

SUPPLEMENTING PASTURE WITH A TOTAL MIXED RATION

Larry Muller, Karen Sullivan, Kathy Soder^a

Many graziers in the United States are located in the Northeast and Midwest. With the climate in these regions, we typically have 6 to 7 months of grazing and 5 to 6 months with confinement feeding of stored forages because of the winter climate. It is not uncommon for dairy graziers to supplement lactating cows on pasture with an additional forage for a variety of reasons. Stored forages are needed to provide adequate forage dry matter intake (DMI) during periods when pasture growth and availability are low, such as in the summer or during droughts. Some dairies have high stocking rates due to increasing herd size, and feeding supplemental forages allows them to graze more cows with the same land base. When feeding additional forages, hay or silage will partially replace the DMI from pasture on a 1 lb. to 1 lb. basis.

Many graziers in the USA have the equipment on the farm to feed a total mixed ration (TMR) during the winter feeding period. An increasing number of dairymen are using the equipment to supplement pasture with a partial TMR (pTMR). This is called a pTMR because pasture is not physically part of the mixed ration. Feeding a pTMR to grazing cows offers more “control” over the entire feeding program compared to offering pasture and grain separately. An estimate of the DMI from pasture should be part of the ration formulation process by the nutritionist in order to develop a “nutritionally balanced” ration.

As with all supplementation strategies on pasture, there are advantages to feeding a pTMR that should be considered along with the goals of the dairy producer. Advantages of feeding a pTMR to supplement pasture include:

- Helps in estimating DMI of pasture since we know the approximate DMI from supplemental TMR.
- Forage is fed with the concentrate rather than separately, which reduces the risk of rumen digestive problems due to “slug” feeding of concentrate.
- Forage provides fiber that may be needed when feeding high quality pasture.
- Higher milk production per cow. Research at Penn State University found that grazing cows supplemented with a pTMR produced 8 lb. more milk per day than grazing cows supplemented with just concentrate (70 vs 62 lb/day). Cows had a higher milk fat and milk protein content, and an improved body condition (see Table 1) when fed the pTMR.

Some of the disadvantages of feeding a pTMR include:

- Extra time and labor involved in feeding a TMR.
- Higher feed costs.
- Management of the TMR; must be flexible and adjust to changing pasture quality in terms of pTMR formulation and amount of pTMR to feed.
- Need of an area to feed the pTMR.
- Need to remove enough silage daily to maintain good quality feed
- Mixing enough TMR in the wagon to have a good TMR mix.

^aDairy Scientist, Penn State University (lmuller@psu.edu); USDA-NRCS, Norwich, NY; and USDA-ARS, University Park, PA.

Managing a “Partial” TMR

A challenge with feeding a pTMR is to determine the amount of forage to include in the mix. Including small amounts of forage with the concentrate mix may mean that some cows in a group may sort feed and eat more of the concentrate. All cows need to have access to the pTMR at any one time to ensure that aggressive cows do not prevent submissive cows from accessing the feed. Adequate feed bunk space (at least 24 inches per cow) is needed since cows will have access to feed for less time than when fed a TMR with a confinement system. There are no written guidelines on the minimum amount of forage to include in a pTMR. We suggest including at least 5 to 7 lb of forage dry matter per cow. This would be about 15 to 20 lb of silage on a wet basis, or at least one lb of wet forage per one lb of concentrate mix in the TMR. As pasture quantity decreases, the amount of forage in the pTMR will need to be increased.

Because most farms have a range in milk production levels within the herd, we may need to target one pTMR to fit all. This should be targeted toward the higher producing cows. Another option is to feed pTMR with lower amounts of concentrate and to feed some concentrates individually in the barn or milking parlor to the higher producing cows. .

The amount of pTMR to feed will depend on the cow's requirements as well as the quantity and quality of available pasture. Time of feeding will also affect intake of both pTMR and pasture. In general, feeding a pTMR before cows graze encourages greater consumption of the pTMR and may decrease pasture intake. However, it may provide a better synchronization of nutrients in the rumen between what is provided from the pTMR (energy) and from the pasture (protein). Offering the pTMR after the initial period of grazing or prior to milking encourages less consumption of the pTMR. In summer heat stress, some dairymen will graze the cows only at night and feed a partial TMR during the day (TMR by day, pTMR by night). Others may graze at night and for a few hours in the morning, and then feed a pTMR during the heat of the day. TMR is sometimes withheld for a few hours before cows graze so that cows will readily consume pasture.

Generally, cows will adjust the intake of pTMR based on how much pasture is available, but quality and palatability of forage species in the pasture will also affect how much pTMR is left in the bunk. Dairy managers and nutritionists need to adjust feeding practices and ration formulation based on two things – the amount of TMR left in the feed bunk and amount of milk going into the milk tank. These need to be monitored daily and the amount of pTMR fed can be adjusted daily.

There are pluses and minuses to feeding different forages in a pTMR. Corn silage can be an excellent supplemental forage to complement pasture because it adds needed rumen fermentable carbohydrates as a source of energy for the rumen microbes and also “dilutes” out the high protein in pasture. It also adds effective fiber that can compliment high quality pastures which may be low in effective fiber. Corn silage is a highly palatable feed, is an excellent carrier for the supplemental concentrates, and may allow for lower amounts of concentrate to be fed. Grass-legume silages tend to be lower in rumen fermentable carbohydrates and higher in protein and do not compliment the nutritional attributes of pasture as well as corn silage since corn silage may be about 40% grain on a dry basis. Consequently, many pTMRs are formulated to contain less grass-legume silage during periods of high pasture availability, and as the quantity of pasture decreases, grass-legume silage is gradually added back to the TMR.

Formulating a pTMR

Balancing a pTMR for cows is similar to balancing a TMR for non-grazing cows except for two things. It is much easier to estimate pasture DMI when supplementing with a pTMR compared to feeding forage and concentrate separately. Pasture DMI could be estimated using

equations from the NRC to estimate total DMI. Using estimated DMI and forage analysis from pasture, it is possible to formulate a reasonably “balanced” ration to complement pasture. Having flexibility in the formulation is key to maintaining optimal feed available for the cows particularly with the continual changing of pasture quantity and quality. We suggest some reformulation of rations every few weeks during the grazing season. Planning ahead for changing pasture DMI from decreased available pasture can help to minimize problems that changes may cause. Monitoring pasture growth rates on a weekly basis is the best method to predict when DMI of pasture may become limited.

Example guidelines to feeding a pTMR are in Table 2. Three different milk production levels (75, 60, and 45 lb/day) and expected total DMI (50, 45, 40 lb/day) are assumed. A high and medium pasture availability are assumed with the subsequent amounts of pasture DMI and pTMR to feed.

For example, cows producing 75 lb of milk would be expected to consume about 50 lb of total DMI/day. With high pasture availability, we would expect cows to consume about 23 lb DMI from pasture. This means that cows are expected to consume 27 lb of DM from a pTMR. We assume that 18 lb of concentrate (1 lb concentrate/4 lb of milk) is a reasonable amount to feed, and should provide enough energy from non-structural carbohydrates. If the forage fed is primarily corn silage, we can reduce the grain (perhaps to 16 lb) fed, since corn silage is typically about 40% corn grain and increase forage to 11 lb. As milk production decreases and the amount of pTMR to feed decreases, the forage:concentrate ratio increases.

Animal Response and Economics

A research study with 30 high genetic merit Holstein cows was conducted at Penn State for 21 weeks from May to October and found that feeding a pTMR with pasture resulted in a higher milk yield, greater milk component percentages and yield, and less body condition loss compared with pasture plus concentrate (Table 1). We calculated the net income per day to be \$0.68/cow/day greater for the pTMR compared to pasture plus concentrate. The pTMR fed was the same TMR that was fed to the confinement herd. Formulating a specific pTMR for this study would have cost less and likely have resulted in an even greater milk yield and profitability. It is noted that these are the costs associated with feeding including tractor and equipment use, labor, fencing, water, and fertilizer costs for the summer grazing season.

A study using a computer simulation model program called Dairy Forage System Model (DAFOSYM) was conducted for a 100 cow herd by Soder and Rotz of the USDA-ARS to evaluate the long term economic impacts of feeding either a concentrate or pTMR on grazing dairies for the entire year. This includes both the grazing and confinement periods. Using the values in Table 1 from the research study at Penn State, net return per cow was \$223 higher per year for the pTMR system than for pasture plus concentrate. Feeding a pTMR to grazing dairy cows provides a viable feeding strategy for increasing milk production and profitability in the USA compared to pasture plus concentrate system.

Table 1. Results of feeding a pTMR to supplement pasture for high producing Holsteins during a 21 week grazing period.

Item	Pasture + 19 lb. concentrate	Pasture + pTMR
INTAKE:		
Pasture intake, lb. DM	28.4	16.5
TMR intake, lb. DM	--	38.9
Concentrate intake, lb. DM	19.1	--
Total intake, lb. DM	47.5	55.4
Total intake, % of body weight	3.58	3.99
PRODUCTION:		
Milk yield, lb. /day	62.5	70.4
Milk fat, %	3.13	3.35
Milk fat, lb. /day	19.6	2.33
True milk protein, %	2.82	2.95
Milk protein, lb. /day	1.74	2.05
MUN, mg/dl	14.9	12.0
BCS change (scale of 1 to 5)	-0.20	0

^aBargo, F. 2002. J. Dairy Sci. 85:2948-2963.

Table 2. Guidelines on amounts of pTMR to feed with varying milk yields and pasture availability.

Milk yield	Pasture available	Expected Total DMI	Expected Pasture DMI	pTMR to feed (Dry Matter Basis) ^a		Forage:Concentrate Ratio (DM Basis)
				Forage ^b	Concentrates	
----- lb/cow/day -----						
75	High	50	23	9	18	64:36
	Medium	50	16	16	18	
60	High	45	22	9	14	70:30
	Medium	45	16	15	14	
45	High	40	22	9	9	78:22
	Medium	40	16	15	9	

^a Assume forage includes grass/legume silage and corn silage.

^b If corn silage is the major forage, then forage amount may be increased by 1 lb and concentrate decreased by 1 lb.