Foaming and emulsifying properties of commercial legume protein isolates as potential egg replacers: A comparative study

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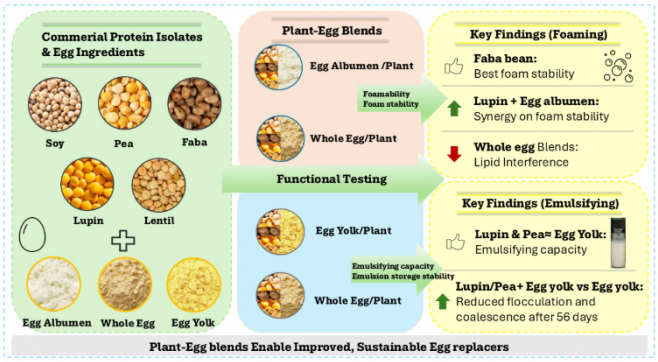
Plant proteins are gaining attention as potential alternatives to egg proteins, yet their functionality in commercially available forms remains insufficiently characterized. This study investigates the foaming and emulsifying properties of commercially processed protein isolates from soy, pea, faba bean, lupin, and lentil, as well as their blends with egg protein ingredients as potential egg replacers. Protein composition, solubility, particle size distribution, and molecular characteristics of all protein sources were determined, followed by evaluation of foaming and emulsifying properties of individual proteins and their blends with egg albumen, egg yolk, and whole egg protein.

Among all the protein sources, faba bean isolate exhibited the highest foam stability, outperforming egg albumen, which was linked to its ability to form small, uniform bubbles and thicker lamellae. In contrast, pea and lentil isolates showed poor solubility and unstable foams, while soy isolate demonstrated relatively high solubility but only moderate foaming performance. Blending plant proteins with egg albumen improved foamability across all samples, with a particularly strong synergistic effect on foam stability observed for the lupin–egg albumen combination. However, blends with whole egg protein resulted in reduced foaming performance, likely due to lipid interference at the air–water interface.

In terms of emulsifying properties, lupin and pea isolates performed comparably to egg yolk, while faba bean showed moderate capacity. Soy and lentil isolates were less effective in emulsifying capacity, likely due to the presence of large aggregates. Blending with egg yolk or whole egg protein enhanced emulsion stability, and mixtures containing pea or lupin proteins reduced droplet flocculation and coalescence compared to egg yolk alone after 56 days of storage.

Overall, these findings emphasize the importance of solubility, composition, and interfacial behavior in determining the functionality of commercial plant protein isolates, which sheds light on how plant proteins can be better utilized in developing sustainable plant–egg ingredients with improved performance.

Keywords:
Plant protein isolates, egg protein ingredients, foaming properties, emulsifying properties, egg protein-plant protein isolate blends



Graphical abstract

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