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Characterisation of "Sicilian Cheese" made from the milk of Sicilo-Sarde breed ewes in the North West of Tunisia

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Abstract. For about one century, "Sicilian Cheese" has traditionally been made in the North West of Tunisia, using milk from Sicilo-Sarde breed ewes (SSE). Recently, some small manufacturers started to make it industrially. In the current study we tried to characterize this cheese as produced using the traditional way (TC) or following small scale industrial methods (IC). The study concerned a farmer producing cheese from his own SSE milk and a small manufacturer in the region of Tunis (100 km far from Béja). In each case, milk was characterised chemically. Both processes of cheese making were described. Cheeses obtained were compared on the basis of yield (G), chemical composition, microbiological and sensory attributes. For all measurements three replications were carried out through three successive trials. The milk used in the two processes was chemically comparable. Output in TC was comparable to IC (averaged 30.5). Dry matter and fat were higher in IC, while higher protein contents were observed in TC ($P < 0.05$). Better hygienic conditions, mainly for coliform and lower microbial contamination, mainly for moulds and yeast were noted in IC ($P < 0.001$). Sensory analysis revealed significant differences between TC and IC. Indeed, TC has a marked yellow colour ($P < 0.05$), better taste ($P < 0.01$) and aromatic intensity ($P < 0.01$). It was concluded than Sicilian traditionally-made cheese could be identified as a labelled product if some improvements in hygienic practices are applied at different steps of milking and cheese manufacturing. A marketing strategy is needed to ensure the promotion of this cheese.

Keywords. Cheese – Sicilo-Sarde – Ewes – Tunisia.

Caractérisation du fromage Sicilien fabriqué à partir du lait de brebis de race Sicilo-Sarde au Nord-Ouest de la Tunisie

Résumé. *La fabrication artisanale du fromage "Sicilien", à partir du lait de brebis Sicilo-Sardes (BSS), est pratiquée depuis une centaine d'années dans la région du Nord-Ouest Tunisien. Actuellement, nous assistons à la production de ce type de fromage par de petites unités industrielles. Dans la présente étude, nous avons tenté de caractériser le fromage "Sicilien" et les techniques utilisées dans les conditions de production traditionnelles (TC), et industrielles (IC). Cette étude a porté sur une ferme de la région de Béja, qui fabrique du fromage "Sicilien" à partir du lait de BSS produit sur place (CT), et une petite unité industrielle (CI) située dans la région de Tunis (à 100 km de Béja). Pour chaque condition de production étudiée, nous avons conduit trois essais de fabrication de fromage. Nous avons caractérisé la composition chimique du lait utilisé, les techniques de production, et les caractéristiques du fromage. Les fromages produits ont été comparés sur la base des rendements fromagers (G), composition chimique, qualité microbiologique et sensorielle. Les mesures de ces caractéristiques sont répétées trois fois. Les laits utilisés dans les deux modes de production ont une composition chimique comparable. Le rendement fromager (G) n'est pas affecté par le mode de production (30,5 en moyenne). Les teneurs en matières sèche et grasses sont les plus élevées pour le fromage TC. La teneur en protéines est la plus élevée pour le fromage IC ($P < 0,05$). Des taux plus faibles de coliformes, levures et moisissures ont été dénombrés dans les fromages IC, indiquant une légère amélioration des conditions d'hygiène. Les caractéristiques sensorielles des fromages IC et TC sont significativement différentes. En effet IC a les notes d'intensité de la couleur jaune et les caractéristiques aromatiques les plus élevées ($P < 0,05$), et les notes plus élevées ($P < 0,01$). Nous avons conclu que le fromage Sicilien traditionnel pourrait faire l'objet d'une démarche visant à lui donner une dénomination permettant de l'identifier. Avant d'entreprendre cette démarche, des efforts doivent être déployés pour améliorer les conditions d'hygiène de production et de commercialisation de ce fromage.*

Mots-clés. *Fromage – Sicilo-Sarde – Brebis – Tunisie.*

I – Introduction

Sicilo-Sarde ewe (SSE) breed was introduced in Tunisia in the early of 18th century by Sicilian farmers in the North West region (Jolivalt, 1990). Currently, this breed is still considered as the main dairy sheep reared around the city of Béja, where it is integrated in two feeding systems. Grazing period could be applied either during summer and autumn after wheat harvest in the large plains, or during the winter and spring in the mountains when the grass is more abundant (Ben Youssef, 2005). After weaning, the milk is used for cheese making, either traditionally in the area of Béja, by local farmers or artisans, to produce a called "Sicilian" cheese and Ricotta, or industrially in the area of Mateur, to produce many other kinds of identified-trade mark cheeses. The traditional "Sicilian" cheese and/or Ricotta are very famous for Tunisian consumer. The demand of these products is particularly high during spring, and occasionally during the Holly month of Ramadan. During these periods, the demand of traditional Sicilian cheese cannot be afforded only by local farmers. Consequently, some small manufacturers, using industrial processing techniques, started to produce a "Sicilian" type cheese. They tried to improve the traditional processing techniques, keeping the main characteristics of the original "Sicilian". However, there is no any identification or quality labelling distinction between the two types of "Sicilian" cheeses.

The aim of this study was to determine the main criteria that could be used to identify and to label the traditionally-made "Sicilian" cheeses in the North West of Tunisia. In this paper we analyzed the main quality criteria of the milk used in both conditions (traditional and industrial) and tried to characterize the process of cheese making procedures. Finally we characterized the cheese made in both conditions and compared them to each other.

II – Materials and methods

In order to characterize milk processing conditions used to produce "Sicilian" cheese, from SSE milk, we considered two kinds of production systems, traditional, and industrial. The traditional conditions (TC) are those used by a farmer in the region of Béja producing cheese from his own folk. In the industrial small scale conditions (IC), the SSE milk was collected from many farms in the region of Béja, and processed in a small factory in the region of Tunis, at about 100 km from Béja.

Two different lots of SSE milk are used in this experiment and processed either in the industrial or traditional cheese-makings. In the last case, the SSE milk was collected from a farm in the region of Béja, and processed in a traditional way in the same farm. Before processing the two different milks were analyzed.

Processing steps and conditions are characterized by describing the run time, and the temperature changes from milk to the end product according to FAO/OMS (1978). For each step we identified all the used ingredients and measured the critical parameters. Three trials were carried out using 100 l of SSE milk for each processing condition. Parameters were measured in triplicate on produced cheese.

The chemical composition of milk and cheese is determined using official methods of dry matter (NT 14-110, 1897), ash (NF V 04-208, 1989), protein (NF V 04-21, 1989), and fat content (NF V 04-210, 1990). Microbiological status of the cheese consisted in counting different types of germs using usual methods for moulds and yeast (ISO 6611, 1992), *coliforms* (ISO 5541, 1992), and total flora (ISO 6610, 1992).

Sensory quality was evaluated using the Sensory Analysis Methodology (ISO-5495, 1983). Measured criteria of both traditional and industrial cheeses are colour intensity (yellowness), flavour (milky, sweetness, acidic, bitterness) and smell (milky, creamy, and ammoniac). They were appreciated by ten initiated referees using a five class's scale intensity for each considered criteria. The General Linear Model procedure (GLM) of SAS (1985) was used to analyze data. Duncan multiple range tests were used to compare treatment means.

III – Results and discussion

1. Milk used for "Sicilian" cheese processing

As indicated in Table 1, SSE milk used to produce the Sicilian cheese in TC was comparable to that used by the manufacturer who produced the cheese in IC. SSE milk composition is comparable to those given for other Mediterranean breeds by Bocquier and Caja (2001).

Table 1. Characteristics of milk used to produce cheese in traditional (TC), industrial conditions (IC)

SSE milk characteristics	TC	IC	Average	SE
Acidity (°D)	23.24	24.27	23.76	0.73
pH	6.79	6.56	6.68	0.68
DM (g %)	16.92	17.66	17.29	0.12
Ash (g %)	0.94	1.10	1.02	0.54
Fat (g %)	7.04	7.55	7.30	0.11
Total nitrogen content (g %)	5.45	5.83	5.64	0.37

2. Sicilian cheese processing steps and conditions

Detailed information on processing steps and conditions applied to produce traditional and industrial "Sicilian" cheese are given in Table 2. Cheese processing steps and conditions applied in IC are different from those applied in TC. IC processing comprised one added step compared to TC, due to milk pasteurisation at 72°C during 16 sec. Differences between I and T conditions are observed at the level of coagulum cutting mechanically to smaller grains in IC than those of TC. Water is added after in IC and before racking in TC. Cheese is moulded in plastic boxes and pressed mechanically in IC. These steps are made by hand in straw baskets for TC. Cheese main production steps are comparable to those described for other Mediterranean ewe milk cheeses (FAO/OMS, 1978; Mahaut *et al.*, 2000). Production steps and conditions of "Sicilian" cheese applied in TC are very similar to those described for some typical Sicilian cheeses produced in Santo Stephano called "Fromaggi canestrat fresci" (Comune di Santo Stephano, 2005). These conditions could be inherited from the original Sicilian farmers who initially produced this cheese in Tunisia by the 18th century.

3. Sicilian cheese composition, microbial and sensory characterization

Characteristics of the Sicilian Cheese processed in TC and IC conditions are given in Tables 3, 4, 5 and Fig. 1. These data indicate that processing output (G) is identical for TC and IC (7). Dry matter and fat were higher in IC, while higher protein contents were observed in TC ($P < 0.05$). Better hygienic conditions, mainly for coliforms and lower microbial contamination, mainly for moulds and yeast were noted in IC ($P < 0.001$). Sensory analysis revealed significant differences between TC and IC, see Fig. 1. Indeed, IC has marked yellow color ($P < 0.05$), better taste ($P < 0.01$) and aromatic intensity ($P < 0.01$). Some off flavours (ammonia, bitterness, acid) are particularly detected in TC. These components could be linked to the microbial contamination and the fermentation process that occurred during cheese the storing period. Hence, the main criteria we can easily use to distinguish between TC and IC, are colour, taste, and even by its typical shape.

IV – Conclusions

"Sicilian" cheese processed using SSE milk in traditional conditionsis markedly different from that produced in the small scale industrial conditions. The main differences between IC and TC are due to milk processing steps and conditions.

Milk pasteurisation is the main added step in IC compared to TC. This step improved the microbial status of the cheese, diminished the off flavour intensity, and enhanced its storing duration. These three conditions are the limiting factors for TC marketing. Some differences between TC and IC are also apparent in the chemical components of the cheese. The criteria we can use to distinguish between the IC and TC are mainly colour, taste, texture and shape.

Sicilian traditionally-made cheese could be identified as a labelled product if some improvements in hygienic practices are applied at different steps of milking and cheese manufacturing. A marketing strategy is needed to ensure the promotion of this cheese.

Table 2. Processing steps and conditions applied to produce traditional (TC) and industrial (IC) cheese

Processing steps	Conditions	TC	IC
Pasteurisation	Temperature	Not applied	72°C
	Run-time		16 sec
Coagulation	Rennet f: 1/10000	65 ml/100 kg milk	35 ml/100 kg milk
	$CaCl_2$	No	15 ml/100 kg milk
	Setting time	5 min	7 min
	Run-time	45 min	30 min
	Temperature	33°C	32°C
Cutting of the curd	Mode	Manuel	Steel rotation
	Run-time	2 min	12 min
	Temperature	24°C	25°C
	Grains size	<1 cm	< 0.5 cm
Washing off lactose	Added water	25% pan volume	Not applied
	Run-time	4 min	
	Water temperature	38°C	
	Milk temperature	32°C	
Mixing 1	Run-time of the cycle	5 min	10 min 5 min resting
	Temperature	28°C	22°C
Racking	Run-time	5 min	5 min
	Temperature	23°C	20°C
	Lacto serum volume	100% volume	30% pan volume
Lactose washing off	Added water	Not applied	30% pan volume
	Run-time		6 min
	Water temperature		55°C
	Milk temperature		40°C
Mixing 2	Run-time	Not applied	7 min
	Temperature		36°C
Moulding	Mode	Ladle	Ladle
	Moulds	Rush straw basket	Plastic box
Pressing	Mode	Manuel	Pressing machine
	Run-time	5 minutes	11 min
	Temperature	19°C	25°C
Draining off	Run-time	1 hour	10 hours
	Temperature	19°C	22°C
Heating/Cooking	Mode	Pulling hot water	Not applied
	Water temperature	89°C	
	Run-time	2 min	
	Cheese temperature	43°C	
Draining off	Run-time	10 hours: 30°C	10 hours
	Temperature		
Storing	Ripening	Not applied	Not applied
	Time, temperature	10 days, 4°C < T < 8°C	22 days at 4°C < T < 8°C
Yield	G (g)	7	7
	kg/100 kg milk	31	30

Table 3. Chemical characteristics of traditional (TC) and industrial (IC) Sicilian cheese

Chemical characteristics†	TC	IC	Average	SE
pH	6.33a	6.66a	6.49	0.23
DM (g %)	45.4a	46.8b	46.10	0.98
Ash (g %)	1.9a	2.1a	2.00	0.01
Fat (g %)	22.7a	23.5b	23.10	0.57
Total nitrogen content (g %)	23.3a	22.5b	22.90	0.56
FFDM	22.8a	23.3a	23.05	0.35
FAT (%DM)**	49.9a	50.2a	50.00	0.21
H (%FFC)*** (%)	76.1a	72.1b	74.10	1.87

†FFDM: fat free dry matter. H (%FFC): humidity (% of fat free cheese.
a, b: values with different letters in the same line are different.
**P < 0.01; ***P < 0.001.

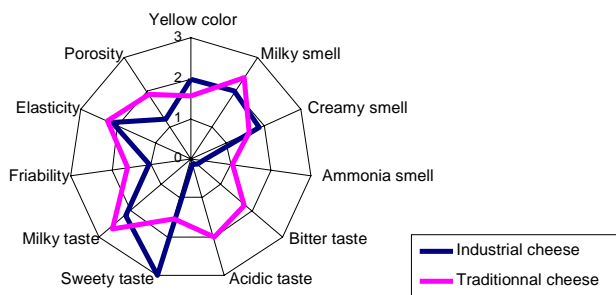**Table 4. Microbial characteristics of traditional (TC) and industrial (IC) Sicilian cheese**

Microbial criteria	TC	IC
Total count flora (UFC)	6.4 10^7	2.4 10^7
Moulds and yeasts****	1.6 10^{3}a	5.0 10^{3}b
Coliforms****	1.2 10^{5}a	0b
Storing conditions	10 days, at 4℃ < T< 8℃	22 days, at 4℃ < T < 8℃

a, b: values with different letters in the same line are different.
****P < 0.001.

Table 5. Sensory characteristics of traditional (TC) and industrial (IC) Sicilian cheese

Cheese characteristics	TC	IC
Type	Spineless	Spineless
Weight	0.7 kg	0.5 kg
Shape	Cylindrical	Cylindrical
Size	Ø: 16.5 cm – H: 6 cm	Ø: 9.5 cm – H: 7 cm
Aspect	Compact pile	Compact pile
Texture	Tough-hard	Tough-hard
Color	White	White

Fig. 1. Sensory profile of traditional (TC) and industrial (IC) Sicilian cheese.

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