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Bioactive compounds from Icelandic marine source

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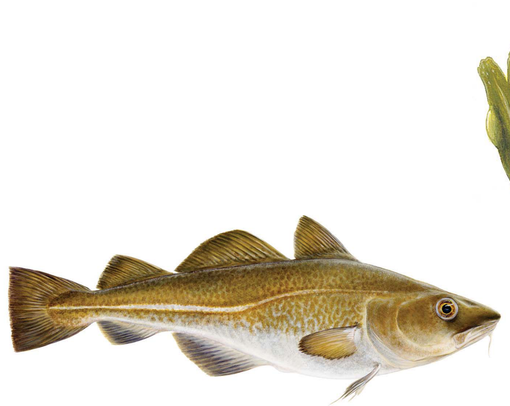

Cod
(*Gadus morhua*)

Seaweed
(*Fucus vesiculosus*)

Abstract

This work was a part of the project *Safe transportation of marine bioactives from source to active site*. The overall aim of the project was to study potential bioactivity losses, toxic effects or changes in protein expression due to oxidation of the bioactives either prior to ingestion (i.e. during storage of the isolate or food product) or during gastrointestinal digestion. Bioactive properties of cod liver oil, cod protein hydrolysate (CPH) and seaweed extract from Icelandic marine source were measured. The results indicated a high antioxidative potential of CPH and especially of the seaweed extract.

Introduction

The marine n-3 PUFA´s are well established functional food ingredients but other marine bioactive compounds, such as fish-derived proteins/peptides and polyphenols derived from seaweeds, are novel. Protein hydrolysates have been found to have certain bioactive properties potentially beneficial to human health (Thorkelsson and others, 2009) and seaweed extracts have shown to be excellent antioxidants as well as a source of functional compounds with potential health benefits (Wang and others, 2009, 2010). The aim of this work was to produce and screen for i*n-vitro* antioxidative properties and Angiotensin Converting Enzyme (ACE) inhibitory activity of bioactive compounds and extracts from cod protein hydrolysate (peptides) and *Fucus vesiculosus* extract (polyphenols) for addition into food model systems as a base for stable novel food products.

Materials and Methods

Cod liver oil was obtained from Lýsi hf. (Reykjavík, Iceland). Fresh cod fillets were obtained from Marland ehf. (Reykjavík, Iceland). CPH was produced by hydrolyzing a cod protein isolate solution (3% protein) using Protamex (Novozymes). *F. vesiculosus* extract was prepared by 80% ethanol extraction followed by ethyl acetate (EtOAc) extraction. Analyses of fatty acids and vitamins were done on the cod liver oil. Antioxidant activity was screened by Oxygen Radical Absorbance Capacity (ORAC), 1,1-diphenyl-2-picrylhydrazyl (DPPH) radical scavenging capacity, reducing power and ferrous ion chelating capacity. ACE inhibitory activity was measured to evaluate the anti-hypertension properties and the results were expressed as the concentration needed to inhibit 50% of the ACE activity. The total polyphenol content (TPC) of the seaweed extract was measured and the results were expressed as phloroglucinol and gallic acid equivalent in g/100 g of extract.

Table 1. Nutritional information of cod liver oil.

Saturated fatty acids [mg/g]	181
Monounsaturated fatty acids [mg/g]	520
Polyunsaturated fatty acids [mg/g]	299
EPA [mg/g]	89
DHA [mg/g]	114
Vitamin A* [µg/g]	59
Vitamin D_3 [µg/g]	2
Vitamin E [mg/g]	0

*Vitamin analyses were done by Lýsi hf. (www.lysi.is)

Table 2. Proximal composition of cod protein hydrolysates (CPH) and freeze dried *F. vesiculosus*.

	CPH	Seaweed
Protein [%]	86.1	7.1
Fat [%]	-	2.0
Ash [%]	-	0.2
Salt [%]	8.8	4.3

- not measured

Table 3. Antioxidant activity and total polyphenol content of cod protein hydrolysates (CPH) and *F. vesiculosus* extract (mean ±S.D. n=2).

	CPH	Seaweed extract
ORAC (µmol TE[1]/g)	1551 ± 99.6	2659 ± 63.7
DPPH (%)	48.4 ± 0.4	88.7 ± 0.4
Reducing Power (ASE[2] mg/g)	3.5 ± 1.1	850 ± 24.5
Fe^{2+} chelating ability (%)	39.5 ± 1.4	20.8 ± 1.7
IC_{50} (mg/mL)	0.6 ± 0.2	0.2 ± 0.1
TPC[3] (g PGE[4]/100g extract)		52.9 ± 2.0
TPC[5] (g GAE[5]/100g extract)		43.9 ± 1.6

[1]TE, Trolox equivalents, µmol/g extract or protein
[2]ASE, ascorbic acid equivalent, mg/g extract or protein
[3]TPC, total polyphenol content
[4]PGE, phloroglucinol equivalents
[5]GAE, gallic acid equivalents

Results and discussion

The content of EPA and DHA in the fish oil was 89 and 114 mg/g, respectively, as expected for cod liver oil (Table 1). No vitamin E was added to the fish oil to prevent the effect of external antioxidants in model studies done in the project (see the poster *Inhibition of haemoglobin-mediated lipid oxidation in washed cod muscle by bioactive compounds from marine source*). The proximate analyses of CPH and freeze dried *F. vesiculosus* (before extraction) are shown in Table 2. The EtOAc fraction of F. vesiculosus extract showed higher DPPH radical scavenging activity, ORAC value and reducing power compared to the cod hydrolysate which however showed higher iron chelating ability (Table 3). The concentration of seaweed extract needed to inhibit 50% of the ACE activity was three folds lower (0.2 mg/ mL) than the concentration of cod protein hydrolysates (0.6 mg/ml). It is well known that small peptides from fish protein hydrolysates posses good antihypertensive ability. In this study the seaweed extract showed much better ability to inhibit ACE activity

Conclusion

The results indicated that EtOAc fraction of *F. vesiculosus* was more efficient antioxidant compared to CPH measured by ORAC, DPPH and reducing power. However, CPH had higher ferrous chelating capacity. According to the in-vitro antihypertensive properties seaweed *F. vesiculosus* extract showed better results compared to cod protein hydrolysates.

Acknowledgement

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