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Determination of Iodine Content in Different Brands of Common Salts

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Abstract

Iodine deficiency disorders (IDD) are recognized as a major global public health problem; it is possible to root out this problem by universal salt iodization. This study was designed to determine iodine concentration in different brand of salt collected from different area of Nepal and India. All samples were collected both in Lahan and India near to Lahan city. Concentration of iodine in salt was determined by iodometric titration method. Reagent was $K_2Cr_2O_7$, standardized $Na_2S_2O_3$, KI, $NaHCO_3$, starch, concentrated HCl, H_2SO_4. Most of the salts collected show iodine level to be in the acceptable range. Result shows that out of nine brands, only seven shown to has a poor content of iodine. It can be decided from the result that most of the people of our country are now using iodized salt aayonune containing high amount of iodine. Evidence is now available from both controlled trials and successful iodization programs that these disorders can be successfully prevented by correction of iodine deficiency.

Keywords: *Iodine deficiency disrders, symptoms, treatment, iodine determination*

1. Introduction

Iodine is an element that is needed for the production of thyroid hormone. The body does not make iodine, so it is an essential part of your diet. If we do not have enough iodine in our body, we cannot make enough thyroid hormone. Thus, iodine deficiency can lead to enlargement of the thyroid hypothyroidism and to mental retardation in infants and children whose mothers were iodine deficient during pregnancy (American Thyroid Association, 2007). Iodine deficiency affects humans at every stage of life and leads to several severe disorders. Iodine deficiency is the leading cause of brain damage and mental retardation in the world. In addition to mental retardation, iodine deficiency causes endemic goiter,

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cretinism, dwarfism, mental retardation, muscular disorders, spontaneous abortions, sterilization, and stillbirths.

Role of iodine in Normal Metabolism

Iodine is needed for the normal metabolism of cells. Metabolism is the process of converting food into energy. Insufficient iodine can slow down the body's metabolism, which can result in weight gain.

Role of inorganic and organic forms of iodine as an antioxidant

Iodine is one of the most abundant electron-rich essential elements in the diet of marine and terrestrial organisms. It is transported from the diet to the cells via iodide transporters. Iodide, which acts as a primitive electron-donor through peroxides enzymes, seems to have an ancestral antioxidant function in all iodide-concentrating cells from primitive marine algae to more recent terrestrial vertebrates (Hetzel, et.al., (1993).

Role of iodine in oral mucosa and in salivary glands physiology

It is hypothesized that dietary deficiency or excess of iodine (I) has an important role in oral mucosa and in salivary glands physiology. Salivary glands derived from primitive I concentrating oral cells, which during embryogenesis, migrate and specialize in secretion of saliva and iodine.

Role of iodine in Healthy Pregnancy

Iodine plays a crucial role in promoting a healthy pregnancy. Iodine deficiency during pregnancy can cause high blood pressure in the mother and mental retardation in the baby.

Iodine and delayed immunity

Iodine was and is sometimes used therapeutically in various pathologies where the immune mechanism is known to play a dominant role. It has in fact been administered to patients with tubercular glaucomatous, lepromatous,syphilitic and mycotic lesions where it facilitates cure. This effect does not depend on iodine's action on the microorganism responsible.

Iodine Deficiency and Pregnancy

Iodine is required for thyroid hormone synthesis. Greater the production of thyroid hormone caused to increase. So fetal iodine requirements, dietary iodine requirements are higher in pregnancy than they are for non-pregnant women. The renal iodine excretion Children of mothers with severe iodine deficiency during pregnancy can have mental retardation and problems with growth, hearing, and speech.

Iodine Deficiency in the Fetus

Fetal iodine syndrome refers to symptoms and signs that may be observed in a fetus

or newborn when the mother was exposed during pregnancy to inappropriate. Iodine deficiency is associated with goiter and hypothyroidism. When severe iodine deficiency occurs during pregnancy, it is associated with congenital hypothyroidism that is manifested by increased neonatal morbi-mortality and severe mental dysfunction, hyperactivity, attention disorders and a substantial decrease of IQ of an irreversible nature.

Iodine Deficiency in the Children and Adolescents

Iodine deficiency in this period is characteristically associated with endemic goiter. Prevalence increases with age, reaching a maximum after the first decade of life. The condition can be effectively prevented by iodization. There is increasing evidence of impaired mental function in apparently normal children living in iodine-deficient areas.

Iodine Deficiency in the Adults

An iodine deficiency in the adult can cause uncomfortable and even severe symptoms. They include swelling in the neck, pregnancy-related issues, weight gain and learning difficulties. Its symptoms are very similar to those of hypothyroidism, or low thyroid hormones. Low levels of iodine are not the only cause of low thyroid function. But a lack ofiodine can cause an abnormal enlargement of the thyroid gland, known as a goiter, and other thyroid problems. In adult, it can cause mental disabilities.

Hyperthyroidism

The term hyperthyroidismrefers to any condition in which there is too much thyroid hormone in the body. In other words, the thyroid gland is overactive. Hyperthyroidism is a disorder that occurs when the thyroid gland makes more thyroid hormone than the body needs.

Causes of Iodine Deficiency

Worldwide, we are experiencing epidemic proportions of iodine deficiency, in part due to deforestation, soil erosion, and poor farming practices that deplete minerals from the soil and yield iodine-deficient crops. There are other contributing factors that exacerbate this disturbing global problem. Exposure to toxic chemicals hinders the uptake of iodine in the body as the toxins compete for iodine receptor sites and inhibit the body's ability to absorb this valuable mineral. These toxins include a group of elements known as halides (and their derivatives), all of which have similar chemical structures. The halides consist of bromide, fluoride, chloride and iodide, the latter being the only one with therapeutic effects in the body. In the 1980s, bromine (a bromide derivative) replaced iodine as a bread dough ingredient. Bromine is a known breast carcinogen. This singular change by the food industry resulted

in an epidemic of bromide toxicity and increases in thyroid disorders, thyroid cancer and other illnesses resulting from iodine deficiency(Buja L. M. & Krueger F. R. G, 2011).

Iodine Stability in iodized salt

In salts iodine stability is affected by storage conditions. Heating, heating with oxidizing agent, incubation by time were the parameters which have been determined. Iodine loss was 41.16% by heating at 200 degrees C up to 24 hours. Whentheiodized salt heated with oxidized agent iodine loss rose up to 58.46% in 24 hours. Iodine loss mechanism seems similar in both cases. However, iodine loss is greater in the presence of H_20_2. After the salt was stored at room temperature with a relative humidity of 30%-45% and in sealed paper bags for three years, 58.5% of iodine content lost in approximately 3.5 years.

Factor influencing in loss of iodine from iodized salt

Iodized salts stored in atmospheres of relative humidity's of 50 percent lose smaller quantities of their iodine than salts

stored under similar conditions at other humidity's. Iodized salts rendered alkaline by the addition of $NaHCO_3$ lose practically none of their iodine during storage, while neutral salts or salts rendered acid lose appreciable quantities. Salts iodized with KIO_3 lose none of their iodine when stored for extended periods. Exposure of iodized salts to sunlight effects a loss of iodine from neutral or acid salts, only a slight Toss from salt rendered alkaline and practically no loss from salts iodized with KIO_3.

Diagnosis of Iodine Deficiency Disorder

Iodine deficiency is diagnosed across populations and not specifically in individuals. Since iodine is released deficiency across a large population is to measure the amounts of iodine in from the body through the urine, the best way to determine iodineconcentration less than Starch was used as an indicator in this reaction as unreacted I_2 will form a deep blue complex with the starch

$$I_2 + 2S_2O_3^{-2} \text{----} > 2I + S_4O_6^{-2}$$

Preparation of a100 ml solution of 0.1N $K_2Cr_2O_7$

Molecular weight of $K_2Cr_2O_7$ = 294mg

Equivalent weight of $K_2Cr_2O_7$ = 49mg

Calculation: For 1000ml of 1N equivalent weight = 49mg

For 1ml of 1N equivalent weight = 49/1000 gm

Therefore, for 100ml of 0.1N equivalent weight = (49×100×0.1)/1000 gm = 0.49gm

Preparation of 100ml of 0.1N $Na_2S_2O_3$ 7

Molecular weight of $Na_2S_2O_3$= 248mg
Equivalent weight of $Na_2S_2O_3$ = 248mg

Calculation: For 1000ml of 1N equivalent weight = 248mg For 1ml of 1N equivalent weight = 248/1000 gm Therefore, for 100 ml of 0.1Nequivalentweigh = (248×100×0.1)/ 1000 gm = 2.48gm

Standardization of Sodium Thiosulphate ($Na_2S_2O_3$)

Table 1. Standardization of $Na_2S_2O_3$

Obs.No.	Burret Reading			Average
	Initial	Final	Diffrence	
1	0.00	9.2	9.2	
2	9.2	18.5	9.3	9.2
3	18.5	27.5	9.3	

The strength of the $Na_2S_2O_3$ is calculated using the following formula:

Volume of $Na_2S_2O_3$, V_1 = 9.2 ml

Strength of $K_2Cr_2O_7$, S_2 = 0.1 N

Volume of $K_2Cr_2O_7$, V_2 = 10ml

$S_1 \times V_1 = S_2 \times V_2$

$S1 = (0.1 \times 10)/9.2$

$= 0.1086N$

Preparation of 0.005N Sodium Thiosulphate

From the calculated strength of the standardized Sodium thiosulfate, the volume required to react with each mole of iodate was determined as follows:

Volume of $Na_2S_2O_3$ required to titrate iodate, V_1=?

Strength of $Na_2S_2O_3$, S_1 = 0.1086N

Volume of Diluted $Na_2S_2O_3$, V_2 = 250ml

Strength of Diluted $Na_2S_2O_3$, S_2 =0.005N

$$\mathbf{S_1V_1 = S_2V_2}$$

$$\mathbf{V_1 = (0.005 \times 250)/0.1086}$$

$$\mathbf{= 11.51ml}$$

Amount of water required to dilute $Na_2S_2O_3$ = 100 – 11.51 = 88.49ml

Titration

10g of salt was weighed using electronic balance and placed into a conical flask. To the flask, 50ml of water, 5ml of 10% KI and 1ml of H_2SO_4 were all added, one by one. The solution turned a yellow/ brown color, as iodine was produced. The solution was then titrated against the Standardized and Diluted $Na_2S_2O_3$ until the yellow/brown color became very pale. Then, 2-3 drops of Starch indicator solution were added, which produced a dark blue-black colored complex with iodine. The titration was continued until the color completely disappears. The process was repeated two more times and an average value for the volume of $Na_2S_2O_3$ was determined.

Result

Calculation

From the average volume of $Na_2S_2O_3$ determined, the number of ppm of iodine in the salt samples was calculated with the following formula:

Iodine ppm = (RX100X1000X0.12XN)/6

Were,

R = Average volume of $Na_2S_2O_3$

0.127 is the weight of iodine equivalent to 1ml of normal thiosulphate solution.

N is normality of thiosulphate solution (which is 0.005N) (Srivastava,et.al., 2006)

Following the standard procedure, as mentioned before, the following results were obtained for each sample collected.

Table 2. Iodine content for Ankursalt (001)

Sample No	O.N	Burret Reading(ml)			Aver Average(ml)	Iodine (ppm)
		I	F	D		
001	1	0	2	2	2	21.17
001	2	2	4	2		

From this result it is seen that **Ankur salt** contains iodine **aboveminimum** level.

Table 3. Iodine content for Paris Salt (002)

Sampe code	O.N	Burret Reading(ml)			Average (ml)	Iodine (ppm)
		I	F	D		
002	1	4.0	7.3	3.3	3.4	35.98
	2	7.3	10.8	3.5		

From this result it is seen that **Paris salt** contains iodine below **maximum** level

Table 4. Iodine content for NokiaSalt (003)

Sampal code	O.N	Burret Reading(ml)			Average (ml)	Iodine (ppm)
		I	F	D		
003	1	14.7	15.9	1.2	1.1	11.65
	2	15.9	16.9	1.0		

From this result it is seen that **Nokia salt** contains iodine below **minimum** level.

Table 5. Iodine content for Anuradha Salt (004)

Sampal code	O.N	Burret Reading(ml)			Average (ml)	Iodine (ppm)
		I	F	D		
004	1	10.8	13.4	2.6	2.4	25.4
	2	13.4	15.6	2.2		

From this result it is seen that **Anuradha salt** contains iodine above minimum level.

Table 6. Iodine content forAayonunSalt (005)

Sampal code	O.N	Burret Reading(ml)			Average (ml)	Iodine (ppm)
		I	F	D		
005	1	15.6	23.3	7.7	7.5	79.375
	2	23.3	30.6	7.3		

From this result it is seen that Aayonun salt contains iodine above **maximum** level.

Table 7. Iodine content forAnna Shakti Salt (006)

Sampal code	O.N	Burret Reading(ml)			Average (ml)	Iodine (ppm)
		I	F	D		
006	1	30.6	31.3	0.7	0.7	7.40
	2	31.3	32	0.7		

From this result it is seen that Anna Shakti salt contains iodine **below minimum** level.

Table 8. Iodine content for Radiance Salt (007)

Sampal code	O.N	Burret Reading(ml)			Average (ml)	Iodine (ppm)
		I	F	D		
007	1	32	33.7	1.7	1.95	20.637
	2	33.7	35.9	2.2		

From this result it is seen that Radiance salt contains iodine above minimum level.

Table 9. Iodine content for AapkapurnSalt (008)

Sampal code	O.N	Burret Reading(ml)			Average (ml)	Iodine (ppm)
		I	F	D		
008	1	35.9	36.9	1	0.9	9.525
	2	36.9	37.7	0.8		

From this result it is seen that **Aapkapurn Salt** contains iodine **below minimum**level.

Table 13. Iodine content for True life salt (009)

S.code	O.N	Burret Reading(ml)			Average (ml)	Iodine (ppm)
		I	F	D		
009	1	37.7	40.0	2.3	2.3	24.34
	2	40.0	42.3	2.3		

From this result it is seen that **True life** salt contains iodine **above minimum** level

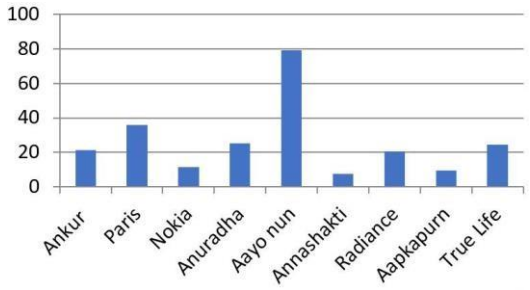
Comparison of different branded table salt on iodine content

Discussion

Nepal mainly depends upon India for the import of household salts. Under the act of universal salt iodization (USI), the Nepal government had launched various strategies to increase the rate of consumption of adequately iodized salt throughout the nation. About one third of world population is exposed to the risk of iodine deficiency disorders.

About 187 million of world population (2.7% of the world population) was end up with goiter in 2010.It can be assumed that producers' salt containing more than 30 ppm iodine contributes to the elimination of iodine deficiency. However, a substantial proportion of the salt examined in this study was clearly not iodized in accordance with the legal requirement. In the present study, most of the salt with less iodine content (<30 ppm) followed by nil (15ppm).About 80% of the producer's salt was clearly under iodized. Figure shows a bimodal distribution reflecting salt sufficiently iodized to contribute to the elimination of iodine deficiency, i.e., containing more than 30 ppm iodine, and under iodized salt contributing little or nothing in this matter, i.e., containing less than 30 ppm iodine.

Comparison of different branded table salt on iodine content



Conclusion

The results of analysis of the nine samples of salt collected from the shop, in Lahan city and India border near to Lahan show that only two brands of the salt samples have iodine content that is agreeable with NAFDAC (30 ppm 80 ppm) to approved range for human consumption. Hence the two brands of salt namely, Aayo nun and Paris sal can be consume by human population in Lahan without any fear of unhealthiness. However, the results obtained are within the acceptance range for human consumption, since NAFDAC approved range is 50 ppm – 30 ppm. Below 30 ppm iodine concentration NAFDAC disapproved, and declared the salt unhealthy for human consumption because it causes goiter.

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