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Synthesis of a Chitosan–Carrageenan-Based Bigel Using Aquatic Lipid as a Sustainable Liquid Phase for Fat-Reduced Chocolate

Wahyu Ramadhan[1,2,3*], Aliyah Indira Sari[1,3], Sugeng Heri Suseno[1], Fajar Domychen Sihombing[1,3]

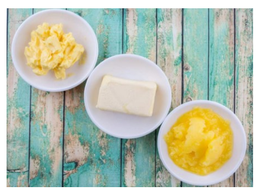
[1]Department of Aquatic Product Technology, Faculty of Fisheries and Marine Science, IPB University, Bogor 16680, Indonesia

[2]Center for Coastal and Marine Resources Studies, International Research Institute for Maritime, Ocean and Fisheries, IPB University, Bogor 16127, Indonesia

[3]Aquatic Gels for Future Advanced Materials and Technologies Research Unit, IPB University, Bogor 16680, Indonesia

*Corresponding author email: wahyu.ramadhan@apps.ipb.ac.id

INTRODUCTION & AIM



🍫 **Food Issues: The Use of Trans Fatty Acids**

📌 **Widely Used in Processed Products**

➡️ Found in margarine, butter, bread, confectionery products, and fast food

🍫 **Chocolate Candy Innovation**

⚙️ **Cocoa Butter Substitution with the Bigel System**

➡️ Reduces fat content by using bigel as a partial cocoa butter replacement

Bigel System

Looking for a more sustainable animal-based liquid phase

By-product

Belly Pangasius catfish

New Liquid phase

The technology employed in bigel synthesis is of critical importance, as the ratio between its components greatly influences the structural and functional properties of the system.

Research purposes

In this study, the newly developed liquid phase is utilized as the main structuring liquid in the bigel matrix.

Evaluation of Hydrogel Concentration in an Oleogel (Bigel Ratio) System derived from Patin Belly Oil By-products and Its Application in Chocolate Formulation.

METHOD

1 Extraction of catfish belly oil (Suseno *et al.* 2015)

Belly catfish → Smoothing with a food processor → Weighing → Addition of 1:1 (v/v) distilled water → Wet rendering extraction, 60°C; 30 minutes → Filtering → Pangasius belly oil

2 Bigel Synthesis (Modification Alkabaa *et al.* 2024)

Hydrogel Synthesis

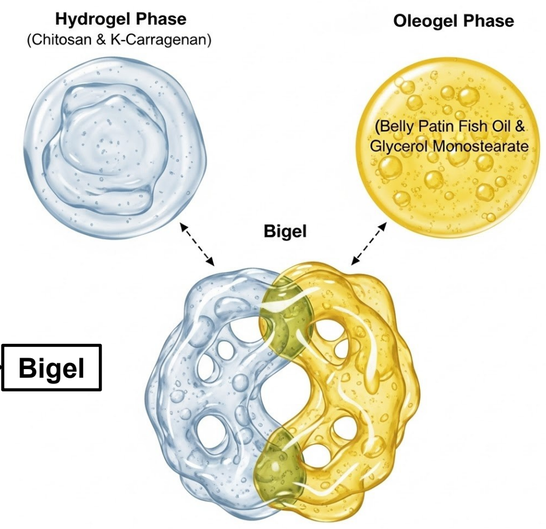
Chitosan

κ-Carra-geenan

Heating (90°C; 1000 rpm; 10 min) → Chitosan Hydrogel / κ-Carra-geenan Hydrogel → Mixing (90°C; 1000 rpm; 10 min) → Hydrogel Phase → Mixing (10,000 rpm; 3 min) → Cooling (4°C; 1 hour) → Bigel

Oleogel Synthesis

Belly patin fish oil + Glycerol Mono-stearate 5% → Heating (temperature 100°C; 1000 rpm; 15 min) → Oleogel Phase

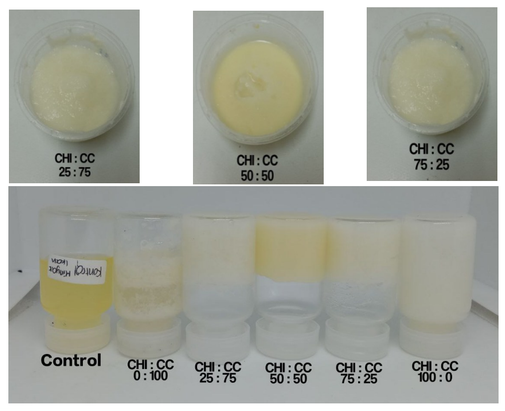


RESULTS & DISCUSSION

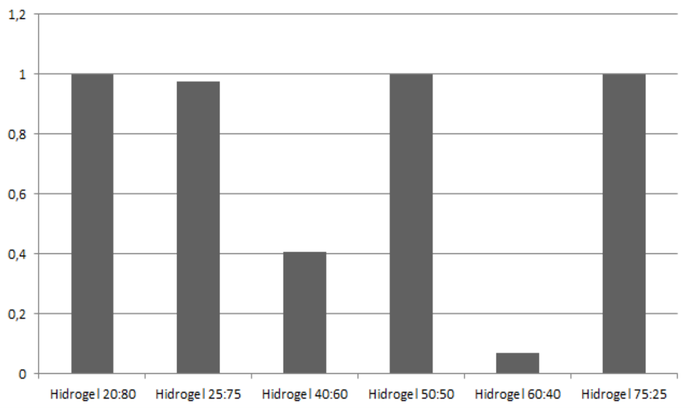
Fatty Acid Profile of Belly Patin

Test results	Fish oil (raw material)	Derivative
SFA (%)	34.39	Palmitic Acid (C16:0) 24.29%
MUFA (%)	26.47	Oleic Acid (C18:1n-9c) 25.02%
PUFA (%)	12.56	Linoleic Acid (C18:2n-6c) 10.28%

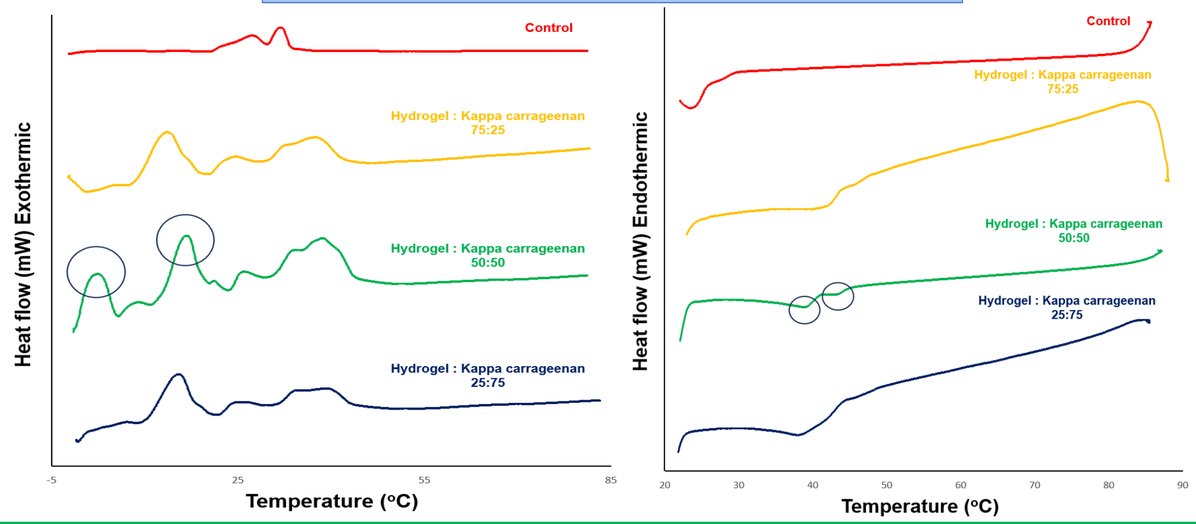
Gelation Test



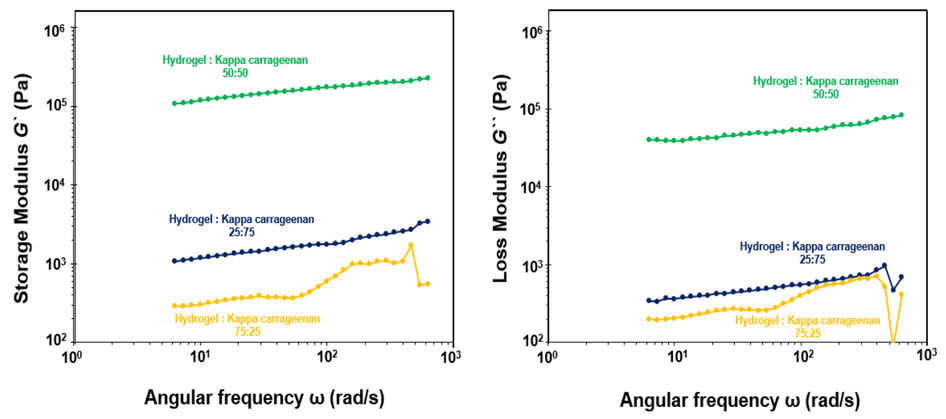
Oil Binding Capacity (OBC)



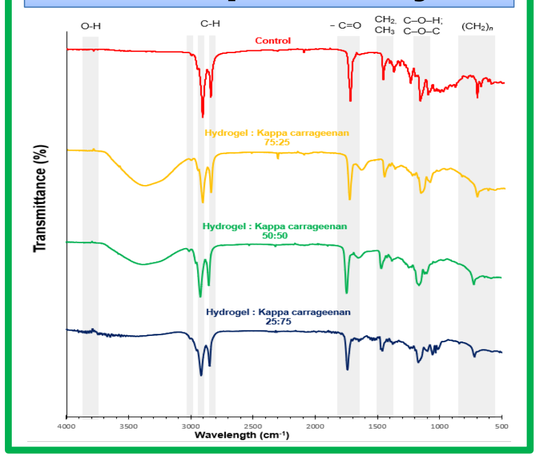
Differential Scanning Calorimetry (DSC)

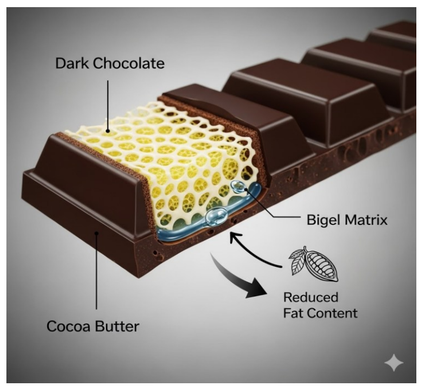


Rheological analysis



FT-IR Spectrometry





CONCLUSION

- The concentration and oleogelator significantly influenced the formation of oleogels from pangasius catfish oil.
- The 50:50 gel (ratio) showed the best gelation with the highest OBC value.
- These findings indicate that GMS and catfish oil-based gels have the potential to replace functional fats in chocolate.

REFERENCES

Alkabaa AS, Akcicek A, Taylan O, Balubaid M, Alamoudi M, Gulzar WA, Alidrisi H, Dertli E, Karasu S. 2024. Production of novel bigels from cold pressed chia seed oil by-product: application in low-fat mayonnaise. *Foods*. 13. 574. https://doi.org/10.3390/foods13040574

Suseno SH, Nurjanah Y, Saraswati S. 2015. Determination of extraction temperature and period of fish oil from tilapia (oreochromis niloticus) by product using wet rendering method. *KnE Life Sciences*. 1(1): 125-135. http://dx.doi.org/10.18502/kls.v1i0.96