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Behavioural factors influencing by-product and residue acceptance by livestock

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ABSTRACT

Waste by-products and crop residues are a valuable source of feed for ruminants. In many instances low feed quality and acceptance limit the utilisation of these resources. The main factors influencing acceptance are the chemical and physical characteristics (palatability factors) of feedstuffs and the dietary experience and social environment of the animals.

The likely acceptance of a new product, relative to that of many other rations, can be predicted from its position on a preference scale. Exposure of sheep or cattle to feedstuffs early in life can produce large increases in the rate of acceptance of, and proportions of animals consuming, typically unpalatable items.

It is clear that by manipulating early feeding experiences and other factors determining ration acceptance, the utilisation of by-products and residues by livestock can be increased substantially.

Keywords By-products; crop residues; acceptance; diet selection; early experience; preference scale.

INTRODUCTION

Industrial by-products and cropping residues represent a huge potential ruminant feedstuff resource. It has been estimated that 2500 million tonnes of fibrous crop residues alone are produced annually (FAO, 1984). A small proportion only of all products are exploited in animal feeding.

The quality of by-products and residues varies widely. As major nutrients such as protein, sugar or starch are removed during harvesting or processing most items would need to be supplemented to produce a balanced ration.

Nutritional factors will dictate to a large extent the ideal contribution of a by-product to the total diet. It will often be necessary to feed the dietary components separately. Therefore, behavioural factors regulating feed selection will have a large influence on the diet actually consumed (Coombe and Mulholland, 1983).

Consideration of these factors will be useful in predicting those items or combinations of items that will be consumed readily and in suggesting ways of altering feed components to improve utilisation.

DIET SELECTION

Diet selection and acceptance in ruminants is determined largely by the reactions of the animals to the chemical and physical properties of feedstuffs (Marten, 1978; Matthews, 1983). Although many of these responses seem to be unlearned, dietary

experiences, social interactions, and the spatial arrangement of feed components influence the diet consumed (Matthews and Kilgour, 1980).

Grazing cattle and sheep usually select diets higher in nutritional value than the average of the material on offer (Arnold and Dudzinski, 1978). Consequently, there have been many attempts to relate food choice to the proximate composition of feedstuffs. Measures of energy, protein and fibre content are correlated with food intake, but are poor predictors of feed preferences (Matthews and Kilgour, 1980). Cattle and sheep maintained on deficient diets do not regulate their requirements for calcium or phosphorous when offered free-choice mineral supplements (Pamp *et al.*, 1975; Muller *et al.*, 1977). These and similar studies show that diet selection is mediated largely by the taste, smell and texture of the feedstuffs (palatability factors) and not by nutrient content.

Feeds that are slightly acidic (e.g. high in citric acid content) or sweet are preferentially selected while bitter items (e.g. high in alkaloid content) or those contaminated with decomposition products (e.g. dung) are avoided (Marten, 1978). However, since most by-products or wastes are a complex mixture of many different olfactory, gustatory and tactile stimuli it is unlikely that acceptability can be predicted reliably from an analysis of individual chemical and physical characteristics alone. Matthews *et al.* (1985), for example, demonstrated that acidity of a product does not guarantee

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acceptance. Tests of three acidic wastes (corn steep liquor, sulphuric acid and lactic acid cheese whey) showed that only steep liquor was readily consumed by cattle.

PREFERENCE SCALES

Hutson and van Mourik (1981) measured the preferences of sheep for 60 different materials. The order of preference for items falling in various food categories (from most to least preferred) was grains, cereals, hays, fruits, vegetables and sweets. Arranging new feedstuffs on an arbitrary preference scale gives some indication of acceptability relative to more commonly-fed items.

Klopfers *et al.* (1981) constructed a quantitative scale of preference for a wide range of feedstuffs selected by cattle. Concentrate feeds were most preferred while several by-products (e.g. brewers trub, plant juice whey, typha silage) were situated in the lower half of the scale. The pairwise choices among the scaled feeds were transitive (Matthews, 1983). This means that the preferences between items not previously paired can be predicted accurately from their relative positions on the scale. Further, the relative distance between feedstuffs on the scale gives a good indication of the likely intensity of selection between items when fed free-choice. Matthews and Kilgour (1980) reported that pasture stubble is preferred by a factor of about 1.5 over protein-extracted pasture cake. Free-choice feeding trials confirmed that selection for stubble over pasture cake was strong. With relative preference magnitudes of about 1.5 or greater, the availability of the preferred item must be restricted to ensure consumption of the less acceptable material.

Mulholland *et al.* (1976) observed that sheep grazed on cereal stubbles select intensively for green herbage (from weeds) and consume very little of the dry stubble. Decreasing the availability of green herbage results in an increase in stubble consumption, but overall intakes remain low.

It appears that some by-products or wastes with very low preference values will not be consumed readily, even when fed as a sole diet, and alternative strategies for improving intake will be required.

EARLY DIETARY EXPERIENCE

Matthews *et al.* (1985) and Kolpfer *et al.* (1981) have shown that cattle are slow to accept cheese wheys and other industrial by-products. Green *et al.* (1984) have reported that most sheep do not readily eat cereal grains. It appears that some items are rejected merely because they are unfamiliar, as intake often increases following prolonged exposure.

Studies have shown that acceptance of grains or molasses-urea block by adult sheep is hastened by prior exposure to the supplements at weaning (Lobato *et al.*, 1980; Green *et al.*, 1984). A similar

effect has been observed recently with cattle (Matthews, 1987). Groups of heifers were first exposed to molasses lick blocks at either weaning, 9 months of age or 15 months of age. Animals first exposed at weaning were retested at 9 and 15 months of age, those first exposed at 9 months of age were retested at 15 months of age, and those first exposed at 15 months of age were retested at 18 months of age. The results are shown in Fig. 1. The times spent licking during each test are shown separately for each group of animals. The acceptability of supplemental molasses blocks by older cattle (15 months of age) was enhanced by experience around weaning or at 9 months of age. The acceptance by animals first exposed at 15 months of age was low and remained low on a later test. The coefficient of variation of the times spent licking at 15 months of age was 36% for animals given early exposure and 119% for those not given such experience. Therefore, early familiarisation reduces the variability between animals in intake.

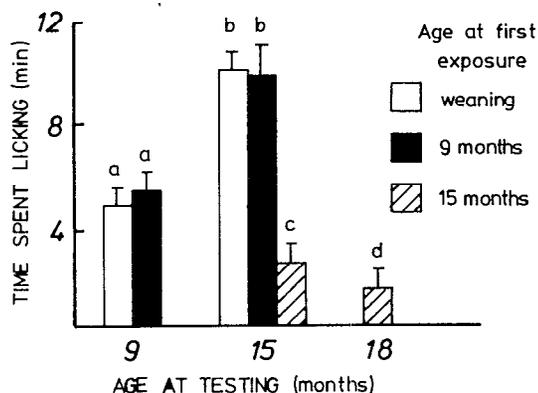


FIG. 1. Licking times (mean and standard error) at molasses blocks by heifers tested at various ages. Means with similar superscripts are not significantly different.

Familiarisation with novel diets occurs rapidly in young sheep and cattle. Ready acceptance of wheat by adult sheep was seen following 5 h of exposure at weaning (Green *et al.*, 1984). In the experiment reported above, calves first offered lick blocks at 9 months of age were given 7 daily 15 min exposures only, yet showed rapid acceptance upon re-exposure.

With sheep, the social environment at the time of early exposure is critical to rapid familiarisation. Lambs exposed in the absence of their mothers subsequently accepted wheat no more rapidly than animals given no early experience. Only lambs exposed with their dams showed rapid acceptance as adults. The effects of early familiarisation are long lasting. Enhanced acceptance is ensured for up to 3 years without the need for interim exposures (Green *et al.*, 1984).

It is clear that early exposure of ruminants to waste products or residues will aid later acceptance of these materials. Acceptance of typically unpalatable (e.g. cheese wheys) and palatable (molasses, grains) items can be enhanced. Sheep accustomed to eating a variety of novel feeds in early life appear more likely to accept other unfamiliar items in later life (Hodge *et al.*, 1981). Therefore, a wide range of feedstuffs should be made available to young animals to aid acceptance of completely new by-products or residues.

Acceptance of by-products can be improved further by the addition of palatable masking materials such as concentrated plant juice whey (Matthews *et al.*, 1985). Kenny and Black (1984) demonstrated that there is a strong association between herbage preference and the rate at which a forage can be eaten. This suggests that the acceptance of dry crop residues can be increased simply by chopping the material to increase the rate at which it can be consumed.

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