Assessment of Iodine Content in Three Different Brands of Commercial Sodium Chloride at Retailer and Consumer Level

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ABSTRACT

The purpose of the study was to assess the loss of iodine content of three branded salts of Bangladesh namely ACI, Fresh and Molla. The samples of salts were collected from manufacturing industries and local market. The samples were stored at room temperature (28ºC-30ºC) for periods up to 6 months and analyzed for iodine content. It was found that impurities had an adverse impact on the iodine loss of the salt. Prior to determining the iodine content, the moisture content of the salt samples was checked. After six months it was found that, the iodine loss of ACI, Fresh and Molla factory salt were 11.76%, 11.37% and 12.87% where iodine loss of ACI, Fresh and Molla local market salt were 23.85%, 26.76% and 27.25% respectively.

Keyword: Branded salt, iodine content, human health, animal health.

INTRODUCTION

Iodine is an essential micronutrient for normal growth and development of human and animals. The human body contains 15–20 mg of iodine, of which 70–80% is concentrated in the thyroid gland (Prodhan *et al.,* 2014). Iodine is primarily obtained through the diet where major dietary iodine comes from iodized salt, saltwater fish, seaweed, grains and from some medications. The thyroid gland uses iodine for synthesis of the hormones thyroxine and triiodothyronine, which are essential for maintenance of the body's metabolic rate by controlling energy production and oxygen consumption in cells, for normal growth, and for neural and sexual development. Iodine deficiency may results delay in puberty, suppressed or irregular estrus, failure of fertilization, early embryonic death, still birth with weak calves, abortion, increased frequency of retained placenta in females and decrease in libido and deterioration of semen quality in male animals (Kumar, 2003). Main sources of dietary iodine are iodized salt, saltwater fish, seaweed, and grains although only trace amounts are present in the latter (WHO, 2007; UNICEF-ICCIDD, 1999; UNICEF-ICCIDD, 2006).

The World Health Organization (WHO), International Council for the Control of Iodine Deficiency Disorders (ICCIDD), and United Nations Internationals Children's Emergency Fund (UNICEF) recommend daily iodine intakes of 90 μg/d for preschool children and 150 μg/d for adults, reaching 250 μg/d for pregnant and lactating women. Despite remarkable progress in the control of iodine deficiency disorders, they remain a significant global public

health problem. An estimated 200–300 million people worldwide show some degree of iodine deficiency disorders (WHO, 2007), especially in Asia and Africa but also in large parts of Eastern Europe (UNICEF, 1993; UNICEF, 2001).

Salt is an excellent carrier for iodine, as it is consumed at relatively constant, well-definable levels by all people within a society, independently of socio-economic status (Acharya, 1987). Salt is iodized by the addition of fixed amounts of potassium iodide or iodate, as either a dry solid or an aqueous solution (Jooste *et al.,* 2009). Potassium iodide is less stable than potassium iodate, as it can be oxidized to elemental iodine by oxygen or other oxidizing agents, especially in the presence of impurities, such as metal ions and moisture, which catalyze the reaction (Jabin, 2009). Moisture is naturally present in the salt or is abstracted from the air by hygroscopic impurities such as magnesium chloride (WHO, 2007). The overall objective of this study is to assess the impurities and moisture content of three branded salt of Bangladesh and observe their effects on iodine loss.

METHODS AND MATERIALS

Iodized salt samples were collected from the selected salt industries (ACI, Fresh and Molla) and same brand salts from local market of Mymensingh. Iodine loss of these iodized salts was determined during 6 month storage at an interval of 7 days and after 43 days interval reach 15 days. After collecting samples were kept in transparent dry plastic pot. The transparent plastic pot was stored under room temperature (28ºC-30ºC) in the Department of Food Technology and Rural Industries, Bangladesh Agricultural University, Mymensingh. Salt samples were analyzed at the start of the experimental series, and after 0^{th} to 180^{th} days. To obtain a representative samples for analysis 10g salt were taken from each of pot and used for the analysis. According to Diosady *et al*., (1998) ten grams salt was weighed and taken into a 50 ml measuring cylinder. Boiled, double-distilled water was slowly added to the cylinder then it was shaken to dissolve the salt completely. More water was added to make the solution 50 ml. Salt solution was poured (50m1) into a conical flask with stopper. 1 ml of 2 N sulphuric acids was pipetted and added this to the salt solution. Then 5 ml of 10% potassium iodide was pipetted out and added to the salt solution. The solution was turned yellow. Then it was closed the flask with the stopper and put it in the dark for 10 minutes. A closed box, cupboard or drawer might be used. After that 0.005N sodium thiosulphate solution was poured into a burette. Burette level was adjusted to "0". After 10 minutes, flask was taken out from the dark box. Then the flask was shaken, and titrated the solution in the flask with sodium thiosulphate from the burette. The titration stopped as soon as the solution turned pale (became very light yellow). Then few drops of 1% starch solution were added to the flask. The solution turned deep purple. Titration was continued until the purple coloration disappears and the solution became colorless. Burette reading was noted down and calculated iodine content at ppm unit. The moisture content was determined gravimetrically. Samples of salt were weighed, then dried at 110°C for 16 hours and reweighed. Heating and weighting continued till constant weight is obtained.

RESULTS AND DISCUSSION

Assessment of the physical characteristics of iodized salt

The physical characteristics of salt samples, affected by the profile of impurities and the extent of processing at the source had a major effect on the stability of the salt. The samples had particle sizes ranging from 100 µm to 15 mm, with great variability in the homogeneity of particle size. It was found that crystal size of ACI salt is smallest which was followed by Fresh and Molla brand. It was also observed that insoluble matter is lowest in ACI salt (0.17%) which is followed by Fresh salt (1.65%) and Molla salt (1.17%). Similar results also found by Prodhan *et al*. (2014) who have found same type impurities present in iodized salt namely Fresh, Ifad, Molla and Pubali brand. Physical properties of different branded iodized salt are shown in table 1.

Table 1: Physical properties of iodized salt collected from factory and local market

Salt collected area	Properties	Brands		
		ACI	Fresh	Molla
Factory	Crystal size	Small	Larger than ACI but not Molla	Large
	Impurities observed	Black sandy type material	Hard black sandy material and some brown substances	Black and brownish type material
	Insoluble matter	0.17%	1.65%	1.17%
Local market	Crystal size	Small	Larger than ACI but not Molla	Large
	Impurities observed	Black sandy type material	Hard black sandy material and some brown substances	Black and brownish type material
	Insoluble matter	0.17%	1.65%	1.17%

Assessment of the moisture content of salt collected from factory and local market

Moisture content of salt samples was determined gravimetric method. It was found that the moisture content samples collected from factory is slightly lower than that of local market (Table 2). Higher moisture content of salt of local market may due to hygroscopic nature of salt and improper packaging system. Moisture of pure salt is zero reported by Hoque (1998). He also reported that salt absorb moisture in presence of humid air due to hygroscopic behavior. Prodhan *et al.* (2014) reported that moisture content of properly packaged ACI and Molla salt is less than 1.0%. He also reported that moisture content of salt increases with the increase of air humidity if there is direct contact of salt with air.

Table 2: Moisture content of iodized salt collected from factory and local market

Sample collected area	Name of the sample	Time interval (days)				
		0	43	88	133	178
Factory	ACI	0.3%	0.3%	0.3%	0.3%	0.3%
	Fresh	0.15%	0.15%	0.15%	0.15%	0.15%
	Molla	0.17%	0.17%	0.17%	0.17%	0.17%
Local market	ACI	0.34%	0.34%	0.34%	0.34%	0.34%
	Fresh	0.17%	0.17%	0.17%	0.17%	0.17%
	Molla	0.20%	0.20%	0.20%	0.20%	0.20%

Assessment of iodine content with respect to storage period:

The Bangladesh Standard Testing Institute-BSTI standard for iodine rich salt is 20 to 50 ppm. From table 3 it is seen that iodine content of salt samples is degraded with respect to storage period. Jebin (2009) reported that iodine content of open salt is zero and iodine content of iodized salt is also decreasing day by day due to moisture and impurities present on it. Prodhan *et al.* (2014) found 49.7 ppm iodine in Molla and 54 ppm iodine in ACI iodized salt that is nearer to the present study. Slight variation might be due to improper packaging or personal error in determination of iodine content.

Table 3: Iodine content of salt (ppm) collected directly from factory

Time interval (days)	Storage period	ACI (Factory salt)	FRESH (Factory salt)	MOLLA (Factory salt)	±SE	Level of significance
7	0	39.19	38.59	38.59	0.29	NS
	7	38.66	38.31	38.30	0.27	NS
	14	38.28[b]	37.85[a]	37.73[a]	0.23	**
	21	37.92	37.50	37.52	0.22	NS
	28	37.39	37.01	37.17	0.23	NS
15	43	36.94	36.58	36.81	0.23	NS
	58	36.83	36.41	36.57	0.24	NS
	73	36.62	36.23	36.25	0.22	NS
	88	36.41	35.98	35.79	0.26	NS
	103	36.23	35.84	35.52	0.24	NS
	118	35.98	35.63	35.11	0.22	NS
	133	35.77[a]	35.45[a]	34.89[b]	0.24	**
	148	35.49[a]	35.24[a]	34.66[b]	0.26	**
	163	34.85[a]	34.89[a]	33.94[b]	0.26	*
	178	34.58a	34.20a	33.62b	0.29	**

*Significant at 5% level of probability

** = Significant at 1% level of probability

NS = Not significant

In a row figures with same letter or without letter do not differ significantly whereas figures with dissimilar letter differ significantly (as per DMRT)

Table 3 and Fig.1 show that up to 118th days the iodine content was not significantly decreased but 133rd days to 178th days the iodine content decreased significantly at the level of 1% level of probability ($p<0.01$). After six months the iodine content of ACI factory salt was 34.58 ppm, Fresh factory salt was 34.20 ppm and Molla factory salt was 33.62 ppm respectively. After six months percent loss of iodine in ACI factory salt was 11.76%, Fresh factory salt was 11.37% and Molla factory salt was 12.87% respectively.

Table 4: Iodine content of iodized salt collected from local market

Time interval (days)	Storage period	ACI (local market salt)	Fresh (local market salt)	Molla (local market salt)	±SE	Level of significance
7	0	36.86	37.59	37.84	0.47	NS
	7	36.58	36.93	37.30	0.53	NS
	14	36.28	36.58	37.19	0.47	NS
	21	36.07	36.06	36.52	0.44	NS
	28	34.73	35.68	35.87	0.50	NS
	43	34.38b	34.92b	35.45a	0.48	**
15	58	33.33b	33.74b	34.57a	0.49	*
	73	32.49	32.88	33.25	0.52	NS
	88	32.28	32.31	32.13	0.48	NS
	103	31.36	31.97	31.85	0.46	NS
	118	30.98	31.02	30.45	0.45	NS
	133	30.11	30.12	29.63	0.34	NS
	148	29.09a	29.24a	28.81b	0.36	**
	163	28.52a	28.49a	27.90b	0.36	*
	178	28.07a	27.53b	27.53b	0.33	**

*Significant at 5% level of probability
** = Significant at 1% level of probability
NS = Not significant
In a row figures with same letter or without letter do not differ significantly whereas figures with dissimilar letter differ significantly (as per DMRT)

From the table 4 and Fig. 2 it is seen that on the 0th day no iodine was lost. From 7th to 103rd days the loss occurred insignificantly. From 133rd days to 178th days the iodine loss occurred significantly at 1% and 5% level of probability ($P<0.01$) and ($P<0.05$). After six months the percent iodine loss of ACI local market salt was 23.84%, Fresh local market salt was 26.78% and Molla local market salt was 29.12% respectively.

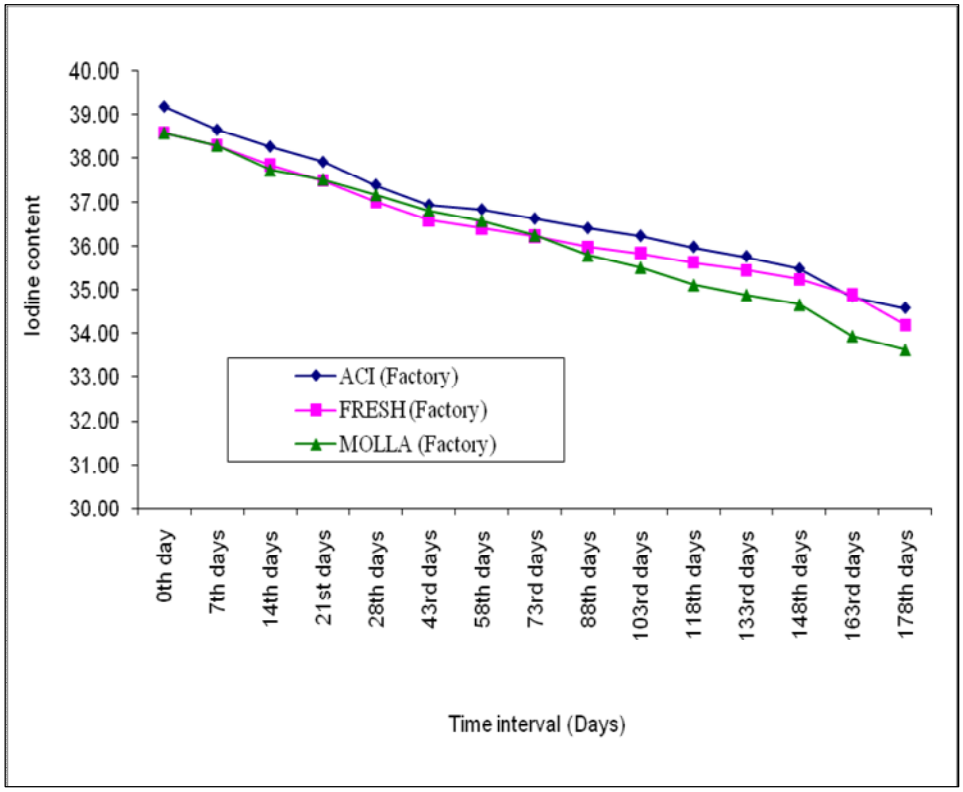

Fig. 1: Graphical representation of iodine content decreased of factory salt

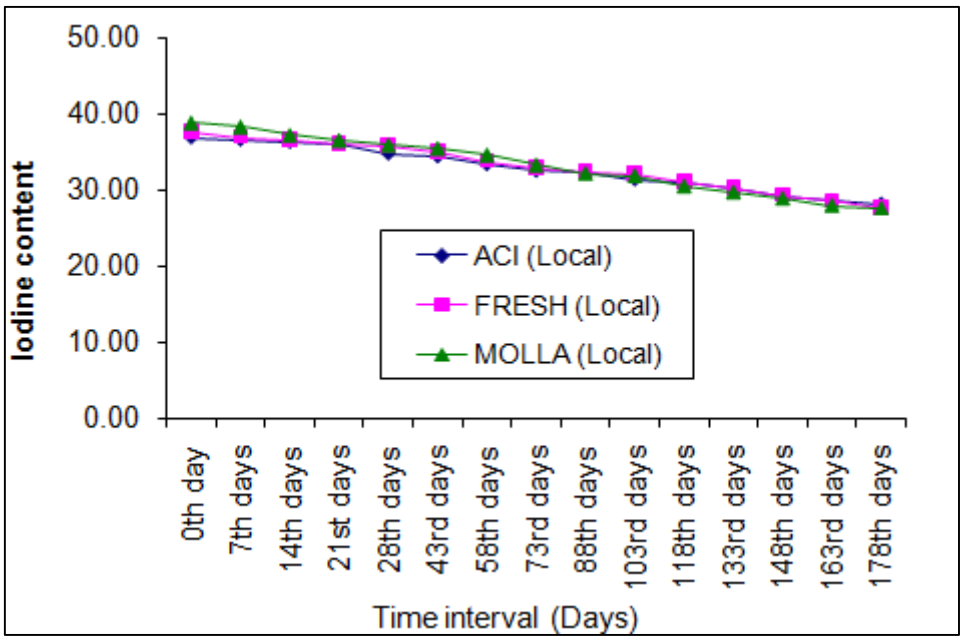

Fig. 2: Graphical representation of iodine content decreased of local market iodized salts

CONCLUSION

Iodine is an important mineral for human and animal health. In this study it was found that the impacts of moisture content, impurities and storage condition are indispensible in terms of iodine loss of the salts. Here three salt samples were good in iodine content but among them ACI factory salt and Molla local market salt contains more iodine compare to others. Loss of iodine is lower in Fresh factory salts and ACI local salts compare to others of same category. Maintaining the minimum moisture content, minimum impurities level and proper storage condition iodine loss of salt can be minimized.

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