USDA/NOSB Dairy Pasture Symposium

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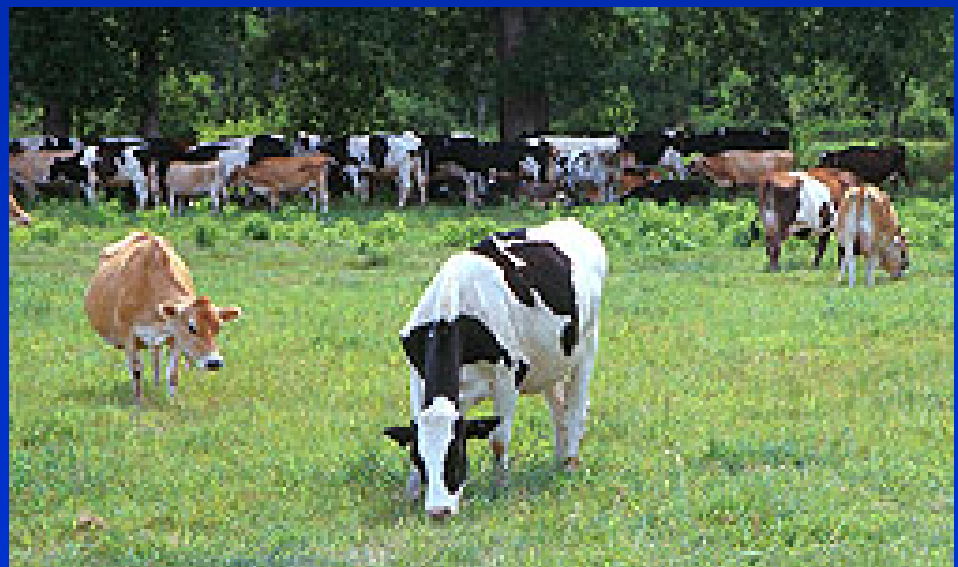


Challenges in Adopting Pasture Requirement

- Sufficient scientific proof
- Application of national standard to all portions of the country
- Enforceability
- Objectively measuring days on pasture or pasture intake
- Milk quality issues during non-pastured periods

Factors Affecting pDMI

- Animal
- Forage
- Environment

Factors Affecting pDMI
Animal

- Time spent grazing
  - Gut fill
  - 8-9 h optimum (full pasture)
  - 12-13 h max
- Grazing Patterns
  - 3-5 major meals/d
  - 2-3 h at dawn, 4-5 h at dusk

Combs, 2001

Factors Affecting pDMI
Animal

- Biting rate, bite mass
  - 0.4 to 0.7 g DM/bite
  - 45-60 bites/min
  - 13-15 kg DM pasture/d
  - 40,000+ bites/d
  - Affected by forage

Rook et al., 1994; Bargo et al., 2001;
Soder et al., 2006

How will a "day" be defined if the 120-d minimum requirement is adopted?

How will a "day" be defined if the 120-d minimum requirement is adopted?

Graze until animals are full?
Minimum number of hours?
Minimum daily intake requirement?

Factors Affecting pDMI

Animal

- Stage of lactation
- Body Size/condition

Combs, 2001

Factors Affecting pDMI

Forage

- Quality/Quantity
- Digestibility

Factors Affecting pDMI

Environment

- Temperature, humidity, sun
- Time of Day
- Supplementation
  - Time, amount, type

pDMI is a Complex Issue

- Many variables that affect pDMI within and between days
- From a scientific standpoint, pDMI is difficult to quantify

Measuring pDMI

- Currently cannot *measure* pDMI
- *Estimates only*
- Can be subjective, variable
- Pre- and post-grazing heights/Rising Plate Meter
  - Utilization rates?

Is a pDMI requirement enforceable?

30% DMI From Pasture

- At face value, not totally unachievable
- Average over grazing season, or absolute daily minimum?
- How to account for drought/wet weather?
  - Absolute minimum per day, every day, or…
  - Average over the 120 minimum grazing season?

pDMI With Supplementation

- 50-60% pDMI maintained high levels (70-80 lb.) of milk production (Bargo et al., 2003; Soder et al., 2006)
- Must consider long-term effects on body condition, reproduction
- Type of supplement must be considered
- pDMI will be lower with pTMR supplementation
- Milk components

Kolver, 2000; Bargo et al., 2002; Soder et al., 2006

Milk Quality
SCC

- Washburn et al. (2002) showed lower incidence of mastitis in pastured herds in NC
- ↓ SCC on pasture
  - Vermont (Goldberg et al., 1992)
  - Hungary (Bela et al., 1995)
- Minnesota study showed no difference in SCC (Rust et al., 1995)

Milk Quality
Milk Fatty Acids

- Total milk fat production usually decreases on pasture (Kolver and Muller, 1996, Bargo et al., 2001, Soder et al., 2006)

	Confine Holstein	Pasture Holstein	Confine Jersey	Pasture Jersey
Milk Fat, %	3.33	3.23	4.10	3.68

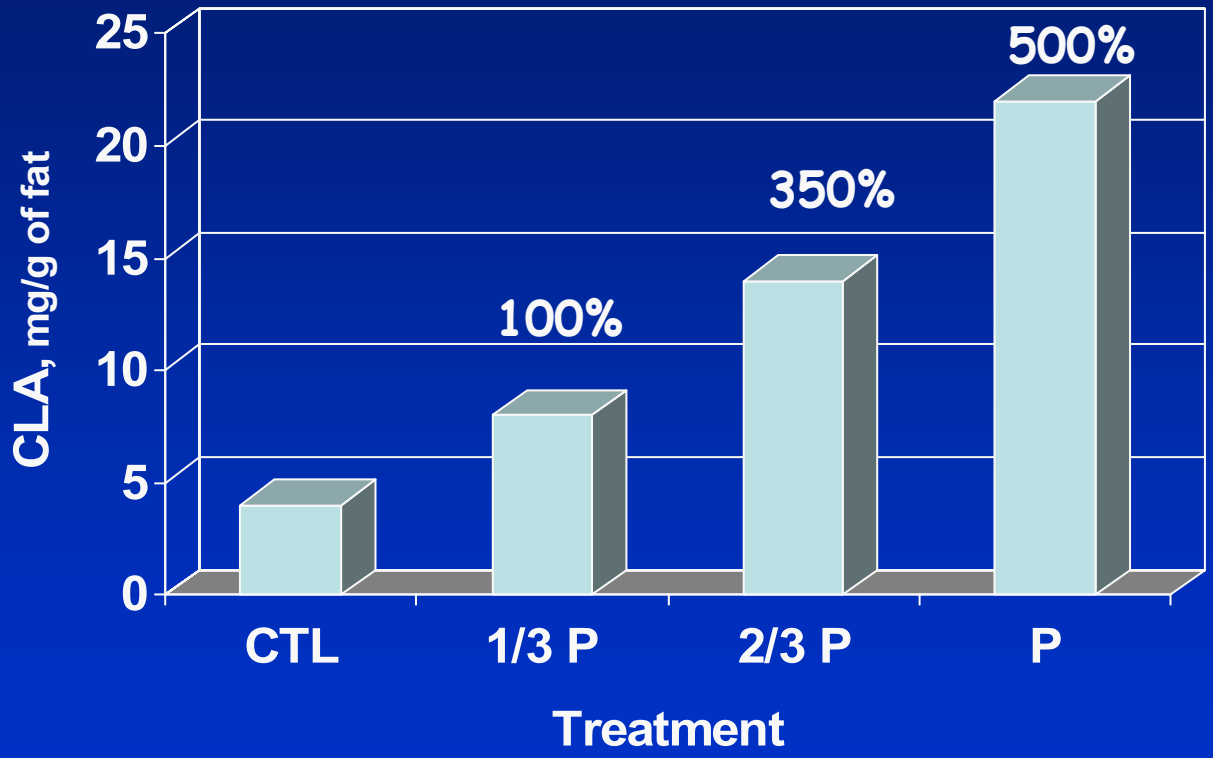
White et al., 2001

- Conjugated Linoleic Acid (CLA)
- Omega-3 and Omega-6

Factors Affecting CLA Concentration in Milk Fat

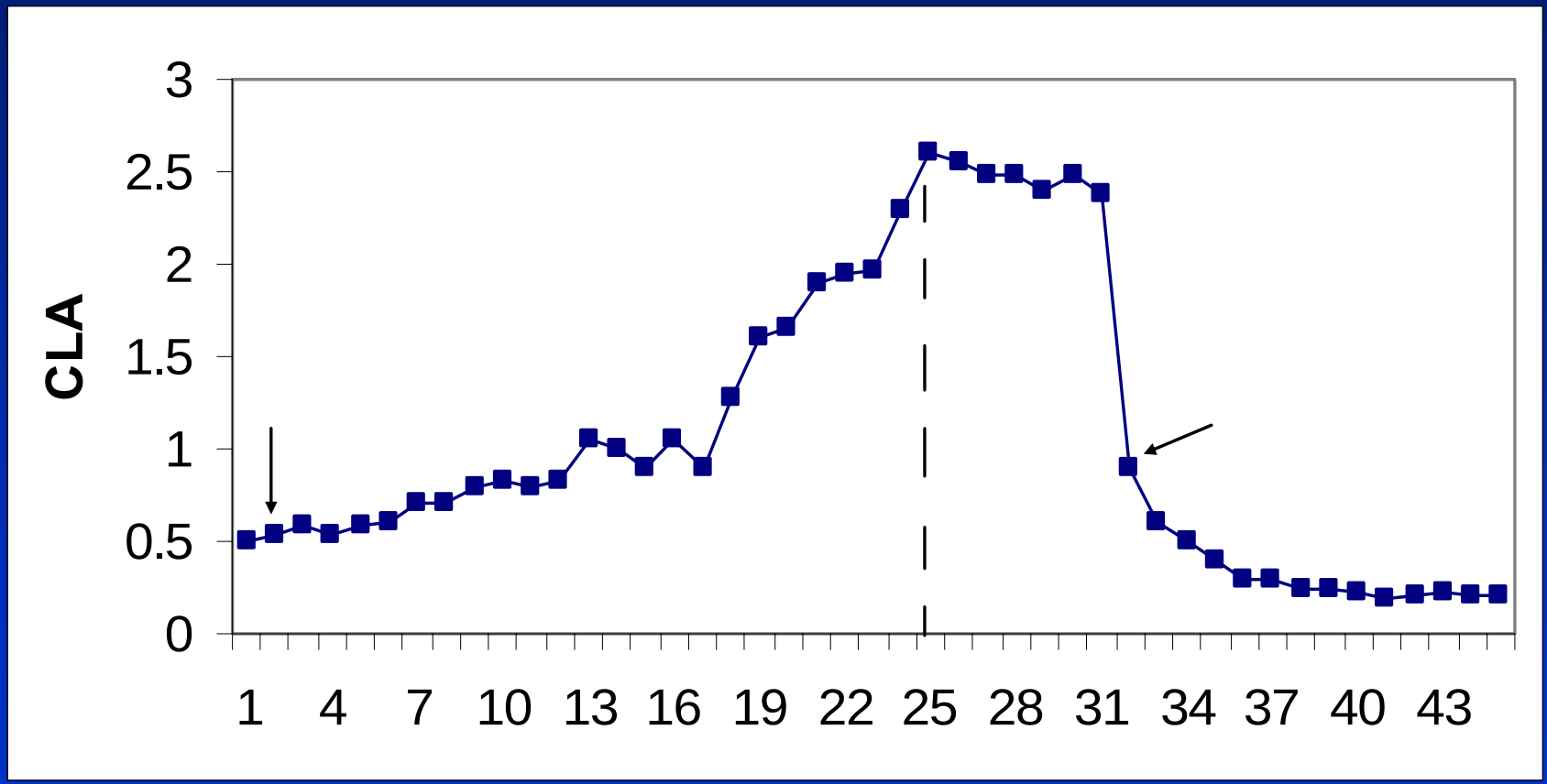
Factors	CLA Conc. in Milk Fat
• Pasture vs. TMR	2-4 fold ↑
• Higher forage diets	2 fold ↑
• Unsaturated fat from flax seed, sunflower, cottonseed	2-3 fold ↑
• Fish oil	↑ CLA and omega-3 FA
• Combinations of above	Further ↑ CLA
• Genetics	may be 5 to 10 fold ↑
	?

CLA Content of Milk from Grazing Cows



Dhiman et al. 1996, 1999

Effect of Turning Cows out to Pasture on CLA of Milk

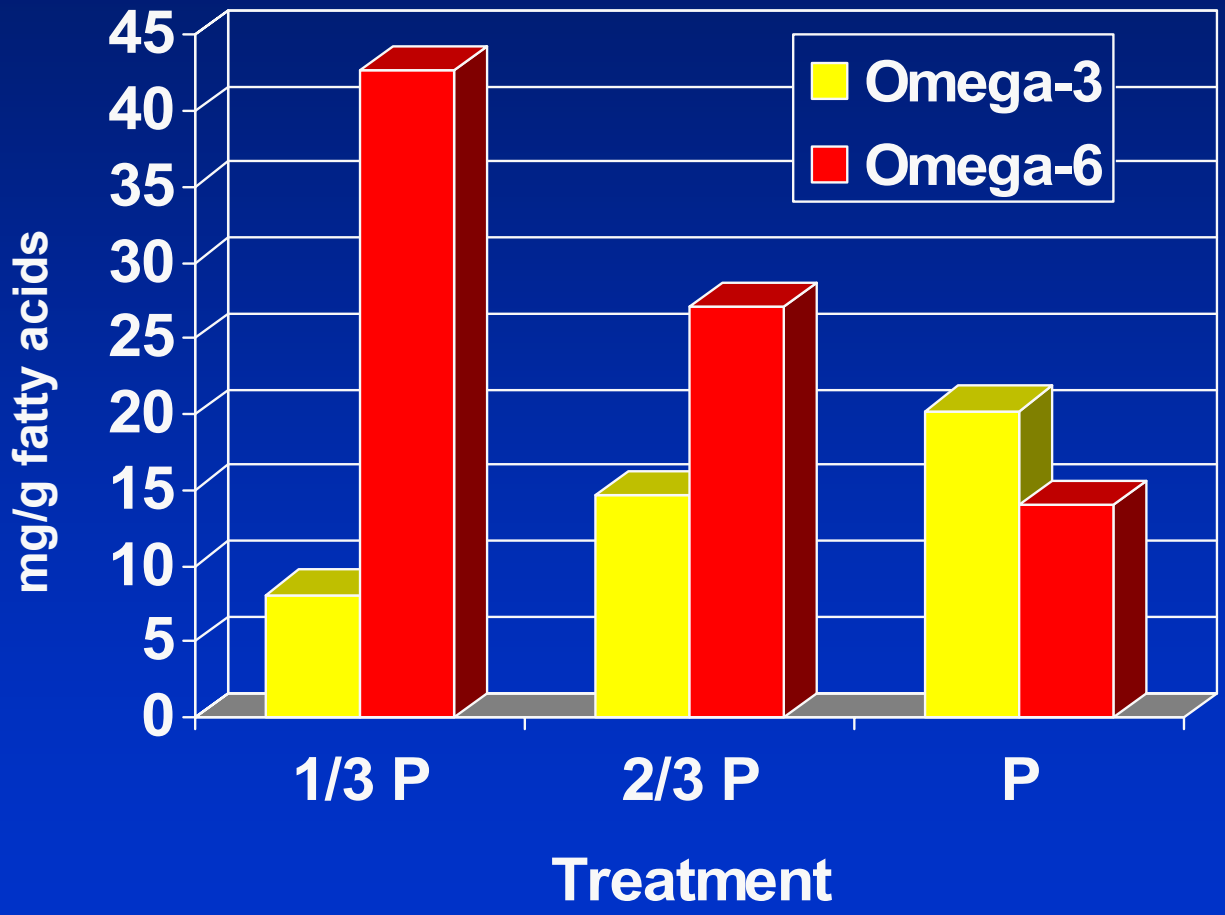


Khanal et al. 2003

In Praise of Older Cows

- Older dairy cows produce more CLA than younger cows. Specifically, a cow that has gone through four lactations (cycles of milk production) produces more CLA than she did when she was younger.

Omega-3 and -6 Content of Milk from Grazing Cows



Dhiman et al., 1999

Factors to Consider

- Regulations need to be enforceable and measurable
- Will stricter regulations exclude too much of the population?
- Would it be feasible to market "pasture-raised' within the current organic standards?
- Consider wide variation in climate and management across the country
- Consider non-grazing season


19 kg DM

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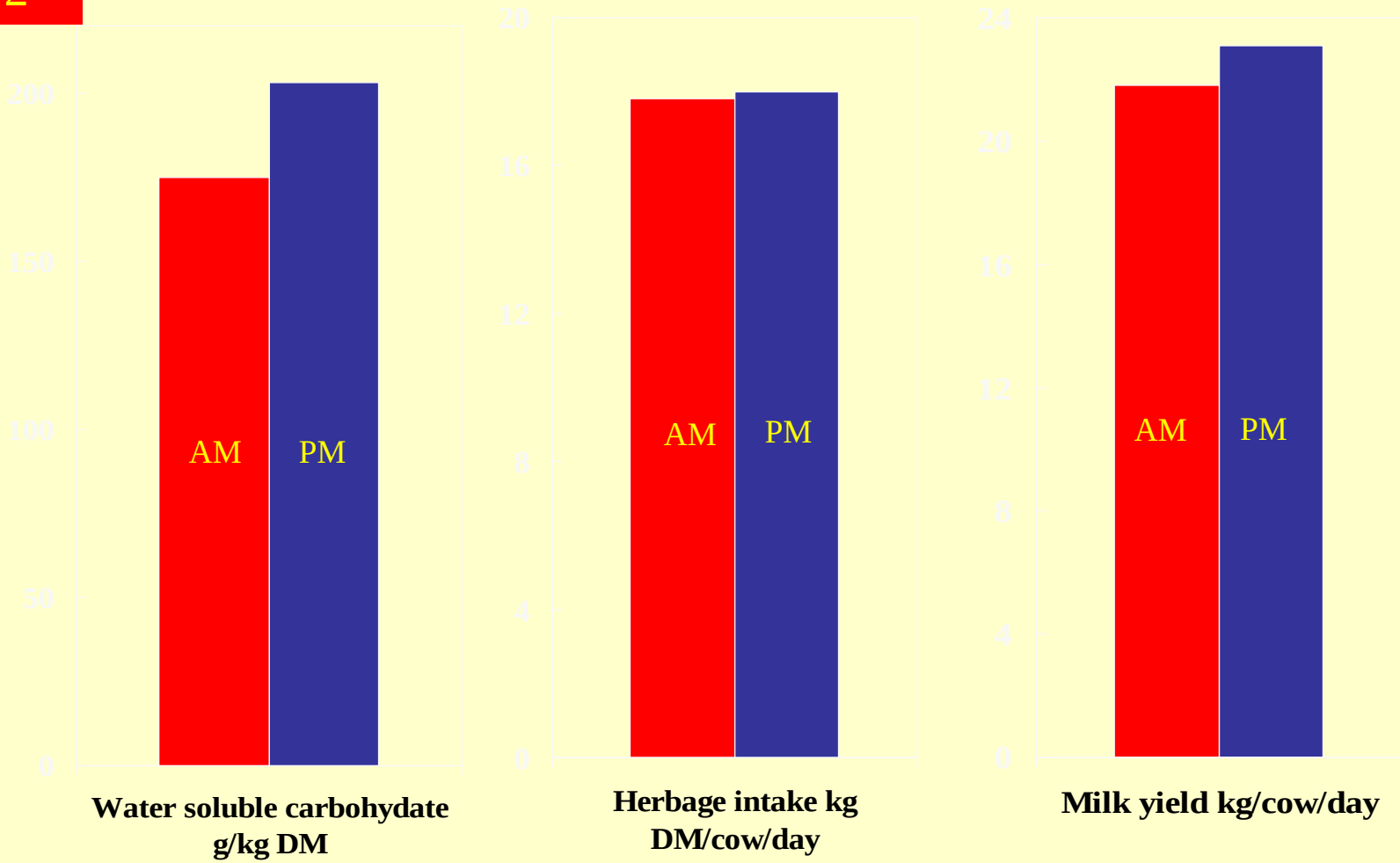


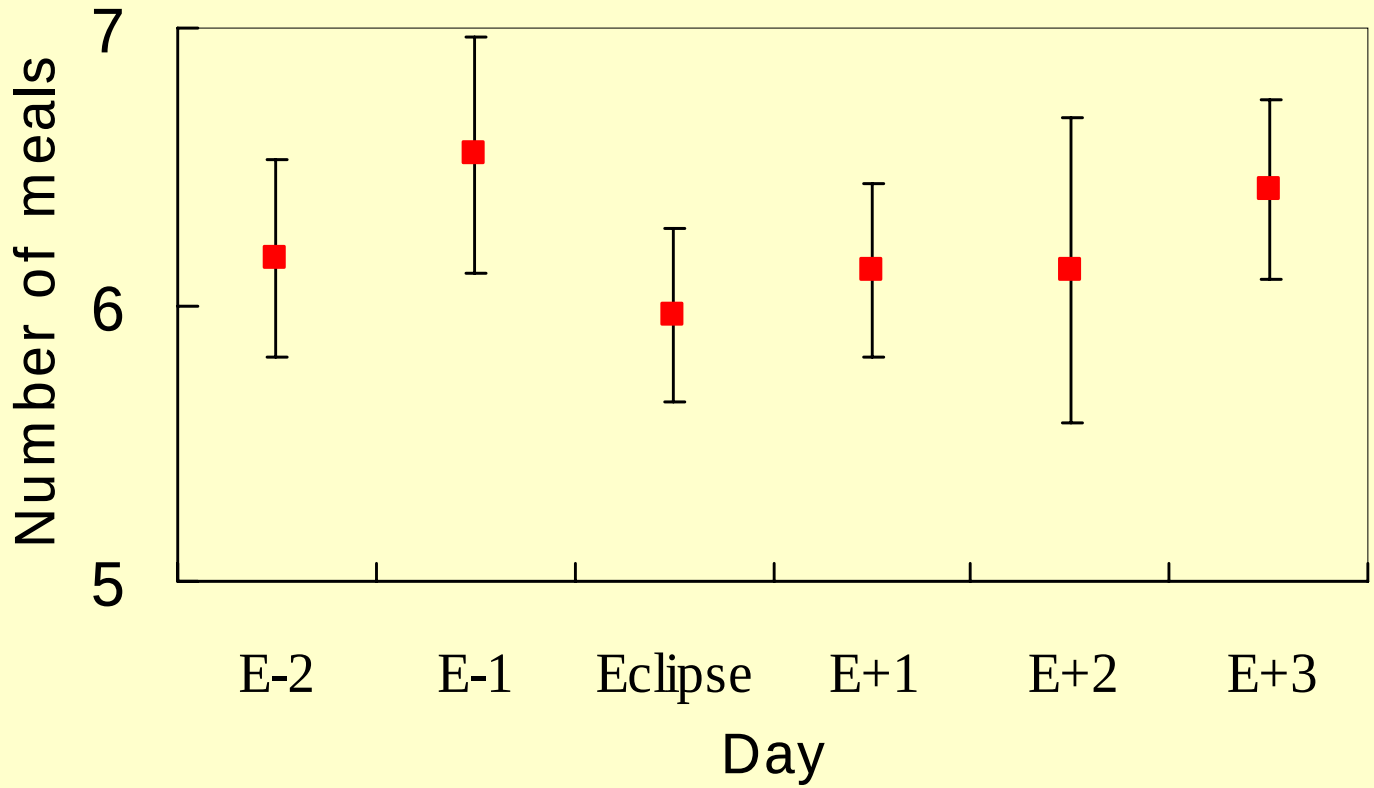
Water soluble carbohydate g/kg DM

Herbage intake kg DM/cow/day

Milk yield kg/cow/day

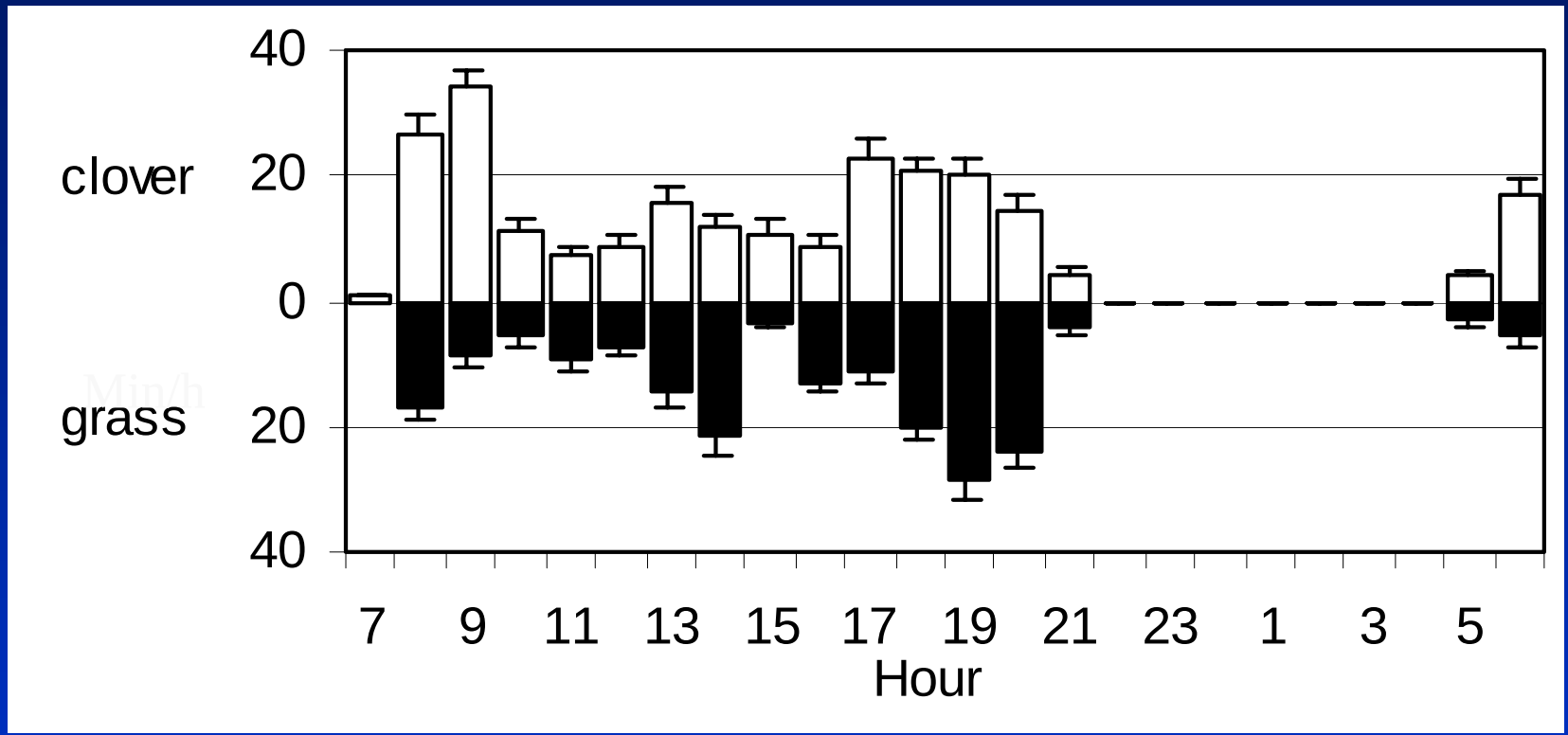
Cows were offered new grass either AM or PM. WSC was higher PM. There was no effect on intake but milk yield was 5% higher.

5



Grazing behaviour of cows was observed for 6 days, with a total solar eclipse on the 3rd day at 11 am. The eclipse had no effect on temporal pattern of grazing.

Diurnal preference for grass and clover



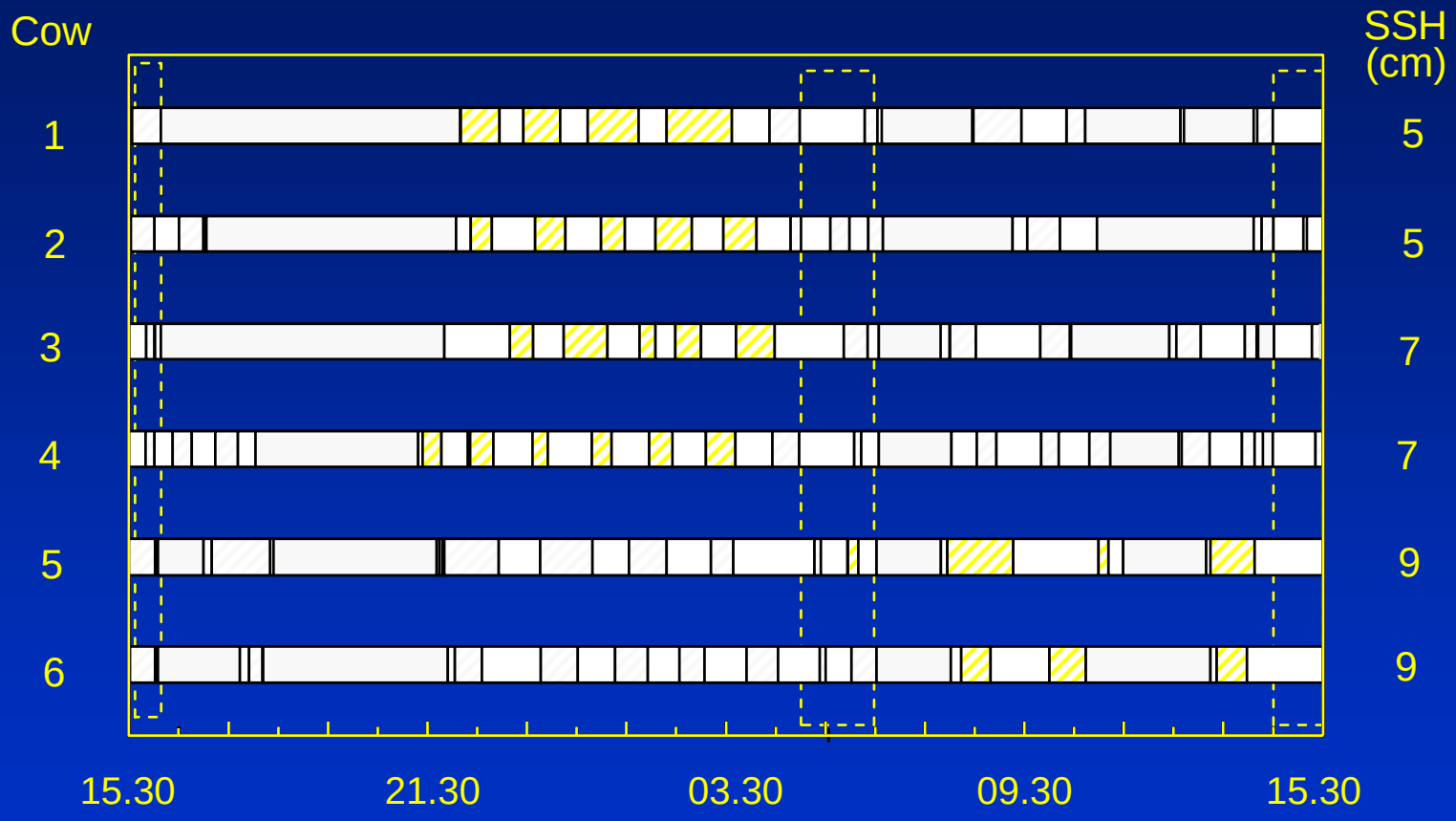
Rutter *et al*. 1998

Effect of timing of herbage allocation

	Time of allocation	
	AM	PM
Herbage intake (kg DM/cow		
(07:45 to 16:45 h)	12.1	2.2
(16:45 to 07:45 h)	5.7	15.8
Total	17.8	18.0
Water soluble carbohydrate (%DM)		
morning	18.1	16.2
evening	15.9	20.3
Milk Yield (kg/day) in week 10	21.8	23.1

Rutter et al., 2000

How would one national standard be written to cover all climates and management systems?



Pattern of grazing and ruminating activity over 24 hours

(indicates time of removal from paddock for milking).

NEW YORK DAIRY FARMS (SIX YEAR AVERAGE (1996-2001)[a]

	Graziers	Non-Graziers	Difference
No. Farms	58	105	
No. Cows	85	83	
Milk sold/cow, kg	7,875	8,333	-458
Operating cost/kg, $ milk	.23	.25	-.02
NFI/cow, $	460	389	+71
Return on Equity, %	3.8	1.5	
Vet. & Med/cow, $	61	74	-13
Machine costs/cow, $	479	541	-62
Investment/cow, $	6,533	7,500	-967

Milk Production On Pasture is Economic Optimization Not Making the Most Milk Per Cow

Pasture Quality

- **Nutrient quality of well managed pasture is higher than same plant material harvested as silage or hay**
- **Develop supplement strategies:**
  - **Make efficient use of the positive nutritional attributes of pasture**
  - **Improve the nutritional imbalances and limitations of pasture**

FACT:

- **Supplemental grain (energy) is required for most high genetic cows (profitability)**
- **With substitution effect:**
  - **↑ grain fed**
  - **↓ pasture intake**
  - **↑ total DMI**
- **Substitution Rate - 0.5 kg**

- Concentrate ↑ 1 kg; pasture ↓ 0.5 kg DM

Expected Economic Response (Early Lactation) to Supplemental Concentrates

Pasture[a]		Concentrate[b]		Total		Milk[c]		INC/FC[e]	Marginal Return
DMI	Cost	DMI	Cost	DMI[c]	Cost	(kg)	($)	($)	($)
Kg	($)	(kg)	($)	(kg)	($)				
18	1.19	0	0	18	1.19	21.0	5.99	4.80	
17	1.12	2	.35	19	1.47	23.3	6.64	5.17	0.37
16	1.06	4	.70	20	1.76	25.4	7.24	5.48	0.31
15	.99	6	1.05	21	2.04	27.0	7.70	5.66	0.18
14	.92	8	1.40	22	2.32	28.4	8.09	5.77	0.11
13	.86	10	1.75	23	2.61	29.6	8.44	5.83	0.06

[a]Pastue cost – 6.6¢ /kg. DM
[b]Concentrate cost – 17.5¢/kg. DM
[c]Assume substitution rate of 0.5 (1 kg. grain with 0.5 kg. decrease in pasture DMI)
[d]Milk price – 28.5¢ /kg. of 3.5% milk; milk:feed price ratio is 1.65:1
[e]Income minus feed cost
[f]Does not consider long-term benefits on body condition and reproductive performance.

Milk and Profit Response to Supplementation[a]

	Early Lactation	Mid Lactation
Expected kg milk response/ kg suppl.	0.8 to 1.2	.6 to .8
Milk:Feed price ratio		
>1.50:1	Profit	Profit
1.25: 1	Profit	Break even
1.00:1	Break even	Loss
<1.00:1	Loss?	Loss

[a]**Does not consider long term benefits on body condition and reproduction**

Supplementation with Grains with Differing Carbohydrate Degradation Rates

Study	Barley vs. Corn
1 – late spring (5.5 kg)	1.2 kg ↑ milk
>Barley ↓ rumen NH_3N	
2 – 140 DIM (6.8 kg)	1.6 kg ↑ milk
>Barley/corn mix the best	
3 – 67 DIM	1.4 kg ↑ milk

SUGGESTS: Need to provide energy sources that differ in rumen carbohydrate degradation

Using "Partial" TMR to Provide Grain

- Provides more uniform ration with less chance of rumen disruption
- Forage fed with grain
  - Reduce risk of rumen digestive problems
- Monitoring of DMI should be more accurate
- Corn silage balances well with pasture
- Higher milk production/cow
- Economics?

Responses to Supplements

- **Immediate response during feeding**
- **Residual response after cessation of feeding**
- **TOTAL RESPONSE**

Potential Human Health Benefits to CLA

- **Anticarcinogenic**
- Reduce risk of heart disease
- Prevent onset of diabetes
- Enhance immune function
- Improves bone formation
- Reduced body fat

ANTI CARCINOGENIC

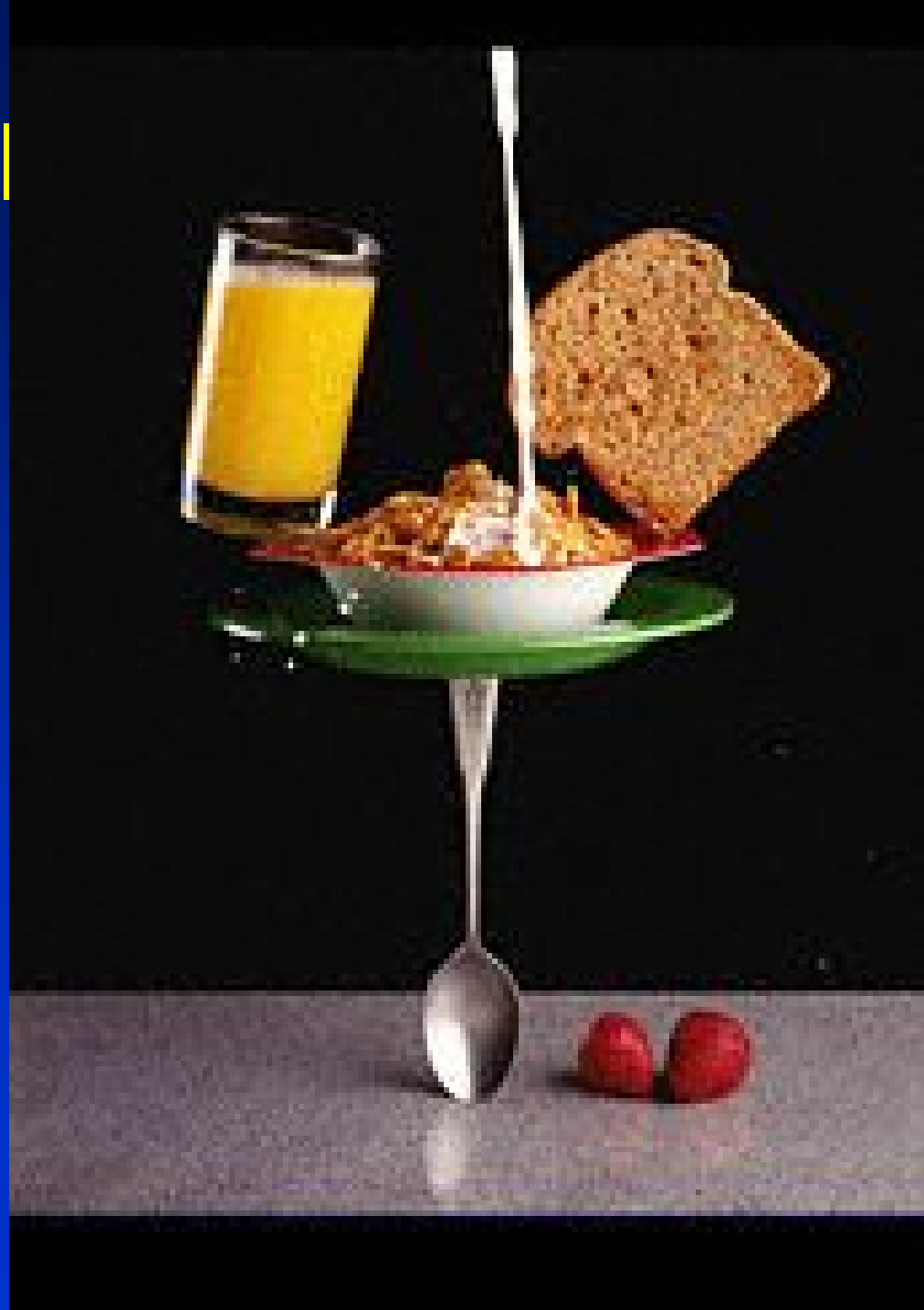
- Reduces incidence of tumors (in vivo)
  - **Mammary (breast)**
  - **Prostate**
  - **Skin**
  - **Stomach**

Representative/relative concentrations of CLA in uncooked foods

Food	Total CLA (mg/g fat)
Dairy Products	
Homogenized Milk	5.5
Butter	4.7
Ice cream	3.6
Cheddar cheese	3.6
Mozzarella cheese	4.9
Meat	
Fresh ground beef	4.3
Lamb	5.6
Pork	0.6
Chicken	0.9
Fish	0.3

Concl

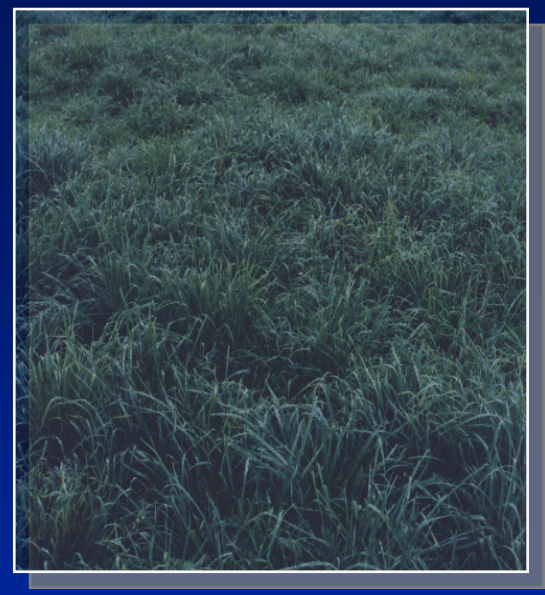
- Fat from Dairy products has benefits
- Important to monitor overall fat intake
- Fresh forage provides increased levels of CLA



Summary of CLA

- Only produced in ruminant animals
- Amount can be ↑ in dairy products by diet
  - ↑ in pasture fed cows
- Potential benefits to human health
- “Designer milk” – Potential opportunity
- Currently no economic incentive

Pasture as Only Forage



- **High Quality and Quantity**
  - **DMI of 37-40 lb from pasture (3.0 - 3.2% of BW)**
  - **Loss of body condition likely**
  - **Reproductive performance?**
  - **Milk production –45-55lb/da**

Kolver and Muller, 1996

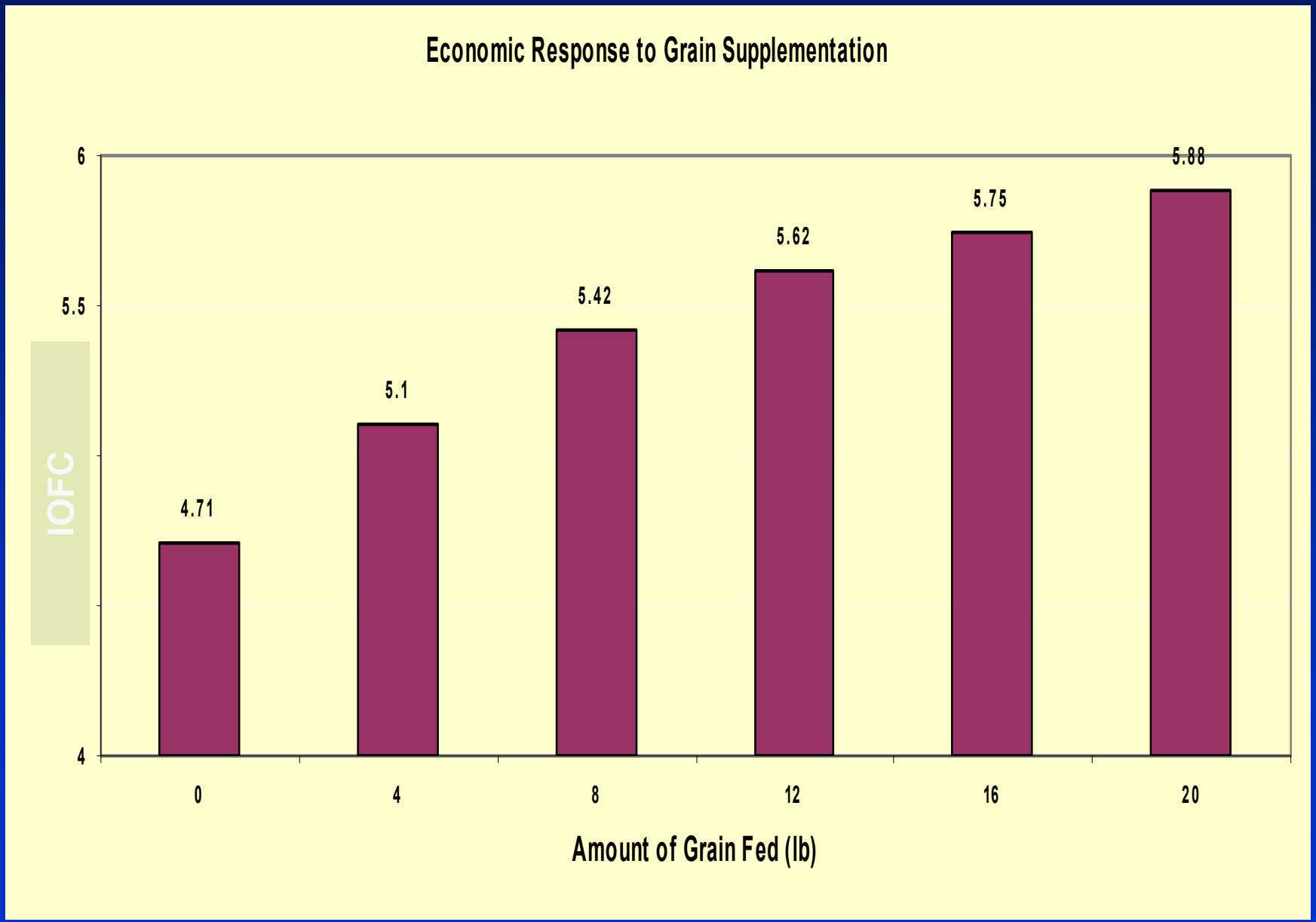
With No Grain Supplementation

Pasture	Expected Milk Yield[a] lb/cow/day
Grasses	40-50
Grass/legume mixture	45-55

[a]Assume no body weight loss or gain

[b]Holsteins

Kolver and Muller, 1996



Data from Larry Muller, PSU

Experiment 1 (Unsupplemented): Grazing behavior

	Pasture Allowance		
	Low	**High**	**SEM**
Grazing time, min/d	461[a]	638[b]	46
AM, min	324	337	27
PM, min	137[a]	301[b]	34
Biting rate, bites/min	52	57	2
Bite mass, g DM/bite	0.66[a]	0.53[b]	0.03

[a, b] Means in rows with different superscripts differ ($P < 0.05$)

Experiment 1 (Unsupplemented): Grazing behavior and rumen pH