Dry Distiller's Grains:
Process, Use and Impacts

Do I Know Any More About This Than You?

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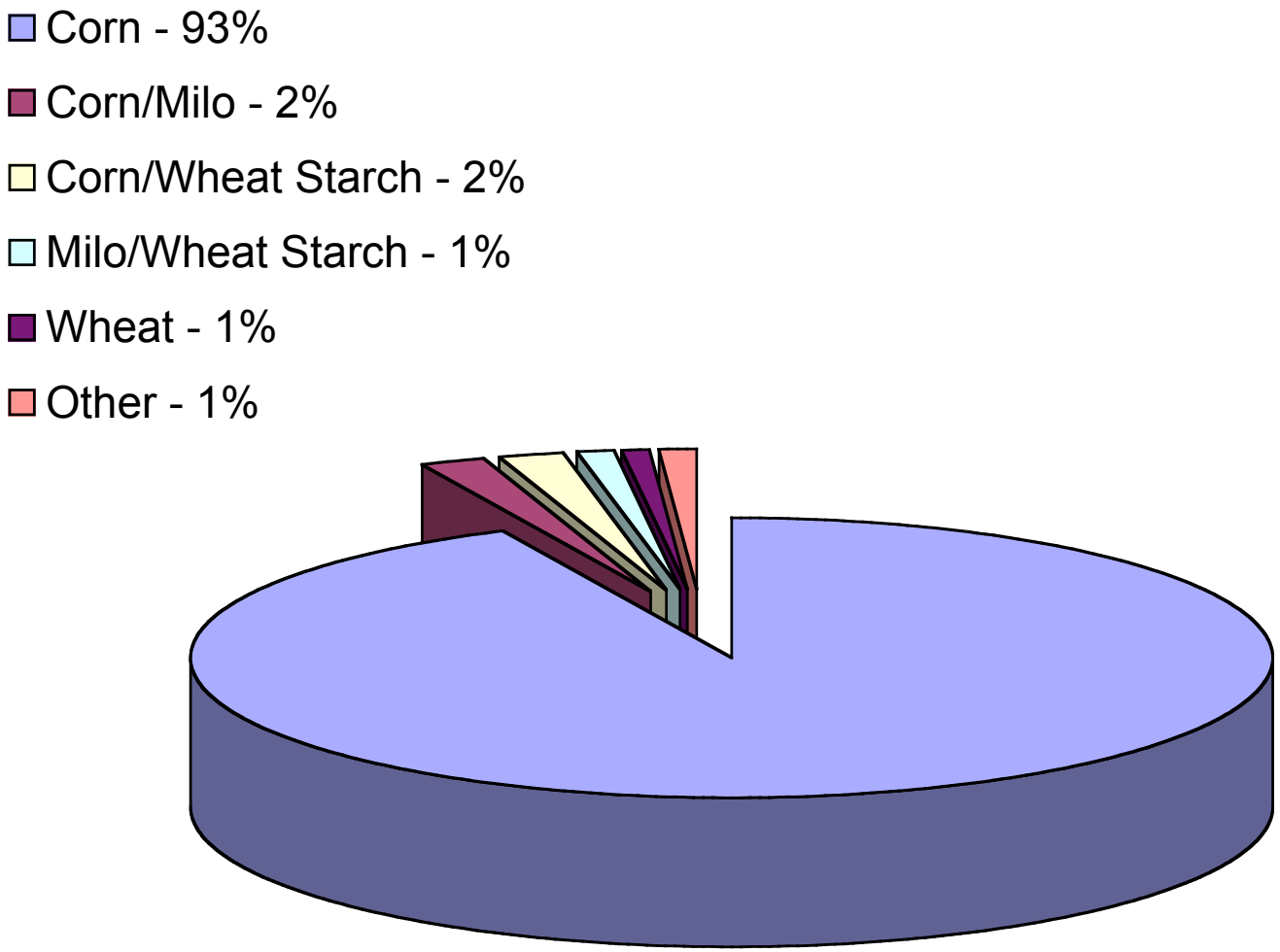
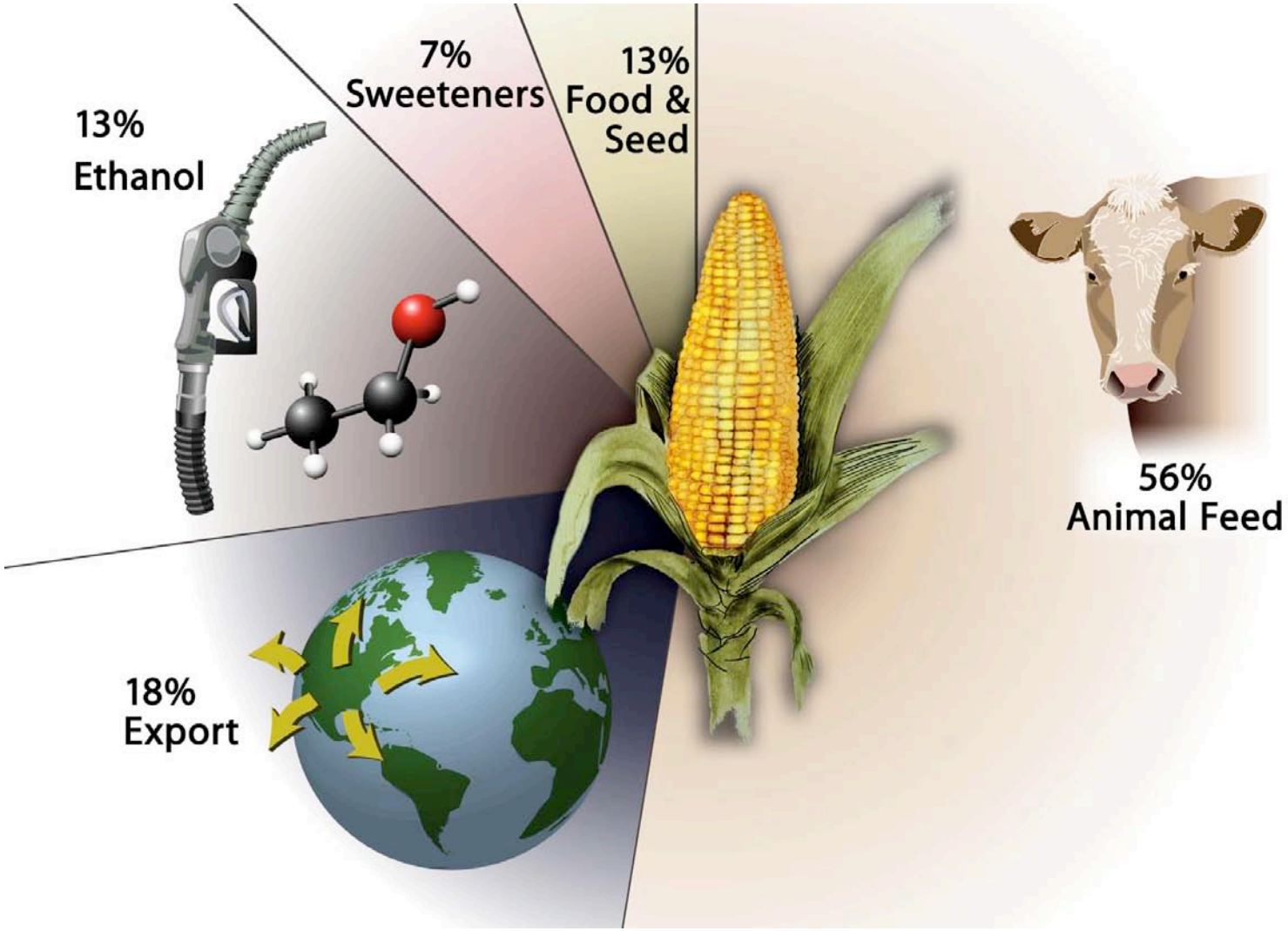
U.S. Fuel Ethanol Feedstocks



Source: **IBB International Media 2006**

U.S. Corn Utilization



Source: *Nicolle Rager Fuller, National Science Foundation, 2005*

Ethanol Plant Consumption/Production

(2.8 gal ethanol and 17 lbs DDGS per bu)

- 114 plants in operation = 5.6 billion gal.
  - 2.0 billion bushels of corn (about 20 % of our corn)
  - 34 billion pounds of DDGS
- 85 plants under construction = 6.2 billion gal.
  - 2.2 billion bushels of corn
  - 37.4 billion lbs of DDGS
- Combined 11.8 billion gal.
  - 4.2 billion bushels of corn (35-40 % of our corn)
  - 71.4 billion lbs of DDGS

Ethanol Production Technologies

- Dry-grind, Most Facilities
- Wet-milling
- New Emerging Technologies
  - Quick Germ
  - Quick Germ, Quick Fiber
  - Enzymatic Milling
  - Corn fiber to ethanol

Processing Methods or Technologies

- Conventional dry grind
- Modified dry grind
  - Recovers germ and pericarp fiber with a horizontal drum degerminator
- Quick germ quick fiber
  - Recovers germ and pericarp fiber by soaking corn in water for 6 to 12 hours with alpha-amylase
- Enzymatic Dry Grind (E-Mill)
  - Uses enzymes to recover additional endosperm fiber

Corn Dry-Grind Process

Corn grain

Size reduction (hammer-mill)

CO_2 to Dry Ice

CO_2

Liquefaction & Saccharification

(alpha-amylase and glucoamylase enzymes)

Fermentation

(Yeast-*Saccharomyces cerevisiae*)

Distillation & Dehydration

whole stillage

thin stillage

Centrifuge

Ethanol

Heat (Gas or Coal)

Evaporator

TS syrup

wet cake

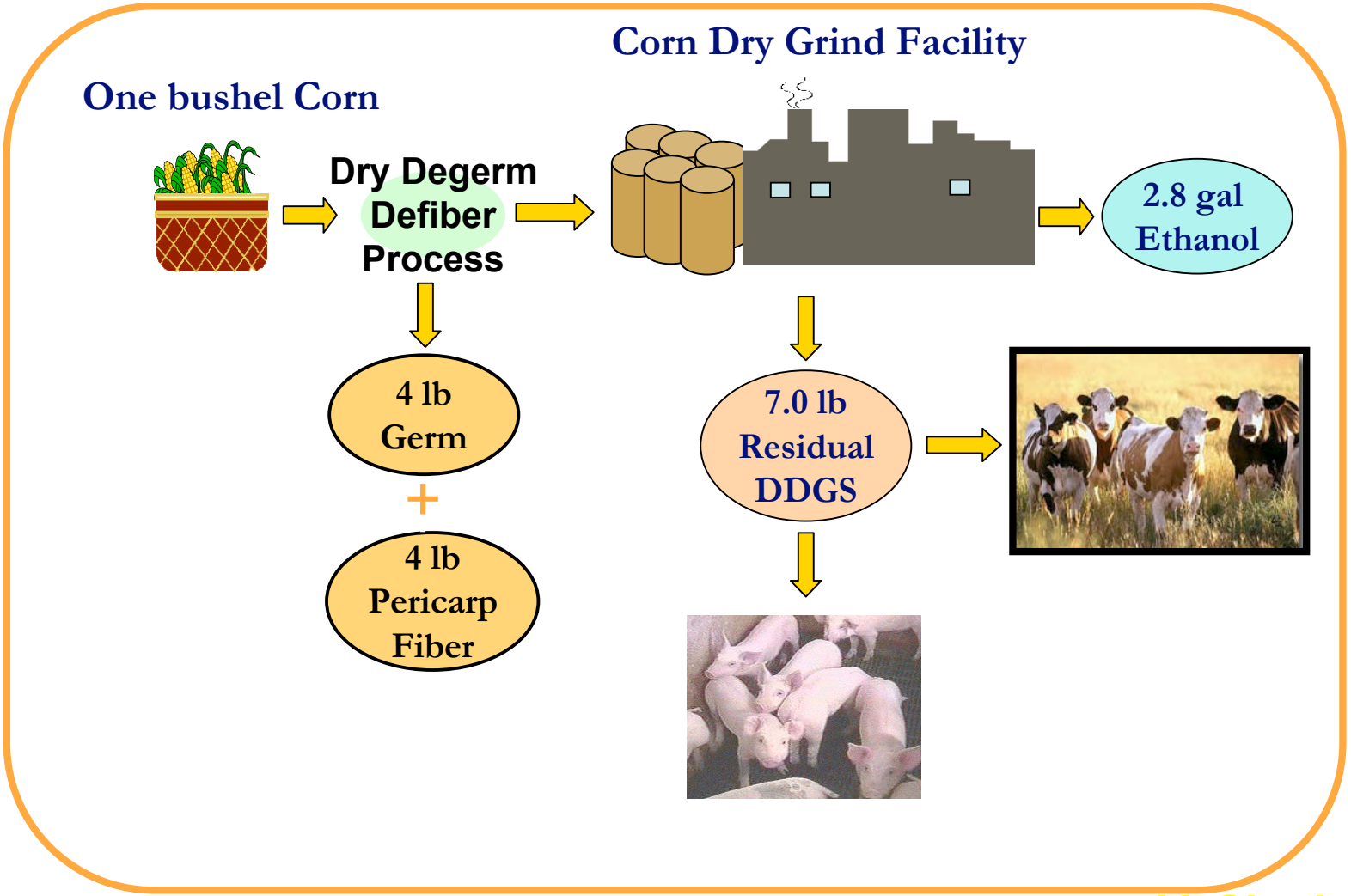
Dryer

Distillers Dried Grains with Solubles - DDGS

New Fractionation Processes Will Change DDGS Nutritional Value

- Degerming
  - Press the oil to human or Bio-diesel
  - Reduces oil and may reduce P
- Dehulling
  - Reduces fiber
- Seperation post-fermentation
  - Fiber and/or oil removed
- Syrup levels used and fractioning or recycling

Co-Products from Modified Dry Grind and Quick Germ Quick Fiber Processes



V. Singh, UIUC

Comparison of Conventional DDGS and Fractionated Products

	Conventional	Fractionated
Ethanol	2.8 gal	2.8 gal
DDGS	17 lb	7 lb
Germ	---	4 lb
Fiber/ hull	---	4 lb
Corn Oil	---	2 lb

Potential Uses for DDGS

- Land Fills
- Crop fertilizer - pelletized
- Further refinement
  - Pyrolysis
  - Gasification
  - Component fractionation
  - Industrial
- Co-fire in power plants
- Livestock Feed
  - Domestic
  - International

DDGS Feed Quality Issues

- Feed nutritionists have concerns about using DDGS for feed formulations due to its inconsistency in nutrient composition and overall quality.
- Studies have shown variability of product within batches in a plant and also from plant to plant.

How is DDGS Quality Defined?

- Color?
- Nutrient availability to livestock?
- End-use, different measures?
- Who should do this, the industry?
- ????????

Visual Variability of DDGS

Source: http://www.ddgs.umn.edu/profiles/album-us/index.htm

Nutritional Variability of DDGS

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

Data reported for samples from 32 DDGS sources (100% DM basis)

Source: **Dr. J. Shursonhttp://www.ddgs.umn.edu/ppt-swine/2006-Shurson-Quality characteristics (NGFA).pdf**

Potential US Livestock Use of DDGS

Finishing Cattle	18.25 billion lbs
Beef Cows	20.34 billion lbs
Dairy Cows	16.75 billion lbs
Heifers and calves	18.20 billion lbs
Cattle Total	73.54 billion lbs
Swine	17.58 billion lbs
Broilers & Turkeys	6.02 billion lbs
Grand Total	97.14 billion lbs

100% of the livestock category using DDGS at current recommended levels

Indiana Proposed Ethanol Plants

- Dry grind – possible fractionation
- Estimated 1.4-1.9M tons DDGS
- Typical inclusion rates
  - Beef & Dairy 20%
  - Swine 10%
  - Poultry 5%
- Maximum IN utilization:
  - 1.33M tons (70-90%)
- Realistic Utilization in Indiana
  - 0.60 M tons (30-50%)

Handling, Storage & Transportation

- Wet system: frequent delivery of wet DGs
  - Flat storage
  - Cost of transporting water
  - 3-7 day shelf-life
  - Ensiling (corn stover, silage, soyhulls, straw)

- DDGS
  - Bridging in bins and rail cars
  - Separation
  - Particle size ≤ 400 microns
  - Pellets (limited to 5-7% inclusion rate)

Animal Performance, DDGS Quality & Nutrient Management

- Historical use has been WDG by beef feedlots (proj. 25-30% of by-product)
- Excess N, P and S
  - Amino acid imbalance
  - Environmental implications
- Limited data across species
  - ADG, G/F, reproductive impacts, longevity
  - Fiber digestibility, milk quality,
  - Carcass composition, marbling, FA profile

Potential DDGS Use in Beef

- Beef industry prefers dry product
- Research is clear concerning the utilization of DDGS in feedlot diets
  - Max. of 40% DM intake, 15-20% may increase performance
  - > than 25% may decrease marbling
- Excess N, P and S
  - Atmospheric emissions
  - Increased land base for P
  - Must add Ca to diet

DDGS Inclusion Rate Impacts on 1000 Head of Feedlot Steers

% DDGS	0	15	25	40
% Crude Protein	12.6	12.6	14.6	17.8
% P	0.35	0.42	0.47	0.55
N excret/an	60	60	72	89
P excret/an	10	12	14	17
Acres needed for P	769	923	1077	1308

Dairy Cattle Feeding Guidelines

- Young Calves: up to 50% of the grain mix
- Older calves: could be greater than 50%
- Max. of 20% DMI in Lactation Rations
- Check particle size of final ration to ensure adequate effective fiber
- Balance for RUP and RDP
- Determine Fat, P, and mycotoxin levels of purchased distillers products

Potential Issues for Ruminates

- Storage
- Transportation
- Upper limits for cow and creep diets
- Reproductive efficiencies
- Variability of product
- P and S content
- N and P Excretion
- Fat level
- Effective fiber
- Long term issues

Ensiling/Storage of DDGS

- Many small producers
  - Can't utilize semi-load lots of product
  - Need a longer term storage method
- 100% wet product
  - Will bust ag bag seams
    - Need a "diluter" for density and N (CP)
- Potential "diluters"
  - Corn silage, corn stalks, straw, soyhulls, hay

Swine and Poultry Nutrient Excretion Issues with DDGS

- N excretion increases 15-200+%
  - Ammonia emissions?
- P may be managed by decreased MCP/DCP
- Increased DM Excretion/Increased solids? Increased Sludge?
- Crust formation? Flies? Ammonia?

Feeding DDGS to Poultry

Dry Product Only

- Broilers: 5-7.5% typical, 10% max.
- Layers: 10% could be used, 15% in non-peak production
- Turkeys: 5-15% inclusion rates
- Sodium content a big concern

Swine Feeding Issues

- Reproductive performance (sows and boars)?
  - Any effects on sow longevity?
  - Effects on fatty acid composition of milk?
  - Feeding level during high energy demands of lactation and Paylean feeding?

Recent Research With Pigs

- Hastad et al., 2005 (grower pigs)
  - Palatability Study
  - 30% DDGS vs Corn-soy
  - Corn and sorghum DDGS resulted in decreased feed consumption
  - Drying process did not impact the reduced feed intake of DDGS

Recent Research

- Decreased carcass yield may decrease DDGS value in swine
  - For each 10% inclusion in the diet carcass yield went down 0.6%
  - That is 1.6 lb of lost carcass wt. at 10% inclusion
  - $1.05/pig lost income at 10% inclusion
  - At 10% inclusion 1 ton of DDGS could be fed to 33 pigs for all of grow-finish = $34.65/ton lower value of DDGS to swine

Swine Feeding Issues

- Ingredient shifts
  - Oil in DDGS displaces animal fat
  - Less need for inorganic P and/or less phytate P available for phytase activity?
- Fiber content and energy availability from fiber

DDGS and Pork Quality

- Processing/Handling issues
  - Fat firmness
  - Shelf life
  - Export marketing: decrease in marbling score
  - Increased problems with processed products
- Potential health issues
  - Fatty acid composition

DDGS Impact on Bacon Quality

0% DDGS

20% DDGS

10% DDGS

30% DDGS

DDGS Impact on Brat Quality

100 % Corn for last 14 days

100 % DDGS for last 14 days


110
NO SEPARATION


104
SEPARATION

Use of DDGS in Swine Diets
(Dry Product Only)

- Brian Richert's Recommendations

	0% DDGS	5% DDGS	10% DDGS	20% DDGS	40% DDGS
Gestation				XX	
Lactation	XX				
Nursery		XX	XX		
Grower				XX	
Finishing	XX	XX	XX		

Overall Issues with DDGS

- Product Variation
- Handling, Storage, Transportation
- Effect on Animal Performance
- Effect on Product Quality
- Effect on Nutrient Management
- Antibiotic contamination
- Producer Education
- Food vs. Fuel National Policy

Proper Production/Utilization

- Increase value of co-products
  - Mitigate negative environmental effects
  - Separate phosphorus, fat, protein, fiber
- Potentially make livestock industry
  - More competitive
  - More attractive

College of Agriculture – DDGS Rapid Response Team

- COA Agricultural Research Programs ($100k)
- COA Cooperative Extension Service ($100k)
- Animal Sciences ($50k)
- Agricultural & Biological Engineering ($50k)
- Agricultural Economics ($50k)
- Agronomy ($50k)

- In partnership with Indiana stakeholders:
  - Indiana State Department of Agriculture ($200k)
  - Indiana Soybean Association ($200k)

Project Objectives

- Processing, Handling, Storage and Digestibility of DDGS
- Animal Performance and Product Quality
- Environmental Impact of DDGS Ration Inclusion

➔ Phase I: next 9-12 months

➔ Phase II: 9 months & beyond

Final Thoughts

- Infrastructure does not exist in Indiana
  - Handling, storing, distribution
- Cost of livestock production could increase
  - By-products shipped out of state
  - Rising corn price
  - Diverting soybean acres to corn
- Opportunities for alternative processing or fractionation

Questions?