Barley and Gut Health (in Pigs)

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& 24th BMBRI Triennial Meeting

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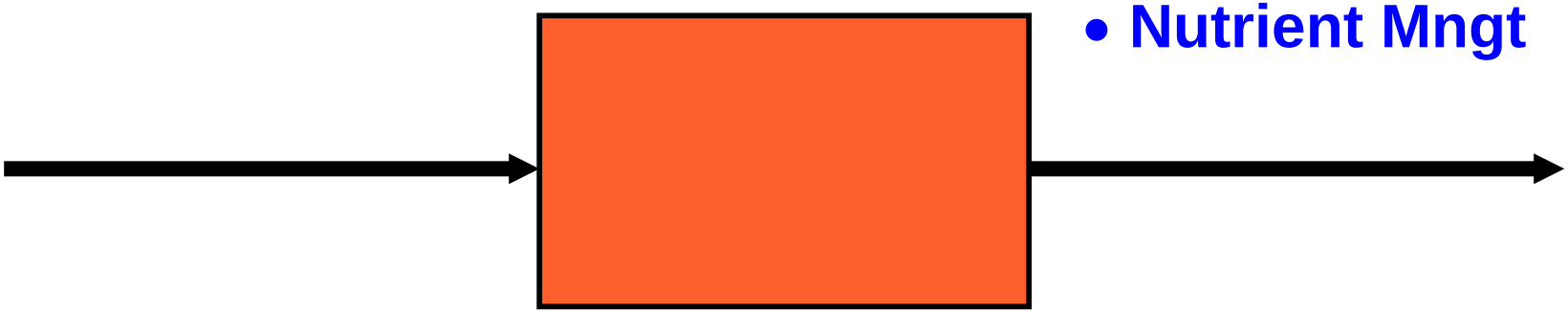
Importance of Feedstuff Quality

Input

- Ingredients
- Intake

Output

- Carcass Wt & Q
- Meat Q
- Nutrient Mngt



Pig

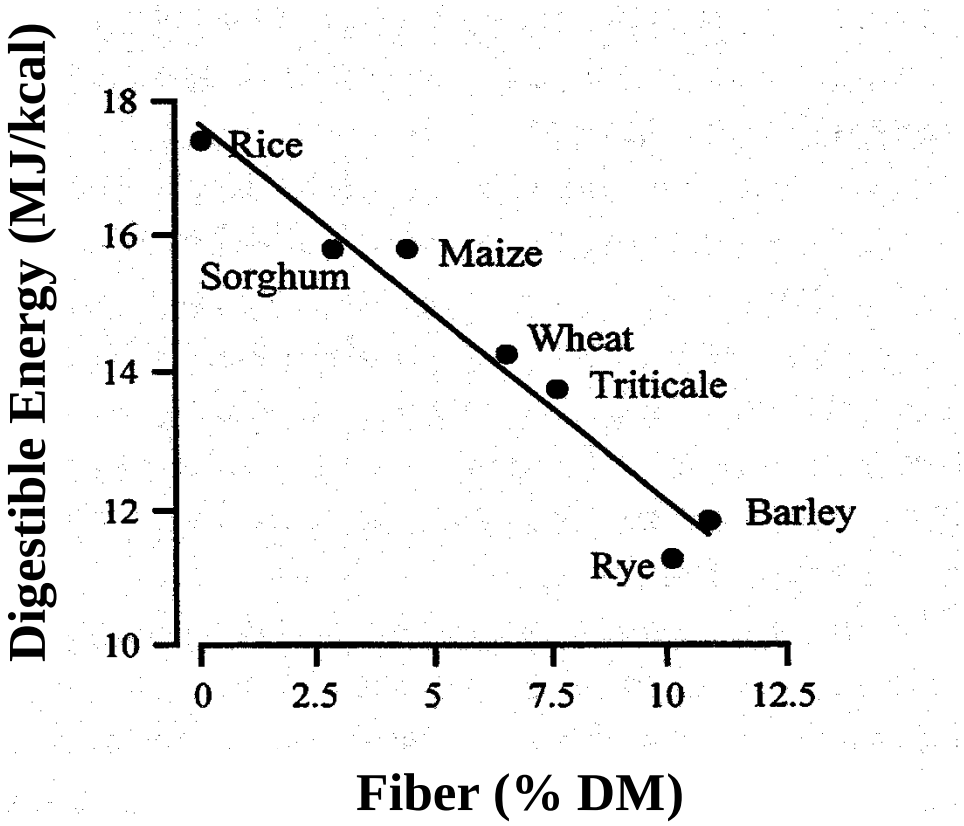
- Growth (predictable)
- Animal Health
- Welfare

Myths

- **Barley**
  - Is too low in energy for young pigs
  - Does not have purpose in diets for young pigs

- **Young pigs**
  - Must be fed high energy diets
  - Cannot handle fiber

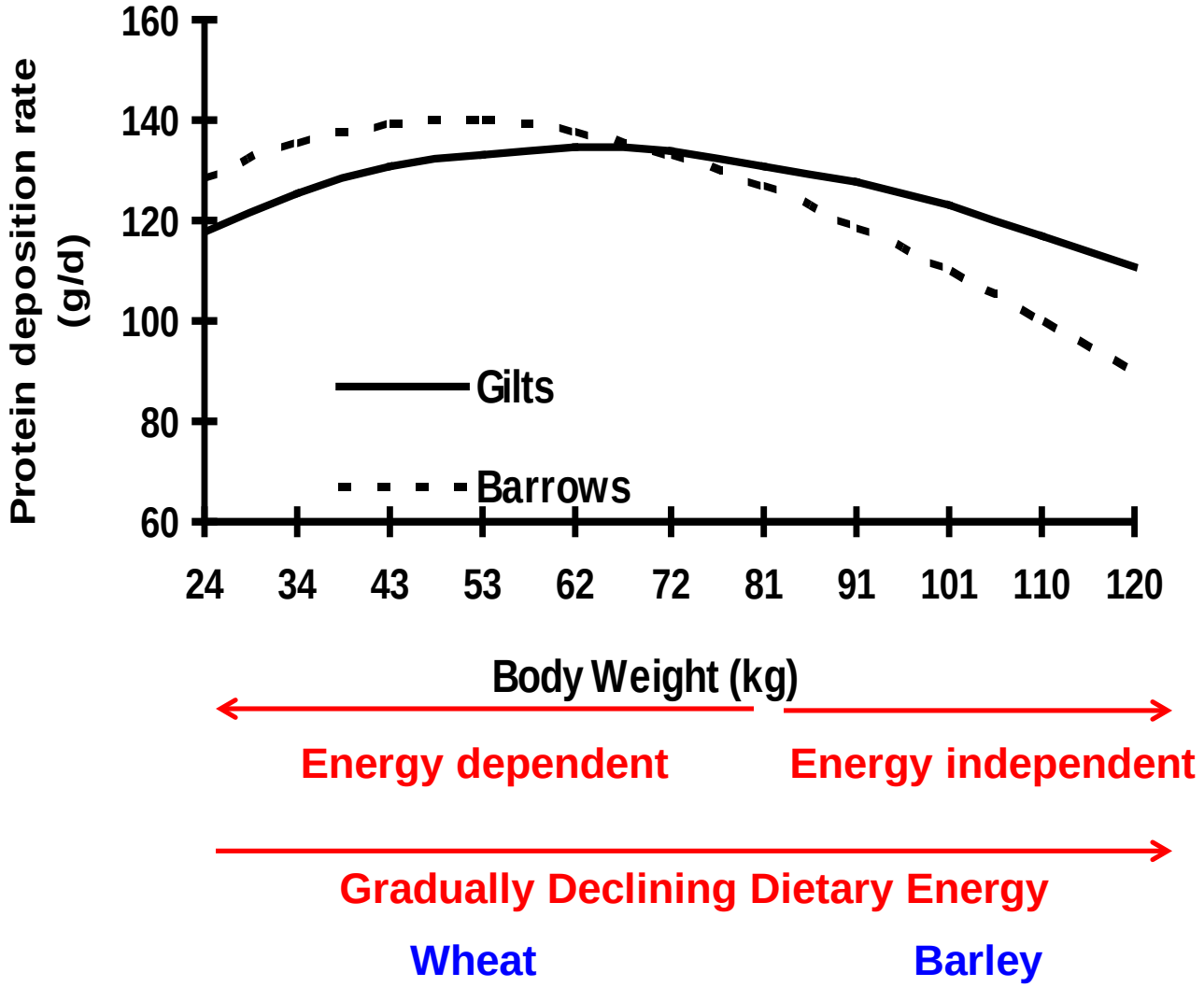
Energy Value of Grains



Increased fiber is associated with lower available energy among cereal grains

Barley contains most fiber among feed grains that are fed to swine

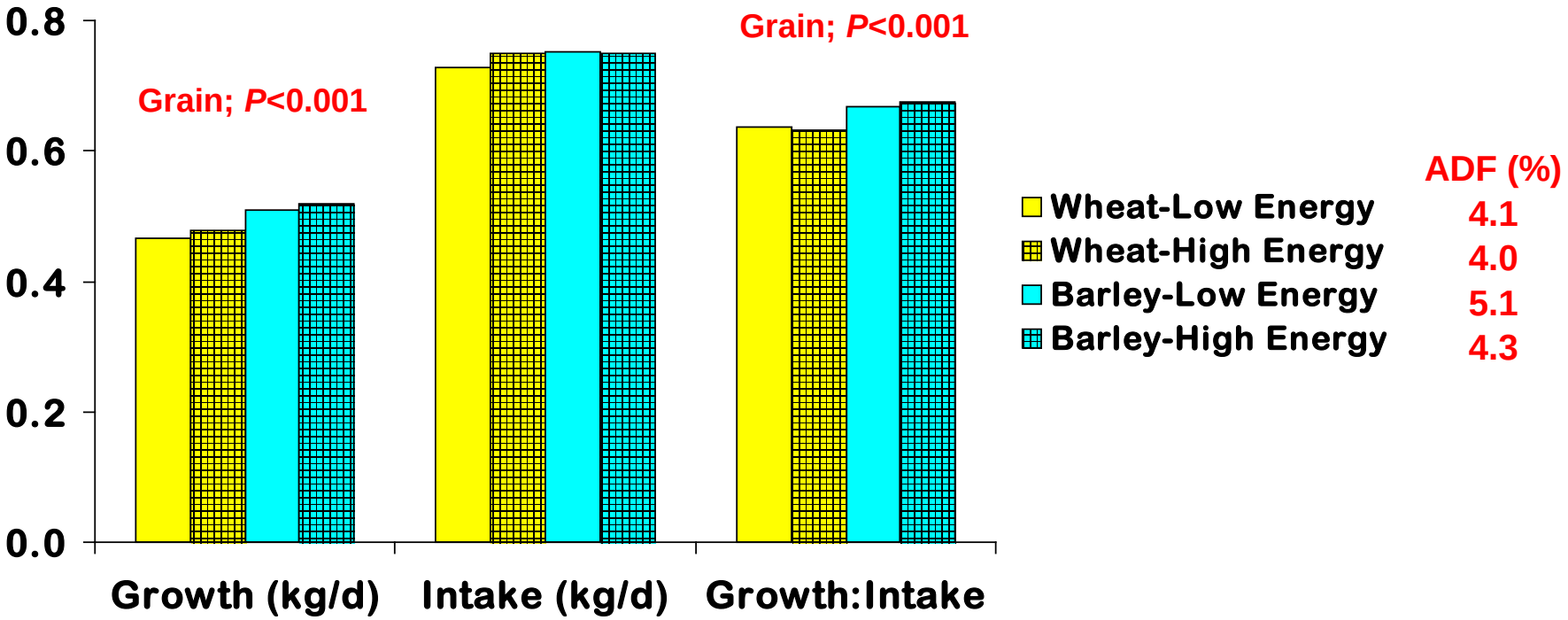
Approach to Support Growth



In young pigs, energy intake drives growth

Young Pigs

Wheat and barley



(Zhou et al., 2016)

No impact of reduced nutrient density: 9.63 or 10.0 MJ NE/kg (Δ~150 kcal NE/kg)

Barley increased growth: why?

Questions: lean growth & gut health (prebiotic)

Pig Production: Reducing Antibiotic Use

Featured Articles

Controlling Antimicrobial Resistance in Swine Production Systems

08 October 2013

Is the United States Ready for New Rules on Antibiotics?

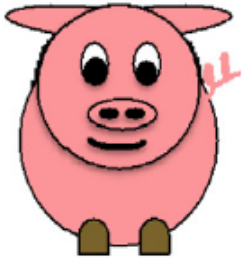
20 September 2016

Antimicrobial use on farms is about to change for animals across the US, writes Rachel Lane.

Beginning in January 2017, revised Veterinary Feed Directive regulations by the US's Food and Drug Administration (FDA) will reduce use of antimicrobials in animals. Specifically, the new rules will make it illegal to use any antimicrobial drug that is medically important to humans for growth or to improve feed efficiency in animals. Use of these drugs to treat, control or prevent diseases in animals will need veterinarian oversight.

The role of gut microbiota in the health and disease of pigs

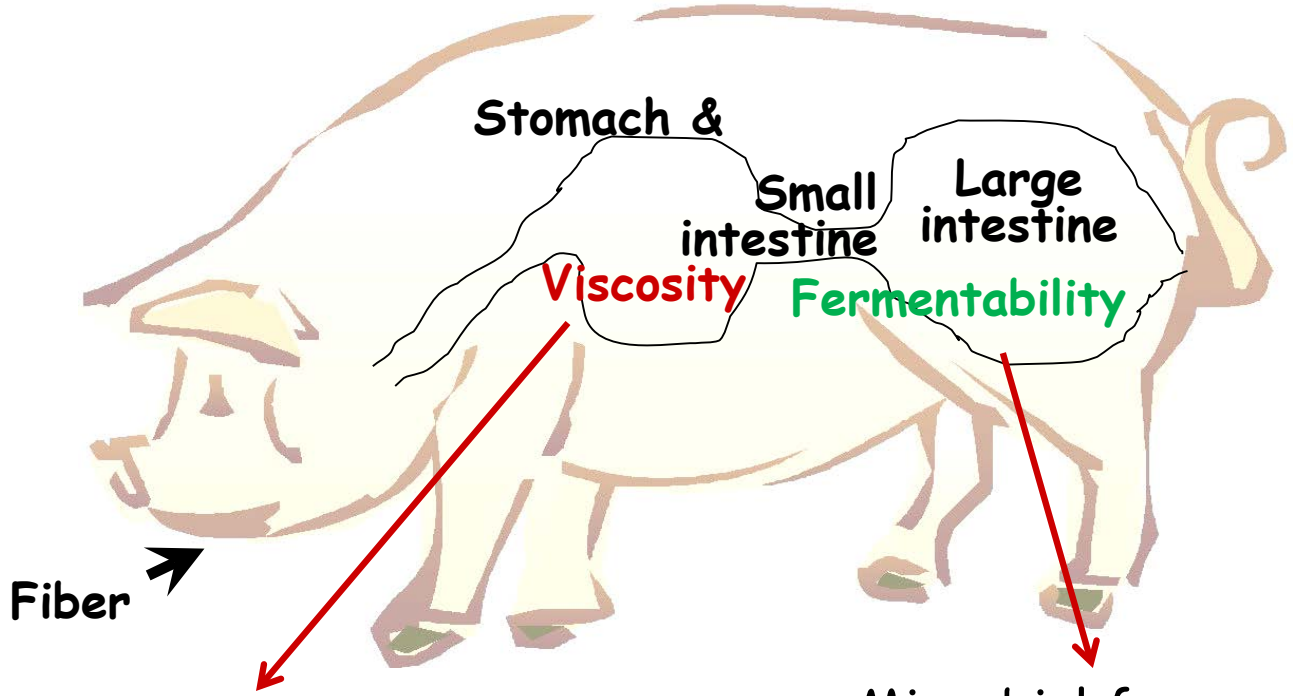
J.M. Fouhse, R.T. Zijlstra, and B.P. Willing
Department of Agriculture, Food, and Nutritional Science, University of Alberta, Edmonton AB T6G 2P5, Canada



Can barley play a role as prebiotic?

Fiber and Starch Properties

Functional properties of Fiber (viscosity & fermentability) important for Fiber effects in the gut (Dikeman and Fahey, 2006)



Nutrient digestion and hormones kinetics

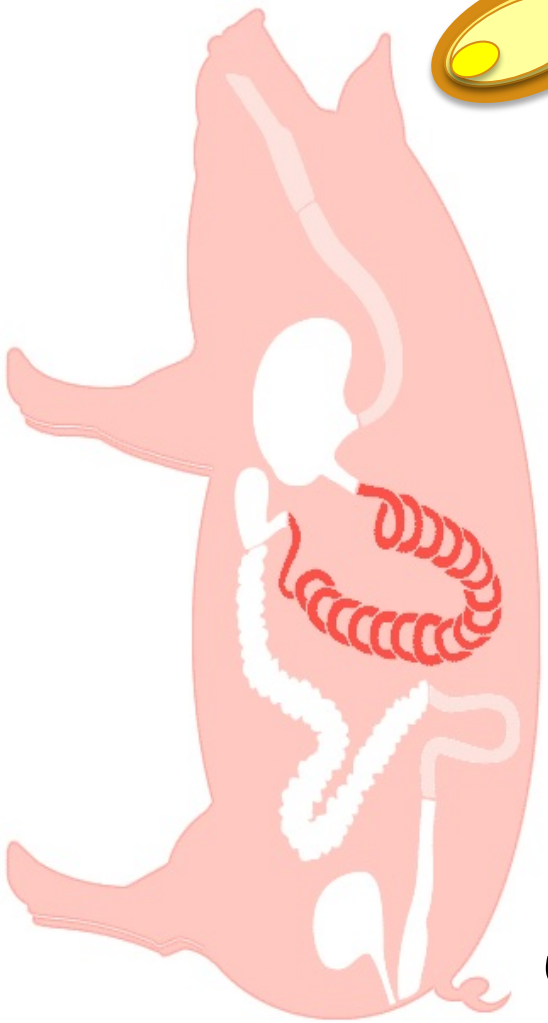
Reduce

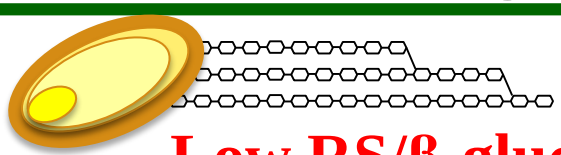
Microbial fermentation, SCFA production, gut health

Increase

Move beyond soluble vs. insoluble fiber

Starch & Fiber Fermentation & Energetic Efficiency





Low RS/β-glucan

Small Intestine

Glucose

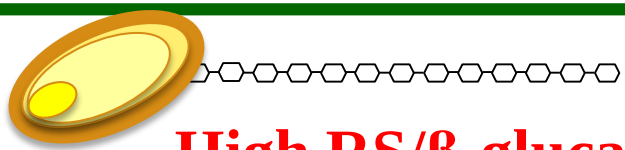
SCFA

Cecum Large Intestine

SCFA

Energy Lost

Energy



High RS/β-glucan

Glucose

SCFA

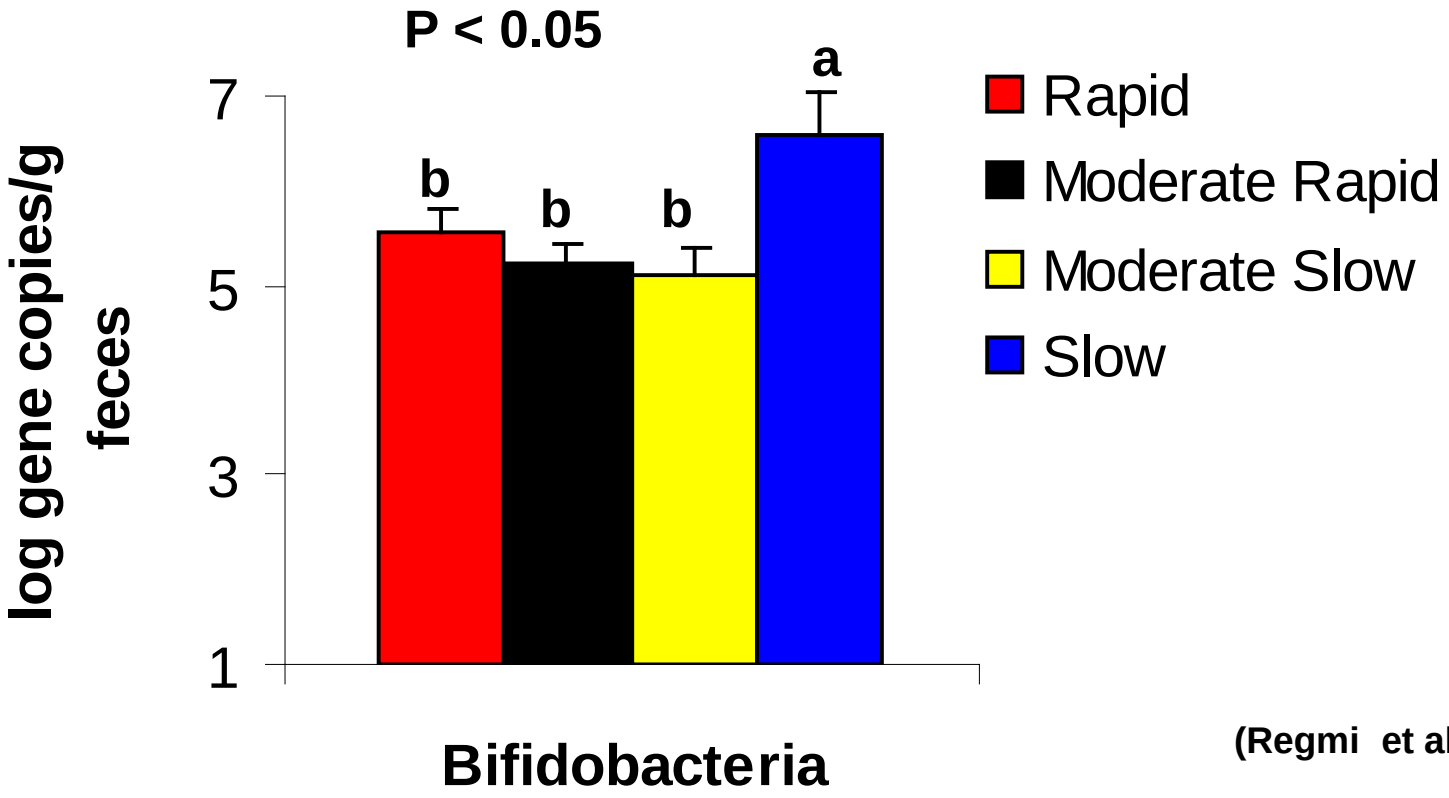
SCFA

Energy Lost

Energy

~60-80%

Bifidobacteria; grower pig



(Regmi et al., 2011b; J. Nutr.)

(matches Topping et al.; Bifidogenic effect of resistant starch)

Overall, relatively minor changes in microbiome numbers/g, but total increases (more g), and measured changes are unique

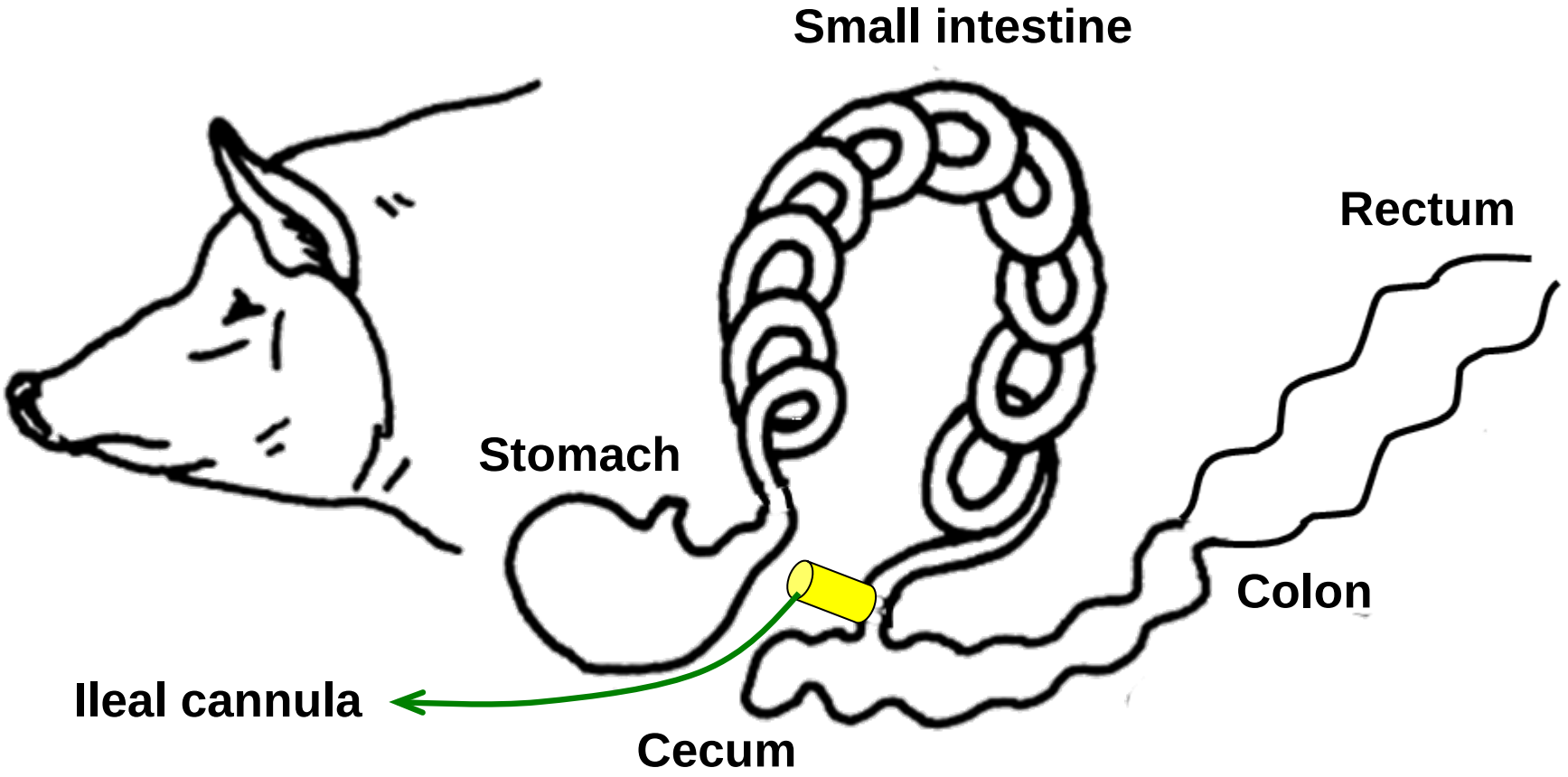
Cereal Grains

Content, % DM	Hull-less barley			Hulled barley	Wheat
	Highly fermentable, high β-glucan (HFB)	Highly fermentable, high amylose (HFA)	Moderately fermentable (MFB)	Low fermentable hulled barley (LFB)	Low fermentable wheat (LFW)
Crude protein	20	17	16	14	20
Amylose	0	18	11	11	12
Total β-glucan	10	7	5	4	1
Total dietary fiber	22	18	15	17	14
ADF	5.5	6.2	6.2	9.4	6.4
Viscosity, mPa × s	342	316	303	319	0

Cereal grains were characterized in detail in ileal-cannulated grower pigs

(Fouhse et al., 2017a,b; J. Nutr.)

Ileal-cannulated pig



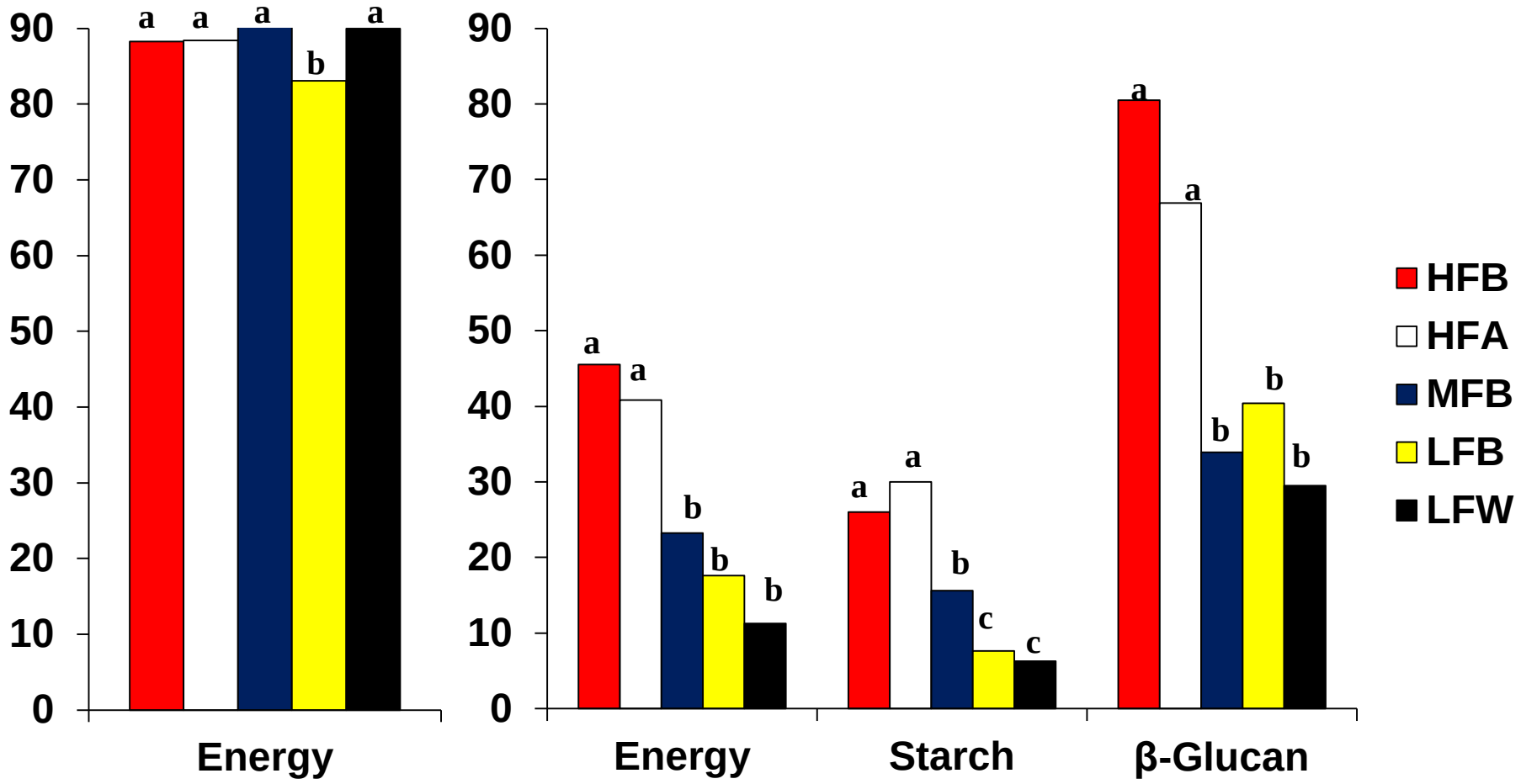
Total extent of digestion

- Can separate between small and large intestine
- Measure substrate flow and bacteria profiles in gut

Digestibility patterns

Total tract digestibility

Large intestine fermentability

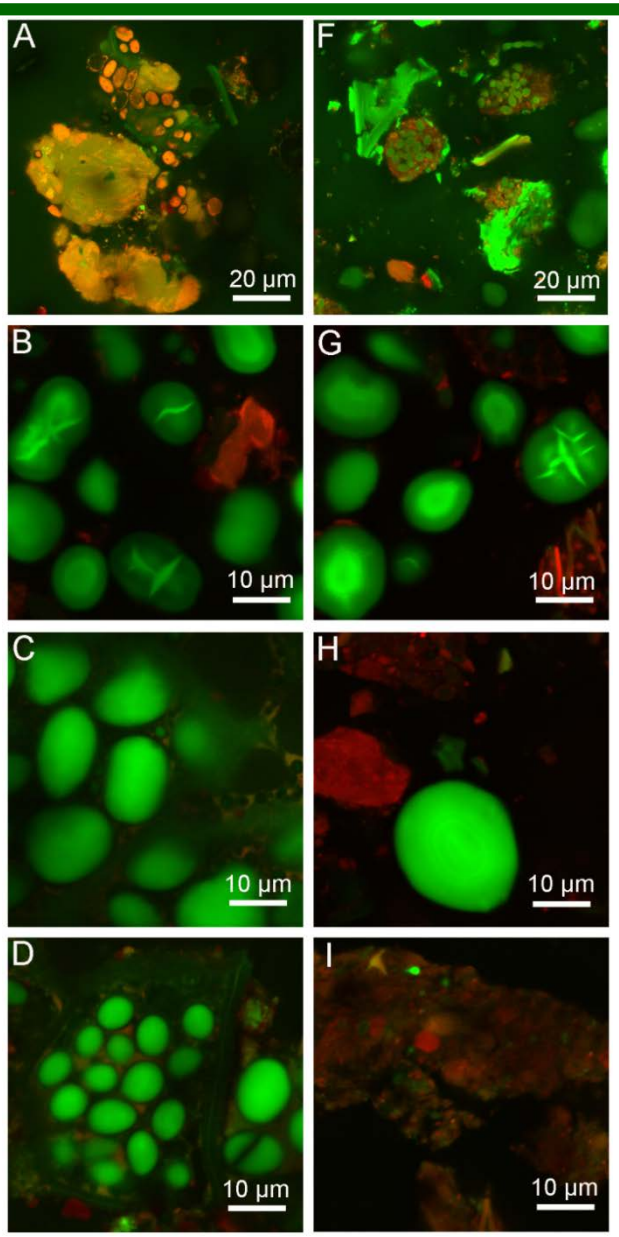


DE & ME are poor indicators of energy and carbohydrate flow within the gut

(Fouhse et al., 2017a; J. Nutr.)

Nutrient flow

Diets **Digesta**



High-fermentable, high β-glucan

High-fermentable, high amylose

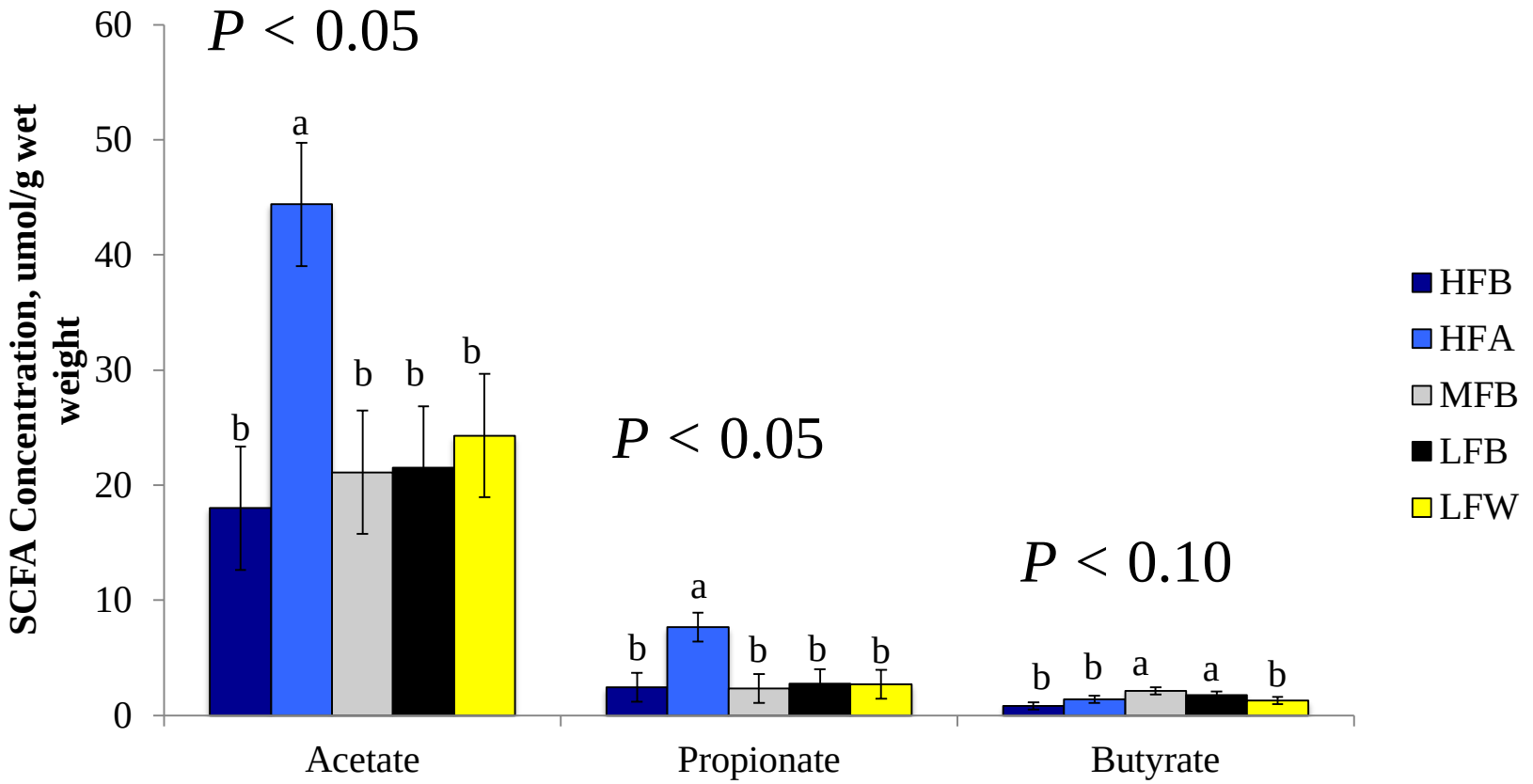
Moderate-fermentable

Low-fermentable

Barley can provide easily-fermentable substrate (prebiotic) to stimulate growth of gut bacteria that support gut health

(Fouhse et al., 2017)

Ileal short chain fatty acids



- **Dietary amylose increases SCFA (Regmi et al., 2011. J Nutr.)**
- **Unique barley cultivars clearly can function as prebiotic**

Processing and Fermentation

- **Steam explosion to enhance fiber fermentation**
  - **High pressure, short time**
  - **Make hulled barley a prebiotic**

- **Currently being studied**

Conseil de l'orge du Canada

Barley Council of Canada

Take Home Message

- **Young pigs can handle barley better than being credited for**
- **Starch and fiber nutrition becoming more important**
- **Need to understand role of barley to stimulate**
  - **Lean growth**
  - **Gut health**
- **With reduced dietary antibiotics, opportunities exist for barley as preferred feedstuff for young pigs**

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Swine nutrition research

- **Basic carbohydrate nutrition**
- **Feedstuff development**
- **Rapid feed quality evaluation**