Factors Affecting Digestibility

Food composition

The digestibility of a food is closely related to its chemical composition, and a food such as barley, which varies little in composition from one sample to another, will show little variation in digestibility. Other foods, particularly fresh or conserved herbages, are much less constant in composition and therefore vary more in digestibility. The fibre fraction of a food has the greatest influence on its digestibility, and both the quantity and quality of the fibre are important. Modern methods of food analysis attempt to distinguish between the cell wall and cell content fractions.

When forages are heated with neutral detergent solution, the cell contents dissolve and the cell walls remain as a residue called neutral-detergent fibre (NDF) consisting of total cell wall material. The cell wall fraction may be further divided into acid-detergent fibre (ADF), representing cellulose and lignin, and acid detergent lignin (ADL), representing lignin .The cell contents are almost completely digested (i.e. true digestibility = 1.0), although their apparent.

Ration composition

The digestibility of a food is influenced not only by its own composition but also by the composition of other foods consumed with it. These associative effects may be positive or negative, although negative associative effects are perhaps the most common. A positive associative effect occurs when the digestibility of one ration component is enhanced by feeding it in combination with another. For example, the digestibility of poor-quality forage such as straw may be enhanced by feeding it in combination with a protein supplement. In this example, the provision of protein may enhance the activity of the rumen microorganisms, which are then better able to digest the straw. A negative associative effect occurs when the digestibility of one ration component is reduced by feeding it in combination with another.

Food processing

Foods are often processed before feeding in order to increase and optimise their digestibility. The commonest treatments applied are normally chopping, chaffing, crushing and grinding. Typically, cereal grains should be crushed for cattle and ground for pigs, otherwise they may pass through the digestive tract intact. The grinding of cereal grains fed to cattle may enhance their rate of fermentation to such an extent that it predisposes the animal to rumen acidosis. Sheep on the other hand are able to effectively chew whole grain during rumination, thereby reducing the need for mechanical processing. However, this appears to be dependent on the dynamics of regurgitation, which are influenced by both the type of cereal grain and the nature of the basal diet. Oats appears to be more efficiently-regurgitated than barley.

Enzyme supplementation of foods

In non-ruminants, the digestive system is ill-equipped to deal with some foods because the animals lack appropriate enzyme systems. Enzyme preparations (usually of fungal origin) may be added to foods to increase nutrient availability. The most

consistently successful enzyme additive has been the use of _-glucanase in poultry diets containing barley. _-Glucans, which constitute a large part of the endosperm cell wall of cereals, are largely indigestible. If they escape digestion, they appear in the excreta as gels that cause undesirable 'sticky droppings'. _-Glucans also protect other dietary components from digestion. Consequently, their enzymatic destruction causes a general improvement in digestibility.

Animal factors

Digestibility is more a property of the food rather than of the animal consuming it. However, this is not to say that a food given to different animals will be digested to the same extent. The most important animal factor affecting digestibility is animal species. Foods that are low in fibre are equally well digested by both ruminants and non-ruminants, but foods high in fibre are better digested by ruminants. Apparent digestibility coefficients for protein are frequently higher for pigs because their excretion of metabolic faecal nitrogen is smaller than that of ruminants. Differences in digestive ability between sheep and cattle tend to be small and of little significance, and hence digestibility values are often determined in sheep and applied to cattle. However, highly digestible foods such as cereal grains tend to be better digested in sheep, and poorly digestible foods such as low-quality roughages tend to be better digested by cattle. Digestibility values determined in sheep are not always applicable to cattle; for example, the digestibility of the grain component in whole-crop cereal silages is lower in cattle than in sheep because whole grains pass through the digestive tract intact.

Level of feeding

An increase in the quantity of food consumed by an animal generally causes an increase in the rate of passage of digesta. The food is then exposed to the action of digestive enzymes for a shorter period of time and digestibility is reduced.

In animals, level of feeding is often expressed in multiples of the quantity of food required for maintenance (i.e. the quantity required to maintain equilibrium;). In ruminant feeding systems, the level of feeding for growing and fattening animals can be 2.0–3.0 times their maintenance requirement and for lactating animals 3.0–5.0 times their maintenance requirement. For high-fibre diets such as hay, silage and grazed grass, increasing the level of feeding by 1 unit reduces the digestibility of the diet by only a small proportion . Falls of this magnitude may be due to negative associative effects, which become more pronounced at higher levels of feeding. The greatest reductions in digestibility with increasing feeding level occur with ground and pelleted forages and some fibrous by-products , the reason being that the rate of passage of foods with a small particle size is increased to a greater extent than is possible with long forages, which generally require more extensive fermentation in the rumen before further passage.

In non-ruminants, level of feeding rises to 2.0–3.0 times maintenance in poultry, 3.0–4.0 times maintenance in growing pigs and 4.0–6.0 times maintenance in

lactating sows, but there is little evidence for an effect of level of feeding on the digestibility of conventional (i.e. low-fibre) diets.