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in

Ledin I. (ed.), Morand-Fehr P. (ed.).
Sheep and goat nutrition: Intake, digestion, quality of products and rangelands

Zaragoza : CIHEAM
Cahiers Options Méditerranéennes; n. 52

2000
pages 183-186

Concentrate grain choice by grazing goats according to the ingested herbage quality in a free-choice feeding system

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SUMMARY – The objective of this study was to verify if grazing goats were capable of choosing the concentrate grains that better interact with the quality of herbage intake in a free-choice feeding system. A native pasture in a Basilicata valley (Italy) was used for this experiment. Thirteen Maltese goats grazed for eight hours/day an area of 1.2 ha from 24 April to 7 July. Goats received barley and maize grain, beet-pulps, chick-peas and broad beans grain (hydrated in water), in unlimited amount and simultaneously. Each feed was offered in a single pail. For the first four weeks goats received the feeds only in the goat house, for the following seven weeks, apart from in the goat house, also on pasture. The herbage intake was estimated by four oesophageal-fistulated goats. The double concentrate distribution, in goat-house and on the pasture, did not modify the total concentrate intake (TCI): only less than 4% was eaten on the pasture (0.038 kg vs 1.05 kg indoor). The TCI evolved according to milk production (r = 0.864**), while herbage increased until 5th week (from 0.23 kg to 0.49 kg) and then decreased (from 0.49 kg to 0.21 kg). The preferred diet resulted richer in barley and maize (33.3% and 30.9% on TCI) and less rich in beet-pulps and chick-peas (12.7% and 15.8% on TCI). Broad-beans, instead, contributed only for 7.3%.

Key words: Concentrate choice, free-choice system, herbage quality, grazing, goats.

RESUME – *"Choix des concentrés en relation avec la qualité de l'herbe ingérée par les chèvres dans un système de libre choix". L'objectif de l'expérience a été d'étudier la capacité de la chèvre à choisir le concentré qui va mieux interagir avec la qualité de l'herbe ingérée. Pour cet essai une prairie naturelle dans la région Basilicate (Sud de l'Italie) a été utilisée. On a utilisé 13 chèvres Maltaises en lactation qui ont pâturé, pendant 10 semaines (24 Avril-7 Juillet), huit heures/jour dans un parc de 1,2 hectares. Les chèvres reçoivent, seulement à la chèvrerie, dans les 4 premières semaines, 5 types de concentrés (orge, maïs, pulpes de betterave déshydratées, pois chiches, fèves) en libre choix et simultanément. Pour les 7 semaines suivantes, elles reçoivent les mêmes concentrés au pâturage. Quatre chèvres portant des fistules oesophagiennes et des sachets ont été utilisées pour la collecte du bol alimentaire et des fèces. Les deux modalités de distribution du concentré, à la chèvrerie et au pâturage, ne modifient pas l'ingestion totale du concentré (ITC): seulement 4% est ingéré au pâturage (0,038 kg vs. 1,05 kg). L'ITC est liée à la production de lait (r = 0.864**): lorsque la production laitière diminue de 2,07 à 1,30 kg, l'ITC baisse de 1,53 kg à 0,76 kg. Au contraire, l'ingestion de l'herbe s'accroît jusqu'en 5ème semaine (de 0,23 kg à 0,49 kg) et ensuite elle baisse (de 0,49 kg à 0,21 kg). Le régime sélectionné a été plus riche en orge et maïs (33,3% et 30,3% de l'ITC) et plus pauvre en pulpes de betterave déshydratées et pois chiches (12,7% et 15,8% de l'ITC). Les fèves ont représenté seulement 7,3%.*

Mots-clés : *Choix du concentré, alimentation en libre choix, qualité de l'herbe, chèvres, pâturage.*

Introduction

The herbage chemical composition changes according to the phenological stage of the plants and the botanical composition of pasture. From late autumn to winter the sugars and the nitrogen, rapidly fermentable, increase and the fibre decreases; the contrary effect takes place from late winter to summer (Smith, 1973; Fedele *et al.*, 1993; Claps *et al*., 1998). On controlled feeding supply systems, it was difficult to pick out the effect of each concentrate that better interacts with herbage nutrients. The studies of Claps *et al.* (1994) and Rubino *et al.* (1995) showed that grazing animal performance can be improved by cereal grain or commercial concentrates with low or medium protein content (12-17%) and not by legume grain or commercial concentrates with high protein content. The study of Claps *et al.* (1994) showed, moreover, that the best performance was obtained when the grazing goats were free to choose and had continuous access to different concentrates. The objective of this

study was to verify how feeding behaviour of grazing goat changes according to the seasonal variation of ingested herbage quality, and a different modality of concentrate distribution.

Materials and methods

A native pasture in a Basilicata valley (Southern Italy) was used for this experiment. The pasture botanical composition changed considerably during grazing season. In the spring, the pasture was very rich in grasses: 50-60% (*Lolium perenne, Avena barbata, Festuca arundinacea, Poa pratensis, Bromus* spp.), and poor in legumes: 20-25% (*Trifolium repens, Medicago polimorfa*) and forbs: 25-30% (*Galium verum, Foeniculum* sp.). In the summer, grasses decreased to 20-30%, legumes to 10-15% and forbs increased to 55-60%. In this season, *Cynosurus cristastus*, *Festuca arundinacea*, *Plehum pratense*, *Melilotus sulcata*, *Cichorium* spp., *Daucus carota*, *Ranunculus bulbosus*, were the dominant species. Thirteen Maltese goats grazed for eight hours/day an area of 1.2 ha from 24 April to 7 July. Goats received simultaneously and in unlimited amounts barley and maize grain, beet-pulps, chick-peas and broad-beans grain (hydrated in water). Each feed was offered in a single pail. For the first four weeks, they received these grains only in goat house; for the following seven weeks, indoor and on the pasture. In the week between the trial periods there were no relieves.

The herbage intake was estimated by four oesophageal-fistulated goats in according to Fedele *et al.* (1993) method. Taking into account pasture botanical and chemical variation, herbage intake was estimated in five different weeks. Dry matter intake (DMI) for each concentrate was measured daily, milk production weekly. Samples were chemically analysed determining dry matter content (AOAC, 1990), crude protein and neutral detergent fiber (NDF) content (Goering and van Soest, 1970).

Linear correlation was calculated using SAS procedure (1987). Means were compared using the T-test.

Results and discussion

The double concentrate distribution, in the goat-house and on the pasture, did not modify the total concentrate intake (TCI): in fact, only less than 4% was eaten on the pasture (0.038 kg vs 1.05 kg) (Table 1). The TCI evolved according to milk production (r = 0.864**): as milk production decreased from 2.07 kg to 1.30 kg, the TCI decreased from 1.53 kg to 0.76 kg. On the contrary, herbage intake increased until 5th week (from 0.23 to 0.49 kg) and then decreased (from 0.49 to 0.21 kg).

Table 1. Milk production and DMI (kg) (mean ± s.d.)

Week	Milk production	Herbage DMI	Concentrate DMI	
			Indoor	Pasture
1	2.07 ± 0.62	0.23 ± 0.06	1.53 ± 0.08	–
2	2.17 ± 0.58	–	1.54 ± 0.10	–
3	2.06 ± 0.60	0.42 ± 0.09	1.43 ± 0.07	–
4	1.99 ± 0.72	–	1.23 ± 0.14	–
5	1.86 ± 0.68	0.49 ± 0.08	0.76 ± 0.05	0.051 ± 0.054
6	1.45 ± 0.54	–	0.82 ± 0.12	0.029 ± 0.031
7	1.59 ± 0.48	–	0.88 ± 0.09	0.020 ± 0.039
8	1.71 ± 0.59	0.32 ± 0.05	0.82 ± 0.08	0.067 ± 0.090
9	1.50 ± 0.42	–	0.80 ± 0.09	0.020 ± 0.032
10	1.30 ± 0.41	0.21 ± 0.04	0.76 ± 0.05	0.039 ± 0.053
Mean	1.60 ± 0.62	0.33 ± 0.06	1.05 ± 0.09	0.038 ± 0.056

The preferred diet (Table 2) resulted richer in barley and maize (33.3% and 30.9% on TCI) and less rich in beet-pulps and chick-peas (12.7% and 15.8% on TCI). Broad-beans, instead, contributed

only for 7.3%. Maize's diet contribution increased until 6th week (from 28.8% to 38.1%) and then decreased until 23.1%. In a different way, the barley contribution on TCI showed a low variability within a week and another. Beet-pulps and chick-peas trend was almost similar to the maize one, while broad- beans trend was not linear.

Table 2. Diet concentrate composition (% on TCI) (mean ± s.d.)

Week	Barley	Maize	Beet -pulps	Chick peas	Broad beans
1	29.1^{a} ± 5.5	28.8^{a} ± 1.9	16.0^{b} ± 1.4	16.2^{b} ± 2.8	9.9^{c} ± 5.4
2	33.8^{a} ± 1.8	27.8^{b} ± 1.8	15.6^{c} ± 2.7	17.7^{c} ± 1.6	5.1^{d} ± 1.1
3	34.4^{a} ± 3.0	30.3^{a} ± 4.3	13.7^{b} ± 2.1	14.9^{b} ± 4.8	6.7^{c} ± 2.9
4	36.9^{a} ± 4.2	31.9^{a} ± 1.8	11.7^{b} ± 4.1	14.7^{b} ± 6.5	4.8^{c} ± 3.3
5	31.8^{b} ± 6.0	35.0^{a} ± 5.6	13.0^{c} ± 5.3	14.3^{c} ± 5.5	5.9^{d} ± 3.8
6	27.5^{b} ± 7.0	38.1^{a} ± 9.2	8.1^{c} ± 3.0	14.9^{c} ± 7.4	11.4^{c} ± 4.3
7	34.1^{a} ± 3.3	31.8^{a} ± 6.7	10.1^{c} ± 2.2	19.9^{b} ± 4.5	4.1^{d} ± 1.3
8	36.1^{a} ± 6.2	30.7^{b} ± 5.2	13.1^{c} ± 1.6	14.6^{c} ± 3.5	5.5^{d} ± 0.8
9	32.7^{a} ± 3.0	31.4^{a} ± 9.9	12.6^{b} ± 4.9	13.2^{b} ± 4.0	10.1^{b} ± 5.6
10	36.6^{a} ± 5.6	23.1^{b} ± 6.7	13.6^{d} ± 3.0	18.0^{c} ± 9.0	8.7^{d} ± 2.5
Mean	33.3^{a} ± 7.5	30.9^{a} ± 7.3	12.7^{b} ± 3.9	15.8^{b} ± 6.3	7.3^{c} ± 4.4

^{a,b,c,d}Results in rows are different $P < 0.05$.

The crude protein content of TCI was almost constant (13.7% ± 0.5), on the opposite of the herbage intake that increased until 5th week (from 10.5% to 14.1%) and then decreased progressively (Table 3). The NDF content of TCI decreased until 6th week (from 30.3% to 26.1%) and then increased until 29.6%.The NDF herbage content always increased from 1st to 10th week (from 43.9% to 79.9%).

Table 3. Diet chemical composition (%) (mean ± s.d.)

Week	Crude protein		NDF	
	Herbage	Concentrate	Herbage	Concentrate
1	10.5^{b} ± 1.6	14.4^{a} ± 0.4	43.9^{a} ± 5.8	30.3^{b} ± 0.6
2	–	13.7 ± 0.4	–	30.1 ± 0.7
3	9.5^{b} ± 3.2	13.9^{a} ± 0.7	46.3^{a} ± 2.9	29.1^{b} ± 1.1
4	–	13.5 ± 0.3	–	28.3 ± 0.8
5	14.1^{a} ± 3.4	13.2^{a} ± 1.9	54.2^{a} ± 2.3	27.1^{b} ± 2.9
6	–	13.9 ± 1.2	–	26.1 ± 1.6
7	–	13.7 ± 0.9	–	27.9 ± 2.4
8	9.1^{b} ± 3.6	13.1^{a} ± 0.8	75.3^{a} ± 0.7	27.2^{b} ± 1.9
9	–	14.0 ± 1.1	–	27.6 ± 2.6
10	8.2^{b} ± 2.3	13.9^{a} ± 0.8	79.9^{a} ± 2.8	29.6^{b} ± 1.5
Mean	10.3^{b} ± 2.6	13.7^{a} ± 0.5	59.9^{b} ± 2.6	28.3^{b} ± 1.7

^{a,b}Results in rows are different $P < 0.05$.

The availability of grains in the pasture did not change the indoor intake, in fact the animals almost ignored grains preferring to graze. The herbage intake could seem low, but this value is similar to those observed by Fedele *et al.* (1996) in grazing goats supplied with 850 g/h of commercial concentrate.

The goats herbage intake was positively related to dry matter content and herbage availability (Morand-Fehr *et al.*, 1993; Fedele *et al.*, 1996). The lower intake in the first three weeks was,

probably, due to a lower herbage availability and to a higher water content of herbage (82-84%). In this period, goats ingested more beet-pulps than in other weeks; in this manner animals increased the diet NDF content to better balance the rapidly degraded starch of barley and sugars of herbage.

The herbage intake increased when the pasture offered the maximum availability (5^{th} week). In this period the diet contribution of barley, beet pulps and chick peas decreased, while the contribution of maize increased. This behaviour involved an increase of herbage fermentable carbohydrate, crude protein and NDF intake, that the goats balanced through the intake of specific grain.

The barley contribution increased particularly in the last four weeks, when in the Mediterranean pastures the fermentable sugars were very low. In the same period, although the high content in fibre, goats increased also the beet-pulps intake, feed particularly rich in NDF, so contributing to better regulate the digestive processes. The herbage NDF was negatively correlated to TCI ($r = 0.749^*$) and consequently with milk production ($r = 0.927^*$).

Conclusion

The results of the present study show that goats in a free-choice system tend to offset the unbalance of ingested herbage quality through a specific choice of concentrates. This behaviour suggests that this supply has to be of no constant quality but related to the grazing season.

References

AOAC, Association of Official Analytical Chemists (1990). *Official Methods of Analysis*, 15^{th} edn. Association of Official Analytical Chemists, Washington, DC.

Claps, S., Rubino, R., Cogliandro, E. and Fedele, V. (1994). Fabbisogni alimentari e nutritivi, comportamento alimentare e produzione di latte di capre allevate al pascolo con differenti integrazioni alimentari. In: *Proc. Miglioramento dell'Efficienza Produttiva degli Ovini e Caprini*, Bella (Italy), 24 November 1994, pp. 2.1-2.16.

Claps, S., Rubino, R., Fedele, V. and Morone, G. (1998). Influenza dello stato fisiologico e del sistema alimentare sulla degradabilità della dieta di capre al pascolo ed alla stalla. In: *Proc. XIII Congresso Nazionale SIPAOC*, Palermo (in press).

Fedele, V. and Claps, S. (1996). Strategie alimentari per l'allevamento della capra nell'ambiente meridionale. *L'allevatore di Ovini e Caprini*, 5: 5-10.

Fedele,V., Pizzillo, M., Claps, S., Morand-Fehr, P. and Rubino, R. (1993). Grazing behaviour and diet selection of goats on native pasture in Southern Italy. *Small Ruminant Res.*, 11: 305-322.

Goering, H.K. and van Soest, P.J. (1970). *Forage Fiber Analyses (Apparatus, Reagents, Procedures and some Applications)*. Agric. Handbook No. 379. ARS-UDSA, Washington, DC.

Morand-Fehr, P., Fedele, V. and Schmidely, P. (1993). Relationship between chemical composition of pasture plants and dietary preferences of goats In: *Workshop report on "Sheep and Goat Nutrition",* Thessaloniki, 24-26 Sept., pp. 1-5.

Rubino, R., Moioli, B., Fedele, V., Pizzillo, M. and Morand-Fehr, P. (1995). Milk production of goats grazing native pasture under different supplementation regimes in Southern Italy. *Small Ruminant Res.*, 17: 213-221.

SAS/STAT (1987). *User's Guide Release 6.04.* SAS-Institute Inc., Cary, NC, USA.

Smith, D. (1973). The nonstructural carbohydrates. In: *Chem. and Biochem. of Herbage*, Vol. 1, Buttler, G.W. and Bailey, R.W. (eds), pp. 106-151.