



## SENSORY EVALUATION OF GOAT MILK CHEESE UNDER DIFFERENT FREEZING CONDITIONS

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**Abstract:** *The purpose of this paper is to investigate the effects of different freezing treatments on textural and sensorial characteristics of goat cheese in order to explore the possibility of storing for a longer period of time. Goat cheese samples were prepared from raw goat milk and treated under four different freezing methods: 1) natural convection of air (-20°C); 2) deep freezing (-70°C); 3) immersion in eutectic solution of NaCl 23% and 4) cryogenic freezing using liquid nitrogen and compared with a control sample kept at 4-6°C. After freezing, the samples were stored for 3 months at -18...-20°C then they were thawed and stored for 14 days at 4...6°C. The textural and sensory aspects were undertaken using 12 panelists. At the end, the samples were classified, depending on the score obtained from good to unsatisfactory.*

**Keywords:** *goat cheese, freezing methods, long term storage, sensorial aspects.*

### 1. Introduction

The goat milk and cheeses are considered ideal foods for their high nutritional value due to its higher digestibility, its dietary characteristics with smaller diameter fat globules, density, variety, availability, good taste and affordable price [1, 2].

Many of cheese characteristics such as flavor and texture are determined by the spatial arrangement of the main compounds including: casein particles which form the proteic matrix, fat globules, the dispersed water and minerals [3]. Changes that occur under different freezing conditions can alter the curd protein's micro-structure and thus can degrade the functional properties of the final product. The sensorial and textural perception (sensory perception of cheese structure) [4], represents a very important analysis for dairy products especially for cheeses.

Sensory quality of food refers to a set of characteristics such as appearance, colour, taste, smell, aroma, texture and auditory properties [5].

Sensory analysis techniques have developed into a powerful tool for understanding how the appearance, flavor and texture attributes of dairy products drive the consumer preferences [6].

The aim of this research is to evaluate the potential changes of the texture and sensorial characteristics of frozen goat cheese samples through human perception.

### 2. Materials and methods

#### 2.1. Preparation of goat milk curd-style cheese

The raw whole milk was acidified by its native microbiota. The coagulation

process of milk took place at 32<sup>0</sup>C by adding about 1, 5 % of commercial calf rennet (strength 1/10000). The coagulum was cut into pieces (8 -10 mm cubes). The coagulum was left to stand for 45 minutes to remove the whey, then transferred into the cotton bags for drainage. The draining was done after 5 hours at 20<sup>0</sup>C.

### 2.1.1. Sampling

The blocks of curd – style cheese weighing 2 -2.5 kg were divided into

samples with dimensions of 50 × 40 × 25 mm (approximately 50 g). The samples thus prepared were subjected to vacuum prepackaging or directly freezing according to freezing method.

### 2.2. Set up of the freezing methods

The freezing procedures used are presented in Table 1.

**Table 1.**

**Characteristics of freezing processes**

Freezing procedures	CODE	Parameters of Freezing Processes					Freezing type	Equipment
		$t_{room,0}$ [°C]	$t_{i, sample,0}$ [°C]	$t_{f,0}^*$ [°C]	$w_c$ [cm/h]	$\tau_c$ [h]		
Freezing by natural convection of air -20 <sup>0</sup> C	<b>MCL</b>	-20...-22	6...8	-20	0.45...0.5	5.5	Slow	Home freezer
Deep freezing -70 <sup>0</sup> C	<b>QAC</b>	-70	6...8	-25	1...1.5	2.5	Fast	Superfreezer ANGELANTONI-INDUSTRIES
NaCl 23% solution (Eutectic solution)	<b>RQA</b>	-15	6...8	-15	3.3...4	0.5-0.6	Very fast	Immersion freezing (direct contact with samples)
Cryogenic freezing	<b>SBT</b>	-196	6...8	-25	15...20	0.15-0.18	Ultra fast	Cryogenic freezer (Cryogen sprayed on samples)
Control sample	<b>PRS</b>	-	4...6	-	-	-	-	Refrigeration

$t_f$  - freezing temperature, °C;  $t_{i, sample}$  - sample initial temperature, °C  $t_f$  - sample final temperature, °C;  $w_c$  - average freezing rate, cm/h;  $\tau_c$  - average freezing time, h.

### 2.3. Sensory and texture analysis

The sensory evaluation was performed by 12 panelists [7, 8]. The textural profile included the following properties:

springiness (ability to recover its initial thickness rapidly after compression and deformation), firmness (resistance that the sample presents with small displacements of the jaws), friability (ability to generate

several pieces from the beginning of chewing), deformability (ability of the sample to deform successively or stretch easily before breaking the sample in the oral cavity), adhesiveness (moving the tongue to detach the sample stuck in the palate or teeth), and cohesiveness (firmness of the internal joints in the cheese sample) [9, 10]. To determine the fully sensorial profile the following attributes has been used: external appearance, section appearance, odor, taste, colour and consistency.

Sensory analysis was organized according to STAS 12656-88: Sensory Analysis. Method of scoring scales [11]. A continuous, one (minimum) to five (maximum), scale was used to estimate the felt intensities for each attribute.

Global sensorial qualities of frozen goat milk cheese samples were evaluated by comparison between samples using a 20 points scale.

Table 2.

Correlation of average score with total qualifying	
Average score	Total qualifying
18.1.....20	Very good
15.1...18	Good
11.1.....15	Satisfactory
7.1.....11	Unsatisfactory
0...7	Inadequate

### 3. Results and discussion

#### Sensory analysis

The SBT (freezing at  $-70^{\circ}\text{C}$ ) and QAC (cryogenic freezing) samples had greater values for elasticity than the control sample (PRS) (Fig. 1). This allows us to appreciate that the rapid and ultra-rapid methods of freezing which generate small crystals of ice into [10, 11], extra- and intracellular space, do not adversely affect the textural characteristics but it could improve some of these (such as elasticity). Significant changes of hardness have been observed for the RQA sample (frozen in salt solution), which was the least appreciated by the evaluators in the terms of all textural parameters. The lowest score awarded by evaluators to RQA sample, may have been due to very high concentrations of salt, about 3.8%. The cheese texture could be affected by the high salt concentration by changing the moisture content, the casein structure and interactions of calcium-p-caseinate-

phosphate complex [12]. The high salt content from RQA samples had unfordable consequences on all attributes. The panelists consider that sample to be undesirable for consumption (Table 3). As we expected, control sample recorded the highest score. However, the score obtained demonstrate that goat cheese sample treated under cryogenic method (SBT) and cheese sample treated under  $-70^{\circ}\text{C}$  (QAC) doesn't change their quality attributes especially external appearance, section appearance. Fast freezing methods have little or no effect on the external appearance of the samples because the freezing process took place quickly and the ice crystals formed were small and uniform. Cheese sample frozen under conventional procedures ( $-20^{\circ}\text{C}$ ) obtained a medium score ( $\sim 3.5$ ).

After correlations of the obtained scores by panelists the analyzed samples were classified as follow in Table 3.

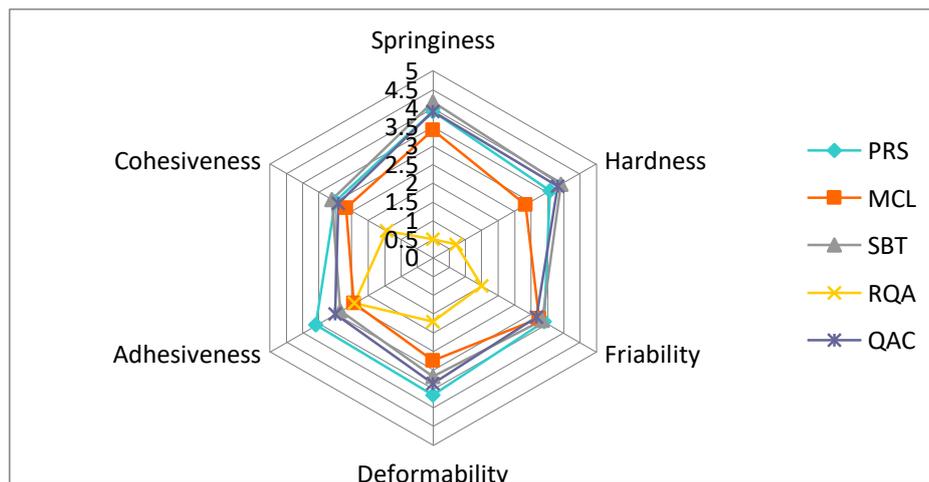


Fig. 1. Graphical representation of scores obtained for textural characteristics of goat milk cheese samples after freezing procedures

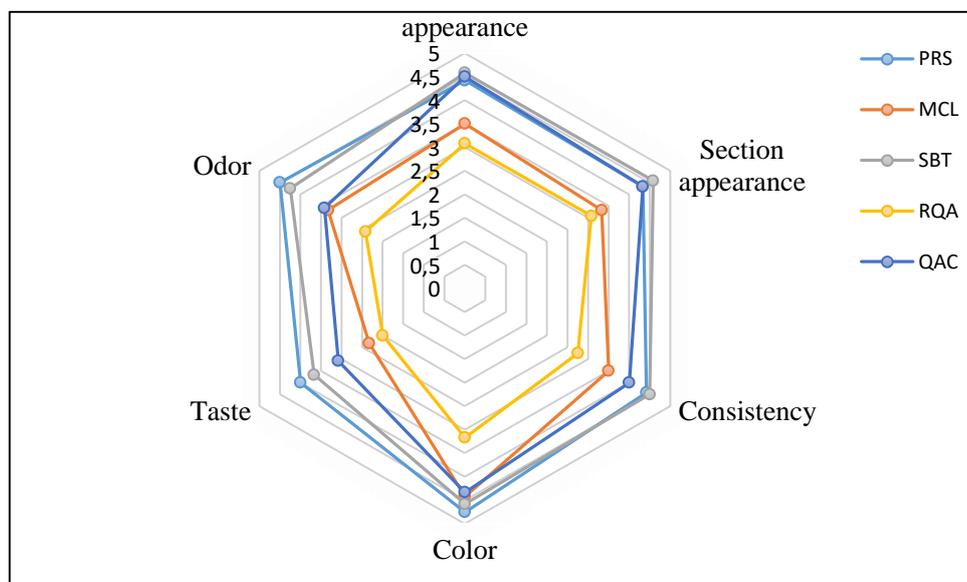


Fig. 2. Score of sensory attributes of goat milk cheese samples after freezing procedures

Table 3.

Correlation of the average score with the total qualifying for the analyzed samples			
PRS	Control	17.518	Good
SBT	Frozen at -70°C	16.816	Good
QAC	Liquid nitrogen	14.730	Satisfactory
MCL	Frozen at -20°C	13.094	Satisfactory
RQA	Frozen in NaCl 23%	10.238	Unsatisfactory

#### 4. Conclusions

Conventional freezing by natural convection of air at  $-20^{\circ}\text{C}$  determined several changes which affect sensorial aspects.

The high score obtained by deep freeze sample demonstrates that the frozen rate and temperature have a major impact on sensorial aspects.

After the analysis of textural aspects, it was found that the samples have not suffered significant textural changes except the goat milk cheese sample frozen in eutectic salt solution which was not agreed by the evaluators.

Freezing can be used as a method for long-term preservation of goat milk cheese, but the freezing operation should be performed only after the establishment of optimal parameters to ensure minimal structural changes of sensory attributes.

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