

Project number: 5673
Funding source: Teagasc

Date: September, 2010
Project dates: Nov 2006 – Oct 2009

The role of total mixed ration (TMR) feeding in pasture-based dairy systems



Key external stakeholders:

Dairy farmers- national; feed and nutrition companies; consultancy agencies

Practical implications for stakeholders:

In a post-milk quota scenario, supplementing pasture with total mixed ration (TMR) could be used to increase milk output from a limited land base. A high level of pasture utilization is essential for profit, so decisions to supplement the milking herd diet with TMR must be based on pasture supply.

- TMR feeding should be considered as a means of increasing stocking rate rather than simply to improve milk yield per cow. High stocking rate systems are more sensitive to milk and feed price changes, therefore greater fluctuations in farm profit are to be expected.
- There is no clear benefit to animal performance of using a dry cow TMR containing high levels of straw compared to grass silage.
- Body condition and blood mineral status are the key drivers of dry period nutrition, and these can be successfully managed on a grass silage diet. Consequently, there is little justification for incurring the additional cost of feed and extra machinery required for the TMR system

Main results:

- Buffer feeding with TMR in a high stocking rate scenario increased milk output per grazing hectare but did not affect milk yield per cow.
- The profitability of high stocking rate systems is very sensitive to milk price and feed cost changes.
- Compared to grass silage alone, feeding a dry cow diet containing high levels of chopped straw did not improve subsequent milk production, health or fertility.

Opportunity / Benefit:

Protocol developed for efficient use of feed supplements on high stocking rate dairy farms
Updated guidelines for nutrition and management of spring-calving cows during the dry period

Collaborating Institutions:

University College Dublin

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1. Project background:

The guiding principle for a grazing system is to maximize grass in the diet and use supplements to balance forage supply with herd demand. However, at a practical level other concerns are commonly brought to bear on feeding decisions, such as improving milk yield per cow, balancing the nutrient composition of pasture, or improving health status. This often translates into more complex feeding practices involving greater mechanization and use of imported feed. Total mixed ration (TMR) feeding is one such system, which operates on the idea that offering a consistent diet, with all ingredients physically blended together, will improve animal performance. Use of TMR feeding has been adopted on many Irish dairy farms in advance of independent research.

A large degree of farm-to-farm variation in feed costs is evident even after correcting for factors like land type and stocking rate. It is therefore essential that the rationale for using supplements in pasture-based milk production is clearly defined. This project sought to address some of the issues surrounding use of TMR feeding in particular. The three main objectives were to benchmark milk productivity of pasture versus TMR, to clarify the role of buffer feeding with TMR (i.e. feeding TMR in conjunction with grazing), and finally to examine the efficacy of high-fibre TMR for dry cows.

2. Questions addressed by the project:

- How does milk production on pasture compare to a TMR diet formulated for maximum milk output?
- What are the main nutritional limitations to milk production from pasture?
- What are the health and welfare implications of an indoor milk production compared to pasture-based milk production?
- What is the role for buffer feeding in a pasture-based feeding system?
- Are there production and health benefits to be gained from feeding a high fibre TMR to dry cows?

3. The experimental studies:

Three experimental studies were carried out under this project:

- **Benchmarking pasture versus a total mixed ration.** 48 Holstein Friesian cows were assigned equally to either pasture or 100% TMR (maize silage, grass silage, concentrate blend, molasses and straw) for a full lactation. The TMR group was housed for the duration of the experiment. The energy, fibre, and protein content of the TMR were formulated for maximum milk yield. Pasture-fed cows were offered swards managed to a target pre-grazing mass and post-grazing height. Measurements included milk production, feed intake, BCS and blood profiles.
- **Comparison of pasture and buffer feeding systems.** This study took the approach of looking at buffer feeding for a high stocking rate scenario. Two systems were compared:
 - **Partial TMR (PMR)**- Stocked at 4.0 cows per hectare and supplemented with total mixed ration (maize silage, grass silage, concentrate blend and molasses).
 - **GRASS**- Stocked at 2.5 cows per hectare with moderate concentrate input - Buffer feeding with TMR was used to balance pasture supply for the PMR group.Measurements included milk yield, pasture use efficiency, feed intake, blood profiles and fertility.
- **Comparison of high-fibre TMR and grass silage for dry cows.** 58 mature spring-calving Holstein cows were assigned equally to one of two diets for the duration of the dry period:
 - **Grass silage** (72% DMD)
 - **High-fibre TMR** (Comprising 40% straw, 25% grass silage, 25% maize silage, 10% soybean meal). The high-fibre TMR ingredients were mixed in a diet wagon prior to feeding. Diets were offered ad-lib and supplemented with the necessary minerals/vitamins.

Both groups were fed pasture plus concentrate after calving. Health, BCS, blood profiles and subsequent milk yield were monitored.

4. Main results:

100% TMR versus Pasture

- Pasture-fed cows produced 21% lower milk solids yield (486kg versus 591kg) compared to TMR—fed cows.
- Energy intake was the main factor limiting milk production at pasture
- Both diets supplied protein in excess of requirements for delivered milk yield.
- Cows fed TMR had greater bodyweight and body condition score (BCS) gain from mid-lactation
- Cows at pasture had lower incidence of hoof disorders and mastitis throughout lactation.

Buffer Feeding with TMR at pasture

- Milk solids yield per cow was similar at 456kg and 465kg for GRASS and PMR, respectively.
- Milk solids output per hectare was 63% greater for PMR due to a higher stocking rate
- Pasture quality and post grazing heights were similar for both treatments
- The GRASS system used 0.45t DM concentrate per cow and was self-sufficient for forage. The PMR system used 0.74t DM concentrate per cow, and imported 1.5t DM of forage per cow for use during lactation and the dry period.

High-Fibre TMR versus grass silage for dry cows

- Cows fed high-fibre TMR had lower BCS at calving compared to silage-fed cows (3.11 versus 3.48).
- Dry period diet had no effect on milk production over the full lactation.
- Dry period diet had little effect on blood metabolite or mineral profiles post calving
- No difference in health or fertility.

5. Opportunity/Benefit:

The outcomes of this research, in conjunction with existing research, were used to develop a protocol for efficient use of feed supplements on high stocking rate dairy farms. The outcomes also provided updated guidelines for nutrition and management of spring-calving cows during the dry period.

6. Dissemination:

Results of the project were presented under the dairy cow nutrition section for the Moorepark Open Day 2009, the Ballyhaise College Dairy Open Day 2009 and at Teagasc Feed and Forage Events (2008-2009). Findings have also been presented at other Teagasc seminars, invited industry events, to Teagasc advisory staff and to dairy discussion groups visiting Moorepark as well as through popular publications, e.g. Today's farm, IFJ, Farmer's Monthly.

Popular publications:

- Butler M., Patton J., Murphy J.J., and Mulligan F.J. (2010) 'Evaluation of a high-fibre total mixed ration as a dry cow feeding strategy for spring-calving Holstein Friesian dairy cows. *Livestock Science* 136 (2): 85-92
- Butler M., Patton J., Mulligan F.J. and Murphy J.J. (2009) 'Comparison of milk production performance of Holstein Friesian cows managed under pasture or partial mixed ration feeding systems' *Agricultural Research Forum, Tullamore, 12-Mar-2009, p.25*
- Patton J., Murphy J.J., and Butler M. (2009) 'Comparison of total mixed ration and pasture feeding systems' - *Irish Dairying New Thinking for Challenging Times (Moorepark Open Day 2009). Teagasc IE pp. 107-109*

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