Utility of Spot Testing Kit in the Quantitative Estimation of Iodine Content in Salt

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The use of iodized salt has been evolved as a major strategy to combat iodine deficiency disorders(IDD). Quality control of iodized salt is vital for the successful implementation of this strategy.

The iodine content of iodized salt is routinely assessed in the laboratory by the standard 'iodometric titration' method(l). Recently, a simpler method has been developed which is popularly known as the 'spot test for iodine estimation'. In these test, estimation of iodine content in salt is done with the help of a kit. The most commonly used kit provided by the Government of India for 'on the spot' estimation of iodine is manufactured by a Madras based company. The kit consists of two plastic bottles, one containing test solution (A) and other with recheck solution (B). A paper strip with 4 color zones is pasted on the container of the bottles. The first zone is white in color and it indicates absence of iodine: the second, light blue which indicates iodine content of 7 to 15 ppm of iodine; the third zone is blue which indicats 15 to 30 ppm of iodine; and the fourth color zone is deep blue which indicates more than 30 ppm of iodine. When Solution A is added to the salt, a color develops due to interaction of iodine in salt and chemicals present in Solution A.

The procedure of estimation of iodine content of salt is as follows: (i) A small amount of salt sample is taken and 3-4 drops of Solution A is added. If there is no change in color then Solution B (re-check solution) is added to make the salt medium acidic. (ii) After adding the Solutions A and B, the color of the iodized salt sample immediately changes to varying shades of blue according to it's iodine content. The intensity of blue color is directly proportionate to the iodine content in the salt. The spot testing kit (STK) has been advocated as a qualitative method of iodine estimation in salt but it's utility for quantitative assessment remains unexplored. The present study was therefore, conducted to assess the utility of the 'spot testing kit' for the quantitative estimation of iodine in salt.

Material and Methods

In this double blind study, the following methodology was followed:

Step I: 589 salt samples were collected from an equal number of the families from rural Himachal Pradesh and each sample was coded.

Step II: Two Research Assistants (A and B) were assigned the independent responsibility of estimation of iodine content of salt samples. Firstly, the Research Assistant 'A' estimated the iodine content of all 589 samples by iodometric titration. Subsequently, Research Assistant 'B' estimated

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the iodine content by using the "spot testing kit". The Research Assistant B was not aware of the iodine content of the salt analyzed by Research Assistant 'A'.

Step III: The interpretation of the results was done after the completion of laboratory analysis.

Twenty salt samples were sent to reference laboratory for quality control of iodine content as estimated by iodometric titration method by Research Assistant A.

The specificity, sensitivity, positive predictive value (PPV), and negative predictive value (NPV) of the spot testing kit in relation to iodometric titration method were calculated using the standard formulae(2).

Results

The sensitivity of spot testing kit was assessed, in terms of the number of salt samples having <15 ppm iodine correctly identified by STK against the total number of salt samples identified as having <15 ppm iodine by titration method. The sensitivity was 96.5% *(Table I).*

The specificity was determined as the number of salt samples having 15 ppm and more iodine, correctly identified by the spot testing kit to the total number of salt sample having 15 ppm and more iodine content as identified by titration method. The specificity was 25% *(Table I).*

The positive predictive value was determined as the percentage of salt samples with iodine content 15 ppm or more as indicated by STK and titration to the total number of samples with iodine content 15 ppm or more as indicated by the spot testing kit. The positive predictive value of the test was 90.7% *(Table I).*

Conversely, the negative predictive value was expressed as the percentage of salt samples with less than 15 ppm iodine content indicated by both titration and STK to the total number of salt samples with less 15 ppm iodine content as indicated by the spot testing kit. The negative predictive value of the test was 48.5% *(Table I).*

TABLE I-*Results obtained by Both Methods*

STK method	Titration method	
	<15 ppm	>15 ppm
<15 ppm	503	57
>15 ppm	18	17
	521	68

$$\text{Sensitivity} = \frac{503}{521} \times 100 = 96\%$$

$$\text{Specificity} = \frac{17}{68} \times 100 = 25\%$$

$$\text{Positive predictive value} = \frac{503}{554} \times 100 = 90\%$$

$$\text{Negative predictive value} = \frac{17}{35} \times 100 = 48\%$$

Discussion

Iodometric titration is the recommended method for assessment of iodine content of salt. However, it requires a laboratory set up and trained manpower. The STK is simple and can be used by peripheral health functionaries, school teachers, community leaders and traders without any formal training. The STK is recommended by the Government of India to be used routinely by the Government and non-government functionaries for quantitative assessment of iodine in common salt. The present study revealed that for quantitative estimation, STK had a high sensitivity but low specificity. These findings suggest that STK can be used for

qualitative and quantitative estimation of iodine by the government and non-government functionaries. Thus STK can be utilized as a quantitative method for assessment of iodine content of salt only for the purpose of monitoring the quality of salt available to the community.

For monitoring the quality of iodized salt available to the community members, it is necessary to analyze a large number of salt samples to visualize the trend. In this context, the spot testing kit can prove a simple and useful tool as compared to iodometric titration which requires laboratory facilities.

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