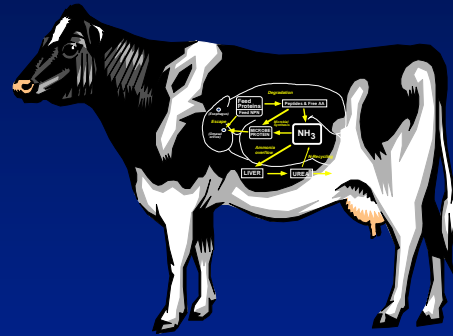# Are We Feeding Our Cows Too Much Protein?

World Dairy Expo
October 2005

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Madison, Wisconsin

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Dairy Cows Uses Crude Protein 2-3 X More Efficiently than Beef Animals

Feed N utilization

Manure N utilization

# How can Nitrogen Excretion be Reduced Without Losing Production?

Strategies to Reduce N Excretion

1. **Feed the Minimum Crude Protein (CP).**

2. Accurately Track Dietary CP.

3. Use Model (e.g., NRC) to Meet Needs for Rumen-Degraded Protein (RDP) & Rumen-Undegraded Protein (RUP).

4. Reduce Rumen Degradability of Forage CP.

5. Feed "Complementary" RUP & Protected AA.

6. Use New Approaches to "Fine-Tune" Feeding.

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Effect of CP (Solvent SBM) or Energy on Protein Yield
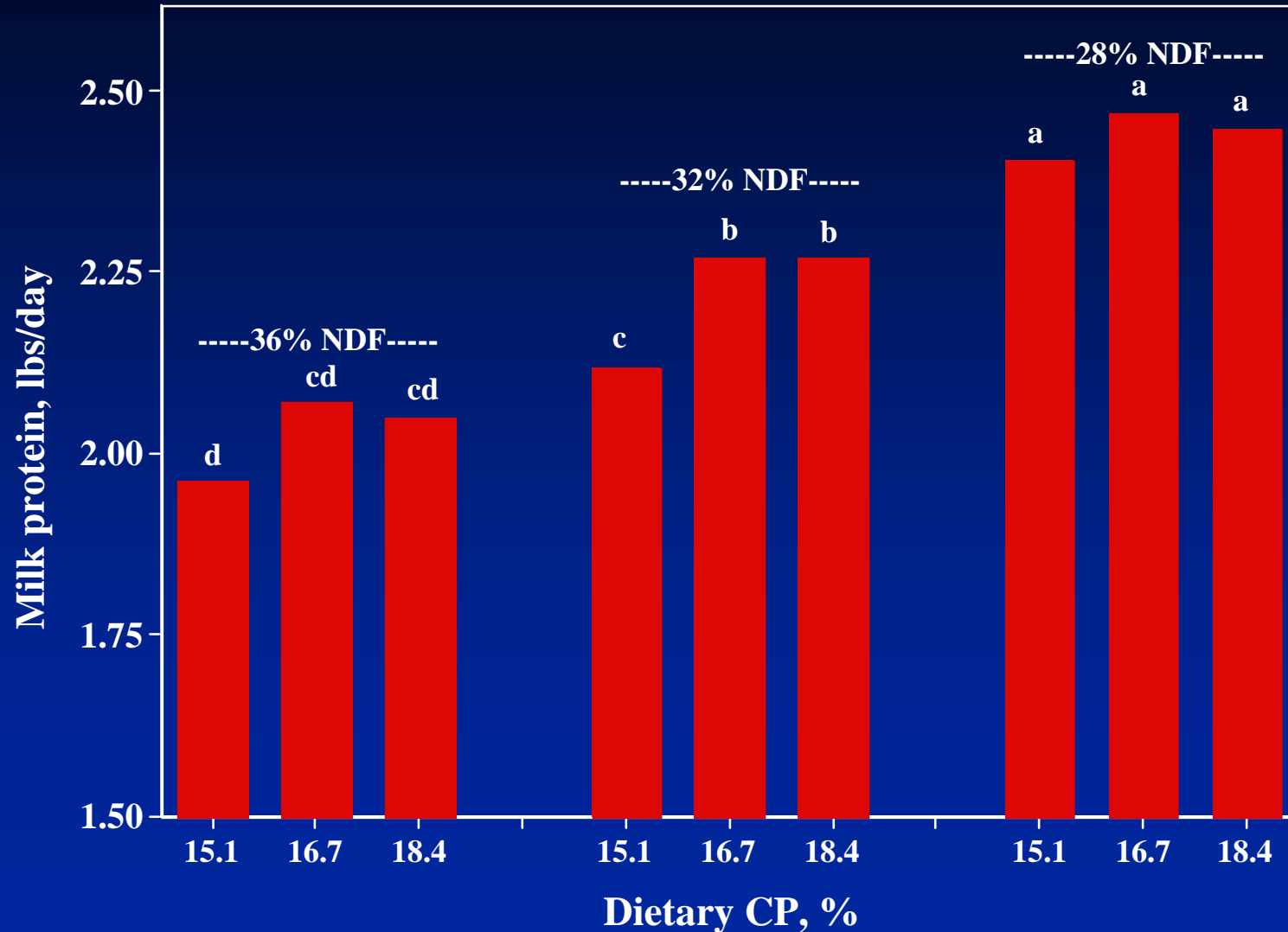
Effect of CP (Solvent SBM) on Milk & Protein Yield (Olmos & Broderick, 2003)

Milk yield max = 16.7% CP

Milk protein max = 17.1% CP
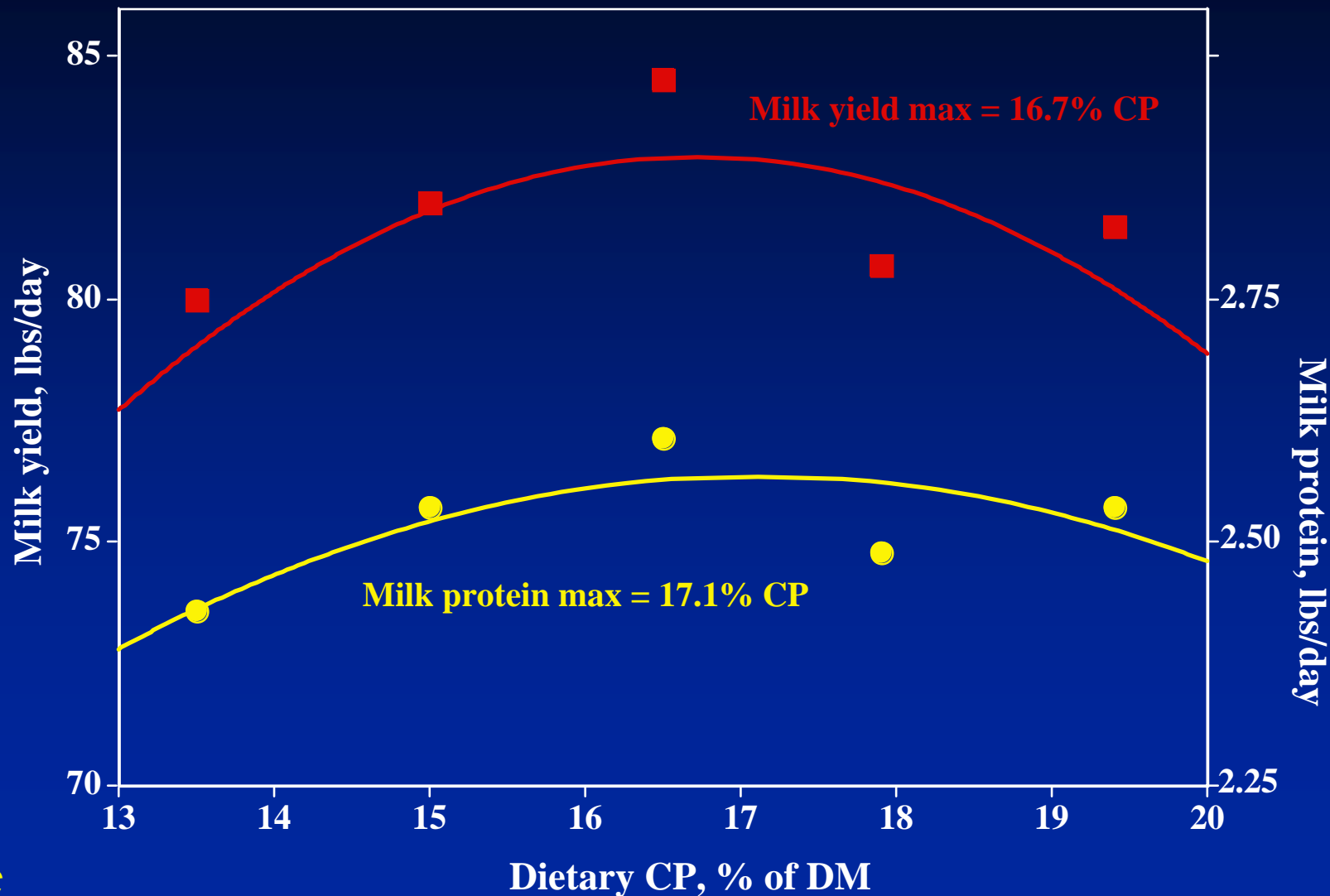
Effect of Forage Source & CP on Production

(Wattiaux & Karg, 2004)

| | Forage/CP (%) | | | | Prob.[1] | |
| | Alfalfa silage | | Corn silage | | | |
Item	16.5	18.0	16.2	17.1	*For.*	*Prot.*
DMI, lb/d	53.8	55.8	53.4	54.0	0.41	0.30
Milk, lb/d	101.6	103.0	108.7	107.4	0.03	0.97
3.5% FCM, lb/d	101.6	102.3	101.4	101.2	0.84	0.95
Fat, lb/d	3.77	3.51	3.35	3.26	0.08	0.35
True protein, lb/d	2.80	2.80	2.91	2.89	0.20	0.88
MUN, mg/dl	11.7	12.2	11.5	12.8	0.35	< 0.01

[1]No significant Forage*Protein interactions were observed (P > 0.60).

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Effect of Dietary CP on the Lactation Curve
(Wu & Satter, 2000)
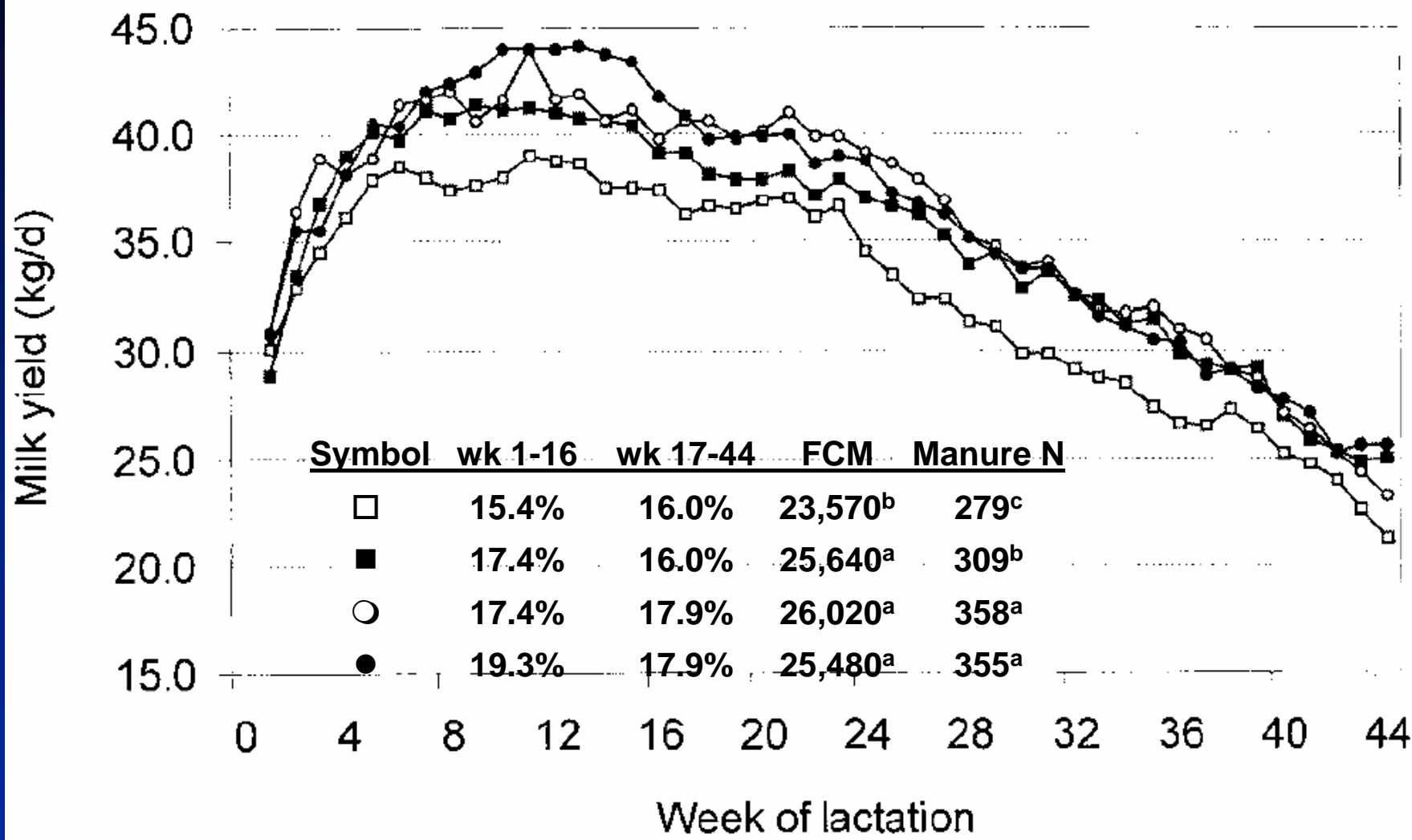
Symbol	wk 1-16	wk 17-44	FCM	Manure N
□	15.4%	16.0%	23,570[b]	279[c]
■	17.4%	16.0%	25,640[a]	309[b]
○	17.4%	17.9%	26,020[a]	358[a]
●	19.3%	17.9%	25,480[a]	355[a]

Milk yield (kg/d)
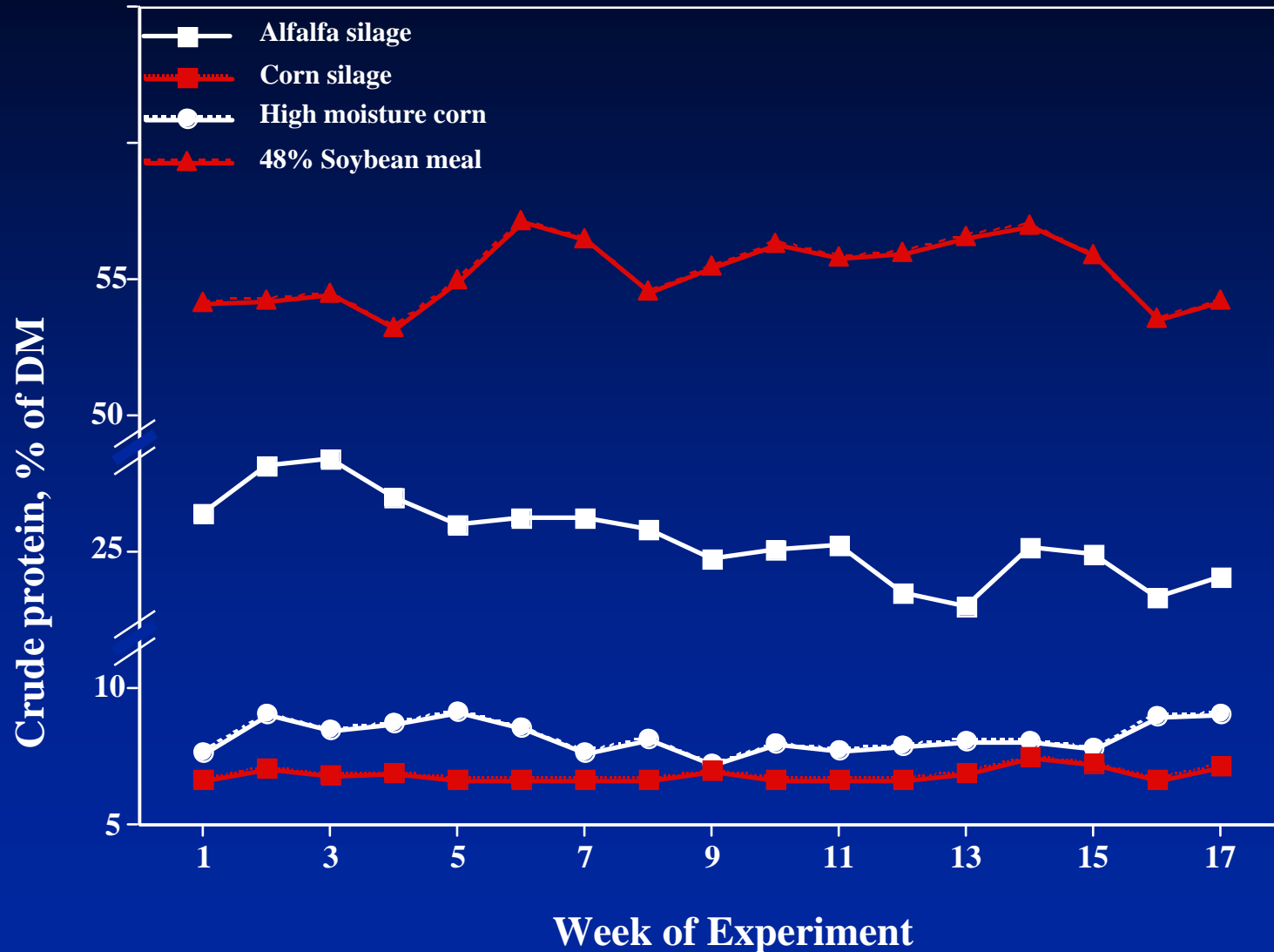
Week of lactation

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5. Feed "Complementary" RUP & Protected AA.

6.   Use New Approaches to "Fine-Tune" Feeding.
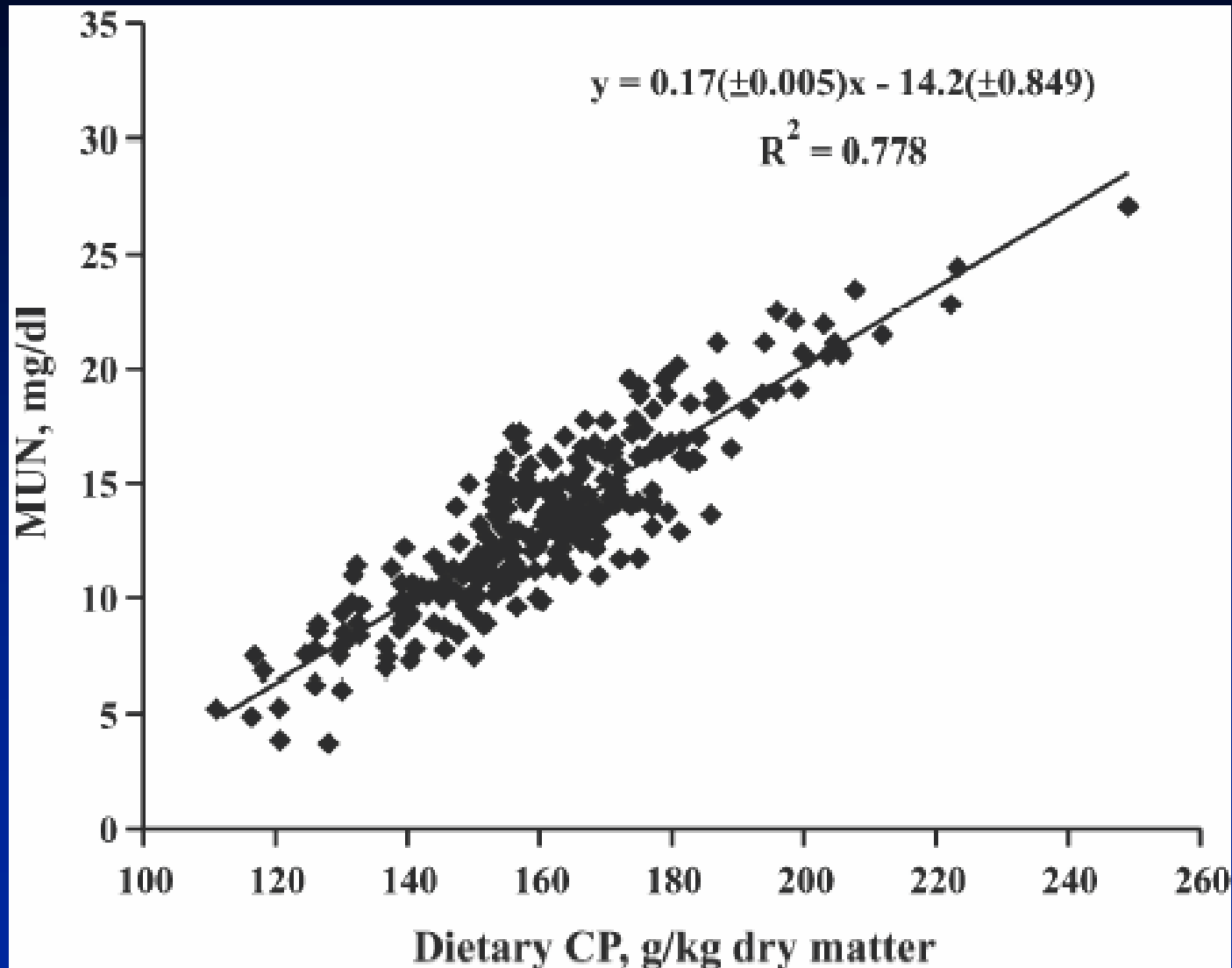
Sampling Forage is Most Important

Relationship of Dietary CP to MUN
(Nousiainen et al., 2004)

$$y = 0.17(\pm 0.005)x - 14.2(\pm 0.849)$$
$$R^2 = 0.778$$

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NRC (2001) Protein Model

1. Meet Microbial Needs for **RDP**.

2. Supply Metabolizable Protein to Meet Cow Needs with **RUP**.

3. Match Protein Quality to Cow's Requirements (Not All RUP sources are Equal).

Matching Rumen Available Energy with RDP

Get The Most Bang Out of Your Dietary Carbohydrate (But Not Too Much)

Effect of Processing on Digestion of Corn Starch (Owens et al., 1986)

Processing Method	Proportion of Starch Digestion, %			
	Rumen	Small Intestine	Large Intestine	Total tract
Cracked Corn	69	13	8	89
Ground Corn	78	14	4	94
High Moisture Corn	86	6	1	95

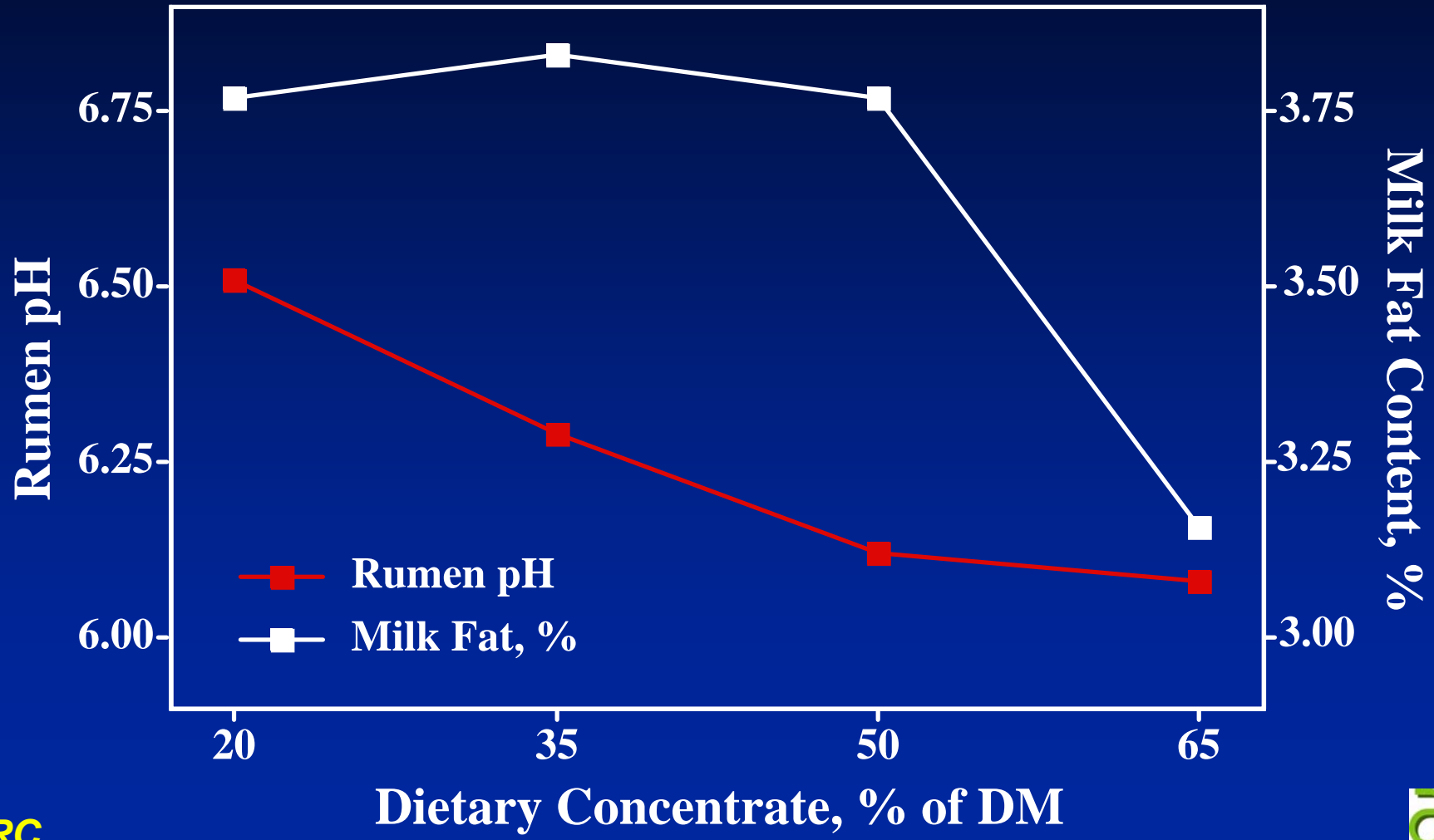# Rumen Ammonia & Production of Cows fed Alfalfa Silage & Ground HMEC (Ekinci & Broderick, 1997)
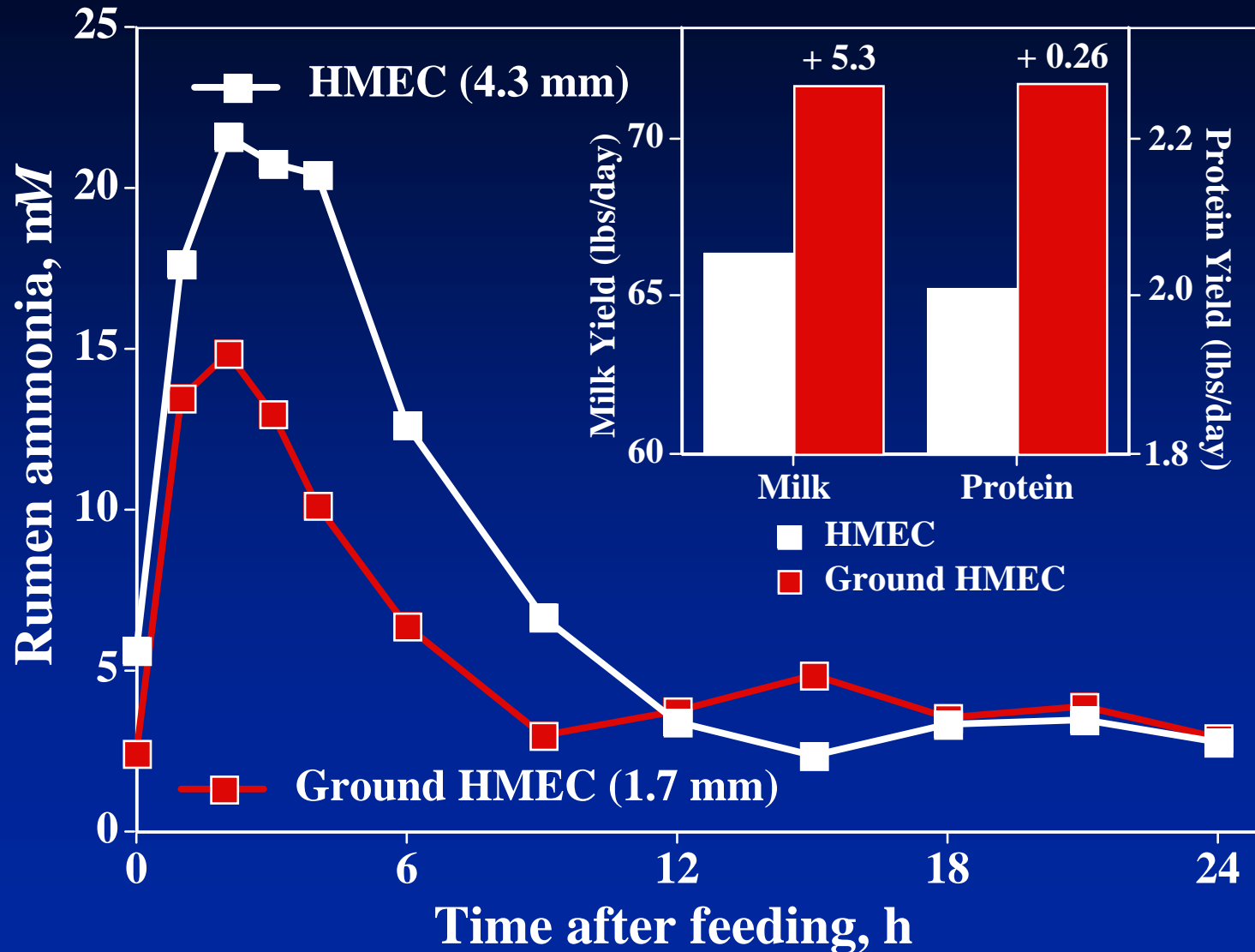
Effect of Replacing Alfalfa Silage with Concentrate (Valadares et al., 2000)
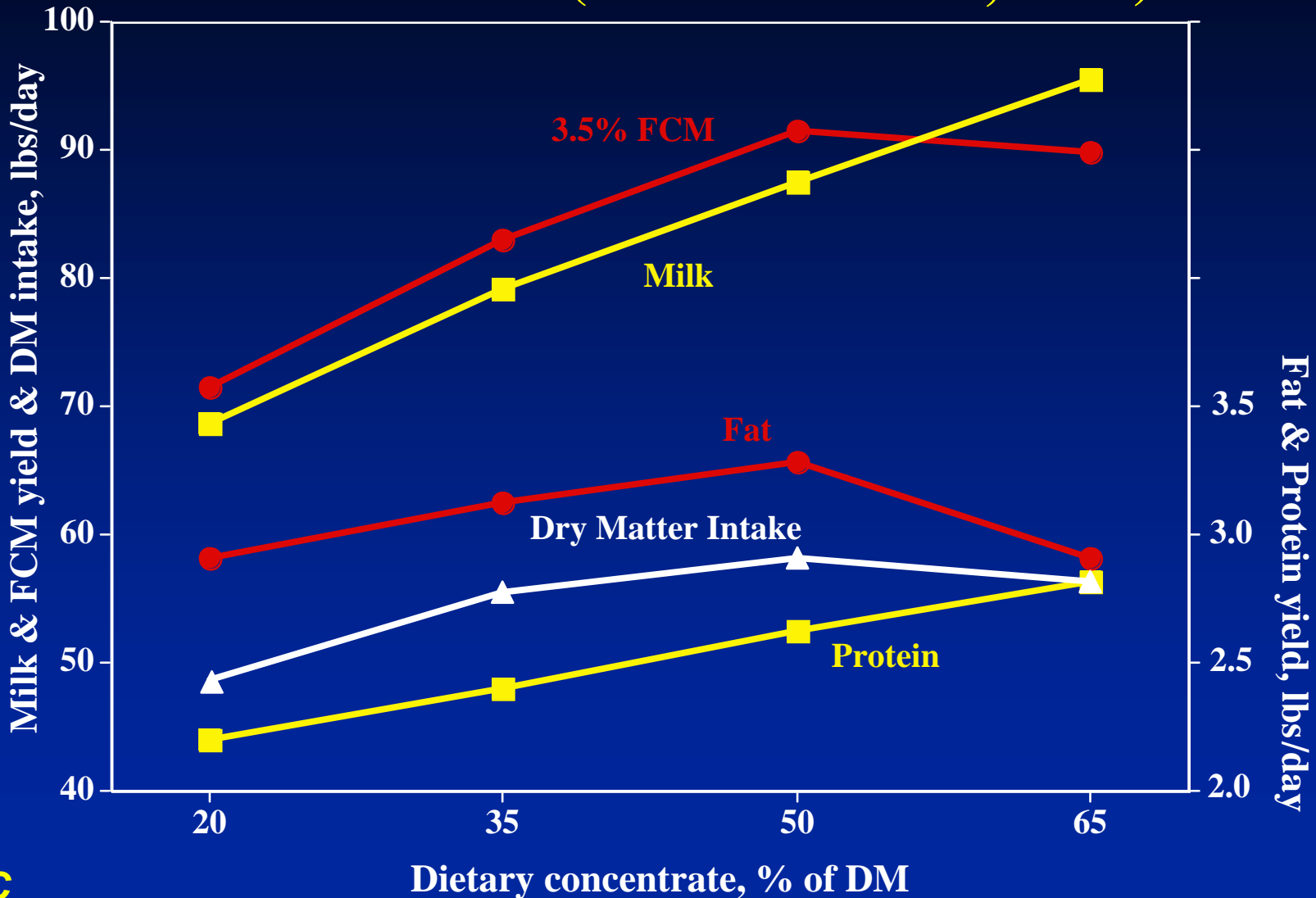
Over-Feeding Grain Depresses Rumen pH & Milk Fat (Valadares et al., 2000)

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Lameness from Over-Feeding Grain

Too Little Fiber in the Diet Results in Release of Histamine & Metalloproteinases, leading to Foot & Leg Damage.

Replacing Alfalfa Silage with Corn Silage
(Brito & Broderick, 2003)

Item	Alfalfa Silage:Corn Silage			
	51:0	37:13	24:27	10:40
Composition (% of DM)				
Alfalfa Silage	50.5	37.1	23.6	10.2
Corn Silage	0	13.3	26.7	40.0
Crude Protein	17.2	17.0	16.8	16.6
Production				
DM Intake (lbs/d)	58.4[a]	57.1[a]	55.1[b]	51.1[c]
Milk Yield (lbs/d)	91.5[a]	92.6[a]	91.5[a]	87.1[b]
Rumen NH_3 (mg N/dl)	10.5[a]	10.0[ab]	8.7[b]	6.2[c]

[a,b,c]($P < 0.05$)

Feeding Sugar with Alfalfa Silage

1. Replacing Dietary Starch with ~2.5% Sugar Increased <u>Intake</u>, OM Digestibility & <u>Fat Yield</u>.

2. Reduced Rumen Ammonia.

3. Small Effects on Milk & Protein Yield.

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Harvest Alfalfa as Silage or Hay?

Mean Composition of Alfalfa Silage & Hay

Item	Silage	Hay	Change, %
DM, %	41	86	---
CP, % DM	20.6	18.1	-12
NPN, % CP	51.9	8.0	-85
Est. RDP, % CP	71	73	NS
NDF, % DM	38	38	NS
NE_L, Mcal/kg DM	1.51	1.50	NS
Ash, % DM	10.4	9.8	-6

Production on 50% Alfalfa Silage or Hay +/- Fish Meal (FM) Supplementation (Vagnoni & Broderick, 1997)
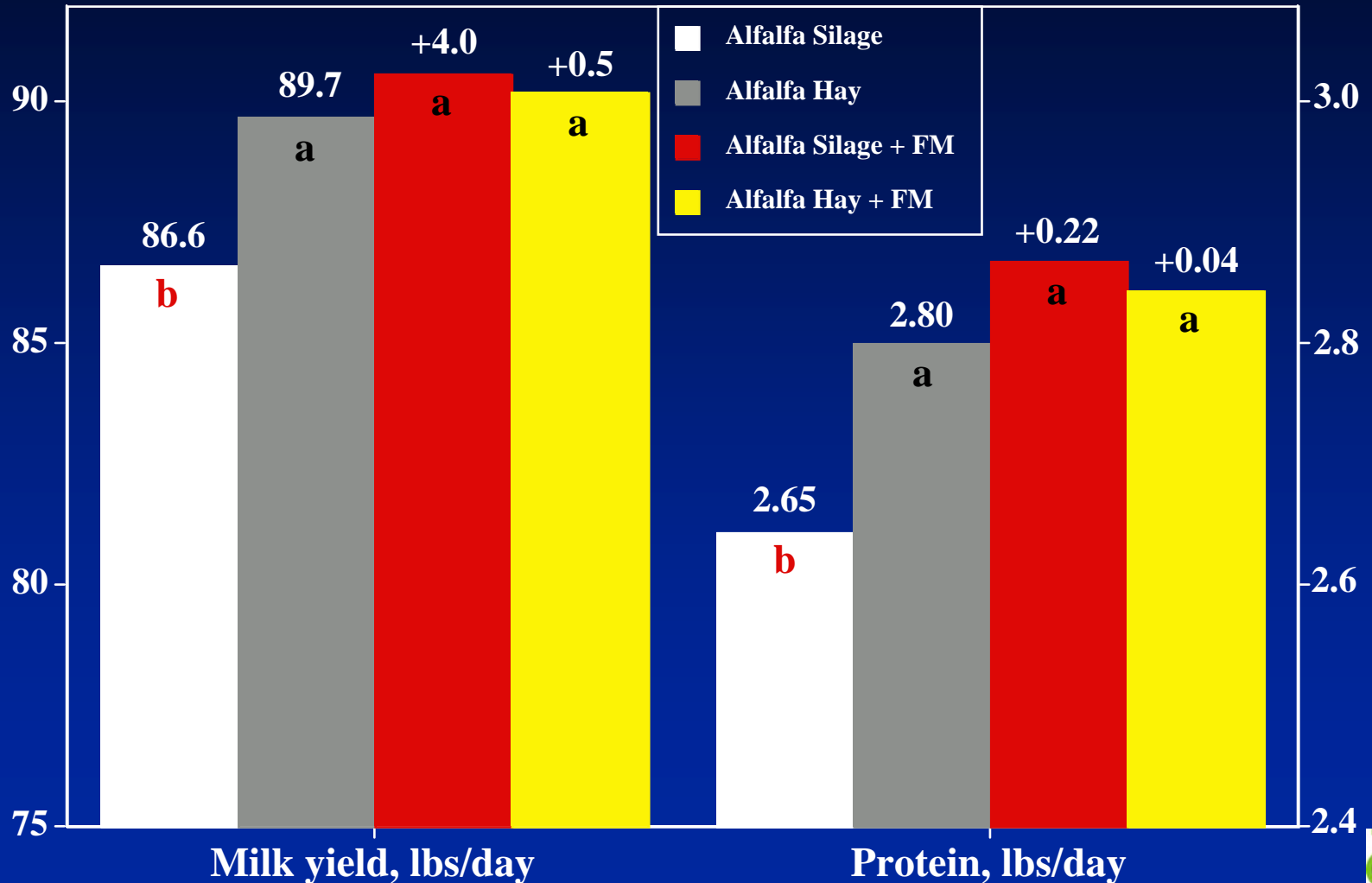
Legend:
- ☐ Alfalfa Silage
- ■ Alfalfa Hay
- ■ Alfalfa Silage + FM
- ■ Alfalfa Hay + FM

Milk yield, lbs/day:
- Alfalfa Silage: 86.6 (b)
- Alfalfa Hay: 89.7 (a)
- Alfalfa Silage + FM: +4.0 (a)
- Alfalfa Hay + FM: +0.5 (a)

Protein, lbs/day:
- Alfalfa Silage: 2.65 (b)
- Alfalfa Hay: 2.80 (a)
- Alfalfa Silage + FM: +0.22 (a)
- Alfalfa Hay + FM: +0.04 (a)

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CP Supplement & Production
(AS, CS, HMSC, 16.5% CP; Brito, 2004)

Item	Diets[1]				$P > F$
	Urea	SSBM	CSM	CM	
	--------------(lbs/day)--------------				
DM intake	48.7^c	53.4^b	54.5^{ab}	54.9^a	< 0.01
Milk yield	72.5^b	88.2^a	89.3^a	90.6^a	< 0.01
Milk protein	2.03^c	2.71^{ab}	2.60^b	2.80^a	< 0.01
Milk fat	2.23^c	2.69^{ab}	2.60^b	2.84^a	< 0.01

[1]SSBM = Solvent Soybean Meal; CSM = Cottonseed Meal; CM = Canola Meal
^{a,b,c}($P < 0.05$)

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CP Supplement & Omasal Protein Flows
(Brito, 2004)

Item	Diets[1]				
	Urea	SSBM	CSM	CM	$P > F$
	-----------------g/d--------------------				
RUP ("Bypass")	538[c]	987[b]	1348[a]	1150[ab]	<0.01
Microbial protein	2344[b]	2706[a]	2706[a]	2775[a]	0.04
Total protein	2882[c]	3693[b]	4054[a]	3925[ab]	<0.01

[1]SSBM = solvent soybean meal; CSM = cottonseed meal; CM = canola meal
[a,b,c]($P < 0.05$)

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Supplementing Rumen Protected-Met While Decreasing CP

Item	CP, %	18.6	17.3	16.1	14.8	P > F
	RP-Met, g/d	0	8	17	25	
Milk, lbs/d		87.7[ab]	91.7[a]	91.9[a]	87.5[b]	0.06
Milk/DMI		1.72[ab]	1.80[a]	1.77[ab]	1.69[b]	0.06
Protein, lbs/d		2.54	2.71	2.71	2.65	0.19
MUN, mg/dl		14.5[a]	11.8[b]	9.4[c]	7.9[d]	< 0.01
Milk N/NI, %		26[c]	30[b]	32[b]	34[a]	< 0.01

[a,b,c,d]($P < 0.05$)

RP-Met = Mepron

New Approaches to Consider

1. **Protected Amino Acids**
   - <u>**Rumen-Protected Met Sometimes Effective.**</u>
   - <u>**Rumen-Protected Lys (Feeding with Corn Distillers).**</u>
   - <u>**Other Possible Zero-N "Amino Acids" (RP-MHA).**</u>

2. **Slow-Release RDP (Bugs Fed N at "Right Rate")**
   - <u>**Slow-Release RDP from True Protein.**</u>
   - <u>**Alfalfa Hay has Slow Release RDP vs. Alfalfa Silage.**</u>

3. **Suppressing Rumen Protozoa**
   - <u>**Protozoa Waste Protein but Improve Rumen Stability.**</u>
   - <u>**Suppress Protozoa & Use Rumen Supplements.**</u>

Same Milk for Less Crude Protein

1. More Profits, Less Pollution, Better Manure

2. How Much Over-Feeding of Protein is Risk Management ("Safety Margin")?

3. How <u>Low</u> Can We go & Maintain Production?