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## Introduction

Seaweeds grow in abundance around the coast of Ireland, Scotland and France. They are a valuable source of nutrients and some are recognised as foods, like *Himanthalia elongata* (Sea Spaghetti) found in pasta. Seaweed extracts may be rich in polyphenols and other bioactives. Dairy products, including butter, yoghurt and cheese are excellent carriers for bioactive ingredients. For example, berry polyphenols are commonly found in yoghurt products. Sales for plant-based foods increased by 5.5% to €5.4 billion, in the EU for 2023. These products cater for the vegan/vegetarian/flexitarian consumer.

The aim was to develop a variety of vegan, alternative, "dairy" products incorporating algal extracts generated from different brown and green seaweeds harvested from Brittany, France. Vegan yoghurt, butter, French-style Brie and sun-dried tomato cheeses were made using a combination of methods developed at Teagasc. Extracts were made into vegan and traditional dairy products and survival of polyphenols and bioactivities were compared.

## Material and Methods

Different dairy products (butter, cheese and yoghurt), vegan butter and cheese, and pesto and fairy cakes (Figure 1) were made using Teagasc recipes [1] that incorporated extracts from the French seaweed species at up to 4% inclusion rates based on total weight (w/w) in the final product.

The French algal extracts and final food products (Figure 1) were assessed for their bioactive contents and bioactivities using a number of different protocols as follows:

**Proximate compositional analysis:** Total proximate analysis was carried out to determine the protein, ash, lipid and moisture content for each extract and food product developed with the same (Figure 2) [2].

**Total Polyphenol content:** The polyphenol content of test samples was determined following the method Folin-Ciocalteu AOAC method [3]. The content of polyphenols in each test sample is shown in Figure 3.

### Bioactivities:

Alpha (α) amylase and cyclooxygenase 1 and 2 inhibitory activities were determined as described previously by our group [4], (Figure 4).

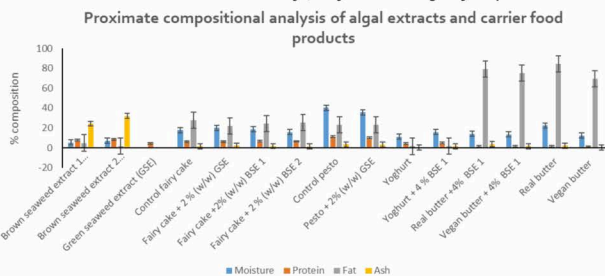
## References

- [1] Teagasc recipes developed as part of Algae4IBD ([www.algae4ibd.eu](http://www.algae4ibd.eu)).
- [2] Association of Official Analytical Chemists International Association of Official Analytical Chemists Washington, DC, 648 USA, 1995 Volume 1 p 870.
- [3] Kupina, S., Fields, C., Roman, M. C., Brunelle, S. L. (2018). Determination of total phenolic content using the Folin-C assay: Single-Laboratory Validation, First Action 2017.13. Journal of AOAC International, Vol, 101, No5, 2018. DOI: <https://doi.org/10.5740/JAOXimr-8-0031>
- [4] Shannon, E., Conlon, M. & Hayes, M. In vitro enzyme inhibitory effects of green and brown Australian seaweeds and potential impact on metabolic syndrome. *J Appl Phycol* 35, 893–910 (2023). <https://doi.org/10.1007/s10811-022-02900-1>.

## Results & Discussion

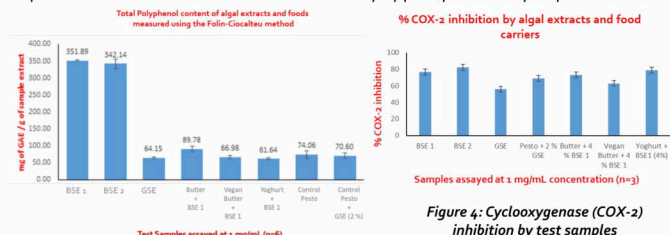


**Figure 1:** Vegan and real butter, fairy cakes, pesto and soft cheese made using algal extracts included at a concentration of 4 % of the total weight of the product.



**Figure 2:** Proximate compositional analysis of algal extracts and carrier foods with and without extracts.

Extracts contained between 4.5 % (Green Seaweed Extract (GSE)) – 8.67 % (Brown Seaweed Extract (BSE) 1) protein. Ash content ranged from 24 – 31 % for BSEs. The lipid content of BSE 1 was highest at 4.95 %. The highest protein content was observed for the pesto and pesto + 2 % GSE product (values 11.97 and 10 %, respectively). The highest polyphenol content was found in BSE 1 (351.89 mg GAE/g sample) and in real butter containing this extract (89.78 mg GAE/g sample), Figure 3. Butter and yoghurt (Figure 3) were found to be excellent carriers for BSE<sub>1</sub> as these foods inhibited COX-2 by 73.28 and 78 %, respectively (Figure 4). The nutritional value of vegan products, in terms of protein, were less than traditional products but vegan products were capable to maintain the COX-2 inhibitory bioactives. All extracts stimulated α-amylase production. This indicates enhanced sensory appeal/palatability of products.



**Figure 3:** Total polyphenol content of samples

**Figure 4:** Cyclooxygenase (COX-2) inhibition by test samples