

Measuring salt as NaCl in food using conductivity

Liquid and semi-solid foods

Water Analysis Instruments, Thermo Fisher Scientific

Key Words

Salt, sodium chloride, NaCl, food, conductivity, conductivity cell, 013005, 013005MD, StarA 212, Versa Star Pro, measuring, determination

Goal

This application note utilizes a Thermo Scientific™ Orion™ conductivity meter and electrode to measure salt as sodium chloride (NaCl) in food.

Introduction

During food production, it is important to monitor the salt levels in food to assure food quality and taste. Salt, as NaCl, is used as a preservative and a flavoring agent. It enhances color, taste, and functions as a stabilizer and binder. The Thermo Scientific™ Orion™ conductivity meter and probe allow salt to be measured simply and quickly throughout the production of food products, giving results that are comparable to classic salt titration results.

Recommended Equipment

- Orion conductivity meter (Thermo Scientific™ Orion Star™ A 212, Thermo Scientific™ Orion™ Versa Star Pro™, or equivalent)
- Thermo Scientific™ Orion™ DuraProbe™ conductivity electrode (Cat. No. 013005MD or equivalent)

Optional:

- Thermo Scientific™ Barnstead™ water purification system



Recommended Solutions

- Conductivity standards 111.9 mS/cm and 12.9 mS/cm (Cat. No. 011007 and 011006)
- Deionized or laboratory reagent water (LRW)

Meter Setup

Connect the conductivity electrode to the meter. Go to Setup, Cond Channel, Mode and Settings. Input the following parameters: measure mode = TDS; read type = continuous; cell K = 0.475 (for 013005MD); TDS factor = 0.55; ref temp = 25C; temp comp = linear; temp coeff = 2.1%; cell type = standard. After setup, in measure mode, you will see the ATC temp, TDS mode, the calibration information, and temp comp (Tc:-Ln) displayed. If the meter and probe have never been calibrated, proceed with an initial calibration¹.

Electrode Calibration Verification

The conductivity electrode does not need to be calibrated prior to each use, but calibration verification is recommended. Verify calibration by measuring the 111.9 mS/cm standard. Place the electrode in the standard, immersing the entire sensing opening, and wait until the meter reads 'ready'. In TDS measuring mode, the reading of the 111.9 mS/cm standard should read 61.5 ppt \pm 5% (between 58 and 65 ppt) or within your lab quality criteria². If the reading is not within the acceptable quality criteria, discard the old standard, pour fresh 111.9 mS/cm standard, and re-read. If the reading is still not within the acceptable range, clean the electrode (see below) and recalibrate the conductivity electrode¹.

Sample Preparation

Place about 80 mL of sample into a 100 mL beaker. Use enough sample to submerge the entire sensing opening of the probe.

For high salt samples: For samples with a salt content equal to or greater than 100 parts per thousand (ppt) or 10% or 39 mg/mL Na, perform a 1:10 dilution before testing.

- Liquid sample: measure 10 mL of sample into a clean and dry 150 mL beaker. Add 90 mL of LRW and stir until well mixed
- Semi-solid sample (such as a salsa or a thick solution): weigh out 10 g of sample and bring the entire solution to 100 g using LRW

Rinse the electrode thoroughly with LRW before and after each sample. If the sample does not rinse off easily, a lint-free wiper may be used to remove excess sample from the electrode. Rinse thoroughly with LRW after wiping. If the sample is oily or greasy, use a lint-free wiper to remove excess sample from the probe. Then place the probe in 1% lab detergent solution and agitate to remove residue. Rinse thoroughly with LRW.

Analysis

Rinse the conductivity electrode with LRW and place into the prepared sample. Make sure that the entire sensing opening is submerged. Stir the solution with the electrode to ensure that no air bubbles are trapped in the sensing opening. Read the salt measurement in ppt. For hot or cold samples (much warmer or much cooler than room temperature), the probe may require a few minutes to adjust to the hot or cold temperature. Wait until the temperature reading is stable before recording the salt measurement.

Electrode Storage

Store the probe clean and dry.

Electrode Maintenance and Cleaning

Over time, a gradual shift in calibrated cell constant may be an indicator that the electrode needs a thorough cleaning. Soak in 1% lab detergent for 15 – 30 minutes. Use a soft brush, such as a toothbrush, to gently brush the inner and outer surfaces. Rinse well with LRW water and soak for 5 minutes in LRW water.

Quality Control (QC)

Recommended QC procedures may include: calibration, calibration verification, sample duplicates, and/or QC samples.

Food Sample Results

An assortment of different liquid and semi-solid food samples with concentrations above and below 100 ppt (10%) NaCl were tested by titration and by conductivity. The titrations were performed according to the classic salt determination by Mohr titration with silver nitrate. Each titration was done in triplicate, and the average salt value as ppt NaCl is reported. The conductivity readings were performed according to the instructions in this application note. The samples having >100 ppt or 10% salt (soy sauces) were diluted 1:10 using LRW prior to conductivity testing.

Sample	Titration Determination	Conductivity Reading
Soy Sauce Brand 1	155 ppt	156 ppt*
Soy Sauce Brand 2	183 ppt	185 ppt*
Kosher Dill Pickle Juice Brand 1	20.5 ppt	24.6 ppt
Kosher Dill Pickle Juice Brand 2	21.3 ppt	20.2 ppt
Chicken Broth	7.2 ppt	9.1 ppt
Condensed Chicken Noodle Soup	17.6 ppt	15.5 ppt
Chunky Mild Salsa	15.6 ppt	17.1 ppt
Sports Drink Fruit Punch	1.2 ppt	1.7 ppt

*Soy sauces diluted 1:10 prior to testing. Results on the meter were multiplied by 10 to obtain final results.

The results listed in the table above show that the Orion meter and conductivity electrode can be used as an effective salt meter when using these experimentally determined TDS parameters.

Calculations

- Samples diluted 1:10 due to high salt content (>100 ppt or >10%):
 - final result=reading on meter (in ppt) × 10
 - Example, soy sauce: 15.6 ppt (reading on meter) × 10 = 156 ppt salt in soy sauce
- To convert ppt results to % salt:
 - result in % salt = result in ppt ÷ 10
 - Example, chicken broth: 7.2 ppt ÷ 10 = 0.72% salt

Notes

¹See the meter manual for conductivity calibration instructions. Conduct a one-point calibration using the Orion 12.9 mS/cm standard, which works with the Autocal feature of the Orion meter calibration function. After calibration, return to measure mode, and verify the calibration using the 111.9 mS/cm standard, according to the Electrode Calibration Verification section above.

²For example, if your quality requirements are for ±10%, then the 111.9 mS/cm standard should read 61.5 ppt ±10% or between 55 and 68 ppt.

To purchase an Orion conductivity meter and electrode, or other related products, please contact your local equipment distributor and reference the part numbers listed below.

Product	Description	Cat. No.
Meters	Thermo Scientific Orion Star A212 Conductivity Benchtop Meter Kit	STARA2125
	Thermo Scientific Orion Star A215 pH/Conductivity Benchtop Meter Kit	STARA2155
	Thermo Scientific Orion Versa Star Pro 20 Conductivity Benchtop Meter Kit	VSTAR22
Solutions	Thermo Scientific Orion Conductivity Standard, 111.9 mS/cm	011005
	Thermo Scientific Orion Conductivity Standard, 12.9 mS/cm	011006
Laboratory Reagent Water	Thermo Scientific Barnstead Smart2Pure 12 UV Water Purification System	50129890*

*Please contact your local Thermo Scientific representative for support on ordering the best water purification system for your applications.

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