Milk quality

Introduction

Improving milk quality can have a beneficial impact on farm profitability as pricing arrangements encourage the production of milk with a high compositional quality, which attracts bonus payments. Dairy products are a rich source of protein and play an important role in our diet. Milk proteins contribute directly to the nutritional value and physical characteristics of many dairy products.

Factors that affect milk quality

1- Feeding

The overall energy intake, the type and the quality of feed offered to the cow has a major impact on milk protein production.

Grass

Grazed grass is the cheapest feed available to the dairy cow. The Northern Ireland climate is well suited to growing high yields of quality grass. As well as maintaining margins, maximising the proportion of quality grass in the diet of the dairy cow throughout the season will boost milk protein levels.

Optimal grassland management involves balancing the supply of quality grass for grazing with the grazing demand throughout the season. Measuring the grass covers on the farm and maintaining a grass wedge throughout the season will help to ensure each grazing is as close to the optimal pre grazing cover of 3,000 kg DM/ha as possible.

It is especially important to focus on grazing management in the spring, as this will determine the quality of the grass later in the season in subsequent grazing rotations. Studies looking at milk protein production have found a decrease in milk protein later in the season from swards grazed laxly in the spring vs swards grazed tightly in the spring. However a balance must be found as if cows are grazing too tightly in the spring it will decrease intakes and hence milk protein production.

The seasonal growth curve of grass and the weather make maintaining quality grass for grazing throughout the season a continual challenge. There are many tools available to manage grass surpluses and deficits including altering stocking levels, altering the grazing area, fertiliser applications, removal and baling of surplus grass, supplement inclusion, on-off grazing etc.

Research evidence and experience at Greenmount has demonstrated that milk protein content can be increased by extending the grazing season, allowing cows to graze in the early spring and late autumn.

At Greenmount the grazing season usually starts in mid-March and extends to mid-November, depending on weather conditions and grass cover. Planning the final rotation length and paddock closing schedule is critical in preparing a grazing wedge for early turnout in the following grazing season.

Maintaining a minimum ryegrass content of 60-70% across the grazing swards is important to be able to grow grass early in the season and maintain grass yields throughout the season. Swards with higher ryegrass contents will increase energy intake and milk protein production due to the increased digestibility of the ryegrass varieties compared with non-sown species.

Silage

Autumn and winter calving cows will produce a large proportion of their lactation from silage and therefore silage quality is crucially important. Silage quality during this period can also have a significant effect on milk protein content. Table 1 illustrates the effect of silage quality on milk protein percentage. Increasing the D-value of silage from 62 to 73 increased milk protein concentration by 0.18% and at the same time increased milk yield.

Table 1. Effect of digestibility of grass silage on milk composition and yield

D-value of silage	62	70	73
Silage Intake (kg DM/day)	8.1	10	10.7
Milk Protein %	3.17	3.22	3.35
Milk Fat %	3.68	3.68	3.77
Milk yield (litres/day)	26.3	28.2	28.9

Source: Adapted from AFBI, Hillsborough

The rapid wilting of silage over a 24 hour period has been shown to increase dry matter intake and increase milk protein concentration by 0.10% (Table 2).

Table 2. The effects of rapid wilting on silage intake, milk composition and milk yield, results from 11 trials

	Unwilted	Wilted
Silage intake (kg DM/day)	10.2	11.9
Protein (%)	3.27	3.38
Fat (%)	4.52	4.66
Milk yield (litres/day)	20.7	21.2

Source: AFBI, Hillsborough

At Greenmount there is a strong emphasis placed on producing high quality silage for the autumn calving herd. A minimum dry matter of 25% is targeted, with an ME of least 11.5 MJ/kg DM. This is achieved by harvesting young leafy swards, which are wilted for up to 24 hours and tedded if weather conditions permit.

Alterative forages such as wholecrop cereals, forage maize, fodder beat and kale tend to increase the total dry matter intakes, however they do not all necessarily increase milk protein percentage. If high quality maize silage can be produced, it will be high in starch and will in general increase milk protein concentration by approximately 0.10%.

Concentrates

The ingredient concertation of the concentrate can have a significant effect on milk protein. Increasing the level of starch in the concentrate from cereals has been shown to increase milk protein content (Table 3).

Table 3. Effects of increasing concentrate starch content on animal performance

	Concentrate starch content (%DM)		
	4	**18**	**33**
Milk yield (litres/day)	26.8	26.5	26.4
Protein (%)	3.21	3.26	3.36

Source: AFBI, Hillsborough

However excessive levels of starch levels in the diet can lead to digestive upsets such as acidosis, depressing intake. High levels of oils in the diet have also been shown to depress milk protein and butterfat levels.

The level of concentrate required to support a specific yield will be influenced by the quality of the forage in the diet.

At Greenmount concentrates are fed to yield through the milking parlour at a rate of 0.45kg for each litre of milk produced above the production level set from grazed grass or the partial mixed ration silage and concentrate diet.

2- Breeding

Breeding can make a significant contribution to increasing milk protein in the medium to long term. Differences in milk protein content occur between breeds, however large variations in milk protein content can exist within breeds also. Selection on the basis of positive protein deviation can improve milk protein concentration. The two key factors in a breeding programme are dam and sire selection.

Dam selection – An important first step in a breeding programme is to know where you are starting from. Milk recording is an important practice to monitor the performance of the cows and will highlight the levels of milk protein produced by each individual cow. This information can allow informed breeding and management decisions, such as which cows to breed replacements from and which to cull.

Sire selection – A large selection of artificial insemination sires are available on the market and time should be spent carefully identifying which bulls are going to breed the herd in the direction you would like to achieve. Milk protein percentage has a

relatively high heritability of 40%, higher in fact that milk yield, therefore breeding for milk protein is both feasible and worthwhile.

Further information on the breeding policy and selection criteria within the CAFRE dairy herd can be found on the CAFRE website, including the CAFRE Dairy Herd Sire Selection article within the £PLI section.

3- Management

The production cycle of a dairy cow involves many changes including feed intake, milk yield and bodyweight. The management of these changes can influence milk protein content. Cows reach peak milk yield before achieving their maximum dry mater intakes, therefore energy intake in early lactation is lower than energy demand, causing an energy deficit and bodyweight loss.

Body condition scoring – is the 'hands-on' assessment of the cow to determine the fat cover over certain key areas including the short ribs and tail head. Scoring helps to determine their nutritional status and changes in bodyweight which is recorded on a scale of 1 to 5 (1 = very thin, 5 = very fat). Table 4 shows body condition score targets for different stages of lactation. If cows don't calve down in optimum condition it is likely they will lose excessive weight, resulting in reduced milk protein content as well as a reduced milk yield, fertility and overall health.

Table 4. Optimal body condition scores throughout lactation

	Target condition score
Drying off	2.5 - 3.0
Calving	3
8 - 10 weeks calved	2.5

Calving pattern – Typically spring calving herds have a higher milk protein content than those calving in the autumn. This is partly due to the energy requirements of the spring calving cow being closely matched to the supply of spring grass and partly due to lower average milk yields typical within spring calving dairy herds.

Replacement rate – Milk protein is highest in first lactation cows, generally decreasing by 0.05% between the first and fourth lactation. Maintaining a younger herd will

improve milk protein and enhance the rate of genetic progress from a strategic breeding programme.

Heifer management – When calved at 24 months, dairy cows do not reach mature weight until their second or third lactation. Therefore heifers in their first lactation need to be fed for milk production and also for growth. Separate grouping of these first lactation heifers will reduce bullying from mature cows, reduce stress, increase dry matter intakes, increase milk production and also milk protein content.

Cow health- Milk protein content is directly affected by the overall health and nutritional status of the herd. Milk protein content tends to increase when a cow is back in calf, therefore good herd fertility will have a positive effect on milk protein concentration.

Lameness and mastitis are major economic losses to the dairy herd and contribute to reduced milk protein levels as well. The energy intake of a lame cow is reduced, therefore reducing milk yield and quality. Milk protein levels are reduced during a case of clinical mastitis and also in cows with persistently high cell counts.

Dry cow management – The correct management of the cow during the dry period is essential to prepare her for the subsequent lactation, through replenishing body reserves and rebuilding mammary tissue. Calving the cow down at the correct body condition score of 2.5 – 3.0 will allow her to consume much higher intakes in early lactation than over fat cows at calving. This leads to less mobilisation of body fat reserves and has a beneficial effect on milk protein.

Transition feeding – In the final two to three weeks of pregnancy, dry matter intakes can fall by 25%. The energy requirement of the cow increases rapidly post calving and therefore it is essential to condition the rumen for high feed intakes prior to calving. In the CAFRE dairy herd, cows are moved onto straw pens one week before calving, where they are transitioned onto the milking herd total mixed ration in small quantities. This gradual transition helps to minimise nutritional stress and to achieve peek feed intake as quickly as possible in the lactation. This will help to improve milk protein content and reduce body condition loss.

CAFRE dairy herd performance (year ended 31 March 2020)

Performance measure	CAFRE dairy herd	Top 10% Benchmarking
Annual Production/Cow (Litres)	8,932	7,914
Butterfat (%)	4.11	4.18
Protein (%)	3.41	3.39
Meal Fed Per Cow (Kg)	2,816	2,310
Milk From Forage/Cow (Litres)	2,675	2,781