The Fermentation of *Fucus vesiculosus:* Sensory evaluation and product innovations

Megan Maher
Supervisors: D.Sc. (tech.) Niina Kelanne, Doc. Annelie Damerau, Doc. Oskar Laaksonen, Prof. Baoru Yang
FOOD DEVELOPMENT (TECH.)

Introduction

Seaweed, particularly *Fucus vesiculosus*, is a widely distributed macroalgae found along the coastal regions of North Sea, the western Baltic Sea and in both Atlantic and Pacific oceans. On a global scale, the seaweed market has been projected to grow from over $15 billion in 2021 to just under $25 billion by 2028 [3]. Despite its recognized health benefits, consumption in Western cultures remains relatively low [1].

This study aims to explore the potential of different fermentation strategies to enhance the sensory qualities and consumer acceptance of seaweed-based products.

Materials & Methods

- Seaweed samples sourced from the Finnish archipelago, washed, and stored at -20℃.
- Fermentation strategies include chopping vs. blending, with glucose concentrations at 10% vs. 20%, varying seaweed concentrations, heat treatments, & inoculation rates.
- Lactic acid bacteria (LAB) strains used: *Lactiplantibacillus plantarum* DSM 20174 and naturally occurring LAB from cabbage for product innovation.
- Chemical analysis monitoring fermentation: pH, brix, and CFU. Post-fermentation sugar and acid analysis for lactic acid concentrations using GC-FID.
- Two product innovations developed: a pesto & sauerkraut-style product.

Results – Fermentation monitoring

Fig. 1A

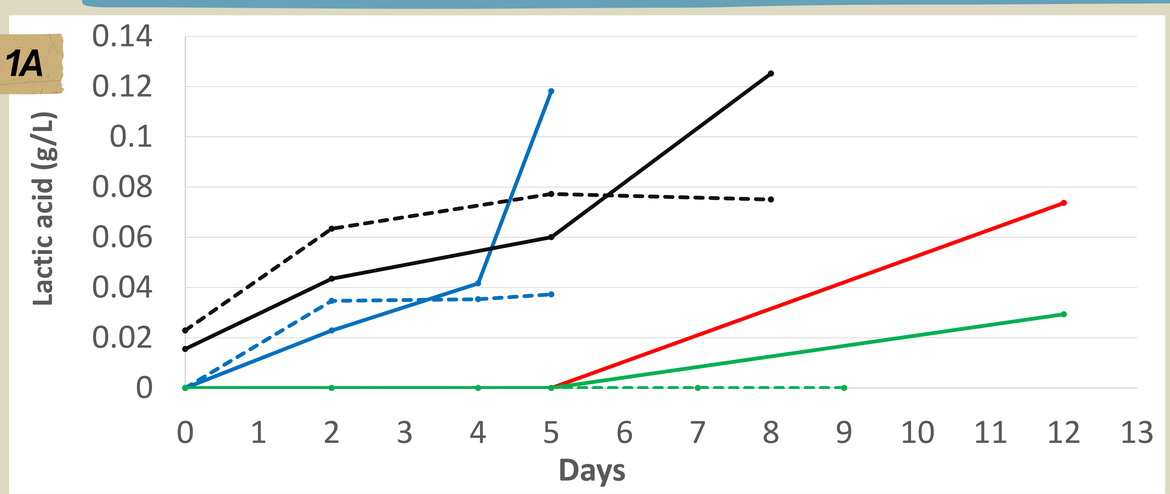


Fig. 1B

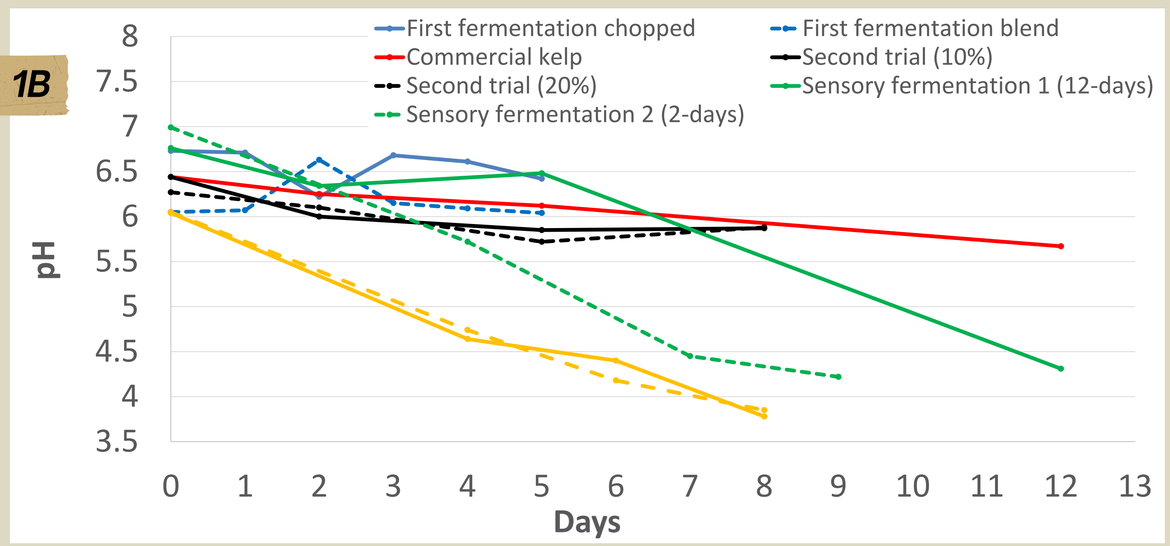


Fig. 2

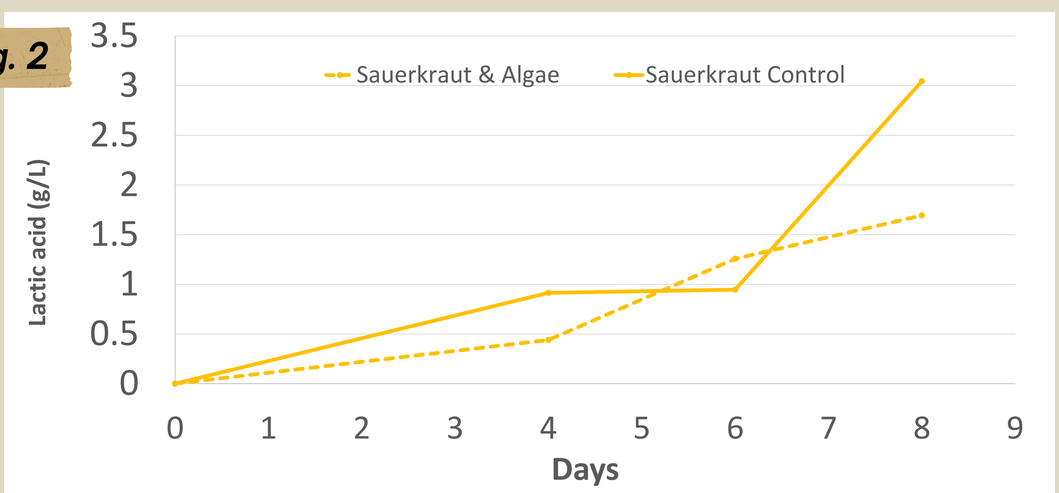
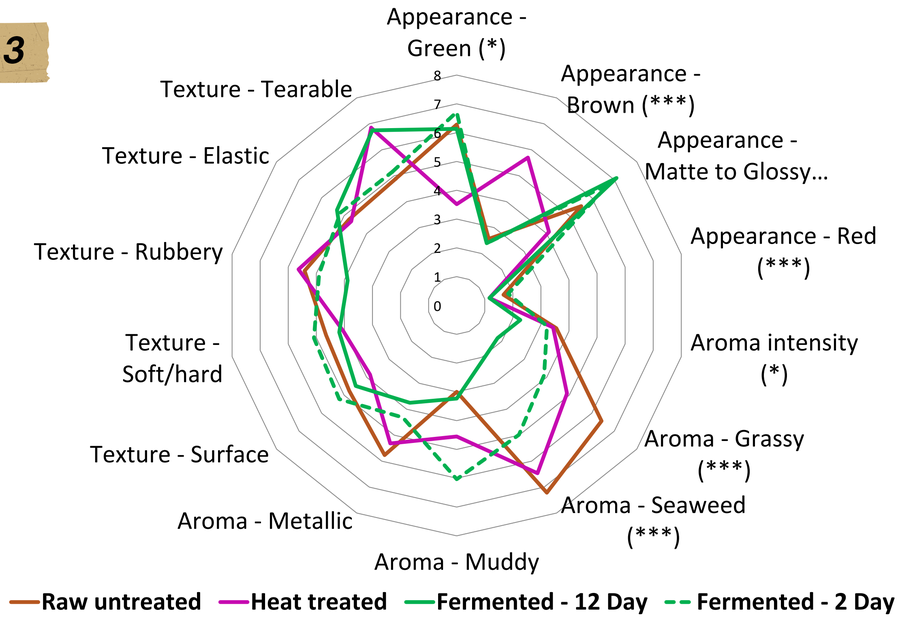


Fig. 1 A *The lactic acid concentrations in the various fermentation condition tested using LAB DSM 20174. Results were obtained from GC-FID in duplicate samples.*
Fig. 1 B *The pH reduction which was monitored for the duration of each of the fermentation strategies.*
Fig. 2 *Spontaneous fermentation in sauerkraut style product, seen a much larger production of lactic acid when utilizing LAB which was naturally present in the cabbage. Results indicate that algae may have hindered the production of lactic acid by day 8 of the fermentation*

Results - Sensory

Fig. 3



Sensory panel results for all selected attributes of seaweeds subjected to different treatments.

Both fermented samples showed lower intensities of seaweed and grassy aromas. Heat treated sample increased the brown appearance of seaweed.

Post Hoc: Tukey's HSD 0.05	
Significant at alpha 0.1	*
Significant at alpha 0.05	**
Significant at alpha 0.01	***

Conclusions

- Fermentation enhances sensory qualities and consumer acceptance of seaweed-based products which aligns with some previous research conducted on fermented kelp [2].
- Optimization of fermentation conditions improves lactic acid production and reduces undesirable aromas.

Future works

- Explore the impact of fermentation on the nutritional profile of seaweed products.
- Assess scalability and commercial viability for industrial applications.
- Further research is needed to fully unlock the potential of seaweed fermentation for sustainable and nutritious products.

References

1. Afonso, N. C., Catarino, M. D., Silva, A. M. S., & Cardoso, S. M. (2019). Brown Macroalgae as Valuable Food Ingredients. Antioxidants (Basel, Switzerland), 8(9), 365. https://doi.org/10.3390/antiox8090365
2. Bruhn, A., Brynning, G., Johansen, A. et al. (2019). Fermentation of sugar kelp (Saccharina latissima)—effects on sensory properties, and content of minerals and metals. J Appl Phycol 31, 3175–3187 . https://doi.org/10.1007/s10811-019-01827-4
3. CBI Ministry for foreign affairs. (2022, February 14). The European market potential for seaweed. Retrieved from Seaweed market potential: https://www.cbi.eu/market-information/fish-seafood/seaweed/market-potential