added value INFO

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Industrial tests on products from spruce logging residues

At Centria UAS we have analyzed total extractives and total phenolics in logging residues which were obtained from harvesting of spruce trees in May 2021, September 2021 and in May 2022. These valuable ingredients could be utilized in high value-added products such as functional food and beverages, food supplements, cosmetics. Within the project, two industrial tests have been made together with Lumene and Kokkolan Nahka.

POLYPHENOLICS IN SPRUCE

Pure samples of needles, bark and branches as well as various mixtures of logging residues were extracted and analyzed. We found that concentrations of valuable ingredients can vary between different batches as was expected. The highest concentrations of polyphenolic compounds were found in needles: 58 mg GAE/g (average of three batches). Bark has also quite high concentrations: 35 mg GAE/g. The lowest concentrations were found in branches: 7,5 mg GAE/g. Dark berries typically have concentrations varying between 40 – 60 mg GAE/g.

The quantities of needles, bark and branches in a spruce tree have been estimated by Luke to be 37 kg, 29 kg and 69 kg which means that the potential quantity of total phenolic compounds in a spruce tree could be about 2 kg in needles, 1 kg in bark and 0,5 kg in branches.

Table 1. The calculated quantities of needles, bark and branches in a spruce tree and also the polyphenolics. GAE = Gallic Acid Equivalent

Sample	Total polyphenolics, TPC (mg GAE/g)	Quantities in a spruce tree (kg)	Polyphenolics in a spruce tree (kg)
Needle	58	37	2
Bark	35	29	1
Branches	7.5	69	0.5

Figure 1. Needles, bark and branches used for quantification of polyphenolics in spruce.

POLYPHENOLICS

- Polyphenols are a class of phytochemicals that typically have high antioxidant capacities.
- Polyphenols are generally involved in the defense of ultraviolet radiation and aggression of pathogens and are considered to be anti-inflammatory, antiviral and antimicrobial.
- Tannins are one type of polyphenols.

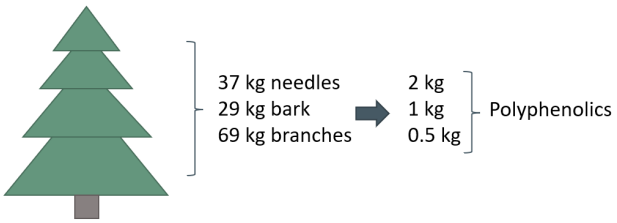


Figure 2. The quantities of needles, bark and branches in a spruce tree and the amount of polyphenolics in the different parts.

INDUSTRIAL APPLICATIONS

In this project we had two industrial demonstration cases:

- case Lumene- a cosmetics emulsion formulation with high total phenolics concentration and antioxidant capacities
- case Kokkolan Nahka- a leather treatment with tannin extract powder

CASE LUMENE: A POLYPHENOLIC EXTRACT IN A COSMETICS EMULSION FORMULATION

Polyphenols have typically high antioxidant capacities which is becoming more and more important in cosmetics applications. In addition, Lumene is interested in the Nordic Nature Based and Circular Economy based raw materials.

Centria extracted polyphenolic compounds in a 5-liter glass reactor. Extraction conditions were optimized by Luke and modified by Centria:

temperature: 65 °C and 80 °C, time 1 hour, ethanol as solvent (85 % v/v).

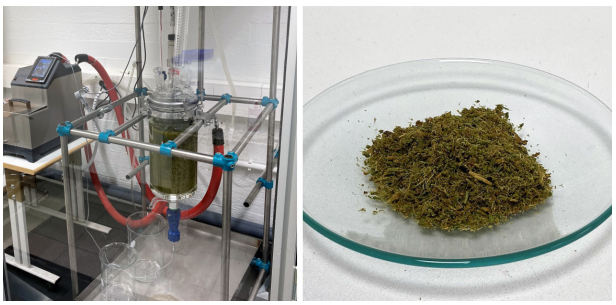
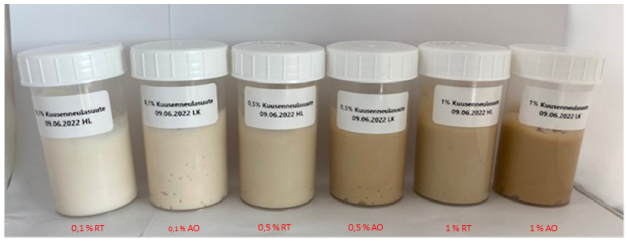


Figure 3. Extraction of polyphenolics (left) and the starting sample (right).

The dried extract was added to Lumene's own unscented and white base emulsion. The results of the test period can be seen in Figure 4. All samples turned from green to brown during storage due to oxidation of chlorophylls. According to Lumene e.g. the following further testing would be needed in order to continue product development: ensuring general safety aspects, efficacy testing (cells, skin).



RT = Room temperature, AO = Ageing oven

Figure 4. The original colour of the needle extract turned from green to brown during storage, staining Lumene's white base emulsions to beige. The shade of brown darkened during experiment.

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CASE KOKKOLAN NAHKA: LEATHER TREATMENT WITH TANNIN EXTRACT POWDER

There is an increasing demand for naturally tanned leather. Because current biomass-based tannin extracts are imported, local and ecologically sound alternatives for tannin extracts from logging residues would be very interesting. This would create opportunities for export of biomass-based tannin extracts as well as tannin treated leather.

Optimization of the extraction parameters and the extraction of tannin in pilot-scale was done by Luke. Kokkolan Nahka made leather treatment trials with the freeze-dried tannin extract. According to the CEO Juha Örnberg the results are promising and Lovia will test the tannin treated leather by making a demo bag.

Figure 5. A leather from Kokkolan Nahka treated naturally using tannins from spruce logging residues.

"Lovia will test the tannin treated leather by making a demo bag." - Juha Örnberg, CEO

PROMISING INDUSTRIAL POTENTIAL

Globally polyphenolic compounds are typically obtained from grape seeds and green tea. The availability of logging residues in the Nordic countries is high, which means that logging residues could be a good source for industrial refining of high value-added products.

Figure 6. The Centria UAS team holding a leather from Kokkolan Nahka treated naturally using tannins from spruce logging residues. From left to right: Tatu Hiltunen, Leif Hed, Riitta Miettinen, Tero Tuuttila, Ritva Mäkelä and Leena Favén.

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