The possibility of using microwaves to obtain extracts from berry press residues and jelly products with bioactive characteristics

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INTRODUCTION

Berries, as sources of biologically active compounds (BAC) that come in an easily digestible form, play a huge role in human nutrition. Compared to other fruits, they contain more phenolic compounds, flavonoids and anthocyanins, which give them a higher antioxidant activity (AOA). Microwave extraction allows extracting both free and bound phenolic compounds, which increases their bioavailability in the human body.

The purpose of the work is to study the composition of BAC and the antioxidant activity of berry press residues remaining after squeezing juice from them for use in microwave technology as raw materials for water extracts and jelly products based on them with bioactive characteristics.

MATERIALS AND METHODS

For the purposes of this research, we used *Vaccínium genus* berries – bilberries and cranberries – collected in the Leningrad Region, Russia.

Water extracts were obtained from raw pressed berries in a microwave oven, at the power of 800 W, and the frequency of 2450 MHz, with the range of exposure modes from 144 to 800 W. Water extract was obtained in the ratio (hereinafter water ratio): 1:10 and 1.5:10 (berry press residue: water).

For production of jelly products, we used water extracts of bilberries, cranberries and their mixtures both without sugar and with addition of sugar 2.5 wt%, as well as a building agent (gelatin) 3 wt%. Production of jelly products was carried out in two methods. When the first method was applied, all components were mixed together and left to sit for 40 minutes, then mixed again, heated at 800 W in a microwave oven for 1 minute, cooled to the room temperature, and placed in a refrigerator 4±2 °C until solidified. When the second method was used, gelatin was not allowed any time to swell.

Determination of AOA was carried out by two methods: by their reaction to the DPPH-radical, by FRAP method. The strength of the 'Bloom strength' jelly products was determined with the use of 'ST-2 Structometer', manufactured by Quality Laboratory LLC, Russia. This method is based on measuring penetration force by the Bloom indenter, when it penetrates the prepared jelly sample to the depth of 4 mm (at the penetration speed of 1.0 mm s-1, and the touch force of 7 g).

RESULTS

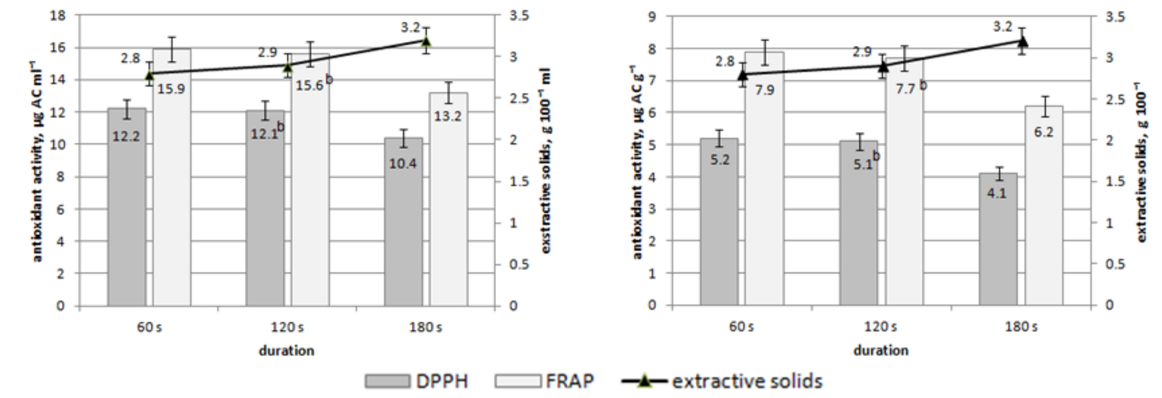
Bilberries and cranberries collected in the Leningrad Region had a typical biochemical composition. Test samples of whole berries contained total phenolic compounds, total flavonoids, total anthocyanins and vitamin C. The amount of biologically active substances in berry press residues was more than in whole berries. The AOA was related with the content of biologically active substances. The AOA was used as an integral indicator.

Composition of biologically active substances, mg 100 g^{-1}, in berries and in berry press residues, ± standard deviation

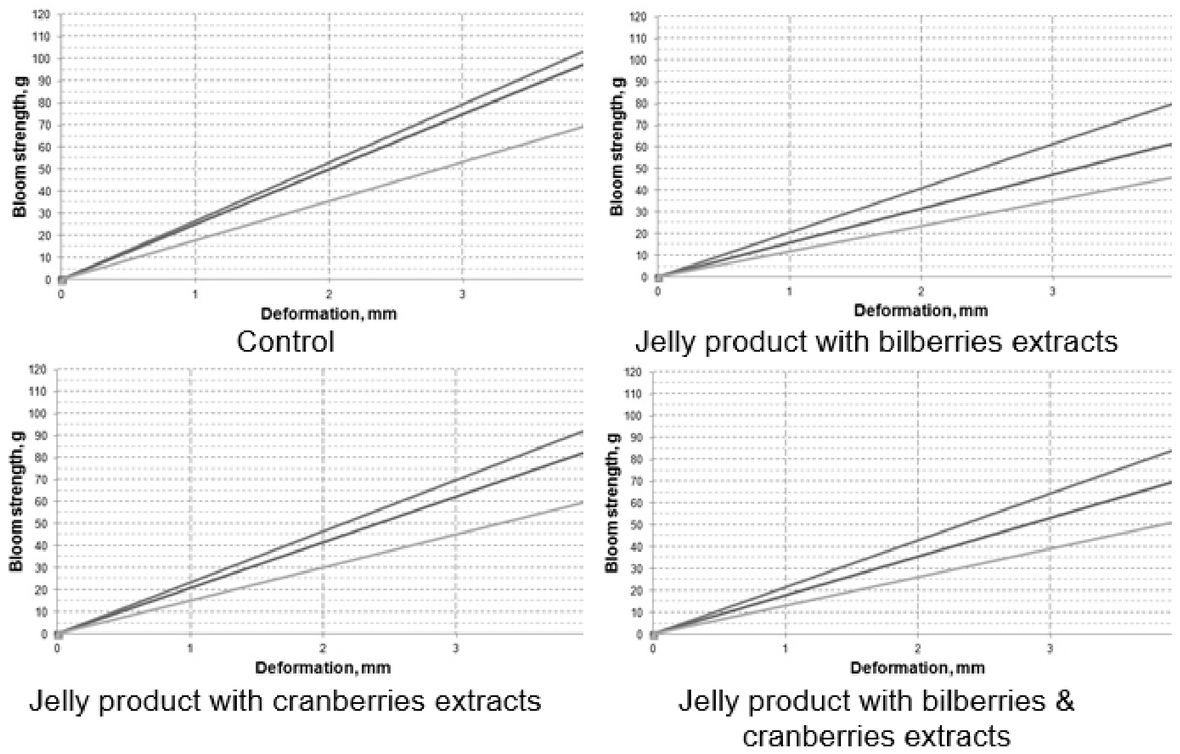
Indicators	Bilberry		Cranberry	
	whole berry	berry press residues	whole berry	berry press residues
Total phenolic compounds	588.9 ± 22.6	682.4 ± 20.9	452.5 ± 18.0	551.6 ± 21.0
Total flavonoids	465.0 ± 18.4	510.2 ± 20.5	358.5 ± 18.5[a]	469.1 ± 20.4
Total anthocyanins	313.0 ± 8.8	514.8 ± 8.5	175.9 ± 9.0[a]	201.7 ± 9.2
Vitamin C	18.34 ± 0.62	6.88 ± 0.53[a,b]	21.20 ± 0.56	7.50 ± 0.39[a,b]

The differences are not statistically significant: [a] – between replicates of experiments; [b] – between raw berry press residues; ($p < 0.05$).

The microwave exposure led to increase in the concentration of solids in the extracts. Their sensory properties improved, but their AOA values decreased. Concentration of the solids during extraction did not show any dependence on the type of berry press residues used, and increased when the duration of the microwave exposure was lengthened. Thus the microwave exposure for the duration of 180 seconds in comparison to 60 seconds increased concentration of the extractive solids by 12.5%.



The manufactured Jelly products were distinguished by their consistency from dense for samples using traditional technology to plasticity for products obtained by microwave technology. Jelly products obtained by traditional technology were denser in structure. Bloom strength values decreased by 12–23% when using extracts from berry press residues. The formation of the gelatin-based product structure and berry press residues extracts is associated with protein-polyphenol interaction and crosslinking. The physical properties of such a product depend on the amount and composition of the polyphenols. The predominance of anthocyanins in the extract from bilberry press residues led to the formation of a more plasticity product with the lowest Bloom strength values.



CONCLUSIONS

In bilberry press residues, the AOA is associated with a predominance of anthocyanins, which confirmed the close relation (R2) with DPPH and FPAP tests, which were 0.998 and 0.991 respectively. AOA of cranberry press residues is associated with flavonoid predominance: R2 for DPPH and FPAP is 0.973 and 0.979 respectively. The ratio of the berry press residues and water to obtain extracts was experimentally found: 1:10 for the extract from bilberry press residues, and from cranberry press residues – 1.5:10. Mixing the extracts with a pronounced sweetish (bilberry) and sour (cranberry) taste can allow their use without sugar in the production of jelly products.

More plasticity jelly products based on extracts are obtained by microwave exposure of the prepared recipe mixture with preliminary swelling of gelatin or with the absence of this operation. The clot formation time is up to 80 min. at a temperature of 4±2 °C. Absence of pre-swelling gelatin increases time to 140–160 minutes. Manufactured jelly products have greater AOA than products by traditional technology. Microwave technology will allow using of press residues after obtaining freshly squeezed juices for production jelly products without sugar and with AOA in such food business, as restaurants and catering services.

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