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Communication

Northern berries as a source of carotenoids*

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Carotenoids are bioactive substances in human diet. The aim of the study was to determine β-carotene and xanthophylls in four berries species. An HPLC gradient elution system were used for separation and quantification of the carotenoids. The highest total carotenoid content among the berries studied was found in cloudberry (2840 µg/100g dw), followed by blueberry (2140 µg/100 g). All berries had lutein but it was a predominant carotenoid in blueberry. The highest β-carotene levels were found in cloudberry (83% of total Car content). Cranberry and cowberry were the poorest sources of carotenoids. Our data will be included in the regional database of resources with the increased nutritional value.

Key words: berries, carotenoids, HPLC analyses

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INTRODUCTION

Carotenoids (Car) are bioactive substances in foods with powerful antioxidant bioactivity. There are abundant data showing theirs preventive effects in humans for a number of diseases (Stahl & Sies, 2003; Lila, 2004; Schmidt, 2004). Car provide protection to vision and eye function. They may support the immune system and inhibit development of cardiovascular diseases and several types of cancer. About 50 Car have been identified in the human diet. Many different fruits and vegetables with red, orange and yellow colours contain Car pigments useful for maintenance of human health. Data of Car content in wild berries from the taiga zone of the European North-East are limited (Golovko *et al.*, 2011). Therefore the aim was to determine β-carotene and xanthophylls content in four berry species.

MATERIALS AND METHODS

Cloudberry (*Rubus chamaemorus*), blueberry (*Vaccinium myrtillus*), cranberry (*Oxycoccus palustris*) and cowberry (*Vaccinium vitis-idaea*) were selected for this study.

R. chamaemorus (Rosaceae) is a perennial herbaceous plant. The occurrence area of the investigated plants covers Eurasia and North America. Central part of area occupies the Komi Republic territory. Cloudberry plants grow mainly on sphagnum bogs. *V. myrtillus* (Ericaceae) is a deciduous dwarf shrub, boreal and arctic circumpolar species. Plants inhabit dark and light coniferous forests. *V. vitis-idaea* (Ericaceae) is an evergreen dwarf shrub, widespread in taiga. *O. palustris* (Ericaceae) is an evergreen dwarf shrub, belongs to the arctic group of plants. Plants inhabit mainly upland and transitory sphagnum bogs and msharas. Biological resources of cloudberry, blueberry, cranberry and cowberry are equal about 28, 113, 50 and 126 thousand tons, respectively, in taiga zone of the Komi Republic.

Fruits of berries were harvested in August-September 2010. For each berry three individual samples were analyzed. Samples were selected in field and immediately transported to laboratory, where they were quick-freezed and kept at –76°C. Frozen tissues were liophilized with Freeze Dry Systems (Labconco, USA) during 60 hours. Car in freeze-dried samples were extracted with acetone. Individual Car were separated using the reversed-phase high-performance liquid chromatography (HPLC) system (Knauer, Germany) equipped with a column 4.0×250 mm Diasphere-110-C18NT. The pigments were eluted for 34 min with gradient solvent systems A (acetonitrile:methanol:water, 75:12:4, v/v) and B (methanol:ethyl acetate, 68:32, v/v) at a flow rate of 2 ml/min. Initial conditions were 100% A for 17 min, followed by linear gradient to 100% B at 7 min, and once again 100% A for 9 min until the end of the run. Identification of Car was carried out by comparing of HPLC retention times with corresponding standarts.

RESULTS AND DISCUSSION

The highest total Car content among the studied berries was found in cloudberry (2840 µg/100g dw) and blueberry (2140 µg/100 g) (Table 1). Cranberry and cowberry were characterized by a significantly lower Car content, 200 and 140 µg/100 g dw, respectively. All berries had β-carotene but this pigment prevailed greatly in cloudberry (83% of total Car content). Lutein was a principal Car in blueberry (71%) (Fig. 1A). The major contributors to the total Car content of cranberry were β-carotene (28%), lutein (23%) and neoxanthin (20%). With the exception of blueberry, only some amount of violaxanthin cycle pigments (violaxanthin, antheraxanthin and zeaxanthin) were measured in berries.

It was established that the carotenoid HPLC profile of the extract from cloudberry are complex (Fig. 1B). The naturally occurring carotenoids (lutein, zeaxanthin, and violaxanthin) in this berry are esterified with a straight chain of fatty acids. The similar HPLC profile of extract from papaya before saponification was shown (Khachik *et al.*, 1991). Unidentified carotenoid constituents were presented in the unsaponified extract of cloudberry.

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Abbreviations: Car, carotenoids; HPLC, high-performance liquid chromatography.

Table 1. Total carotenoids in berries, µg/100g dw
Data are mean ±S.E. of 6 measurements on each berries species

Carotenoids	*Rubus chamaemorus*	*Vaccinium myrtillus*	*Vaccinium vitis-idaea*	*Oxycoccus palustris*
Neoxanthin	20.1 ± 1.1	79.6 ± 1.5	6.1 ± 0.1	27.1 ± 1.5
Violaxanthin	12.9 ± 2.7	100.8 ± 2.4	9.5 ± 1.0	11.3 ± 1.8
Antheraxanthin	21.1 ± 2.9	49.2 ± 0.9	9.0 ± 0.6	23.4 ± 1.7
Lutein	50.0 ± 15.0	1530 ± 24	76.0 ± 6.0	48.1 ± 4.8
Zeaxanthin	411.0 ± 46.0	20.4 ± 0.3	8.8 ± 1.9	31.2 ± 2.9
β-carotene	2320.0 ± 200.0	365.0 ± 5.0	27.5 ± 1.6	56.6 ± 2.1

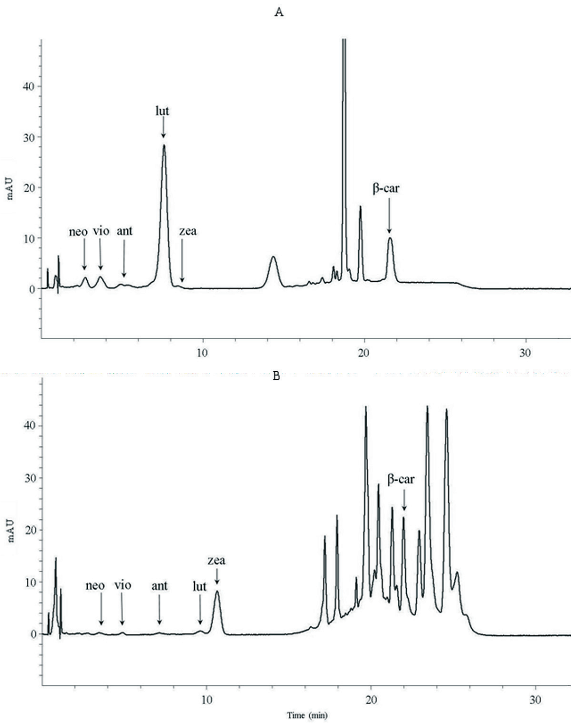

Figure 1. Chromatograms of an extract from blueberry (A) and cloudberry (B).
Carotenoids: neo, neoxanthin; vio, violaxanthin; ant, anteraxanthin; lut, lutein; zea, zeaxanthin; β-car, β-carotene.

Our results are meant a regional database of resources with the increased nutritional value. Cloudberry and blueberry, which accumulate more β-carotene and lutein as compared to other berries, are a perspective source of valuable carotenoids.

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