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FEED INTAKE OF DICOTYLEDONOUS HERBS MIXED WITH MEADOW HAY IN GOATS

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ABSTRACT

The aim of this study was to determine which of the two kinds of dicotyledonous plants- *Sanguisorba officinalis* and *Plantago lanceolata* added to meadow hay at 10 % are preferred by goats. Seven goats of brown shorthaired and white shorthaired breeds were used in four preference tests. They
were fed with 6.25 kilograms of meadow hay in the first and third preference tests. During the second and fourth preference tests goats received 6.25 kilograms of meadow hay with 10 % of *Sanguisorba officinalis* or 6.25 kilograms meadow hay with 10 % of *Plantago lanceolata.* The mean consumption of meadow hay with 10 % of *Plantago lanceolata* was higher by 44.8 % than the mean consumption of meadow hay after 8 hours ($P<0.001$). The mean consumption of meadow hay with 10 % of *Sanguisorba officinalis* was higher by 10.4 % than the mean consumption of meadow hay only ($P<0.05$). These results demonstrate that the supplement of dicotyledonous herbs improved consumptions of the meadow hay.

Keywords: goat, preference test, *Sanguisorba officinalis, Plantago lanceolata,* meadow hay

INTRODUCTION

Recently there has been a substantial increase in the use of herbs and their products not only as herbal medicinal products and for food supplements but also in the field of animal nutrition. Some of the plant species have positive influence on animal health and digestion (Čerešňáková et al., 1999). Most considerable species in this respect are *Taraxacum officinale, Plantago lanceolata, Alchemilla vulgaris* and *Achillea millefolium* (Klimeš et al., 2004).

In a valuable pasture community, there has to be 60 - 70 % grasses, 20 - 25 % clovers and 10 - 15 % wet species with favourable dietetic effects (e.g. *Plantago lanceolata, Taraxacum officinale, Achillea millefolium*) (Klimeš et al., 2007). Dicotyledonous plants contained 3.1 times more Ca and 2.6 times more Mg than grasses on an average (Kuusela, Hytti, 2001). There is 0.54 % Ca in dry matter and for comparison, the content of Ca in clover crops is three times higher (1.79 %) (Mrkvička, Veselá, 2002).

Plantago lanceolata prefers light, medium and heavy soils, also dry or moist soils (Huxley, 1992). The leaves contain mucilage, tannin and silic acid. An extract of this herb has antibacterial properties. *Plantago lanceolata* has bitter flavour with astringent, mildly expectorant, heamostatic and ophthalmic effects (Phillips, Foy, 1990). *Plantago lanceolata* provides a dietetically valuable fodder poor in crude protein, rich in sugars and contains a lot of Na and Mn. However, production is not high (Klimeš, 1997). According to Klimeš (2004), hay mixed in feed ration with *Plantago lanceolata* gives excellent forage value.

Sanguisorba officinalis prefers light, medium and heavy soils and can grow in nutritionally poor soil. It requires dry, moist or wet soils (Huxley, 1992). It gives a tasty fodder. Main chemical components are triterpenoids and tannins (Zhu et al., 1999). Similar to *Plantago*

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lanceolata it has astringent, refrigerant and tonic effects (Foster, Duke, 1990; Chevallier, 1996). The hay with *Sanguisorba officinalis* gives satisfactory forage value. The presence of this species on a pasture improves intake of dry matter (Klimeš, 2004).

Since the early 1970s, scientists have used preference tests (tests that require animals to choose between two or more different options or environments) as a means of answering questions concerning animal welfare (Appleby and Hughes, 1997). Fundamental to this research is the assumption that animals make choices that are in their own best interest, and that the knowledge of preferences shown by animals will help us understand and improve their welfare.

Various methods have been devised for determining preferences of grazing animals (Žitňan et al., 2002). The most accurate and most direct way is to collect the food eaten by animals with open esophageal fistulas. Another method is to observe the animals closely. This method is more accurate if forages are planted in narrow pure stands from which ruminants may choose. The third method is to sample the plant species and height of plants before and after a pasture has been grazed (Provenza, 1995). Studies using these methods have revealed that ruminants graze selectively; that is, they do not necessarily eat plants in proportion to the number of each plant species in a pasture. For example, Houpt (1991) found that cattle mostly preferred meadow fescue and timothy; perennial rye grass and cocksfoot were the next most preferred plants and *Agnotis* and red fescue the least preferred. Rapidly growing plants are the most palatable, if they are high enough in fibre content.

Goats showed similar, but more variable, plant preferences and appear to be more selective than cattle (Houpt, 1991). In general, the preferences were correlated with the dry matter and carbohydrate content of the grasses. Goats and sheep select a diet higher in protein and lower in fibre content than that obtained from clipped pasture samples, indicating the advantage of selective grazing for animals.

Objective of this paper was to evaluate the choice of goats on the dicotyledonous herbs supplemented with meadow hay and determine whether 10 % meadow hay supplementation influenced the total food intake.

MATERIAL AND METHODS

Plantago lanceolata and *Sanguisorba officinalis* were used as experimental dicotyledonous species, those were added to meadow hay (MH) at the amount of 10 %. There were four tests during 2006 and 2007, duration of each test being one week. Meadow hay was cut in August, 2006 in a locality near České Budějovice (altitude 415 m a.s.l., average yearly temperature 8.05 °C, total annual rainfall 645.0 mm, loamy soil). *Plantago lanceolata* (PL) was obtained from meadow herbage near Kaplice in August, 2006 (altitude 625 m a.s.l., average yearly temperature 6.83 °C, total annual rainfall 708.0 mm, sandy-loamy soil). *Sanguisorba officinalis* (SO) was obtained from meadow herbage near České Budějovice in August, 2006 (altitude 420 m a.s.l., average yearly temperature 8.03 °C, total annual rainfall 645.0 mm, sandy-loamy soil).

The group of experimental animals consisted of seven goats of brown shorthaired and white shorthaired breeds. All animals had no previous experience with observed dicotyledonous species. Feed intakes were recorded individually during 8 hours. During the first and second preference tests, goats were fed 6.25 kilograms of meadow hay and 6.25 kilograms of meadow hay with 10 % *Sanguisorba officinalis.* During the third and fourth preference tests, goats were fed 6.25 kilograms of meadow hay and 6.25 kilograms meadow hay with 10 % *Plantago lanceolata.* Remaining feed were weighted after 4 and 8 hours.

Samples of meadow hay and meadow hay with 10 % *Plantago lanceolata* and *Sanguisorba officinalis* were dried at room temperature to constant weight and ground in a laboratory cutting mill SM 100 (RETSCH) . Aliquots of the dried samples were ashed at 550°C. Cell wall constituents (NDF, CF, ADF, ADL) were analyzed in an Ankom fibre bag analyzer. Dry matter content and fat content were determined by a default laboratory procedure of Weende analysis. Results of these analyses are presented in Table 2.

The data were analyzed using a paired t-test by the statistical package Statistica. All data confirmed to a normal distribution. Values are expressed in the text of results as means ± standard deviation of the mean.

RESULTS AND DISCUSSION

The mean consumption of feed is expressed in Table 1. The highest consumption of mixed feed ration during the first four hours was the hay with 10 % *Plantago lanceolata* (0.58 kg vs. 0.41 kg respectively). Difference between MH and MH+PL was significant (P<0.001). The intake of MH and MH+SO also differed (0.29 kg vs. 0.38; P<0.01). We found significant difference only between MH and MH+PL (0.17 kg vs. 0.25 kg; P<0.01) during a period from 5th to 8th hours.

All the observations lasting 8 hours recorded significant differences. The mean consumption of meadow hay with 10 % *Plantago lanceolata* after 8 hours was higher by 44.8 % compared to the mean consumption of meadow hay only (MH 0.58 kg vs. MH+PL 0.84 kg, P<0.001). The mean intake of meadow hay with 10 % *Sanguisorba officinalis* was higher by 10.4 % than the mean consumption of meadow hay only (MH 0.48 kg vs. MH+SO 0.53 kg).

Table 1.: The consumption of feed (kg/head/hour)

Hour	*Plantago lanceolata*			*Sanguisorba officialis*		
	MH	MH+PL	Significance	MH	MH+SO	Significance
1 – 4	0.41 ± 0.03	0.58 ± 0.06	***	0.29 ± 0.05	0.38 ± 0.06	**
5 – 8	0.17 ± 0.02	0.25 ± 0.05	**	0.19 ± 0.02	0.14 ± 0.02	NS
1 - 8	0.58 ± 0.03	0.84 ± 0.02	***	0.48 ± 0.01	0.53 ± 0.01	*

*P<0.05 **P<0.01 ***P<0.001 NS = non significant

MH = meadow hay; MH+PL = meadow hay with 10 % *Plantago lanceolata*; MH+SO = meadow hay with 10 % *Sanguisorba officinalis*

The higher consumption of *Plantago lanceolata* agrees with the statement of Klimeš (2004) who pointed out that the hay with *Plantago lanceolata* gives excellent forage value. Therefore, the supplement of *Plantago lanceolata* in the group of mountain herbs can be specified as a „spice of forage". The hay with *Sanguisorba officinalis* gives satisfactory forage value (Klimeš et al., 2007). This agrees with our results of lower consumption of the hay with *Sanguisorba officinalis* in comparison with the hay with *Plantago lanceolata.* Also, the results presented in Table 2 indicate that content of CF and other cell wall constituents in meadow hay without herbs was distinctly higher compared to the hay with 10 % *Sanguisorba officinalis*.

Goats preferred *Plantago lanceolata* to *Sanguisorba officinalis* and they spent more time feeding. *Plantago lanceolata* was consumed more and *Sanguisorba officinalis* less. When food quality is similar, structure becomes an important determinant of food choice. In contrast, when food quality is different and the need for particular nutrients increases/decreases, the food biochemical composition becomes crucial in food selection.

Animals' preferences, as revealed by preference tests, often identify environmental features that promote their welfare. However, the link between preferences and welfare may break down if the choices offered in preference tests fall outside the animals' sensory, cognitive and affective capacities or if animals are required to choose between short-term and long-term benefits.

The preferences of ruminants for plant species vary and depend on a number of factors, including the growth stage of a plant; most ruminants prefer fast-growing succulent species. The mixture of species - clover, for example, may not be eaten if it is growing in a pure stand but will be eaten if grasses are growing with it. The important factor is the season of the year - ruminants will consume species that are green during the winter although the same species will be rejected in the summer when other species are green. It is unclear what senses are involved in forage preferences of goats (Houpt, 1991). An animal's ability to select a diet depends also on forage availability, the density of herbivores, and the allocation of forage resources. Biochemical diversity of plant mixtures interacts with herbivore foraging behaviour to influence diet selection. There is

Table 2: Nutrient content of feed in preference tests (in % of DM)

Feed	DM	ash	fat	CP	CF	NDF	ADF	ADL	OM	NFEC
MH (1. test)	94.24	6.98	1.27	7.36	27.90	65.53	35.65	2.74	87.26	50.73
MH + SO	94.3	7.71	1.83	9.46	22.30	50.46	30.92	3.35	86.59	53.00
MH (2. test)	92.96	9.46	1.8	8.84	27.00	61.90	34.58	1.93	83.50	45.86
MH + SO	93.22	9.37	1.7	8.8	24.48	57.27	32.92	2.32	83.85	48.87
MH (3. test)	93.7	10.35	1.53	8.67	27.22	62.84	34.94	2.11	83.35	45.93
MH + PL	93.36	10.34	1.49	9.11	27.02	59.41	34.89	3.61	83.02	45.40
MH (4. test)	88.14	9.06	2.19	7.79	26.72	56.39	30.27	1.35	79.08	42.38
MH + PL	90.46	9.72	2.06	8.06	26.19	53.40	29.57	1.99	80.74	44.43

DM-Dry matter; CP- crude protein; CF- crude fibre; NDF- neutral detergent fibre; ADF- acid detergent fibre; ADL- acid detergent lignin; OM- organic matter; NFEC- nitrogen free extractive compound

MH = meadow hay; MH+PL = meadow hay with 10 % *Plantago lanceolata*; MH+SO = meadow hay with 10 % *Sanguisorba officinalis*

evidence of the independent effects of plant physical and chemical characteristics on foraging, but little has been done to determine how these traits interact to affect food selection. 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. According to Villalba and Provenza (1999), goats select diets from an array of plant species that differ in physical and chemical characteristics and their preference can affect the composition of milk (Margetín and Milerski, 2001).

CONCLUSION

We investigated whether adding small amounts of dicotyledonous species cause goats to increase their preference for meadow hay. It may be concluded that dicotyledonous species can significantly impact production and could obviously influence commercial goat farms.

The higher consumption of the hay with *Plantago lanceolata* pointed to the fact that this plant is very tasty for goats. This knowledge can be utilised in situations when there is a lack of appetite or in case of diseases when the food intake is reduced. Obtained knowledge appears to be useful especially for ecological agriculture. It is possible to recommend harvesting the hay from the area with higher coverage of *Plantago lanceolata* separately and use it as a supplement to meadow hay, especially in the period when voluntary intake needs to be increased. An advantage is also the possibility of exploitation of *Plantago lanceolata* in monoculture. These results also indicate that the supplement of dicotyledonous herbs improved consumptions of the meadow hay.

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