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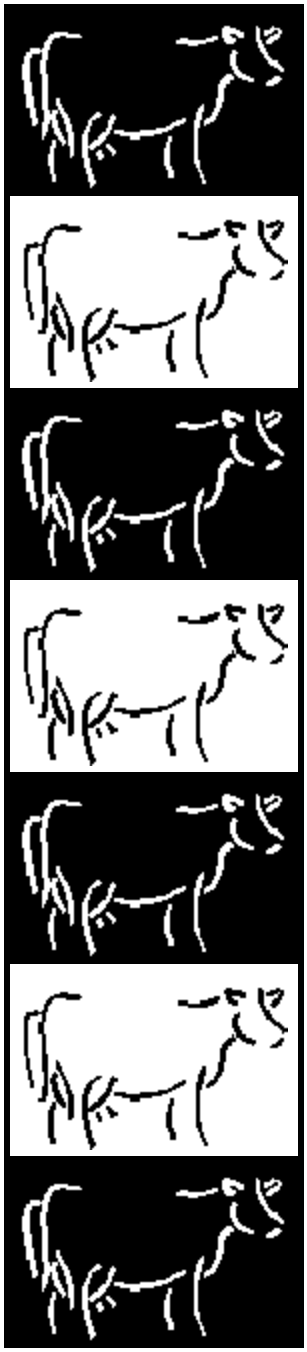

Feeding for Milk Components and Profit

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> *"Proper feeding management of the dairy herd can improve the economy of production and provide for a healthier cow."*

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Nutrition of the dairy cow affects the yield and proportion of milk components. Through the diet, the mammary gland is supplied with blood components to synthesize milk. Non-nutritional factors such as heredity, days in milk, parity, infections, number of secretory cells, as well as temperature and humidity often overshadow nutritional effects.

Proper feeding management of the dairy herd can improve the economy of production and provide for a healthier cow. Feeding to increase production of milk with maximum levels of milk fat and protein is essential for achieving these benefits.

Recently, the method of determining the payment for milk has changed in North Dakota. The new pricing system, known as multiple component pricing, or MCP, took effect in five Upper Midwestern federal milk market order areas on or before January 1, 1996. The recent change has heightened interest in feeding for milk components. When discussing how this will affect your feeding strategies, you must keep two key points in mind.

First, payment will be for yield of components, not component percentages. Second, protein is the highest value component. Protein has over twice the economic value as fat or other solids (OS) in MCP Because of this, it is the component that will get the most attention as you try to enhance the economic value of milk under MCP. Milk protein has economic value because higher protein leads to higher cheese yields. Increasingly, milk protein content is being emphasized as milk fat price differentials decline due to the public's demand for low-fat dairy foods.

Can Milk Be Altered?

Multiple component pricing (MCP) has created a lot of interest in how to increase milk protein, fat, and other solids. The thing to remember is that price is based on the *amount* of components, not the percentage. A cow producing 60 pounds of milk with 3.1 percent protein returns the same income from protein as one producing 55 pounds of milk with 3.4 percent protein. Under MCP, feeding programs that maximize milk yield while maintaining normal component percentages will be the most profitable. The key is to optimize rumen fermentation. Feeding programs balanced for protein, energy, and fiber along with good bunk management will increase both milk yield and component percentages.

To evaluate your herd, look at milk yields and compare components to the breed average (Table 1). Calculate your protein-to-fat ratio. If the ratio falls below 0.8 or above 0.9 for Holsteins, check the nutrient balance of your rations. A higher ratio indicates an opportunity to increase milk production.

Table 1. Average composition of milk.

	Protein	Fat	Protein/ Fat Ratio	Lactose
	(%)	(%)		(%)
Ayrshire	3.3	4.0	0.83	4.6
Brown Swiss	3.5	4.1	0.85	4.8
Guernsey	3.6	4.7	0.77	4.8
Holstein	3.2	3.7	0.87	4.7
Jersey	3.8	4.9	0.78	4.7

USDA-DHI

Milk solid components include protein, fat, lactose, and minerals. Normal values for milk protein range from 3.1 percent (Holstein) to 3.8 percent (Jersey); milk fat ranges from 3.7 percent (Holstein) to 4.9 percent (Jersey). Lactose is usually 4.6 to 4.8 percent for all breeds. Minerals (ash) average .74 percent.

Feeding for MCP

Factors which affect milk composition include genetics, stage of lactation, level of milk production, age of cow, environment, disease (for example, mastitis), and nutrition. Fifty-five percent of the variation in milk composition is due to heredity, while 45 percent is due to environmental factors such as feeding management. Generally, if the milk protein to milk fat ratio is less than .80 for Holsteins, milk protein depression is a problem. When this ratio is greater than 1.0, the herd suffers from milk fat depression (low milk fat test). Milk protein percent follows changes in milk fat test, except during milk fat depression and when high levels of fat are fed.

The following feeding guidelines should help the dairy producer increase production of solids-corrected milk:

- maximum feed intake;
- proper nutritional factors;
- properly feeding energy (carbohydrates and fats), protein, fiber, minerals, and vitamins;
- monitoring diet composition (use routine forage, feed analyses);
- harvesting and/or buying high quality forage and proper forage allocation.

Maximize Feed Intake

The importance of maximizing feed intake is related to minimizing negative energy balance during early lactation. As cows move into positive energy balance, body weight is regained, loss of body condition is minimized, and cows produce milk of normal fat and protein composition.

Increased feed intake can improve milk protein by .2 to .3 percentage units. This increased milk protein percentage may be due to overall increases in balanced energy intake as total feed intake increases. High producing dairy cows should eat 3.6 to 4.0 percent of their body weight daily as dry matter.

Example: 1350 pound cow x .04 (4 percent)
= 54 pounds of dry matter intake

If the diet is 55 percent dry matter,
the cow should eat 98 pounds of feed as fed
(54/.55 = 98).

If a herd is consuming less dry matter than 3.5 to 4.0 percent of bodyweight, production of milk solid components may be limited. Major feeding factors which affect feed intake include:

- feedbunk management (keep them clean, shaded during hot weather, and have adequate space per cow);
- increase feeding frequency and sequence;
- control ration moisture (50 percent moisture or less, prefer: 35 to 50 percent moisture);
- examine herd for social interactions (boss cow problems when heifers and mature cows are mixed together in one group);
- avoid sudden ration changes; and
- provide proper flooring and ventilation.

Increased feeding frequency increases fat test, especially with low fiber, high grain diets. The greatest response is seen for diets with less than 45 percent forage and when grain is fed separately, as in parlor feeding. When diets are fed as total mixed rations, feeding frequency is not as important as long as feed remains palatable and is fed at least once daily.

Proper Nutritional Factors

Concentrates

Proper feeding of concentrates primarily involves maintaining proper forage to concentrate ratios and non-fiber carbohydrate (NFC) levels. Non-fiber carbohydrates include starch, sugars, and pectin. The level is calculated as:

NFC = 100 - (crude protein + neutral detergent fiber + fat + minerals)

Non-fiber carbohydrates should range between 20 and 45 percent. A level of 40 to 45 percent is typical of diets with forage to concentrate ratios of 40 to 60 or less forage. Diets with large amounts of high quality forage and minimal grain may be deficient in non-fiber carbohydrates. Feeding proper non-fiber carbohydrate levels can improve both milk fat and protein test, while overfeeding leads to milk fat depression of one unit (.1) or more and often increases milk protein by .2 to .3 percentage units.

Grain should be limited to 7 pounds per feeding to avoid rumen acidosis, off feed problems, and reduced fat content of milk. Grain feeding guidelines to maximize milk protein and fat production follow:

Holstein and Brown Swiss

Milk Level (pounds)	Grain Level
less than 40	1 pound per 4 pounds milk
41 to 70	1 pound per 3 pounds milk
greater than 70	1 pound per 2.5 pounds milk

Breeds with High Milk Solids

Milk Level (pounds)	Grain Level
less than 30	1 pound per 3 pounds milk
31 to 60	1 pound per 2.5 pounds milk
greater than 60	1 pound per 2 pounds milk

Grain should be limited to a maximum of 30 to 35 pounds per cow daily. Manure which contains much undigested corn or with pH less than 6.0 indicates that too much grain, or non-fiber carbohydrates, is being fed improperly.

Grain processing also can influence milk composition. Feeding flaked corn has been shown to increase milk protein percent. Expect oats to decrease milk protein percent by .2 units compared with barley. Process grains by cracking, rolling, grinding, or possibly steam-flaking to enhance rumen starch digestion, improving milk yield and protein percentage. Pelleting has a similar effect.

Be careful, though. Processed grain causes acidosis more easily than whole or very coarse-textured grains. Generally, rolled or ground barley or flaked corn causes a rapid and severe decrease in milk fat when overfed. Fibrous byproducts, such as soybean hulls, can replace a portion of starchy grains and reduce the severity of milk fat depression.

Fiber

Both fiber level and particle size contribute to the effectiveness of a fiber source for stimulating rumination (cud chewing) and salivation and maintaining normal milk protein and fat composition. Minimum acid detergent fiber (ADF) levels required in the ration dry matter are 19-21 percent. Neutral detergent fiber (NDF) should not fall below 26-28 percent. Below these levels, cows risk a low milk fat test, acidosis, lameness, chronic feed intake fluctuations, and poor body condition (especially in early lactation).

To assure adequate particle length, forage should not be chopped to less than 3/8 inch theoretical length of cut (TLC). Chopping finer than this may dramatically decrease fat percent and increase milk protein by .2 to .3 percentage units. However, while this practice might seem advantageous, be

reminded that, as with overfeeding non-fiber carbohydrates (starchy concentrates), even though milk protein content increases, *the cow and her rumen are not healthy.* Feeding inadequate fiber is not recommended for increasing milk protein content. Rather, 75 percent of the neutral detergent fiber in a diet should come from long or coarsely-chopped forage to fully satisfy the cow's fiber requirement.

Rations too high in fiber (too low in energy) limit milk protein production because not enough energy is consumed. Generally, 40-50 percent forage dry matter in a ration is the minimum amount necessary to avoid low milk fat test. When feeding 65 percent or more forage, it must be of high quality to avoid energy deficiencies which also lower milk protein. For different corn silage and alfalfa haylage mixtures (dry basis), recommended minimum forage dry matter levels are as follows:

Forage Mixture	% of Dry Matter From Forage
100% corn silage	50 to 60
75% corn silage:25% haylage	45 to 55
50% corn silage:50% haylage	45 to 50
25% corn silage:75% haylage	40 to 50
100% alfalfa haylage	40 to 45

Ration Formulations

Carbohydrates

Starch and sugars, expressed as nonfiber carbohydrates, affect milk yield and fat and protein percentage. Excess NFC increases protein percentage and possibly yield, but lowers fat percentage. Insufficient NFC, usually associated with high fiber, increases fat percentage and reduces yield and protein percentage. Rations containing 35 to 40 percent NFC (dry matter basis) generally yield the most milk and components.

Fat

Adding fat (cottonseed, soybeans, sunflower seed, tallow, or rumen-inert fat) to the ration will lower milk protein percentage. As a guideline, 1 pound of added fat will lower milk protein percentage by about 0.1 percent (e.g., from 3.2 to 3.1). Animal and rumen inert or bypass fats tend to increase milk fat percentage, whereas vegetable fats, such as soybeans and sunflower seed, decrease the percentage. Milk production, however, can increase 7 pounds per day per pound of added fat. That means that adding fat to rations can be profitable, even if milk protein and fat percentages decrease.

Generally recommended guidelines for feeding fat are:

Source	Maximum Percent of Ration Dry Matter
Forages, grains (basal diet)	3 percent
Natural fats	2 to 4 percent
whole oil seeds	1 pound
tallow	1 pound
Protected fats	2 percent (1 pound)
Total	7 to 8 percent maximum

Adequate Protein

Meeting the dairy cow's requirement for both crude and escape protein is essential to maintaining normal milk protein test. For a 1,300-pound cow producing 4 percent butterfat, crude protein requirements range from 15 percent for 50 pounds of milk to 18 percent for cows producing 110 pounds of milk.

Generally, dietary crude protein level affects milk yield but not milk protein percentage, unless the diet is deficient in crude protein. Milk protein percentage generally drops 0.02 for every 1 percent decrease in crude protein in the ration from 17 to 9 percent. However, shorting protein in the ration has a much larger effect on milk yield. For example, a producer may feed his herd a 14.5 percent crude protein ration when the requirement

is 16.5 percent. This herd will probably have a low milk protein test. This situation often occurs when poor quality forage is fed and the producer has not tested the forage to properly formulate a grain mix. Also, feeding excessive degradable crude protein, such as urea, can reduce milk protein. Generally, limit urea feeding to cows past 120 days in milk. Urea should make up only 1 to 2 percent of the concentrate mix to maintain feed palatability. It works best when mixed well into the diet, as with a total mixed ration.

Rumen Degradable Protein

Rumen degradable protein should be about 65 percent of the total or crude protein in the ration. If you feed rumen degradable protein at less than 60 percent of the total protein, you will reduce milk yield and component production. Be sure rations have adequate degradable protein from sources such as soybean meal, alfalfa, and, if necessary, urea.

Bypass Protein and Rumen-Protected Amino Acids

The amino acids methionine and lysine have been shown to increase milk protein percentage by as much as 0.2 without affecting milk yield. Sources of these amino acids are high-quality by-pass protein supplement and rumen-protected amino acids. However, there are added costs associated with these benefits. If you choose to increase dietary lysine and/or methionine, expect to see an increase in protein percentage within two weeks as you analyze its economic benefits.

Table 2 shows the responses in milk yield and protein percentage in studies where ruminally undegradable intake protein (UIP) or bypass protein sources were substituted for soybean meal. Neither yield nor protein percentage con-sistently improved. The percentage of fat, lactose, and mineral in milk generally does not change with amino acid feeding. Methionine alone can increase milk fat in early lactation.

Table 2. Results of substituting various protein sources for soybean meal (SBM) on milk yield and milk protein percent (10-year summary).

	MILK YIELD			MILK PROTEIN %		
Protein Source	**—**	**0**	**+**	**—**	**0**	**+**
	Number of Studies					
Heated SBM	0	10	3	5	8	0
Fish meal	0	13	6	4	9	4
Brewers grains	0	5	2	0	7	0
Animal byproducts	2	19	1	4	16	1
Corn gluten meal	4	9	2	2	13	0
Distillers grain	2	4	2	4	4	0

Theurer, Huber and Santos, Arizona 1995.

Feed Additives

Rumen buffers increase milk fat percentage, and possibly yield, when low-fiber, high-grain rations are fed. Feed sodium bicarbonate with or without magnesium oxide when cows are consuming more than 30 pounds of wet corn silage, fine-ground grain, or high levels of rumen-fermentable fiber from byproduct feeds. This will not only help milk fat percentage, but also help maintain a healthy rumen environment. Rations in which all the forage is alfalfa generally do not benefit from buffers.

Niacin can alleviate the milk protein percentage decrease with feeding supplemental fat but can also slightly reduce yield and fat percentage. Niacin most notably helps prevent ketosis in early lactation, especially with overconditioned cows. Feeding niacin to thin cows (body condition score less than 3 at freshening) reduces yield and is not recommended. Evaluate your herd's body condition and ketosis problems before feeding niacin to increase milk protein percentage.

Summary of Feeding Practices

Feeding practices proven to maximize solids-corrected milk production include:

- maintaining a proper fiber level of 26 to 32 percent neutral detergent fiber of adequate particle length;
- maintaining a proper starch level with 40 to 45 percent NFC maximum;
- keeping forage to concentrate ratio in line with forage sources;
- maintaining a proper crude protein of 17 to 18 percent;
- maintaining a proper escape protein of 33 to 40 percent of crude protein;
- staying within recommended guidelines for fat feeding; and
- maximizing intake of a balanced diet.

Table 3 summarizes the feeding practices which influence milk solids. Correctly feeding dairy cows, despite the complexity, is the only way to produce milk with maximum levels of milk fat and protein.

Checking Out Multiple Component Pricing (MCP)

Under the new milk pricing system, known as MCP for the Upper Midwest, dairy producers are paid for the pounds of protein, butterfat, and other milk solids they ship. Adjustments are made for bacteria and SCC (somatic cell count) and producer price differential.

The new pricing system was directed by the Secretary of Agriculture based on several hearings with extensive testimony from producers, industry representatives, and consumers. The new system received strong support from producer groups and industry.

MCP is mandated for all Grade A milk marketed in the five federal milk market areas. Grade A milk accounts for approximately two-thirds of milk produced in North Dakota. The new pricing scheme has been generally adopted for all milk. Prices for the components and quality, however, are not mandated, nor are there producer price differentials for Grade B (manufacturing grade) milk.

Table 3. Summary of feeding management changes which alter milk solids production.

Management Factor	Milk Fat Percent	Milk Protein Percent
Maximum intake	increase	increase .2 to .3 units
Increased feeding frequency of grain	increased .2 to .3 units	may increase slightly
Underfeeding energy	little effect	decrease .1 to .4 units
High NFC[1] (>45%)	decrease by 1% or more	increase .1 to .2 units
Normal NFC (25-40%)	increase	maintain normal level
Excessively high fiber	marginal increase	decrease .1 to .4 units
Low fiber[2] (<26% NDF)	decrease by 1% or more	increase .2 to .3 units
Small particle length[3]	decrease by 1% or more	increase .2 to .3 units
High crude protein	no effect	increase if previous diet was deficient
Low crude protein	no effect	decrease if diet is deficient
Escape protein (33 to 40% of CP)	no effect	increase if previous diet was deficient
Added fat (>7 to 8%)	variable	decrease by .1 to .2 units

[1] NFC = nonfiber carbohydrates

[2] Low dietary fiber, high non-fiber carbohydrates, small forage particle length and low forage levels may all increase milk protein percent and greatly reduce milk fat test. These are not desirable ways to improve milk solids-not-fat. These feeding practices cause acidosis, lameness, and feed intake fluctuations. The cow is not healthy.

[3] Less than 15% of particles greater than 2 inches indicates inadequate particle length.

Source: 692-1077-A, Feeding to Maximize Milk Solids, Risk Grant, UNL.

Key determinants of milk price are:

Determinant	Typical Price Range (changes frequently)
Pounds of protein	$1.60-$2.00/lb protein
Pounds of butterfat	$0.60-$1.00/lb butterfat
Pounds of other solids	$0.55-$0.93/lb other solids
Producer price differential	$0.00-$0.70/cwt
SCC* (somatic cell count)	$0.0372-$0.0748/100,000 SCC/cwt
Bacteria**	$0.00-$0.20/lb

For every 1,000 your SCC is below 350,000, you receive more money. For example, if the SCC rate is $0.00069 per 1,000 SCC, the value of milk with an SCC of 150,000 goes up by $0.138/cwt. An SCC of 550,000 would reduce payment by $0.138/cwt.

* For every 1,000 your SCC is above 350,000, your payment drops.

** For plants that pay a premium for quality, you may receive, as an example, $0.10/lb for milk with a total bacteria count between 5,000-10,000 SPC, and more for less than 5,000.

The protein level of milk typically ranges from 3.0 to 3.4 percent. Colored breeds tend to test a bit higher than Holsteins. Protein and fat percentage tend to vary together.

What difference will this make for your milk check? Producers of milk exceptionally high in protein, fat, and other solids will get a small boost in price compared to the old price system. Those exceptionally low in solids will receive a slightly lower price.

MCP has added a few twists and turns to the pathway to your bottom line. The specific format and kinds of information included in your check depend on your milk plant. But at the very least, somewhere on that stub you will see:

- pounds of protein, milk and other solids in the milk you sold
- buyer's prices for each of these components
- for Grade A milk, a producer price differential
- an adjustment or adjustments for milk quality/SCC
- other adjustments (e.g., volume premium)
- total milk sold
- gross payment
- net payment (gross minus deductions for advances, supplies, etc.)

Does quality still pay? Yes. Under the old system, the milk plant decided how to adjust your payment for somatic cell count (SCC). Under MCP, the government sets the minimum adjustment factor based on the effect of SCC on cheese yield. As a result, quality premiums are now less variable among processors, and may be lower than previous premiums. For a more in-depth description of the calculation of your overall payment per hundredweight, see your milk buyer or field representative.

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