APPLICATION NOTE

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EXCELLENCE IN ELEMENTS

N/protein analysis of food products high in salt

Introduction

The determination of the total protein content in foods is an essential tool for quality control and protein declaration according to international labeling laws. Many foods contain sodium, either naturally or added in form of salt or other sodium-containing substances. The main reasons to add sodium to processed foods are to enhance flavor, to increase shelf life as it helps prevent growth of bacteria and other disease-causing agents, and to improve texture and appearance.

High-temperature combustion according to Dumas is an inexpensive, fast and evironmentally-friendly method for the determination of the total protein content. Many Dumas instruments on the market have problems with the lifetime of the analyzer and/or it's wear parts when samples with a high salt content are analyzed regularly. Salt may cause electrochemical corrosion, especially at high temperatures. This fact certainly does not exclude the analysis of high-salt samples by Dumas instrumentation. Special features can protect the instrument against corrosion. Additionally, it is important to know which measures can be taken to correctly analyze high-salt samples to ensure a long lifetime of the high-temperature combustion analyzer.

This application note demonstrates that Elementar's N/protein analyzer, the rapid MAX N exceed, is perfectly suited for the analysis of high-salt foods. Analysis results of common high-salt foods consumed around the world are shown, and measures which should be taken to reach high instrument uptimes and long lifetimes of steel components are presented.

rapid MAX N exceed

Dumas instrument for N/protein analysis with special features for the analysis of food products with a high salt content.

rapid MAX N exceed

With over 110 years of experience producing elemental analyzers and more than 50 years of experience producing dedicated Dumas N/protein analyzers, Elementar offers the rapid MAX N exceed analyzer, which combines high-throughput and ease of operation with reliable determination of nitrogen, even at low concentrations and in difficult samples. The 90-position autosampler utilizes stainless steel crucibles that can hold up to 5 mL of liquid or 5 g of solid. All positions of the random-access autosampler are always available, which combined with easy-to-use software means time-critical samples can easily be promoted to be the next sample measured.

The crucibles are introduced to a 900 °C combustion furnace by a gripper arm which includes the oxygen inlet. By dosing the oxygen directly at the sample, less oxygen is necessary to achieve complete combustion, which is a key aspect of our unrivaled low price-per-sample. Further savings are realized by our proprietary EAS REGAINER® and EAS REDUCTOR® technology. This system utilizes a non-toxic, metal-free material for not only binding excess oxygen but also regenerating the material that reduces the nitrogen oxides from combustion to nitrogen gas for reliable detection. In this way, the reduction tube filling can analyze over 1000 samples before needing replacing, greatly reducing one of the major cost drivers for Dumas analysis without compromising analytical performance. Additional savings can be realized by using argon, instead of the typical helium, as a carrier gas.

Because the rapid MAX N exceed can analyze up to 1 g of organic material, samples can be quite heterogeneous, such as various seasonings or snacks, and still yield accurate, reproducible results. With a robust three-stage gas drying system, routinely measuring several grams of aqueous solutions, such as soy sauce and liquid seasonings, present no challenges to the instrument. Because the same, upright crucibles can be used for liquids or solids, switching between liquid, solid and semi-solid samples requires no additional chemicals or materials, such as sample liners or absorbers.

The rapid MAX N exceed is equipped with special features to enable analyses of samples with a high salt content. The crucible technique not only automatically removes the ash after every analysis, but also, most of the salt coming from the sample is removed from the system. Additionally, brass wool inside the post-combustion tube captures any salt which has left the crucible protecting the instrument from corrosion. Durable and resistant steel tubes and steel crucibles can be washed easily multiple times to remove any salt residuals and reused. The gripper arm consists of a corrosion-safe nozzle, allowing the handling of salt containing samples. Elementar additionally offers a non-toxic, salt binding powder DESALT which can be used as additive when analyzing high-salt foods.

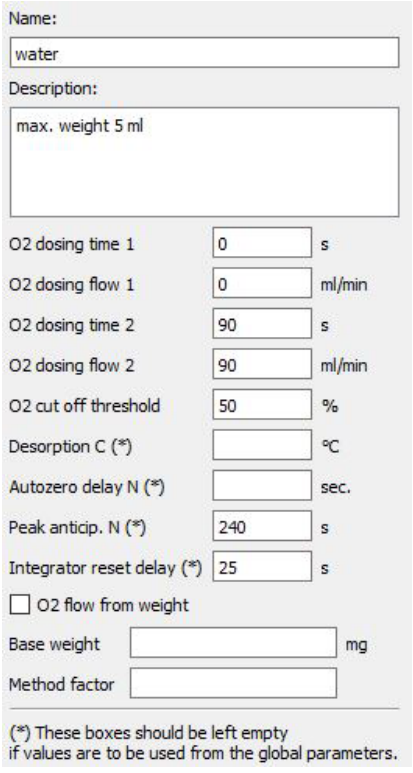
Analyzing high-salt foods

When measuring samples with a high salt content (> 5 %) on a routine basis, the following measures should be taken to protect steel components of the instrument from corrosion:

1. Add 0.5 – 1 g of DESALT to each sample directly into the crucible after weighing the sample. Analyze the samples as usual.
2. After every 20–50 salt samples, routinely analyze four times 4 ml of water using the method "water"*.
3. After every 500 samples, rinse the steel combustion tube with water. Leave the filling in place, it is not damaged by water. Let the rinsed tube air dry before further use. Easiest is to use two sets of tubes.
4. Regularly rinse the combustion tube plug with water.

Remember that salts are water soluble, so rinsing parts made out of steel with water is easy and very effective. Another possible remedy which can be taken to protect the instrument from salt is to simply reduce the sample weight.

*For measuring the water samples, create a new method with the following settings:



Common high-salt samples

Twenty common food products with a high salt content were analyzed on the rapid MAX N exceed. The salt content ranged from 3–45 %. The samples were weighed into standard steel crucibles with a sample weight of about 500 mg. 0.5 g of DESALT was added to every sample. Each sample type was analyzed five times and the average nitrogen content and the absolute standard deviation were calculated from all five measurements. Table 1 summarizes the results and lists the results starting with the sample with the highest salt content. The average nitrogen content ranges from 0.14 to 11.2 %. Great standard deviations are achieved averaging 0.037, even for non-homogeneous samples and samples with low N concentrations.

Table 1. N-analysis of typical high-salt foods.

SAMPLE	SALT [%]	N [%]	SD
Seaweed tea	45.0	0.75	0.008
Dried Japanese seasoning	37.0	1.42	0.020
Fish particles	30.0	2.77	0.011
Dried seaweed	24.1	2.43	0.065
Maggi seasoning	24.1	1.66	0.016
Seaweed	22.5	4.42	0.037
Dried plum	18.3	0.14	0.004
Soy sauce	17.0	1.47	0.010
Mushroom soup	16.0	3.87	0.045
Anchovy	14.8	4.68	0.114
Miso	12.1	1.87	0.015
Tomato soup	8.8	1.35	0.018
Japanese curry	8.0	0.92	0.022
Seaweed paste	7.0	0.71	0.014
Fish meal	7.0	10.84	0.131
Ham chips	6.5	11.20	0.085
Beef jerkey	5.6	5.95	0.057
Salami	4.9	5.88	0.059
Bacon snack	3.1	1.51	0.012
Pretzels	3.0	1.80	0.008

precision with DESALT

To test the precision of the measurements when adding DESALT, a reference standard, 250 mg ethylenediaminetetraacetic acid, was analyzed with the addition of 500 mg DESALT. The absolute and relative standard deviations were determined for a 10-fold determination and are shown in the table below.

SAMPLE	N [%]	SD (ABS)	relative SD
EDTA + DESALT	9.583	0.006	0.064

The low standard deviations show that the precision of the results are not influenced by the addition of DESALT.

Adding DESALT slightly increases the blank value. However, this is not a problem, as it can be subtracted by using a blank correction which is done automatically by the software.

Summary

As many food products contain salt, especially processed foods, it is important that N/protein analyzers are ready to analyze such samples without damaging the instrument.

Elementar's rapid MAX N exceed is the right instrument for high-salt foods, as it is equipped with multiple features which protect the instrument against corrosion. For long instrument uptime and flawless operation during routine analysis of high-salt foods, it is recommended to use DESALT as additive and to rinse steel components of the instrument on a regular basis.

The rapid MAX N exceed achieves great standard deviations of repeated measurements of typical foods high in salt with a highest sample throughput.

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Elementar is the world leader in high performance analysis of organic and inorganic elements. Continuous innovation, creative solutions and comprehensive support form the foundation of the Elementar brand, ensuring our products continue to advance science across agriculture, chemical, environmental, energy, materials and forensics markets in more than 80 countries.

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