

Challenges and Considerations for Iodine Measurement in Urine

Joisha Girme, Purnendu K. Dasgupta
Department of Chemistry and Biochemistry

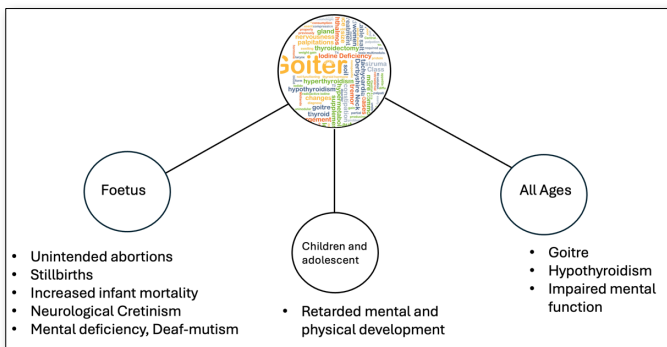


Background

- Iodine is essential for the biosynthesis of thyroid hormones T3 and T4 which serve a critical purpose in maintaining the liver, kidney, muscle and brain.
- Iodine deficiency in a developing fetus is one of the main causes for preventable neuroimpairment.
- Despite the implementation of salt iodization programs worldwide, 30 % of the world's population is still at risk.
- Urinary iodine (UI) is the epidemiological indicator used to measure iodine status in a population.

Iodine sufficiency	Urinary Iodine concentration ($\mu\text{g/L}$)
Severely deficient	<20
moderately deficient	20-49
Mildly deficient	50-99
Adequate nutrition	100-199
Above requirements	200-299

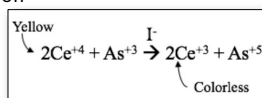
Adapted from Shelor, C. P.; Dasgupta, P. K. Review of Analytical Methods for the Quantification of Iodine in Complex Matrices. *Analytica Chimica Acta* **2011**, *702* (1), 16-36. <https://doi.org/10.1016/j.aca.2011.05.039>.



Adapted from : Hussain, H.; Selamat, R.; Kuang Kuay, L.; Md Zain, F.; Yazid Jalaludin, M. Urinary Iodine: Biomarker for Population Iodine Nutrition. *Biochemical Testing - Clinical Correlation and Diagnosis* **2020**. DOI:10.5772/intechopen.84969.

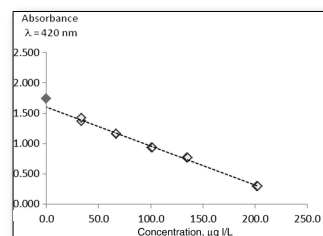
Methods of testing Iodine

1) Sandell-Kolthoff



Chutiane, H. Spectrophotometric Analysis of Urinary Iodine in 18-22 Year-Old Women in Central Minnesota. **2016**.

- Rate of Disappearance of yellow color in Ce (IV) –As (III) mixture is used as a measure of iodine content.



Machado, A.; Lima, L.; Mesquita, R. B. R.; Bordalo, A. A. Improvement of the Sandell-Kolthoff Reaction Method (Ammonium Persulfate Digestion) for the Determination of Iodine in Urine Samples. *Clinical Chemistry and Laboratory Medicine (CCLM)* **2017**, *55* (9). DOI:10.1515/cclm-2016-1094.

Challenges

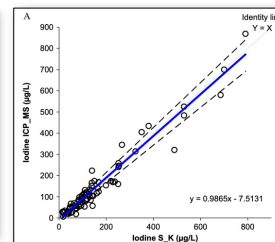
- Requires time consuming pre-digestion of samples, typically uses perchloric acid and special hoods due to explosion hazards.
- Digestion processes may lead to loss of elemental I_2 But without digestion there may be interferences.

2) ICP-MS

- It is referred to as the “Gold standard” because its specificity and sensitivity as compared to other techniques is far superior (0.08-0.22 ppb)



Wikipedia Contributors. Inductively coupled plasma mass spectrometry. Wikipedia. https://en.wikipedia.org/wiki/Inductively_coupled_plasma_mass_spectrometry

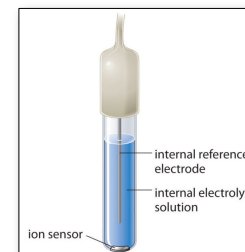


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Challenges

- High capital and running costs, skilled operator needed.
- Sample dilution is required. Isotope dilution needed for accuracy

3) Potentiometric probes



https://chem.libretexts.org/Courses/Mount_Royal_University/Chem_1120/LH_P/03A_Electrochemistry/6.2/03A_Standard_Electrode_Potentials

Interferences in the ISE Assay of Halides and Procedures for Preventing These Interferences

Halides	Interferences*	Procedures for Preventing Interference
Chloride	OH ⁻ = 80 Br ⁻ = 3×10^3 I ⁻ = 5×10^7	1) Acidification 2) Chromatographic separation from other halides
Fluoride	OH ⁻	Acidification with Orion special ISA-TS1AB, added to urine samples at equal volumes
Bromide	OH ⁻ = 3×10^3 Cl ⁻ = 400 I ⁻ = 2×10^4	Chromatographic separation from other halides
Iodide	Cl ⁻ = 10^3 Br ⁻ = 5×10^3	Chromatographic separation from other halides

Cleary, J.; Saunders, R. A. A Simplified Procedure for the Measurement of Total Hydroxyprogesterone in Urine. *Clinica Chimica Acta* **1974**, *57* (3), 217-223. [https://doi.org/10.1016/0009-8961\(74\)90040-6](https://doi.org/10.1016/0009-8961(74)90040-6)

Challenges

- Commercial iodide ISE are based on insoluble silver salt membrane and respond to other anions ,

Conclusion

- Many methods here can be carried out for determination of iodine in urine with low cost, accuracy, free of interference.
- However, few can be carried out without sample treatment, such methodologies would be a boon.
- Potentiometry poses to be a technologically advanced and accurate method, however further research is required to establish this method viable for commercial use.
- Along side potentiometric measurements of Iodide, a simultaneous measurement of conductivity would allow to measure the amount of Cl⁻ content which is one of the main constituents in urine and hence reduce the interference in iodide measurements

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