UNIVERSITY OF MINNESOTA

College of Veterinary Medicine

VETERINARY CONTINUING EDUCATION
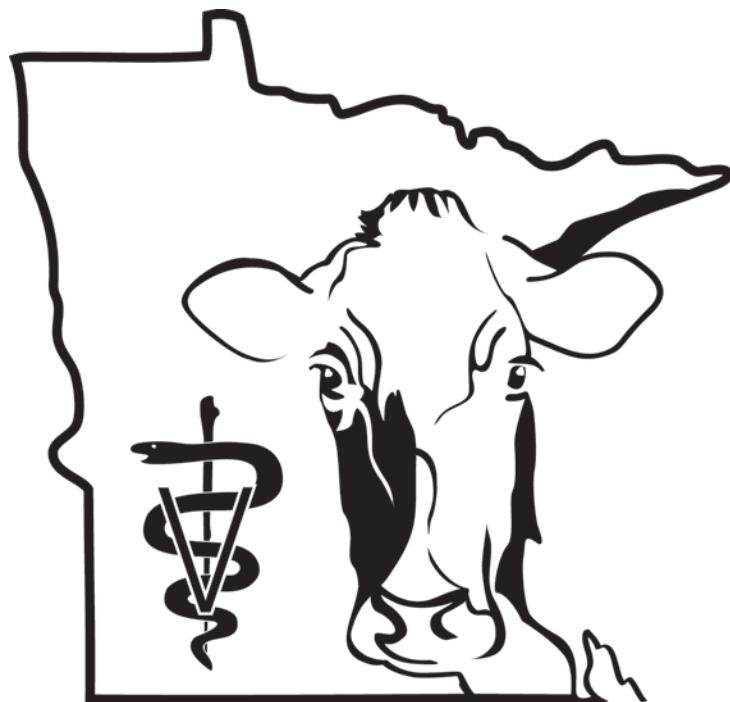
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Nutritional Strategies for Small Herds
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Effective herd health programs are traditionally based on strategies to control disease prevalence so that farm profit is maximized. In the past veterinary services focused on improving production efficiency primarily through reproductive consultation and mastitis control programs. Veterinary nutritional consulting has only recently become an integral component of herd health programs and it is gradually becoming recognized that sound management advice in this area may have a greater impact on economic efficiency then other traditional services. A survey of ration evaluation revealed a mean potential 14% feed cost savings through ration re-formulation.

Nutrition is an important economic input component for the dairy herd, large or small. Feed can range from 40-60% of the value of milk production depending on herd size and on efficiency of production. Small herds, which do not enjoy the economies of scale effects on feed prices realized by large herds will tend to have higher feed cost/lb of product produced. Inefficient feeding programs will have a higher proportional effect on small farm profitability.

Table 1)

Projected Feed Savings[1]

Projected Feed Savings % of Current Feed Cost	Number of Farms
0-5	0
6-10	6
11-15	3
16-20	4
21-25	2
Mean 14.4 +- 6.3	Total 15

[1] Farms visited by veterinarians in the Section
of Nutrition, New Bolton Center, University of Pennsylvania.

Feeding efficiency can be divided into two phases; 1) feed selection, 2) feed delivery. Each of these phases offers opportunity for controlling cost or effecting production.

Feed Selection:

Selecting cost efficient feed is the first step to having efficient production. One nutritional strategy would be to decrease cost while maintaining or improving production. Another strategy would be to increase feed cost by using a new supplement and hopefully increase production to cover the associated cost. To facilitate decision making regarding these strategies, we find it useful to be able to economically evaluate feed ingredients. The economic value of feed ingredients is based on nutrient composition and nutrient density. Many methods have been developed to economically evaluate nutrient composition. Substitution valuation methods and linear programming techniques are the most common.

MILK REVENUE AND FEED COST/DAY
Strategies
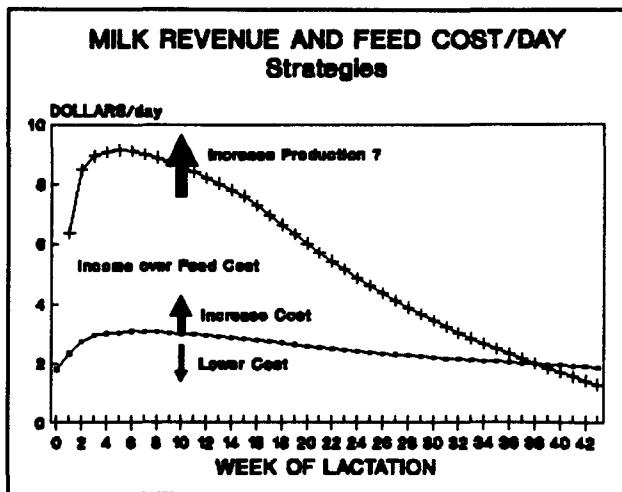
Substitution method:

The substitution method used to estimate ingredient value is based on the assumption that economic value of an ingredient is the sum of it's nutrient composition multiplied by economic weight factors for each nutrient in the ingredient. Energy and protein content are the major nutrients that determine economic value. Approximately 90% of the variation in feed prices are attributable to these two nutrients. Economic weight factors for nutrients can be determined by using as references, feeds which are commonly traded. Normally an energy source (shelled corn) and a protein source (soy bean meal) are selected as reference feeds (Table 2). The substitution value of a particular feed ingredient can be calculated by multiplying the economic weight factors by the nutrient content of the feed ingredient. Substitution values thus represent costs of supplying the same amounts of nutrients contained in one ton of feed by a combination of the reference ingredients (Table 3). However it is important to realize that this method does not take into account the value of nutrient density in the feed but only the amounts of nutrients. Hence, the combination of reference feeds needed to deliver the same amount of nutrients in one pound of the feed being evaluated may exceed 1 pound in total weight.

Table 2) Calculation of economic nutrient weights.

Let X = $/(% of crude protein in a feed)/ton of feed
     Y = $/(mcal/lb of net energy in a feed)/ton of feed

Base feeds:	Market $/ton	CP Factor	CP%		NE Factor	NE (mcal.lb)
Soybean meal	200 =	X	48	+	Y	.75
Shelled corn	100 =	X	8.9	+	Y	.82

Solving the simultaneous equations for X and Y yields

$$Y = \$105$$
$$X = \$237$$

Table 3) Calculation of the substitution value of a feed ingredient:

Feed	X	CP%	Y	NE(MCAL/LB		Substitution Value
Corn Silage	237 *	.028 +	105	.25	=	$32.89
Hay	237 *	.082 +	105	.53	=	$75.08

Linear programming:

Linear programming techniques are used for resource allocation problems. These methods are very efficient in that if a solution exist (ie. is feasible and thus meets all constraints) it will also be the lowest in cost possible (or maximum in profit). A feed ingredient can be economically evaluated in terms of the cost of combinations of other ingredients. Reduced costs tell the change in price needed for a feed ingredient to be included in a mix and hence can be used to calculate the opportunity price. It is important to realize that the calculated reduced cost of a feed ingredient is based on the assumption that all other cost and constraints are constant (Table 3).

Marginal nutrient values are also calculated and indicate the change in mix cost from increasing or decreasing a nutrient density level by one unit. Hence sensitivity of the total mix cost to marginal changes in each nutrient is known. Linear programming methodologies allow one to control for the effects of nutrient density on feed value.

Table 3) Dual Cost (Marginal values of nutrients) and Reduced Cost

Dual Cost

Nutrients	Marginal value
Dry matter	$ 0
Net energy	$ 10[1]
Crude protein	$ 28
Bypass protein	$ 12
Calcium	$ 0[2]
Phosphorus	$ 0

1) Mix cost will increase by $10 if net energy
   density is increased by one unit.
2) Mix cost will not change if the calcium
   density is increased by one unit.

Reduced Cost

Name	Current $/Ton	Solution % of mix	Opportunity Price to include $/Ton
HAYLAGE 1	30	0.0	28[1]
HIGH MOISTURE CORN	80	25	80
CORN SILAGE	25	0.0	15
DISTILLERS GRAINS	180	60	161
SOYBEAN MEAL 48%	320	20	320
WHOLE COTTON SEEDS	200	10	186

1 The cost of HAYLAGE 1 will have to be reduced from $30/ton
to $28/ton to be included in the mix.

Feed Delivery:

The next level of potential inefficiency may exist at the feed delivery. There are a variety
of systems ranging from individual feeding systems to groups. Each of these systems
has advantages and disadvantages (Table 4).

Table 4) Advantages and Disadvantages of Feed Delivery Systems

Feed System	Advantage	Disadvantage
Stanchion	Each cow is fed based on production and condition score Precise nutritional and cow observation Lowest feed cost	Pulsatile grain feeding Labor intensive Poor estimates of forage intakes
Total Mixed Rations	Efficient use of labor Possible to focus attention on groups of cows in similar stages of lactation Possible to manage larger numbers of cows More constant nutrient deliver Consistent feed source	Labor for regrouping cows Decreases in production with cows changing groups Optimum number of groups for ration balancing Difficult to monitor individual cows Potential over and under feeding individual cows

References

1) Black JR, Hlubik J. Basics of computerized linear programs for ration formulation. J Dairy Sci 63:1366-1378, 1980.

2) Ferguson J, Galligan D, Ramberg C, Kronfeld D. Veterinary Nutritional Advisory Services to Dairy Farms. Compendium on Continuing Education for the Practicing Veterinarian 9:5: F192-F201, 1987.

3) Galligan D, Ferguson J, Ramberg C, Chalupa W. Ration formulation and evaluation on microcomputers. J Dairy Sci 69:1656-1644, 1986.

4) Noordhuizen, JPTM, Wilbrink H, Dobbelaar P, Brand A. Veterinary herd health and production service on dairy farms. V. Index list on metabolic/nutritional disease, body condition score and ration composition. Prev. Vet. Med 3:289-300, 1985.

5) National Research Council. Nutrient requirements of dairy cattle. Nat. Acad. Sci., Washington, DC. 1989.

6) Peterson, W. E. 1932. A formula for evaluating feeds on the basis of digestible nutrients. J. Dairy Sci. 15:293