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Quality assessment of commercial Bulgarian brined cheese, purchased in the commercial network

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Abstract. *Three types of Bulgarian brined cow cheese, produced according to the Bulgarian State Standard 15:2010 (BDS), and five types, according to individual cheese makers' firm technological production instruction (TPI), have been studied. Salt content, dry matter, titratable acidity, and fat content have been determined. Using the gas chromatographic method, we have identified the fatty acid composition according to ISO 12966-1. A descriptive sensory profiling test have been conducted for each sample to determine the studied parameters such as appearance, taste, smell, and consistency. Some of the TPI samples have been characterized by a high concentration of salt (% in the total mass), a low percentage of dry matter, and high water content. Only one of the examined samples, according to TPI, met the criteria for acidity according to BDS. The gas chromatographic analysis showed an increased content of palmitic acid in one of the TPI samples. For the examined samples of white brine cow cheese, labeled as produced according to the BDS standard, the obtained results were close to or fully compliant with the standard, with the exception of the titratable acidity in one of the samples. For the samples produced by TPI, the obtained results for these samples are not inferior to those produced by BDS.*

Keywords: white brined cheese, food, fatty acid, physicochemical characteristics, sensory analysis, quality

Introduction

Cheese is food the history of which dates back to ancient times. One of the widespread beliefs (Edgarian and Panayotov, 2011) indicates that the beginning of processing milk into cheese is the period between 5000 and 7000 BC, when in the mountain valleys of Southwest Asia, in the region of present-day Iran, Iraq and Turkey, cheesemaking was born. It is believed that the first cheeses were soft, the raw material for which was goat's milk. The Greeks spread the cheese in the Mediterranean in the form of white matured brined cheeses, and after that, the Romans popularized it in Western Europe. Other sources (Baltadzhieva and Slavchev, 2003) claim that the types of brined cheese established themselves as a national product in the Balkans, the Caucasus, and Central Asia regions where sheep farming was the main livelihood.

The technology of the types of brined cheese historically spread widely in the world in the 1990s (Baltadzhieva and Slavchev, 2003). In many countries, this production has taken a first-rate place. Brined cheese is becoming popular and in demand in world markets.

Bulgarian white brined cheese can be made from cow's, sheep's, buffalo's or goat's milk. It has a specific taste, aroma, and a distinct fracture (cut surface). For optimal quality, the fermentation should proceed slowly, smoothly, and at low temperatures so that the lactic acid bacteria destroy the pathogenic bacteria contained in the unpasteurized milk from which it is prepared. From a technological point of view, the ripening process of cheese is extremely important for its final product characteristics (Balabanova and Stankov, 2021). It has been shown that more intensive physical and chemical processes occur during the ripening of white brined cheese from cow's milk, compared to buffalo milk cheese (Ivanov et al., 2016). The rennet coagulant used in cheese production during ripening does not alter the proteolysis process in the samples (Balabanova et al., 2017).

Since cheese is a staple food product, its quality control is essential. Indicators determining its quality include dry matter, water content, fat content in the dry matter, titratable acidity, salt content, among others. Additionally, essential organoleptic parameters include consistency, smell, taste, cut surface, and appearance. The determination of most of these indicators is carried out according to precisely established (standardized) methods, however, the organoleptic ones are determined subjectively by experts in the field (Bosakova-Ardenska et al., 2015).

The purpose of the present work is to investigate the physicochemical indicators and sensory characteristics of Bulgarian white cow brined cheese, purchased in the commercial network, and to compare them with those of cheese meeting the quality parameters according to the Bulgarian state standard.

Material and methods

Samples

A total of 8 types of Bulgarian white brined cheese made from cow's milk, purchased from major commercial chains in Bulgaria, have been investigated. A detailed description of the studied samples, categorized by number, can be found in Table 1. Three samples of each type of commercially available white brined cheese have been purchased.

Table 1. Specification of Bulgarian cow's white brined cheese

№	Type product	Production technology
1.	vacuum cured cheese	BDS
2.	vacuum cured cheese	BDS
3.	vacuum cured cheese	BDS
4.	vacuum cured cheese	TPI
5.	vacuum cured cheese	TPI
6.	bulk brine cheese	TPI
7.	bulk brine cheese	TPI
8.	bulk brine cheese	TPI

Methods

The research has been conducted using the following standards:

1. Methods for determining water content and dry matter (BDS 1109:1989).
2. Cheese - Determination of fat content - Van Gulik method (ISO 3433:2008)
3. Animal and vegetable fats and oils - Gas chromatography of fatty acid methyl esters - Part 1: Guidelines on modern gas chromatography of fatty acid methyl esters (ISO 12966-1:2014).
4. Milk and milk products. Determination of acidity (BDS 1111:1980).
5. Milk and milk products. Methods for content determination of sodium chloride (BDS 8274:1982).
6. Dairy products. Sensory analysis (BDS 15612:1983).

Sensory analysis

A quantitative descriptive sensory profiling test has been conducted to determine parameters such as appearance, taste, smell, consistency, and crumb of cow brined cheese. The analysis has been performed by twelve trained tasters, previously familiar with the terminology and rating scales. The coded cheese samples have been presented simultaneously and evaluated in random order by the sensory assessors. The obtained results have been processed with Microsoft Excel 2020. Packaging and labeling conformance has been assessed based on Regulation 1169 from 2011.

Statistical methods:

Each parameter has been investigated based on three parallel measurements, with the average value presented as the result.

The average value has been presented as the result. To assess the influence of the factor labeled as "cheese brand", we employed a one-way analysis of variance and Duncan's test. Differences have been evaluated at a statistical significance level of 0.05. IBM Statistics 19, USA software has been used.

Results and discussion

According to BDS 15:2010, the water content of white cow brined cheese should be in the range of 54-55%. Of samples 1, 2, and 3, which according to the labeling were prepared according to BDS, only sample 2 meets the requirements of the standard. In the other two, the water content is below the minimum required value. For products 4 through 8, which are prepared according to different TPIs, the water content varies widely from 49.9 to

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63.7, sample 8 being the closest to the standard based on these indicators. The observed water content is about 10-15% above the one mentioned in the standard for samples 4÷6), while for samples 7 and 8, it is lower. According to some researchers, an increase in the water content of white brined cheese can be due to: pasteurization at a higher than the permissible temperature or the addition of highly hydrophilic additives, for example, E466, functioning as a moisture binder (Atanassova et al., 2023). Other authors (Ivanova et al., 2015) have found that the water content of brined cheeses can vary (46.89 % ÷ 56.04%) depending on the lactation period.

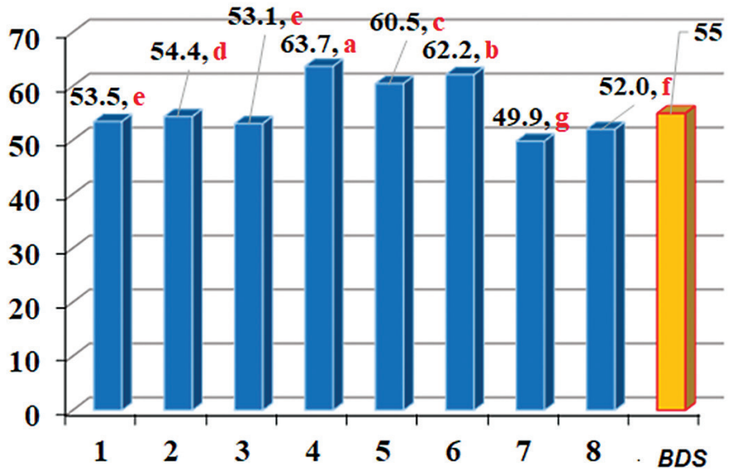

Figure 1. Water content of Bulgarian cow brined cheese

According to BDS 15:2010, the dry matter for cow's cheese must be no less than 46%. Therefore, samples 1 and 3 meet the standard (Figure 2). For sample 2, the values for dry matter have a minimal deviation of less than 1%. The result obtained for samples 7 and 8, which were not produced according to BDS, but meet the requirements of the dry matter standard, is interesting. The remaining samples 4, 5, and 6 show dry matter content between 6.5% and 10% lower than required by the specified standard.

It is known that dry matter depends on the level of minerals, fat and protein content. Therefore, the study continued with the determination of oil content in the dry matter for the samples produced by BDS and fatty acid composition for those produced by TPI, their results are presented in Table 2. According to BDS, the fat content in the dry matter should not be less than 44%. Sample 1 meets the requirements of BDS 15:2010, in terms of fat content in dry matter - 46.8%. Samples 2 and 3 have values lower than the reference, 40.4% and 32.0%, respectively.

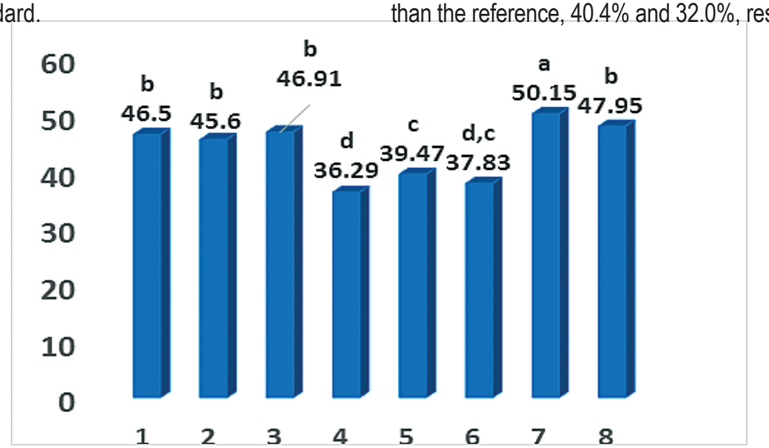

Figure 2. Dry matter of Bulgarian cow brined cheese
Different letters next to the values mean significant differences ($p < 0.01$) using Duncan's test.

Table 2. Fatty acid composition for samples obtained by TPI technology

Fatty acids	4	5	6	7	8
Butyric acid ($C_{4:0}$)	0.36±0.02	0.47±0.02	0.64±0.03	-	0.72±0.05
Caprolic ($C_{6:0}$)	2.43±0.5	3.17±0.1	2.41±0.1	-	2.56±0.2
Caprylic acid ($C_{8:0}$)	2.73±0.09	3.94±0.2	2.64±0.1	0.12±0.01	2.79±0.2
Capric acid ($C_{10:0}$)	0.15±0.01	0.17±0.02	0.11±0.02	-	0.17±0.02
Lauric acid ($C_{12:0}$)	10.1±0.6	37.6±0.5	9.48±0.5	0.91±0.01	10.4±0.5
Tridecanoic acid ($C_{13:0}$)	0.84±0.05	1.25±0.05	0.79±0.05	-	0.86±0.05
Myristoleic acid ($C_{14:0}$)	1.14±0.03	1.37±0.04	1.03±0.03	0.05±0.005	1.15±0.02
Myristooleic acid ($C_{14:1}$)	0.34±0.02	0.28±0,02	0.28±0.02	-	0.36±0.02
Palmitic acid ($C_{16:0}$)	30.4±0.3	36.2±0.5	39.4±0.03	44.1±0.5	31.7±0.5
Palmitoleic acid ($C_{16:1}$)	1.94±0.2	2.31±0.23	1.91±0.03	-	1.99±0.1
Margaric acid ($C_{17:0}$)	0.46±0.06	0.36±0.05	0.41±0.02	0.46±0.12	0.45±0.05
Margarineoleic acid ($C_{17:1}$)	0.52±0.09	0.59±0.03	0.47±0.01	0.10±0.01	0.57±0.02
Stearic acid ($C_{18:0}$)	3.97±0.09	2.91±0.05	4.34±0.05	6.57±0.15	3.12±0.12
Oleic acid ($C_{18:1}$)	38.7±0.8	29.5±0.5	40.27±0.54	37.39±0.62	38.30±0.15
Linoleic acid ($C_{18:2}$)	3.75±0.08	3.52±0.51	4.20±0.15	9.22±0.78	2.94±0.20
Linolenic acid ($C_{18:3}$)	0.33±0.02	0.25±0.02	0.38±0.22	0.12±0.02	0.46±0.03
Arachinic acid ($C_{20:0}$)	0.48±0.07	0.37±0.03	0.62±0.05	0.17±0.01	0.61±0.05
Eicosenoic acid ($C_{20:1}$)	0.56±0.07	0.12±0.01	0.16±0.05	0.36±0.02	0.16±0.01
Arachidonic acid ($C_{20:4}$)	0.34±0.02	0.20±0.02	0.25±0.04	0.41±0.08	0.32±0.01
Eicosapentaenoic acid ($C_{20:5}$)	0.25±0.01	0.23±0.01	0.21±0.01	-	0.17±0.01

Different letters next to the values mean significant differences ($p < 0.01$) using Duncan's test.

The results given in Table 2 show that the short-chain butyric and caproic fatty acids are relatively low in content. The $C_{12:0}$ content in sample 5 should be noted of the medium-chain fatty acids. This high value may be due to: the composition of the raw materials used, the production technology, or the addition of fats. In three samples 4, 6, and 8 oleic acid was the main one, and in 5 and 7 it was palmitic acid. The main saturated fatty acid in all samples was palmitic, and of the unsaturated fatty acids, the content of oleic acid (C 18:1) was the highest. These acids are major ones in cow, goat, and buffalo milk, with palmitic exceeding oleic. Balabanova et al. (2014), Cismileanu et al. (2020), Dimitrova et al. (2021) have investigated and observed the change in the fatty acid composition of raw sheep's milk from Karakachan sheep and the Tulum cheese obtained from it. Sheep's milk has the highest content of oleic ($C_{18:1}$) - 32.76 g/100 g, palmitic ($C_{16:0}$) - 25.68 g/100 g, and lauric ($C_{12:0}$) - 10.7 g/100 g fatty acids, while in the mature Tulum cheese obtained from it, an increase in the content of palmitic ($C_{16:0}$) and lauric ($C_{12:0}$) fatty acids has been found to 33.87 and 14.56 g/100 g, respectively, and a decrease in the content of oleic ($C_{18:1}$) fatty acid to 21.04 g /100 g. Therefore, not only the composition of milk for cheese production but also the introduced bacteria according to technological production instructions of individual cheese makers (TPI), are able to influence the butyric acid composition of the final product.

According to BDS, the salt content should be 3.5 ± 0.5%. All samples produced according to BDS are within the limits of the requirements of the standard. Elevated salt content has been reported in TPI-produced samples (4, 5, and 6). And for 7 and 8, the values meet the requirements of the BDS (Figure 3).

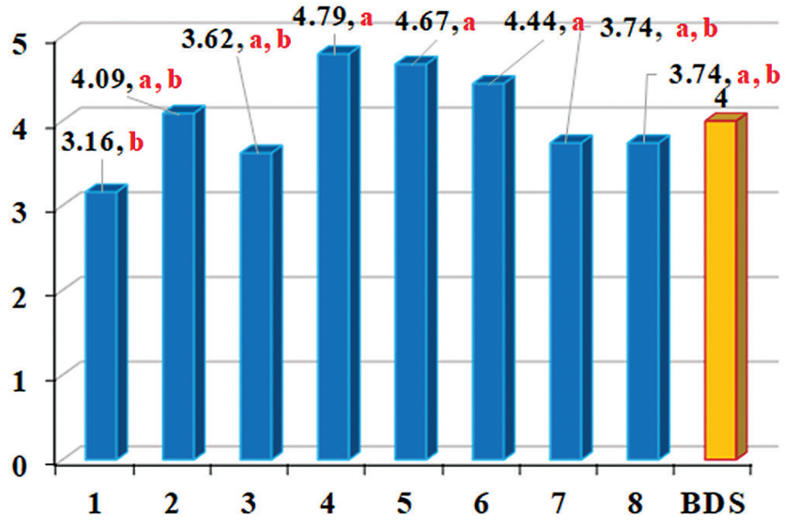

Figure 3. Content of NaCl in percent in the investigated samples of cow cheese
Different letters next to the values mean significant differences ($p < 0.01$) using Duncan's test.

In a number of articles, the existence of correlation dependences between the water content and the salt content of white brined cow cheese has been noted (Lu et al., 2015; Bae et al., 2017; Loudiyi and Aït-Kaddour., 2019). A similar dependence has been observed in this study, as well (Figure 4).

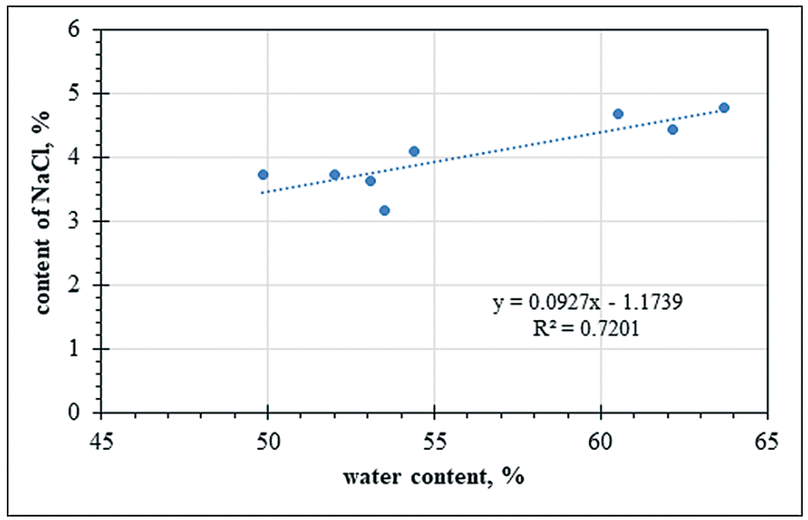

Figure 4. Dependence between water content and NaCl content for the studied samples

During the ripening of the cow's cheese, a constant tendency to increase the titratable acidity has been observed, as it is closely related to the temperature regime of cheese ripening (Ivanov et al., 2015). According to BDS 15-2010, the titratable acidity of white brined cow's cheese must be from 200˚T to 270˚T (Figure 5.). For sample 2, it is within the limits, with the measured value being 256˚T, while for sample 3, this indicator is slightly above the norm. The acidity in sample 1 is 1.71 times higher than the lower limit of the standard.

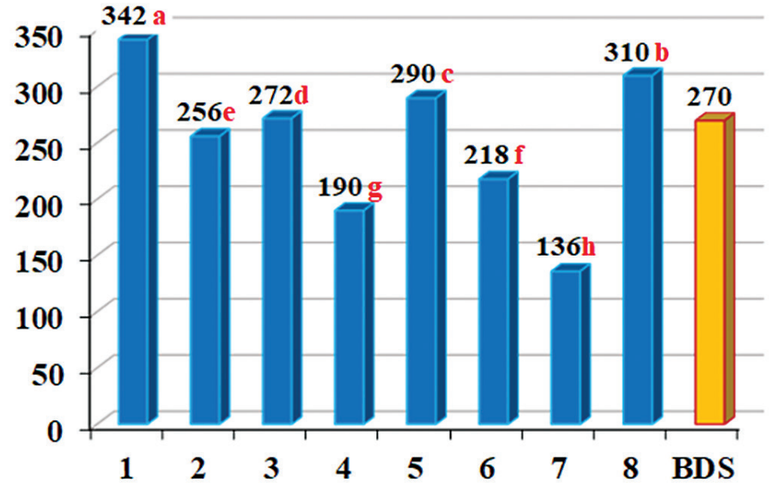

Figure 5. Acidity in degrees Torner for the investigated samples
Different letters next to the values mean significant differences ($p < 0.01$) using Duncan's test.

The best appearance sensory analysis (Figure 6) determined samples 1, 3, and 8, all others received lower results. Sample 3 (44.6 points) has the best specific, distinct taste and smell of mature brined cheese. The cut surface, determining the correct course of the technological process, has the highest value for samples 1, 5 and 8. In the first place with a moderately hard consistency is sample 3, with very close results sample 4 (19.3 points) and 8 (19 points) out of a maximum number of 20. Except for samples 6 and 7, all others received the maximum number of points for packaging and marking. This proves the good condition of the packaging, legible and clear marking, meeting the requirements of Regulation 1169/2011. Figure 7 presents the summary characteristics of the studied samples from the sensory analysis.

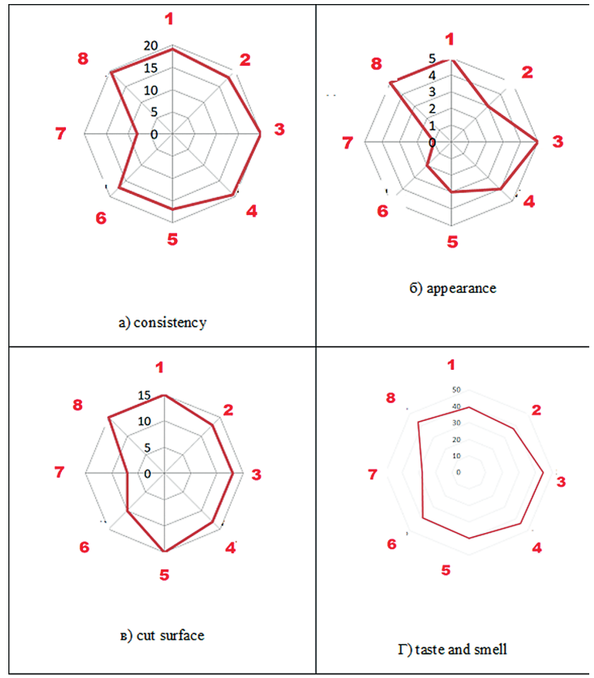

Figure 6. Sensory analysis of cow cheese samples

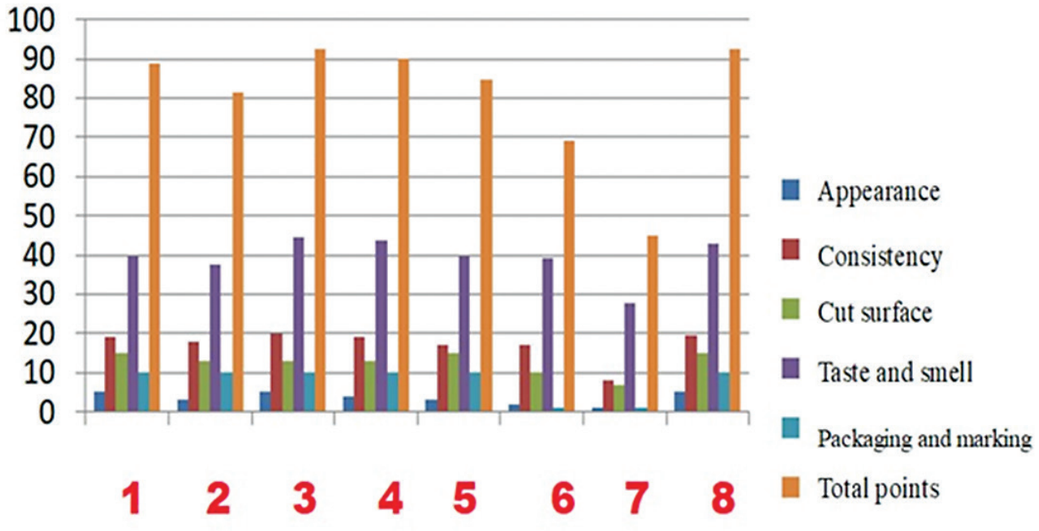

Figure 7. Summary results of the sensory analysis of samples of Bulgarian cow brined cheese from the commercial network

Except for samples 6 and 7, all other samples received the maximum number of points for packaging and labeling. Samples 3 and 8 received the highest total scores across all sensory analysis indicators, followed closely by samples 1 and 4, with values close to them.

Conclusion

In the analyzed samples of white brined cow's cheese labeled as produced according to the BDS standard, most results either aligned closely with or fully met the standard criteria. A significant deviation has been noted in the titratable acidity of one sample. For the other five cheese varieties, certain assessed indicators displayed a broad range. Despite this, the sensory evaluation of three of these samples — considering consumer preferences and perceptions — was comparable to the BDS samples. Thus, even though these samples were produced based on TPI guidelines, some demonstrated a quality level not inferior to cheeses produced under the BDS standard.

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