A Method in Field Measurement of Urinary Iodine

Romsai Suwanik, M.D.*, Siriporn Chongchirasiri, M.Sc.*, Chaveevan Pattanachak, M.Sc.*, Rudee Pleehachinda, M.D.*, Supong Pattanachak, M.Ed.(Ad)*, Napaporn Tojinda, M.Sc.*, Thavorn Jaipetch, Ph.D.*, Nucharee Putrasreni, M.Sc.*, Chulalak Komoltri, Ph.D., Pratan Wongtala, M.Sc.***, Ian Buttfield, M.D. ******

**Department of Radiology, **Department of Epidemiology, Faculty of Medicine Siriraj Hospital, Mahidol University, Bangkok 10700, ***Department of Radiological Technology, Faculty of Allied Health Science, Naresuan University, Pitsanulok 65000, Thailand, ****Drug and Alcohol Service council of S.A., Australia.*

ABSTRACT

The objective of this study is to determine a very cheap, reliable, relatively rapid portable field unit for quantitative urinary iodine measurements. As Individual Urine Excretion (IUE) approximate those of Daily Iodine Intake (DII), iodine deficiency can be measured in casual urine samples of individual. Using the criteria, the frying pot method has been introduced and modified from the long and tedious Zak's method after Pino et al, and Robbins and Dunn et al. This modified method has many advantages. The assay takes 84 tubes of urine per pot in 100 °C paraffin oil and changes into water. It has been shortened from one hour to 25 minutes. Change of to intermediate violet is observed by adding ferroine as the indicator, resulting in a standard curve reading the concentration of iodine in micrograms per liter. The results of 255 subjects from Mukdaharn Province indicate the reliability of the method as the results are the same as those in the heating block and spectrophotomete. This has been confirmed by the results of 1,007 samples. This new technique provides good results; between oil and water, the results on using water are even better. This modification reduces significantly by lowering the cost of equipment. It is rapid, simple and reliable. The method is portable and valuable for measuring and monitoring iodine deficiency studies and for epidemiological studies of iodine deficiency its control in developing countries.

Keywords: Urinary iodine; Iodine intake; Frying pot method

Siriraj Med J 2006; 58: 962-966
E-journal: http://www.sirirajmedj.com

Rapidity and portability of urinary iodine measurements are needed in most situations which in clude the monitoring and evaluation of Iodine Deficiency Disorders (IDD). Monitoring of iodine levels in urine is essential in evaluating the success or failure of prophylaxis in IDD programs. Iodine levels can indicate iodine deficiency or excess; should such conditions be detected, corrective measures can be rapidly introduced.

Because most ingested iodine is excreted in urine, it is possible to estimate daily iodine intake from iodine excretion in casual urine samples.[1-5] In monitoring urinary iodine levels in the field, the Iodine Study Team at the Faculty of Medicine Siriraj Hospital, used a method of on-site testing of urinary iodine samples. The method is useful for population studies en mass, at a significantly lower cost and with speedy results. Using this method, iodine deficiency can be documented quantitatively in micrograms of iodine per day from standard curves of iodine. The results indicate the severity of a public health program (from a joint WHO/UNICEF/ICCIDD definition). The criteria for iodine deficiency includes samples below those of the standard concentration threshold level; <100μg per liter per day is considered mild, less than 50 moderate, and below 20 a severe iodine deficiency. Excess of urinary iodine may also be demonstrated in situations such as oral iodized oil administration in women of reproductive age or an over-dosage of KIO3 as a result of errors in preparing iodized water.

The objective of this study was to evaluate our technique for iodine measurement in urine, which is especially (a) portable (b) rapid and (c) reliable for (d) field use. The new method used water instead of paraffin oil with a short time (25 minutes instead of one hour) in the frying pot with ammonium persulfate before adding of Sandell-Kolthoff[6] (SK) reagents. Changes in color of the digested solution were noted after adding ferroine.[1,7]; constructing a standard curve and urinary iodine concentration was read.

MATERIALS AND METHODS

At present, for unknown urine samples, the iodine value can be estimated quantitatively and rapidly. The results are expressed in micrograms of iodine per liter and

Correspondence to: Siriporn Chongchirasiri

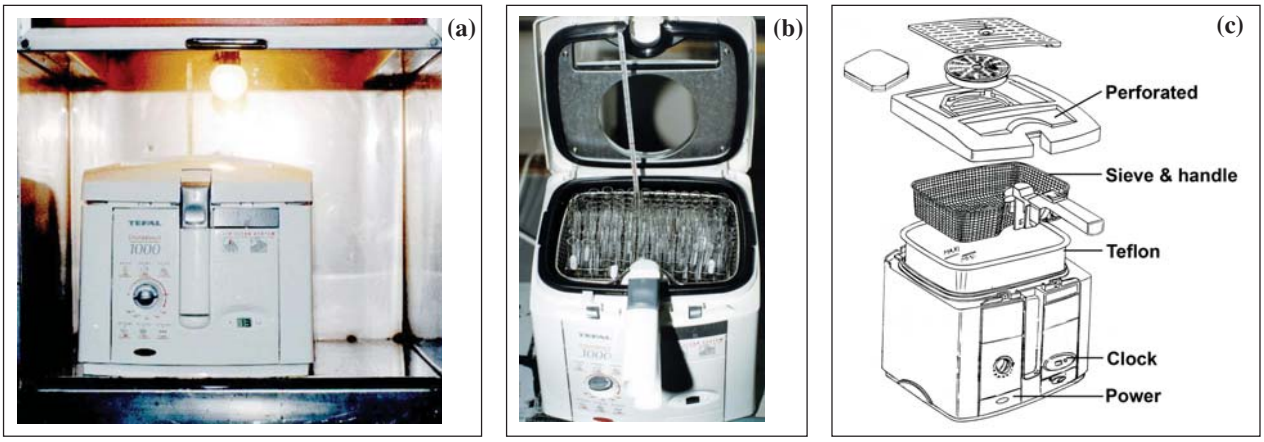


Fig 1. Modified digestion of urine, (a) by the use of a frying pot-"Tefal" in small home-made fume hood. (b) The urine is heated at 100°C for 25 minutes using either paraffin oil or water, which is put in a teflon container around the rows of 84 urine samples. (c) The diagram shows separate parts of the frying pot.

compared favorably by using either the portable frying pot or the gold standard method of a heating block and spectrophotometer.

Assay performance of the good method for urinary iodine analysis should have satisfactory results; as the assay performance can be performed as follows

a. Minimal Detection Concentration (MDC) or sensitivity of the assay- 20 blanks (zero point) run in assays (n=20). MDC is calculated as the concentration corresponding to two standard deviations below the mean of time of color change in replicates of the zero point.

b. Analytical recovery 5, 12.5, 20 ng iodine added, in duplicate, to urine samples prior to digestion (n=10). Recovery was calculated as the amount of added iodine measured, expressed as a percentage of the amount of iodine added.

c. Precision - Intra (within) assay: replicate samples run in 1 assay. - Inter (between) assay: duplicate samples in 10 or 15 assays.

In our technique the samples were digested with oil and changed into water which resulted in a shorter time to complete the reaction. Recently, two hundred and fifty five subjects from Mukdaharn Province, Thailand, were measured and confirmed by 1,007 studies of urinary iodine using two methods:

(I) the cheaper frying pot method, and

(II) the conventional gold standard heating block-spectrophotometer.

(I). Modified and cheap method using the portable frying pot

In this modified frying pot method, urine samples were digested for 25 minutes with ammonium persulfate.8 After adding Sandell-Kolthoff (SK) reagents and ferroine, the developed color was observed for change against time and a standard curve was constructed. The procedure of digestion was by the use of a frying pot "Tefal" (Fig 1). A paraffin oil bath was later changed into a water bath in a home-made hood, avoiding the use of expensive standard heating blocks, spectrophotometer, and an elaborate perchloric fume hood.



Fig 2. The homemade fume hood illustrates all three pots grouping together with 3x84 samples. Note the broad band of plastic above, preventing the blowing back of the vapor from each frying pot.

The frying pot 'Tefal' is a domestic appliance, consisting of two overlying containers. The lower one is coated with teflon (polytetrafluoroethylene) and filled with water instead of paraffin oil. The upper one is a sieve with a handle and contains a rack of 84 test tubes of urine. The pot also has a perforated lid and filter, which were not used in this application. Accessories such as power, time and heat control (the temperature is measured separately in the back), are assembled in the front.

A battery of three frying pots is housed in the home-made fume hood in which the three compartments are covered vertically above with a broad band of polyethylene to prevent the blowing back of the contaminating vapor from within the hood. The fume hood is shown in Fig 2.

Procedure

A) Two hundred and fifty microliters (µl) of casual urine samples and the standard were put into tubes, each containing 1 ml of 1M ammonium persulfate and digested in oil alternated with water at 100°C for 25 minutes (in-stead of the conventional one hour) in the frying pot. After digestion, the procedure continued as follows.

B) 100 µl of 10% ceric sulphate were dissolved in 10% H_2SO_4 and 100 µl of 7 M NH_4Cl were mixed in one bottle. Besides, 25 µl of 0.5N acetic acid were added to acidify the solution. This addition of acetic acid comes from past experience and teaches us to discriminate the color of paper.

C) One hundred and fifty µl of 5% sodium arsenite and 150 µl of ferroine were put in another bottle.

The reagents in both bottles of SK reagents (B and C) were then mixed and added to the digested urine (A) and the color changed from blue to violet (before the final orange). The time of change to an intermediate violet was considered critical to construct the standard curve.

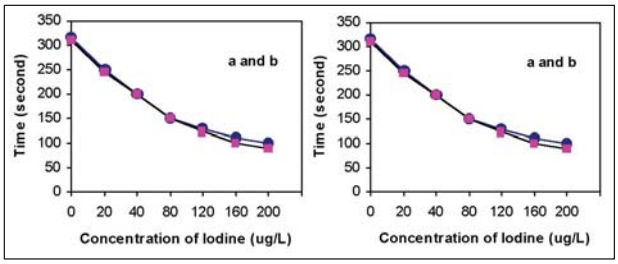


Fig 3. Comparison of standard curves between frying pot method using oil (■), water (●) and gold standard method (◆).

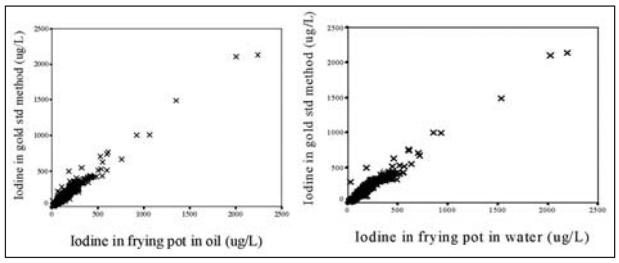


Fig 4. Correlation of the values of urine iodine specimens, digested by oil (X) and by water (Y) in the frying pot and gold standard method.

Preparation of standard solutions for construction of the standard curve:

In the modified method described in this paper, 0.5 (g/ml standard KIO_3 stock or urine (A) was diluted to 250 (l with the following concentrations: 0, 20, 40, 80, 120, 160, 200 µg/L/tubes after which one ml of ammonium persulfate was added to each tube. The tubes were then digested in the frying pot and added to the previously described reagents - (B) and (C). Finally, ferroine was added to the tubes which indicated different degrees of change of color from a faded blue to the critical violet, (finally to orange). Data regarding concentrations were plotted on graph paper.

II. Gold standard method[8]

In this standard method, a heating block and spectrophotometer were used; ferroine was omitted. Ammonium persulfate was used in the digestion with the heating block, the SK reagents were added, and a laboratory spectrophotometer was chosen to measure optical density.

In the gold standard method, standard KIO_3 concentrations are likewise prepared as above but a spectrophotometer is used to measure the fading of the original yellow color up to the iodine quantity as optical density (O.D.). Having compared the O.D. with various KIO_3 concentrations, the standard curve was plotted on graph paper (Fig 3c).

RESULTS

All results of the modified methods compared favorably with those of the original method. This point is important since it indicates that the precision of all current results are confirmed. Past studies have shown that urinary iodine measurements from the modified Pino method agree with those of the perchloric acid method.[8,9] A correlation coefficient (r) for the urinary iodine measurements between ammonium persulfate and perchloric acid digestion was 0.994 (n=110, Pino[9]) whereas those between the modified Pino method and the perchloric acid digestion method had r = 0.898 (n= 845, Suansawan[8]), respectively. Again, in the ammonium persulphate method [8], there was a high correlation between the digestion time of 25 minutes and one hour (r= 0.927, n=1,290); therefore, the shorter time of 25 minutes of digestion was chosen for economic reasons. Neither was found to give false positive or false negative results.

Some years ago we used Zak's method 10 in which a hot plate was used, but it was changed into a heating block technique to prevent evaporated corrosive digestion.[11] Perchloric acid was changed to ammonium persulfate[8,9] to prevent potential explosions and has been in use until now. All changes are supported as compatible with the current method.

TABLE 1. Assay performance of the frying pot method using paraffin oil and water.

	Paraffin oil	Water
Minimal Detection Concentration (MDC,µg/L), n=20	2.18	0.77
% Recovery	98.20	94.80

TABLE 2. Precision of the intra- and inter-assay of the frying pot using paraffin oil and water at 100°C.

		Urine iodine (µg/L)							
		Frying pot using paraffin oil				Frying pot using water			
	Concentration	n	Mean	SD	%CV	n	Mean	SD	%CV
Intra - assay	Low	15	25.77	2.57	7.42	40	32.94	1.56	4.74
	Medium	15	54.26	2.35	4.33	40	56.70	2.34	4.13
	High	15	131.66	2.59	1.97	40	115.52	3.17	2.74
Inter - assay	Low	15	23.88	1.79	7.49	10	27.99	1.82	6.50
	Medium	15	55.56	2.82	5.08	10	55.82	2.34	4.19
	High	15	121.86	5.08	4.17	10	101.36	4.89	4.82

TABLE 3. Comparison of the urinary iodine values (n = 1,007) obtained by the gold standard method and two frying pot methods.

Method of analysis	Urinary iodine range (µg/L)	Correlation coefficient (r)
Frying pot using oil	5.72-2,242.42	
		r_1 = 0.914 (p<0.01)
Gold standard	5.50-2,134.07	
		r_2 = 0.939 (p<0.01)
Frying pot using water	5.22-2,193.50	

Assay performance of the frying pot method using paraffin oil and water

In Table 1, Minimal Detection Concentration (MDC) of the paraffin oil using the frying pot method was shown to be only 2.18 µg/L, (n=20), compared with 6.8 µg/L using the gold standard method; the % recovery of the urine assay by the frying pot method was as high as 98.2%. For water, the MDC was as low as 0.77 µg/L, (n=20) and the % recovery was 94.8.

Table 2 showed the intra- and inter-assay of frying pot using either paraffin oil or water at different concentrations of urine iodine i.e., low, medium and high. To evaluate preci-

TABLE 4a. ne measurements in oil and water in 255 cases with a categorization of urine iodine deficiency, normal and excessive.

	Gold Standard			
	Iodine Deficiency (n=63)	Iodine Normal, Excessive (n=192)	Total (n=255)	Predictive value (PV)
Frying pot using oil				
Iodine Deficiency	50(79.4%)	11(5.7%)	61	PPV=82.0%(50/61)
Iodine Normal, Excessive	13(20.6%)	181(94.3%)	194	NPV=93.3%(181/194)
Frying pot using water				
Iodine Deficiency	59(93.6%)	9(4.7%)	68	PPV=86.8%(59/68)
Iodine Normal, Excessive	4(6.3%)	183(95.3%)	187	NPV=97.9%(183/187)

sion of intra-assay, each sample was measured repeatedly 15 or 40 replicates in 1 assay. On the other hand, inter-assay precision was obtained by measuring the same samples in duplicate repeatedly 15 or 10 assays. The results showed that frying pot using either paraffin oil or water had high intra-assay precision as shown by CV of 1.97% -7.42% which was less than the highest acceptable CV of 10%. Regarding inter-assay precision, frying pot method also demonstrated a high precision with CV of 4.17% -7.49% which were much less than the highest CV of 15%.

The results shown in Tables 1 and 2 demonstrate that the frying pot method using water digestion is reproducible, sensitive and accurate when compared with the frying pot method using paraffin oil.

Similarities of standard curves of the two methods:

Fig 3 a, b and c displayed a comparison of standard curves between two frying pot methods and gold standard method. For two frying pot methods (using oil or water), standard iodine concentrations (0, 20, 40, 80, 120, 160, 200 μg/L) were plotted against the time of color change from blue to violet (Fig 3a and 3b). For the gold standard method (Fig 3c) iodine concentrations were plotted against the fading reaction of reagents as different optical densities. The three standard curves showed a very similar pattern.

Correlation between values for urine iodine samples by the frying pot and gold standard (heating block and spectrophotometer) methods as shown below

Fig 4x and 4y show urine iodine measurements from the frying pot using oil and the gold standard method, and the frying pot using water and the gold standard method, having a high positive correlation (r_1 in oil = 0.914, n= 1,007 and r_2 in water = 0.939, n= 1,007, respectively as shown in Table 3).

TABLE 4b. Showing the results of a bigger series into 1,007 cases using paraffin oil and water for digestion.

	Gold Standard		
	Iodine Deficiency (n=408)	Iodine Normal, Excessive (n=599)	Total (n=1,007)
Frying pot using oil			
Iodine deficiency	377(92.4%)	77(12.9%)	454
Iodine normal, excessive	31(7.6%)	522(87.1%)	553
Frying pot using water			
Iodine deficiency	370(90.7%)	40(6.7%)	410
Iodine normal, excessive	38(9.3%)	559(93.3%)	597

In term of categorization of urine iodine deficiency (severe, moderate and mild), no iodine deficiency (normal and excessive) is present (Tables 4a and 4b).

Table 4a displayed sensitivity, specificity, positive predictive value (PPV) and negative predictive value (NPV) of frying pot using either oil or water compared to heating block - spectrophotometer which was considered as a gold standard. Frying pot using oil had a sensitivity of 79.4% (95%CI=69.4%-89.4%), specificity of 94.3% (91.0%-97.6%) and accuracy of 90.6% (87.0%-94.2%), respectively. In terms of predictive values, frying pot using oil had a high PPV of 82.0% (70.0%-90.6%) and NPV of 93.3% (88.8%-96.4%). For frying pot using water, it had a very sensitivity of 93.6% (87.6%-99.7%), specificity of 95.3% (92.3%-98.3%) and accuracy of 94.9% (92.2%-97.6%). Frying pot using water had also a very high PPV of 86.8% (76.4%-93.8%) and NPV of 97.9% (94.6%-99.4%).

The prevalence of iodine deficiency in this study was 24.7% (63/255) which was similar to the prevalence in the Thai rural population. Therefore, all predictive values obtained from this study could be directly applied to the Thai rural population.

Table 4b demonstrated sensitivity and specificity of frying pot using oil and water in another series of 1,007 subjects. These sensitivity and specificity were in a good agreement with those from Table 4a. Since the prevalence of iodine deficiency in Table 4b was much higher (40.5%) than the general Thai rural population, predictive values were not presented.

It should be mentioned that using water for digestion in the frying pot provided the best sensitivity, specificity and accuracy.

DISCUSSION

The degree of iodine deficiency is demonstrated by the following iodine values. Iodine deficiency is generally associated with low urinary excretion rates of less than 20, 50 to 100 μg/L of iodine per 24 hours approximately.[5,12] The results of urine iodine can be categorized into four deficient groups, i.e., severe (< 20 (g/L), moderate (20- 50 (g/L), mild (50 - 70 (g/L) and equivocal (70-100 (g/L). A low iodine value is associated with more severe complications, e.g., mental and physical deficiency. Normal values (l00 - 200 (g/L) and excess (>200 (g/L)13 are in the iodine replete groups.

Many advantages are derived from this frying pot method, particularly accuracy. The frying pot for the field method can avoid the high cost of heating blocks, perchloric fume hood and spectrophotometer. The SK reagents, prepared after Robbins,7 gave a change of color that can be easily differentiated. The time of color change from blue to violet in par-

affin oil and later in water in the frying pot method was accurately determined, indicating the exact quantitative concentration of urine iodine (Fig 3a and 3b). This accuracy was reconfirmed by the large series (n= 1,007). Urine samples, no matter how long they are kept in a freezer, can be digested by ammonium persulfate and give similar accuracy.

This study has shown that this new frying pot method provides good sensitivity and specificity. This new method is convenient for field use because of its portability. It simply requires water for digestion and needs no conventional fume hood. The water bath technique of the frying pot method can be readily carried out anywhere outside a laboratory by personnel with minimal training. By using only a stop-watch, construction of the standard curve for iodine concentrations in urine is simple and the time for color change from blue to violet can easily be observed. Moreover, the frying pot with the water method is safe and rapid because of non-explosive ammonium persulfate and needs only 25 minutes at 100°C[8] instead of one hour for perchloric acid. In the field, using three frying pots and adequate numbers of laboratory personnel, the maximum number of samples tested per day can rise to 240.

Testing by the use of water in the frying pot can reduce the cost from 30 Baht 11 to <5 Baht per person (about US $ 0.10), at the current exchange rates. This makes the procedure affordable for project managers, villagers and schools. Therefore, it is a satisfactory field method integrated into the list of techniques of measurement of iodine for evaluating and monitoring the IDD project in recent publications.[14-16]

CONCLUSION

This new modified field method of iodine detection in urine is simple, cheap and portable, using a frying pot with water for digestion for rapid and reliable results. It is satisfactory for quantitative measurements of urinary iodine concentrations in a large number of urine samples in a day. By replacing paraffin oil the method uses water for digestion and improves the procedure. The mathematic measurement can be very practical in monitoring and evaluating epidemiological studies in developing countries.

ACKNOWLEDGEMENTS

We thank Mrs. Kanda Rujiklin and Mrs. Sukanya Pansawasd for their technical assistance.

REFERENCES

1. Dunn J, Crutchfield H, Gutekunst R, Dunn A. Two simple methods for measuring iodine in urine. Thyroid 1993; 3: 119-23.
2. Hetzel BD. The Story of Iodine Deficiency. An International Challenge in Nutrition. Oxford University Press, 1989.
3. Stanbury JB, Brownell GL, Riggs DS, et al. Endemic goiter - the adapta tion of man to iodine deficiency. Cambridge, Massachusettes, Harvard University Press, 1954.
4. Delange F, Ermans AM. Iodine Deficiency. In: Braverman LE, Utiger RD, eds. The Thyroid. A Fundamental and Clinical Text. JB. Lippincort Publishers, Philadelphia, 1991.
5. Middlesworth LV. Thyroid Physiology. In: Middlesworth LV, ed. The Thyroid gland. Chicago,Year Book Medical Publishers, 1986: 1-18.
6. Sandell EB, Kolthoff IM. Microdetermination of iodine by a catalytic method. Mikrochim Acta 1937; 1: 9-25.
7. Robbins J. An indicator paper and a spray for the micro-detection of iodine. Compt Rend Trav Lab, Carlsberg, 1961; 32: 233-39.
8. Suansawan S. Assessment of iodine deficiency in Thai school children by measuring thyroid volume and urinary iodine excretion. A thesis in partial fulfillment of the requirement for the degree of Master of Science (Radiological Sciences) Mahidol University, Bangkok 2001: 69-70.
9. Pino S, Fang SL, Braverman LE. Ammonium persulfate: a safe alternative oxidizing reagent for measuring urinary iodine. Clin Chem 1996; 42: 239-43.
10. Zak B, Willard HH, Myers GB, Boyle AJ. Chloric acid method for determination of protein-bound iodine. Anal Chem 1952; 24: 1345-48.
11. Chongchirasiri S, Pattanachak C, Pattanachak S, et al. An investigation into methods of urine iodine analysis for use among villagers with goiter. Siriraj Hosp Gaz 1994; 46: 522-30.
12. Bourdoux P, Delange F, Filletti S, Thilly C, Ermans AM. Reliability of iodine/creatinine ratio: a myth? In: Hall R, Kobberling J, eds. Thyroid disorders associated with iodine deficiency and excess. New York, Raven Press, l985: 145-52.
13. Moulopoulos DS, Koutras DA, Mantrozo J, et al. The relation of serum T4 and TSH with the urinary iodine excretion. J Endocrin Invest 1988; 11: 437-39.
14. Gnat D, Dunn A, Chaker S, et al. Fast colorimetric method for measuring urinary iodine. Clin Chem 2003; 49: 186-88.
15. Rendl J, Bier D, Groh T, Reiners C. Rapid urinary iodide test. J Clin Endocrin & Metab 1998; 83: 1007-12.
16. Dunn JT, Crutchfield HE, Gutekunst R, Dunn AD. Methods for Measuring Iodine in Urine. ICCIDD/UNICEF/WHO. Print in the Netherlands, 1993: 46-8.

บทคัดย่อ

วิธีตรวจวัดไอโอดีนในปัสสาวะมีค่าเป็นตัวเลขสำหรับภาคสนาม

ร่มไทร สุวรรณิก พ.ค.*, ศิริพร จงจิระศิริ วท.ม.*, ฉวีวรรณ พัฒนจักร วท.ม.*, ฤดี ปลีหจินดา พ.บ.*, สุพงษ์ พัฒนจักร ค.ม.*, นภาพร โตจินดา วท.ม*., ถาวร ใจเพ็ชร ปร.ด.*, นุชรี ปุตระเศรณี วท.ม.*, จุฬาลักษณ์ โกมลตรี ปร.ด.,ประธาน วงศ์ตาหล้า วท.ม.***, เอียน บัตต์ฟิลด์ พ.ค.******

ภาควิชารังสีวิทยา, ภาควิชาอายุรศาสตร์, คณะแพทยศาสตร์ศิริราชพยาบาล มหาวิทยาลัยมหิดล, กรุงเทพมหานคร 10700, ***ภาควิชาวิทยาศาสตร์สิ่งแวดล้อม,มหาวิทยาลัยนเรศวร, พิษณุโลก 65000,ประเทศไทย, ****หน่วยยาเสพติดและแอลกอฮอล์, เมืองแอเดเลด์เลท, ออสเตรเลีย.*

การศึกษานี้มีจุดประสงค์ที่จะหาวิธีการภาคสนาม ซึ่งมีราคาถูก เชื่อถือได้ รวดเร็ว และอ่านค่าของไอโอดีนในปัสสาวะเป็นตัวเลขได้ การขับถ่ายทางปัสสาวะของไอโอดีนในแต่ละคนมีค่าใกล้เคียงกับการได้รับไอโอดีนในแต่ละวัน ทำให้วัดการขาดไอโอดีนในปัสสาวะของคนนั้น ๆ ได้ วิธีหม้อทอดได้ใช้หลักนี้ดัดแปลงมาจากวิธีของ แซค (ใช้เวลานานและยุ่งยาก) ตามหลักของ ฟิโน และคณะ, ร็อบบินส์ และ ดันน์ และคณะ วิธีดัดแปลงนี้ มีข้อดีหลายประการ โดยสามารถวัดหลอดปัสสาวะได้ถึง 84 หลอดต่อหนึ่งหม้อทอด ในอุณหภูมิ 100°ซ. ในน้ำมันพาราฟิน และต่อมาได้ดัดแปลงเป็นการใช้น้ำแทน วิธีหม้อทอดนี้ ลดระยะเวลาจาก 1 ชั่วโมง เป็น 25 นาที การเปลี่ยนเป็นสีม่วงในระยะกลางนั้น เกิดขึ้นโดยผสมเฟอร์โรอีนเป็นตัวบ่งชี้ และทำเป็นกราฟมาตรฐานสำหรับอ่านความเข้มข้นของไอโอดีนเป็นไมโครกรัมต่อลิตร ผลของเด็กนักเรียนจังหวัดมุกดาหาร 255 คน แสดงว่าเชื่อถือได้ เพราะผลเหมือนกับการใช้วิธีมาตรฐานที่ใช้สีทติ้งบล็อก และ สเปคโตรโฟโตมิเตอร์ ผลนี้ได้รับการยืนยันในอีก 1,007 ตัวอย่าง วิธีใหม่นี้ ให้ผลที่แน่นอน และผลของน้ำนั้นดีกว่าน้ำมัน การดัดแปลงทำให้ลดเวลาและค่าใช้จ่ายของเครื่องมือได้มาก วิธีนี้ รวดเร็ว, ง่าย, เชื่อถือได้ สะดวกในการวัดภาคสนาม และตรวจตราภาวะขาดไอโอดีน และการศึกษาทางระบาดวิทยาของการขาดไอโอดีน และควบคุมโรคนี้ในประเทศที่กำลังพัฒนา