**Development of biorefining schemes for recovery of high-added value products from *Aphanizomenon flos-aquae* biomass**

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**Highlights**

* Supercritical CO2 extraction can be employed for recovery of lipophilic products
* Residual biomass is rich in antioxidant products
* Phycobiliprotein rich extracts can be obtained by ultrasonic treatments
* A streamof products with various applications can be recovered from this biomass

**1. Introduction**

Cyanobacteria are ubiquitous photosynthetic bacteria that can have significant effects on the water quality as well as the functioning of aquatic ecosystems [1]. The massive proliferation of cyanobacteria can lead to excessive surface water blooms in heavily eutrophicated systems [2]. During the last decade's appearance of this kind of cyanobacterial blooms has also been verified in the Curonian lagoon [3]. This region, which is listed in UNESCO’s world heritage sites, provides many ecosystem services, and thus, it is a crucial area for recreation, tourism, and aquaculture.

Recent reports suggest that removal of wild cyanobacterial blooms from the Curonian lagoon as a management measure, should be considered and prioritized [3]. To turn this threat into gain herein we envisioned the utilization of a wild cyanobacterial bloom as a feedstock within a biorefinery concept. Towards this end, fractionation of this biomass was achieved with high-pressure and or conventional extraction techniques This underutilized biomass could be considered as a source of products with potential biotechnological, food, agrochemical and pharmaceutical applications

**2. Methods**

For the optimization of SFE-CO extraction, a central composite design (CCD) and response surface methodology (RSM) were used. Fatty acid methyl esters were identified and quantified by means of GC-FID. Tocopherol content was assessed by HPLC with a fluorescence detection. Phycobiliprotein rich extracts were obtained by conventional techniques (freeze-thaw cycles, homogenization, solid-liquid extraction). Ultrasound-assisted extraction in combination with conventional techniques was further optimized with a CCD-RSM for the highest phycocyanin, allophycocyanin, phycoerythrin and total phycobiliprotein yields. Residual biomass was further treated either with pressurized liquid extraction (PLE) or conventional techniques to obtain antioxidant rich extracts. *In vitro* antioxidant capacity of obtained extracts was evaluated with the Folin-Ciocalteu, DPPH and ABTS assays. Functional properties of obtained extracts were further evaluated for their ability to inhibit catalase, superoxide dismutase and acetylcholinesterase activity. Preliminary phytochemical characterization was achieved by means of UPLC-ESI-TOF-MS.

**3. Results and discussion**

For the SFE-CO2 CCD-RSM indicated 42.5 MPa, 55 °C and 120 min of extraction as optimal conditions, under which SFE-CO2 yielded 4.43 g/100 g DW of non-polar extract characterized by the presence of α-linoleic acid and α-tocopherol [4]. Under optimal extraction conditions, the SFE-CO2 proved to be faster and more efficient compared to conventional hexane extraction [4]. In a next step, isolation of aqueous phycobiliprotein rich extracts was based on several conventional techniques in combination with optimized ultrasound-assisted extraction. The highest total phycobiliprotein yields were observed for samples, treated with homogenization followed by application of 8.75 min of ultrasounds at 84% amplitude [5]. During the next steps, residual biomass was further treated with increasing polarity solvents either by conventional or pressurized liquid extraction techniques. The acetone, ethanol and water extracts showed a strong antioxidant capacity in various radical scavenging assays. Moreover, the obtained extracts showed inhibitory effects against biologically relevant enzymes. In a last step, preliminary phytochemical composition of obtained extracts as assessed by means of UPLC-ESI-TOF-MS revealed the presence of a number of natural pigments as well as auxins, compounds that could be potentially utilized as biofertilizers.

**4. Conclusions**

In conclusion, the potential of wild cyanobacteria for recovery of a stream of products within a biorefinery concept were shown. Wildly harvested *Aphanizomenon flos-aquae* biomass could be considered as a feedstock for recovery of products with potential food, nutraceuticals, biotechnological and agricultural applications. Further studies focusing on life-cycle assessment and techno-economic feasibility of the developed biorefinery schemes would be of further interest in this field.

**References**

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