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Increasing herd size, greater mechanization and higher labor costs have 'motivated' many dairymen to look for ways of reducing the amount of time each cow spends in the milking parlor. Although a number of things can be done to improve parlor efficiency, one has little control over how rapidly cows eat their grain allotment. The dilemma for many managers, therefore, is how to insure that each animal gets all the concentrates she needs without keeping her in the parlor beyond the time required for milking.

One possible 'solution' might be to feed additional concentrates free-choice outside the parlor. The problem here, however, is that the manager does not control individual cow intake, thus runs the risk of underfeeding his high producers or overfeeding the low producers, which can lead to further complications from 'fat cow syndrome.' This alternative, therefore, appears undesirable from both economic and nutritional standpoints.

Another approach would be to eliminate parlor feeding altogether, providing instead in the outside feed bunks a total mixed ration (TMR) that contains the right amounts of all ingredients needed for a balanced diet. This feeding system has been used successfully on a number of Indiana dairy farms, including Purdue University’s Dairy Center for over 10 years now. TMRs are also being formulated for dry cows, pregnant heifers and calves over 90 days.

The purpose of this publication is to help the dairymen assess the potential of a total mixed ration feeding system for his particular operation. Discussed are the advantages and drawbacks (both management and nutritional) of feeding TMRs, what factors would favor a change to such a system and when the changeover might best be made. Also presented in table form are the recommended nutrient levels in TMRs for cows in various productivity groups and for replacement animals.

Importance of a Balanced Ration

In the feeding of animals, emphasis should be on supplying a balanced ration—that is, one containing all the nutrients needed for proper nourishment during a 24-hour period, with neither an excess nor a deficiency of any one nutrient. The importance of a balanced ration is based on a simple nutritional law that, "Growth is limited by the least available nutrient." This can be illustrated by a barrel's ability to hold water (Figure 1), where the water represents an animal's production level and the barrel staves are the various nutrients in a ration.

![Figure 1. The barrel illustration of the importance of nutrient balance. Left: ration components in proper proportion maximize animal productivity. Right: component deficiencies mean lowered productivity and inefficient utilization of nutrients in adequate supply.](image-url)
When the ration is balanced with all nutrients present in the right proportions (i.e., the staves are of equal length), a level of production equal to the 'full barrel' can be expected. With a poorly-balanced ration, however, the production level achieved is limited by the nutrient most deficient (the shortest stave); at the same time, the full value of other nutrients (the longer staves) is not being realized, even if present in adequate amounts.

**How TMRs Insure Nutrient Balance**

In conventional feeding systems, various components of the animals' total ration are fed separately. For instance, alfalfa silage is fed at one place or time, corn silage at another and the grain mix at still another. This allows an animal to possibly overeat one component while ignoring another. Even if all the feed is consumed, the intake of each component could still be poorly-distributed throughout the day.

By contrast, a total mixed ration is a thoroughly-blended mixture of all forage and concentrate components, formulated to specific ingredient proportions so that every bite contains a balance of nutrients. It is provided to the animals on a continuous-access (free-choice) basis. Table 1 shows percentages of the ingredients in TMRs that meet the daily nutrient needs of various types of dairy animals.

**Advantages of Feeding TMRs**

1. **No feeding is done in the milking parlor.** This means: (a) no need for grain handling equipment in the parlor; (b) faster milking because no waiting for cows to finish eating; (c) cows calmer during milking and defecate less in the parlor; (d) no feed waste or dust; and (e) greater attention can be given to the milking process.

2. **A balanced diet is assured.** TMRs are formulated to meet the animals' nutritional requirements. Since the cows cannot choose what and what not to eat, they receive a uniform, definable, balanced nutrient intake with each bite. This also means better distribution of nutrients throughout the day.

3. **There is greater flexibility to change ration composition.** TMRs tend to 'mask' the taste of unpalatable feeds, so that ingredients can be introduced or changed with less chance of encounter-
ing problems. Also, as the situation dictates, rations can be changed to force consumption of given amounts of certain feeds, such as forages to prevent milk fat test depression.

4. Intake of 'problem ingredients' can be better controlled. Non-protein nitrogen products, such as urea, are utilized more efficiently if consumed in small amounts throughout the day, instead of in large amounts once or twice a day, as is the case when fed in concentrates at milking time. With total mixed rations provided free-choice, cows cannot consume too much of any one ingredient at any one time.

5. Digestive upsets are less likely. If given the chance, cows eat too much of the more palatable feeds too fast. With TMRs, they will eat more slowly and cannot overeat any one component. In fact, a TMR is the recommended feeding method if corn silage is the sole forage, to insure a balanced nutrient intake.

6. Free-choice mineral supplements are not necessary. Proper mineral intake to meet animal requirements is an important nutritional concern. Total mixed rations are formulated to contain recommended levels of all essential nutrients, including minerals.

7. Feeding can be done using mixer wagons. These wagons equipped with electronic load cells permit a flexibility in blending and feeding that is not possible with augers and conveyors.

Disadvantages Inherent in TMRs

1. Hay is difficult to use. It must be chopped or shredded before mixing with other components; and even then, it may be difficult to blend and feed.

2. Weighing and blending equipment is needed. Mixer trucks and wagons are expensive; and there should also be some provision for alternate equipment in case of breakdown.

3. Cows should be grouped according to production level. Some concerns relative to the grouping of dairy animals are that: (a) cows lose their individuality, which could be a problem for those that thrive on attention; (b) a noticeable drop in milk production may occur as cows are shifted from higher- to lower-producing groups; and (c) there is disagreement as to how many groups are needed. Some recent research shows that only one ration will suffice, if the milking herd is fed free-choice and dry cows are separated and fed limited amounts of the same ration.

4. A feeding system changeover may upset the cows. Some claim that cows are not interested in entering the milking parlor when they know there is no feed in the parlor. Most cows adjust in about 2 weeks; some may never adapt. Consider using a crowd gate to solve this problem.

5. Greater nutritional knowledge and management are required. There can be no guesswork in formulating and mixing rations; the animals cannot compensate for errors in feed rations. The manager must make the right calculations to have properly-formulated total mixed rations for his particular feeding groups. And there will probably be some trial-and-error, since specifications for TMRs are not well-defined at this point.

6. There are apt to be some facility problems. Many housing systems are not designed for handling groups of cows and for feeding TMRs; thus, there may be limitations imposed by the physical facilities that make a TMR system unfeasible.

Conditions Favoring Conversion to TMR Feeding

A dairyman should consider changing to a total mixed ration system of feeding if faced with one or more of the following situations or management decisions:

- **When planning to build a new milking parlor.** The money saved by eliminating the grain feeding system in the parlor can be used instead for a feed mixer.
- **When the present feeding system wears out.** The equipment needed to change over to TMR feeding would cost about the same as replacing the old system.
  - If considering feeding by-products (brewers wet grains, etc.) or non-protein nitrogen (urea) in the ration. A mixer makes possible the blending of silages and by-product feeds that will be more palatable to the animals.
  - If part of the herd (e.g., dry cows and heifers) is housed at another location. When such is the case, a TMR not only insures proper nutrient balance but also is easily transported, regardless of distance from the feed center.
  - If the cows are not eating a balanced diet. Some animals pick and choose, thus do not eat a balanced ration. TMRs eliminate that possibility since the components cannot be sorted out.

The Next Step

If the information here indicates that total mixed ration feeding would 'fit' your particular operation, consider a visit with your local Cooperative Extension Service agriculture agent. He can help you in assessing facility needs, formulating the proper rations for your herd and planning for an orderly changeover to the new system.
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