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

R Jónsdóttir[1], DB Hermund[2], C Jacobsen[2], and HG Kristinsson[1]

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*.

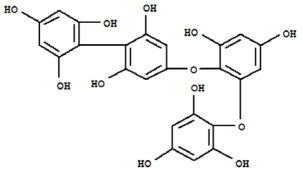

Figure 1. Fucodiphlorethol E.

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.
- The bioactive compounds were characterized using HPLC, LC-MS and NMR analysis.
- 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 milk or mayonnaise, 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 and oxidatively derived volatiles related to oxidation of fish oil (Figure 3).

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

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

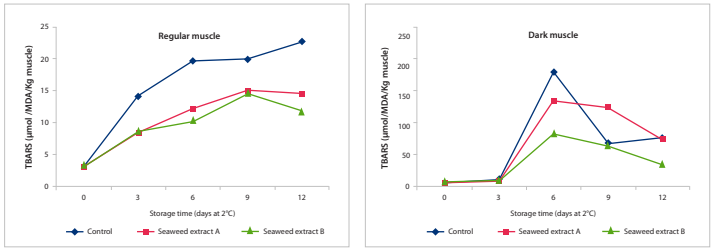

Figure 2. Lipid oxidation in salmon regular and dark muscle at 2°C as assessed by TBARS. Control represents samples with no treatment.

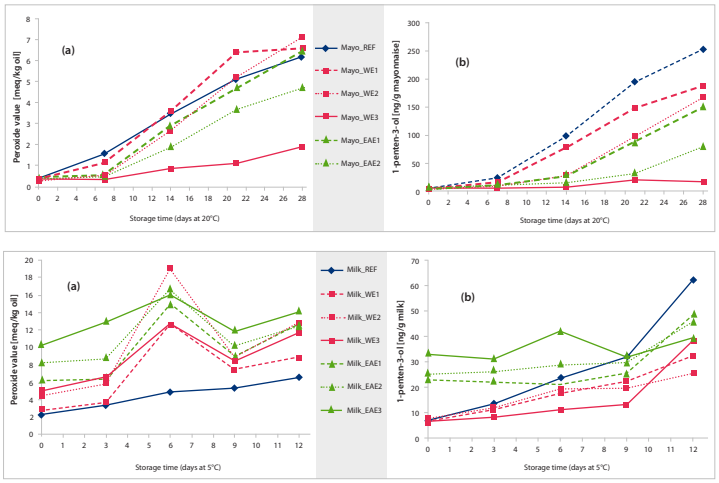

Figure 3. 5% Fish oil enriched mayonnaise (upper figures) and milk emulsions (lower figures) with water and ethyl acetate extracts (WE and EAF) in three concentrations; 1.0 (1), 1.5 (2) and 2.0 (3) g dry extract/kg mayonnaise or milk. Concentration of peroxides measured as PV [meq. peroxides/kg oil] (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.

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 oxi-dation in different food model systems rich in DHA and EPA.

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References

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Rósa Jónsdóttir (rosa.jonsdottir@matis.is; http://www.matis.is)

[1] Matís Ltd, Vinlandsleid 12, IS-113 Reykjavik, Iceland

[2] Division of Industrial Food Research, National Food Institute, Technical University of Denmark, Søltofts Plads, Building 221, DK-2800 Kgs, Lyngby, Denmark

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