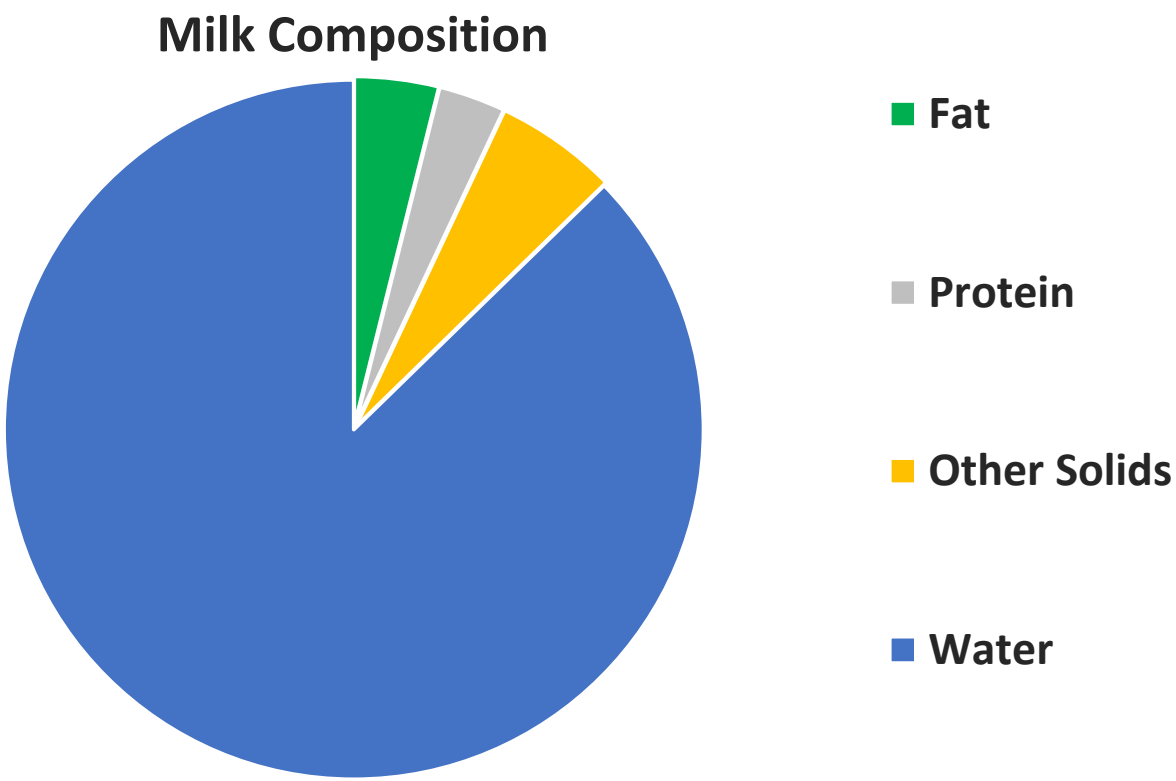
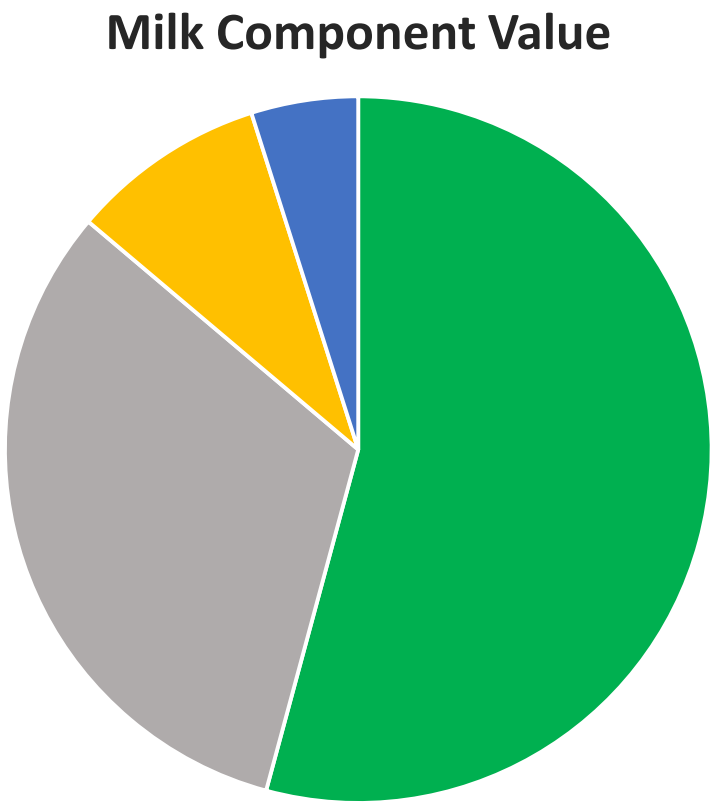
Milk Components and Value

Benjamin Wenner, PhD

Milk components have disproportionate value





3.8% Fat, 3.1% Protein, 5.7% Other Solids, 87.4% Water

What's in 1 lb of butter?

1 lb butter = 0.825 lb fat + 0.175 lb of H_2O

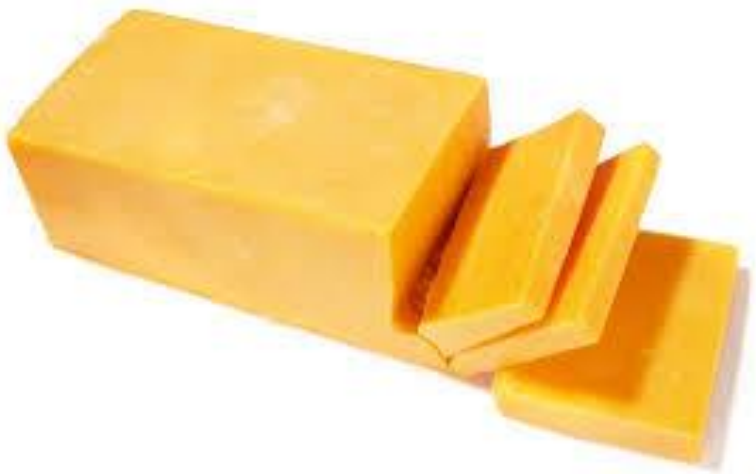
How do we calculate butterfat value?

$$Butterfat\$ = \frac{butter\$ - \ make\ allowance\$}{0.825}$$

make allowance $ = 17.15 cents

Slide used courtesy of
Normand St-Pierre

What’s in 1 lb of cheese?



- Fat, protein, other solids, water…

- To calculate protein price
  - Calculate weighted average price of cheese blocks and cheese barrels
  - Subtract make allowance (20.03 c/lb)
  - <u>Subtract the butterfat value in cheese</u>
  - Remove the water

Slide used courtesy of
Normand St-Pierre

What's in 1 lb of dry whey?

1 lb dry whey = 0.97 lb OS + 0.03 lb of H_2O

How do we calculate other solids value?

$$OtherSolids\$ = \frac{whey\$ - \ make\ allowance\$}{0.97}$$

make allowance $ = 19.91 cents

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Normand St-Pierre

What's in 1 lb of Nonfat Dry Milk?

1 lb NFDM = 0.99 lb NFS + 0.01 lb of H_2O

How do we calculate non-fat solids value?

$$NonfatSolids\$ = \frac{Nonfat\_dry\_milk\$ - \ make\ allowance\$}{0.99}$$

make allowance $ = 16.78 cents

Slide used courtesy of
Normand St-Pierre

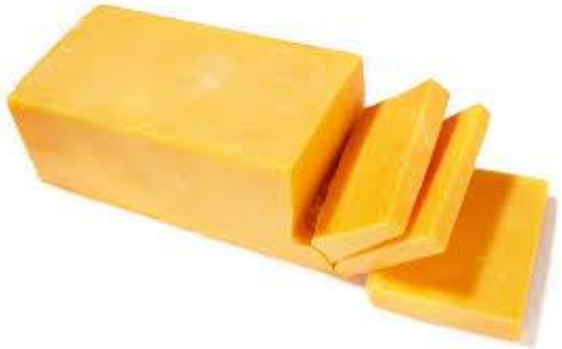
From Components to Class Prices?

- Class IV (Butter-Powder)
  - Class IV ($/cwt) = (8.685 x NFS$) + (3.5 x Fat$)
- Class III (Cheese)
  - Class III ($/cwt) = (3.0 x Prot$) + (5.7 x OS$) + (3.5 x Fat$)
- Class II (Soft Products)
  - Class II ($/cwt) = (8.685 x NFS$) + (3.5 x Fat$) + $0.68
- Class I (Fluid Milk)
  - Class I ($/cwt) = (0.965 x Skim$) + (3.5 x Fat$) + Differential

Slide used courtesy of
Normand St-Pierre

Who determines prices…

- Wholesale price of butter determines butterfat price
- Wholesale price of cheese determines protein price
- Wholesale price of dry whey determines other solids
- Wholesale price of nonfat dry milk determines nonfat solids price
- Unregulated wholesale prices
- Blend price is a weighted average of 4 classes based on utilization in set order



Slides adapted with permission from Normand St-Pierre

	December 29, 2017	January 5, 2018	Change	Month to date
CME cheddar cheese - blocks ($/lb)	$ 1.5400	$ 1.4950	- $ 0.0450	$ 1.4950
- barrels ($/lb)	$ 1.4425	$ 1.3900	- $ 0.0525	$ 1.3900
CME butter ($/lb)	$ 2.2075	$ 2.2375	+ $ 0.0300	$ 2.2375
Dry whey ($/lb) (Dairy Market News)	$ 0.2700	$ 0.2650	- $ 0.0050	$ 0.2650
Nonfat dry milk ($/lb) (National Plants)	$ 0.7061	$ 0.7035	- $ 0.0026	$ 0.7035
-------	--------	Projected Prices	--------	-------
Butterfat ($/lb)	$ 2.466	$ 2.502	+ $ 0.036	$ 2.502
Protein ($/lb)	$ 1.612	$ 1.416	- $ 0.196	$ 1.416
Other solids ($/lb)	$ 0.073	$ 0.068	- $ 0.005	$ 0.068
Class III ($/cwt)	$ 13.87	$ 13.38	- $ 0.49	$ 13.38
Class IV ($/cwt)	$ 13.26	$ 13.36	+ $ 0.10	$ 13.36

Information courtesy of Perdue AgriBusiness Animal Nutrition

PERDUE AgriBusiness

Quiz…

- Herd 1
  - 500 cows
  - 100 lbs of milk
- Herd 2
  - 500 cows
  - 90 lbs of milk

Quiz…

- Herd 1
  - 500 cows
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- Herd 2
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  - 90 lbs of milk

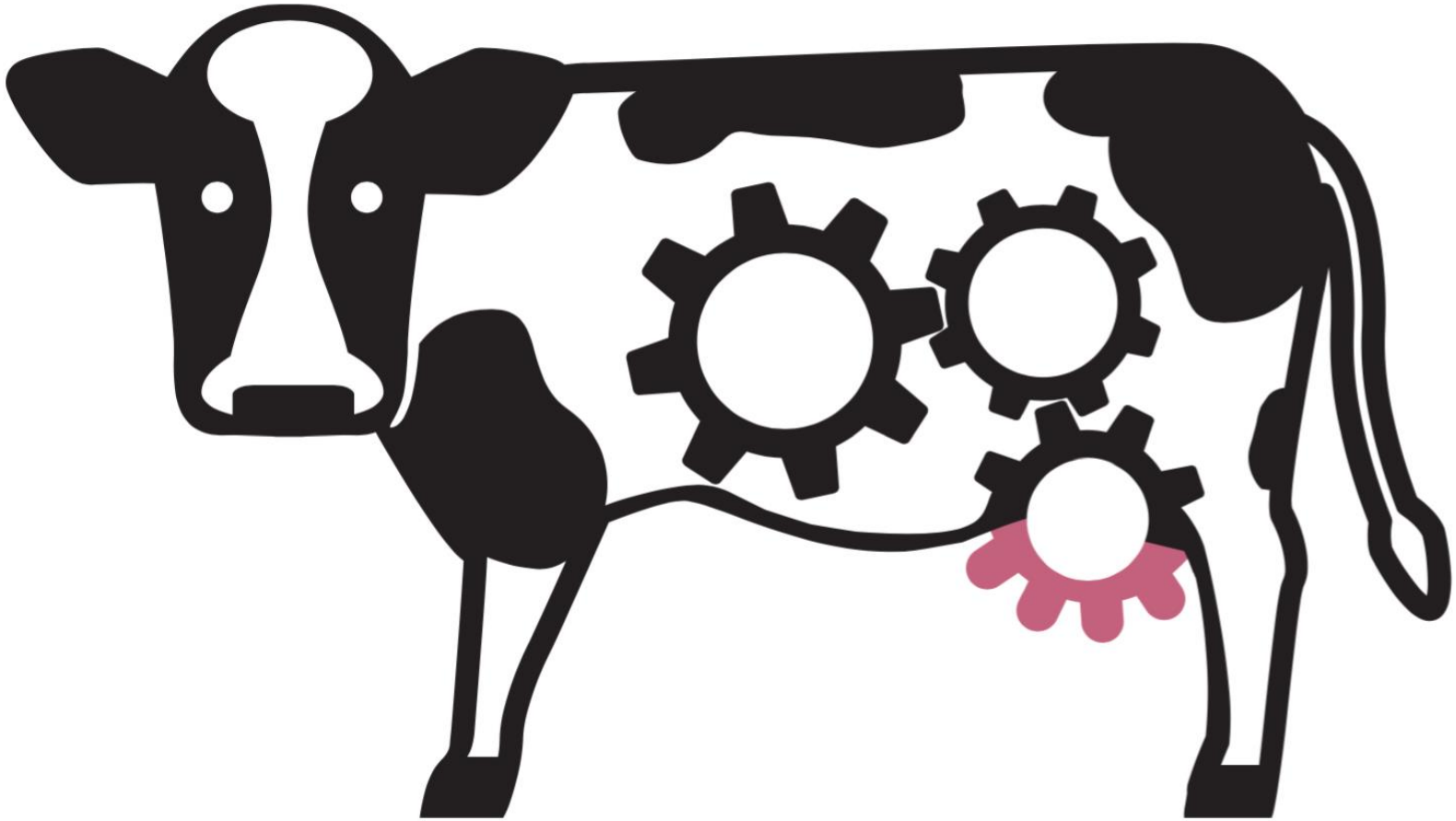
Quiz…

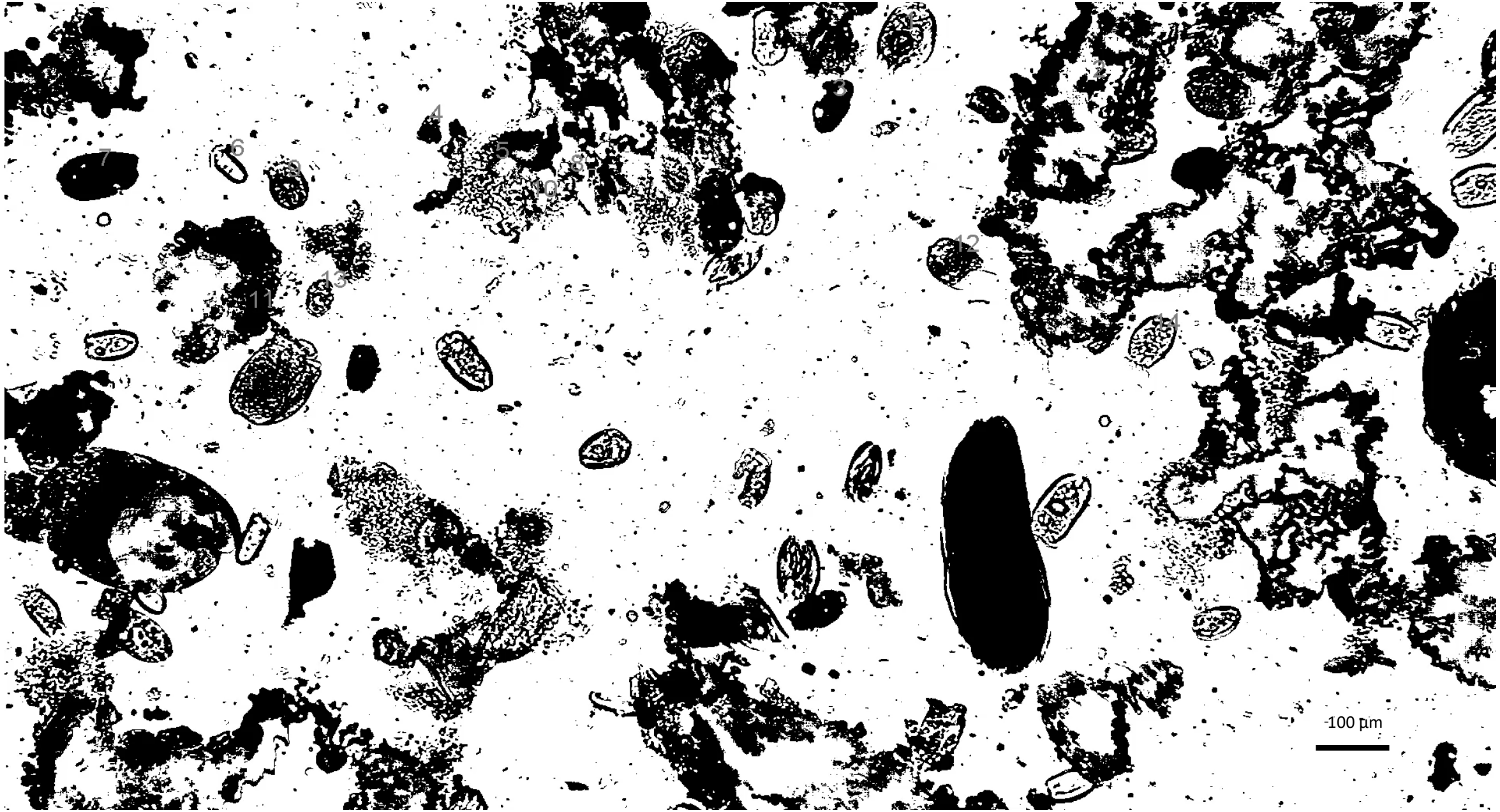
- Herd 1
  - 500 cows
  - 90 lbs of milk
  - 3.5% butterfat
- Herd 2
  - 500 cows
  - 90 lbs of milk
  - 3.8% butterfat

+ $342/d over Herd 1

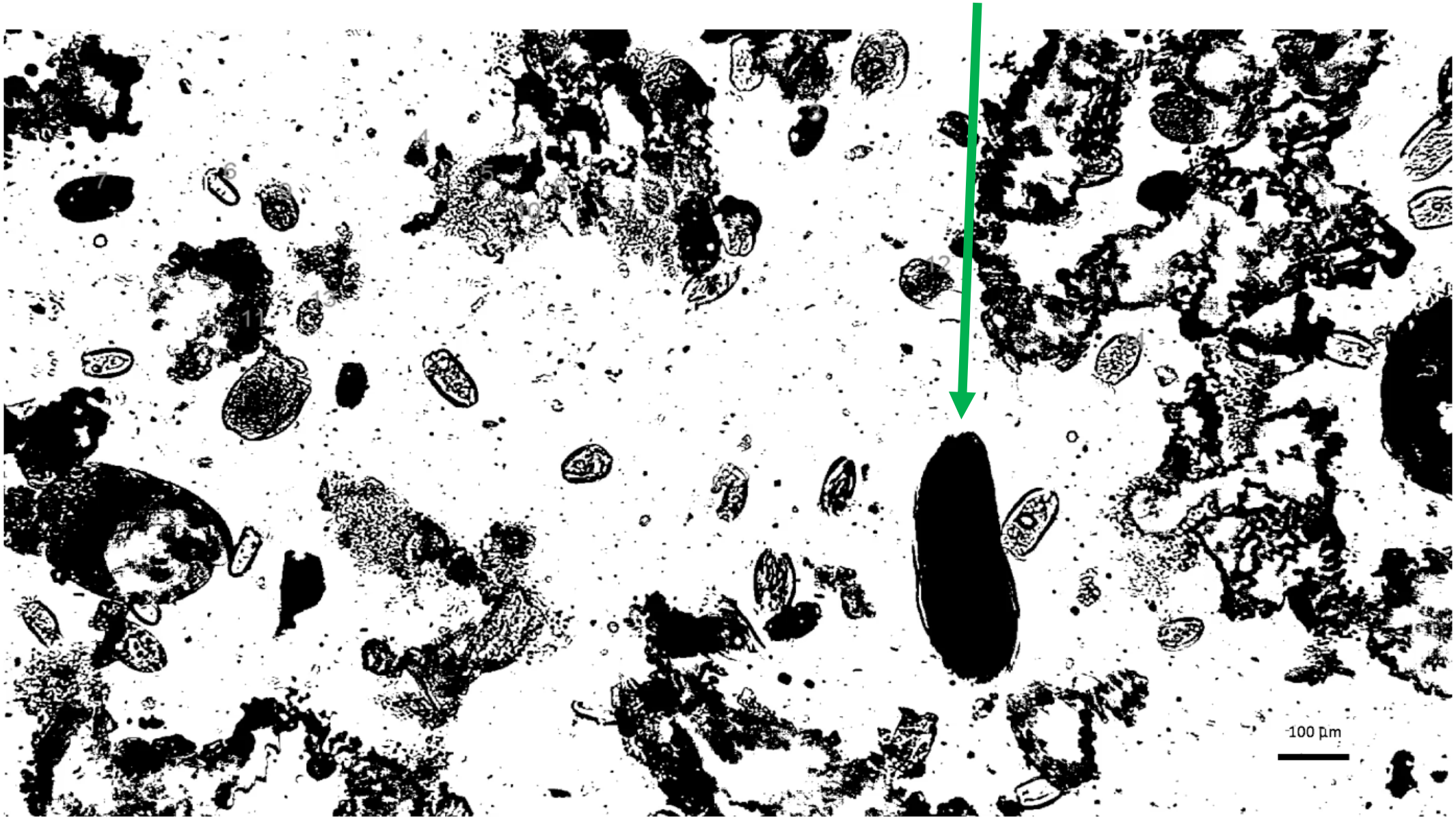
More fat pays

- The question is how to make the cow work harder for you?
- Rumen consistency should be a goal that costs least amount of money

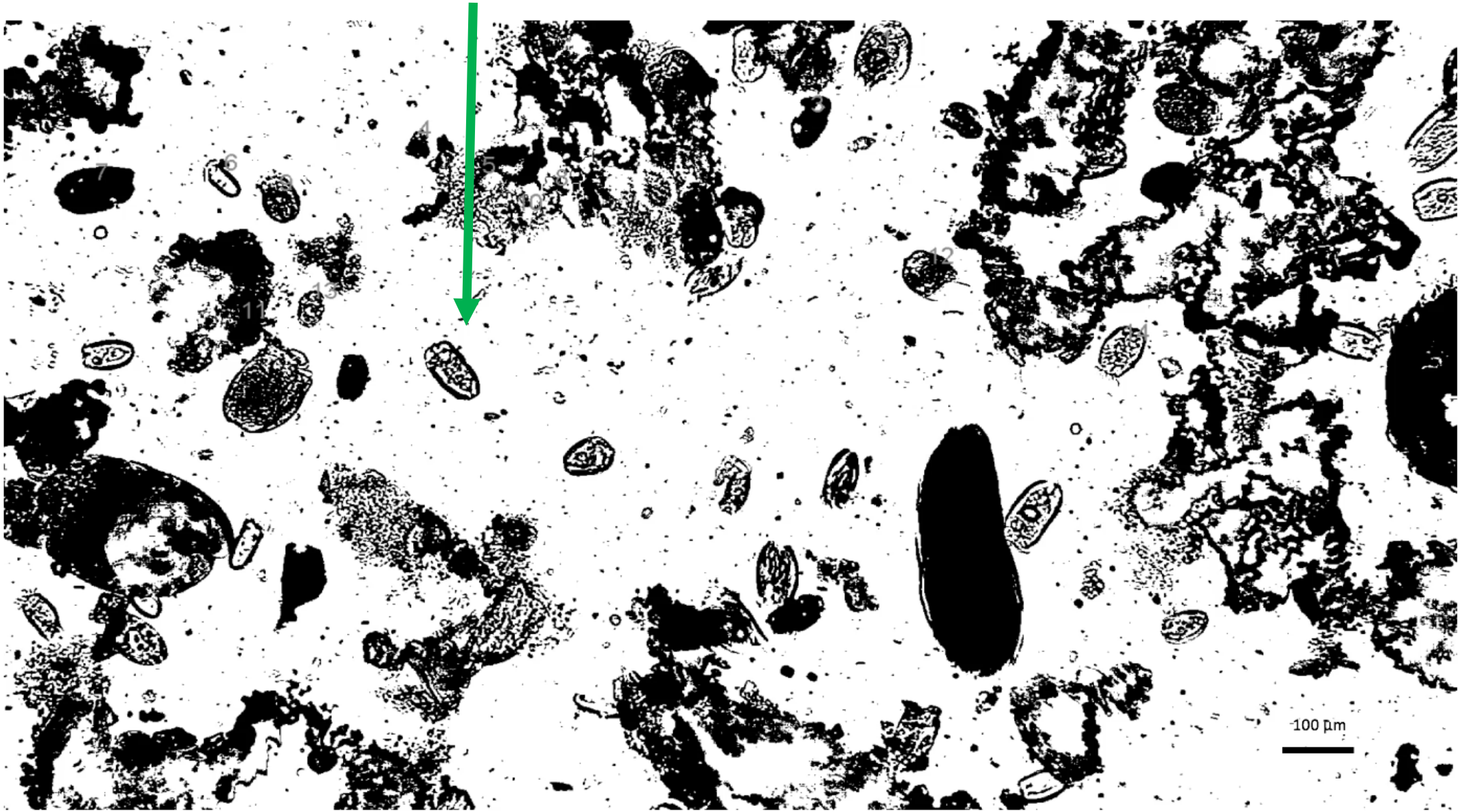



1
2
3
4
5
6
7
8
9
10
11
12
13
14
100 µm

Isotrichids consume copious amounts of starch, buffering rumen pH



Entodiniomorphids can be small but active in starch and protein degradation



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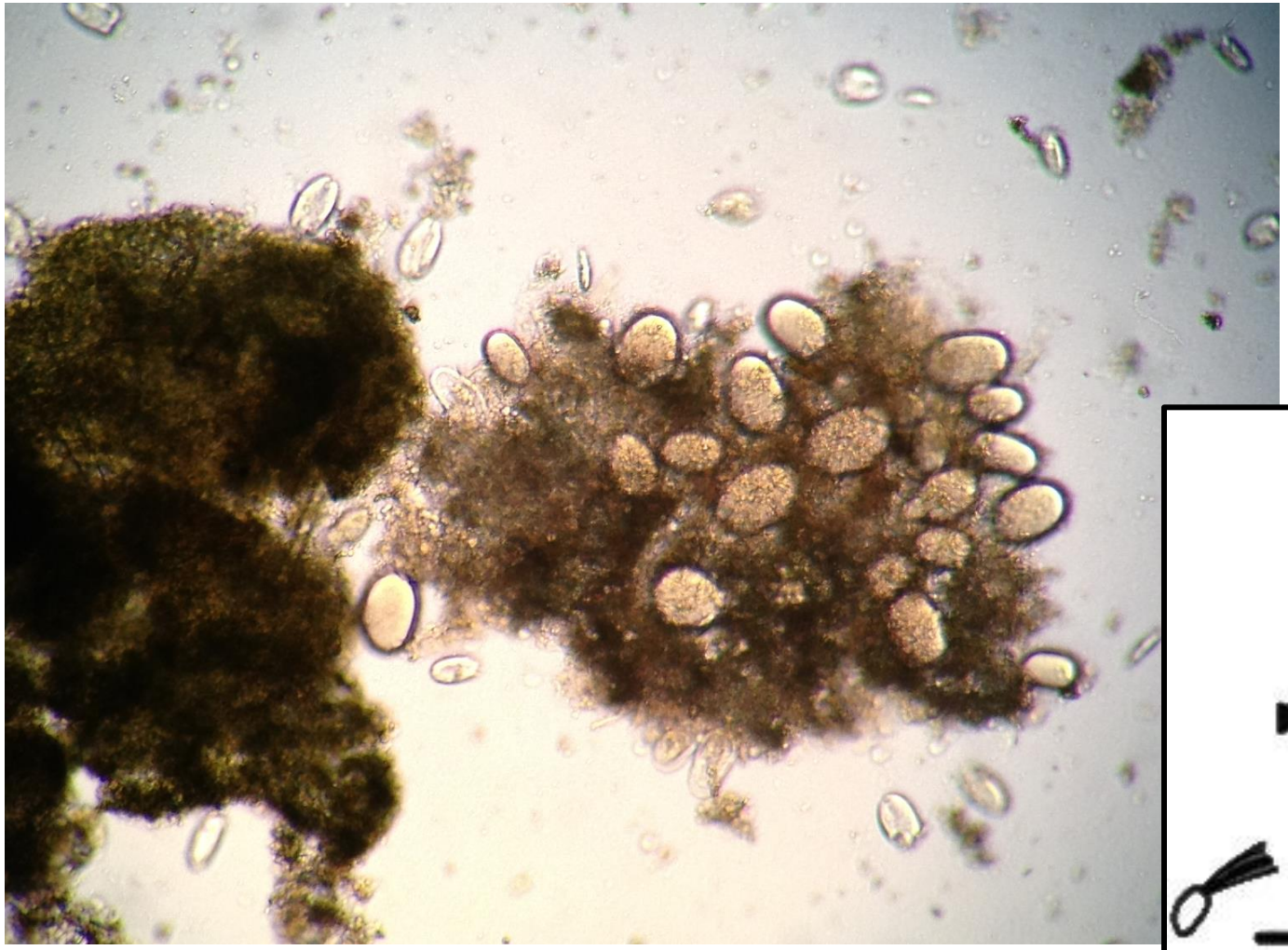
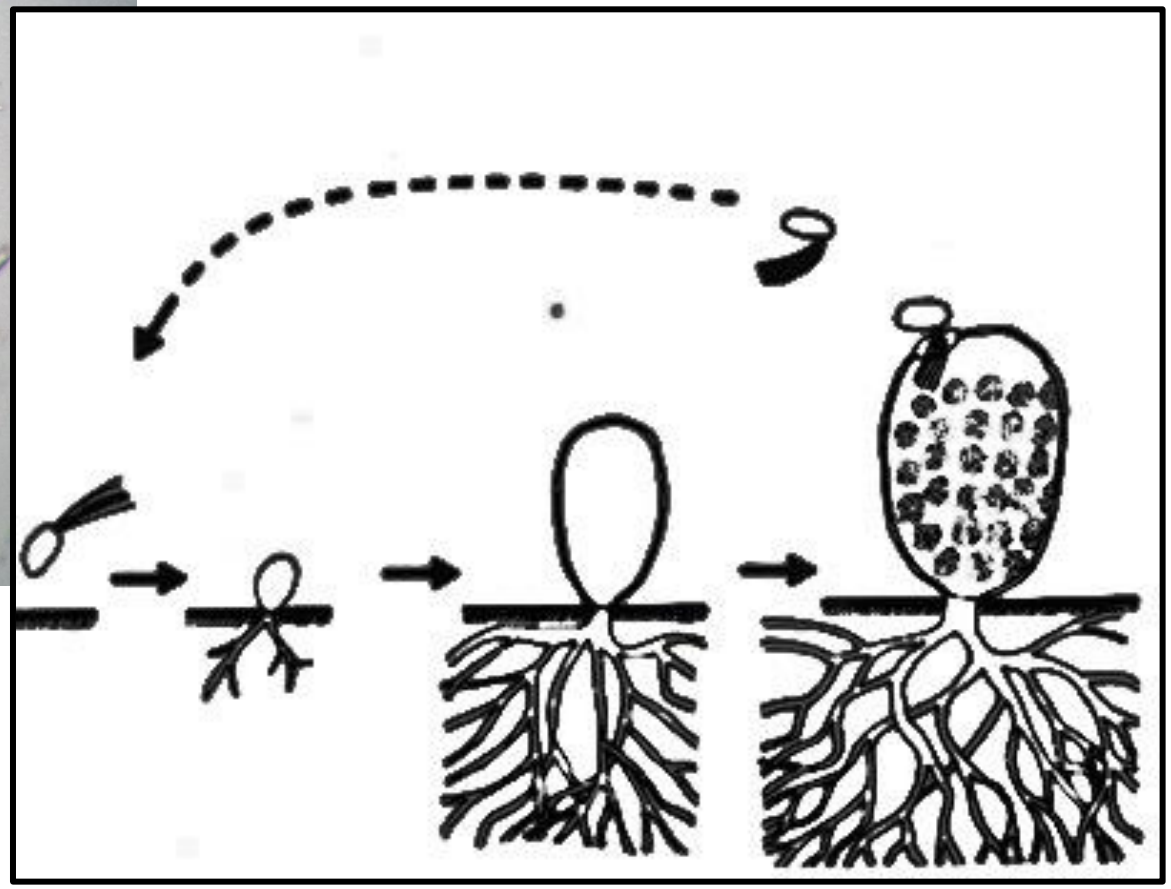
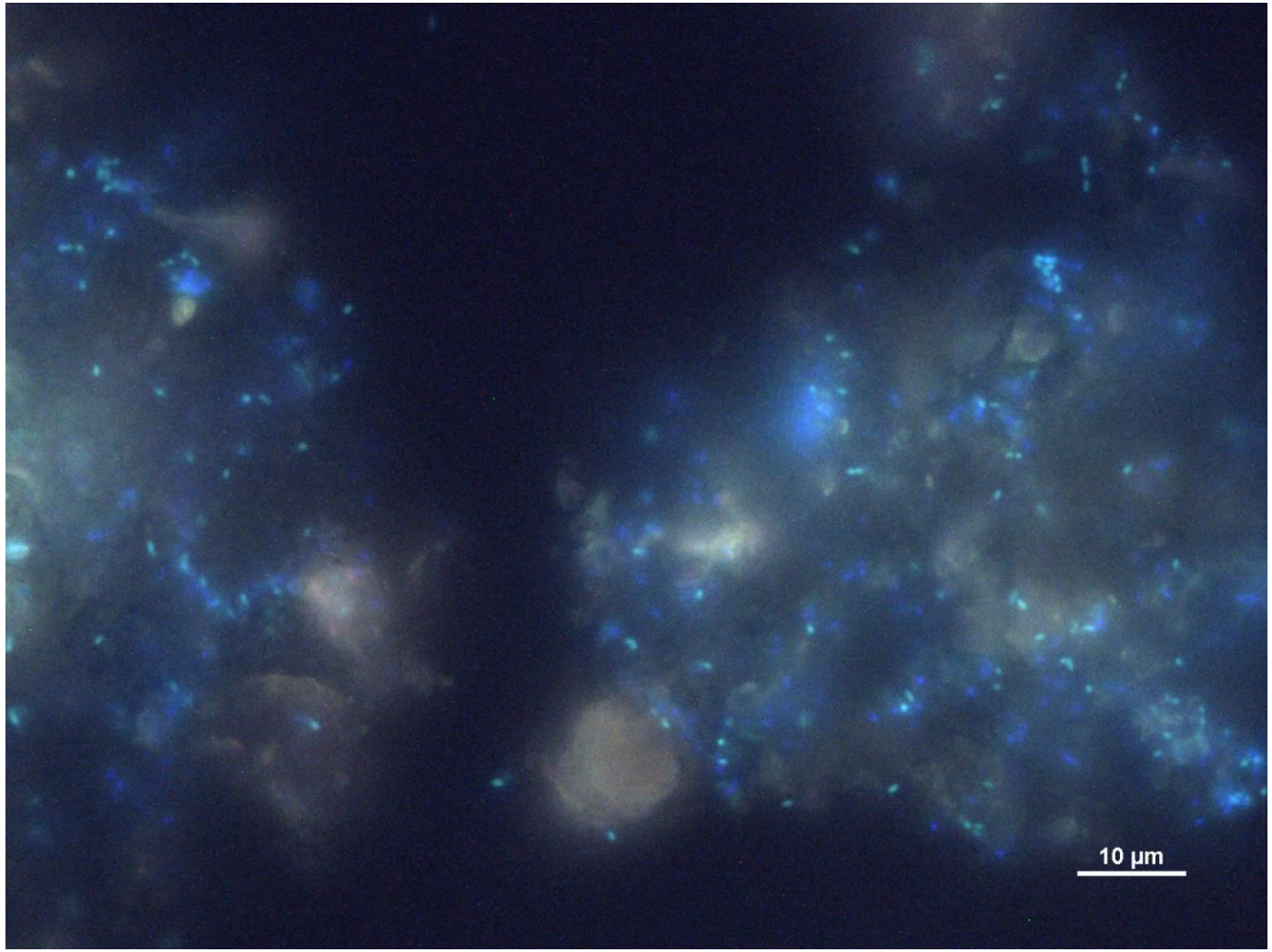




Cooperative biofilm

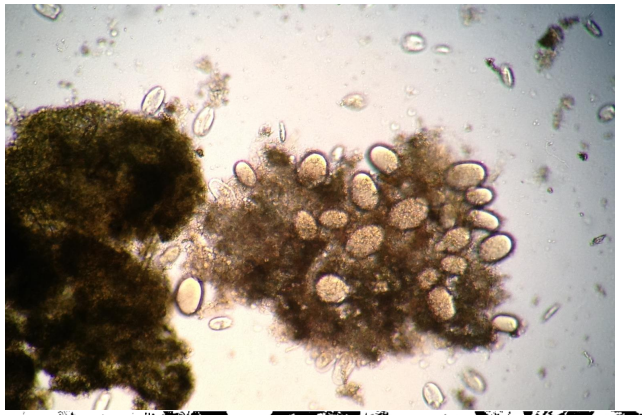
- Bacteria specialize
  - Sugar
  - Starch
  - Lactate
  - Fiber
  - Protein

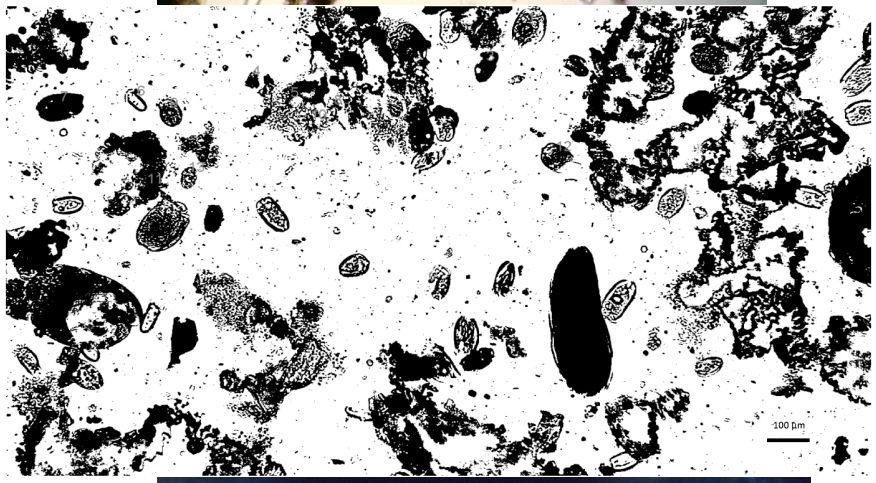
- Or they can generalize
  - It’s all about competitive strategies

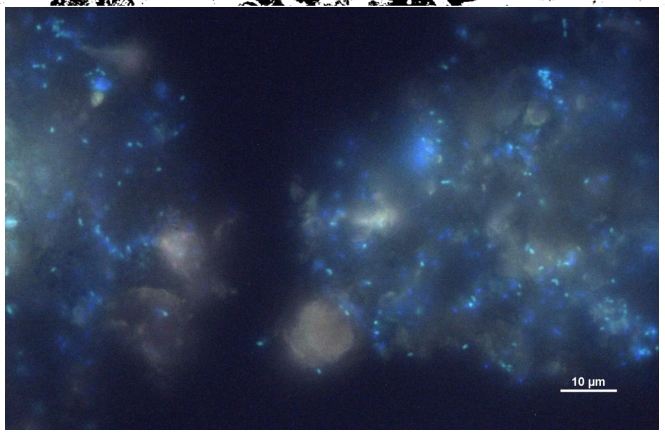


Keep the workers happy

- To imagine a cow's rumen at work, there is more than 1,000,000 x more microbes
- Estimates of up to 5,000 OTUs in the rumen mean more than 100 x more species
- The variety of microbial roles work in synergy and are best kept in balance



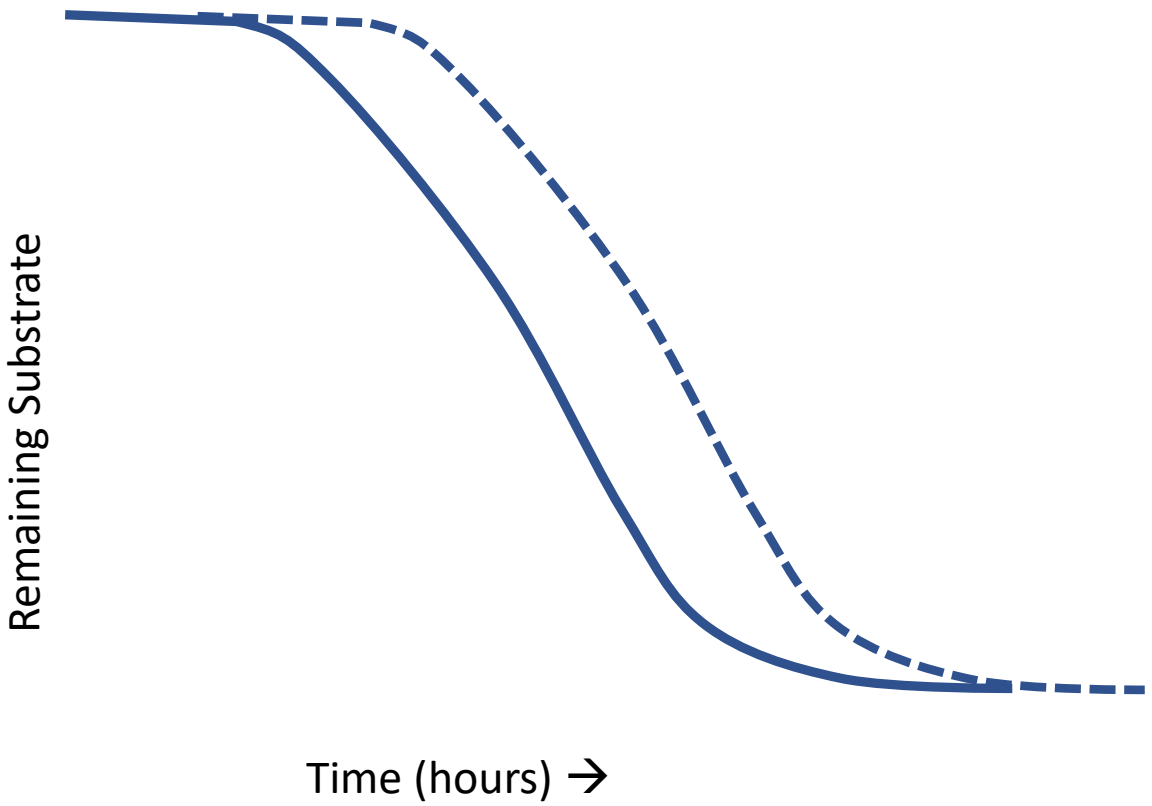




Kim et al., 2011

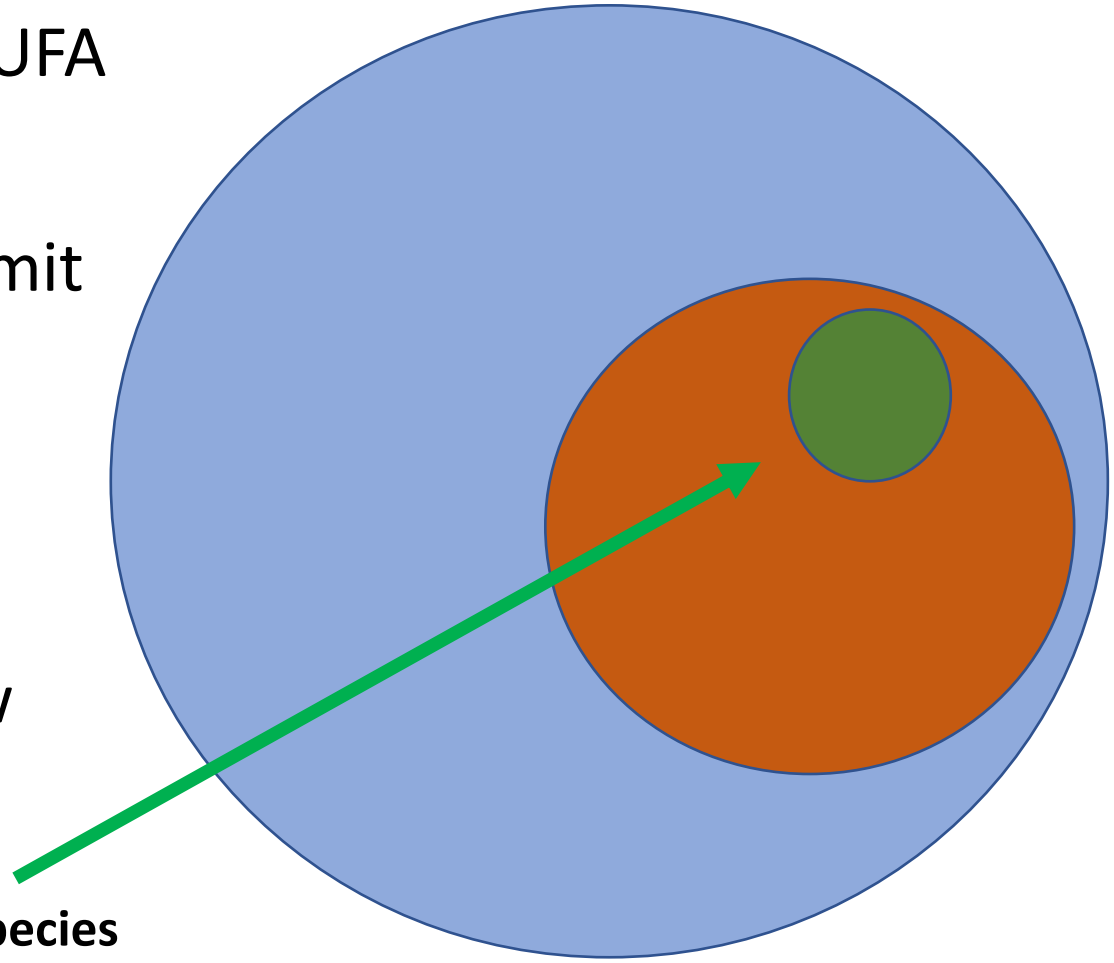
Lag phase

- Amount of time between microbial contact and significant fermentative activity
- Can be decreased/increased
  - pH
  - Minerals
  - Feed additives
  - Nitrogen source for microbes



Milk fat depression from the microbe's view

- Rumen microbes vary in sensitivity to UFA
- Sensitivity drives biohydrogenation
- Disruption of cellulolytic activity will limit ability of microbes at large to biohydrogenate to C18:0
  - pH, PUFAs, increased UFAs
- Protozoa can sequester fatty acids and pass them downstream during outflow

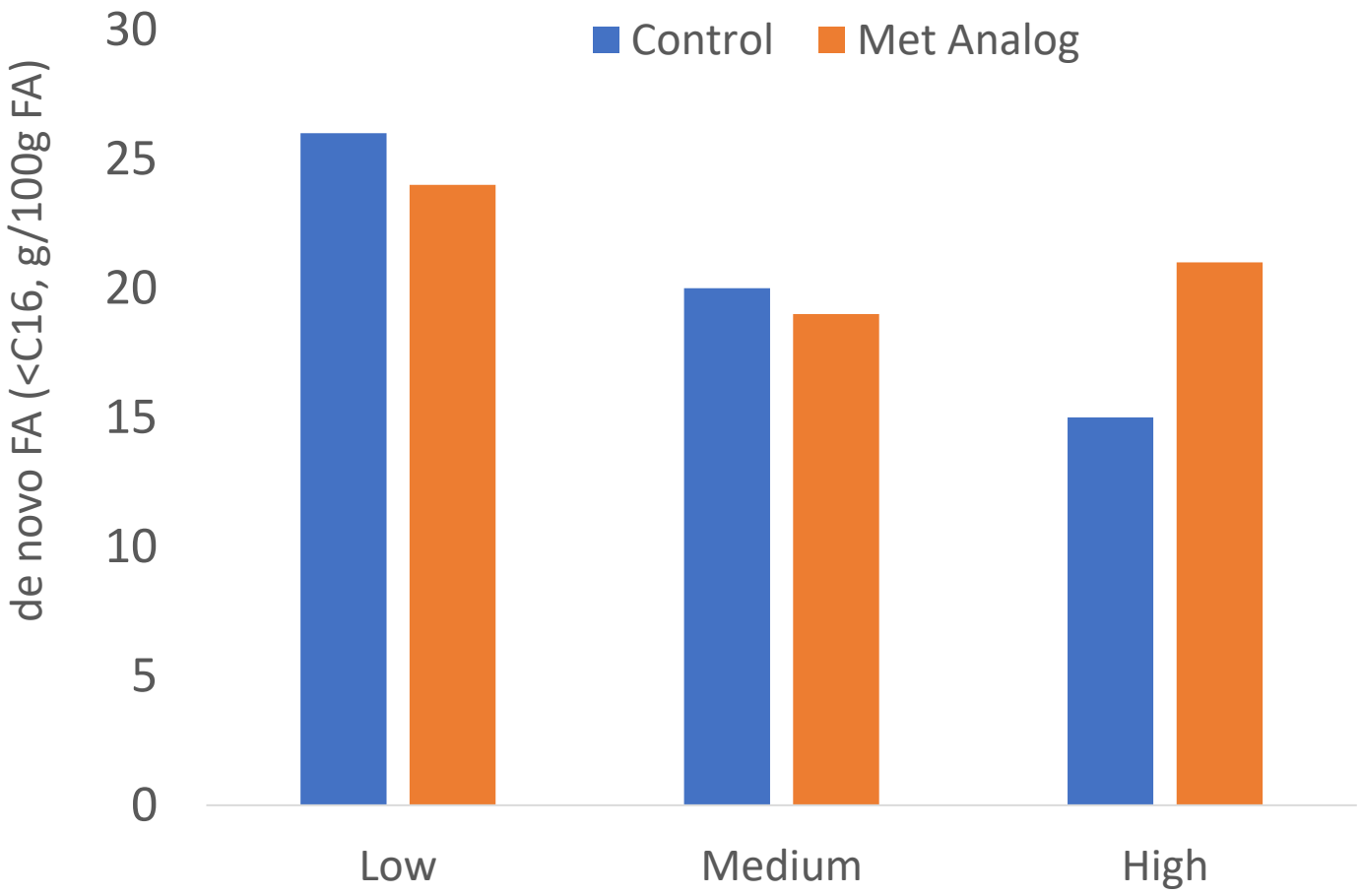


Some Butyrivibrio species

Jenkins et al., 2008, Lourenco et al., 2010

Methionine analogs

- Rumen microbes respond to methionine
- Increased cellulolytic bacteria
  - Tied to role in biohydrogenation
- Decrease outflow of trans-10 C18:1 in high cows
- Increased de novo (< C16) fatty acids in milk



Adapted from Baldin et al., 2017

AA Composition of Microbes

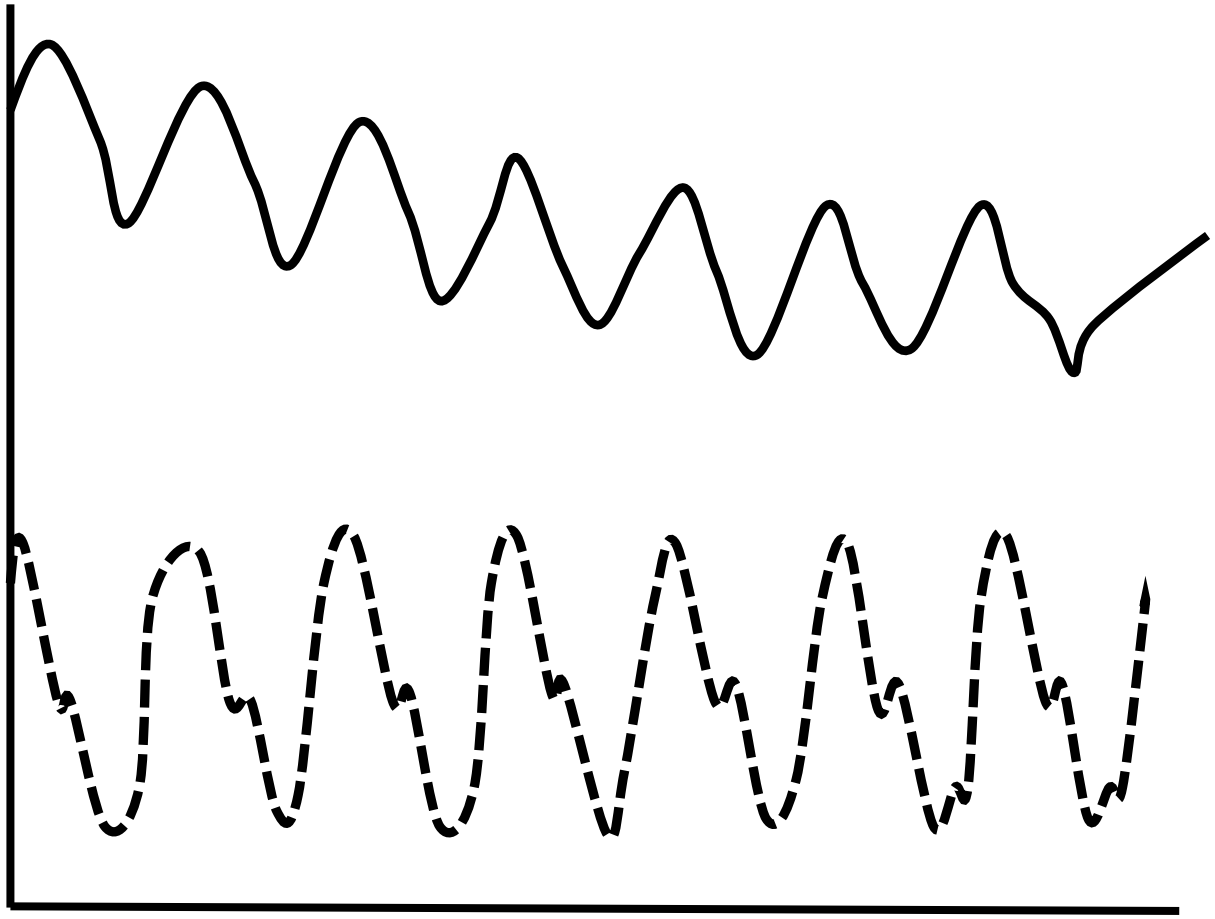
Amino Acid	Bacteria[1]	Protozoa[1]	AA Suppl.	Blood Suppl.	Blood
Methionine	1.5	1.2	6.1	0.8	1.1
Lysine	7.8	11.6	9.3	6.0	8.3
Histidine	2.8	3.0	5.8	4.0	5.7
Threonine	3.7	3.4	3.3	3.2	4.3
Valine	4.5	3.9	7.7	6.7	7.9
Leucine	4.6	5.4	12.4	10.0	11.8
Isoleucine	3.7	4.6	0.4	1.5	1.0
Phenylalanine	2.4	3.1	6.6	5.4	6.5
Arginine	9.0	9.4	3.3	3.8	4.0

[1]Hungate, 1966

Hoeller and Harmeyer (1964) demonstrated protozoa can have vast (5% units) difference between genera, possible species.

Time below pH versus unpredictable pH

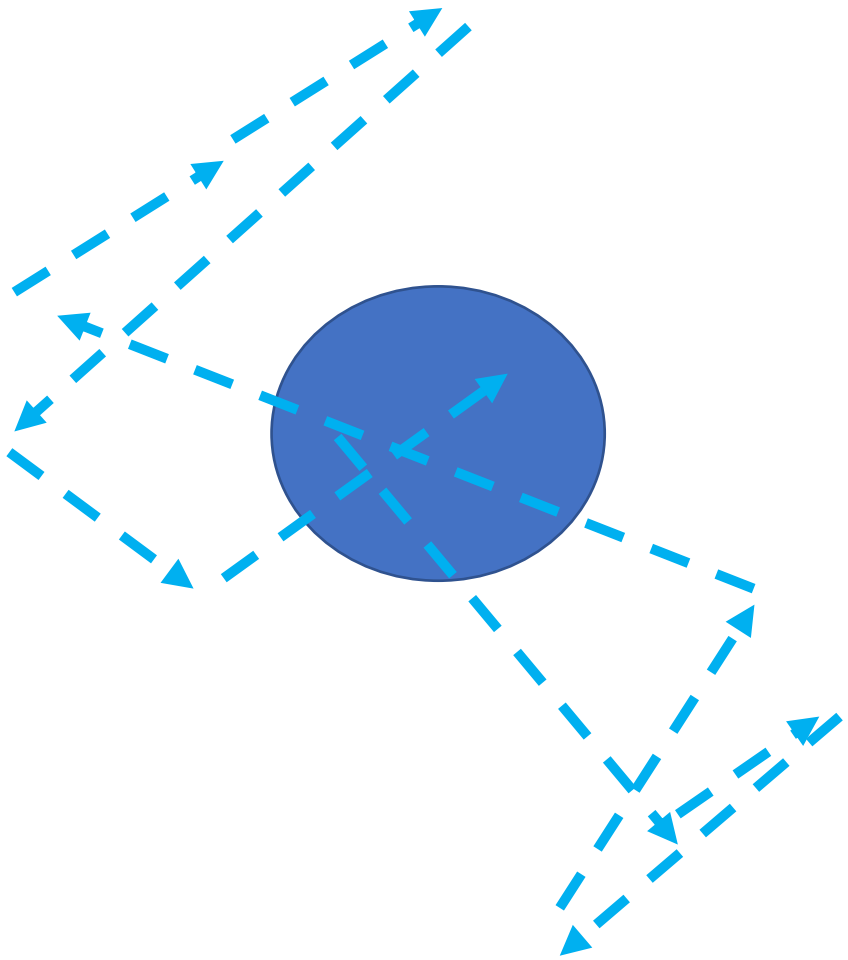
- Low pH can leave cows susceptible for depression
- Variation in pH can be a trigger
- Loss in cow production correlated with aberrations in pH
  - Not just time below anymore
  - Predicted up to 2 d in advance



Adapted from Denwood et al., 2018

Crosstalk Between Cows/Microbes

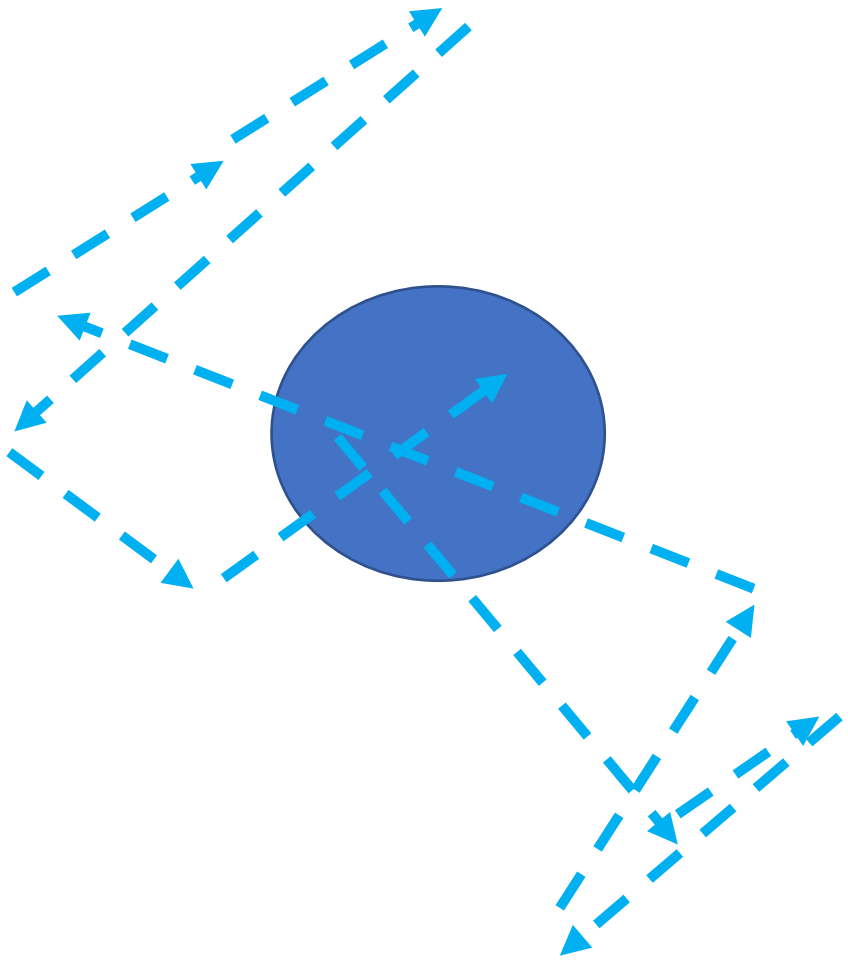
- Cows cross-innoculated shift back to original microbial communities in 3-9 weeks
  - pH and VFAs return to cow averages
- Cows can recover from acidosis insults
  - <u>If the CAUSE is removed</u>



Weimer et al., 2010

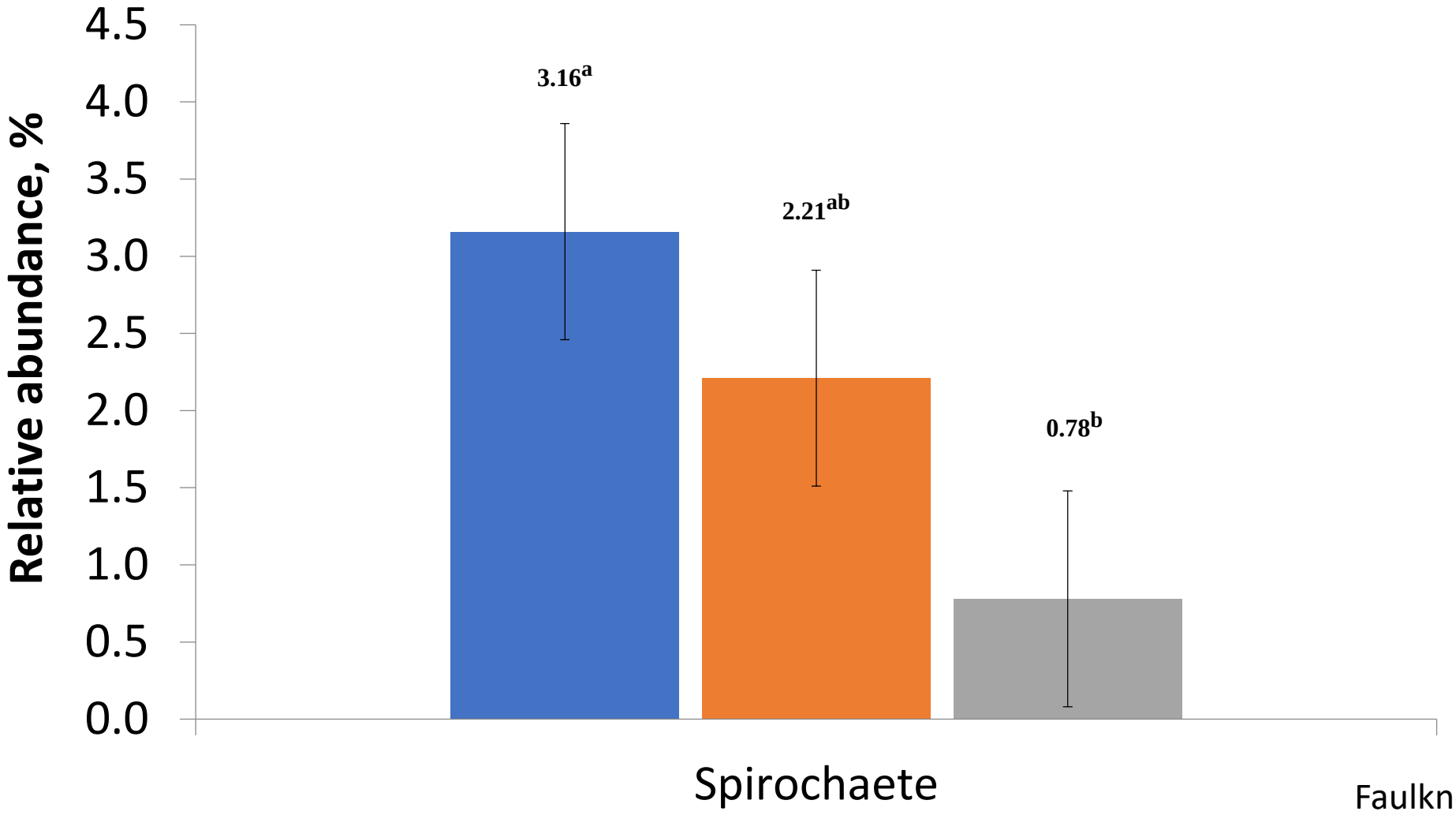
Crosstalk Between Cows/Microbes

- Cows cross-innoculated shift back to original microbial communities in 3-9 weeks
  - pH and VFAs return to cow averages
- Cows can recover from acidosis insults
  - <u>If the CAUSE is removed</u>
- Recovery can take at least 2 weeks
  - Even adding healthy fluid doesn't help



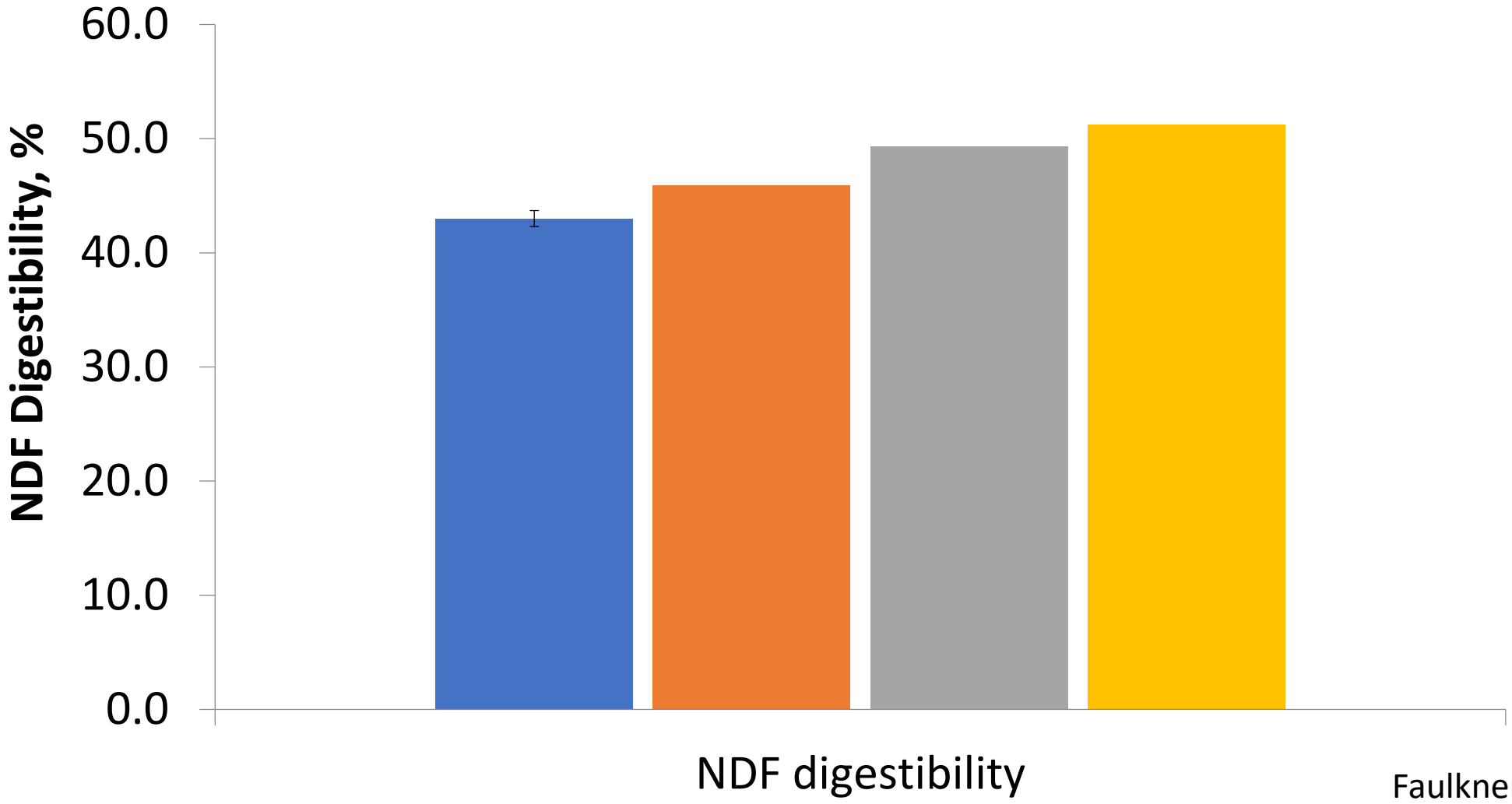
Weimer et al., 2010; Pitta et al., 2018

Can mineral source affect hoof health?



Faulkner et al., 2016

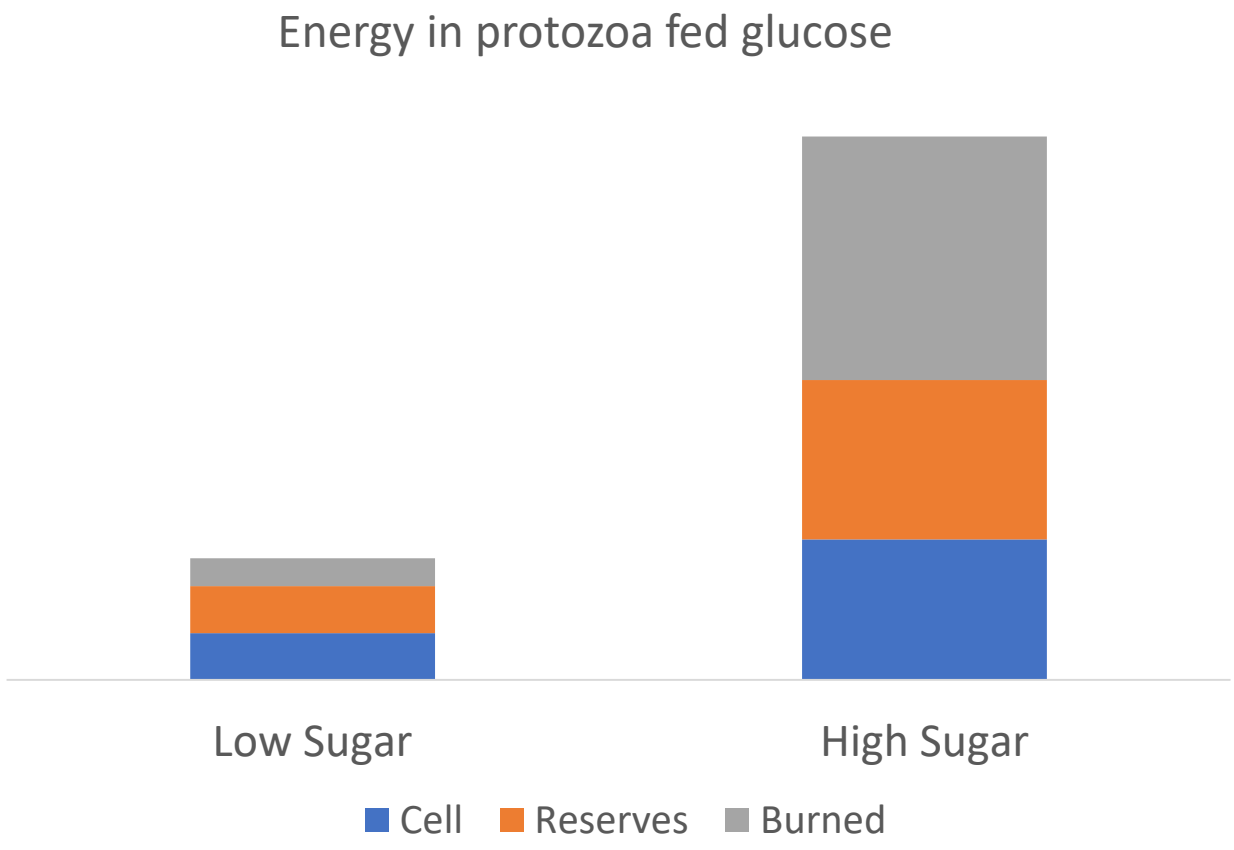
Do minerals shift microbial activity?



Faulkner et al., 2016

Microbes can be more or less efficient

- Microbes can be very efficient when substrate is limiting
- When substrate is in excess, the wheels can come off
- Don’t provide energy without nitrogen, or the other way around



Adapted from Hackmann and Firkins, 2015

Takeaways – back to basics

- We know that fat pays, the world around
- A lot of products advertise increased components
- But you can improve management TODAY and many ways can be free

1) Consistency in feed ingredient handling, mixing, and delivery
   - bunk space, sorting, spoilage, shrink
2) Consistent delivery time
   - avoid variation in rumen pH, keep feed pushed up
3) Consistent daily routine
   - parlor efficiency, rest and rumination, less stress