

# A! BUSINESS MUST GO ON!

Aalto-yliopisto  
Kemian tekniikan  
korkeakoulu



## RECOVERY OF ESSENTIAL EXTRACTS FROM HERBACEOUS PLANTS: TECHNOLOGY AND TECHNO-ECONOMIC ASSESSMENT

Pekka Oinas, Oliwer Śliczniuk

**Exporting to distant markets and product development trends today**

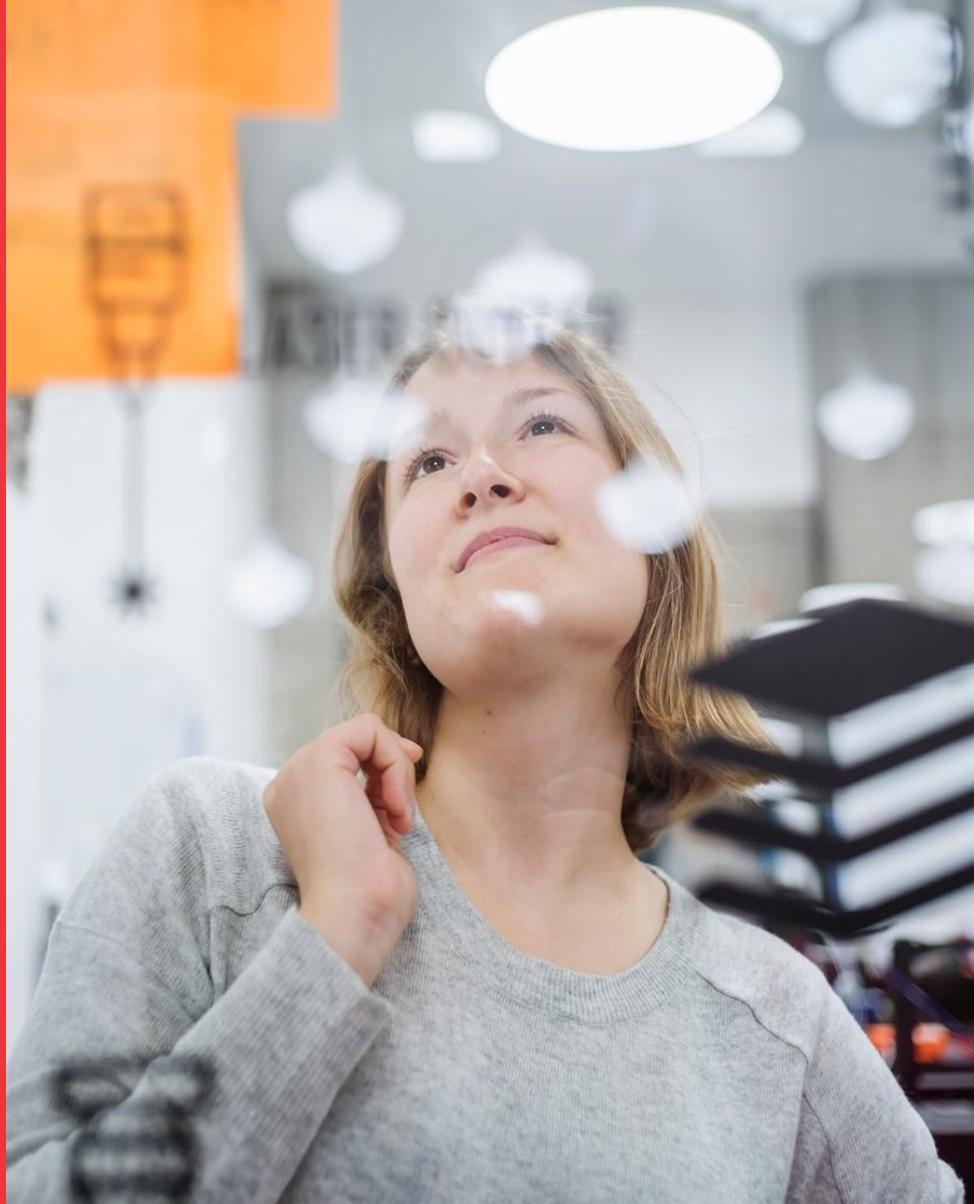
OCTOBER 7, 2020  
ZOOM WEBINAR

# Aalto University

—  
shaping the future



Aalto-yliopisto  
Aalto-universitetet  
Aalto University



# Merger of three leading Finnish universities

1849

Helsinki University of Technology

1871

University of Art & Design Helsinki

1911

Helsinki School of Economics

A”

Aalto University

2010

A?

Aalto University

# A diverse community

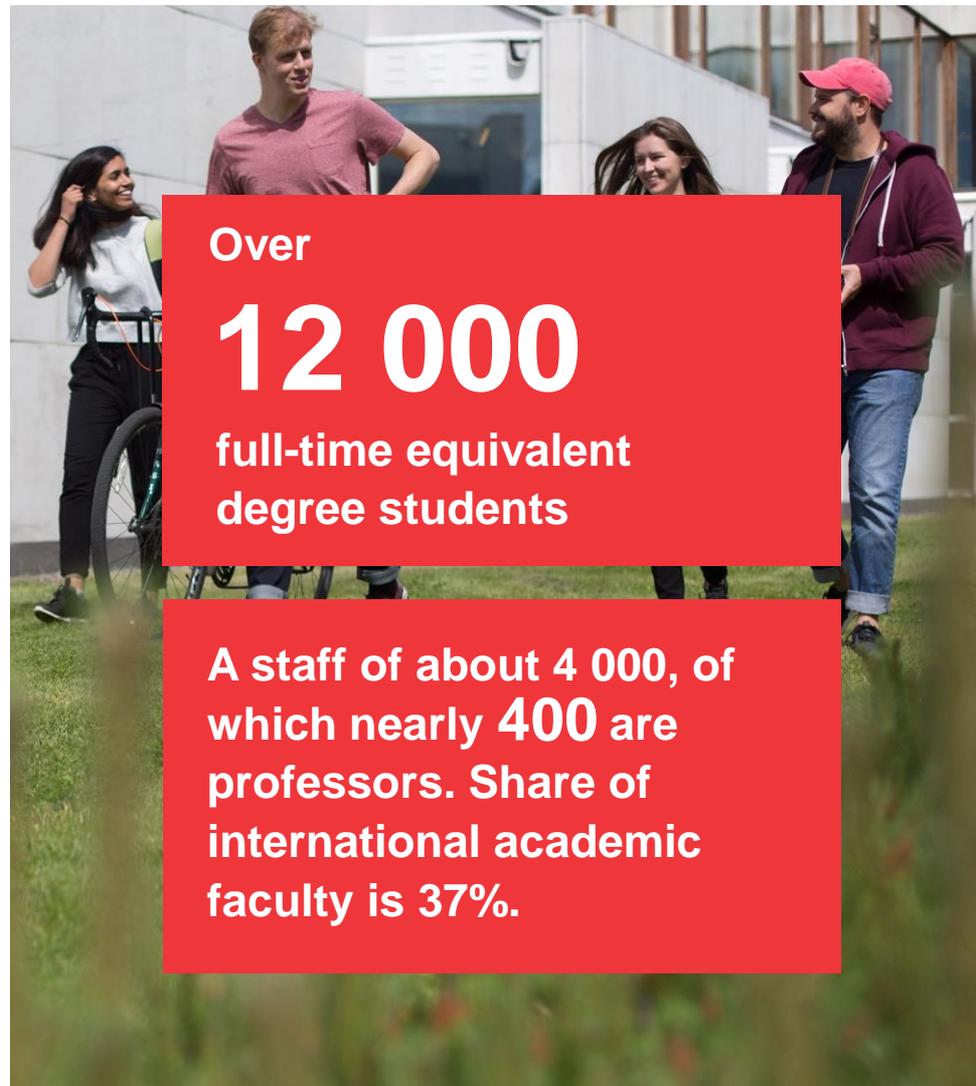
In 2017, our students graduated with:

**256** doctoral degrees,

**1927** master's degrees,

**1178** bachelor's degrees

**360** graduates from the MBA and EMBA programmes



Over

**12 000**

full-time equivalent  
degree students

A staff of about 4 000, of which nearly **400** are professors. Share of international academic faculty is 37%.

# Six dynamic schools

## School of Arts, Design and Architecture

architecture; art; design; media; film, television and scenography

## School of Business

accounting; economics; finance; management studies; marketing; information and service management

## School of Chemical Engineering

bioproducts and biosystems; chemistry and materials science; chemical and metallurgical engineering

## School of Electrical Engineering

communications and networking; electronics and nanoengineering; electrical engineering and automation; signal processing and acoustics

## School of Engineering

built environment; civil engineering; mechanical engineering

## School of Science

applied physics; computer science; industrial engineering and management; mathematics and systems analysis; neuroscience and biomedical engineering

# Outside the box

Top young  
universities

**7th**

best young university in  
the world (Top 50 under 50,  
QS 2017)

Top technology  
challenger universities

**55**

top institutions that have  
thought outside the box on  
research collaboration and  
funding (THE 2017)

# Made in Aalto University



A total of **90 000** alumni of whom more than **40 000** have joined the alumni network

More than **40%** of Finnish listed companies' CEOs are alumni of Aalto University

# Promoting entrepreneurship

**70 to 100**

companies  
are founded every year  
in our ecosystem

**50%**

of Finnish start-ups  
that originate from  
universities come from  
the Aalto community

Entrepreneurship is  
a more popular career  
option than ever – in  
the last four years, over

**2 000**

students have studied  
through the Aalto  
Ventures Program



# Research group – Plant design

Prof. Pekka Oinas

## Research focus

- **Techno-economic assessment** of industrial plants and processes
- Development and design of **bio-based** and **waste-based** processes
- **Safety and sustainability** of processes
- **Special topics:**
  - Process design of cellulose-based fibers
  - Production of colloidal lignin nanoparticles
  - Green solvents
  - Sulfate reduction from mining waters
  - **Non-wood forest products**
  - Digitalization of chemical reactors



IONCELL

7.10.2020

# Natural products in Finland

Natural products: large and growing business.  
Health and superfoods: a rising trend

Combined revenue in Finland **300 million €** (2016)  
Tough competition (Asia)

Problems: poor quality, low concentration of active ingredients

Lack of standardization → customer has a lot of responsibility

Company volumes in Finland: 1-10 M€  
Puhdistamo, AromTech, Ruohonjuuri, Caraway Finland, Life

# Questions:

Can valuable products be produced from some herbaceous plants profitably?

Is there a market for these products?

Are there enough raw material?



# Plants studied by Aalto University



***Garden angelica***  
*Angelica archangelica*



***Roseroot***  
*Rhodiola rosea*



***Maral root***  
*Rhaponticum*  
*carthamoides*



***Caraway***  
*Carum carvi*

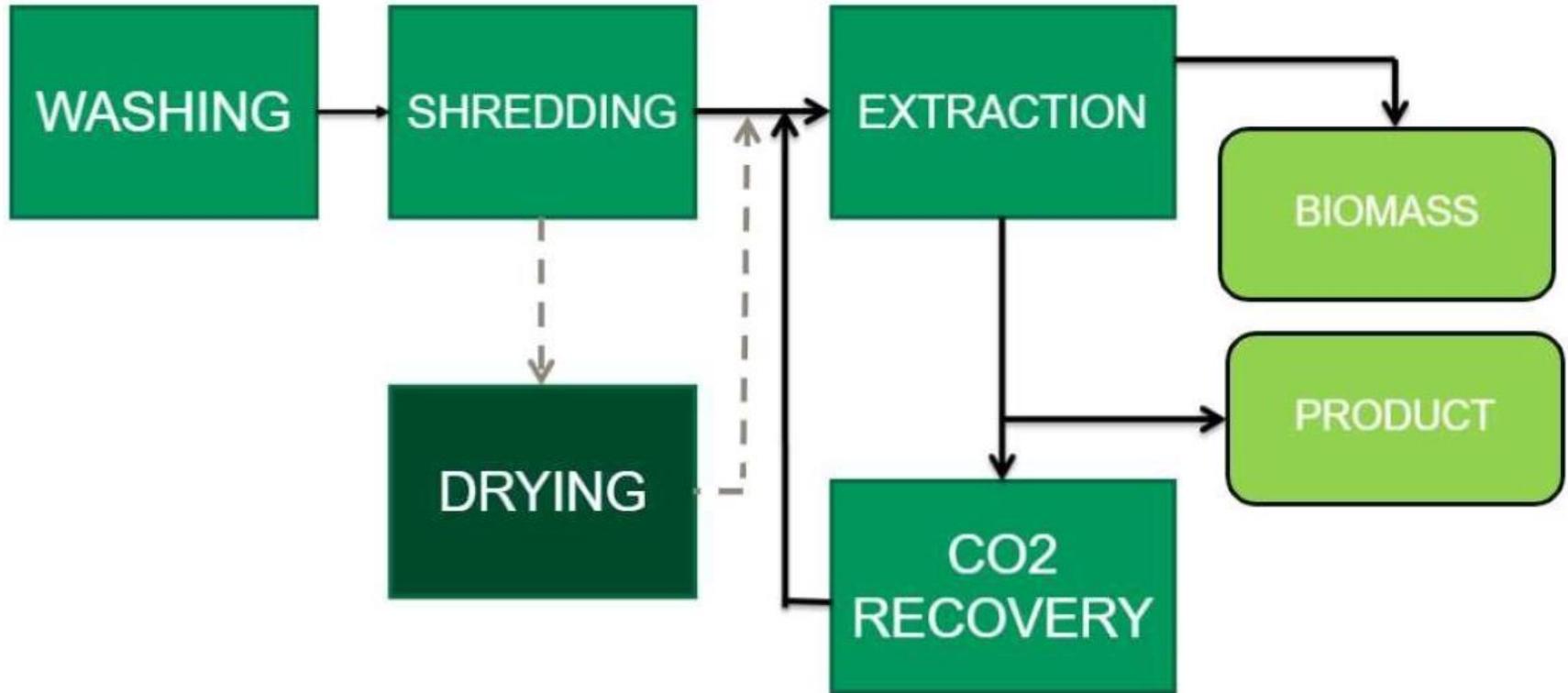
# End product uses

- Extracts and oils have adaptogenic properties
- Dietary supplements, cosmetics, medical applications

Garden angelica	Roseroot	Maral root
Indigestion	Anti-fatigue	Performance enhancer
Gastric and pancreatic secretions	Anti-depressive and anxiolytic effects	Focus and reflex stimulant
Cold and cough remedy	Antioxidant effect	Recovery enhancer
Cytoprotective agent against liver damage	Focus and learning stimulant	Anti-fatigue during exercising



# Process steps: from raw material to essential oils



# Designed plant

- Multi-product production plant
- 3 plants as raw materials
- Processing capacity: raw material 350 t/a
- Area: 5460 m<sup>2</sup>

Month	7	8	9	10	11	12	1	2	3	4	5	6	Amount (kg)
Angelica root oil	▒	▒	▒	▒									100
Rose root extract					▒	▒	▒	▒	▒				3500
Maral root extract										▒	▒	▒	350



# Prices

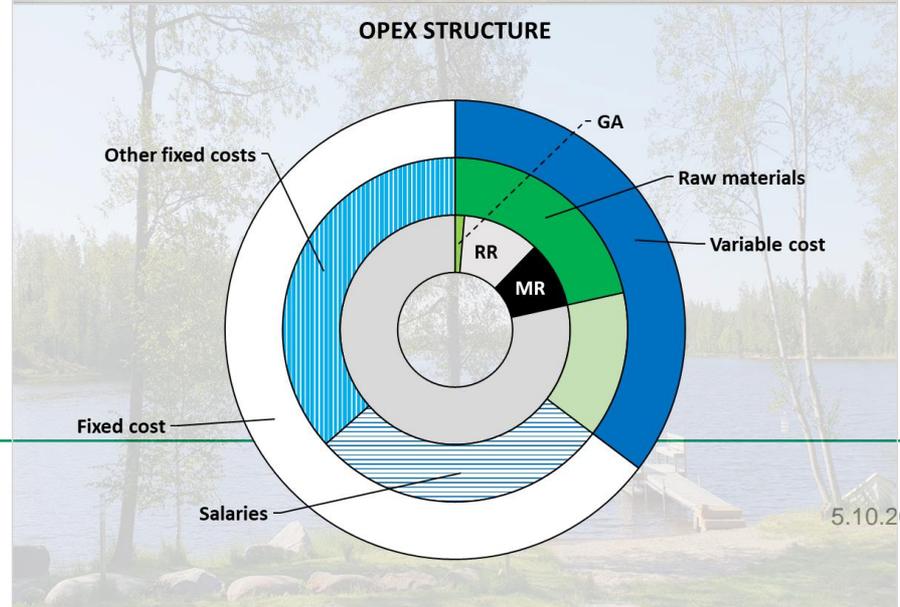
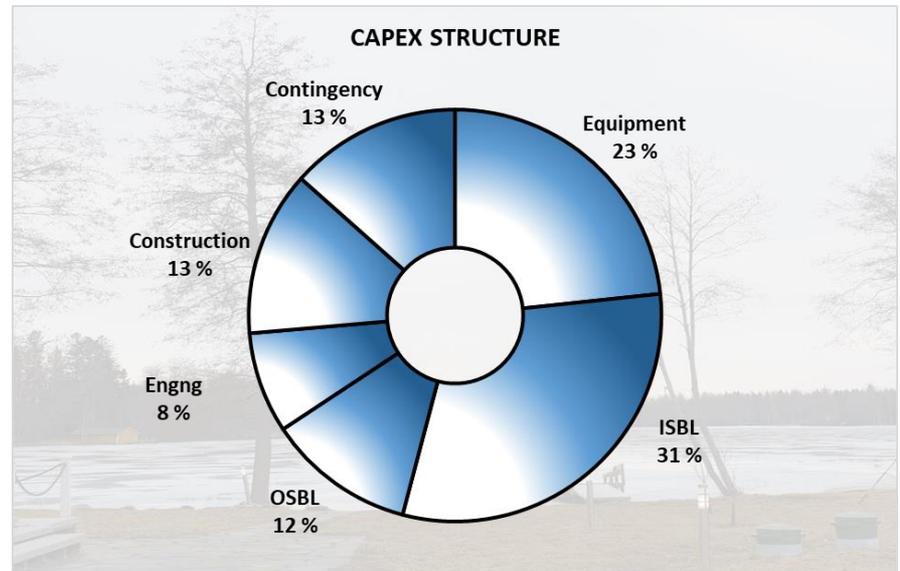
Product	Price (€/kg)
Angelica oil	1230
Roseroot extract	1210
Maral root extract	1240

Product	Sales revenue (M€/a)
Angelica oil	0.12
Rose root extract	4.19
Maral root extract	0.43

Raw material	Price (€/kg)
Angelica	0.74
Roseroot	1.49
Maral root	2.97
(Carrot)	(~ 0.70)

# Cost assessment

- Fixed capital investment: 6 M€
- Operating cost: 3 M€/a
- Production cost: 1000 €/kg
- Payback time: 4 years
- IRR: 9 %



# Conclusions

Alternatives to traditional farming needed in Finland

- Special plants provide a great option
- Availability and pricing are challenging

Growing and potential markets exist

- Awareness in Finland increases steadily

Attractive, new technologies can be utilized

- Small scale facilities required for testing (scale-up)
- Supercritical CO<sub>2</sub> extraction is a promising green technique

Customer and B2B requirements need clarification

# NovelBaltic project group



## Professor

Pekka Oinas, Aalto

## Instructors

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Oliwer Śliczniuk, Aalto

Tiia Viinikainen, Aalto

Elham Khalati; Aalto

Unto Pulkkinen, Farmer

Ilona Vanaga, SilvExpo

## Students

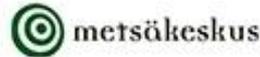
Valpuri Happo

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Lotta Wallinmaa

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**Thank you!**



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# Questions

