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The urinary profile of seaweed polyphenol metabolites in humans

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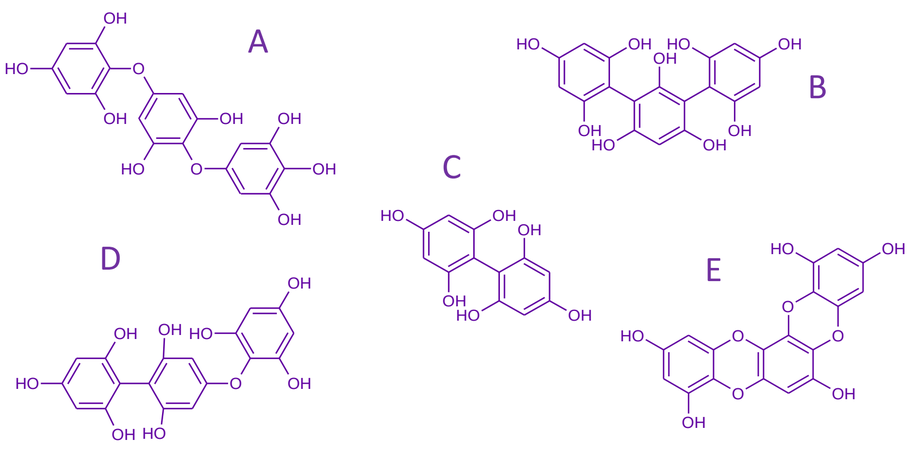
Seaweed polyphenols

Seaweeds are a rich source of polyphenolic compounds [1]. The types of polyphenols in seaweed show similarities to those found in land plants and include phenolic acids, tannins and flavonoids. In brown seaweeds, phlorotannins (oligomers and polymers of phloroglucinol units), which are unique to seaweeds of this type, can comprise 5 to 15 % of the dried weight [2].



Structures of phlorotannins: (A) trifuhalol A. (B) trifucol. (C) difucol. (D) fucophlorethol. (E) eckol.

Biological activities and bioavailability

Studies have suggested that seaweed consumption may deliver polyphenols to the circulation capable of expressing anti-inflammatory effects for both food and pharma applications [3, 4]. However, such studies have been hindered by the fact that, to date, little is known about the bioavailability of seaweed polyphenols.

Aim

The aim of this study is to investigate the absorption and metabolism of seaweed polyphenols in healthy subjects after ingestion of a food grade seaweed polyphenol extract.

References

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3. HE Moon, N Islam, BR Ahn, SS Chowdhury, HS Sohn, HA Jung and JS Choi, Biosci Biotechnol Biochem 75 (2011); 1472-1480.
4. I Wijesekara, NY Yoon and SK Kim, Biofactors 36 (2011);408-414.

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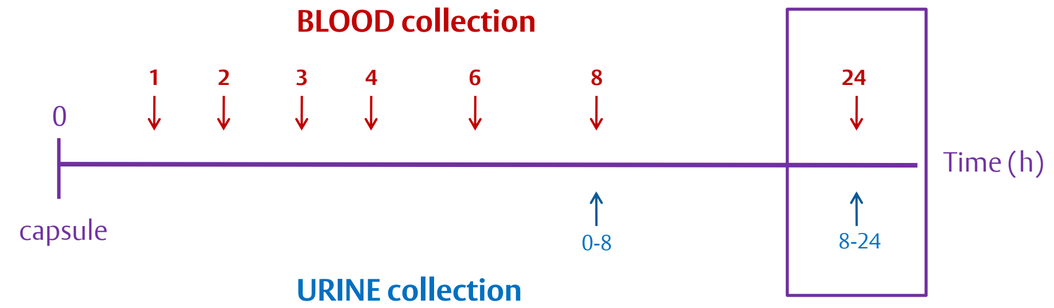
http://www.seaweedforhealth.org/swafax/

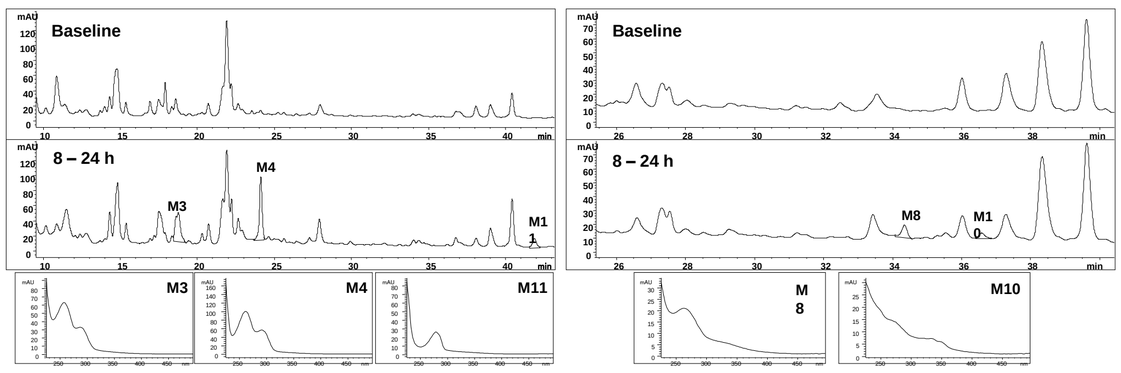
Study design

Volunteers followed a defined low polyphenol diet for 24h prior to and during the study day. Volunteers received the test material in the form of a capsule containing 100mg of polyphenols. Blood and urine samples were collected pre- and post-ingestion.



Urine analysis by HPLC

Urine samples were processed with and without enzymatic treatment (glucuronidase/sulfatase) and aliquots were injected on HPLC-DAD. Examples of chromatographic traces (268nm) are shown.



HPLC-DAD analysis of the urine samples with and without enzymatic treatment (glucuronidase/sulfatase) showed the presence of a variety of metabolites (M1-M15) absent in the baselines (before seaweed capsule ingestion) in urines from 15 volunteers (among 24). Some peaks (M3 and M4) show similar UV spectra characteristics and might therefore be structurally related.

Table 1. Metabolites in urines processed without (A) and with (B) enzymatic tretment (glucuronidase/sulfatase)

		0 - 8 h				8 - 24 h				
		A		B		A		B		
peak	RT (min)	mean	N	mean	N	mean	N	mean	N	metabolite type
M1	16.7	8.89	1			43.6	1			glucuronide/sulfate
M2	17.7					6.7	1			glucuronide/sulfate
M3	18.7					54.6	1	57.0	1	un-conjugate
M4	24.1							98.5	1	glucuronide/sulfate
M5	29.6					3.0	1			glucuronide/sulfate
M6	30.8					5.1	1			glucuronide/sulfate
M7	33							12.6	1	glucuronide/sulfate
M8	33.1					13.4	1	12.2	1	un-conjugate
M9	34.3					7.4	1	5.2	1	un-conjugate
M10	36.5					6.9	3	5.3	3	un-conjugate
M11	41.8			12.4	6			20.7	2	glucuronide/sulfate
M12	43.7							2.5	1	glucuronide/sulfate
M13	45.5					6.9	1			glucuronide/sulfate
M14	46.1							2.5	1	glucuronide/sulfate
M15	46.7							7.0	1	glucuronide/sulfate

[a] data are expressed in mg (phloroglucinol equivalents)

Some metabolite peaks were present in both samples with and without enzymatic treatment, and therefore could be assigned to un-conjugated metabolites. Some other metabolite peaks were present only in samples without enzymatic treatment or were only appearing in samples enzymatically treated, and were attributed to conjugate forms (glucuronides and/or sulfates).

Some metabolites were found in samples collected at 0-8h after capsule ingestion, thus the majority of the metabolites was found in samples collected at 8-24h.

This could be due to an high colonic metabolism, following fermentation of high molecular weight phlorotannins in the large intestine.

Bioavailability is a critical factor influencing in vivo biological activity and this study puts the basis for further investigating the seaweed-derived bioactive components in the body after ingestion and their mechanism of action in vivo.