FORAGES IN TOTAL MIXED RATIONS

Mireille Chahine

Forages in the diet of dairy cows

Feed costs account for 40 to 50 % of total production costs on dairies with forages cost allocation varying between 38 and 45 % of the feed cost (Figure 1). There is an economic incentive for forage growers to produce good quality forage because high quality forage is more valuable to dairymen. If balanced properly, rations containing high quality forages will allow cows to produce more milk. As milk production increases, forage quality becomes more crucial because the amount of concentrate that could be added to the ration is limited. Although fiber could be provided by other ingredients of the diet, at least 40% of the fiber consumed by dairy cows should come from forages to ensure a healthy rumen.

Total mixed rations

Total mixed rations (TMRs) are rations where all ingredients fed to the cow are blended together. The first reported research study that used TMR was done at the Purina Milling Co. farms in the mid-1930’s (McCullough, 1991). Since then, TMR has become the most common system of feeding on large dairies. Initially, TMR was promoted in areas where both corn silage and haylage were fed because it prevented cows from expressing preference for one forage over the other. The use of TMR has increased steadily in recent years especially in large sized herds. A 1993 Hoard's Dairy survey reported that 29.2 percent of surveyed U.S. dairy farms had adapted this system of feeding dairy cows. In 1996, a dairy survey of management practices demonstrated that use of TMR was a common practice in herds of all sizes (Table 1). One interesting finding was that use of TMRs was a common practice among all high producing herds independently of size.

Advantages of TMR

One of the major advantages of TMR is the ability to consistently provide cows with a ration where all nutrients are in the same ratio even if the dry matter intake of the cow is changing (assuming there is limited feed sorting). If balanced properly, each mouthful of the ration fed has the same amount of nutrients. The cow is unable to eat significantly more forage or significantly more concentrate. This results in a healthier rumen and thus a healthier cow. If the ingredients are properly tested, a TMR provides great accuracy in formulation with the possibility to utilize ingredients like wet products and liquid supplements that are hard to feed alone. This leads to a greater flexibility in formulating the rations to meet the requirements of various production groups. It also allows nutritionists to include in limited amounts some ingredients that have low palatability without adversely affecting intake. Feed efficiency and milk production are also expected to be improved when TMR is fed.

---

Disadvantages of TMR

Disadvantages of TMR involve additional cost and maintenance which could be prohibitive for small herds. Over mixing of the feed can cause pulverization which could negatively affect dry matter intake. Over mixing can also greatly reduce the size of the particles within the TMR. On the other hand, under-mixing causes inadequate blending of the different ingredients. A mistake in balancing and/or feeding the ration could also affect a large number of cows which might lead to a big reduction in performance and a significant economic loss.

TMR mixer selection

There are several mixer types available on the market. The choice of a mixer depends mainly on the type of forages being used in the ration. Vertical mixers are usually more appropriate when big, round and square bales of hay are used. The knives in the vertical mixers should be rotated to a new cutting edge frequently and replaced when necessary. Note, however, that some vertical mixers also have problems chopping hay of low quality. Most of the horizontal mixers do not work well when large clumps of hay are added to them. When a horizontal mixer is used, hay that is added to the mixer should be chopped before it is mixed. A mixer selection should also be based on the size of the batch that has to be mixed.

Forage particle size

Particle size plays a very important role in a TMR. TMR mixing produces dramatic decreases in particle size of ration components (Heinrichs et al., 1999). Reduced forage particle size decreases chewing time (Woodford and Murphy, 1988). As chewing time decreases, less saliva is produced (Grant et al., 1990). Saliva acts as a buffer and a decrease in saliva production decreases the rumen pH and reduces the number of microorganisms that digest fiber. This will cause the development of metabolic disorders such as acidosis, laminitis, displaced abomasum, reduced digestibility, and decreased milk fat. It is very important to regularly determine TMR particle size after mixing to determine the extent of reduction in the forage particle size. A particle size determination should also be regularly conducted on the refusal to determine whether cows are sorting. It is recommended that the TMR contain 8 to 10% (as-fed) particles on the top screen of the Penn State shaker box if silage is the main forage. When dry hay is used as the main forage in the ration, a TMR with 6% on the top screen is adequate.

Forage and TMR analysis

Forage composition is very variable. Forage should be sampled when it is from a different field, different cutting, different silo, etc. Routine testing should also be performed regularly because the quality of forage decreases with time. TMR should also be tested regularly. Any change in the composition of the TMR is a signal that all the ingredients of the diet should be tested. It is recommended that the dry matter of the ration be determined at least once a week. A decrease in moisture of the forage will increase sorting. The diet that is consumed by the cows will be different from the diet on the paper. When cows sort, they will eat more concentrate than forages and this will negatively affect rumen, and subsequently, the cow health. A lab analysis of the refusal should also be conducted to determine whether the cow is sorting the feed. The nutrients (NDF, CP, NSC etc.) of the refusal should correspond to the diet being fed and should be similar to what’s on the paper.
Idaho hay growers have a competitive edge over other areas in the country because they are able to produce good quality hay. The key for maintaining this competitive edge consists in producing forages with predictable, consistent quality. Efforts should be made to minimize variation in nutrient composition and quality in forages and to provide a more “predictable” and consistent product to dairymen. Factors that have a direct implication on forage quality should be managed to ensure a more consistent product among different growers. Dairymen should manage their TMR properly. If not managed properly, the high hay diets might contribute to TMR sorting, which could cause a wide variety of metabolic problems varying from low milk fat to acidosis to laminitis.

REFERENCES


Figure 1: Ration cost allocation of a typical dairy cow diet according to the stage of lactation (Adapted from Wilson et al., 2002).
Table 1. Percentage of dairy herds using TMR by herd size (adapted from Keown, 1997)

<table>
<thead>
<tr>
<th>Herd Size</th>
<th>Lbs/cow*</th>
<th>N^</th>
<th>TMR</th>
</tr>
</thead>
<tbody>
<tr>
<td>30-99 Cows</td>
<td>19,600 15,750</td>
<td>247 256</td>
<td>47.8a 31.3</td>
</tr>
<tr>
<td>100-199 Cows</td>
<td>20,450 16,174</td>
<td>95 97</td>
<td>82.1a 59.8</td>
</tr>
<tr>
<td>200-499 Cows</td>
<td>21,200 16,500</td>
<td>66 69</td>
<td>90.9a 72.5</td>
</tr>
<tr>
<td>500 or more cows</td>
<td>22,390 18,668</td>
<td>38 38</td>
<td>86.8 84.4</td>
</tr>
</tbody>
</table>

*Values for high herds are minimum production per cow. Values for low herds are maximum production per cow.

^Number of herds

P < 0.05