

HARMONY IN PROGRESS:

**INTEGRATING SCIENCE, TECHNOLOGY,
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FOR SUSTAINABLE DEVELOPMENT GOALS**



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PST011 - ALGALEAN MEAT (LOW-FAT MEAT ANALOGUE WITH BORNEO SEA GRAPES)

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ABSTRACT

AlgaLean Meat is a plant-based meat analogue developed to meet the increasing global demand for healthy and sustainable protein alternatives. Conventional meat production is associated with high greenhouse gas emissions and intensive resource use, while many existing meat analogues rely heavily on synthetic additives, offering limited functional benefits. To address these gaps, AlgaLean Meat incorporates *Caulerpa lentillifera* (sea grapes), a nutrient-rich green seaweed native to Sabah, into textured vegetable protein-based formulations. The novelty of AlgaLean Meat lies in its integration of *C. lentillifera* into a meat analogue matrix, a combination rarely explored in commercial or research settings. The sea grapes are naturally rich in dietary fibre, bioactive compounds, as well as hydrocolloids that enhance water retention and cooking yield. By leveraging these properties, the product achieves functional improvements without artificial binders or preservatives. At an optimal inclusion level, seaweed enhances nutritional value and oxidative stability while maintaining desirable sensory qualities such as flavour, juiciness, and texture. The usefulness of AlgaLean Meat extends beyond its nutritional and sensory benefits. It offers consumers a healthier, lower-fat protein source with added dietary fibre, while its natural antioxidant capacity may extend shelf life. The product also showcases the potential of underutilized marine resources in the creation of value-added foods, aligning with sustainable development goals and market trends toward functional, eco-conscious eating. By combining Borneo's premium sea grapes with plant-based technology, AlgaLean Meat delivers an innovative, functional, and sustainable solution for the next generation of meat alternatives.

Keywords – plant-based meat, sustainable protein, functional food, seaweed

INTRODUCTION

In recent years, the market for plant-based meat analogues has expanded rapidly, driven by increased product availability and strong media promotion (Xie et al., 2024). Meat analogues, also referred to as plant-based meat, are designed to replicate the structure and texture of conventional meat, although they differ significantly in composition (Ahmad et al., 2022). According to a survey, the market share of plant-based meat analogues accounted for just 0.1% of fresh meat sales in January 2017; however, it increased fourfold to 0.4% within 18 months, highlighting the growing interest in sustainable meat alternatives

(Zhao et al., 2023). Meat analogues are typically made from textured vegetable protein (TVP), a dry, protein-rich material derived from soy protein concentrates.

However, TVP lacks the ability to form a cohesive structure on its own and therefore requires the addition of binders (Kim et al., 2024). Polysaccharide-based binders, particularly dietary fibers, are commonly added to improve water-holding capacity and modify texture of plant-based meat. Seaweed has garnered significant attention in recent years as a promising alternative source of food ingredients, owing to its abundance, low production cost, and environmental sustainability. Among the various edible seaweeds, *C. lentillifera* stands out as a species with considerable nutritional and functional promise. Traditionally, *C. lentillifera* is consumed fresh in salads and side dishes, appreciated for its succulent texture and slightly salty, ocean-like flavor. These sensory attributes, along with their nutritional richness, suggest that *C. lentillifera* could be further utilized in a wide array of processed food products.

Developed in collaboration between SCU Southeast Asia and Universiti Malaysia Sabah, AlgaLean Meat is crafted to attract vegans, vegetarians, and health-conscious consumers, delivering a distinctive ocean-fresh flavor with a strong Bornean identity. By harnessing an underutilized marine crop, this innovation not only meets the rising demand for nutritious, eco-friendly meat alternatives but also supports sustainable aquaculture and the local coastal economy in Borneo.

OBJECTIVE

- i. To enhance the nutritional profile of plant-based meat by increasing dietary fiber and incorporating natural antioxidants without added fat.
- ii. To evaluate the functional properties contributed by *C. lentillifera*, including texture, cooking yield, and oxidative stability.
- iii. To promote the use of underutilized local marine resources in sustainable, value-added food products.

DESCRIPTION OF THE PROJECT

AlgaLean Meat (Figure 1) is a locally inspired plant-based meat that pairs textured vegetable protein with *C. lentillifera* to deliver a distinctive flavor and functional benefits. The inclusion of seaweed enhances cooking yield, reduces cooking loss, and slows lipid oxidation, extending shelf life without synthetic preservatives, while natural hydrocolloids improve water-binding and texture. This distinctive product delivers a subtle ocean-fresh flavor and meat-like bite, providing a healthier, lower-calorie alternative to conventional meat and many existing plant-based products. Practical to prepare and versatile in use, it can be pan-fried, grilled, or served in burgers, catering to vegans, vegetarians, flexitarians, and health-conscious consumers. By utilizing a locally sourced, underused marine crop, AlgaLean Meat supports the blue economy and reduces reliance on imported ingredients, making it a functional and commercially viable meat alternative for both local and international markets.



Figure 1: AlgaLean Meat.

NOVELTY

AlgaLean Meat introduces a unique formulation that combines textured vegetable protein with *C. lentillifera* to produce a no-added-fat plant-based meat with enhanced nutritional and functional qualities. Unlike conventional meat analogues that rely on synthetic binders and added fats, this product harnesses the seaweed's natural antioxidants, dietary fiber, and hydrocolloids to improve texture, cooking yield, moisture retention, and oxidative stability. The seaweed is processed into powder form (Figure 2), which helps reduce the intensity of its ocean-like flavor, increasing consumer acceptability while still delivering its health benefits. The integration of this locally sourced, underutilized marine crop imparts a subtle ocean-fresh note and a natural green hue, creating a product that is nutritionally superior, sensorially distinctive, and strongly tied to Borneo's identity. This innovative approach elevates the value of sea grapes beyond their traditional fresh consumption and aligns with clean-label, eco-friendly food trends.



Figure 2: Seaweed powder.

CONCLUSION

AlgaLean Meat demonstrates how local marine resources can be transformed into a sustainable, value-added plant-based meat alternative that meets the rising demand for healthier, functional foods. By incorporating *C. lentillifera*, the product delivers improved texture, extended shelf life, and higher dietary fiber without added fat or synthetic additives. Its distinctive flavor, appealing appearance, and versatility in preparation make it attractive to a wide range of consumers, from vegans to health-conscious flexitarians. Beyond its consumer appeal, AlgaLean Meat supports the blue economy, reduces reliance on imported ingredients, and showcases the potential of integrating traditional coastal resources into modern food innovation.

REFERENCES

- Ahmad, M., Qureshi, S., Akbar, M. H., Siddiqui, S. A., Gani, A., Mushtaq, M., Hassan, I., & Dhull, S. B. (2022). Plant-based meat alternatives: Compositional analysis, current development and challenges. *Applied Food Research*, 2(2), 100154.
- Kim, Y. J., Kim, J. H., Cha, J. Y., Kim, T. K., Jang, H. W., Kim, D. H., & Choi, Y. S. (2024). Quality characteristics of meat analogs through the incorporation of textured vegetable protein and *Tenebrio molitor* larvae in the presence of transglutaminase. *Food science of Animal Resources*, 44(5), 1028.
- Xie, Y., Cai, L., Zhou, G., & Li, C. (2024). Comparison of nutritional profile between plant-based meat analogues and real meat: A review focusing on ingredients, nutrient contents, bioavailability, and health impacts. *Food Research International*, 187, 114460.
- Zhao, S., Wang, L., Hu, W., & Zheng, Y. (2023). Meet the meatless: Demand for new generation plant-based meat alternatives. *Applied Economic Perspectives and Policy*, 45(1), 4-21.