Seaweeds { The Future Of Anti-Obesity Therapeutics }

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Introduction

- Seaweeds have been found to inhibit lipase and α-amylase [1], helping in controlling obesity and type-2 diabetes by reducing the breakdown and absorption of dietary fats and carbohydrates [2]
- Ethanol extracts of seaweeds in particular, have demonstrated significant inhibition on lipase and α-amylase[1, 2]. Polyphenols are likely to be the main component found in ethanol extracts, and studies have shown their importance[2]
- As ethanol extraction is not physiologically relevant, further research on polyphenol release profiles of various seaweeds under simulated digestion (Model Gut System) is necessary to optimise the dose

Project Aims

① Quantify polyphenol content from two seaweeds (*Ascophyllum nodosum* & *Fucus vesiculosus*) using 4 extraction techniques: Methanol & Acetone for standard total polyphenols contents, Water, and the MGS with and without enzymes

② Determine the most appropriate extraction technique to allow assessment of polyphenols release in humans

Methodology

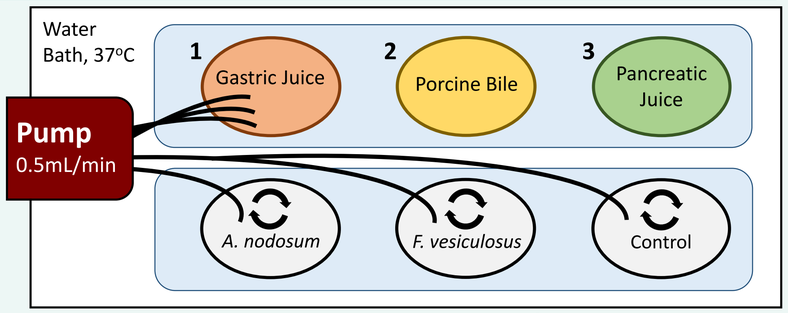

Figure 1. The Model Gut System for simulated digestion[3]. Seaweed samples were churned in synthetic saliva to begin the salivary phase of the model gut before samples were added to the gastric phase (1 hour) with gastric juice pumped to each sample. Porcine bile was added to each sample to initiate the pancreatic phase (2 hours) with pancreatic juice pumped into each sample. The control does not contain a seaweed sample. All samples and control contents were constantly stirred.

- Standard total polyphenols were extracted from the seaweeds using water and a methanol & acetone mixture, then measured to compare with the polyphenols released from the MGS with and without enzymes. All polyphenol extraction and measurement procedures followed the methods of Zhang et al., 2006[4]
- There were two variations of the model gut diluents used: One contained enzymes (salivary, gastric and pancreatic enzymes), and one without. Samples were collected at four time points: end of the salivary phase (Saliva), start of gastric phase (G0), end of gastric phase (G60) and at the end of the pancreatic phase (P120)

Results & Discussion

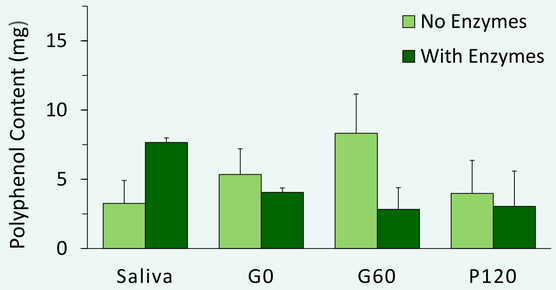

Figure 2. Polyphenols released from ***Ascophyllum nodosum*** samples in each section of the MGS respectively: End of salivary phase (Saliva), start of gastric phase (G0), end of gastric phase (G60) and end of pancreatic phase (P120)

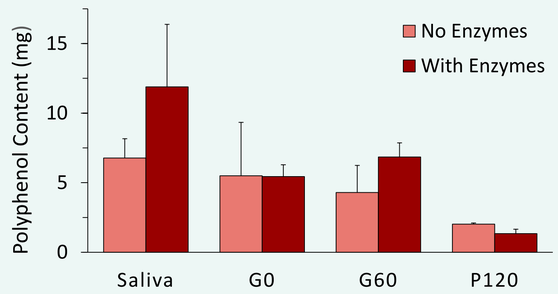

Figure 3. Polyphenols released from ***Fucus vesiculosus*** samples in each section of the MGS respectively: End of salivary phase (Saliva), start of gastric phase (G0), end of gastric phase (G60) and end of pancreatic phase (P120)

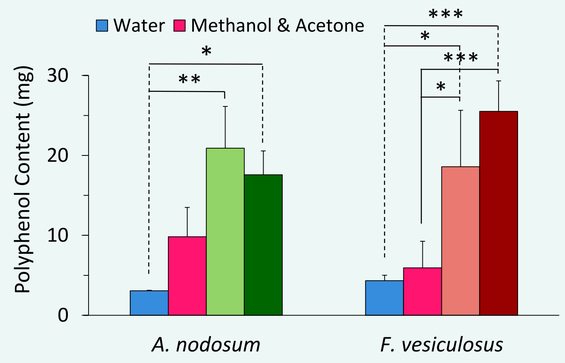

Figure 4. Comparison of total polyphenol content in respective seaweeds by different extraction methods: Water, Methanol & Acetone, and the MGS with and without enzymes (using same legends in Figure 2 and 3 for the type of seaweed samples)

- The highest amount of polyphenols were released during the salivary phase of the MGS containing enzymes **(Figures 2 and 3)**; preceding a decline in polyphenol amounts released over the rest of the simulated digestion process. The decline could be caused by the instability of the polyphenols in physiological conditions or enzymatic breakdown
- A significantly higher amount of polyphenols were released from **both *A. nodosum* and *F. vesiculosus* samples** when run through the MGS (both with and without enzymes) as compared to the amount released during **water extractions**. There was also a significantly higher polyphenol release from ***F. vesiculosus*** extracted in the MGS than methanol and acetone (both with and without enzymes), but **not** significantly higher for ***A. nodosum*** **(Figure 4)**
- The model gut enzymes may have been responsible for facilitating an enhanced release of polyphenols from ***F. vesiculosus*** in particular, where the total polyphenols extract using methanol and acetone yielded 5.9mg of polyphenols per gram of seaweed, but **nearly 5 times more at 25.5mg per gram of seaweed** when put through the **Model Gut System with enzymes (Figure 4)**

Conclusions

- ✓ ***F. vesiculosus*** released the **highest amount of polyphenols** in the most physiologically relevant model
- ✓ Acetone and water is **not a good predictor** of polyphenol release in humans**; simulated digestion is most relevant**
- ✓ Experimental results could help in the selection of seaweeds as potential **anti-obesity therapeutics**

References & Acknowledgements

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4 Zhang et al., (2006). A Simple 96-Well Microplate Method for Estimation of Total Polyphenol Content in Seaweeds. J Appl Phycol, 18(3-5), pp.445-450.

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