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# Determination of water and lipid-soluble arsenic compounds in the commercial edible seaweed Hijiki (*Hizikia fusiforme*)

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## Introduction

Organic arsenic compounds are abundant in marine ecosystems. Although most of the arsenic compounds identified so far have been water-soluble species, the early work on arsenic marine chemistry focused on lipid-soluble compounds. In 1988, an arsenolipid was first rigorously characterized and identified as an arsenosugar-containing phospholipid in algae [1]. Subsequently, several arsenic-containing fatty acids and hydrocarbons have been discovered in different fish products, which origin was presumed to be algae. In this work, we report the water and lipid-soluble arsenic compounds profiles of the brown alga Hijiki.

## Experimental

Water-soluble arsenicals were extracted by a microwave-assisted extraction with deionized water and determined by HPLC-(UV)-HG-AFS [2], whereas lipid-soluble arsenicals were extracted by mechanical shaking with a (2:1) chloroform/methanol mixture, purified by SPE on home-made silica columns and determined by *on line* HPLC-ICPMS/ESMS analysis [3].

## Results and Discussion

The anion exchange HPLC-(UV)-HG-AFS (1) and reversed-phase HPLC-ICPMS (2) chromatograms for Hijiki extracts are shown in Figure 1.

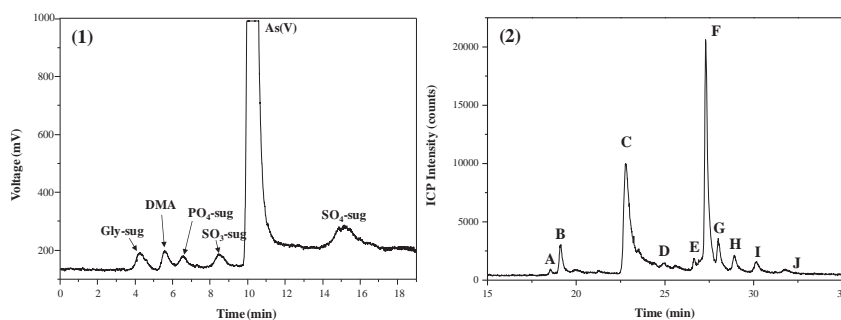


Figure 1. HPLC-(UV)-HG-AFS and HPLC-ICPMS chromatograms obtained for the water (1) and lipid-soluble arsenic compounds (2) in Hijiki extracts.

Water-soluble arsenic compounds identified in Hijiki comprised DMA, As(V) and four arsenosugars (glycerol (Gly-sug), phosphate (PO<sub>4</sub>-sug), sulfonate (SO<sub>3</sub>-sug) and sulfate (SO<sub>4</sub>-sug) sugars), As(V) being the major compound and accounting for approximately 70% of the total arsenic extracted [2]. Regarding lipid-soluble arsenic compounds, eleven arsenosugar-containing phospholipids (As-PL) and two arsenic-containing hydrocarbons (As-HC) were identified in Hijiki (Table 1), whose main structures are shown in Figures 2 and 3. Furthermore, two compounds remained unidentified (U1 and U2). The arsenic-containing hydrocarbon As-HC332 and the arsenosugar-containing phospholipid As-PL958, which is the arsenolipid first reported in algae [1], were the major compounds and accounted for approximately 23% and 18%, respectively, of the lipid arsenic [3].

Peak	Assigned structure	Molecular formula
A	U1	-
B	U2	-
C	As-HC332	C <sub>17</sub> H <sub>37</sub> OAs
D	As-HC360	C <sub>19</sub> H <sub>41</sub> OAs
E	As-PL930	C <sub>43</sub> H <sub>85</sub> O <sub>14</sub> PAs
	As-PL944	C <sub>44</sub> H <sub>87</sub> O <sub>14</sub> PAs
	As-PL956	C <sub>45</sub> H <sub>87</sub> O <sub>14</sub> PAs
	As-PL982	C <sub>47</sub> H <sub>89</sub> O <sub>14</sub> PAs
F	As-PL958	C <sub>45</sub> H <sub>89</sub> O <sub>14</sub> PAs
	As-PL984	C <sub>47</sub> H <sub>91</sub> O <sub>14</sub> PAs
G	As-PL986	C <sub>47</sub> H <sub>93</sub> O <sub>14</sub> PAs
	As-PL1012	C <sub>49</sub> H <sub>95</sub> O <sub>14</sub> PAs
H	As-PL1014	C <sub>49</sub> H <sub>97</sub> O <sub>14</sub> PAs
I	As-PL1042	C <sub>51</sub> H <sub>101</sub> O <sub>14</sub> PAs
J	As-PL1070	C <sub>53</sub> H <sub>105</sub> O <sub>14</sub> PAs

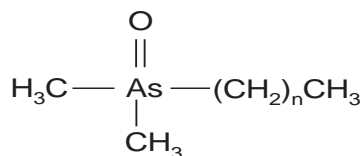


Figure 2. Structure for arsenic hydrocarbons.

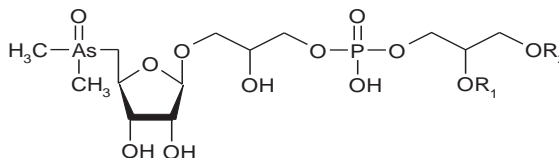


Figure 3. Structure for arsenosugar-phospholipids.

Table 1. Arsenolipids identified in Hijiki.

#### Acknowledgements

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#### References

1. Morita, M., Shibata, Y., *Chemosphere*, **17**, 1147-1152. (1988).
2. García-Salgado, S., Quijano, M.A., Bonilla, M.M., *Anal. Chim. Acta*, **714**, 38-46 (2012).
3. García-Salgado, S., Raber, G., Raml, R., Magnes, C., Francesconi, K.A., *Environ. Chem.*, **9**, 63-66 (2012).