Research concerning the changes of curd texture along the cascaval cheese making process

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Abstract
The purpose of the study was to evaluate the changes of the curd texture along the Cascaval cheese making process. The texture was studied using rheological tests and scanning electron microscopy (SEM) for fresh curd, plasticized curd, 7 days ripened curd and 14 days ripened curd.

From rheological point of view, frequency sweep test was used to evaluate storage modulus (G'), loss modulus (G'') and loss tangent (tan δ) of the four samples mentioned above. With development of ripening, storage and loss moduli increased at varying rates. SEM revealed that the amorphous curd structure before stretching was completely disrupted by the shearing forces of the screws, resulting in a reorganization of the aggregated para-casein matrix into roughly parallel aligned para-casein fibers.

Keywords: Cascaval cheese, firmness, storage modulus, loss modulus

1. Introduction
Cascaval cheese is one of the most popular cheeses in a wide area represented by Balkan countries (Turkey, Greece, Bulgaria, Romania, Albania) but also in Crimea, South Ukraine, Caucasus, Italy, Tunisia, Egypt, Algeria and Morocco [2,11]. Although there are many variants and names of Cascaval cheese, the technological process is almost the same, including two distinct phases, curd making and curd processing [1]. Curd making phase includes preliminary treatment of milk (standardisation, pasteurisation) different for each type of Cascaval cheese, renneting, draining of whey. The result of this phase is the fresh curd having an amorphous structure. The second phase of technological process includes curd ripening, texturing (heat treatment of curd), forming, salting and ripening. The most important operation is texturing, which consists in soaking the curd in salt water or whey, at 72-75°C.

This operation determines the aggregation of para-casein matrix into parallel aligned casein fibres. Texture is a complex property of cheese that plays an important role in consumer’s acceptance.

Texture is affected by a series of factors including casein–casein, casein–water, and casein–fat interactions, the state of water (bulk, or bound to the casein matrix), pH and the state of calcium (ionic or bound to the casein matrix), temperature, sodium chloride content, and extent of proteolysis [3].

The rheological properties of cheese are those that determine its response to stress or strain, as applied, for example, during compression, shearing or cutting. There have been reported several results of cheese rheological analysis but they refer at Cheddar cheese [9,14], Mozzarella cheese [5,10,13,16,19], Feta cheese [6].
Taking into account the fact that the Cascaval cheese technological process includes two operation that affect the structure of proteins (heat treatment of curd and ripening) and the lack of information about the rheological properties of Cascaval cheese, it has been considered an opportunity to study the changes of curd texture and microstructure along technological process.

The frequency sweep is probably the most common mode of oscillatory testing because it shows how the viscous and elastic behaviour of the material changes with the rate of application of strain and stress. In this test the frequency is increased while the amplitude of the input signal (stress or strain) is held constant [12,17]. Frequency sweeps are very useful in comparing different food products or in comparing the effects of various ingredients and processing treatments on viscoelasticity. Materials usually exhibit more solid like characteristics at higher frequencies.

2. Materials and methods

Cascaval cheese was made at a dairy plant in Galati County, according to the procedure used in the plant. Raw cow milk was standardized at 3.2% fat and heated at 35 °C as specified in rennet’s prospectus. Renneting took place for 50 minutes. The coagulum was cut and graded and after that the coagulum and whey mix was heated at 40 °C stirring continuously in order to expel the whey. After 20 minutes the coagulum was put on a sieve and pressed for 25 minutes. The obtained fresh curd was then cut into slices and ripened at 30 °C until the 200 °T acidity was reached.

The curd was cut into pieces with 0.5 cm thickness, put in wicker basket and soaked in 12% brine, at 70 °C for 60 seconds. The curd was then manually kneaded and stretched in order to reorient the amorphous curd structure into a unidirectional fibrous ribbon of hot plastic curd.

Then the plasticized curd was put into moulds and dried for 24 hours at 20°C. The ripening process took place in two stages: first at 18-20 °C for 7 days and second at 10-12 °C for other 7 days. The samples were encoded as follows: fresh curd – sample 1, plasticized curd – sample 2, 7 days ripened curd – sample 3 and 14 days ripened curd – sample 4.

An AR 2000ex rheometer from TA Instruments was used to determine small-amplitude oscillatory shear measurements following (with some modifications) a method adapted by Karami et al, 2009 [6] to measure frequency sweep test. Storage modulus (G’), loss modulus (G”) and loss tangent (tan δ) for fresh curd, plasticized curd, 7 days ripened curd and 14 days ripened curd were measured. The measurement system consisted of two parallel plates with a diameter of 25 and a gap size of 1.0 mm (sample thickness). Samples were cut using a razor and were immediately placed in plastic bags, sealed and equilibrated at room temperature at least 2h. A small piece of cheese was then placed on the lower plate and then the upper plate was slowly moved down until the pre-set gap size was reached. The extra cheese parts were trimmed off carefully with a razor blade. A frequency sweep test was performed from 0.1 to 50 Hz.

Microstructure of fresh curd, plasticized curd, 7 days ripened curd and 14 days ripened curd was analysed using a scanning electron microscope (SEM) (XL Series, model XL30, Philips). Thin layers (0.5 mm) of curd samples were freeze and placed on stainless steel plates, then examined at the microscope [1,4].

3. Results and discussion

Rheological characterization of cheese is important as a means of determining body and texture characteristics and also for examining how these parameters are affected by processing techniques and storage conditions. In order to characterise the linear viscoelastic region of the samples, an amplitude sweep test was performed [7,15]. The variation between storage modulus and frequency is presented in figure 1 and the variation between loss modulus and frequency is presented in figure 2. It can be observed that for all the samples booth storage modulus and loss modulus increased exponentially at low values of frequency and for frequencies greater than 20 Hz the increase of storage modulus in linear.

This evolution can be explained by the fact that slow frequency allows sufficient time for flow units within a sample to move and rearrange during the experiment, thus the sample is more fluid-like. Greater frequencies do not allow sufficient time for the flow units to move, thus the sample is more solid-like [3].
At the same value of frequency fresh curd showed the lowest values of storage modulus, varying between 20 and 75 KPa. It can be observed that the plasticization of curd increases the values of storage and loss modulus from 20 to 100 KPa, and from 10 to 25 KPa, respectively. The result of ripening is a new increase of moduli.

For all samples values of tan(delta) were lower than 1, this meaning that the samples are more solid like. Both elastic moduli are calculated from the ratio of stress to strain [8,18], so for a given applied stress, any factor that reduces the strain will increase the elasticity and firmness.

In figures 4, 5, 6 and 7 are presented SEM imagines. It can be observed the continuous microstructure of the fresh curd and the fibrous microstructure of the plasticized curd. Proteolysis occurred in ripening process is well represented in figures 6 and 7.
4. Conclusion

Due to its special technological process Cascaval cheese has a special fibrous texture that makes it very appreciated by consumers. Its rheological characteristics are more solid or gel-like and storage and loss moduli increased from fresh curd to plasticized curd and ripened cascaveal cheese.

References

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