Determination of arsenic species in algae by microwave-assisted extraction and high performance liquid chromatography-inductively coupled plasma-dynamic reaction cell- mass spectrometry

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Arsenic is very well known that toxicity depends not only on the total concentration but also related to its chemical form: Of the inorganic forms, arsine is highly toxic, and arsenite is accepted as being more toxic than arsenate. The methylated species monomethylarsonic acid (MMA) and dimethylarsinic acid (DMA) are less toxic than the inorganic forms. These compounds represent precursors of more complex organic and non-toxic forms, like arsenobetaine (AsB) and arsenocholine (AsC). Arsenic may enter the environment from industrial processes, or as inorganic arsenic pesticides and fertilizers used in agriculture. The presence of arsenic in seafood has been known for many years. Inorganic arsenic can be methylated in the environment forming organic forms. It is well known that algae have the ability to bioaccumulate the non toxic arsenic species.

The analytical procedure for analysis of arsenic species in algae was developed. It involved microwave-assisted extraction with 50% ethanol. At the power of 60 W, sample preparation time is only 6 min. An Inductively Coupled Plasma-Dynamic Reaction Cell-Mass Spectrometry (ICP-DRC-MS) was used as a High Performance Liquid Chromatography (HPLC) detector for the speciation analysis of arsenic. The six arsenic species inclusive of arsenite (As^{III}), arsenate (As^{V}), monomethylarsonic (MMA), dimethlyarsinic (DMA), arsenobetaine (AsB) and arsenocholine (AsC) were separated by Hamilton PRP-X100 anion exchange column. Gradient elution using 3% methanol 100 mmol ammonium carbonate buffer and water at pH 8.5 allowed the chromatographic separation of all species within less than 20 min. Methane as reactive cell gas in the DRC while an Rpq value of 0.5 was used. The recoveries of arsenic species were 93.9-118.5%, 102.1-130.4%, 106.2-113.8%, 101.2-112.9%, 97.8-108.7% and 85.2-95.4% for As^{III}, As^{V}, MMA, DMA, AsB and AsC, respectively. The detection limits of method for six arsenic species were in the range of 0.02-0.06 ng/mL based on 3 σ of blank response (n = 7). The precision was calculated to be 3.1-7.3% (CV) for all six species. It indicated that the method was well available to detect the arsenic species in algae.