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SUITABILITY OF FRUITS OF *Crataegus* L., *Viburnum opulus* L., *Hippophaë rhamnoides* L., *Aronia melanocarpa* (Minch) Elliott, *Sorbus aucuparia* L., *Rosa cinnamomea* L., *Chaenomeles japonica* (Thunb.) Lindl. FOR PROCESSING

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Introduction

Fruits of *Crataegus* L., *Viburnum opulus* L., *Hippophaë rhamnoides* L., *Aronia melanocarpa* (Minch) Elliott, *Sorbus aucuparia* L., *Rosa cinnamomea* L., *Chaenomeles japonica* (Thunb.) Lindl. are rich in biologically active substances. However, their utilization in large scale processing plants is rather negligible [SHIRKO, YAROSHIEVICH 1991; ZUIKEVICH, MAKSYMENKO 1997; KAWECKI et al. 1999]. They were used to making of home-made preserves [CHAKHOVSKII et al. 1986; LOIKO 1998]. As it was suggested in our earlier papers the small fruits may be important source for manufactured canned food [MAKSYMENKO, ZUIKIEVICH 1996; LOIKO et al. 1997a, 1997b; ZUIKIEVICH, MAKSYMENKO 1997; MAKSYMENKO, ZUIKIEVICH 1999].

The aim of our research was to determine the suitability of small fruits for manufacturing of canned food.

Materials and methods

For our researches the following fruits have been used: 3 species *Crataegus* L., 3 selections *Viburnum opulus* L., 4 cultivars of *Hippophaë rhamnoides* L., 4 selections of *Aronia melanocarpa* (Minch) Elliott, 5 cultivars *Sorbus aucuparia* L., 9 cultivars *Rosa cinnamomea* L., 4 selections *Chaenomeles japonica* (Thunb.) Lindt., 22 selections *Malus* L. with small fruits, 1 cultivar *Vaccinium corymbosum* L, 1 cultivar *Cucurbita pepo* L.

Canned food (juices, sauses, mushes, stewed fruits, fruits in fruit juice) manufactured and sterlized (100°C) in 500 ml glass jars was tested material [Anonymus 1980].

The organoleptical and biochemical tests of fresh fruits and preserves after 6 month of their storage were done using generally accepted techniques [SPANYAR et al. 1963; ERMAKOV, ARASIMOVICH 1987]:

- total soluble solids measured refractometrically;
- total sugars according to Bertran's with modifications;
- total pectins measured according colorimetric carbazol method;
- ascorbic acid measured by reaction with L-L-dyperedil at presence of H_3PO_4 and $FeCl_3$;
- total phenols compounds measured colorimetrically with utilization of reactive Folin-Denis;
- carotenoides measured colorimetrically;
- mineral composition was measured with spectrofotometer „Plazma-100".

Results

Chemical composition of small fruits

Small fruits under studies were characterized by high content of phenolic compounds which ranged from 173.0 (*Hippophaë rhamnoides* L.) to 495.8 mg·100 g^{-1} (*Aronia melanocarpa* (Minch) Elliott), (Table 1). Total pectin content varied from 0.6 (*Crataegus* L.) to 2.0% (*Rosa cinnamomea* L.). Content of ascorbic acid appeared to be relatively low (6.6–59.3 mg·100 g^{-1}) and the only exception was fruit of *Rosa cinnamomea* L. which contained 183.6 mg·100 g^{-1}. High concentration of carotenoides was determined in fruits of *Viburnum opulus* L., *Hippophaë rhamnoides* L. and *Rosa cinnamomea* L. (5.4–6.0 mg·100 g^{-1}) and low in the fruits of *Crataegus* L. (0.15 mg·100 g^{-1}).

Products of processing

180 prototypes of canned food were manufactured: juices, sauses, mushes, stewed fruits, fruits in fruit juice.

Mash from fruits with sugar

Content of pectins in investigated canned food ranged from 0.15 up to 3.45%. The highest content of pectins was found in canned food made of miscellaneous kinds and sorts of a dogrose – 1.99–3.95%, from a dogrose with apples (up to 3.45%) and rowan ashberry with apples (up to 2.58%).

The highest concentration of ascorbic acid was found in canned food: dogrose (31.99–32.62 mg·100 g^{-1}), dogrose + apple (up to 64.35) and seabuckthorn + apple + bilberry (up to 33.8).

Carotenoides were found in majority of samples of canned food: dogrose (8.51–11.99 mg·100 g^{-1}), dogrose + apple (2.97–4.79), rowan ashberry (2.38), rowan ashberry + apple (0.96–3.16 mg·100 g^{-1}).

All investigated samples, except Japanese quince contained high levels of phenolic compounds – from 101.0 to 365.4 mg·100 g^{-1}.

Canned food under investigation showed high content of mineral compounds however high variability was noted.

Mashes showed attractive exterior and good taste. Only products made of hawthorn had rough, fibrous solid to liquid ratio, brown colour and unattractive exterior.

Table 1; Tabela 1

Chemical composition of selected small fruits (average for 1990–1995)
Skład chemiczny wybranych owoców (średnio w latach 1990–1995)

Characteristics Cecha		*Crataegus* L. Głóg	*Viburnum opulus* L. Kalina koralowa	*Hippophaë rhamnoides* L. Rokitnik zwyczajny	*Rosa cinnamomea* L. Róża girlandowa	*Chaenomeles japonica* (Thunb.) Lindl. Pigwowiec japoński	*Aronia melanocarpa* (Minch) Elliot Aronia	*Sorbus aucuparia* L. Jarząb zwyczajny
Total soluble solids; Substancje rozpuszczalne (%)	range zakres	17.0–19.6	10.9–11.3	7.4–8.0	16.6–26.0	9.7–9.6	15.0–17.9	13.5–13.8
	$\bar{x}$	18.3	11.0	7.8	20.7	9.3	16.4	13.6
Titrable acidity Kwasowość (%)	range zakres	0.4–0.7	1.7–2.1	2.2–2.5	0.8–1.3	4.0–5.0	1.2–1.6	0.9–1.0
	$\bar{x}$	0.6	1.9	2.4	1.2	4.5	1.4	0.95
Total sugars Cukry ogólne (%)	range zakres	4.0–7.8	7.0–8.7	3.4–4.4	5.7–15.0	2.2–3.5	5.5–5.8	6.5–6.6
	$\bar{x}$	5.9	8.1	3.9	9.9	2.8	5.65	6.55
Total pectins Pektyny ogólne (%)	range zakres	0.5–0.7	0.4–0.6	0.4–0.5	1.2–2.8	0.4–0.6	0.2–0.7	0.5–0.6
	$\bar{x}$	0.6	0.5	0.45	2.0	0.5	0.45	0.5
Ascorbic acid; Kwas askorbinowy (mg·100 g^{-1})	range zakres	6.5–12.1	16.6–18.0	49.9–70.8	167.3–200.0	27.4–57.3	2.8–10.5	17.0–17.2
	$\bar{x}$	9.3	17.3	60.3	183.6	42.3	6.6	17.1
Total phenolics; Związki fenolowe (mg·100 g^{-1})	range zakres	295.4–315.7	404.3–555.0	168.0–178.0	137.0–238.0	356.8–533.4	404.3–587.3	400.0–404.8
	$\bar{x}$	305.6	463.9	173.0	187.5	445.1	495.8	402.4
Anthocyans; Antocjany (mg·100 g^{-1})	range zakres	3.6–27.9	6.8–9.2	9.6–15.4	52.8–65.3	2.3–5.7	–	–
	$\bar{x}$	15.8	8.0	12.5	59.1	4.0		
Carotenoids; Karotenoidy (mg·100 g^{-1})	range zakres	0.1–0.2	4.3–6.8	3.5–7.8	3.2–8.9	–	0.7–0.7	0.4–0.8
	$\bar{x}$	0.15	5.4	5.7	6.0		0.7	0.6
K_2O (mg·100 g^{-1})	range zakres	132.0–151.4	60.6–72.7	107.0–132.0	116.0–197.0	64.6–80.2	74.7–110.2	100.0–112.4
	$\bar{x}$	141.7	67.3	118.5	156.5	72.4	92.4	106.2

Table 2; Tabela 2

Consumption quality characteristics of selected kinds of canned food
Cechy konsumpcyjne wybranych rodzajów przetworów

Canned Zakonserwowane owoce	Total pectine Pektyny	Ascorbic acid Kwas askorbinowy	Carotenoides Karotenoidy	Total phenolics Związki fenolowe	Mineral composition; Skład chemiczny								
					Na	K	Ca	Mg	P	Fe	Si	Mn	Zn
	%	mg·100 g^{-1} fresh matter; mg·100 g^{-1} świeżej masy											
Mashed rose rugosa; Przecier z róży pomarszczonej	3.90	132.0	10.9	373.2	2.28	92.0	51.3	8.8	14.2	0.21	0.04	0.09	0.12
Mashed apples and rose rugosa; Przecier z jabłek i róży	2.70	8.7	4.1	325.0	1.83	83.1	30.1	6.7	9.8	0.29	0.03	0.006	0.08
Mashed guelderrose; Przecier z owoców kaliny	0.30	24.8	–	359.0	1.65	100.2	11.4	4.5	7.0	0.30	0.02	0.03	0.08
Mashed ashberries and apples; Przecier z owoców jarząbu zwyczajnego i jabłek	0.24	3.8	3.2	264.3	1.21	121.1	23.3	8.4	9.7	0.59	0.02	0.39	0.08
Mashed seabuckthorns; Przecier z owoców rokitnika	0.30	49.3	8.5	94.8	1.11	119.4	35.5	11.8	14.8	0.32	0.03	0.09	0.11
Mashed apples and seabuckthorns; Przecier z jabłek i owoców rokitnika	0.80	26.3	5.51	200.0	–	–	6.7	4.0	11.7	0.8	0.05	0.05	0.05
Black chockberry in apple juice; Aronia w soku jabłkowym	1.0	29.4	–	513.3	0.90	100.6	44.2	14.9	16.6	0.60	0.06	0.57	0.17
Diurnal need of the man; Dzienne zapotrzebowanie człowieka	2–3 g	70–100 mg	3–5 mg	25 mg	4–6 g	2.5–5 g	0.8–1 g	300–500 mg	1.0–1.5 g	15 mg	0.1–0.2 mg	5–10 mg	10–15 mg

Stewed fruits

The majority of stewed fruits showed low content of total pectines (from 1.08 to 0.2%), ascorbic acid (0.10–64.75 mg·100 g^{-1}), carotenoids (0.12–4.75 mg·100 g^{-1}). At the same time many samples of stewed fruits were rich in phenolic compounds.

The content of mineral nutrients was lower comparing to puree products with sugar addition.

The majority of investigated stewed fruit products obtained high score in organoleptic estimation scale.

Fruits in fruit juice

This canned food had low level of ascorbic acid (0.08–6.88 mg·100 g^{-1}), high level of pectins (0.27–0.86%) and phenolic compounds (114.0–513.3 mg·100 g^{-1}). The mineral composition of these canned food was similar to the composition of fresh fruits (Table 1).

Highest organoleptic estimation have received canned food: in apple juice and black cockberry in the extract from Japanese quince.

Juices and sauces

The majority of samples contained low level of ascorbic acid (0.08–14.62 mg·100 g^{-1}), carotenoids (0.02–0.61 mg·100 g^{-1}) and pectins (0.19–0.78%). According to the contents of ascorbic acid juices from seabuckthorn are rather rich (49.32–96.20 mg·100 g^{-1}), carotenoids from rowan ashberry (to 1.15 mg·100 g^{-1}), viburnum (1.61), seabuckthorn (4.32), black currant (5.93 mg·100 g^{-1}). The contents of phenolic compounds in the majority samples of juices was low.

The best organoleptical estimation have received juices from a rowan ashberry and the mixture from juices of apples and viburnum.

Discussion and conclusion

Canned food from investigated fruits have a rich and miscellaneous elemental composition. The high content of phenolic compounds is the greatest value of investigated preserves. Such substances miss in the majority other food [PETROVA 1986]. Some phenolic compounds have P-vitamin activity and consequently increase resiliency elascitity of vessels, prevent hypodermic haemorrhage [ZUIKEVICH, MAKSYMENKO 1997; MAKSYMENKO, ZUIKEVICH 1999]. Some of them are very effective in curing radiation injuries, allergic diseases, malignant swellings [ZUIKEVICH, MAKSYMENKO 1997].

High contents of total pectins have been found in the mashes from *Rosa cinnamomea* L. (3.9%), mashes from apples and dogrose (3.7%). The high level of ascorbic acid have the mashes from *Rosa cinnamomea* L. (132.0 mg·100 g^{-1}) and *Hippophaë rhamnoides* L. (39.3 mg·100 g^{-1}). These samples contained high level of carotenoides (2.9–10.9 mg·100 g^{-1}).

The investigated small fruits are characterized by the high contents of mineral substances [ZUIKEVICH, MAKSYMENKO 1997]. In all samples of canned food macro- and indispensable trace elements were also detected. In all canned kinds of food there was high content of potassium on a background of the low content of sodium. It is very important because exuberant quantity of sodium negatively

influences the activity of human organism [MUROKH, STIEKOLNIKOV 1985; PETROVA 1986; SHIRKO, YAROSHIEVICH 1991; LOIKO 1998]. Calcium, iron, phosphorum and other deficient elements also were found.

All fruits appeared to be a relevant source of raw material for obtaining canned food with the high content of natural biologically active and nutritive substances.

The perspective canned food contains: more than 1% total pectins, above 50 mg·100 g^{-1} of ascorbic acid, above 200 mg·100 g^{-1} of total phenolics, more than 1 mg·100 g^{-1} carotenoides, at have a high level of sensual index.

In the results of research the following kinds of canned food are designed: mashed rosa rugosa, mashed rosa rugosa and apples, mashed guelder rosa, mashed ashberries and apples, mashed seabuckthorn, mashed seabuckthorn and apples, black chockberry in apple juice (Table 2).

The same kinds of canned food have passed the biomedical tests under clinical conditions.

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Key words: small fruits, biochemical and mineral composition, canned food

Abstract

The possibility of using small fruits of some plants (*Crataegus* L., *Viburnum opulus* L., *Hippophaë rhamnoides* L., *Aronia melanocarpa* (Minch) Elliott, *Sorbus aucuparia* L., *Rosa cinnamomea* L., *Chaenomeles japonica* (Thunb.) Lindl.) for production of canned food (juices, sauses, mushes, stewed fruits, fruits in fruit juice) was studied. The biochemical indices and mineral composition of small fruits were investigated as well as of the 180 samples of their products. In the canned products high level of biologically active substances were detected.

PRZYDATNOŚĆ OWOCÓW *Crataegus* L., *Viburnum opulus* L., *Hippophaë rhamnoides* L., *Aronia melanocarpa* (Minch) Elliott, *Sorbus aucuparia* L., *Rosa cinnamomea* L., *Chaenomeles japonica* (Thunb.) Lindl. DO PRZETWÓRSTWA

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Słowa kluczowe: owoce jagodowe, skład chemiczny, przetwory owocowe

Streszczenie

Badano przydatność używania niektórych owoców jagodowych (*Crataegus* L., *Viburnum opulus* L., *Hippohaë rhamnoides* L., *Aronia melanocarpa* (Minch) Elliott, *Sorbus aucuparia* L., *Rosa cinnamomea* L., *Chaenomeles japonica* (Thunb.) Lindl.) do produkcji przetworów (soków, przecierów, kompotów, owoców w soku owocowym). Określono skład chemiczny i niektóre wskaźniki biochemiczne owoców i 180 próbek produktów. W przetworach wykazano obecność dużej ilości substancji biologicznie czynnych.

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