Tropical and Subtropical Agroecosystems

SHORT NOTE [NOTA CORTA]

INFLUENCE OF SEMIARID SUMMER BROWSING ON CHEMICAL COMPOSITION IN GOAT'S MILK CHEESES

[INFLUENCIA DEL RAMONEO SEMIÁRIDO DE VERANO EN LA COMPOSICIÓN QUÍMICA DE LOS QUESOS DE CABRA]

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SUMMARY

A group (A) of 20 female French Alpine goats (50 ± 5 Kg BW) were fed on summer semiarid vegetation in Querétaro, México. Other group (B) with similar characteristics was fed in full confinement with Lucerne hay and concentrate food made of cereals. The different diets were offered for 15 days before the trial. Browsing goats did not eat other feed. Four kinds of cheese were prepared during five days: 1) browsed-raw (BR), 2) browsed-pasteurized (BP), 3) indoor-raw (IR) and 4) indoor-pasteurized (IP); using 30 kg of milk per group, 15 kg each group were proceed in raw and 15 kg each were pasteurized. Moisture, energy, protein, ash, lipids, cholesterol, fatty acids profile and CLA (Conjugated Linoleic Acid), EPA (Eicosapentaenoic acid), DHA (Docosahexaenoic acid) were determined in the cheeses. The results were analyzed with a variance analysis in a 2x2 factorial arrangement. Energy, fat and ash did not affect for feeding system and heat treatment. Protein content was higher in IP cheese compared with BR and BP cheeses. BR cheese had a lowest cholesterol value in relation to BP, IR and IP cheeses. The browse cheeses had the highest concentration of CLA, EPA and DHA acids in relation to indoor cheeses. Pasteurization did not have effect in cheese quality. Browsing increased concentration of compounds with a beneficial effect on human health, factor that could add revenue to the small farmer's income.

Key words: *Goat's milk cheese; summer browsing; CLA; PUFA.*

INTRODUCTION

Mexican traditional semiarid shrublands are a critical resource of animal forage. Small ruminants browsing encounter a diverse range of dietary phytochemicals that have an effect on animal performance (Puga *et al.* 2009), and thus in the chemical composition of its products. Feeding appears to be the most important effect to differentiate cheese quality (Morand-Fehr et al., 2007; Sanz Sampelayo et al., 2007). On other hand, the effect of milk pasteurization on cheese chemical composition has been attributed not only to the thermal degradation of natural components but also to the formation of novel constituents, such as melonoidinas, with important antioxidant activity; however this activity is limited (Calligaris *et al.* 2004). The effect of feeding systems on the chemical composition of Mexican soft goat's cheese, from raw or pasteurized milk was determined.

MATERIALS AND METHODS

The study was conducted in Querétaro, México (latitude: 20° 35'; longitude: 100° 18'), with a dry semiarid climate with 460 mm of average precipitation per year. Two groups of goats were formed (A and B), each one with 20 French Alpine goats (50 ± 5 kg body weight). All animals had between 70 to 80 milking days. Females were milked once daily. Group A included daily browsing on shrubby rangeland after milking, and browsing 8 hours/d on 14 ha of rangeland vegetation (without receiving supplement). Group B was kept in full indoor confinement during the study; fed 1.5 kg Lucerne hay and 1 kilogram of cereal concentrate (18% of CP and 2.5 Mcal/kg). Thirty kilograms of goat milk from each group (A and B) were collected from five days; 15 kg from each group were pasteurized (63 °C/30 min) and the other 15 kg each group proceed in raw, making 4 kinds of cheeses: 1) browsed-raw (BR), 2) browsed-pasteurized (BP), 3) indoor-raw (IR) and 4) indoor-pasteurized (IP). The milk was processed with a mix of 100 ml of the whey lactic bacteria saved from the previous day, adding 1ml of rennet (Cuamex). The milk was set at the same temperature (18-24 °C) to coagulate for 24h (Medina and Nuñez, 2004). After which, curd was scooped into cheese cloths for 48 h, hand salting was made, and a moulded for 24 h. Five samples of each kind of cheeses (500 g) were kept frozen at -80° C; before chemical analyses; the samples were thawed at 4° C.

Chemical analyses

Moisture, ash, nitrogen and gross energy were determined according to AOAC (2003) methods. Total cheese lipids were determined (Folch et al., 1957). Cholesterol was determined through gas chromatography (GC) using 5-α-cholestane as internal standard (Fenton and Sim, 1991), and a Varian 3400 CX chromatograph, using a DB-5 column. Fatty acids methyl esters (FAME) were determined through trans-estherification of cheese fat (AOAC, 2003) and quantified by GC using a CP-3380 equipped with a DB 23 column. A FAME mix internal standard (including EPA and DHA) was used (18919-1; Sigma-Aldrich). Conjugated linoleic acid (CLA) was determined using a mixture of isomers (9*cis*, 11*trans* and 10*trans*, 12*cis*) as standard (O5632; Sigma-Aldrich). Nitrogen was used as carrier gas. All samples were made by triplicate.

Statistical analyses

The results (gross chemical composition, fatty acid profile and CLA concentration) were analyzed with a completely random variance analysis in a 2 x 2 factorial arrangement. Comparison of the means (which ones, please explain) with a significant difference ($P<0.05$) was established by Tukey's test. All data were analyzed using the GLM for SAS program (SAS, 1997).

RESULTS

The gross composition in all cheeses did not show differences ($P>0.05$); however, the protein content was higher ($P<0.05$) in IP, that BR and BP cheeses. In relation to fatty acid profile, fifteen different fatty acid were higher ($P<0.05$) in browsing chesses than indoor cheeses; including essentials compounds as EPA, DHA fatty acids; and others important as CLA and stearic fatty acids. The total concentration of monounsaturated, polyunsaturated fatty acids were higher ($P<0.01$) in BR and BP than IR and IP cheeses. The value of Ω-3 and Ω-6 series fatty acids were higher ($P<0.05$) in browsing cheeses than indoor products (Table 1).

DISCUSSION

In 2004 Soryal and co-workers, determined the effect of feeding system (full confinement and grazing with supplementation) on protein and fatty acids in goat milk cheese; theirs results showed that the diet did not have a significant effect on cheese quality. In contracts, the result of this study showed that fed in browsing affected positively, the concentration of protein and important fatty acids as DHA, EPA and CLA. The CLA had been related with the inhibition of chemical-induced cancers of the mammary gland, stomach, colon and skin; inhibited also tumourigenesis in cell lines as lung adenocarcinoma, melanoma and nueroglioma in animal models (Gnädin et al., 2003). The CLA is formed in the rumen by anaerobic bacteria as an intermediate in the biohydrogenation of linoleic acid (LA), and from desaturation of vaccenic acid in the mammary gland via Δ9-desaturase (Tsiplakou et al., 2006).

CONCLUSIONS

Soft goat cheese nutritional quality was modified by the animal feeding system. Browsing represents an option to produce a healthy profile of fatty acids as EPA, DHA and CLA. Pasteurization did have a significant effect on cheese quality.

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Table 1 Chemical composition (g/100 g, DM) and FAME profile (mg/100 g of fat, DM) of soft goat's milk cheeses.

Topics	Kinds of cheese				SEM	*P*-value
	BR	**BP**	**IR**	**IP**		
Protein (N x 6.23)	30.5bc	28.4c	32.0ab	34.0a	0.79	*
Ash	3.9	5.1	4.7	5.1	0.23	NS
Energy (MJ/Kg)	23.2	22.8	23.0	23.6	0.04	NS
Total lipids	49.2	50.9	46.9	45.8	2.20	NS
Cholesterol (mg/100g)	155.5	187.9	185.8	204.5	46.7	NS
C6:0 Caproic	14.6	20.7	15.6	19.7	12.47	NS
C8:0 Caprylic	123.9	162.6	125.1	152.2	75.68	NS
C10:0 Capric	1072.4	1255.2	1169.2	1186.9	317.32	NS
C12:0 Lauric	623.5b	635.3b	786.7a	765.0a	69.04	*
C14:0 Myristic	2076.2	1951.1	1991.2	1863.8	176.39	NS
C15:0 Pentadecilic	263.1a	254.8a	174.8b	165.9b	27.59	**
C15:1	70.0a	62.3b	55.0c	51.5c	3.66	**
C16:0 Palmitic	6443.5a	6044.7a	4735.0b	4674.1b	567.27	*
C16:1 Palmitoleic	183.6a	184.9a	148.7b	145.6b	11.28	**
C17:0 Margaric	268.0a	247.9a	135.9b	127.3b	25.70	**
C17:1	119.7a	113.3a	61.3b	59.2b	12.34	**
C18:0 Stearic	2108.8a	1948.7a	1119.4b	1122.8b	188.35	**
C18:1 Oleic	6329.3a	5909.4a	3933.4b	3695.3b	476.8	**
C18:2 Linoleic (LA) Ω-6	610.6a	542.3a	447.7b	430.0b	40.09	*
C18:2 CLA Ω-6	166.6a	153.0a	66.6b	63.7b	10.65	*
C18:2 Linolelaidic	70.7a	65.7a	44.3b	33.9b	7.24	*
C18:3 Alpha-linolenic (ALA) Ω-3	240.1a	206.0ab	176.6bc	166.6c	19.6	**
C18:3 Gama-linolenic Ω-6	6.7a	5.2a	5.0a	4.9a	1.09	NS
C20:0 Arachidic	78.1a	67.9a	45.8b	41.4b	7.72	**
C21:0 Heneicosanoic	5.7a	4.5ab	2.8c	3.0bc	0.81	**
C22:0 Behenic	26.5a	23.0a	13.3b	12.9b	2.87	**
C20:2	6.3a	7.6a	6.7[a]	6.6a	1.37	NS
C22:1 Erucic	1.6c	1.9bc	2.1ba	2.5a	0.25	**
C20:3 homo-γ-linolenic Ω-6	5.6a	3.9b	3.9b	3.8b	0.84	*
C20:3 Ω-3	23.9a	19.3b	10.9c	9.8c	2.46	**
C20:4 Araquidonic (AA) Ω-6	51.4a	48.1a	37.2b	35.2b	4.04	**
C20:5 Timnodonic (EPA) Ω-3	20.3a	17.6a	13.5b	12.8b	2.20	*
C23:0 Tricosanoic	15.2a	11.9ab	7.1bc	6.4c	2.68	**
C22:6 Cervonic (DHA) Ω-3	9.8a	9.8a	5.6b	4.9b	0.71	*
C24:0 Lignoceric	13.3a	11.2a	6.9b	6.9b	3.42	**
Σ Saturated FAME	13163.1	12673.5	10432.0	10176.4	1008.9	NS
Σ Monounsaturated FAME	6728.0a	6291.2a	4213.4b	3966.9b	497.3	**
Σ Polyunsaturated FAME	1216.4a	1085.2a	822.2b	775.8b	76.9	**
Σ Ω-3	294.2a	252.9a	206.6b	194.3b	23.3	**
Σ Ω-6	845.8a	762.5a	567.2b	543.7b	51.4	**
Ratio Ω-6:Ω-3	2.884	3.017	2.747	2.810	0.15	NS

BR = cheese made from browsing goat raw milk, BP = cheese made from browsing goat pasteurized milk, IR = cheese made from indoor goat raw milk, IP = cheese made from indoor goat pasteurized milk. Means with different letters indicate differences between columns. SEM= standard error of the means. NS= Non significant (F test for full statistical model, P>0.05). **P*<0.005. ** *P*<0.001. FAME = Fatty acid methyl esters.

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