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G98-1358 Feeding to Maximize Protein and Fat

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Feeding to Maximize Protein and Fat

This NebGuide describes feeding guidelines to increase milk fat and protein production.

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Proper feeding management of dairy herds can both improve the economy of production and provide a healthier cow. To achieve these goals, producers must feed to increase production of milk with maximum levels of milk fat and protein.

Milk solids components include fat, protein, lactose and minerals. Normal values for milk fat range from 3.7 percent (Holstein) to 4.9 percent (Jersey); milk protein ranges from 3.1 percent (Holstein) to 3.8 percent (Jersey). Lactose is usually 4.6–4.8 percent for all breeds; minerals (ash) average .74 percent. Because current milk pricing formulas emphasize milk fat and protein, maintaining milk fat and protein tests provides an economic advantage. Normal milk fat percentages also reflect good rumen and cow health. Generally, diets which cause low milk fat test also cause sore feet (laminitis), acidosis and feed intake problems. Milk protein has economic value because higher protein leads to higher cheese yields. Increasingly, milk protein content is being emphasized.

How Can Milk Solids be Altered?

Factors which affect milk composition include genetics, stage of lactation, level of milk production, age of cow, environment, disease (for example, mastitis) and nutrition. Of the variation in milk composition, 55 percent is due to heredity; 45 percent is due to environmental factors, such as feeding management.

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 both fat and protein in milk.

Feeding Strategies to Maximize Milk Solids

The following guidelines are critical to maximizing solids-corrected milk production:

1. proper ration formulation;
2. maximum feed intake;
3. monitoring dietary composition (use routine forage, feed analyses);
4. harvesting and/or buying high-quality forage and proper forage allocation;
5. properly feeding protein, energy, fiber, minerals and vitamins.

Because nutritional changes can be made rapidly, they are most effective in responding to changing market demands. Important aspects of feeding management to produce high levels of milk solids are outlined below.

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, losses in body condition score are recovered and cows produce milk of normal fat and protein composition. Increased feed intake can improve milk protein by .2–.3 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 3.6–4.0 percent of their body weight or more daily as dry matter.

Example: 1,350 pound cow x .04 (4 percent)
= 54 pounds of dry matter intake

If the diet is 50 percent dry matter, the cow should eat 108 pounds as fed (54/50 = 108). If a herd is consuming less dry matter than 3.5–4.0 percent of bodyweight, production of solids-corrected milk may be limited. Major feeding factors which affect feed intake include:

1. feedbunk management (keeping them clean, shaded during hot weather and adequate space-per-cow);
2. feeding frequency and sequence;
3. ration moisture (50 percent moisture or less);
4. social interactions ("boss" cow problems when heifers and mature cows are mixed together in one group);
5. sudden ration changes;
6. proper flooring and ventilation.

Increased feeding frequency increases fat test, especially with low fiber, high grain diets. The greatest response is seen in 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.

Properly Feed Concentrates

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

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

Non-fiber carbohydrates should range between 30–40 percent. A level of 40–45 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 NFC deficient. While feeding proper NFC amounts can improve both milk fat and protein test; overfeeding leads to milk fat depression of one unit or more and often increases milk protein percent by .2–.3 unit.

The amount of grain-per-feeding should be limited to 7 pounds to avoid rumen acidosis, off-feed problems and reduced fat content. The following grain feeding guidelines will maximize milk fat and protein production:

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 30–35 pounds per cow daily. Manure which contains much undigested corn or with pH less than 6.0 indicates too much grain, or non-fiber carbohydrates, is being fed.

Grain processing also can influence milk composition. For example, flaked corn may increase milk protein percentage, while oats have decreased milk protein percent by .2 unit compared with barley. Generally, rolled or ground barley or flaked corn, when overfed, will cause a rapid and severe decrease in milk fat. Fibrous byproducts, such as soybean hulls, can replace starchy grains and reduce the severity of milk fat depression. University of Nebraska research indicates soybean hulls can replace 50–75 percent of the corn in a concentrate mix to maintain normal milk fat test.

Meet Fiber Requirements

Fiber requirement of dairy cattle include both fiber concentration and fiber particle size, which contribute to the effectiveness of a fiber source for stimulating rumination (cud chewing), salivation and maintaining normal milk fat and protein 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, do not chop forage to less than 3/8 inch theoretical length of cut (TLC). Finer chopping may dramatically decrease fat percent and increase milk protein percent by .2–.3 units. As with overfeeding non-fiber carbohydrates (starchy concentrates), even though milk protein content increases, *neither the cow, nor her rumen, are healthy*. Feeding inadequate fiber is not recommended for increasing milk protein content. Of the neutral detergent fiber in typical diets, 75 percent should come from long or coarsely-chopped forage.

Rations too high in fiber (too low in energy) limit milk protein production. Generally, 40–50 percent forage dry matter is the minimum amount to avoid low milk fat test. When feeding 65 percent or more forage, it must be high quality, to avoid the energy deficiencies which lower milk protein. For different

corn silage and alfalfa haylage mixtures (dry basis), the following minimum forage dry matter levels are recommended:

Forage Mixture	*Percent of dry matter from forage*
100 percent corn silage	50 to 60 percent
75 percent corn silage: 25 percent haylage	45 to 55 percent
50 percent corn silage: 50 percent haylage	45 to 50 percent
25 percent corn silage: 75 percent haylage	40 to 50 percent
100 percent alfalfa haylage	40 to 45 percent

Feed Adequate Protein

Meeting the dairy cow's protein requirements – both crude and escape – is essential to maintaining normal milk protein test. For a 1,300-pound cow producing 4 percent milk fat, crude protein requirements range from 15 percent for 50 pounds of milk to 18 percent for cows producing 110 pounds of milk. For cows in early lactation (90 to 120 days in milk), the amount of escape protein should range from 33–40 percent. Although a precise requirement has not been defined, it appears having at least 33 percent escape protein (as a percent of crude protein) is necessary to maintain normal milk protein levels. More information concerning total protein requirements is given in NebGuide G91-1027, *Protein and Carbohydrate Nutrition of High Producing Dairy Cows*.

Generally, dietary crude protein concentration affects milk yield, but not milk protein percentage, unless the diet is deficient in crude protein. 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, which 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 1–2 percent of the concentrate mix to maintain palatability and it works best when mixed well into the diet as with a total mixed ration.

Added Fat and Milk Protein

Supplemental fat feeding is increasingly common as production levels per cow climb toward 20,000 pounds/year. It is necessary to follow guidelines when feeding fat, to avoid a drop in milk protein level of .1–.2 unit. If fed properly, added fat results in maintained or slightly increased milk fat percentage, relatively little change in milk protein test and increased milk production. The net result: total production of milk protein and solids-not-fat increase.

Generally recommended guidelines for fat feeding 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

Niacin, fed at 6–12 grams per day, may correct the milk protein depression seen with high levels of fat feeding. Also, limit fat feeding to the first 120 days in milk, balance the ration for non-fiber carbohydrates and crude protein, follow recommended limits for fat sources, feed proper forage levels and increase calcium and magnesium concentrations to .95 percent and .35 percent of ration dry matter. Higher levels of these two minerals counteract their loss as calcium and magnesium soaps when higher levels of fats are fed.

Summary

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

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

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

Table I. Summary of feeding management changes which alter milk solids production.		
Management Factor	*Milk fat percent*	*Milk protein percent*
Maximum intake	increase	increase .2–.3 units
Increased feeding frequency of grain	increase .2–.3 units	may increase slightly
Underfeeding energy little effect	decrease	.1–.4 units
High NFC[1] (> 45 percent)	decrease by 1 percent or more	increase .1–.2 units
Normal NFC (30-40 percent)	increase	maintain normal level
Excessively high fiber	marginal increase	decrease .1–.4 units
Low fiber[2] (< 26 percent NDF)	decrease by 1 percent or more	increase .2–.3 units
Small particle length[3]	decrease by 1 percent or more	increase .2–.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 (33–40 percent of CP)	no effect	increase if previous diet was deficient
Added fat (> 7–8 percent)	variable	decrease by .1–.2 units

[1]NFC = nonfiber carbohydrates

[2]Low dietary fiber, high non-fiber carbohydrates, small forage particle length and low forage levels all may 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 percent of particles greater than 2 inches indicates inadequate particle length.

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