

VALORIZATION OF AGRI-FOOD WASTES & BY-PRODUCTS: CONTRIBUTIONS OF ERA-CHAIR IN VALORTECH *[Food (By-) Products Valorisation Technologies]*

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Key themes of the research town:

- Circular economy (Circular bioeconomy)
- Green deal
- Green revolution
- Sustainable food production
- Climate-neutral economy
- Valorization technologies
- Digitalisation
- [Green university initiative](#)



Sustainable waste/by-products management strategies:

- Minimise the natural resources consumed;
- Adopt appropriate food processing technologies;
- Minimize wastes/by-products generated;
- RRRR (reduce, reuse, recycle, recover) + concepts of circular bioeconomy.
- **Why?** Mainly for environmental concerns (landfills, burning, and composting are common)
- Unsustainable disposal: High costs incurred





SUSTAINABLE DEVELOPMENT GOALS

17 GOALS TO TRANSFORM OUR WORLD



The SDGs were set up in 2015 by the United Nations General Assembly and are intended to be achieved by 2030

Nearly €164 million worth of food discarded every year in Estonia

NEWS

ERR

30.05.2021 09:12



Groceries Source: Kairit Leibold/ERR

A survey commissioned by the Ministry of the Environment reveals that around 84,000 tons of food worth around €164 million is discarded in Estonia every year.



Food Bank: Most of the surplus food in Estonia goes to waste

NEWS

ERR News

24.09.2020 16:47



A Toidupank van. Source: ERR



September 29, the first International Day of Awareness of Food Loss and Waste, will be celebrated by a video conference where the Estonian Food Bank (Toidupank), the Ministry of Social Affairs and many



HOME BALTICS SOCIAL POLITICS MONEY INTERVIEWS OPINIONS INVESTIGATION

Home > Baltics > Estonia

BALTICS ESTONIA SOCIAL

Research: Estonian food waste amounts to 84 000 tonnes of foodstuffs per year

BNN May 31, 2021

In Estonia:

- According to a study made by the Ministry of the Environment: **Estonians throw away 63 million Euros worth of food every year**, and a third of this would still be usable.
- Food waste: in households (42%), **food processing industry (39%)**, catering services (14%) and retail services (5%).

(<https://vm.ee/en/newsletter/estonia-combat-food-waste>)



ABOUT ERA-CHAIR in VALORTECH

▶ The ERA (European Research Area) Chair, funded by the **EU Horizon 2020** program, was launched in 2018:

▶ **Aim:** To create a new chair focusing on the **application of advanced technologies for minimum waste generation & maximum utilisation of by-products (valorisation) for value addition.**

Brings together know-how and technological base from 2 EMU Institutes:



▶ The **broader vision** related to the creation of the ERA Chair in **VALORTECH: This Chair will develop into a leading centre of research excellence & as a strong partner for local industries** offering practical values to increase efficiency, reduce waste and **explore new business opportunities.**

EXPECTED IMPACTS



Increased attractiveness of
the institution & host
country for international
excellence & mobility of
researchers

Improve the level of
teaching & young
researchers development

Disseminate &
popularize
ERA Chair's R&D
topics and building
(inter) national
collaboration

Building a top-level
research team that
fosters excellent research

Improve research
expertise related to
zero waste & by-
products valorisation
technologies

Contribution of ERA-Chair in **VALORTECH** to the
academia, research & industry

Academia (Teaching)

- - Specialty teaching module is offered for **Masters students**:
Subject code VL.1331 Valorisation of Agri-food By-products:
- - Both **Estonian & Erasmus students** are taking the course.
- - During the last 2 academic years, >15 Master's and 8 PhD students have taken the courses of the revised curricula; in total they have obtained 321 ECTS credit points from the changed or new subjects (**MSc students 253 ECTS and PhD students 68 ECTS**).



R & D activities:

- **Publications (Jan. 2019 to October 2022):**
 - **Journal articles:** 22 (+ 06 submitted)-
Impact factored journals
 - **Book chapters:** 12 (+ 04 Submitted)
 - **Popular articles/news:** 05
 - **Conference papers:** 22
 - **Invited keynotes:** 12



Training activities & reaching out to public:

- (i) **International lecture sessions** with the sub-theme focusing on '*Biomass Valorization and Bioprocessing Technologies*' & 'Green extraction technologies' were introduced
- (ii) A series of **Webinars** related to 'Food Wastes and by-products valorization' have been introduced
- (iii) **Summer Schools** have been successfully completed: "Valorization of Food Industry Wastes and By-products", held in hybrid mode
- (iv) More seminars, webinars, **summer/winter schools** to be conducted by end of 2022 and early 2023



Industry: Collaboration efforts:

- (i) Innovation cluster MTÜ Liivimaa Lihaveis - in cooperation with the cluster our researcher is carrying out **product development tests for the production of meat products enriched with plant additives**.
- (ii) Scanola Baltic AS, Baltimere Invest AS - **Ensuring the supply of by-products from oil & protein concentrate production**, used for Valortech PhD students (research experiments).
- (iii) Valortech researchers are working in **cooperation with the representative of Estonian Chamber of Agriculture and Commerce**
- (iv) Estonia's well-established food company Estonian Bread Industry (Eesti Leivatööstus AS) in Tartu
- (v) Murimäe winery: Understanding the Nordic viticulture system and various agronomic practices involved in the sustainable production of wine
- (vi) 'Anu Ait OÜ: opportunities for collaboration, **solutions for livestock feed production** in the local market



Valorization of Food Industrial Wastes & By-products

Fruits & Vegetable processing industry:

Bioactive compounds, flavoring compounds, natural food colorants, Compost, Biogas, etc.

Dairy industry: Colostrum (Ig are more: high in nutrients), Whey

Fish industry: Fish wastes (Gelatin, oils, fertilizer)

Poultry Wastes: Feather, skin, egg shell, excreta (Fertilizer, bio-fuel, bioplastic)

Meat Industry: Bones, skin, etc

Underutilized produce: Wild fruits, vegetables, legumes

Opportunities: Food, Cosmetics & Pharmaceutical industries

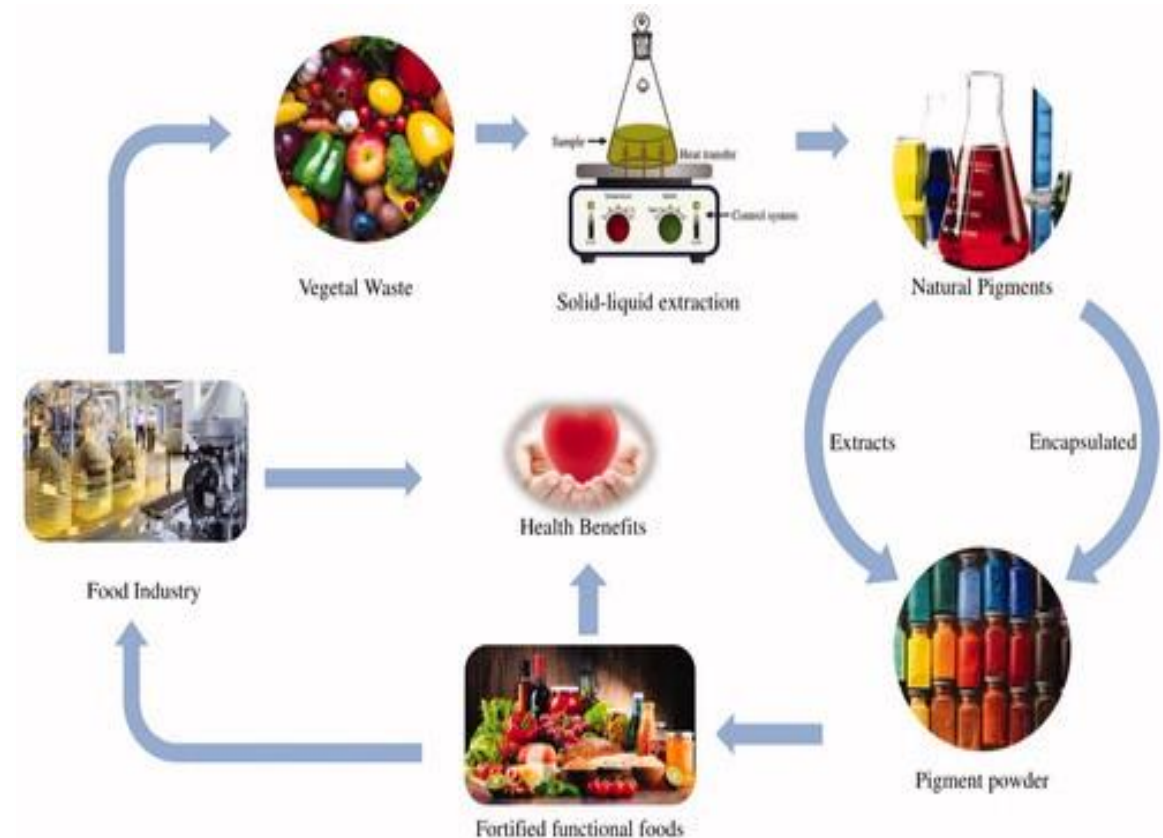
Zero wastes, Taste the Waste, Waste to Wealth concepts & Technological innovations....



Applications: Food, Cosmetics & Pharmaceutical industries:

High value-added components:

- Functional foods
- Supplements (dietary fiber)
- Nutraceutical products
- Food preservatives (Antioxidant compounds)
- Natural colorants (Pigments)
- Livestock feed
- Bioplastics
- Plant Ev's in the medical field

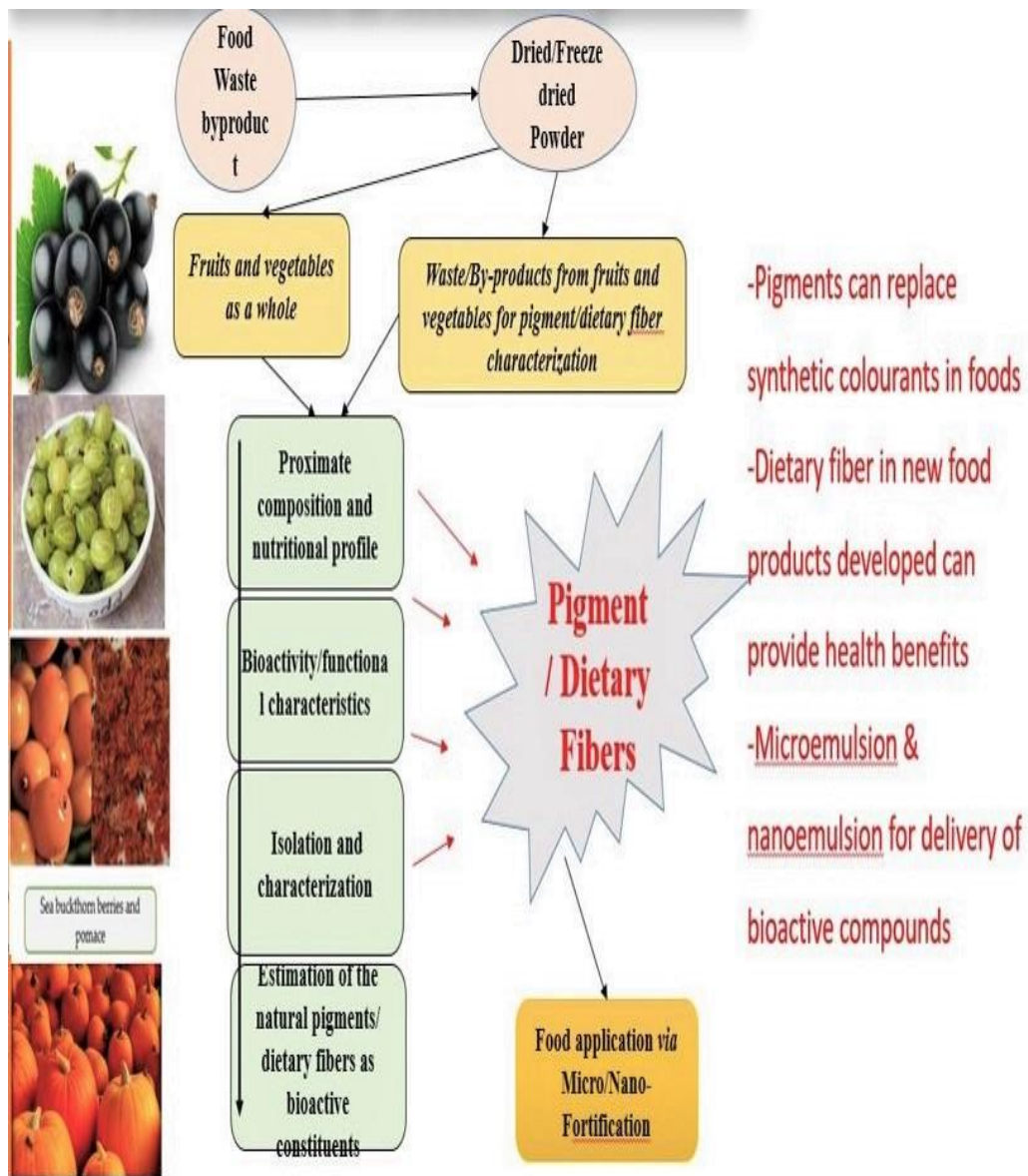


Source: Sharma et al. 2020;

<https://doi.org/10.1080/07388551.2021.1873240>

Raw materials (wastes & by-products) investigated:





Review Articles

Valorization of fruits and vegetable wastes and by-products to produce natural pigments

Minaxi Sharma , Zeba Usmani , Vijai Kumar Gupta & Rajeev Bhat

Pages 535-563 | Received 05 Jan 2021, Accepted 05 Jan 2021, Published online: 26 Feb 2021

Download citation | <https://doi.org/10.1080/07388551.2021.1873240>



Open Access Article

Extraction of Carotenoids from Pumpkin Peel and Pulp: Comparison between Innovative Green Extraction Technologies (Ultrasonic and Microwave-Assisted Extractions Using Corn Oil)

by Minaxi Sharma and Rajeev Bhat

Open Access Article

Valorisation of Sea Buckthorn Pomace by Optimization of Ultrasonic-Assisted Extraction of Soluble Dietary Fibre Using Response Surface Methodology

by Shehzad Hussain , Minaxi Sharma and Rajeev Bhat

ERA-Chair for Food (By-) Product Valorisation Technologies (VALORTECH), Estonian University of Life Sciences, Fr.R. Kreutzwaldi 56/5, 51006 Tartu, Estonia

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Winery wastes:

- Effect of cultivation & growth factors on phytoconstituents
- Optimizing extraction techniques for recovery of targeted bioactive compounds
- Chemometric assessment, polyphenolic content and antioxidant activity of bioactive compounds
- Flavonols (quercetin), Stilbenoids (ϵ -viniferin)

Recommendations for sustainable food production



antioxidants



Article

Recovery of Polyphenols from Vineyard Pruning Wastes—Shoots and Cane of Hybrid Grapevine (*Vitis* sp.) Cultivars

Reelika Rätsep ^{1,2,*}, Kadri Karp ³, Mariana Maante-Kuljus ³, Alar Aluvec ², Hedi Kaldmäe ² and Rajeev Bhat ¹

Open Access Article

Polyphenols and Resveratrol from Discarded Leaf Biomass of Grapevine (*Vitis* sp.): Effect of Cultivar and Viticultural Practices in Estonia

by Reelika Rätsep ^{1,2,*}, Kadri Karp ³, Mariana Maante-Kuljus ³, Alar Aluvec ² and Rajeev Bhat ¹

Valorisation of different genotypes (17 cultivars) of rowan berries for functional food ingredients



➤ The **addition of rowanberry pomace extracts & defatted pomace to meat products** would give extra value to these products in terms of their **shelf-life & additional fibre content**.

➤ The **lipophilic components** obtained from SC-CO₂ fractionation of rowanberry pomace **can be used as nutraceuticals** due to their high content of **beta-carotene and PUFAs**

➤ Rowanberry pomace could **replace artificial preservatives** (meat preservatives)



Open Access Article

Antioxidants Characterization of the Fruit, Juice, and Pomace of Sweet Rowanberry (*Sorbus aucuparia* L.) Cultivated in Estonia

by [Viive Sarv](#)^{1,2,*}, [Petras Rimantas Venskutonis](#)^{1,3}, [Reelika Rätsep](#)^{1,2}, [Alar Aluvec](#)¹, [Rita Kazernavičiūtė](#)³ and [Rajeev Bhat](#)²

Open Access Review

The *Sorbus* spp.—Underutilised Plants for Foods and Nutraceuticals: Review on Polyphenolic Phytochemicals and Antioxidant Potential

by [Viive Sarv](#)^{1,2,*}, [Petras Rimantas Venskutonis](#)^{1,3} and [Rajeev Bhat](#)¹

Valorization of apple by-products

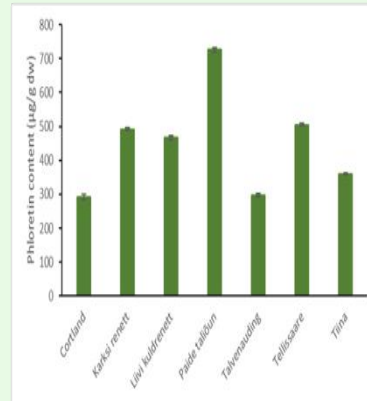
Leaves from apple trees pruning residues of 7 cultivars widely grown in Estonia

Optimisation of phloretin extraction

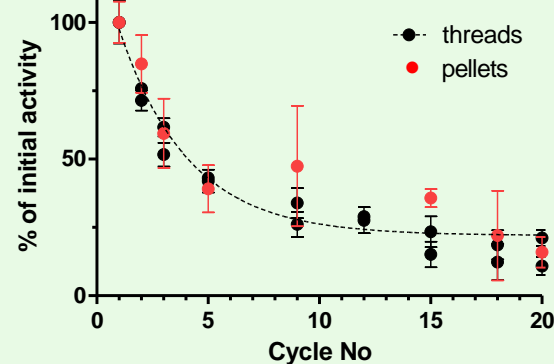
Comparison of phloretin content in different cultivars



Response Surface Method with Box-Behnken design



Immobilization of pectinase and cellulase on nylon carriers for multiple enzyme use



Potential application as a bioactive additive in food



Open Access Feature Paper Article

Optimization of Ultrasound-Assisted Extraction of Phloretin and Other Phenolic Compounds from Apple Tree Leaves (*Malus domestica* Borkh.) and Comparison of Different Cultivars from Estonia

by Sana Ben-Othman^{1,*}, Hedi Kaldmäe², Reelika Rätsep^{1,2}, Uko Bleive², Alar Aluvee² and Toonika Rinken^{1,*}

Immobilized enzymes can increase the efficiency of berries juice production

Open Access Article

Immobilization of Pectinolytic Enzymes on Nylon 6/6 Carriers

by Sana Ben-Othman^{1,*} and Toonika Rinken^{1,2,*}

¹ ERA Chair for Food (By-) Products Valorisation Technologies Valortech, Estonian University of Life Sciences, Kreutzwaldi 56/5, 51006 Tartu, Estonia

² Institute of Chemistry, Faculty of Science and Technology, University of Tartu, Ravila 14a, 50411 Tartu, Estonia

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Bioplastics production from oil industry & fish industry wastes/by-products:

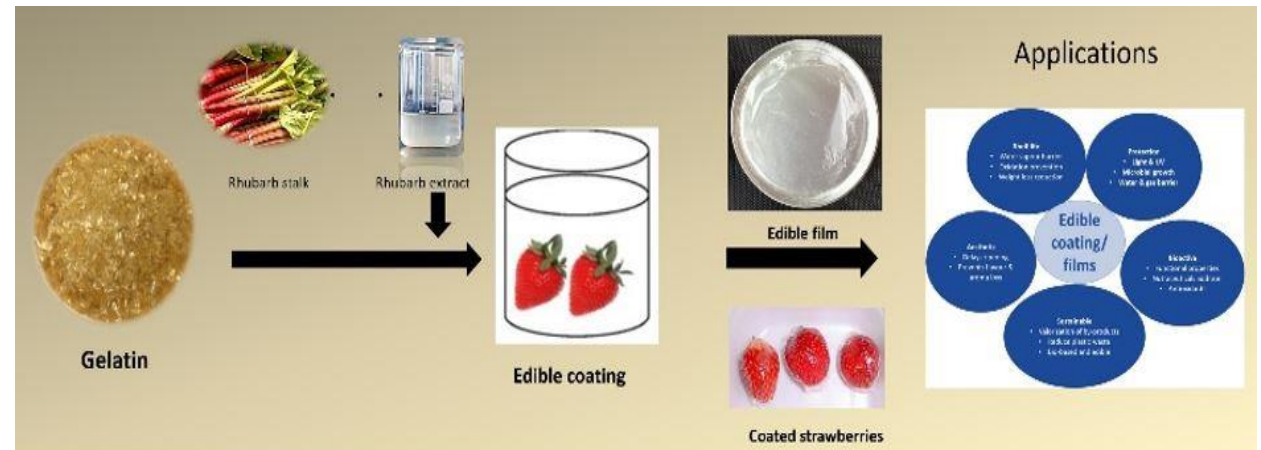
- Improve mechanical properties (thickness, tensile strength, elongation at break), gas permeability, water vapour permeability, moisture and water barrier properties
- Biodegradability in compost, soil and aquatic environment)
- Gelatin-based edible coating and films with rhubarb extract for preserving the quality of food products



Rapeseed husk



Fish wastes



Possibility to replace petroleum based plastics



Valorization of food processing wastes and by-products for bioplastic production

Katrin Jögi, Rajeev Bhat

Development of livestock feed:

Hempseed hull & sea buckthorn pomace

- Composition, amino acids, minerals, fatty acids, antioxidant compounds, *in vitro* digestibility, *in vitro* gas production (in cooperation with SLU)
- Feed analyses & marketing

Major outcome:

Sustainable production of livestock feed that is expected to tackle environmental pollution & feed shortage in the future

Low cost, nutritious livestock feed can be developed



Agronomy Research **18**(S3), 1760–1795, 2020
<https://doi.org/10.15159/AR.20.086>

Review article: Current research trends in fruit and vegetables wastes and by-products management-Scope and opportunities in the Estonian context

D. Malenica* and R. Bhat

Estonian University of Life Sciences, Institute of Veterinary Medicine and Animal Sciences, Kreutzwaldi 56/5, EE51006, Tartu, Estonia

Development and application of vegetable origin additives for improving safety and health benefits of meat products



Open Access Article

Application of Raw and Defatted by Supercritical CO₂ Hemp Seed Press-Cake and Sweet Grass Antioxidant Extract in Pork Burger Patties

by Kristi Kerner^{1,2,3}, Ivi Jõudu^{1,3}, Alo Tänavots^{1,4,*} and Petras Rimantas Venskutonis^{2,*}

Oat β -glucan valorization

Investigate the effect of adding β -glucan and probiotics bacteria (e.g. *L. acidophilus*, *L. casei* sp.) on producing low-fat yoghurt.



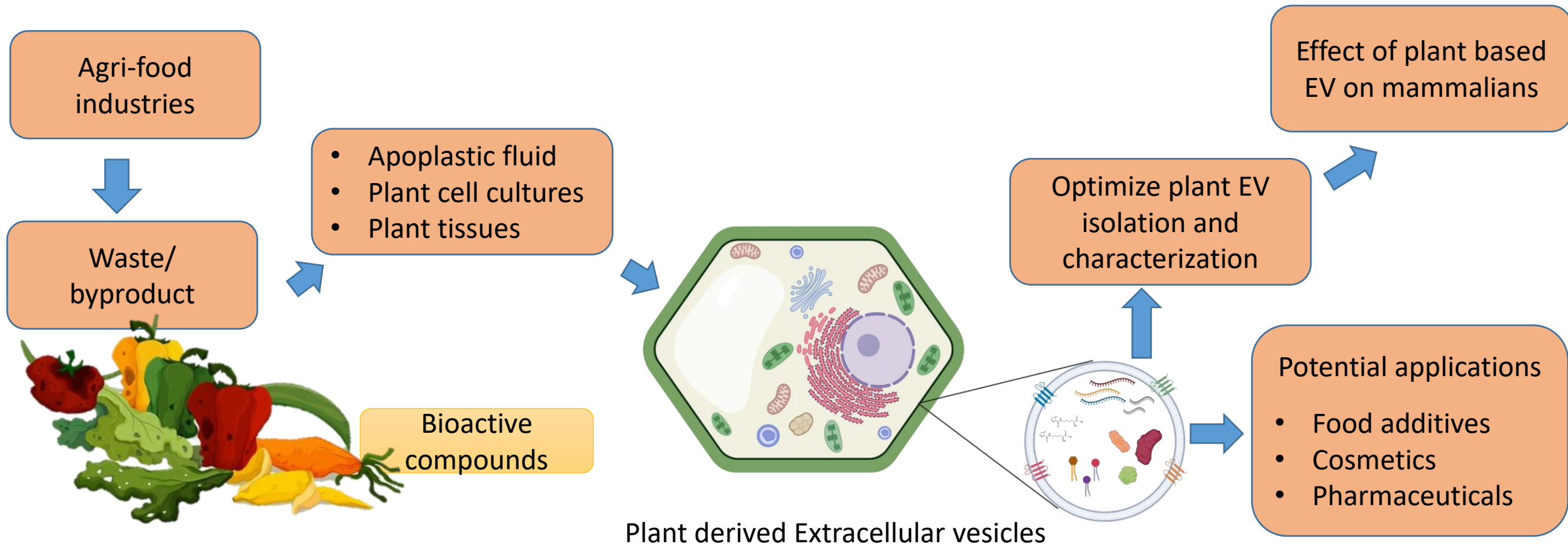
Outcome: The production of low-fat yoghurt containing prebiotic dietary fiber (β -Glucan) & probiotic starter will improve its functional quality & shelf life with promoting its consumer acceptance.

Agronomy Research 18(S3), 1689–1699, 2020
<https://doi.org/10.15159/AR.20.024>

Enrichment of the low-fat yoghurt with oat β -glucan and EPS-producing *Bifidobacterium bifidum* improves its quality

M. Ibrahim^{1,2,*}, N. Barakova¹ and I. Jõudu^{2,3}

Purification and characterization of Extracellular vesicles:

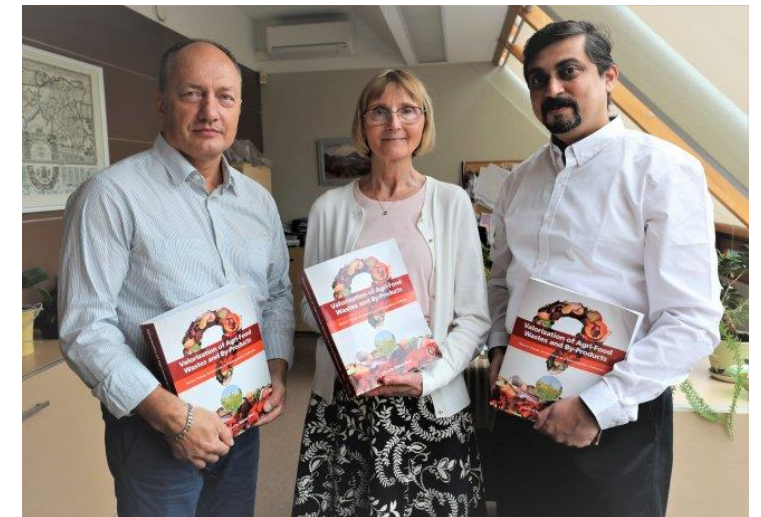
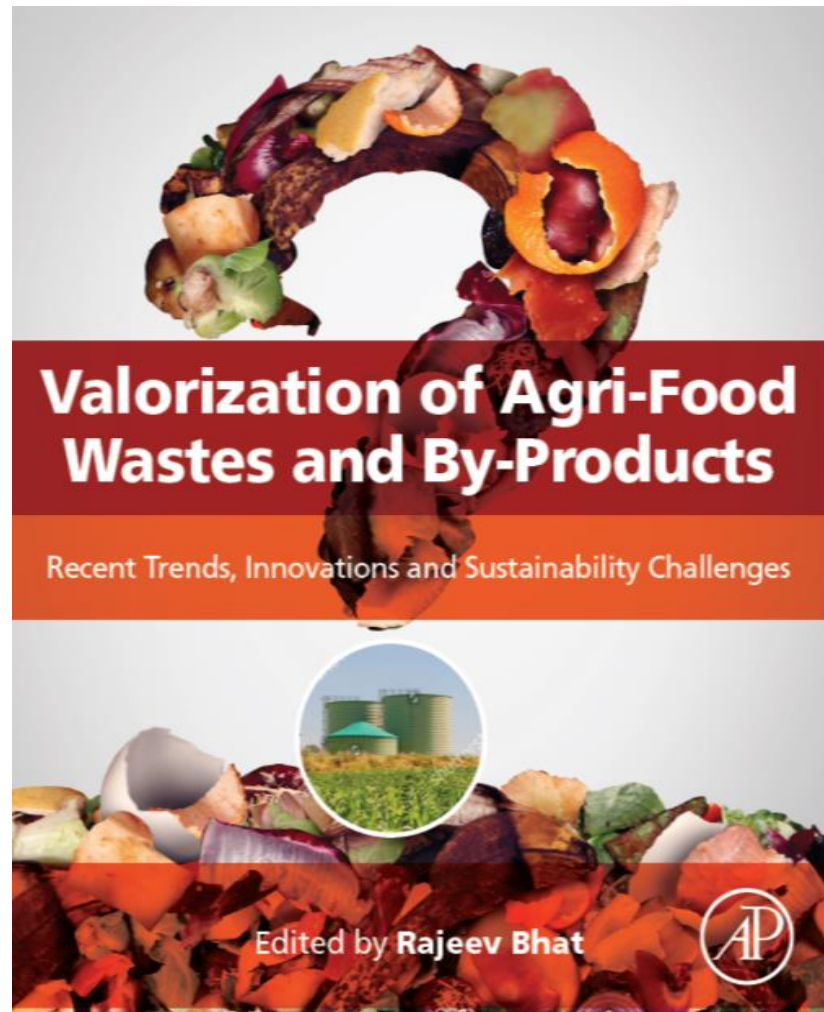


Hypothesis : Fruit and vegetable wastes have functional EVs capable of affecting mammalian tissue & cell function.

Valorization of Agri-Food Wastes and By-Products: Recent Trends, Innovations and Sustainability Challenges

Editor: **Rajeev Bhat**

- 1st Edition: **Paperback**
ISBN: 9780128240441
- **Imprint:** Academic Press/Elsevier
- **Published Date:** 1st September 2021
- **Page Count:** 994



Future prospects:

- What new innovations can be expected?
 - What all sectors are affected and benefitted?
-
- ✓ New market opportunities in Estonia and beyond
 - ✓ Economic benefits for local industries?
 - ✓ Life Cycle Analysis (LCA) needs to be undertaken
 - ✓ Suggestions for policy-makers?
 - ✓ Knowledge transfer of lab-generated data.
 - ✓ Support new start-ups

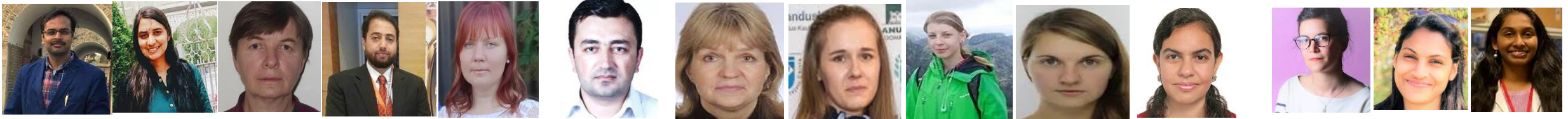


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(who are and were linked with VALROTECH)



THANK YOU!

For more information visit our **VALORTECH** website:

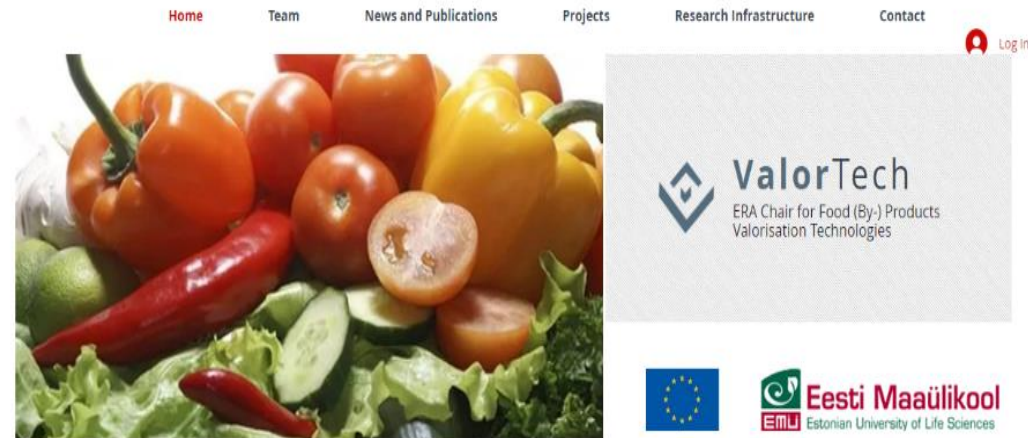


<https://www.valortecherachair.com/>

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ERA Chair for Food (By-) Products Valorisation Technologies of the Estonian University of Life Sciences

Acronym: VALORTECH

Duration of the project:
01.07.2019 – 30.06.2023

Programme: H2020 - Horizon
2020

Call: H2020-WIDESPREAD-03-
2017-ERACHairs

Project number: 810630

Coordinator: Estonian University
of Life Sciences (EMU)

Advanced food processing technologies, minimum waste and maximum utilization of raw material used as well as valorization of by-products constitute a highly relevant range of topics in the EU and worldwide. These are matters that the University of Life Sciences (Eesti Maaülikool, EMU) has been dealing with for a long from various angles and perspectives. However, to realize the full potential of EMU in this domain, structural changes are needed to bring various related competencies under a unified umbrella as well as to cover several gaps hindering further development.

The main objective of the VALORTECH ERA Chair is to establish a new internationally recognized research team, and recruit a top-level researcher/research manager (ERA Chair holder) to lead this interdisciplinary, inter-unit entity, formed based on a joint effort by the Institute of Agricultural and

News

October 19, 2021

On 2nd of November Valortech is organising a guest lecture session "Biomass Valorization and Bioprocessing Technologies". The registration is open. Register [HERE](#) [Read More](#)

October 19, 2021

On 28th of October Valortech is organising a workshop/webinar "Food Waste Valorization: Natural Pigments - Perspectives". The registration is open until 25th of October. Register [HERE](#) [Read More](#)

October 4, 2021

The first Valortech ERA Chair Summer School "Valorization of Food Industry Wastes and By-Products" is taking place on October 4-5, 2021. Register [HERE](#) [Read More](#)

Reduce, Reuse, Recycle, Recover