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Measurements of Iodine Contents in Some Iodized Salts (Consumer Level) in Myanmar

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Abstract

The amount of iodine contents in iodized salt (consumer level) of six brands in Myanmar were measured by means of volumetric method (WHO recommended) and vibrational spectroscopic technique. The results obtained from both methods were in good agreement within the statistical error.

Introduction

Humans need sufficient iodine to make thyroid hormones which are produced by the thyroid gland. The deficiency of iodine has several important health consequences called IDD (Iodine Deficiency Disorders).[1,2,3&5] To eliminate the IDD definite Iodine content in iodized salt is very important for all. Careful and continuous monitoring at the point of the consumer level is also critical in maintaining the desired iodine level (15-30ppm) of iodized salt. In Myanmar so far conventional volumetric method (WHO recommended) was used to determine the iodine content in iodized salt. In this work iodine contents in iodized salts were also measured by vibrational spectroscopic method.

Volumetric method

To study the iodine contents in iodized salts for consumer level, six samples of iodized salt: KK salt (KK), Myanmar Sar Thant salt (MST), Phuu Pwint San salt (PPS), Aung Thiha salt (ATH), Sein Myittar salt (SMT), and Annawar Min salt (ANAWA) collected from different homes and each sample was measured by using volumetric method. The iodized

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salt was treated with concentrated sulphuric acid, which liberated iodine. The free iodine was titrated with sodium thiosulfate, using starch as indicator.

Reaction steps for iodometric titration of iodate.

1. IO_3^- + $5I$ + $6H^+$ → $3I$ + $3H_2$
   (*from salt*) (*from KI*) (*from* H_2SO_4)
2. $2Na_2S_2O_3$ + I_2 → $2NaI$ + $Na_2S_4O_6$
   Sodium thio sulphate — *Iodine* — *Sodium iodide* — *Sodium tetrathio sulphate*

Experimental Procedure of Volume metric Method[1,3]

Salt sample 10 g in weight was poured into a 50 ml measuring cylinder. Distilled water was added and shaken to dissolve the salt completely. More water was added to make 50 ml solution. The salt solution (50ml) was poured into the conical flask. 1ml of 2N sulphuric acid was added to the salt solution. The solution turned yellow and the flask was closed with the stopper and put it in the dark for 10 minutes.

The flask was taken out of the dark and was shaken. Then the solution was titrated with the sodium thiosulfate from the burette until the solution turned pale. 1 to 5 ml of 1% starch solution was added to the flask and the solution turned deep purple. Then the titration was continued until the purple color disappeared and became colorless.

The burette reading showed the iodine content (ppm) of the sample by calibration curve Figure (1) using WHO recommended data [2]. The results were mentioned in Table (1). It was found that iodine contents in all iodized salt samples were within the recommended consumer level (15-30 ppm).

Vibrational Spectroscopic Technique

Vibrational spectroscopic method or Fourier Transform Infrared (FT-IR) spectroscopy is the analysis of the sample by using infrared radiation. Infrared radiation refers broadly to electromagnetic spectrum between the visible and microwave regions. When infrared radiation of wave number in the range from about 10 000 - 100 cm^{-1} interacts with matter it can be absorbed, causing the chemical bonds in the material to vibrate. The presence of chemical bonds in a material is a necessary condition for infrared absorbance to occur. In addition to chemical structures, infrared spectra can provide quantitative information as well, such as the concentration of a molecule in a sample. The relation between absorbance (A) and transmittance (T) is

$$A = \log_{10} \frac{1}{T}$$

The infrared band gives information about the strength and nature of molecular interactions. Thus, an infrared spectrum provides a great deal of information about a sample. The frequency of absorptions depends on the relative mass of the atoms, the force constants of the bonds and the geometry of the atoms.

The following equation derived from Hooke's law states the relationship between of oscillation atomic mass, and force constant (*f*) of the bond. For single bond force constant is $5x10^5$ *dynes / cm* .[4,5]

$$\bar{\nu} = \frac{1}{2\pi c}\left[\frac{f}{\frac{M_x M_y}{M_x + M_y}}\right]^{\frac{1}{2}}$$

where $\bar{\nu}$ = the vibrational frequency or wave number
c = velocity of light (cm/s)

According to the above equation vibrational frequency or wave number between potassium (K) and iodine (I) is carried out

$$1\text{amu} = 1.64 \times 10^{-24}\ \text{g}$$

$$M_K = 1.64 \times 39.09 \times 10^{-24} = 64.107 \times 10^{-24}\ \text{g}$$

$$M_I = 1.64 \times 126.9 \times 10^{-24} = 208.1 \times 10^{-24}\ \text{g}$$

$$\frac{M_K M_I}{M_K + M_I} = 49.01 \times 10^{-24}\ \text{g}$$

$$\therefore \bar{\nu} = 0.053 \times 10^{-8} \left[\frac{5 \times 10^{5}}{49.01 \times 10^{-24}}\right]^{\frac{1}{2}}$$

$$= 535\ \text{cm}^{-1}$$

The Measurement Condition of Vibrational Spectroscopic Technique

Sample	:	Six Iodized Salts
Instrument	:	Perkin Elmer GX System (FT-IR)
Atmosphere	:	substracted hydrogen and carbondioxide
Laser Source	:	He-Ne Laser (Standard II)
IR Source	:	High Brightness Ceramic
Detector	:	GaAs Detector (Temperature Controlled High Sensitivity Detector)
Analyzing Technique	:	HATR (Horizontal Attenuated Total Reflectance)

In present work calibration curve set up by using 0.2% potassiumiodate standard iodized salt sample. Because of horizontal attenuate total reflectance (HATR) a surface-sampling technique samples are analyzed that are strongly absorption for conventional transmittance measurements. In attenuated total reflectance, an infrared beam enters a fine powder (sieve aperture size 150 um) made from the various sources that transmits infrared and that also has a high refractive index. Internal reflection of the beam within this material creates an evanescent wave.

At each reflection, the wave continues beyond the crystal surface and into a sample that is held in close contact. The penetration of the beam is typically of the order of a few microns, which means that materials that are too thick for transmittance measurements can be sampled with little preparation. HATR technique analyze all sample material such as paste, gels, semi-solids, powders and film by holding the sampling surface in a horizontal position. In this work six samples of iodized salts (mentioned in volumetric method) were measured. The transmittance T (%) Vs vibrational frequency spectrums were carried out by using instrument of Perkin Elmer GX system FT-IR. The HATR with a sample trough and the optical path of the HATR were shown in Fig 2 and Fig 3. The block diagram of the vibrational spectroscopic method by using instrument of Perkin Elmer GX System FT-IR is expressed in Fig 4.

Results and Discussion

The results obtained from above two methods are in agreement within the statistical error. Since the experimental preparation time of the volumetric method was longer than vibrational spectroscopic technique, the determination of the iodine content in iodized salt by using vibrational spectroscopic technique was a reliable as well as quick method.

Conclusion

We hope that the information and results of this work will be useful for all and that will contributed to our common goal of the elimination of iodine deficiency disorder (IDD).

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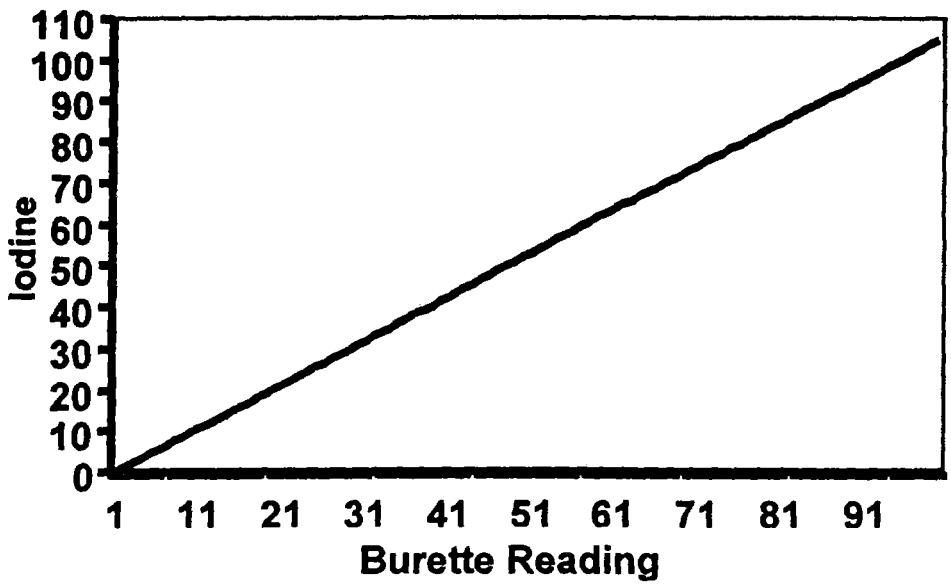

Figure 1: Calibration curve of iodine content versus burette reading

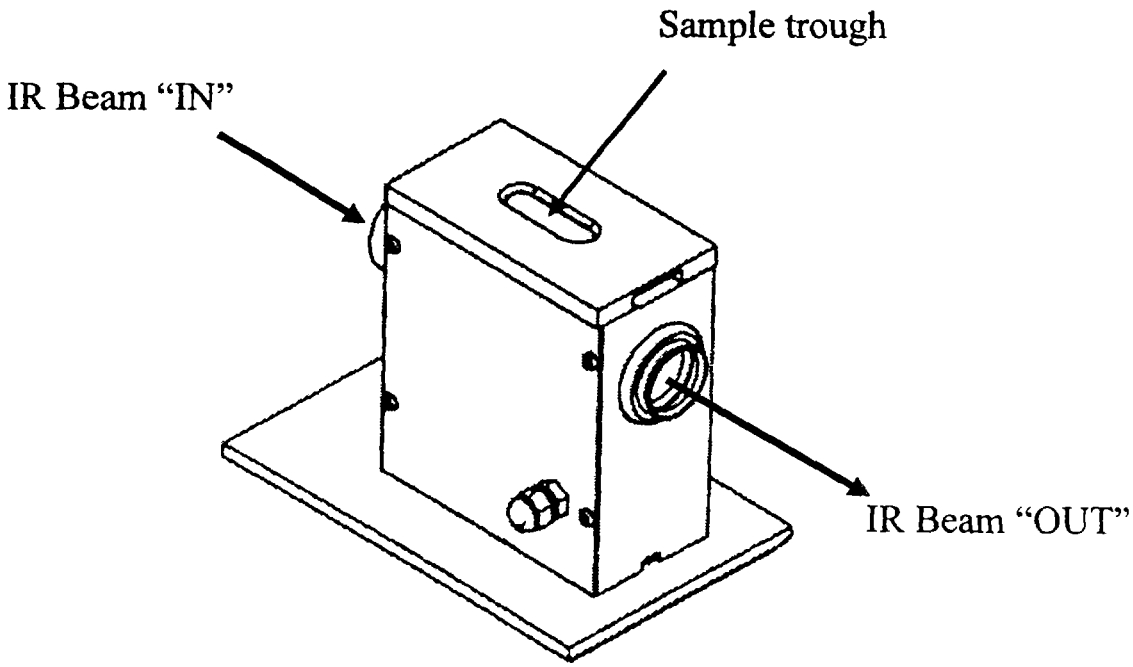

Fig 2: The Horizontal Attenuated Total Reflectance (HATR) with a Sample

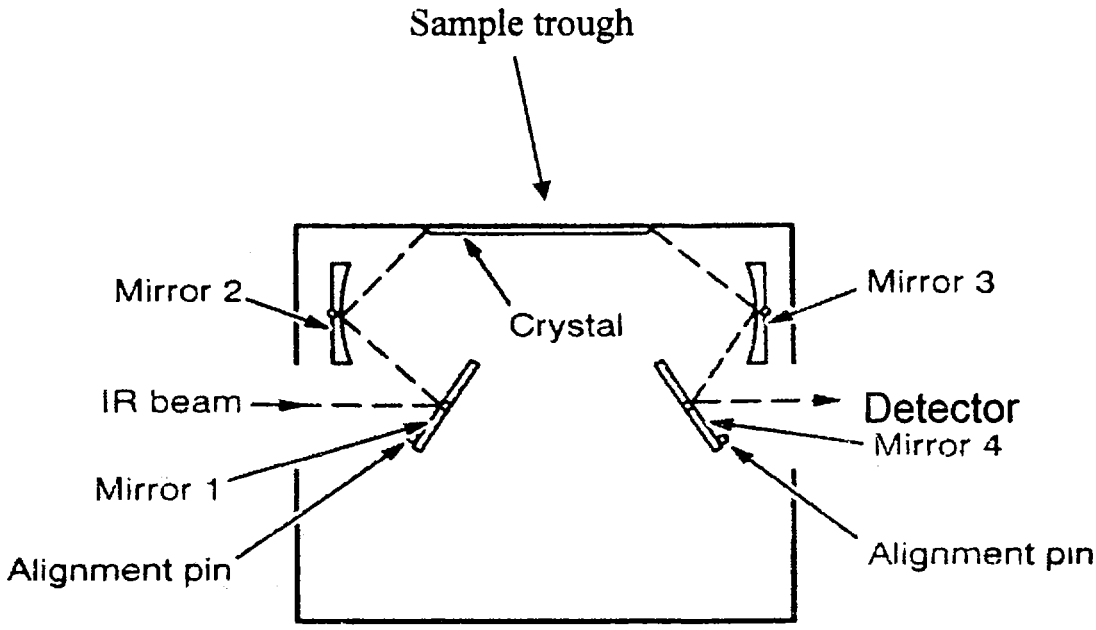

Fig 3: Optical Path of IR Beam in the HATR Sample Trough

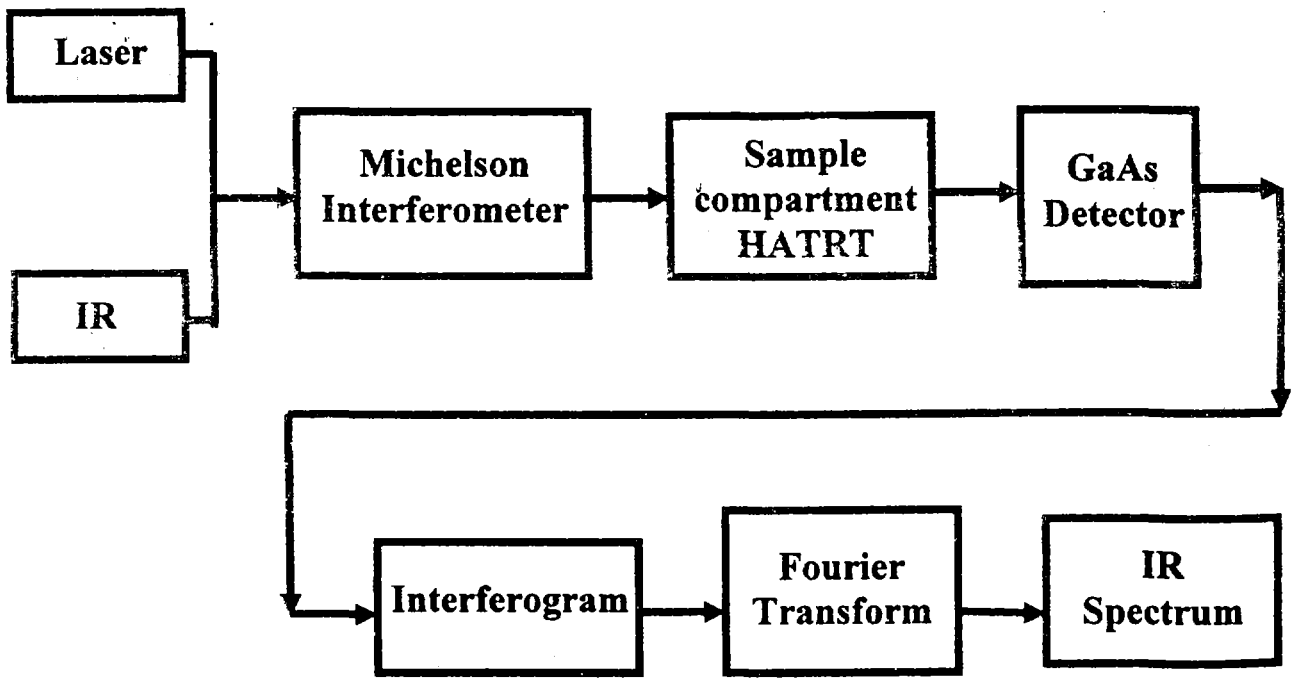

Fig 4: Block diagram of the Vibrational Spectroscopic Method

Sr No	Iodized Salt Brand	Volumetric Method Iodine Content (ppm)	Vibration spectroscopic method Iodine Content (ppm)
1	KK	26.44± 0.95	26.45
2	Myanmar Sar Thant	30.38± 0.95	30.43
3	Phuu Pwint San	22.34± 0.95	22.33
4	Aung Thiha	28.56± 0.95	28.57
5	Sein Myittar	20.10± 0.95	20.21
6	Annawa Min	15.87± 0.95	15.87

Table 1: Iodine Contents in Iodized Salts (Consumer Level) by using Volumetric Method and Vibrational Spectroscopic Technique at 301 K

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