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CONCENTRATION OF VITAMIN C AND ANTIOXIDANT ACTIVITY OF ROSEHIP EXTRACTS

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ABSTRACT

Rosehip fruits (Rosa canina L.) are rich of antioxidant compounds, especially Vitamin C. In this study different parts of the fruit (skin, seeds, and pappi) were extracted separately for determination of their content of Vitamin C. The antioxidant capacity of the extract was evaluated. The results show that the dog rose has a significantly large amount of Vitamin C, most of it being concentrated in the skin. High oil content is found in the seeds, so they can be used for oil production. It was also found that the pappi had a high calorific effect and might be used as a source of thermal energy.

Keywords: rosa canina, extraction, vitamin C, antioxidant capacity.

INTRODUCTION

Bulgaria is rich in medicinal plants, which are natural sources of various bioactive substances and have many useful medicinal qualities. Their health effects are mainly due to antioxidant substances as ascorbats, polyphenols, carotenoids, tocoferols [1]. Wild rose (*Rosa canina L.*) is among the most popular and widely used herbs worldwide. There is large empirical evidence for its therapeutic effects. The high content of vitamins, organic acids and flavor define it as a valuable dietary supplement. The wild rose is a thorny shrub that ripens in autumn with bright red fruits of spherical to elongated form. This plant grows in different climates and latitudes. In addition to Europe, it is commonly spread in Asia, Africa and North America. The principal action of rosehip is anti scurvy, diuretic and astringent [2].

A number of scientific studies have shown that the wild rose fruit contains many antioxidant compounds - phenolic acids, anthocyanins [3], flavonoids [4], carotenoids [5, 6]. It belongs to the group of fruits with highest content of ascorbic acid (up to 6 times more than in oranges) [7, 8].

Previous studies have researched the whole rosehip fruit. However, it consists of three different parts: skin, seeds and pappi. There is a lack of information concerning the content and distribution of valuable compounds among its parts. Consequently, the aim of this work is to examine separately the different parts of the fruit in order to determine their antioxidant activity and their content of a key component - vitamin C.

The rise of the share of recycled energy resources for generation of heat and electricity is a general world trend. So, an additional objective of this work is to assess the possibility for using pappi as a material for production of fuels pellets.

EXPERIMENTAL

Plant material and preparation

The raw material is a dried ripe fruit of the rosehip variety Plovdiv 1, vintage 2011. The fruits are crushed

before being separated into three fractions - skins, seeds and pappi, and then milled to a particle size less than 2 mm.

Extraction procedure

The extraction is carried out by mixing the raw material and the solvent in flasks. The mass transfer process is performed under continuous agitation using a magnetic stirrer or a thermostatic shaker. An excess of solvent is used in order to avoid solubility limitations in the liquid phase. The extraction is carried out at a ratio of solvent/plant material 10/1 at 100°C for 2 hours.

Chemicals

Vitamin C, 96 % ethanol, iodine and starch (Valerus), DPPH (Sigma), methanol (99.9 % Lab Scan), were used to determine the antioxidant activity and the content of vitamin C.

Analytical methods

Vitamin C concentration was determined by the method described in the European Pharmacopoeia [9]: Titration with a solution of iodine 0,05 mol l^{-1} using starch as an indicator.

The antioxidant capacity (AOC) was determined by the DPPH method, which measures the degree of neutralization of free radicals by measuring the color change of a sample [10]. The measurement was made by a spectrophotometer Helios β (Unicam, USA) at a wave length of 517 nm [11]. AOC was expressed by the factor IC 50 %, which corresponds to the concentration of the extract resulting in 50 % inhibition of active radicals. For determination of IC 50 % a series of solutions was prepared by diluting the extract with the solvent. By measuring their inhibition a graph was constructed presenting extract concentration (ml l^{-1}) versus inhibition (%). From this graph the concentration corresponding to 50 % inhibition, and corresponding to the factor IC 50 % was determined.

Table 1. Gravimetric analysis of a rosehip fruit.

Fraction	% of the whole fruit
Skins	36,5
Seeds	57,6
Pappi	5,9

Measurement of the calorific value of the pappi was conducted according to the methodology of the Bulgarian State Standard using a calorimetric device [12].

RESULTS AND DISCUSSION

Fractionation of the fruit

Table 1 shows the results for the mean percentage of the various parts of the fruit.

According to the results, the seeds comprise the majority of the fruit (by mass), followed by the skin. The pappi mass is much less, but pappi is of low density and has a larger volume.

Vitamin C content

A traditional preparation of infusions from rosehips is by water boiling. The water is a suitable solvent for our study because vitamin C is water soluble [13]. The vitamin C concentration was measured in the obtained extracts. The results are shown in Table 2.

The analyses show that vitamin C is unequally distributed in the different parts of the fruit. Highest is the concentration in the skin. Significantly lower (6 times) is the concentration in the seeds. Pappi contain the lowest quantity of vitamin C, more than ten times lower than

Table 2. Vitamin C content in the different parts of the fruit.

Fraction	Vitamin C content mg g^{-1}
Whole fruit	1,1
Skins	2.3
Seeds	0,4
Pappi	0,2

Table 3. Antioxidant activity of extracts.

	Plovdiv 1	Wild rosehips
Fraction	IC50% (ml l^{-1})	
Whole fruit	2.59	5,78
Skins	2.05	NA
Seeds	20.41	NA

in the skin. For comparison, we give also data for the vitamin C content of blackcurrant, which is about 1,5 mg per 1 g fruit [14].

Table 3 contains results for the antioxidant capacity of the seeds and skins, which contain the majority of the target component.

AOC is expressed by the factor IC 50 %, as described above. A smaller value of this factor corresponds to a higher antioxidant capacity, i.e. a smaller amount of starting extract neutralizes a standard amount of DPPH. According to Table 3, the skin extract shows the highest antioxidant activity followed by the total extract of whole fruit. The seed extract is ten times weaker. A comparison to a wild rosehip shows that the antioxidant capacity of its analogous extract is more than two times lower, i.e. the cultivar Plovdiv 1 has improved antioxidant properties.

Another valuable product that can be obtained from rosehip fruits is the oil. It is located in the seeds and contains linolic, linolenic, palmitic and stearic acids [15], making it suitable for use in medicine and cosmetics [16]. In this study, the seeds were analyzed for oil content. They were milled and then extracted with hexane. The results showed a significant content of oil - 4.89 %.

Pappi are 6 % of the fruit (by mass), and may be considered as a ballast component because they contain a lean amount of bioactive substances. Recently an increased interest in substitutes for fossil fuels is seen, focused on increasing the share of recycled energy resources for generation of heat and electricity. Correspondingly, an additional purpose of this work is to assess the possibility for using pappi as raw material for production of energy through incineration. Their calorific value was determined with a calorimetric device according to the method approved by the Bulgarian Standard. The measured value of 4315 kcal kg^{-1} shows that this is a valuable energy source, suitable for production of fuel pellets. For comparison we point out that the calorific value of the wood pellets is 4300 kcal kg^{-1}.

CONCLUSIONS

Rosehip fruits were disintegrated in their parts (skin, seeds, pappi), which were extracted separately in boiling water. The extracts were analyzed for determination of vitamin C content. It was found that the main amount of vitamin C is located in the skin. The seeds contain a significant amount of oil, which can be extracted and used for medical and cosmetic applications. Pappi can be considered as a waste product from hips processing with a high energy value, which can be used for production of an alternative solid fuel.

It can be concluded that the rosehip fruits contain significant amounts of valuable bioactive substances. Fractionation of the fruits for individual processing of their parts can bring significant economic benefits, since it allows to obtain products with a high antioxidant capacity, additionally it provides an oil with a practical application, and the waste is a highly calorific fuel.

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