MANAGING PROTEIN IN DAIRY DIETS TO MINIMIZE NITROGEN LOSS FROM MANURE TO THE ENVIRONMENT

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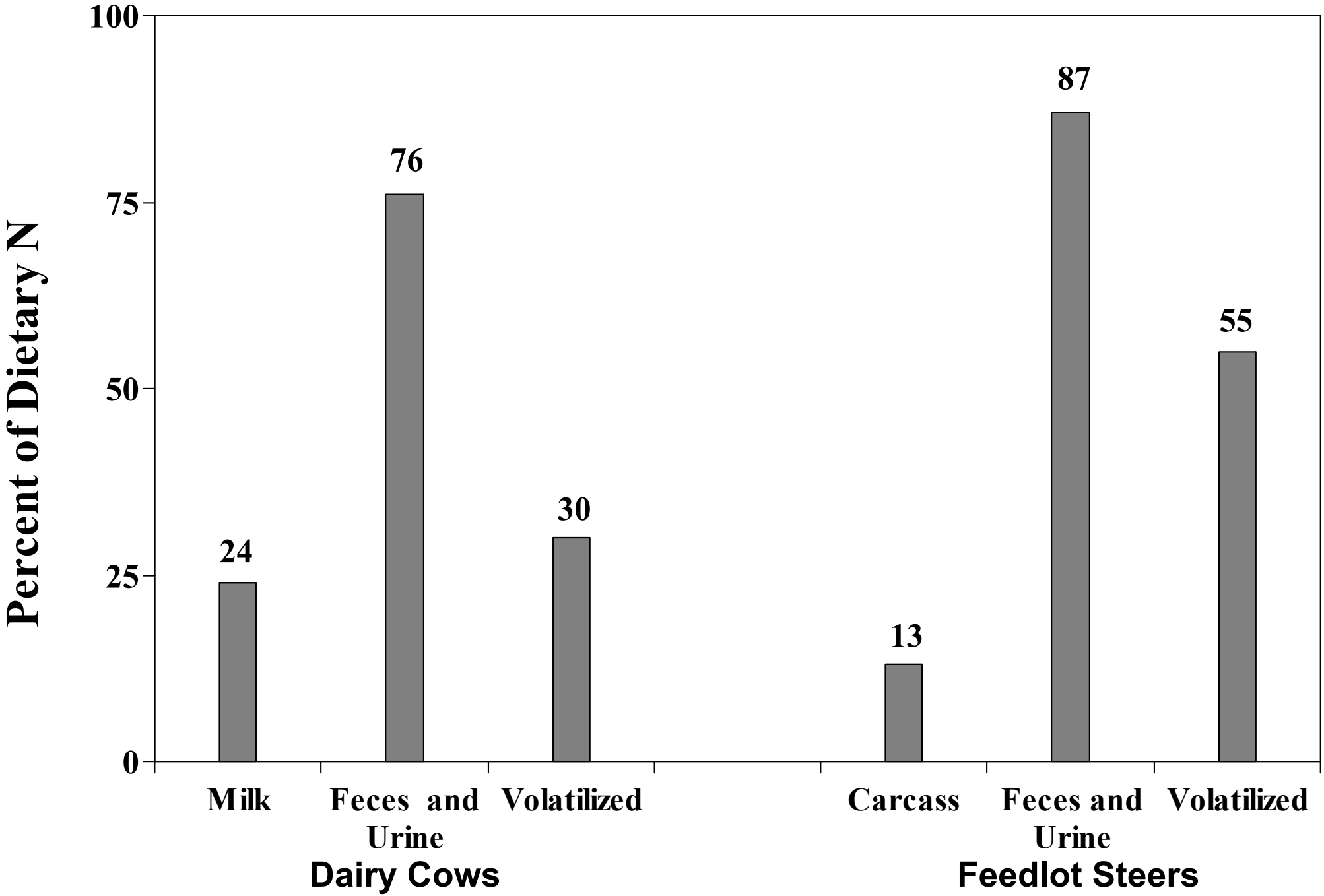
PROBLEMS ASSOCIATED WITH EXCESS RELEASE OF N COMPOUNDS INTO THE ENVIRONMENT

1. **Nitrate contamination of ground water**
2. **Over-fertilization of coastal zones and excess algae growth**
3. **Ammonia (plus nitrous oxide) release into atmosphere, resulting in:**
    a. **Acid rain**
    b. **Formation of particulates**
    c. **Excess deposition of N forms on fragile ecosystems**

MISSISSIPPI RIVER NITROGEN (CAST, 1999)

- About 2 million tons of N flows down the river each year. (originates from agricultural practices, human sewage, nonagricultural fertilizer use, and precipitation)
- About 2-3 lbs N lost each year per acre from agricultural lands to the river.
- Lost N has a fertilizer value of about $410 million.


Percent of Dietary N
100
75
50
25
0
24
76
30
13
87
55
Milk
Feces and Urine
Volatilized
Carcass
Feces and Urine
Volatilized
Dairy Cows
Feedlot Steers

THE DAIRY AND FEEDLOT BEEF INDUSTRIES CAN REDUCE N LOSSES.

1. Reduce N excretion by feeding less protein.
2. Reduce volatile N losses during collection, storage and field application of manure.
3. Use of crop rotations that provide opportunity for utilizing manure N.

REDUCING DIETARY PROTEIN REDUCES VOLATILE N LOSSES

Strategies for Lowering Protein Content of Dairy Diets

1. **Fine tune and balance supply of Rumen Undegraded Protein (RUP) and Rumen Degraded Protein (RDP).**
2. **Enhance microbial protein synthesis in the rumen.**
3. **Fine tune and balance supply of rumen undegraded methionine (and lysine).**
4. **Group animals according to milk production level.**

Fine Tune and Balance Supply of Rumen Undegraded Protein (RUP) and Rumen Degraded Protein (RDP)

Tools available for assisting with this:

a. **NRC Nutrient Requirements of Dairy Cattle (2001)**

b. **Cornell Net Carbohydrate Net Protein System**

EXAMPLE OF HOW CHOICE OF DIET INGREDIENTS AFFECTS DIETARY CRUDE PROTEIN REQUIREMENT (NRC 2001).

Cow producing 45kg milk/d - 90 DIM

55% Forage

All Alfalfa Silage

Ground high moisture shelled corn

Soybean meal

20.8% CP

55% Forage

Half Alfalfa Hay - Half Corn Silage

Dry ground shelled corn

Blood meal, distillers grains, meat bone meal

15.8% CP

PROTEIN — MORE LIMITING THAN ENERGY IN ALFALFA

SUMMARY OF ANIMAL RESPONSE TO FEEDING OF HEATED SOYBEANS[1] (SOCHA, 1991).

Treatment	Milk	Change in Milk fat	Change in milk protein	Dry matter intake
	lb/d	%	%	lb/d
Roasted soybeans	3.5 (16)[2]	+.06 (16)	-.07 (16)	-.2 (16)
Extruded soybeans	2.9 (20)	-.17 (19)	-.06 (17)	+.2 (18)

[1]Soybean meal or unheated soybeans served as the control.

[2]Number in parenthesis is the number of comparisons.

Increase the Amount of Microbial Protein Synthesized in the Rumen

1. **Fine grinding or steam flaking of corn grain**
2. **Feeding high moisture shell corn**
3. **Roller milling of corn silage (kernel processing)**
4. **Feeding more highly digested forages, such as brown midrib-3 corn silage, or macerated alfalfa.**

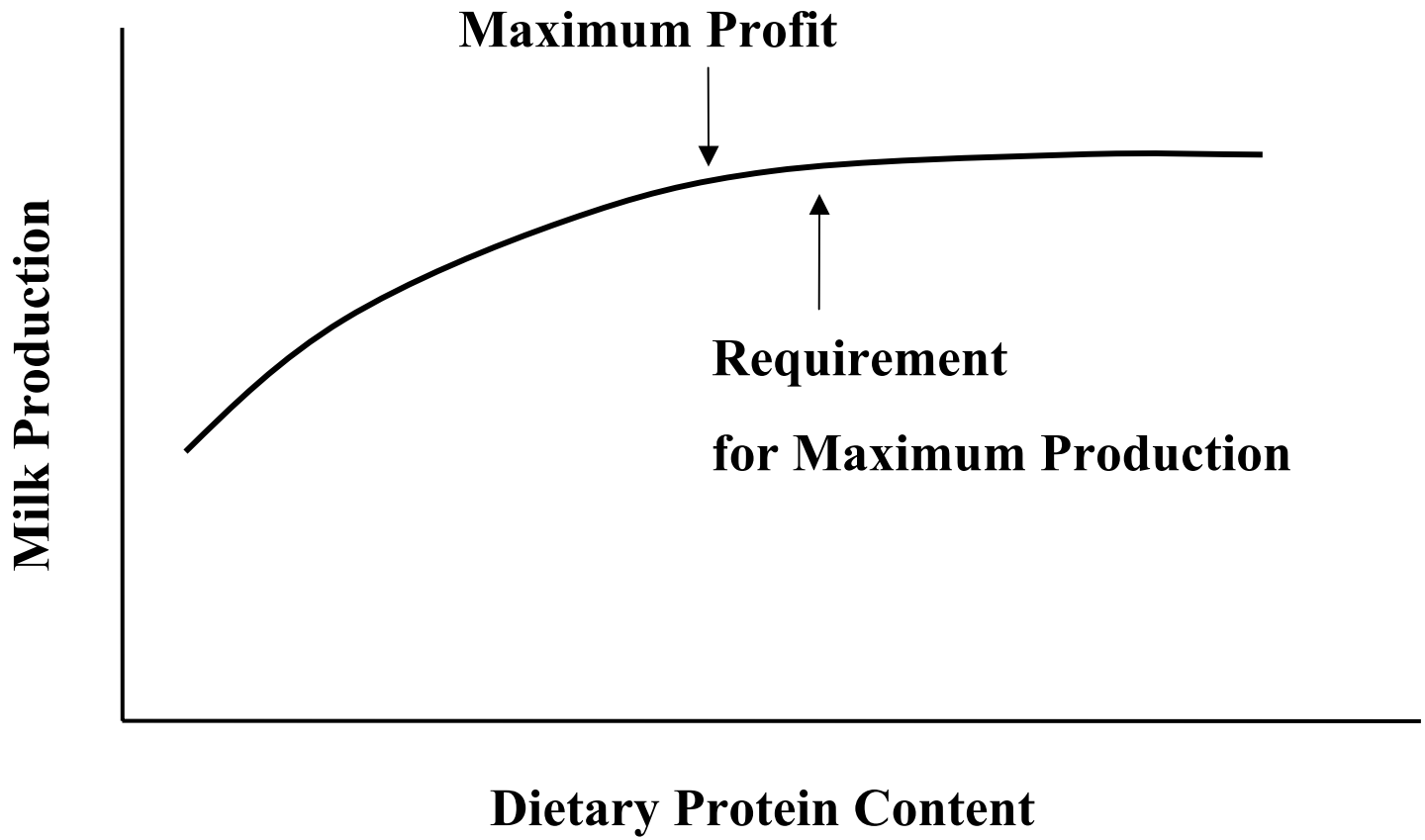
Improve Balance of Amino Acids by Feeding Rumen Protected Methionine (or Lysine)

AVERAGE RESPONSE TO FEEDING PROTECTED AMINO ACIDS
(Summary of 12 trial comparisons by Garthwaite et al, 1998)

Dry matter intake (lb)	**+ 1.1**
Milk (lb)	**+ 1.1**
Milk protein (%)	**+ .15**
Milk fat (%)	**+ .06**

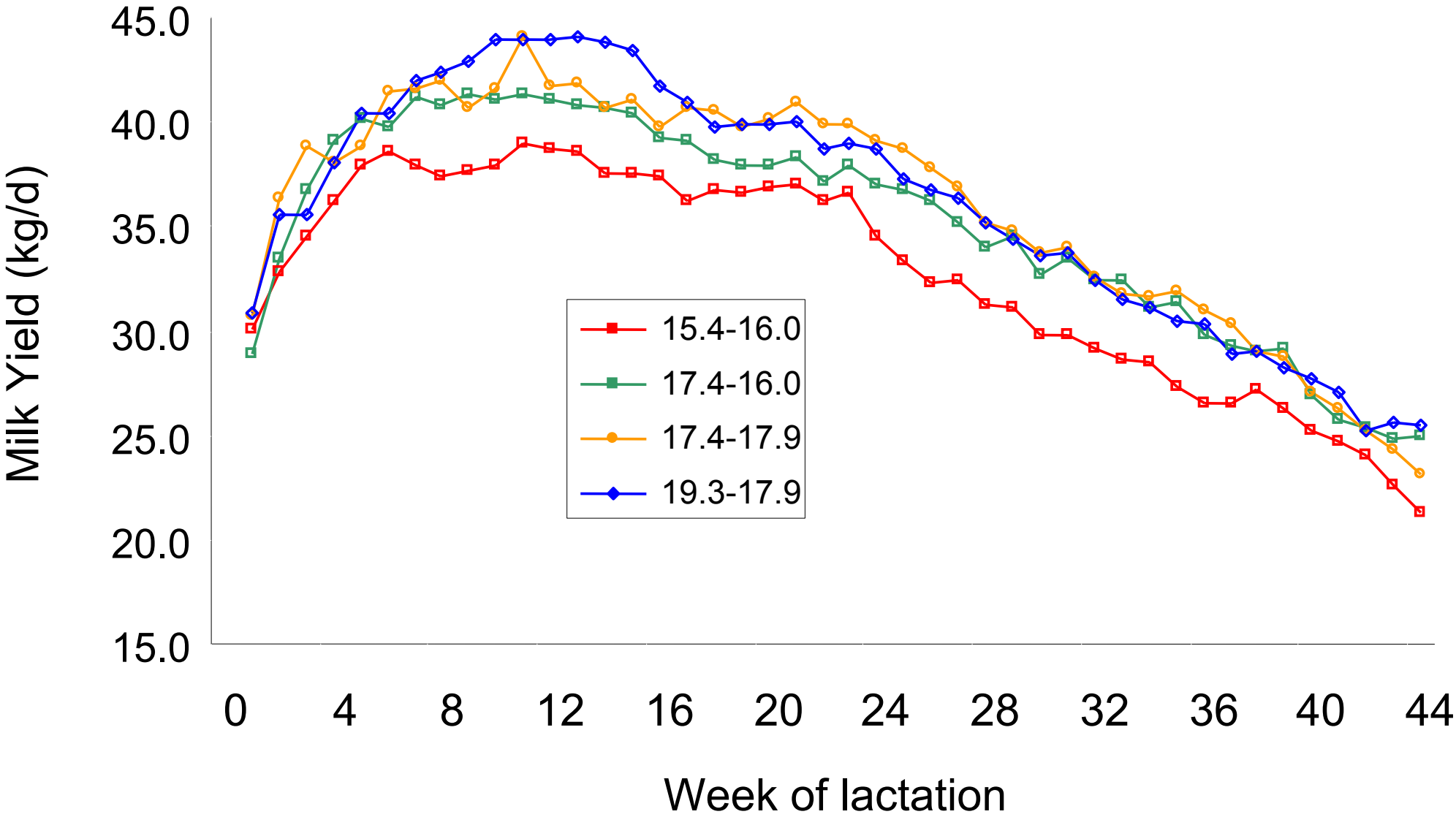
HOW MUCH CAN WE REDUCE DIETARY PROTEIN, THUS DECREASING THE AMOUNT OF NITROGEN IN FECES AND URINE?

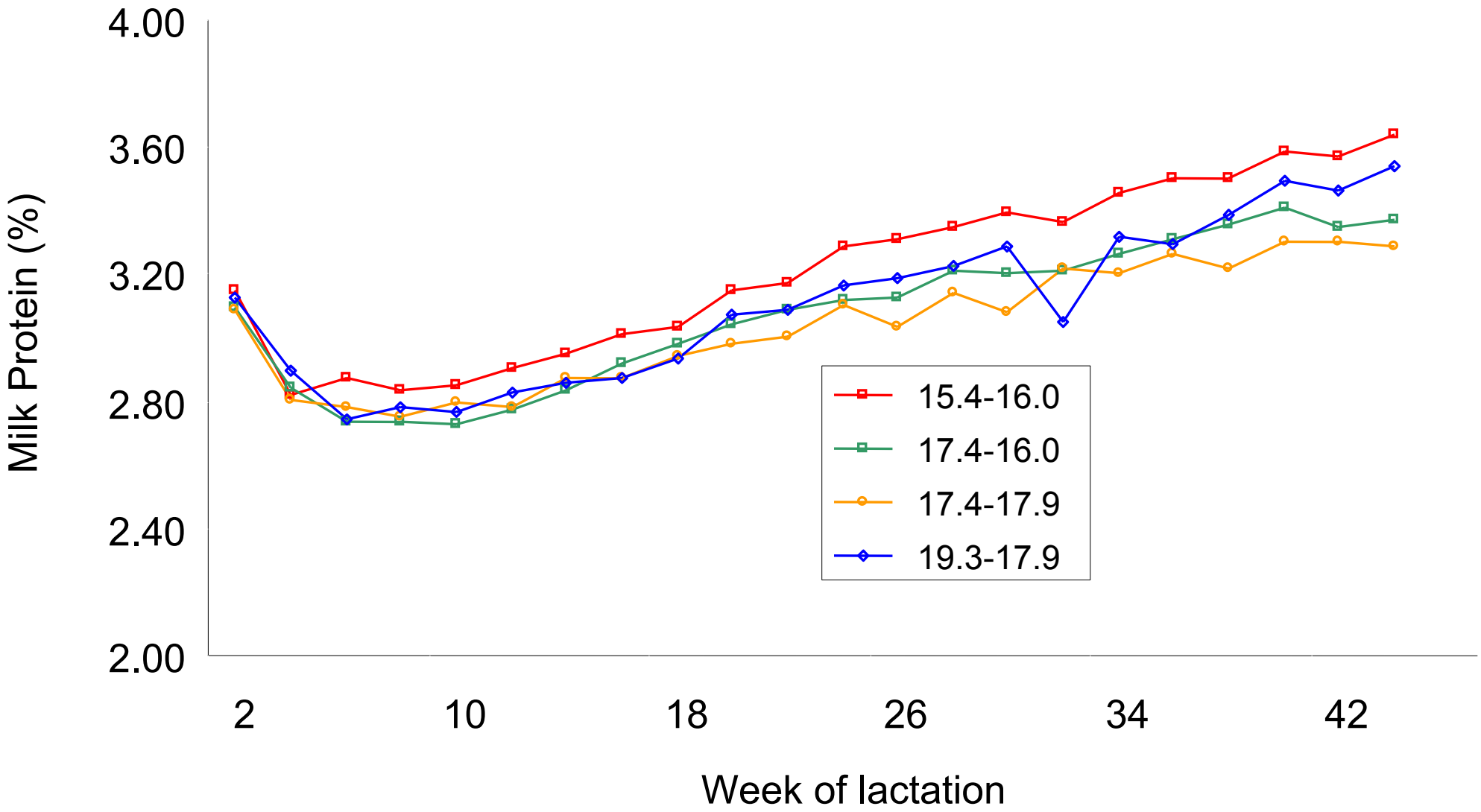
LAW OF DIMINISHING RESPONSE

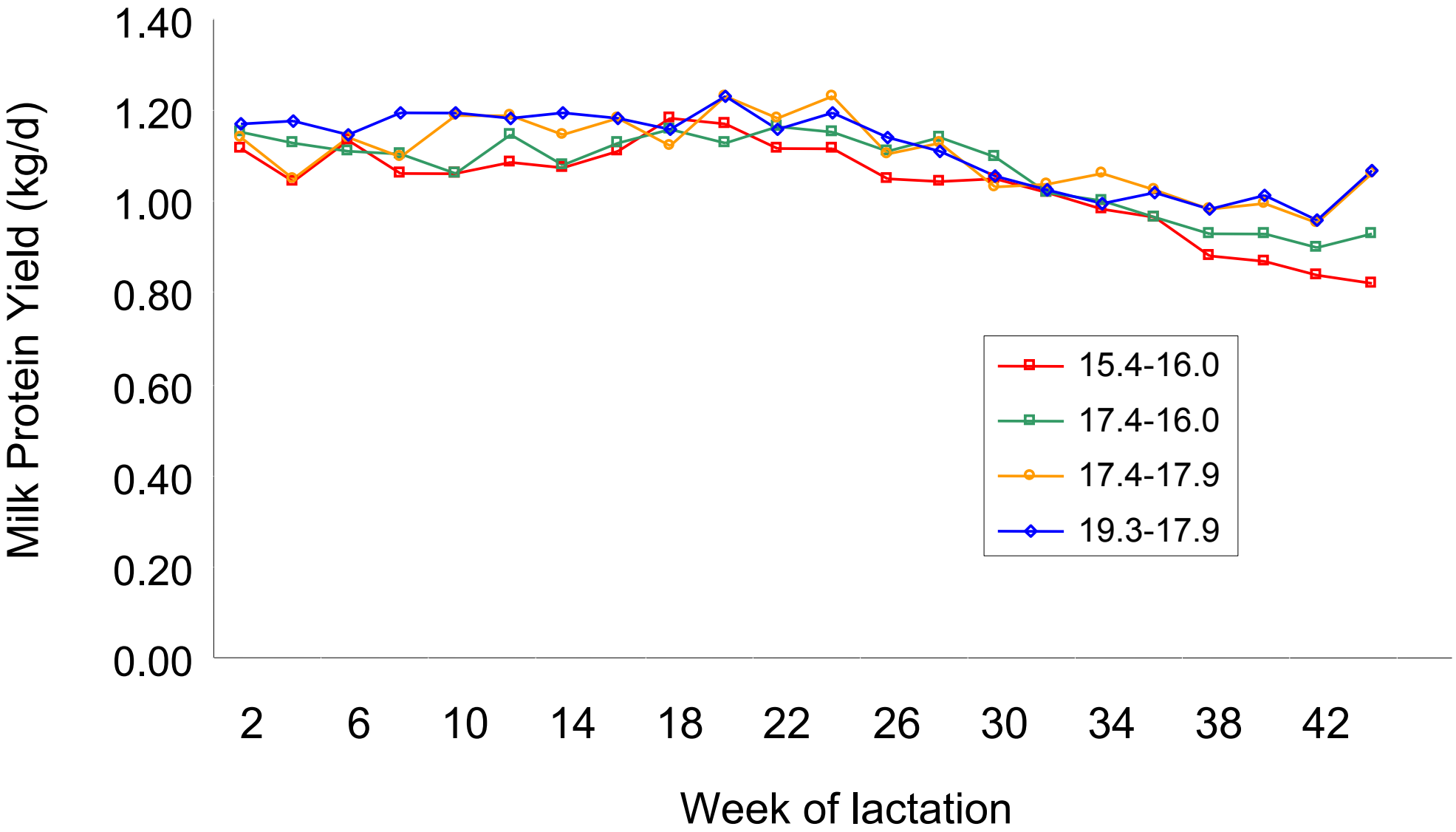


MILK YIELD AND NITROGEN EXCRETION OF LACTATING COWS FED DIFFERENT DIETARY PROTEIN LEVELS DURING A COMPLETE LACTATION

	Treatment			
	15.4 → 16.0	17.4 → 16.0	17.4 → 17.9	19.3 → 17.9
Number of cows	15	15	14	14
Milk yield (lb/44wk)	22,123	23,828	24,409	24,490
Intake N (lb/44wk)	391	416	470	471
Milk N (lb/44wk)	113	108	113	117
Manure N (lb/44wk)	278	308	357	354


45.0
40.0
35.0
30.0
25.0
20.0
15.0
Milk Yield (kg/d)
0
4
8
12
16
20
24
28
32
36
40
44
Week of lactation
15.4-16.0
17.4-16.0
17.4-17.9
19.3-17.9


4.00
3.60
3.20
2.80
2.40
2.00
Milk Protein (%)
2
10
18
26
34
42
Week of lactation
15.4-16.0
17.4-16.0
17.4-17.9
19.3-17.9


Milk Protein Yield (kg/d)
1.40
1.20
1.00
0.80
0.60
0.40
0.20
0.00
2
6
10
14
18
22
26
30
34
38
42
Week of lactation
15.4-16.0
17.4-16.0
17.4-17.9
19.3-17.9

REALISTIC GOAL FOR LACTATION DIETS

Reduce dietary CP by	**10-15%**
This reduces manure N by	**13-20%**
This reduces N vulnerable to volatilization by	**30-35%**

DISTRIBUTION OF N BETWEEN URINE AND FECES (% OF EXCRETED N)

Urine	Feces
45-60	40-55

What will reduce proportion of N in urine?

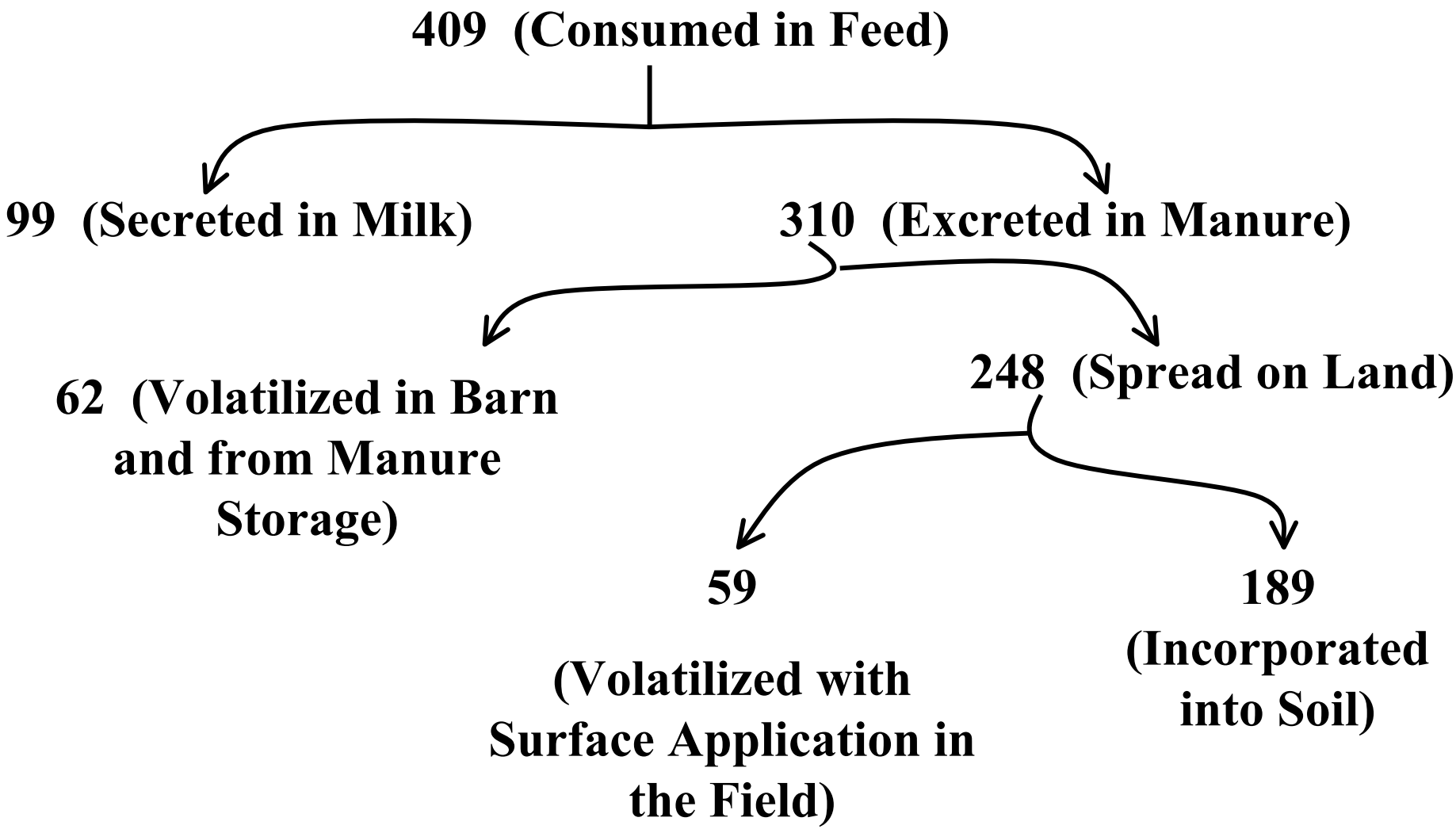
Reduce dietary protein

Balance for rumen undegraded and degraded protein

Supplement protected amino acids

LOSS OF NITROGEN DURING COLLECTION, STORAGE AND FIELD APPLICATION OF MANURE FROM A FREE STALL BARN

Pounds of nitrogen fed, secreted and excreted, and volatilized during a 305 day lactation by a cow producing 20,000 lbs milk.



HOW MUCH CAN WE REDUCE NITROGEN VOLATILIZATION?

- Injection or incorporation of manure in the field can reduce volatilization by 50-80% compared to surface application.

- Frequent scraping of the barn*

- Covering of manure storage (plastic sheeting or floating mat composed primarily of bedding materials)*

* The two combined may reduce manure collection and storage losses by 10-20%

Field incorporation of manure and improved manure handling could reduce total ammonia emissions by ~ 38%, or about 45 lb N per cow per year.

SUMMARY

1. **Nitrogen release into the environment is a growing issue, and will likely have an important impact on livestock producers**

2. **Fine tuning of dietary RUP and RDP, enhancing microbial protein synthesis in the rumen, selective use of rumen protected methionine, and grouping of cows are approaches to reducing dietary protein.**

SUMMARY con't

3. **We can reduce dietary protein (N) by a modest amount (10-15%), but this can have a big effect on reducing N volatilized to the atmosphere (30-35%)**

4. **Good management of manure, such as incorporation of manure into the soil, along with diet management, will be important to achieve reduced emissions of ammonia to the atmosphere.**