

## Sensory and instrumental evaluation of the whey cheeses

J. Teplá\*, J. Strnková, Š. Nedomová, K. Šustová, M. Jůzl, T. Lužová

Department of Food Technology, Mendel University in Brno, Brno, Czech Republic

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Whey as a relevant dairy by-product is still not used in completely effective way, not only in the Czech Republic. There is the possibility of typical whey cheese production as mainly in the Scandinavian countries. Experimental whey cheeses were made according to the experimental recipes. Samples were evaluated by a sensory evaluation and texture analysis. The most sensory acceptable ( $P < 0.05$ ) was the sample with the addition of caramel. Changes of consistency of cheese samples during storage were detected. The result was the increase in hardness as confirmed by sensory analysis and instrumental measurements. Hardness of all produced whey cheeses was significantly affected by raw material and production technology. Following this model experiment will continue further research, particularly stabilization ratio of ingredients and verification of selected recipes for sensory panel.

**Key words:** dairy product, sensory evaluation, texture, hardness

### INTRODUCTION

In the Czech Republic like everywhere in the world, whey remains in large volumes from the cheese production. It is still not completely solved this problem with this dairy by-product. One of possible utilization is the whey cheese production. Moreover to the better known Ricotta, whey can be processed into the form of a brown caramel cheese typical and known especially in the Scandinavian countries. Their different names depend on the region or country of origin. In Norway, e.g. Mysost is made from the whey cows and Gjetost from goat whey, while Mesost is typical for Sweden [1].

The lactose caramelisation and whey protein coagulation are typical for the production of these brown whey cheeses. Steam is the sole resulting by-product. The highly concentrated whey arises and other ingredients, such as cream or milk, can be possibly added. Evaporation, stirring and cooling are the main technological processes [2,3]. Brown whey cheeses are mostly of rectangular shape, rindless, characterized by a distinctive sweet and typically caramel flavor, aroma reminding fine caramels, and by rougher texture [2,4-6].

The texture is regarded as one of the main cheese quality attributes and plays an important role as a determinant of the final use of the cheese, as well as for the consumer acceptance. Various cheeses are characterized by different textures. Therefore, different predominant attributes of

texture are expected at each type of cheese. E.g. Mozzarella cheese is "fibrous" or "elastic" and Parmesan is "friable", etc. Among the most commonly used terms to describe the cheese structure or texture include hardness, adhesion, fragility, creaminess, friability, chewiness, cohesiveness, staleness, firmness, gumminess and elasticity [7,8].

### EXPERIMENTAL

All samples of cheeses were manufactured according to the designed recipes in the laboratory of Department of Food Technology (Mendel University in Brno). They were used for the texture and sensory analysis. The sample of goat whey was used directly from the farm and was not subjected to any heat treatment. Whey was vaporized in the amount specified in the recipe up to the desired pasty consistency. The resulting paste was cooled and then evaporated again. After achieving of optimal consistency, resulting paste was put into plastic containers and stored in a refrigerator at a temperature of 7 °C. The samples were divided according to the designed recipe into three groups – the samples with addition of cream (No. 3, 4, 7, 8), samples without addition of cream (No. 1, 2, 5, 6) and samples flavored with various ingredients (No. 9 – 25). To produce the samples without the addition of cream, 2.6 l of goat whey was used (samples No. 1, 2, 5, 6). To produce samples with addition of cream, 0.17 l of cream was added to whey (samples No. 3, 4, 7, 8). According to the same recipe, to produce samples variously flavored, these ingredients were chosen to be added into goat

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\* To whom all correspondence should be sent.  
E-mail: jana.tepla@mendelu.cz

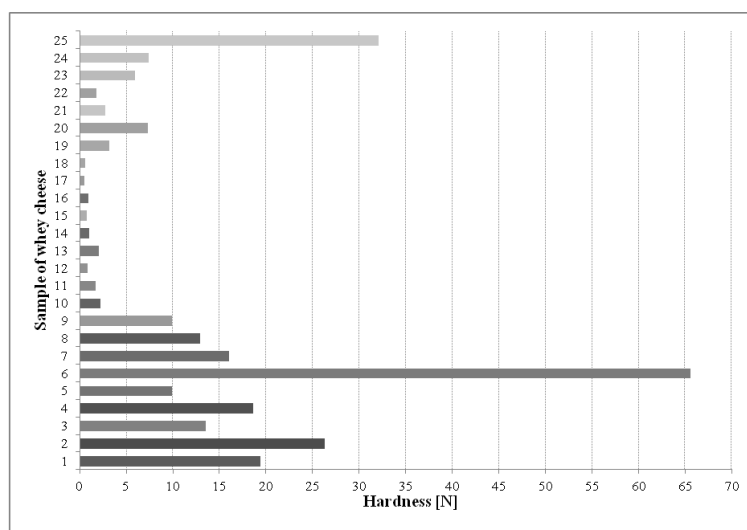
whey: vanilla sugar (No. 9); apples with cinnamon sugar (No. 10); dried prunes (No. 11); chocolate with cream (No. 12); extract of dried sweet marjoram (No. 13); plum butter and poppy seeds (No. 14); extract of wild garlic (No. 15); bananas with cinnamon sugar and cream (No. 16); prunes and cream (No. 17); dried cranberries with cream (No. 18); light brown caramel (No. 19); chocolate (No. 20); medium brown caramel (No. 21); sweetened condensed cream (No. 22); chocolate and dried prunes (No. 23); dark brown caramel (No. 24); and caramel with chocolate (No. 25).

Overall, it was therefore analyzed 25 samples of whey cheese – 4 samples with the addition of cream (No. 3, 4, 7, 8), 4 samples without the addition of cream (No. 1, 2, 5, 6) and 17 samples flavored with various ingredients (No. 9 – 25) in order to find the most organoleptic acceptable one. For the sensory evaluation of the appearance of the entire sample, whole loaf of cheese was used. 10 g of the samples were evaluated by eight assessors (with ISO 8586-1) in the sensory laboratory (under conditions ISO 8589). Sample of cheese was given to the evaluators on a white porcelain plate 15 minutes after removing from the refrigerator. To ensure the anonymity of the samples, four-digit codes were used. Milk was used as a neutralizer. Following descriptors were monitored: overall pleasantness of appearance, color, uniformity in coloring, overall pleasantness of smell, intensity of caramel smell, typical cheese smell, foreign smell, goat smell, hardness, spreadability, sandiness, friability, the overall pleasantness of taste, flavor intensity of sweet, salty, caramel, cooked, foreign taste and goat taste. Evaluation was based on unstructured graphical scale with a length of 100 mm with a verbal description of the extreme points. When the

higher value of the descriptor was detected, the more positive evaluation was estimated. Texture analysis of produced samples was performed in the 7<sup>th</sup> day after the production. The samples were left for 30 min at room temperature before the measurement. Determination of selected textural properties was performed by the universal testing machine. The penetration test was used for the determination of the hardness of whey cheeses. After the sensory evaluation, the most sensory acceptable whey cheese was sample No. 21. Therefore, this sample was analyzed (texture and sensory analysis) for longer time period – every seventh day for 6 weeks (7<sup>th</sup>, 14<sup>th</sup>, 21<sup>st</sup>, 28<sup>th</sup>, 35<sup>th</sup> and 42<sup>nd</sup> day). All data were analyzed using the software program Unistat 5.1 by the analysis of variance (ANOVA) with multiple comparisons followed by Tukey's test.

## RESULTS AND DISCUSSION

Sensory evaluation of whey cheese has detected no statistically significant difference ( $P > 0.05$ ) within all descriptors characterizing flavor and aroma between samples with or without added cream. Thus, the addition of cream recipe has no effect on the taste and smell of the products. In both groups of samples, there was identified high intensity of salty taste which was not accepted as positive characteristic by the evaluators. Such excessive salty taste may be caused by whey because most of the minerals of milk in cheese production are transferred to whey. Statistically significant difference ( $P < 0.05$ ) was not observed at descriptor of coloration uniformity. It was the most frequently detected by evaluators as creamy yellow color within the both groups of samples (with and without the addition of cream).



**Fig. 1.** Instrumental determination of hardness of whey cheeses.

Table 1 shows results of sensory evaluation of the data obtained from sensory questionnaires. Due to the high intensity of the salty taste of produced whey cheese, which was perceived negatively, it was necessary to adjust production technology and upgrade existing recipes using different ingredients that are listed in materials and methods. Whereas the each sample was made according to a specific recipe, it was not possible to statistically compare obtained results of flavored whey cheeses, because of its distinctive taste. The values of hardness determined by penetration test are shown for individual samples of whey cheeses in the Figure 1.

Sample with medium brown caramel (No. 21) was the most acceptable according the evaluators.

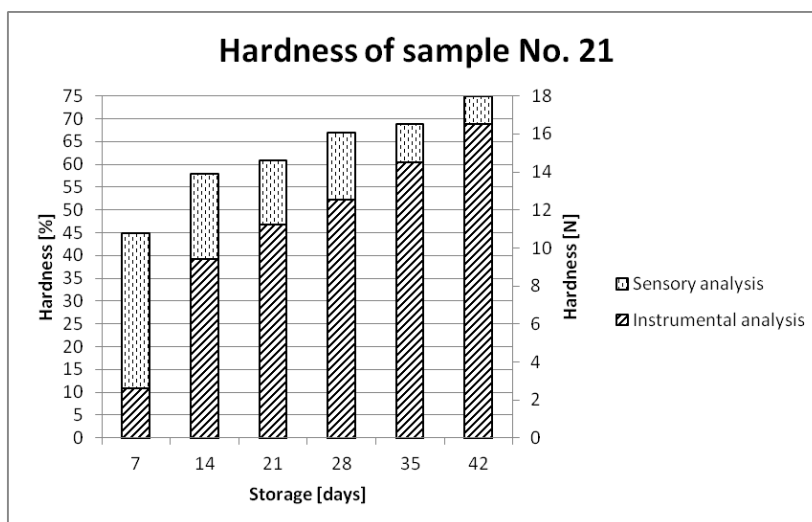
For this reason, it was analyzed during storage in detail with sensory and texture analysis. The results in Table 2 and Figure 2 show changes in consistency of the cheese samples (No. 21) during storage. These data are in increasing the hardness of the sample. The highest difference in hardness was noticeable between the 7th and the 14th day of storage when the hardness value increased approximately 3 times. Significant increasing hardness was slowed after three weeks. This was compared with the results of sensory analysis. There is the significant positive correlation between these methods. Sample (No. 21) was the most acceptable in the fourth week of measurement.

**Table 1.** The sensory evaluation of whey cheeses produced according to recipe with or without the addition of cream (mean +/- SE).

Descriptor	Without cream	With cream	P
Overall acceptance of appearance	61.72±3.93	63.25±3.41	SN
Coloring uniformity	81.99±2.82	84.48±2.73	SN
Overall pleasantness of smell	69.18±3.13	75.63±3.87	SN
Intensity of caramel smell	41.68±5.36	50.92±4.79	SN
Intensity of typical cheese smell	38.54±4.89	39.20±4.42	SN
Intensity of goat smell	17.08±3.57	16.33±3.34	SN
Intensity of foreign smell	93.77±2.64	96.38±1.61	SN
Hardness	48.37±3.61	52.00±4.48	*
Spreadability	57.81±3.32	54.70±5.13	SN
Sandiness	56.09±5.84	67.65±4.87	*
Friability	66.64±4.72	74.48±3.90	*
Overall pleasantness of taste	47.72±4.87	55.50±4.45	SN
Intensity of sweet taste	49.28±4.46	53.33±4.79	SN
Intensity salty taste	32.78±4.35	33.79±4.55	SN
Intensity of caramel taste	53.23±4.29	55.24±4.50	SN
Intensity of goat taste	74.85±4.72	75.03±5.28	SN
Intensity of foreign taste	93.75±2.34	92.97±2.45	SN

SN – statistically non-significant (P>0.05);

\* – statistically significant (P<0.05)



**Fig. 2.** Comparison of hardness of sample No. 21 determined by instrumental and sensory methods during storage.

**Table 2.** Comparison of hardness of sample No. 21 determined by instrumental and sensory methods during storage (mean +/- SE).

Duration of storage [days]	Hardness of sample No. 21	
	Instrumental analysis [N]	Sensory analysis [%]
7	2.65±0.15 <sup>a</sup>	45.3±8.3 <sup>a</sup>
14	9.44±1.01 <sup>b</sup>	58.2±8.0 <sup>ab</sup>
21	11.23±1.22 <sup>bc</sup>	60.9±9.0 <sup>ab</sup>
28	12.58±1.01 <sup>c</sup>	67.1±8.9 <sup>b</sup>
35	14.52±0.91 <sup>d</sup>	69.2±7.7 <sup>b</sup>
42	16.53±1.15 <sup>d</sup>	75.4±9.8 <sup>b</sup>

<sup>a, b, c, d</sup> – means between rows with different superscripts indicates statistically differences (P< 0.05)

## CONCLUSION

The assessors did not notice the difference in taste and smell of the samples produced by designed recipe with or without the cream addition. The intensity of the salty taste of these two groups was not perceived positively by evaluators.

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Regarding mentioned facts, it was necessary to modify and upgrade the technology of existing recipes using various additives in order to reduce the salty taste of the produced whey cheeses. From these samples, the most acceptable one from a sensory point of view was the sample with the addition of medium brown caramel (No. 21). For this reason, this sample was analyzed by instrumental and sensory method during longer period of time and the results show significant changes in consistency of the product during storage, which resulted in an increase in hardness with the ideal values around the fourth week of storage. Hardness of produced whey cheese was significantly affected by raw materials and production technology. On this model experiment will be followed by further research. In this research will be selected a few recipes which will be tested by consumers.

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## СЕНЗОРНА И ИНСТРУМЕНТАЛНА ОЦЕНКА НА СИРЕНЕ ОТ СУРОВАТКА

Я. Тепла\*, Я. Стрнкова, Ш. Недомова, К. Шустова, М. Юзл, Т. Лужова

Катедра по хранителна технология, Мендел Университет в Бърно, Чехска република

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(Резюме)

Суроватката е млечен вторичен продукт, който не само в Чешката република все още не се използва достатъчно ефективно. Главно в Скандинавските страни съществува възможност за производството на характерно сирене от суроватка. Направени са експериментални сирена от суроватка според рецептата, създадена от МЕНДЕЛУ. Образците са оценени посредством сензорен и текстурен анализ. С най-висока сензорна приемливост ( $P < 0.05$ ) беше образецът с добавка на карамел. Бяха забелязани промени в консистенцията на сирената по време на съхранението. Резултатът беше увеличаване на твърдостта, което беше потвърдено от сензорния анализ и инструменталното измерване. Твърдостта на всички произведени сирена от суроватка беше значително повлияна от суровината и технологията на производство. Следвайки описания моделен експеримент, бъдещият експеримент ще включва главно оптимизиране на състава и верификация на избрани рецепти за сензорен панел.