An effort to improve the organoleptic properties of a soft cheese from rustic goat milk

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Abstract An investigation was carried out to reduce the unpleasant flavour of a soft cheese obtained from milk of rustic non-selected goats. To this purpose, goat milk fat was transesterified with unsaturated fatty acids (C_{18:1} and C_{18:2}) using an immobilised lipase and was then reincorporated into the partly skimmed milk. Two curdlings (one test and one control with unmodified milk) were then performed in the laboratory and the effect of fat reincorporation was evaluated by comparing the main constitutive parameters characterising the obtained cheeses, with particular reference to the lipid fraction and to the organoleptic properties. The findings demonstrated a significant decrease in the total amount of short and medium chain fatty acids (C_{4:0}–C_{14:0}) and also a significant increase in the total content of C_{18:1} plus C_{18:2} both in triglycerides and in free fatty acids of test cheese. The data obtained, as well as the results of a panel test, indicated that the organoleptic properties of test cheese were improved.

Key words Goat cheese · Fatty acid composition · Transesterification · Cheese flavour

Introduction

The use of goat milk has increased in the past few years so much so that it is currently being introduced in the human diet as an alternative to cow milk. Almost all the goat milk produced in Italy is processed into cheese mainly by means of non-industrial technologies. The demand for goat cheese is also rising quite considerably, especially among gourmets and consumers of health and diet products [1], due to its high nutritional value in terms of proteins and fat [2]. In addition to this, whey proteins, present in cheeses in which curdling is preceded by strong heating of the milk, further contribute to enhance the nutritional properties [3] and were found to be highly correlated with taurine [4], involved in important physiological functions especially in the new-borns [5–8]. Finally, whey proteins bind to the surface of fat globules when the milk is heated at temperature higher than 65 °C [9].

It is well known that goat milk products have a typical flavour due to the presence of short chain fatty acids [10–12]. This flavour is more prominent, and in certain case is considered unpleasant, when the milk comes from rustic goats or goats close to their dry period [13]. In Southern Italy, goat milk mainly comes from rustic non-selected animals and the cheeses obtained from their milk present a strong pungent-hircine flavour, perceptible after production and increasing during ripening. For this reason, goat milk from these animals is blended with cow milk and the cheese obtained is sold after a very short ripening period to reduce the unpleasant flavour and to permit easier marketing.

In a previous investigation [14] a method to modified the triglyceride fraction of goat milk fat by transesterification using an immobilised lipase and oleic and linoleic acids was set up to diminish the amounts of short and medium chain fatty acids. After transesterification the saturated/unsaturated fatty acid ratio was 0.85 as compared to the baseline value of 3.12. In particular, the percent sum of the oleic and linoleic acids was observed to exceed 50% at the end of the treatment while the initial percent sum had been 21.76%; concomitantly, a 40% decrease was noticed in the short and medium chain fatty acids (C_{4:0}–C_{14:0}) as their percent sum dropped from 36.88% (0 h) to 22.63% (6 h).
In this investigation we attempted to reincorporate goat milk fat, transesterified in this way, into the corresponding partly skimmed milk of rustic non-selected goats, after heat treatment. A curdling was then performed to obtain a very short ripening cheese with the aim to reduce the unpleasant flavour without adding other kinds of milk. The effects of this procedure on the main constitutive parameters characterising the cheese, with particular reference to the fatty acid composition as well as to the organoleptic properties, were evaluated against a traditionally processed control product.

**Materials and methods**

**Milk**

Samples taken from homogenous milk mixtures of rustic non-selected goats were used for the study.

**Transesterification reaction**

The transesterification reaction was run for 6 h with lipozyme IM (Novo Nordisk) as reported in a previous paper [14]. The activity declared for this lipase was 5–6 Batch Acidolysis Units (BAUN) with a moisture content of 2–3%. Fat obtained from goat milk by centrifugation was separated from the aqueous phase through a separating funnel, vacuum dehydrated in a rotary evaporator, and finally transesterified. The reactants used were: 160 mg of lipozyme IM, 400 mg of oleic acid, 250 mg of linoleic acid, 10 ml of hexane, per g of dehydrated fat. The incubation was carried out by shaking in a thermostated water bath at 40°C. When the 6 h were over the mixture was paper-filtered; the filtrate was neutralised with 0.1N NaOH and repeatedly washed under distilled water to remove saponified free fatty acids. After solvent removal the transesterified fat was reincorporated in a partial skimmed milk to prepare the test cheeses.

**Sample preparation**

Goat cheese was processed in the laboratory following the technological scheme reported in Fig. 1. For the test product, each batch of goat milk was pasteurised at 95°C for 1 min, subsequently cooled at 40°C and submitted to centrifugation at 1500 rpm for 5 min with a Beckman centrifuge to remove 1% of fat. At this point, 1% of transesterified goat fat was added to the partly skimmed milk thus obtained. The reconstituted milk was homogenised with an ultra-turrax for 1 min and a liquid calf rennet (1:10,000 per 0.5 ml/l of milk) was added and a 7-min clotting time observed. After 20 min pause, the whey was removed and the curd was placed in plastic basket-shaped moulds. The control product was prepared with the same unmodified goat milk as illustrated in Fig. 1 (continuous lines). A total of three test curdlings and three control curdlings were prepared from 2 l of milk and the corresponding cheese was analysed 12 h after production. The preliminary heat treatment of the milk did not seem to influence the curdling process [15].

**Milk, whey and cheese analysis**

The amounts of total nitrogen and of non-protein nitrogen (NPN), corresponding to the fraction of nitrogen soluble in 15% TCA (trichloroacetic acid), were measured using the Kjeldahl technique while moisture was determined according to the official analytical methods [16]. The amount of fat present in the milk and in the whey was determined by the butyrometric method, in the latter case using a whey butyrometer with a scale ranging from 0 to 0.5%. The extraction of total free fatty acids and their qualitative and quantitative determination was carried out as described by De Felice et al. [17]. In particular, total free fatty acids were recovered by liquid-liquid extraction utilising diethyl ether/petroleum ether b.p. 40–60°C (1:1, v/v) as extraction solvent. The ether extract, with an ethanol/water solution (4:1, v/v) added, was brought to pH 10.0 with NaOH solution: soaps, once separated and concentrated, were methylated directly in a glass flask with 6% anhydrous HCl in methanol and subjected to gas chromatographic analysis utilising the methylundecanoate as an internal standard. Fat was extracted from the cheese by the Soxhlet method while fatty acid compositional analysis was performed by chromatography as reported by Caponio et al. [14]. The free amino acids were extracted and purified from the cheese according to the method.

**Fig. 1** Technological scheme of goat cheese processing. The phases *joined by continuous lines* are related to the control cheese while the phases *joined by broken lines* represent the changes introduced for the test cheese.