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Characterization of food and animal feed related products by the Thermo Scientific Flash*Smart* Elemental Analyzer

Authors

Dr. Liliana Krotz and
Dr. Guido Giazzi
Thermo Fisher Scientific, Milan, Italy

Keywords

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Goal

To demonstrate the performance of the Thermo Scientific Flash*Smart* Elemental Analyzer for nitrogen/protein determination in food and animal feed.

Introduction

Food and animal feed is made up of chemical compounds that determine flavor, color, texture and nutritional value, and are carefully regulated by federal authorities and various international organizations to ensure that they are safe to eat and are accurately labelled.

One of the main analyses for quality control and R&D purposes is elemental characterization. The determination of nitrogen, carbon, hydrogen and sulfur, provides useful information on the characterization of these materials. It is therefore very important to have an accurate and precise technique, preferably automatic, that allows fast analysis with excellent reproducibility. The Thermo Scientific™ Flash*Smart*™ Elemental Analyzer (Figure 1) copes effortlessly with the wide array of laboratory requirements such as accuracy, precision and day to day reproducibility.

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

Methods

For CHNS determinations, the elemental analyzer operates according to the dynamic flash combustion of the sample. The sample is weighed in a tin capsule and introduced into the combustion reactor via the Thermo Scientific™ MAS Plus Autosampler with oxygen. After combustion, the resultant gases are carried by a helium flow to a layer filled with copper, then swept through a GC column that separates the combustion gases, finally being detected by a Thermal Conductivity Detector (TCD) (Figure 2). Total run time is less than 10 minutes. For NCS or for sulfur only determination, the water produced during combustion is adsorbed through a H_2O trap before entering the GC column.

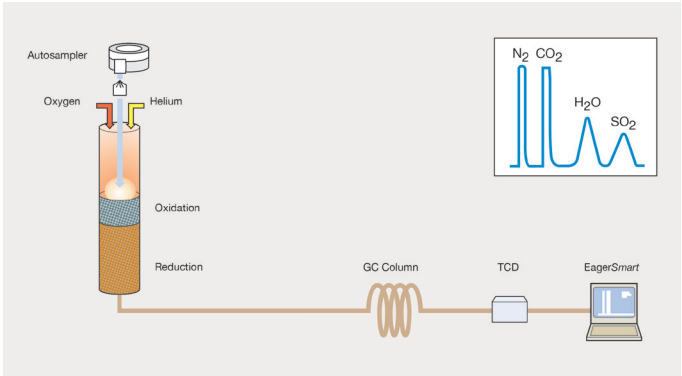

Figure 2. Flash*Smart* CHNS configuration.

For NC determination, after combustion, the produced gases are carried by a helium flow to a second reactor filled with copper, then swept through a H_2O trap, a GC column, before finally being detected by a thermal conductivity detector. Total run time is less than five minutes (see Figure 3).

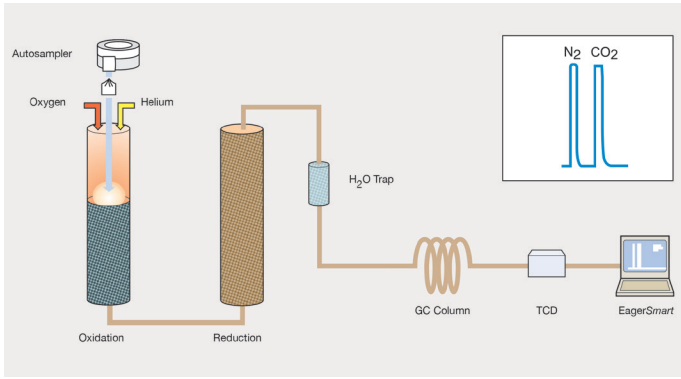

Figure 3. Flash*Smart* NC configuration.

A complete report is automatically generated by the Thermo Scientific™ Eager*Smart*™ Data Handling Software and displayed at the end of the analysis.

Results

Different food and animal feed related products with a large range of elemental concentrations were analyzed in various configurations, to show the performance of the instrument in terms of repeatability.

For the CHNS, NCS and sulfur only determinations, the addition of Vanadium Pentoxide (oxygen donor) was used for a complete conversion of the sulfur, and the instrument was calibrated with the standards BBOT* and nicotinamide. For NC determination, acetanilide and aspartic acid were used as standards to calibrate the instrument. In all cases, K factor was used as the calibration method.

* BBOT: 2,5-Bis (5-tert-butyl-benzoxazol-2-yl) thiophene.

Table 1 shows the CHNS data obtained from different sample matrices. The weight of sample was 2–3 mg for animal gelatines and food supplement A, 3–4 mg for starch and food supplement C, 8–10 mg for food supplement B.

No memory effect was observed when changing the sample nature, indicating complete combustion of all samples with quantitative determination of the elements.

Table 1. CHNS data.

Sample	N%	RSD%	C%	RSD%	H%	RSD%	S%	RSD%
Fish gelatine	16.249 16.212 16.189	0.185	43.023 43.099 43.051	0.089	6.902 6.608 6.586	2.632	0.394 0.408 0.408	2.004
Bovine gelatine	15.796 15.835 15.838	0.148	44.615 44.647 44.624	0.037	6.623 6.658 6.622	0.309	0.531 0.536 0.537	0.601
Porcine gelatine	16.088 16.016 16.043	0.226	44.460 44.397 44.379	0.096	6.631 6.659 6.582	0.585	0.531 0.536 0.537	0.970
Starch	2.530 2.516 2.537 2.520 2.528	0.329	31.008 30.850 31.000 30.956 30.967	0.204	5.396 5.456 5.415 5.373 5.310	1.004	0.399 0.396 0.391 0.392 0.398	0.902
Food supplement A	13.168 13.160 13.194	0.137	52.179 52.084 52.178	0.104	6.665 6.626 6.626	0.311		
Food supplement B	0.071 0.071 0.073	1.109	8.0197 8.0251 8.0241	0.036	2.207 2.199 2.209	0.254		
Food supplement C	0.330 0.332 0.329	0.533	40.615 40.396 40.630	0.323	6.274 6.331 6.323	0.488	0.366 0.368 0.357	1.581

Table 2 shows the NCS data obtained from different sample matrices. The weight of the sample was 3–4 mg.

No memory effect was observed when changing the sample nature, indicating complete combustion of all samples with quantitative determination of the elements.

Table 2. NCS data.

Sample	N%	RSD%	C%	RSD%	S%	RSD%
Animal feed 1	2.525 2.523 2.444	1.850	40.432 40.342 40.215	0.270	0.160 0.143 0.155	5.723
Animal feed 2	3.892 3.845 3.810	1.069	44.752 44.893 44.235	0.776	0.287 0.282 0.277	1.773
Meat 1	13.726 14.057 13.931	1.199	50.315 50.107 50.026	0.298	0.776 0.790 0.784	0.901
Meat2	12.939 12.979 13.013	0.286	51.064 50.886 50.879	0.206	0.724 0.732 0.721	0.742
Meat 3	12.255 12.243 12.232	0.094	53.381 53.486 53.495	0.118	0.764 0.774 0.764	0.798
Meat 4	12.451 12.369 12.459	0.399	52.603 52.701 52.597	0.111	0.785 0.783 0.781	0.199
Potato tuber	0.874 0.893 0.896 0.868 0.883	1.330	39.542 39.528 39.382 39.389 39.348	0.229	0.0709 0.0698 0.0716 0.0721 0.0709	1.221

Table 3 shows the sulfur data obtained from different soya and maize samples. The weight of the sample was 3–4 mg.

Table 3. Sulfur data.

Sample	S%	RSD%
Soya 1	0.356 – 0.336 – 0.338 – 0.350 – 0.343 – 0.341	2.214
Soya 2	0.351 – 0.344 – 0.343	1.635
Soya 3	0.372 – 0.373 – 0.363	1.725
Soya 4	0.366 – 0.363 – 0.364	0.388
Maize 1	0.115 – 0.114 – 0.116 – 0.113 – 0.113 – 0.106	3.137
Maize 2	0.119 – 0.111	4.919
Maize 3	0.104 – 0.104	0
Maize 4	0.112 – 0.102	6.608
Maize 5	0.102 – 0.100	1.396

Table 4 shows the NC data of blood flour, meat flour and food supplements. The weight of sample was 9–10 mg for blood flour and meat flour while for food supplements the weight was 10–20 mg.

Table 4. NC data.

Sample	N%	RSD%	C%	RSD%
Blood flour	14.536 14.307 14.427	0.797	48.791 49.238 49.052	0.458
Meat flour	7.213 7.474 7.385	1.804	32.008 33.287 32.722	1.963
Food supplement 1	5.739 5.747 5.744	0.071	14.598 14.623 14.612	0.084
Food supplement 2	11.365 11.391 11.369	0.123	45.625 45.303 45.343	0.385
Food supplement 3	5.845 5.831 5.863	0.269	17.127 17.115 17.161	0.138
Food supplement 4	3.630 3.613 3.634	0.310	37.093 36.975 36.956	0.201

Conclusions

The Flash*Smart* EA allows the quantitative recovery of the elements from any matrix with no memory effect observed when changing the sample. The advantage of the Flash*Smart* EA lies in its ability to perform NC determination or simultaneous CHNS determination in a single run. By a simple modification of the CHNS configuration, the analysis of NCS or sulfur only can be performed using the same analytical conditions.

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