
**EFFECT OF STORAGE AND COOKING ON THE IODINE CONTENT OF
LOCALLY AVAILABLE IODIZED SALTS****PATEL, I. N.*; DHADUK, J. J.; PATEL, B. G. AND REMA, S.**

DEPARTMENT OF FOOD SCIENCE AND NUTRITION,
ASPEE COLLEGE OF HOME SCIENCE AND NUTRITION
S. D. AGRICULTURAL UNIVERSITY, SARDARKRUSHINAGAR-385 506,
GUJARAT, INDIA

***E.mail: in_patel@yahoo.co.in**

ABSTRACT

Iodine is an essential micronutrient for all forms of life. It is an essential element for thyroid function and physical and mental development of the person. Some of the recent study indicated considerable prevalence of Iodine Deficiency Disorders (IDD) in Gujarat. Iodine Deficiency Disorders (IDD) can be effectively treated and prevented by the use of iodized salt, but storage and cooking can make significant effect on iodine content, as iodine is a volatile substance. The present investigation was undertaken to study the effect of storage and cooking on the iodine content of salt. The experiment was laid out to measure the loss of iodine content after 12 months of storage in 10 various samples of iodized salt collected from local market within the same month of manufacture. Salt samples were also tested for iodine loss during closed and open pan cooking. A highly significant difference ($p < 0.01$) was observed among salt samples of measured as fresh and also after the 12 months of storage. It was also observed that increasing the duration of open as well as closed cooking decreased the iodine content of salt. A highly significant difference ($p < 0.01$) was observed in iodine content of salt at different interval of cooking. The loss of iodine content was higher in case of open cooking as compared to closed cooking. From the results, it is clearly concluded that iodine content lost significantly during storage and cooking procedures, which may leads to decrease in the availability of iodine content from iodized salt, which may affect the health of the consumers.

KEY WORDS: Cooking, Iodine content, Salt, Storage

INTRODUCTION

Iodine is required for the synthesis of the thyroid hormones, thyroxine (T4) and triiodothyronine (T3) and essential for the normal growth and development and well being of all humans. It is a micronutrient and normally required around 100-150 microgram for normal growth and development. Iodine deficiency has been identified all over the world. It had significant health problems in 130 countries and affected 740 million people of the world. One third of the world population is exposed to the risk of Iodine Deficiency Disorders (IDD). It is estimated that in India alone, more than 6.1 crore people are suffering from endemic goiter and 88 lakh people are mental handicaps. A national level survey of 25 states and 5 union territories of India revealed that out of 282 districts surveyed, in 241 districts, it is a major public health problem, where the prevalence rate is more than 10 per cent. It is estimated that more than 71 million persons are suffering from goiter and other Iodine Deficiency Disorders like mental retardation, deaf mutism, squint, and neuromotor defects due to iodine deficiency.

Some of the recent study indicated considerable prevalence of Iodine Deficiency Disorders (IDD) in Gujarat. Iodine Deficiency Disorders (IDD) can be effectively treated and prevented by the use of iodized salt, but storage and cooking can make significant effect on iodine content of salt, as iodine is a volatile substance. The present investigation was undertaken to study effect of storage and cooking on the iodine content of locally available iodized salts.

MATERIALS AND METHODS

Collection of Salt Samples

Ten (10) various salt samples comprising nine branded salt samples (Tata salt, Nature salt, Dandi salt, Saffola salt, Shudh salt, Annapurna salt, Captain Cook salt, Dharati salt, Amrut salt) and one unbranded, crystalline salt (Crystal salt) were collected from the local market (shop keepers) for iodine estimation. Salt samples were stored in a labeled glass jar. Iodine estimation was carried out from fresh samples

and from stored samples (after 12 months of storage) using the titrametric method (DeMaeyer *et al.*, 1979). The salt samples were coded for unbiased estimation as:

A: Tata salt, B: Nature salt, C: Dandi salt, D: Saffola salt, E: Shudh salt, F: Annapurna salt, G: Captain Cook salt, H: Dharati salt, I: Amrut salt and J: Crystalline salt.

Loss of Iodine Content from Salt during Storage

To observe the loss of iodine content from the different samples of salts, the samples were analyzed after 12 months of storage. All the ten samples were purchased from the retail market within one month of manufacture. Samples were weighed in triplicate on every occasion and used for the estimation of iodine content (DeMaeyer *et al.*, 1979).

Loss of Iodine Content from Salt during Cooking

Salt samples were also tested for iodine content loss during closed and open pan cooking. Three commonly used samples of salts by the local population viz., Tata salt, Shudh salt, and Annapurna salt were used for the cooking procedure. The iodine content was analyzed at 0, 2, 5, 7, 10, 15, 20, 25 and 30 minutes during closed as well as open pan cooking. Triplicate samples (10 g) were cooked with 50 ml double distilled water, in stainless steel vessels with and without lids. Iodine content of samples was estimated by using a semi-automatic method for the determination of total iodine in food described by Moxon and Dixon (1980).

RESULTS AND DISCUSSION

Iodine content of fresh and stored (after 12 months of storage), branded and non-branded salt samples was presented in Table 1. A highly significant difference ($p < 0.01$) was observed among the various brands for iodine content of fresh salts. The initial (fresh) iodine content ranged from 0.00 to 50.43 ppm. All the above salt samples, which were purchased within one month of manufacture, were stored for 12 months at room temperature and they were again analyzed for iodine content. A highly significant difference ($p < 0.01$) was observed among the stored salt

samples for iodine content. The iodine content after 12 months of storage ranged between 0.00 to 40.53 ppm. Thus, it can be concluded that iodine content was lost during storage at room temperature. The per cent loss of iodine content during storage ranged from 17.43 to 23.28 ppm. Two samples, i.e. samples I (Amrut salt) and J (Crystal salt) were not iodinated and therefore, showed no storage loss.

Effect of cooking (open and closed pan) on the iodine content in three locally adopted samples of salts viz., Tata salt, Shudh salt, and Annapurna salt was presented in Table 2. The iodine content was analyzed at 0, 2, 5, 7, 10, 15, 20, 25 and 30 minutes during closed as well as open pan cooking. For sample A (Tata salt), maximum (42.67 ppm) iodine content was recorded after 0 minutes of closed pan cooking, while minimum (36.33 ppm) was found at 30 minutes of closed pan cooking. It was observed that increasing the duration of cooking (closed pan) decreased the iodine content of salt. Similar trend was observed in open pan cooking. The iodine content was found to be maximum (41.63 ppm) at 0 minutes of open pan cooking and was reduced drastically to 32.07 ppm at 30 minutes of open pan cooking. A highly significant difference ($p < 0.01$) was observed for the iodine content of salt at different intervals of cooking in open as well as closed pan cooking.

For sample E (Shudh salt), A highly significant difference ($p < 0.01$) was observed for the iodine content of salt at different intervals of cooking in open as well as closed pan cooking. The maximum (38.68 ppm) iodine content was observed at 0 minutes of closed pan cooking, while minimum (32.43 ppm) after 30 minutes of closed pan cooking. A similar trend was observed in open pan cooking too. The maximum (38.68 ppm) iodine at 0 minutes of cooking and was reduced to 29.67 ppm at 30 minutes of open pan cooking. The results of the third sample of salt (Annapurna salt) were followed the same trend. A highly significant difference ($p < 0.01$) was observed for the iodine content of salt at different intervals of cooking in open as well as closed pan cooking. The maximum (31.03 ppm) iodine level was at 0 minutes of closed pan cooking, while minimum (25.77 ppm) after 30 minutes of closed pan cooking. Similarly, the iodine content was maximum (31.03 ppm) at 0 minutes of open pan cooking and was reduced to 22.57 ppm at 30 minutes of open pan cooking.

Looking to the values of iodine content in three samples, it can be concluded that increasing in the duration of open as well as closed pan cooking, the iodine content was decreased. The data also revealed that loss was higher in case of open pan cooking as compared to closed pan cooking. This may be attributed to the fact that iodine being a volatile substance, which escapes during open pan cooking.

The results of the present investigation are close in accordance with the findings of some earlier investigators. While studying the loss of iodine during different cooking procedures in 50 recipes, commonly cooked in Indian families, Goindi *et al.* (1995) found that the mean loss of iodine was 22 per cent in pressure cooking, 37 per cent in boiling, 27 per cent in shallow frying and 20 per cent in deep-frying. Pandav *et al.* (1995) reported that the iodine content ranged from 0-95 mg/kg of salt; it was particularly low in the Gorakhpur and Varanasi regions, where over 80 per cent of samples contained less than the minimum recommended level of 15 mg/kg; 37 per cent of samples were in this category in the Dehradun region. Kapil *et al.* (1997) observed in Bihar that none of the families were consuming salt with nil iodine content and about 29.3 per cent were consuming salt with <15 ppm of iodine. Of the 35 salt samples collected from traders, all had iodine and about 17 per cent had <15 ppm of iodine. Of the 10 salt samples tested, 7 branded samples had adequate iodine content ranging from 25.77 to 50.43 ppm. One branded sample had low iodine content (8.47 ppm). One local non-iodinated salt sample and one sample of crystal salt had no iodine content. After 12 months of storage, iodine content, ranging from 17.43 to 23.28 per cent. Cooking loss was greater in open pan cooking compared to close pan cooking.

CONCLUSION

Tata salt sample containing the highest amount of iodine (50.43 ppm) followed by Nature salt (48.67 ppm) and Dandi salt (38.43 ppm). A highly significant difference ($p < 0.01$) was observed among the various brands for iodine content of fresh salts. This difference was also highly significant for stored samples. A highly significant difference ($p < 0.01$) was observed for the iodine content of salt at different intervals of cooking in open as well as closed pan cooking. It is also observed that increasing the duration of open as well as closed pan cooking, the iodine content was decreased. The loss was higher in case of open pan cooking as compared

to closed pan cooking. This may be attributed to the fact that iodine being a volatile substance, which escapes during open pan cooking.

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Table 1: Iodine content of fresh and stored, branded and non-branded salt samples.

Sr. No.	Code No. for Brand of Salt	Iodine Content		
		Initial (ppm)	Final (ppm)	Storage loss (%)
1	A	50.43 ± 3.57 ^f	40.53 ± 0.94 ^f	19.63
2	B	48.67 ± 0.61 ^f	38.77 ± 0.94 ^f	20.34
3	C	38.43 ± 1.26 ^e	31.73 ± 0.61 ^e	17.43
4	D	37.73 ± 3.03 ^e	31.03 ± 1.26 ^e	17.76
5	E	30.67 ± 0.61 ^d	24.33 ± 0.61 ^d	20.67
6	F	37.73 ± 1.54 ^e	29.63 ± 1.59 ^e	21.47
7	G	25.77 ± 0.79 ^c	19.77 ± 0.94 ^c	23.28
8	H	8.47 ± 0.61 ^b	6.70 ± 0.70 ^b	20.90
9	I	0.00 ± 0.00 ^a	0.00 ± 0.00 ^a	0.00
10	J	0.00 ± 0.00 ^a	0.00 ± 0.00 ^a	0.00
	F-test	103.65 ^{**}	288.09 ^{**}	

- Values are mean of three trials ± SEM
- Storage period = 12 months at room temperature
- Values sharing a common superscript letter within a column are not significantly different.
- ** P < 0.01

Table 2: Effect of cooking (open and closed pan) on the iodine content in three locally adopted samples of salt

Cooking Time (minutes)	Iodine Content (ppm)					
	A		E		F	
	Closed Pan Cooking	Open Pan Cooking	Closed Pan Cooking	Open Pan Cooking	Closed Pan Cooking	Open Pan Cooking
0	42.67 ^c ±0.37	42.67 ^g ±0.37	38.68 ^f ±0.77	38.68 ^f ±0.77	31.03 ^g ±0.33	31.03 ^g ±0.33
2	42.33 ^c ±0.61	41.63 ^g ±0.33	37.15 ^e ±0.58	37.37 ^{ef} ±0.91	30.70 ^{tg} ±0.00	30.70 ^g ±0.00
5	41.97 ^c ±0.33	40.57 ^f ±0.37	36.57 ^{de} ±0.57	36.33 ^{de} ±0.33	29.97 ^f ±0.37	29.63 ^f ±0.61
7	40.20 ^b ±0.64	38.07 ^e ±0.61	35.27 ^{cd} ±0.37	35.27 ^d ±0.37	28.93 ^e ±0.33	28.60 ^e ±0.00
10	39.83 ^b ±0.37	37.37 ^{de} ±0.37	34.57 ^{bc} ±0.33	32.80 ^c ±0.64	28.60 ^e ±0.00	27.87 ^{de} ±0.37
15	39.13 ^b ±0.61	36.33 ^d ±0.33	34.23 ^{bc} ±0.33	31.70 ^{bc} ±0.00	27.87 ^{cd} ±0.37	27.17 ^d ±0.33
20	38.77 ^b ±0.33	34.93 ^c ±0.61	33.53 ^{ab} ±0.37	31.37 ^{bc} ±0.33	27.17 ^{bc} ±0.33	25.40 ^c ±0.00
25	37.03 ^a ±0.61	33.53 ^b ±0.37	33.17 ^{ab} ±0.37	30.73 ^{ab} ±0.55	26.83 ^b ±0.33	23.97 ^b ±0.33
30	36.33 ^a ±0.33	32.07 ^a ±0.37	32.43 ^a ±0.37	29.67 ^a ±0.07	25.77 ^a ±0.37	22.57 ^a ±0.37
F-test	21.70**	73.65**	18.80**	37.42**	34.53**	81.10**

- Values are mean of three trials ± SEM
- Values sharing a common superscript letter within a column are not significantly different.
- ** P < 0.01