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"PREGRETA SMETANA" (OVERHEATED CREAM) – A REVIVED SLOVENIAN TRADITIONAL DAIRY PRODUCT

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"Pregreta smetana" (overheated cream) – a revived Slovenian traditional dairy product

The aim of the study was to standardize the technological process for an almost unknown traditional dairy product from the south-eastern part of Slovenia, called "pregreta smetana" or "overheated cream". Traditional process for its production was and still is passed from generation to generation by oral tradition and personal notes, resulting in many variations of a final product. Nevertheless, there are some steps, common in all traditional processes regardless to the local area of origin: milk is poured into wide and shallow containers, and after fat-layer is formed on the milk surface during cooling period, the overheating follows. However, time/temperature regimes of overheating and other handlings differ from producer to producer. Therefore, four different technological processes were accomplished, where special attention was focused to parameters as follows: the size of crust patches, the temperature and the time of overheating, and the mode of stirring. From the results of chemical and sensory analysis of the overheated cream samples, the technological process was standardized. Taste and aroma of the standardized product were typical, soft, creamy and caramelized, the texture was buttery, smooth to slightly crumbly with crust patches, while colour was golden brown to brownish and evenly marbled with crust patches.

Key words: traditional dairy products; overheated cream; technology; standardization; chemical analysis; sensory evaluation; Slovenia

"Pregreta smetana" (overheated cream) – obujen slovenski tradicionalni mlečni izdelek

Cilj raziskave je bil standardizirati tehnološki postopek za izdelavo malo poznanega tradicionalnega mlečnega izdelka z jugo-vzhodne Slovenije, imenovanega »pregreta smetana«. Tradicionalni tehnološki postopek njene izdelave se je in se še vedno prenaša iz roda v rod predvsem z ustnim izročilom in osebnimi zabeležkami, kar ima za posledico številne različice končnega izdelka. Ne glede na njen izvor pa je nekaj korakov v tehnološkem postopku izdelave pregrete smetane skupnih, in sicer ko mleko razlijemo v široke in plitve posode, ga hranimo na hladnem do oblikovanja plasti smetane na površini, čemur sledi pregrevanje v pečici. Vendar pa se časovno/temperaturni režimi pregrevanja in ostala rokovanja razlikujejo od proizvajalca do proizvajalca. Zato smo pregreto smetano izdelali v štirih različicah, pri čemer smo posebno pozornost namenili spremljanju parametrov kot so velikost zaplat skorje, temperatura in čas pregrevanja ter intenzivnost mešanja. Na podlagi rezultatov kemijske in senzorične analize vzorcev pregrete smetane smo standardizirali tehnološki postopek. Okus in vonj standardiziranega izdelka sta značilna za pregreto smetano, prijetna, kremasta, čista, brez tujih primesi in karamelizirana, medtem ko je testo masleno, mazavo, gladko do rahlo grudasto z zaplatami skorje. Barva je maslena, zlato rumena do rjavkasta, marmorirana z rjavimi zaplatami skorje.

Ključne besede: tradicionalni mlečni izdelki; pregreta smetana; tehnologija; standardizacija; kemijske analize; senzorična ocena; Slovenija

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1 INTRODUCTION

Overheated cream is poorly-known dairy product, made of cream that is formed on the surface of boiled milk after a long cooling period through milk fat aggregation with participation of milk proteins, and is further overheated in oven for few hours. Although that protocol for overheated cream production is very simple and especially in first part strongly reminds on kaymak production (Puđa et al., 2006), there is a lack of any technological records on its manufacture. Mostly the technology was and still is passed from generation to generation by oral tradition and personal notes what is resulting in final products of diverse chemical and sensorial characteristics.

In the past, overheated cream was known in Styria, Dolenjska and Zasavje regions where it was produced by lengthy overheating of milk in a shallow clay containers (earthenware). Raw milk was poured into earthenware, then cooled from 6 to 24 h, and finally heated, on stove or in baker's oven, with temperatures above 90 °C. The temperature was not monitored by thermometers, but was empirically estimated by observing the milk until the blisters were formed. Overheated milk was carefully taken to a cool place for additional 12 to 26 h. After, the separated upper layer was collected from the milk and applied directly for consumption, as a spread on bread, or was used as an ingredient for the preparation of some festive dishes.

Nowadays, overheated cream is still produced in Dolenjska, Posavje and Bela Krajina regions in Slovenia where it is known under many different local names such as "škrlup", "pečena smetana", "škrlupec" and "škrlubec". In Dolenjska region, milk in earthenware is slowly heated in baker's oven, usually after bread baking. Thick layer of yellowish cream, so called "škrlupec" is formed on the top of the milk, while the remaining milk is delicious in taste due to mild caramelization. Two to three days after being collected from the milk, cream becomes slightly sour (Renčelj et al., 1995). In Bela Krajina, raw milk is left for 12 h in cool place, then slowly heated to the boiling point that helps to the formation of thick cream layer, and finally overheated in the oven at 200 °C for 10–15 min until cream turns golden yellow to brownish. Overheated cream is collected from the milk, while occasionally the remaining milk is boiled and coagulated with addition of apple vinegar (Bogataj, 2007). In Posavje region, milk in earthenware is left for 1 day to allow fat separation, the next day is overheated in oven at 170 °C until cream becomes golden yellow to brownish, and is left for another day at cool place that the cream surface becomes crusty. After, the layer of the overheated cream is collected from the milk surface (Ilich, 2013). Regardless to the region, during overheating phase the cream layer is frequently dipped into the milk, which results in formation of thicker layer of cream.

Housewives, who still produce overheated cream, use one of the described traditional technological procedures, at which in the phase of overheating, milk drastically changes and is improper for further processing. They also explain that milk, remaining after overheating, is fed to animals or simply discarded, what is unacceptable from either economic or technological point of view. Therefore more and more overheated cream production implements raw milk boiling, followed by a long cooling period to allow the formation of skin-like layer (crust) on the surface of milk through milk fat aggregation with significant participation of milk proteins that is collected from milk and further overheated. In this case, the remaining milk is a by-product of very low fat content but technologically still of proper quality and can be utilized for production of wide range of other fermented dairy products, similarly as reported at kaymak production (Puđa et al., 2006). Almost fat-free remaining milk can be further processed into fresh cheese, yoghurt or sour milk, or can even be used as an ingredient at baking. According to empirical estimation of housewives, approximately 12 l of milk is needed for yielding 1 kg of overheated cream (personal communications). Therefore, with such optimization of technology, between 10–11 litres of by-product is not discarded but usefully applied in production of diverse fat-free products on farm level.

The overheated cream can be used as a topping, as a stuffing ingredient (for traditional Bela Krajina rolled cake), and as addition to everyday and special occasion (festive) dishes such as "potica" nut-roll, "štruklji" dough-rolls, soups, gravies (Grum, 1983; Kuhar, 2002).

Around the globe there has been growing interest in preserving local dairy products that reflect tradition, habits, heritage, and above all, the identity of a certain nation. Preserved autochthonous dairy products are national goods that possess promotional as well as culinary potential. The role of science is that together with producers find the way to revive and preserve the uniqueness of traditional processes, as is the case with overheated cream. In addition, the presented work faced the greatest challenge because there is no literature available on the overheated cream production and mostly personal communications were the most valuable source of information.

Thus, according to all the available and gathered information the attempt for standardized technological procedure for overheated cream production was introduced that also helped to unify its sensorial characteristics. To standardize the parameters of chemical and

sensory quality of overheated cream, a draft specification was prepared as well.

2 MATERIALS AND METHODS

2.1 MILK

Raw cow milk for overheated cream production was obtained from the local dairy farm. First, milk was analysed for basic chemical composition (International Organization for Standardization [ISO], 2013), for microbiological quality (ISO, 2004), for somatic cell count (ISO, 2008) and for freezing point (ISO, 2009).

2.2 OVERHEATED CREAM PRODUCTION

Overheated cream was made in four different batches, one batch per week, in four consecutive weeks, from 30 l of milk that was heated to a boiling point, left for several minutes and poured into wide containers to allow fat separation. Separated fat with a portion of proteins that formed skin-like layer, also called crust, was transferred into baking tin for overheating. Phases of milk heat treatment and fat separation were identical in all batches, whereas during overheating phase several technological parameters were changed as follows: the size of crust patches (whole crust, smaller crust pieces), the temperature (150 °C, 170 °C) and the time (up to 4 hours) of overheating, and the mode of stirring (no stirring, stirring every half hour, stirring every hour). The cream was overheated to a golden yellow colour with dark brown patches of crust, cooled and filled into glass containers. All four variations of technological process that were applied for overheated cream production, are presented in Table 1.

Table 1: *Technological processes for overheated cream production*

Step	Batch 1	Batch 2	Batch 3	Batch 4
Milk heating (30 L)	to the boiling point (around 95 °C)			
Milk handling	Leaving heat treated milk for few minutes			
Milk pouring	into 4 exact the same wide containers, same volumes			
Fat separation	2 days at room temperature			
The size of crust patches	Whole crust	Cut	Cut	Cut
Temperature (T/°C) of overheating	150	170	170	150
Time of overheating	4 h	2 h 45 min	3 h	3 h 50 min
Stirring	None	At the beginning, and then every hour	At the beginning, then every half hour	At the beginning, and then every hour
After overheating	Cooling of overheated cream, overnight at room temperature			
Packaging	Filling of overheated cream into glass containers			
Storage	At 5–7 °C			
Analysis	Chemical and sensorial analysis of overheated cream			

2.3 CHEMICAL AND SENSORY ANALYSIS OF OVERHEATED CREAM

Chemical and sensory characteristics of overheated cream samples were determined within 14-days after production. Until analysis, samples of overheated cream were stored at 5–7 °C. The overheated cream composition was determined by standard methods as follows: total solids (ISO, 2010), protein content (ISO, 2014), and fat content (Methodenbuch, 1985). Fat in dry matter was calculated as ratio between fat and total solids, and was expressed in %. Sensory analysis was performed by three assessors according to the 20-point system, where appearance (2 points), texture (3 points), aroma (3 points), colour (2 points), and taste (10 points) were evaluated with evaluation range of 0.25 point. Depending on the overall points collected, products were classified into four quality classes: extra class (18.01–20.00), class I (16.01–18.00), class II (13.01–16.00), and class III (10.01–13.00).

Table 2: *Gross composition and microbiological quality of milk for overheated cream production*

Dry matter (%)	SNF (%)	Fat (%)	Protein (%)	Lactose (%)	FP (°C)	SCC/mL	TBC/mL
13.0	8.55	4.45	3.24	4.58	−0.515	236000	13000

SNF = solids non-fat, FP = freezing point; SCC = somatic cell count; TBC = total bacterial count

3 RESULTS AND DISCUSSION

3.1 CHEMICAL AND MICROBIOLOGICAL QUALITY OF MILK

The results of chemical composition, microbiological quality (total bacterial count = TBC), somatic cell count (SCC) and freezing point (FP) of milk for overheated cream production are presented in Table 2. Basic chemical composition of raw milk was very satisfactory and all parameters were in accordance with current legislation (Uredba (ES) št. 853/2004; Ministry of Agriculture, Forestry and Food, 2017). Milk fat, which is very important component for overheated cream production, was very high, 4.45 %. Besides, microbiological quality of raw milk was also very satisfactory, as very low numbers of TBC, 13000 CFU/mL, and SCC, 236000/mL, reflected very good hygiene in primary production and good health in herd, respectively. According to all parameters measured it was concluded that milk from the local farm was of very high quality which was probably a result of good manufacturing practice (GMP) and of proper level of knowledge of farmers. Therefore, only milk for overheated cream production in batch 1 was analysed.

3.2 CHEMICAL COMPOSITION OF OVERHEATED CREAM

Overheated cream shares 1st phase of production with kaymak, very well known dairy product from Balkan. Briefly, milk is heated to the boiling point, poured into wide containers and left for some time to allow formation of skin-like layer due to milk fat aggregation with significant participation of milk proteins. But for kaymak, the skin-like layer is then collected on daily basis, usually in wooden containers, until the container is full, salted in layers, and can be consumed as young kaymak instantly after production, or ripened for up to 2 months (Puđa et al., 2006), whereas for overheated cream the skin-like layer is overheated. For this reason, very similar chemical composition of overheated cream and young kaymak was anticipated, that according to Bijeljac and Sarič (2005) is as follows: water 33.96 %, fat 57.51 %, fat in dry matter 87.17 %, and proteins 6.68 %. Chemical characteristics of overheated cream samples (n = 4) are shown in Table 3. Compared to chemical composition of young kaymak, higher content of dry matter and fat in overheated cream was observed, but fat in dry matter was in the same range as in kaymak, and the protein content was somewhat lower. Higher fat and dry matter were somehow expected since the overheating phase of cream causes some loss of water content, but the ratio between the parameters stays comparable (86.68 %) to that in young kaymak (87.17 %). The highest contents of proteins and fat in dry matter, 6.02 % and 87.27 %, respectively, were observed in overheated cream from batch 3.

3.3 SENSORY EVALUATION OF OVERHEATED CREAM SAMPLES

After each batch of overheated cream was sampled for chemical analysis, the rest was used for sensory analysis, where the appearance, texture, taste, aroma and colour were evaluated. For overheated cream the unified appearance, smooth and buttery body, with visible crust patches was expected, where the aroma and taste should be typical for overheated cream, pleasant, creamy, with a pronounced note of the Maillard reaction, golden brown

Table 3: *Chemical composition of analysed overheated cream samples (n=4)*

Batch	Dry matter (%)	Fat (%)	Fat in dry matter (%)	Protein (%)
1	83.20	72.00	86.54	5.34
2	87.49	76.00	86.87	5.97
3	84.22	73.00	87.27	6.02
4	85.13	73.25	86.04	5.66
Mean value ± SD	85.01 ± 1.83	73.56 ± 1.71	86.68 ± 0.52	5.75 ± 0.31

SD = standard deviation

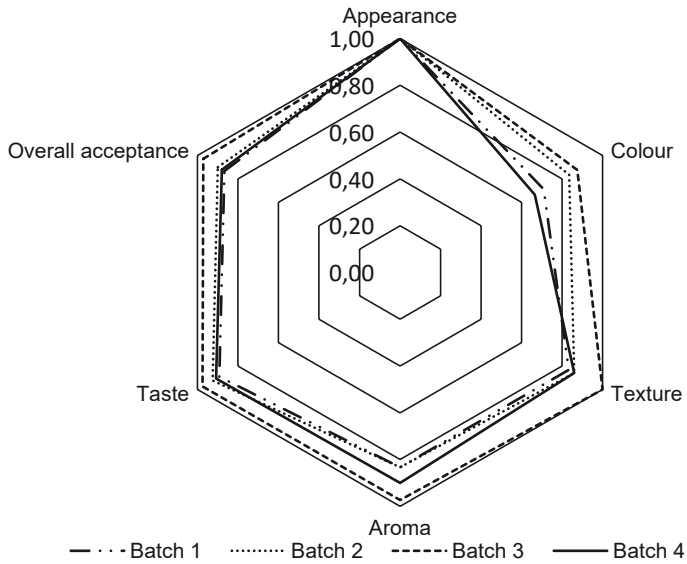

Figure 1: *Reduction of the sector output per 1 US$ subsidy reduction per sector*

to brownish in colour and evenly marbled with crust patches. In batch 1, uncut crust of cream was overheated at 150 °C for 4 h, with no intermediate stirring. This protocol resulted in an unevenly roasted or even burnt crust patches, therefore the stirring of crust was applied in all following batches. In batches 2, 3 and 4 different stirring/time/temperature regimes of overheating were applied (Table 1). All four variations were sensory evaluated by three assessors whose scores highly agreed and are presented in Figure 1. Each attribute was calculated as an average value of three assessors and for easier understanding then expressed as ratio between the calculated average value and the maximum possible points for a certain attribute.

Overheated cream from batch 1 was scored with an average of 17.33 points (overall acceptance 0.87; Figure 1). The most pronounced defect was discoloration that was a result of burnt crust and the highest point deduction was for colour attribute. Burnt crust patches consecutively affected attributes of texture, aroma and taste that were described as uneven, too strong and bittering defects, respectively. In batch 2, crust of cream was cut, overheated at 170 °C for 2 h and 45 min, with intermediate stirring at the beginning and on every hour. This protocol resulted in better sensory assessment with an average score of 18.00 points (overall acceptance 0.9; Figure 1). Compared to overheated cream from batch 1, overheated cream from batch 2 scored slightly better for all attributes but evidently better in colour, where size of crust patches (cut) and intermediate stirring positively affected the colour of final product. Assessors agreed that taste and aroma could be more intense. Therefore, in batch 3 the parameters of temperature (170 °C) and size of crust (cut) remained unchanged but the time of overheating was extended (for 15 min) and the intermediate stirring was intensified (every half hour). These modifications resulted in very high average score of 19.42 points (overall acceptance 0.97; Figure 1), where again colour received the highest deduction. Assessors were missing some more brownish crust patches that would intensify the colour and, consecutively, the taste. Nevertheless, assessors had almost no remarks to appearance, texture, and aroma. The note of caramelisation was detected in taste, but was very mild. Technological procedure used in batch 4 was a compromise between batches 1 and 2 as some improvement in sensory quality of the final product was expected. But the expectations were not fulfilled and the average score of overheated cream in batch 4 was 17.57 (overall acceptance 0.88; Figure 1) what was in between scores of overheated creams 1 and 2. According to the points collected for overall acceptance, overheated cream samples from batches 1, 2 and 4 were classified in class I, while overheated cream sample from batch 3 was classified in extra class.

3.4 OPTIMAL TECHNOLOGICAL PROCESS FOR OVERHEATED CREAM PRODUCTION AND SPECIFICATION DRAFT PREPARATION

From the results of chemical and sensory analysis of the samples, it was concluded that optimal technological process with the most balanced and harmonised sensory attributes was the overheated cream from batch 3 as fol-

Table 4: *Specification draft for overheated cream*

Parameter	Description
Definition	Overheated cream is dairy product, made of cream that is formed on the surface of boiled milk, poured in wide containers, over a long cooling period through milk fat aggregation with significant participation of milk proteins that is collected and further overheated
Origin	Overheated cream is locally still produced in Posavje, and as well in Dolenjska and Bela Krajina regions
Technology	Raw milk is heat-treated at 90–95 °C for 5–10 minutes, poured into a wide containers and left for 1–2 days at room temperature to allow separation of the fat layer with a portion of proteins. Separated skin-like layer (crust) with a smaller amount of fraction of softer cream is transferred into baking tin and overheated at 150–170 °C for 3–4 h or to the appearance of golden yellow to brownish colour patches and dark brown crust. During overheating the cream is stirred several times (3–4 ×). After overheating, the cream is cooled and filled into containers
Packaging	Overheated cream is filled in packaging units of 100 g, 200g, or 500 g
Appearance	Overheated cream is filled into plastic or glass containers. SURFACE is smooth, flush, dry and uniform, FILLING is without visible air spaces
Body	Buttery, spreadable to soft-spreadable, smooth to slightly crumbly with patches (crust). Intermediate spaces are filled with softer fraction of overheated cream
Taste and aroma	Are characteristic and typical for the overheated cream. Pleasant, clean, free of foreign admixtures, aromatic, buttery-caramelised, crusts – patches have a pronounced note of the Maillard reaction, tender, creamy
Colour	Buttery, golden yellow to brownish, marbled with lighter tones of milk fat and with dark brown, evenly scattered crusts – patches
Consumption time	Immediately after completion of the technological process of manufacturing, and cooling to refrigerator temperature
Raw material	Fresh, raw cow milk
Composition	Fat: min. 60 %; Dry matter: min 70 %; Fat in dry matter: min 80 %
Shelf life	Up to 1 month at 5–7 °C

lows: prior overheating crust was cut into smaller pieces and overheated for 3 hours at 170 °C with intermediate stirring every 30 minutes. Taste and aroma were typical for overheated cream – soft, creamy and caramelized. The texture was buttery, smooth to slightly crumbly with crust patches, golden brown to brownish in colour and evenly marbled with crust patches.

Since there is no specification available for overheated cream production and its sensory characteristics, no information was available whether the presented approach of standardizing the technological procedure for overheated cream production was successful. Therefore, the overheated cream from batch 2 (the 2nd best scored) was presented to housewives, who prepared overheated cream by themselves, and they were asked for their opinion. In general their sensory evaluation was very good with general remark that the cream was not overheated enough as they were used to stronger taste. Finally, the specification draft for overheated cream production was prepared (Table 4) that could serve as a starting-point for assessors to objectively evaluate the quality of overheated cream.

4 CONCLUSIONS

Housewives who still produce overheated cream according to a traditional procedure, which usually involves overheating of crust together with milk, are facing major losses of milk. During this process of overheating, milk drastically alters and is less suitable for further processing. Thus, milk losses technological importance and can only be used for drinking (caramel flavour) or to be fed to animals, or simply discarded. Such technological process is irrational, and it specially cannot be afforded at up-scaled production of overheated cream. Therefore, up-to-date traditional technological process was set up in which only crust of cream is overheated resulting in better yield and the remainder of the milk can be utilized for making a variety of dairy products. The results of the presented work complemented the technological process and to some extent unified chemical and sensory characteristics of overheated cream. The technological procedure was successfully optimized and allowed standardisation of chemical and sensorial parameters of overheated cream, and at last but not least enabled the preparation of specification draft. Presented work impor-

tantly contributes to the revitalization and preservation of almost disappeared Slovenian traditional dairy product, overheated cream.

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