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# G97-1320 Feeding to Maximize Milk Solids

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# Feeding to Maximize Milk Solids

**This NebGuide describes feeding guidelines to increase production of solids-corrected milk.**

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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.

Milk solid 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 to 4.8 percent for all breeds and minerals (ash) average .74 percent. Dairy producers focus on maximizing milk fat and protein content. Current milk pricing formulas emphasize milk fat, giving maintenance of normal milk fat test 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 as milk fat price differentials decline due to the public's demand for low-fat dairy foods.

## 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. 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.

## 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 diet composition (use routine forage, feed analyses);
4. harvesting and/or buying high quality forage and proper forage allocation; and
5. properly feeding protein, energy, fiber, minerals, and vitamins.

Nutritional changes can occur rapidly and are the best way to respond to changing market demands. The following sections describe important aspects of feeding management to produce high levels of milk solids.

### 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 of body condition score are minimized, and cows produce milk of normal fat and protein composition. Increased feed intake can improve milk protein by .2 to .3 units. This increased milk protein percent 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 × .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 to 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 having 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; and
6. 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. More information concerning ways to maximize intake is given in NebGuide *G90-1003, Maximizing Feed Intake for Maximum Milk Production*.

**Properly Feed Concentrates**

Properly feeding 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 or more and often increases milk protein percent by .2 to .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 of milk. Grain feeding guidelines to maximize milk fat and protein 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. Flaked corn may increase milk protein percent. Oats have decreased milk protein percent by .2 unit compared with barley. 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 starchy grains and reduce the severity of milk fat depression. University of Nebraska research indicates that soybean hulls can replace 50-75 percent of the corn in a concentrate mix to maintain normal milk fat test.

**Meet Fiber Requirements**

The dairy cow's fiber requirement consists of fiber level and fiber particle size. Both level and particle size 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, 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 percent by .2 to .3 units. 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. Seventy-five 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 to avoid low milk fat test. When feeding 65 percent or more forage, it must be of high quality to avoid energy deficiencies which 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 |

**Feed 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. For cows in early lactation (90 to 120 days in milk), the level of escape protein should range from 33 to 40 percent. Currently, a precise requirement has not been defined, but having at least 33 percent escape protein (as a percent of crude protein) appears necessary to maintain normal milk protein levels. More information concerning total protein requirements are given in NebGuide *G91-1027, Protein and Carbohydrate Nutrition of High Producing Dairy Cows*.

Generally, dietary crude protein level affects milk yield but not milk protein percent, 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. 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 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 has become increasingly common for today's dairy herds as production levels per cow climb toward 20,000 pounds yearly and higher. It is necessary to follow certain guidelines when feeding fat to avoid a drop in milk protein level of .1 to .2 unit. If fed properly, added fat usually results in maintained or slightly increased milk fat percent, relatively little change in milk protein test, and

increased milk production. The net result is that 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 to 12 grams per day, may correct the milk protein depression seen with high levels of fat feeding. Be certain to 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, respectively. 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 to 32 percent neutral detergent fiber of adequate particle length;
2. maintaining a proper starch level with 40 to 45 percent NFC maximum;
3. keeping forage to concentrate ratio in line with forage sources;
4. maintaining a proper crude protein of 17 to 18 percent;
5. maintaining a proper escape protein of 33 to 40 percent of crude protein;
6. staying within recommended guidelines for fat feeding; and
7. maximizing intake of a balanced diet.

*Table I* 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.

| 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 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 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% of particles greater than 2 inches indicates inadequate particle length.

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