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Utilization of **Chickpea Cooking Water** **for** the Production of **Polymeric Foams**

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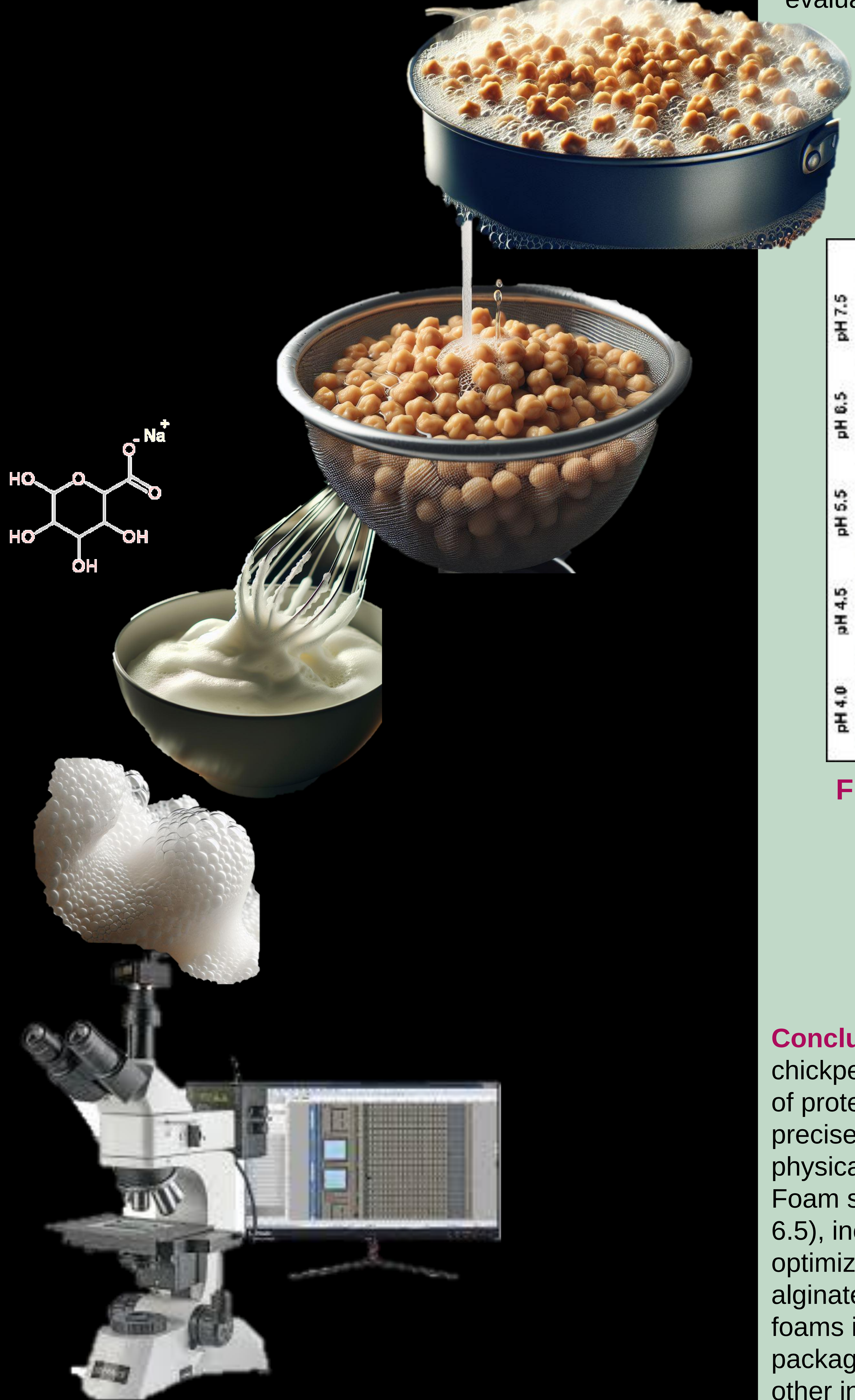
Introduction. Foams have been widely studied across various disciplines, including biomedicine, cosmetics, food, agriculture, and construction. Although foams are extensively used, many of them rely on petroleum-based polymers, thereby contributing to environmental pollution. However, foams exhibit remarkable mechanical properties, such as thermal and physical resistance, and they can be manufactured using polysaccharides or proteins. This study aimed to develop and characterize the stability of a polymeric foam based on chickpea protein and sodium alginate for potential use in biodegradable packaging materials.

Methods. To prepare the foams, a 2.5% sodium alginate solution, aquafaba (chickpea cooking water), and an equimolar solution of calcium chloride–sodium citrate as a chelating agent were used. Various ratios of alginate to protein (1:1, 1:0.5, 1:5, and 1:0) were tested, and the pH was adjusted to optimize the foam' s stability and mechanical properties. Micrographs were taken every 30 min to evaluate air loss and bubble size as shown in **Fig. 1**.



Fig, 1. Foam preparation and analysis process

Results. The results showed that foams could not be obtained using alginate alone, and excess protein led to excessive air incorporation and poor gelation. Decreasing the protein content improved the texture but reduced the amount of entrapped air.

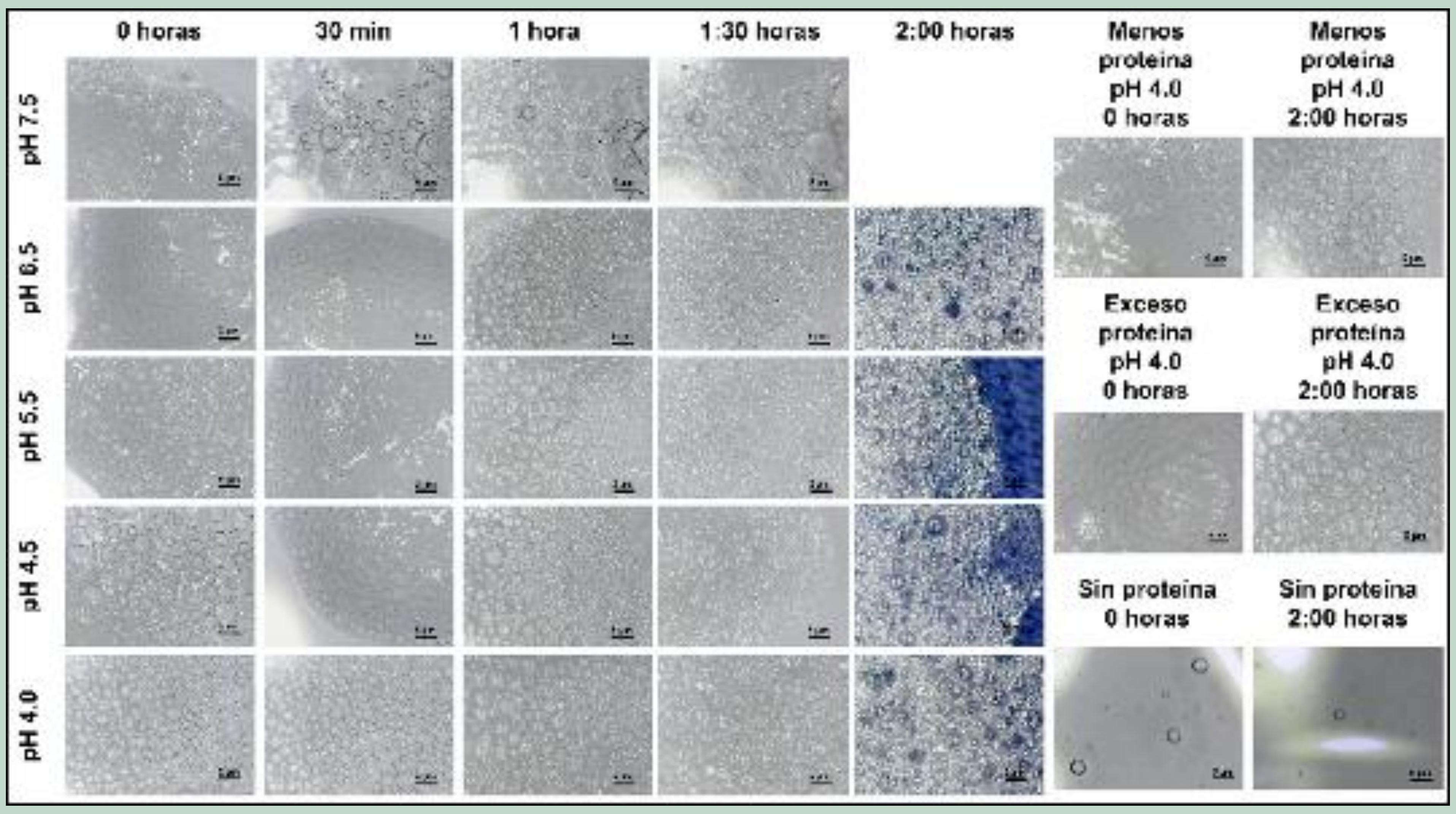


Fig. 2. Foam stability at different pH values, change in bubble structure

The most stable foams with a homogeneous bubble size were achieved at a 1:1 alginate-to-protein ratio and a pH between 5.5 and 6.5 (**Fig. 2**). The foam's stability improved with a reduction in pH, and its firmness increased between a pH of 5.5 and 6.5. Additional optimization of the formulation by varying the speed, time, and alginate–calcium ratio is necessary.

Conclusions. The production of foams based on chickpea protein and alginate is feasible. The addition of proteins is necessary to incorporate air. Similarly, precise protein addition is required; otherwise, the physical properties and foam stability are affected. Foam stability improves with a reduction in pH (5.5-6.5), increasing foam firmness. Formulation optimization is needed by varying speed, time, and the alginate-calcium ratio. The use of protein-alginate foams is an environmentally friendly option for packaging production, with potential applications in other industries.

Illustration depicting: Applications of foams (Created with Copilot).

References.

1. Ellen MacArthur Foundation. “The New Plastics Economy: Rethinking the future of plastics”. How to Build a Circular Economy | Ellen MacArthur Foundation. 2016. [En línea]. Disponible: https://www.ellenmacarthurfoundation.org/the-new-plastics-economy-rethinking-the-future-of-plastics
2. R. Geyer, J. R. Jambeck y K. L. Law, “Production, use, and fate of all plastics ever made”, Sci. Advances, vol. 3, n.º 7, julio de 2017, art. n.º e1700782. [En línea]. Disponible: https://doi.org/10.1126/sciadv.1700782
3. Buteler, Micaela, “¿Qué es la contaminación por plástico y por qué nos afecta a todos?”, Universidad Nacional del Comahue. Centro Regional Universitario Bariloche; Desde la Patagonia. Difundiendo Saberes; 16; 28; 12-2019; 56-60. [En linea]. https://desdelapatagonia.uncoma.edu.ar/index.php/que-es-la-contaminacion-por-plastico-y-por-que-nos-afecta-a-todos/
4. R. Flores Varela, L. Barrios Rentería y G. J. De la Torre Pérez, “Deterioro ambiental: una investigación sobre el consumo excesivo de recipientes de un solo uso (unicel) en la Universidad de Sonora”, Rev. Vertice Univ., 2020. [En línea]. https://doi.org/10.36792/rvu.vi86.21
5. Á. A. Castro, “Claves sobre poliestireno expandido (EPS): fabricación, usos y reciclaje,” Plastics Technology México, 22-Jan-2024. [Online]. Available: https://www.pt-mexico.com/articulos/claves-sobre-poliestireno-expandido-(eps)-fabricacion-usos-y-reciclaje.

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