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CONTENT OF ANTIOXIDANTS IN SOME MEDICINAL PLANTS SOLD IN GEORGIAN PHARMACY CHAINS

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ABSTRACT

Background: Antioxidant compounds are widely used in medicine to protect the organism from the impact of various stresses and strengthen the immune system. The primary source of natural antioxidants is considered plant-based products. That is precisely why scientists are interested in extracting active compounds out of plant materials and use them. However, diverse resources of medicinal plants of Georgia is poorly studied and used as a source of antioxidants. **Aim:** The research aimed to study the antioxidant composition and total antioxidant activity of some dried medicinal plants sold in the pharmacy network in Tbilisi, Georgia. **Methods:** Several types of medicinal plants (3 berry plants and 3 herbaceous plants) sold in the pharmacy chain were chosen as the research object. These are *Crataegus sp., Sorbus sp., Viburnum sp., Helichrysum sp*., *Leonurus quinquelobatus* Gilib, *Origanum vulgare* L. **Results:** As a result, it has been found that the content of ascorbic acid and carotene in the studied plants is not so high to fill the daily intake of a man with an infusion prepared from one tablespoon. As for proline and the number of total antioxidants, all the plants we have chosen are high in content, considerably increasing their medicinal value. **Discussion:** The low amount of ascorbic acid and carotine found in studied plant, this increases their medicinal value, and in combination with other antioxidants/plants, the healing effect of the raw materials has been used. **Conclusions:** The studied plants are characterized by high levels of proline and antioxidant activity, so their infusions can be safely used as a source of antioxidants both in folk medicine and for the preparation of biologically active preparations.

Keywords: *Medical plants, Antioxidant, Ascorbic acid, Proline, Carotene.*

1. INTRODUCTION

The understanding of the use of medicinal plants for treatment has been formed for millennia in fighting diseases. The man studied the actions of those substances in the bark, seeds, and other parts of plants. Modern science recognizes the active effect of plants in pharmacotherapy as effective protective agents against the impact of various stresses on the organism, as well as means for strengthening the immune system (Crozier *et al*., 2006; Petrovsk, 2012; Bakuridze *et al*., 2016).

The antioxidant system of plants includes secondary metabolites of various groups, such as vitamins (tocopherol - vitamin E, ascorbic acid - vitamin C), flavonoids (anthocyanins), terpenoids (carotenes and xanthophylls), as well as antioxidant enzymes. Antioxidants of plant origin protect the human body from the development of sclerosis, and cardiovascular diseases, lessen the risk of developing cancer, help slow down the aging process, and strengthen the immune system (Nasyrov, 1983).

The use of medicinal plants in Georgia has a long history. One can find the first information about it in “The Argonautica” of Apollonius of Rhodes. As the author tells us, the use of medicinal plants in Colchis was widely spread. Hecate, famous for her knowledge of the healing properties of plants, had set up a special garden for medicinal plants, where she grew several dozens of them (Shengelia, 2016).

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The flora of Georgia includes about 4100 species, of which more than 400 are used in folk and traditional medicine (Gegechkori *et al*., 2011). However, the resources of the medicinal plants in Georgia have been poorly studied and used, especially as a source of antioxidants.

Therefore the purpose of our research was to study the antioxidant composition (quantitative content of ascorbic acid, proline, and carotene) and the total antioxidant activity of some dried medicinal plants sold in the pharmacy network in Tbilisi, as well as, based on a comparison of the results obtained, to identify species-rich in antioxidant compounds, and to determine what part of the daily dose of the studied compounds is contained in the plants under the experiment

2. MATERIALS AND METHODS

2.1. Materials

Several medicinal plants (3 berry plants and 3 herbaceous plants) sold in the pharmacy network were chosen as the research object. These were: *Crataegus sp*., *Sorbus sp*., *Viburnum sp*., *Helichrysum sp*., *Leonurus quinquelobatus* Gilib, *Origanum vulgare* L. The plant material was packaged in cardboard boxes indicating the respective genera.

2.2. Methods

2.2.1 Carotene measurement

The carotene content in the dried plant material was determined spectrophotometrically. First, 3 ml of aviation gasoline was poured into 100 mg of fragmented material, which was crushed for 2-3 minutes. Colored gasoline was poured into a 50 ml volumetric flask, and 10 ml aviation gasoline was added to the remaining mass, which was crushed for another 3-5 minutes. This procedure was repeated several times until the gasoline changed color (which indicated the complete removal of carotene from the analyzed material). The optical density of the extract obtained was measured with a spectrophotometer (SPECOL11, Carl Zeiss, Germany) in the range of 448 to 484 nm. The carotene content of the plant material was calculated in mg%-s according to Equation 1:

$$\mathbf{X} = ((0.00626\ V\ D)/a)*100 \qquad \text{(Eq. 1)}$$

where X is the content of carotene in the resulting compound mg/100 g; V is the volume of the resulting solution ml; D - testimony Spectrophotometry; a - a sample of a plant product g; 0.00626 - conversion factor mg/ml (Burova and Bazarnova, 2008).

2.2.2 Proline measurement

The spectrophotometric method studied the proline content in the dried plant material. First, it was taken 100 mg of ground material added 10 ml of 3% sulfosalicylic acid to it for extraction, and filtered it. Then, 2 mg of the extract was taken from the filtrate, and 2 ml glacial acetic acid and 2 ml of ninhydrin solution were added. The flasks were covered with glass lids and placed in a water bath for an hour. Next, the extract was cooled, 4 ml of toluene was poured and shaken. The resulting extract was transferred to a separating funnel. The lower one was poured into the two layers formed, transferred the upper one, with toluene, to the flasks, and measured its optical density with a spectrophotometer. Toluene was used as a control (Bates *et al.,* 1973).

2.2.3 Ascorbic acid measurement

The content of ascorbic acid in the dried plant material was determined by titration by dichlorophenolindophenol solution. First, 1000 mg of ground material were taken, then added quartz sand and 15 ml of 2 % HCL to it and quickly crushed it to get a mushy mass. The resulting mass was filtrated. Next, the pestle was washed with 10 ml of 2 % metaphosphoric acid, to which the filtrate was added. Finally, 1 ml of the extract was taken from the filtrate, and 25 ml of distilled water was added to it. The resulting solution was titrated by 0,011 N dichlorophenolindophenol solution to pink color. The ascorbate content in the sample was calculated according to the amount of dichlorophenolindophenol consumed (Ermakov *et al*., 1987).

2.2.4 Total antioxidant activity measurement

In the dried plant material was determined spectrophotometrically. Was took 200 mg of ground material for analysis and extracted it three times with ethyl alcohol. 96 % alcohol was used for the first extraction and the two subsequent extractions - 80 %. Each extraction was carried out in closed flasks for 12 hours in the dark. In this way, the alcohol removed all the oxidants present

in the plant. The resulting extract (30 ml) was evaporated. The evaporated precipitate was dissolved in 5 ml of H2O and 5 ml of 96 % alcohol. The resulting liquid was centrifuged and placed in weighing bottles. 0,9 ml of alcohol was poured into 0,1 ml of the solution, and 0.1, 0.2, and 0.3 ml were taken separately from this mother liquor. Was added 5 ml of the solution of 40 μMDPPH (diphenylpicrylhydrazyl) to each of them and placed them in the dark for 30 minutes. Was measured the optical density of the solution (relative to alcohol). According to the indications obtained, the percentage of inhibition was calculated by Equation 2:

% of inhibition = ((C-S)/C)×100% (Eq. 2)

where C is the initial concentration of DPPH, S is the concentration of DPPH after adding an antioxidant (Koleva *et al*., 2002).

The quantitative content and total antioxidant activity of ascorbic acid, proline, and carotene in the experimental plant material are represented by mean value of three biological replicates.

3. RESULTS AND DISCUSSION

3.1. Results

The plants under study are used for treatment in the form of infusion or tea. Following the preparation rule, one tablespoon of dried mass is poured with one glass of boiling water for extraction. We were interested in how much of each antioxidant compound we studied would correspond to this amount of plants. To get an answer to this, we weighted one tablespoon of each plant and, based on the results, calculated the content of ascorbic acid, proline, carotene, and the total content of antioxidants, that is, we determined how much of these compounds a man would receive together with one glass of infusion prepared from one tablespoon (see: Table 1).

The ascorbic acid content in the plants under study fluctuated within 33-65 % mg range. Namely, its highest content was noted in *Crataegus sp*., the lowest in *Origanum vulgare* (Fig. 1). When recalculating the results obtained for one tablespoon of raw material, we found that a man, together with one glass of infusion of *Crataegus sp*., would take an average of 5,33 mg of ascorbic acid, and in the case of *Origanum vulgare*, 0,64 mg. If the food contains more than 20 % of the daily dose of ascorbic acid, it is considered a food rich in this substance.

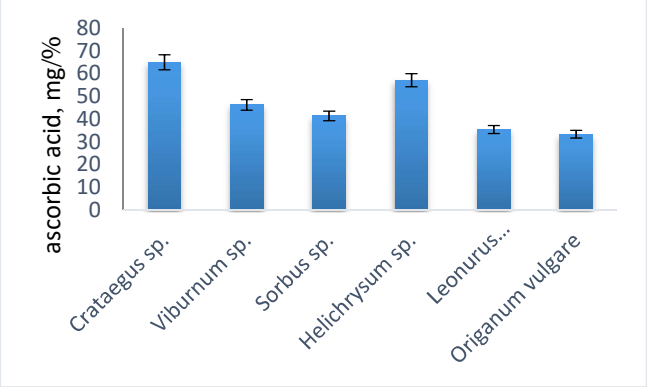

Figure 1. *The ascorbic acid content in the studied species.*

The carotene content in the studied plants ranged from 0,2 to 1,18 mg %. *Helichrysum* sp, *Leonurus quinquelobatus* were distinguished by a particularly high carotene content. In them, the content of the compound was twice as high as in other studied species. The content of carotene in*Crataegus* sp.,*Viburnum* sp., *Sorbus* sp. and*Origanum vulgare* was almost the same (Fig. 2).

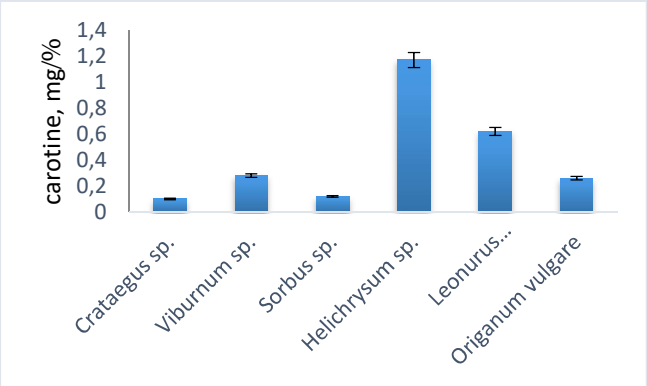

Figure 2. *The carotene content in the studied species.*

The proline content in the plants under study fluctuated within the range of 0,3-11,6 mg %, *Helichrysum* sp. stood out with a particularly high index. On the other hand, nearly the same proline content was established in raw materials of *Crataegus* sp., *Sorbus* sp., *Viburnum opulus* (Fig. 3).

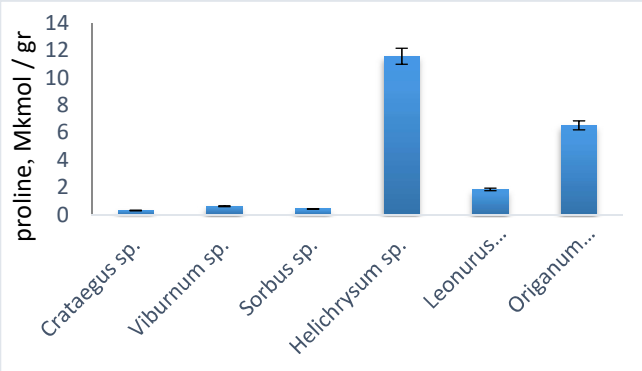

Figure 3. *The proline content in the studied species.*

Total antioxidant activity in the studied plants, with the percentage of pronounced inhibition in various plant materials, ranged from 22 to 93 %. By comparing the results obtained, it may be concluded that the researched plants are characterized by high antioxidant activity. Even though the analyzed material was dried, which means a quantitative decrease of antioxidants, *Origanum vulgar*e was distinguished with a particularly high index. The total antioxidant activity of its dried material was 93,3 % (Fig. 4).

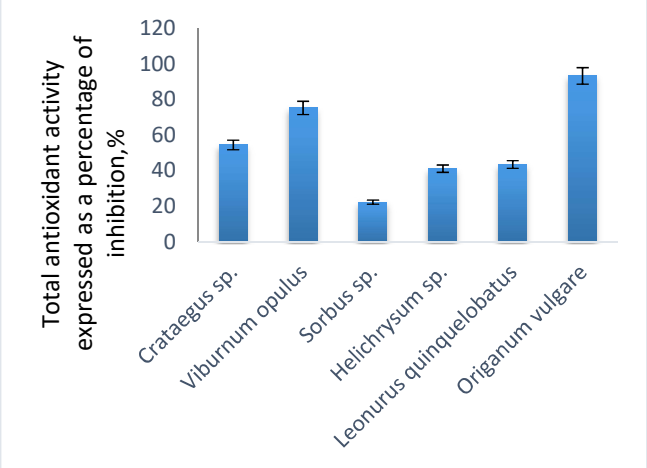

Figure 4. *Content of total antioxidant activity in the studied species*

3.2. Discussions

The recommended daily intake of vitamin C is 90-100 mg. (Carr and Frei, 1999). With this in mind, the content of ascorbic acid in the raw materials we studied is not so high that a man can replenish the daily dose with only one glass of an infusion. However, the medicinal purpose of each of the researched species does not provide for filling the lack of vitamin C in the human body. Thus, the amount of ascorbic acid found in these plants increases their medicinal value and, in combination with other antioxidants, the healing effect of the raw materials used. It should also be noted that during the drying process, many substances present in plants, including ascorbic acid, disintegrate (Frolova, 2009). Therefore, it is best to use these plants in their raw form if possible.

When calculating the carotene content in one tablespoon of raw material, it was found that a man receives an infusion prepared from one tablespoon of Helichrysum sp., having the highest carotene content of 0,028 mg of carotene. Given that the daily dose of an adult man is 5-6 mg (NCI, USA, recommend that) (Müller, 1996), the carotene content in all six plants is low. However, like ascorbic acid, carotene plays the role of an additional antioxidant when using this medicinal raw material and increases its medicinal value. It is important to not forget that during drying, particularly at light, carotene decomposes as well.

It is accepted that the daily therapeutic dose of proline for an adult man is from 500 to 1000 mg. (Kuznetsov, 1999).

Suppose the consumption of one glass of an infusion of Helichrysum sp., has the highest index among the studied plants. In that case, a body will get 3188 mg. of proline which significantly exceeds the daily human need for this compound.

Based on this, we can say that all plants we selected are characterized by a high proline content, significantly enhancing their curative effect.

The studied plants are distinguished with strong total antioxidant activity that considerably increases their medicinal value. Their infusions can be safely used as a source of antioxidants, increasing the organism's resistance to stress and prophylactic against infections.

4. CONCLUSIONS

1. The content of ascorbic acid and carotene in the studied raw materials is not so high to make up for the daily dose of a man with an infusion obtained from one tablespoon (in the studied plant material, the content of ascorbic acid and carotene ranged from 33-65 mg% to 0,2-1,18 mg%). However, the medicinal purpose of each of the studied species does not at all provide for the

replenishment of the body with vitamin C and carotene. Thus, the amount of ascorbic acid and carotene found in the researched species increases the medicinal value of these plants and, in combination with other antioxidants, the healing effect of the raw materials used.

2. All plants selected by us are distinguished by a high content of proline, which significantly increases their medicinal value (the content of proline in a tablespoon of raw materials ranged from 300 to 3000 mg with a daily intake of 500-1000 mg).

3. The studied plants are characterized by strong antioxidant activity (from 22 to 93 %), substantially increasing their medicinal value. Their infusions can be safely used as a source of antioxidants both in folk medicine and for the preparation of biologically active preparations.

5. DECLARATIONS

5.1. Study Limitations

The study is limited to the samples analyzed and the studied plants.

5.2. Acknowledgements

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5.3. Funding source

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5.4. Competing Interests

The authors have declared that no competing interests exist.

5.5. Open Access

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Table 1: *Content of antioxidants in 1 tablespoon of raw material*

plant / Subs. Mg.	*Crataegus* sp.	*Sorbus* sp.	*Viburnum* sp.	*Helichrysum* sp.	*Leonurus quinquelobatus*	*Origanum vulgare*
carotene	0.0084	0.009	0.02	0.028	0.012	0.005
proline	311.14	380.66	516.94	3188	402.59	1431
ascorbic acid	5.33	3.12	3.25	1.37	0.66	0.64