PHYSICOCHEMICAL QUALITY OF SELECTED STRAWBERRY JAMS WITH FRUCTOSE

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ABSTRACT

Four different commercially available strawberry jams with fructose were characterized in relation to acidity and reducing sugar, ash, micro- and macroelement contents. The results showed that the jams differed in active and total acidity, ash, as well as reducing sugar content. Differences between the jams were more pronounced for microelements than for macroelements.

Keywords: strawberry jam, fructose, chemical composition

INTRODUCTION

Strawberry fruits are very popular among berries and are widely consumed fresh or as derived products such as jams, puree, juices, nectar or ice cream. In the Polish market the most common strawberry products consumed are the jams, especially because of their low cost, all year availability and organoleptic properties **(Anonim, 2002)**. Jam is one of the most popular shelf-stable products made from fruits, both at the household and commercial levels. To manufacture fruit jams, fruits and sugar are combined in similar ratios, and cooked to produce a tasty product of sufficiently high sugar content with satisfactory storage qualities. Nowadays, consumers are increasingly better informed about diet and health, and as a result, desire more foods which offer, in addition to convenience, high quality, safety, optimum nutrient balance, less fat and sugar and fewer calories. At the same time foods must remain tasty and at an economical price **(Abdullah and Cheng Cheng, 2001)**. Jams sweetened with fructose are an example of food for diabetics. Fructose is natural and healthy sweetener that balances the sugar level in blood and reduces appetite. Fructose seems to have a beneficial effect on the heart muscle and reduces the decay risk. Fructose is low-calorie sweetener, and consumed in appropriate amounts prevents both obesity and obesity related ailments like: diabetes, high blood pressure, and arteriosclerosis **(White J.S., 2008)**.

MATERIAL AND METHODS

Four different brands of strawberry jams with fructose were obtained from local market (Krakow, Poland), indicated as *A, B, C, D*: (*A*) Melangerie Diät Diabetic Strawberry Extra Jam, LIDL Stiftung & Co. KG, Neckarsulm, Germany, (B) Strawberry jam with fructose, Radix-Bis, Rotmanka, Poland, (*C*) Dietetic strawberry Jam with Fructose, Stovit Group Sp. z o.o., Bygdoszcz, Poland, (*D*) Dietetic strawberry Jam with Fructose, BioFan, Piekary Śląskie, Poland.

Jam samples were thoroughly homogenized and undergo the following physicochemical analyses: moisture content [PN-90/A-75101/03], active acidity (PN-A-75101-06:1990), titratable acidity (PN-A-75101-04:1990), reducing sugar content by the Fehling method (PN-A-75101-07:1990) and total ash content (PN-A-75101-08:1990). The content of mineral elements (Na, K, Mg, Ca, Fe, Mn, Zn, Cu) was also evaluated by Atomic Absorption Spectrometry method in Avanta Sigma GBC (Australia) spectrometer with an air-acetylene flame atomization. The gel samples were dry mineralized according to PN-A-75101-08:1990, and then the resulted ash was solubilized in 0,1M nitric acid.

RESULTS AND DISCUSSIONS

The results of the physicochemical analysis of strawberry jams are presented in Tables 1-4.

Water content of the strawberry jams varied from 57.1-71.1% (Table 1). The strawberry jams had a pH of 4.66 – 4.89 ±0.01 with no significant differences within *C* and *D* jams (Table 1). These values were higher than these reported in literature **(Rada-Mendoza et al., 2002, Suutarinen et al., 2000)**.The differences may result from the concentration of added citric acid during jam production. The titratable acidity was estimated by the sample titration using standard 0.1 $mol \cdot L^{-1}$ solution of NaOH and the results were expressed as citric acid content in jam. The titratable acidity of all the samples showed to be statistically different from each other ($\alpha = 0.05$) (Table 1). The values of this parameter meet the Polish Standard's requirements (PN-A-75100:1994) and are also similar to those found in literature **(Kallio et al., 2000)**. It is worth to notice that the increase in pH values of the jams was not accompanied with the decrease in the titratable acidity values. The highest titratable acidity was stated in the *A* jam, whereas the lowest one in the *D* jam. All the analysed jams differed statistically in the concentration of ash (Table 1). The content of ash in the strawberry jams was estimated to be from 0.737±0.018 to 1.096±0.036 g per 100 g of dry mass of jam. These values are in accordance with the available literature data **(Castro et al., 2002; Kunachowicz et al., 2005)**.

The results of sugar content determination are presented in Table 2. The mean values for reducing sugar components varied in the ranges 28.31-41.50 g per 100 g of jam. These values are typical for low-sweetened jams and are comparable with data presented in the literature **(Jarczyk and Berdowski, 1999; Kunachowicz et al., 2005; PN-A-75100:1994)**. The *A* jam contained higher amounts of sugars compared to the other jams. The differences in sugar contents between the analysed jams can mainly result from different amounts of fructose used to production of jams, as well as from possible differences in sugar content of the strawberries.

Table 1 Physicochemical properties of jams (mean values and standard deviations)

Kind of jam	Dry mass in %	pH	Titratable acidity expressed as citric acid, in g.100 g^{-1}	Ash content, in g.100 g^{-1} d.w.
A	42.9±0.3	4.66±0.01	0.96±0.001	0.737±0.018
B	28.9±0.5 a	4.89±0.01	0.71±0.006	1.096±0.036
C	29.5±0.4 ab	4.84±0.01 a	0.64±0.003	0.746±0.038
D	30.2±0.3 b	4.83±0.01 a	0.56±0.001	0.779±0.018

Means with the same letters in the columns do not differ significantly at $\alpha = 0,05$.

Table 2 Reducing sugar content in jams (mean values and standard deviations)

Kind of jam	Reducing sugar content, in g/100 g
A	41.50±0.48
B	28.31±0.20 a
C	28.74±0.16 a
D	29.82±0.14

Means with the same letters in the columns do not differ significantly at $\alpha = 0,05$.

The mineral content of jams is shown in Tables 3 and 4. As for macroelements, all considered samples contained a high amounts of potassium and sodium and relative low amounts of calcium and magnesium (Table 3). Analysis of variance showed that the differences in potassium content in jams between *B*, *C* and *D* samples were not statistically significant for $\alpha = 0.05$.

The amount of mineral elements in jam depends mainly on the concentrations of the elements in the processed fruits. The chemical composition of strawberries is influenced by cultivar and also by other factors such as production area, soil and climate, agricultural practices, quality of the irrigation water and eventually the storage and commercialization conditions. Mineral element composition could be influenced by heating of fruits during the production of jam, as well as by dilution with sugar **(Castro, 2002; Plessi et al., 2007)**. In our study the sodium concentrations in all the jams were higher than those found in the literature **(Kunachowicz et al., 2005;** of the Ca and K determined in the strawberry jams were some lower than these reported by **Kunachowicz et al. (2005)**. Among the determined macroelements of the strawberry jams magnesium occurred in relatively small amount, however this phenomenon is common for fruit jams **(Plessi et al., 2007)**.

The concentrations of zinc and copper in the analyzed jams were in accordance with Polish Standard's requirements (PN-A-75100:1994). As it can be seen in Table 4, iron was the most abundant metal in the jams with an average content of 2034 μg.$g100^{-1}$ dried weight. The *B* and *D* jams did not differed significantly in zinc, manganese and iron contents. Moreover, the amounts of zinc, copper and manganese determined in the above jams were higher than the respective values determined in *A* and *C* jams (Table 4). All the results presented in Table 4 are in sufficient accord with the data published in the literature **(Kunachowicz et al., 2005)**.

Table 3 Macroelements contents in jams expressed as mg.100^{-1} g dried weight (mean values)

Kind of jam	Mg	Ca	Na	K
A	16.46 a	29.62 ab	33.36	140.72
B	22.62	55.44	91.81 a	187.62 a
C	18.48 b	34.05 a	86.59 a	191.05 a
D	17.27 ab	27.26 b	85.52	198.86 a

Means with the same letters in the columns do not differ significantly at $\alpha = 0,05$.

Plessi et al., (2007). On the other hand, the mean contents.

Table 4 Microelements contents in jams expressed as μg.100 g^{-1} dried weight (mean values)

Kind of jam	Zn	Cu	Mn	Fe
A	221.77	62.6 a	498.2	974.5 a
B	428.90 a	131.4	653.7 a	2092.7 bc
C	306.01	88.6 a	420.5	3061.2 c
D	396.06 a	215.4	704.3 a	2009.1 ab

Means with the same letters in the columns do not differ significantly at $\alpha = 0{,}05$.

CONCLUSIONS

Physicochemical quality parameters of strawberry jams with fructose are influenced by the raw material and processing conditions. The jam *A*, that was produced in Germany, was characterized by higher dry mass, total acidity and reducing sugar contents as compared to the Polish jams. The amounts of ash and micro- and macroelements determined in *B, C, D* jams were greater than these stated for the *A* jam. All the physicochemical parameters of Polish strawberry diabetic jams (*B, C, D*) did not exceed allowable levels indicated in Polish Standard's quality requirements.

REFERENCE

ABDULLAH A, CHENG CHENG T., 2001. Optimization of reduced calorie tropical mixed fruits jam. Food Qual. Pref., 12, 63-68.

ANONIM, 2002. Słodkie przetwory owocowe – rynek produktów dżemowych. Hurt & Detal, 2(12).

CASTRO I., GONCALVES O., TEIXEIRA J.A., VICENTE A.A., 2002. Comparative study of Selva and Camarosa strawberries for the commercial market. J. Food Sci., 67, 2132-2137.

JARCZYK A., BERDOWSKI J.B., 1999. Przetwórstwo owoców i warzyw. Cz. I. WSiP, Warszawa.

KALLIO H., HAKALA M., PELKKIKANGAS A.-M., LAPVETELÄINEN A., 2000. Sugars and acids of strawberry varieties. Eur. Food Res. Technol., 212, 81-85.

KUNACHOWICZ H., NADOLNA I., PRZYGODA B., IWANOW K., 2005. Tabele wartości odżywczej produktów spożywczych i potraw. Instytut Żywności i Żywienia, Warszawa.

PLESSI M., BERTELLI D., ALBASINI A., 2007. Distribution of metals and phenolic compounds as criterion to evaluate variety of berries and related jams. Food Chemistry, 100, 419-427.

PN-90/A-75101/03. *Przetwory owocowe i warzywne. Przygotowanie próbek i metody badań fizykochemicznych. Oznaczanie zawartości suchej masy metodą wagową.*

PN-A-75100:1994. *Przetwory owocowe. Dżemy*.

PN-A-75101-04:1990. *Przetwory owocowe i warzywne. Przygotowanie próbek i metody badań fizykochemicznych. Oznaczanie kwasowości ogólnej.*

PN-A-75101-06:1990. *Przetwory owocowe i warzywne. Przygotowanie próbek i metody badań fizykochemicznych. Oznaczanie pH metodą potencjometryczną.*

PN-A-75101-07:1990. *Przetwory owocowe i warzywne. Przygotowanie próbek i metody badań fizykochemicznych. Oznaczanie zawartości cukrów i ekstraktu bezcukrowego.*

PN-A-75101-08:1990. *Przetwory owocowe i warzywne. Przygotowanie próbek i metody badań fizykochemicznych. Oznaczanie zawartości popiołu i jego alkaliczności.*

RADA-MENDOZA M., OLANO A., VILLAMIEL M., 2002. Determination of hydroxymethylfurfural in commercial jams and in fruit-based infant foods. Food Chem., 513-516.

SUUTARINEN J., HONKAPÄÄ K., HEINIÖ R-L., AUTIO K., MOKKILA M., 2000. The effect of different prefreezing treatments on the structure of strawberries before and after jam making. Lebensm.-Wiss. u.-Technol., 33, 188-201.

WHILE J.S., 2008. Weak association between sweeteners or sweetened beverages and diabetes. J. Nutr., 138, 138.

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