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Abstract	:	<p>In this study, a novel and cost-effective method for using onion peel as a biostimulant is presented to overcome the challenge of low microalgae biomass productivity. The study successfully optimized and modelled the extraction parameters, including solid-to-solvent (SS) ratio, temperature, and time, using the response surface methodology (RSM) tool. The results indicated a strong correlation between the extraction parameters and microalgae biomass concentration (BC) and lipid content (LC), with R² values of 0.9440 and 0.9638, respectively. The optimum biostimulant extraction conditions were SS ratio of 0.006 g/mL, temperature of 90 °C at 1.00 h, attaining BC and LC of 1.76 g/L and 19.42 %, respectively, without any negative impact on LC. Findings on bioactivities of biostimulant recovered at optimal extraction conditions supported its biostimulation capacity on microalgae, with reasonable total phenolic content (TPC) of 9.1094 ± 0.748 mg GAE/g dry weight, total flavonoid content (TFC) of 3.1307 ± 0.210 mg RE/g dry weight, and antioxidant activity (AA) of 78.65 ± 3.421 % and 73.68 ± 9.608 % for DPPH and ABTS inhibition, respectively. The results of this study suggest that biostimulant derived from onion waste has great potential for promoting rapid proliferation of microalgae even with extremely low inoculum cells. These findings present a promising roadmap for high-density microalgae farming, and the developed RSM model can be utilized for process optimization while improving the efficiency, quality, and cost-effectiveness of microalgae industry.</p>