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FLAVOUR OF GOAT FARM BULK MILK

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SUMMARY

The flavour of goat farm bulk milk have been studied from 40 dairy herds of goats (Alpine-Saanen) selected among rearers from 2 dairy cooperatives in Poitou-Charentes (France). Two samples were collected in each herd and somatic cells counts (Fossomatic), physico chemical and sensory characteristics determined (n = 80).

The goat flavour intensity of bulk tank milks varies significantly : milks with strong goat flavour (n = 25) are produced in middle lactation and characterized, in average, by fat content significantly lower, somatic cells counts and free fatty acids contents higher than flock milks with weak goat flavour (n = 28). Influences of breed, herd size, pH, acidity and protein content of milk on the flavour are not significant. These results indicate a strong relationship between goat flavour and caprine fat in flock milk. Intensity level of milk flavour affects goat flavour of fresh acid curd cheese. However, differences between cheeses from milks with strong and weak goat flavour disappear during ripening : the biochemical phenomenons occurring during ripening contribute strongly to development of goat flavour in cheese ; their effects are preponderant in comparison with the effect of goat flavour intensity of milk.

KEYWORDS

Goat, milk flavour, milk composition, bulk milk, goat cheese

INTRODUCTION

Among features which allow to distinguish goat milk from milk of other species, physico-chimical, biochemical and nutritional characteristics are currently well recognised (Jenness 1980, Juarez and Ramos 1986, Grandpierre *et al.* 1988, Chandan *et al.* 1992). On the other hand, sensory characteristics of goat milk have been the subject of very few studies. Nevertheless the typical goat flavour is one quality components of particular importance to the cheese producer.

The most important investigations on the typical flavour of goat milk have been realized in Norway (Ronningen 1965, Skjevdal 1979, Astrup *et al.* 1985) : the variability in the specific flavour of individual goat milk has been demonstrated and a significant relationship between flavour and composition of milk is reported. The effects of free fatty acids content, animal related factors (age, stage of lactation, yield) and, to a lesser extend, type of feeding have been established.

The purpose of the present work was to assess goat milk flavour variability at herd level in intensive rearing system of the Poitou-Charentes Region, to compare flock milk characteristics according to the goat flavour intensity, and finally to evaluate the effect of goat flavour intensity of milk on goat flavour of cheese.

MATERIALS and METHODS

Goats farm bulk milk

Forty dairy herds of goats (Alpine and Saanen breeds) have been selected among rearers from 2 dairy cooperatives in Poitou-Charentes. Two samples were taken after an interval of 6 weeks from the bulk milk tank of each farm, after the morning milking (mixing of evening and morning milkings). The samples were put on ice in cooler and sent to the laboratory to be analyzed in the afternoon.

Milk analysis

Titrable acidity was determined using NaOH 0,111 N and following Dornic's method, pH with a WTW pH meter 196 (Bioblock, France). Milk composition (fat and protein contents) was evaluated using a Milko Scan 605 (Foss Electric, Danemark) and somatic cell counts (SCC) using a Fossomatic 360 (Foss Electric). Total solids (TS) was measured by the FIL method (FIL-IDF, 1987a) and the Free Fatty Acids (FFA) content by the automatized copper soap method according to Koops and Klomp (1977).

Cheese making and cheese analysis

Mould ripened soft cheeses (lactic curd type Crottin) were elaborated from raw milk according to the technological process described by Gay *et al.* (1993). Mean characteristics of packaged cheeses were : pH =

4,3, total solids : 34,6 %, Fat content = 15,9 %. The FFA content was determined on 7, 24 and 52 days old cheeses according to the FIL method (FIL-IDF 1987b).

Sensory evaluation

Sensory evaluations were conducted in a light and temperature controlled panel room (NF 09-105). Milk analyses were realized by a group of 10 to 12 subjects, experienced tasters working in goat milk production or processing industry ; milk samples for tasting were coded and served in random and different order for all subjects, under red light at 20°C. Cheeses analyses were realized by a group of 12 subjects trained in the judging of goat cheeses and experienced tasters ; cheese samples were served in the same conditions than milk samples under white light at 14°C.

Goat flavour and goat odour intensities were assessed on scale of 0-10 where the higher numbers represent more intense goat flavour or odour.

The statistical analysis of the results was performed using STATITCF (ITCF - Version 3 copyright 1987, Boigneville, France).

RESULTS and DISCUSSION

Herds and (farm bulk) milks characteristics

Distribution of the herds according to their dairy production levels and breeds are shown in Table 1. In average, the production level is near 90 000 l/year and corresponds to a mean herd of 140 to 150 goats. Mean lactation stage of herds at the takings date varies between 1 and 9 months (4,3 ± 1,7 months in average).

Physico-chemical, biochemical and sensory characteristics of milks are shown in Table 2 : farm bulk milks don't reveal typical odour ; on the other hand, goat flavour is detected and its intensity varies significantly. These results suggest that in intensive production system, goat flavour intensity of farm bulk milk presents an important variability between herds, whatever breed (Alpine or Saanen) or herd size.

Comparison of milks characteristics according to goat flavour intensity

Farm bulk milks samples (n = 80) have been classified and divided into 3 groups according to their goat flavour intensity. Mean characteristics of the 3 groups have been compared (Table 3).

Milks with a strong goat flavour (n = 25) are produced in the middle of lactation ; in comparison with milks with a weak goat flavour (n = 28), they are characterized by a significant lower fat content, and a significant higher free fatty acids and somatic cell contents. Influences of breed, herd size, pH, acidity and protein content of milk on goat flavour are not significant.

Goat flavour intensity is influenced by the mean stage of lactation of herd and negatively linked to milk fat content. These observations realized at herd level are in accordance with the results achieved at animal level by Ronningen (1965), who suggests the existence of a positive genetic correlation between goat flavour and milk yield and negative genetic correlation between goat flavour and fat percentage of milk. Furthermore, the relationship observed between goat flavour and free fatty acids content of farm bulk milk confirms the results of several Norvegian works realized at animal level (Bjoerke and Gaisberg 1976, Bakke *et al.* 1977, Astrup *et al.* 1985). Higher FFA content observed in milk with strong goat flavour can be explained by a more important lipolytic activity in this milk (Bakke *et al.* 1977). This phenomenon could result from the presence of higher quantities of leucocyte enzymes (proteases, lipases) associated with higher somatic cells content in the milk. Moreover, differences in free fatty acids content could reflect physiological changes of lipoprotein-lipase activity in goat milk (Chilliard and Morand-Fehr 1978).

Effect on goat flavour of cheeses

Three cheesemaking series have been realized with farm bulk milk from herds of C group (milk with strong goat flavour) and A group (milk with weak goat flavour). Development of goat odour and goat flavour in cheese during ripening is shown in Figure 1.

Fresh acid curd cheeses from milk with a strong goat flavour were found to have a stronger goat odour and goat flavour, and a higher FFA content than cheeses from weakly goat flavoured milk, respectively + 23 %, + 17 % and + 40 %. These observations are in accordance with the results of Fyksen and Steinsholt (1974) and Bakkene and Steinsholt (1975) achieved on white cheese and whey cheese. During ripening of cheeses, FFA content increases ; in the same way, goat odour and flavour intensities are developing, and differences observed between the 2 groups of cheeses at the first stage (fresh curd) disappear. These results indicate that goat flavour intensity of milk have an effect on flavour intensity of cheeses with low FFA content (< 1 g OA/100 g Fat). For cheeses with higher FFA content (> 2 g OA/100 g Fat), the complex biochemical

phenomenons occurring during ripening and particularly lipolysis, contribute strongly to the development of goat flavour in cheese ; their effects are preponderant in comparison with the effect of goat flavour intensity of milk.

The present work clearly demonstrate the relationship between goat flavour intensity and caprine fat characteristics (total content and level of lipolysis) in farm bulk milk and goat cheese. These informations will allow to contribute to define criteria for quality evaluation of goat farm bulk milk intended to collection, with a view to improve sensory quality of dairy goat products.

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Table 1. Distribution of herds according to breeds and dairy production

Dairy production (10^3 l/year)	Number of herds	Dairy breed	Number of herds
< 50	8	Alpine	11
50 à 75	8	Saanen	17
75 à 100	10	Predominant Alpine	6
100 à 125	6	Predominant Saanen	5
> 125	8	Poitevine	1

Table 2. Mean characteristics of goat farm bulk milks (n = 80)

		Mean	Standard deviation	Minimal value	Maximal value
Acidity	(°D)	13,2	1,2	11,0	16,0
pH		6,76	0,12	6,47	6,98
Total solids	(g/kg)	114,0	6,2	103,5	145,6
Fat content	(g/l)	33,0	3,6	25,5	39,8
Protein content	(g/l)	28,9	1,7	24,4	32,7
FFA content	(g OA/100g Fat)	0,39	0,44	0,10	2,96
SCC	(10^3 cel/ml)	913	444	385	3 679
Goat odour	(score/10)	1,6	0,8	0,5	4,2
Goat flavour	(score/10)	3,7	1,3	1,8	8,0

Table 3. Comparison of mean characteristics of farm bulk milk according to goat flavour intensity

Groups		A	B	C	s
Goat flavour	(note/10)	2,4	3,6	5,3	***
n		28	27	25	
Stage of lactation	(month)	4,0a	4,2ab	4,8b	*
SCC	(10^3 cel/ml)	722a	924b	1113b	**
pH		6,78a	6,75a	6,74a	NS
Acidity	(°D)	13,3a	13,2a	13,1a	NS
Total solids	(g/kg)	115,0a	114,4a	112,4a	NS
Protein content	(g/l)	28,8a	29,2a	28,7a	NS
Fat content	(g/l)	33,6a	33,4ab	31,8b	*
FFA content	(g OA/100g Fat)	0,30a	0,34ab	0,55b	*
Goat odour	(score/10)	1,5a	1,6a	1,6a	NS

a, b, c = homogeneous groups.
s = level of significance : NS = no significantly different ; *, **, *** = significant at 5 %, 1 % and 0,1 % level.

Figure 1. Evolution of free fatty acids content of goat odour and goat flavour intensity of Crottin cheese during ripening (mean values from 3 trials)