Session C6.9, Abstract no.282, Poster presentation

Effects of dietary herb supplements for cows on milk yield and technological quality of milk

J. Kraszewski, J. A. Strzetelski, B. Niwińska
Research Institute of Animal Production, Department of Animal Nutrition,
Sarego Street, no. 2, 31-047 Krakow, Poland

Summary

The effects of supplementing herbs mixture consisting of peppermint (*Mentha piperita* L.*), wild* pansy (*Viola tricolor* L), camomile (*Matricaria chamomilla L.*), stinging nettle (*Urtica dioica L.*), common yarrow (*Achillea millefolium L.*) and thyme (*Thymus vulgaris* L.) on the feed intake, milk yield; composition and technological properties of milk used for cheese making were investigated. The experiment was carried out on 30 Holstein-Friesian X Black and White Lowland crossbreed cows divided into 3 groups (n=10). In the control group (C) cows were received the diet without herbs; in group H_1 the daily ration was supplemented with 100 g of herb mixture and in group H_2 with 200 g of herb mixture.

The herbs supplement had a positive effect on nutrient intakes of the cows. The herbs improved milk composition, technological properties of milk for cheese-making processes, and the rheological properties of rennet-induced gels. The fatty acid composition of milk fat of cows of group H_2 was characterized by lower SFA to UFA ratio and higher content of C18:2, C18:3 acids and CLA than in other groups.

Key words: cows, feeding, herbs mixture, milk composition, rheological properties,

Introduction

Many substances found in herbs show prophylactic and therapeutic effects (Linde et al., 2001). Over the last years there has been an increasing interest in utilization herbs in cattle nutrition, because some investigations have confirmed an impact on nutrients digestibility and on performance (Broudiscou et al., 2002; Tedesco et al., 2004). Successful application of herbs in feeding of cows was presented by Grega et al. (2004). At present there is a lack of information about the changes in chemical composition and technological value of milk affected by the herbs mixture additives

The aim of the experiment was to investigate the influence of herbs mixture additives on the feed intake, milk composition, cheese-making production processes and rheological properties of rennet-induced gels.

Material and methods

Animals and feeding

The experiment was carried out on 30 Holstein-Friesian X Black and White Lowland crossbreed (62.5% genes of Holstein-Friesian breed) cows. The animals were divided into 3 groups (n=10), according to the maximal daily milk production during the first 90 days of the last lactation, lactation rank (2-5) and body weight at 21 days before calving (650±50 kg). Cows were individually fed twice per day of total mixed ration (TMR; Table 1) covering

production of 22 kg milk/day and supplement of concentrate mixture (0.5 kg per 1 kg of milk above 22 kg of basic yield). Composition of TMR, concentrate mixture and feeding level were established according to Polish Feeding Standards IZ-INRA (2001). From 7 to 91 days of lactation cows of the control group (C) were offered the diet without herbs; in the group H_1 the daily diet was supplemented with 100 g of herbs mixture and of group H_2 200 g. The experimental trial lasted 12 wk. Composition of the herbs mixture is given in Table 2.

Table 1. Feed ingredients for the TMR

Ingrediens	% of DM
Lucerne silage	36.8
Maize silage	44.7
Barley straw	5.0
Concentrate [1]	10.0
Mixture of minerals and vitamins [2]	3.5

[1] Concentrate was a mixture of (%): 15 soybean meal, 10 rapeseed meal, 10 wheat bran, 10 oats, 20 triticale, 22 wheat, 13 maize (205.6 g CP, 122.2 g PDI and 1.12 UFV kg^{-1}DM)

[2] "Kuhgold" produced by "Sano" Company, Poland

Table 2. Composition of herbs mixture[1]

Ingredients	%
Peppermint (*Mentha piperita* L.*)*	20
Wild pansy (*Viola tricolor* L.)	15
Camomile (*Matricaria chamomilla* L.)	20
Stinging Nettle (*Urtica dioica* L.)	15
Common Yarrow (*Achillea millefolium* L.)	15
Thyme (*Thymus vulgaris* L.)	15

[1] produced by " Vipera" Company, Poland

Sample collection, chemical and statistical analyses

The amounts of feed offered and refused by individual animals were recorded daily. Proximate analysis of feed and refusals was carried out according to AOAC (1990), the nutritive value and composition of diets were formulated according to the IZ-INRA (2001). Milk yield at each milking was recorded using True-Test milk meters. Milk samples were collected once a week from two consecutive milking and analysed for fat, protein, casein, lactose, total solid and solid non fat content by infrared spectophotometry (AOAC, 1990; Foss FT 120 Milko-Scan, Foss Electric, Hillerød, Denmark). Specific gravity and titratable acidity (^{o}SH) of milk were determined according to standard methods. Somatic cell counts were estimated using Fossomatic Cell Counter (Fossomatic 500) and heat stability according to Dovies and White (1996). Fatty acid composition of milk fat was analysed using gas chromatography on Pye Unicam Sc 104, 30 m column Supelcowax 10 column (f=0.35 mm).

Samples of milk for estimation both technological properties and rheological of rennet-induced gels properties were collected every 4 weeks. Results of alcohol test; fermentation test and fermentation-renneting test were recorded using methods described by Pijanowski (1984). Rheological properties of rennet-induced clot were evaluated with Texture-meter TA-XT2 by Texture Expert 1.05 software (Wangin, 1989).The results were analyzed statistically

using the one-way (group) analysis of variance procedure of STATISTICA ver. 5.1 (1997). Differences were declared significant at P< 0.05.

Results

Nutritive value of feed is listed in Table 3.

Table 3. Nutritive value of diets

Item	TMR	Concentrate mixture
Dry matter, g	367.2	856.0
	g kg^{-1} DM	
Crude protein, g	145.1	205.6
PDIN, g	87.2	142.7
PDIE, g	77.5	133.6
Crude fibre, g	277.2	71.3
UFL	0.83	1.12

For cows of groups H_1 and H_2 daily dry matter intake was significantly higher (P<0.05) than for cows of C group (Table 4).

Table 4. Daily feeds intake and milk production

Item	Group:			L.s.[1]<	Mean	SEM[2]
	C	H_1	H_2			
Feed intake, kg day^{-1}						
TMR	45.1[b-3]	45.8[a]	45.8[a]	0.01	45.6	0.07
Concentrate mixture	2.94	2.83	3.26	0.29	3.01	0.11
Nutrient intake per day						
Dry matter, kg	19.08[b]	19.23[ab]	19.61[a]	0.04	19.31	0.10
Crude protein, g	2920	2937	2974	0.09	2945	23.2
PDIN, g	1803	1811	1864	0.12	1825	15.30
PDIE, g	1620	1626	1676	0.13	1640	13.37
UFL	16.57	16.66	17.08	0.09	16.77	0.11
Milk production, kg day^{-1}	27.9	27.7	28.5	0.51	28.02	0.30

[1] L.s.- level of significance
[2] Standard Error of Mean
[3] Differences in the same row with different superscripts are statistically significant at P<0.05

The milk of cows of H_2 group contained the higher amounts of protein, casein, lactose and solid not fat components and was characterised by higher specific gravity, acidity and heat stability compared with control group (P<0.05; Table 5).

Table 5. Physicochemical and hygiene parameters of milk

Item	Groups			L.s.[1]<	Mean	SEM[2]
	C	H_1	H_2			
Milk fat, %	3.95	3.99	4.12	0.08	4.02	0.025
Milk protein, %	3.34^{b-3}	3.41^{b}	3.48^{a}	0.01	3.41	0.013
Casein, %	2.80^{b}	2.90^{a}	2.98^{a}	0.02	2.87	0.014
Milk lactose, %	4.83^{b}	4.89^{b}	4.94^{a}	0.04	4.89	0.01
Total solid, %	12.58	13.28	13.21	0.06	13.02	0.14
Solid non fat, %	8.60^{b}	9.29^{a}	9.19^{a}	0.01	9.02	0.083
Specific gravity, g x $(cm^3)^{-1}$	1029.2^{b}	1031.1^{a}	1031.8^{a}	0.01	1030.7	0.30
Acidity (^{o}SH)	6.80^{b}	7.09^{a}	7.01^{a}	0.04	6.98	0.03
Somatic cell counts, cells/mL	69,500	66,200	68,700	0.60	68,133	1,610
Heat stability, minute	10.39^{a}	10.51^{a}	12.11^{b}	0.03	11.00	0.03

[1] L.s.- level of significance
[2] Standard Error of Mean
[3] Differences in the same row with different superscripts are statistically significant at P<0.05

The milk fat of cows in the group H_2 was characterized by the highest UFA/ SFA ratio and the highest contents of $C_{18:2}$, $C_{18:3}$ and CLA compared with other groups (Table 6).

Table 6. Fatty acids composition of milk fat (% of fat)

Specification		Group			L.s.[1]<	Mean	SEM[2]
		C	H_1	H_2			
SFA		64.5^{a-3}	63.23^{a}	60.96^{b}	0.01	62.90	0.45
C	4:0	2.38^{a}	2.30^{a}	2.21^{b}	0.01	2.29	0.02
	6:0	1.92	1.89	1.89	0.71	1.90	0.03
	8:0	1.29	1.30	1.31	0.80	1.30	0.03
	10:0	3.25	3.24	3.21	0.79	3.23	0.08
	12:0	4.24	4.19	4.12	0.72	4.18	0.10
	14:0	12.62^{a}	12.44^{a}	11.86^{b}	0.02	12.30	0.13
	15:0	1.63	1.60	1.58	0.35	1.60	0.02
	16:0	28.60^{a}	27.55^{a}	25.90^{b}	0.01	27.36	0.28
	17:0	0.85^{b}	0.91	0.95	0.01	0.90	0.01
	18:0	7.72	7.81	7.93	0.59	7.82	0.17
UFA		25.47^{b}	25.90^{b}	27.91^{a}	0.01	26.43	0.30
C	10:1	0.40	0.40	0.41	0.81	0.40	0.01
	14:1	1.63^{a}	1.50^{b}	1.51^{b}	0.03	1.55	0.02
	16:1	2.72	2.71	2.66	0.69	2.70	0.08
	17:1	0.48	0.50	0.51	0.33	0.50	0.01
	18:1	17.77^{b}	18.10^{b}	19.70^{a}	0.01	18.52	0.29
	18:2	1.80^{b}	1.92^{b}	2.23^{a}	0.01	1.98	0.04
	18:3	0.34^{b}	0.40^{a}	0.44^{a}	0.01	0.39	0.007
CLA		0.33^{b}	0.37^{b}	0.45^{a}	0.01	0.38	0.01
UFA/SFA		0.40^{b}	0.41^{b}	0.45^{a}	0.01	0.42	0.008

[1] L.s.- level of significance
[2] Standard Error of Mean
[3] Differences in the same row with different superscripts are statistically significant at P<0.05

The supplement of herb mixture affected technological parameters of milk used for cheese making (Table 6) and the rheological properties of rennet gels (Table 7).

Table 7. Technological suitability for cheese making of milk (%)

Parameters		Group		
		C	H_1	H_2
Alcohol test, dl	<4	3.4	6.7	3.3
	4-5	24.2	10.0	13.3
	>5	72.4	83.3	83.3
Solidity time, sec.	<61	13.8	16.7	16.7
	61-90	51.7	40.0	50.0
	91-120	24.1	33.3	30.0
	121-150	10.3	6.7	3.3
Fermentation test, type of clot	jelly-like	13.8	10.0	6.7
	caseous	75.9	83.3	80.0
	grainy	-	-	6.7
	bulgy	10.3	6.7	6.7
Fermentation renneting test, type of clot	compact and elastic	-	6.7	3.3
	weakly compact	62.1	60.0	66.7
	spongy	37.9	33.3	30.0

Table 8. Rheological properties of rennet-induced gels

Item	Group			L.s.[1]<	Mean	SEM[2]
	C	H_1	H_2			
Hardness	32.06^{b-3}	37.97^{a}	38.94^{a}	0.01	36.32	1.11
Cohesiveness	0.62^{b}	0.65^{b}	0.71^{a}	0.02	0.66	0.02
Springiness	0.41^{b}	0.49^{b}	0.71^{a}	0.01	0.54	0.04
Gumminess	19.84^{b}	26.16^{a}	27.81^{a}	0.01	24.95	1.28

[1] L.s.- level of significance
[2] Standard Error of Mean
[3] Differences in the same row with different superscripts are statistically significant at P<0.05

Discussion

In our study, the herbs mixture additives improved the appetite of cows and induced differences in chemical composition of milk. The mechanisms by which herbs improve feed intake, milk quality are not completely understood. Higher daily dry matter intake by cows receiving herbs mixture compared to the control group indicates that herbs have a soothing effect and stimulate appetite. Many herbs in experiment in vitro show the influence on rumen microbial metabolism, which enhanced protein synthesis and efficiency of yield of biomass production (Broudiscou et al. 2002). Tedesco et al. (2004) reported the positive effects on milk production that can be obtained when periparturient dairy cows are fed a ration with a natural hepatoprotector. Johnson et al. (1985) indicated that some active substances in herbs affect secretory cells of the mammary gland. Results obtained in our experiment suggested that the herbs mixture seems to be the most beneficial due to the cumulative effects of herbs.

Better quality of technological properties of milk in groups supplemented with herbs compared with milk of the control group probably resulted from higher content of solids not

fat component and crude protein, including casein (Marzioli and Ng-Kwai-Hang, 1986). The cheese yield and quality increase in direct proportion to the content of the above mentioned components (Sutton, 1989). Our results indicated that the use of herbs mixture influenced the rheological characteristic of rennet clot too. The noted differences in the fatty acids indicated, that the herbs may increase the polyunsaturated FA content in the milk fat.

Conclusion

The results obtained in our experiment showed that the herbs additives in dairy cows feeding could improve feed intake, composition of milk and technological properties for cheese making.

References

1. AOAC. 1990. Association of Analytical Chemists. Official Methods of Analysis. 15th Edition, Arlington, VA.
2. Broudiscou L. P., Papon Y., Broudiscou F. 2002. Effect of dry plant extracts on feed degradation and the production of rumen microbial biomass in a dual outflow fermenter. Anim. Feed Sci. Technol. 101, 4, 183-189
3. Dovies D.T., White J.C.D. 1996. The stability of milk protein to heat. J. Dairy Res. 33, 67-69
4. Grega T., Sady M., Kraszewski J. 2002. Effect of herb mixture supplementation in ration on milk yield, milk composition and its technological suitability. Biotech. Anim. Husb. 18,3, 15-20
5. IZ-INRA. 2001. Standards for Cattle, Sheep and Goat Nutritional value of Feed for Ruminants. Research Institute of Animal Production, Balice (in Polish)
6. Johnson I.D., Hart I.C., Simonds A.D., Morant S.V. 1985. Pre-pubertal mammogenezis in the sheep. Anim. Prod. 41, 333-340
7. Linde K., ter Riet G., Hondras M., Vickers A., Saller R., Melchart D. 2001. Systemic review of complementary therapies – an annotated bibliography. Part 2: Herbal medicine. BMC Compl. and Alternative Med. 1: 5
8. Marzioli A.S., Ng-Kwai-Hang K.F. 1986. Relationships between milk protein polymorphism and cheese yielding capacity. J. Dairy Sci. 69, 1193-1201
9. Pijanowski E. 1984. The chemistry and technology outline. Warszawa PWRiL (in Polish)
10. Sutton J.D. 1989. Altering milk composition by feeding. J. Dairy Sci. 72, 2801-2814
11. Tedesco O., TavaA., Galletti S., Tameni M., Varisco G., Costa A., Steidler S. 2004. Effect of silymarin, a natural hepatoprotector, in periparutien dairy cows. J. Dairy Sci. 87, 2239-2247
12. Wangin J. 1989. Renning cheese technology. Warszawa PWRiL.