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Review Article

Phytochemical Research and Complex Use Perspectives of Crataegus Orientalis Fruits in the Flora of Nakhchivan AR, Azerbaijan

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Abstract

The article provides information about phytochemical research and complex use perspectives of crataegus orientalis fruits in the flora of Nakhchivan. It is a naturally widespread fruit plant in Nakhchivan AR. This species included in Crataegus L. genus. The fruits, which are not very large, are sour-sweet, full-bodied and juicy. Some species of Crataegus L. have been used in folk medicine in various countries since ancient times. Pharmacological and toxicological studies have shown that various extracts of hawthorn have a positive effect on cardiovascular diseases. The main pharmacological effects of hawthorn are associated with the presence of flavonoid-type compounds in them. Fruits of Eastern hawthorn were collected in the ripening phase from Batabat area of Shahbuz region of Nakhchivan AR and extracted with diethyl ether, ethyl alcohol, water and aqueous alkaline solutions (1% ammonium oxalate, 5 and 10% NaOH) to produce carotenoids, flavonoids and polycarbonate complexes (water-soluble polycarbohydrate, pectin, A- and B-hemicelluloses, α-cellulose) were obtained. As a result of research, natural compounds belonging to different chemical classes: carotenoids, flavonoids, water-soluble acidic polycarbohydrates, pectin, A- and B-hemicelluloses were obtained from the fruits of oriental hawthorn by sequential extraction.

Introduction

Identification of plant species rich in biologically active substances and their phytochemical research is one of the current problems of modern science. Many natural compounds have irreplaceable properties and are in great demand in various sectors of the economy, including medicine, pharmaceuticals and the food industry. The plant flora of Nakhchivan AR, which can be renewed every year and therefore has inexhaustible reserves and a very diverse composition, is a source of natural biologically active substances. The genus Crataegus L. (hawthorn) belongs to the family Rosaceae and has 280 species distributed in temperate regions of the world. It is known that 19 species of hawthorn are distributed in the territory of Nakhchivan AR [7].

Some species of Crataegus L. have been used in folk medicine in various countries since ancient times. Pharmacological and toxicological studies have shown that various extracts of hawthorn have a positive effect on cardiovascular diseases [1]. Extracts from the flowers and fruits of hawthorn have also been found to have antiviral and antioxidant activity. Hawthorn extracts have also been shown to significantly inhibit thromboxane A2 synthesis and platelet adhesion, thereby reducing the rate of atheroma and thrombosis formation [2].

The main pharmacological effects of hawthorn are associated with the presence of flavonoid-type compounds in them. Many flavonoids have been found to have extensive biological effects. They have antibacterial, antiviral and anti-inflammatory, antiallergic, antithrombotic activity and have the ability to dilate capillaries, increase their elasticity. The chemical composition, flavonoids, polycarbohydrate complex and other compounds of oriental hawthorn fruits widespread in the territory of the Nakhchivan Autonomous Republic have not been studied before. For this reason, it is of scientific and practical importance to conduct phytochemical analysis of hawthorn fruits and to determine the ways of their complex processing on the basis of the obtained results [3].

Material and Methods

Fruits of Eastern hawthorn were collected in the ripening phase from Batabat area of Shahbuz region of Nakhchivan AR. The fleshy part of the fruit was separated from the seeds, dried at room temperature and then ground. The ground plant sample (570 g) was sequentially extracted with diethyl ether, ethyl alcohol, water and aqueous alkaline solutions (1% ammonium oxalate, 5 and 10% NaOH) to produce carotenoids, flavonoids and polycarbonate complexes (water-soluble polycarbohydrate, pectin, A- and B-hemicelluloses, α-cellulose) were obtained. Separation of individual substances from the extracts and their purification was carried out using paper, thin layer and column chromatography methods. Paper chromatography was performed on Filtrak FN-7 and FN-11 paper, thin-layer chromatography was performed on Silufol UV254 plates, and column chromatography was performed on aluminum oxide, silica gel (Silica Gel, -1 70-140) and Sephadex LH-20 columns [3].

Determination of pure substances was carried out by chemical and physicochemical methods. The UV spectra of the substances were obtained in Jasco V-750, IR-sectors Specord

71 IR, 1H-NMR-spectra in Option 200 MHz, and 13C-NMR spectra in Option 50 MHz [4-9].

Results and Discussion

Fractionation of a set of carotenoids obtained from the fruits of ornamental hawthorn was carried out by colon chromatography, pulse analysis paper and thin layer chromatography, quantitative analysis by UV-spectrometric methods. As a result of the analysis, it was determined that the carotenoid content of hawthorn fruit consists of α-carotene, b-carotene, lutein, phytoin and phytofluin. Percentage of individual carotenes: α-carotene (37.5%), b-carotene (30.3%), lutein (15.5%), phytoin (2.3%), phytofluin (3.8%) has been designated as.
Percentage of individual carotenes: α-carotene (37.5%), b-carotene (30.3%), lutein (15.5%), phytoin (2.3%), phytofluin (3.8%) has been designated as. The obtained substances were purified from Sephadex LH-20 column. Pure substances were identified as quercetin, rutin, hyperoside, isocversitrin and catechin based on the results of analysis of chemical transformations (complete and partial hydrolysis, enzymatic and alkaline hydrolysis in acid medium), as well as UV- and 1H-NMR spectra and comparison of these results with the literature. The total content of flavonoids in oriental hawthorn is 1.05%.

After extraction with ethyl alcohol, the solvent was removed from the plant sample residue and water-soluble polycarbohydrates were obtained by extraction with water. SHOK water-soluble polycarbohydrates were precipitated with ethanol after dialysis. The precipitate was successively washed with ethanol and acetone and dried under vacuum at 40oC. The yield was 6.90%.

Specific and quantitative characteristics (%) of water-soluble carbohydrates (WSC) were determined by titrometric method: free carboxyl groups - 4.62, esterified carboxyl groups - 6.75%, total carboxyl groups - 11.37, methoxyl groups - 4.65 and degree of methoxylation - 59.37. The amount of galacturonic acid in WSC was determined to be 37.5%. The high content of galacturonic acid indicates that WSC is pectin. 6.60% pectin substances (PS) were extracted from the sample residue with a 1% aqueous solution of ammonium oxalate. The total amount of WSC and PS in Crataegus orientalis fruits was found to be 13.50%. WSC and PS were completely hydrolyzed in an acidic environment and their monosaccharide compositions were analyzed by paper chromatography. The analysis revealed that the characteristics of both polycarbohydrates are the same monosaccharide, consisting of arabinose, galactose, xylose and rhamnose.

Analysis of WSC complete hydrolysis products showed that it contained high amounts (37.5) of galacturonic acid, along with neutral sugars. The high content of galacturonic acid in SHOC indicates that it is an acidic and pectin-containing polycarbohydrate.

The pectin was partially hydrolyzed to obtain galacturon (40%). Chromatographic analysis of the products of hydrolysis of galacturon in an acidic environment and by enzymatic methods showed that this substance consists mainly of galacturonic acid.

One of the main reasons for the growing interest in the study of the chemical composition, properties and structure of plant-derived carbohydrates is the recent determination of the physiological activity of some polycarbohydrates. These compounds have the ability to remove heavy metal ions and radionuclides from the body. They have a gastroprotective effect, have a positive effect on the endocrine and immune systems.

Pectins are also widely used for technical purposes. They are used in the production of D-galacturonic acid, in geological drilling, in the textile industry, in printing. Pectin substances are irreplaceable natural compounds due to a number of specific properties (gel formation, complex formation etc.).

At present, the development of chemical technologies is focused on the integrated use of plant raw materials. To this end, it is preferable to apply and develop continuous and waste-free processes while maintaining environmental safety. Therefore, the development of waste-free or low-waste complex processing schemes of plant raw materials is very important and is the demand of the day.

The results of the research allow to propose a complex scheme of processing of hawthorn fruits, consisting of the following stages:
1.Obtaining a set of carotenes by extraction of fruits with diethyl ether. Separation of individual carotenes by chromatographic methods.
2.Extraction of flavonoids from the sample residue by extraction with ethyl alcohol. Separation of individual flavonoids by chromatographic methods.
3.Sequential extraction of water-soluble polycarbohydrates, pectin, A- and B- cellulose from the sample residue.
4.Oil was extracted from hawthorn seeds by extraction method (1.86%).
Physicochemical constants of the obtained oil (acid number -11.1, amount of free fatty acids 5.5, saponification number 238, peroxide number 1.04, iodine number 82.4 and nd - 1.4735) were determined.

As a result of research, natural compounds belonging to different chemical classes: carotenoids, flavonoids, water-soluble acidic polycarbohydrates, pectin, A- and B-hemicelluloses were obtained from the fruits of oriental hawthorn by sequential extraction. The wide range of applications of carotenes, flavonoids and polysaccharides, as well as the impossibility of adequately replacing these substances with other substances in most cases, allow us to characterize hawthorn fruit as an invaluable source of raw materials for food supplements, medicines and technical means.

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