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# Synthesis of Chitosan–Alginate–Gelatin Aerogel Using Freeze Drying and Dehydrator Techniques as a Matrix for Virgin Fish Oil-Based Oleogel


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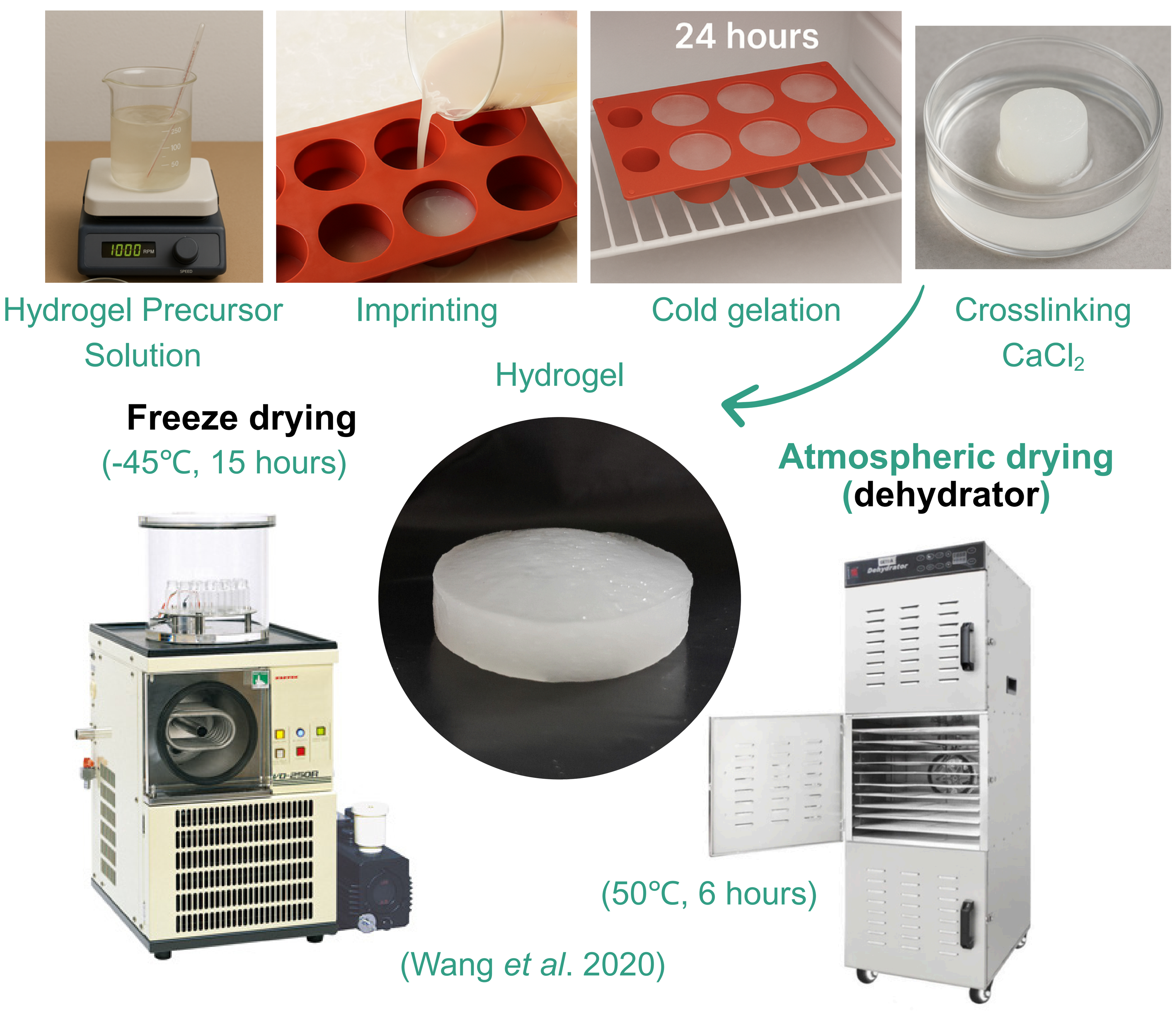
## INTRODUCTION & AIM

Omega-3 fatty acids (**EPA** and **DHA**) play a vital role in health, but the body converts less than 5% of ALA, making direct intake highly recommended. **Virgin fish oil**, a rich source of **DHA**, faces challenges such as low solubility, oxidation, and undesirable odor. **Oleogels** offer an innovative solution to improve oil stability without altering its structure, featuring thermo-reversible, viscoelastic, and self-standing properties (Li *et al*. 2019).

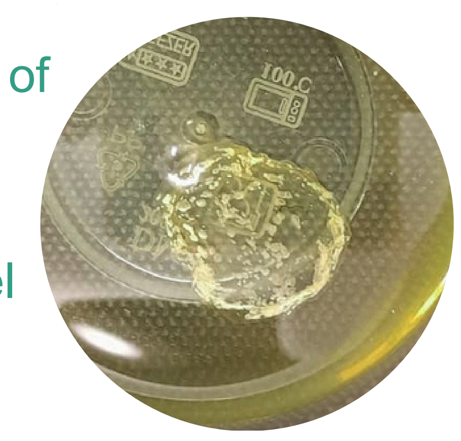
**The indirect oleogelation** method using aerogels is considered safer for heat-sensitive compounds (Plazzotta *et al*. 2019). **Aerogels**, porous materials with high surface area, can effectively bind oils and are safe for food applications. The use of marine-based biopolymers such as **chitosan**, **alginate**, and **gelatin** as aerogelators remains underexplored, including **comparisons of drying methods**, presenting a promising research opportunity.

This study aims to develop and evaluate chitosan, alginate, and gelatin-based **aerogels as templates** for fish oil oleogel synthesis, as well as to assess the effect of conventional drying methods (**freeze drying** and **atmospheric drying**) on the **structure** and **absorption capacity** of the aerogels.

## METHOD

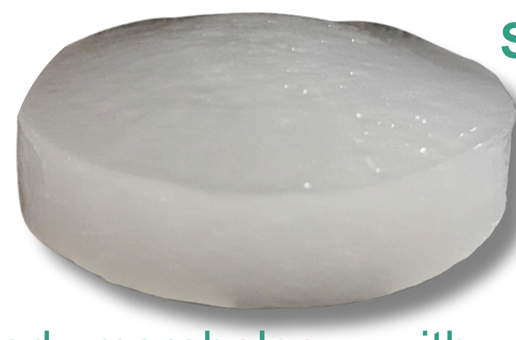



**Impregnation** of the **aerogel** in 30 mL of **virgin fish oil** at room temperature (±25°C). The **sorption process** was carried out **passively** until the aerogel **reached saturation** (1 hour).



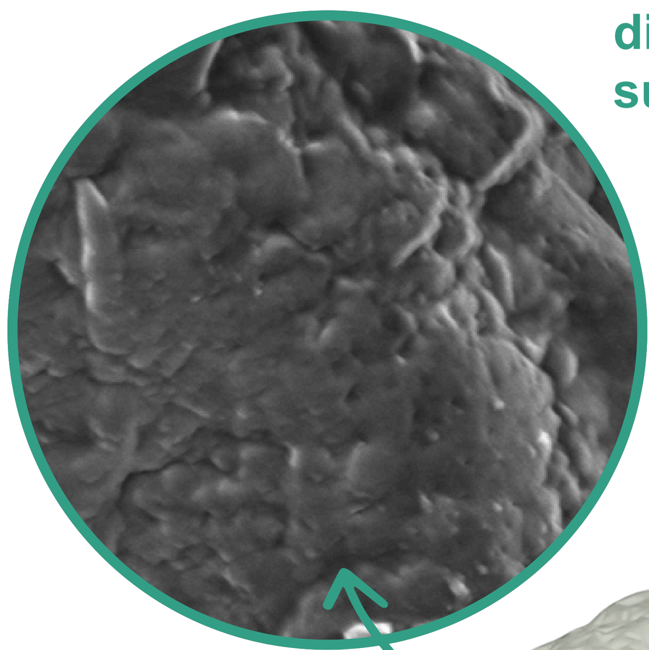
## RESULTS & DISCUSSION

**Cylindrical** in shape, **smooth surface without** bubbles or **cracks**, **homogeneous semi-transparent** white color, **elastic** and **not brittle**.



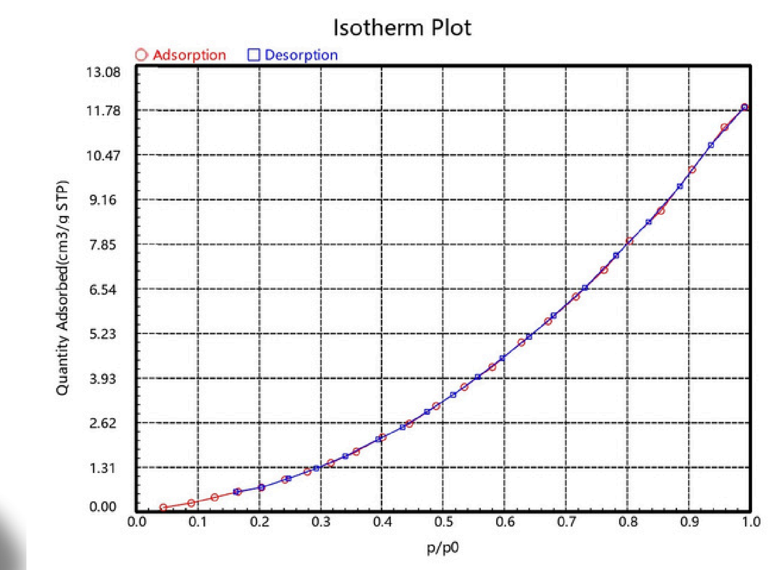
**Swelling Ratio**
9,63±0,94%

A layered morphology with a **wavy surface**, irregular **large cavities**, and a preserved **three-dimensional porous structure** resulting from **sublimation**.



**Surface area**
15,629 m²·g⁻¹

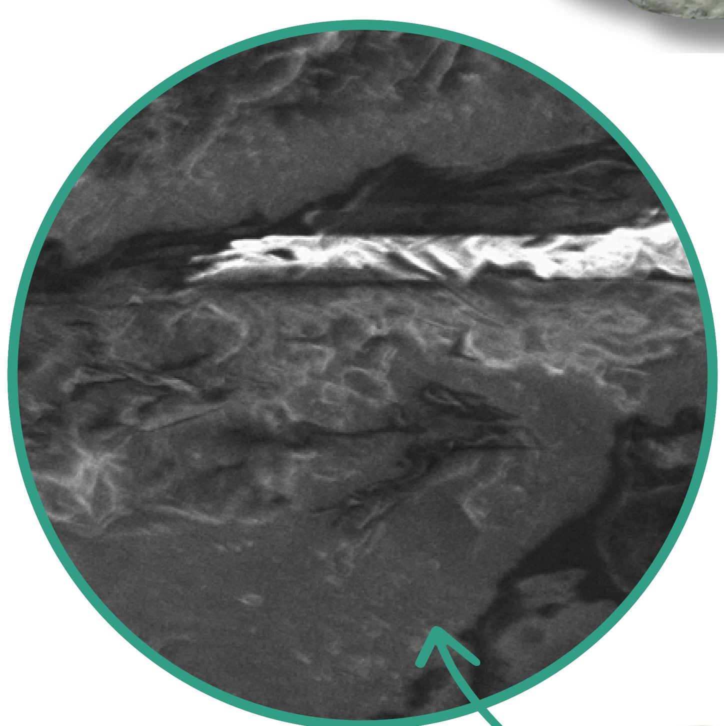
**Average pore diameter**
4,701 nm




**Aerogel Freeze Drying**

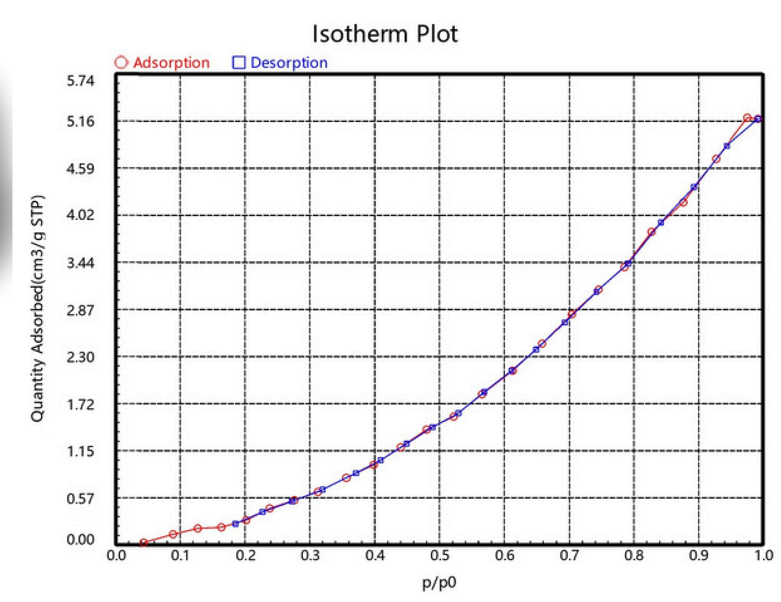
**Absorption capacity**
4,48±0,21 g/g

**Oil Binding Capacity**
85,59 ± 3,73%



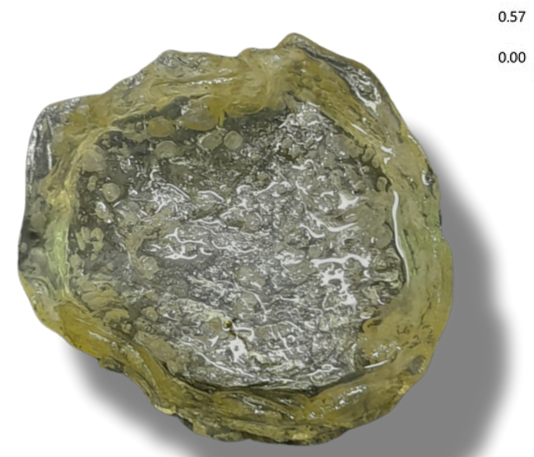
A **dense**, **folded**, and **wrinkled** surface with **no open pores**, resulting from **structural collapse** caused by **capillary forces** during water evaporation at **high temperatures**.

**Aerogel Dehydrator**




**Absorption capacity**
Value **not detected** significantly

**Oil Binding Capacity**
Value **not detected** significantly



**Average pore diameter**
4,450 nm

**Surface area**
7,241 m²·g⁻¹

## REFERENCES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## CONCLUSION & FUTURE WORK

Chitosan, alginate, and gelatin-based aerogels were **successfully developed as matrices** for oleogel synthesis, with **freeze drying showing superior** results. These aerogels feature an **open-porous three-dimensional** structure with an average **pore size of 4.701 nm**, **high absorption** capacity of **4.48 ± 0.21 g/g**, and significantly higher **oil-binding capacity** of **85.59 ± 3.73%**.

**Optimization** of the biopolymer composition is needed to achieve improved **rheological** and **morphological** properties. Future research could focus on **evaluating the oxidative stability** of oleogels during storage, as well as **characterizing** their **mechanical** and **thermal properties**.