Proceedings of the 8th World Congress on New Technologies (NewTech'22)
Prague, Czech Republic– August 03-05, 2022
Paper No. ICBB 022
DOI: 10.11159/icbb22.022

Fractionating Of Synthetic Biology Waste Stream into Nutrient Rich Extract for Cosmetic Industry

Bruno Horta, Carla Cálix, João Burgal, Catarina Oliveira
Universidade Católica Portuguesa

Extended Abstract:

Amyris is a world-leading manufacturer of sustainable ingredients producing environmentally friendly products. Biofene® (or trans-β-farnesene) is a synthetic biology derived product using yeast fermentation of sugarcane. This production originates spent broth, an aqueous waste stream typically applied to land by fertirrigation. On one hand, spent broth contains recoverable added-value compounds; on the other hand, an improper disposal of this waste stream could result in negative effects and give rise to environmental concerns. Hence the importance of implementing the bio-waste refinery and circular bio-economy concepts for recovering high-value bio-products. Cosmetic industries are committed to find natural, sustainable, and functional ingredients meeting consumer's and entities rigorous demands. Spent broth may be a source of such ingredients. Thus, the objective of this work was to assess the fractionation of the spent broth stream from Biofene® production to obtain a concentrated nutrient rich extract with potential application on cosmetics.

The spent broth's was pretreated for mineral recovery, using a chemical free process developed within the Alchemy Project. The pre-treated spent broth was then fractionated in a cascade membrane filtration process, in an attempt to recover a rich peptide and minerals fractions. This process comprised three steps: microfiltration (MF), ultrafiltration (UF), and nanofiltration (NF). The composition of the obtained fractions was monitored in terms of total proteins and minerals contents, amino acids profile, and antioxidant capacity. All experiments were done in a crossflow filtration unit (Sepa CF, Sterlitech), coupled to a pump (G13-X, Hidra-Cell®) applying a feed recirculation of ca. 250 L/h.

Microfiltration aimed to the clarification of the pre-treated spent broth, removing suspended mineral and organic particles; a Toray's sanitary TMF membrane presented a total solids rejection factor of 51.1 %, and rejection factors towards total proteins and minerals of 60.5 % and 26.4 %, respectively. The antioxidant capacity was higher in the obtained permeate than in the pre-treated spent broth (560 ±59 and 317 ±56 µmol TE/g by ORAC, respectively). The subsequent ultrafiltration of the MF permeate with a 5 kDa MWCO membrane (Toray Sanitary TUF) had rejection factors towards total proteins of 5.9 % and of 20.0 % towards minerals. The retained fraction had an interesting antioxidant capacity (685 ±64 µmol TE/g by ORAC), amino acids content (61.9 ±0.9 mg/g-dw), comprising mainly glutamic acid and aspartic acid (27 and 26 wt%, respectively), and minerals (103.6 ±5.6 mg/g-dw), mainly calcium (ca. 65 wt%). The UF permeate was further filtrated using a Toray's sanitary NF membrane, which retained 61 % of total solids, thus being a concentration step. The retained fraction was similar to that retained on the UF membrane, presenting higher antioxidant capacity (738 ±64 µmol TE/g by ORAC) and minerals content (232.4 ±17.7 mg/g-dw, mainly calcium ca. 65 wt%).

The fractions resultant from the cascade filtration process, namely the UF and the NF retentates, presented interesting characteristics for cosmetics applications, particularly significant amino acids and minerals contents, and high antioxidant capacity. Indeed, amino acids are highly desired in cosmetics for their capacity to improve skin and hair quality [1]; mineral based salts, including calcium and magnesium act as absorbents, abrasives, and astringent agents, promoting skin softening and moisture [2]. Powerful antioxidant and free radical scavenging properties are also extremely valuable in anti-aging and skin protection products [3].

This work demonstrates a potential practical valorization for developing increased value bio-derived products from the Biofene® fermentation spent broth stream. The product preliminary characterization reveals interesting nutrients and bioactivities, suggesting a potential application in cosmetic industry.

References:

[1] Kalasariya, H. S., Patel, N. B., Yadav, A., Perveen, K., Yadav, V. K., Munshi, F. M., Yadav, K. K., Alam, S., Jung, Y. K., & Jeon, B. H. (2021). Characterization of Fatty Acids, Polysaccharides, Amino Acids, and Minerals in Marine Macroalga Chaetomorpha crassa and Evaluation of Their Potentials in Skin Cosmetics. Molecules (Basel, Switzerland), 26(24), 7515. https://doi.org/10.3390/molecules26247515

[2] Polefka, T. G., Bianchini, R. J., & Shapiro, S. (2012). Interaction of mineral salts with the skin: a literature survey. International journal of cosmetic science, 34(5), 416–423. https://doi.org/10.1111/j.1468-2494.2012.00731.x

[3] Gupta, P. L., Rajput, M., Oza, T., Trivedi, U., & Sanghvi, G. (2019). Eminence of Microbial Products in Cosmetic Industry. Natural products and bioprospecting, 9(4), 267–278. https://doi.org/10.1007/s13659-019-0215-0