Streszczenie w języku angielskim

The aim of this work was to:

• evaluate an influence of selected parameters of technological treatment at industrial conditions on a change of composition and stability of milk during storage;

• investigate a difference in composition and stability of different types of liquid milk depending on a season;

• asses a suitability of selected methodologies for tracking changes in emulsion stability;

• investigate a destabilization mechanism of o/w milk emulsions.

Samples were taken at different stages of technological process from three sources (A, B, C) and four industrial lines. Material was preserved and stored at 4°C for 2 months (raw, standardized and homogenized ESL milk) or 6 months (homogenized UHT milk). These samples were compared with samples of market milk stored in commercial packaging. Product storage tests were carried out for the full shelf-life and in an accelerated mode: centrifuge method.

Changes in physicochemical composition were analysed: milk fat, total protein, casein, non-protein nitrogen, whey proteins. The research was focused on the analysis of a dispersed phase of milk, i.e. the fat phase. Therefore, changes of fat globules' size and their organization in the continuous phase, a share of fat globules >2μm, fat globule size distribution, homogeneity/ homogenization efficiency and the amount of protein bound to fat globules were studied. A fatty acid profile, free fatty acids and peroxide value were also determined.

It was found that season had a significant effect on the physicochemical composition of raw milk (SR) in terms of fat content (Z<L), fatty acid composition (C4:0 Z<L, C16:1 Z<L, C20:0 Z<L, C18:2 Z>L), as well as on the size distribution of fat globules (Z>L) and the rate of physical destabilization processes (Z>L).

Standardized milk (ST) differed significantly between autumn-winter and spring-summer seasons in parameters: non-protein nitrogen (Z<L) and fatty acid profile (C4:0 Z<L, C6:0 Z<L, C14:0 Z>L). Season affected also destabilization rate of the fat phase of standardized milk, with winter standardized milk creaming faster than summer standardized milk.

Winter homogenized milk (H) had significantly lower non-protein nitrogen content (Z<L). Winter homogenized milk was further characterized by higher C14:0 and C18:2 fatty acid content and lower C18:1 trans fatty acid content. Season affected the rate of phase separation of homogenized milk, but a trend was in this case reversed, i.e. homogenized summer milk creamed faster than homogenized winter milk. It was found that in the case of raw milk, the

differences in the composition of fatty acids and the size of fat globules (and therefore probably also the composition of the membrane itself) translate into different susceptibility of milk fat to the homogenization process. Homogenized winter milk had more proteins adsorbed on the membrane than summer milk, which may be one of the reasons why homogenized winter milk was more resistant to creaming.

Comparison of raw and standardized milk at different time levels revealed that proteolysis in standardized milk occurred more intensively than in raw milk.

Standardization and pasteurization made milk more susceptible to physical destabilization processes (reduction of membrane puncture force). Moreover, the strength of this effect exceeded dependence of creaming rate on the fat content.

Homogenization (together with heat treatment: UHT/ quenching of milk) protected the milk against unfavorable changes in physicochemical composition (unsaturated fatty acids), probably caused by the activity of lipolytic enzymes, better than pasteurization of standardized milk. At the same time, it was found that heat treatment applied to homogenized milk caused a higher degree of whey proteins denaturation. Moreover, the heat treatment of homogenized milk caused a decrease in the protein content, which most likely denatured and fell out of the system, depositing on the walls of a heat exchanger.

The rate of gravity separation of homogenized milk depended on the season, as well as on the amount of pressure and the type of homogenization used. It was shown that creaming occurred slower in autumn-winter milk, homogenized at higher pressures (non-aseptic homogenisation). It was also observed that at a similar pressure level, the use of aseptic homogenization contributed to the improvement of milk stability. Based on the results of the size distribution of fat globules, the efficiency of the homogenization process was determined.

In addition, it was found that the amount of protein bound to fat globules of homogenized ESL milk was lower than that from the homogenized UHT milk, which is consistent with scientific reports showing a correlation of this parameter with the height of the applied pressures. ESL milk had lower sediment content than UHT milk.

The microscopic technique was found to have low sensitivity, i.e., it couldn’t detect changes in the size of fat globules in milk during refrigerated storage. It also didn’t allow comparison of fat globule size between samples of milk homogenized using different homogenization pressures. Laser diffraction had higher sensitivity and gave more information about the changes occurring in the emulsion. It allowed to describe the direction of these changes and to conclude on the destabilization mechanism. It also allowed to characterize the sample and indicate which homogenization conditions were the best in terms of process efficiency. Fat globule size

distribution results were characterized by a very high correlation with the homogeneity/ homogenization efficiency results determined by the NIZO method.

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