Examination of Physicochemical Parameters of Products Based on Cornelian Cherry (Cornus mas L.) and Honey

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ABSTRACT

The natural plant Cornus mas, sometimes called Cornelian cherry, has been known since ancient times and the fruit is used for various purposes. Cornus mas gives healthy fruits without the use of chemical protection, which are used as healthy, tasty and medicinal food. Cornus mas fruits can be used for eating fresh or in the form of numerous processed products: marmalade, jam, sweet, compote, syrup, juice, fruit yogurt, liqueur, wine and brandy. Due to its antioxidant, antiallergic, antimicrobial and antihistamine properties, it is increasingly used as a dietary supplement, as well as for medical purposes. Taking into account all the above, the aim of this paper is to examine samples of a mixture of honey and fresh wild Cornelian cherry, as well as a sample of honey and Cornelian cherry and determine the physical - chemical parameters: electrical conductivity, pH value, vitamin C content, HMF (hydroxy methyl furfural), as well as individual heavy metals such as iron, cadmium, lead, zinc, copper. Based on the obtained results, appropriate conclusions will be given and the possibility of registering these products as food supplements will be determined.

Based on the performed analyzes, it was shown that the sample of honey and Cornelian cherry mixture had the highest pH value and electrical conductivity, and that the honey sample had the lowest value. Also, the highest value of water activity had the sample of a mixture of honey and Cornelian cherry, while the highest content of hydroxymethylfurfural had the content of Cornelian cherry. The analysis showed the absence of manganese (Mn), cadmium (Cd) and lead (Pb) in all samples, while it was shown that the highest content of Cu and Zn has the sample of Cornelian cherry 2.665 mg/kg Cu and 14.41 mg/kg Zn, followed by a mixture of Cornelian cherry and honey Cu 2.778 mg/kg, Zn 14.670 mg/kg, while the honey sample has the highest Fe content of 16.72 mg/kg. This shows that the samples are rich in zinc, iron and copper, and that they are a good source for those minerals that could meet daily needs.

Keywords: honey, Cornelian cherry, physico-chemical analysis, heavy metals.

I. INTRODUCTION

Consumers around the world are showing increasing interest in high-quality natural fruits, such as Cornelian cherry. Until recently, this plant was considered exclusively a medicinal and decorative species, while in recent decades, cultivation programs aimed at the development of this fruit and high-yielding trees have been launched. [1] Cornelian cherry is a rare plant species that can be grown without the use of chemicals, and which has a good yield potential even under modest agronomic conditions. Cornelian cherry can have various applications in medicine, and is especially used because of its antioxidant, antiallergic, antimicrobial and antihistamine properties [2] In some Asian countries, Cornelian cherry is the main ingredient in herbal preparations used in the treatment of diabetes. [3] [4] At the stage of technological maturity, Cornelian cherry acquires a sweet-sour taste, so it can be eaten fresh or in the form of various processed products. The fruits are usually made into juice syrup or processed into jams, liqueurs, etc. Due to the astringent effect of tannins, it is...
also used to treat diarrhea.

Cornelian cherry is also an important honey plant because it blooms in early spring providing valuable nectar and pollen at a time when very few flowering plants are available to bees for food. [5] Fresh Cornelian cherry fruits contain twice as much ascorbic acid than oranges; compared to other juices derived from plum, pear and apple. The fruit of the Cornelian cherry is rich in trace elements such as copper, zinc and manganese. The values of the concentration of these minerals in fresh fruit are estimated at 110–170, 260–350 and 2400–2900 µg / 100 g, respectively.[6] Cornelian cherry is a strong source of potassium - it contains over 3500 mg /100 g of fresh fruit, which means that 1 g of Cornelian cherry meets the full potassium intake recommended by the WHO [7] The fruits are rich in organic acids, tannins, anthocyanins, phenols and others. antioxidants which is why it is increasingly used for medical purposes. [8]

Honey is a naturally sweet product that honey bees (Apis mellifera) produce from nectar of honey plants, secretions of living parts of plants or secretions of insects that suck on living parts of plants, which bees collect, add their own specific substances, store, secrete water and dispose of in honeycomb cells to maturation. It consists of carbohydrates, water, proteins, amino acids, organic acids and minerals, which is why it gives strength, gives strength to the body and ensures physical endurance and mental stability. Therefore, the combination of these two ingredients is a high quality product rich in vitamins and minerals that can be used for everyday use as a supplement, but also for various medical and pharmaceutical purposes. As an important factor in the testing of these products is the pH value, vitamin C content, hydroxymethylfurfural, water activity, and heavy metal content, these parameters were analyzed.

II. EXPERIMENTAL PART

2.1 Material

The paper examined three samples that are presented in the table 1.

| Sample 1 | A mixture of honey and fresh wild Cornelian cherry in a ratio of 1: 1 |
| Sample 2 | Cornelian cherry |
| Sample 3 | Honey |

2.2 Methods

As part of the analysis, the physico - chemical properties of all three samples were examined, and the following parameters were determined: pH value; electrical conductivity; water activity; vitamin C content; HMF (hydroxy methyl furfural); content of certain heavy metals: iron, manganese, cadmium, lead, zinc, copper.

The pH value was determined by electrochemical method, measured on a pH meter Mettler Toledo 220.

The electrical conductivity of all three samples was defined by a 20% by volume aqueous solution at 20 °C, where 20% refers to the dry matter. Results are expressed in milliSimens/cm.

Water activity (aw) expressed as the ratio of partial water vapor pressure of food and pure water vapor pressure at a certain temperature was determined using a Novasin apparatus, by placing the samples in PVC sample containers and placed in an apparatus that read the value of water activity for all 3 prepared samples.

The determination of hydroxymethylfurfural (HMF) was based on the absorbance of hydroxymethylfurfural in the UV part of the 284nm spectrum, where the difference between the absorbance of the pure sample solution and after the addition of disulfite determined the value for all three samples.

The determination of vitamin C in the samples was based on titration with standard iodine solution with starch as an indicator, where the content of vitamin C (g) was calculated according to the reaction.

The determination of heavy metals in the samples was based on the homogenization of the samples which were transferred to pre-annealed pots and placed in an annealing furnace at 550 °C. After heating, the contents were filtered through filter paper (white band) and analyzed on an Perkin Elmer atomic adsorption spectrophotometer.

III. RESULTS AND DISCUSSION

The analyzed parameters are presented in the tables 2.
When measuring the pH value, the highest value had the sample 1 – mixture of honey and fresh wild Cornelian cherry 2.44; sample 2 – Cornelian cherry had a pH value of 2.39, while sample 3 – honey had the lowest pH value of 2.33. (Table 2.) Otherwise, the pH value changes as a result of chemical, physical and biological processes in the samples. Therefore, the difference in pH values in the samples relates to the composition of the sample, as well as to the concentration of anthocyanins and organic acids of Cornelian cherry that are related to pH. Where the pH value is natural for Cornelian cherry juice. [9] Sample 1 also had a maximum electrical conductivity of 392 mS/cm, followed by Sample 2. 312 mS/cm, and Sample 3. 240 mS/cm. Previous research has shown that the association of the amount of minerals with electrical conductivity, which suggests that a sample that has a higher electrical conductivity also contains larger amounts of minerals. [10]

Water activity is a suitable parameter by which it is possible to control the growth and development of microorganisms, ranging from 0 to 1, because most bacteria cannot grow if the content of water activity is below 0.91, while for most molds the value of aw must be above 0.80. The analysis of the samples showed that the highest value of water activity was in Sample 1. 0.749, while the lowest value of water activity was in Sample 2. 0.720. Approximate values were in Sample 1. and Sample 3. Based on these results, it was determined that the samples belong to the food of medium water activity (aw = 0.6-0.9) [11]

Analysis of HMF values in the prepared samples showed that the highest value of HMF in the sample of Cornelian cherry- Sample 2, then in the sample of a mixture of Cornelian cherry and honey - Sample 1, and in the sample of honey itself - Sample 3 (Graph 1). These values are in accordance with the Regulations for honey and bee products of Official Gazette of the Federation of Bosnia and Herzegovina No.37/09 and 65/10, and are in the limit values. [12]

![Graph 1: HMF value in samples](image)

During the determination of heavy metals, the absence of manganese (Mn), cadmium (Cd) and lead (Pb) was proven in all three samples. The value of iron (Fe) in the honey sample was 16.72 mg/kg; copper (Cu) 1.702 mg/kg, and zinc (Zn) 4.740 mg/kg. The sample of the mixture of Cornelian cherry and honey contains iron (Fe) 6.360 mg/kg; copper (Cu) 2.778 mg/kg and zinc (Zn) 14.670 mg/kg. The Cornelian cherry sample contains iron (Fe) 10.216 mg/kg; copper (Cu) 2.665 mg/kg and zinc (Zn) 14.41 mg/kg. These values showed that the highest content of Fe, Cu and Zn has a sample of Cornelian cherry, while the sample of honey has a higher content of Fe than the sample of Cornelian cherry and a mixture of honey and Cornelian cherry, and a lower content of Zn and Cu. (Graph 2.) Otherwise, iron is necessary for the production of hemoglobin, and also plays an important role in the transfer of oxygen and electrons in the human body as well as for the normal functioning of the central nervous system. [13] In the absence of Fe, it is impossible to bind hemoglobin and thus anemia. [14] In addition to Fe, Zn, which is found in samples at higher concentrations, is important for a number of metabolic activities. It is needed for catalytic activity, plays a role in immune function, protein synthesis and wound healing. It also supports normal growth and development, which is why its daily intake in the body is very important. [15]
Ascorbic acid is vital for the proper functioning of the immune system, as it takes part in the immunomodulatory processes and stimulates the interferon synthesis. Vitamin C is a cofactor of numerous enzymes containing ferrous ions, i.e., hydroxylases and oxygenases. The presence of the ascorbic acid is vital for keeping ferrous ions reduced.[16] Analysis of a sample of a mixture of honey and Cornelian cherry - Sample 1 showed that it contains 0.02610 g of Vitamin C.

IV. CONCLUSION

Analysis of these samples showed that the highest pH value and electrical conductivity had a sample of a mixture of honey and Cornelian cherry, and that the honey sample had the lowest value, with a large role played by sample composition, concentration of anthocyanins and organic acids and minerals. Also, the sample of the mixture of honey and Cornelian cherry had the highest value of water activity, while the sample of Cornelian cherry had the highest content of hydroxymethylfurfural. Based on these results, it was determined that the samples belong to the food of medium water activity.

The analysis of these samples showed that these are samples that are rich in zinc, iron and copper, and that as such they are a good source for those minerals that could meet daily needs. It was shown that the highest content of Cu and Zn had a sample of Cornelian cherry 2.665 mg/kg Cu and 14.41 mg/kg Zn, followed by a mixture of Cornelian cherry and honey Cu 2.788 mg/kg, Zn 14.670 mg/kg, while the sample of honey had a higher content Fe 16.72 mg/kg. In addition, the analysis showed that the absence of manganese (Mn), cadmium (Cd) and lead (Pb) in all samples.

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