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ASSESSMENT OF SOME PHYSICAL-CHEMICAL AND MICROBIAL PROPERTIES OF WHITE BRINE CHEESE

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Abstract

The purpose of this article is to assess the quality and safety of white brined cheese. The cheese was industrially produced from pasteurized cow milk and ripened in brine at 4±1°C.Cheese is a rich source of essential nutrients; in particular, proteins, bioactive peptides, amino acids, fat, fatty acids, vitamins and minerals, which make it an important dairy product and an integral part of a healthful diet due to its substantial contribution to human health. Cheese is generally considered a safe and nutritious food, but some food borne illnesses caused by: *Listeria monocytogenes, Staphylococcus aureus, Salmonella spp., Escherichia coli* are linked to cheese consumption.
These parameters were analyzed for the quality assessment of the cheese: salt content, protein, dry matter/ moisture content, acidity, and ash content whereas for safety assessment was analyzed the presence of *Salmonella spp.* and *Listeria monocytogenes*. The compositional characteristics of the analyzed cheese are normal levels of protein (16.12% - 16.17%), dry matter (45.28% - 45.66%), moisture content (54.34% - 54.72%), salt (3.35% - 3.40%), acidity (250.00°Th - 257.18°Th) and ash content (4.10% - 4.18%). As for the safety assessment of the cheese, bacteria *Salmonella spp.* and *Listeria monocytogenes* were not isolated.
The obtained results indicate that the examined cheese is of good quality and meets the microbial criteria for food safety.

Keywords: White brined cheese, cow milk, quality, safety, bacteria

1. Introduction

White brined cheese is one of the most popular cheese varieties manufactured and consumed in North Macedonia. An important amount of white cheese is traditionally manufactured in small dairy plants but in the last decade, the cheese has been produced on a large scale in well-organized dairy plants, where standardized production methods are applied.

This type of cheese is manufactured originally from raw or pasteurized sheep, goat, cow milk, or a combination of these milk and ripened by mesophilic lactic culture (pasteurized type) before renneting. It is matured in brine at 4–8°C for a period of 1 to 3 months in cold storage **Invalid source specified.**. Contains quality attributes such as creamy taste, crumbly texture and brackish taste.

Cheese is a rich source of essential nutrients; in particular, proteins, bioactive peptides, amino acids, fat, fatty acids, vitamins and minerals, which make it an important dairy product and an integral part of a healthful diet due to its substantial contribution to human health. Cheese is

generally considered a safe and nutritious food, but some food borne illnesses caused by: *Listeria monocytogenes, Staphylococcus aureus, Salmonella spp.*, *Escherichia coli* are linked to cheese consumption **Invalid source specified.**.
The purpose of this article is to assess the quality and safety of a white brined cheese produced industrially in Tetovo, North Macedonia.

2. Material and methods

The cheese for the study was taken in the local markets of Tetovo, North Macedonia. The analysis was performed in the laboratories of the Faculty of Food Technology and Nutrition, University of Tetova.
For each chemical parameter were analyzed four samples (replicas) of the same cheese for an average value.

These following parameters were analyzed:

1. salt content,
2. protein content,
3. dry matter/ moisture content,
4. acidity,
5. ash content,
6. presence of *Salmonella spp*,
7. presence of *Listeria monocytogenes.*

Determination of salt content - Salt content was determined by potentiometric titration method EN ISO 8943:2006, IDT.
Determination of protein content - Protein content was determined byAOAC Official Method 991.20, Nitrogen (Total) in Milk and Dairy products, Kjeldahl Methods. To calculate the percentage of total protein first should be calculated the nitrogen content and then that value is multiplied with the protein factor for milk and milk products.
Determination of dry matter/ moisture content - Dry matter/ moisture content was determined by EN ISO 5534:2010, IDT.
Determination of acidity -Acidity was determined by the titratable method where samples were titrated with NaOH 0.1 mol/l solution in the presence of phenolphthalein indicator. The acidity in this research is calculated as Therner degree. The degrees describe the consumption of a defined NaOH solution per 100 ml of milk, where °Th = ml NaOH 0.1 mol/l / 100 ml milk.
Determination of ash content - Ash content was determined by heating the samples on a Muffle furnace at 550°C until the sample remains just a grayish-white ash.
Detection of *Salmonella spp* - *Salmonella spp.* was analyzed by a horizontal method for the detection, enumeration and serotyping of Salmonella -part 1: detection of *Salmonella spp.* a standard method by ISO 6579-1:2017, where the sample was pre-enriched, enriched with a selective medium and then plated and incubated for a limited time until the results were read.
Detection of *Listeria monocytogenes* - *Listeria monocytogenes* was analyzed by a horizontal method for the detection and enumeration of *Listeria monocytogenes* and of *Listeria spp*. - part 1: detection, where the sample was pre-enriched, enriched with a selective medium and then plated and incubated for a limited time until the results were read.

3. Results and discussion

The results presented in Table 1 show the values of the chemical analysis of the analyzed cheese, but each one of them will be discussed further. From the same sample were taken four replicas for more reliable results.

Table 1. Results of the chemical analysis

Analysis	Salt - %	Protein - %	Dry matter - %	Moisture content - %	Acidity - °Th	Ash - %
1	3.40	16.17	45.28	54.72	252.05	4.14
2	3.35	16.12	45.45	54.55	257.50	4.18
3	3.40	16.16	45.45	54.55	257.18	4.10
4	3.37	16.16	45.66	54.34	250.00	4.14
Average value	**3.38**	**16.15**	**45.46**	**54.54**	**254.18**	**4.14**

Salt content

Salt has three main functions in cheese: it acts as a preservative, contributes directly to flavor and is a source of dietary sodium. Along with the desired pH value, water activity and redox potential, salt assists in cheese preservation by minimizing spoilage and preventing the growth of pathogens **Invalid source specified.**.

The concentration of salt in cheese depends on the initial or original state of the cheese, % of the salt in the brine, the type of salt, the temperature and the pH of the cheese **Invalid source specified.**.

In table 1 and figure 1 are presented the results for salt content, where we can see that the average value for salt content for the white brined cheese is 3.38 %, which is comparable to the results of other study conducted on the evaluation of salt content in white brined cheese ***Invalid source specified.***.

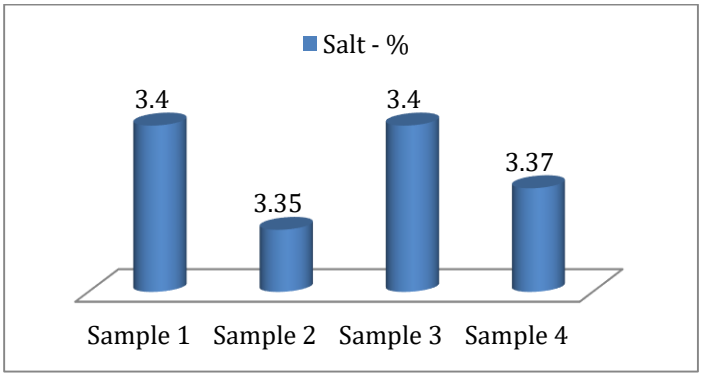


Figure 1. Salt content of the white brined cheese

Protein content

Proteins play an essential role in cheese production. The total protein content in cheese varies depending on the amount of casein and cheese production techniques. Determination of proteins by *Kjeldahl* method is based on the determination of nitrogen content of the cheese. The change in the total amount of nitrogen in the cheese composition is related to protein degradation. This can be explained by the reduction of nitrogenous substances in other compounds (amine, acids, thiols, etc.) **Invalid source specified.**.
The results presented in figure 2 shows that the level of protein content ranges from 16.12% to 16.17% in the four samples analyzed.

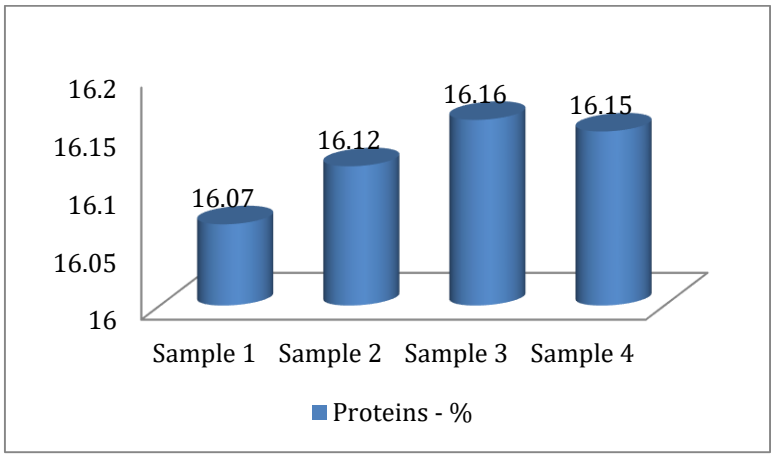
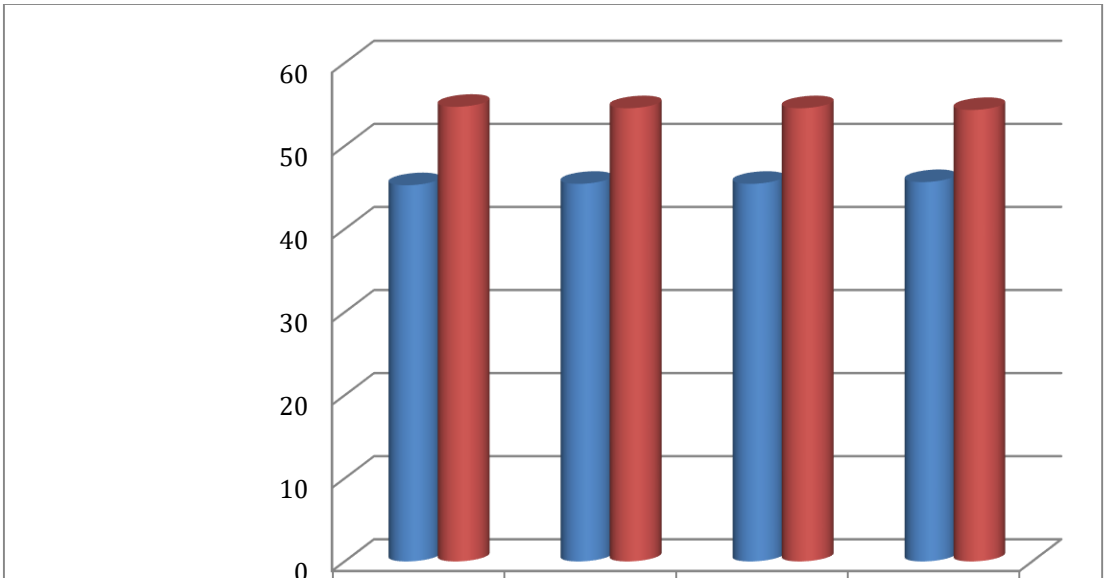


Figure 2. Protein content of the cheese samples

*The study from other authors **Invalid source specified.** show a slightly lower content of proteins in their analyzed cheese comparing to the results we obtained from our research.*

Dry matter/ moisture content

The dry matter contains fat, protein, lactose and minerals.
Dry matter content and moisture content of the white brined cheese are presented in table 1 and figure 3, where the average result for dry matter content is 45.56% whereas for moisture content is 54.54%.



	Sample 1	Sample 2	Sample 3	Sample 4
Dry matter - %	45.28	45.45	45.45	45.66
Moisture content - %	54.72	54.55	54.55	54.34

Figure 3. Dry matter and moisture content of the cheese samples

The study from other authors ***Invalid source specified.****show a lower content of dry matter or total solids in their analyzed cheese which can differentiate because of the different milk composition which was used for the production of the cheese.*

Acidity value

Acidity is used to test the quality, because this parameter has a major influence on the taste of the product.
The results for acidity are presented in figure 4, where we can see a range of values from 250.00°Th to 257.50°Th.

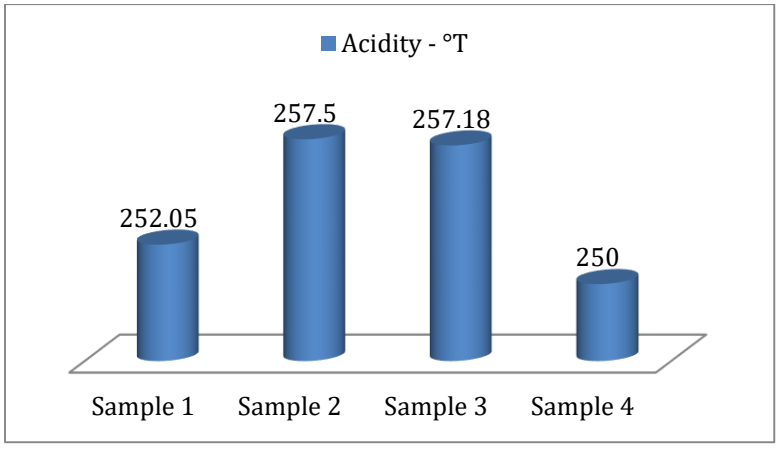


Figure 4. Acidity value of the analyzed white brined cheese

The study from other authors ***Invalid source specified.*** *show a lower value of acidity which differentiates because of the different ripening time of the cheese.*

Ash content

Ash content values are shown in figure 5, where we can see a value range from 4.10% to 3.18%.

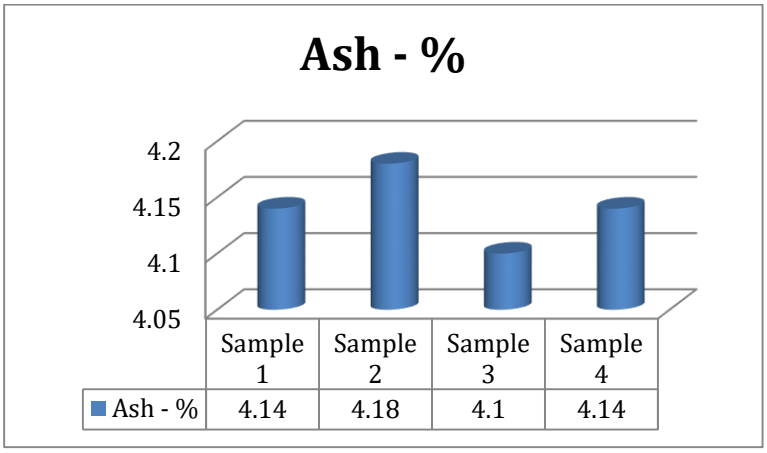


Figure 5. Results of ash content of the analyzed cheese

The results obtained as shown in figure 5 show us that the values are comparable to the results of other study conducted on the evaluation of ash content in white brined cheese ***Invalid source specified.***.

***Salmonella spp*. detection**

Salmonella spp. in white brined cheese was not isolated based on the results obtained from the incubated plates as shown in followed figures where no colonies or no typical colonies have been formed. The typical *Salmonella spp.* on XLD agar shows red colonies with black centers whereas on CHROM agar Salmonella shows magenta-red colonies, wherein we had neither one of them.

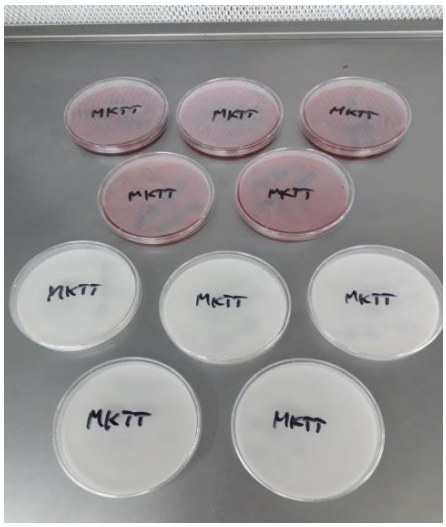


Figure 6. No colonies formed in XLD agar (above) and CHROMagar Salmonella (below) taken from MKTTn broth as a selective enrichment medium

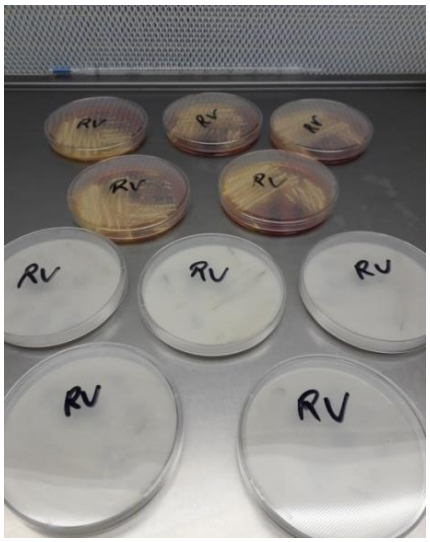


Figure 7. No typical *Salmonella spp.* colonies formed in XLD agar (above) and CHROMagar Salmonella (below) taken from RVS broth as a selective enrichment medium

Because there were not formed typical *Salmonella spp.* colonies the confirmation with API 20E was not proceeded.

Listeria monocytogenes detection

Listeria monocytogenes in white brined cheese were not isolated based on the results obtained from the incubated plates as shown in followed figures where no typical colonies have been formed.
The typical *Listeria monocytogenes* on ALOA agar shows green - blue color colonies surrounded by an opaque halo whereas on PALCAM agar shows greyish green colonies with black halo, wherein we had neither one of them.

Figure 8. No typical *Listeria monocytogenes* colonies formed in ALOA Agar

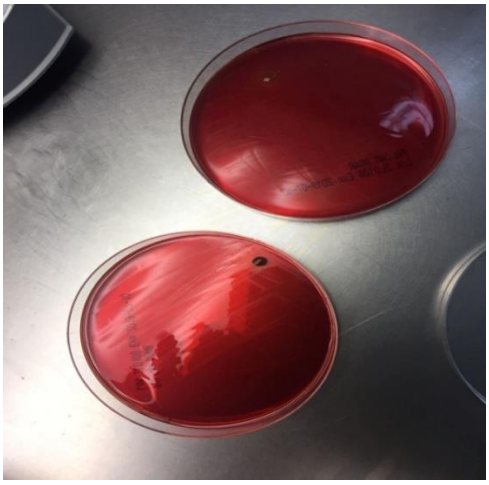


Figure 9. No typical *Listeria monocytogenes* colonies formed in PALCAM Agar

Because there were not formed typical *Listeria monocytogenes* colonies the confirmation with API Listeria was not proceeded.

4. Conclusions

The chemical analysis indicated that most of the chemical components in the analyzed cheese samples were in close agreements to that of literature values with slight variations and according to the rulebook on requirements for raw milk quality, quality standards for consumed milk, dairy products published by Official Gazette of the Republic of North Macedonia. High content of moisture and salt are the major chemical characteristic features of white brined cheese produced from pasteurized cow milk.

The microbiological analysis revealed no presence of the pathogenic bacteria *Salmonella spp.* and *Listeria monocytogenes.*

The obtained results indicate that the examined cheese is of good quality and meets the microbial criteria for food safety.

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