

IODINE IN SALT CAN BE DETERMINED RELIABLY, AFFORDABLY, AND SIMPLY IN A COMMON UV/VIS SPECTROPHOTOMETER

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Spectrophotometric methods are useful for measuring iodine in salt.

BACKGROUND

- The iodometric titration method is considered the reference standard for measuring iodine in salt.
- Iodine testing: The Association of Official Analytical Chemists recommends preparing salt solution with 50 grams of salt.
- Manufacturers of the single-wavelength spectrophotometers recommend preparing salt solution using different amounts of salt - 0.1 gram for the iReader, 1 gram for WYD, and 10 grams for the iCheck.
- Variation in iodine content can be due to—
 - performance of the equipment and the specific reagents of each method
 - preparation of salt solution with different salt amounts.

OBJECTIVE

- Determine the performance of a laboratory spectrophotometric method and three single-wavelength spectrophotometric devices for quantifying iodine in salt against the standard iodometric titration method.
- Compare the analytical accuracy and precision, simplicity of use, and cost.
- Demonstrate the use of 50 g of salt in solution to produce similar results across multiple devices (variation from preparation of salt solution is eliminated).

METHODS

- Setting: Laboratory
- Devices: Three single-wavelength spectrophotometers (WYD, iReader, and iCheck) and a common ultraviolet-visible spectrophotometer (UV/Vis)
- Reference: Iodometric titration
- Outcome: Iodine from iodate in salt
- Metrics:
 - Accuracy and precision
 - Time taken
 - Simplicity of use
 - Cost

Table 1. Results—Analytical Performance

Salt sample (I ² in ppm)	Titration		UV/Vis		WYD		iReader		iCheck	
	mean	SD	mean	SD	mean	SD	mean	SD	mean	SD
Kooksy (95)	95.9	0.5	102.8	7.8	95.4	6.8	91.0*	2.4	ND ^a	-
Habari/Kooksy (65)	64.0	1.0	66.9	3.8	62.7	3.3	59.5*	1.2	53.3*	1.6
Habari (35)	35.6	0.5	36.1	0.2	34.2*	0.3	32.5*	0.9	31.6*	0.8
Kensalt (22)	22.5	1.2	25.4	1.9	23.3	0.3	23.3	2.7	21.7	0.5
Kensalt (11)	12.6	0.7	12.9	0.8	13.3	1.0	11.2*	0.5	13.3	0.2
Kensalt (5.5)	8.0 ^b	0.5	6.7*	0.1	8.0	0.1	5.3*	0.1	9.0*	0.3

^aP<0.01
^a. ND as I2 content was too high for this method.
^b. Only the UV/Vis and the iReader are able to determine iodine contents lower than this value.

Table 2. Results—Time Required for Testing*

Personnel time	Titration	UV-Vis	WYD	iReader	iCheck
Sample preparation and procedure (min)	260	180	180	120	180
Wash/dispose glassware (min)	40	40	30	30	30
Calculations and supervisor (min)	20	20	10	10	10
Total time (min)	320	240	220	160	220
Estimated time for a single sample (min)	16	12	11	8	11
Estimated # samples in an 8-hour period	30	40	44	60	44

* per 20 samples in duplicate

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Table 3. Results—Cost*

Cost (in USD)	Titration	UV/Vis	WYD	iReader	iCheck
Equipment	182.00	90.00	119.60	139.88	624.00
Glassware and materials	172.40	690.50	690.50	964.10	10,063.50
Reagents	1,416.00	24.00	24.00	24.00	24.00
Total cost for 1,200 samples (w/o personnel)	1,770.40	804.50	834.10	1,127.98	10,711.50
Cost per sample (w/o personnel)	1.48	0.67	0.70	0.94	8.93
With Uganda personnel costs added					
Personnel cost	477.22	535.79	356.08	271.32	331.42
Total cost for 1,200 samples	2,247.62	1,340.29	1,190.18	1,399.30	11,042.92
Total cost per sample	1.87	1.12	0.99	1.17	9.20
Proportion attributable to personnel cost	0.39	0.45	0.29	0.23	0.27

*in USD, based on testing of 1,200 samples

CONCLUSION

- Spectrophotometric methods accurately and precisely reproduce the results of the titrimetric method for iodine if applied to solutions made with sufficient salt.
- The linear range of the iodine content in salt varied among methods— UV Spectrophotometer and iReader: 5–100 ppm; titration and WYD: 10–100; and iCheck 10–50 ppm.
- Use solutions prepared with 50 grams of salt.
- With considerations of analytical performance, ease of use, time required, and cost:
 - iReader is the device of choice for limited laboratory conditions.
 - In fully equipped labs, the UV/Vis spectrophotometer is a good alternative to titration.



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