



Australian Export Grains Innovation Centre

Integrating Australian barley into Viet Nam dairy diets

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Primary Industries and
Regional Development



GRDC
GRAINS RESEARCH
& DEVELOPMENT
CORPORATION

AEGIC is an initiative of the Western Australian State Government and Australia's Grains Research and Development Corporation



In this presentation

Feeding dairy cows as ruminant animals

Designing dairy cow diets

Grains as metabolic fuel for rumen microbes and cow

Advantages of Australian barley

Processing barley – what to aim for



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Processing barley – what to aim for

Transitioning smoothly from corn to barley as primary grain in dairy cow diets



Dairy cows eat a wide range of feedstuffs

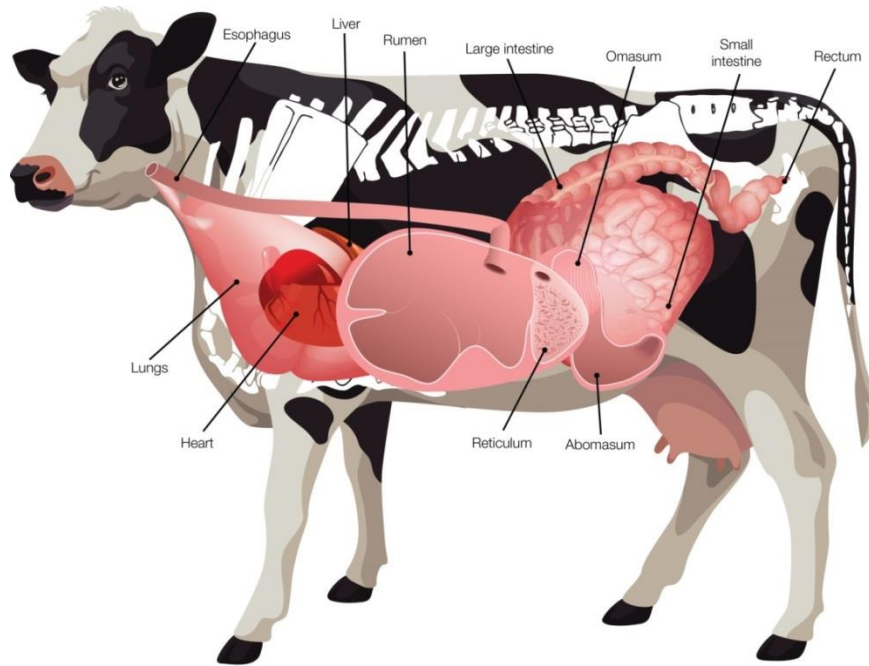
Around the world, cows eat many different feeds within each of these categories:

- Grazed forages
- Conserved forages
- Grains
- Protein supplements
- Wet and dry co-products from many industries

Feed is the biggest cost – we need to be flexible with ingredients when designing diets



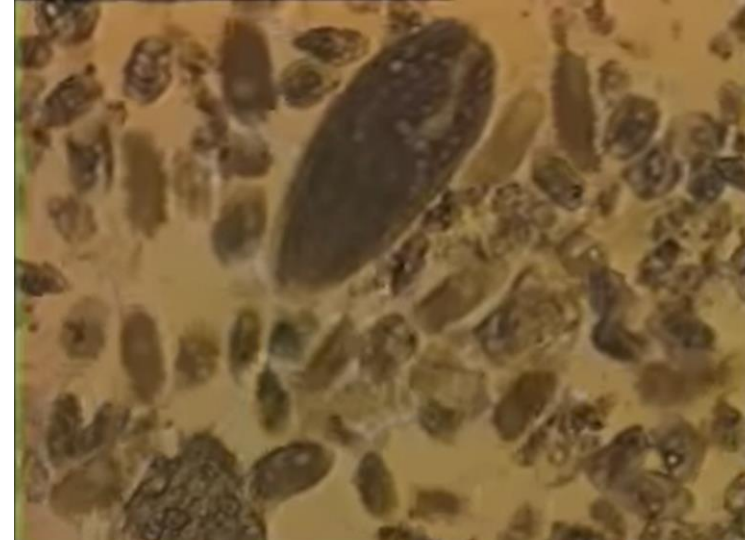
Dairy cows are ruminant animals



Feed digestion and absorption occurs in:

- rumen,
- small and large intestines

Rumen microbes digesting feed particles



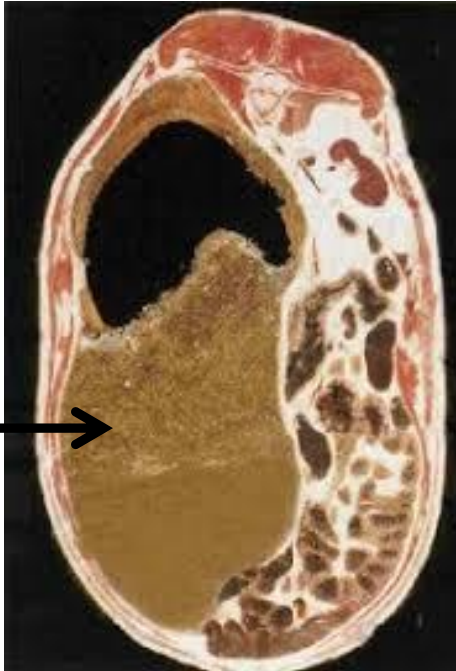
Stable, healthy rumen = Healthy, productive cow

Dairy cows are ruminant animals

Cross-section
of a cow's
abdomen

Left
side

Rumen



Right
side

Feed digestion and
absorption occurs in:

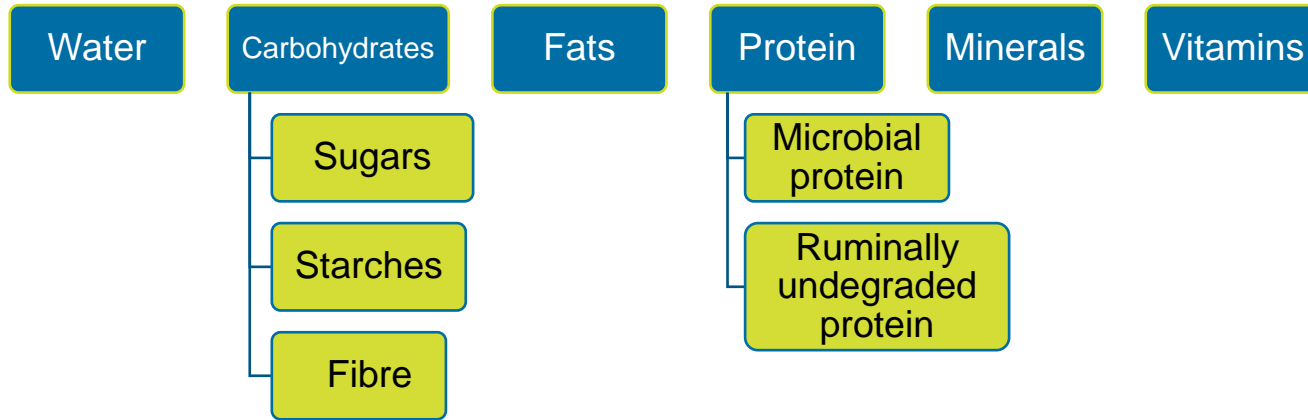
- rumen,
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Rumen microbes digesting feed particles



Stable, healthy rumen = Healthy, productive cow

Dairy cows require nutrients, not specific ingredients



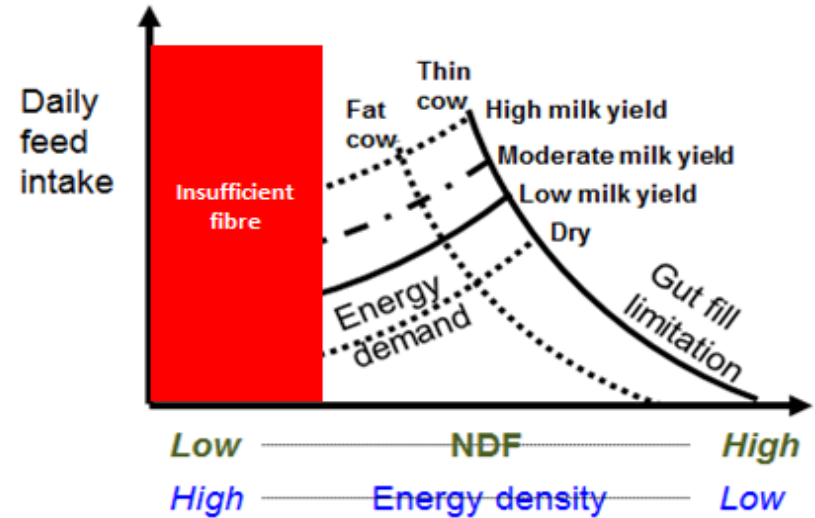
provide oxidizable metabolic fuels for:

- body functions (essential)
- growth, milk production (reducible)
- reproduction, fat storage (expendable)

Dairy cows require nutrients, not specific ingredients

General milking cow diet formulation targets / guidelines

Dry matter intake	3.5-4% bodyweight
Crude Protein	16-18%
Metabolisable Energy	Positive balance
Metabolisable protein	Positive balance
Neutral Detergent Fibre	30-33% (3/4 as long fibre)
Acid Detergent Fibre	18-21%
Starch	23-25%
Starch and Sugar	Max. 30%
Macro-minerals and micro-minerals	10% above requirement



A minimum dietary NDF concentration is necessary to maintain a stable, healthy rumen

Dairy cows require nutrients, not specific ingredients

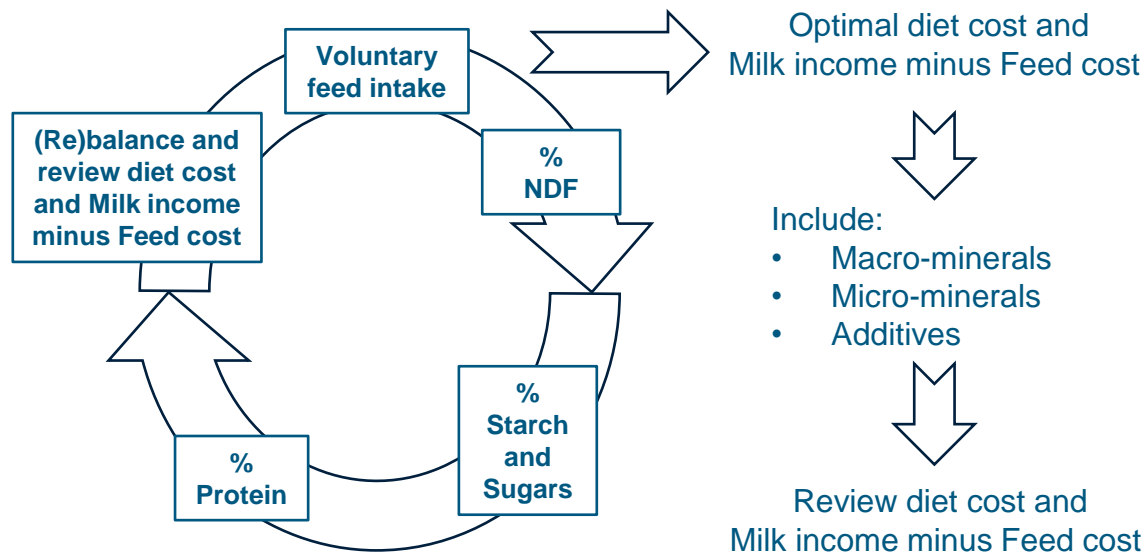
Designing diets:

Step 1: Calculate cows' nutrient requirements

Step 2: Select feedstuffs (nutrients provided, cost/nutrient, palatability, safety)

Step 3: Estimate cow's voluntary feed intake

Step 4: Formulate the diet



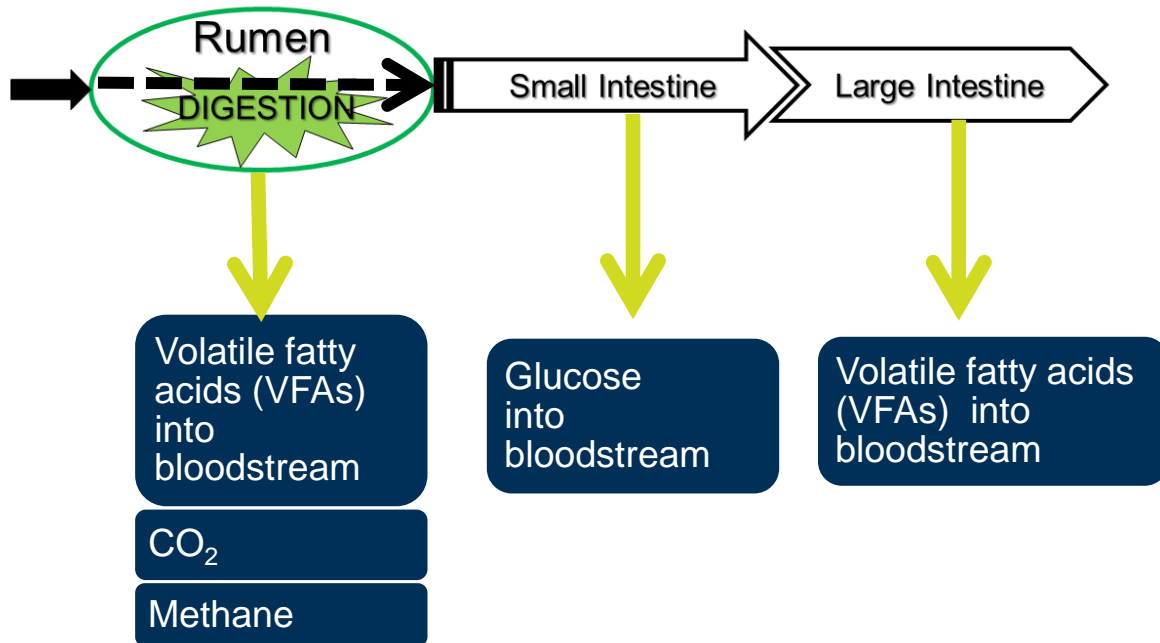
(Adapted from Hannah and Barber, 2007)

Objective is to meet cows' nutrient requirements:

- without excesses
- within cows' feed intake limit
- with good feed efficiency
- with optimal diet cost and milk income minus feed cost

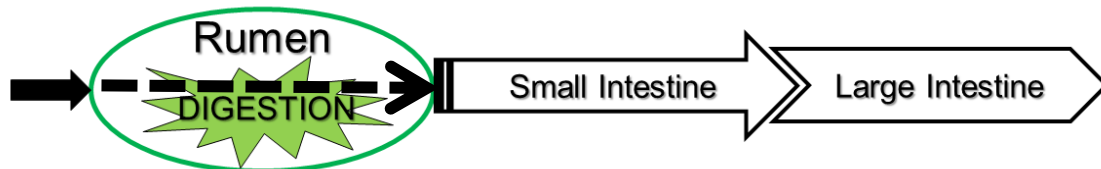
Feeding dairy cows is all about balance!

Balancing ruminal and intestinal digestion of dietary **starch**



Feeding dairy cows is all about balance!

Balancing ruminal and intestinal digestion of dietary **protein**



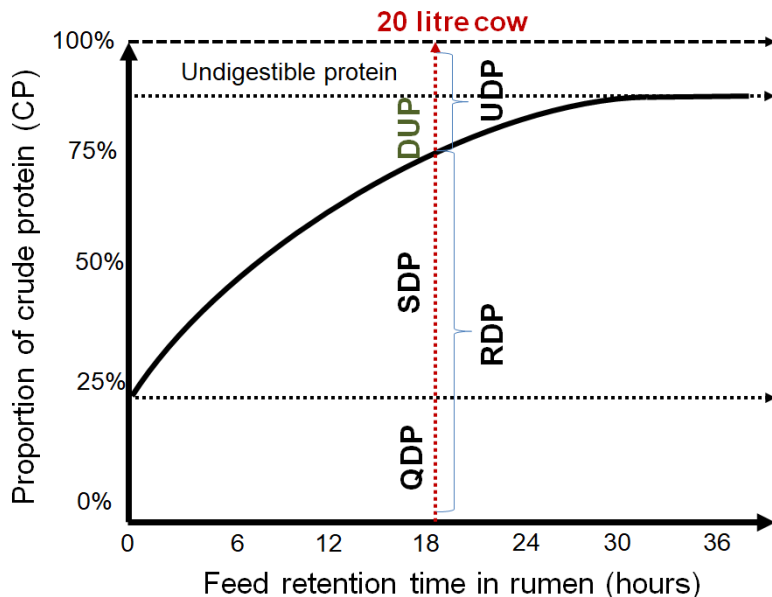
Higher milk yield



Faster feed
passage rate



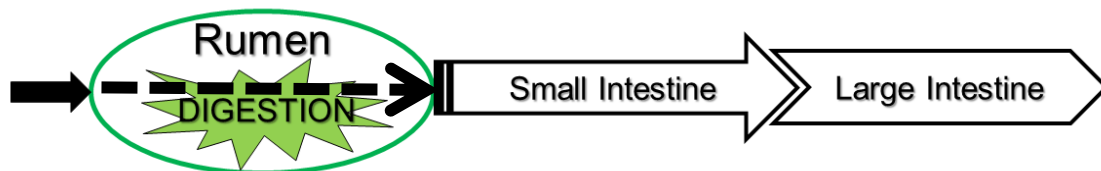
More crude protein
bypasses the
rumen (UDP)



(Adapted from Chamberlain and Wilkinson, 1998)

Feeding dairy cows is all about balance!

Balancing ruminal and intestinal digestion of dietary **protein**



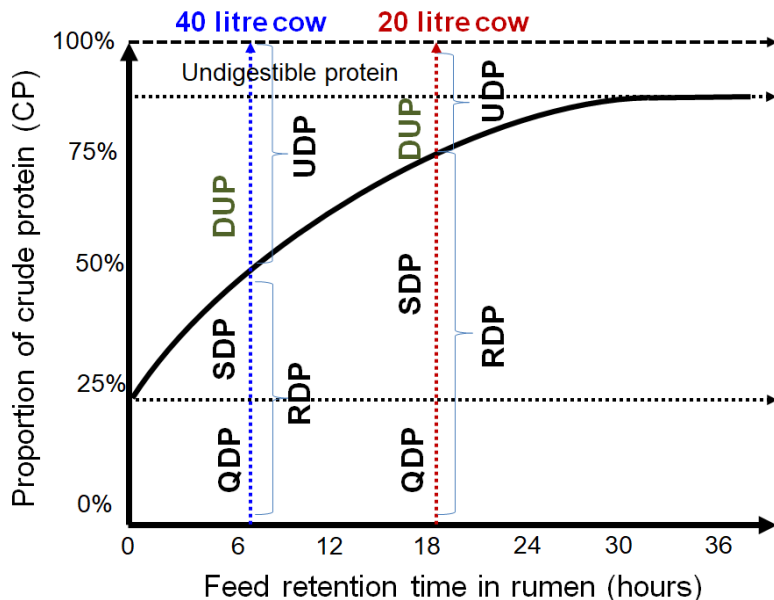
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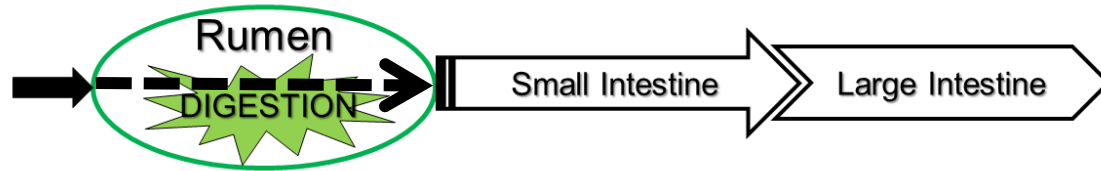


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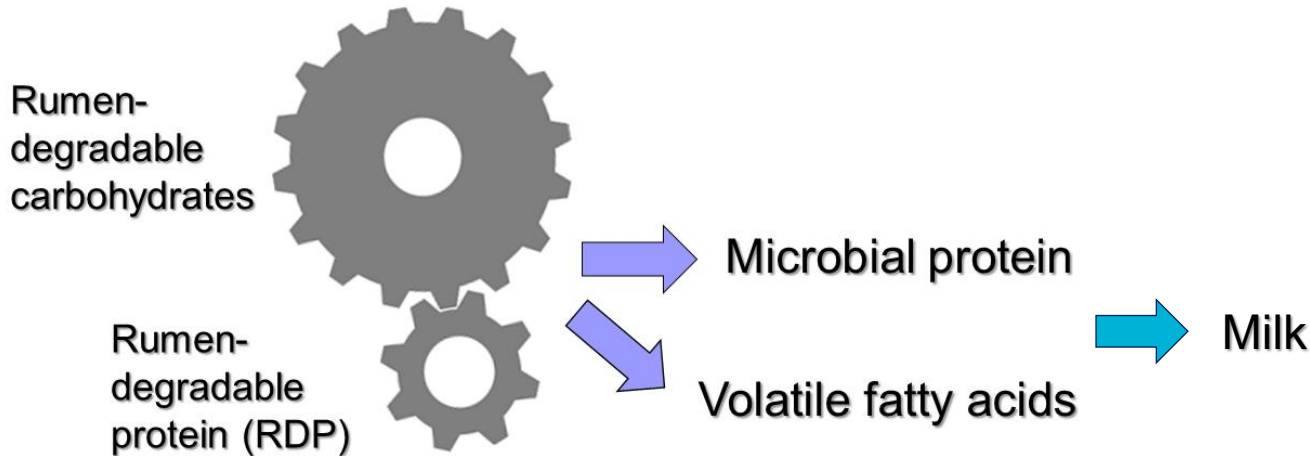


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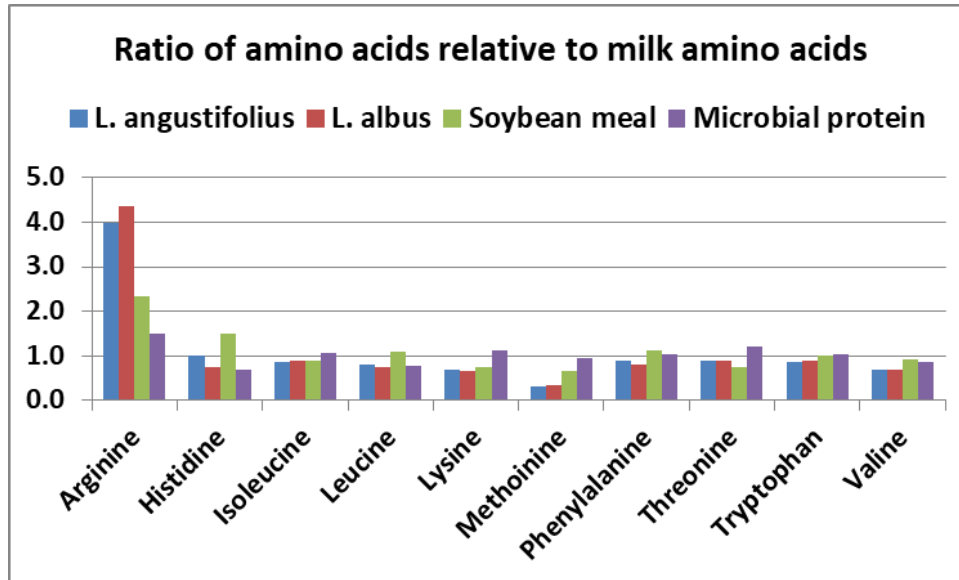
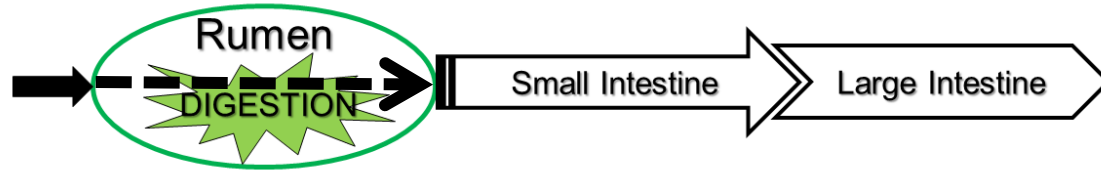
Grains are metabolic fuel for rumen microbes and cow



Carbohydrate fermentation and microbial protein synthesis are interlinked



Grains are metabolic fuel for rumen microbes and cow



Microbial protein is a highly digestible protein source for the cow with a pattern of essential amino acids very similar to milk's

Australian barley for Viet Nam dairy cows

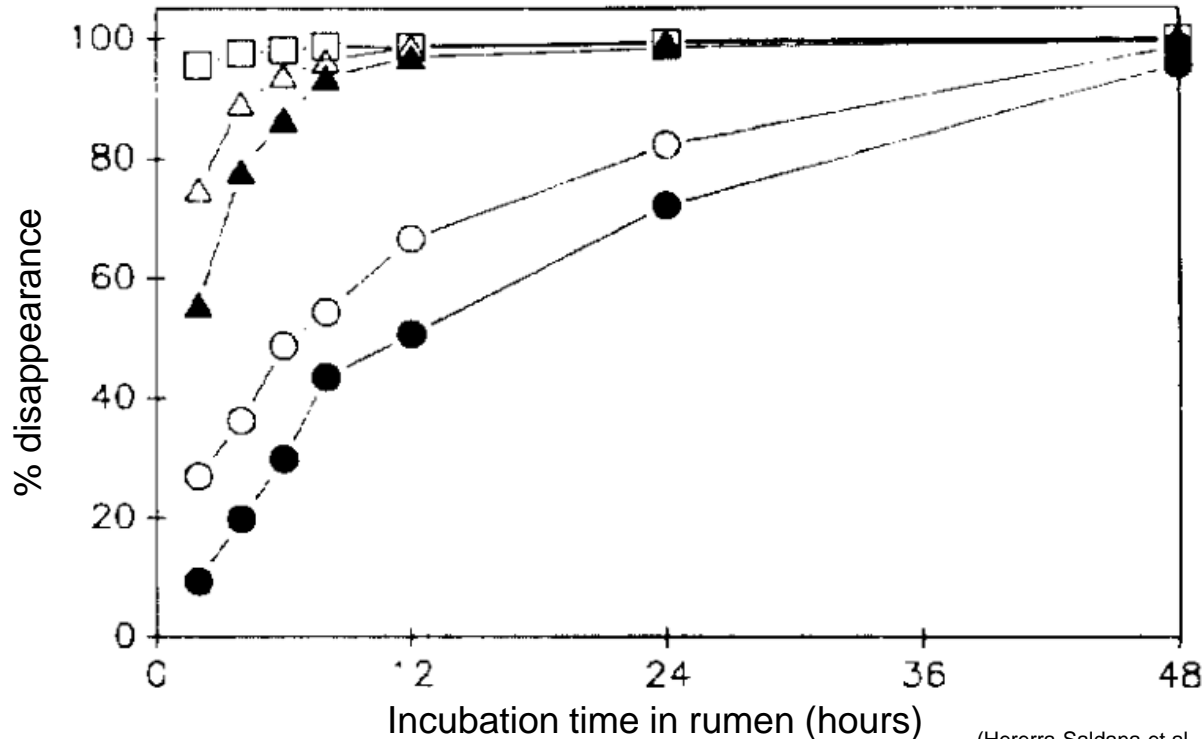
Advantages:

- ✓ Highly digestible feed ingredient
- ✓ Costs less than corn per unit energy
- ✓ Very good source of rumen degradable starch for synthesis of microbial protein
- ✓ Higher in protein, methionine, cysteine, lysine and tryptophan than corn grain
- ✓ Costs less than corn per unit protein
- ✓ Easy to handle and store due to low moisture level
- ✓ Low mycotoxin risk
- ✓ Coarse-medium dry rolling is sufficient



Grain type and processing method

Balancing ruminal and intestinal digestion of dietary **starch**

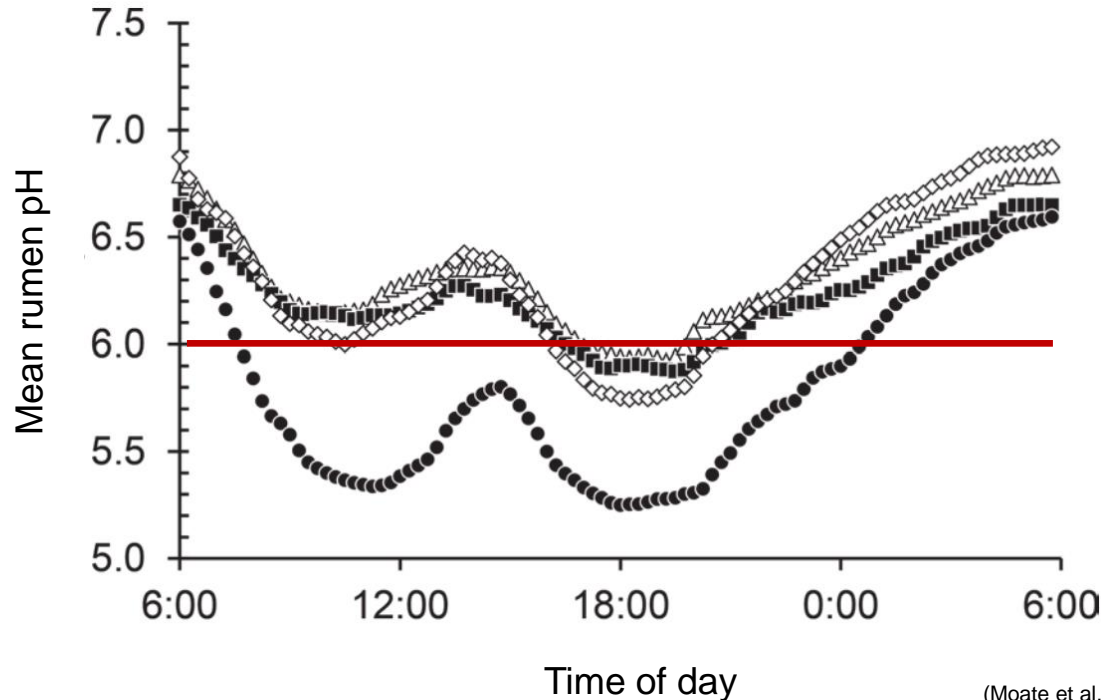


In situ starch disappearance of five grains:

- corn;
- milo;
- △ wheat;
- ▲ barley;
- oats

Grain type and processing method

Balancing ruminal and intestinal digestion of dietary **starch**



Diurnal ruminal pH of cows fed:
● Wheat;
■ Corn;
◇ Barley, single-rolled;
△ Barley, double-rolled

(Moate et al., 2017)

Grain type and processing method

Balancing ruminal and intestinal digestion of dietary **starch**



Rate of ruminal fermentation



Processed grain	Rumen degradation, %	Post-rumen digestion, %	Total tract digestion, %
Ground barley	88.0	10.5	98.5
Steam-rolled barley	84.6	13.6	98.2
Dry-rolled barley	80.7	13.7	94.3
Dry-rolled corn	76.2	16.2	92.4
Ground corn	49.5	44.0	93.5

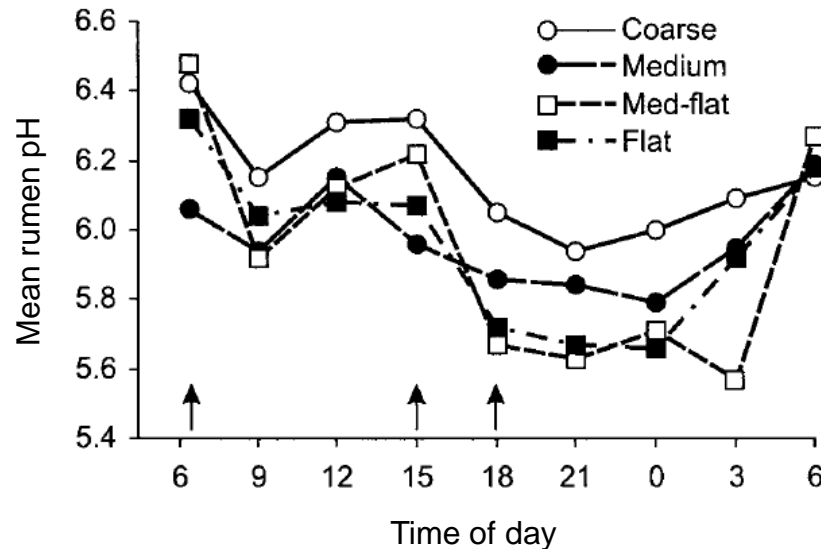
(Adapted from Nikkhah, 2012)

Grain type and processing method

Balancing ruminal and intestinal digestion of dietary **starch**



Rate of ruminal fermentation



Diurnal fluctuation of ruminal pH in lactating dairy cows fed diets containing processed barley

(Yang et al., 2000)

Grain type and processing method

Balancing ruminal and intestinal digestion of dietary **starch**



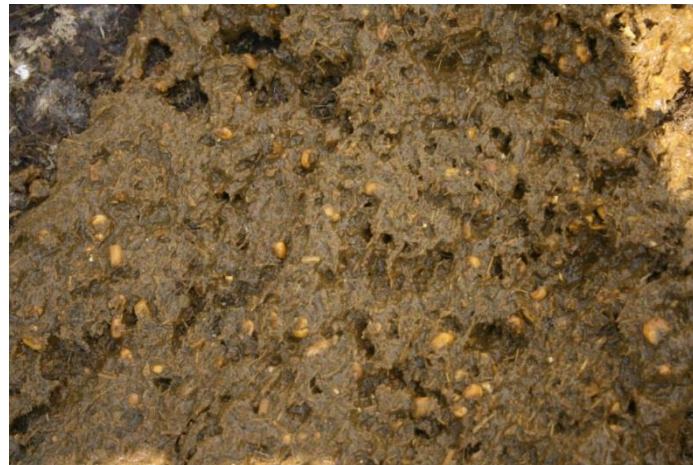
If under-process grain, may result in:

- reduced starch digestibility in rumen and total digestive tract
- reduced milk production, feed efficiency and profit

Look for:

- Undigested grain pieces in manure (visual test)
- Starch in manure (chemical test by feed laboratory)

Undigested grain in manure



Grain type and processing method

Balancing ruminal and intestinal digestion of dietary **starch**



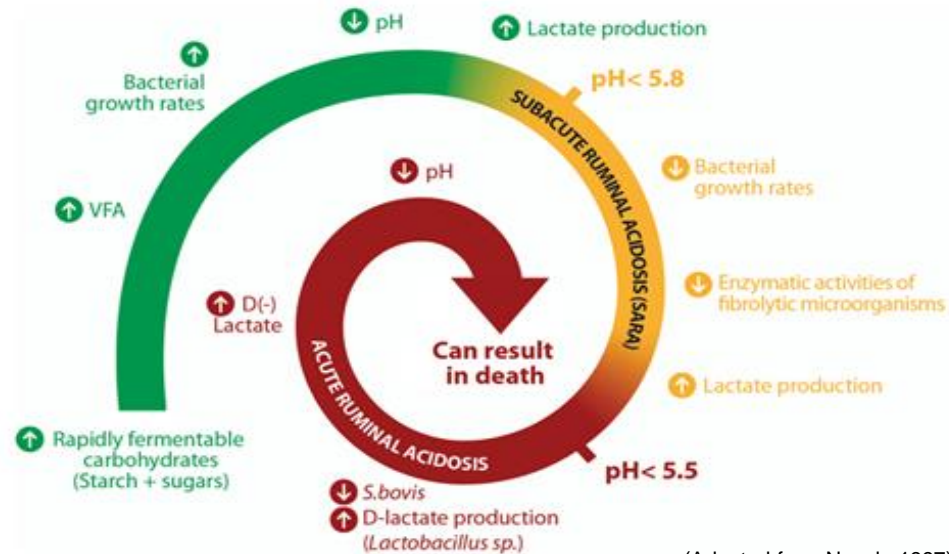
If over-process grain, may result in:

- excessively fast rumen starch degradation
- ruminal acidosis, with reduced milk production, feed efficiency and profit

Look for:

- Reduced fibre digestion
- Reduced feed intake in some cows
- Mild milk fat suppression
- Possible diarrhoea and laminitis

Rumen dysfunction leads to many problems



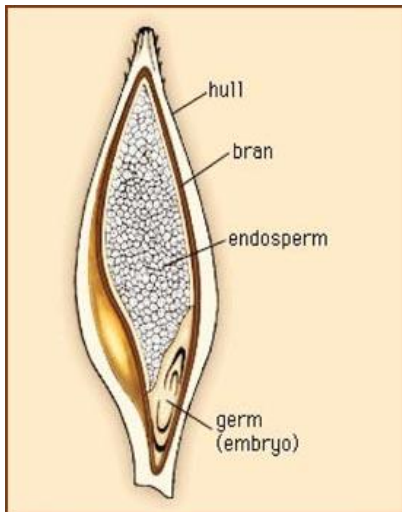
(Adapted from Nocek, 1997)

Grain type and processing method

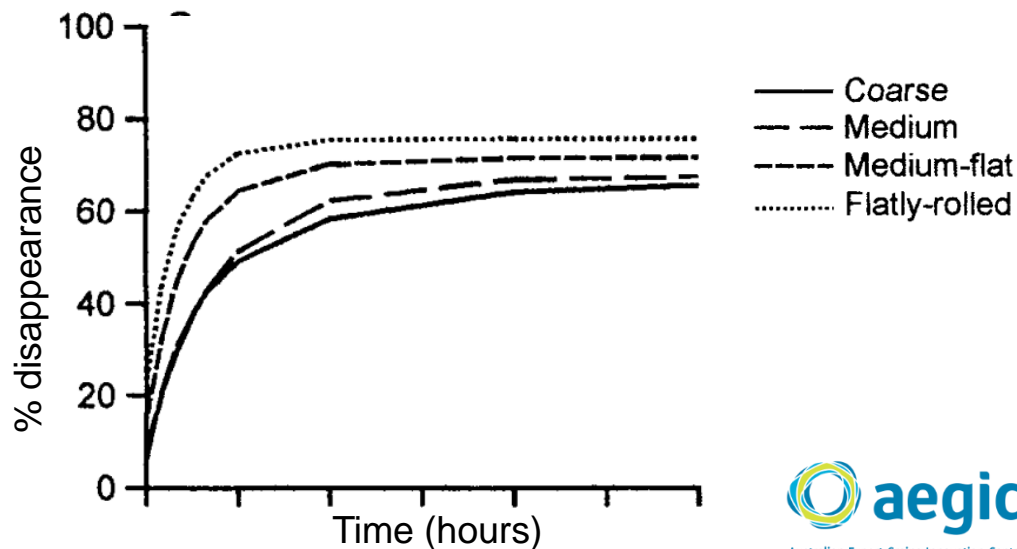
Balancing ruminal and intestinal digestion of dietary **starch**



Barley should not be processed as much as corn. Coarse-medium dry rolling is sufficient to expose the endosperm to rumen microbes



DM disappearance of processed barley from bags incubated in rumen of steers

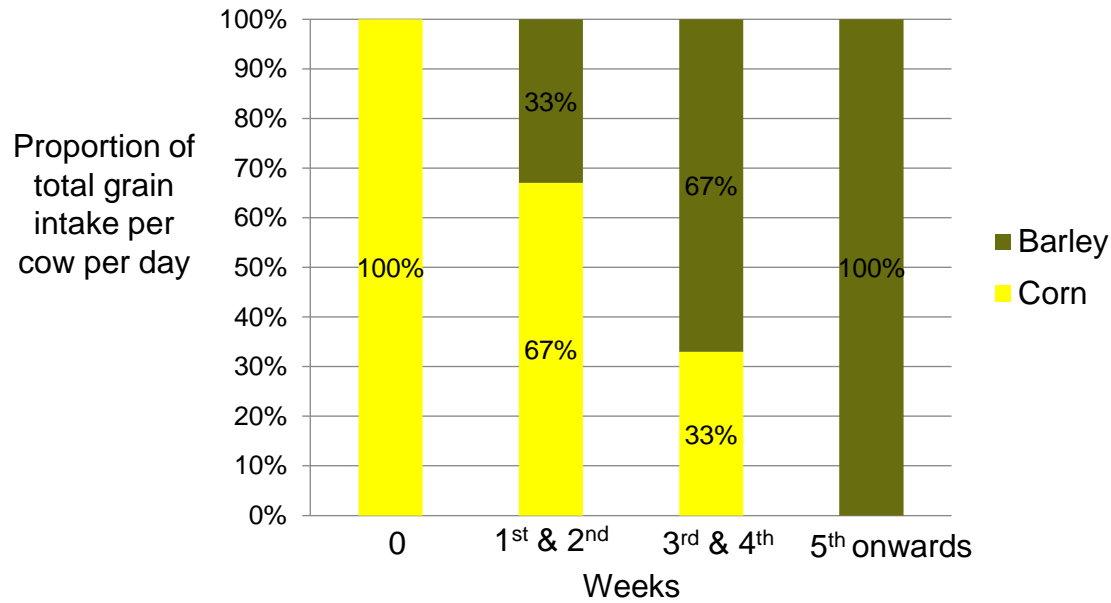


(Beauchemin et al., 2001)

Transitioning from corn to barley as primary grain in diet

When alter diet, must give rumen microbes time to adapt

- Maintain daily feeding rate of good quality forage
- Maintain daily feeding rate of grain
- Transition grain input from corn to barley in 3 stages



Key messages

Dairy cows around the world eat a wide range of feedstuffs

Dairy cows are ruminant animals – we need to feed the rumen microbes and the cow

Dairy cows require nutrients, not specific ingredients. Designing diets is a 4 step process

Feeding dairy cows is about balancing ruminal and intestinal digestion of starch and protein

Australian barley offers many advantages. It costs less per unit energy and protein than corn

Barley should not be processed as much as corn. Coarse-medium dry rolling is sufficient

To avoid rumen dysfunction, transition from corn to barley progressively in 3 stages



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Thank You