EUROPÄISCHE UNION

Interreg Österreich-Tschechische Republik

Europäischer Fonds für regionale Entwicklung

ATCZ221 Algae4Fish

Fakulta rybářství a ochrany vod / Faculty of Fisheries and Protection of Waters — Jihočeská univerzita v Českých Budějovicích / University of South Bohemia in České Budějovice

ALGATECH

Bundesamt für Wasserwirtschaft

BEST Bioenergy and Sustainable Technologies

Digestate-grown microalgae as feed for rotifers

[1] BEST—Bioenergy and Sustainable Technologies GmbH, Tulln/AT
[2] University of South Bohemia, Faculty of Fisheries and Protection of Waters, České Budějovice/CZ
[3] University of Natural Resources and Life Sciences, Institute for Environmental Biotechnology, Tulln/AT

Lisa Bauer,[1] Matthias Neubauer[1], Philipp Niebauer[1], Carlos Yanes Roca[2], Katharina Ludwig[1], Bernhard Drosg[1,3]

AREA 3

Bioconversion & Biogas Systems

Introduction

In aquaculture, a healthy diet for fish larvae, rich in polyunsaturated fatty acids, is crucial to obtain high-quality fish [1]. Rotifers are considered “living food capsules”, meaning that they can transfer nutrients to fish larvae [2]. Thus, when fed with microalgae, rotifers accumulate valuable nutrients like fatty acids that fish will take up. Nutrient-rich waste products, such as digestate, can be used to cultivate microalgae which serve as feed [3]. This process chain is investigated in the Interreg project “Algae4Fish” (Fig. 1). The aim of this study was optimizing the fatty acid profile of *Brachionus plicatilis* by feeding it microalgae, grown on mineral medium as well as digestate.

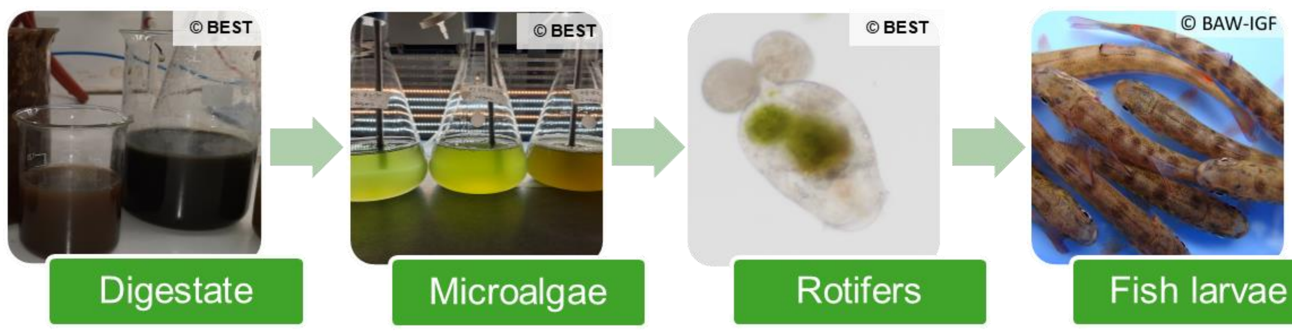

Fig. 1: Process chain of the project „Algae4Fish“.

Material and Methods

Chlorella vulgaris were cultivated using mineral medium (BG-11) and two different kinds of digestate (from a dairy and a potato factory) for three weeks. The resulting paste was used to feed rotifers (*Brachionus plicatilis*). As a reference, rotifers were fed with Nanno-paste (*Nannochloropsis*).

B. plicatilis were cultivated in artificial seawater. After hatching in petri dishes, cultivation volume was doubled, when a density of 150 - 200 rotifers/mL was reached. At a density of 200-250 rotifers/mL in 50 L, they were harvested and their fatty acid (FA) profile was analyzed.

Digestate as nutrient source

The characteristics of digestate (residuals after biogas production) depend on the feedstock used in the biogas plant. The resulting digestates differ in pH, solids content, colour and nutrient composition. [4] Depending on these characteristics, digestate has to undergo several steps of pre-treatment (e.g. flocculant addition, centrifugation, dilution) to receive a suitable cultivation medium for microalgae [3].

Results and Discussion

Density growth was fastest in the cultures that were fed with digestate-grown *C. vulgaris* (Fig. 2, C and D).

The nutrient source of *C. vulgaris* had an impact on the FA content and composition of *B. plicatilis*. Compared to the standard feed Nanno-paste, the FA content of rotifers fed with digestate-grown *C. vulgaris* was only slightly higher (dairy) or lower (potato waste). When fed with BG-11-grown *C. vulgaris*, the FA content was lower. This suggests that using alternative nutrient sources for microalgae, like digestate, can be beneficial. (Fig. 3)

C. vulgaris transferred high amounts of α-linoleic acid to rotifers, in contrast to Nanno-paste. Arachidonic acid, eicosapentaenoic acid and docosahecanoic acid are important Ω-3-FA for fish larvae [1], [5]. Such FA were low in rotifers fed with BG-11-grown *C. vulgaris*.

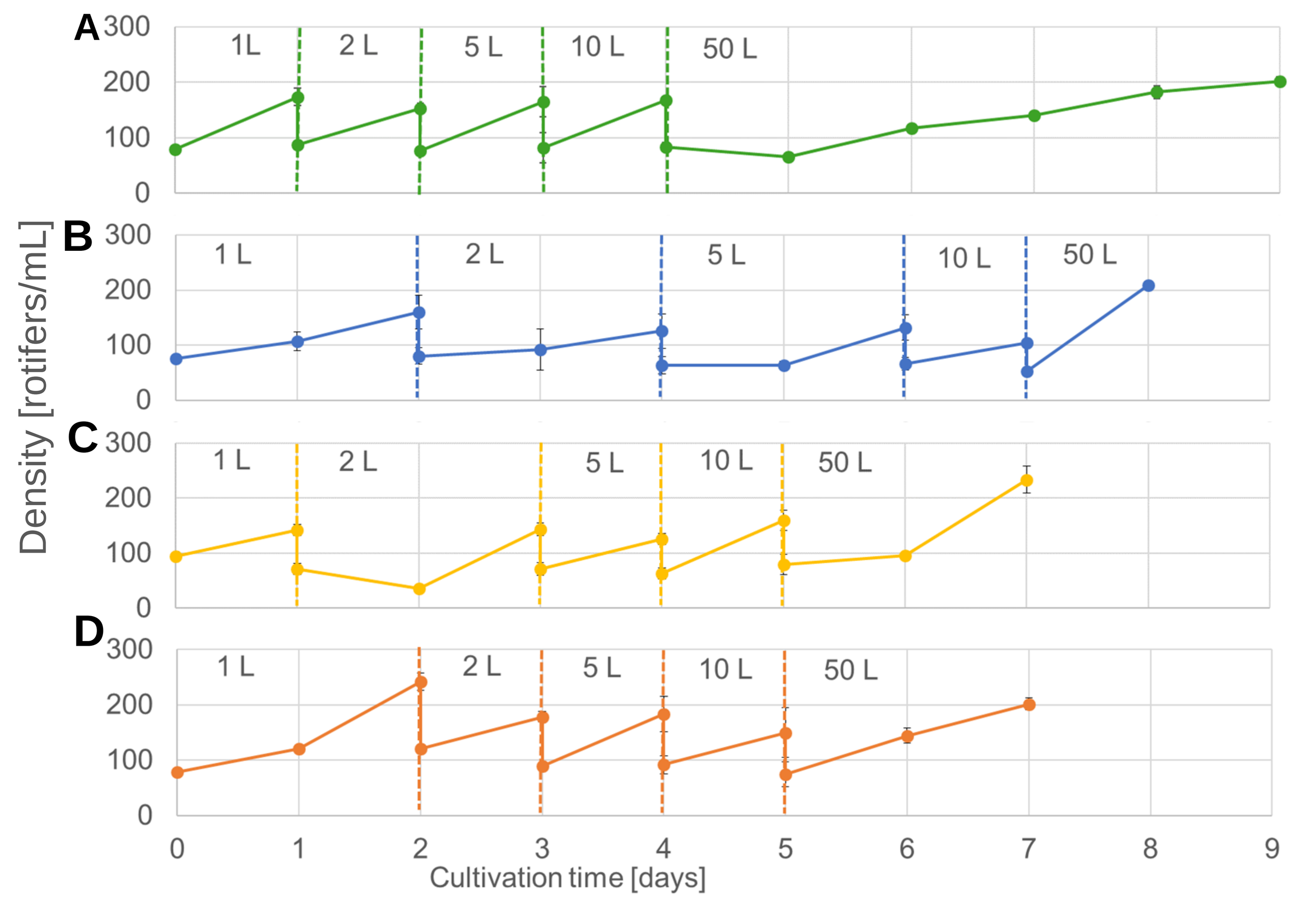

Fig. 2: Density growth curves of *B. plicatilis*. Cultures were fed with: A: Nanno-paste. B: *C. vulgaris* grown on BG11. C: *C. vulgaris* grown on dairy digestate. D: *C. vulgaris* grown on potato waste digestate.

In both cultures that were fed with digestate-grown *C. vulgaris*, eicosapentaenoic acid was higher (33 and 45 % of PUFA), while it was even higher (68 % of PUFA) in *B. plicatilis* fed with Nanno-paste. (Fig. 3)

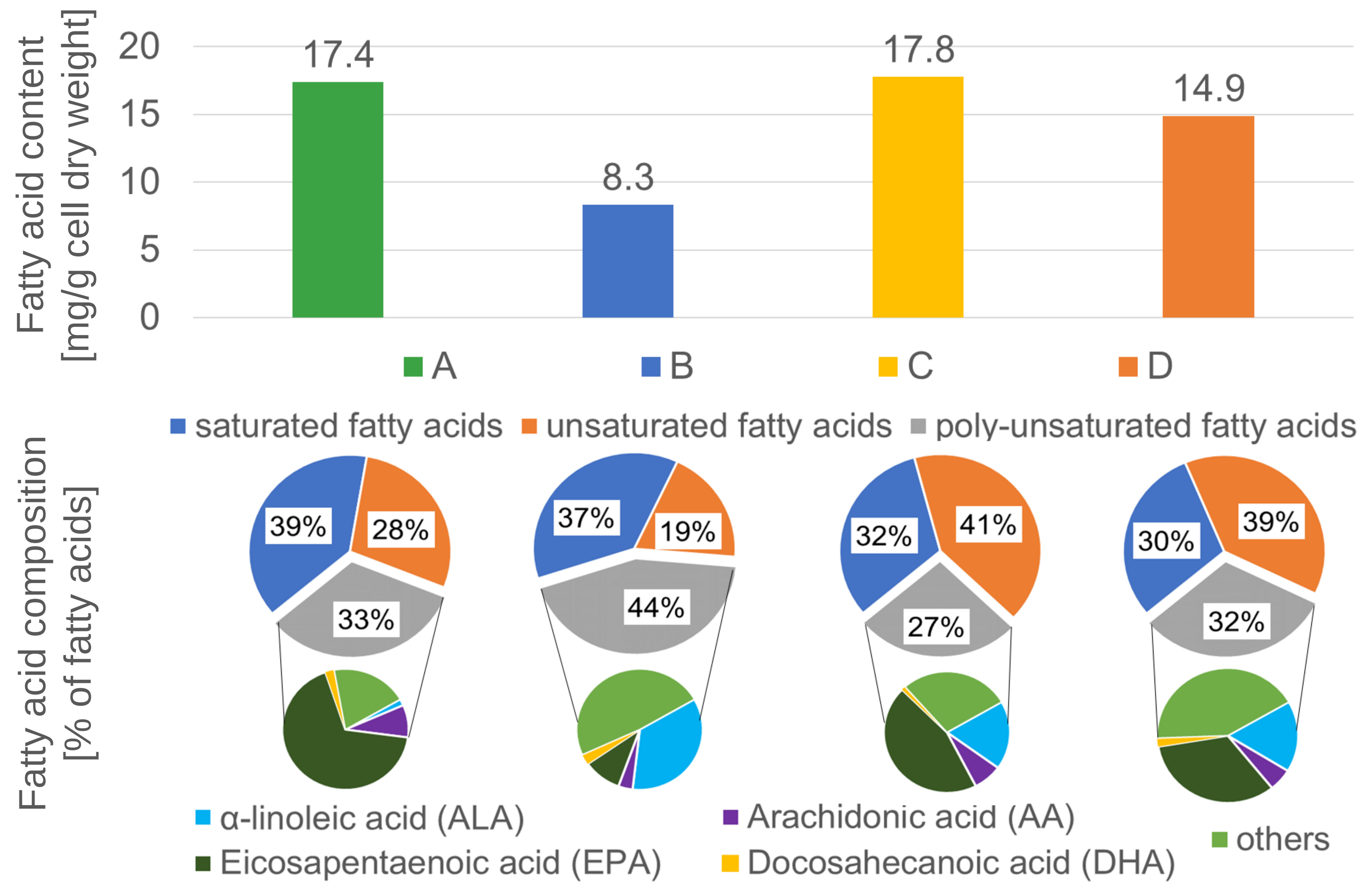

Fig. 3: Fatty acid content and composition of *B. plicatilis*. Cultures were fed with: A: Nanno-paste. B: *C. vulgaris* grown on BG-11. C: *C. vulgaris* grown on dairy digestate. D: *C. vulgaris* grown on potato waste digestate.

Conclusions

Digestate-grown *C. vulgaris* are a suitable feed for *B. plicatilis* due to the following benefits:

- Increased density growth of *B. plicatilis* compared to using other microalgae as feed
- Similar fatty acid content of *B. plicatilis* as when fed with Nanno-paste
- Desirable fatty acid profile – rich in unsaturated fatty acids like eicoapentaenoic acid

Acknowledgements

The research leading to these results was funded by Interreg (European Regional Development Fund) – Interreg V-A Program for cross-border cooperation between Austria and the Czech Republic 2014–2020 (project Algae4Fish, grant number: ATCZ221).

References

[1] Seychelles LH, Audet C, Tremblay R, Fournier R, Pernet F. Essential fatty acid enrichment of cultured rotifers (Brachionus plicatilis, Müller) using frozen-concentrated microalgae. Aquaculture Nutrition. 2009;15(4):431-439. doi:10.1111/j.1365-2095.2008.00608.x

[2] Yanes-Roca C, Mráz J, Born-Torrijos A, Holzer AS, Imentai A, Policar T. Introduction of rotifers (Brachionus plicatilis) during pikeperch first feeding. Aquaculture. 2018;497:260-268. doi:10.1016/j.aquaculture.2018.08.004

[3] Bauer L, Ranglová K, Masojídek J, Drosg B, Meixner K. Digestate as Sustainable Nutrient Source for Microalgae—Challenges and Prospects. Applied Sciences. 2021;11(3):1056. doi:10.3390/app11031056

[4] Al Seadi T, Drosg B, Fuchs W, Rutz D, Janssen R. Biogas digestate quality and utilization. In: Wellinger A, Murphy J, Baxter D, eds. The Biogas Handbook. Woodhead Publishing Series in Energy. Woodhead Publishing; 2013:267-301. doi:10.1533/9780857097415.2.267

[5] Sargent J, Bell G, McEvoy L, Tocher D, Estevez A. Recent developments in the essential fatty acid nutrition of fish. Aquaculture. 1999;177(1-4):191-199. doi:10.1016/S0044-8486(99)00083-6

BEST – Bioenergy and Sustainable Technologies GmbH

Head Office Graz
Inffeldgasse 21b
A 8010 Graz

P +43 5 02378-9201
office@best-research.eu
www.best-research.eu

FFG Forschung wirkt.

Bundesministerium Digitalisierung und Wirtschaftsstandort

Bundesministerium Klimaschutz, Umwelt, Energie, Mobilität, Innovation und Technologie

wirtschafts agentur wien — Für die Stadt Wien

Das Land Steiermark

SFG NEUES DENKEN. NEUES FÖRDERN.