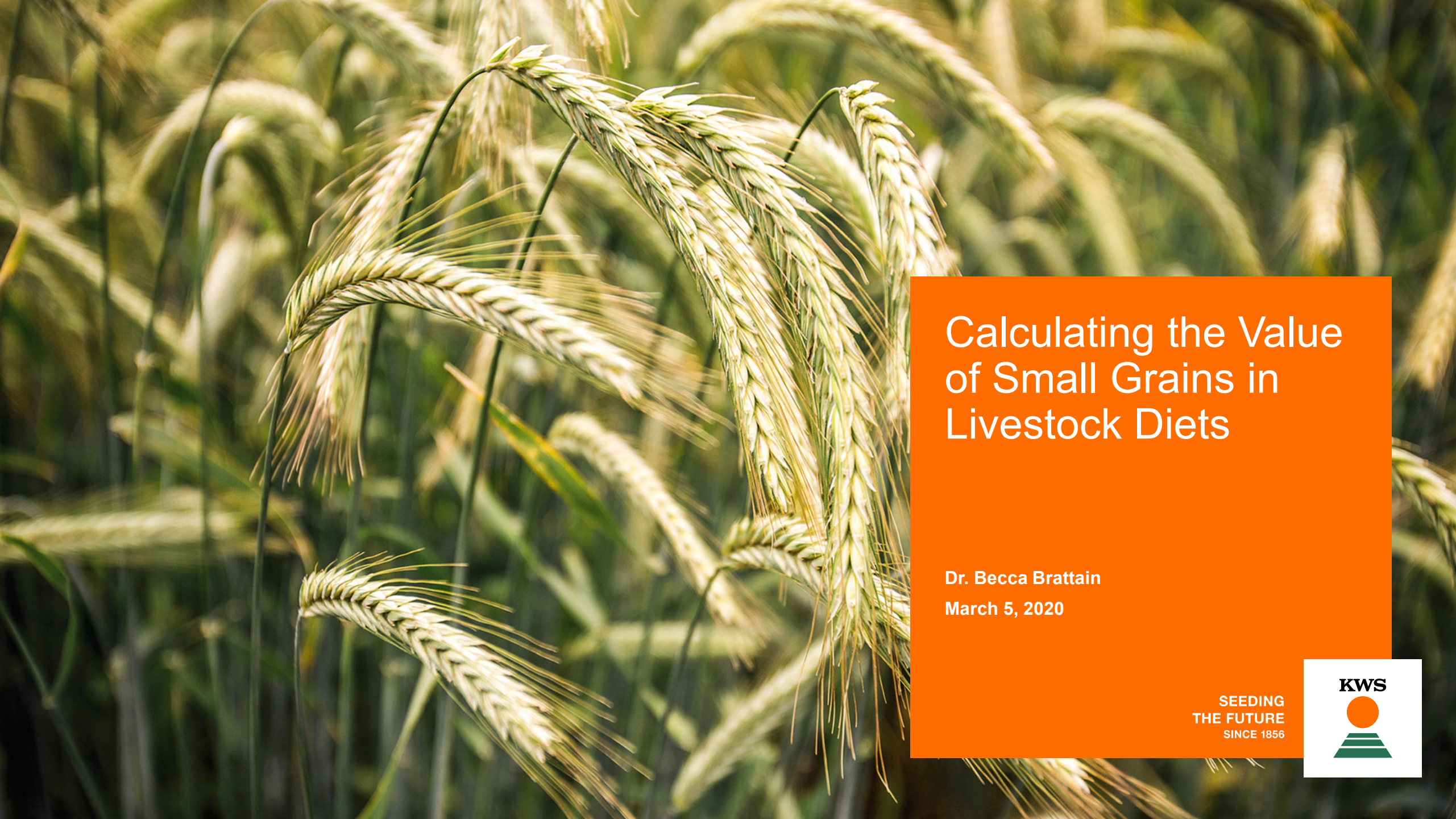

Calculating the Value of Small Grains in Livestock Diets

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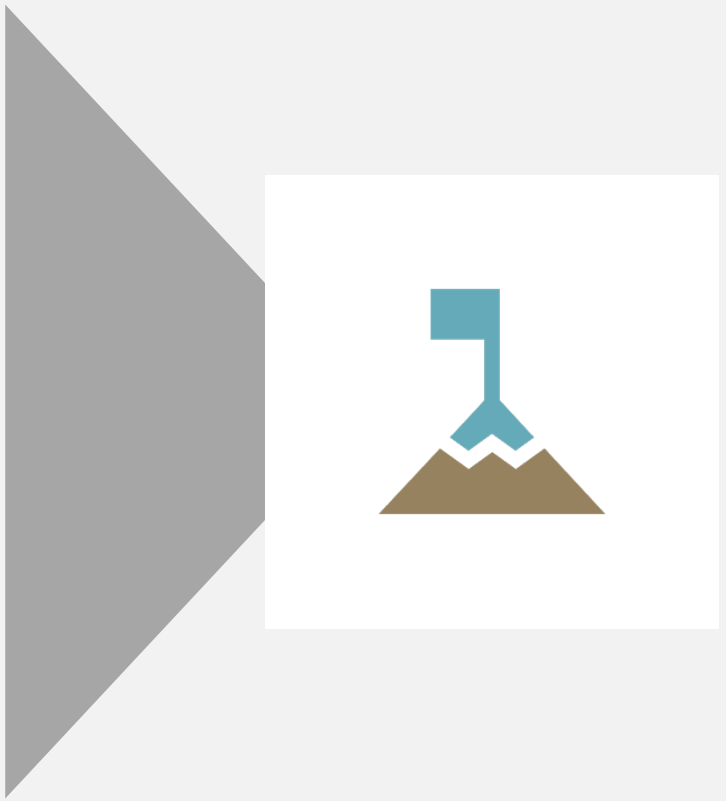
Outline

A	Introduction
B	Evaluating Feed Ingredients
C	Small grains for the integrated farmer
D	Added value of small grain utilization
E	Conclusions



Introduction

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Introduction

- ***Cost*** – the leading consideration in selecting feed ingredients
- ***Required Nutrients*** – from maintenance, growth, reproduction
- ***Nutritional Value*** – allows cost comparison

Objective of swine nutrition

"Provide each nutrient in both quantity and form that will precisely meet the pig's requirements for growth, reproduction, milk production, and if necessary, maintenance, at the least possible cost."

-Dr. Robert Easter

Introduction

- ***Essential Nutrients***
  1) *Carbohydrates*
  2) *Protein*
  3) *Fat*
  4) Vitamins
  5) Minerals
  6) Water

Energy Yielding Nutrients:

Carbohydrates, fats, and protein are referred to a the 3 energy yielding nutrients. With *carbohydrates* being the major source of energy in cereal grains.

Protein and Amino Acids:

Crude protein is important for formulating ruminant diets but understanding amino acid concentration is critical for formulating swine diets

Introduction

- ***Corn and Soy*** have been industry standards for energy and protein
- ***Small grains*** such as wheat, hybrid rye, conventional rye, barley, and oats can also serve as energy sources
- ***Price*** can vary based on seasonal variability and markets
- ***Cost effectiveness and nutritional value*** should be determined for all potential feed ingredients

Evaluating Feed Ingredients

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Evaluating Feed Ingredients

1. ***Supply*** – availability of a specific commodity
   - Purchasing or growing – when and how much is available
   - Don't forget to factor in logistics, handling, processing, etc.

2. ***Physical Characteristics*** – moisture, flow, particle size, storage life
   - Small grains typically have different moisture/storage requirements
   - Ensure augers and grinders are capable of handle small grains
   - Proper storage is always essential to maintain quality and decrease risk of mold and spoilage

Evaluating Feed Ingredients

3. ***Nutrient Composition*** – critical for determining value of a small grain
   - Feed analysis should be attained whenever possible
     - Buying or growing – it is important to know the exact composition of your ingredient!
     - Don't forget to test for molds, mycotoxins, etc. – these can limit inclusion levels
   - Energy, Crude Protein (CP) for cattle, Amino Acid content for swine, fiber, mineral levels
   - Feedstuffs are usually classified as *Energy, Protein, or Roughage* based on nutrient values
     - Some feedstuffs may fit into more than one category!
     - Small grains are typically considered *Energy Sources*

Evaluating Feed Ingredients

4. ***Cost*** – Cheap does not always mean good value!
   - The amount of nutrients supplied by the replacement feed
     - Challenging as most feed ingredients cannot be directly compared!
   - Should include factors like:
     - Transportation, processing, storage
   - Nutrient contribution should then be compared to *palatability* (typically not an issue with small grains), *digestibility, and cost!*
   - Know the difference in value between food and feed grain
     - Milling and distilling markets for human consumption typically take the highest quality and pay the highest price
     - Food grain prices rarely fit into livestock markets – but be aware of what quality you might be giving up with lower priced grains

Evaluating Feed Ingredients

5. ***Relative Value*** – Price per quantity of nutrient delivered
   - The nutritional makeup determines a feedstuff actual value
   - Compares the value of a feed ingredient to the price of the industry standard
     - In this case *Corn*
   - Reflects the value of a new ingredient as it relates to the most expensive nutrients in a diet
     - Protein and Energy
6. ***Limitations and Restrictions***
   - Digestibility – how available is the nutrient for the cow or pig
   - Palatability – will they consume it
   - Inclusion rate – can vary based on above factors
     - Effects on animal health and carcass quality

Evaluating Feed Ingredients

- ***Corn*** – the gold standard for energy feed
  - Advantages:
    - Excellent energy source for swine, cattle finishing, and dairy diets
    - High energy due to high starch content
    - Starch is rapidly digestible for both hogs and cattle
    - Highly palatable
  - Limitations:
    - Low CP – 7-9% and low lysine
    - Cattle: rapid digestibility, high inclusion levels, and excessive processing can result in acidosis issues
    - Minimal fiber components

Evaluating Feed Ingredients

- ***Wheat***
  - Advantages:
    - Similar energy source to corn for swine
    - Greater energy source than corn for ruminants
    - Similar to corn in digestibility, palatability, and amino acid availability for swine
    - Greater crude protein value than corn for ruminants
    - Highly palatable

Evaluating Feed Ingredients

- ***Wheat***
  - Limitations:
    - Dusty and less palatable in too finely ground
    - Rapid digestibility can result in even greater instances of acidosis in cattle if not properly managed
    - Typically grown for human consumption
      - Substantially higher priced than corn
      - Availability and logistics can = even higher prices

Evaluating Feed Ingredients

- ***Conventional Rye***
  - Advantages:
    - Good energy source – about 94% the energy as corn for swine and ruminants
    - Similar amino acid availability for swine
    - Higher content of fiber
      - May promote gut health in swine
      - May minimize risks of acidosis in ruminants
    - Greater crude protein value than corn for ruminants

Evaluating Feed Ingredients

- ***Conventional Rye***
  - Limitations:
    - Highly susceptible to ergot
      - Ergot decreases palatability, decreases potential inclusion level, and can severely decrease performance and intake of animals
      - Sow diets must be virtually free of ergot
      - Should always be tested for ergot prior to use in livestock diets!
    - Minimal acreage grown and primarily goes to cover crop market and for human milling and distilling
      - Can be very high priced compared to corn
    - Fine grinding can result in dusty, unpalatable diets

Evaluating Feed Ingredients

- ***Hybrid Rye***
  - Advantages:
    - Good energy source – about 94% the energy as corn for swine and ruminants
    - Similar amino acid availability for swine
    - Higher content of fiber
      - May promote gut health in swine
      - May minimize risks of acidosis in ruminants
    - Greater crude protein value than corn for ruminants
    - Minimal risk for ergot contamination
    - Highly palatable

Evaluating Feed Ingredients

- ***Hybrid Rye***
  - Limitations:
    - Minimal acreage grown and primarily goes to human milling and distilling markets
      - Can be very high priced compared to corn
      - Some distilling markets will pay a premium for hybrid rye
    - Fine grinding can result in dusty, unpalatable diets
    - Poor management can still result in some risk for ergot contamination
      - Should always be tested for ergot prior to use in livestock diets!

Evaluating Feed Ingredients

- ***Barley***
  - Advantages:
    - Good energy source – about 90% the energy of corn
      - Even though lower energy hogs typically compensate by consuming more
    - High fiber
    - Similar to corn in amino acid availability for swine
    - Greater crude protein value than corn for ruminants
    - Similar energy value to corn for ruminants

Evaluating Feed Ingredients

- ***Barley***
  - Limitations:
    - Minimal acreage grown and primarily goes to human milling and distilling markets
    - Large variability between types and varieties of barley and can result in notable differences in animal performance
      - Test weight can also vary drastically between varieties and due to growing conditions
    - Lower digestibility than corn

Evaluating Feed Ingredients

- ***Oats***
  - Advantages:
    - Highly palatable in both swine and ruminant diets
    - High fiber
      - Can be beneficial in gestating sow diets – gut fill and to combat constipation issues
      - Can be included to help with incidence of diarrhea in weaned or small feeder pigs
      - Lower potential for bloat or acidosis in cattle
    - Greater crude protein than corn for ruminants

Evaluating Feed Ingredients

- ***Oats***
  - Limitations:
    - Lowest energy source of small grains <90% corn
    - Lower digestibility for swine and ruminants
    - Minimal production and increased demand for oats in human milling and for horse feed
      - Low production and high cost often limit their use in livestock diets
      - Often too expensive for livestock diets

Evaluating Feed Ingredients

Protein and Energy Value of Small Grains for Ruminants (NRC, 2001)

Grain	Crude Protein, %	Net Energy-gain (Mcal/cwt)
Corn	9	64
Wheat	14	65
Rye	12	59
Barley	12	61
Oats	13	52

Evaluating Feed Ingredients

- ***Calculating*** the per bushel energy value of a small grain relative to corn
  - Corn NEg = 64
  - Wheat NEg = 65
  - Bushel of corn = 56 lbs
  - Bushel of wheat = 60 lbs
  - Corn = $3.75/bu…. What should we pay for wheat/bu?

$3.75/bu ÷ 56lbs/bu = $0.067/lb

(65 ÷ 64) x 100 = 101.6% more energy in wheat than corn

$0.067 x 1.016 = $0.068/lb

$0.067/lb x 60lbs/bu = **$4.08/bu for wheat**

Evaluating Feed Ingredients

Equivalent Value of Corn Grain and Small Grains for Ruminants

Grain	Bushel weight (lbs)	Energy price ($/bu)	Protein price ($/bu)
Corn = $3.75/bu			
Wheat	60	$4.08	$6.25
Rye	56	$3.46	$5.00
Barley	48	$3.07	$4.29
Oats	32	$1.74	$3.10

Evaluating Feed Ingredients

Energy Value and Lysine Content of Small Grains for Swine

Grain	Lysine, %	DE (kcal/kg)
Corn	0.29	3961
Wheat	0.37	3820
Rye	0.43	3716
Barley	0.46	3427
Oats	0.45	3112

Evaluating Feed Ingredients

Equivalent Value of Corn Grain and Small Grains for Swine

Grain	Bushel weight (lbs)	Energy price ($/bu)	Protein price ($/bu)
Corn = $3.75/bu			
Wheat	60	$3.88	$5.13
Rye	56	$3.52	$5.56
Barley	48	$2.78	$5.10
Oats	32	$1.68	$3.33

Evaluating Feed Ingredients

- ***Summary*** – Evaluating Feed Ingredients as a Commodity
  - Small grains used as an energy source should be competitively priced to corn
  - Remember they also contribute protein and amino acids to the diet
  - Consider using a least cost diet formulation software
  - Don’t forget other factors including:
    - Supply, logistics, grinding and processing requirements, etc.
  - Purchasing small grains as a commodity is different than growing them for your own feeding system!
    - Lets talk about the ***integrated*** row crop and livestock farmer!

Small Grains for the Integrated Farmer

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Small Grains for the Integrated Farmer

Production Budget Model per Unit of Energy Produced for Cattle

	Corn (University of Illinois, 2019)	Wheat (University of Illinois, 2019)	Hybrid Rye (KWS, 2019)	Oats (PFI, 2017)
Yield, bu/acre	180	85	100	80
Seed	$116.00	$50.00	$55.00	$36.00
Fertilizer	$125.00	$76.00	$65.00	$25.00
Pesticides/Herbicide/Fungicide	$75.00	$27.00	$25.00	$5.00
Drying	$40.00	$0.00	$0.00	$0.00
Crop Insurance	$22.00	$9.00	$7.00	$7.00
Total Direct Costs/acre	**$378.00**	**$162.00**	**$152.00**	**$73.00**
NE (Mcal/acre)	6,451.2	3,315	3,304	1,331.2
Cost/Mcal of Energy	**$0.059**	**$0.049**	**$0.046**	**$0.055**

Small Grains for the Integrated Farmer

Production Budget Model per Unit of Energy Produced for Swine

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Crop Insurance	$22.00	$9.00	$7.00	$7.00
Total Direct Costs/acre	**$378.00**	**$162.00**	**$152.00**	**$73.00**
DE (Mcal/acre)	18,110	8,837	9,439	3,614
Cost/Mcal of Energy	**$0.021**	**$0.018**	**$0.016**	**$0.020**

Small Grains for the Integrated Farmer

- Crop Diversity
  - Diversified rot
  - Improved soil health
  - Winter cover crop opportunity – N fixing legume
- Additional Straw or Organic Matter from small grain
- Labor and Resource management
  - Summer manure application
- Market Flexibility

Added Value of Small Grain Utilization

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Added Value of Small Grain Utilization

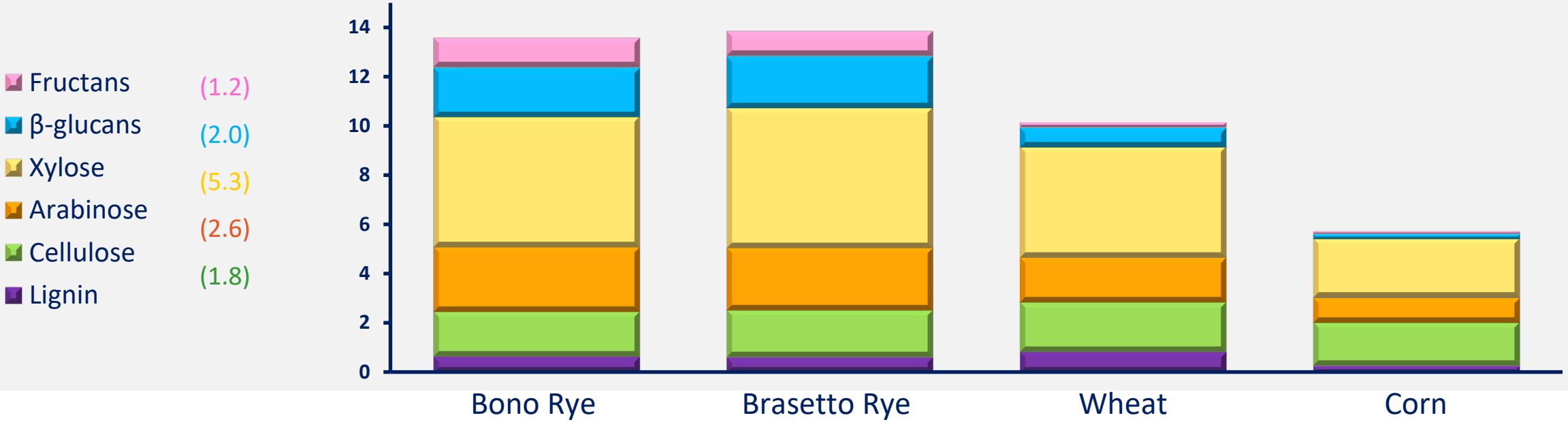
Swine Health

Fiber and Gut Function

Satiety and Behavior

Added Value of Small Grain Utilization

- High in soluble fibers including arabinoxylans and fructans
  - Increased Butyrate production
- Improved gut health and mucosa
  - Decreased salmonella prevalence
  - Reduced antibiotic usage



Added Value of Small Grain Utilization

- Increased fiber = increased satiety
  - Digesta mass and slower passage rate
- More continuous levels of glucose and insulin
- Aggression, tail biting, belly rooting
- Group housing – Sows

Conclusions

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Conclusions

- Wheat, rye, barley, and oats all offer a favorable nutritional profile and can be incorporated into livestock diets as an alternative for corn
- The economic value of small grains looks different depending on your market system
  - Commodity prices need to be competitive with corn
  - Integrated farmer can see huge benefit from using small grains
- Cost of production and yield make small grains an attractive feed stuff for livestock producers
- The nutritional profile of small grains make them unique to corn and added value from these small grains may also be noted!

Questions?

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