

## **Plant-based 3D printed meat analog based on chickpea protein isolates, alginate, and Spirulina biomass**

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There has been growing interests in the development of novel foods based on sustainable eco-friendly proteins. In this study, the formulation for 3D- printing of a meat analog based on chickpea and microalgae biomass were studied. The results showed that the optimal conditions for concentration of calcium chloride in solution, the residence time of the meat substitute sample in calcium chloride solution and the spirulina protein substitution were 1% (w / v), 3 hours and 2% (w / v), respectively. Three samples coded as M1 (meat substitute based on chickpea and rice protein), M2 (meat substitute based on chickpea and rice protein with 0.8% beet root extract) and M3 (meat substitute based on pea protein, rice and Spirulina with 0.8% beet root extract) using a 3D printer (print speed 0.03 mL / min, nozzle size 1 mm, syringe volume of 20 mL, nozzle height 1.8 mm, and layer height equal to 1.7 mm) were produced. The results showed that by applying these changes in the formulation, the elongation at break (%) (from 50 to 53 and then 60%), tensile strength (MPa) (from 2.18 to 2.71 and then to 52.5 2), the breaking time (s) (from 16 to 17 and finally to 18) increased, indicating an increase in the elasticity of the meat substitute samples. These changes, along with the increase in scores obtained from sensory evaluation, indicated an increase in the desirability of meat analog samples (M2 and M3) compared to the M1 sample. In addition, it was found that spirulina protein substitution did not result in significant changes in the physicochemical properties of the sample, such as pH, moisture, and ash. The results of this study show that the proposed formulation, in addition to increasing environmental sustainability, led to the production of desirable meat analog.