

Project Number: 6193
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Precision supplements for high quality forage diets to improve milk protein composition



Key external stakeholders:

Irish dairy farmers, milk processors, animal nutrition industry

Practical implications for stakeholders:

Dairy farmers strive to produce milk solids in a profitable manner, whilst maximising the efficiency with which milk is processed into high value dairy products is a clear objective for milk processors. This project generated information for both stakeholders on the implications for milk production and milk processability of feeding different types of supplementary feeds to grazing dairy cows. Supplementary feed composition should be carefully matched to the composition of the base feed. If early lactation spring calving dairy cows grazing high quality grass require supplementary feed to be offered for a period – a low crude protein concentrate should be used. Using high crude protein does not offer any benefits, and indeed may give rise to reduced Nitrogen Utilization Efficiency (NUE) and milk with poorer processability characteristics. Similarly, there may be benefits from choosing a fibre-based rapidly degradable concentrate over a starch-based rapidly degradable concentrate.

Main results:

- In the case of early lactation dairy cows grazing high quality grass in spring, offering high crude protein concentrate
 - o had no effect on milk yield, milk protein concentration or milk solids yield
 - o but did increase milk urea nitrogen (MUN) and significantly reduced milk heat stability at pH 6.8, which are negative from a milk processability perspective
 - o it also gave rise to poorer NUE compared to offering medium or low crude protein concentrate
- Supplementing grazing dairy cows in early lactation in spring with a starch-based rapidly degradable concentrate
 - o decreased milk fat concentration
 - o and was also associated with reduced milk heat stability, which is undesirable from a milk processing perspective
- In contrast supplementing grazing dairy cows in early lactation in spring with a fibre-based rapidly degradable concentrate
 - o increased total protein concentration, true protein concentration and casein concentration in milk
 - o and had the highest milk heat stability, which is desirable from a milk processability perspective

Opportunity / Benefit:

These results provide information to dairy farmers, milk processors and the animal nutrition industry on how best to supplement grazing dairy cows so as to maintain high grass intake and milk production performance, produce milk which is highly processable, and can maximise NUE thus minimizing nitrogen losses to the environment.

Collaborating Institutions:

AFBI NI
MTT Finland

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1. Project background:

In 2009, 56% of whole milk produced in Ireland was utilised in the manufacture of butter and 31% in the production of cheese, and these proportions are increasing over time. Hence, the suitability of milk for manufacture into these products (processability) is increasing in importance. The protein composition of milk is central to milk processability. Therefore, improving the protein composition of milk could further improve the quality of milk from a processability-perspective. Low casein number can decrease the yield of dairy products and high MUN is an indicator of excess protein in the diet. As a result, in Ireland there is interest in testing different feeding strategies in early spring in order to optimise milk protein composition.

2. Questions addressed by the project:

- In early lactation in spring, when a small quantity of supplementary feed is required, is it beneficial to offer a high crude protein concentrate to grazing dairy cows compared to offering a medium or low crude protein concentrate?
- Do fibre-based and starch-based concentrate feeds offered as supplements to grazing lactating dairy cows in spring have differing effects on milk composition, milk protein profile and milk processability?

3. The experimental studies:

In spring, early lactation dairy cows grazing early spring pasture, were offered different supplementary feeds. The following measurements were made

- i. Dry matter intake
- ii. Milk yield and composition
- iii. Milk protein profile
- iv. Milk processability
- v. NUE

In the first spring study cows were offered 13 kg DM grass with 4 kg DM concentrate; the concentrate contained a high, medium or low concentration of crude protein. In the second study, the same feeding levels were used, and the same parameters were investigated; however, the source of energy (fiber or starch) and rate of degradation (rapid or slow) of the concentrates differed among the treatments. In both studies, the treatment groups were grazed separately.

4. Main results:

Early lactation dairy cows grazing high quality grass in spring, were offered high, medium or low crude protein concentrate

- No effect on milk yield, milk protein concentration or milk solids yield
- High crude protein concentrate increased MUN
- As dietary crude protein concentration increased milk Non Protein Nitrogen (NPN) increased. Milk urea nitrogen is a component of milk NPN.
- High crude protein concentrate was associated with a significantly reduced milk heat stability at pH 6.8
- As MUN increased heat coagulation time at pH 7.4 also increased
- High crude protein concentrate had the poorest NUE

The second study assessed the effects on milk production, milk heat stability and NUE, of offering four supplementary concentrates differing in energy source and rate of energy release, to grazing spring-calving dairy cows in early lactation. The concentrates were offered for 8 weeks. Early lactation dairy cows grazing high quality grass in spring were allocated to four treatments: fibre-based rapidly degradable (FR) (citrus/sugar beet-based), fibre-based slowly degradable (FS) (soya hulls-based), starch-based rapidly degradable (SR) (wheat-based) and starch-based slowly degradable (SS) (maize-based).

- Supplementing with a starch-based rapidly degradable concentrate

- decreased dry matter intake
 - decreased milk fat concentration
 - decreased milk solids yield
 - was associated with reduced milk heat stability, which is undesirable from a milk processing perspective
- Supplementing with a fibre-based rapidly degradable concentrate
- increased total protein concentration, true protein concentration and casein concentration in milk
 - had the highest milk heat stability, which is desirable from a milk processability perspective

5. Opportunity/Benefit:

These results provide data on milk production performance and milk processability when different types of concentrate feeds are offered to grazing dairy cows in spring. The results indicate the positive effects on milk processability when feeds which complement grass are chosen.

6. Dissemination:

The primary stakeholders for this research are Irish dairy farmers, milk processors and animal nutrition companies. The results of this project have been disseminated through the popular press and at the Teagasc Moorepark Open Days, as well as at scientific conferences and in scientific peer-reviewed publications.

Main publications:

Reid, M., O'Donovan, M., Elliott, C.T., Bailey, J.S., Watson, C.J., Lalor, S.T.J., Corrigan, B., Fenelon, M.A., Lewis, E. 2014. The effect of dietary crude protein and phosphorus on grass-fed animal production, nutrient status and milk heat stability. *Journal of Dairy Science* 98: 517-531

Reid, M., O'Donovan, M., Murphy, J.P., Fleming, C., Kennedy, E., Lewis, E. 2015. The effect of high and low levels of supplementation on milk production, nitrogen utilisation efficiency and milk protein fractions in late-lactation dairy cows. *Journal of Dairy Science* 98: 5529-5544

Popular publications:

Lewis, E. 2013. Grass as a feed for dairy cows. In: 'Irish Dairying-Harvesting the Potential', Moorepark'13 Open Day, 3rd July 2013

Patton, J., Reid, M., Lewis, E. 2014. Nutrition for profitable pasture-based dairy systems. In: Proceedings of the IGFA Feed Forum, 26-27th June, Portaloise, Co. Laois, 13 pages

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