the U.S. Ethanol Industry

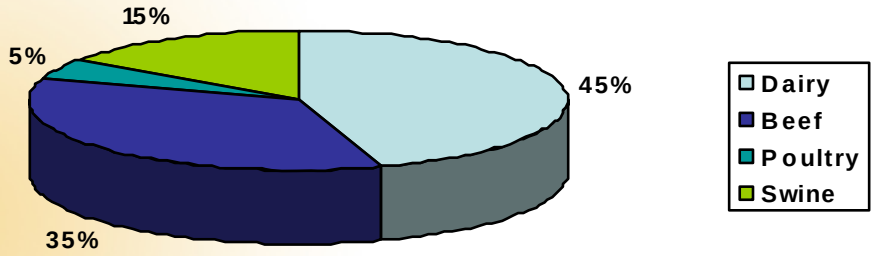
- 2004
  - 80 fuel ethanol plants
    - 3.640 billion gallons of ethanol
    - 6.928 million metric tonnes DDGS
- 2005 and 2006
  - 92 ethanol plants in production
  - 23 ethanol plants under construction
    - 5.6 billion gallons of ethanol
    - 10.658 million metric tonnes DDGS

# Livestock and Poultry Feed Use of DDGS in the U.S.

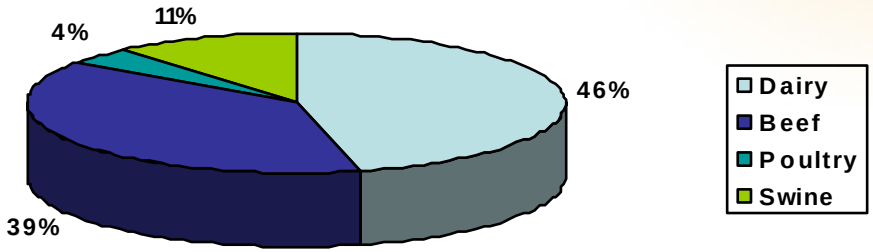
## Estimate 2001



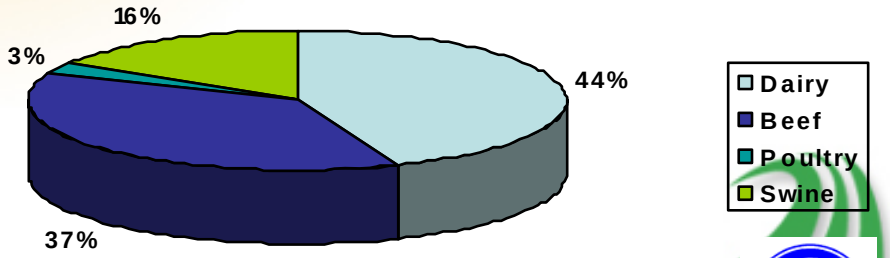

## Estimate 2002




## Estimate 2003




## Estimate 2004



# Types of Distiller's By-Products from Dry-Grind Ethanol Plants

- Wet distiller's grains
  - Primarily beef, some dairy
- Dry distiller's grains
  - Beef and dairy
- Wet distiller's grains with solubles
  - Beef and dairy
- Dried distiller's grains with solubles
  - Dairy, swine, poultry, some beef
- Modified wet cake (blend of wet and dry distiller's grains)
  - Primarily beef, some dairy
- Condensed distiller's solubles
  - Beef and dairy
  - Ontario, Canada - swine liquid feeding systems

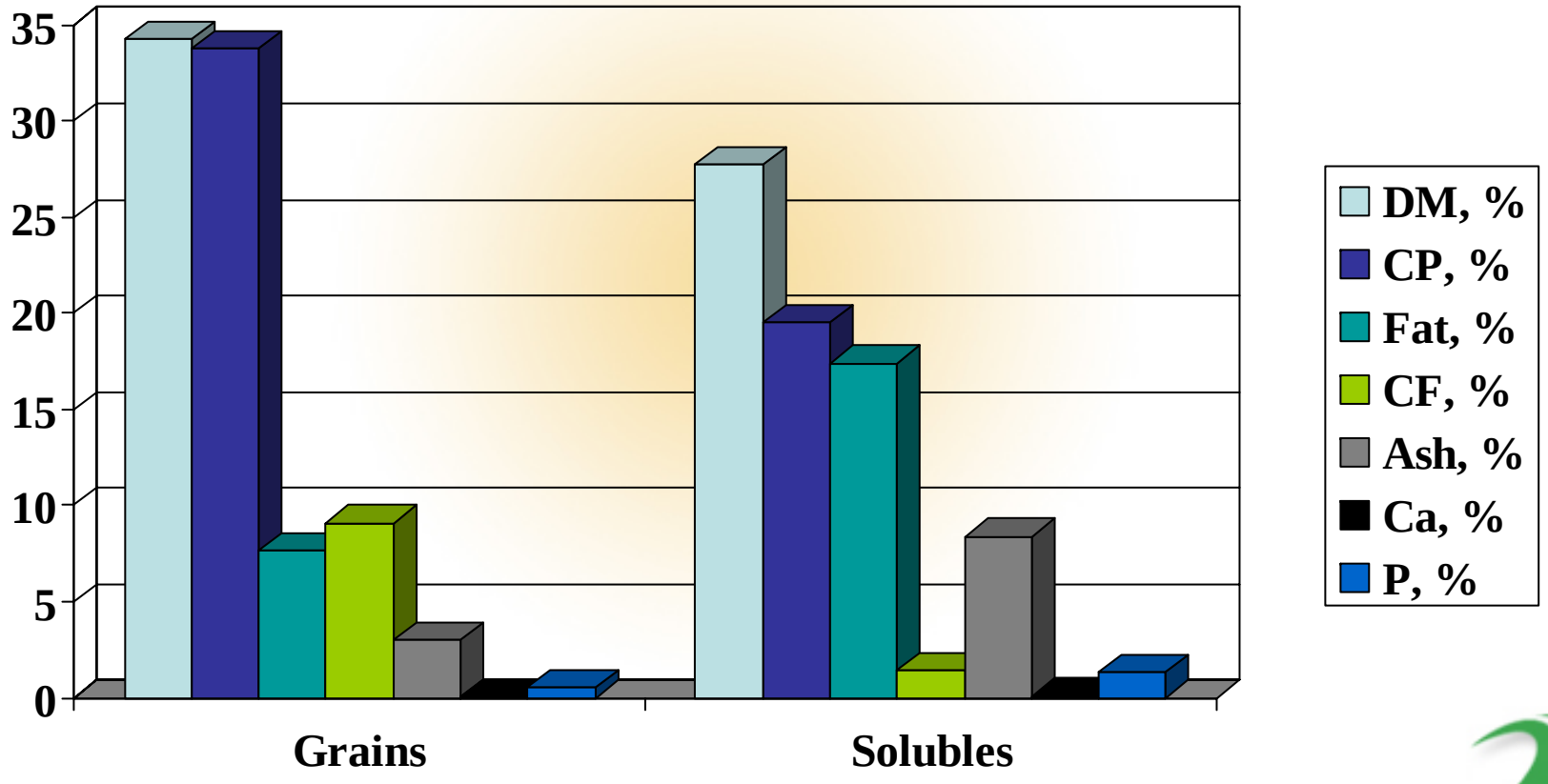
# Averages, Coefficients of Variation, and Ranges of Selected Nutrients Among 32 U.S. DDGS Sources (100% Dry Matter Basis)

| Nutrient | Average | Range |
|---|---|---|
| Dry matter, % | 89.3 | 87.3 – 92.4 |
| Crude protein, % | 30.9 (4.7) | 28.7 – 32.9 |
| Crude fat, % | 10.7 (16.4) | 8.8 – 12.4 |
| Crude fiber, % | 7.2 (18.0) | 5.4 – 10.4 |
| Ash, % | 6.0 (26.6) | 3.0 – 9.8 |
| Swine ME, kcal/kg | 3810 (3.5) | 3504 – 4048 |
| Lysine, % | 0.90 (11.4) | 0.61 – 1.06 |
| Phosphorus, % | 0.75 (19.4) | 0.42 – 0.99 |

# AAFCO DDGS Definition

- 27.6 ____ **Distillers Dried Grains with Solubles** is the product obtained after the removal of ethyl alcohol by distillation from the yeast fermentation of a grain or a grain mixture by condensing and drying at least ¾ of the solids of the resultant whole stillage and drying it by methods employed in the grain distilling industry. The predominating grain shall be declared as the first word in the name.

# Comparison of the Nutrient Content of Corn Distiller's Grains and Corn Condensed Distiller's Solubles

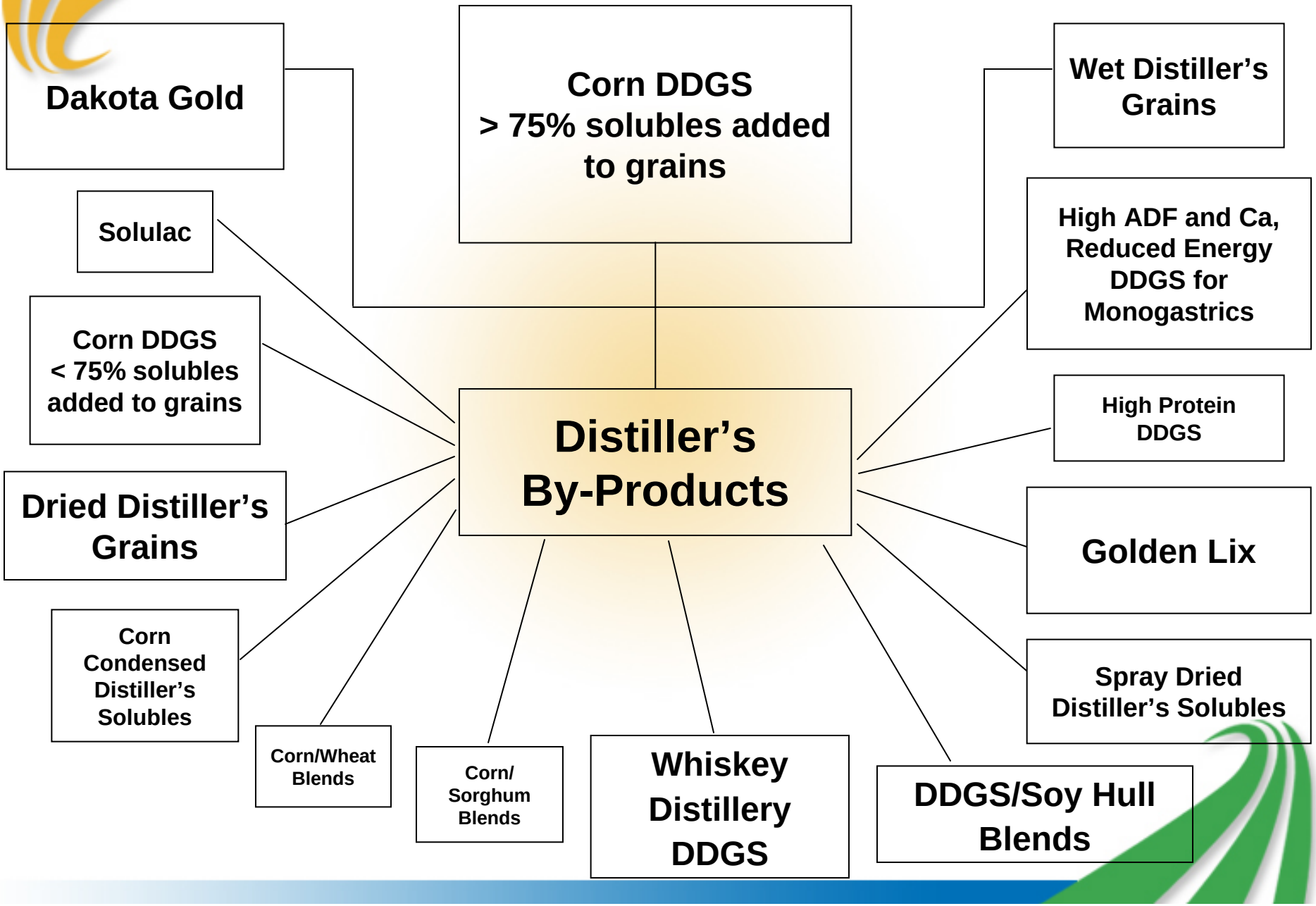


# Comparison of Nutrient Composition of Golden DDGS to Other "DDGS Sources" (100% Dry Matter Basis)

| | Golden Corn DDGS | "DDGS" | High Fat DDGS | Partial De-germed DDGS | Whiskey DDGS | Pelleted DDGS |
|---|---|---|---|---|---|---|
| Protein, % | 31.8 | 29.3 | 31.6 | 30.1 | 29.9 | 27.0 |
| Fat, % | 11.3 | 3.5 | 15.3 | 8.9 | 8.8 | 9.00 |
| Crude fiber, % | 6.3 | 7.9 | No data | 7.8 | 10.6 | 15.10 |
| ADF, % | 12.4 | 11.8 | 17.9 | 21.0 | 20.2 | No data |
| Ash, % | 6.9 | 5.3 | 4.6 | 7.3 | 3.7 | 4.28 |
| DE, kcal/kg* | 4053 | 3808 | No data | 3796 | No data | No data |
| ME, kcal/kg* | 3781 | 3577 | No data | 3560 | 3789 | No data |
| Lys, % | 0.92 | 0.61 | 0.90 | 0.83 | 0.99 | No data |
| Met, % | 0.62 | 0.54 | 0.54 | 0.66 | 0.61 | No data |
| Thr, % | 1.17 | 1.01 | 1.04 | 1.13 | 1.10 | No data |
| Trp, % | 0.25 | 0.18 | 0.23 | 0.25 | 0.27 | No data |
| Ca, % | 0.07 | 0.12 | 0.06 | 0.51 | 0.04 | 0.17 |
| P, % | 0.77 | 0.78 | 0.89 | 0.68 | 0.57 | 0.62 |

*Calculated energy values for swine

# Example Categories of Distiller's By-Products



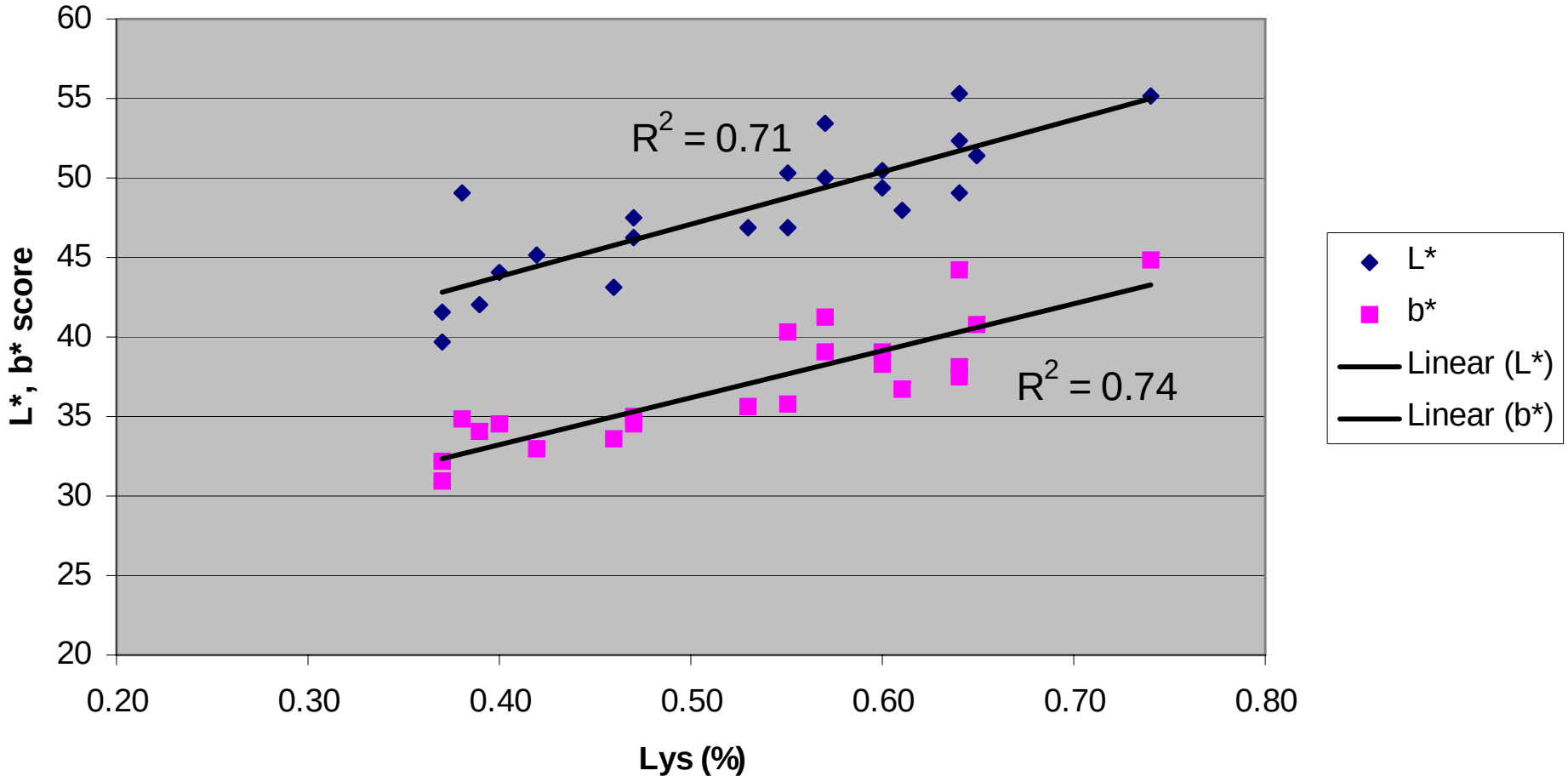
# DDGS Varies Nutrient Content, Digestibility, Color, and Particle Size Among U.S. Sources

# Color Extremes of DDGS

**Lower Quality,
Less Digestible
DDGS**

**High Quality,
Highly Digestible
DDGS**

## Fig. 1. Regression of digestible lys (%) and color (L*, b*)




Source: Dr. Sally Noll (2003)

# Variability of Results from AOAC Approved Testing Procedures

| | Moisture (%) |
|---|---|
| Procedure 1 | 12.69 |
| Procedure 2 | 10.48 |
| Procedure 3 | 10.09 |
| Procedure 4 | 10.64 |
| Procedure 5 | 13.30 |
| Procedure 6 | 12.60 |

# Use of DDGS in Dairy Rations

# Benefits and Limitations for Lactating Dairy Cows

## Benefits

- More protein and energy than corn
- Feed at up to 20% of ration dry matter
- Highly digestible fiber source
  - Fewer digestive upsets
  - Can be a partial forage replacement
- “Golden” DDGS gives best performance
- Highly palatable

## Limitations

- Low protein (lysine) quality
  - add other supplements high in lysine
- Manure P excretion increases at high feeding levels
- No effect on milk fat if adequate forage in the ration

# Use of DDGS in Beef Rations

# Benefits and Limitations for Finishing Feedlot Cattle

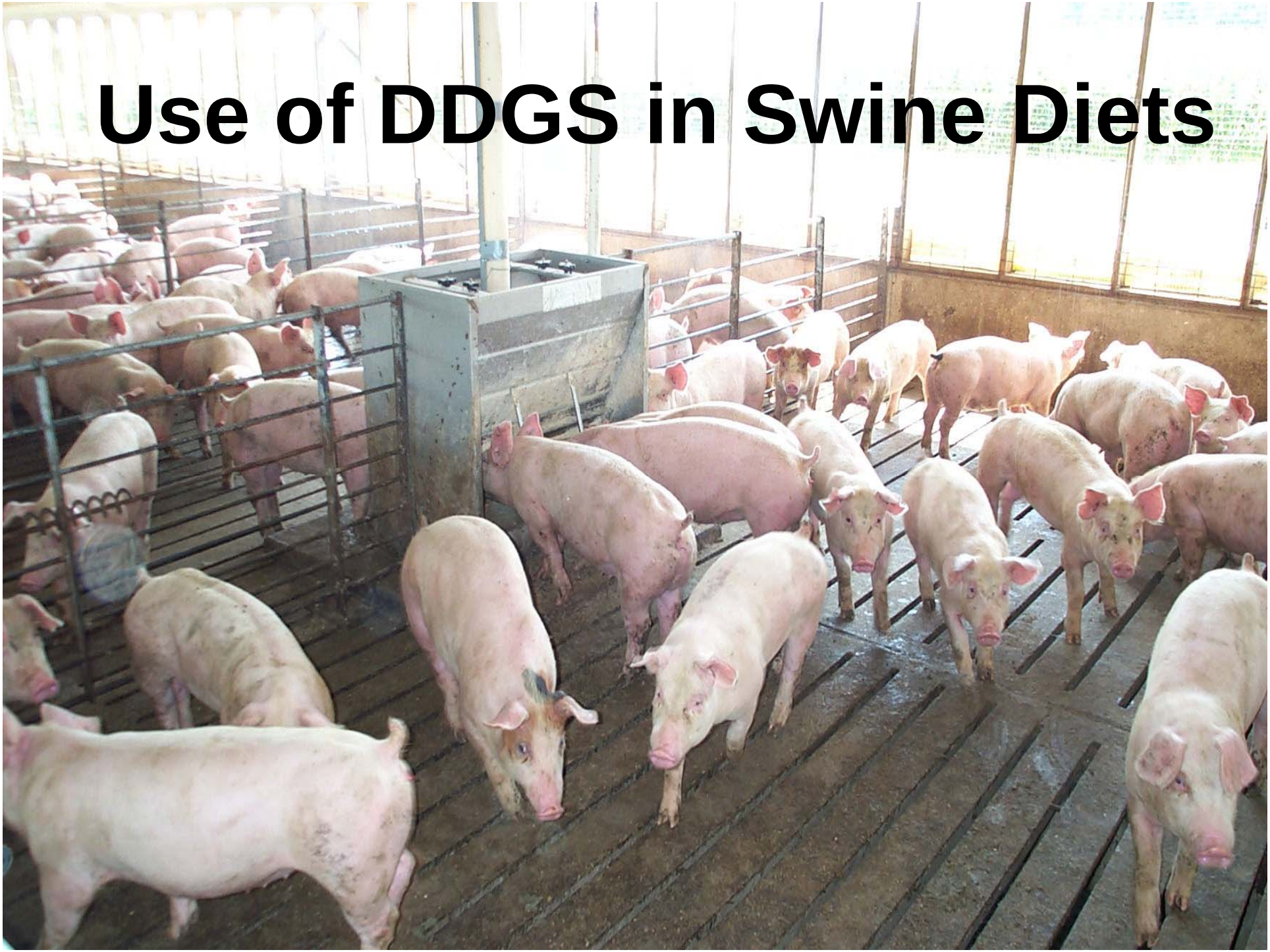
## Benefits

- More protein and same energy as corn
- Feed up to 40% of ration dry matter to replace corn
  - Excess protein and P
- Highly digestible fiber source
  - Fewer digestive upsets
- “Golden” DDGS gives best performance
- No effect on carcass yield, quality, or eating characteristics of beef

## Limitations

- Need to supplement calcium to achieve proper Ca:P ratio
  - Avoid urinary calculi
- Manure N and P excretion increases at high feeding levels
- Monitor sulfur level of water and diet (< 0.4% ration DM)
  - Avoid polioencephalmalacia

# Use of DDGS in Swine Diets



# Benefits and Limitations for Swine

## Benefits

- Energy value = corn
- High available P
  - Reduce diet P supplementation
  - Reduce manure P excretion
- Commonly fed at 10% of diet
  - Higher levels can be used if amino acids are supplemented
- Only “golden” DDGS should be used
  - High amino acid digestibility
- Appears to reduce gut health problems due to ileitis
- May increase litter size weaned when fed at high levels to sows

## Limitations

- Low protein (lysine) quality
  - add other supplements high in lys and trp
- Manure N excretion increases
- Belly firmness and pork fat quality issues when > 20% in the diet
- Mycotoxin free grain should be used to produce ethanol and DDGS
- Short-term feed intake may be reduced when feeding high DDGS diets to sows

# Use of Corn DDGS for Poultry

# Benefits and Limitations for Poultry

## Benefits

- Good energy and amino acid source when limited to < 15% of the diet
- Source of highly available P
  - Reduce manure P
- May improve egg yolk and skin color (xanthophyll)
- Source of “unidentified growth factors” ?
- “Golden” DDGS gives best performance
- Highly palatable

## Limitations

- Energy value ~ 84% of corn
- Low protein quality
  - add other supplements high in lys, arg, trp
- Sources high in sodium may increase litter moisture if adjustments to dietary salt levels are not made

# Relative Value of DDGS Differs Depending on Species

**Assumptions:**

- **Corn** — **$2.00 / bu**
- **SBM** — **$175.00 / ton**
- **Urea** — **$360.00 / ton**
- **Non-ruminant diets corn/SBM**
- **Ruminant diets typical diets with competing by-products.**

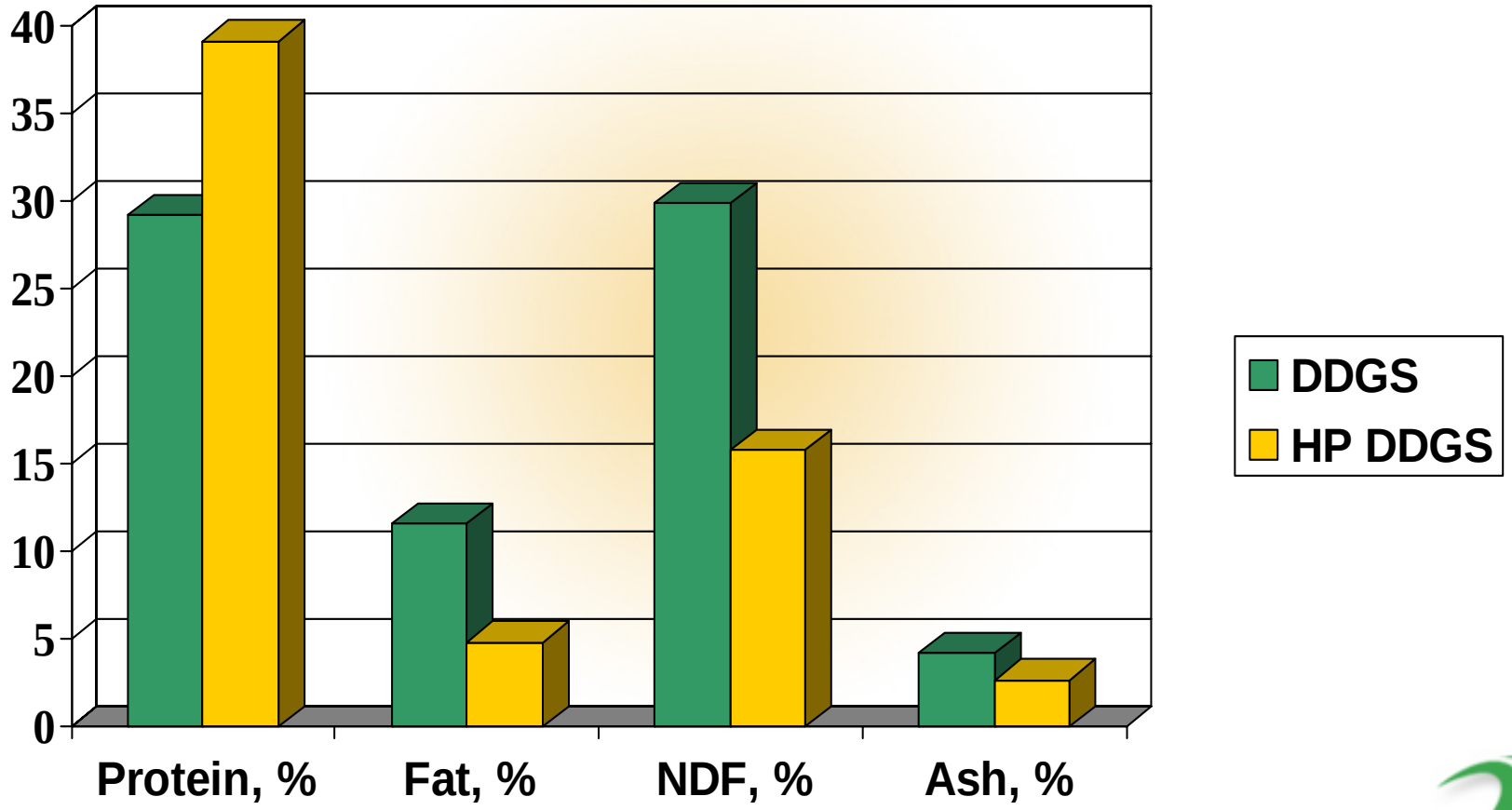
| Feed | Dollars/ ton |
|---|---|
| Dairy Lactation | $114.24 |
| Poultry Finisher | $100.09 |
| Layer Diet | $104.66 |
| Swine G-F Diet | $96.34 |
| Beef Feedlot | $108.00 |

Source: Tilstra, Land O' Lakes

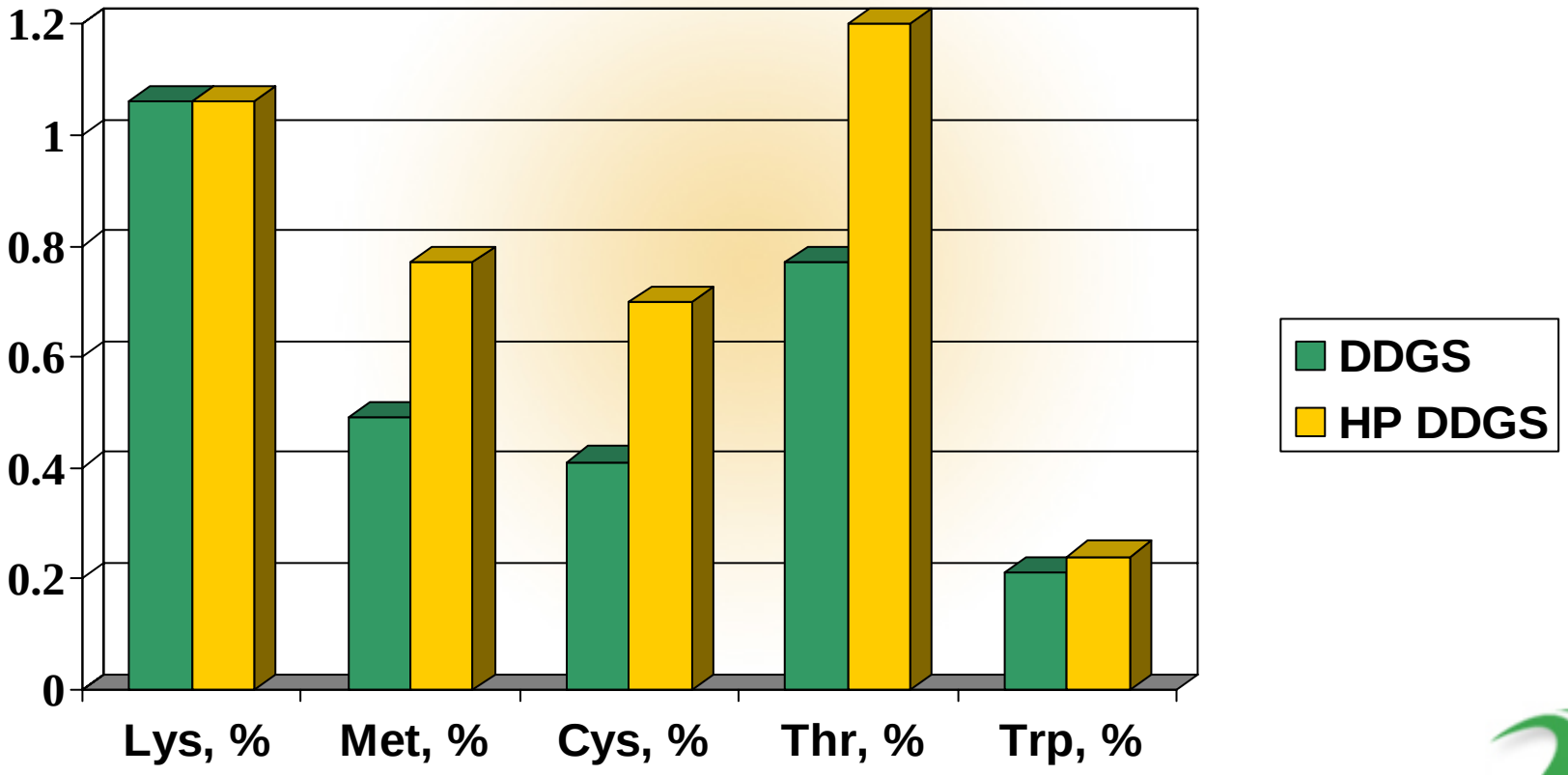
# New Distiller's Grains By-Products

- Examples of modified processes
  - Use of new enzyme technology to increase DDGS protein
  - Removal of bran and/or germ prior to fermentation
  - Removal of phosphorus

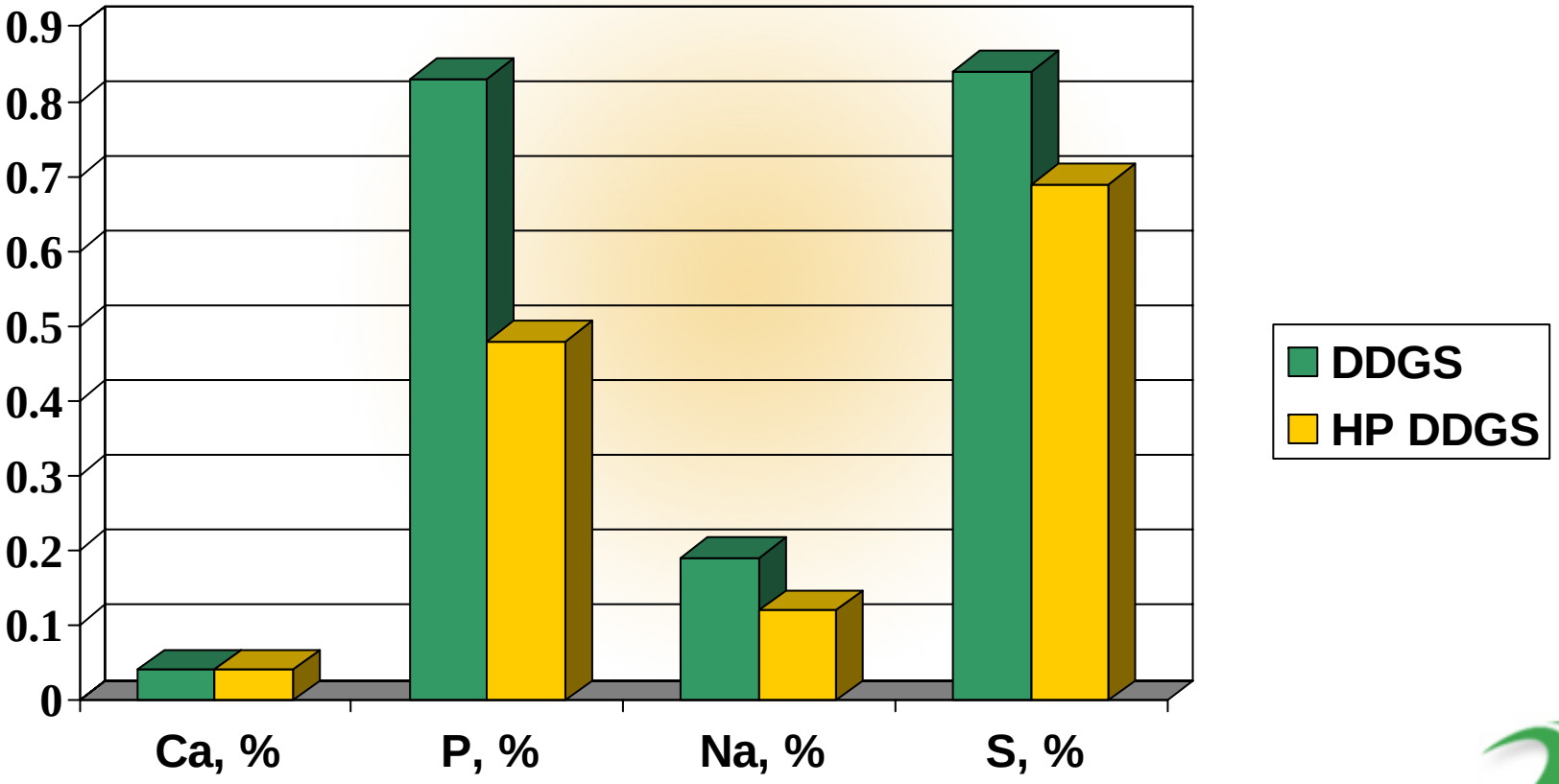
# Comparison of Nutrient Content of Dakota Gold DDGS with High Protein Dakota Gold (100% DM Basis)



# Comparison of Amino Acid Content of Dakota Gold DDGS with High Protein Dakota Gold (100% DM Basis)



# Comparison of Mineral Content of Dakota Gold DDGS with High Protein Dakota Gold (100% DM Basis)



# Opportunity Costs of Corn By-Products in Swine Diets

| | DDGS Nutrient Spec. 1 | DDGS Nutrient Spec. 2 | High Protein DDGS | Corn Protein Conc. |
|---|---|---|---|---|
| **Swine** | $80.00 | $78.00 | $51.00 | $61.60 |

# U of M DDGS Web Site
# www.ddgs.umn.edu

We have developed a DDGS web site featuring:

* nutrient profiles and photos of DDGS samples
* research summaries
    - swine, poultry, dairy, & beef
    - DDGS quality
* presentations given
* links to other DDGS related web sites
* international audiences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