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Preliminary quality/price analysis for some Betula products

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Abstract

Species from Betula genus have been proven to have bioactive features, including anti-inflammatory, anti- carcinogenic and anti-rheumatic properties. They are either used for therapeutic or pharmacological purposes. There are a variety of types of products, from the well-known sap to tinctures or extracts, having different flavors, for a wider range of preferences. Thus, the purpose of this study was to compare the quality of liquid products produced from birch sap, from various companies and harvested naturally, in relation to the price of each product. This study required a thorough monitoring of prices over a period of several months, as well as qualitative and quantitative analyses. For the investigation of these indices, 6 types of products were used. The price rise research was conducted between November 2023 and January 2024, with 11 samples drawn from each type. All these tests reveal a link between the price of a product and its quality; thus, the more expensive products have a greater amount of sugar, which shows that the products have been preserved well.

Keywords: Birch sap, glucose, fructose, Brix, acidity.

1. Introduction

Betulaceae is a family of Angiosperms, primarily found in the Northern Hemisphere, but also is occasionally found in the Southern Hemisphere, particularly in South America. Of this family, the largest genus is Betula [1]. Two naturally occurring, commercially significant treelike birch species are found in Europe: downy birch (Betula pubescens) and silver birch (Betula pendula) [2]. Birch trees have various usage for example, in ancient China, in the Xinjiang Province, Betula sp. wood has been used for carving plates due to its high rigidity and intensity [3], in the Himalayan region of India, Betula utilis is used in religious ceremonies [4], Betula pendula is used as a bioindicator for urban pollution [5]. Different birch species are used for pharmaceutical purposes [6, 7, 8]. Because of their anti-inflammatory qualities, birch buds are infused and used in otolaryngology and stomatology to treat acute respiratory diseases, chronic tonsillitis, glossitis, gingivitis, periodontitis and sore throats [6]. Birch buds also have the potential to be utilized as antiseptics and anti- inflammatory agents for decontaminating, cleaning and healing wounds on human skin [9].

As an adjuvant for minor urinary complaints, birch leaf is a traditional herbal medicinal product that helps flush the urinary tract and increases the amount of urine produced [10]. Additionally, birch leaves extracts have been shown to exhibit a variety of pharmacological properties, including diuretic, antimicrobial, antifungal and anticancer properties [11]. Birch sap flow starts inearly spring. The time for harvest depends on the geographical location, climate, and weather course [12]. During the winter, a portion of the energetic

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metabolites that were produced in the leaves during the growing season are stored in the trunk and roots [13].

The purpose of spring sap is to feed the buds that are opening by releasing nutrients that have been stored as lipids, proteins, carbohydrates, and minerals that the roots have taken up from the soil [12]. Through a hole drilled to reach the xylem in each tree, sap emerges from birch tree trunks in the early spring. A single season can yield up to 180 liters of sap from birch trees [14] and depending on the species it can typically secrete sap for two to four weeks [12]. The sap that is exuded undergoes seasonal changes in its chemical composition [14].

Starting as an old folk medicine, the sap has been used for various treatments, such as illnesses of the lungs, gout, skin, infertility, revitalization, kidney stones, jaundice, diuretics, rheumatism, stomach disorders, arthritis, pneumonia, and cholera [8, 15]. Its natural qualities enable it to effectively eliminate harmful substances from the body. It also possesses strong antimicrobial, antipyretic, phagocytosis-influencing, and antiphlogistic properties [16].

It is a non-timber forest product that is considered to have important economic and recreational value. Due to a broad distribution of birch species and the integration of sap into the former Soviet economic system, birch sap harvesting is still a significant activity, primarily in Belarus, Finland, Estonia, Latvia, Lithuania, Romania, Poland, Russia, and Ukraine [8]. Minerals are among the most important substances promoting the beneficial effect of tree sap on human health [17]. According to Rubinskiene [18], soluble sugars, ascorbic acid, phenolic compounds, and micro- and macroelements, potassium being the main component, may be present in birch sap. The most abundant minerals found are potassium, calcium, magnesium, with the least abundant mineral being copper [19].

The amino acids valine, glutamine, isoleucine, citrulline, and asparagine are most frequently found in birch sap analyses [20]. Birch sap contains oligosaccharides such as fructosyl/glucosyl- sucrose, gentiobiose, manninotriose and melibinose. Oligosaccharide levels fluctuate depending on the season and the dendrometric parameters [13]. Additionally, organic, and inorganic acids, specifically citric, succinic, phosphoric, and malic acids, are found in birch sap [21]. Birch sap contains vitamin C as well as various phenolic compounds and glycosides [22]. In birch tree sap, the majority of the glycosides are glucose and fructose [23]. Mineral micro- and macroelements abound in sap: the most common elements are calcium (Ca), sodium (Na), magnesium (Mg), potassium (K), and iron (Fe), with trace levels of Mn, Zn, Cu, Al, and Ni [23, 24].

Birch sap is an odorless, colorless, or slightly opalescent liquid with a sweetish taste [25].

Because it is perishable, its consumption should be limited. When leaf buds split, the amounts of malic, citric, phosphoric, and succinic acids in sap significantly decline from their peak during the period of intense sap exudation. When it comes to sap's sugar content, the trend is completely the reverse of that of acids [26].

It can be refrigerated (4-8 C) for a few days (5-7) or used in a single day at room temperature [17].Birch sap can also be processed, usually into pasteurized, sweetened beverages [27], may be boiled until syrup is obtained [28], or made into alcoholic beverages by fermentation with yeast, sugar, and other aromatic compounds [29].

Recommended amount of birch sap per day is 100-300 ml per day, because, while birch water is considered safe and healthy, more research is needed on its potential side effects. For people with liver disease excessive intake could pose a potential risk of manganese toxicity [30].

There are limited scientific investigations and research in the European production technology of tree sap, therefore less is known of the physiochemical properties of the European tree sap [31].

The aim of this paper is to analyze some Betula products, based on a quality/price analysis.

2. Materials and Methods

Six different liquid products made from birch sap were employed in these qualitative and quantitative evaluations. Using a pricing system, the liquids are arranged in increasing order. So, the following samples are included: 1-Byarozavik birch water; 2- absolutely wild birch water; 3-sap extract; 4-birch tincture; 5-Oemine birch juice and 6-Natural birch juice.

The Fehling test, which is used to highlight the presence of glucose in the samples, was the

initial test conducted on samples. Three milliliters of Fehling reagent I and an equivalent volume of Fehling reagent II were needed for this procedure. In order to emphasize the glucose, 2 ml of filtrate were placed on top of this and put the test tubes were heated. For each of the six samples, this procedure was repeated. The reducing qualities of the monosaccharides cause cuprous oxide, which has a brick-red coloring, to develop if glucose is present.

The identification of potassium in samples was made feasible by placing a drop of each sample on a microscope slide. The slides were allowed to dry, then a drop of sodium hexanitrocuprit was added. Placed under a microscope (Optika model), if potassium was present, cubic crystals of cupro- plumbo-potassium nitrite (triple nitrite) were detected.

The determination of the amount of sucrose in the samples was possible thanks to the brix index. To determine the brix index, the A670 Automatic Refractometer was used.

The samples for which the analysis of various biochemical indices was carried out were 6 in number, of which 5 were products bought in different price ranges and one is a frozen sample of sap collected directly from the bark of the tree. The samples, in turn, were placed on the refractometer.

Additionally, the acidity index of the samples is tested, by means of the titration method in the presence of phenolphthalein. The number of samples used to determine the acidity of the samples was identical. For the method, a burette, clamps and support, 25 ml of birch sap, 2-3 drops of phenolphthalein, 50 ml of NaOH with a concentration of 20% are used.

The price study took place over a period of several months, for 11 different types of products. The study began in November of 2023 and ended in January of 2024. The data obtained were processed using Microsoft Excel and statistical analysis were done utilizing PAST v.4.03 [9].

3. Results and Discussion

By gathering data on both the saccharide content and acidity of the samples, a comparison was done with the collection of product price data, which varied greatly from one type to another. The purpose of this study was to demonstrate if there is a relation between the quality of 6 different types of liquid birch sap products and their prices. Thus, the 6 products were subjected to experimental techniques. For the determination of sucrose content, only four of the six samples could have these measurements; tinctures were omitted because a refractometer was used to assess the variation of glucose in the samples.

Figure 1 shows the variation of sucrose content depending on the sample. The ―Byarozavik birch water‖ presented the highest amount of sucrose (3.63ºBx), the ―Absolutely wild birch sap‖ had the second highest value of sucrose content (2.05ºBx), the natural sap (0.48ºBx), contains a smaller amount of sucrose compared to the first two samples, but more than the ―Oemine birch water‖ (0.22ºBx), which represents the lowest value of the sucrose content of the analyzed samples. A decrease in the amount of sucrose with the increase in the price of the product can be observed. The product with the lowest content being the most expensive of the tested samples, it has a quantity close to that of preserved natural sap.

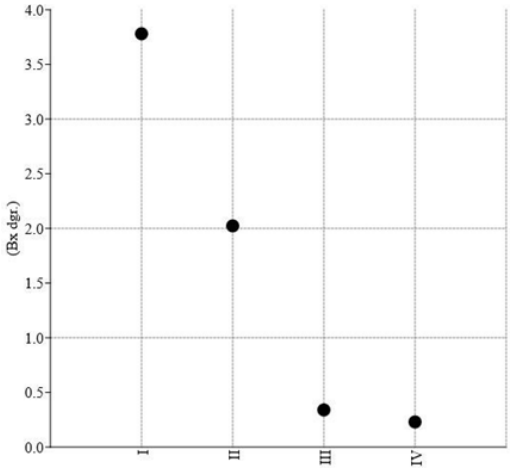

Figure 1. Variation of sucrose content depending on sample (ºBx)

Figure 2 shows the average acidity of the analyzed samples. Number VI-sap extract had the highest acidity, followed by sample II-birch sap "Absolutely Wild" which had the second highest acidity. Sample I-"Birch Water" being in 3rd place due to the degree of acidity, sample V, Birch Tincture has the next highest acidity. Sample IV-natural sap and III-Oemine birch juice having the lowest acidity values. Acidity is quite difficult to correlate with the price of the products because it is quite diverse. It can be observed, however, that the lowest value of the degree of acidity was that of the most expensive product -Oemine birch juice, followed by natural

sap, and the sample IV-sap extract had the highest degree of acidity.

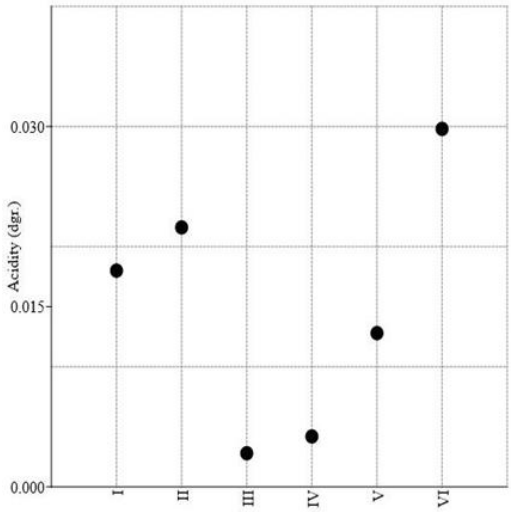

Figure 2. Mean acidity (º) of the analyzed samples

In figure 3, it is possible to observe the presence of glucose in each sample, because of the orange coloration. This happened due to the reducing properties of the monosaccharides, which form cuprous oxide. The ―Byarozavik birch water‖ shows the most intense coloration, followed by ―Oemine birch juice‖ and the natural sap. The rest of the samples show weak orange coloration. The weakest coloration is shown by the ―sap extract‖. Both the most expensive sample and the cheapest show a high concentration of glucose. A concentration similar to theirs is represented by the natural sap.

Figure 3. Variation of glucose content in the analyzed samples, highlighted with the Fehling test.

In figure 4, the presence of tripelnitrite cubic crystals that highlight the presence of potassium can be observed in all the tested samples, ranging from the cheapest sample to the most expensive one.

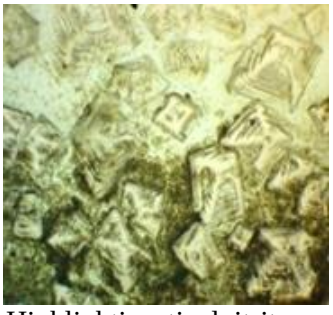

Figure 4. Highlighting tipelnitrite crystals with an optical microscope

In figure 5, the increase in prices over the course of 4 months for multiple products is highlighted, including the ones used for experiments. It can be seen that there was no sudden increase in them, but the biggest increase is highlighted for the product with the highest price. The price is in relation to the quality of the product, less so for the cheapest, which showed a remarkable test result, similar to that of the most expensive tested sample, and closely related to the natural sample.

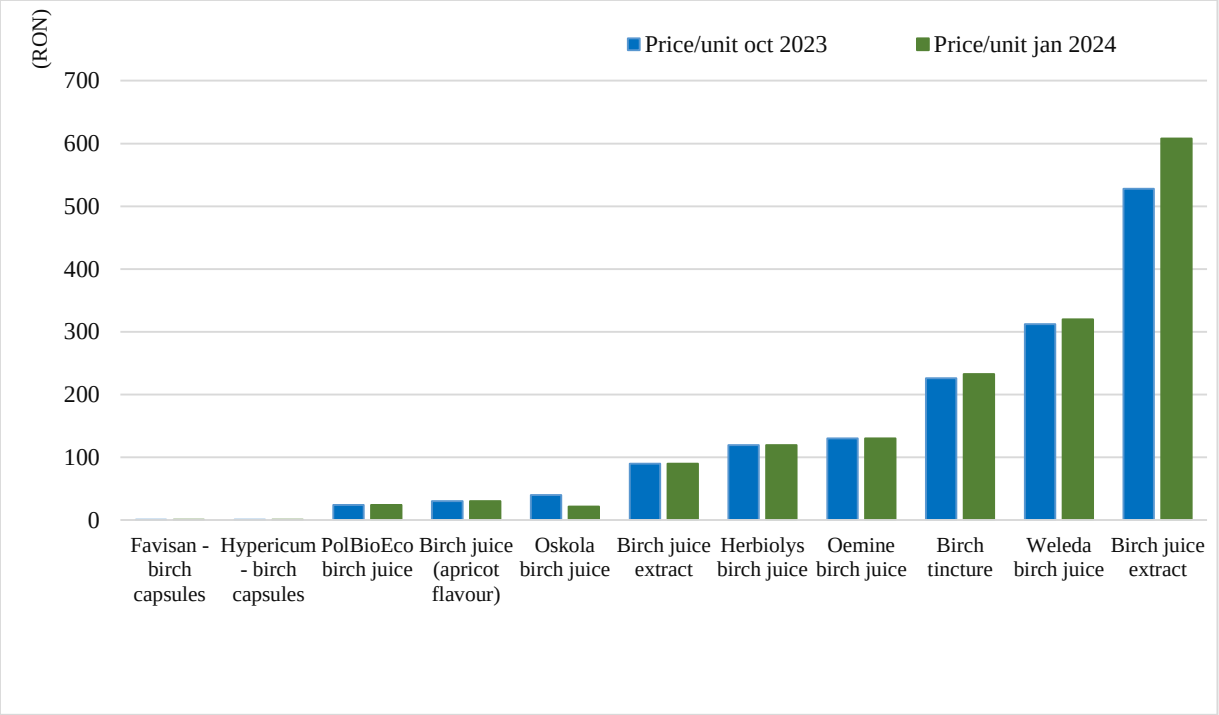

Figure 5. Graphic with the evolution of price

4. Conclusion

The cost of the samples corresponds to the caliber of the goods. The least expensive one ―Byarozavik birch water‖, revealed a welcome surprise. The outcomes of the tests conducted on the diluted samples and the tinctures were comparable. The product associated with ―Byarozavik birch water‖ is underpriced. An additional observation is the resemblance between the costly sample and the natural sample. To summarize the evidence, the methods show that there are more carbs in the pressed samples than in the tinctures. Their acidity varied; therefore, it is unaffected by the product's cost.

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