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Effect of the type of protein concentrate free-choice offered on goat feeding behaviour

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SUMMARY - Two groups of six dry goats were allocated in metabolic cages for two weeks. Group P was fed with alfalfa hay and 4 different types of concentrate (barley, sugar beet pulps, broad-beans and chick-peas). In the other one (S), chick-peas were substituted by soya-beans. All feeds were free-choice offered. Goats selected a diet with variable proportions of sugar beet pulps and proteic concentrates, but with the same quantities of alfalfa hay and barley. In spite of different behaviour, the nutrient content in the diet was very similar. The crude protein (CP) content was 12.5% in group P and 13.0% in group S, the neutral detergent fibre (NDF) content was respectively 39.9% and 41.7%, crude fibre (CF) 15.1% and 15.3%. The proportion of feeds chosen by the goats does not seem random but oriented towards the achievement of optimal nutrient intake.

Key words: Feeding behaviour, free-choice feeding, proteic concentrates, goats.

RESUME - *"Effet du type de concentré protéique offert en libre choix sur le comportement alimentaire des chèvres". Deux groupes de six chèvres taries ont été placées dans des cages métaboliques pendant deux semaines. Le groupe P recevait du foin de luzerne et 4 types différents de concentré (orge, pulpe de betterave sucrière, fèves et pois chiches). Dans l'autre groupe (S), les pois chiches ont été remplacés par des graines de soja. Tous les aliments ont été offerts en libre choix. Les chèvres ont sélectionné un régime avec des proportions variables de pulpe de betterave sucrière et de concentrés protéiques, mais avec les mêmes quantités de foin de luzerne et d'orge. Malgré des comportements différents, la teneur en nutriments dans le régime était très similaire. La teneur en protéine brute était de 12,5% dans le groupe P et de 13,0% dans le groupe S, la teneur en fibre neutro-détergente était respectivement de 39,9% et 41,7%, la fibre brute était de 15,1% et 15,3%. La proportion d'aliments choisis par les chèvres ne semble pas aléatoire mais orienté vers l'obtention d'une ingestion optimale de nutriments.*

Mots-clés : *Comportement alimentaire, alimentation en libre choix, concentrés protéiques, chèvres.*

Introduction

Free-choice feeding system have generated great interest because of their facilitating role in the assessment of the abilities of animals to choose their own nutrients. While much research has been carried out on monogastric animals, particularly pigs, few studies have been conducted on ruminants animals.

The literature (Cooper and Kyriazakis, 1993; Kyriazakis and Oldham, 1993) shows that sheep can select a diet that meets their protein requirements when they are given a choice between two feeds varying in protein content, one being excessive and the other deficient.

Given the lack of specific studies on goats, the aim of this research was to determine whether the same capacity to select a diet constant in nutrients (Rubino *et al.*, 1988; Fedele *et al.*, 1988, 1993), is maintained when fed hay and grain concentrates *ad libitum*, differing in palatability, chemical and botanical composition, as is observed under grazing conditions.

Materials and methods

Twenty dry Maltese goats were allocated in metabolic cages for a preparatory period of 40 days. At the same time and *ad libitum*, they received hay and concentrate grains in single containers. At the end of the adaptation period, two groups of six goats were formed.

The first group (P) was fed with alfalfa hay, 3 different types of concentrate grain (barley, broad-beans and chick-peas) and sugar beet pulp. In the second one (S), chick-peas were substituted by soya-bean grain.

For two consecutive weeks, individual goat intake was measured. Samples of each feed were analysed for dry matter (DM) (AOAC, 1990), nitrogen (N), crude fibre (CF) and neutral detergent fibre (NDF) (Goering and van Soest, 1970).

Analysis of variance procedures were used to test for differences between group (SAS, 1987).

Results

Results showed that (DM) intake was not significantly different in the two groups (Table 1), even though group P was about 200 g higher.

The alfalfa hay and barley proportion were similar in both diets, while sugar beet-pulps varied from 16.7% in group P to 25.0% in group S ($P<0.05$) and broad-beans from 2.2% to 5.7% ($P<0.05$). The percentage of proteic concentrates in group P (chick-peas + broad-beans) was twice that of group S (soya-beans + broad-beans), 13.2% *vs* 7.1% ($P<0.01$).

In spite of this different behaviour, the diet chemical composition was almost constant (Table 2). CP content was 12.5% in the P group and 13.0% in the S group, CF was 15.1% and 15.3% respectively, NDF was 39.9% and 41.7%.

Table 1. Dry matter intake (DMI) and feed diet composition of goats (means ± s.d.)

	Group P		Group S		Group effect
	x	s.d.	x	s.d.	
DMI (g/h/day)	1400	783.20	1184	349.70	NS
Diet composition (%)					
Alfalfa hay	24.3	8.7	21.9	11.3	NS
Barley	45.8	15.7	46.0	17.6	NS
Sugar beet-pulps	16.7	7.1	25.0	19.3	*
Chick-peas	11.0	7.5			
Soya-beans (Sb)			1.4	1.8	
Broad-beans (Bb)	2.2	5.2	5.7	8.3	*
Proteic conc.(Sb+Bb)	13.2	7.6	7.1	8.4	**

NS: non-significant; *P<0.05; **P<0.01

Discussion

Goats offered choices between hay and concentrates successfully regulated their feeding ingredient intakes to optimize the nutrient content in the diet. The goats substituted some concentrates with others in order to obtain their preferred content for each nutrient. Despite the much lower contribution of sugar beet pulps in group P (a concentrate rich in NDF), with respect to that of group S, the percentage of NDF in both diets was very similar.

Table 2. Diet chemical composition (%) of goats (means ± s.d.)

	Group P		Group S		Group effect
	x	s.d.	x	s.d.	
Crude protein	12.5	1.1	13.0	2.03	NS
Crude fibre	15.1	3.0	15.3	3.77	NS
Neutral detergent fibre	39.9	3.3	41.7	4.6	NS

NS: non-significant

We can hypothesize that 40% of NDF represents the optimal threshold for good rumination and ensalivation and to form a normal rumen mat that functions as a filtering system and prevents acidosis risks (van Soest *et al.,* 1991).

Moreover, it should not be excluded that this NDF content offers the goats a greater bacterial colonization, given that NDF plays this important role (Yang, 1991; van Milghen *et al.,* 1993).

The substitution of chick peas by soya-beans did not modified the contribution to the diet of hay and barley. Hay, with its NDF content, represents the ideal substrata for the regularization of ruminal digestive processes. Barley, with its highly degradable starch content, is the best source of energy for ruminal microbial growth (Sauvant *et al.,* 1994).

It is with regard to proteic concentrates however that the selective capacity of goats is best manifested. In order to better regulate their protein intake the proportion of these feeds was halved in group S.

Through this feeding system, goats have an opportunity to synchronize their nutrient intakes in order to develop a synchronous nutrient supply for rumen micro-organisms and thus favour microbial protein production (Clark *et al.,* 1990; Russell *et al.,* 1992; Sinclair *et al.,* 1992).

The goats, despite the low forage/concentrate ratio, did not manifest any digestive-metabolic problems. Recent studies (Di Trana *et al.,* 1994) have shown that diets rich in concentrates do not produce critical metabolic alterations in goats.

Thus, feed proportions do not seem to be subject to random choice by goats, but rather oriented towards optimal nutrient intakes.

Conclusions

The results of this research demonstrate that not only grazing goats but also housed goats are capable of choosing diverse ingredients which have the effect of regulating their nutrient intake.

Free-choice feeding systems could represent a valid means of determining goats nutrient requirements and of obtaining valuable information on diet formulation.

Future research should determine whether this feeding system effectively favours nutrient synchronization and what mechanisms guide the animal's choices.

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