

APPLICATION NOTE



N/protein analysis of liquid food products

Introduction

The determination of the total protein content is an essential tool for quality control and protein declaration according to international labeling laws in the food and feed industry. Protein content can directly correspond to product properties and classifications. For liquid and semi-liquid food products, a highly precise, matrix-independent protein analysis is essential.

With over 110 years of experience producing elemental analyzers and more than 50 years of experience producing dedicated Dumas N/protein analyzers, Elementar currently has two N/protein analyzers in its portfolio: the rapid N exceed® and the rapid MAX N exceed analyzer. Both analyzers combine high-throughput and ease of operation with reliable determination of nitrogen, even at low concentrations and in difficult samples.

Our proprietary EAS REGAINER® and EAS REDUCTOR® technology is used in both systems. This technology utilizes a non-toxic, metal-free method for binding excess oxygen and regenerating the metals that reduce the nitrogen oxides from combustion to nitrogen gas for reliable detection. In this way, the reduction tube filling can analyze over 1000/2000 samples before needing replacement, greatly reducing one of the major cost drivers for Dumas analysis without compromising on analytical performance.

N/protein analysis

rapid N exceed®
rapid MAX N exceed



rapid N exceed

The rapid N exceed comes with a 60-position autosampler which can hold capsules with a maximum sample volume of 1 ml. Liquid samples are weighed directly into tin capsules which are then closed with the help of a capsule sealing press. The capsules are injected to the combustion furnace via our patented ball-valve which ensures that the samples can be measured blank-free. Oxygen is introduced directly at the point of combustion by an oxygen lance, which not only leads to reduced oxygen consumption for complete combustion, but also to a low price-per-sample. A three-stage gas drying system enables routine analysis of liquid samples.



Tin capsules are available in different sizes for the analysis of liquid samples with the rapid N exceed.



The capsules are sealed using the Elementar capsule press.



rapid MAX N exceed

The rapid MAX N exceed is equipped with a 90-position autosampler which utilizes stainless steel crucibles that can hold up to 5 ml of liquid. All positions of the random-access autosampler are always available, which combined with easy-to-use software means that time-critical samples can easily be promoted to be the next sample measured. Sample preparation is made easy by weighing the sample directly into the upright crucibles without the need of using sample liners or absorbers.

The crucibles are introduced to the combustion furnace by a gripper arm which includes the oxygen inlet. By dosing the oxygen directly at the sample, less oxygen is necessary to get complete combustion, which is a key aspect of our unrivaled low price-per-sample, similar to our rapid N exceed.

Because the rapid MAX N exceed can measure up to 5 ml, samples can be quite heterogeneous, such as fruit juices and milkshakes, and still yield accurate, reproducible results. With a robust three-stage gas drying system, routinely measuring several grams of aqueous solutions presents no challenges to the instrument.



Steel crucibles used for the analysis of solid and liquid samples with rapid MAX N exceed.



N/protein analysis

To demonstrate the suitability of both the rapid N exceed and the rapid MAX N exceed for the analysis of liquid food products, eight different products were analyzed on both instruments. The samples range from various types of milk to juices and sauces, with nitrogen contents ranging from 0.06 % to 0.87 %.

Both instruments were operated in standard configuration using helium as carrier gas for the rapid MAX N exceed and CO₂ for the rapid N exceed.

Five replicates of each sample were measured with varying sample sizes depending on the instrument. As the rapid MAX N exceed allows larger sample sizes, 2 ml or 1 ml were mostly used instead of 0.5 ml, which is typically used for the rapid N exceed analyses.

The mean value, absolute standard deviation (SD), relative standard deviation (RSD) and the difference between the highest and lowest value (delta) were calculated for the five replicates. The results are summarized in the Table below.

SAMPLE	rapid N exceed		rapid MAX N exceed		SAMPLE	rapid N exceed		rapid MAX N exceed	
	VOLUME	N [%]	VOLUME	N [%]		VOLUME	N [%]	VOLUME	N [%]
hazelnut milk	0.5 ml	0.0604	2 ml	0.0636	soy milk	0.5 ml	0.5438	2 ml	0.5511
		0.0609		0.0634			0.5517		
		0.0603		0.0638			0.5404		0.5516
		0.0594		0.0630			0.5394		0.5515
		0.0609		0.0637			0.5451		0.5493
	Mean value	0.0604		0.0635	Mean value	0.5409		0.5510	
SD (abs)	0.0006		0.0003	SD (abs)	0.0036		0.0010		
RSD [%]	1.0377		0.4882	RSD [%]	0.6679		0.1793		
Delta	0.0016		0.0008	Delta	0.0091		0.0024		
almond milk	0.5 ml	0.1293	2 ml	0.1314	soy sauce	0.5 ml	0.4813	1 ml	0.4501
		0.1275		0.1314			0.4866		0.4559
		0.1276		0.1323			0.4859		0.4494
		0.1276		0.1315			0.4823		0.4505
		0.1290		0.1302			0.4873		0.4540
	Mean value	0.1282		0.1314	Mean value	0.4847		0.4520	
SD (abs)	0.0009		0.0007	SD (abs)	0.0027		0.0028		
RSD [%]	0.6693		0.5638	RSD [%]	0.5562		0.6172		
Delta	0.0017		0.0021	Delta	0.0060		0.0065		
protein drink	0.5 ml	0.8775	0.5 ml	0.8548	tomato juice	0.5 ml	0.1165	2 ml	0.1134
		0.8785		0.8574			0.1189		0.1123
		0.8650		0.8667			0.1173		0.1121
		0.8702		0.8579			0.1084		0.1131
		0.8846		0.8637			0.1178		0.1126
	Mean value	0.8752		0.8601	Mean value	0.1158		0.1127	
SD (abs)	0.0077		0.0049	SD (abs)	0.0042		0.0005		
RSD [%]	0.8747		0.5709	RSD [%]	3.6449		0.4779		
Delta	0.0196		0.0119	Delta	0.0105		0.0013		
coconut milk	0.5 ml	0.2893	0.5 ml	0.2929	orange juice	0.5 ml	0.1202	2 ml	0.1246
		0.2950		0.2967			0.1162		0.1239
		0.2979		0.2919			0.1201		0.1232
		0.2957		0.2909			0.1153		0.1247
		0.2936		0.2924			0.1181		0.1244
	Mean value	0.2943		0.2930	Mean value	0.1180		0.1242	
SD (abs)	0.0032		0.0022	SD (abs)	0.0022		0.0006		
RSD [%]	1.0961		0.7555	RSD [%]	1.8902		0.5065		
Delta	0.0087		0.0058	Delta	0.0049		0.0016		

Results

Both N/protein analyzers achieved excellent RSD < 1 % for almost all samples. Slightly larger standard deviations result from the inhomogeneity of the samples. Here, the advantage of the rapid MAX N exceed stands out, as it allows larger sample sizes. This can be seen for the tomato and orange juice analyses, where the standard deviation is lower when a larger sample size of 2 ml is used on the rapid MAX N exceed instead of only 0.5 ml on the rapid N exceed.

Summary

The rapid N exceed and the rapid MAX N exceed are well suited in analyzing liquid and semi-liquid food products. Both achieve great standard deviations of repeated measurements, even for non-homogeneous samples. If choosing between the two instruments for the daily analysis of liquid and semi-liquid foods, the rapid MAX N exceed has the advantages of a larger sample size capacity, its reduced sample preparation and its automatic ash removal.

		
	rapid N exceed	rapid MAX N exceed
carrier gas	CO ₂	He or Ar
maximum sample volume	1 ml	5 ml
sample homogeneity (recommended)	medium	low
sample container	sealed tin capsules	open steel crucibles
sample feeding	automatic	automatic
ash removal	manual	automatic

Main differences between the rapid N exceed and rapid MAX N exceed instruments for the analysis of liquid food samples.

Elementar – your partner for excellent elemental analysis

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.

Elementar Analysensysteme GmbH

Elementar-Straße 1 · 63505 Langenselbold (Germany)

Phone: +49 (0) 6184 9393-0 | info@elementar.com | www.elementar.com

