



Application Note AN-I-035

Sodium content in food using an ion-selective electrode

Fast, accurate, and selective determination in table salt, potato chips, and baby food according to AOAC 976.25

World Health Organization (WHO) guidelines recommend a maximum daily sodium intake of 2 g for adults, which is equivalent to 5 g of dietary salt (sodium chloride, NaCl). Diets high in sodium can have negative health consequences as the risk of developing high blood pressure (hypertension) increases. High blood pressure is one of the main risk factors for cardiovascular disease. Therefore, increased sodium intake indirectly increases this risk. Sodium in our food is mainly present in the form of sodium chloride salt and should be measured accordingly. Ion-selective electrodes (ISEs) are an

accurate, selective, and rapid way to measure sodium in food. Compared to chromatographic or spectroscopic methods, ISEs are cost effective, space saving, and easy to use. This Application Note describes sodium analysis in different matrices like table salt, potato chips, and baby formula (milk powder) using the separate sodium-selective electrode (Na-ISE).

Both direct measurement and standard addition are demonstrated. The method is based on the standard AOAC 976.25.

INTRODUCTION

This application utilizes a Na-ISE. The ion-selective polymer membrane of the electrode is made of polyvinyl chloride (PVC), plasticizer, and ionophore including additive. It is not necessary to condition the PVC membrane – the polymeric membrane is immediately ready for use. The ionophore within the polymer membrane is responsible for the selectivity, i.e., it is able to selectively take up Na^+ ions.

Direct measurement is recommended for unproblematic samples and in the case of low-level sodium measurements (mg/L or $\mu\text{g/L}$ range). The ion activity in the sample is interpolated from a calibration curve. Plot the calibration curve using standard

solutions. The expected ion activity in the sample should be in the middle of the concentration range of the standard solutions.

Standard addition (STDADD) is recommended for undefined or complex sample matrices. In the standard addition method, a defined amount of the ion of interest is added to a known volume of sample (in several steps). The unknown concentration can be calculated from the resulting potential differences between the sample and the sample with added standard solution. This calculation is performed automatically by modern ion meters or software such as OMNIS.

SAMPLE AND SAMPLE PREPARATION

The analysis is demonstrated on table salt (NaCl), potato chips, and baby food (milk powder).

For all samples, solutions were prepared in advance

by dissolving an appropriate amount of sample in deionized water.

EXPERIMENTAL

This analysis is performed on an OMNIS Advanced Titrator and an OMNIS Dosing Module equipped with a separate sodium-selective electrode (Figure 1).

To a reasonable amount of sample, either ISA solution consisting of $c(\text{CaCl}_2) = 1 \text{ mol/L}$ is automatically added and the potential is measured, or the standard addition is carried out with the sodium standard solution $\beta(\text{Na}^+) = 2000 \text{ mg/L}$.



Figure 1. OMNIS Advanced Titrator and OMNIS Dosing Module equipped with Na-ISE for the determination of sodium.

RESULTS

Both direct measurement and standard addition provide accurate and reproducible results for different sodium levels with SD(rel) < 2.0% as shown in **Table 1** and **Table 2**.

The calibration for direct measurement is shown in **Figure 2** and an example of standard addition is shown in **Figure 3**.

Table 1. Results for sodium in table salt (NaCl) by direct measurement.

Sample (n = 6)	Mean value in %	SD(abs) in %	SD(rel) in %
Table salt	39.34	0.00	0.0

Table 2. Results for sodium in potato chips and baby food (milk powder) by standard addition.

Sample (n = 6)	Mean value	SD(abs)	SD(rel) in %
Potato chips	3912 mg/kg	42.6 mg/kg	1.1
Baby food	2606 mg/kg	3.58 mg/kg	0.1

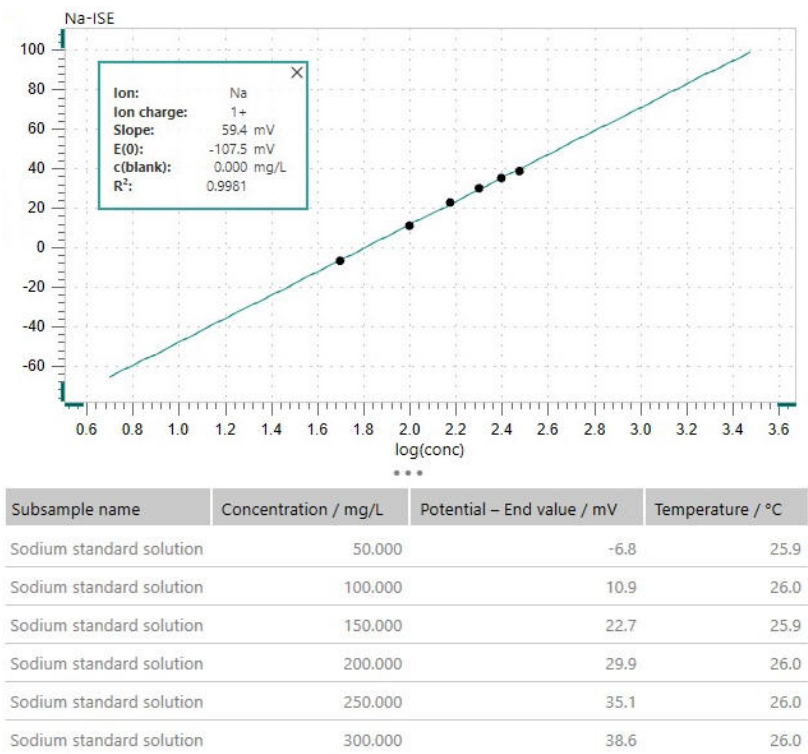


Figure 2. Calibration of six standard solutions with 50 mg/L, 100 mg/L, 150 mg/L, 200 mg/L, 250 mg/L, and 300 mg/L sodium.

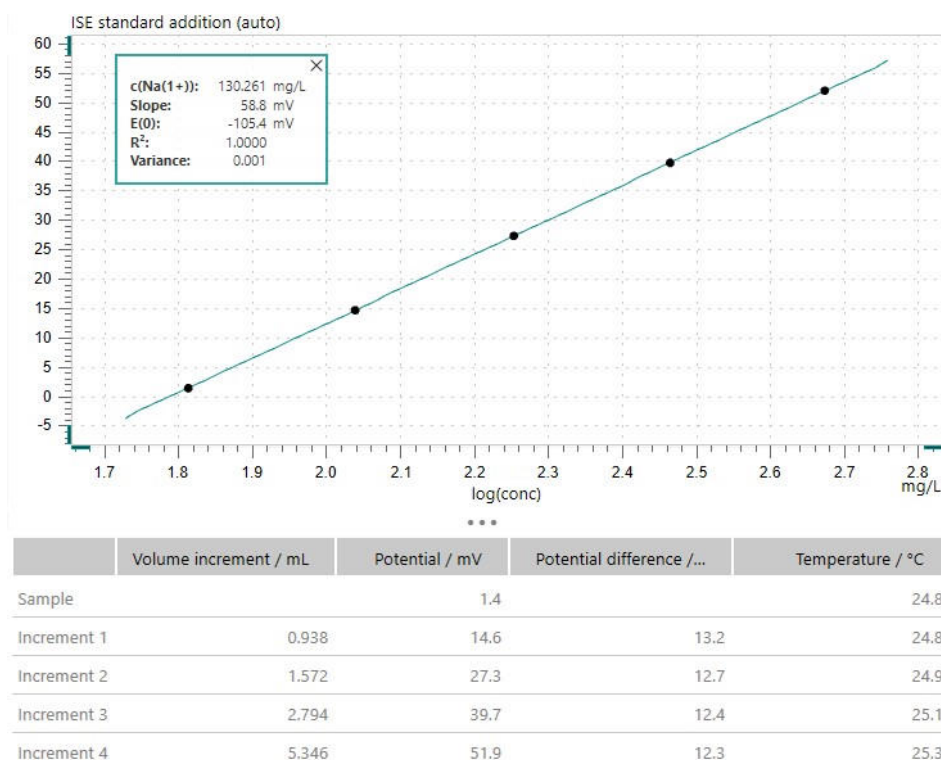


Figure 3. Standard addition of baby food (milk powder) with four increments made with 2000 mg/L sodium.

CONCLUSION

Ion-selective electrodes can determine sodium content in food with fast, reproducible, and accurate results.

Handling the Na-ISE is user-friendly. There is no need to condition the electrode, which means it is immediately ready for use. Furthermore, this method conforms to AOAC 976.25.

The system used in this Application Note offers users flexibility combined with high-end software. The measuring range of the separate polymer Na-ISE lies between 5×10^{-6} mol/L and 1 mol/L Na⁺

(corresponds to approximately 0.11 mg/L Na⁺) and is suitable for a wide range of different samples, from foodstuffs like fast food or table salt with reduced sodium content to pharmaceutical products and cosmetics.

Metrohm helps you to measure sodium content in food with confidence. As well as improving the precision and speed of measurements, OMNIS delivers results that are equal to or better than other established titration systems.

CONTACT

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CONFIGURATION



Titolatore OMNIS Advanced con agitatore magnetico

Titolatore OMNIS potenziometrico, innovativo e modulare per il funzionamento autonomo o come cuore di un sistema di titolazione OMNIS per la titolazione a punto finale e a punto di equivalenza (monotonica/dinamica). Grazie a Liquid-Adapter con tecnologia 3S, la gestione delle sostanze chimiche è più sicura che mai. Il titolatore è configurabile liberamente con moduli di misura e unità cilindriche e, in caso di necessità, può essere ampliato con un agitatore a elica. All'occorrenza, è possibile dotare OMNIS Advanced Titrator della relativa licenza di funzionamento del software per la titolazione parallela.

- Comando tramite PC o rete locale
- Possibilità di collegare fino ad altri quattro moduli di dosaggio e titolazione per ulteriori applicazioni o soluzioni ausiliarie
- Possibilità di collegamento di un agitatore a elica
- Disponibili varie grandezze del cilindro: 5, 10, 20 o 50 mL
- Liquid Adapter con tecnologia 3S: gestione sicura delle sostanze chimiche, trasferimento automatico dei dati del reagente originale del produttore

Modalità di misura e opzioni del software:

- Titolazione a punto finale: licenza di funzionamento "Basic"
- Titolazione a punto finale e a punto di equivalenza (monotonica/dinamica): licenza di funzionamento "Advanced"
- Titolazione a punto finale e a punto di equivalenza (monotonica/dinamica) con titolazione parallela: licenza di funzionamento "Professional"



OMNIS Dosing Module senza agitatore

Modulo di dosaggio per il collegamento a un titolatore OMNIS per l'ampliamento di un'ulteriore buretta per titolazione/dosaggio. Ampliabile con un agitatore magnetico o a elica per l'utilizzo come stand di titolazione separato. Unità cilindriche a scelta libera da 5, 10, 20 o 50 mL.



Separate polymer membrane electrode, Na

Sodium-selective electrode with polymer membrane. This ISE has to be used in combination with a reference electrode and is suitable for:

- ion measurements of Na^+ (10^{-6} to 1 mol/L) in aqueous solutions
- ion measurements in small sample volumes (minimum immersion depth 1 mm)
- titrations in aqueous solutions

Thanks to a robust/break-proof plastic shaft made of PVC, this sensor is mechanically very resistant.