Molasses as the Primary Source of Energy for Grazing Dairy Cows

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eOrganic webinar, Dec 2018

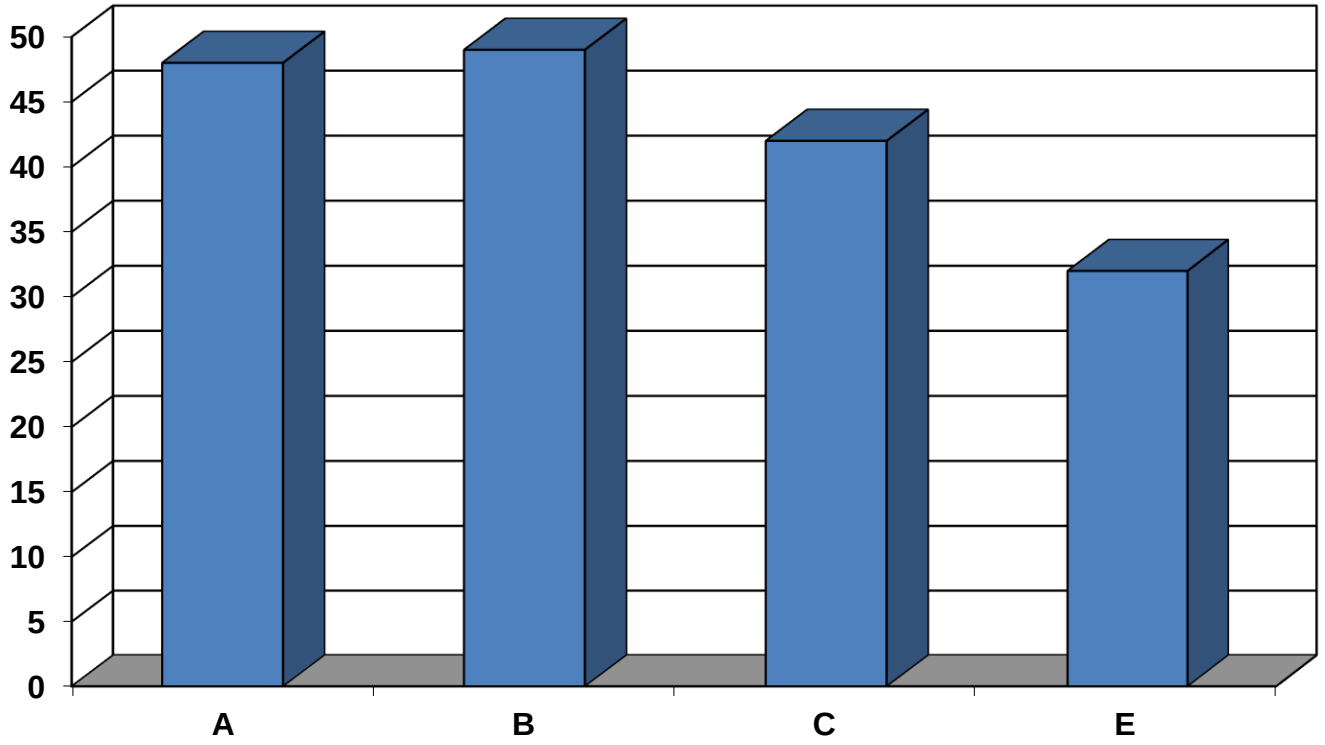
Why look at alternative energy sources for dairy cows?

- Organic corn prices/availability
  - Farmers seeking alternative (energy) supplement
- Farmer questions
  - How much- does it work?
  - Claims (3:1 molasses/corn)
  - No research on grazing dairy cows in temperate pastures
- Other benefits (i.e,. milk FA)?

Grassfed milk

- Growing consumer market
  - Commercially available milk in some regions
  - Premium milk price (~$4/cwt over organic price)
- No concentrates (grains), corn silage or small grains with seedheads allowed
- Potential Drawbacks:
  - ↓ Milk yield
  - ↓ BCS
  - Breeding efficiency
- No-grain ‘train wrecks’ have happened

How Much Milk Can We Expect if We Feed Only Pasture and No Grain?



Results from recent research trials

Does it Make Sense to Feed Some Energy to Cows on Pasture?

- High-quality pasture is high in protein, high in rumen degradable protein and low in non-fiber carbohydrates (energy)

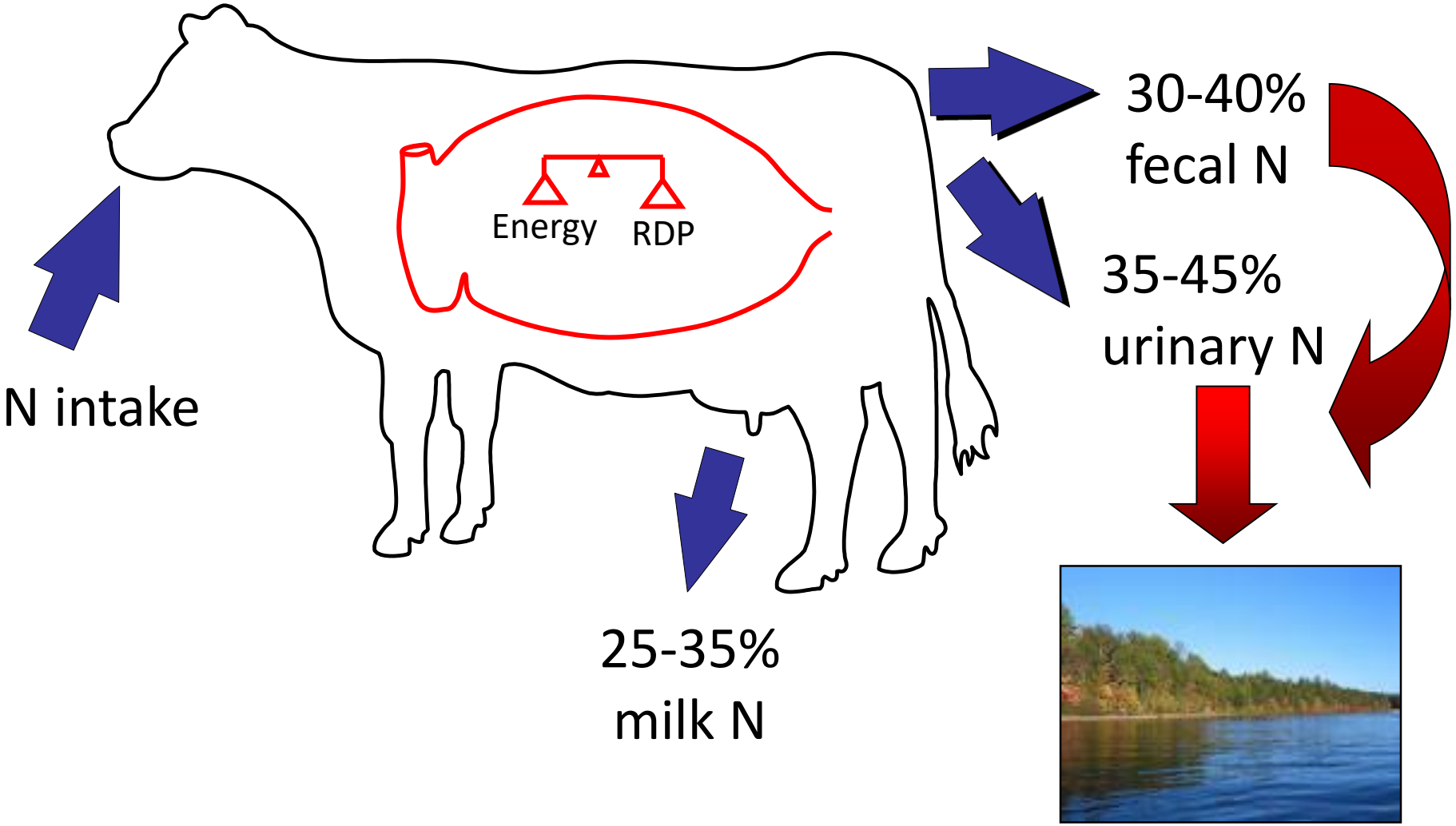
How Excess Degradable Protein Wastes Energy

Degradable Protein

Used by microbes → **microbial protein - used by cows**

Not used → **converted to ammonia** → **energy** → **ammonia into blood** → **ammonia in blood to liver** → **energy** → **liver converts to urea** → **urea excretion**

Nitrogen (N) Efficiency in Dairy Cows



Molasses

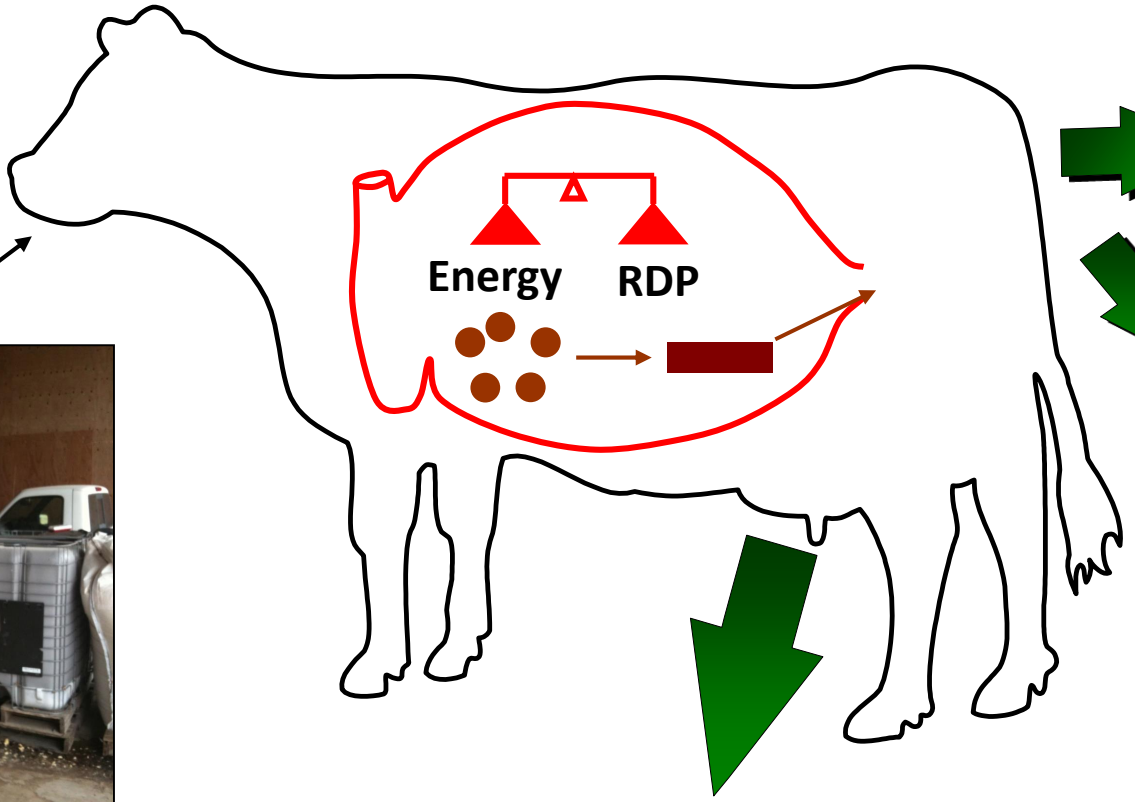
Primary source of energy on some grassfed and/or organic dairies

Why Molasses?

- High energy feed
  - 14 different sugars
- Less expensive per pound fed
  - Depends on organic grain prices
  - $0.39 vs. $0.45 or more
- Farmer testimonials
  - Feed at 1/3rd substitution rate to corn meal – 3 to 7 lbs/cow/day

Hypothesis

Molasses



Reduce fecal N

Reduce urine N

Increase milk N

But…..

- Some farms have little or no success
- No research to confirm 3:1 ratio
  - NRC – same energy value as corn
  - Sucrose vs. starch
- Prior molasses research
  - Not fed at high rates
  - Not fed to grazing dairy cows
  - Fed in combination with grain
  - 1950’s to 1970’s

Nutrition Issues

- High sugar levels
- Low starch levels
- High protein from pasture
- Ammonia & Milk Urea Nitrogen (MUN)

= loss of body condition, low breeding performance, low milk production, acidosis and laminitis, nutrient management issues, etc.

Effects of Molasses or Corn Meal Supplemented to an Herbage Diet on Ruminal Fermentation in Continuous Culture

✓*Kathy Soder, USDA-ARS*
✓ *Karen Hoffman, USDA-NRCS*
✓*André Brito, UNH*

Prof. Anim. Scientist. 26:167-174. 2010
Prof. Anim. Scientist. 27:35-42. 2011.

Dual Flow Continuous Culture Fermenters

MOL vs. CM

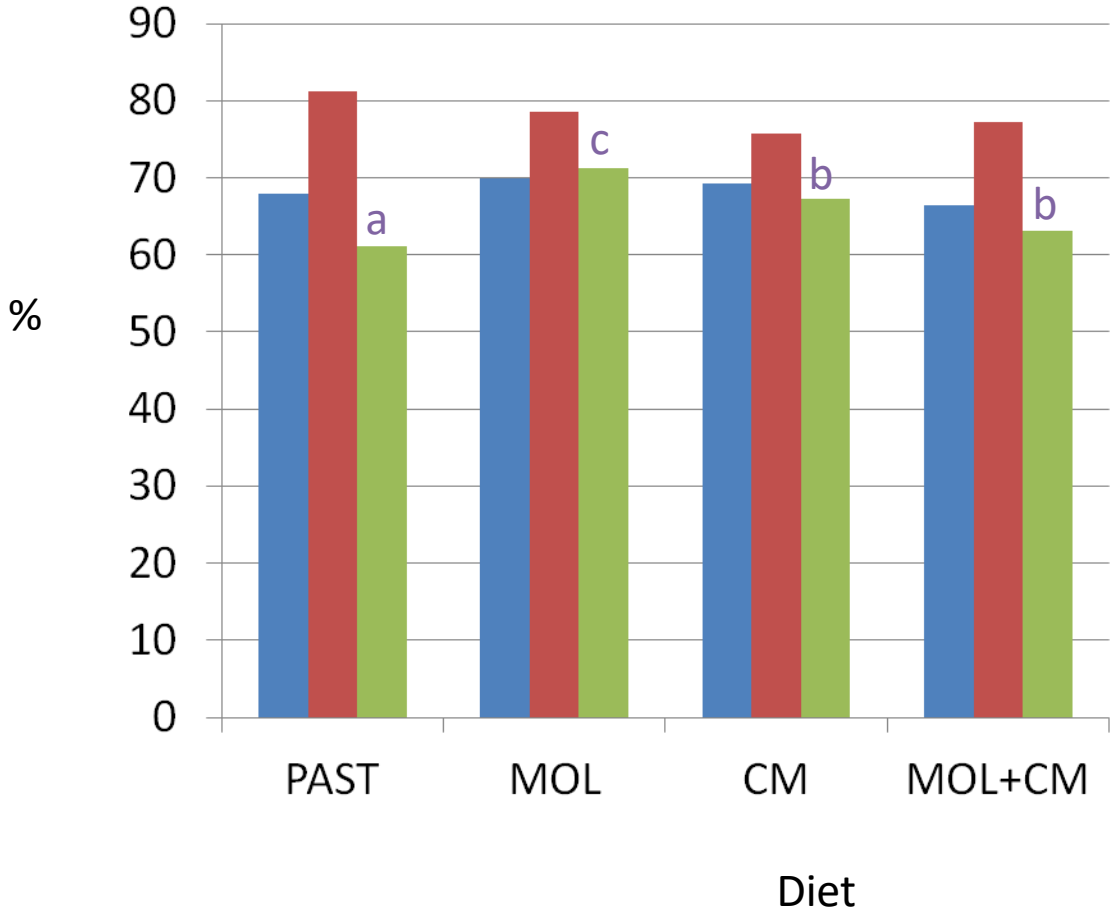
- Compared molasses with corn meal
- Treatments
  - Orchardgrass pasture only (CON)
  - Molasses (5%) + pasture (MOL)
  - Corn meal (7%) + pasture (CM)
  - MOL + CM + pasture

MOL vs. CM

- Measured
  - Ruminal pH
  - Volatile fatty acid (VFA)
  - Bacterial nitrogen efficiency
  - Nutrient digestibility
  - Nitrogen utilization

MOL vs. CM

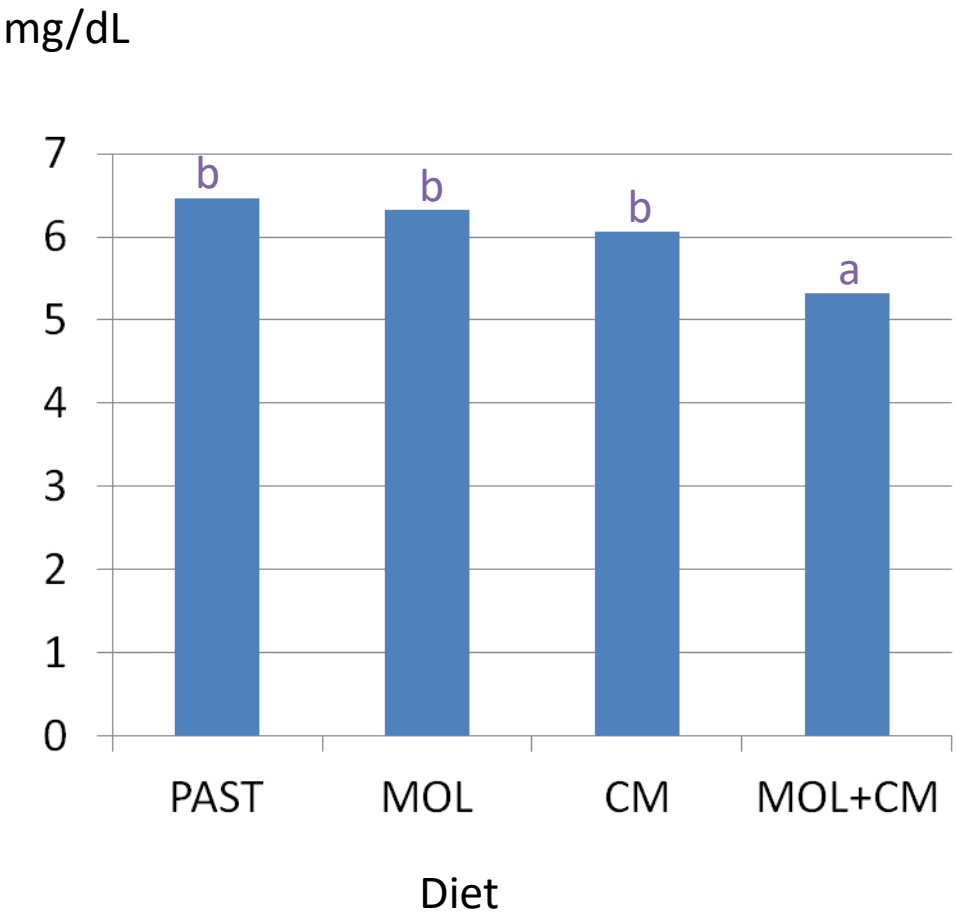
Nutrient Digestibility



- No change in DMd or NDFd
- CPd >MOL, < PAST

MOL vs. CM

NH_3-N Concentration

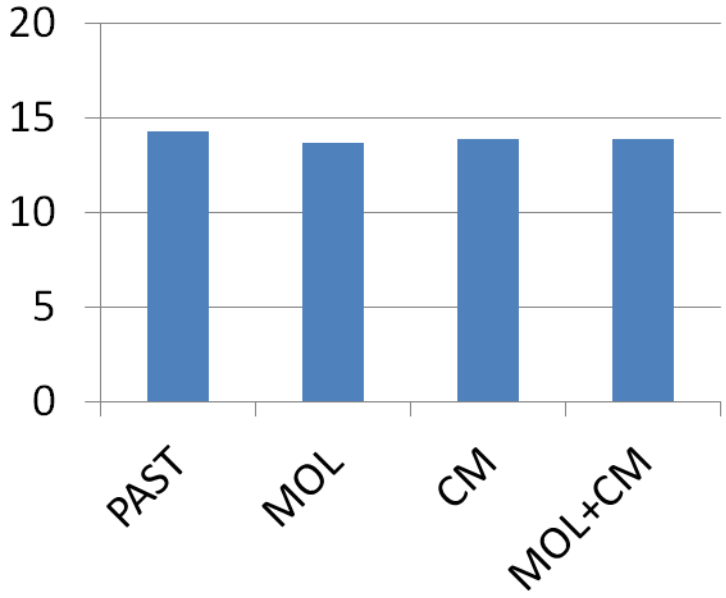


- < MOL+CM
- Decreased N intake due to greater supplementation level
- 5 mg/dL minimum to stimulate microbial growth (Satter and Slyter, 1974)

MOL vs. CM

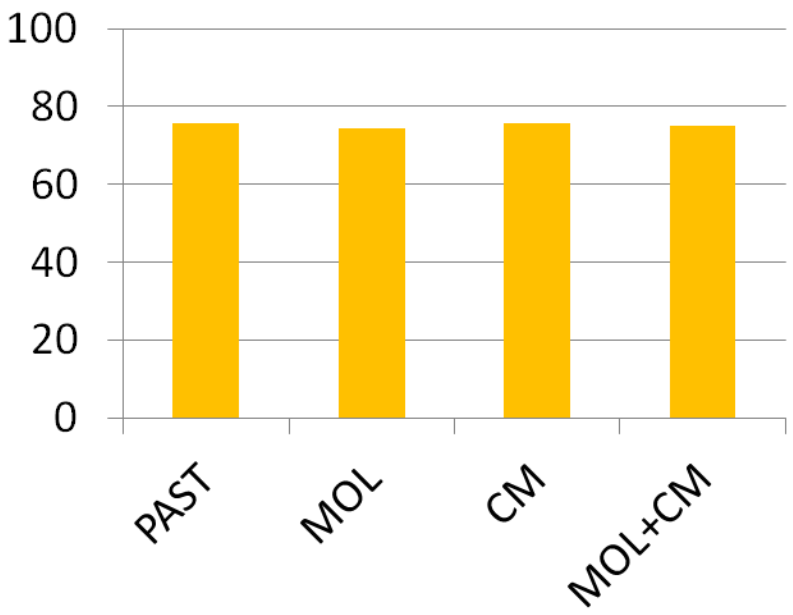
Bacterial Efficiency

g N/kg OM digested



Total VFA

mmol/L



- No impact on VFA or efficiency of bacterial N synthesis

Application to Pasture Diets

- Variability in on-farm response to molasses supplementation
  - Forage quality
  - Molasses source/nutrient content
  - Other supplements
- Greater supplementation rates may be warranted, but have been shown to depress nutrient digestibility (Broderick and Radloff, 2004)
- Cost must be evaluated

Implications

- MOL responded similarly to CM in improving *in vitro* N utilization
- Both only minimal improvements over PAST diet
- Needs to be evaluated at the cow level
  - Milk production/composition
  - Body condition
  - Reproduction

Molasses Level x Forage Quality

- Forage quality (FQ) may influence response to molasses (Heldt et al., 1999; Titgemeyer et al., 2004)
- There may be an interaction between FQ and level of molasses supplementation
- This interaction has not been investigated with temperate pastures

MOL vs. FQ

- Evaluate interaction between molasses and forage quality
- Treatments
  - 5% Molasses + Good Quality Pasture (G5)
  - 10% Molasses + Good Quality Pasture (G10)
  - 5% Molasses + Lower Quality Pasture (L5)
  - 10% Molasses + Lower Quality Pasture (L10)

MOL vs. FQ

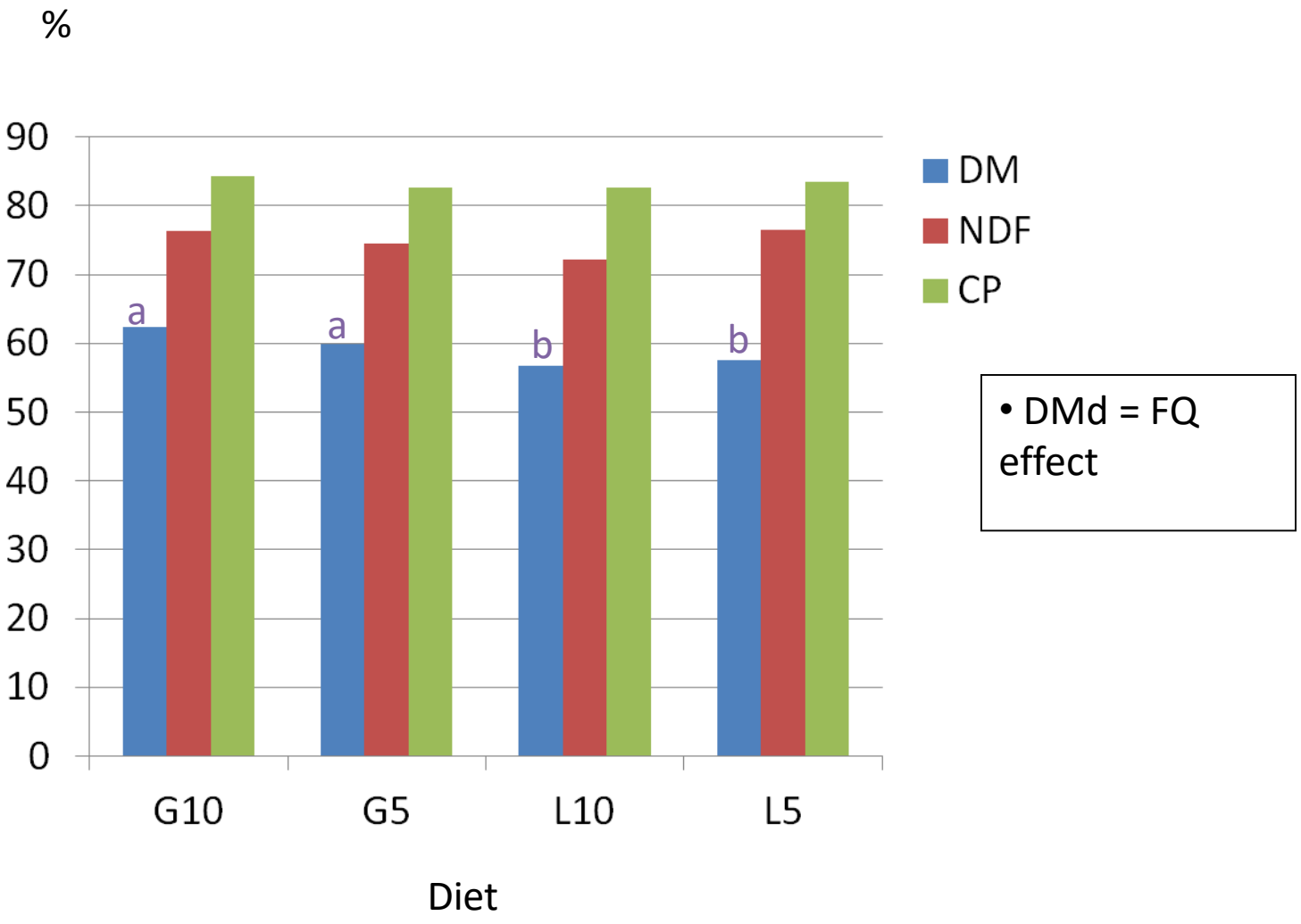
Forage quality

	Good quality	Lower quality
CP, % DM	26.8	20.4
RDP, % CP	65.0	61.0
NDF, % DM	35.9	45.3
Starch, % DM	3.8	2.4
WSC, % DM	11.3	10.8
NE_L, Mcal/lb	0.74	0.65

- Typical range of forage quality for NE dairy pastures

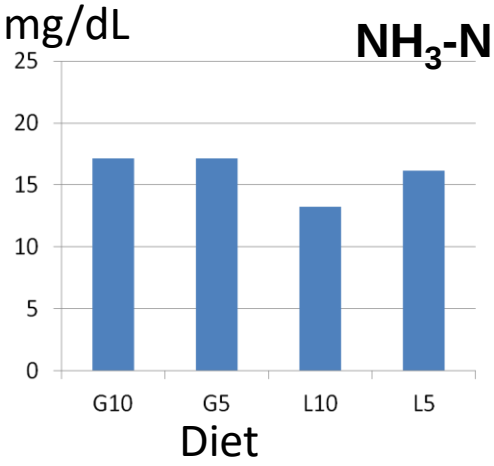
MOL vs. FQ

Nutrient Digestibility

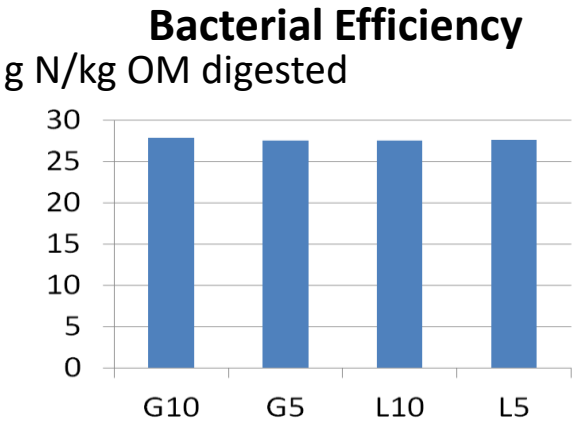


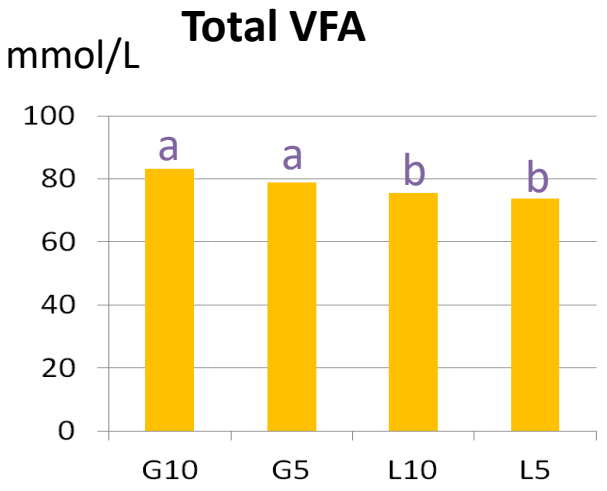
- DMd = FQ effect

MOL vs. FQ



- Tendency ($P = 0.07$) for lower NH_3-N w/ lower FQ
- Due to lower N intake





- FQ effect

Implications

- No significant interactions between FQ and MOL
- FQ not as extreme in original studies
  - Winter range in Intermountain West
- Disparity in animal production on farms may be due to a number of factors
  - Timing of supplementation
  - Molasses source
  - Level of molasses
  - Adaptation of cows
  - Forage quality

Conclusions

- Molasses did not significantly impact ruminal fermentation, either alone or in combination
- No interaction with forage quality differences found in NE temperate pastures
- Farms using molasses successfully must consider other management factors that may be cause for ‘success’
- Cost must be evaluated
- Ease of handling (summer flies, cold weather)

MOLASSES SUPPLEMENT TO GRAZING DAIRY COWS

On-Farm Case Study

Prof. Anim. Scientist. 28:234-243. 2012

Karen Hoffman[1], Larry E. Chase[2], and Kathy J. Soder[3]

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2008-09 Observational Study

- Central NY organic dairy farm feeding molasses successfully
  - 2008 - 3 lbs molasses with 1 lb corn meal/barley grain mix
  - 2009
    - April – May - 2 lbs molasses w/3 lbs grain
    - June - 3 lbs molasses w/2 lbs grain
    - July – 2.5 lbs molasses w/2 lbs grain
    - August – October - 2 lbs molasses w/2 lbs grain

2008-09 Observational Study

- Data collected monthly during grazing season
  - 80 acres of orchardgrass, red and white clover, forbs, etc. pasture
- The herd:
  - 2008 - 56 cross-bred cows, 1000 lbs
    - 2009 – 66 cows
  - Seasonal calving starts in March

Molasses

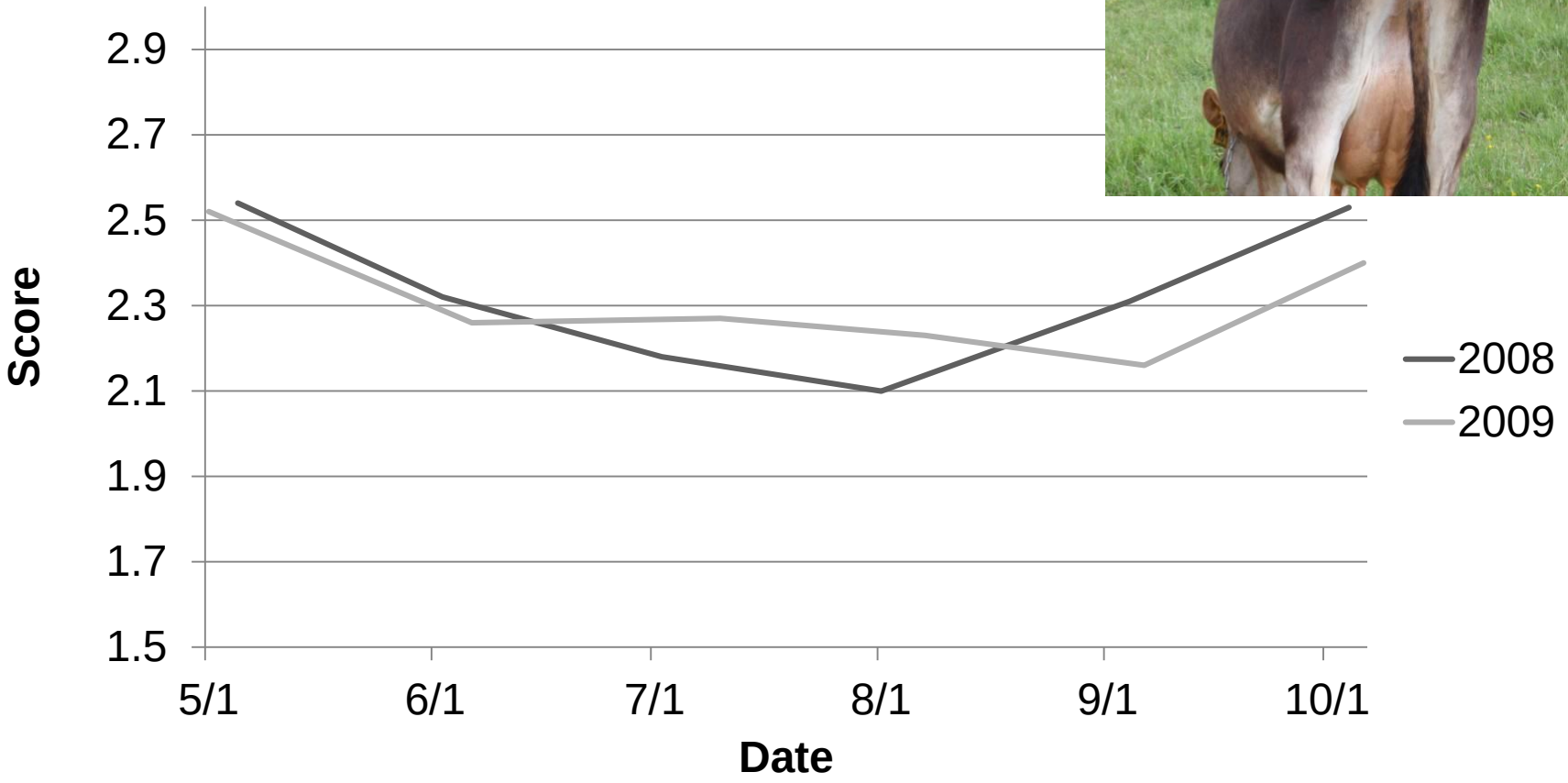
Molasses is poured over corn meal to slow intake

✓Data collected:

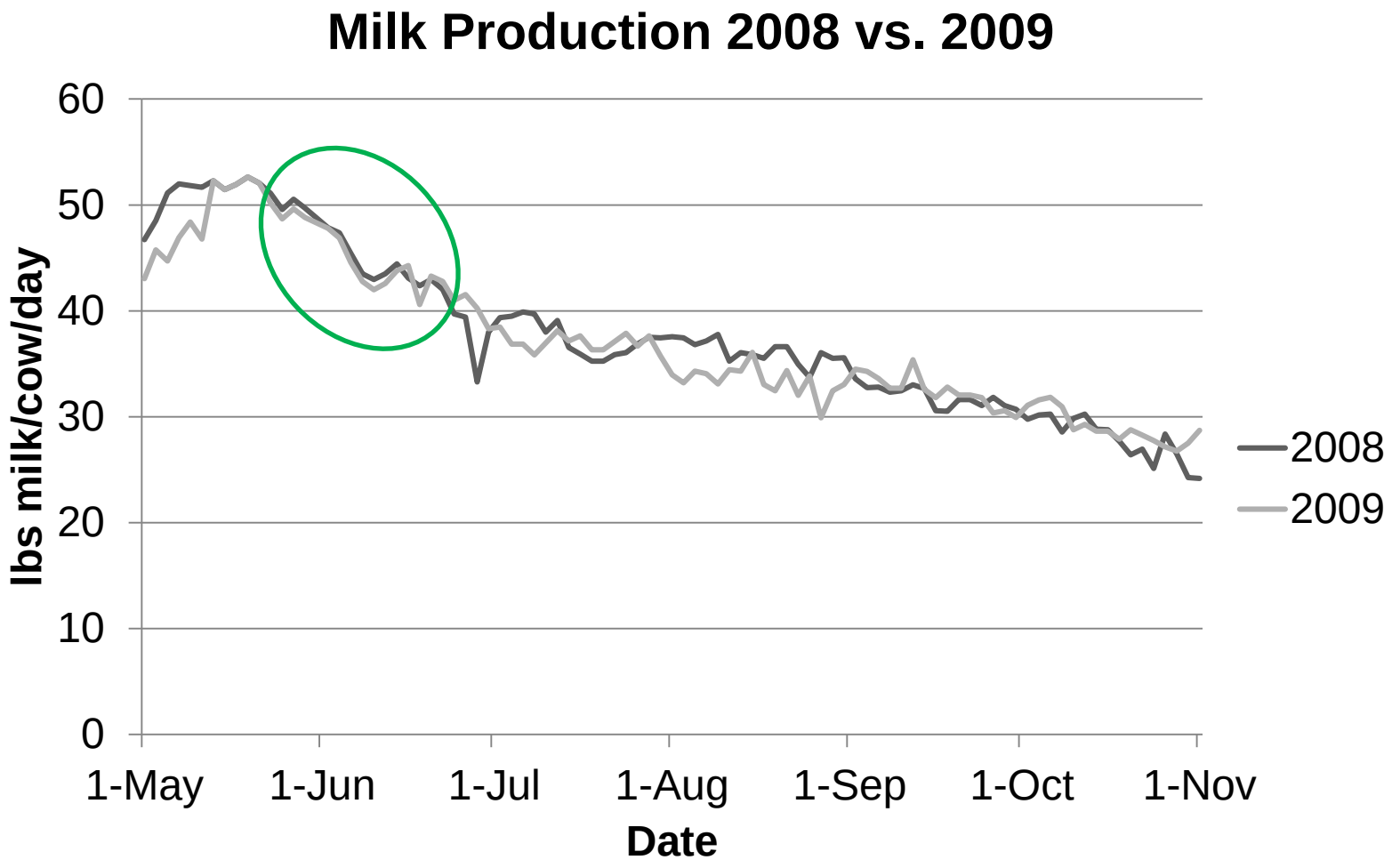
- body condition scores
- milk production, SCC, components, MUN
- pasture quality

Cornell Net Carbohydrate and Protein System (CNCPS) model used to analyze diets

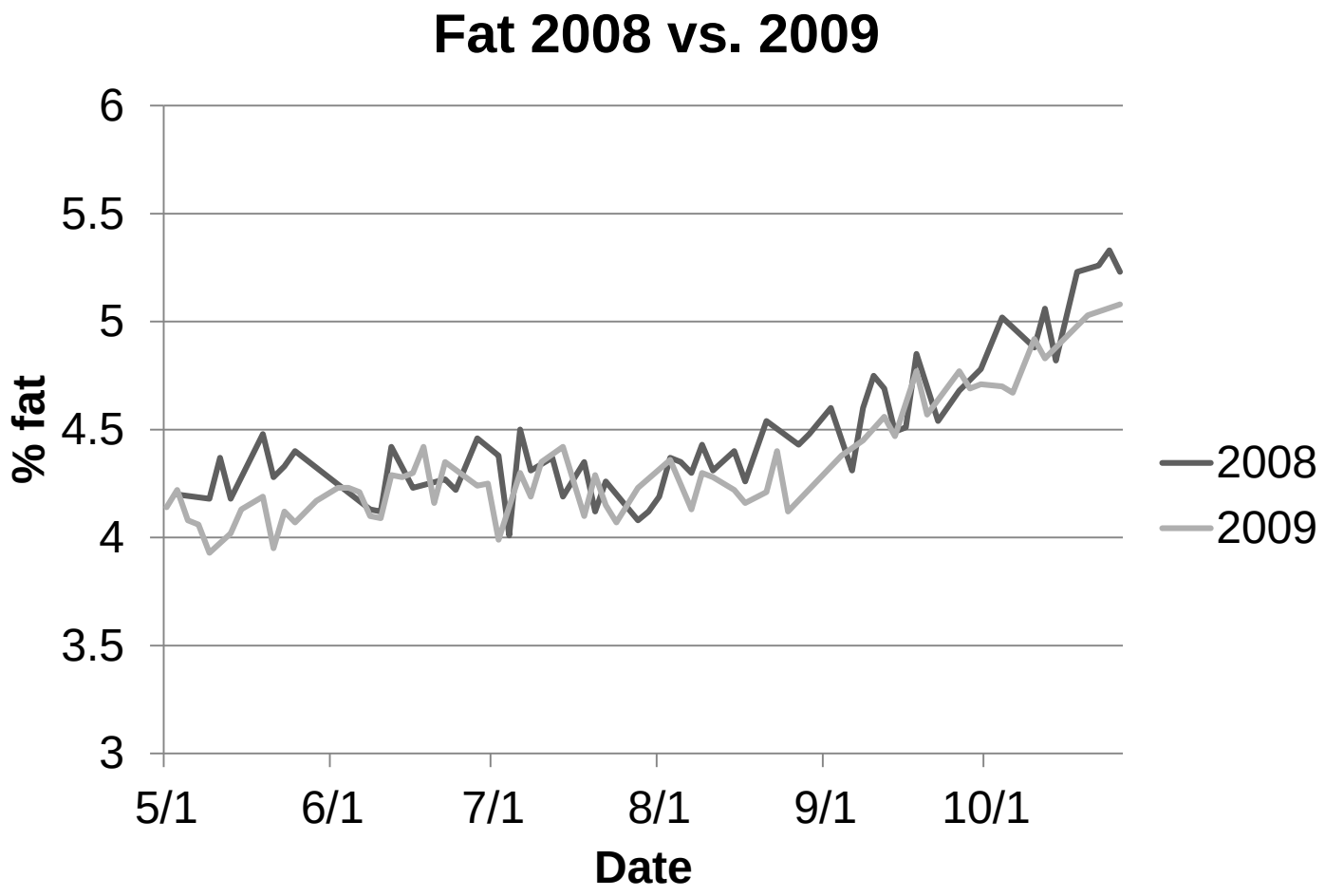
BCS 2008 vs. 2009



- ✓ Dry period BCS unknown in 2008 – in 2009 avg. dry cow BCS = 2.34
- ✓ Lowest BCS is well after peak production

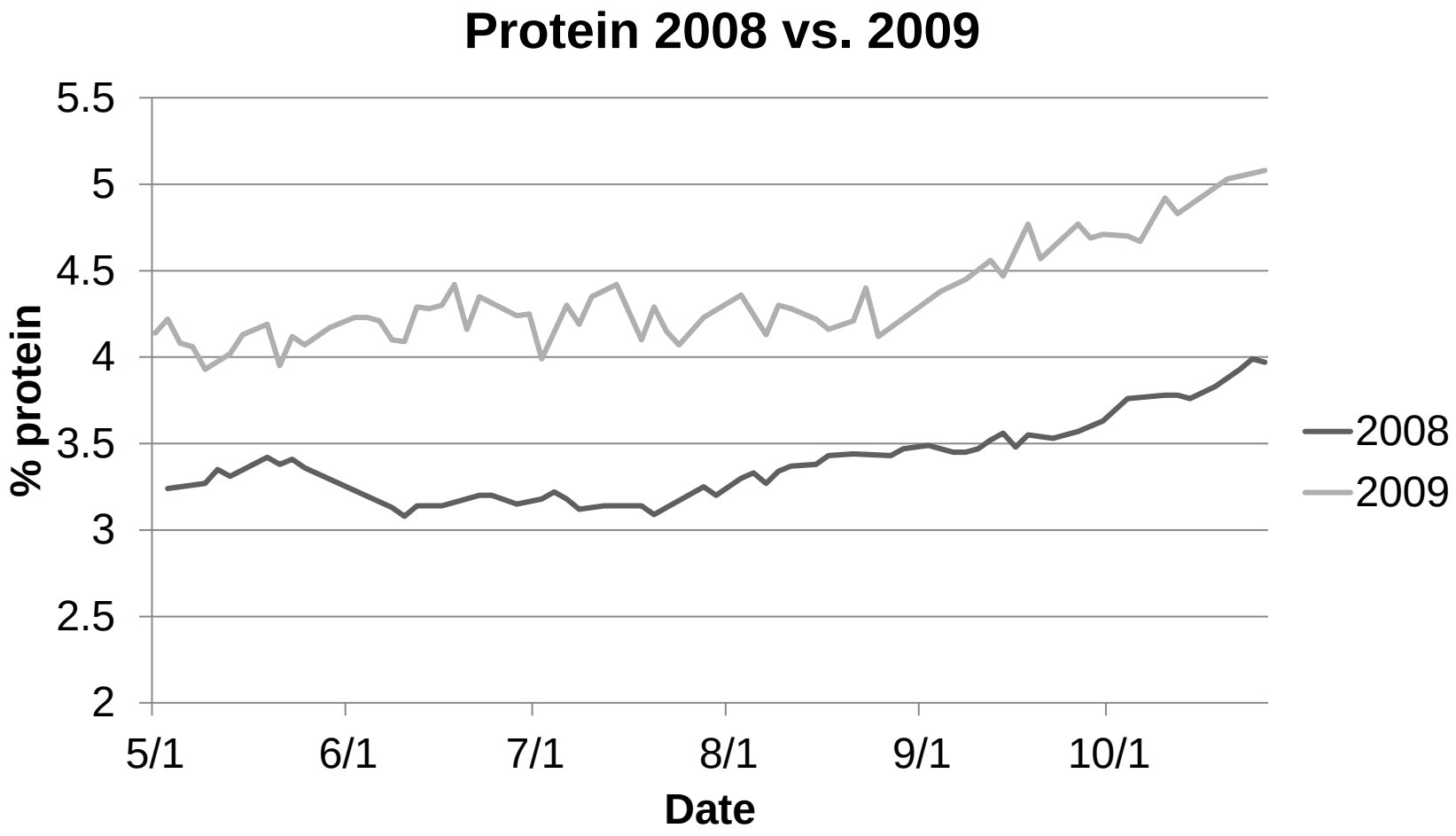


- ✓ 6 month persistency rate = 12% per month
- ✓ Late May to late June = 25% per month – low pasture quality
- ✓ Typical PR is 3-9% per month

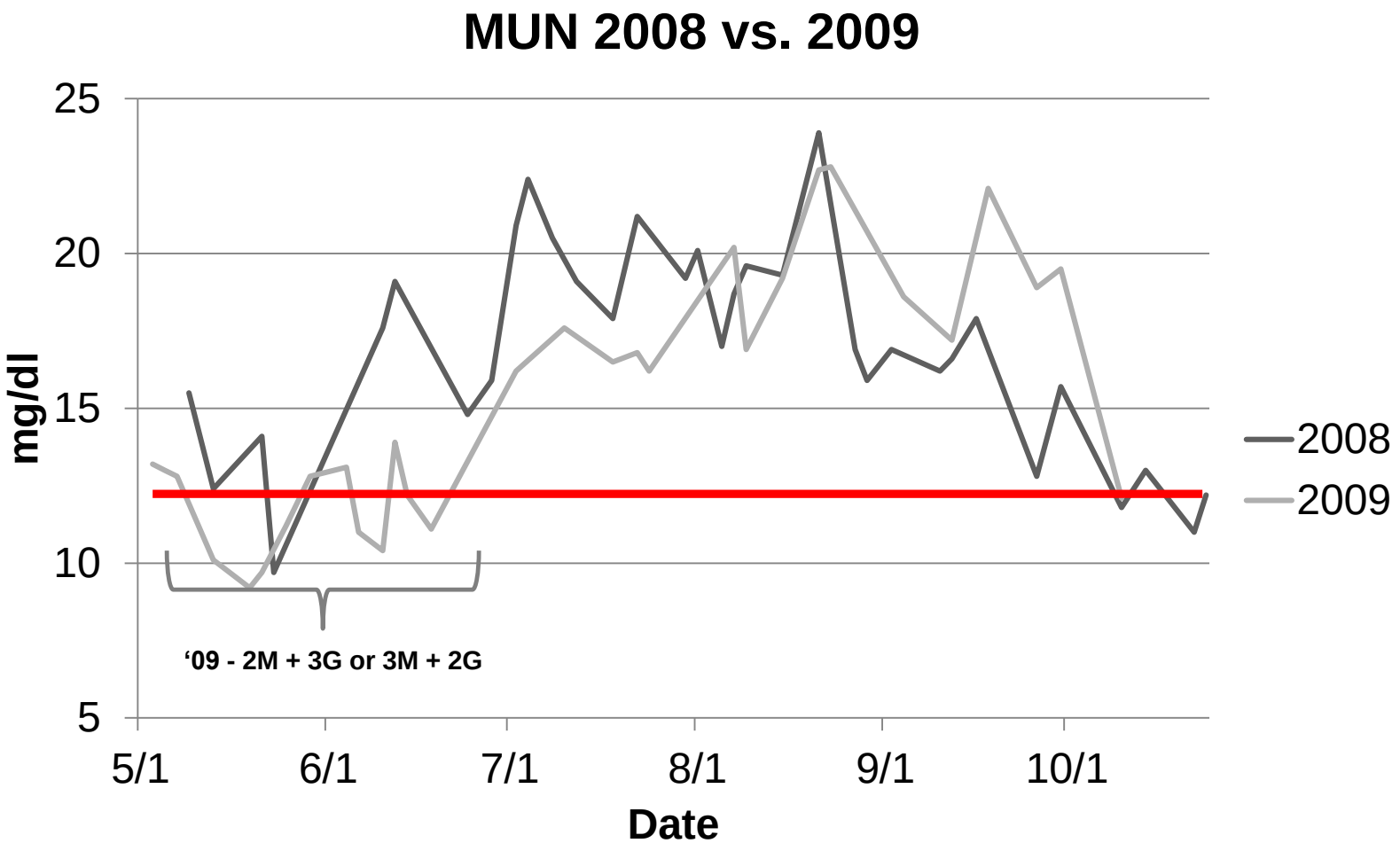


✓ Butterfat trends higher later in lactation

- dry hay and baleage fed beginning in September 2008, & October 1st, 2009



- ✓ 2008 may be statistically significant vs. 2009
- ✓ 3.39% average vs. 4.32% over season



- ✓ Recommended range is 8 to 12 mg/dl
- ✓ Herd averaged 16.15 in 2008 vs. 14.46 in 2009
- ✓ May and June lowest due to pasture quality in 2008
- ✓ Supplementation in 2009?

Pasture Quality Analysis Results

Date	% DM		% NDF		% CP		SolP, %CP	
	2008	2009	2008	2009	2008	2009	2008	2009
May	21.5	21.6	46.7	47.0	18.7	29.7	40	26
June	21.2	21.3	47.7	51.4	19.7	25.6	30	28
July	17.6	16.9	46.5	42.7	25.3	23.7	42	28
August	19.3	22.7	46.5	51.7	23.7	20.4	31	30
September	20.1	17.2	43.6	48.9	22.7	27.2	38	37
October	14.4	20.9	51.4	45.9	27.0	27.4	27	25

Pasture Quality Analysis Results

Date	% NFC		% Starch		% ESC	
	2008	2009	2008	2009	2008	2009
May	28.2	27.3	2.9	2.1	13.4	12.8
June	27.7	24.2	2.8	2.1	10.3	13.3
July	20.2	28.3	1.9	3.4	3.4	7.7
August	23.6	23.0	5.4	3.8	9.5	9.1
September	27.9	22.0	2.4	5.6	7.8	3.6
October	22.2	25.2	0.5	4.2	5.8	11.1

Milk Production Results vs. CNCPS Model Predictions

Date	Year	Actual milk lb/day	ME milk lb/day	MP milk lb/day	MET milk lb/day	LYS milk lb/day
		- 4.94 Mcal/day				
May	2008	50.0	40.8	50.8	57.6	59.9
	2009	48.8	44.6	91.7	72.8	88.5
June	2008	42.4	42.5	65.7	67.7	73.2
	2009	42.8	43.5	66.1	61.7	69.4
July	2008	37.5	40.7	62.5	58.1	66.2
	2009	36.8	43.9	67.0	66.5	72.8

Cows were probably using BCS for additional energy

Milk Production Results vs. CNCPS Model Predictions

Date	Year	Actual milk lb/day	ME milk lb/day	MP milk lb/day	MET milk lb/day	LYS milk lb/day
		- 9.24 Mcal/day				
August	2008	36.2	36.8	54.1	54.0	59.4
	2009	33.1	15.7	29.4	25.1	31.2
September	2008	31.9	37.3	57.1	57.4	62.8
	2009	32.5	34.9	49.9	43.1	50.8
October	2008	30.0	24.8	25.0	31.2	33.3
	2009	29.0	30.5	40.5	39.4	43.4

hay and/or baleage fed

Actual MUN Values vs. Predicted MUN, N excretion, and Urea Cost

Date	Year	Actual MUN, mg/dl	Predicted MUN, mg/dl	Predicted N excreted, g/day	Urea cost, Mcal/day
May	2008	15.5	11	36	0.02
	2009	11.5	33	451	1.64
June	2008	17.6	11	100	0.60
	2009	11.9	25	302	1.48
July	2008	20.9	24	306	1.47
	2009	16.7	16	197	0.89

Molasses = 3x corn?

CNCPS value for molasses?

Nutrient management issue

Conclusions

- Sugar from molasses may not compensate for lack of starch
- Higher starch appears to improve BCS, milk protein, and MUN
  - '09 – cows reached + energy balance sooner
  - '09 pasture quality higher
- Cost of organic starch sources a concern
- Research on-going
  - Rumen dynamics - fermenter
  - Animal trial w/treatment groups

Effects of Cornmeal or Molasses on Milk Production of Grazing Organic Dairy Cows

- ✓ *André F. Brito, UNH*
- ✓ *Kathy J. Soder, USDA-ARS*
- ✓ *Shara Ross, UNH*
- ✓ *Kristen Greene, UNH*
- ✓ *Ashley Green, UNH*
- ✓ *Melissa Rubano, USDA-ARS*

USDA ARS United States Department Of Agriculture Agricultural Research Service

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Objectives

- ✓ Compare the effects of cornmeal or molasses on:
  - Milk production
  - Milk composition
  - Nitrogen metabolism

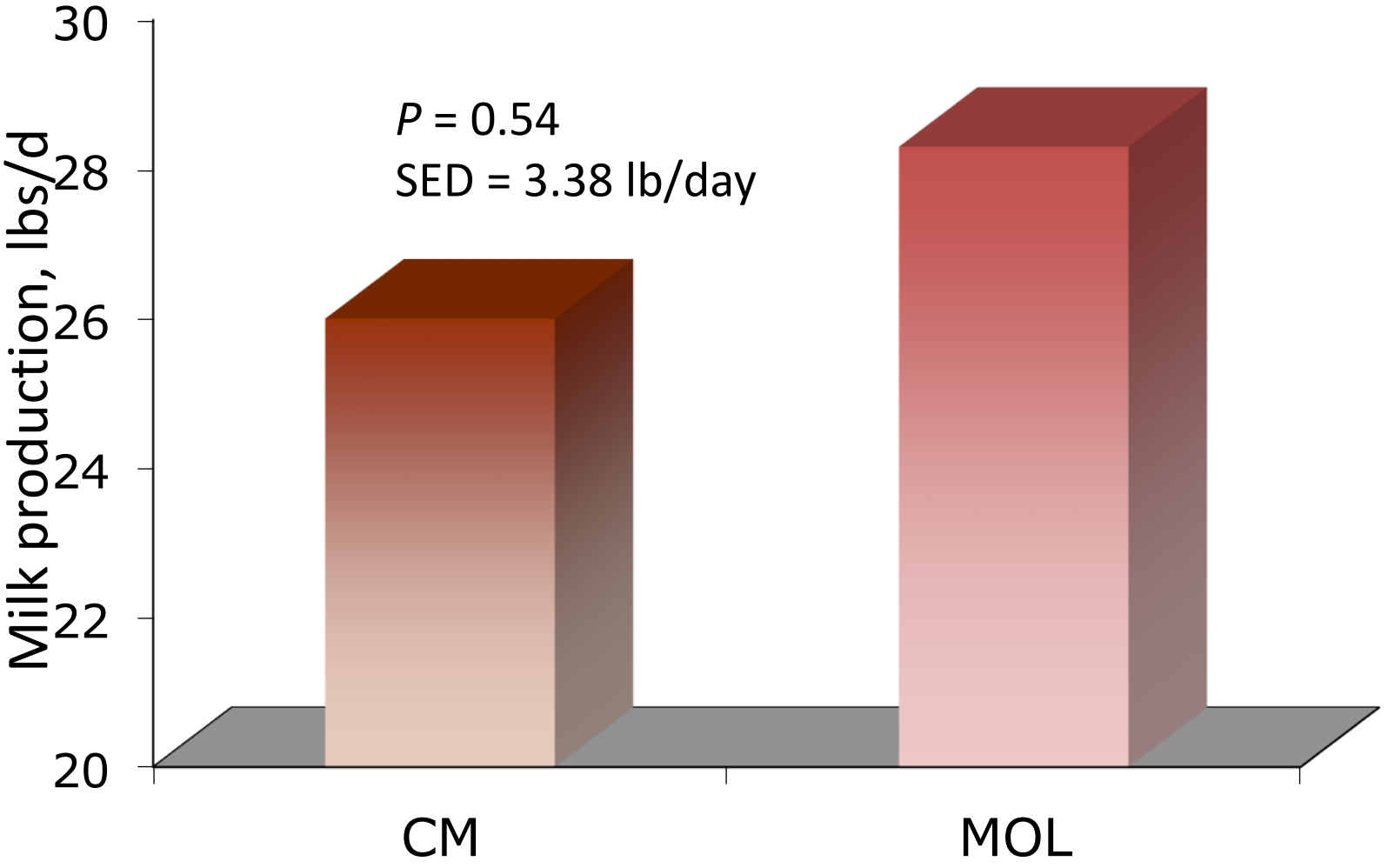
Methods

- ✓ **Molasses or corn meal fed at 12% of DMI (May-Sept)**
  - ✓ Topdressed on alfalfa baleage (18% DMI)
- ✓ **Data collected**
  - ✓ Milk yield
  - ✓ Milk Composition
    - ✓ Fat (FA), protein, SCC, MUN
  - ✓ Blood metabolites
  - ✓ Urine (N efficiency)
  - ✓ BW, BCS
  - ✓ Grazing behavior
  - ✓ Pasture sampling
    - ✓ Quality
    - ✓ Biomass
    - ✓ Botanical composition

Cows Grazing on Assigned Paddocks

Calan Gates: Individual Intake

Milk Production in Organic Grazing Cows Fed Cornmeal (CM) or Molasses (MOL)



Pasture and Supplement Dry Matter Intake (DMI) in Organic Grazing Cows Fed Corn meal (CM) or Molasses (MOL)

	Diets			
Item	CM	MOL	SED[1]	*P* > *F*
Pasture, lbs/day[2]	22.1	25.4	-	-
Supplement, lbs/day[3]	8.10	9.43	0.29	<0.01
Total DMI, lbs/day	31.1	34.8	-	-
Pasture, % of total	71.1	72.0	-	-
Supplement, % total	26.0	27.1	-	-

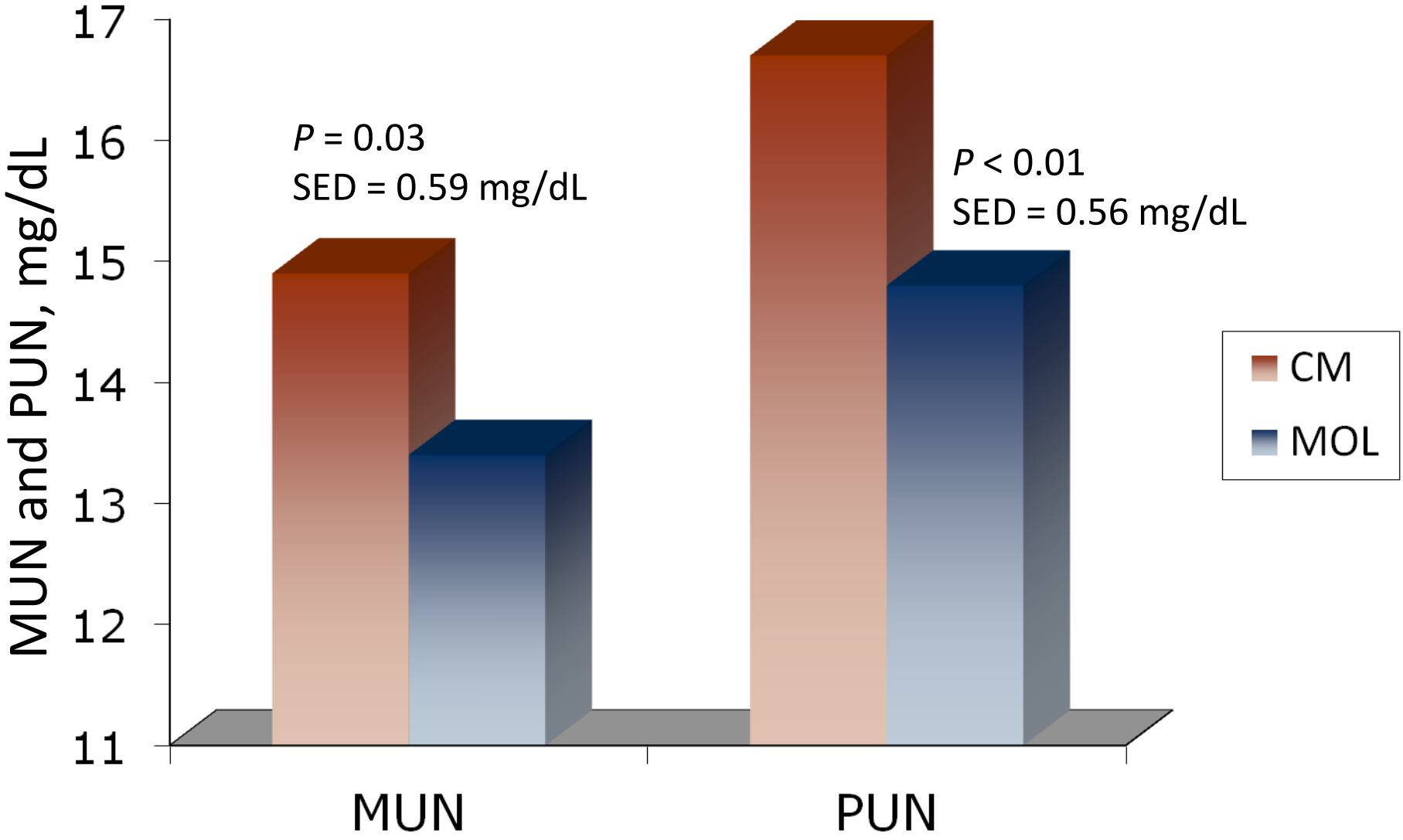
[1]SED = standard error of the least square means difference
[2]Group pasture intake estimated using pre- and post-grazing pasture height measurements
[3]Supplement = CM or MOL plus a grass-legume baleage

Milk Yield and Composition, and Body Weight (BW) Gain in Grazing Cows Fed Cornmeal (CM) or Molasses (MOL)

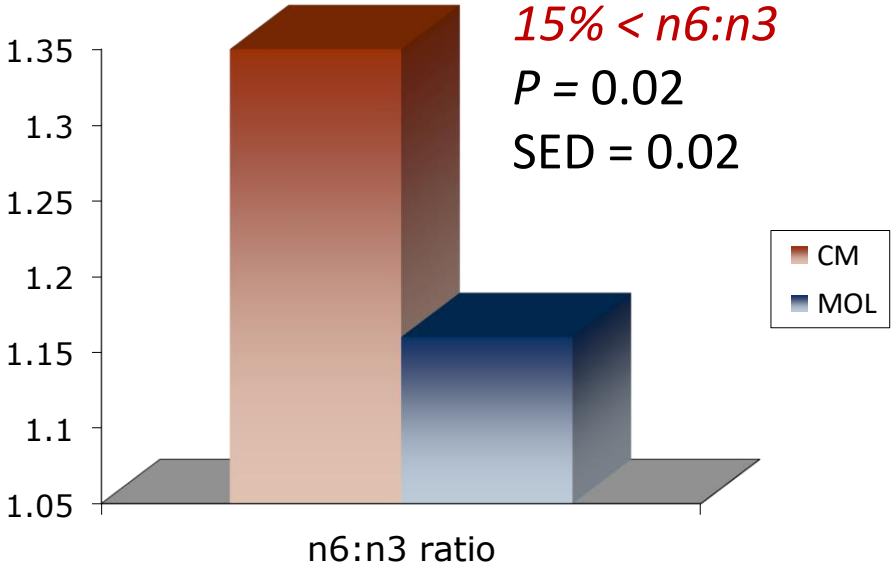
	Diets			
Item	CM	MOL	SED	*P* > *F*
Milk yield, kg/d	11.9	12.6	0.54	NS
Milk fat, %	4.81	4.82	0.22	NS
Milk fat, lbs/d	1.24	1.35	0.31	NS
Milk protein, %	3.46	3.45	0.15	NS
Milk protein, lbs/day	0.88	0.95	0.20	NS
Milk lactose, %	4.64	4.70	0.04	NS
Milk lactose, lbs/d	2.67	2.91	0.33	NS
BW gain, lbs/day	0.49	0.79	0.37	NS

SED = standard error of the least square means difference
NS = not significant ($P > 0.05$)

Concentration of Milk Urea Nitrogen (MUN) and Plasma Urea Nitrogen (PUN) in Grazing Cows Fed Cornmeal (CM) or Molasses (MOL)



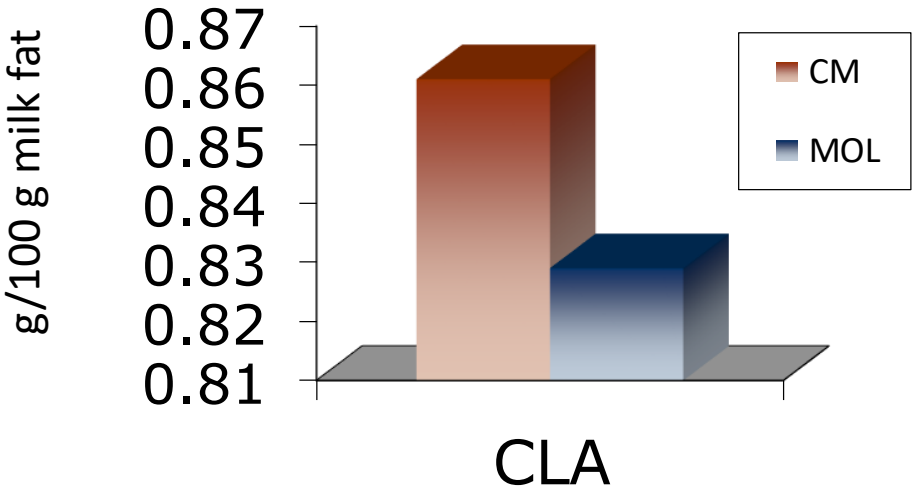
Fatty Acid Profile [conjugated linoleic acid (CLA), n:6:n-3 ratio] in Grazing Cows Fed Cornmeal (CM) or Molasses (MOL)



15% < n6:n3

P = 0.02

SED = 0.02



CLA

5% > CLA

P = 0.04

SED = 0.041

Conclusions

- Liquid molasses fed at 3.5 lb. can replace same amount of corn when fed as only NSC source.
  - Not 3:1 per anecdotal claims
  - No effect on milk yield, components
  - Decreased MUN (↑ N utilization)
  - Slight positive effect on CLA and n6:n3 fatty acids
- Must be economically competitive or for specific milk market.

Questions??