bio hub NEWS

Chemicals from Spruce

OLD AND NEW PRODUCTS FROM TREES

Extractive compounds are chemicals find in trees and they have bioactive and protective properties. Our aim is to find really valuable compounds for future products to increase the value of the forest.

Extractives have been utilized for long time; tar since 16th century and tall oil and turpentine since 1910. Today wood extractives can be raw materials in e.g. health foods, medicines and cosmetics.

WHAT CAN BE DONE WITH BARK?

The volume of side-streams from forest industries, such as stumps, branches and bark, is significant. Bark is currently used mainly for producing heat and power or compost for horticulture use. However, it is probable that a considerable amount of it could be also used for manufacturing various value-added products.

BARK CONTAINS VALUABLE CHEMICALS

Wood bark is a rich source of extractives. Spruce bark contains about 39 % of extractives in inner bark and 25-34 % of extractives in outer bark (1,0-2,5 % in stem wood). Spruce bark is also rich source of phenolic extarctives, e.g. tannins. For this reason, it can be considered a potential raw material for biorefining industry.

VOLATILE AND CHEMICALLY UNSTABLE

Many extractives suitable for potential applications are either rather volatile or chemically unstable. The content of extractives starts to decrease immediately after tree felling and this degradation continues during storage. This is why we need to develop new methods to handle the material better in future forest terminals.

CHEMICAL FACTS

Composition of a spruce tree:

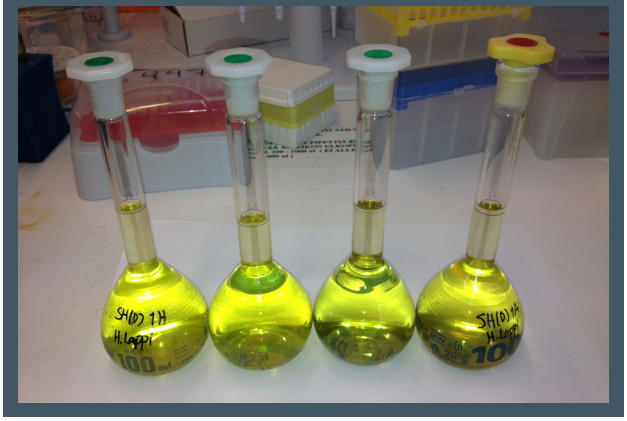
- 55 % stem wood
- 23 % branches and needles } 8-10 % bark
- 23 % stump and roots

Chemical composition of a spruce tree:

- 40-45 % cellulose
- 25-30 % hemi-cellulose
- 25-30 % lignin
- 1-2,5 % extractives

Valuable bioactive compounds from spruce bark:

- Sterols
- Phenolic compounds
  - Tannins (condenced and hydrolysed): antioxidative and radical-scavenging power.
  - Stilbenes: anti-inflammatory, anti-cancer, anti-ageing etc.
  - Flavonoids: possibly preventing cancer and heart diseases.



Feedstock characterization and fractioning

”Our main aim is to create new feedstock delivery regimes for the refining industries, based on the principle of ”right material for right industry”. The challenge is to identify the key points in the feed stock procurement chain where chemical and mechanical changes take place.” says work package leader Hanna Brännström from Luke. Other researchers are Eelis Halmemies from Luke and Robert Samuelsson, Marjan Bozaghian, Dan Bergström, Sylvia Larsson and Hamid Salehi Kahrizsangi from SLU.

THREE TYPES OF STORAGE STUDIES

Storage studies focus on changes in the chemical composition and physical properties of bark during storage. The main goal is to provide information for the planning of feasible recovery processes.

Main focus of chemical analysis is on extractives as this is the fraction where the changes occur most rapidly and studied assortments are extractives-rich. Emphasis will also be paid on the phenolic extractives fraction.

1. Spruce bark piles

In February 2017 two 450 m^3 sawmill spruce bark piles were piled at mill site of UPM Pietarsaari for 24 weeks storage study. One pile was left as such and other was covered with snow.

Luke, SeAMK and SLU participated in the construction of study and taking samples. Samples were taken from fresh raw material and after 4, 12 and 24 weeks of storage. Samples were analysed at Luke and SLU.

Luke analysed the extractives’ contents of the samples. SLU analysed carbohydrates, measured ash content, pH, moisture content, particle size distribution and bark flow properties as well as performed PCR and DNA sequencing.

2. Single stem experiments

Experiments with spruce sawlogs and pulpwood is going on. Knots are studied at SLU and bark samples are analysed at Luke. The wintertime setup, lasting 24 weeks, was constructed in February 2017 and the summer time setup in the end of MAY 2017.

Knots are studied because they are known to contain high amount of lignans (6-24 %), escpecially 7-hydroxymatairesinol (HMR). HMR has e.g. retarding influence on the development of breast prostate and colon cancer. Lignans also help to maintain good cardiovascular health and to moderate other estrogen dependent health problems, i.e. menopause and osteoporosis.

3. Storage study with logging residues

Storage study with logging residues has begun and samples are analyzed at Luke. The 24-week storage study with spruce stumps begun in May 2017. Stumps are studied because it is known that also rootneck heartwood contains higher amount of lignans than stemwood.

WHAT NEXT?

KOKKOLA MATERIAL WEEK
28.10.–3.11.2017

Aim of the research work is to formulate the ”rules of thumb” for material delivery to biorefinery. Rules will include information how the storage conditions effect on the chemical reactions and the rate of them. New analysis methods have been developed for the analysis of these valuable chemical compounds.

More detailed results of the studies will be published as infosheets in BioHub web page. Reviewed articles will also be published in scientific journals. Some results will also be presented at Kokkola Material Week in October 31. Read more and register: http://materialweek.fi/

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