BIOLOGICALLY ACTIVE COMPOSITION AND HEALTH IMPACT OF ALLIUM CEPA

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Summary. The aim of this study is to present contemporary information for the biologically active compounds in Allium cepa and correspondingly their health benefits, as well as to present analytical HPLC results for the content of the main antioxidants in Allium cepa – the flavonols quercetin and kaempferol, in different types of Bulgarian onion, and to submit data about onion consumption on national and international level. The potent antioxidant activity of the biologically active compounds in onion is an important factor for the prevention against different degenerative diseases like cardiovascular disease, cancer, diabetes. Results for content of the flavonols quercetin and kaempferol in different types of Bulgarian onions are presented. The red onion contains highest amount of quercetin – average value 452.5 mg/kg and a maximum value found – 832.2 mg/kg. It was determined that the green part of spring onion contains relatively equal values of quercetin (30.2 – 61.1 mg/kg) and kaempferol (27.4 – 52.3 mg/kg). This results characterize spring onion as very important dietary source of kaempferol in Bulgarian healthy diet emphasizing their role in development of different preventive diets.

Key words: *Allium cepa, onion, health impact, quercetin, kaempferol*

INTRODUCTION

The onion family (Allium) comprises more than 500 species, thus making it difficult to trace their origin. A candidate for the predecessor of the culture type Allium cepa is not only one, but five wild plant species from Central Asia. The onion bulbs were used as food for thousands of years. During the centuries, the onions were esteemed not only for their culinary use and gustatory qualities, but also for their healing properties. It is known that the Allium cepa representatives are rich source of biologically active substances like flavonoids, namely quercetin; sulfides; isothiocyanates; the microelement chrome, etc. Anti-inflamma-

tory properties of onions and their preventive role against cardiovascular diseases, diabetes and other contemporaneous degenerative diseases are well known. Recently research articles on the biologically active compounds in foods increase like avalanche, requiring presentation of the summary of general information.

The aim of this study is to present a contemporary information for the biologically active compounds in *Allium cepa* and correspondingly their health benefits, as well as to present analytical results for the content of the main antioxidants in *Allium cepa* – the flavonols quercetin and kaempferol, in different types of Bulgarian onion, and to submit data about onion consumption on national and international level.

MATERIALS AND METHODS

Plant material

In the present study, three different types of *Allium cepa* were analysed as follows: 7 samples white onion, 5 samples red onion, and 3 samples spring onion, divided to hole plant, white and green part. In order to obtain representative samples, the sampling plan was conducted during two years. Each analysed sample of *Allium cepa* comprises composite of tree individual samples, purchased from three different places in one day. The individual samples were not less than one kilogram (BDS ISO 874:1996) [1]. From the composite sample by random selection an average sample was made, and non-edible parts were removed. The average sample was freeze-dried and stored at 4°C in a hermetically sealed vacuum container. Right before the analysis, the lyophilized average sample was grinded to fine powder, sieved through a 0.5 mm pore size, and homogenized.

Methods

In the present study, the extraction and hydrolysis of the flavonols from the plant material was performed with 1.2 M HCl in 50% methanol, refluxing lyophilized sample for 2 h at 90°C.

HPLC analysis. For the quantitative determination of quercetin and kaempferol the internal standard morine was used. The chromatographic separation was performed by using Hewlett Packard liquid chromatograph, HP pump 1050; thermostat: HP 1100; UV detector: HP 1050; and data handling software ChemStation (Agilent Technology); Alltima (100 × 4.6 mm i.d., 3 μm) C18 analytical column, connected to pre-column Alltima (4 × 4.6 mm i.d., 3 μm) C18, Alltech Association Inc. An isocratic elution with 28% acetonitrile in 2% acetic acid was applied, with a flow rate of 0.9 ml/min, resulting to a working pressure of 11.5-12.0 MPa. For determination of the selected flavonoids a fixed UV detection at 365 nm was used.

The method used for determination of flavonols is characterized by a limit of detection 1 mg/kg fresh weight for quercetin and 2 mg/kg fresh weight for kaempferol, and by very good repeatability (RSD < 5%) [2].

RESULTS AND DISCUSSION

Onion – health benefits

Onions contain quercetin – a potent antioxidant from the group of flavonoids [3]. The antioxidants are compounds helping the delay of the oxidative damages in cells [4]. A large number of articles have shown that quercetin may act as scavenger of free radicals, and as inhibitor of the low-density lipoprotein oxidation (important step in development of atherosclerosis and coronary diseases). Quercetin also may regenerate the activity of other potent antioxidant – vitamin E, and may inactivate the transitional metal ions, catalysts of oxidative processes in the body by chelating [5]. In the literature, there is great number of data for the physiological role of the flavonoids. In addition to the antioxidant activity, their vasodilatation, anticarcinogenic, anti-inflammatory, antibacterial, immunostimulation, antiallergenic activity were described, as well as their antivirus activity against HIV, herpes simplex, influenza, rhinovirus, and their ability to act as inhibitors of platelet aggregation [5, 6]. The flavonoids have specific influence upon the activity of different enzymatic systems like cytochrome P450, phospholipase A2, lipoxygenase, etc. [7].

Recent studies of Briggs et all. show that the onion consumption inhibits the blood platelet aggregation in vivo [8, 9]. Onion extract inhibits the enzymes cyclooxygenase and 12-lipoxygenase (in thrombocytes), taking part in the arahidonic acid metabolism. Via this biochemistry pathway, the active compounds in onion give rise to inhibition of thromboxane synthesis and play a positive role on blood coagulation function, i.e. have a preventive effect against thrombus formation and consequently against development of cardiovascular diseases [10, 11, 12].

The anti-inflammatory properties of onion are well studied [13]. It is determined that it alleviates the pain in osteoarthritis and rheumatic arthritis, has a beneficial effect in asthma and common influenza. The anti-inflammatory activity of *Allium cepa* is due to vitamin C, quercetin, and other biologically active compounds like isothiocyanates, which have synergic antioxidant activity. Therefore in the popular medicine of almost all countries in the world, the onion consumption is recommended.

The regular intake of onions, for instance two or three times per week is associated with a considerable decrease of the risk for colon cancer development [14, 15, 16]. As already was mentioned, onion is rich source of quercetin. It can suppress the tumor growth in animals, and protect the colon cells from the harmful effect of some known carcinogens.

Furthermore the onions are rich dietary source of other biologically active compounds, like organic acids, disulfides, three sulfides, etc. *Allium cepa* is a good source of vitamin C, vitamin B6, potassium, dietary fibers, folates, calcium, iron. The onions are pour source of sodium and do not contain fats. Onion is a very reach source of the microelement chromium, important factor of insulin mechanism of action and for glucose tolerance [17]. Clinical research on diabetic patients has shown that chromium can reduce the blood glucose level, improve glucose tolerance, as well as reduce cholesterol and triglycerides level. In many developed

countries, the chromium deficiency is widespread, since the chromium level sharply lowers with consumption of refined sugar and white flour products. It is important to know that one glass of row onion may assure about 20% of the recommended daily intake of this important microelement.

Important study conducted by University of Bern in 2005 reports that one gram of onion added to the food of rats inhibits significantly ($p < 0.05$) bone resorption as assessed by the urinary excretion of tritium released from bone of 9-week-old rats prelabeled with tritiated tetracycline from weeks 1 to 6. It was determined that during the above conditions the mineral density increased by 17%, which is by 13% higher in comparison with the control group animals. This result suggests that high onion consumption has a potential to reduce the risk for development of osteoporosis. In this study, a new compound in onion was isolated, L-glutamyl-trans-S-1-propenyl-L-cysteine sulfoxide, inhibitor of osteoclast activity. The study suggests that Allium cepa may play an important role for menopausal women with a high risk for osteoporosis development [18].

Flavonol content in Bulgarian onion

On table 1, analytical results for the quercetin and kaempferol content in different types Bulgarian onions are presented.

Three types of *Allium cepa* representatives were analysed: white, red and spring onion. In order to study the flavonoids' distribution in spring onion the green and white part of the plant were analysed separately.

Table 1. Quercetin and kaempferol content in Bulgarian onions

		Quercetin			Kaempferol		
		mg/kg fresh weight					
Samples	**n**	**Average value**	**Min**	**Max**	**Average value**	**Min**	**Max**
White onion	7	204.1	91.9	292.8.	n.d.		
Red onion	5	452.5	264.7	832.2	n.d.		
Spring onion (hole)	5	103.2	75.6	158.4	14.6	2.0	27.1
Spring onion, (green part)	5	45.4	30.2	61.1	45.4	27.4	52.3
Spring onion, (white part)	5	179.4	110.2	230.5	< 2	0.7	2.8

n – number of samples analysed, Min – minimum value, Max – maximum value, n.d. – not detected

The results show that the red onion contains higher level of quercetin – average value of 452.5 mg/kg, and maximal value – 832.2 mg/kg. The present results are similar to literature data. The data for quercetin content of Bulgarian white onion are lower than those reported by Hertog et al., 1992; Crozier et al., 1997; Justesen et al., 1998 [19, 20, 21], but higher than results of Bilyk et al., 1984; Mattila et al., 2000, Price et al., 1995 [22, 23, 24]. The data for flavonols in spring onion are fare more scattered in

comparison with those for white and red type of Allium cepa. Only Justesen et al., 1998 reported data for flavonoids content in spring onion samples [20]. Due to the lack of literature data for quercetin and kaempferol in spring onion, the present results enrich the knowledge of the composition of this plant variety. It was determined that the green part of spring onion contains relatively equal values of quercetin (30.2 – 61.1 mg/kg) and kaempferol (27.4 – 52.3 mg/kg). This result characterizes the green part of spring onion as very important dietary source of kaempferol in Bulgarian healthy diet since its distribution in plant kingdom is very restricted. In the white part of spring onion, high amounts of quercetin are concentrated (110.2 – 230.5 mg/kg), while kaempferol was detected in only two of the samples analysed, but in very low levels (maximum value 2.8 mg/kg). The analysis of whole spring onion shows that the average values for quercetin and kaempferol have a medium position among the above-mentioned data.

On the basis of the analysis of the recent scientific information for the health benefits of onion, its large part in healthy diet is recommended. The onion is the third vegetable consumed in Bulgaria, after potatoes and tomatoes – about 5 kg per capita per year. According to FAO statistics for onion production and consumption for 2007, the highest intake is in Libya – 28 kg per capita per year. In Europe, the highest amount of onion per year is consumed in Balkan and Iberia peninsulas, as follows: Romania – 16.7 kg, Greece – 15 kg, Croatia – 8.9 kg, Spain – 20.1 kg, Portugal – 14.3 kg per capita. In some other European countries, the average onion consumption is very low, for instance in Norway and Belgium it is only 1.3 kg per capita [25].

CONCLUSION

On the basis of the recent scientific data for physiological importance of onions' compounds, the traditional involvement of onion in national diet is very appreciable. Expanding the spectrum of Allium cepa participation in other diets, it can be mentioned that onion definitely takes a central part in the Balkan diet, which along with the Mediterranean diet are considered as examples of healthy nutrition.

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