The loss of high-value chemicals in the forest biomass supply chain

The side streams of the forest industry, such as bark and logging residues, represent an attractive source of high-value chemicals. They are currently utilized mainly in energy production. Their high extractives content and attractive chemical composition offer opportunities for extraction of valuable compounds before combustion following the principle of cascading use of biomass.

Wood extractives include a large group of compounds with versatile bioactive properties. They provide potential functionalities for biologically active cosmetic ingredients or pharmaceuticals, as well as various other value-added products, such as bioplastics, coatings, dietary supplements, biopolymers, foams/emulsions, platform, and specialty chemicals.

Storing feedstock is typically necessary to ensure a constant supply of raw materials. The biorefining industry sets new demands for the raw material supply chain. Many of the extractives are either volatile or chemically unstable. Immediately after tree felling, the extractives content begins to decrease, accompanied by changes in their chemical composition. The type of harvesting, transportation, and storage determine the nature, magnitude and rate of changes in the properties of wood extractives. Environmental conditions, particle size and storage time all affect the processes responsible for extractives losses. In many cases, the major losses occur rapidly, especially with volatile compounds such as monoterpenes and hydrophilic phenolic extractives. Thus, the potential bottleneck in the industrial valorization of forestry side streams lies in logistics. Therefore, it is crucial for the entire supply chain to be efficient, ensuring that delivery times are kept short and the loss of valuable compounds is minimized during harvest and transportation.

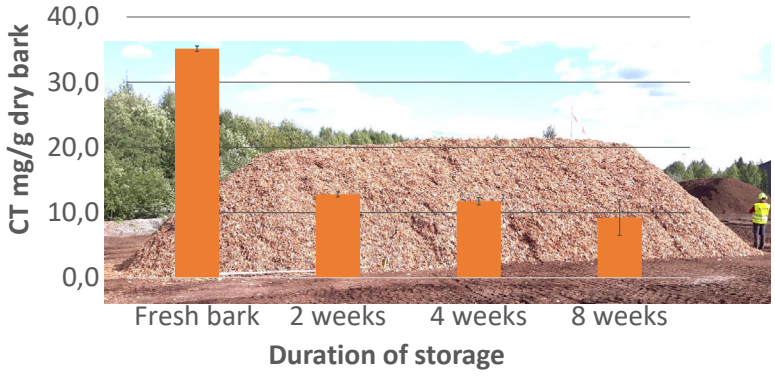

Figure 1 Decrease in the content of condensed tannins (CT) during Scots pine bark storage in pile [1].

KEY WORDS

Forest, biomass, supply chain, extractives, bark, side streams

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ADDITIONAL INFORMATION

Extractives content and composition of Norway spruce and Scots pine bark changed markedly during an 8-week storage in piles. The extractives content in Scots pine bark and Norway spruce bark decreased by 44% and 34%, respectively, over the 8-week storage period [1,2]. The most significant changes in extractives content and composition occurred within the initial two weeks of storage. About 60% of condensed tannins of Scots pine bark were lost within 2 weeks (Fig. 1). Similarly, over 50% of condensed tannins and 67% of stilbenes of Norway spruce bark were lost within 4-week storage [3]. Condensed tannins and stilbenes are particularly interesting compound groups found in the bark, holding commercial potential due to their preservative, antioxidative, and antimicrobial properties. They could find applications in various industries, including food, cosmetics, and pharmaceuticals. The rate and magnitude of the changes decreased when Norway spruce bark was stored intact on logs [4]. Debarking results in a smaller particle size of the material, thus accelerating the degradation processes of valuable compounds. These changes were slower during winter than in summer. The weather conditions during summer with higher atmospheric temperature and higher precipitation seem to accelerate the processes leading to the losses of extractives. To minimize extractives losses, effective management of the supply chain is essential [5]. Storage time should be limited, and whenever possible, storage at low temperatures, especially below zero degrees Celsius, should be preferred. Protecting the biomass from UV radiation (direct sunlight) and restricting ventilation (i.e., limiting access to oxygen) are also advisable. To preserve hydrophilic compounds, contact with water should be avoided. Debarking and chipping material into smaller particles should occur immediately before further processing to prevent accelerated extractives losses.

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ABOUT BRANCHES

BRANCHES is a H2020 "Coordinaton Support Action" project, that brings together 12 partners from 5 different countries. The overall objective of **BRANCHES** is to foster knowledge transfer and innovation in rural areas (agricolture and forestry), enhancing the viability and competitiveness of biomass supply chains and promoting innovative technologies, rural bioeconomy solutions and sustainable agricultural and forest management.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 101000375