Chapter 1
Introduction

1.1. Background

Channa striata (snakehead fish) is a freshwater species native to Southeast Asia that is highly valued for its dense nutritional and therapeutic properties. The fish has rich in protein profile, with a crude albumin fraction constituting approximately 6.22% of its biochemical composition. (Hapsari & Tjandrawinata, 2025), which contain polyunsaturated fatty acids (*PUFAs*), bioactive peptides, and essential trace minerals (Berlian et al., 2023). Physiologically, *C. striata* albumin is essential for metabolic support, maintaining intravascular osmotic balance, and tissue proliferation through anti-inflammatory and angiogenic pathways. In regions like Indonesia, it is traditionally consumed as broths or steamed dishes. (Laoli et al., 2023; Mustafa et al., 2022). However, consuming the fish in its whole form limits bioavailability and stability. Extracting and concentrating the albumin fraction from the raw tissue matrix isolates the target bioactive protein, increasing its bioavailability and facilitating its incorporation into shelf-stable food formats suitable for wider distribution (Arisanti et al., 2025). Despite its clinical uses, concentrated fish albumin extract has a pungent, volatile fishy aroma that creates a sensory barrier for consumer oral compliance. This fishy odor is driven by low-molecular-weight amines and lipid oxidation products that diffuse rapidly into the product headspace (Ramakrishna et al., 2025; Yarnapakdee et al., 2012).

Previous studies have attempted to mask this aroma by incorporating *C. striata* protein concentrate into solid matrices like cookies (Ikasari et al., 2020) and hard candies (Diana et al., 2024) to improve oral compliance. Other efforts have used liquid dispersion; for instance, Prasetyo et al. (2023), stabilized liquid formate using xanthan gum (0.3%), which maintained viscosity over seven days, whereas carrageenan alone exhibited severe phase separation (40-60%). While flavored liquid dispersion showed the feasibility to limit the odor masking (Irwan et al., 2023), the study also highlighted a physical limitation. Liquid formate remains inherently prone to phase separation, sedimentation, and oxidation degradation (Setyawati et al., 2024). Transforming the extract into a hydrocolloid gel system offers a method to mitigate the aroma smell through encapsulation (English et al., 2023). During gelation, hydrocolloids form a three-dimensional polymeric network that physically entraps volatile odor-active compounds, limiting their molecular mobility and preventing them from diffusing into the surrounding headspace (Ćorković et al., 2021; Petzold et al., 2013).

To overcome the stability issues, a semi-solid gel format can help with liquid instability challenges by limiting molecular mobility, preventing sedimentation, and protecting sensitive proteins like albumin from degradation (Yuan et al., 2024). A semi-solid gel relies on a continuous, three-dimensional polymer that physically traps solvent molecules within its protein network. This dense matrix serves as an immobilization barrier that limits the molecular mobility and diffusion coefficients of volatile compounds, effectively encapsulating and masking the fishy notes. However, choosing a suitable gelling agent is important, as fish-derived proteins easily aggregate or lose solubility in incompatible hydrocolloid systems (Petcharat et al., 2025). When k-CA and KGM are used, upon cooling the kCA random coils into ordered double helices while the KGM chains physically entangle within the forming junctions. This interaction is stabilized by intermolecular hydrogen bonding and hydrophobic cross-linking between the unsubstituted mannose regions of KGM and the sulfated ester fractions of k-CA. The resulting binary gel improves elasticity, minimizes brittleness, and improves water-holding capacity. This dense scaffold alters phase separation kinetics, preventing the positively charged C. striata albumin particles from aggregating or precipitating below their isoelectric point (Li et al., 2024).

To date, no published study has addressed the research gap of the stabilization of *C. striata* albumin within a synergistic κ-carrageenan/KGM gel network designed for a food product and the interactions under specific conditions of the hydrocolloids. This study, therefore, proposes the development of a functional gel, a single-serve, shelf-stable, semi-solid food product that co-formulates *C. striata* albumin extract with a κ-C/KGM hydrocolloid system, by lemon for flavor and functional botanical extracts (acai berry and red ginger) for additional bioactivity and color. The end product is intended as a convenient, ready-to-consume supplement.

1.2. Objective

The objective of this study is to evaluate how varying concentrations of the kappa-carrageenan and konnyaku hydrocolloid blend affect the physical properties, textural profile, syneresis, color, aW, and stability of the gel containing and 1.5% *C. striata* albumin extract under acidic conditions.

1.3. Hypothesis

Null Hypothesis (H0): Varying the concentrations of the kappa-carrageenan and konnyaku hydrocolloid blend does not significantly affect the physical properties, textural profile, or storage stability of the acidic *C. striata* albumin sachet gel containing 1.5%.

Alternative Hypothesis (H1): Varying the concentrations of the kappa-carrageenan and konnyaku hydrocolloid blend significantly affects the properties, textural profile, and storage stability of the acidic *C. striata* albumin sachet gel containing 1.5%, specifically dictating the occurrence of syneresis, matrix degradation, and overall structural integrity.