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A Sensitive Determination of Iodide Species in Fresh or Saline Matrixes Using High Performance Chromatography and UV/Visible Detection

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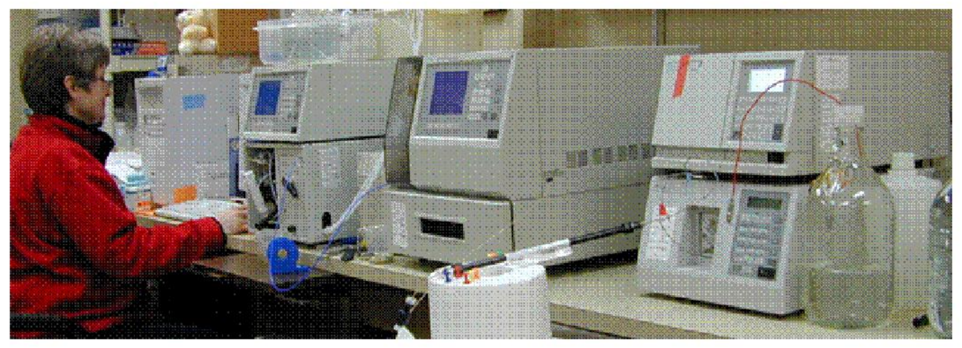


Objective

To develop an analytical method that uses readily available instrumentation and minimal sample preparation for the determination of stable iodine species at nanomolar concentration levels in a range of environmental water matrixes.

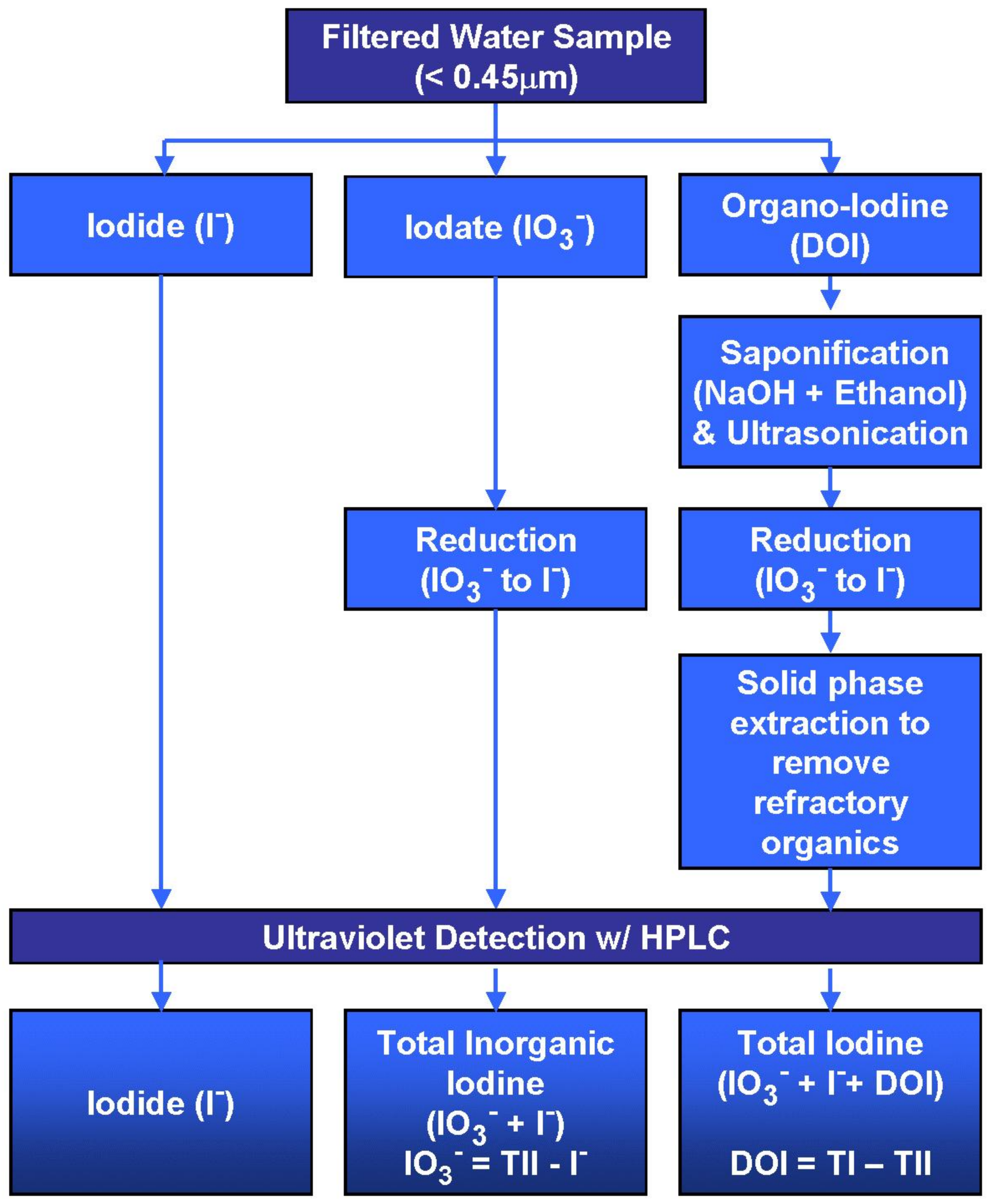
Importance

Recent studies employ $^{129}I/^{127}I$ as an oceanographic tracer of water mass movement (1, 2). The potential exists to extend the use of the iodine isotopic ratio as a tracer in fresh (3) and estuarine waters. Using the biophilic nature of iodine, $^{129}I/^{127}I$ may even provide a new tool for the geochronometry of organic matter. A thorough characterization of iodine speciation is required in preparation for these goals.

We present here a new method combining anion exchange chromatography and spectrophotometric detection to directly measure iodide (I-). The species determined are those that dominate natural water systems, iodide, iodate, and dissolved organic iodine. The analytical scheme for determination of these species is shown below.

Radioactive ^{129}I will be measured separately for the different iodine species, after special processing, by Accelerator Mass Spectrometry.

Sample Processing Scheme for the Determination of Iodine Species



Validation of Method

- Recovery of certified reference material
- Standard additions
- Comparison with measurements by ICP-MS

Certified Reference Material, SRM 1549, Powdered Milk

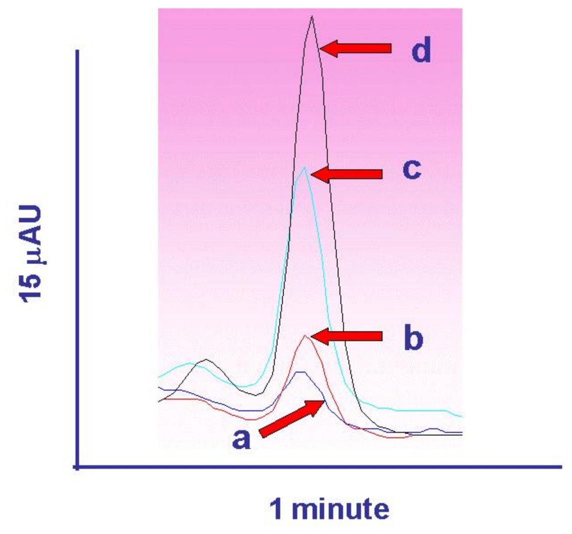


Figure 1. Overlay of chromatograms for standard additions to the milk reference standard.

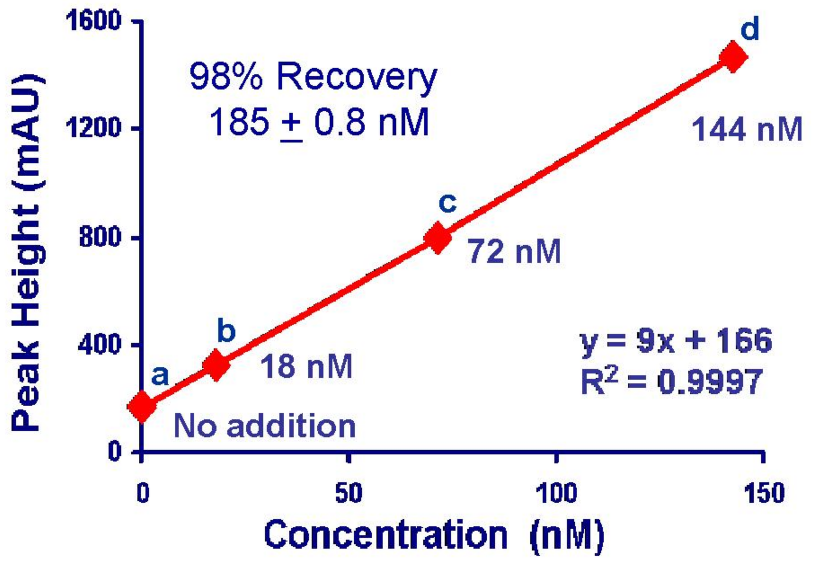


Figure 2. Linear regression for standard additions to milk reference standard.

Comparison With Measurements by ICP-MS

Seawater: Gulf of Mexico (Depth 1787 m)

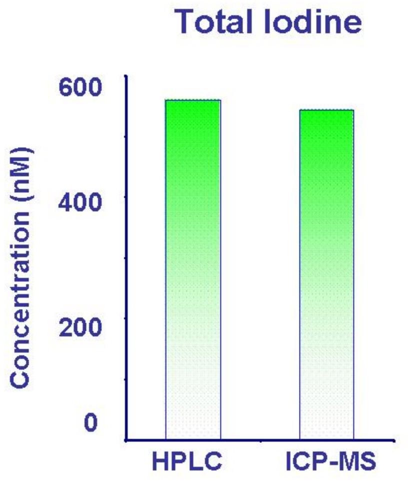


Figure 3. Comparison of total iodine from an alternate method. Recovery was 97% of average ICP-MS value.

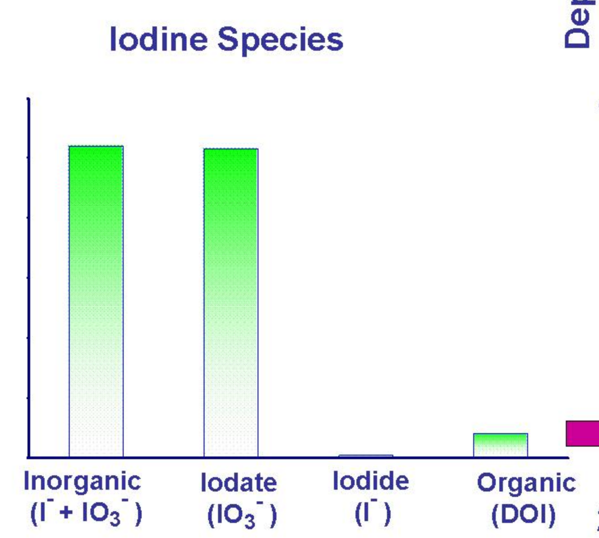


Figure 4. Iodine species for same seawater sample. Organic iodine is 7% of the total iodine.

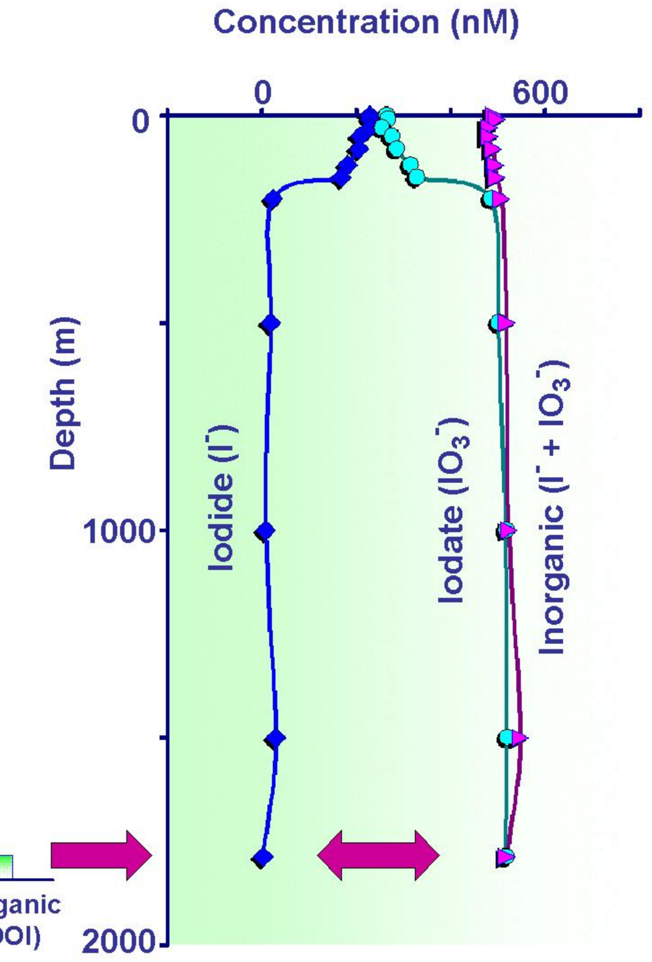


Figure 5. Vertical profile of warm core ring, 26ºN, 95ºW, July, 2000. Arrow indicates sample in Figures 3 & 4.

Fresh Water: Trinity River (Surface)

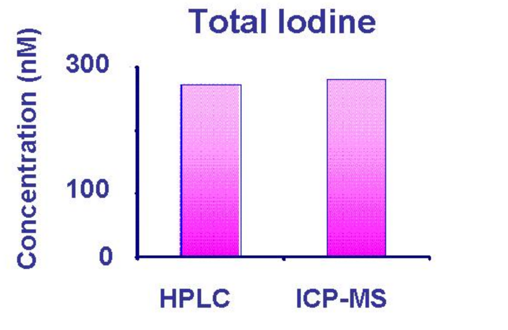


Figure 6. Comparison of total iodine from an alternate method. Recovery was 97% of average ICP-MS value.

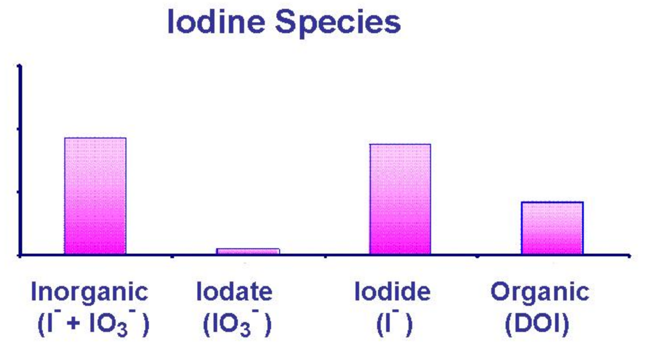


Figure 7. Iodine species for same fresh water sample. Organic iodine is 30% of the total iodine.

Results

Fresh Waters: Central and Southeast Texas

Station	Location	Date	$[I^-]$ nM	$[IO_3^-]$ nM	TII nM	Literature (5)
Galveston Rain	29.3°N, 94.8°W	Aug-02	4.9	19.4	24.3	$\leq$ 31
Gorman Springs	30.9°N, 99.8°W	Jan-00	62.8	4.5	67.3	60 avg.
Cave pool water	30.9°N, 99.8°W	Jan-00	40.4	24.0	64.4	60 avg.
Trinity River	29.8°N, 94.7°W	May-01	176.1	11.2	187.3	40 - 400

Measured concentrations are within cited literature values (5). The detection limit is $\leq$1 nM with an RSD of $\leq$ 3%.

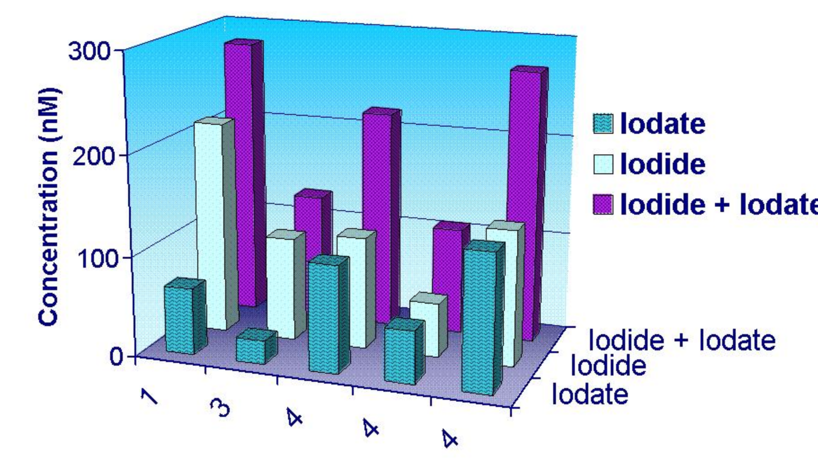


Figure 8. Inorganic iodine species distribution for the Bay surface waters values are given in the table below.

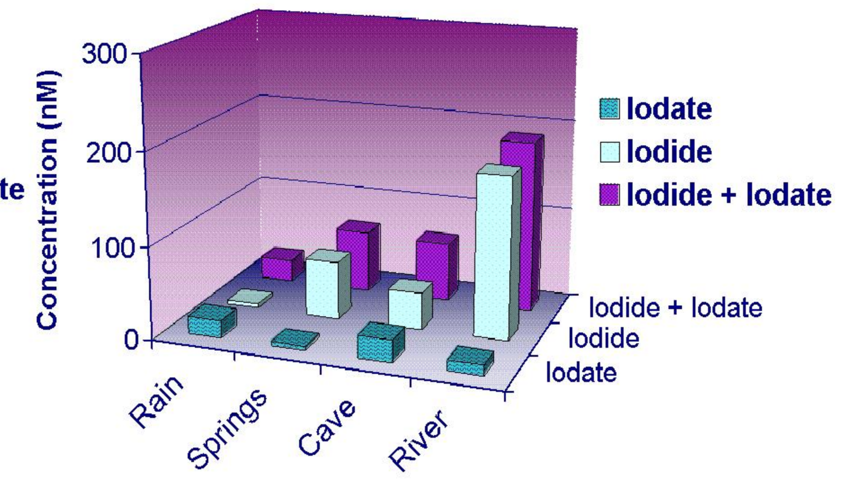


Figure 9. Inorganic iodine species distribution for the fresh surface waters values are given in the table above.

Estuarine Waters: Trinity and Galveston Bay

Station #	Location	Date	Salinity	$[I^-]$ nM	$[IO_3^-]$ nM	TII nM	Estimate*
1	29.7°N, 94.7°W	Sep-99	16.5	213.5	67.1	280.6	229
3	29.6°N, 94.8°W	Nov-99	9	103.6	23.4	127.0	125
4	29.5°N, 94.9°W	Sep-99	21	112.0	107.0	219.0	292
4	29.5°N, 94.9°W	Oct-99	12	54.1	52.6	106.7	167
4	29.5°N, 94.9°W	Nov-99	18	135.1	136.3	271.4	250

*Estimate is based on a 13.9 nM/salinity relationship. Literature values for the total iodine to salinity ratio for coastal waters range from 10 to 17 nM/salinity (4).

Conclusions

This new method is sensitive for detection of nanomolar concentrations of iodine species in fresh, estuarine, and saline water matrixes over a useful linear range.

Recovery for total inorganic and organic iodine species has been validated through several methods. The detection limit for inorganic species is 3 nM for saline waters and 1 nM for fresh waters. The detection limit for total iodine is 15 nM. Total and inorganic species have a RSD of $\leq$ 5%.

References

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Acknowledgements

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