ISGC 2019
May 13th - 17th

N°995 / PC
TOPIC(s) : Alternative technologies

High Pressure Homogenization: An eco-friendly extraction processing for microalgae bio-products.

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PURPOSE OF THE ABSTRACT

Spirulina plantensis (also known as Arthrospira plantensis) is a blue-green microalgae considered for many years as a great feedstock of valuable compounds such as proteins (up to 70% of the dry weight), polysaccharides (15-25%), lipids/fatty acids (3-9%), vitamins, minerals and pigments like phycocyanin [1]. Spirulina extracts have been used in fields of healthcare, cosmetics and pharmaceuticals owing to a variety of biological features.

Recently, high attention has focused on polysaccharides from marine sources, especially sulfated derivates, which endowed with special physicochemical properties and a wide variety of important biological activities [1,2].

Cell-wall disruption is often the primary and more critical step in intracellular bio-products isolation. Hence, the challenge is to achieve high yield of targets in short time, at low energy input, with reproducible and scalable results while preserving the structure and existing form of the molecules on which the bioactivity depends.

In this work, we investigated the efficiency of obtaining polysaccharides from the blue-green microalgae Spirulina platensis using high-pressure homogenization (HPH) as a potential eco-friendly extraction technology. Main processing variables that affect cell disruption performance and polysaccharide yield that are: inlet pressure (Dp) and number of passes (Np), were optimized though single factor experiments.

A comparison was made with the conventional hot-water extraction (100°C, 1hour) considering both polysaccharides yields and specific energy consumption.

Dried Spirulina powder produced on the peninsula of Plougastel-Daoulas was purchased from TAM (France). The process of polysaccharides extraction from Spirulina powder by HPH was performed in a laboratory GEA Niro Soavi (Palma, Italy) homogenizer. 30g of the raw matter were stirred in 500 mL of distilled water in a beaker (solid to liquid ratio 1:6) and then pumped into the homogenizer at a rated flow (Q) of 9L/h. The microalgae suspension was homogenized between 1 to 10 times (Np=1-10) at different inlet pressures (Dp= 500-1500 Bar). After HPH treatment, the extracted slurry was centrifuged at 4200 rpm/min for 15 min to collect the supernatant that was evaporated to dryness. Thereafter, polysaccharide and protein content were determined in the extracted slurry.

Purified polysaccharides samples were qualitatively analyzed by FTIR and by HPSEC.

As shown on fig.1, Dp=500 Bar and Np=7 passes allowed the maximum recovery of polysaccharides. Under these conditions, a crude polysaccharide yield of 13.5 ± 0.8 % was obtained which was about 2.4 times more than those achieved by maceration (5,6 ± 0,2%).

However, the method was found to extract the cellular components non-selectively as proteins were release in a similar manner.

From an energetic point of view, considering 7 consecutive passes at an operating pressure of 500 bar and an overall efficiency of the pumping system of 87%, the specific energy input was 1.96 kWh/kg which is quite low in comparison with other extraction technologies.

Accordingly, it was evidenced that Spirulina polysaccharides can be extracted using HPH under mild conditions, without solvent and at room temperature, with a high yield of recovery and a low energy consumption. HPH can then be considered as an eco-friendly extraction method for the recovery of marine bioactive molecules.

FIGURES

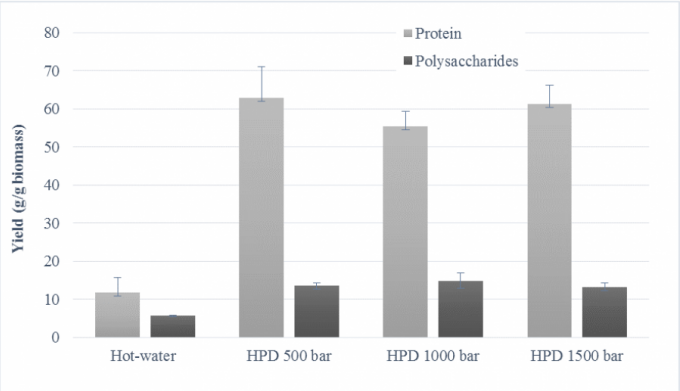

FIGURE 1

Fig. 1

Recovery yields of Spirulina polysaccharides by hot-water extraction or by HPH varying the inlet pressure. Solid-to-liquid ratio 1:6 m/v, Np=7.

FIGURE 2

KEYWORDS

High Pressure Homogenization | Eco-friendly extraction | Spirulina | Polysaccharides

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