Short-Term Scientific Mission - Abstract

Intensive biomass production of *Ulva* in tanks, training and experimental trials

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Abstract

The development of the production of *Ulva* biomass is the challenge of the WG2 on the COST Action 20106, which aims to adapt the traditional aquaculture techniques to specific productivity purposes (food, feed, and bioactive products). This STSM project lies within this goal, by transferring knowledge on *Ulva* tank intensive cultivation between the two institutes (University of Cagliari (UNICA) and Banco Español de Algas (BEA) – University of Las Palmas de Gran Canaria (ULPGC)). *Ulva* production activities at BEA go back 30 years, this STSM gave the exchanger the possibility to be trained in *Ulva* production in outdoor pilot-scale, to carry out the laboratory analyses for the characterization of the quality of the biomass produced.

At BEA, in September 2020, *Ulva* biomass was collected and scaled-up in order to increase biomass production. The growth parameter indicated that the Ulva productivity can be highly variable according to the growth conditions, and the maximum increase in biomass was observed in the 750-L tanks with an increase of 450% during the period, starting from inoculation of 1 g/L and harvesting about 5g/L. With subsamples of *Ulva* biomass, firstly, the wet weight-dry weight (WW/DW) ratio for different *Ulva* batch was determined. The results indicated that the DW is between 20 – 18% of the WW (DW/FW = 0.19). *Ulva* cultivation can be carried out both for purposes of production and as a biofilter, in all cases, the evaluation of the uptake efficiency of nutrients (NUE) and nutrient uptake rate (NUR) is fundamental for *Ulva* production and were calculated as reported by Vega et al. (2020). NUE values ranged between 75 and 60 with higher values in tanks (750L) with a higher surface (1.8 m^2) in comparison with small capacity tanks 90L; 0.2 m^2), indicating that the reduction (%) of this nutrient concentration in the effluent was probably dependent on higher light availability. Similarly, the NUR was between 0.375 and 0.749 µmol N-NH_4^+ L^{-1} h^{-1}, with differences between tanks assayed. These results were probably related to the health status of the culture. However, according to the final use of *Ulva* biomass (discharge clean waters to the environment or increase the biomass), the NUR is the parameter to maximize or to control according to our objectives. *Ulva* produced in the facility was analyzed and characterized in terms of total phenols (Phloroglucinol equivalent: mg DWg^{-1}), photosynthetic pigments (chlorophyll-a; chlorophyll-b; total carotenoids), and antioxidant activity (DPPH standard method, % inhibition).

Prior the analyses, *Ulva* extracts were obtained from fresh biomass fine grinded with a mortar and three different extractions were performed using: Methanol (90%); Distilled water; Ethanol 50%. Analyses were conducted in triplicate for each tank using subsamples of Ulva biomass following the standard protocols provided by the laboratory.

The results showed that the best extraction for the analyses of the total phenol is the methanol (90%), whereas distilled water and ethanol (50%) provide similar results. Total phenol in *Ulva* was affected by the health condition of the biomass, no matter the solvent. In details, considering the methanol extraction, it showed a higher value (600.29 mg g^{-1}± 33.04SD) in high-quality biomass compared to lower-quality *Ulva* (489.97mg g^{-1}±30.77SD).

Photosynthetic pigments content was analysed only in methanol extract. The results show that also the chloroplastic pigments were affected by the health state of the biomass, showing higher values in good-shape Ulva. The antioxidant activity was carried out using the methanol and distilled water extracts, however, the methanol ones showed good results with an inhibition between 26 and 28%.

Similarly, chlorophyll fluorescence determination in vivo using the AQUAPEN (Fv/Fm; Fm–F0) provide information about the health status of the culture. Samples were dark- adapted for 30 min prior to fluorescence measurements for the determination of the optimal quantum yield (Fv/Fm).

The knowledge acquired represents the starting point to boot the production of high-quality *Ulva* at UNICA, where it will be used, raw or mixed with other ingredients, as feed for echinoderms.

References

Vega J, Álvarez-Gómez F, Güenaga L, Figueroa FL, Gómez-Pinchetti JL, (2020). Antioxidant activity of extracts from marine macroalgae, wild-collected and cultivated, in an integrated multi-trophic aquaculture system. Aquaculture 522: 735088