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THE EFFECTIVENESS OF HEAT TREATMENT PROCESSES APPLIED TO SOUR CREAM FOR THE PRODUCTION OF BUTTER, VALIDATED BY ENZYMATIC METHODS

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Abstract

The purpose of this article was to evaluate the efficacy of heat treatment procedures used on sour cream, a raw material used to make butter. To investigate the safety of sour cream, 25 samples of unpasteurized sour cream, 25 samples of pasteurised sour cream, and 25 samples of butter were evaluated. The samples were then subjected to enzymatic and biochemical analysis. The titratable acidity of unpasteurized sour cream resulted was 19.84±0.10 °T. All 25 samples tested positive for peroxidase activity. The titratable acidity of pasteurised sour cream was 20.24°T, although the peroxidase activity was negative. Using the reductase test with methylene blue, the samples of unpasteurized sour cream ranged in the second quality class, with a discoloration interval of samples substrate till 289.60±3.49 minutes. The titratable acidity of the butter was 2.59±0.04°T, and the peroxidase activity was negative in all 25 samples. The sour cream heat treatment techniques have been validated, with the examination of the two dairy products yielding good findings in compliance with standards.

Key words*: butter, dairy products, enzymatic methods, heat treatment, sour cream.*

INTRODUCTION

Milk has an important role in the human diet, as drinking milk, fresh, or kept for a longer period of time through the application of sterilization methods, either in the form of dairy products. Cattle are the primary source of milk in the world's most important regions, with the exception of the Indian subcontinent and Egypt, Mediterranean regions, parts of the Middle East and some African regions where buffalos, sheep and goats contribute significantly to native milk production (Davidescu et al., 2020; Grădinaru et al., 2015).
A specific category of dairy products, favoured by consumers, lies the dairy products with higher fat content, for example –sour cream and butter.
For all milk products, in a separate measure, must be respected as a basic condition, for consumers safety (Banu, 2009; Stănescu, 2010). This condition is observance of the safety throughout production process of dairy products. To reduce the risk of contamination of product, shall apply the heat treatment processes to raw material. The peroxidase is an important enzyme, whose presence has been tested on sour cream, raw material for butter. This enzyme can be identified and in butter, whether the pasteurization of sour cream has not been made properly (Fox & Kelly, 2006; Kosikowski, 2006).
The aim of this paper was to investigate the effectiveness of heat treatment processes applied to sour cream by using enzymatic methods.

MATERIALS AND METHODS

For each test sample, respectively, pasteurized sour cream (PSC), unpasteurized sour cream (USC) and butter (B) were harvested work samples and analyses were made to determine the freshness and degree of microbial load of the sour cream raw material and butter. In the second stage, were made enzymatic analysis for the validation of the effectiveness of the pasteurization sour cream (PSC), a process

which is considered to be carried out at a temperature of > 90°C. For each analysis, we applied 25 replicates. In the first stage, as work samples, used sour cream, random harvested, up to a volume of 2 liters, in sterilized containers. The harvesting was made in the dairy factory, after centrifugal separation of fat, from the milk. In the second stage of research, was harvested pasteurized sour cream, in quantities of 100 milliliters in 5 consecutive rounds.

For each analysis method, we applied 25 replicates, the same as unpasteurized sour cream. In the third stage of research, was analysed the butter with a content of 65% fat, up to a volume of one kilo. For determine the freshness of the unpasteurized sour cream and pasteurized sour cream, raw material for butter, has been measured the titratable acidity, by titrimetric analysis, respectively Thorner method, which consist in neutralizing the acids from a batch of 100 milliliters sour cream, using NaOH (n/10) and phenolphthalein as a color indicator.

The enzymatic analysis that were carried out for the appreciation of status hygiene of sour cream, involved reductase test using methylene blue and resazurine (Fernandes, 2012). Reductase enzyme is a microbial-origin enzyme and has the ability to reduce certain colored substrates. The principle of the method is based on the fact that the reductase enzyme reduces the amount of 5 mL of methylene blue to colorless substances called leuco-derivatives. Depending on the decolorization interval of the sample substrate, the degree of microbial load is assessed. Classifying samples in the two quality classes (corresponding/inadequate) was done in accordance with the resazurin method which is based on the action of the reductase in the samples, which, in the presence of resazurin, produces color changes (William, 2007).

In the case of butter, the freshness was appreciated by Kreis reaction, identifying, degree of lipids oxidation (Fernandes, 2012.

In validation of heat treatment processes applied to pasteurized sour cream we applied peroxidase test, using hydrogen peroxide and benzidine, method which help to determine effectiveness of the pasteurization processes applied to sour cream (Sakkas et al., 2014; Stănescu, 2010). Was used module of statistical calculation, MS Excel and we determine for each analysis, the parameters: arithmetic mean ($\bar{x}$), standard deviation (s), standard error of the mean (±) and coefficient of variation (C.V.%).

RESULTS AND DISCUSSIONS

Milk contains a large number of native enzymes with varying functions, processing stability, impact on dairy products, and consumer safety significance (e.g., antimicrobial enzymes). Some enzymes are of interest for their beneficial activity (e.g., lactoperoxidase), some for use as processing indices (e.g., alkaline phosphatase) and some for effects on the quality of dairy products (e.g., plasmine, lipoprotein lipase), which may be positive or negative for various products (Kelly & Fox, 2006; Rankin et al., 2010; Savu, 2008).

The investigation for unpasteurized sour cream were carried out in a number of 25 samples. Following Thorner's analysis, the analytical range of acidity was between a minimum of 19.20°T and a maximum of 20.80°T, with a calculated mean of 19.84 ± 0.10°T. The coefficient of variation presented a value of 2.54%, suggesting that the homogeneity of the analyzed samples, as well as the accuracy of the method application, was sufficiently good. The obtained value is close to the one specified by the butter production standard regarding the quality of the raw material used, SR ISO 6092:2008 (max. 20°T) (Figure 1).

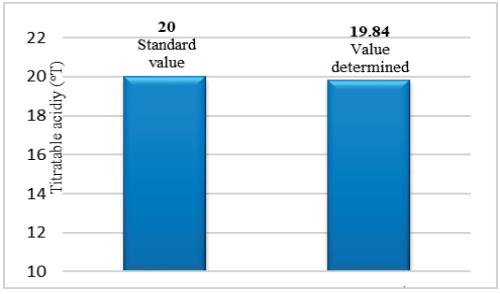

Figure 1. The titratable acidity of unpasteurized sour cream, compared to maximum permissible value of the standard

Appreciation of hygienic status for the unpasteurized sour cream, was effected through reductase test using methylene blue. We noted

the length of time until the complete discoloration of samples, after incubation at 37°C. The rate of observation it is been every 20 minutes. For the 25 of samples analyzed, the minimum discoloration interval of samples was 260 minutes and the maximum discoloration amount was 320 minutes, with an average of 289.60±3.49 minutes (Figure 2). According to scale of assessment, it follows that the samples of unpasteurized sour cream ranged in second quality class (satisfactory rating).

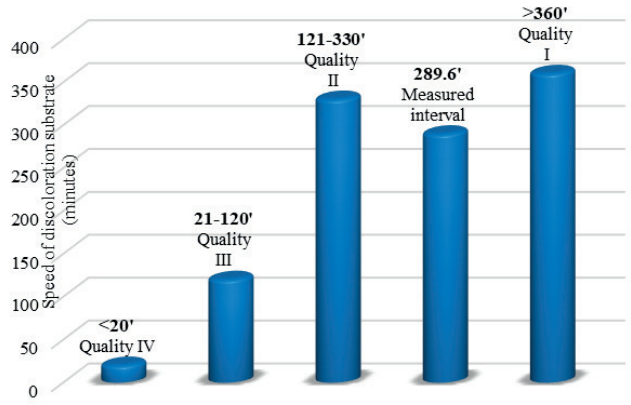

Figure 2. The hygienic quality of unpasteurized sour cream, appreciated by reductase test using methylene blue

According to the obtained results by carrying out the reductase test using resazurine: no samples doesn´t ranged in first quality class and the fourth quality class but 16 samples (64% of the total) ranged in second quality class and 9 samples (36% of the total) ranged in third quality class (Figure 3).

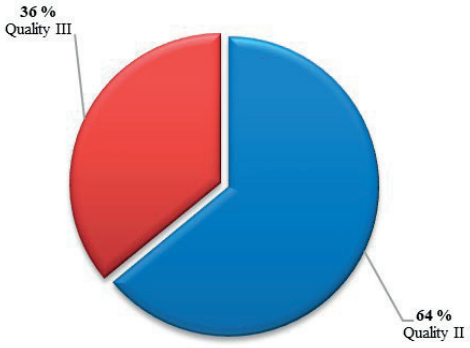

Figure 3. The distribution of unpasteurized sour cream samples by quality class (reductase test using resazurine)

To have a reference value was made the peroxidase test for unpasteurized sour cream, the reaction was positive (color in blue-green), for all 25 samples. The values obtained for measurement of titratable acidity for pasteurized sour cream ranged between 19.39°T and 21.42°T, with an average of 20.24°T±0.1°T (Figure 4). And in this case, the measured value was close to the standard value (SR ISO 6092:2008).

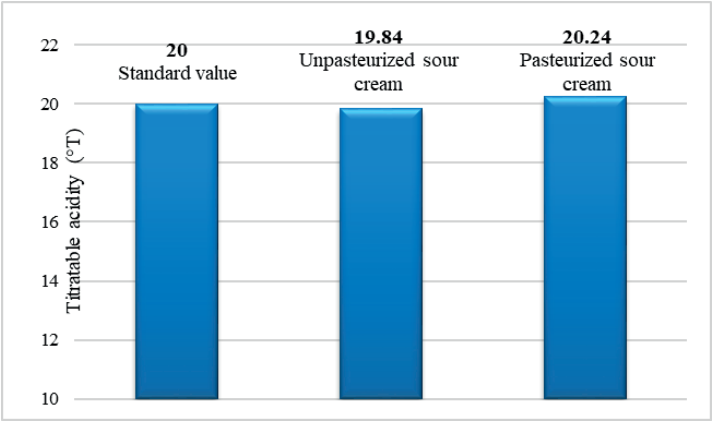

Figure 4. The titratable acidity of pasteurized sour cream, compared to value for titratable acidity of unpasteurized sour cream and with the maximum permissible value of the standard

In the case of pasteurized sour cream samples, was made the peroxidase test to establish the efficacy of the high pasteurization. The results were negative for all 25 samples, after the benzidine are added, the sour cream´s color remained unchanged, contrary to the case of unpasteurized sour cream, when the color changed in blue-green. Therefore, it is considered that pasteurization of sour cream, raw material for butter, was made at an appropriate level at temperatures above 90°C, which distorted the marker enzyme and destroyed the microorganisms.

The acidity of butter with 65% fat content, was measured by titrimetric method (Thorner). The values obtained ranged between 2.4°T and 2.8°T with an average of 2.59±0.04 °T, value close to the standard value (SR ISO 1740:2008), which is 2.8°T (Figure 5). Interpretation of results was carried out in accordance with specific literature (Ramesh, 2011; Usturoi, 2020).

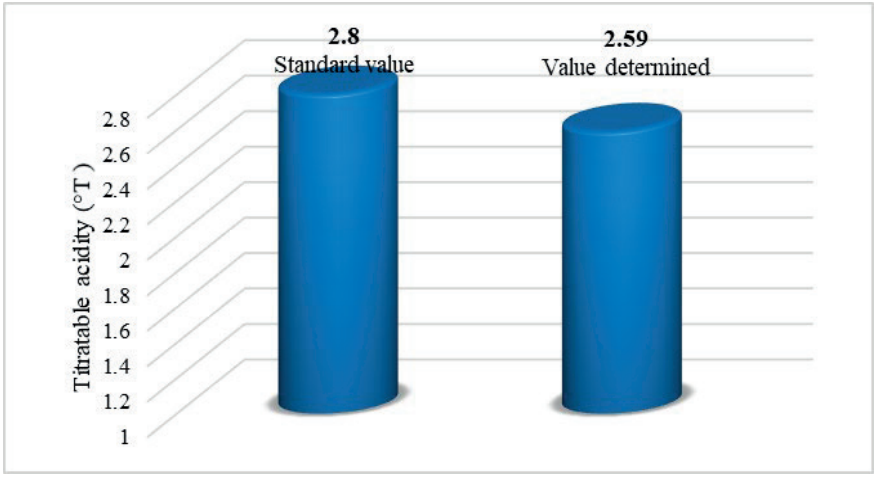

Figure 5. The distribution of unpasteurized sour cream samples by quality class (reductase test using resazurine)

For the titratable acidity expressed in grams of oleic acid (%), the values obtained ranged between 0.91 g oleic acid (%) and 1.11 g oleic acid (%) with an average of 1.02±0.02 g oleic acid (%), value close to standard value which is 1 g oleic acid (%) (Figure 6).

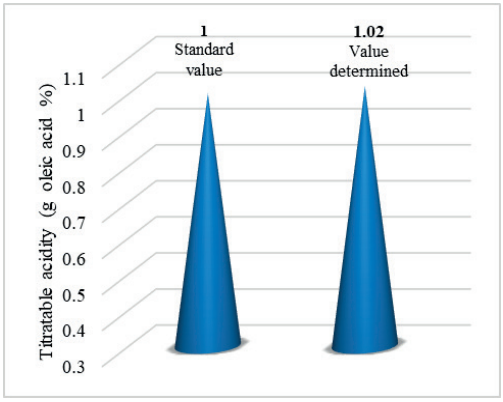

Figure 6. The acidity of butter expressed by grams oleic acid (%), compared to standard value

According to the results of the Kreis reaction, the samples of butter which have been analysed have presented variable colors, from yellowish white, serous or opalescent to yellow serous, according to Figure 7. The shades of white were the most common and the shades of yellow were the least common.

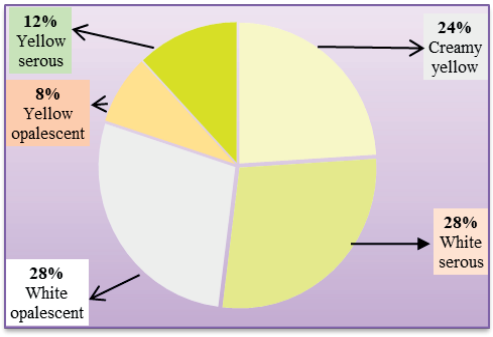

Figure 7. The frequency of colors butter determined by Kreis reaction

So, the results obtained in laboratory are representative of fresh butter (yellowish white color, of different shades), therefore, the peroxidase test has been validated. The peroxidase test applied to butter was negative, for all 25 samples, the color of butter has remained unchanged.

CONCLUSIONS

The research performed to determine the freshness and safety of sour cream, raw material for butter and freshness of butter, finished product, have generated satisfactory results, close to optimal values, in accordance with the specific standards. So, the heat treatment processes applied to sour cream have been validated. The quality of butter is heavily influenced by the quality of raw material, in this case, sour cream. Thus, the main objective of research was the investigation effectiveness of heat treatment processes applied to sour cream, by enzymatic methods. A few recommendations on improve the quality of researched dairy products, in this study, related to the analyses that have been made in laboratory, are: increase the level of automation analytical of laboratories, of the equipment, improving of the food safety by maintaining comply of hygienic status, monitor activity in laboratory and control of product traceability from the producer to consumer.

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