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**IODINE AVAILABILITY AND BEHAVIORAL
ASPECT IN THE USE OF SALT IN NEPAL**

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WATER IODINE LEVEL IN KATHMANDU VALLEY



Project sponsored by:

Nepal Medical College Research Council,
Nepal Medical College Teaching Hospital, Kathmandu.

Principal investigator:

Dr. Biswajit Mohanty
Associate Professor and Head
Department of Clinical Biochemistry
Nepal Medical College, Kathmandu.
E mail: biochemistry@nmcth.edu

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IODINE AVAILABILITY AND BEHAVIORAL ASPECT IN THE USE OF SALT IN NEPAL



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Participants:

Dr.B.Mohanty and Mr.A. Kumar

Mrs.M. Mohanty

Dr.A.Agarwal

Dept. of Clinical Biochemistry

Dept. of Community Medicine

Dept. of Pathology



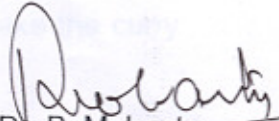
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With a great pleasure and sincerity I would like to extend my acknowledgement to Dr.S.B.Rizyal, Founder Principal of Nepal Medical College for his sustained encouragement to faculties to undertake research projects. He is a man with vision. I would also like to appreciate the effort taken by him and Dr. A.P.Sharma to establish the research council in Nepal Medical College Teaching Hospital and availing financial grants to various projects even if the college is going through monetary constraints.

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 Dr. B. Mohanty 3.8.2011

Department of Clinical Biochemistry
 Department of Clinical Biochemistry
 Nepal Medical College
 Atterkhel Jorpati
 Ktm., Nepal



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Introduction and Literature Review

After decades of sincere effort, iodine deficiency disorders (IDD) are still a major public health problem in Nepal. It has one of the highest prevalence rates of IDD. Total goiter rate (TGR) according to the last nation wide survey was found to be 39.7%^{1,2,3}. Rate of decline in IDD was not sufficient enough to achieve the national commitment of eliminating it by the year 2000. Now it has been rescheduled to year 2001¹. Innate habits and attitudes in the use of salt have been implicated to be one of the hindrances for IDD elimination program⁴. According to a survey by Salt Trading Corporation (STC) an apex organization of His Majesties Govt./Nepal responsible for salt fortification program, 50% of households still use big crystal salt commonly called as *baragara noon / phoda noon / dhika noon*¹. People feel it is tastier and less costly. Many people feel the big crystal salt if not washed, the dirt on it may cause infection like scabies or diarrheal diseases. This practice leads to further loss of the iodine. Population in remote mountainous area prefers to buy the basic needs in bulk, store it for animal and their consumption for the whole year. People of Tibetan origin prefer to consume *bhote* salt. This salt is prepared from inland salt-water lakes. In rural and semi-urban areas, for daily use in the kitchen, salt is commonly kept in hollow bamboo or wooden pot or earthen pot. These are porous containers and salt being hygroscopic leads to leaching of iodine. Instead of using salt as table salt it is commonly used while cooking, further risking the iodine loss by evaporation. To make the curry tasty it is a common practice to make the curry little sour (*amilo*).

Aim and Objectives

We had undertaken this study to look into the following aspects of salt use and measure the iodine content by iodometric titration method in our laboratory. The specific objectives are as follows:

1. Iodine content of STC salt at retailer's level in Kathmandu valley.
2. Iodine content of crystal salt, Bhote noon, Sedhe Noon and black salt.
3. Measure iodine level after changing the pH of the medium to simulate the actual curry taste ie. *Amilo*, *Khar* etc.
4. Study the effect of temperature on salt iodine.
5. Effect of container on salt iodine content i.e. earthen pot, bamboo container, galss and plastic container etc.
6. Measure the salt iodine level before and after washing the salt.
7. Effect of storage versus salt iodine.

Conclusion:

Materials and methods:

Salt packets (STC) and other salts are collected from 15 different retailer shops covering the whole valley. To study the effect of storage we collected salt pack and kept it for one year and study the iodine level at the end of one year. Iodine estimation was done by standard volumetric method utilising the principle of liberation of iodine, trapping and finally titrating it against sodium thiosulfate. This work is done in the department of Clinical Biochemistry, Nepal Medical Colleg, Kathmandu.

We conclude from our study that the iodine content of STC polythine salt

Result: is adequate to meet the daily requirement and if the salt is kept and use properly than it's iodine content is preserved for longer time. This in turn will

The iodine content of STC salt packet collected from 15 different places in Kathmandu valley for the month of June 2000 was found to be 44.2 ppm at retailer level as against company specification of 50 ppm. Other salts available in the market are big crystal salts, *sedhe* salt (use in Hindu religious functions), rock salt / black salt & *bhote* salt. Except big crystal salt other salts had negligible iodine content. The mean value of iodine content of big crystal salts (n=12) was found to be 7.3 ± 4.7 ppm. Washing the salt before the use decreased the iodine content by 67% whereas 15.6% decrease in iodine content was observed while cooking it for 60 minute. There is no change in iodine content when the pH of the medium altered. There was maximum loss up to 9.9% when the salt was kept in bamboo container and less so in wooden container but the loss was minimal when kept in roosted earthen container with a lid. We had preserved the salt packets for one year to measure the effect of storage on salt iodine level. Because of poor correlation between months no specific conclusion can be drawn but it certainly points to post-production quality control.

Conclusion:

1. Salt supplied by STC contains adequate amount of iodine but needs better post production quality control.
2. Crystal salts can be used as an alternate source of iodine provided the salt is properly stored and used.
3. Results indicate glass, plastic and roosted clay pots are better container for preserving the iodine for day to day use in the kitchen.
4. Washing drastically decrease the iodine level of salt.

We conclude from our study that the iodine content of STC polythine salt pack is adequate to meet the daily requirement and if the salt is kept and use properly than it's iodine content is preserved for longer time. This in tern will overcome the IDD problem particularly for those living in remote areas.

REFERENCE:

1. HMG/MOH/DoHS, Annual Report. 2055/56 (1998/99), p 27-28.
2. Joshi AB, Jima M. Current status of iodine deficiency disorders control in Nepal. BPKIHS 1999; Vol.1(No.1):49-54.
3. Hetzel BS, Potter BJ, Duberg EM. The iodine deficiency disorders: nature, pathogenesis and epidemiology. World review of nutrition and diet, 1990,62:59-119.
4. Dhal BR. Salt consumption pattern and iodine availability: An epidemiological study covering eco-developmentally distinct three Nepalese districts. NMCJ 1999; Vol.2, p 71-76.

Table I.

IODINE CONTENT OF COMMERCIAL SALTS

Date of Packing- June 2000.

Date of analysis- 8th July 2000.

S.N.	Place of collection	Company	Iodine in ppm	Mean value
1	Budhanilkantha	STC	47.5	44.39
2	Balaju	STC	46.4	
3	Aterkhel	STC	40.2	
4	Bhaktapur	STC	56.8	
5	Lagankhel	STC	42.2	
6	Chovar	STC	42.2	
7	Asan	STC	41.2	
8	Thankot	STC	44.4	
9	Sanku	STC	42.1	
10	Chavel	STC	42.1	
11	Jorpati	STC	43.6	
12	Jhaunkhel	STC	44.1	

STC company specification – 50 ppm.

OTHER COMMERCIAL SALT IODINE

1. Gyan salt (N₅) - 38.1 ppm

2. BP Salt (N₅) - 14.8 ppm

Table II.

IODINE LEVEL OF CRYSTAL SALTS

Date of Analysis – 9th July 2000.

S.N.	Place of Collection	Iodine present	Mean
1	Budhanilkantha	4.2	6.2
2	Balaju	4.7	
3	Aterkhel	6.3	
4	Bhaktapur	8.2	
5	Lagankhel	3.7	
6	Chovar	4.2	
7	Asan	17.8	
8	Thankot	2.1	
9	Sanku	4.5	
10	Chavel	6.3	
11	Jorpati	5.6	
12	Jhaunkhel	6.3	

OTHER SALTS

1. Bhoote nun - <1ppm
2. Black salt - <1ppm
3. Sedha nun - <1ppm

Table V.

EFFECT OF pH ON SALT IODINE LEVEL (in ppm)

Table III.

EFFECT OF WASHING ON SALT IODINE LEVEL (values in ppm)

Type of salt	Before washing	After washing	Loss of iodine
Powder (N=5)	44.4	15.9	63.8
Crystal (N=5)	6.2	2.3	74.7

Table IV.

EFFECT OF TEMPERATURE ON SALT IODINE LEVEL (in ppm)

Type of salt	0 min	20 min	40 min	60 min
Power salt (N= 5)	44.3	42.8	41.0	37.0
Crystal Salt (N=50)	8.6	8.0	7.4	6.3

Table VII.

EFFECT OF STORAGE ON IODINE LEVEL

Date of packing – Dec'99 to Dec'2000.

Date of analysis – January-2001.

Company specification at the time of packing – 50 ppm.

Table V.

EFFECT OF pH ON SALT IODINE LEVEL (in ppm)

Type of salt	pH 7	pH 4	pH 9
Power salt (N= 5)	44.3	43.8	44.5
Crystal salt (N=5)	8.6	8.3	8.4

Table VI.

SALT IODINE AND EFFECT OF CONTAINER (in ppm)

Container	0 day	10 day	20 day	30 day	60 day
Wooden	44.4	44	41.9	40.2	26.5
Clay pot	44.4	44	43.6	43.2	42.3
Plastic	44.4	43.4	43.2	43	42.2
Bamboo	44.4	44.2	41.3	40	33.9
Glass	44.4	44.1	44	43.6	43

Date of analysis – January 2001.

Company specification at the time of packing – 50 ppm.

Table VII.

EFFECT OF STORAGE ON IODINE LEVEL

Date of packing – Dec'99 to Dec'2000.

Date of analysis – January 2001.

Company specification at the time of packing – 50 ppm.

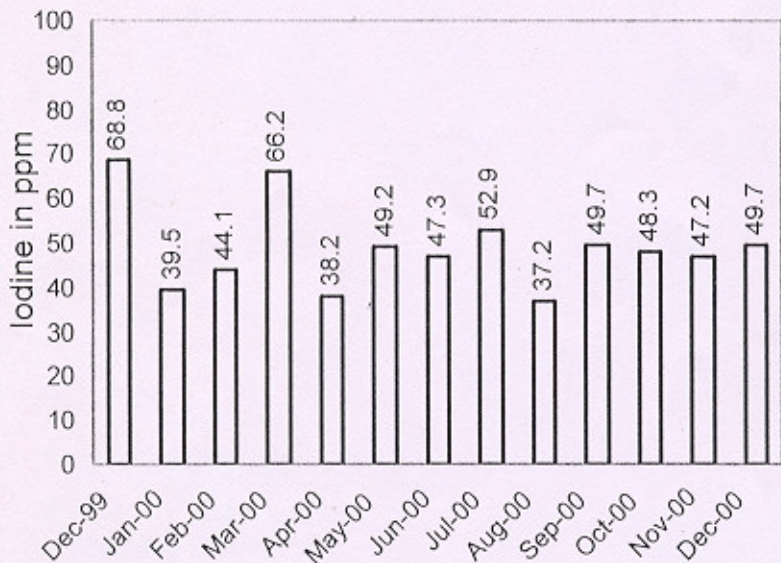
S.No.	Date of collection	Sample size (n)	Iodine in ppm
1.	Dec'99	5	68.8
2.	Jan'00	5	39.5
3.	Feb'00	5	44.0
4.	March'00	5	66.0
5.	April'00	5	38.2
6.	May'00	5	49.2
7.	June'00	5	47.0
8.	July'00	5	52.9
9.	Aug'00	5	37.0
10.	Sept'00	5	49.7
11.	Oct'00	5	48.3
12.	Nov'00	5	47.2
13.	Dec'00	5	49.7

EFFECT OF STORAGE ON IODINE LEVEL:

Date of packing – Dec'99 to Dec'2000.

Date of analysis – January 2001.

Company specification at the time of packing – 50 ppm.



Study on:

WATER IODINE LEVEL IN KATHMANDU VALLEY.

Study conducted by:

B.Mohanty and A.Kumar
M.Mohanty and S.Ojha
A. Agarwal

Dept. of Clinical Biochemistry
Dept. of Community Medicine
Dept. of Pathology

Medicine, Nepal Medical College, Kathmandu, PO. Box. 13344, Nepal.

Introduction and Literature Review:

Iodine occurs in a fairly constant amount in ocean water but is distributed very unevenly in the earth's crust. Inland regions farther from ocean have the greatest risk of iodine deficiency. With the melting of glacier, torrential rain and frequent flooding there is constant leaching and washing away of the surface soil iodine, further decreasing the soil iodine content. Country like Nepal is a victim of such geographical situation. It has one of the highest prevalence rate of iodine deficiency disorders (IDD) in the world^{1,2,3}. Studies conducted in Sub-Himalayan zone, Assam in India, showed very low level of iodine (mean $1.52 \pm 0.48 \mu\text{gm/l}$) in drinking water^{4,5}. There is paucity of published data regarding water iodine level in Kathmandu valley and Nepal as a whole.

Various sources of elemental iodine that can be available to meet our biological need are from 1) soil iodine – through agricultural

Materials and methods:

We have collected water samples from 26 different points covering the entire valley and the samples were divided into surface water & shallow ground water. The analysis for iodine concentration was done by an authentic catalytic reduction method using modified Sandell-Kolthoff reaction. Iodine catalyses the reduction of ceric ions by arsenous acid. The reaction is stopped after specific time interval by adding ferrous ammonium sulphate. The resulting ferric ions are directly proportional to the remaining ceric ions that develops a colour complex with KSCN.

Aims and objective:

Various sources of elemental iodine that can be available to meet our biological need are from 1) soil iodine –through agricultural products 2) water –ground water and surface water 3) salt –iodine fortified.

The objective of this study was to estimate the water iodine level in the Kathmandu valley and see if the drinking water could supplement some iodine to the dietary requirement of population residing in this area.

Result:

The findings showed that the surface water collected from rivers, ponds and artificial reservoirs (n=7) nearer to the foothills around the valley had very low iodine level $<2 \mu\text{gm/l}$ (Table I) . The valley population receives this water through Municipal Corporations. Shallow ground water collected from the central part of the valley had a higher iodine content i.e. tube well (n=6) mean $14.4 \pm 11.1 \mu\text{gm/l}$, deep well (n=5) mean $7.9 \pm 4.7 \mu\text{gm/l}$ and stone spout(n=8) mean $8.3 \pm 3.4 \mu\text{gm/l}$ (Table II) . Population consuming water from the conventional source in the central part of the valley gets a better amount of iodine, though this has to be supplemented by other sources. In one water sample collected from a tube well in Sukuldhoka, Bhaktapur exhibited the maximum level of iodine ($38 \mu\text{gm/l}$).

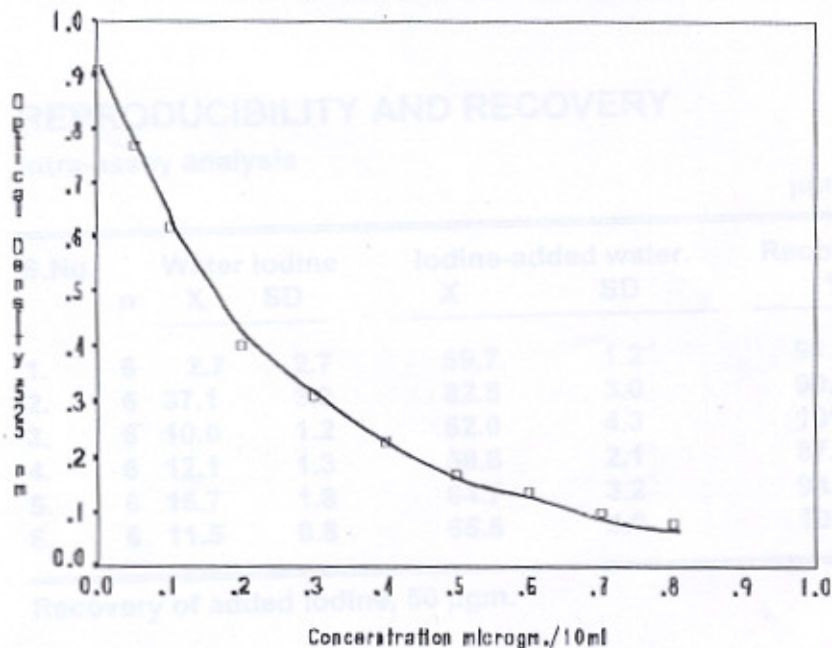
CONCLUSION:

1. Portable water supplied through Municipality Corporation contains $<2 \mu\text{gm/l}$ Iodine.
2. Ground water in the central part of the valley contains some amount of iodine which should be supplemented by other source to meet the daily requirement.

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1. HMG/MOH/DoHS, Annual Report. 2055/56 (1998/99), p 27-28.
2. Joshi AB, Jima, M. Current status of iodine deficiency disorders control in Nepal. BPKHS 1999; Vol.1(No.1):49-54.
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5. Sharma SK, Challeng PK, Gogoi S, Mohanta J. Iodine status of food and drinking water of a Sub-Himalayan zone of India. Int. J. Food Sci. Nutr. 1999 Mar; 50(2):95-8.

Calibration curve of Iodine



REPRODUCIBILITY AND RECOVERY

Intra-assay analysis

µgm/ml.

S.No.	n	Water iodine		Iodine-added water		Recovery %
		X	SD	X	SD	
1.	6	2.7	2.7	59.7	1.2	91.5
2.	6	37.1	3.9	82.5	3.0	90.8
3.	6	10.0	1.2	62.0	4.3	101.7
4.	6	12.1	1.3	58.8	2.1	87.4
5.	6	16.7	1.8	64.7	3.2	94.8
6.	6	11.5	0.8	65.5	3.0	102.2

Recovery of added iodine, 50 µgm.

Table I.
SURFACE WATER

1. Reservoir

S.No	Location	Amount in ml.	Iodine μ gm/ l
1.	Mahankal Bansbari	10	<2
2.	Balaju Nagargun	10	<2
3.	Sundarighat - Kirtipur	10	<2
4.	Shaibu Bhasepati	10	<2
5.	Bansbari - Bhaktapur	10	<2
6.	Sundarijal	10	<2
7.	Mahankal	10	<2

2. Khola

S.No	Location	Amount ml.	Iodine μ gm/ l
1.	Budhanilkantha	10	<2
2.	Sundarijal	10	<2
3.	Dakshinkali	10	<2

3. Tape Water

S.No	Location	Amount In ml.	Iodine μ gm/ l
1.	Gabahal Patan	10	<2
2.	Baudha	10	<2
3.	Gyaneswar	10	<2
4.	Lagimpat	10	<2
5.	New road	10	<2
6.	New Baneshwar	10	<2
7.	Layakuli Bhaktapur	10	<2

Table II.
GROUND WATER

1.Dhuge dhara

S.No	Location	Amount ml.	Iodine $\mu\text{gm/l}$
1.	Shesnarayan	10	4.2
2.	Jhagha-patan	10	13.5
3.	Sundhara	10	24.1
4.	Ghabahal	10	<2
5.	Dillibajar	10	9.3
6.	Bhairabstan	10	4.4
7.	Chabahil	10	7.3
8.	Arubari	10	3.3

2.Deep well

S.No	Location	Amount ml.	Iodine $\mu\text{gm/l}$
1.	Dhalache Patan	10	8.5
2.	Mahankhal Bansbari	10	<2
3.	Arubari	10	3.6
4.	Thamel	10	7.5
5.	Ganabahal	10	17.3

2.Tube well

S.No	Location	Amount ml.	Iodine $\mu\text{gm/l}$
1.	Sukuldhoka-Bhaktapur	10	38.0
2.	Mahankal-Govt.boring	10	<2
3.	Kamalpokhari	10	10.1
4.	Maharajgang	10	14.3
5.	Ashan	10	18.3
6.	Shesnarayan	10	4.5

