Grass Sugars Make Milk Production Sweeter

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Razed grass is the cheapest feed for dairy cows, although cows are relatively inefficient at converting grass protein into milk protein. Only about 20 to 25% of grass protein is incorporated into milk with most of the remainder being wasted in dung and urine (Figure 6.1). This is not only financially costly but also contributes to environmental pollution.

A major reason for this poor efficiency is the imbalance in the relative amounts of energy and protein in grass. Proteins in grass are broken down rapidly when they enter the cow’s rumen, and micro-organisms use the products of breakdown (amino acids) to grow and produce more protein that is later digested in the small intestine and used by the cow to produce milk. However, when the diet lacks readily available energy such as sugars, rumen microbes either cannot grow or, instead use amino acids to provide energy, which means less of them can be used to produce protein. To use amino acids in this way is a wasteful process, which results in much of the nitrogen being released from grass into the rumen as ammonia. This ammonia is then absorbed by the animal and is eventually excreted in urine. Feeding energy-rich foods in a concentrate feed is one way to increase the efficiency of protein use in milk production, but a cheaper way is to use the sugars that are naturally present in grass. New varieties of perennial ryegrasses, produced as part of IGER’s plant breeding programme from specimens collected in alpine areas, have high levels of sugar –
at times almost double those found in conventional ryegrass varieties – which, when fed to cows, increase the efficiency of milk production (Figure 6.2).

**Milk production from high-sugar grasses**

Recent studies at IGER have found that when grass with a high-sugar content is fed to dairy cows, the efficiency of use of the grass proteins increases, and cows can eat more grass and produce more milk.

To test the efficiency of use of forages, we use zero-grazing techniques, where fresh grass is cut daily and fed to cows in special indoor housing which allows accurate measurements of feed intake. In addition, the partitioning of feed nitrogen between milk, urine and dung can be accurately determined using these facilities.

The data in Table 6.1 show that the dry matter intakes were more than 2 kg per day higher for cows offered a high-sugar grass compared to a control grass, and diet digestibility was increased by 3 percentage units. Increased digestibility means that more nutrients in the diet can be used for milk production, and milk yields of early lactation cows fed on the high-sugar grass were increased by more than 2 kg per day without any detrimental effects on milk composition. Similar results were found in late lactation cows, when they ate marginally more grass and yielded over 20% more milk when offered high-sugar grass.
Increasing the content of sugar in grass tends to ‘dilute’ other components like fibre and protein. The fibre content of a feed has a large influence on the amount of the feed that the cow can eat, and so a reduced fibre content allows the cows to eat more grass (Figure 6.3). This is particularly important for low-input farming systems (e.g. organic farms), when farmers want their animals to gain as much of their nutrients from grazed grass as possible. Sugars are also inherently digestible, which contributes to increased intakes by animals given high-sugar grasses to eat.

**Efficiency of use of grass nitrogen**

The amount of feed nitrogen lost in urine is significantly less from cows eating high-sugar grasses. This means that less feed nitrogen is lost to the environment – in some experiments this has been much as 24% less. In early lactation, the cow’s own body proteins are often used to support milk production, which is seen as a negative N balance. However, in an experiment carried out in early lactation, the animals offered the high-sugar grass were gaining body nitrogen at the same time as producing more milk, whereas the animals offered the control grass were still losing body nitrogen (Figure 6.4). Similar results were seen in mid-lactation and in late lactation cows, with less grass protein nitrogen being excreted in urine from animals fed on the high-sugar grass.

**Project achievements**

Even though high-sugar grasses tend to have a lower protein content — because the extra sugar ‘dilutes’ the other constituents — animals perform as well or better on this grass as they do on a normal grass. This project has shown that the protein in the high-sugar grass was used more efficiently in animal performance and milk production, and that nitrogen excretion to the environment was reduced.
Research continuation

High-sugar ryegrass varieties continue to be bred at IGER with improvements in growth characteristics. IGER has recently released its first commercial high-sugar variety, AberDart, through its associated seed company Germinal Holdings Ltd. AberDart, and other new high-sugar grass varieties, will be tested in long-term experiments for productive performance in the near future.

Project Funding

The work detailed here is part of a larger programme jointly co-ordinated by Professor Mike Theodorou (IGER) and Professor John MacRae (Rowett Research Institute). Funding has come from a Sustainable Livestock Production LINK programme, which combines support from the Ministry of Agriculture, Fisheries and Food, the Milk Development Council, the Meat and Livestock Commission and Germinal Holdings Ltd. The programme is also now supported by the EU, with European partners from Ireland, Germany, Sweden and Norway.

Figure 6.4  Nitrogen partitioning in early lactation dairy cows offered High-Sugar or Control grasses