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APPLICATION NOTE 42217

Nitrogen and carbon determination in flours by the Thermo Scientific Flash*Smart* Elemental Analyzer using argon as carrier gas

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Goal

This application note reports data on nitrogen and carbon determination in flour reference materials in different concentrations and shows the performance of the Thermo Scientific Flash*Smart* EA using argon as alternative carrier gas.

Introduction

Flour is a fine powder, made by grinding cereal grains or other edible plant matter, which contains starch such as polysaccharides and protein. It is most commonly made from wheat but also from rye, barley, rice and corn (something similar to *polenta*, a thick maize porridge served with meat, cheese, etc). Ground legumes and nuts, such as soy, peanuts, almonds, and other tree nuts, are also called *flours*. Flour is the key ingredient of bread, which is a staple food in many countries. Therefore, the availability of adequate supplies of flour has often been a major economic and political concern.

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In many countries quality control of flour is strictly regulated. One of the most important parameter is the determination of protein content. The monitoring of its amount, through the determination of nitrogen must be accurate in order to verify the nutritional quality of these products. The Thermo Scientific™ Flash*Smart*™ Elemental Analyzer (Figure 1), which operates with the dynamic flash combustion of the sample, meets many important analytical requirements, providing accuracy, day by day reproducibility and high sample throughput.

Figure 1. Thermo Scientific Flash*Smart* EA Elemental Analyzer.

However, the potential shortage and the rise in the cost of helium have increased the need for an alternative gas, such as argon. This application note reports data on nitrogen and carbon determination in flour reference materials in different concentrations and shows the performance of the Flash*Smart* Elemental Analyzer with argon as carrier gas.

Methods

The Flash*Smart* Elemental Analyzer operates with the dynamic flash combustion of the sample. Samples are weighed in tin containers and introduced into the combustion reactor by the Thermo Scientific™ MAS Plus Autosampler, with oxygen. After the combustion, the gases produced are carried by the carrier gas flow to a second reactor containing copper, and then they are swept through a H_2O trap and a GC column and in the end detected by a Thermal Conductivity Detector (TCD). The analytical configuration and the TCD detector are the same as those used with helium as carrier gas (Figure 2).

A report is generated by the Thermo Scientific™ Eager*Smart*™ Data Handling Software and displayed at the end of the analysis. The Eager*Smart* Data Handling Software provides the option AGO (Argon Gas Option), which allows the management of the argon carrier flow during the run.

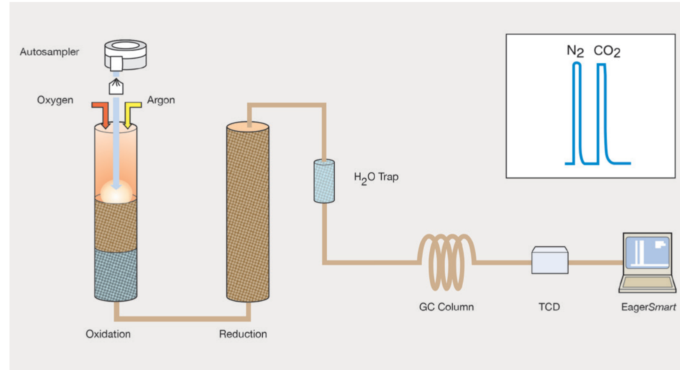

Figure 2. Flash*Smart* NC configuration.

Analytical Conditions	
Combustion Furnace Temperature	950 °C
Reduction Furnace Temperature	840 °C
Oven Temperature	95 °C
Argon Carrier Flow	60 ml/min
Argon Reference Flow	60 ml/min
Oxygen Flow	250 ml/min
Oxygen Injection Time	20 sec
Sample Delay	12 sec
Run Time	10-14 mins

Results

Oatmeal Reference Material was analyzed in order to evaluate the performance of the Flash*Smart* EA with argon as carrier gas. Results were compared with the expected data and with those obtained using helium as carrier gas.

With argon, the calibration was performed with 14-15 mg of atropine, EDTA (EthyleneDiamineTetraAcetic acid) and aspartic acid using Linear Fit as calibration method while with helium the calibration was performed with 4-5 mg of aspartic acid using K factor as calibration method. Sample of oatmeal were weighed at between 14-15 mg with argon, while with helium 4-5 mg of sample was used.

Table 1 shows the certified N% and C% and the relative uncertainty. Table 2 shows the results obtained with both argon and helium as carrier gas.

Table 1. Expected N% of oatmeal reference materials

Sample Description	Supplier Specification			
	N%	Uncertainty (±)	C%	Uncertainty (±)
Oatmeal Reference Material	1.9	0.10	45.51	0.17

Table 2. Experimental nitrogen and carbon data of oatmeal reference material.

Sample	Argon Carrier Gas						Helium Carrier Gas					
	N%	Av. N%	RSD%	C%	Av. C%	RSD%	N%	Av. N%	RSD%	C%	Av. C%	RSD%
Oatmeal Reference Material	1.98 1.94 1.87	1.95	1.16	45.61 45.42 45.22	45.42	0.26	1.99 2.06 1.92	1.99	0.64	45.65 45.72 45.45	45.61	0.30

In order to prove the performance of the Flash*Smart* EA, four flour samples were analyzed. Table 3 shows the results with argon and helium as carrier gases.

Using argon as carrier gas, the flour sample weighted between 15-16 mg while with helium as carrier gas between 4-5 mg.

Table 3. Experimental nitrogen and carbon data of flours.

Sample	Argon Carrier Gas						Helium Carrier Gas					
	N%	Av. N%	RSD%	C%	Av. C%	RSD%	N%	Av. N%	RSD%	C%	Av. C%	RSD%
Wheat Flour	1.48 1.50 1.46	1.48	1.35	39.52 39.87 39.92	39.77	0.73	1.30 1.29 1.30	1.30	0.44	39.95 39.93 39.93	39.94	0.03
Rice Flour	1.55 1.54 1.53	1.54	1.28	43.20 43.56 43.47	43.41	0.35	1.51 1.51 1.53	1.52	0.11	43.43 43.55 45.63	43.54	0.25
Barley Flour	1.82 1.77 1.85	1.81	0.92	43.60 43.77 43.47	43.61	0.34	1.89 1.78 1.78	1.79	0.64	43.51 43.45 43.42	43.46	0.10
Soy Bean Meal	7.83 7.79 7.80	7.81	0.79	45.28 45.55 45.01	45.28	0.80	7.81 7.86 7.85	7.84	0.33	45.31 45.43 45.46	45.40	0.25

Conclusions

Good repeatability, accuracy and precision were obtained with the Thermo Scientific Flash*Smart* Elemental Analyzer using argon as carrier gas. This experimental data confirmed excellent compatibility with the results obtained using helium as carrier gas.

No memory effect was observed when changing sample, meaning the complete combustion and detection of the sample during the analytical run.

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