

COLLECTION AND USE OF BIRCH SAP, A LESS KNOWN NON-WOOD FOREST PRODUCT IN ROMANIA

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Abstract

Silver birch (*Betula pendula* Roth.) is generally recognized as a useful tree species across its wide natural distribution range. In Romania, even if the presence of this species especially in mountainous and hilly regions is quite common, little is known about the uses of its sap, a special category of non-wood forest products. The aim of this paper was to test different methodologies for sap harvesting and syrup and alcoholic beverage production. Forty mature birch trees were sampled. During two days of spring, more than 70 liters of sap were collected. Syrup and alcoholic beverage were also obtained. At a small-scale, birch syrup and alcoholic beverage production could become an important source of income for birch forest owners.

Key words: birch sap, *Betula pendula*, non-wood forest product

INTRODUCTION

Tree sap contains a range of diverse chemical elements (e.g. Calcium, Magnesium), enzymes, plant hormones, carbohydrate, lipid products, organic acids, amino acids and other biochemicals, C vitamin and vitamins from B complex, considered to be an important source of this kind of elements for human consumption [7], [8], [10], [11].

The sap can be consumed fresh and can be stored in the refrigerator for a limited term (about a week), or may be boiled and transformed in syrup, or alcoholic beverage by fermentation with yeast, sugar and other aromatics [5], [9], [12]. Recently, the consumption of tree saps has been increasing significantly [2].

In countries with a tradition in extracting and valuing the sap of trees, such as Canada, United States of America, Russian Federation, China, Northern European countries (e.g. Estonia, Latvia, Lithuania, Belarus), the most commonly used species are maples (Genus *Acer* L.) and birches (Genus *Betula* L.). The concentration of maple sap in sugars is between 2-4%, being double than in the case of birches [3], [4], [12], [14].

In Europe, the most common birch species are

the Silver birch (*Betula pendula* Roth.) and downy birch (*B. pubescens* Ehrh.) that occur particularly in northern regions [1]. For example, in Lithuania several state forestry divisions and private forest owners obtain profits by collecting and marketing the birch sap [13].

In Romania, one of the species of interest for the extraction of sap is the Silver birch, until now few studies addressing this topic being conducted. According to pollen analysis, at the onset of Holocene, on the current territory of Romania, the first species that appeared were the elms and the birches [16]. Birch trees are among the species of sanogenous interest in our country, being mostly present in mountain and hilly regions. In addition to sap (*Betulae limfa* or *succus*), also the bark, buds or leaves of *B. pendula* can be use for several medicinal purposes [6], [15].

The aim of this paper was to test different methodologies for sap harvesting and syrup and alcoholic beverage production.

MATERIALS AND METHODS

The study site was located in parcel 1A (45°19'47.0'' N latitude, 25°58'37.7'' E longitude, 630 m elevation) of Crasna

Production Unit, administrated by Mănețiu Forest District (Prahova County). Within this stand, the Silver birch accounts for more than 80%, the average age of the trees was 70 years, the average diameter was 26 cm and the average height was 17 m. Forty trees, with different diameters and height, were sampled.

The working method consisted of extracting the sap from each tree by making a single hole per tree, recording the time and the volume of the sap harvested.

The necessary tools were: drills (diameter 12 or 16 mm), drill with batteries, transparent and flexible hoses (diameter 14 or 16 mm), compass, forest caliper, time counter, rope, scissors, hammer, saw, plastic containers with capacities between 0.5 and 2 l and writing instruments.

After the trees were sampled and numbered by using permanent markers, the methodology for extraction of sap consisted in: a) drilling a hole, with an inclination of 15-20 degrees, depending on the desired exposure (10 trees per each cardinal point); two types of drills, 16 mm (17 trees), and 12 mm (23 trees) were used, and the hole depth was between 1.5 and 2.5 cm; b) putting into the holes the transparent hoses with diameters of 16 mm (for the holes with the same diameter) or 14 mm (for holes with diameter of 12 mm); the time (hour and minute) was recorded; c) positioning the bottles with capacities of 0.5 to 2 liters on the trees by using the rope (Figure 1). After completion of the extraction, the holes were sealed with plugs made of wood, which were subsequently severed from the trunk by means of the saw. In parallel, the diameter was assessed.

The sap was collected between 4th and 5th of April 2015, and the following variables were assessed: diameter at breast height ($D_{1.30}$), hole diameter (H_d), hole exposition (H_e), quantity of collected sap per tree (Q), time length of extraction (T) and sap flow (F).

Birch syrup was obtained by boiling raw sap content immediately after extraction, on a stove. The boiling was done until the quantity decreased in a proportion of 7:1, *i.e.* from 7 liters of raw sap 1 liter of syrup was obtained.



a) Realization of the hole



b) Introduction into the holes the transparent hoses



c) Positioning the bottles on the trees

Fig.1. Methodology for sap extraction

The recipe for obtaining the alcoholic beverage consisted in the following steps: i) in a container of 10 liters, 5 liters of raw sap were placed and 1 kg of sugar, 4 cubes of yeast of 5 grams each, the juice of four lemons and half of kg of raisins were added; ii) the composite was maintained for 24 hours, time during which the fermentation process began; iii) after the 24 hours, the composite has been added to another 20 liters of raw sap and 4 kg of sugar in a demijohn with a capacity of 50 liters, fitted with kettle, and placed in a cellar.

Data were centralized and the calculations were performed with STATISTICA software.

RESULTS AND DISCUSSIONS

Results regarding sap collection

In the first day, the total amount of sap extracted in the time frame 9:30-17:00 was 29.55 liters. The smallest quantity was recorded in the case of tree no. 1 (0.1 l) and the largest amount in the case of tree no. 24 (2.85 l). The sap flow rate per tree ranged from 0.7 ml/min to 8.7 ml/min, the average value being 3.0 ml/min (180 ml per hour).

In the second day, the total amount of sap extracted between 10:00 and 15:00 o'clock was 26.65 liters. As in previous day, trees no. 1 and 24 recorded the lowest, and the largest quantities, respectively. The flow rate per tree ranged from 0.5 ml/min to 8.9 ml/min, the average value being 2.7 ml/min.

Between April 4, 17:00 o'clock and April 5, 10:00 o'clock the collection containers (plastic bottles with capacities of 0.5 liters and 2 liters) were maintained on the trees, collecting a quantity of 17 liters. Therefore, the total sap extracted from the 40 trees in two days was 73.2 liters.

Regarding the hypothesis according to which the average sap flow is higher on the north-south orientated holes compared with the ones orientated on east-west, the obtained results confirm it. The highest quantity of sap collected and the highest flow rate were recorder for the holes facing north, while the lowest values were recorded in the case of the holes facing east

The diameter of the 40 trees, measured at a height of 1.30 m above the ground, varied between 15 cm and 40 cm, and the mean diameter was 27.7 cm. The correlation coefficient between $D_{1.30}$ and Q was 0.10.

Results regarding the obtained syrup and alcoholic beverage

Fresh birch sap was colorless, odorless and had a sweet taste. Stored in a refrigerator at 4-5° C temperatures, the sap retained its qualities for about a week. After this deadline, the sap presented a "muddy" look and a sour taste.

After the first 30 minutes of boiling, at the surface of the liquid, colorless foam formed which was immediately removed. At 60 minutes after the start of the boiling process,

the liquid began to be colored in a shade of light brown. After 90 minutes, the liquid became browner (Figure 2). The ratio of 7:1 was achieved in 5 hours of boiling, resulting a final product with sweet taste and brown shades.



Fig.2. The aspect of sap after 90 minutes of boiling

After the completion of boiling, the fresh syrup obtained (hot) was stored in glass bottles, left to cool in ambient temperature for 24 hours, after which it was stored in a refrigerator at 4-5° C. Without further treatment and stored in such conditions, the syrup kept its qualities (taste and color) for about three weeks after which a sour taste and some deposits were observed.

Regarding the alcoholic beverage, the fermentation lasted for three months.

The study confirmed the results of similar research carried out in Romania [1], according to which the amount of sap extracted is directly proportional to the diameter of trees. Also, the largest amounts of sap were extracted from the holes facing north.

Even if the guidelines described in other studies regarding the ration between the raw sap and the syrup obtained were not followed, a flavored syrup with caramel taste, which has maintained its qualities for nearly one month, was obtained.

CONCLUSIONS

Regarding the method for sap extracting, the best results were obtained by using a drill with a diameter of 12 mm and a hose with a

diameter of 14 mm. It is also preferable to use the bottles of 0.5 liters for harvesting sap in order not to exercise a tension too high in the rope, causing tearing, on the one hand, and to increase the stability of the bottles especially when strong currents appear, on another hand. When working in a team with two members and using the methodology proposed in this study, it is recommended not to exceed the number of 40-50 trees from which sap is extracted in order to track and collect the sap in an optimally way, without loss.

Future research should be conducted in partnership with experts from the food industry in order to increase the quality of the obtained derived products from sap.

Even if the birch sap is considered to be an exclusive non-wood forest product, in some regions across Romania the potential for collecting and marketing of the birch syrup and alcoholic beverage is high. At a small-scale, birch syrup and alcoholic beverage production could become an important source of income for birch forest owners.

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