Application Note AN-I-023

Fluoride in tea

Fast and inexpensive determination according to DIN 10807

Fluoride is found in soil, water, rocks, air, plants, and animals in different quantities. One of the major sources of fluoride intake for humans comes from foodstuff (e.g., tea). Tea actually has one of the highest potentials to increase the daily fluoride intake. Tea trees accumulate and store fluoride mainly in their leaves by absorbing it from the air and soil. After harvesting, leaves are dried, and a substantial amount of fluoride is then released during tea infusion, as fluoride is easily water-soluble. In the gastrointestinal tract, fluoride is absorbed at almost 100%, which then becomes relevant to human health. Excessive fluoride intake may lead to dental or skeletal fluorosis. The WHO (World Health Organization) does not recommend consuming water with a fluoride content higher than 1.5 mg/L.

Therefore, it is important to monitor the fluoride content in extracted tea leaves, allowing classification of the amount of fluoride in the tea. In the presented method according to DIN 10807, the fluoride content can be assessed quickly with an ion selective electrode.

SAMPLE AND SAMPLE PREPARATION

The method is demonstrated for two different dried tea samples. The tea leaves are extracted for 5 minutes in boiling water. After cooling down to room temperature, the suspension is filtered.

EXPERIMENTAL

The direct measurement is carried out using an OMNIS Basic Titrator equipped with a fluoride ion selective electrode, a reference electrode, and a temperature sensor. The ion selective electrode is calibrated prior to the analysis with four calibration standards.

To the prepared sample, the same volume of total ionic strength adjustment buffer (TISAB I) is added to fix the ionic strength and pH value. The sensors are placed into the sample and while stirring, the fluoride concentration is measured.

Figure 1. OMNIS Basic Titrator for precise and reliable ion measurement.

RESULTS

Results are taken after a minimum of 10 seconds when the concentration reading is stable. The obtained absolute standard deviation for the analyzed samples is smaller than 3 mg/kg (SD(rel) < 1.1%).

Table 1. Amount of fluoride in mg per kg dried tea leaves (n = 3).

	Mean F^- content in mg/kg	SD(abs) in mg/kg	SD(rel) in %
Green tea	198.3	0.4	0.22
Black tea	259.6	2.8	1.09

CONCLUSION

The concentration of fluoride can be assessed quickly and inexpensively according to DIN 10807 by using direct ion measurement technique. It is possible to measure concentrations of fluoride in dried tea between 50 and 10,000 mg/kg with the presented technique.
Using an OMNIS Titrator for measurements allows a system customization according to your needs, and the added ability to expand it for other titration or measurement applications required for the quality control of tea (e.g., moisture analysis). Furthermore, the analysis can be fully automated to increase throughput and accuracy while saving valuable time.

Internal reference: AW ISE CH2-0168-042019

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CONFIGURATION

OMNIS Basic Titrator with magnetic stirrer

Innovative, modular potentiometric OMNIS Titrator for stand-alone operation or as the core of an OMNIS titration system for endpoint titration. Thanks to 3S Liquid Adapter technology, handling chemicals is more secure than ever before. The titrator can be freely configured with measuring modules and cylinder units and can have a rod stirrer added as needed. If required, the range of functions of the OMNIS Basic Titrator can be supplemented with a corresponding software function license.

- Control via PC or local network
- Connection option for up to four additional titration or dosing modules for additional applications or auxiliary solutions
- Connection option for one rod stirrer
- Various cylinder sizes available: 5, 10, 20 or 50 mL
- Liquid Adapter with 3S technology: Secure handling of chemicals, automatic transfer of the original reagent data of the manufacturer

Measuring modes and software options:

- Endpoint titration: "Basic" function license
- Endpoint and equivalence point titration (monotonic/dynamic): "Advanced" function license
- Endpoint and equivalence point titration (monotonic/dynamic) with parallel titration: "Professional" function license

Measuring module analog

Analog measurement channel for one OMNIS Titrator or Titration Module for the connection of analog electrodes.

OMNIS

A WHOLE NEW LEVEL OF PERFORMANCE

OMNIS Stand-Alone license

Enables stand-alone operation of the OMNIS software on a WindowsTM computer.

Features:

- The license already includes one OMNIS instrument license.
- Must be activated via the Metrohm licensing portal.

Ion-selective electrode, F

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

- ion measurements of F-
- ion measurements in small sample volumes (minimum immersion depth 1 mm)
- titrations

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

LL ISE reference electrode

Silver / silver chloride reference electrode with double junction system.
This reference electrode is well suited for:

- automated applications
- ion measurements
- surfactant titrations

The ground-joint diaphragm, which is insensitive to contamination, offers a constant and reproducible electrolyte outflow. Additionally, the reference electrolyte is gelified for even better signal stability. The sensor is delivered with c(KCl) = 3 mol/L as bridge electrolyte, which can be freely selected and exchanged as needed.

Pt1000 temperature sensor (installation length 12.5 cm)

Pt1000 temperature sensor (class B) made of glass.
This PT1000 temperature sensor is also available under the article number 6.1110.110 with an installation length of 17.8 cm.