“SODIUM BICARBONATE AMENDMENT FOR ENHANCED ASTAXANTHIN PRODUCTION FROM HAEMATOCCUS PLUVIALIS”

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ABSTRACT

Haematococcus pluvialis is a freshwater green microalga that is widely considered to be the richest natural source of the high value carotenoid astaxanthin. The use of bicarbonate salts as a means of efficiently delivering inorganic carbon in microalgal cultivation is a relatively new concept and its application is continuously growing. Previous studies have largely focused on increasing the lipid content in microalgae via the use of high concentrations of sodium bicarbonate under nitrogen deplete culture conditions. Lipid accumulation is directly related to astaxanthin production as astaxanthin is dissolved and stored in lipid bodies in H. pluvialis. Because of this relationship, the effects of sodium bicarbonate addition on astaxanthin production in this microalga was investigated in this study. Due to its complex life cycle, H. pluvialis is commonly cultivated in two stages called the “green” and “red” stage. Different approaches have been proposed in each stage to increase the astaxanthin production, namely by growing microalgae under nutrient-limited conditions or resuspending the cells into nutrient deplete conditions after reaching optimal growth. In this study, H. pluvialis (UTEX 2505) was cultured in stirred batch reactors containing MES-Volvox medium continuously shaken at 120 rpm with a 12 h:12 h light/dark cycle. 2.5mM of sodium bicarbonate was used as an additional inorganic carbon source in the green stage and 50mM of sodium bicarbonate was used as a trigger mechanism to induce astaxanthin production in the red stage. Following the trigger, the astaxanthin accumulation rate increased from 0.13 mg L\(^{-1}\) day\(^{-1}\) to 0.64 mg L\(^{-1}\) day\(^{-1}\) with an astaxanthin concentration of 1.56 ± 0.01 mg L\(^{-1}\) and 3.95 ± 1.25 mg L\(^{-1}\) respectively. Whereas, an addition of 2.5 mM sodium bicarbonate at the green stage increased the final astaxanthin accumulation rate up to 2.12 mg L\(^{-1}\) day\(^{-1}\) and the astaxanthin concentration to 11.2 ± 0.56 mg L\(^{-1}\). Increasing biomass in the green stage resulted in higher astaxanthin content at the end of the red stage. In addition to increasing the total astaxanthin content, 2.5mM of sodium bicarbonate led to a faster nitrogen utilization during the green stage. With this faster utilization of nitrogen, the cultures were grown with a one-stage cultivation approach, where the astaxanthin production occurred in a continuous mode. The final astaxanthin dry weight was calculated as 2.36 ± 0.08 % (w/w).