Mitmekülgselt kasulikud mikrovetikad

Vetika- ja karbikasvatuse seminar

15.11.2021

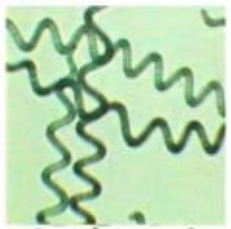
Liina Joller-Vahter | Power Algae OÜ / Tartu Ülikool

Kes nad on?

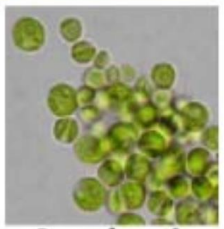
- „Mikrovetikad“ on tihti kasutuses üldterminina, mis hõlmab mitmeid erinevaid, evolutsiooniliselt eraldiseisvaid elusorganisme, sh tsüanobakterid ja eukarüootseid fotosünteetilisi organisme.
- Mikrovetikad on üherakulised, paari kuni paarikümne mikromeetri suurused.
- Üle **700 000** liigi!
- Viimastel aastatel aktiviseerunud ka geneetiline muundamine.
- Looduslikult leidub vetikaid nii **mage**- kui merevees, lisaks mullas ja muudes niisketes paikades maismaal.
- Temperatuuri taluvuselt on samuti varieeruvus suur - mikrovetikaid leidub nii igijääl kui kuumaveeallikates.
- Toitumistüübi alusel võib vetikad jagada autotroofideks, heterotroofideks ja miksotroofideks.
- Vetikatele on kõige iseloomulikum **fotoautotroofne toitumine**, mille puhul toodetakse elutegevuseks vajalikke aineid kasutades anorgaanilisi aineid ja päikeseenergiat.
- Vetikad suudavad hinnanguliselt konverteerida 2-10% päikeseenergiast biomassiks, samal ajal kui maismaataimede fotosünteesi efektiivsus jääb alla 1%.
- Mikrovetikad kasvavad **20–30 korda kiiremini** maapealsetest taimedest. Mõned kiirekasvulised vetikaliigid võivad kahekordistada oma biomassi mitu korda ööpäevas.

Microalgae

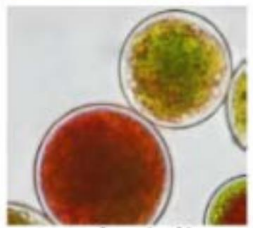
Class	Cyanophyceae (blue-green algae)	Chlorophyceae (green algae)			Porphyridiophyceae (red algae)	Bacillariophyceae (including the diatoms)
Species	- *Arthrospira platensis* - *A. maxima*	*Chlorella sp.*	*Haematococcus pluvialis*	*Dunaliella salina*	*Porphyridium sp.*	*Phaeodactylum tricornutum*
Metabolite	C-phycocyanin	-β-1,3-glucan -Peptides	Astaxanthin	β-carotene	-Phycoerythrin -PUFAs	-EPA -Fucoxanthin
Biological activities	Antitumor, antioxidant antibacterial, anti-inflammatory, hepatoprotective	Immune-stimulator, antioxidant, reducer of blood lipids, antitumor	Antioxidant, antihypertensive, anti-inflammatory, anticancer, photoprotection	Antioxidant , eye protection, anticancer	Antiviral (herpes), antibacterial, antioxidant, immunomodulatory	Improve insulin resistance, anticancer, anti-inflammatory, eye and cardiovascular protection



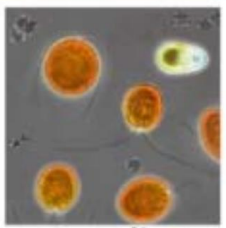
A. platensis



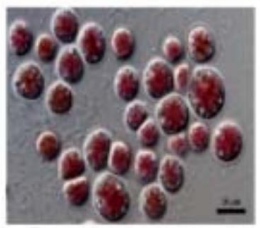
C. vulgaris



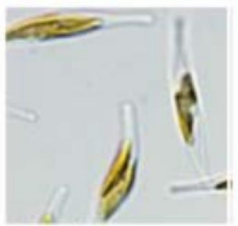
H. pluvialis



D. salina



P. purpureum



P. tricornutum

https://www.mdpi.com/1660-3397/18/12/644/htm

Bioplastics

Poly (hydroxyalkonate)

PHA and derivatives

Pharmaceuticals

Glycoprotein

Glycerols

Polysaccharides

Antibiotics

Green Microalgae (Dry)

Fatty acids

Biofuels

Biogas

Biodiesel

Bioethanol

Antioxidants

Vitamins

Carotenoids

Milleks saab (mikro)vetikaid kasutada?

Products	Time to market Years	Cost of development	Resource availability	Need for documentation	Potential market value	Skills and competencies
Pharmaceuticals	10 – 15 +	Very high	Limited	Very high	Very high	Extensive medical and market
Cosmetics	3 – 5 +	Low to high	Fair	Medium	High	Toxicology, effects
Nutraceuticals	3 – 5 +	Medium to high	Fair	Medium to high	High	Nutrition and medicine
Food	2 – 5 +	Low to medium	Good	Medium	Medium to High	Nutrition, Food science
Feed	2 – 5 +	Low to medium	Very good	Medium	Medium to high	Nutrition, animal science
Bioenergy	2 – 5 +	Low to medium	Very good	Low to medium	Moderate	Energy
Fertilizers	1 – 2	Low	Very good	Low to medium	Moderate	Agriculture, agronomy etc

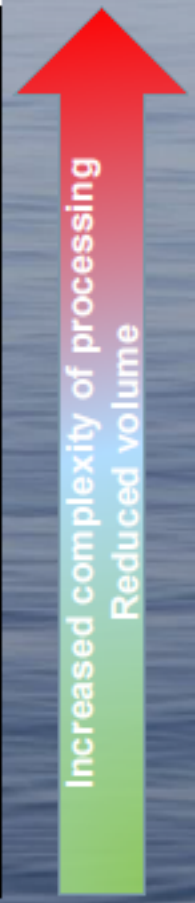


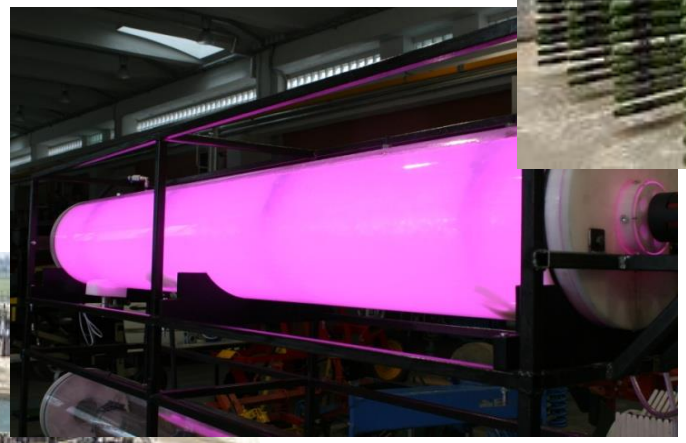
Illustration: ©Nofima/Whitaker & Fylling-Jensen

Nofima

Turg

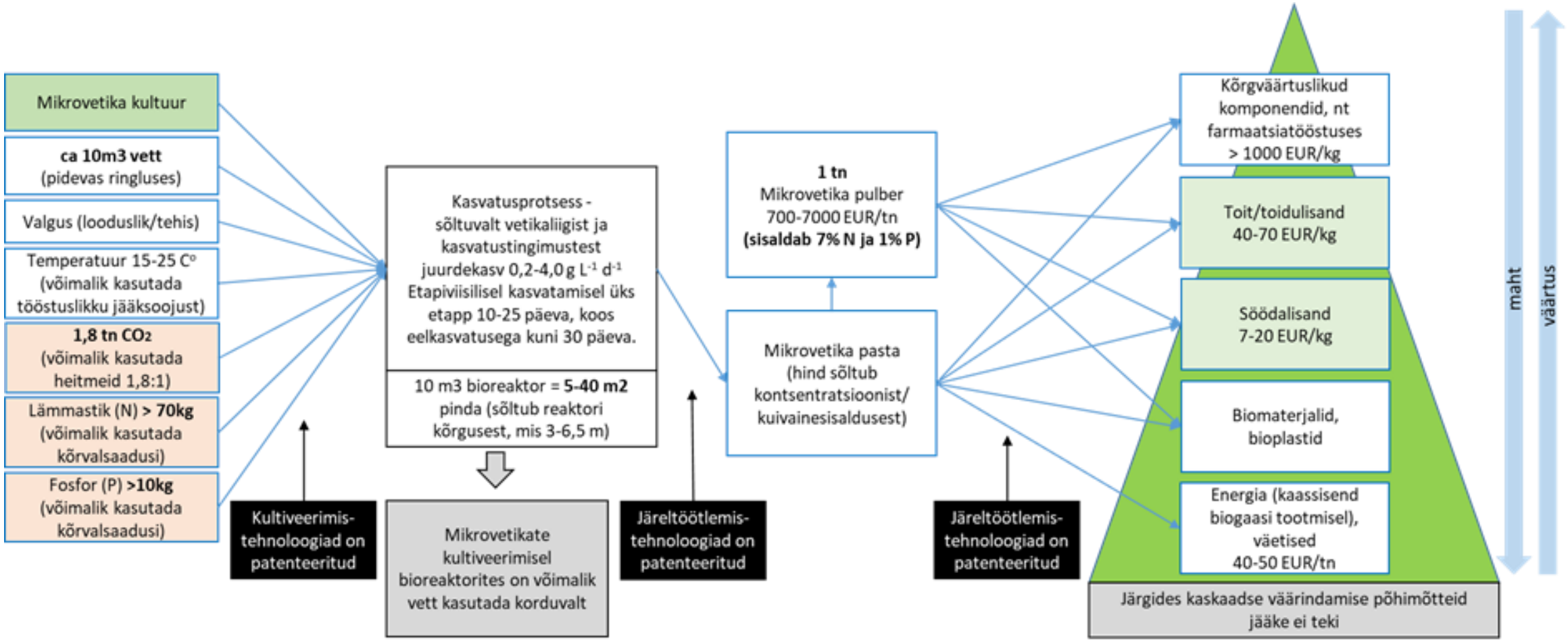
- Globaalse turu mahuks hinnati 2020. aastal kõige tagasihoidlikumalt 50 mln EUR ning prognoositakse selle kasvu 70 mln euroni aastaks 2025 (aastane kasvumäär 7%). Teiste arvamuste kohaselt on 2028. aastaks turumaht koguni 1,8 miljardit USD.
  >erinev arvestusmetoodika ja andmete valik
- Sõltuvalt vetikaliigist ja biomassi puhtusest võib biomassi hind varieeruda 5-500 EUR/kg, spetsiifiliste vetikapõhiste komponentide puhul ulatuda mitme tuhande euroni kg kohta.
- Suuremad turud USA ja Hiina toodavad ise ca poole globaalsest tarbimisest. Euroopa hetke aastane tootmismaht on vaid ligikaudu 500 tonni, kuid lähiaastatel on oodata kasvu. (see ei sisalda madalama väärtusega kasutusalasid nt, veepuhastuse otstarbel kasutamist)
- Euroopas on juba praegu hinnanguliselt 480 ettevõtet, kes tegelevad mikrovetikate kasvatamisega. Enamus neist on mikroettevõtted (<1 tn/a), suuremaid alla 20.
- Suurima turuosaga vetikaliigid on Spirulina ja Chlorella, mis on vastavalt uuendtoidu direktiivile lubatud toidulisandina müügiks ka Euroopa Liidu turul.

Näiteid erinevatest kasvatusmeetoditest



Power Algae OÜ ja Maaülikool
1. prototüüp 2015. aastast

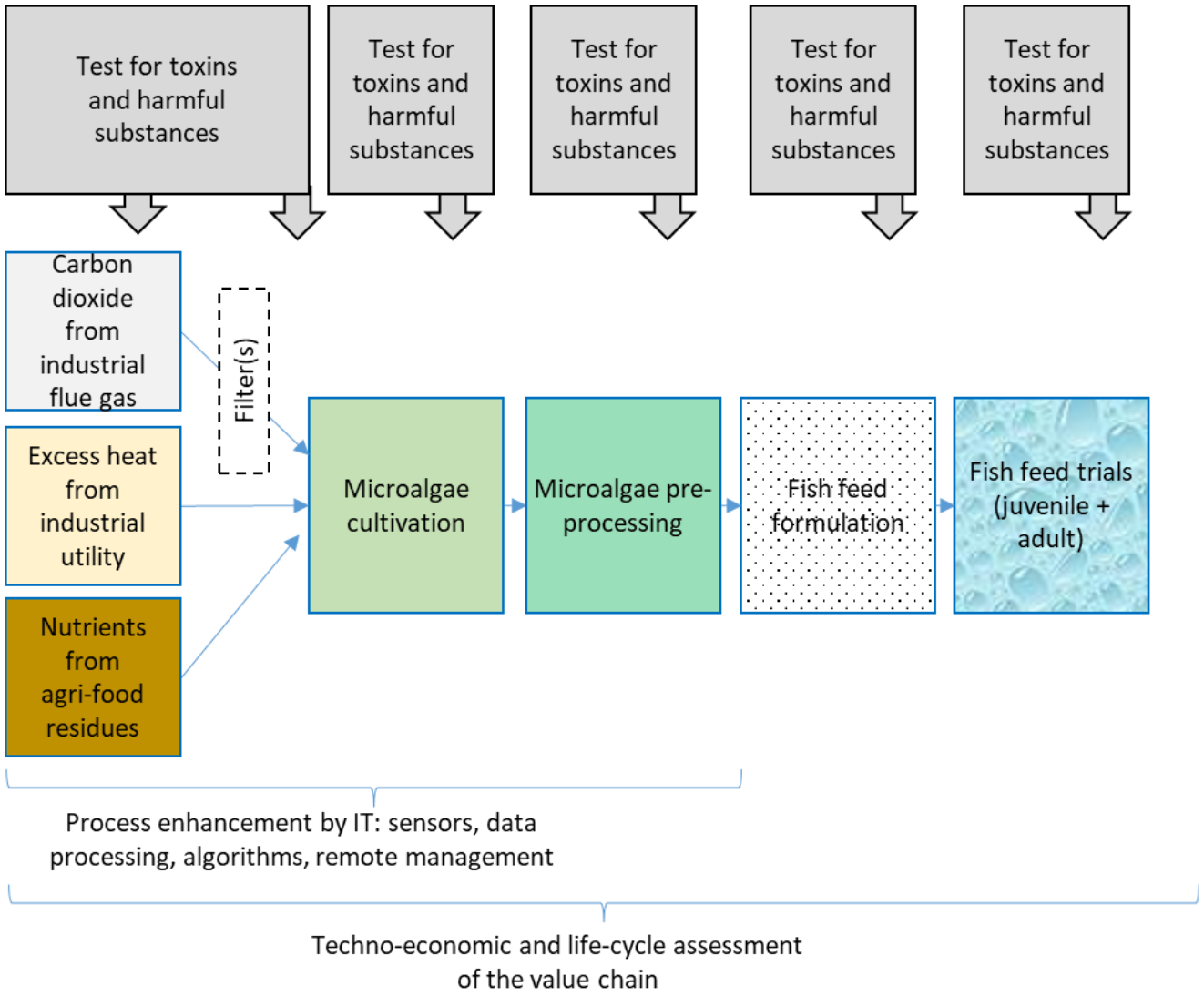
ADDVAL-BIOEC: Lisandväärtuse tõstmine ja toorme tõhusam kasutamine Eesti biomajanduses (RITA)



Joller-Vahter, L. et al. (2021) Uudsed võimalused Eesti biomajanduse väärtusahelate mitmekesistamiseks ja lisandväärtuse tõstmiseks. ADDVAL-BIOEC uuringu tööpaketi 3 raport, Tallinn & Tartu. https://taltech.ee/biomajandus

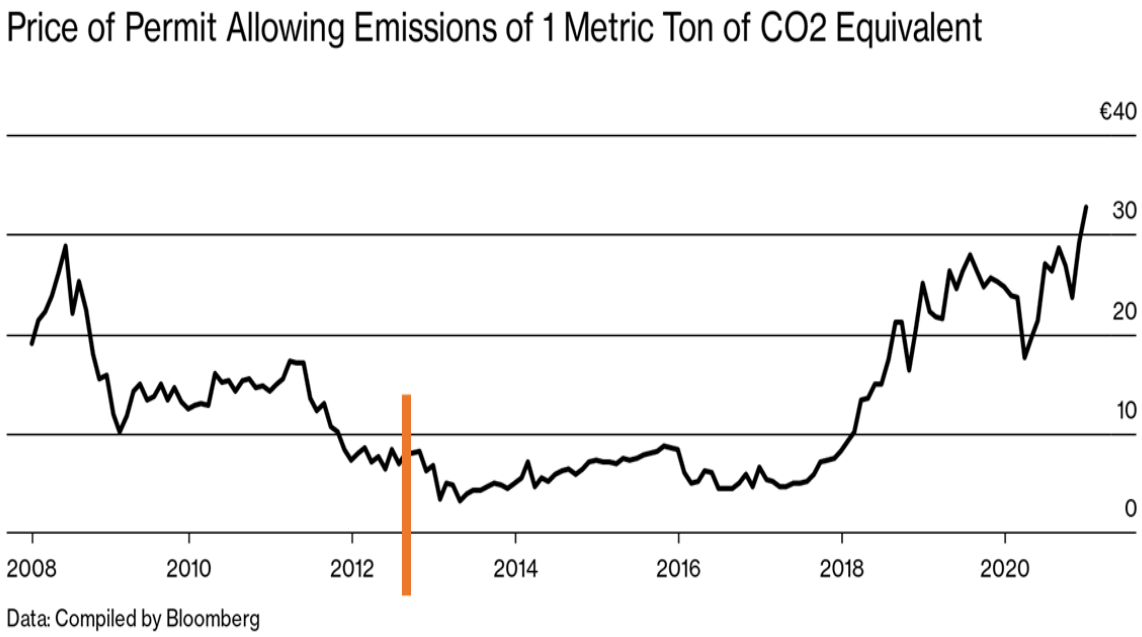
Microalgae based, safety-tested and optimized fish feed value chain by using Interdisciplinary R&D and IT solution

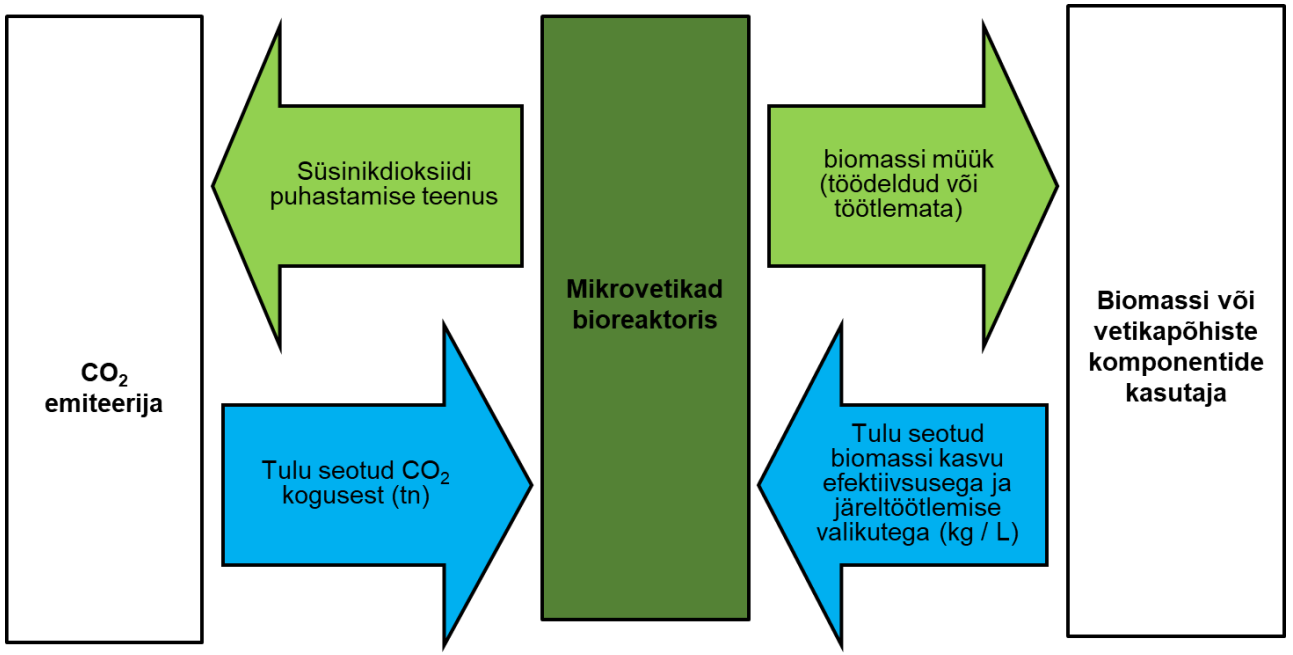
2021-2024



This work is supported by the BlueBio Project Microalgae In IT, partially funded by the Estonian Research Council.

Võimalik ka kahepoolne tulumudel





Tegeletakse ka vetikapõhiste biopolümeeridega, kuid meie (hetkel veel) mitte

polymers

an Open Access Journal by MDPI

IMPACT FACTOR 4.329

Covered in: PubMed

Algae-Based Polymers: Current Trends and Emerging Opportunities

Guest Editors:

Dr. Matteo Gigli
Department of Chemical Science and Technologies, University of Rome Tor Vergata, Via della Ricerca Scientifica 1, 00133 Roma, Italy

matteo.gigli@uniroma2.it

Dr. Heiko Lange
Department of Pharmacy, University of Naples Federico II, Naples, Italy

heiko.lange@unimib.it

Deadline for manuscript submissions:
closed (31 October 2019)

Message from the Guest Editors

Plastics play a crucial role in most aspects of modern society. However, the well-known environmental burdens associated with the massive use of these materials have exposed the need for the development of greener and more sustainable solutions.

Among possible natural sources of biopolymers, aquatic biomass, such as macro- and micro-algae, offers a rich variety of valuable molecules. Polysaccharides, proteins, lipids, and polyphenols are in fact the main classes of materials found in algae, which have been employed for packaging, food, pharmaceutical, and other biomedical applications.

This Special Issue aims at establishing a platform where the latest discoveries in the field of production and exploitation of algae-based materials can be shared, covering all interdisciplinary aspects of this research area, from algae identification and cultivation to materials' functional properties and final application. Authors are encouraged to submit their studies in the form of full papers, communications or critical reviews.

International Journal of *Environmental Research and Public Health*

MDPI

Review

Bioplastic Production from Microalgae: A Review

Senem Onen Cinar [1,*], Zhi Kai Chong [1], Mehmet Ali Kucuker [2], Nils Wieczorek [1], Ugur Cengiz [3] and Kerstin Kuchta [1]

1 Sustainable Resource and Waste Management, Hamburg University of Technology, 21079 Hamburg, Germany; kai.chong@tuhh.de (Z.K.C.); nils.wieczorek@tuhh.de (N.W.); kuchta@tuhh.de (K.K.)
2 Faculty of Engineering, Department of Environmental Engineering, Canakkale Onsekiz Mart University, 17020 Canakkale, Turkey; kucuker@comu.edu.tr
3 Faculty of Engineering, Department of Chemical Engineering, Canakkale Onsekiz Mart University, 17020 Canakkale, Turkey; ucengiz@comu.edu.tr
* Correspondence: senem.oenen@tuhh.de; Tel.: +49-40-428-783-527

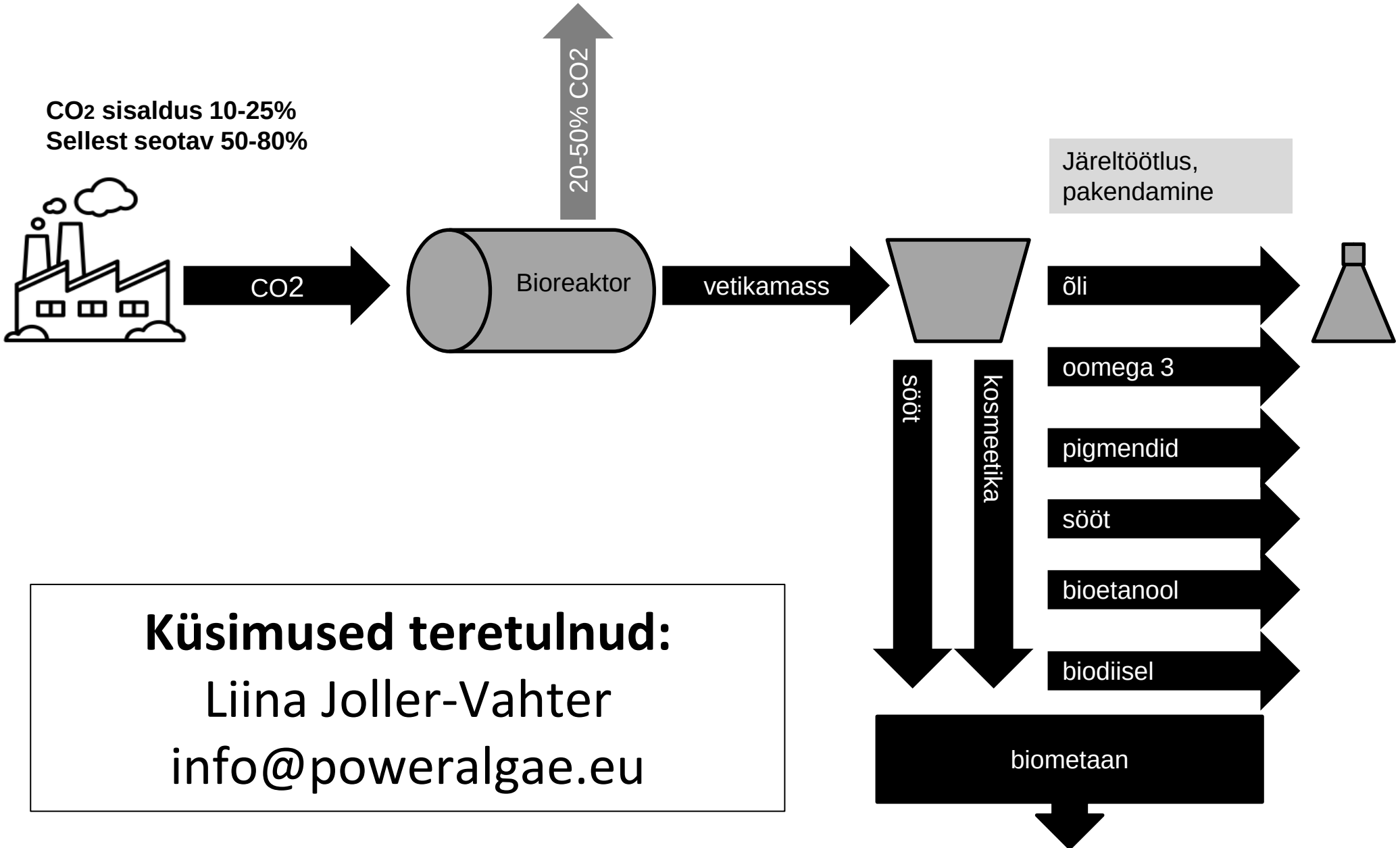
Received: 17 April 2020; Accepted: 26 May 2020; Published: 28 May 2020

check for updates

Abstract: Plastic waste production around the world is increasing, which leads to global plastic waste pollution. The need for an innovative solution to reduce this pollution is inevitable. Increased recycling of plastic waste alone is not a comprehensive solution. Furthermore, decreasing fossil-based plastic usage is an important aspect of sustainability. As an alternative to fossil-based plastics in the market, bio-based plastics are gaining in popularity. According to the studies conducted, products with similar performance characteristics can be obtained using biological feedstocks instead of fossil-based sources. In particular, bioplastic production from microalgae is a new opportunity to be explored and further improved. The aim of this study is to determine the current state of bioplastic production technologies from microalgae species and reveal possible optimization opportunities in the process and application areas. Therefore, the species used as resources for bioplastic production, the microalgae cultivation methods and bioplastic material production methods from microalgae were summarized.

Keywords: bioplastic; microalgae; bioeconomy; biodegradable plastic; circular economy; bio-based plastic

Kokkuvõtteks



Küsimused teretulnud:
Liina Joller-Vahter
info@poweralgae.eu