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EFFECT OF THE ADDITION OF MODIFIED STARCH ON THE TEXTURE AND THE FLAKING OF THE MELTED CHEESE®

Wpływ dodatku modyfikowanej skrobi na teksturę i płatkowanie sera topionego®

Key words: processed cheese, texture, starch, thickening, texturometer, hardness.

The paper presents the effect of modified starch on the texture and meltability of processed cheese. Four different processed cheeses of the same species (gouda) but from different producers were used in the tests. Three processed cheeses were cuboid-shaped and one was triangular. All processed cheeses analyzed did not deviate from the factory standards. The first processed cheese had a relatively low viscosity and its structure was the most compact and compact. The second processed cheese showed the highest viscosity - its texture was the least stable. The third processed cheese, like the first cheese, was characterized by a relatively low melting point. The fourth processed cheese after unpacking from foil was characterized by the lowest viscosity and meltability. The color of all cheeses was uniform throughout the mass. The taste and aroma of all analyzed processed cheeses was mild, slightly salty, with no aftertastes or foreign smells. The taste was characteristic of the type of cheese from which it was made. In order to analyze the texture of the examined objects, the Brookfield CT3 texture analyzer and the TexturePro CT V1.4 Build 17 software were used. A straight conical probe was used with the guidelines for selecting an appropriate probe for the texture test. The processed cheese was tested by placing each cheese on a measuring table, which was then loaded with a conical probe. All samples were subjected to a single compression test. The texture test showed that processed cheese I had the highest hardness, and processed cheese II the lowest. The highest hardness of processed cheese I was caused by the presence of a greater amount of thickeners (starch) in the composition. Processed cheese II contained less thickening substances, which contributed to its highest viscosity and the least stable structure.

Słowa kluczowe: ser topiony, tekstura, skrobia, zagęszczanie, teksturometr, twardość.

W pracy zaprezentowano wpływ skrobi modyfikowanej na teksturę i topliwość serów topionych. Do badań użyto czterech różnych serów topionych, tego samego gatunku (gouda) lecz pochodzących od różnych producentów. Trzy sery topione miały kształt prostopadłościanu natomiast jeden miał kształt trójkąta. Wszystkie sery topione poddane analizie nie wykazywały żadnych odchyleń od norm zakładowych. Pierwszy ser topiony charakteryzował się stosunkowo małą lepkością a jego struktura była najbardziej zwarta i zbita. Drugi ser topiony wykazał się największą lepkością – jego tekstura była najmniej stabilna. Trzeci ser topiony, podobnie jak ser pierwszy, odznaczał się stosunkowo małą topliwością. Czwarty ser topiony po odpakowaniu z folii charakteryzował się najmniejszą lepkością oraz topliwością. Barwa wszystkich serów była jednolita w całej masie. Smak i zapach wszystkich serów topionych poddanych analizie był łagodny, lekko słony, bez posmaków oraz zapachów obcych. Smak był charakterystyczny dla gatunku sera. W celu przeanalizowania tekstury badanych obiektów wykorzystano analizator tekstury Brookfield CT3 oraz oprogramowanie TexturePro CT V1.4 Build17. Zgodnie z wytycznymi dotyczącymi wyboru odpowiedniej sondy do badania tekstury zastosowano sondę prostą stożkową. Badanie serów topionych polegało na umieszczeniu każdego sera na stoliku pomiarowym, a następnie obciążeniu go sondą stożkową. Wszystkie próbki poddane były jednokrotnemu testowi kompresyjnemu. Badanie tekstury wykazało iż największą twardością charakteryzował się ser topiony I, najmniejszą zaś ser topiony II. Największa twardość sera topionego I była spowodowana obecnością w składzie większej ilości substancji zagęszczających (skrobia). Ser topiony II zawierał mniej substancji zagęszczających, co przyczyniło się do jego największej lepkości oraz najmniej stabilnej struktury.

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INTRODUCTION

Changing the eating habits contributes to increased consumption of processed food, including melted cheese. The delicate and subtle flavor of the melted cheese compared to the sharp and expressive taste of ripened cheeses is more endorsed by consumers, especially young people. Furthermore, melted cheese is a food with a wide use and show the possibility of modifying functional features [6]. Production of melted cheese was initiated by European countries. The year 1890 can be considered as initial date [7]. The dynamic growth in the production of melted cheese in the early twentieth century was conditioned by the development of special equipment used in the melting process, but mainly plastics used in the manufacture of packaging and packaging machines [2]. Creation various textures and forms of processed cheese (sliced, spreadable, block and cream) it was conditioned by higher nutritional value than ripened cheeses, and by high digestibility and digestibility, and especially high stability [2]. The most effective method of preservation ripening cheeses is melting process [7]. Today, there are many types of melted cheese that by using thickening additives, they can take various shapes and consistency. The most popular forms of cheese includes sliced form, spreadable, blocky and creamy [2, 7]. The correct selection of ingredients and melting salts is a key element in the production of melted cheese. The composition of the melted cheese mixture plays a crucial role in the correct melting process and affects the quality of the final melting of the product [5]. The ingredients used in the production of melted cheese are ripened cheese rennet, cottage cheese, butter, sheep's milk called brynza, skimmed milk powder, whey in powdered form, whey protein concentrate, coprecipitates. From the extras the following are used: fluxes, cheese paint, salt, flavor additives, which can be used in food production, ingredients and food such as ham, mushrooms, etc [2]. Since the Second World War, an increase in the mass production of various substances obtained with the use of starch has been observed, also in the food industry. As a result of the activity of physical and chemical factors, substances with various qualitative properties are obtained. Often these compounds have different characteristics than starch occurring in its natural form [8]. Naturally occurring starch is characterized by a reduced resistance to physical factors. This phenomenon can be observed mainly during processing and storage of finished products. In order to improve the resistance to physical conditions, the starches are modified. This process makes it possible as well producing a wide range of articles [1]. Modified starch is produced as a result of physical, chemical or biochemical changes of natural starch. As a result of these changes, its features are modified with slight changes in the structure of the molecule, improving its rheological properties [1,4].

PURPOSE AND SCOPE OF WORK

The aim of the work is to analyze the effect of modified starch on the texture and meltability of selected processed cheeses. The work was done in a laboratory and includes sensory evaluation processed cheese and texture testing with the Brookfield CT3 texture analyzer.

Fig. 1. Brookfield CT3 9 texture analyzer.
Rys. 1. Analizator tekstury Brookfield CT3 9.
Source: Own study
Źródło: Opracowanie własne

Fig. 2. Testing of the 1st processed cheese sample using a texture analyzer.
Rys. 2. Badanie pierwszej próbki sera topionego za pomocą analizatora tekstury.
Source: Own study
Źródło: Opracowanie własne

Fig. 3. Testing of the 2nd processed cheese sample using a texture analyzer.

Rys. 3. Badanie drugiej próbki sera topionego za pomocą analizatora tekstury.

Source: Own study

Źródło: Opracowanie własne

Fig. 4. Testing of the 3rd processed cheese sample using a texture analyzer.

Rys. 4. Badanie trzeciej próbki sera topionego za pomocą analizatora tekstury.

Source: Own study

Źródło: Opracowanie własne

RESEARCH METHODOLOGY

The tests were carried out in a laboratory and include sensory evaluation of the processed cheese and texture testing with the Brookfield CT3 texture analyzer. Four were used for the research types of processed cheese of the same grade (gouda) from four different producers. Three processed cheeses were cuboid-shaped and one was triangular. All processed cheeses analyzed did not deviate from the factory standards. The cheeses were wrapped in aluminum foil and special casings, which informed about the type of cheese and indicated the name of the producer. The unit packets of all cheeses were undamaged, the surface was smooth and the shape was regular. As mentioned earlier, three cheeses had the shape of a cuboid, while one was in the form of a triangle. The texture of all cheeses was spreadable, elastic, creamy with a slight sheen on the cross-section. The first processed cheese showed a relatively low viscosity and melt ability after unwrapping. This cheese also showed the greatest stability – its structure was the most compact and compact. The second processed cheese showed the highest viscosity. After taking it out of the foil, the cheese melted by itself. Its structure was the least stable. The third processed cheese, like the first cheese, had relatively little melting and its consistency was relatively firm. The fourth processed cheese analyzed was the only one that was triangular in shape. After unpacking from foil, it was characterized by the lowest viscosity and fusibility. Its structure was quite compact. The color of all cheeses was uniform throughout the mass. The texture of the tested objects was examined using an analyzer that measures the resistance of the analyzed product against the applied force. The force is imparted by the method of vertical compression. The resistance is measured by the transducer of which the data are properly explained and create a measure of the texture and various parameters of the tested product[3]. The analyzer works by inserting the probe into the tested object. The resistance of the tested object against the compressive force is measured by means of an adjustable load transducer and presented on the analyzer screen in grams [3].

Table 1. The method of selecting the appropriate measuring probe [3]

Tabela 1. Sposób doboru odpowiedniej sondy pomiarowej [3]

Probe Type	Typical Application
Cylinder	Samples with a well-defined shape, uniform surface, universal probes, most often used for texture profile analysis (TPA)
Ball	Samples with slight surface irregularities, universal probes
Cone	Spreadable samples, penetrometry and samples with a hard surface layer
Knives and cutting wires	Samples that are cut and sliced, e.g. hard cheese
Pistons	Semi-liquid and liquid samples
Shear knives	Samples that are cut, e.g. meat

The test was carried out with the use of TexturePro CT V1.4 Build 17. According to the table (Tab. 1), a straight conical probe was used to test the texture of processed cheese. The probe was attached to the extension arm of the apparatus using a right-hand thread. In addition, the probe had to be screwed on carefully as it could damage the thread. After the probe was properly prepared and the appropriate data entered, the texture of four processed cheeses of the same grade from different manufacturers were measured. Each cheese was placed on a measuring table which was then loaded with a conical probe.

Fig. 5. Testing IV of a processed cheese sample using a texture analyzer.

Rys. 5. Badanie IV próbki sera topionego za pomocą analizatora tekstury.

Source: Own study

Źródło: Opracowanie własne

Each sample was subjected to a single compression test after which the probe was returned to its starting position and the texture analyzer was ready for the next measurement [5]. Each examined processed cheese was appropriately labeled as: Processed cheese I, processed cheese II, processed cheese III and processed cheese IV. The processed cheese texture was tested by means of a one-time compression (Test Type) in which the probe penetrated (compressed) the sample. The Trigger Load, which means that the probe contacts the sample surface, was 4 g. The test speed was 0.5 mm / s, while its return speed was 4.5 mm / s. The Hold Line time was 0 seconds because this parameter is only used for the Hold to line method. The text description area also includes the date and time of the test [3].

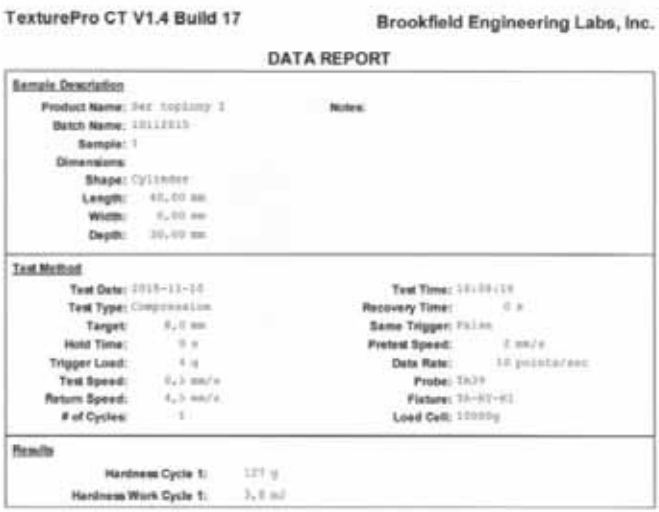
ANALYSIS AND DISCUSSION OF THE RESULTS

As a result of the research, four different reports were obtained, which contain detailed information about the given calculations and four graphical presentations of the measurement data. Each processed cheese was tested for hardness, i.e. the maximum force needed to compress the sample.

The results also take into account the work that was performed during the hardness measurement. Each report is divided into three parts:

- Sample Descriptions
- Test Method
- Results

In the Identification Control Area, the determination, shape and shaping of the probe can be distinguished. All reports have these data on these three parameter values, which are related to the fact that for the testing of processed cheese tissues it was used that they have supplemented technical data with graphic values (which were supplemented with tabular technical values in the technical service of graphic analysis), i.e.: height 40 mm, section diameter 30 mm. parameter properties differed individual reports are what names. The results obtained are presented below:


TexturePro CT V1.4 Build 17 Brookfield Engineering Labs, Inc.

DATA REPORT

Sample Description

Product Name: Ser topiony 1 Notes:

Batch Name: 18112015

Sample: 1

Dimensions:

Shape: Cylinder

Length: 40,00 mm

Width: 0,00 mm

Depth: 30,00 mm

Test Method

Test Date: 2015-11-18 Test Time: 18:38:19

Test Type: Compression Recovery Time: 0 s

Target: 8,0 mm Same Trigger: False

Hold Time: 0 s Pretest Speed: 2 mm/s

Trigger Load: 4 g Data Rate: 10 points/sec

Test Speed: 0,5 mm/s Probe: TA39

Return Speed: 4,5 mm/s Fixture: TA-RT-KI

# of Cycles: 1 Load Cell: 10000g

Results

Hardness Cycle 1: 171 g

Hardness Work Cycle 1: 3,8 mJ

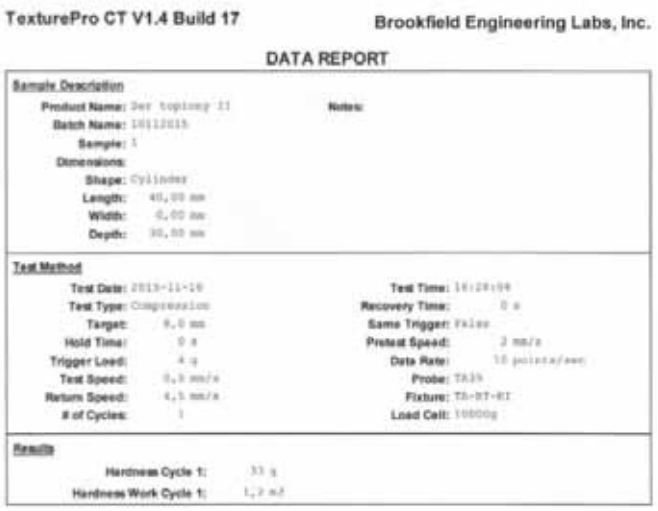
Fig. 6. The results obtained after examining the texture of processed cheese I.

Rys. 6. Wyniki uzyskane po zbadaniu tekstury sera topionego I.

Source: Own elaboration based on [3]

Źródło: Opracowanie własne na podstawie [3]

The results also included the work that was done during the hardness measurement. The table below shows a comparison of the results of the four processed cheeses in terms of hardness and the work performed during the hardness measurement:


TexturePro CT V1.4 Build 17 Brookfield Engineering Labs, Inc.

DATA REPORT

Sample Description

Product Name: Ser topiony II Notes:

Batch Name: 10112015

Sample: 1

Dimensions:

Shape: Cylinder

Length: 40,00 mm

Width: 0,00 mm

Depth: 30,00 mm

Test Method

Test Date: 2015-11-10 Test Time: 16:28:08

Test Type: Compression Recovery Time: 0 s

Target: 8,0 mm Same Trigger: False

Hold Time: 0 s Pretest Speed: 2 mm/s

Trigger Load: 4 g Data Rate: 10 points/sec

Test Speed: 0,5 mm/s Probe: TA39

Return Speed: 4,5 mm/s Fixture: TA-ST-KI

# of Cycles: 1 Load Cell: 10000g

Results

Hardness Cycle 1: 33 g

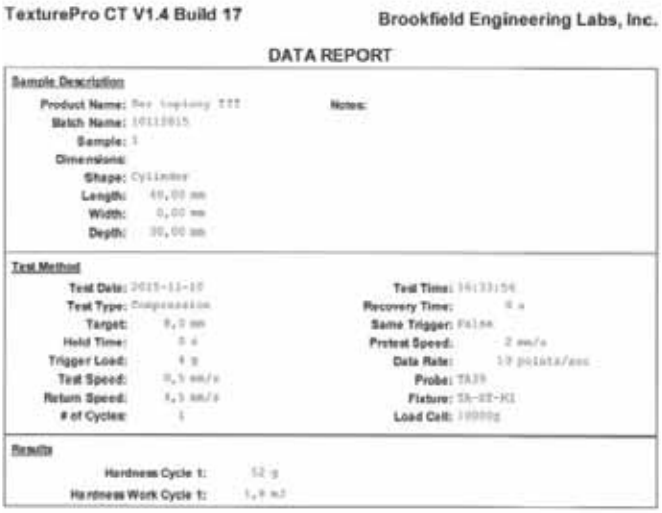
Hardness Work Cycle 1: 1,2 mJ

Fig. 7. The results obtained after examining the texture of processed cheese II.

Rys. 7. Wyniki uzyskane po zbadaniu tekstury sera topionego II.

Source: Own study based on [3].

Źródło: Opracowanie własne na podstawie [3].


TexturePro CT V1.4 Build 17 Brookfield Engineering Labs, Inc.

DATA REPORT

Sample Description

Product Name: Ser topiony III Notes:

Batch Name: 10112015

Sample: 1

Dimensions:

Shape: Cylinder

Length: 40,00 mm

Width: 0,00 mm

Depth: 30,00 mm

Test Method

Test Date: 2015-11-10 Test Time: 16:33:56

Test Type: Compression Recovery Time: 0 s

Target: 8,0 mm Same Trigger: False

Hold Time: 0 s Pretest Speed: 2 mm/s

Trigger Load: 4 g Data Rate: 10 points/sec

Test Speed: 0,5 mm/s Probe: TA39

Return Speed: 4,5 mm/s Fixture: TA-ST-KI

# of Cycles: 1 Load Cell: 10000g

Results

Hardness Cycle 1: 52 g

Hardness Work Cycle 1: 1,8 mJ

Fig. 8. The results obtained after examining the texture of the processed cheese III.

Rys. 8. Wyniki uzyskane po zbadaniu tekstury sera topionego III.

Source: Own study based on [3].

Źródło: Opracowanie własne na podstawie [3].

Table 2. Comparison of the obtained hardness results for individual processed cheese samples.

Tabela 2. Porównanie uzyskanych wyników twardości dla poszczególnych próbek serów topionych.

Parameters	Melted Cheese I	Melted Cheese II	Melted Cheese III	Melted Cheese IV
Hardness [g]	121	33	52	111
Work done during measurement [mJ]	3,8	1,2	1,8	3,6

Source: Own study

Źródło: Opracowanie własne

TexturePro CT V1.4 Build 17 Brookfield Engineering Labs, Inc.

DATA REPORT

Sample Description

Product Name: Ser topiony IV Notes:

Batch Name: 10112015

Sample: 1

Dimensions:

Shape: Cylinder

Length: 40,00 mm

Width: 0,00 mm

Depth: 30,00 mm

Test Method

Test Date: 2015-11-10 Test Time: 16:39:42

Test Type: Compression Recovery Time: 0 s

Target: 8,0 mm Same Trigger: False

Hold Time: 0 s Pretest Speed: 2 mm/s

Trigger Load: 4 g Data Rate: 10 points/sec

Test Speed: 0,5 mm/s Probe: TA39

Return Speed: 4,5 mm/s Fixture: TA-ST-KI

# of Cycles: 1 Load Cell: 10000g

Results

Hardness Cycle 1: 111 g

Hardness Work Cycle 1: 3,6 mJ

Fig. 9. Results obtained after examining the texture of processed cheese IV.

Rys. 9. Wyniki uzyskane po zbadaniu tekstury sera topionego IV.

Source: Own study based on [3].

Źródło: Opracowanie własne na podstawie [3].

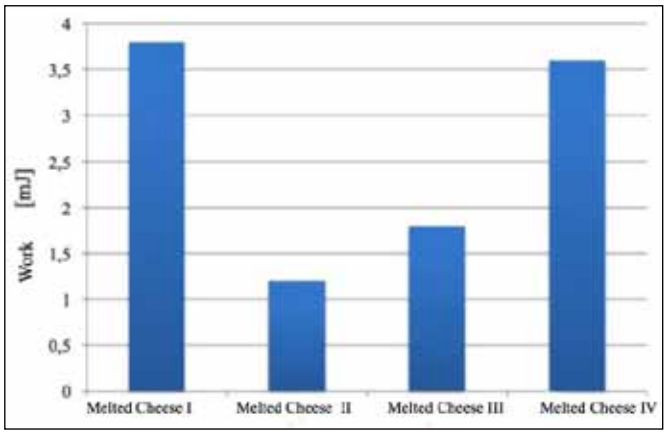


Fig. 10. Comparison of the work performed during the measurement of hardness of processed cheese analyzed.

Rys. 10. Porównanie pracy wykonanej podczas pomiaru twardości analizowanych serów topionych.

Source: Own study

Źródło: Opracowanie własne

Based on Table 2 and Figures 8 and 9, it can be read that processed cheese I was characterized by the highest hardness, and thus the work performed during the hardness measurement was also the highest. The lowest hardness and work were recorded in processed cheese II. Processed cheese IV had a similar hardness and work done to processed cheese I. In the case of processed cheese III it can be concluded that it had medium hardness compared to the other cheeses analyzed.

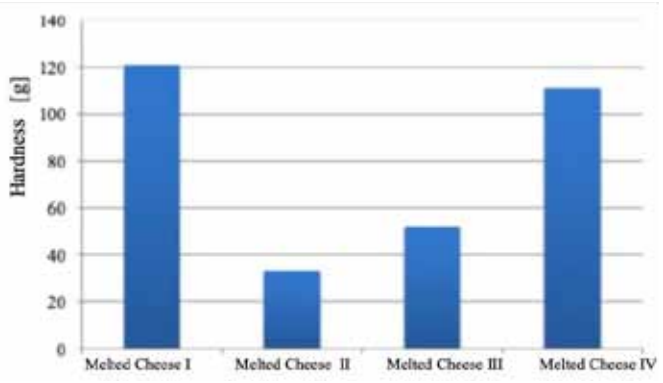


Fig. 11. Comparison of the hardness of the analyzed processed cheeses.

Rys. 11. Porównanie twardości analizowanych serów topionych.

Source: Own study

Źródło: Opracowanie własne

CONCLUSIONS

From the carried out research, the following conclusions can be drawn:

1. Processed cheese I and processed cheese IV contain more thickeners which contribute to the hardness of the cheese and to its firmer structure.
2. Processed cheese II, which was characterized by the highest viscosity and the least stable structure, was also distinguished by the lowest hardness during the texture test.
3. Processed cheese III had a relatively firm consistency, and thus its hardness, compared to other cheeses, was at an average level.

PODSUMOWANIE

Z przeprowadzonych badań można wyciągnąć następujące wnioski:

1. Ser topiony I i ser topiony IV zawierają więcej zagęszczaczy, które przyczyniają się do twardości sera i jego jędrnej struktury.
2. Ser topiony II, który charakteryzował się najwyższą lepkością i najmniej stabilną strukturą, odznaczał się również najniższą twardością w teście tekstury.
3. Ser topiony III miał stosunkowo zwartą konsystencję, a co za tym idzie jego twardość w porównaniu z innymi serami była na średnim poziomie.

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