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Evaluation of Iodine in Distributed Salts in Abarkouh City in 2017-2018

Mahrokh Jalili [1], Ali Asghar Ebrahimi [1], Mohammad Hassan Ehrampoush [1], Fariba Abbasi [2], Hadi Eslami [3*], Reza Ali Fallahzadeh [1], Mehrnosh Shirdeli [4], Fereshteh Molavi [1]

[1] *Environmental Science and Technology Research Center, Department of Environmental Health Engineering, School of Public Health, Shahid Sadoughi University of Medical Sciences, Yazd, Iran.*
[2] *Department of Environmental Health Engineering, Shiraz University of medical science, Shiraz, Iran.*
[3] *Department of Environmental Health Engineering, School of Health, Rafsanjan University of Medical Sceiences, Rafsanjan, Iran.*
[4] *Research Center for Food Hygiene and Safety, Shahid Sadoughi University of Medical Sciences, Yazd, Iran.*

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***Corresponding Author:**
Hadi Eslami
Email:
Hadieslami1986@yahoo.com
Tel:
+989177094695

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ABSTRACT

Introduction: Iodine deficiency and associated disorders, which lead to a wide range of clinical manifestations, have been raised as one of the health and nutritional problems in Iran. Therefore, this study was aimed to investigate the amount of iodine in distributed salts in Abarkouh city in 2017-2018.

Materials and Methods: Random sampling was done by census on all 30 distributed brands in Abarkouh city in the different stores across the city. Sixty samples (30 samples after one month from the production date and 30 samples after 6 months from the production date) were collected and transferred to the laboratory. The measurement of iodine was done according to the British Pharmacopoeia recommended method. T-test was used to analyze the data.

Results: The Mean iodine concentration in the salts supplied in the Abarkouh was 29.83 ± 19.9 ppm, which was 50% less than the Iran's standard, with a statistically significant difference ($P \leq 0.001$). 66.6% of the studied brands did not contain adequate iodine. Six months after production date, the average iodine amount in salts was reduced to 24.26 ± 16.94 ppm, but the reduction was not statistically significant ($P = 0.224$).

Conclusion: Average iodine amount in most of the salts supplied across the Abarkouh city was not acceptable and some salts lacked iodine. Therefore, careful and continuous supervision and monitoring the process of iodized salts production in factories is recommended.

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Introduction

Iodine deficiency is one of the factors affecting growth factor and the main cause of human growth decline. Iodine deficiency is also the most common preventable cause of brain damage worldwide [1]. More than 2 billion people (38%) of the world's population in 130 countries are at risk due to iodine deficiency. Iodine deficiency diminishes the production of thyroid hormone, that is, iodine is an essential component for the thyroid hormone secretion, and iodine deficiency is known as one of the main causes of goiter development [2], but now studies have shown that the effects on the growing brain (in children and infants) are much more deadly and threaten the social and economic development of many countries [3]. Iodine deficiency disorders, which are known to be one of the health priorities in any country, have created

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many problems for more than 400 million people in Asia [4], with 50% of the world's population receiving less-than -required amounts of iodine [5]. Given the fact that iodine is a small amount and vital mineral to human life [6], and soils in many areas do not contain sufficient amount of this essential microelements, then agricultural and livestock products are deficient in iodine [7], the best way to compensate for iodine deficiency is use of iodized salt [8]. In addition, in areas where this strategy cannot be implemented quickly, temporary use of iodine supplements is recommended. In 1989, assessing the prevalence of goiter in all provinces of Iran showed that goiter was hyper endemic due to iodine deficiency [9]. In 1994, the Joint Committee of the World Health Organization (WHO) and UNICEF proposed a global food iodization plan as a safe and cost-effective strategy to supply the required amounts of iodine for all individuals. Iodizing edible salt has been one of the most effective interventions worldwide to eliminate iodine deficiency disorders [10]. Various studies have shown that human daily need 100 micrograms of iodine that reach the body by nutrients. According to reports, the most important source of iodine in Iran is iodized salt and the standard iodine value for these salts is set at 40 ± 10 ppm [11]. Complications due to iodine deficiency are various depending on different life stages and have various complications such as abortion, congenital malformations, increased mortality at birth, cretinism, neurological disorders, increased neonatal mortality, infant goiter, hypothyroidism, mental impairment, and physical developmental delays [12]. According to statistics, the prevalence of goiter in Iran declined to 8.9% in 2013, reflecting that there is still a risk of iodine deficiency among people in the community [6]. In Iran, some measures have been taken in this regard since 1989 which significantly increased the level of urinary iodine and reduced the prevalence of goiter in most regions of the country [13]. In the third national monitoring of the program in 2001, the results were very satisfactory and Iran was recognized as an iodine deficiency-free zone [9, 14]. But the results of the fourth national monitoring in 2006 showed the fact that the iodine intake in the regions of the country significantly decreased, leading to the concern that the level of iodine-induced abnormalities would increase again in the event of insufficient attention and supervision [10].The results of this monitoring in Yazd province showed that the percentage of goiter was desirable, and the median urinary iodine in the province was higher than 100 µg/l, which represents the success of the country's program and the accuracy monitoring of the iodization program [15]. A study in 2014 on the assessment of impairments of height, weight and head circumference in the five years old childs with congenital hypothyroidism in Yazd in showed that, iodine deficiency in pregnant mothers could lead to permanent mental retardation and physical development impairment [16]. Some studies have also shown that iodine intake in households in Yazd is lower than the Iran standard [15]. Therefore, the aim of this study was to evaluate iodine levels in iodized salts distributed in Abarkouh city during 2017-2018.

Materials and Methods

This cross-sectional study was conducted to evaluate the iodine concentration of iodized salt brands distributed in Abarkouh city in 2017-2018. Random sampling was done by census on all 30 distributed brands in Abarkouh city in different stages in stores across the city. Sixty samples (30 samples after one month from the production and 30 samples after 6 months from the production the salts) were collected and transferred to the laboratory. Each sample was tested twice. To measure iodine levels in iodized salts, the British Pharmacopoeia recommended method [17]. Data analysis was performed by the SPSS version 20 and using independent sample *t*-test and one-sample t-test and $P \leq 0.05$ was considered significance level.

Results

A total of 120 experiments were carried out on salts as 60 distributed salt brands across the city (30 samples after one month from the production and 30 samples after 6 months from the production the salts). were tested twice, in 34% of the tested

samples produced one month before, the iodine concentration was compatible with the standard iodine salt in Iran (50-50 ppm), in 50%, the iodine concentration was lower than the standard, and in 16%, the iodine concentration was higher than the standard. In salt samples produced six months before, in 37% of samples, iodine concentration was compatible with Iran standard, in 57% of them was lower, and in 6%, was higher than Iran's standard (Table 1).

Table 1: Comparison of Percentage of iodine concentration in studied salts with Iran standard

The date of production	The salts with standard iodine concentration (%)	The salts with less than standard iodine concentration (%)	The salts with higher than standard iodine concentration (%)
One month after production	34	50	16
Six months after production	37	57	6

The average iodine concentration in salts decreased one month after production date by 29.8 ppm and in salts six months after production date by 24.26 ppm. Independent *t*-test showed that iodine reduction was not statistically significant six months after production date (P = 0.242). The maximum iodine concentrations in salts at one and six after production date were 69 ppm and 52 ppm, respectively. And the minimum iodine content was zero (according to the fact that the two brands of iodine were iodine-free (Table 2).

Table 2: Mean ± standard deviation of iodine concentration in studied salt samples

The date of production	The mean Iodine concentration range (ppm)	Standard Deviation (SD)	Concentration rate (ppm)	*P* -value
One month after production	29.83	19.76	0-69	0.242
Six months after production	24.26	16.64	0-52	

From the total salt brands tested one month after production, iodine concentration in 50% of the samples was below the minimum standard, 34% in compliance with the standard, and 16% higher than the standard (30-50 ppm) (Figure 1).

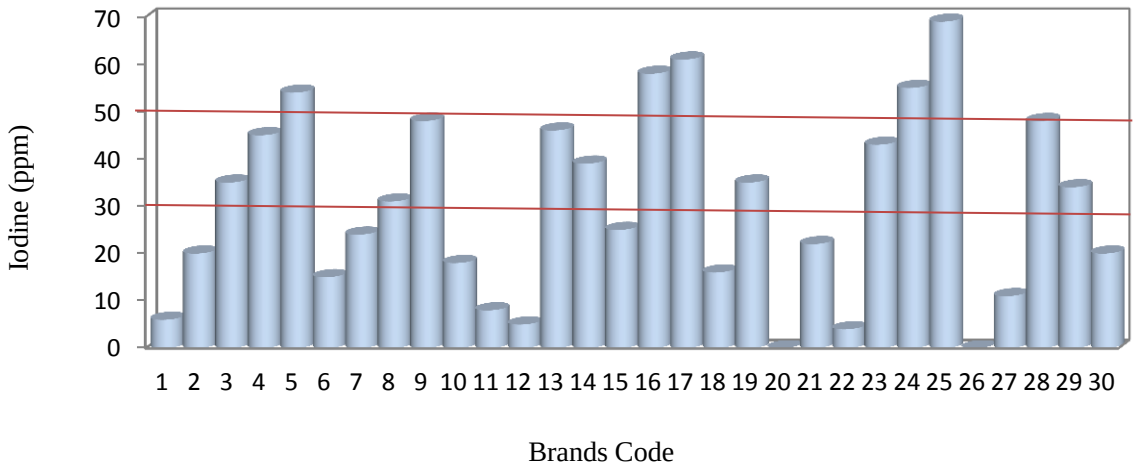

Figure 1: Average iodine in the salts examined (one month after the production date)

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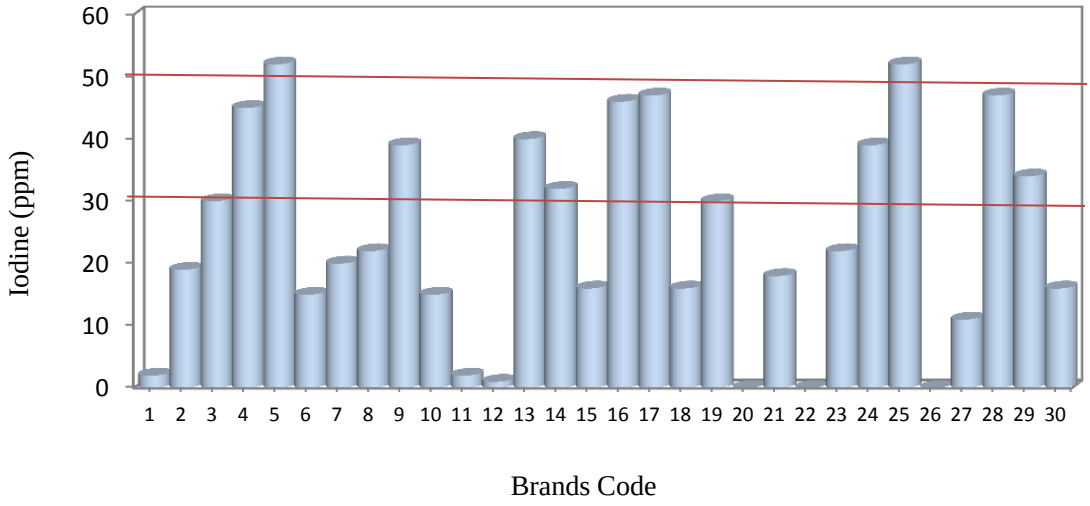

Figure 2: Average iodine in the salts examined (six months after the production date)

In addition, one-sample *t*-test to compare iodine concentration in the produced salts and Iran's standard showed that the difference between iodine concentration in the salt samples and the set standard concentration was significant ($P \leq 0.001$), meaning that the shortage of iodine concentration in both dates after production is not in line with the standards set by the Iran's Standard Organization, and in most of the distributed brands across the city, the iodine concentration is less than standard.

Discussion

In this study, the average iodine concentration in 50% of the supplied salts was lower than the Iran's standard (30-50 ppm), and the concentration of iodine decreased six months after production date. A study by Pasdar and et al in 2013-2014 showed that iodine in salts delivered in Kermanshah was less than Iran's standards in over 50% of the samples, and after the date of production of salts, their iodine content decreased significantly over time [17]. The findings of this study also confirm that, over time, iodine levels are reduced by the influence of physical factors such as exposure to light, humidity and ambient temperature; more clearly, the exposure of salt to light relative to darkness, humidity relative to the dry environment, and the high temperatures relative to lower temperatures, can cause more iodine loss in iodized salt at a faster rate [18, 19]. Other studies have also found that excessive humidity destroys the iodine in iodized salts and significantly reduces iodine levels [17]. In addition, the results of a study in Karaj showed that 40% of the studied salt samples were good, 39% were acceptable, and 21% were unacceptable [8]. The results also showed that 79% of the samples were from in view of iodine, 61% of samples are acceptable for purity and 60% for insoluble matter [8]. The present study also confirms that iodine content of salt in the market is unacceptable according to Iran's standards. A study was conducted in 2009 in order to evaluate the adequacy of iodine, goiter prevalence and urinary iodine concentration at 17 years after iodization and iodized salt consumption in Yazd province, showed that a high percentage of households in Yazd province used refined and iodized salt as well as the method of salt storage was acceptable in 48% of households. Five percent of household salts also had less than 15 gamma iodine, which controlled some of the diseases associated with iodine deficiency, including hypothyroidism due to iodine deficiency [20], but the households' iodine was still below the Iran's standard, which is consistent with the findings of this study [15]. The findings of the study of Mahdinia showed that none of the iodized salts distributed in Semnan province

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during the study complied with the standard, and 31.2 % of distributed iodized salts we're outside the acceptable range of 30-50 ppm [21], which is consistent with the findings of the present study. A direct correlation between the amount of iodine in salt and urine iodine level in southern Tehran in 2011 showed that, due to inadequate iodine amount in salt, the amount of iodine intake decreases and, in some cases, the amount of iodine in the salts used by households in Tehran was less than the standard set by the Iranian Bureau of Standards [22], which is consistent with the findings of this study. Nourooz-zadeh and et al, reported iodine deficiency in 87% of cases, and the rate of using iodized salt in cooking and dinner table salt was 92% and 96%, respectively. In 49% of cases, iodized salt was kept under favorable conditions, and 16% of households added salt in the final stages of cooking, which results in loss of iodine in salt due to heat during cooking [5]. According to the study of Arab conducted in Shirvan in 2010, 11% of households used untreated salt for daily consumption, and 27% did not know favorable conditions of maintaining iodized salts and 15% the correct way to use iodized salt in cooking [6]. During the years 1955 to 1970, the problems of iodine deficiency in the Soviet Union were largely eliminated due to the significant production of iodine salts and the accurate monitoring and control of iodine deficiency. In 1969, the prevalence of goiter was less than 5%, but during the 1970s and 1980s, iodine deficiency gradually recurred [15] due to discontinuation of monitoring and controlling prevention programs. The reduction of iodized salt consumption by people and the use of iodized salts by a few food-producing factories in Australia is another example of the recurrence of iodine deficiency in this country [23]. Finally, due to the lack of continuous monitoring of intake and consumption of edible iodine and the lack of systematic and periodic implementation of anti-iodine deficiency programs are the most important reasons for failure to control iodine deficiency in some population [24]. Despite the desirable iodine amounts in some salt brands, it is necessary to educate the housewives to keep salt under favorable conditions and then consume it, and only monitoring the amount of iodine in the household salts is not enough.

Conclusion

The results of this study indicate that the amount of iodine in the salts distributed across Abarkouh city is often less than the WHO standard. Therefore, it is suggested that, in order to reduce the risks of iodine deficiency for people's health, iodine amount of distributed salts across the Abarkouh city should be monitored continuously and accurately.

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Conflict of interest

There was no conflict of interest.

References

1. Gerensea H, Yohannse A, Baymot B, et al. Knowledge, attitude and practice (KAP) towards iodized salt utilization in HaweltiKebelle, Axum, Tigray, Ethiopia, 2015. Edorium J Nutr Diet. 2016; 2: 1-8.
2. Delshad H, Atiye A, Salehi F. Prevalence of goiter and urinary iodine in primary school students in Qazvin province in 2007; Comparison of 17 year results of salt iodization program in the country. Journal of Endocrinology and Metabolism of Iran. 2009; 13(3): 283-7.
3. Delshad H. History of the Iodine Deficiency in the World and Iran. Iranian Journal of

Endocrinology and Metabolism. 2008; 9(4): 439-53.
4. Hetzel B. Iodine deficiency disorders (IDD) and their eradication. The Lancet. 1983; 322(8359): 1126-9.
5. Nourooz-zadeh J, Beiranvand A, Rostami R, et al. Evaluation of dietary iodine status during pregnancy in urmia city: Association to the quality of iodinated-salts and itilization. The Journal of Urmia University Medical Sciences. 2012; 23(4): 440-5.
6. Datta A, Karmakar N, Nag K, et al. A study on knowledge, attitude and practices regarding household consumption of iodized salt among selected urban women of tripura, India. Journal of Clinical & Diagnostic Research. 2018; 12(11): 16-20.
7. Vitamine and mineral nutrition information system. The WHO Global Database on Iodine Deficiency. 2010; Available form: http:// www.who. int/ vmnis/ iodine/en/ [Cited April 25, 2010].
8. Ramezani H, Aalami A, Mohammadzadeh Moghadam M, et al. Comparing the quality of iodine in edible salt in iranian households living in the Southern province of Khorasan-e-Razavi using WHO standards (2010- 2015). J Food Qual. 2017; 17: 1-6.
9. Azizi F, Shekholeslam R. National programme for control of iodine deficiency in Iran. Teb & Tazkyeh. 1996; 19: 18-22.
10. Azizi F, Aminorroya A, Hedayati M, et al. Urinary iodine excretion in pregnant women residing in areas with adequate iodine intake. Public Health Nutr. 2003; 6(1): 95-8.
11. Malaya University. Titration methods for salt iodine analysis. monitoring universal salt lodization programmes. 2014; Available from: http://hatnim.co.kr/new/data/titration.pdf. [Cited March 25, 2017].
12. Zarghani H, Amiri F, Atiye A. Knowledge, attitude and practice of pregnant mothers about the incidence of iodine intake and its relationship with iodine intake during pregnancy. Iranian Journal of Endocrinology and Metabolism. Iranian Journal of Endocrinology and Metabolism Research. 2016; 17(6): 469-76.
13. Mozaffari H, Dehghani A, Afkhami M. The prevalence of goiter and urinary iodine in 6-11 year old students in Yazd province in 2002, 10 years after the start of iodized salt. Iranian Journal of Endocrinology and Metabolism. Iranian Journal of Endocrinology and Metabolism Research. 2003; 5(4): 283-91.
14. Nazeri P, Karimi M, Hedayati M, et al. Urinary and breast milk iodine concentrations in lactating mothers and its association with certain demographic characteristics in an area with iodine sufficiency. Iranian Journal of Endocrinology and Metabolism. 2018; 20(3) :109-15.
15. Azizi F, Delshad H, Amouzegar A, et al. Assessment of iodine intake in Yazd province 17 years after universal salt iodization (The fourth national survey: 2007). The Journal of Shahid Sadoughi University of Medical Sciences. 2010; 18(3): 263-70.
16. Lotfi MH, Rahimi Pordanjani S, Mohammad zadeh M, et al. The Evaluate prevalence growth disorders of weight, height and head circumference first 5 years of life in children with congenital hypothyroidism city of Yazd in 2014. Razi Journal of Medical Sciences. 2016; 23(143): 34-46.
17. Pasdar Y, Mohammadi G, Mansouri A, et al. Iodine content in salt used in Kermanshah, 2013-2014. J Mazandaran Univ Med Sci. 2016; 26(135): 144-8.
18. Fallah H, Kalantari N, Mahdinia M, et al. Investigation of iodine stability of iodized salts against light and moisture in Damghan city. Journal of Ardabil University of Medical Sciences. 2009; 8(1): 98-105.
19. Joint FAO/WHO Expert Committee on Food Additives. Evaluation of Certain Food Additives and Contamination. Rome, Italy. Report number: 67, 2007.
20. Parvin. M, Hajipoor R, Azizi F. Continued thyroid integrity with iodized salt in people with history of hypothyroidism due to iodine

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[DOI: 10.18502/jehsd.v3i4.227]

deficiency. Research in Medicine. 2004; 28(4): 275-9.
21. Mahdinia M, Nasehi H, Gharib R, et al. Study of iodine levels in iodized salts distributed in Semnan province in autumn 2004. Koomesh. 2006; 6(4): 285-90.
22. Nazeri P, Parvin M. Concentration of urinary iodine and consumption of salt iodine in southern Tehran households. Iranian Journal of Endocrinology and Metabolism, Iranian Journal of Endocrinology and Metabolism Research,. 2010; 12(3): 294-9.
23. Li M, Waite KV, Ma G, et al. Declining iodine content of milk and re-emergence of iodine deficiency in Australia. The Medical Journal of Australia. 2006; 184(6): 307.
24. Haddow JE, Mcclain MR, Palomaki GE, et al. Urine iodine measurements, creatinine adjustment, and thyroid deficiency in an adult United States population. J Clin Endocrinol Metab. 2007; 92(3): 1019-22.

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