More About Nutrition

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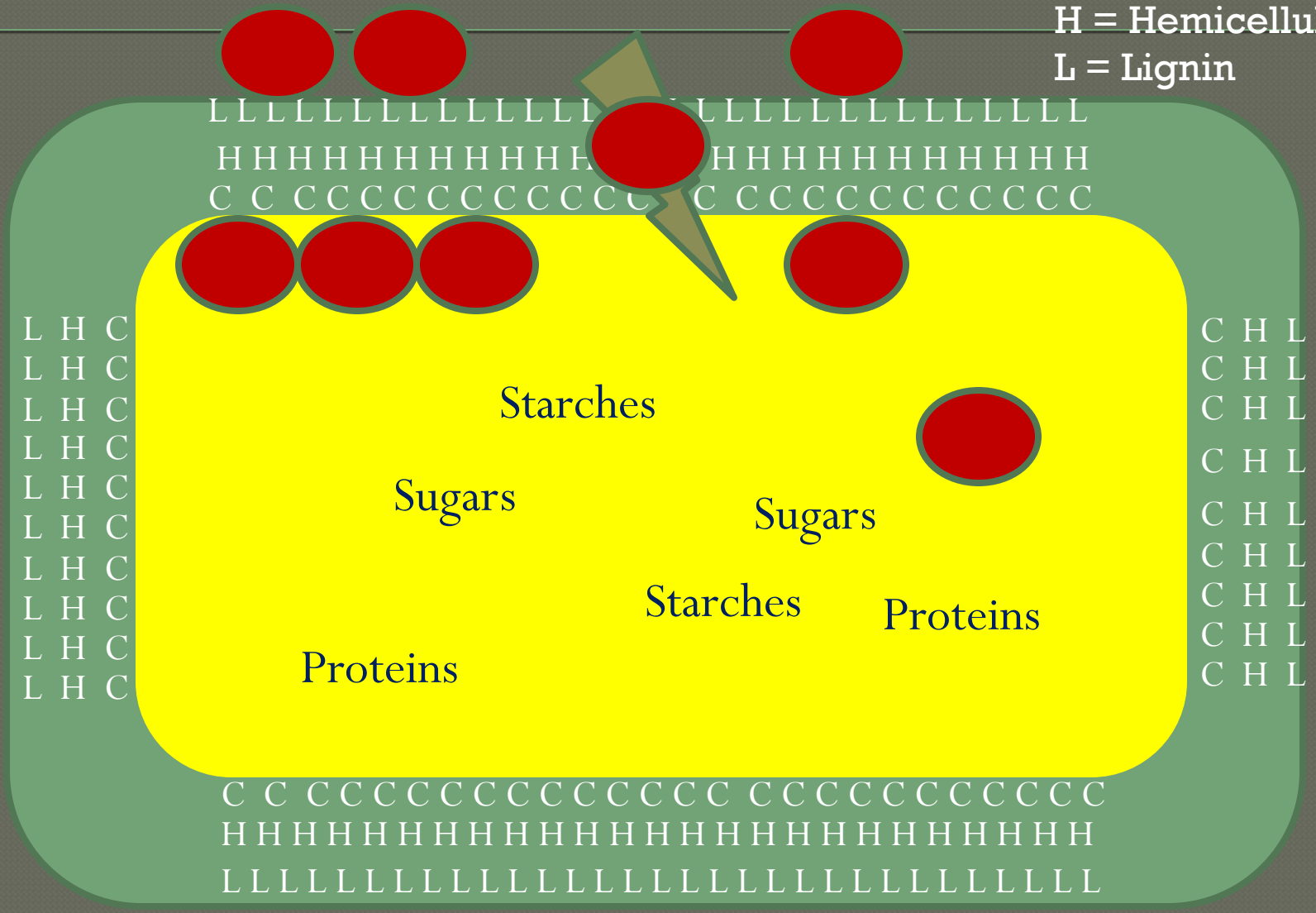
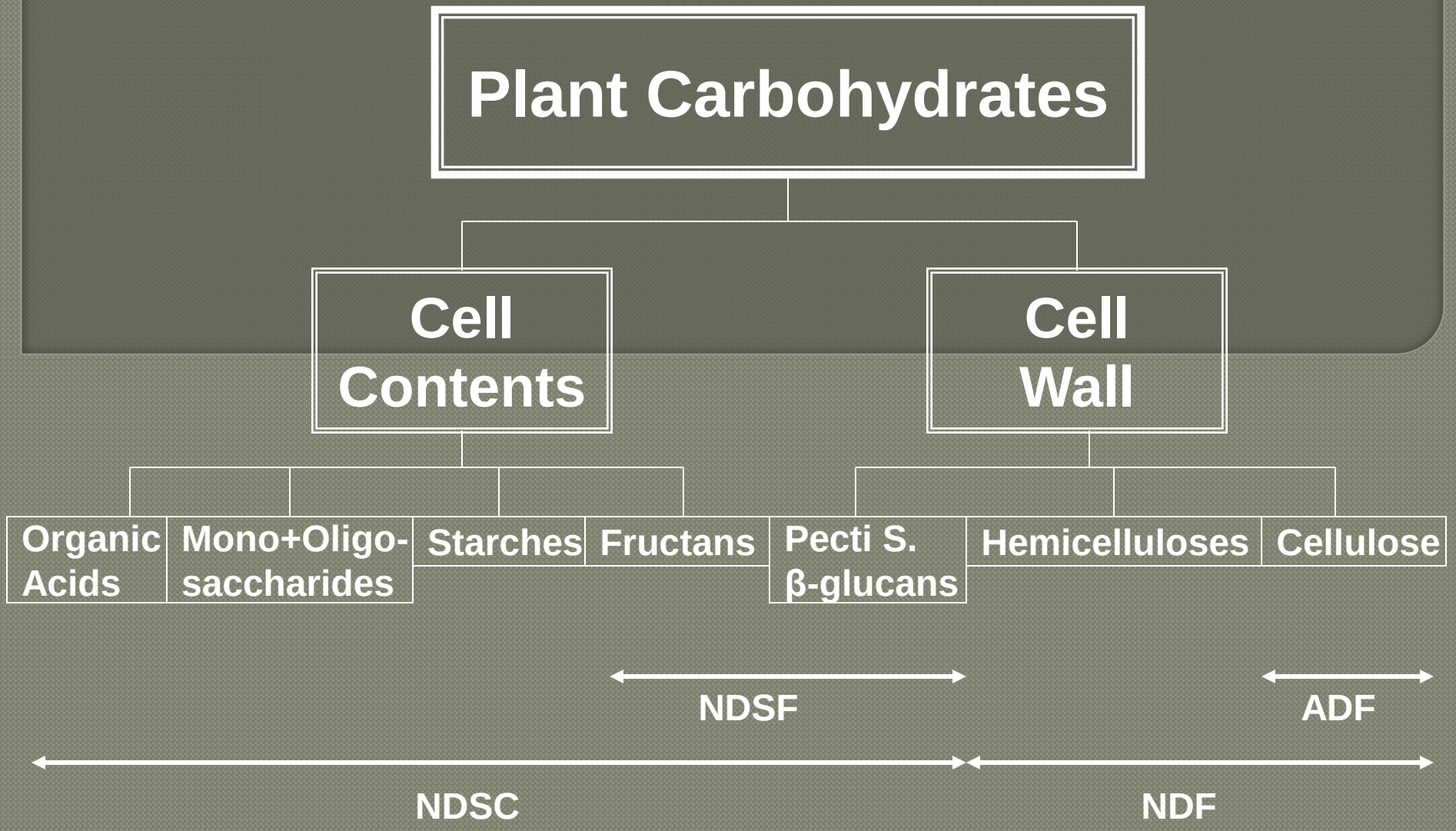
Overview

- Key topics to "touch" on:
  - Fermentable fiber
  - Pregnancy toxemia (ketosis)
  - Milk fat/protein depression
  - Pasture supplementation

Plant Cell Structure

C = Cellulose
H = Hemicellulose
L = Lignin




Plant Carbohydrates
Cell Contents
Cell Wall
Organic Acids
Mono+Oligo-saccharides
Starches
Fructans
Pecti S.
β-glucans
Hemicelluloses
Cellulose
NDSF
ADF
NDSC
NDF

NDF Terms

- Indigestible NDF (INDF) = not digested in the animal and appears in feces
- Potentially fermentable NDF (pfNDF) =
  Total NDF – INDF
  The NDF that can be fermented and used by the animal
- Digestible NDF (NDFD) – NDF digested – A value that can be measured in the lab. An index of pfNDF.

NFC (Nonfiber Carbohydrates)

- Sometimes called NSC (Nonstructural carbohydrates)
- Mainly starch, sugar and pectin
- Provide fermentable carbohydrate energy for the rumen bugs
- Rumen bugs synthesize microbial protein for use by the animal - high CP, high bypass, high intestinal digestibility and excellent ratio of lysine to methionine
- Cheap protein source!!

Why is This Important?

- Sheep and goats have small rumens and we need to maximize fiber digestion, rumen fermentation and microbial protein production.
- To stimulate feed intake, we need feeds that are digested in the rumen, pass from the rumen and make space for additional feed to enter.
- INDF takes up space, stays in the rumen and lowers feed intake

NDF in Common Forages

Item	NFC, % of DM	NDF, % of DM	INDF, % of DM	pfNDF, % of DM
Alfalfa hay – 1	27	42	23	19
Alfalfa hay – 2	23	55	32	23
Orchardgrass – 1	20	47	10	20
Orchardgrass – 2	13	67	31	36
Timothy – 1	20	55	15	40
Timothy – 2	14	68	29	39
Corn silage	42	41	13	28

Source: Dr. M. L. Thonney

NDF in Common Feeds

Feed	NFC,%	NDF, %	INDF, % of DM	pfNDF, % of DM
Corn	75	9	3	6
Barley – heavy	63	19	5	14
Beet pulp	32	54	14	40
Corn gluten feed	18	45	5	40
Distillers grain	10	50	8	42
Soy hulls	11	70	8	62
Soybean meal	28	14	5	9
Oat hulls	9	78	50	28

Source: Dr. Mike Thonney

How do we Use This?

- To help in selecting the forages (type, quality) to be fed
- To select the grain ingredients to provide
- Can use the Feed Form spreadsheet from Dr. M. Thonney to formulate rations (www. sheep.cornell.edu)

Late Pregnancy Ration Guidelines

Item	1 lamb	2 lambs	3 lambs
DMI, lbs.	4	4.2	4.4
CP, % of DM	11	11.5	12
INDF, % of DM	25	23	20
Minimum pfNDF, % of DM	22	22	22
Maximum NFC, % of DM	32	34	36

Source: Dr. M. Thonney

Early Lactation Ration Guidelines

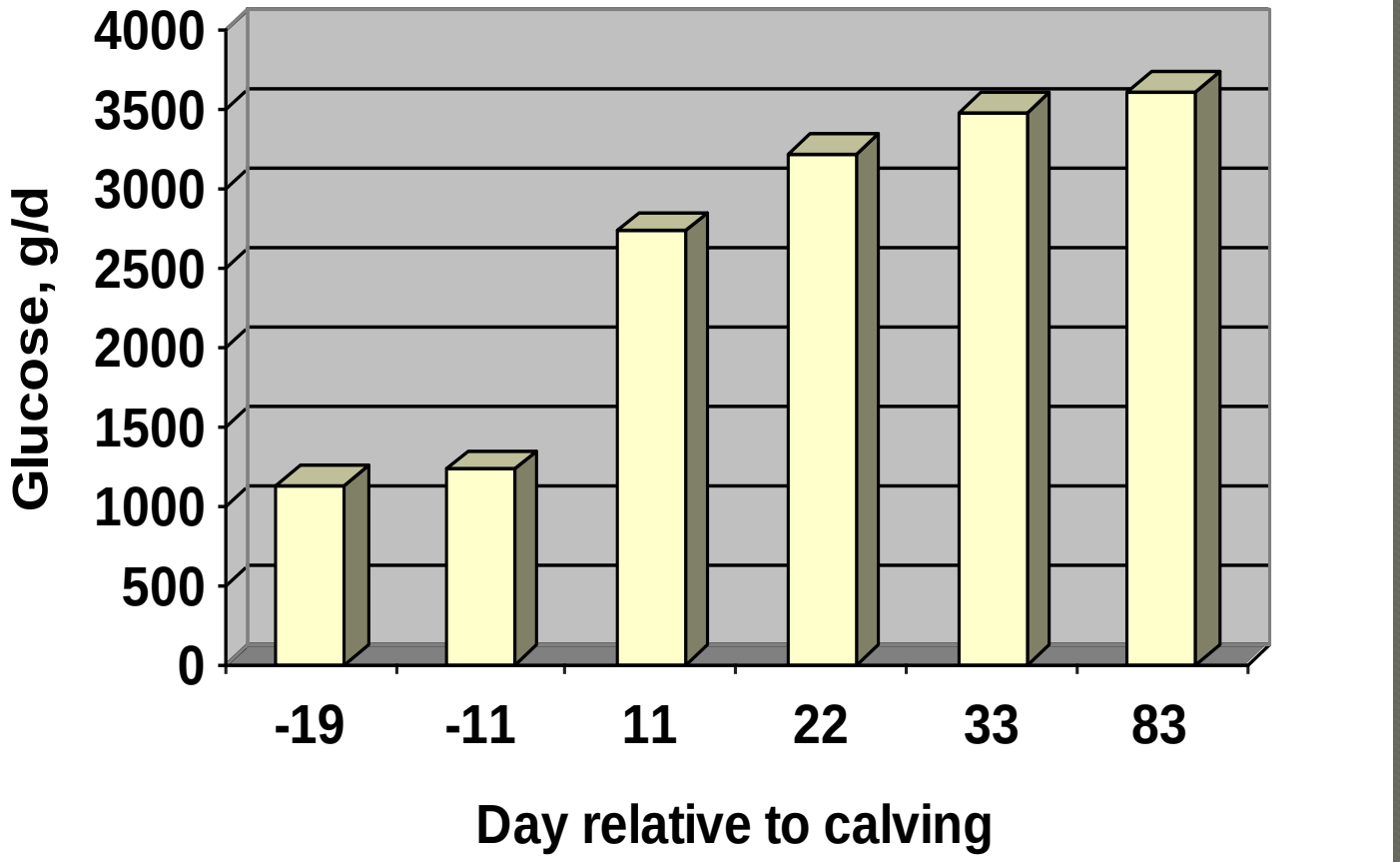
Item	1 lamb	2 lambs	3 lambs
DMI, lbs.	6	7	8
CP, % of DM	14	15	16
INDF, % of DM	20	15	10
Minimum pfNDF, % of DM	22	26	30
Maximum NFC, % of DM	34	34	34

Source: Dr. M. Thonney

Pregnancy Toxemia (ketosis)

- It's actually very simple!!!
- Energy available from feed is < than the energy required by the animal for maintenance, fetal growth, mammary gland rebuilding and colostrum formation.
- Accentuated by the rapid change in demand at lambing and when milk production starts.
- May be confounded with calcium.

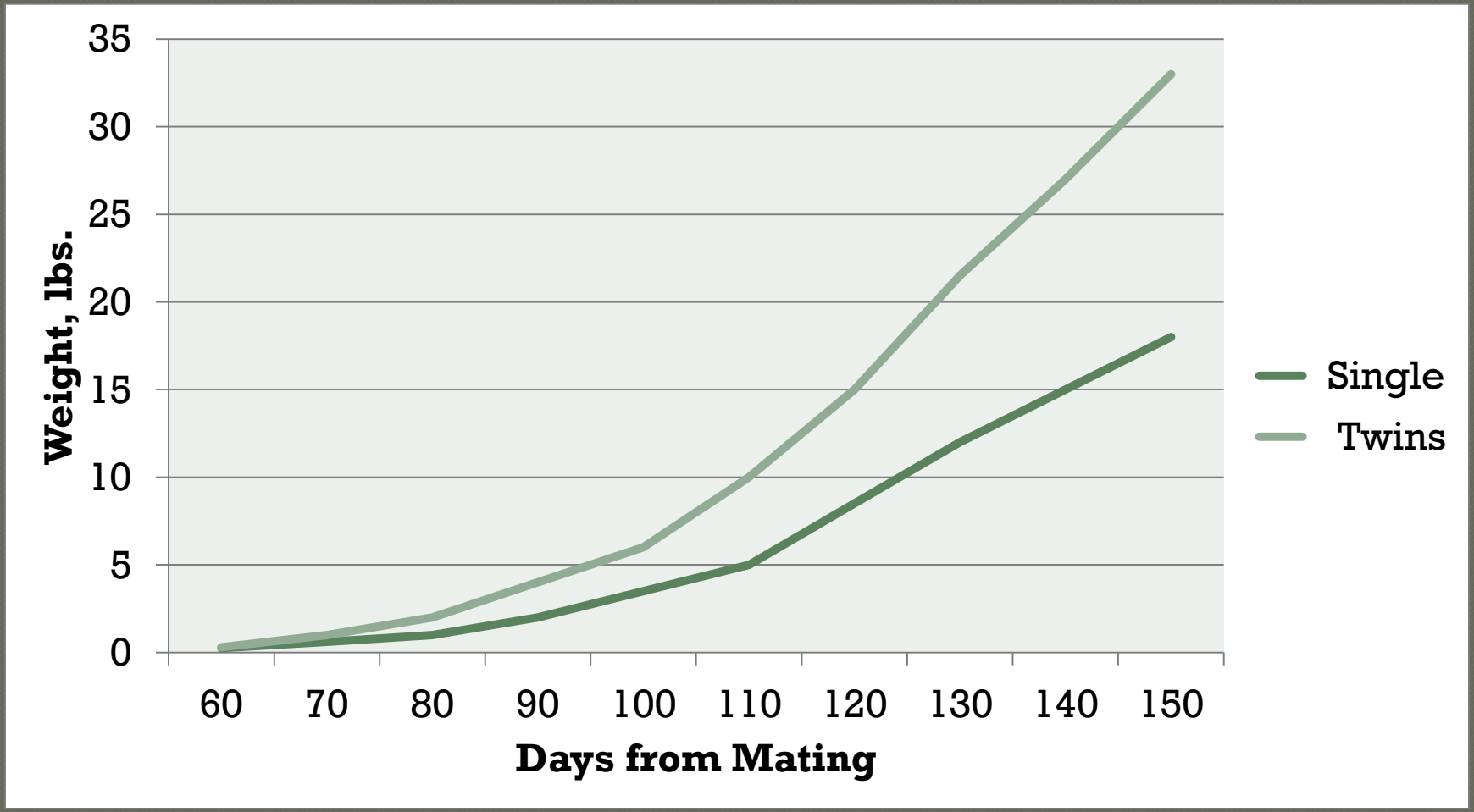
Net release of glucose by splanchnic tissues during the transition period and early lactation (Reynolds et al., 2003)



What Are the Driving Factors?

- Rapid fetal growth (60-70% of fetal growth in last trimester).
- Energy and protein needed to support fetal growth.
- Number of lambs the ewe is carrying
- Age of ewe (young and still growing versus mature).
- Thin ewes.
- Fat ewes.

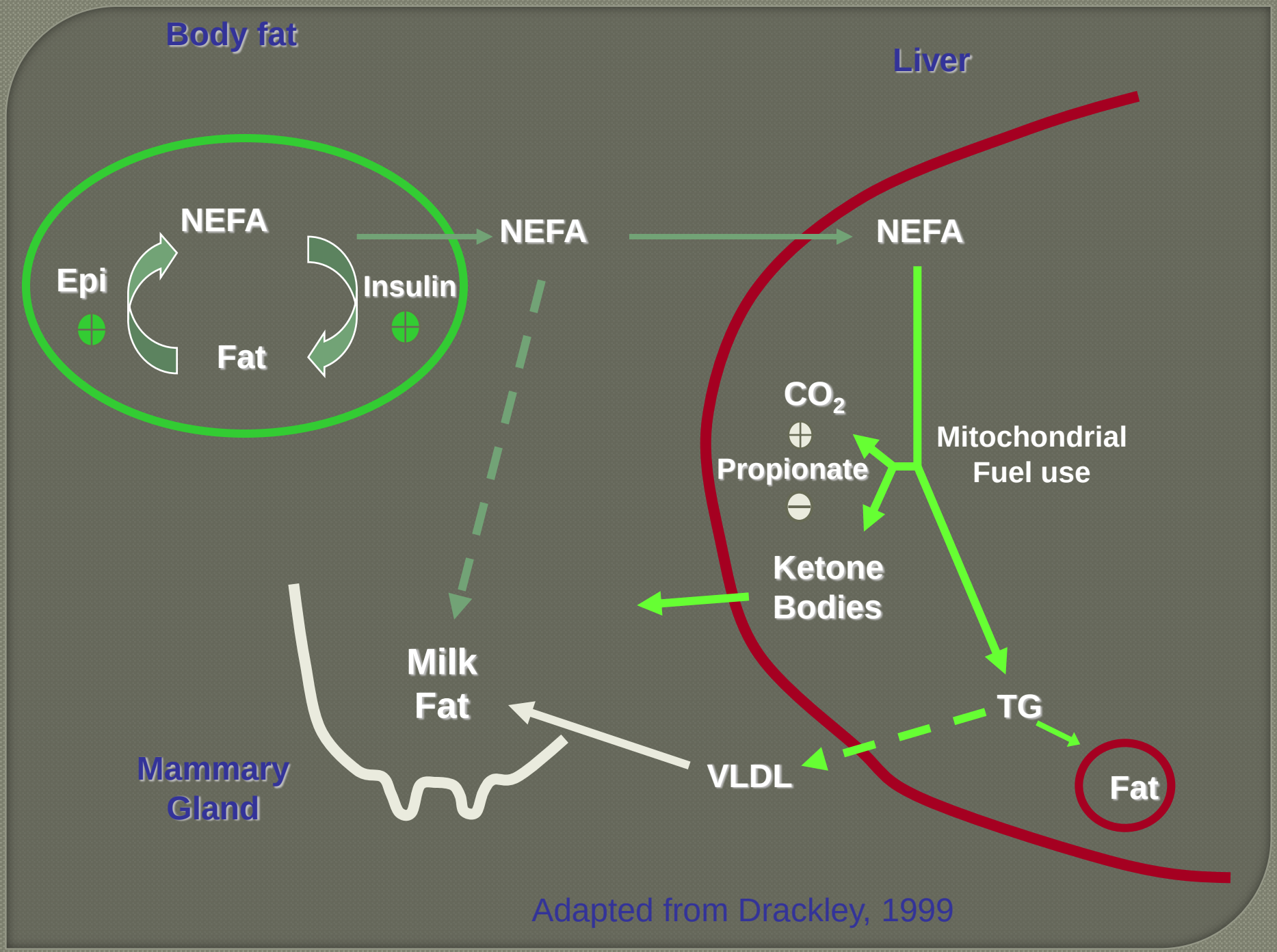
Conceptus Weight in Sheep



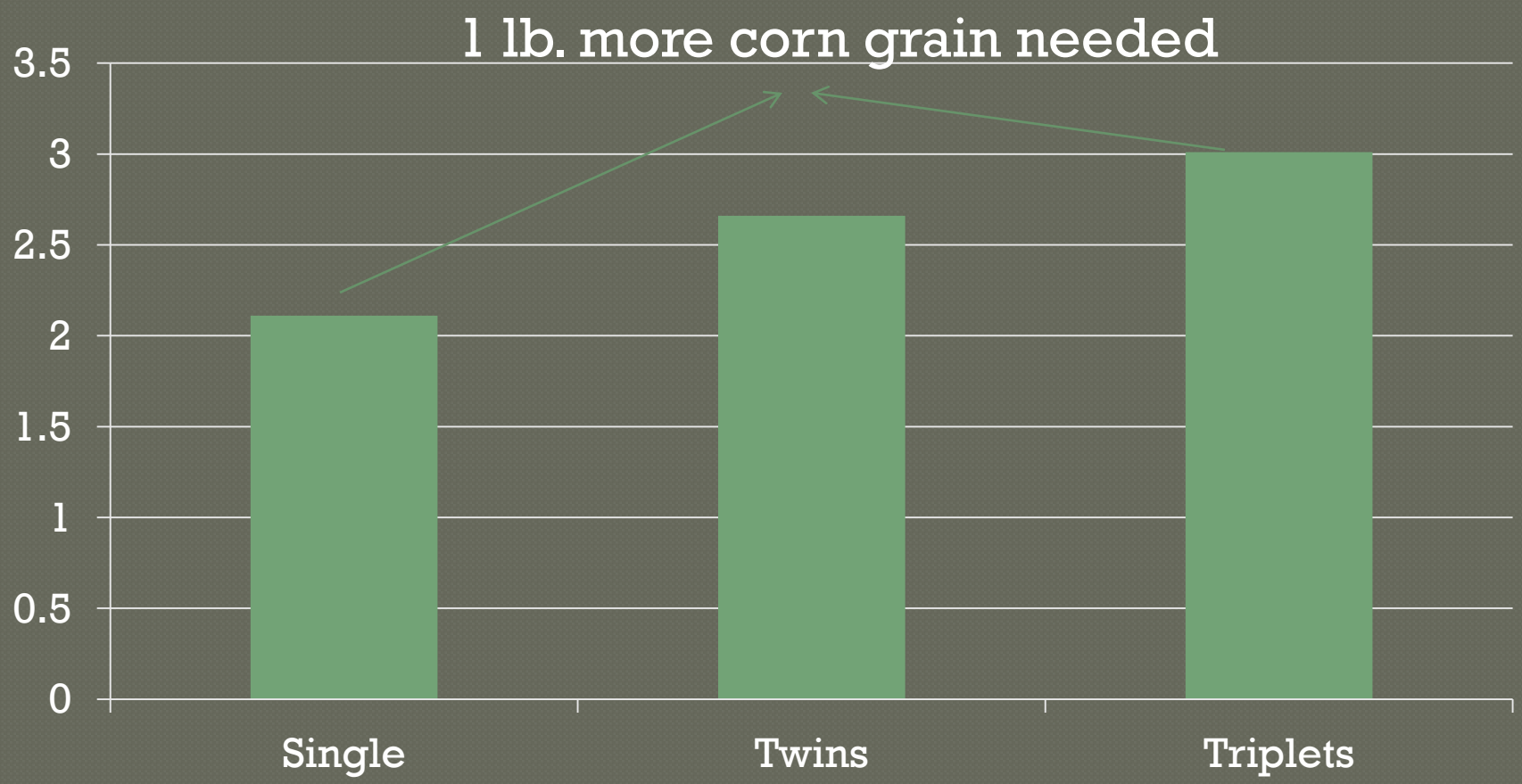
Source: Dr. R. Van Saun – Penn State

Key Considerations

- If energy intake is low:
  - animals try to mobilize body fat for energy
  - can lower lamb birth weight
  - less lamb vigor
  - lower quantity and quality of colostrum
- Can test for ketones in urine with test strips (purple if positive).


Body fat
Liver
NEFA
Epi
Insulin
Fat
NEFA
NEFA
CO_2
Propionate
Mitochondrial
Fuel use
Ketone
Bodies
Milk
Fat
TG
VLDL
Fat
Mammary
Gland
Adapted from Drackley, 1999

Late Gestation Daily TDN Required, lbs.



Based on 2007 NRC, 154 lb. ewe

Prevention

- Feed high quality and high digestible forages and feeds in late gestation and early lactation.
- Early detection of ewes that are off-feed, lethargic, droopy heads, etc.
- Make sure there is adequate access space for feed and water.
- Separate young ewes from older ewes.
- Forage testing to determine quality.
- Feed extra grain to ewes with twins or triplets.

Treatment

- Most common:
  - Drench with 2-3 oz. propylene glycol (may need to repeat 2-3 times/day)
  - IV glucose (and/or calcium)
  - B vitamins?
- Check with vet for other treatments.
- Find highly palatable feeds and get them eating!!!! (dairy cows often like a low NDF grass hay or some calf starter with molasses).

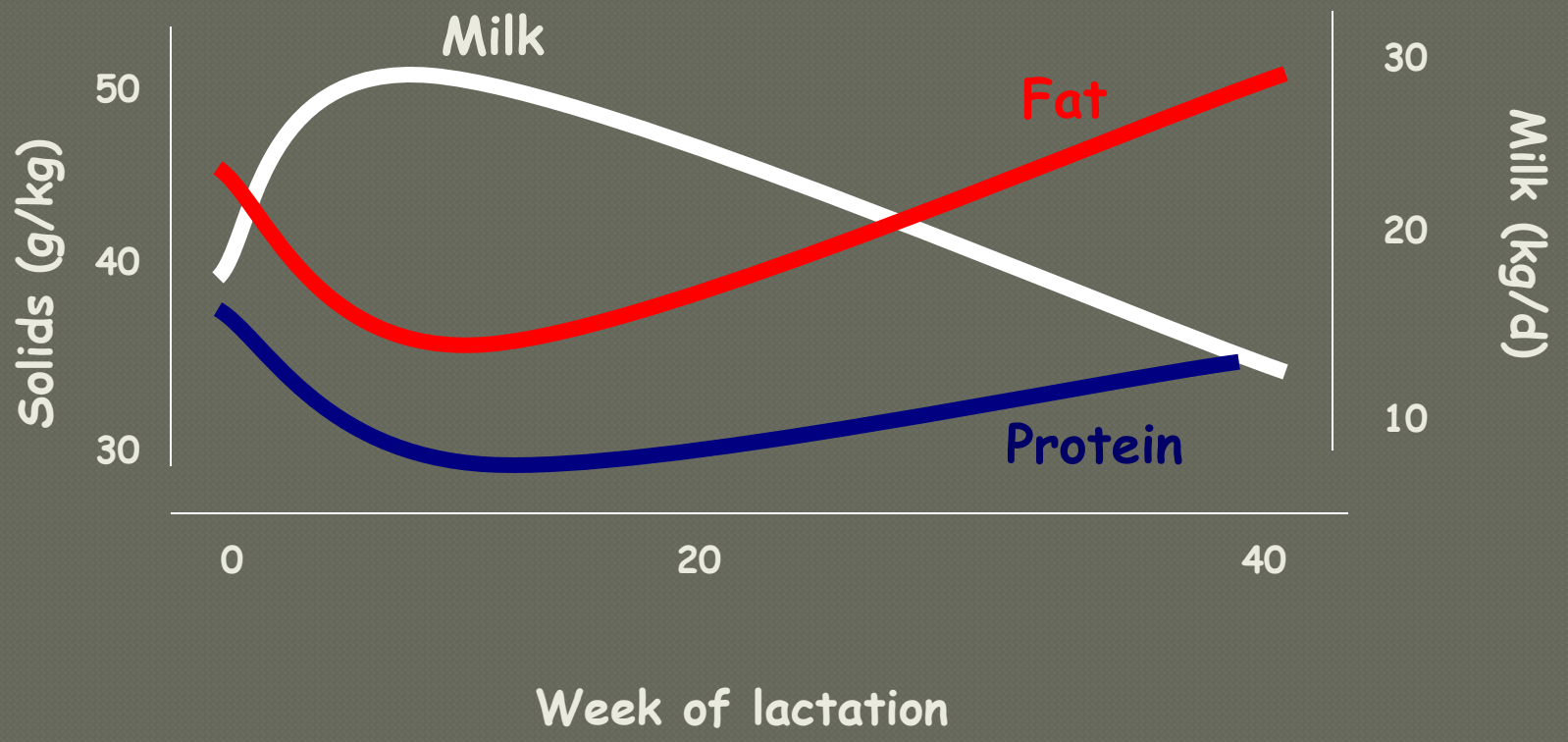
Milk Composition

Item	Dairy Cow	Sheep	Goat
Protein, %	3.2 – 3.8	5. 4 – 6	3.1 – 3.5
Fat, %	3.5 – 4.5	6 – 7	3.5 – 4
Lactose, %	4.7 - 5.2	5.1 – 5.4	4 – 4.6
Energy, kcal/100 g	60 – 70	95 – 105	60 - 70

Factors affecting milk composition

- Genetics
- Stage of lactation
- Age
- Health
- Nutrition

Stage of lactation



Milk Fat Affected by Many Factors

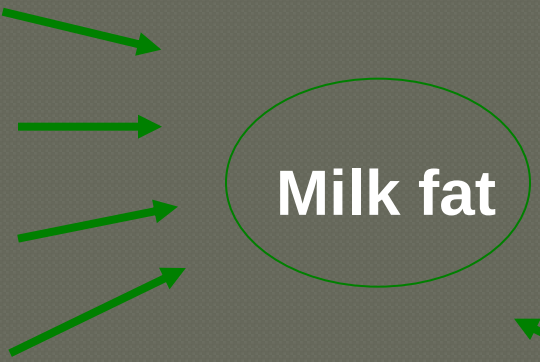
Nutritional Factors

fiber in the diet

specific feeds

feeding strategy

ionophores



Non-nutritional Factors

genetics

stage of lactation

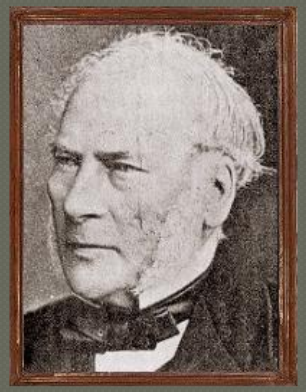
season

parity

ambient temperature

Milk constituent	Blood precursor
Lactose	Glucose
Protein	
Casein	
Lactoglobulin	Amino acids
Lactalbumin	
Immune globulins	Immune globulins
Butterfat	
Fatty acids	Acetate, β-OH Butyrate
	Long-chain FA
Glycerol	Glucose
	Glycerol

History of Milk Fat Depression



Boussingault

- Recognized by Boussingault in 1845
- Naturally occurs with certain diets
- Milk fat reduced but milk yield and other milk components unaffected

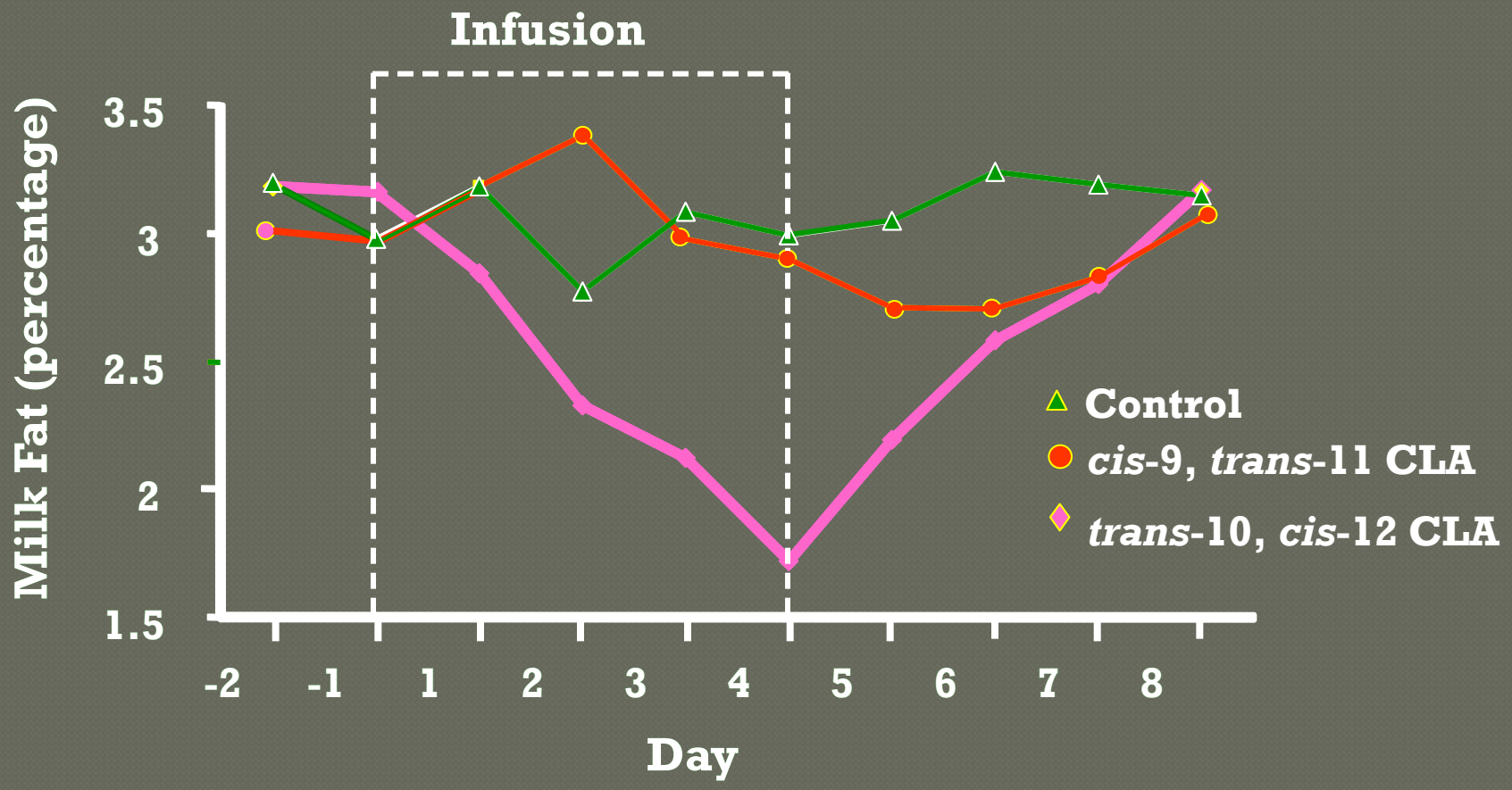
Milk Fat Depression Characteristics

Diet-induced

- high concentrate, low fiber
- low in effective fiber
- plant and fish oil supplements
- unsaturated fatty acids

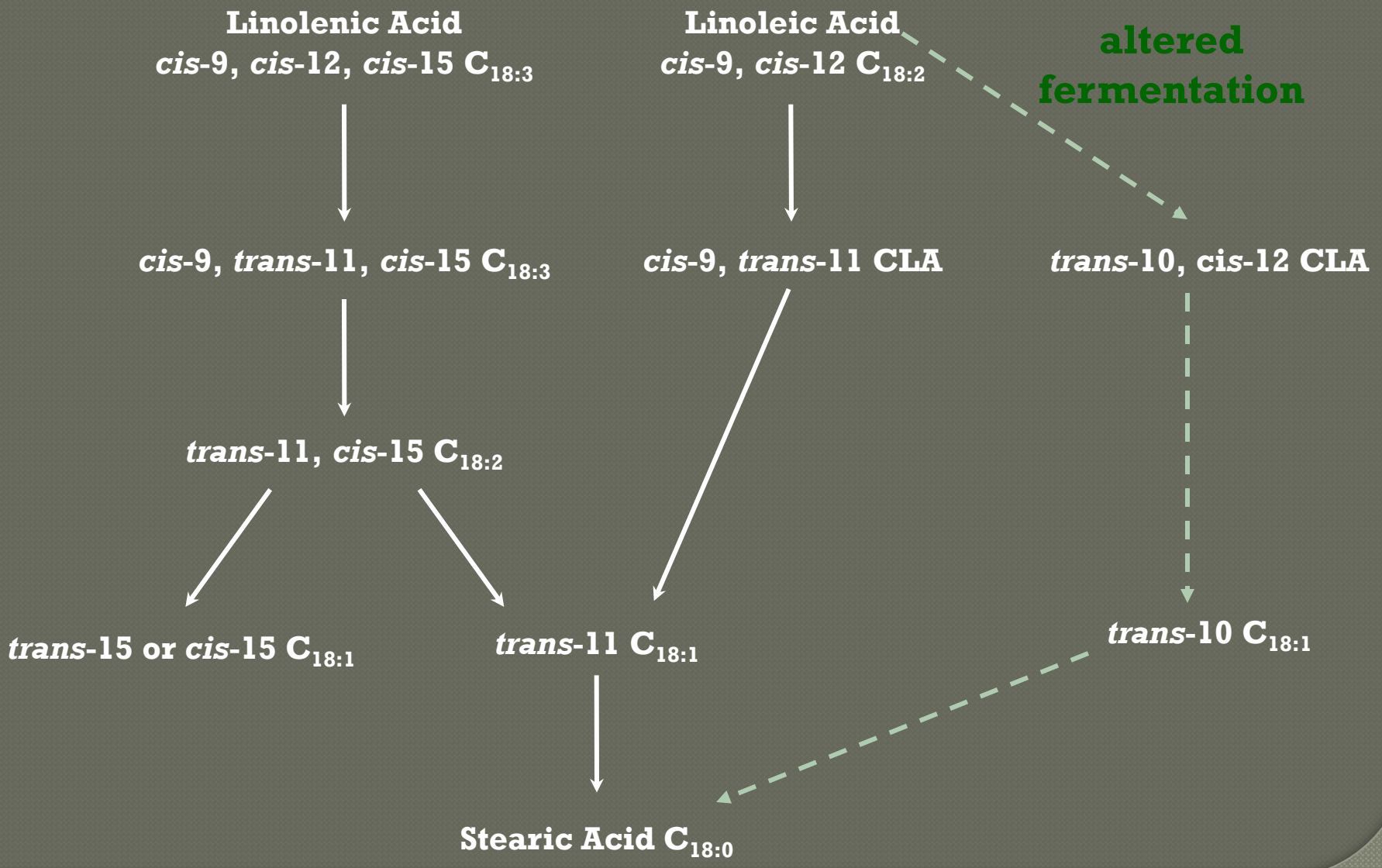
- Specific for milk fat, up to 50% decrease
- Decreased yield of all fatty acids, but greatest for de novo synthesized fatty acids

Effect of CLA Isomers on Milk Fat

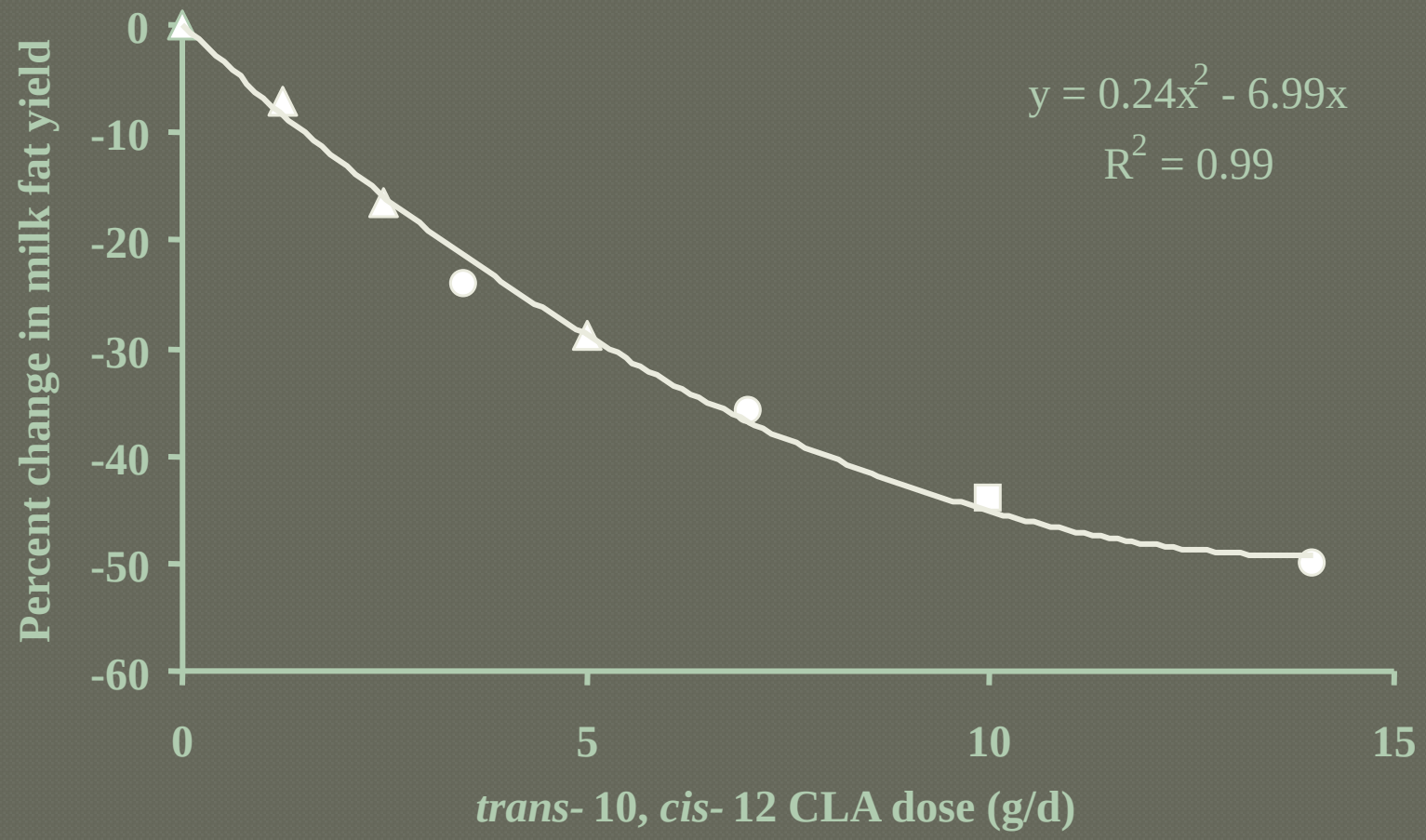


Baumgard et al., 2000

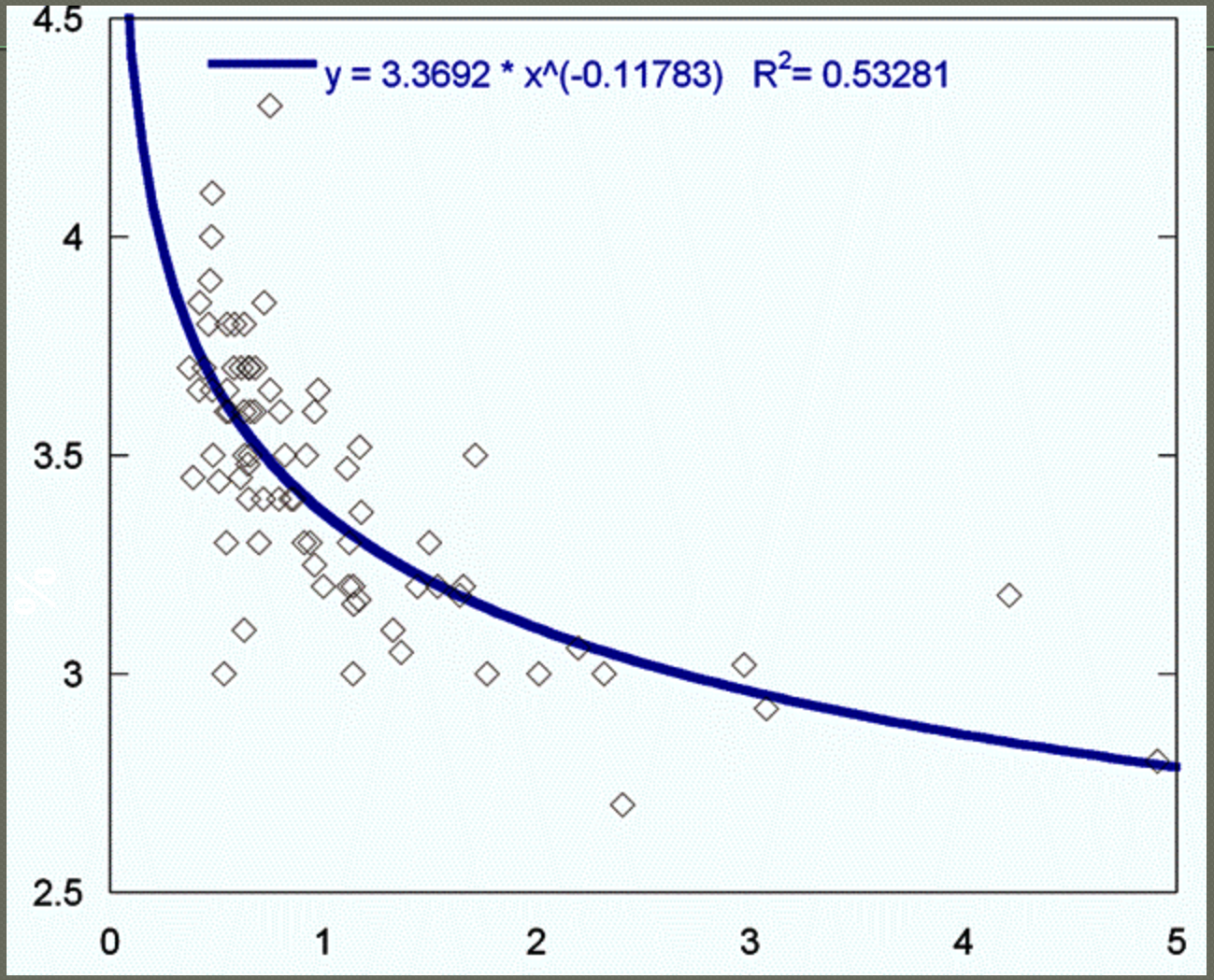
Rumen Biohydrogenation



trans-10, *cis*-12 CLA Dose-Response

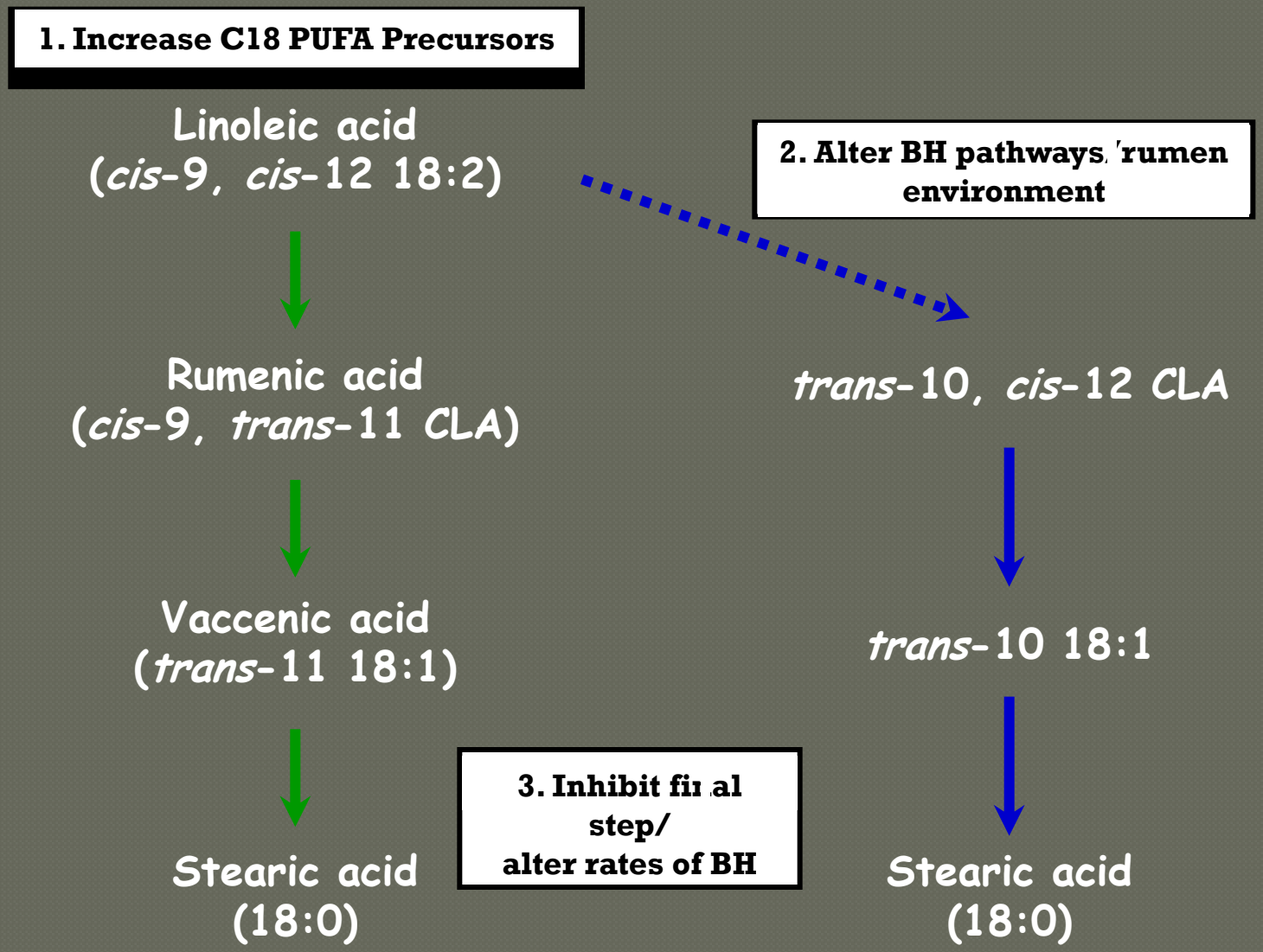


Relationship Between Milk t10 C18:1 Content & Milk Fat %



Overton et al., 2008 CNC

Dietary components can impact the risk of MFD in 3 ways



How to Lower the Risk of MFD

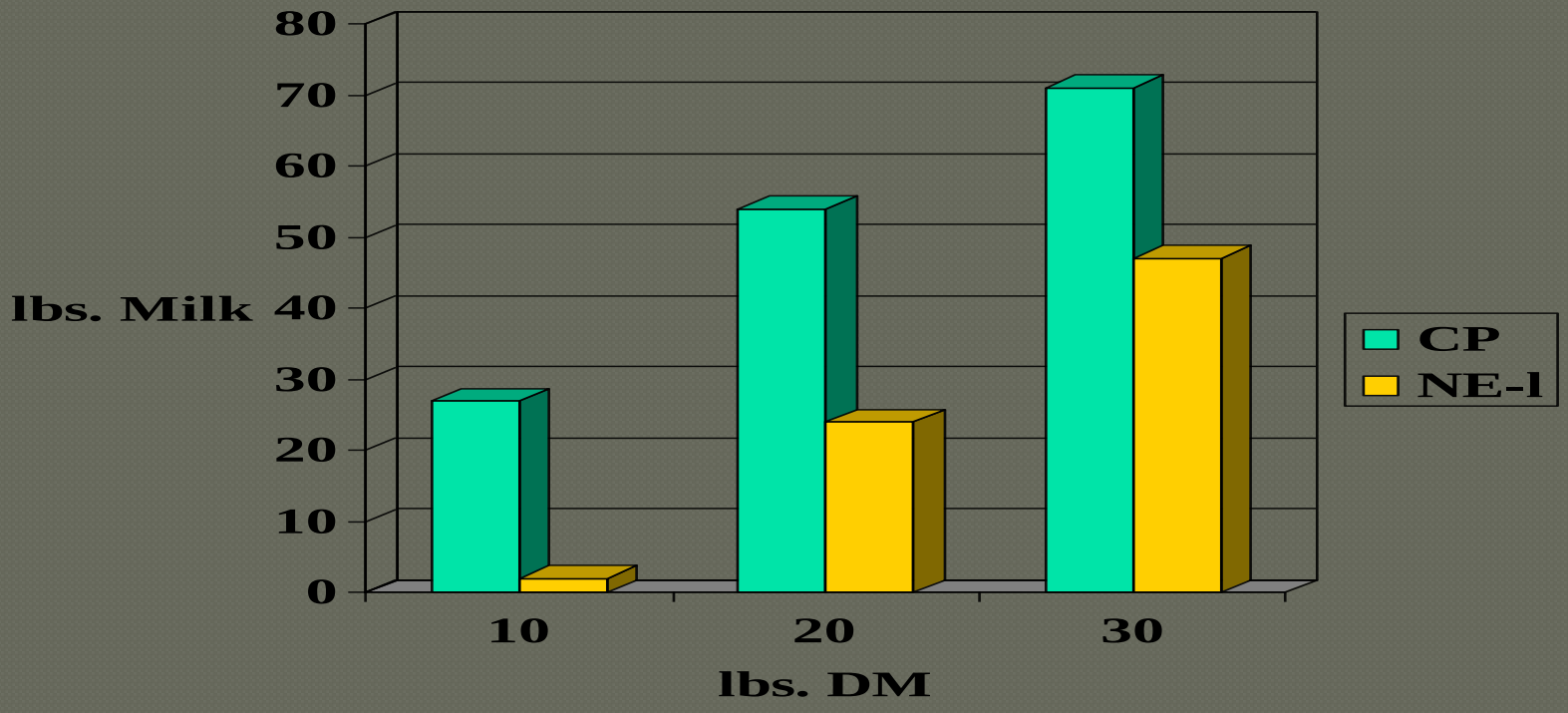
- Don't feed high levels of unsaturated fatty acids.
- Control levels of NFC (guideline for maximum is 32-34% in ration).
- Minimize sorting of feed.
- Adequate feed bunk space.
- Minimize "slug" feeding.

Supplementing Sheep on Pasture

- Well manage pastures are:
  - high in CP (20-30% of DM)
  - low in NDF and lignin
  - high digestibility
  - high sugar, low starch, low NFC
  - medium energy
- Protein is usually in excess relative to the energy the animal needs to utilize it.
- Inefficient protein use, nitrogen excretion to the environment.

How Much Milk from Pasture?

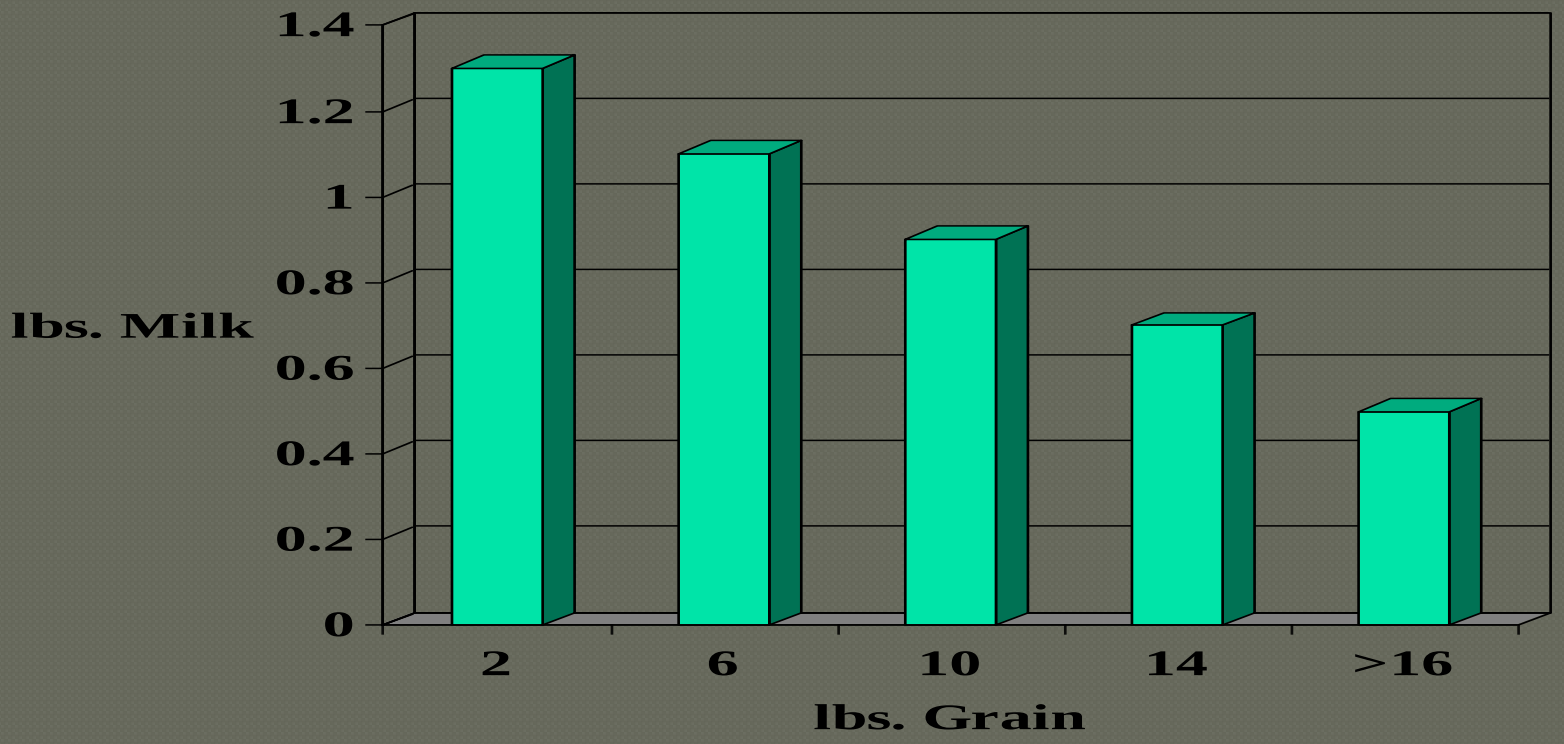
(CP = 22%, NE-l = 0.7 Mcal/lb.)



Nutrient Limitations of Pasture

- Protein:energy imbalance (high CP, low NE-l)
- High rumen degradable protein (low bypass protein)
- NFC is low
- "Effective" fiber may be low
- May see body condition loss
- May see low milk fat
- Reproduction may decrease

Expected Milk Response to Added Grain



NE SARE Project

- Bruce Clement – UNH (1999-2001)
- Used dairy sheep and goats
- Done on commercial farms
- Sheep – supplemented with 0.5, 1.5 or 2.5 lbs. of a grain mix
- Goats – supplementation rates were 1, 3 and 5 lbs. grain/day
- Done over 3 years

Grain Mix Used (14-16% CP)

Feed	Lbs./ton
Corn meal	567
Soy hulls (or beet pulp)	380
Wheat midds	364
Wheat Red Dog	200
Distillers grain	150
Soybean meal (48% CP)	110
Molasses	80
Bakery byproduct	50
Minerals & vitamins	99

Conclusions

- No differences in daily milk production in sheep producing 2-3 lbs. of milk per day.
- Pastures averaged 20% CP (up to 28%), average TDN of 60% (up to 67%)
- As more grain was fed, did sheep eat less pasture?
- For goats, the recommendation is to feed 1 lb. of grain for each 3 lbs. of milk produced.

Overall Summary

- Adequate nutrition and balanced rations are key components of an overall management program.
- Forage and forage quality are the primary factors that determine success.
- Forage testing, including NDFD, needs to be a component of your program.
- With high quality forage, minimal grain supplementation is needed to maintain animal health and productivity.

Overall Summary - 2

- With poor quality forage feeding grain will add cost and may still not optimize health and performance.
- Forage allocation -
  - Do you have different qualities of forage?
  - Where are they stored?
  - What is the analysis?
  - Can you feed specific forages to specific animal groups?

Overall Summary - 3

- The basic principles are relatively simple.
- Implementation is the hard part.
- Your observational skills are key.
- 2 information sources:
  - www.sheep.cornell.edu
  - www.sheepandgoat.com (Maryland)