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EFFECT OF SOME HYDROCOLLOIDS ON THE QUALITY OF HEALTH BENEFICIAL SOY ICE

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Abstract. The aim of this study was to work out a recipe for fruit ice with addition of soy protein isolates. The influence of sorts and dose of hydrocolloids on the physicochemical and sensoric properties of fruit soy ice was studied. The soy and whey proteins were compared as ice stabilizer. The investigations were performed to work out recipes for soy ice containing similar contents of protein as that of based on milk or containing higher contents of soy protein up to 6.25 g in a portion of ice. The quality of products was determined on the basis of the sensory evaluation, the apparent viscosity and density of ice mixture and on the basis of overrun and melting time of the ice.

Key words: isolated soy protein, isolated whey protein, fruit ice, ice overrun

INTRODUCTION

Soy proteins can compose an important ingredient of many vegetarian products consumed not only from viewpoint of philosophical, religious and/or economical reasons but also due to the health benefits of soy proteins which have a high nutritive value and attractive functional properties. Many studies have supported the health benefits of soy proteins especially when they are together with its native isoflavones like genistein and daidzein [Anthony et al. 1996].

Soy consumption influences significantly the reduction of the cardiovascular disease risk and the decrease of some cancer risks [Bakhit et al. 1994]. Epidemiological investigations show that in the Western populations the risk of breast, prostate and colon cancers is larger than in the Asian populations applying a typical plant diet containing high proportion of soy proteins [Messina et al. 1994].

In 1999 the U.S. Food and Drug Administration confirmed and released information that food products containing at least 6.25 g soy protein in the product portion is beneficial for health [Massey et al. 2001].

The PDCAAS (Protein Digestibility Corrected Amino Acid Score) takes into account the true digestibility of protein and its ability to supply essential amino acids in

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the amounts adequate to the needs of a two- to five-year old child, which represent the most demanding amino acid requirements of any age group. The PDCAAS value for soy protein is 1.00 similarly as for egg white [Messina 1995].

The functional properties of soy proteins like the emulsifying capacity, water and fat binding, foaming properties allow composition of new products being analogues to those of the traditional milk and meat ones.

The aim of this study was to work out a recipe for ice with addition of isolated soy proteins. The influence of kind and dose of hydrocolloids on the physicochemical and sensoric properties of fruit soy ice was studied. The following ice stabilizers were compared: soy and whey proteins. Some samples of ice containing similar contents of protein as that based on milk or containing higher contents of soy proteins up to 6.25 g in a portion of ice have been worked out. This content of soy proteins entitles to inform on the labels of food products about the health benefits of soy proteins (e.g. in USA).

MATERIALS AND METHODS

Materials

The isolated soy protein FP 94018 non-GMO produced by Du Pont Protein Technologies International, isolated whey protein produced by Proliant Poznań, strawberry fruit powder produced by Maspex Wadowice, gelatine, carrageenan, guar gum, xanthan gum and locust bean gum purchased from Degussa Texturant Systems Poland and sugar produced by Cukrownia Chybie S.A. were used in this study. In all fruit ice recipes, the sugar and strawberry fruit powder were applied in the same proportions.

Fruit ice preparation

The ice concentrates were obtained by weighing ingredients according to recipies and after powdering and proper mixing. Ice ready to eat was obtained by dissolving ingredients in drinking water and heated for 30 minutes on 80°C temperature. In the next step ice mixture was cooled down to temperature of 15°C and frozen in ice machine model IC 5000 DeLønghi, Treviso-Italy.

MEASUREMENTS

Overrun

Overrun and ice melting time were measured after driving in the metal cooling ring with known volume into the ice and keeping it all for 24 hours on –25°C temperature. After this time the ice was pushed out from the ring and put on the funnel. The ice could not touch the funnel, pins from two sides carried it. After weighing all, the ice with the kit were kept in thermostat on 25°C temperature and ice melting time was measured. The melting time is measured from the moment of placing the ice on the funnel to the moment of the apparent first drop. The overrun of ice X is evaluated by the formula:

$$X = [(V - m/d) / (m/d)] \cdot 100 \ (\%)$$

where: m – mass of ice filling the ring, g,
d – density of ice mixture, $g \cdot cm^{-3}$,
V – volume of ice filled the ring, cm^3 [Dłużewska and Gwiazda 1998].

The melting resistance was measured by volume (cm^3) of ice effluent after 45 minutes keeping it in the thermostat on the temperature of 25°C.

Viscosity

The apparent viscosity was determined by means of the Rheotest 2/50 HZ type RV2, by using the roll and cylinder type S.

Density

The density of the ice mixture (water solution of dry ingredients after mixing, pasteurisation and cooling) was measured by pycnometer method.

Sensory evaluation

Using the scaling method the sensory evaluation of fruit ice samples was carried out by a group of 10 people [Baryłko-Pikielna 1995].

RESULTS AND DISCUSSION

The proper ratio of ingredients in the recipe has influence on the quality of the fruit ice [Bergamn-Szczepanik and Kałuziak 1988]. Based on previous results of studies it was found that the best fruit ice obtained from ice mixture contains 19% of fruit powder, 18% of sugar with adding stabiliser gelatine or mixture of gelatine with polysaccharide hydrocolloids in amount 0.5% [Dłużewska et al. 2003].

Results of physicochemical properties of fruit ice with addition of 3% soy proteins are presented on Figure 1 and in Table 1. This dosage of soy proteins needs to be apply to fruit ice to achieve similar content of protein in ice cream based on milk. The quality of those samples compares to the quality of fruit ice stabilized by gelatine in amount of 0.5%. The apparent viscosity of fruit mixture ice with addition of soy proteins and polysaccharide hydrocolloids was significantly higher and density was lower in comparison to the apparent viscosity and density obtained only with addition of gelatine (Fig. 1). Probably increasing of apparent viscosity of fruit mixture ice with addition of soy proteins has beneficial influence on the overrun of ice. The fruit ice with addition of soy proteins has higher overrun than ice without soy proteins (Table 1). To apply the mixture of gelatine with polysaccharide gums or the mixture of two different types of gums in ice with soy proteins as a stabilizer has allowed obtaining ice characterized with longer melting time as well as it significantly decreased the effluent of the corresponding samples stored for 45 minutes on 25°C temperature (Table 1). The highest overrun and a high melting resistance characterizes the sample of soy ice stabilized by xanthan gum and guar gum in 0.3% dosage.

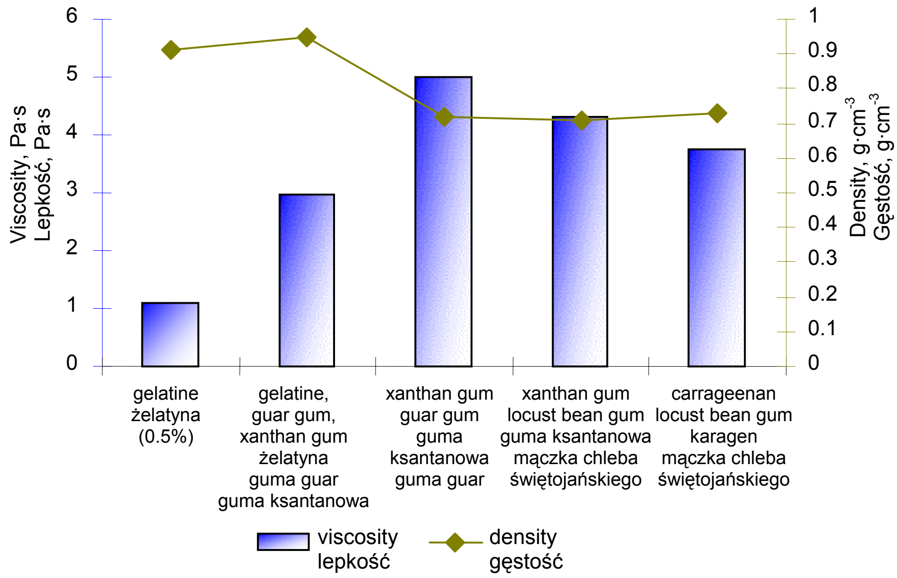

Fig. 1. Apparent viscosity and density of fruit ice with addition of soy proteins
Rys. 1. Lepkość pozorna i gęstość lodów owocowych z dodatkiem białek sojowych

Table 1. Physicochemical properties of fruit ice with addition of soy proteins
Tabela 1. Właściwości fizykochemiczne lodów owocowych z dodatkiem białek sojowych

Kind and amount of stabilizer Rodzaj i dawka stabilizatora	Addition of isolated soy protein Dodatek izolatu białka sojowego %	Overrun Puszystość %	Melting time Czas top-nienia min	Effluent Wyciek cm^3
Gelatine (0.5%) – Żelatyna (0,5%)	–	63.0	11	23.0
Gelatine, guar gum, xanthan gum 2:1:1 (0.3%) Żelatyna, guma guar, guma ksantanowa	3.0	75.4	24	10.0
Xanthan gum, guar gum 1:3 (0.3%) Guma ksantanowa, guma guar		74.9	21	7.5
Xanthan gum, locust bean gum 1:3 (0.3%) Guma ksantanowa, mączka chleba świętojańskiego		62.2	23	6.5
Carrageenan, locust bean gum 1:3 (0.3%) Karagen, mączka chleba świętojańskiego		66.2	22	10.0

To obtain the highest content of protein in fruit ice with the dosage of 6.25% of protein in a portion of the product and having desired texture and sensoric properties the ice needs to be made by choosing the amount of the portion in the range from 100 g to 200 g. Prepared samples of fruit ice enriched in soy proteins and in whey proteins were compared.

According to the measurement of apparent viscosity and density of fruit mixture ice (presented on Figure 2) it was concluded that using higher percentage content of soy proteins results in higher viscosity and density of fruit ice.

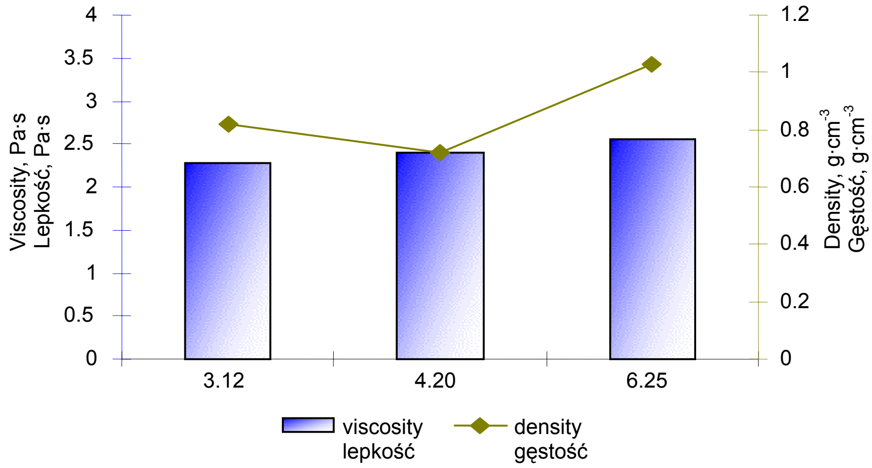

Fig. 2. Apparent viscosity and density of soy ice mixtures
Rys. 2. Lepkość pozorna i gęstość sojowych mieszanek lodziarskich

Results of physicochemical properties of fruit ice containing addition of soy proteins with different dosage are shown in Table 2. No other stabilizers were added to those samples. After the physicochemical evaluation it was found that higher addition of isolated soy proteins in ice mixture has significant influence on the overrun of fruit ice. The melting resistance has not changed proportionally to higher addition of isolated soy proteins. The melting time and the volume of melting ice (effluent after 45 minutes) showed no definite differences between samples with addition of 2.12% and 6.25% soy proteins (Table 2).

The analyses of the results of apparent viscosity and density of fruit mixture ice with addition of whey proteins concluded that using higher percentage portion of whey proteins in ice mixtures results in lower viscosity and higher density. The viscosity of ice mixture contents 3.12% of protein was 3.7 Pa·s, density was 0.85 g/cm^3. Higher amount of whey proteins up to 6.25% causes appreciation density ice mixture up to 0.92 g/cm^3 and viscosity drop up to 2.6 Pa·s.

Similarly to soy fruit ice an increasing addition of whey proteins in fruit mixture ice substantially affects ice overrun. Also the increased addition of whey proteins rises the melting resistance (Table 3). The comparison of fruit ice with addition of soy proteins to fruit ice with addition of whey proteins suggested that both are characterized by similar melting resistance. The fruit ice with addition of whey proteins showed higher overrun compared to fruit ice with addition of soy proteins (Table 2, 3).

Based on the results of consumer's desirability (Fig. 4) indicated that fruit ice with addition of isolated whey proteins was significantly more accepted in comparison to fruit ice containing soy proteins. Although fruit ice with addition of isolated soy proteins is characterized by a high aeration ratio, the intensive soy flavour was less desired

Table 2. Physicochemical properties of soy ice
Tabela 2. Właściwości fizykochemiczne lodów sojowych

Contents of protein Zawartość białka %	Amount of ice portion Wielkość porcji lodów g	Overrun Puszystość %	Melting time Czas topnienia min	Effluent Wyciek cm^3
3.12	200	47	15	14.0
4.20	150	57	11	16.0
6.25	100	68	16	13.5

Table 3. Physicochemical properties of ice with addition of whey proteins
Tabela 3. Właściwości fizykochemiczne lodów z dodatkiem białek serwatkowych

Contents of protein Zawartość białka %	Amount of ice portion Wielkość porcji lodów g	Overrun Puszystość %	Melting time Czas topnienia min	Effluent Wyciek cm^3
3.12	200	50	11	17.5
4.20	150	58	12	16.0
6.25	100	72	17	12.0

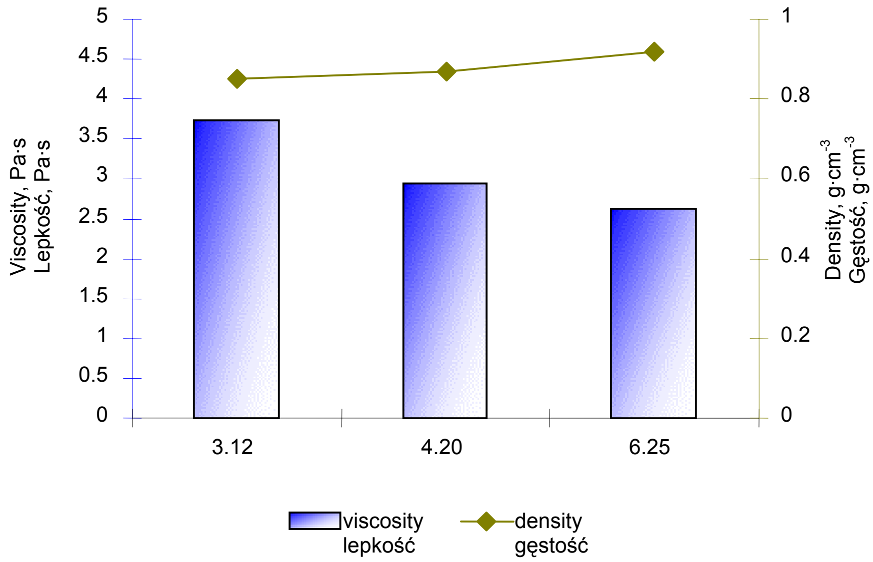

Fig. 3. Apparent viscosity and density of fruit ice mixtures with addition of whey proteins
Rys. 3. Lepkość pozorna i gęstość mieszanek lodziarskich z dodatkiem białek serwatkowych

than the ice containing whey proteins. Fruit ice with whey proteins has more neutral taste and does not initiate strange flavour. Consumers did not accept only the sample of fruit ice with dosage of 6.25% of soy proteins. The consumer's desirability of this sample was evaluated at the level of 0.94 units. Presumably the addition of aroma or soy mask substance could result in products acceptable to consumers, even soy fruit ice is characterized by good physicochemical properties.

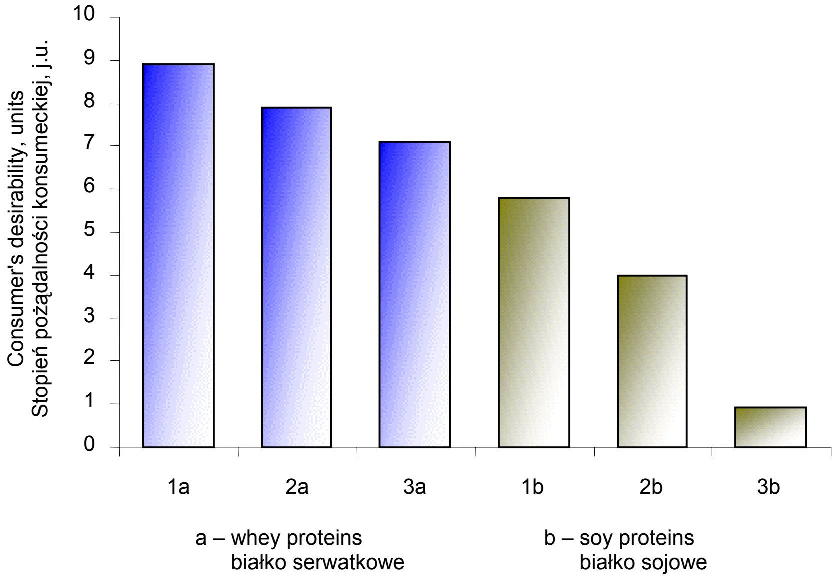

Fig. 4. Consumer's desirability of fruit ice
Rys. 4. Stopień pożądalności konsumenckiej lodów owocowych

From the viewpoint of physiochemical properties as well sensoric evaluation the best samples of fruit ice were: a sample with dosage of 6.25% of whey proteins and sample with dosage 3.12% of soy proteins.

CONCLUSIONS

1. The high overrun can be obtained by adding isolated soy proteins in amount of 3% of ice mass. The addition of the gelatine and polysaccharide gums mixture increased melting time of soy ice.
2. The ice containing isolated soy proteins is characterized with similar physicochemical properties as the ice containing whey proteins but they were worse in respect to sensoric properties.
3. From the viewpoint of sensory evaluation the best amongst the fruit ice samples with addition of whey proteins was found to be the ice containing 6.25% isolate, but among the fruit ice samples with addition of soy proteins was the ice which contained 3.12% isolate.

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WPŁYW WYBRANYCH HYDROKOLOIDÓW NA JAKOŚĆ PROZDROWOTNĄ LODÓW SOJOWYCH

Streszczenie: Celem badań było opracowanie receptur lodów owocowych z dodatkiem izolatów białek sojowych. Określono wpływ rodzaju i dawki hydrokoloidów na właściwości sensoryczne i fizykochemiczne sojowych lodów owocowych. Jako stabilizatory zastosowano izolaty białek sojowych i izolaty białek serwatkowych. Badania przeprowadzono na lodach sojowych zawierających podobną ilość białek – lody mleczne lub zawierających wyższą dawkę białek sojowych – 6,25 g na porcję. Jakość produktów określono na podstawie oceny sensorycznej, lepkości pozornej i gęstości mieszanek lodziarskich jak również zmierzono puszystość i czas topnienia lodów.

Słowa kluczowe: izolat białek sojowych, izolat białek serwatkowych, lody owocowe, puszystość lodów

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