SAT–LCR-P-2-BFT(R)-13

RESEARCH OF MILK-PROTEIN CONCENTRATES AND FRUIT VEGETABLE PUREE SURFACE ACTIVITY IN THE ICE CREAM COMPOSITION

Prof. Galyna Polischuk, DeS
Departament of of Milk and Dairy Products Technology
National University of Food Technology, E-mail: milknuft@i.ua

Assoc. prof. TetianaOsmak, PhD
Assoc.Ulyana Kuzmyk, PhD
Departament of of Milk and Dairy Products Technology
National University of Food Technology
E-mail:osmaktg@ukr.net, ukuzmik@gmail.com

PostgraduateViktoria Sapiga
MSc ArturMykhalevych
Departament of of Milk and Dairy Products Technology
National University of Food Technology
E-mail: vika.sapiga@i.ua, artur0707@ukr.net

Abstract: *The purpose of the scientific paper is to study the surface activity of milk-protein concentrates and pectin-containing fruit-vegetable purees as functional and technological components in the composition of creamy ice cream. The surface activity of milk proteins and the surface neutrality of pectin-containing purees were confirmed. Synergism of proteins and polysaccharides interaction for the formation of dispersed ice cream systems, in particular, milk fat emulsion, has been established. The conclusion about the important role of complex application of protein compounds exhibiting surface activity and polysaccharides that determine the structural and mechanical stability factor of dispersed ice cream systems is formulated.*
Keywords: *ice cream, surface activity, milk proteins, pectin-containing purees*

INTRODUCTION

Ice cream as an object of colloidal chemistry is characterized by heterogeneity and dispersion. In the continuous aqueous phase of this product, dispersed particles of different sizes are uniformly distributed – ice crystals, fat balls, air bubbles. The most important factor influencing the formation and stabilization of these dispersed ice cream systems is the surface activity of the individual recipe components (Tvorogova, A. A., 2004). It is known that surface activity in the composition of ice cream is detected by emulsifiers and proteins. At the same time, mono-, di- and polysaccharides are surface neutral (Murray, B. S., 2007; Hemar, Y., Hall, C. E., & Singh, H., 2000).Considering the increased consumer demand for natural foods, the use of chemically modified and synthesized food additives is limited in the technology of modern types of ice cream. Therefore, animal and vegetable proteins, as well as polysaccharide-containing vegetable raw materials, have attracted the attention of scientists as an alternative replacement for stabilization systems in ice cream(Anwar, S, Shukat, R, & et al., 2018).It is the surface tension of food dispersion systems that is an important characteristic that depends on the temperature, presence and composition of proteins and fat, phospholipids, etc. (Sofijan, R. P., & Hartel, R. W., 2004). Therefore, the use of functional-technological ingredients - proteins and pectin-containing raw materials in ice cream requires additional study of their surface activity.

MATERIALS AND METHODS

The purpose of the study is to study the surface activity of sodium caseinate (CSo), a serum protein concentrate obtained by the method of ultrafiltration (CWP-UF), as well as pectin-containing apple puree (AP) and beet puree (BP), which is intended to be used in the composition of ice cream.

The surface tension of creamy ice cream mixtures in the content of milk-protein concentrates in the range from 0.2 to 1.0%, fruit and vegetable raw materials by solids – within 1 ... 5%, as well as mixtures containing complexes of proteins and polysaccharides - 1.2 ... 6.0%.

Protein concentrates were pre-hydrated at 40 °C for 20 minutes and added to the mixture under constant stirring before pasteurization at 85 ± 2 °C for 3 min. At the same temperature, the mixtures were homogenized at 12.5 MPa and cooled to 20 °C. Samples of apple and beet puree were added to the mixture for heat treatment and homogenization. The mixtures were normalized by the milk fat content by the introduction of molten butter with a fat content of 82.5%.

In the prototypes of the mixtures the content of dry skimmed milk residue was taken at 10%, sugar - 14%, milk fat - 8.0%.

The microstructure of the mixtures was studied using a light microscope to increase x600. The surface tension was determined by the stalagmometric method.

RESULTS AND SISCUSSIONN

The background surface tension of drinking water as solvent was 75.02 J $m^2 \cdot 10^{-3}$. The surface tension of the control sample without milk-protein concentrates and pectin-containing purees was 57.63 J/$m^2 \cdot 10^{-3}$. The surface tension of the samples is given in Table 1.

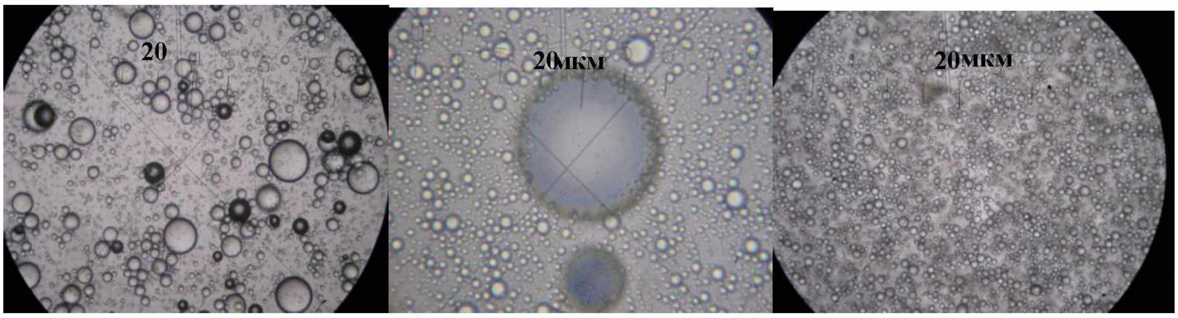
According to table. 1, the highest surface activity was detected for CSo. The surface tension of CWP-UF mixtures is slightly less affected. As for pectin-containing apples and beets, their role as surfactants is rather indirect. The slight decrease in surface tension in their presence can be explained by the wettability of the pectin substances of apples and beets and the corresponding slight increase in the concentration of dissolved surfactants in the residue of the aqueous phase. It should also be noted some increase in the surface activity of milk protein concentrates when combined with fruit and vegetable purees. The greatest effect on reducing the surface tension was found for the composite mixture CSo+AP, the value of which is highlighted in table 1 gray background. To achieve a surface tension of cream mixtures of less than 50 J $m^2 \cdot 10^{-3}$, it is recommended to use a protein-pectin complex in the amount of not less than 2.4% by the content of solids CSo and apple puree.

In order to prove the technological efficiency of complex application of sodium caseinate with apple puree in ice cream, its microstructure was investigated under different combinations of recipe composition.

The microstructure of ice cream samples is shown in Fig. 1.

Table 1. Surface tension of milk mixes for ice cream production (J/$m^2 \cdot 10^{-3}$)

Type of component	**Mass fraction of dry matter of component,%**				
Milk-protein concentrates (MPC)					
	0,2	0,4	0,6	0,8	1,0
CSo	52,23±1,12	50,46±1,30	48,02±1,15	47,68±1,12	46,20±0,97
CWP-UF	54,29±0,95	52,88±1,05	50,67±1,11	49,92±0,76	48,11±0,82
Fruit-vegetable puree (FP)					
	1,0	2,0	3,0	4,0	5,0
AP	56,84±1,24	55,86±1,02	55,69±0,93	55,16±0,94	54,52±0,68
BP	56,98±1,14	56,39±1,30	56,01±1,26	55,42±0,97	55,26±1,32
Complexes (MPC+FP)					
	1,2	2,4	3,6	4,8	6,0
CSo +AP	51,83±1,10	49,04±0,76	47,80±0,98	46,03±0,59	45,21±0,44
CWP-UF+AP	53,75±0,99	52,35±1,12	50,09±0,89	49,12±0,57	48,83±0,89
CSo+BP	51,99±0.68	49,52±0,78	48,24±0,57	46,47±0,63	46,00±0,45
CWP-UF+BP	54,02±1,11	52,44±0,78	50,13±0,69	49,72±0,65	49,00±0,34



a bc

Fig. 1. Microstructure of mixtures of creamy ice cream with apple puree (a), caseinate of sodium (b) and with the complex CSo + AP (c)

Fig. 1 clearly demonstrates the advantage of the complex application of apple puree and caseinate sodium, which allows to obtain a fine oil/water emulsion due to the synergistic interaction between functional and technological components.

The following phenomenon should be noted: despite the rather low surface activity, apple puree plays a significant role in the process of emulsifying milk fat. Small fat balls concentrate on the surface of the air bubble, reduce surface tension at the interface of the air/plasma phase and, accordingly, stabilize the foamy structure of the ice cream.

The distribution of fat globules by individual fractions in cream mixtures is shown in Fig. 2.

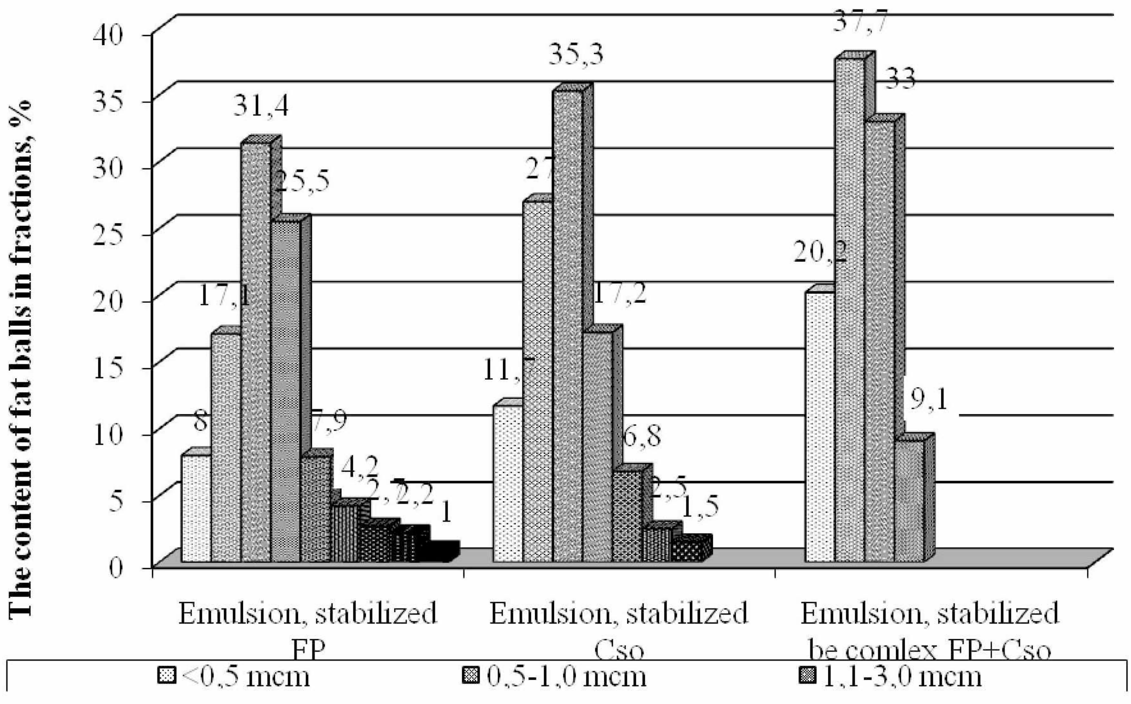


Fig. 2 Distribution of fat globules in size in cream mixtures with different fungicidal components

The difference in fat globules by fractions is significantly narrowed by the use of the emulsifying complex (maximum size of fat globules reached 6 μm), compared with emulsions containing only apple puree (up to 21 μm) while reducing the average diameter of fat globules from 3.29 to 3.29 microns. Therefore, it can be concluded that not only surface tension determines the ability of systems to form dispersed ice cream systems, in particular emulsions. The effectiveness of this process is also influenced by other factors, such as structural-mechanical factor - stable protective membranes on the phase separation surface formed by flexible chains of macromolecules of polysaccharides (pectin) and milk proteins.

CONCLUSION

Milk-protein concentrates exhibit moderate surface activity, and fruit-vegetable purees are almost surface-neutral components. Due to the combination of the surface activity of milk proteins and the stabilizing ability of pectin-containing purees, it is technologically feasible to have their complex application in the composition of creamy ice cream mixtures.

REFERENCES

1.Tvorogova, A. A. (2004). Stabilization of the structure of ice cream.*Milkprocessing*, 8 (58), 22–24. (***Оригинално заглавие:*** Творогова,А. А. (2004). Стабилизация структуры мороженого.*Переработка молока*, 8 (58), 22-24).

2. Murray, B. S. (2007). Stabilization of bubbles and foams. *Current Opinion in Colloid &Interface Science,* 12 (4-5), 232-241.

3. Hemar, Y., Hall, C.E., &Singh, H. (2000). Rheological properties of oil-in-water emulsions formed with milk protein concentrate. *Journal of Texture Studies*, 36, 289-302.

4. Anwar, S, Shukat, R, & et al. (2018). Effects of different ingredients on texture of ice cream. *Journal of Nutritional Health & Food Engineering*, 8(6),422-435.

5. Sofijan, R. P. &Hartel, R. W., (2004). Effects of overrun on structural and physical characteristics of ice cream. *International Dairy Journal*, 14(3), 255-262.