Assessing the effect of seaweed extracts (alginates) on digestive enzyme activity using a model gut system

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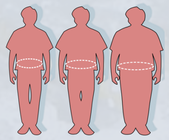
Background



- By 2050, half the UK population could be obese, doubling the cost of obesity to NHS (currently at £4.2 billion/y)
- Inhibiting pancreatic lipase decreases fat breakdown and absorption in the body.
- High-G alginates were effective pancreatic lipase inhibitors with no adverse effects on people (Wilcox *et al*., 2014).
- This research looks at three different alginates (GHB, DMB and PH 157) and their effects on lipase inhibition when released through bread during simulated digestion.

Hypothesis

1. Higher conc. of alginates gives higher percentage lipase inhibition.
2. Highest-G alginates inhibits lipase most; in the order GHB, DMB and PH 157.

Aims

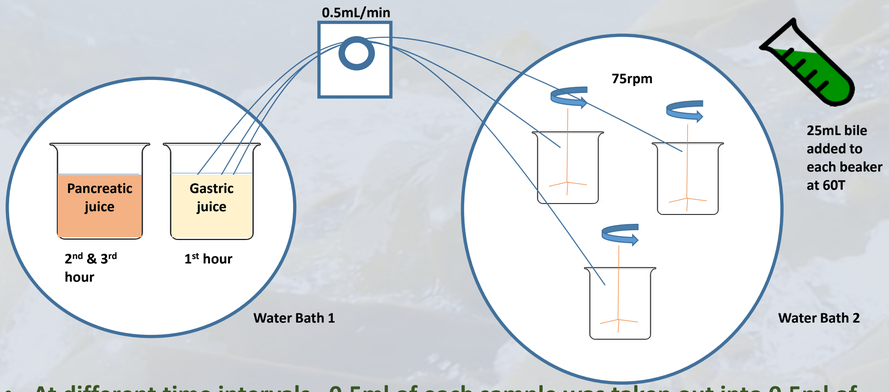
1. Determine the percentage lipase inhibition of the three alginates as compared against orlistat (100%)
2. To quantify the inhibitory effects of bread baked with 4% Alginate (GHB) on fat digestion.

Methodology 1 - Lipase Activity Assay

- Effects of the three alginates were tested through a lipase activity assay, using olive oil as substrate.
- Modified methodology of Vogel and Zieve (1963).

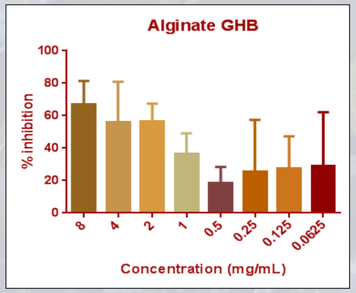
Methodology 2 - Model Gut System

- Olive Oil control, Alginate (GHB) + Olive oil (OO) and Bread (GHB)) +OO were run through a model gut system which replicates digestion in the mouth, stomach and small intestine.



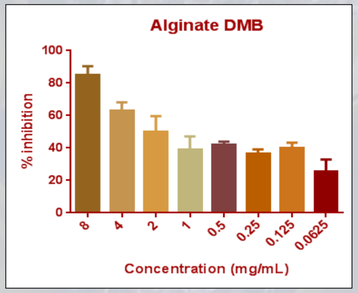
- At different time intervals , 0.5ml of each sample was taken out into 0.5ml of 10% Trichloroacetic acid to stop all enzymatic reactions.
- Glycerol analysis was done to assess the amount of fat digestion.
- Readings from the samples were subtracted from their respective controls

Results 1 - Lipase Activity Assay



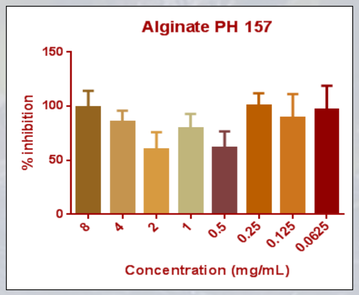
Alginate GHB showed highest level of lipase inhibition (67%) at conc. 8mg/mL and least inhibition (18.5%) at conc. 0. 5mg/mL; with an overall average inhibition of 39.5% (Fig. 1)

Fig. 1



Alginate DMB showed highest level of lipase inhibition (85%) at conc. 8mg/mL and least inhibition (25%) at conc. 0.0625mg/mL; with an overall average inhibition of 47.5% (Fig. 2)

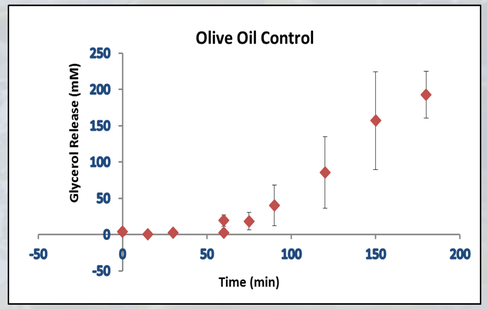
Fig. 2



Alginate PH 157 displayed the highest level of lipase inhibition among the 3 alginates; at least 50% of lipase inhibition for all concentrations (Fig. 3)

Fig. 3

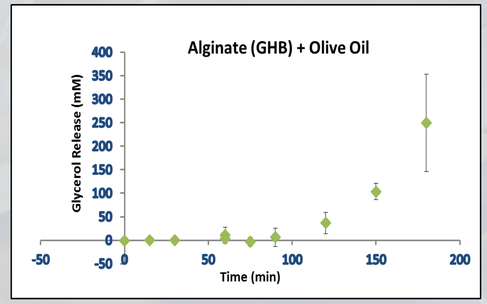
Results 2 - Model Gut System



OO Control, Alginate (GHB) + OO and Bread (GHB) + OO showed no release of glycerol (0mM) during the gastric lipase digestion (Fig. 4, 5 & 6).

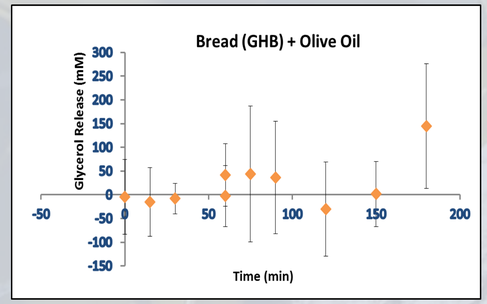
Glycerol released during pancreatic digestion after 60T (Fig. 4).

Fig. 4



Alginate (GHB) + OO (Fig. 5) showed reduction of 57% and 34% of glycerol released at 120T and 150T respectively when compared with the OO Control (Fig. 4).

Fig. 5



Bread (GHB)+ OO (Fig. 6) showed a near complete inhibition of fat digestion at 120 and 150 minutes compared to OO Control (Fig. 4). Glycerol (144mM) was released at 180T (Fig.6).

Fig. 6

Discussion

- Alginate PH157 appears to be the best lipase inhibitor (above 50% for all conc.).
- The hypothesis that highest-G alginates inhibits lipase most was rejected.
- Higher conc. of alginates (GHB & DMB) gives higher percentage inhibition.
- Bread (GHB) inhibited lipase more as compared to the alginate GHB alone.
- Baking (190°C) may have lysed the alginate molecules into smaller molecules and allows for more effective interaction with the lipase enzyme.
- Alginate at the crust (exposed to higher temp.) could be fragmented resulting in different size alginates being released upon digestion.
- Human trial intervention is required for further testing.
- Test whether the alginates interact with the active sites of lipase/ fats or both.

References

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