6. Cattle feeding and rearing

Introduction

6.1 Measures to eliminate BSE have been based on the premise that it was spread through the inclusion of MBM in cattle feed. This chapter reviews general aspects of cattle feeding and rearing, including differences between dairy and beef feeding regimes. It looks at why protein concentrates are added to cattle diets, although vol. 13: Industry, Processes and Controls discusses why MBM in particular became a popular source of protein for inclusion in cattle feed. The chapter also describes the different sources of cattle feed and how a significant proportion (25–40 per cent) is mixed on farm rather than bought in a ‘ready-to-eat’ form. On-farm feed processes and feed storage are covered in this chapter, as are farmers’ knowledge of manufactured feed ingredients, and the role of feed labelling. Table 6.1 describes terms commonly used to designate different types of feed, and which are used throughout this chapter.

Table 6.1: Cattle feed terminology

| Concentrates | The generic term for all non-forage feeds. |
| Compounds | Factory-prepared pellets or nuts manufactured from various ingredients including major minerals, trace elements, vitamins and other additives. The ingredients are mixed and blended in appropriate portions, designed to provide a balanced diet. |
| Protein concentrates | These are intended for further mixing before feeding with planned proportions of cereals and other feedstuffs either on the farm or in a compound mill. They contain blended high-protein ingredients such as MBM, fishmeal and soyabean meal. When mixed with appropriate straights (see below), they can be equivalent in nutritional terms to compounds. |
| Straights | Single feedstuffs of animal or vegetable origin, which can be bought in or grown on the farm. |

Source: S31 Thompson para. 3; M13B tab 11 pp. 3–4

Digestive system of cattle

6.2 Cattle are ruminants. Their stomachs are divided into four compartments – rumen, reticulum, omasum and abomasum – of which the rumen is the largest. Beyond the abomasum are the small and the large intestines. Ruminants differ from other animals insofar as much of the breakdown of food is brought about by fermentation by micro-organisms inhabiting the rumen. The act of rumination, or chewing the cud, plays a part in breaking down the food and exposing it to digestion by micro-organisms. The products of digestion provide the basis for further growth of the rumen micro-organisms which themselves become an important food source for the ruminant.

6.3 Fermentation by the microbial population in the rumen allows ruminants to utilise a wide range of plant products and by-products which non-ruminants (such as pigs and poultry) and humans cannot digest or would not choose to eat.

6.4 Protein supplied to ruminants comes from two sources: microbial protein (produced in the rumen) and protein in feed sources which has escaped breakdown.
Microbial protein is sufficient to meet the ruminant’s protein requirements for maintenance and low levels of milk production. However, cows have been bred since the Second World War to produce ever-greater milk yields, leading to the need for correspondingly greater precision about the diets they are fed to ensure they meet their genetic potential. Developments in the understanding of the protein requirements of ruminants in the early 1980s led farmers to seek to boost milk yield by feeding cows concentrates containing protein that bypassed the rumen. Indeed, the addition of protein concentrates to the diet of dairy cows appears to be an unavoidable consequence of breeding programmes to produce dairy cows with high milk yields. One vet told the Inquiry that cows need to be fed according to their genotype, and that feeding a high-yielding cow with a low-yield diet could result in the cow losing weight and becoming infertile.

Cattle feeding systems

Nature of ruminant feeds – forage and concentrates

Grass is an ideal forage for, and the staple diet of, cattle. During 1986–95, farmers employed various grazing strategies to get the most out of the grass available on the farm during the summer. Grass conserved as silage (ie, pickled) or hay (ie, dried in the sun) during the spring and summer was fed to cattle during the winter when grass growth was limited. After the 1970s, when silage-making techniques became well established, silage was more widely used than hay, particularly on dairy farms. Cattle were sometimes fed other crops conserved as silage, such as maize.

Other forage crops were also fed to cattle during 1986–95, particularly during the autumn and winter when grass growth was limited. Examples include green fodder crops such as kale, forage rape and fodder raddish, and fodder root crops such as swedes, turnips and mangels.

Farmers have a long history of supplementing the forage-based diet for cattle with concentrates, which is the generic term for all non-forage feeds – compound feeds, protein concentrates, and straights. In 1986, the types of feed material typically used as straights or for inclusion in compounds and protein supplements included the following:

- Cereal grains – barley, wheat, maize.
- Cereal by-products – wheat chaff, maize gluten feed, rice bran.
- Pulses (legumes) – field beans, peas.
• Oilseed residues – rapeseed meal, coconut cake, soyabean meal.
• Root crops – cassava (a tropical root crop from which tapioca is made).
• Fibrous materials – sugar beet pulp, chemically treated straw.
• Animal by-products – MBM, blood meal, feather meal, fishmeal.109

Preparation of feed on farm

6.9 In 1986, instead of purchasing manufactured compound feed,110 some farmers grew or bought straights and other raw materials and mixed their own feed on farm. The most commonly used straights were home-grown cereals, but others included rapeseed, palm kernel meal, soyameal, MBM (until the ruminant feed ban in 1988), fishmeal, cottonseed, citrus pulp, sunflower seed and maize gluten. By-products available from feed producers such as wheat feed, malt culms, and brewers grains were also purchased.111

6.10 Most feed manufacturers observed non-statutory codes of practice for the handling of raw materials and production of compound feedstuffs. Farmers producing their own raw material or home-mixing did not observe these codes of practice.112

6.11 Farmers who mixed feed on a large scale could use specialist mixer wagons or vehicles to prepare the feed, while those operating on a smaller scale simply mixed the feed in suitable bins, or occasionally on the floor.

Formulation of cattle diets on farm

6.12 Farmers develop diets for their livestock largely according to custom and practice, although in some cases they apply their formal training in animal nutrition gained at agricultural college or university. A 1991 survey by ADAS showed that most farmers employed feeding patterns based on hearsay, not actual nutritional knowledge. They formulated rations using energy, protein and mineral properties as the basis, without actually knowing the requirements of the animal or how those components interacted. The survey concluded that farmers’ knowledge of nutritional principles was low and their understanding of feedstuffs Regulations and rules was limited.113

6.13 Despite these shortcomings, it was possible to feed dairy cows reasonably successfully without any understanding of nutrition. Successful production levels could be achieved by feeding regimes determined by availability, palatability, cost and experience of what seemed to work in practice.114

6.14 During the period covered by this Report, it was common practice for farmers to seek advice on feeding methods from colleagues (often via local farmers meetings), farming magazines and programmes such as ‘Farming Today’, and to

109 M13B tab 11 pp. 15–17
110 See vol. 13: Industry, Processes and Controls for details on the manufacture of compound feed
113 FEG 76 pp. 10–12
114 J Webster, Understanding the Dairy Cow
keep in touch with the local veterinary surgeon. For those farmers who purchased compounds or concentrate feeds, the supplier provided nutritional advice about the feed. ADAS was another source of nutritional advice to farmers. Up to March 1987 such advice was free of charge, but thereafter ADAS charged farmers for this and other types of advice (see paragraphs 7.6–7.13 for further information on services provided by ADAS).  

6.15 Commercial compounds appear to have been more widely used than home-mixed feeds. In evidence to the Inquiry, Mr Ben Gill, President of the NFU, said that in 1998 about 75 per cent of animal feed was commercial compound, and 25 per cent was mixed on farms; for cattle, the percentage of home mix was higher. Larger cattle producers were more likely to use straights and raw materials on farm. In their evidence to the Expert Group on Animal Feedingstuffs in 1991 the NFU stated that one third of feedstuffs on farms was home-mixed, though farm mixing was undertaken more consistently on pig and poultry farms. The NFU reported that many farmers in the dairy and beef sectors occasionally mixed rations on farm, depending on the availability of raw materials sourced on the farm.  

6.16 By contrast the 1991 ADAS survey on feed knowledge suggested that ‘on farms with more than one livestock enterprise, the general rule was to home-mix for all classes of stock’.  

6.17 According to MAFF/ADAS statistics, the compounders’ overall share of the feedstuff market declined from 66.3 per cent in 1976 to 59.4 per cent in 1986. In June 1991, the Chemical Safety of Food Division of MAFF estimated that 40 per cent of feedstuffs was produced on the farm, and that the compounder’s share of the market was falling as farmers increasingly turned to straights and home-mixing.  

6.18 The NFU felt that home-mixing was not just a cost-cutting practice, but also reflected an increasing interest in what was in the ration and the convenience of having food ‘on tap’. The 1991 ADAS survey suggested that the introduction of the ‘computerised least cost formulation’ in the 1970s resulted in the addition of unfamiliar feeds to the compounds, in levels and combinations that had not been tested thoroughly. Animal performance suffered and the confidence in feed compounders was undermined. Owing to a lack of information on compound feeds, many farmers chose to feed straights, about which they knew more.
Feeding strategies related to animal production requirements

Table 6.2: Typical cattle diet

<table>
<thead>
<tr>
<th></th>
<th>Dairy</th>
<th>Beef</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calvhood</td>
<td>Usually reared away from mothers and given whole milk or proprietary milk substitute. Offered concentrate feed containing protein from 1 week of age.</td>
<td>Calves are usually reared on their mothers, obtaining their protein requirements from milk. Unlike to receive concentrates within first 6 months of life.</td>
</tr>
<tr>
<td>Weaning</td>
<td>At 6 to 8 weeks of age.</td>
<td>At 6 to 10 months of age, depending on season of birth.</td>
</tr>
<tr>
<td>Fattening cattle</td>
<td>Fattening rations are based on forage and concentrates. The quantity of concentrates offered is determined by the fattening system used: cereal beef, 24-month beef or 18-month beef (see paragraph 6.25).</td>
<td></td>
</tr>
<tr>
<td>Breeding and lactating cows</td>
<td>The basic diet is grass and other forage crops, supplemented by concentrates. Concentrate intake will be lower in summer when forage is more abundant. The stage of lactation and quality of grazing available will also influence the quantity of concentrate feed used.</td>
<td>Suckler cows are maintained on grass and other forage for most of the year. Supplementary feed may be offered depending on the quality of grazing.</td>
</tr>
</tbody>
</table>

6.19 The performance of ruminant animals relies on a combination of efficient use of grass and grass products, good livestock management and appropriate use of complementary concentrated feed. The diets offered to the animal depend on its age, whether it is a dairy or beef animal, and seasonal variations.

6.20 The main difference between dairy and beef diets is that the use of concentrated feed, particularly for cows and young calves, is considerably less in beef herds than in dairy herds. This was the case when BSE emerged, as it is today.

6.21 A calf’s rumen is relatively undeveloped at birth and during the first 2 to 3 months of life. Microbial protein is therefore in short supply during this critical period of rapid growth in calves. Suckler calves reared on their mothers obtain their protein requirements from milk. By the time these animals are weaned at about 6 to 10 months – depending on season of birth – the rumen is fully functional and microbial protein is available to contribute to their growth and development. Beef calves are unlikely to receive concentrates within the first 6 months of life.

6.22 Dairy calves, on the other hand, are usually reared away from their mothers and are given whole milk or proprietary milk substitute until weaning at 6 to 8 weeks old. They are also offered hay and concentrated feed containing protein from 1 week of age. This solid food contributes to the calf’s nutrient requirements and stimulates development of the rumen. Upon weaning, dairy calves’ rumens are still immature, so they continue to be fed concentrated feed containing high quality protein to support their natural capacity for growth. When BSE emerged, concentrate feeds commonly contained animal proteins, including fishmeal and MBM.

6.23 The basic diet of weaned cattle, whether in the dairy or beef herd, is grass or other forage crops supplemented with concentrated feed. An adequate intake of forage needs to be maintained to ensure the rumen continues to function. Forage
intake will also be higher and concentrate intake lower in the summer months, as farmers seek to take advantage of favourable growing conditions, and reduce the costs associated with purchasing extra feed.

6.24 The use of MBM in ruminant nutrition was well established by the 1920s.\textsuperscript{129} It has now become common practice to link the feeding of dairy cows directly to target milk production levels.\textsuperscript{130} High levels of concentrate feed are essential to maximise milk production, particularly in early lactation. The stage of lactation and quality of grazing or silage available will influence the quantity and quality of compound feed used.\textsuperscript{131}

6.25 Suckler cows are usually maintained, for most of the year, on grass and other forage. Cattle fattened for beef, whether from the dairy or suckler herd, are fed on one of the three main fattening systems:

i. the ‘cereal beef’ system involves achieving high rates of daily liveweight gain by feeding concentrates \textit{ad libitum} (ie, free access) and some forage to weaned calves (usually from the dairy herd) until slaughter at 15 months;

ii. 24-month beef is a more extensive system than (i.) involving high use of grass and limited concentrates; it produces lower rates of daily liveweight gain to slaughter at 24 months; and

iii. 18-month beef is intermediate between (i.) and (ii.) in daily liveweight gain and is usually adopted for cattle born in autumn. They are fed through the winter, kept on grass from 6 to 12 months of age, and then finished on hay, silage and cereals.\textsuperscript{132}

Storage and distribution of feedstuffs

6.26 Up until the early 1980s it was common practice for animal feed manufacturers to supply compound feeds in pre-packed bags. Thereafter, mainly as a result of increased mechanisation and fewer workers on farm, it became more common for farms to receive deliveries of compound feed in bulk from specialist vehicles, for example in five- or ten-ton loads.\textsuperscript{133} The feed could then be transferred directly from the lorry to storage hoppers or holds.\textsuperscript{134}

6.27 During 1986–95 most dairy cows received concentrates twice a day when they were being milked; these concentrates were usually stored loose in bulk for automated feeding in the milking parlour via hoppers. In addition, during winter housing, high-yielding cows were usually offered top-up feeds of concentrates during the day outside the parlour because they would have been unable to consume sufficient concentrates to optimise milk yield during their brief time in the parlour. These top-up feeds were usually stored in hoppers, troughs or automatic dispensers at various locations around the farm. Alternatively they were stored in, and dispensed from, on-farm feeding and mixing wagons.

\textsuperscript{129} T7 p. 46 as revised in S625 Thomas
\textsuperscript{130} J Webster, Understanding the Dairy Cow, p. 117
\textsuperscript{131} S37A Foxcroft para. 11
\textsuperscript{132} M43A tab 13 p. 5
\textsuperscript{133} S31 Thompson para. 6
\textsuperscript{134} T89 pp. 142–3; see revisions proposed in S299C Waldegrave
6.28 Feeding systems for beef production were usually less complex than for milk production and only needed a limited number of feed storage facilities on farm.

6.29 Supplies of bought-in concentrates were usually replenished every month on dairy farms during the winter housing period, and less frequently during summer, when cows were out at grass and therefore required less in the way of bought-in concentrates.¹³⁵ Farmers did not overstock such feeds partly for cash flow and storage capacity reasons, but also because spoilage could occur during storage. For example, fungal mycotoxins could develop, which could harm the cow’s health.¹³⁶ Witnesses who gave evidence to the Inquiry suggested that the maximum shelf life of concentrate feed on farm was around three or four months.¹³⁷

**Feed labelling and farmers’ knowledge of MBM in compounds**

**Labelling issues**

6.30 The primary legislation governing the controls on feedstuffs is the Agriculture Act 1970 which, among other things, seeks to ensure that feedstuffs when sold should be fit for their intended purpose and free from harmful ingredients.¹³⁸ Under the 1970 Act, suppliers of feedstuffs to farmers were required to provide a statutory statement containing particulars of the nature, substance or quality of the material, and information or instructions on storage, handling and use. The statement had to be given no later than the time at which the feed was delivered to the purchaser.¹³⁹

6.31 Since 1970 various sets of secondary legislation have been made under the Act, prescribing, among other matters, feed labelling requirements, and giving effect to various EC Directives related to feedstuffs. Further details on feed labelling legislation are given in vol. 14: Responsibilities for Human and Animal Health.

6.32 At the time BSE emerged, the Feeding Stuffs Regulations 1986 (SI 1986 No. 177)¹⁴⁰ were in effect. They prescribed, among other things, the particulars that had to be given on the statutory statement delivered with the feedstuff to the purchaser. For compound feed, the statement was required to contain the amount of protein, oil, fibre and ash in the formulation. It was not obligatory for the manufacturers to identify the source of protein, oil and fibre until 1991, when the Feeding Stuffs Regulations 1991 came into force.¹⁴¹

6.33 The lack of information on feed ingredients had long been a source of disagreement between the NFU and the animal feed industry. The NFU claimed that farmers were entitled to know precisely what they were feeding to their animals. Some feed manufacturers were unwilling to disclose what their feed contained as they considered it to be commercially sensitive.

---

¹³⁵ T61 p. 30; T62 p. 80; T57 pp. 27–9 and 96
¹³⁶ T2 p. 22
¹³⁷ T35 p. 129; T61 p. 29
¹³⁸ L3 tab 1 Regulation 68
¹³⁹ Replaced later in 1986 by the Feeding Stuffs (No. 2) Regulations 1986 (L3 tabs 2 and 3)
¹⁴¹ L3 tab 7
Farmers’ knowledge of protein in manufactured feed

6.34 Some farmers may have been unaware that MBM was a component in compound cattle feed. Most farmers were, however, aware of the use of MBM as a protein source in animal feeds, and saw nothing objectionable in the practice. The general consensus was that MBM was a valuable animal protein to include in livestock rations. Mr Gill of the NFU summarised the situation as follows:

Furthermore, the use of protein from meat and bone meal would not have been seen as unusual or wrong. Feed production and farming is a biological cycle with the aim of reusing or recycling all parts of animals providing of course that it can be done in a safe and sustainable way.

6.35 The NFU accepted that farmers were likely to have known about the inclusion of MBM in feed because of the regular coverage in the farming press, and also accepted that such knowledge was unlikely to have influenced their purchasing decisions.

6.36 However, while farmers may have been generally aware of MBM’s use in cattle feed, this did not mean that they knew if it was in the particular compound they had purchased:

A farmer buying compound feed would not know what ingredients had been used to provide protein. He or she would not know if the protein source in the compound was soya bean meal or meat and bone meal. You cannot tell, of course, from a visual assessment of the compound feed itself which is simply a processed item. Similarly, if meat and bone meal were used as a protein source, a farmer would not know that fact nor would he or she know whether the meat and bone meal came from bovines or sheep, or from pig and poultry.

Use of compounds following BSE

6.37 The emergence of BSE did not deter farmers from buying in manufactured compounds when required. A farm husbandry survey carried out recently indicated that bought-in compounds were still regularly used throughout the survey period from 1985 to 1997, although some farmers did become suspicious of these feeds and changed their feeding regime.

---

142 T57 pp. 33–4
143 S47 Gill para. 16
144 S47A Gill para. 7
145 S47 Gill para. 16
146 S465 Wolferstan pp. 5–9; S134 Hoskin p. 1