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ESTIMATION OF LOSS OF IODINE IN EDIBLE SALT DURING INCREASED TEMPERATURE

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Abstract

Iodine is one of the vital microelements necessary for normal physical as well as mental growth of humans. Reduced iodine levels cause deleterious effects such as miscarriages, stillbirths and congenital abnormalities. The main source of iodine is through diet and through iodized salt. However, extreme loss of iodine is noticed with an increase in temperature during cooking. In the present study, brands of crystal and powder salt were taken and analyzed. The present study showed that around 64% of iodine was lost on maximum heat treatment and only 36% were retained. Iodine content started decreasing as the temperature and time increased. Comparing heat treatment at 150ºc for 2 minutes and 3 minutes, at 150ºc for 3 minutes the iodine content reduced drastically and it even more decreased at 230ºC for 2 minutes and much more reduced at 230ºC for 3 minutes. This shows that iodine content decreases when the temperature and time duration increases. Hence, it is appropriate to sprinkle salt on food after cooking and not to add it while cooking like traditionally.

Keywords: Iodine deficiency, Titration method, Loss of iodine, Heat, Temperature

I. INTRODUCTION

Iodine is an important mineral for normal mental and physical growth in humans and animals. As per WHO recommendation, the daily iodine requirement of iodine is 50-200 µg/day (1). Around 70-80% of iodine is stored in the thyroid gland and it is used for the synthesis of thyroid hormones (2). Iodine is taken mainly from dietary sources such as iodized salt, saltwater fish, shellfish, soy sauce, milk, yogurt, seaweed, grains and from some medications (3). Deficiency of iodine causes complications in all stages of life. It not only causes mental retardation, cretinism and reduction in IQ but also causes abortions, stillbirth and infertility (4). Extensive research in the past revealed that iodine deficiency is primarily attributed to iodine deficient salt or less iodine containing salt which is less than the required amount (5, 6). Majority of the countries adopted iodization of salt to combat iodine deficiency in food since it is the best method to decrease the expenditure and support economic and social development in the later period. When there is inaccessibility of iodized salt, sensitive groups can be administered with iodine supplements (7). Past studies have revealed that the stability of iodine in salt is affected by various factors such as the moisture in the salt and atmosphere-humidity, bad packaging, light and heat, impurities in the salt, alkalinity or acidity (8). It has been found that during cooking the loss of iodine from salt ranges from 6.58% to 51.08%. Minimum losses were found during shallow frying where cooking time of salt was 1 min and 15 s and maximum during pressure cooking where cooking time of salt was 26 min (9). Hence, this study is undertaken to analyze the iodine content in different brands of salt before and after heat treatment at different times.

II. MATERIALS AND METHODS

Nine different brands of salt were taken for analysis. Among that four were crystal salt and three were refined salt. The amount of iodine in salt samples was measured before heat treatment and after heat treatment at 150ºC for 2 minutes, 150ºC for 3 minutes, 230ºC for 2 minutes and 230ºC for 3 minutes.

2.1 Preparation of sample:

- Weigh accurately 0.5 -1.0 g of well homogenized sample into the vessel.
- Add 1mL of TMAH and 5 mL of milli-q water.
- Reflux in a water bath for 3 h at 95oC.
- Cool to room temperature and transfer the content into 50-mL volumetric flask
- Makeup to the volume with milli-q water and shake vigorously.
- Centrifuge the above solution and take the aliquot for measurement.

2.2 Instrumentation - ICP-MS

RF Power-1500 W

Sample Depth- 8 mm

Carrier Gas (argon)- 0.95 L/min

Makeup Gas (argon)- 0.21 L/min

Nebulizer Pump- 0.10 rps

Sample Pump -0.02 rps

Spray Chamber Temperature - 2°C

Reaction Gas (helium) - 4.3 mL/min

Integration Time - 0.1 to 0.3 sec

2.3 Calculation: (10-12)

$$\text{Iodine } (\mu g/100g) = \frac{\text{Instrument reading (sample-blank) (ng/mL)} \times \text{Final volume (mL)}}{\text{Weight of sample (g)} \times 10}$$

III. RESULTS

Table 3.1: Iodine content in different brand of salt before and after Heat treatment at different time

Source of salt	Texture	No Heat treatment	Heat Treatment at 150ºC for 2 minutes	Heat Treatment at 150ºC for 3 minutes	Heat Treatment at 230ºC for 2 minutes	Heat Treatment at 230ºC for 3 minutes
A	Crystal	5.03	2.38	2.12	2.12	1.32
B	Crystal	1.9	1	0.92	0.98	0.87
C	Crystal	34.91	12.7	8.46	9.52	7.41
D	Crystal	25.4	21.16	15.87	13.75	9.52
E	Refined	27.99	13.75	8.46	9.52	8.46
F	Refined	32.8	24.33	21.16	21.16	15.87
G	Refined	30.7	26.45	22.22	14.81	13.75
H	Refined	0	NA*	NA*	NA*	NA*
I	Refined	0	NA*	NA*	NA*	NA*
Total iodine in salts		**158.73**	**101.77**	**79.21**	**71.86**	**57.2**
% of Iodine retained after heat treatment		**NA***	**64.1**	**49.9**	**45.3**	**36**
% of Iodine Lost on heat treatment		**0**	**35.9**	**50.1**	**54.7**	**64**
% Average Iodine Lost -- 51.2						
***NA - Not applicable.**						

Table 1 illustrates the iodine content in different brands of salt before and after heat treatment at different times. Before treatment type C crystal salt had a higher amount of iodine followed by salt F, salt G, E and D. After heat treatment at 230ºC for 3 minutes all the salts had lost iodine drastically. The salt C with higher content had lost more iodine after heat treatment. Around 64% of iodine was lost on heat treatment and only 36% were retained.

Table 3.2: Comparison of stability of iodine content at different treatment in different brand of salts by Friedman test & Inter group comparison by Wilcoxon signed test

Heat Treatment at different time	Iodine content in salt at different treatment				Pair wise Comparison by Wilcoxon signed test
	Median	IQR	Chi -Square	p - value	
No Heat treatment	27.99	27.77	26.65	0.000***	**1-2*** 1-3*** 1-4*** 1-5*** 2-3*** 2-4*** 2-5*** 3-4(ns) 3-5*** 4-5*** **
Heat Treatment at 150ºC for 2 minutes	13.75	13.75			
Heat Treatment at 150ºC for 3 minutes	8.46	8.46			
Heat Treatment at 230ºC for 2 minutes	9.52	9.52			

Heat Treatment at 230ºC for 3 minutes	8.46	8.46			

***p<0.05 - statistically significant, ns- not significant

Table 2 depicts the comparison of stability of iodine content at different treatment in different brands of salts.

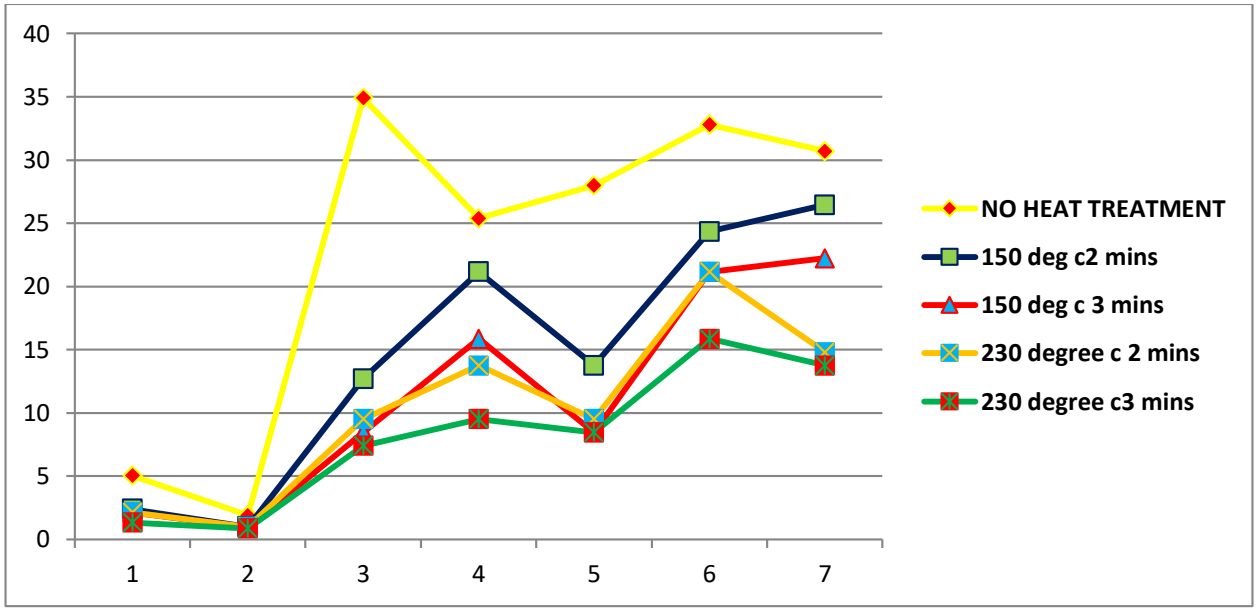

Figure 3.1: Comparison of stability of iodine content at different treatment in different brand of salts by Friedman test

Figure 1 demonstrated the comparison of stability of iodine content at different treatment in different brand of salts. The iodine content starts decreasing as the temperature and time increases. Compared to 150ºc for 2 minutes, 150ºc for 3 minutes reduced the iodine content drastically and it's even more decreased in 230ºC for 2 minutes and much more reduced in 230ºC for 3 minutes. This shows that iodine decreases when the temperature and time duration increases.

IV. DISCUSSION

Iodine deficiency disorders (IDD) are regarded as a major public health issue in the world. In the present study, the loss of iodine during heating was assessed. It was estimated that during different cooking procedures ranges from 6% (roasting) to 37% (boiling) loss of iodine (13). In the present study we have noticed that before treatment, type C crystal salt had higher amounts of iodine followed by salt F, salt G, E and D. After heat treatment at 230ºC for 3 minutes all the salts have lost iodine drastically. The salt C with higher content has lost more after heat treatment. We have found that around 64% of iodine was lost on heat treatment and only 36% were retained.

Verma et.al (2011) reported that there is loss of up to 70% of iodine through cooking (14). The present study is in accordance with the past researchers. Rana et.al, (2013) has shown that maximum loss was found up to 51.08% (9).

The present study showed that the iodine content starts decreasing as the temperature and time increases. Compared to 150ºc for 2 minutes, 150ºc for 3 minutes reduced the iodine content drastically and it's even more decreased in 230ºC for 2 minutes and much more reduced in 230ºC for 3 minutes. This shows that iodine decreases when the temperature and time duration increases.

It is well known that the main source of iodine is from iodized salt, so loss of iodine during cooking should be prevented. So to prevent iodine loss during cooking, it is appropriate to sprinkle salt on food after cooking and not to add it while cooking like traditionally. Likewise, iodized salt should not be stored in hot and humid conditions especially near the cooking stove and oven. So common people should be educated about the cooking loss of iodine

V. CONCLUSION

IDD (Iodine deficiency disorder) is considered as a major global health concern. This study reported that a maximum of around 64% of iodine is lost in increased temperature and duration. So, awareness programs should be conducted in order to educate the public to add salt after cooking in order to prevent cooking loss.

VI. REFERENCES

1. World Health Organization (WHO), Trace Elements in Nutrition and Health, (1996). 49-71.
2. Prodhan UK, Alim MA, Kabir MH et.al. Measurement of iodine availability and stability of some iodized salts in Bangladesh. IJRET. 2014;3(1):470–474.
3. Iodine and Health: eliminating iodine deficiency disorders safely through salt iodization. Geneva: WHO; 2007
4. Verma, Monika, Rita S. Dietary Iodine Intake and Prevalence of Iodine Deficiency Disorders in Adults. J Nutr Environ Med. 2011;175–181.
5. Bd B, Andersson M, Egli I, et al. Iodine status worldwide: WHO global database on iodine deficiency. Geneva: WHO; 2004.
6. Diosady LL, Alberti JO, Venkatesh MMG, et al. Stability of iodine in iodized salt used for correction of iodine deficiency disorders. Food Nutr Bull. 1998;18(4):388–396.
7. M. B. Zimmermann, P. L. Jooste, and C. S. Pandav, "Iodinedeficiency disorders," The Lancet, vol. 372, no. 9645, pp. 1251–1262, 2008.
8. World Health Organization sets out to eliminate iodine deficiency disorder. Geneva: WHO; 1999
9. Rana R, Raghuvanshi RS. Effect of different cooking methods on iodine losses. Journal of food science and technology. 2013 Dec;50:1212-6.
10. AOAC Official method 2012.14, Total Iodine in Infant formula and Nutritional Products
11. Official Journal of the European Communities -Commission Directive- EU No 836/2011 and EC No 1881/2006
12. European Commission Health & Consumer Protection Directorate-General SANCO/12571/2013.
13. Goindi G, Karmarkar MG, Kapil U, Jaganathan J (1995) Estimation of losses of iodine during different cooking procedures. Asia Pac J ClinNutr 4(2):225–227
14. Verma T, Raghuvanshi RS (2002) Nutriguide: manual for calculation of dietary adequacy using nutrient composition of Indian recipes. ICAR, New Delhi