



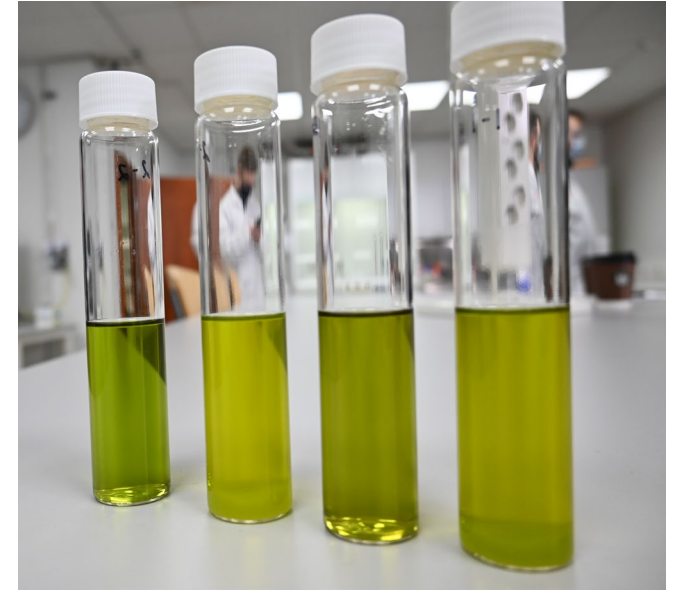
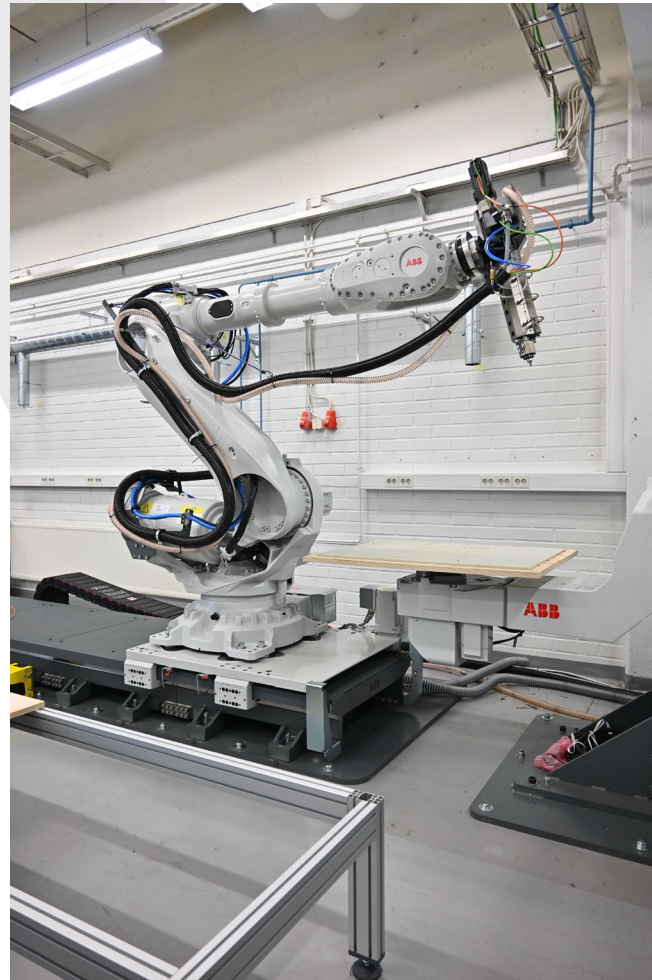
Tero Tuuttila
R&D Manager
Chemistry and Bioeconomy

View to the Arctic Forests, 25.1.2023, Oulu

Contents

- Introduction to Centria's R&D
- Why biomass valuables?
- Forest related projects in Centria
- Added value from logging residues

Introduction to Centria's RDI







CENTRIA R&D

R&D has been defined as one of our strengths and we have been awarded for our R&D activities on the national level.

R&D ACTIVITIES ARE BASED ON THREE PILARS

- Project activities
- Development services
- Training services

FOCUS AREAS

- Chemistry and bioeconomy
- Production technology
- Digitalisation
- Entrepreneurship and wellbeing

R&D 2021

R&D Staff

 **116**

All Projects

122

International
Projects

26



Total Volume of
R&D Activities

8,6M€

External
Financing Share

5,6M€

Total Sale of
Development Services

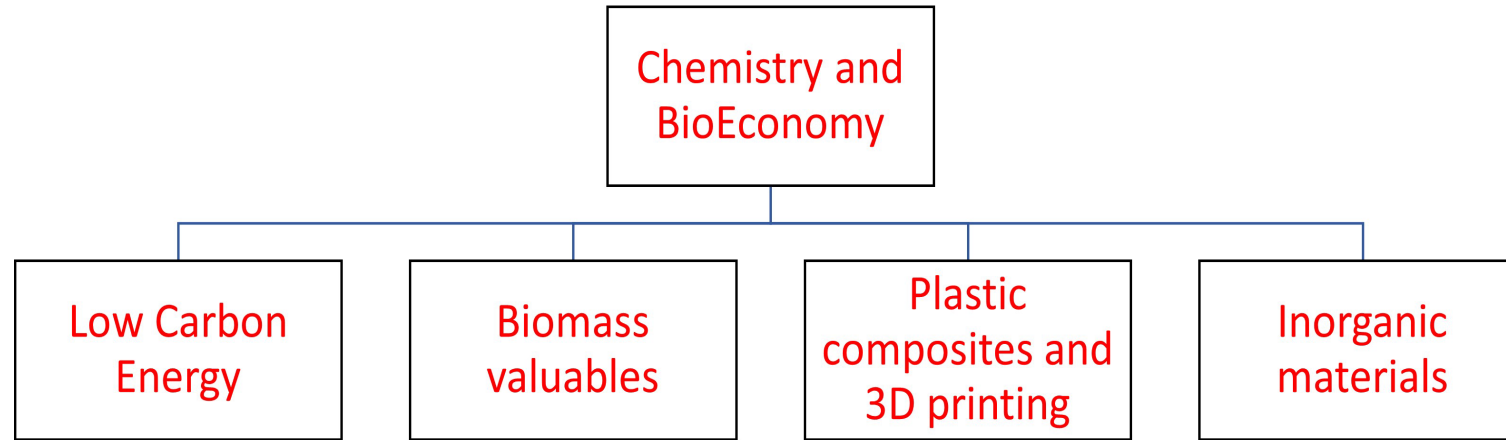
1,8M€

Value of
Project Portfolio

19,1M€



Chemistry and bioeconomy team



- Our team consist of 20 highly educated and experienced coordinators, experts and developers.
- Strong national and international networks
- Modern laboratory facilities (research, chemical analyses, pilot laboratories)

Biomass valuables

Refining and utilization of local biomass

- Side streams of forest industry, food industry
- Natural berries, specialty plants
- Extraction of valuable compounds
- Identification and characterization of compounds
- Development of processes
- New applications
- Increasing the added value



Valuables from biomass

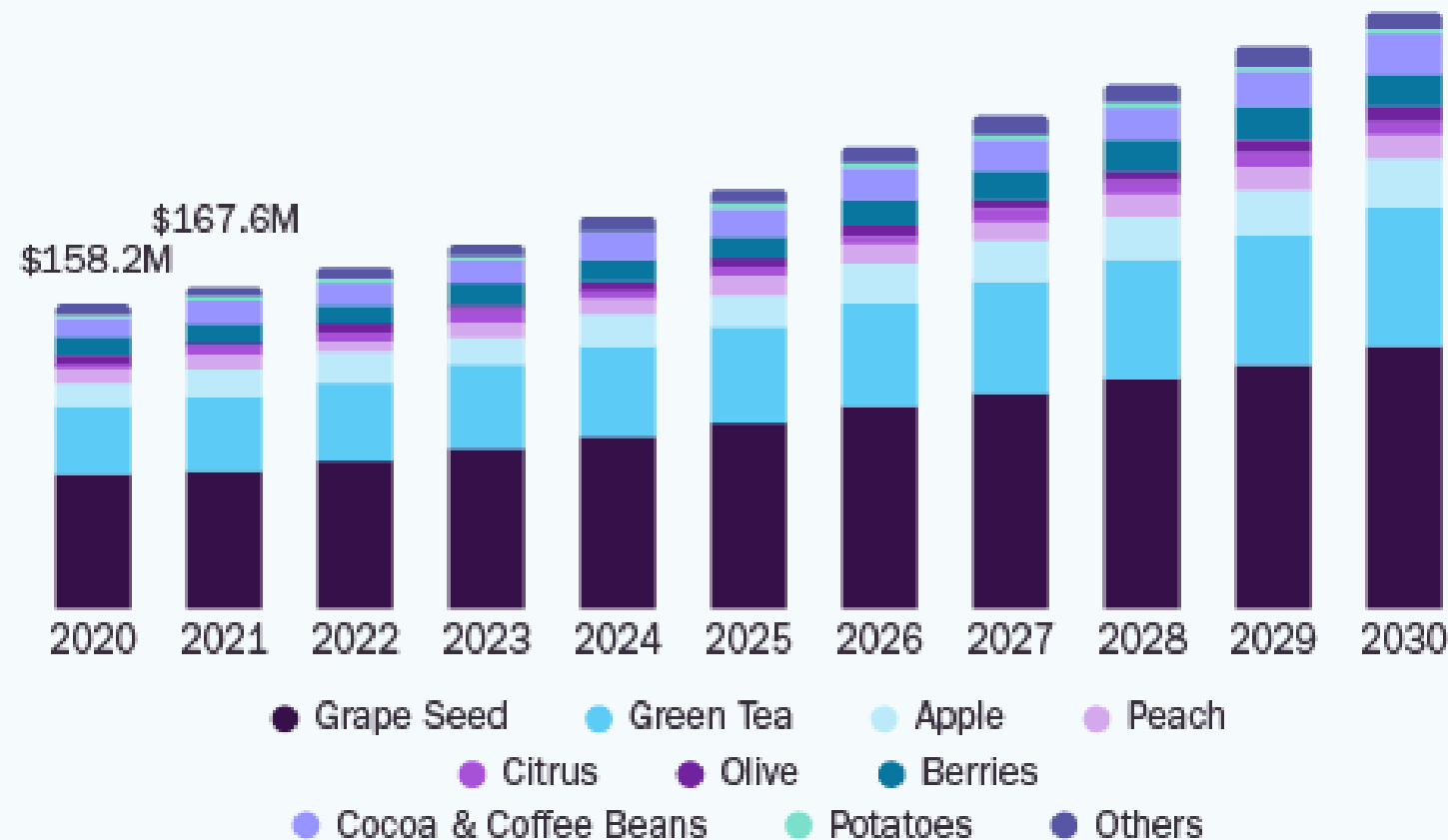
- **Motivation:** Global market demand for **high quality, authentic health food, food supplements, cosmetics, pharmaceuticals**
 - Natural products industry, 155 billion USD/year*
 - Naturex, to 405 mill. €(2017), Indena, to 158 mill. €, Linnea, to 44 mill. €(2017)
- **Opportunity:** plenty of **high quality arctic** raw materials (biomass) with high concentrations of valuable ingredients due to long day light during summer growing period
 - PREMIUM RAW MATERIALS AND REFINED PRODUCTS FROM FINLAND
- Extraction and characterization on valuable compounds from cultivated and collected wild plants, industry side streams, logging residues
 - From existing research results towards industrial procedures

Next steps: from lab scale to pilot scale

Polyphenols market

U.S. Polyphenols Market

size, by product, 2020 - 2030 (USD Million)



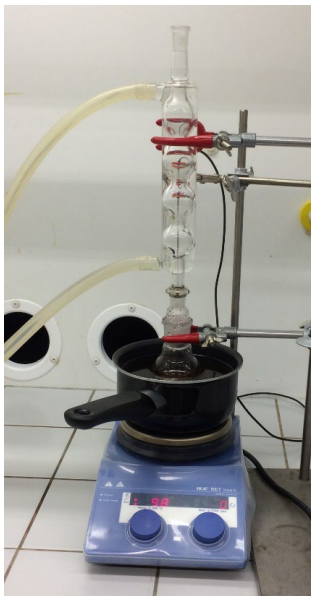
GRAND VIEW RESEARCH

6.4%

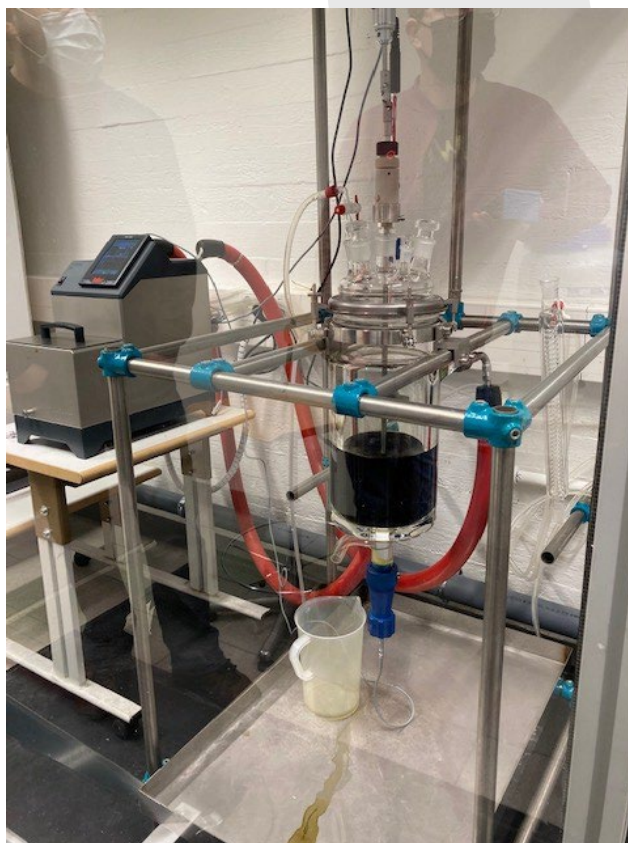
U.S. Market CAGR,
2022 - 2030

Source:
www.grandviewresearch.com

From lab scale to pilot scale



< 1 liter



5 liters



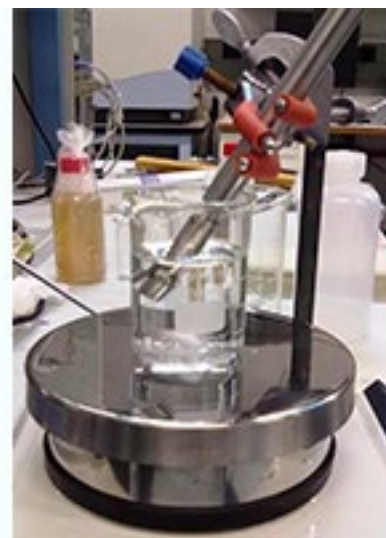
Pilot scale (80 to 200 l)

Forest related projects

industry Towards Nordic Industrial Scale
Manufacturing of Non-Wood Forest Products

NORDIC

2015 - 2018



Interreg
Botnia-Atlantica
Euroopan aluekehitysrahasto



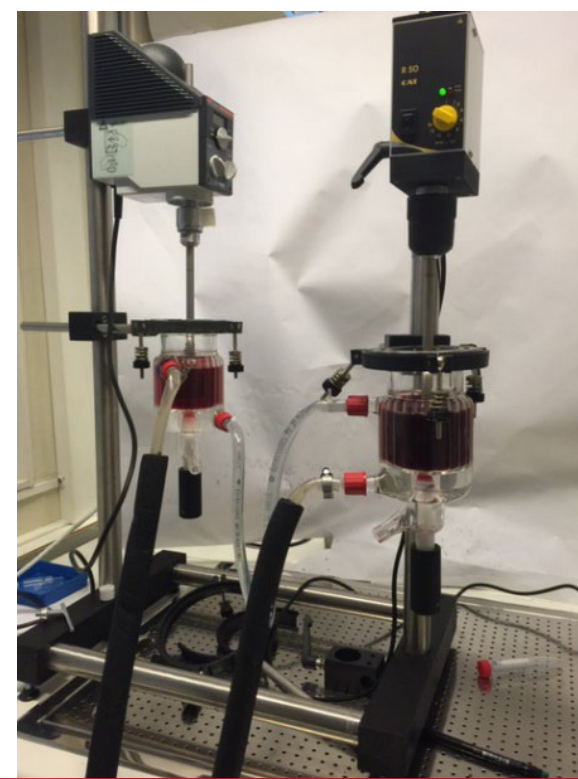
Österbottens förbund
Pohjanmaan liitto



Länsstyrelsen
Västerbotten

Examples of results

- Quality characterization method (UV-Vis) **Marjabothniaberries**
- Quality characterisation of birch sap **Arctic Birch**
- Cyclone drying of bilberry press cake **Mattea**
- Novel extraction method optimization for anthocyanins from black currant juice **Extrx**
- Novel extraction method testing (RBR) **Spinchem**
- Optimization of an industrial extraction method (Modde, NIR-HPLC) **Eevia**





MORENPBIZ.

More Natural Product Business by Enhanced Quality and Energy Efficiency of Drying

The aim is to enhance energy efficient drying of plant biomass materials.

Tasks are:

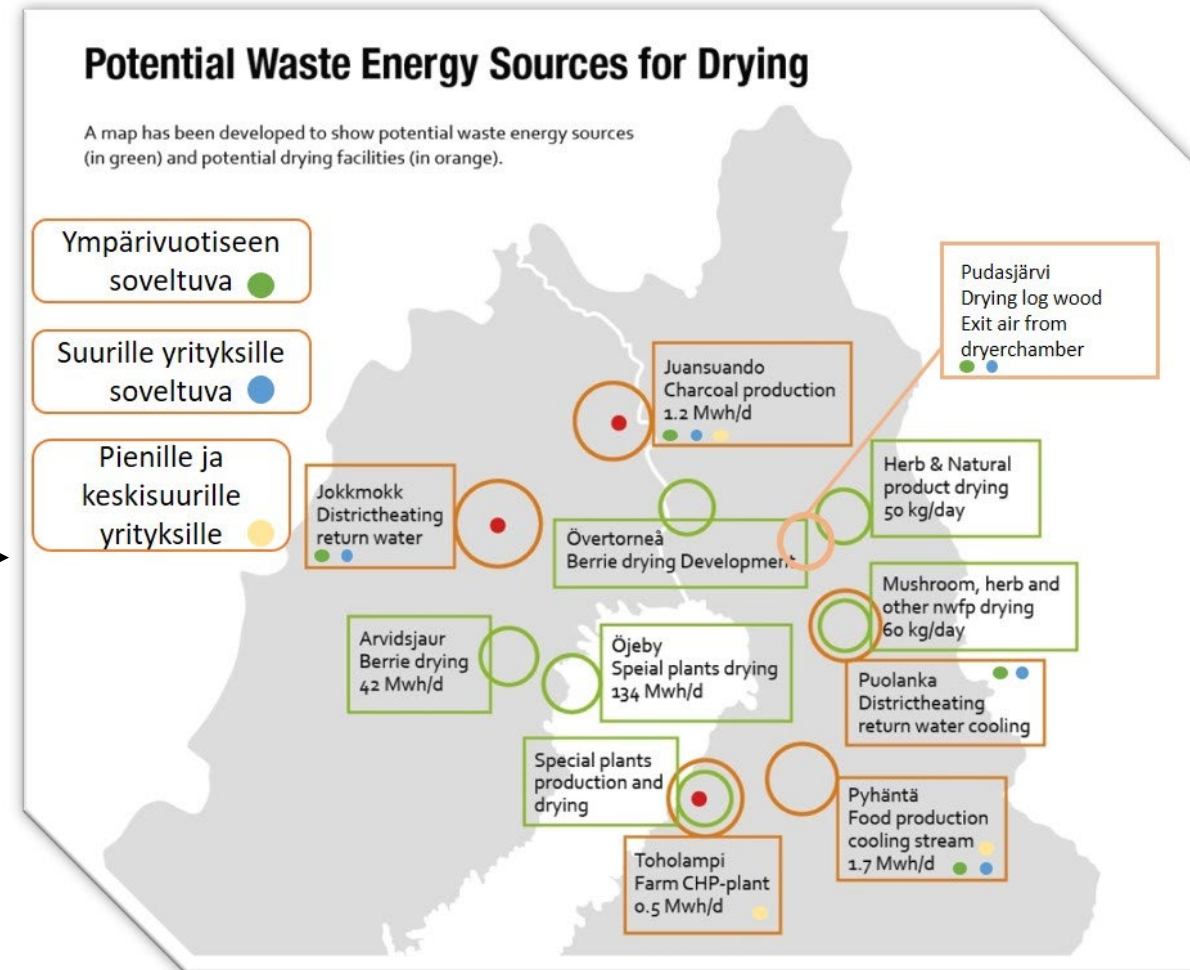
- Survey of potential waste energy sources for drying purposes
- Development/optimization of drying processes and equipment
- Chemical characterization of plant biomass material before and after drying
- Business models for waste energy producers and users, enterprises utilizing drying

Centria, Oulu University of Applied Sciences (Fin),
Luleå University of Technology (Swe),
Hushållningssällskapet (Swe)

2019 – 2021

RESULTS

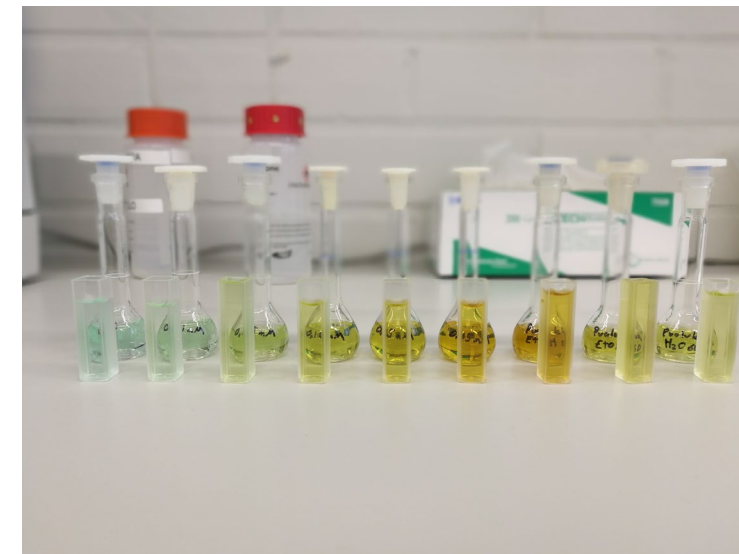
- Optimization of **existing dryers** including Orakas
- Optimization of **drying temperatures** for nettle, rose root and birch leaves
- **Quality characterization** methods, total phenolics and antioxidant capacity measurements
- A map of potential waste energy sources for drying →
- Design and construction of a modular dryer for Central Ostrobothnian farmers
- Preliminary calculations for a model for processing and drying entrepreneurship (OUAS)





Results:

- market demand of NTFP in China
 - Strong collaboration with Beijing Forestry University, Embassy of Finland in Shanghai, Finnish Business Council Shanghai, China Chamber of Commerce, Finchi, China Academy of Chinese Medical Sciences
 - https://www.silvexpo.lv/novelbaltic_brochure/
- a **digital platform** for authenticity and quality related methods
 - www.novelbaltic-platform.com
 - authenticity and quality characterization methods for selected raw materials and products
 - Antioxidant capacity, total phenolics, DNA-based methods
- The feasibility of selected raw materials and manufacturing processes, super critical carbon dioxide extraction



University of Oulu, Centria University of Applied Sciences, University of Latvia, Kaunas University of Technology, Lithuanian Research Center for Agriculture and Forestry/Institute of Horticultur, Aalto university, Tartu Science Park, The Finnish Forest Centre, Silvexpo Ltd

Green Bioraff Solution

Sustainable products from sawdust, fiber sludge, lignin, and bark

Polylactic acid from forest-based biomass

- Saw dust, fibre sludge

Hydrolysis lignin upgrade

- Preparation of activated carbon

Tannins from barks

- Extraction of tannins from bark
- Preparation of tannin foams

2018 - 2021



1.5.2021 – 31.10.2022



Interreg
Botnia-Atlantica
European Regional Development Fund



Added value from logging residues

Main project goal

- to demonstrate innovative methods to produce valuable biochemicals and ingredients from the currently under-utilized, logging residues
 - Raw material potentials and supply chain
 - New innovative process for mechanically separating needles
 - Chemical characterization of logging residues and needles
 - Chemical processing of needles
 - Communication and target group dialogues
 - Project management

DURATION:
2021-05-01 -- 2022-10-31
BUDGET:
0.63 M Euro



LOCATION & PROCUREMENT

RAW MATERIAL
logging resiudes
Branches from
fresh spruce

Method to find
raw material
Guidelines for
procurement



METHODS

FRACTIONATION

Sort out
needles,
by grinding,
sieving
material
to analyse

**Analytical
extractions**

**Chemical
composition**

**Chemical
Composition**

**Bioactivities
of samples**

Reference/analytical/laboratory
Comparison

Logging residue fractions
& hand picked samples

**Extraction
optimization
in laboratory
for pilot scale**

**Scaling up
and what we
can actually
get out of
samples
industrially**

Practical/scale-up/industrial

COMPOUNDS

**Lipophilic
compounds:**
- Resin acids
- Fatty acids
- Waxes

**Hydrophilic
compounds:**
- Phenolic
compounds

Solid residue



**Ash
content**

**Heating
value**

METHODS

Separation/
Purification
(Extraction)

Composting
6 months

INTERMEDIATE PRODUCTS

Tannins

Flavonoids

Waxes

Resins

Growing
media

FINAL PRODUCT

Leather treatment

Cosmetics

Waste-water
treatment

Food and drinks

supplements and
functional food

Packing surface
material

Paint

Garden-soil

added
value

Industrial potential of polyphenolic compounds

- Polyphenols can have several health benefits and have high antioxidant capacities
- Total polyphenolic concentrations with antioxidative properties are high in needles and bark
 - logging residues could be a good potential source for industrial applications utilizing polyphenols

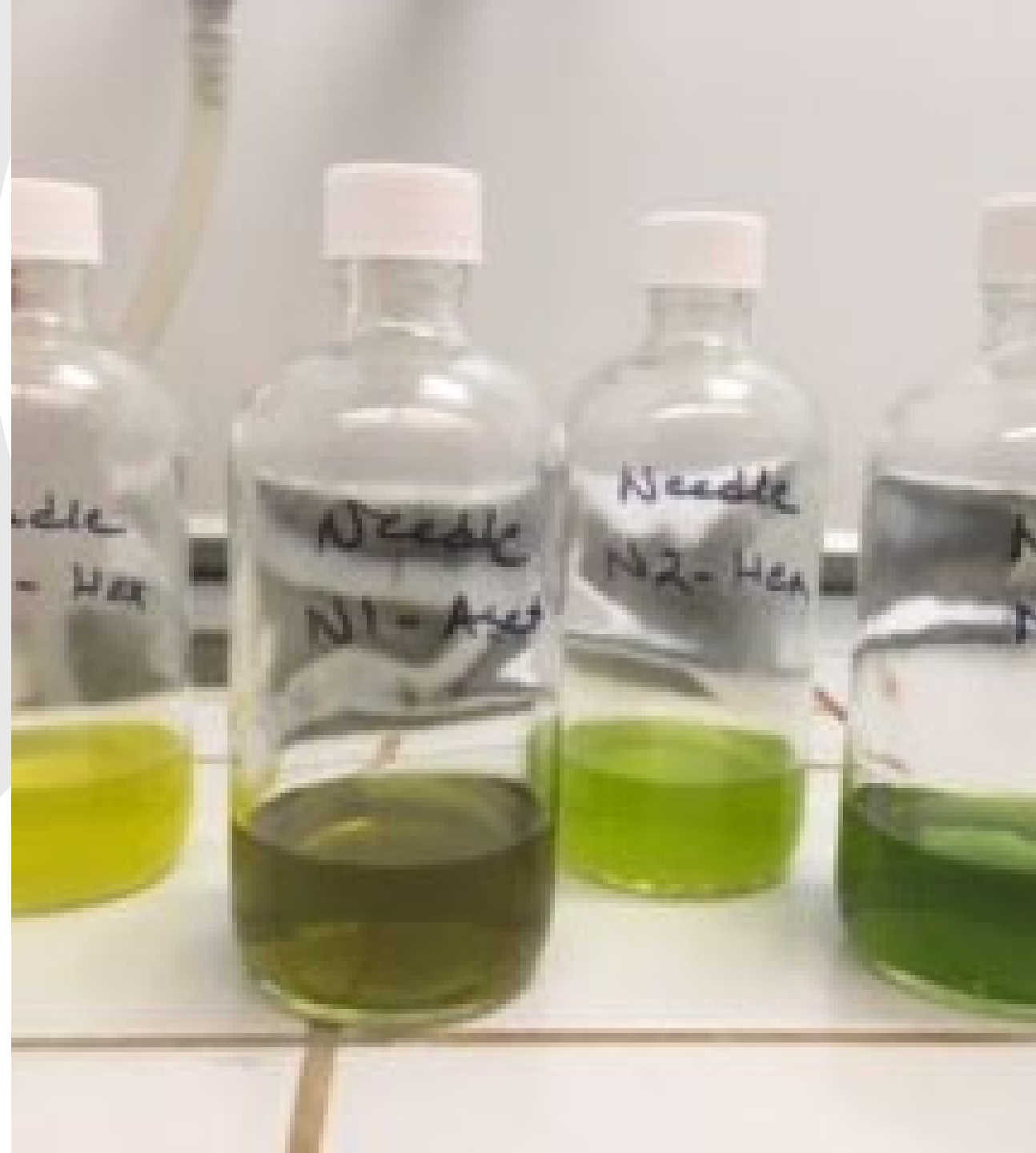


Target groups

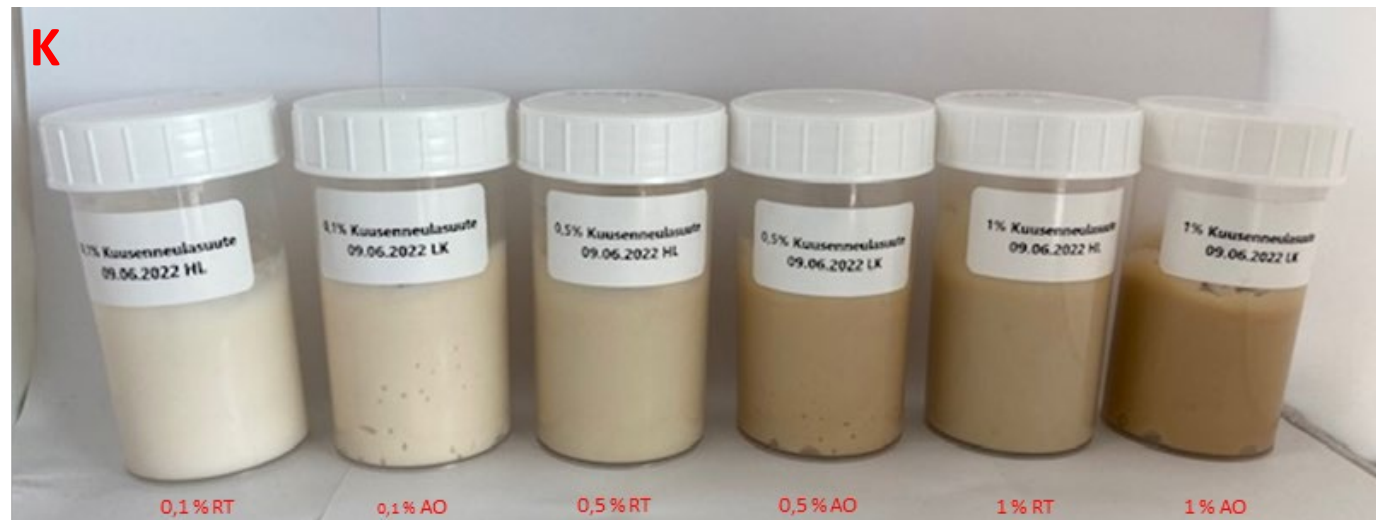
Lumene: extract for testing at Lumene (total phenolics with high antioxidant capacity)

Kokkolan Nahka: extract for testing

Lovia: tannin extract treated leather for a test product



Case Lumene



RT = Room temperature, AO = Ageing oven

c = 0,1 %		c = 0,5 %		c = 1 %	
Room temperature	Ageing oven (40 °C)	Room temperature	Ageing oven (40 °C)	Room temperature	Ageing oven (40 °C)
Light beige	Slightly darker beige	Dark beige	Bit darker beige	Light brown	Brown
Mild spruce scent	Slightly stronger spruce scent	Mild spruce scent	Slightly stronger spruce scent	Typical spruce scent	Strong spruce scent
pH = 5,86	pH = 5,88	pH = 5,82	pH = 5,79	pH = 5,73	pH = 5,51

Extract was added to Lumene's own unscented and white base emulsion

2 months test period

All samples turned from green to brown during storage

- Oxidation of chlorophylls



Case Kokkolan Nahka & Lovia: treatment of leather with tannin extract

- Optimization of the extraction parameters and the extraction in pilot scale by Luke
- Freeze dried tannin extract was sent to Kokkolan Nahka in July
 - Specifications according to commercial powder extract
- Leather treatment trials at Kokkolan Nahka in August
- Results
- Lovia makes bags from waste materials
 - The goal: a demo bag made of leather treated with tannin from logging residue

More information

Added Value from Logging Residues project

<https://biofuelregion.se/en/projekt/added-value/>

Infosheets

- Researchers and project members have summarised the results in a few pages

CEForestry application

Interreg
Baltic Sea Region



Co-funded by
the European Union

Higher value
products/applications from low
value underutilized forest
biomass residues in BSR.

1/2023 – 12/2025

1. Swedish University of Agricultural Sciences, SLU (SE)
2. University of Latvia, **UL** (LV)
3. Joint stock company Biolat, **JSC BIOLAT** (LV)
4. Mineral and Energy Economy Research Institute, **MEERI** (PL)
5. Kaunas University of Technology Food Institute, **KTU FI** (LT)
6. Centria University of Applied Sciences, **Centria** (FI)
7. Natural Resources Institute, **Luke** (FI)
8. Umeå University, **UmU** (SE)
9. Aalto University **Aalto Univ** (FI)

Opportunities and challenges

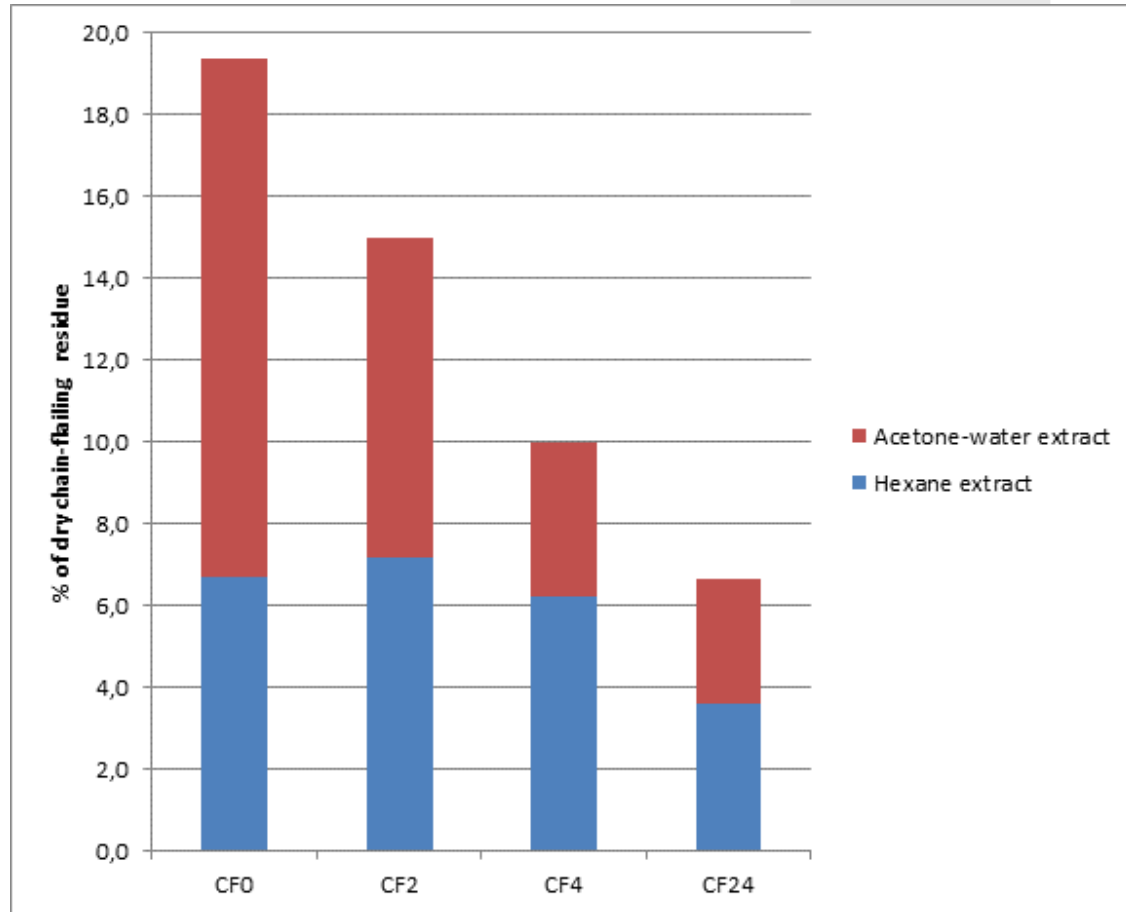
Industrial potential of polyphenolic compounds

Logging residues have high extractives content

	Cellulose, % of d.m.	Hemicellulose, % of d.m.	Lignin, % of d.m.	Extractives, % of d.m.
Pine				
branches	32	32	21	17
needles	29	25	7	37
Spruce				
branches	29	30	23	16
needles	28	25	8	43

Extractives content in stemwood typically varies between 1-5%.

Extractives are quickly lost during storage



Extractive content analyzed after 0,2,4 and 24 weeks of storage

High temperatures, sunlight and chipping/crushing will increase losses

Conclusion – Needles must be delivered quickly to industry for refining

Knowledge gap - Mismatch between end users quality demand and what is available

Biomass properties

- Outspread (expensive to harvest and transport)
- Wet and bulky
- Complex and varied quality
- High ash and alkali
- Varied particle size distribution

End users quality demand

- Cheap and continuous infeed 24/7
- Dry and densified
- Well defined quality
- Low ash and alkali
- Even particle size (sawdust)

Thank you for your interest!

For more information:

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<https://net.centria.fi/tki/tutkimme-ja-kehitamme/kemia-ja-biotalous/>

