FIGURING THE RATIONS OF DAIRY COWS

by T. E. Woodward

This article contains material that supplements the preceding article on The Feeding of Dairy Cows for Intensive Milk Production in Practice. Primarily, the author is concerned with figuring the varying quantities of grain mixture that should be used to supplement roughage, including pasture. He considers this problem in relation to the breed of the cow, the season of the year, and the region in which the producer lives.

GRAIN MIXTURES

The quantity of protein needed in the grain ration of dairy cattle depends on the quantity supplied by the forage crops fed. As it is impracticable to attempt to feed each cow only as much protein as it actually requires, the aim should be to use a grain mixture of such composition that the cows with the highest requirement will be getting enough protein even though this will mean that some of the cows with lower requirements are getting an excess. There are hundreds of combinations of grains that can be used, and a great many are being used successfully. Grain mixtures made up of a few standard feeds and adapted for feeding with roughages of different kinds are shown in table 1. Other feeds may be substituted wholly or in part for the feeds specified in the table. It is assumed that the forages to be fed will be at least of average quality, that silage when used will be fed at the rate of about 3 pounds per 100 pounds of body weight of the animal, and that at least 1 1/4 pounds of hay per 100 pounds of body weight will be eaten in addition to the silage.

Part or all of the corn in the mixtures in table 1 may be replaced by barley, wheat, kafir, or hominy feed. Part of the oats may be replaced by barley, wheat, kafir, hominy feed, or corn. Two parts of gluten feed or dried brewers' grain may replace 1 part of oats and 1 part of cottonseed meal. Linseed meal, peanut meal, ground soybeans, soybean meal, or fish meal may be substituted for part or all of the cottonseed meal. High-grade tankage may be substituted for

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cottonseed meal at the rate of 2 pounds of tankage for each 3 pounds of cottonseed meal. Until further investigations are conducted it is suggested that the quantity of fish meal should not exceed 10 percent of the grain mixture and that the quantity of tankage should not exceed 20 percent.

**Table 1.** Grain mixtures having different protein contents to be fed with different roughages

<table>
<thead>
<tr>
<th>Roughage</th>
<th>Approximate total protein content desired in grain mixture</th>
<th>Grain mixture</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Percent</td>
<td>Pounds</td>
</tr>
<tr>
<td>Legume hay 1 alone</td>
<td>12</td>
<td>400</td>
</tr>
<tr>
<td>Legume hay and silage, or mixed hay 2 alone</td>
<td>16</td>
<td>300</td>
</tr>
<tr>
<td>Mixed hay and silage</td>
<td>20</td>
<td>200</td>
</tr>
<tr>
<td>Grass hay and silage or either alone</td>
<td>24</td>
<td>100</td>
</tr>
</tbody>
</table>

1. If clover, add 100 pounds of cottonseed meal to the grain mixture.
2. One-half grass and one-half legume.

On the basis of the energy value of the feeds, good hay is worth about 60 percent as much as the usual grain mixture, and silage is worth about one-third as much as good hay. If it should happen, therefore, that hay and silage cost more per unit of nutritive value than grains, it will pay to reduce the roughage allowance in the ration and to increase the grain; but in no case should the roughage be reduced to a point at which mineral or vitamin deficiencies may be encountered. Usually it will be advisable to reduce the roughage below an amount that will supply enough total digestible nutrients for maintenance. This will be about 1¹⁄₂ pounds of hay or hay equivalent (1 pound of hay is equal to 3 pounds of silage) per 100 pounds of body weight of the animal. Every reduction of 1 pound in the hay or hay equivalent fed will mean an addition of 0.6 pound of grain in order to provide a similar quantity of nutrients.

The quantity of feed required over and above that needed for maintenance is directly proportional both to the quantity of milk produced and to the energy value of the milk. The nutrients required vary with the percentage of fat in the milk, but not proportionally so. One pound of a good grain mixture will have about 0.75 pound of digestible nutrients. After maintenance requirements are met, the amounts of grain needed for each pound of average milk produced by the different dairy breeds are shown in table 2.

**Table 2.** Amounts of grain needed for each pound of average milk produced by different breeds and digestible nutrients represented

<table>
<thead>
<tr>
<th>Breed</th>
<th>Grain mixture</th>
<th>Digestible nutrients</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pound</td>
<td>Pound</td>
</tr>
<tr>
<td>Holstein-Friesian</td>
<td>0.41</td>
<td>0.307</td>
</tr>
<tr>
<td>Ayrshire and Brown Swiss</td>
<td>0.46</td>
<td>0.340</td>
</tr>
<tr>
<td>Guernsey</td>
<td>0.52</td>
<td>0.391</td>
</tr>
<tr>
<td>Jersey</td>
<td>0.56</td>
<td>0.419</td>
</tr>
</tbody>
</table>

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SUMMER FEEDING

Good pasture provides the best feed there is for dairy cows, and besides is usually cheaper than harvested crops. Good pasture herbage contains all the factors required for perfect nutrition. If cows are permitted to graze such herbage, any nutritive elements that may have become depleted through the feeding of poor-quality roughage during the winter will be automatically restored in their bodies. Pasturage has always been and still is a lifesaver for dairy cattle.

Good pasturage is young, tender, abundant, and grown upon soils that are not seriously lacking in any of the essential mineral elements. Such pasturage is inadequate for dairy cows in only one respect. Cows will graze about 150 pounds a day, which means a dry-matter intake of 30 or more pounds. If no allowance is made for the energy used in grazing, this is enough above maintenance to support a production of 30 to 45 pounds of milk, depending on the richness of the milk, or nearly 1½ pounds of butterfat a day. However, there is no justification for disregarding the energy used in grazing. There is some evidence that cows over an entire pasture season actually use for productive purposes—maintenance and milk—only about 75 percent of the nutrients produced by the pasture. How much of the 25-percent discrepancy is due to trampling and soiling and how much is due to the energy used in grazing has not been determined. Perhaps over most of the country good pasturage should not be depended on to provide the nutrients for the production of more than 1 or 1½ pounds of butterfat a day. Pasturage, therefore, when used as the sole ration, is not a sufficiently concentrated feed to support a heavy production of milk.

Only in certain favored sections of the United States do pastures remain good throughout the whole season. As a rule, they are at their best for not more than a month or so, after which their value declines rapidly. Milk-production surveys show that the milk yields increase markedly at the time the pasturage is at its best, but they also show that the declines in production thereafter are quite rapid. This indicates that good pasturage is unexcelled for the production of milk, but it also indicates that dairymen depend too much upon their pastures. Either supplementary pasturage must be provided for use after the flush season, or more grain, hay, or silage must be fed. Since it is impossible to tell by looking at a pasture how much grass cows will graze from it, an estimation of the supplementary feed required cannot be made in that way. It is therefore suggested that cows be allowed all the good hay they will eat throughout the pasture season. When the grass is good they will eat very little hay, but as it becomes poorer they will eat more and in this way automatically tend to make up for what the pasture lacks. Silage can be fed to replace part or all of the hay if the quantity of feed needed is sufficient to permit the silage to be fed fast enough to prevent its spoiling.

In localities where it pays to feed grain in winter, it usually pays also in summer. With the exception of the last 2 years, when Government purchases have kept the price of butter almost constant throughout the summer, milk prices have ranged considerably lower in summer than in winter. Even then, it has as a rule paid to feed
grain in addition to pasture to cows producing at a fairly heavy rate. Even if the margin between the price of milk and grain is a narrow one, there is also the condition of the cows to consider. Without grain, good cows lose flesh to such a degree that production is depressed later in summer when milk prices improve and below the natural level for the cow later in lactation—a level that otherwise could be sustained on forage. In addition to pasture and hay or silage, grain may be fed for all production over 1 to 1.5 pounds of butterfat a day while the grass is at its best. The grain may be increased if the pasturage for any reason becomes poorer. As long as the pasturage remains reasonably good, it should not be necessary to provide grain for any production below two-thirds of a pound of butterfat a day.

An example will show how this method is applied. A Jersey cow on a fairly good pasture is producing 30 pounds of milk testing 5 percent. Thirteen pounds of this milk (0.65 pound of butterfat) will be supported by the pasturage and hay, leaving 17 pounds that must be supported by grain. Seventeen times 0.56, the quantity of grain required for 1 pound of Jersey milk, equals 9.5 pounds of grain—the quantity to be fed daily in addition to pasturage and hay.

It should be emphasized that ordinarily the greatest declines in milk production take place as soon as the quality of the pasturage begins to decline—in July in the Northern States and in June in the States a little farther south. It should also be emphasized that the effects of loss of milk and flesh at this season are carried over into the late summer and fall. It seems that midsummer is the time when the greatest improvement in the feeding of cows can be made.

**WINTER FEEDING**

The aim in winter feeding should be to get the milking cows to eat as much of the forages as possible and to feed only as much concentrates as are required to bring the total nutrients up to the required level. Investigations have shown that cows in the West fed exclusively on good alfalfa hay produce at least 1 pound of butterfat a day—provided, of course, that they are inherently capable of producing this quantity. Alfalfa is usually cheap in these regions of the West, and grain may be relatively expensive. These facts, combined with a low price for the product, may make the feeding of roughage as the sole ration the most economical practice. Investigations have shown also that the addition of grain to the ration improves production. If the price of the grain is low enough or the value of the product is high enough, it may be economical to feed some grain even in those regions where good alfalfa hay is cheap.

Generally speaking, the quality of hay produced farther east, say in the Central States, is not so good because of the less favorable hay-curing weather. For this reason, and also because much of the hay is made from grasses or mixtures of grasses and legumes, rations of hay alone or of hay and silage will not be eaten in as large quantities as the good alfalfa hay produced farther west and cannot be depended on to support a production of as much as 1 pound of butterfat a day. Furthermore, the price of grain is likely to be lower in relation to the price of roughage. Fraser (392) estimates that cows should have grain

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2 Italic numbers in parentheses refer to Literature Cited, p. 1075.
for all production over and above two-thirds of a pound of butterfat a day. This quantity of butterfat would be contained in about 20 pounds of milk from Holsteins, 16 pounds from Ayrshires and Brown Swiss, 14 pounds from Guernseys, and 12 pounds from Jerseys.

In the East the hay may be even poorer and the value of milk products higher on the average. A more satisfactory rule in this region is to base the grain feeding on the assumption that roughage alone will support a production of only one-half pound of butterfat a day and that for all production exceeding that amount grain should be fed. This means feeding grain for all production above the following quantities (pounds) of milk: Holsteins, 15; Ayrshires and Brown Swiss, 12; Guernseys, 10; and Jerseys, 9.

As an example of how this method would be applied in the East, let us assume that a Holstein cow is being fed all she will eat of average hay or of hay and silage and is producing 40 pounds of milk a day. Fifteen pounds of the milk will be supported by the forage, leaving 25 pounds to be supported by the grain. Twenty-five times 0.41, the quantity of grain required for 1 pound of Holstein milk, equals 10 pounds of grain—the amount to be fed daily in addition to the hay or hay and silage.

This method of feeding cows in the different regions contemplates providing them with all the average-to-good hay or hay and silage produced in the region that they will eat without undue waste. It is realized that certain modifications of this rule should be made if the price relationships between the feeds themselves and between the feeds and the product change materially. It is also realized that the protein content of the roughage may be so low as to require some high-protein grain even at the lower levels of milk production. The figures are offered only as a general guide. In practice, analyses of feeds usually are not used, and the exact quantities fed are not known. The distribution of the feed to the individual cows can never be done satisfactorily and economically solely on the basis of milk yields and feeding standards. The feeder should observe the condition of the cows as regards flesh. Thin cows should have more and fat cows less than the rule provides. The more extensive use of the artificial drier for hay and, what appears to be more important, the making of hay crops into good silage, offer possibilities of improving the roughage of the East to a point where it will compare favorably with that of the West. If that should happen, the quantity of grain fed could be reduced without reducing the quantity of milk produced.

The methods of feeding described are admittedly somewhat crude, yet they probably represent a considerable advance over present common practices. As dairying becomes more intensive and cultivated crops and fertilized pastures, as well as more valuable hay crops, have to be husbanded carefully to make dairy farming pay, the farmer will no doubt adopt more scientific methods of feeding than the one just described, and an effort will be made to have each cow fed more nearly according to her individual nutritive requirements. Until the practice of frequent weighing of the roughage is combined with the weighing and testing of the milk, the quantity of grain needed to complete the ration must continue to be somewhat a matter of guesswork.