# Preparation Of Healthy Salt Alternative With Low Sodium Content Using Brine And Salt Samples Obtained From Selected Salt- Pans Of Tuticorin District, Tamilnadu, India

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**Abstract:**
High sodium intake is a major risk factor for cardiovascular diseases, making low-sodium salt an attractive alternative. The present study explores the preparation of low-sodium salt using various methods to reduce the sodium content. The ionic composition of the prepared low-sodium salt samples was analysed and their production costs were compared to commercially available samples. Results show promising alternatives to traditional salt products with comparable composition and competitive costs. The study highlights the potential of low-sodium salt as a healthier option for consumers and its potential impact on public health.

**Key words:** Low- sodium salt, Salt- pans, Bittern, Chemical composition, Salt- intake.

## Introduction

For several million years, humans consumed very little amount of salt, with an average daily intake of less than 0.25g. Salt was initially introduced as a means to preserve food and this marked a significant transformation in the way civilized societies functioned. The advent of refrigeration subsequently led to a reduction in salt intake; however, the global habituation of salt consumption has significantly increased salt intake in most countries worldwide. It is now estimated that the average daily salt consumption is between 9 and 12 g, which is more than our evolutionary ancestors consumed. The excessive salt consumption is linked to various health concerns including high blood pressure, cardiovascular diseases, renal stone disease, osteoporosis and gastric cancer [1]. There is a strong evidence supporting the reduction of salt intake which helps to lower the blood pressure and can decrease the risk of death from cardiovascular disease. For specific conditions such as heart failure, diabetes and chronic kidney disease (CKD), health guidelines recommend following the World Health Organization's (WHO) guideline of limiting daily salt intake to 5 grams [1].

The World Health Organization (WHO) has reported 10.4 million deaths globally per annum on average as a consequence of high blood pressure [2]. Prevention of early deaths by reducing sodium intake could save vast amounts of healthcare-related costs [3]. Approximately 70–75% of sodium intake comes from food produced either by food companies (products such as bread, cheese, meat and processed meat products, ready meals, soups and sauces) or food services [4]. The remainder originates from sodium inherent in raw materials and salt added during cooking at home and at the table. Consequently, WHO and other authorities worldwide have issued distinct recommendations for sodium reduction [5]. Most countries recommend sodium intake limits of 2.0–2.4 g per day and provide dietary guidelines which suggest reducing sodium intake by choosing food with less salt.

## MATERIALS AND METHODS

Three methods were adopted for the low sodium salt preparation. Samples were collected from salt- pans of Tharuvaikulam, Kallurani and Melmandhai salt- pans of Tuticorin District, Tamilnadu, India. In Tharuvaikulam and Kallurani salt-pans, subsoil brine is used for salt production. In Melmandhai salt-pan, sea brine is utilized for salt preparation. Methods I and II utilize salt samples from the three different salt-pans while method III utilizes bittern from the three different salt-pans.

## METHODS OF PREPARATION OF LOW SODIUM SALT

### METHOD I

To 10 g of sodium chloride obtained from the three different salt-pans in three different beakers, 30 ml of de-ionized water was added to get a saturated sodium chloride solution and 10 g of magnesium chloride was added to that solution. The mixture was stirred continuously during the addition. The precipitated sodium magnesium chloride was filtered and the remaining solution was evaporated to obtain the low sodium salt substitute. The samples were named as LT1, LK1 and LM1.

### METHOD II

10 g each of sodium chloride obtained from the three different salt-pans were taken separately in a blender and added 3 g of magnesium sulphate and 7 g of potassium chloride each and blended for fifteen minutes followed by recrystallization to produce crystals of low sodium salt and the samples were named as LT2, LK2 and LM2. To mask the mild bitterness of potassium chloride, magnesium sulphate was added and it makes the salt substitute more palatable.

**METHOD III**

3g of calcium chloride was added to 100 ml of the brine solution from the three different salt-pans. The addition of calcium chloride was intended to precipitate out the sulphate ions as calcium sulphate. The precipitated calcium sulphate was removed from the solution. Added 5 g of potassium chloride and 5 g of magnesium chloride to the desulphated solution while stirring. Added the remaining sodium chloride to the solution, allowed the solution to crystallize and the formed low sodium salt substitute was dried. The samples were named as LT3, LK3 and LM3.

The standard specific composition of low sodium salt [6] is shown in the following table 1.

**TABLE 1: STANDARD SPECIFIC COMPOSITION OF LOW SODIUM SALT**

| PARAMETERS | PERCENTAGE (%) |
|---|---|
| Chloride (%) | 10.21 |
| Sulphate (%) | 40.55 |
| Calcium (%) | 0.15 |
| Magnesium (%) | 5.14 |
| Sodium (%) | 4.17 |
| Potassium (%) | 14.67 |

Synthesis of low sodium salts can be carried out by different methods. Prepared low sodium salt samples contain various ions such as chloride, sulphate, calcium, magnesium, sodium and potassium. It can be estimated using standard procedures and the results are expressed in table 2.

**TABLE 2: IONIC COMPOSITION OF THE PREPARED LOW SODIUM SALT SAMPLES**

| Methods | Sample | Chloride (%) | Sulphate (%) | Calcium (%) | Magnesium (%) | Sodium (%) | Potassium (%) |
|---|---|---|---|---|---|---|---|
| I | LT1 | 10.32 | 40.61 | 0.20 | 5.27 | 4.05 | 14.73 |
| | LK1 | 10.33 | 40.59 | 0.21 | 5.25 | 4.03 | 14.75 |
| | LM1 | 10.35 | 40.63 | 0.19 | 5.23 | 4.07 | 14.68 |
| II | LT2 | 10.46 | 40.64 | 0.18 | 5.26 | 4.06 | 14.89 |
| | LK2 | 10.43 | 40.66 | 0.17 | 5.29 | 4.09 | 14.87 |
| | LM2 | 10.49 | 40.69 | 0.16 | 5.24 | 4.11 | 14.84 |
| III | LT3 | 10.59 | 40.12 | 0.29 | 5.29 | 4.01 | 14.79 |
| | LK3 | 10.57 | 40.08 | 0.33 | 5.31 | 3.58 | 14.81 |
| | LM3 | 10.63 | 40.17 | 0.25 | 5.28 | 4.02 | 14.78 |

**RESULTS AND DISCUSSION**

According to the procedures mentioned in Method I, the weight of three low sodium salt samples LT1, LK1 and LM1 prepared from the salt samples of Tharuvaikulam, Kallurani and Melmandhai salt- pans were observed to be 19.972 g, 19.983 g and 19.975 g respectively.


**FIG 1: LOW SODIUM SALTS PREPARED USING METHOD I**

The weight of the three low sodium salt samples LT2, LK2 and LM2 prepared from the salt samples of Tharuvaikulam, Kallurani and Melmandhai salt-pans using Method II were observed to be 19.951 g, 19.963 g and 19.981 g respectively


**FIG 2: LOW SODIUM SALTS PREPARED USING METHOD II**

The weight of the three low sodium salt samples LT3, LK3 and LM3 prepared from the salt samples of Tharuvaikulam, Kallurani and Melmandhai salt-pans using Method III were observed to be 16.976 g, 16.985 g and 16.954 g respectively.


**FIG 3: LOW SODIUM SALTS PREPARED USING METHOD III**

## COMPARATIVE STUDY OF PARAMETERS OF LOW SODIUM SALT SAMPLES OBTAINED FROM METHOD I-III

The comparative study of parameters of low sodium salt samples obtained from method I- III is given below

### CHLORIDE(%)

The percentage of chloride was found to be maximum for Method III. This may be due to the addition of calcium chloride, potassium chloride and magnesium chloride for the synthesis of low sodium salt samples. The maximum value of 10.63 was observed at LM3 and minimum value of 10.32 was observed for Method I at LT1.

### SULPHATE(%)

The percentage of sulphate was found to be maximum for Method II. This may be due to the addition of magnesium sulphate for the synthesis of low sodium salt samples. The maximum value of 40.69 was observed at LM2 and the minimum value of 40.08 was observed for Method III at LK3. This may be due to the removal of calcium sulphate for the synthesis of low sodium salt samples in Method III.

### CALCIUM(%)

The percentage of calcium was found to be maximum for Method III. This may be due to the presence of residual calcium chloride in the remaining solution. The maximum value of 0.33 was observed at LK3 and the minimum value of 0.16 was observed to be at LK2.

### MAGNESIUM(%)

The percentage of magnesium was found to be maximum for Method III. This may be due to the addition of magnesium chloride for the synthesis of low sodium salt samples. The maximum value of 5.31 was observed at LK3 and the minimum value of 5.23 was observed at LM1.

### SODIUM(%)

The percentage of sodium was maximum at LM2 and the value is 4.11. The percentage of sodium was minimum at LK3 with a value of 3.58. This may be due to the addition of potassium chloride and magnesium chloride, as it replaces sodium from the salt sample thus reducing the overall sodium content.

### POTASSIUM(%)

The percentage of potassium was maximum at LT2 and the value was 14.89. This may be due to the addition of potassium chloride for the synthesis of low sodium salt samples. The percentage of potassium was found to be minimum for Method I. The minimum value of 14.68 was observed at LM1.

## COST-EFFECTIVE ANALYSIS

The production cost of low-sodium salt is a crucial factor in making it accessible to the public. The research focused on synthesizing low-sodium salt using salt-pan resources like salt, brine and bittern through various methods. Three methods are found to be effective, producing satisfactory quality and quantity of low-sodium salt samples.

Method I has low production cost because it uses salt-pan resources and involves simple processing steps like evaporation which requires minimal energy and equipment costs. Method II involved blending common salt with potassium chloride and magnesium sulphate and dissolving the mixture with brine, followed by evaporation. These methods are cost-effective due to the availability of affordable potassium chloride, magnesium sulphate and the use of salt-pan resources. Method III involved treating bitten with calcium chloride, utilizing waste bittern and inexpensive calcium chloride. Sea bittern was found to have higher calcium chloride content than sub-soil samples.

Overall, the three methods enable low-sodium salt production at a significantly low-sodium salt production at a significantly lower cost compared to industrial production, making it a viable option for public consumption.

## CONCLUSION

The study demonstrates the feasibility of producing low-sodium salt using cost-effective methods, converting waste bittern into a valuable product. The prepared samples met required nutrient standards, offering a healthier alternative to traditional salt. This approach can help reduce waste and promote public health. Overall, the preparation of low-sodium salt offers a promising solution for reducing sodium intake and promoting healthier eating habits.

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