Quality Feeds for Sustainable Livestock Production

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Animal production has faced a series of challenges in recent years. Initial problems related to BSE and the loss of consumer confidence in beef. However, more recently, farm incomes have further declined, particularly in the west of the United Kingdom, areas traditionally used for animal production. Yet according to the Meat and Livestock Commission, the evidence is that consumption of meat is as high as it always was, and sales of dairy products remain buoyant. The solution to the problem of low farm incomes may be partly political, but also rests with the farming and food industries, which need to re-emphasise the quality of their produce and the benign manner in which it is produced.

Quality for consumers
The quality of agricultural produce is judged at a number of levels and the criteria for these judgements change through time. However, one critically important issue is how the consumer perceives products from the livestock sector, where characteristics such as appearance, aroma, taste and texture are paramount (Figure 5.1). Increasingly, many consumers want products that are traceable from farming systems to the shop shelf and are concerned with issues regarding the origin and ethics of food production.

Our focus at IGER is science relating to the production of high value animal products from what are often considered to be low value forages. Therefore, our strategic aim is increasingly directed towards producing systems and plant varieties specifically designed to support prime, healthy livestock. The long-term result of these endeavours will be high quality products with amenity and environmental benefits (Figure 5.2).

A number of quality traits will be high on our research agenda during the next few years:
• Effective use of protein and effective protein protection within the rumen
• Characteristics which enhance the selection and digestion of forages by animals
• Forages with fatty acids and antioxidants to improve the quality of the final milk or meat product

Figure 5.1 Quality agricultural products can often be assessed by appearance as well as by taste, smell and texture. (Photo supplied by The Food Directorate of the Welsh Development Agency)
understand the relationship between the regulation of forage intake and the role of body reserves during the various phases of pregnancy and lactation in cows.

Forage quality is a particular concern in grazing systems, where animals are required to find and harvest their own food. At IGER we have made major advances in understanding the effect of morphological characteristics of swards (i.e. the shape, pattern and architecture of plant components within the field) on grazing strategies of individual animal species. Grazing behaviour and intake studies are underway and we will extend this work to consider beneficial effects on rumen function and nutrient supply to the animal (Figure 5.3).

Quality for the environment
Animals use plant protein rather inefficiently, which results in excretion of much of the nitrogen to the environment. In the case of ruminants such as sheep and cattle, the efficiency of conversion of plant protein to animal protein is rarely greater than 20% for meat and 25% for milk. Producing animal protein more efficiently, whether as milk protein or lean meat, has a very positive effect with regard to reducing nitrogen pollution into the environment. Therefore, improving forage quality and enhancing the effective use of this protein benefits both the producer and the environment. By integrating research on nitrogen flow through soils, plants and animals, together with the use of forages with specific nutrient characteristics, we envisage significant opportunities in understanding such systems with consequent effective allocation of nitrogen.
Farmers will increasingly have to consider new types of feed and feeding strategies and consider their long- and short-term effects on the wider environment. As a result, research on improving the composition of forages as feeds for ruminants will need to take into account effects on other processes, such as turnover of soil organic matter and methane production. Constraints imposed by particular systems of environmental management may mean the adoption of specific plant cultivars, livestock and agricultural practices that correspond to high quality agro-environmental systems that may, in fact, confer valuable marketing opportunities for derived products.

**Science and breeding for quality**

The unique range of science skills at IGER can help to achieve targets relating to objectives in improving quality for the animals and the environment as outlined above. Combining expertise in plant genetics and plant breeding, together with skills in rumen microbiology and animal nutrition along with studies on animal grazing strategies, offers opportunities for identifying and modifying plant traits.

The benefits of such a combined approach are already apparent in an existing breeding programme producing high-sugar grasses. This programme identified a potential for improvements in conversion from plant to animal proteins in ruminants. In the first phase of digestion, microbes in the animal’s gut capture the nitrogen released from the plant cells. However, the microbes themselves require a source of readily available energy (as sugar) from the plants. Disparities...
simplified methods for monitoring factors such as the intake of food, the solubility of nitrogen in the rumen and the digestibility characteristics of forages. We will also see further applications of advanced equipment technologies for monitoring feeds, animal processes and food. Furthermore, our improved forage varieties must be properly evaluated in realistic conditions or in robust but cheaper simulations of real systems. For example, at IGER we have a large programme evaluating the performance of different perennial ryegrass varieties under grazing (Figure 5.4). This programme will identify new breeding goals and will aid the development of cheaper and more robust test systems.

**Conclusions**

IGER plant varieties have made a substantial contribution to advancing agricultural productivity over the last century. The juxtaposition of plant molecular biology and mechanistic science at the interfaces of plant, microbial, animal and environmental sciences, presents IGER with a unique opportunity to deliver new, improved products from ruminant agriculture in the twenty first century. There will be many beneficiaries from this holistic approach. Farmers will benefit through improved income from valued products; animals through better feed and welfare; the environment because of appropriate consideration of all aspects of grassland and ruminant agriculture; and ultimately, the consumer who wants traceable, quality foods produced under sustainable, caring systems.

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