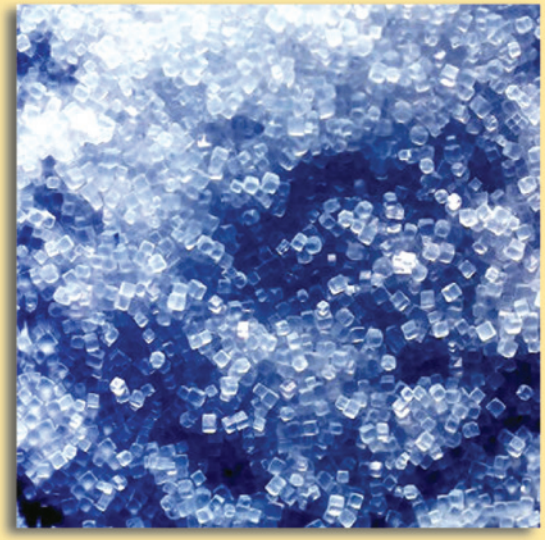

East, Central and Southern African
Health Community

MANUAL FOR EXTERNAL MONITORING OF IODIZED SALT IN SMALL SCALE OPERATIONS

(Technical Auditing and Inspection, combined with Quality Control)

FIRST EDITION – 2007

East, Central and Southern Health Community (ECSA-HC)

Plot 157 Oloirien, Njiro Road
P.O. Box 1009
Arusha, Tanzania
Telephone: +255 27 250 8362 / 3; 250 4106
Fax: +255 27 254125 / 250 8292
Email: regsec@ecsa.or.tz
Website: www.ecsa.or.tz

Foreword

Over the last five years, the East, Central and Southern African Health Community (ECSA-HC) has continued to undertake advocacy and technical assistance to assist member countries to embrace and scale up food fortification initiatives as a key strategy to reduce micronutrient malnutrition in the region.

ECSA has been working with partners in direct response to resolutions of the Conference of Health Ministers to scale up food fortification initiatives as a critical strategy in fighting the devastating effects of micronutrient malnutrition among populations of member states. ECSA partners in the Regional Food Fortification Initiative include the A2Z Project, USAID, UNICEF, Micronutrient Initiative (MI), and ICCIDD, among others.

Part of the outcome of the intensified collaborative initiative, is a series of fortification guidelines developed to guide the industry during the fortification process of staple foods and provide government food inspectors a reference point in enforcing the standards. Similarly, food control manuals have been developed for the Industry and the Government to provide technical reference resources that cover the entire fortification process to ensure that the fortified foods are safe and adequately fortified with the required fortificants.

This manual is part of a series of manuals on food fortification and is meant to directly contribute to the overall effort to strengthen food fortification in the region.

It is our hope that the use of this manual will help strengthen food control activities in our countries in order to deliver safe and quality fortified foods to the ECSA population.

Steven Shongwe
Executive Secretary
ECSA Health Community

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The manual is as a result of joint work by re-known food fortification experts in developing countries. During the drafting of this manual, consultations with senior officers from food control departments of the ECSA member states were made and input incorporated.

About the Authors

Phillip Makhumula: A Malawian food fortification consultant with experience in Africa and Central Asia.

Monica Guamuch: A Guatemalan food fortification consultant with experience in Latin American and the Caribbean.

Omar Dary (PhD): The Food Fortification Specialist of A2Z: The USAID Micronutrient and Child Blindness Project.

ECSA is deeply thankful to the above authors for preparing this manual.

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MANUAL FOR EXTERNAL MONITORING OF IODIZED SALT IN SMALL SCALE OPERATIONS
(Technical Auditing and Inspection, combined with Quality Control)

Iodized salt has become the main source of iodine for most human beings, and in this way they are being protected against Iodine Deficiency Disorders (IDD) and its consequences, such as mental retardation, mutism, cretinism, goiter, and others. Salt is by nature a crystal compound that inhibits growth of bacteria and other pathogens. This natural quality allows for its fortification under very simple conditions especially taking into account the small amounts of the mineral iodine required by human beings. Frequently, raw salt does not comply with the usual specifications to be considered suitable for human consumption such as the need to be dry, have a relative high degree of purity as sodium chloride, and be free of solid contaminants (including remnant from dead animals and plants). In spite of these limitations, it is still used as a vehicle to deliver iodine to the human populations. Raw and inadequately refined salts have been used to deliver iodine to populations in many countries, and in so doing have contributed to the prevention of IDD´s.

Raw and impure salts should only be iodized using potassium iodate. Iodate compounds are less soluble than iodide in water and are also less reactive than iodide and therefore more stable in contact with foods. Iodate has another advantage over iodide in that it is the easiest to detect through simple chemical reaction that involves formation of a purple color when in contact with starch. This easy detection of iodate has allowed for the use of a simple rapid test kit (RTK) to detect the presence of iodate in salt.

Many times, the use of the RTK has been proposed as a tool of choice in small scale operations of salt to carry out quality control of the iodized salt. However, this practice is less helpful since the “kit” will only detect the presence of iodate but not the amount of iodine added. Furthermore, it is unreasonable to expect that small scale operations would maintain even the simplest capability to do a more formal quality control. Therefore, it is proposed here that only quality assurance (storage and management of the fortificant, suitable packaging and labeling, and the simplest records of use of the premix) be required under these circumstances. However, the government would assume the responsibility of frequently visiting these artisan iodization operations to perform both inspection and quality control. This strategy has been proven to be sustainable and successful in Central America for many years in ensuring consistent and adequate fortification of salt at small scale level.

This short manual summarizes the activities of auditing and inspection that the governmental food inspectors are expected to carry out by small scale iodization centers. It also includes the description of the quantitative determination of iodine by titration. Alternatively, the inspectors can use field spectrophotometers (“such as Chinese checkers”) to complete this task.

A. PLANNING INSPECTION VISITS

I. Objectives and Accountability

The purpose of planning inspection visits is to ensure that:

- Resources to visit the salt iodization centers as frequently as needed (preferably every two weeks) are allocated.
- Inspectors receive appropriate training on the iodization process and sampling to perform the auditing and inspection activities, including the analysis of iodine in salt by the titrimetric method or any other quantitative field method chosen.

The *supervisor of Food Control Inspectors* is responsible for achieving the objectives and reporting the plan to the *head of the Food Control Authority*.

II. Procedure

a. Plan, budget and schedule

1. Based on the total number of salt iodization centers that should be visited and experiences from previous year, plan the required number of visits per year.

2. Estimate the financial resources that will be needed considering:

- Personnel
- Transportation and fuel
- Approximate number of samples to be analyzed and cost
- Other issues such as approximate number of extra-visits

3. Report to the head of Food Control Unit the plan, the schedule and estimated budget to carry out the plan.

4. Plan a training workshop every 6 months on the inspection activities governmental food control inspectors shall perform in the salt iodization centers.

B. TECHNICAL AUDITING/INSPECTION AND QUALITY CONTROL VISITS

I. Objectives and Accountability

The purposes of the technical auditing and inspections visits are to verify that the salt iodization centers are carrying out the iodization process as regulated, and the records of use of iodate and amount of iodized salt are kept-up.

The Inspector should plan to spend two to four hours to make detailed examination of processes, including determination of the content of iodine in the salt during the visit. The visit should be made with the view to assist the iodization centers to maintain the quality of the iodization process. The visits may be scaled down or scaled up depending on the performance of the center, but it is recommended to start with a visit every 2 weeks.

The direct responsibility to achieve these objectives falls on the *Food Control Inspectors*, who should report the findings from the visits to their *Supervisor.* The *Supervisor* is responsible for preparing reports every 1-3 months to the *Head of the Food Control Authority* and any other governmental body involved in the enforcement actions.

II. **Procedure** (Food Inspectors)

a. Technical audit

1. Begin the technical audit with the aid of the checklist presented in **Table B-1**. As the audit takes place, record any non-compliance found in the same table.

b. Inspection/Quality Control

2. During the visit, take randomly 5 packaged salt samples (100-500 g). Test the presence of iodine in each one of them using a qualitative test (e.g. RTK). All samples should contain iodine.

3. Prepare a composite sample, mixing equal amount of the single samples. Mix well and determine the iodine level using the tritimetric method adapted for the field.

4. The composite sample should have the specified factory level iodine (e.g. **30 to 60 mg/kg**)[1]. The average concentration of several composite samples should be close to the factory addition level (e.g **45 mg/kg**).

5. Collect 25 g of the undiluted premix used and test for iodine content and compare with the certificate of analysis.

6. If criteria are not fulfilled, request unpacking the lot, and supervise its corrections as needed.

[1] Based on ECSA 2007 guidelines

C. QUANTITATIVE TITRIMETRIC METHOD TO DETERMINE IODINE FROM IODATE IN SALT

I. References

AOAC Official Methods of Analysis. 1984. Section 33, 147.

II. Principle

Most non-refined salts are fortified with potassium iodate (KIO_3). To determine the concentration of the added iodine as iodate, the salt is dissolved in slightly acidic solution to which excess potassium iodide (KI) is added. The iodate from the salt reacts with iodide (I^-) to form iodine (I_2) and triiodide (I_3^-) which is very soluble in water. A yellow color is formed and when a starch solution is added, a blue colored complex is then formed. The amount of iodine in solution is determined by a colorimetric titration with a standard thiosulfate solution, which removes the iodine and as result the blue color disappears. The end point is visually determined by the disappearance of the blue color from solution when no more iodine is present.

III. Critical Points and Cautions

The starch solution should be freshly prepared because it is easily destroyed by microorganisms. In any case, each time that the method is used, a control sample of iodized salt with a known amount of iodine should be analyzed first to confirm its reliability.

IV. Equipment and Materials

- Beaker (250-500 mL)
- Glass rods
- Graduate cylinder (50 mL)
- Graduated pipettes, 1 to 5 mL
- Burettes or graduated pipettes (to measure 10-50 mL)
- 50mL pipette
- Containers calibrated by volume to weigh approximately 10 g of salt.
- Volumetric flasks 100 mL, 250 mL

V. Reagents

- **0.005 N-Sodium Thiosulfate Solution[2]:** Dissolve 1.24 g $Na_2S_2O_3.5H_2O$ (FW= 248) in one liter of distilled water and store in a cool dry place. Solution is stable for 1 month. This amount is sufficient for about 200 samples.

- **2 N-Sulfuric Acid Solution:** Using concentrated sulfuric acid, slowly add 60 mL to 900 mL of distilled water and mix. The solution is cooled down and made up to one liter. This amount is sufficient for about 1,000 samples.

- **10% Potassium Iodide Solution:** Dissolve 100 g of potassium iodide in water and make up to one liter. Store in a cool dark place. This solution is stable for 6 months provided there is no color change. This amount is sufficient for about 200 samples.

- **Starch Solution:** Weigh 1 gram of soluble starch into a 100 mL beaker and add 10 mL of water, heat to dissolve. Prepare a saturated solution of sodium chloride dissolving NaCl in 80 mL of distilled water, heat up the solution until no more NaCl dissolves. Cool the solution and add to the dissolved starch and make up to 100 mL. Store in a cool dark place. This amount is sufficient for about 50 samples. Prepare the starch solution every day. The saturated NaCl solution is stable for 12 months.

VI. Procedure

a. Solubilization of the salt sample

1. Mix well the sample of salt and weigh accurately 50 g[3] and dissolve in a 250 mL beaker. Transfer to 250 ml volumetric flask and fill to the mark.

[2] The thiosulfate solution can be standardized by titrating with a standard 0.005N-potassium iodate solution. This standard solution is prepared from a 0.5 N solutions made by dissolving 4.4585 g analytical grade KIO_3 in water and making up to 250mL. The 0.5 N solution is diluted 100-fold by taking 2.5 mL and diluting to 250 mL with distilled water. Normality of the thiosulfate solution = [volume KIO_3 (sol)/ volume thiosulfate (sol)]/ x Normality of iodate solution (0.005 N)]

[3] Some procedures specify 10 grams of salt, but although this amount may be useful for highly refined salts, it is insufficient for raw and unrefined salts. In order to improve accuracy and precision of the method, at least 50 grams of salt should be solubilized.

2. Transfer 50 mL of the salt solution using a 50 mL pipette to a 200 mL Erlenmeyer flask

3. Using a graduated pipette, add 1 mL of the 2-N sulfuric acid to the salt solution and mix thoroughly.

4. Add 5 mL of the 10% potassium iodide solution using a measuring cylinder or a pipette. If iodine is present a yellow solution is formed.

5. Cover the flask and put in the dark or in a cupboard for 10 minutes.

b. Titrating iodine in the salt solution

6. Fill the 50 mL burette(or a serologic pipette) with the thiosulfate solution in readiness for titration.

7. Titrate the iodine solution in the flask with the thiosulfate and stop the titration when the dark color of the solution turns to pale yellow. Agitate the salt solution continuously.

8. Add 2 mL of the starch solution and the solution should turn blue. Mix thoroughly.

9. Resume titration with thiosulfate until the blue color disappears. Agitate the salt solution continuously and gently.

10. Record the volume from the burette or serologic pipette as accurately as possible to the nearest 0.1 mL.

VII. Calculations

1. The amount of potassium iodate in the salt is determined using the following chart.

CHART 1

CONVERSION CHART FOR IODINE IN FORTIFIED SALT (PARTS PER MILLION)

Salt fortified with Iodate or Iodide

Volume Thiosulfate (mL)	Iodine (ppm)	Volume Thiosulfate (mL)	Iodine (ppm)	Volume Thiosulfate (mL)	Iodine (ppm)	Volume Thiosulfate (mL)	Iodine (ppm)	Volume Thiosulfate (mL)	Iodine (ppm)	Volume Thiosulfate (mL)	Iodine (ppm)
0.1	1.1	2.0	21.2	3.9	41.3	5.8	61.5	7.7	81.6	9.6	101.8
0.2	2.1	2.1	22.2	4.0	42.4	5.9	62.5	7.8	82.7	9.7	102.8
0.3	3.2	2.2	23.3	4.1	43.5	6.0	63.6	7.9	83.4	9.8	103.9
0.4	4.2	2.3	24.4	4.2	44.5	6.1	64.7	8.0	84.8	9.9	104.9
0.5	5.3	2.4	25.4	4.3	45.6	6.2	65.7	8.1	85.9	10.0	106.0
0.6	6.4	2.5	26.5	4.4	46.4	6.3	66.8	8.2	86.9	10.1	107.1
0.7	7.4	2.6	27.6	4.5	47.7	6.4	67.8	8.3	88.0	10.2	108.1
0.8	8.5	2.7	28.6	4.6	48.8	6.5	68.9	8.4	89.0	10.3	109.2
0.9	9.4	2.8	29.7	4.7	49.8	6.6	70.0	8.5	90.1	10.4	110.2
1.0	10.6	2.9	30.7	4.8	50.9	6.7	71.0	8.6	91.2	10.5	111.3
1.1	11.7	3.0	31.8	4.9	51.9	6.8	72.1	8.7	92.2	10.6	112.4
1.2	12.2	3.1	32.9	5.0	53.0	6.9	73.1	8.8	93.3	10.7	113.4
1.3	13.8	3.2	33.9	5.1	54.1	7.0	74.2	8.9	94.3	10.8	114.5
1.4	14.8	3.3	35.0	5.2	55.1	7.1	75.3	9.0	95.4	10.9	115.5
1.5	15.9	3.4	36.0	5.3	56.2	7.2	76.3	9.1	96.5	11.0	116.6
1.6	17.0	3.5	37.1	5.4	57.2	7.3	77.4	9.2	97.5	11.1	117.7
1.7	18.0	3.6	38.2	5.5	58.3	7.4	78.4	9.3	98.6	11.2	118.7
1.8	19.1	3.7	39.2	5.6	59.4	7.5	79.5	9.4	99.7	11.3	119.8
1.9	20.1	3.8	40.3	5.7	60.4	7.6	80.6	9.5	100.7	11.4	120.8

CHECKLIST OF TECHNICAL AUDIT AND INSPECTION VISIT TO IODIZATION CENTERS

Inspection registry:		Date:		Inspector	
Iodization center name:					
Address:					
Telephone:		Fax:		e-mail:	

ASPECTS	YES	NO	N/A	ASPECTS	YES	NO	N/A
1. Iodate and premix:				**3. Iodization Process**			
1.1 Inventory is up to date				3.1 Salt/Premix proportion as expected			
1.2 Sufficient iodate for 6 months or				3.2 Records of iodized salt updated			
Premix for 3 months				**3. Packaging and labeling**			
1.3 Storage is adequate				3.1 Salt packaged in adequately labeled bags			
2. Premix preparation:							
2.1 Potassium iodate amount as indicated							
2.2 Records of premix preparation and date							
2.5 "First-in, first-out" system							

Results of the iodine content

Sample #	Iodine Content	Sample # - of reprocessed samples	Iodine Content
Average (mg/kg) =		**Average (mg/kg) =**	

New Recommendations	
Non-compliances:	
Suggestions for Improvement:	

Inspector:	Received by (Factory representative):	Date
Signature:	Signature:	Date
Supervisor (Name)	Signature	Date

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