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Diet preference for grass and legumes in free-ranging domestic sheep and cattle: Current theory and future application☆

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Abstract

This paper reviews the current theory and potential practical applications of research on the diet preference for grass and legumes in grazing domestic sheep and cattle. Although much of this work has focussed on grass and clover as a model system, it has wider theoretical implications and potential for practical exploitation. Research in this field is of particular relevance with the recent increased interest in maintaining and enhancing biodiversity, both in agricultural systems and semi-natural habitats. One of the most consistent findings of previous research is that sheep and cattle both eat mixed diets, showing a partial preference of approximately 70% for clover. There is a diurnal pattern to preference, with a stronger preference for clover in the morning, with the proportion of grass in the diet increasing towards the evening. Research has also shown that sheep and dairy cattle achieve higher intakes from grass and clover when these are offered as separate monocultures compared with animals grazing a traditional mixed sward. The initial findings were from studies where the animals had free choice, but similar results have been achieved in dairy cows being allocated to clover between morning and afternoon milking and grass for the remainder of the day. The intake benefits, which have been attributed to a lower selection cost, have the potential to be exploited on-farm to increase intake and production. Our increasing understanding of the factors influencing diet selection raises the possibility of developing grazing management practices to maintain and possibly enhance biodiversity. Various theories have been proposed to account for the fact that ruminants eat mixed

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diets. Although some, such as spatial memory and visual discrimination have been discounted, others, such as perceived predation risk and balancing nutrient intake, appear to be more valid. However, further research is still needed to explore and validate hypotheses related to these theories.

Keywords: Diet preference; Selection; Mixed diets; Grass; Clover; Ruminants

1. Introduction

Free-ranging domestic herbivores generally self-select what to eat from the choice available to them (Dumont and Gordon, 2003). Intensification of Western agriculture following the Second World War generally resulted in this choice being restricted to selecting plant components from a ryegrass monoculture, although this trend now appears to be declining. Increased use of legumes, principally to provide nitrogen, in pastures in recent years gives grazing livestock the opportunity to select from at least two different plant species i.e. either a grass or a legume. Further, the desire to maintain and enhance biodiversity has seen a greater interest in grazing to promote biodiversity in pastures (Rook et al., 2004). These developments have increased the need for research to understand the complex interactions betweens plants and the animals that graze them, with diet preference and selection being important components within these interactions. To date, much of the research into diet preference and selection in grazing domestic ruminants has focussed on domestic sheep and cattle as animal subjects and used perennial ryegrass (*Lolium perenne* L., hereafter referred to as grass) and white clover (*Trifolium repens* L., hereafter referred to as clover) as model plant species. This paper reviews this research, summarises the major findings and discusses the various theories proposed to account for the results. Whilst much of this research has been carried out by the author's own group, this review endeavours to cover all of the existing work on diet selection for grass and clover in grazing sheep and cattle. Although the range of animal and plant species studied have to date been limited, the theoretical aspects have much wider applicability. The research has also resulted in the development of novel grazing strategies that can enhance production from grazing stock, and these are also discussed.

2. General methods

2.1. Preference versus selection

It is important to distinguish between what the animals 'want' to eat and what they actually eat because of some external constraint (Parsons et al., 1994). The first of these can be defined as 'preference' (Parsons et al., 1994, ''what the animals select given the minimum physical constraints''), whereas the second can be defined as 'selection' (Hodgson, 1979, ''preference modified by environmental circumstances''). For example, animals offered a sward containing grass and clover in an intimate mixture have to search through the mixture to find their preferred herbage. This requirement to search imposes a