Phenolic Compounds from onion husk (Allium cepa L.): Mode of Extraction

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Abstract. Phenolic compounds contained in plants can prevent cardiovascular and oncological diseases that pose a serious threat to human health and life. Onion Allium cepa L. is a source of natural phenolic compounds This study investigates the effect of extraction temperature and duration on the total content of phenolic compounds in aqueous extracts of onion husk Allium cepa L. The total content of phenolic compounds in extracts has been measured. The prospects of using onion husk as a source of substances of phenolic nature are analyzed in the article.

1 Introduction

Currently, cardiovascular and oncological diseases are the most common cause of death in industrialized countries [1]. Some epidemiological studies have shown an inverse correlation between high consumption of fruits and vegetables and the incidence of such chronic diseases as cardiovascular diseases, cancer, obesity, diabetes, etc. It has been suggested that these beneficial effects of fruit and vegetable consumption result from the presence of various phytochemicals-antioxidants related to the secondary metabolites of plants. These substances are able to absorb reactive oxygen species (ROS), partially responsible for the frequency of the mentioned diseases. Phenolic compounds belong to such antioxidants and secondary metabolites of plants. In the molecules of phenolic compounds, the benzene ring is bound to one or more hydroxyl groups. In plants these compounds function as protectors from ultraviolet solar radiation, as well as from biotic and abiotic stress. Substances of phenolic nature also regulate many cellular processes at various levels, including enzyme inhibition, gene expression modification, protein phosphorylation, etc., have antioxidant properties, and positively affect the human body [2-4].

Various studies demonstrate the protective role of phenolic compounds in patients with cardiovascular diseases; substances can affect endothelial damage, platelet reactivity, and oxidative damage [5, 6]. Currently, research related to the use of encapsulated phenolic compounds with antitumor activity are actively discussed [7]. Among phenolic compounds, flavonoids are distinguished as substances that are derived from the aromatic amino acids, phenylalanine and tyrosine, and have a three-ring structure. The flavonoids include quercetin, which potentially protects against these diseases [1, 4, 8]. The source of quercetin is vegetable raw materials [9, 10]. This compound is of particular interest to plant breeders, food technologists and nutritionists. As studies show quercetin has antioxidant, anti-inflammatory,

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antiviral, and immunoprotective effects. The positive therapeutic effect of quercetin in the fight against COVID-19 has been revealed in [11,12]. Interest in the quercetin health-enhancing properties leads to a significant increase in demand for this compound. Its new sources are searched for, more attention is paid to raw materials that have been neglected so far, such as agricultural production waste.

Onion husk is a source of phenolic compounds in the form of glycosides - derivatives of quercetin, kaempferol, and myricetin. The level of flavonoids in the onion husk is almost 2-10 g / kg, which exceeds the level of flavonoids in the onion pulp. As onion husk Allium cepa L. is a waste product, its use corresponds to the concept of "Zero-waste". The results of studying onion husk as a source of quercetin can be useful in many different industries [2, 13]. Currently, literature proposes a number of different approaches to the extraction of quercetin from plants, including edible and inedible parts of various varieties of onion Allium cepa L., which is one of the most consumed vegetables in the world [9-10, 14-15]. There are two varieties of Allium cepa L. differing in the husk color, namely, yellow and red.

The present research aims to study the effect of temperature and duration of extraction on the total content of phenolic compounds in extracts of onion husk Allium cepa L. The resulting extract can be enriched with a fermented soy-based product, for example, tofu.

2 Materials and methods

Extracts of yellow and red husk varieties of Allium cepa L. were prepared in the ratio of onion husk and water: 1 to 100. The appearance of the extracts is shown in Figure 1. The extraction modes were developed. Extraction was carried out at different temperatures for different times. The obtained extracts were clarified by filtration using paper de-salted filters.

Fig. 1. Appearance of Allium cepa L. extracts.

The total content of phenolic compounds in Allium cepa L. extracts was determined by the Folin-Chocalteu method. The composition of the Folin-Chocalteu reagent includes phosphoric-tungsten acids, which are reduced by interaction with easily oxidizing OH groups of phenol. The resulting tungsten blue gives the samples a blue color. Gallic acid acts as a standard. 1 cm3 of the diluted sample was placed in a graduated tube with a capacity of 10 cm3, 1 cm3 of distilled water and 0.5 cm3 of Folin-Chocalteu reagent were added. After three minutes, the reaction was stopped with 1 cm3 of a 10% sodium carbonate solution, and the volume was brought to 10 cm3 with distilled water. To prepare a blank sample, 1 cm3 of distilled water was taken instead of 1 cm3 of a diluted sample. The samples were kept for one hour at room temperature in a dark place, then the optical density was measured at a wavelength of 760 nm. The total content of phenolic compounds was calculated based on the dependence of the optical density measurement results on the concentration of gallic acid in standard solutions (Figure 2). The arithmetic mean of three parallel definitions was taken as the final result.

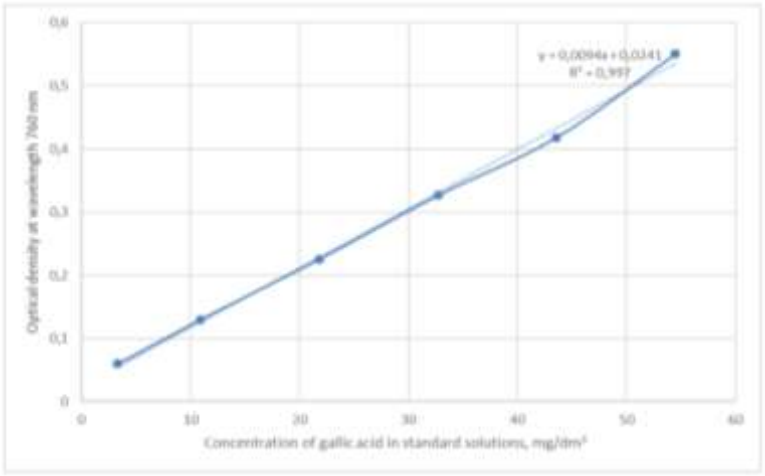

Fig. 2. The dependence of the optical density on the concentration of gallic acid in standard solutions.

3 Results

The results of determining the total content of phenolic compounds in extracts obtained by heat treatment at 60 ° C, 70 ° C and 80 °C for various times are shown in Figures 3-5.

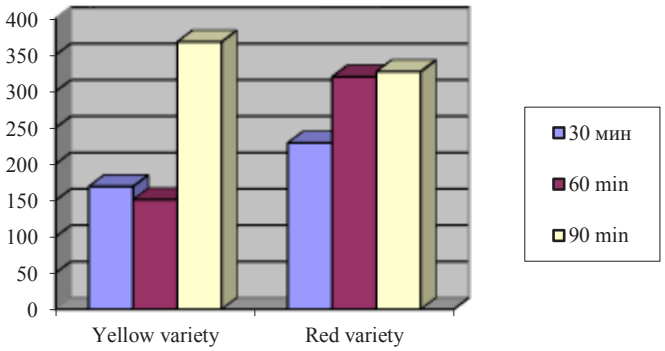

Fig. 3. The measurements of the total content of phenolic compounds (mg GAE/L) in extracts obtained by heat treatment at 60 °C.

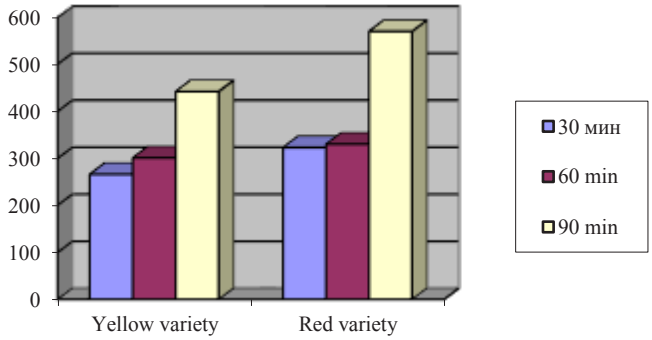

Fig. 4. The measurements of the total content of phenolic compounds (mg GAE/L) in extracts obtained by heat treatment at 70 °C.

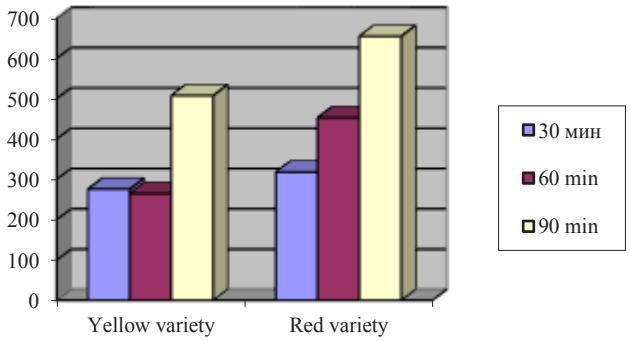

Fig. 5. The measurements of the total content of phenolic compounds (mg GAE/L) in extracts obtained by heat treatment at 80 °C.

As seen in Figures 3-5, the highest values of the content of phenolic compounds were found when the husk of yellow and red onion varieties of Allium cepa L. were extracted for 90 minutes at 60 °C, 70 °C, and 80 °C. The highest content of phenolic compounds (655 mg GAE/L) was found in the extract of the red variety obtained by heat treatment for 90 minutes at 80 ° C. The highest content of phenolic compounds in the extract of the yellow variety (508 mg GAE/L) was determined with the same extraction mode.

4 Conclusion

According to the study, onion husk Allium cepa L. is a promising source of phenolic compounds. Based on the results obtained, that extraction for 90 minutes at 80 ° C provides the highest total content of phenolic compounds in extracts of both red and yellow varieties of Allium cepa L. The highest total content of phenolic compounds (655 mg GAE/L) was observed in the extract of the red variety. It can also be concluded that the husk of the red onion variety is richer in substances of phenolic nature than the husk of the yellow variety. In the future, it is planned to determine the content of quercetin in extracts.

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