THE USE OF NATURAL ANTIOXIDANTS IN OMEGA-3 RICH FOOD PRODUCTS

R Jónsdóttir1, DB Hermund2, C Jacobsen1, and HG Kristinsson1

Introduction

Studies show that a diet high in omega-3 fatty acids may have beneficial effects on human health. However, the changes of lifestyle and dietary habits have resulted in an increased intake of omega-6 and a lower consumption of omega-3. Therefore, it is of interest to enrich food products with omega-3 rich fish oil. Fish oils are very sensitive to lipid oxidation which is an important factor limiting the shelf life of the food products. Natural antioxidants derived from seaweed such as Fucus vesiculosus have high content of bioactive components with great potential to reduce lipid oxidation in food systems. The aim of this project was to develop innovative products rich in omega-3 and natural antioxidants derived from F. vesiculosus.

Materials and methods

Icelandic brown marine algae, F. vesiculosus, was collected in southwest Iceland. The samples were freeze dried and powdered prior to production of extracts, i.e. water or ethanol/ethyl acetate.

The antioxidant activity of the seaweed extracts was characterized using different chemical based antioxidant activity assays: Oxygen Radical Absorbance Capacity (ORAC), 1,1-diphenyl-2-picrylhydrazyl (DPPH) radical scavenging capacity; Metal chelating ability; Reducing power.

Storage experiments were performed using different F. vesiculosus extracts in different food systems, i.e. skinless salmon fillets, milk and mayonnaise, where these samples were stored for up to 12 (salmon and milk) or 28 days (mayonnaise).

Lipid oxidation during storage was followed by determination of peroxide value, TBARS, and/or secondary volatile oxidation products.

Results

Phlorotannins are the dominant polyphenolic compound with superior antioxidant activity. Previous studies using HPLC-ESI-MS analysis showed that the predominant phlorotannin of the most active fraction is a tetramer (499(M+H)+) (1).

The result of this present study confirms those results and the chemical structure of the compound is suggested to be fucodiphlorethol E (Figure 1).

The ethanol/ethyl acetate extract had the highest ORAC, DPPH, and reducing power value (Table 1) but the water extract gave the lowest values.

Aqueous F. vesiculosus extracts showed high antioxidant activity in salmon fillets, both regular and dark muscles (Figure 2). As expected, oxidation was significantly higher in the dark muscle, which was effectively reduced by one of the extract treatment. Also, when the extracts were tested in fish-oil enriched mayonnaise and milk, these extracts showed good antioxidant potential (2,3). Especially the addition to fish oil enriched mayonnaise to some extend decreased formation of primary oxidation products, 1-penten-3-ol (Figure 3).

Conclusions

F. vesiculosus extracts have shown good potential as novel natural antioxidants in food products and were found to be able to reduce both primary and secondary lipid oxidation in different food model systems rich in DHA and EPA.

This work was a part of the project “Novel bioactive seaweed based ingredients and products”, funded by the Nordic marine innovation programme, Nordic Innovation.

References


2. Hermund, DB, Yeşiltaş, R., Honold, P ., Jónsdóttir, R., Kristinsson, H.G., Jacobsen, C. 2015. Antioxidant evaluation of Icelandic F. vesiculosus rich in omega-3 and natural antioxidants derived from F. vesiculosus. Studies show that a diet high in omega-3 fatty acids may have beneficial effects on human health. However, the changes of lifestyle and dietary habits have resulted in an increased intake of omega-6 and a lower consumption of omega-3. Therefore, it is of interest to enrich food products with omega-3 rich fish oil. Fish oils are very sensitive to lipid oxidation which is an important factor limiting the shelf life of the food products. Natural antioxidants derived from seaweed such as Fucus vesiculosus have high content of bioactive components with great potential to reduce lipid oxidation in food systems. The aim of this project was to develop innovative products rich in omega-3 and natural antioxidants derived from F. vesiculosus.

# Table 1. Chemical based in vitro antioxidant activity tests (ORAC value, trolox equvalent (μmol TE/g extract), DPPH scavenging ability (%), Metal chelating ability (%) and Reducing Power (Ascorbic acid equivalent mg/g extract) in two different extracts.

<table>
<thead>
<tr>
<th>Extract</th>
<th>ORAC (μmol TE/g extract)</th>
<th>DPPH scavenging ability (%)</th>
<th>Metal chelating ability (%)</th>
<th>Reducing Power (Ascorbic acid equivalent mg/g extract)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water</td>
<td>2769</td>
<td>54,1</td>
<td>67,4</td>
<td>251</td>
</tr>
<tr>
<td>Ethanol/ethyl acetate</td>
<td>4732</td>
<td>72,7</td>
<td>20,9</td>
<td>555</td>
</tr>
</tbody>
</table>

# Figure 1. Fucodiphlorethol E.

# Figure 2. Lipid oxidation in salmon regular and dark muscle at 2°C as assessed by TBARS. Control represents samples without treatment.

# Figure 3. 5% Fish oil enriched mayonnaise (upper figures) and milk emulsions (lower figures) with water and ethyl acetate extracts (WE and EAE) in three concentrations; 1,0 (1), 1,5 (2) and 2,0 (3) g dry extract/kg mayonnaise or milk. Concentration of peroxides measured as PV (meq. peroxides/kg oil) (a) and development of secondary oxidation product, 1-penten-3-ol (ng/g mayonnaise or milk) (b). Mayonnaise was stored for up to 28 days at 20°C. Milk emulsions were stored for up to 12 days at 5°C Error bars indicate SD of the measurements (n = 2 for PV and n = 3 for volatiles compounds). REF represent samples without seaweed extract.

# Figure 2. Lipid oxidation in salmon regular and dark muscle at 2°C as assessed by TBARS. Control represents samples without treatment.

# Figure 3. 5% Fish oil enriched mayonnaise (upper figures) and milk emulsions (lower figures) with water and ethyl acetate extracts (WE and EAE) in three concentrations; 1,0 (1), 1,5 (2) and 2,0 (3) g dry extract/kg mayonnaise or milk. Concentration of peroxides measured as PV (meq. peroxides/kg oil) (a) and development of secondary oxidation product, 1-penten-3-ol (ng/g mayonnaise or milk) (b). Mayonnaise was stored for up to 28 days at 20°C. Milk emulsions were stored for up to 12 days at 5°C Error bars indicate SD of the measurements (n = 2 for PV and n = 3 for volatiles compounds). REF represent samples without seaweed extract.

This work was a part of the project “Novel bioactive seaweed based ingredients and products”, funded by the Nordic marine innovation programme, Nordic Innovation.