Characterization of Food and Animal Feed Related Products by the Thermo Scientific FLASH 2000 Elemental Analyzer

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Key Words

Food supplements, animal feed, meat, combustion, CHNS

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 2000 analyzer (Figure 1) copes effortlessly with the wide array of laboratory requirements such as accuracy, precision and day to day reproducibility.

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™ 200R autosampler together with a proper amount of 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 1. FLASH 2000 Elemental Analyzer

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).

A complete report is automatically generated by the Thermo Scientific™ Eager Xperience dedicated 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
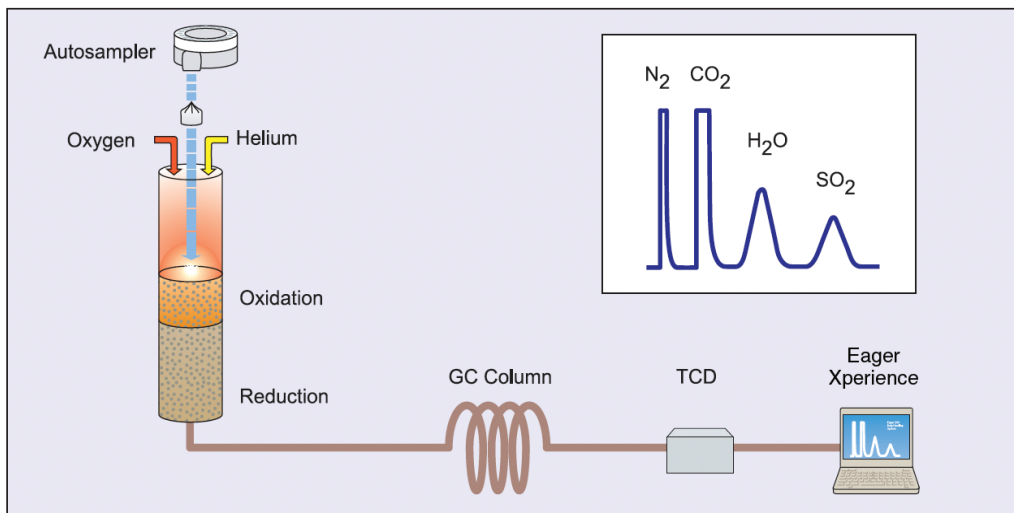

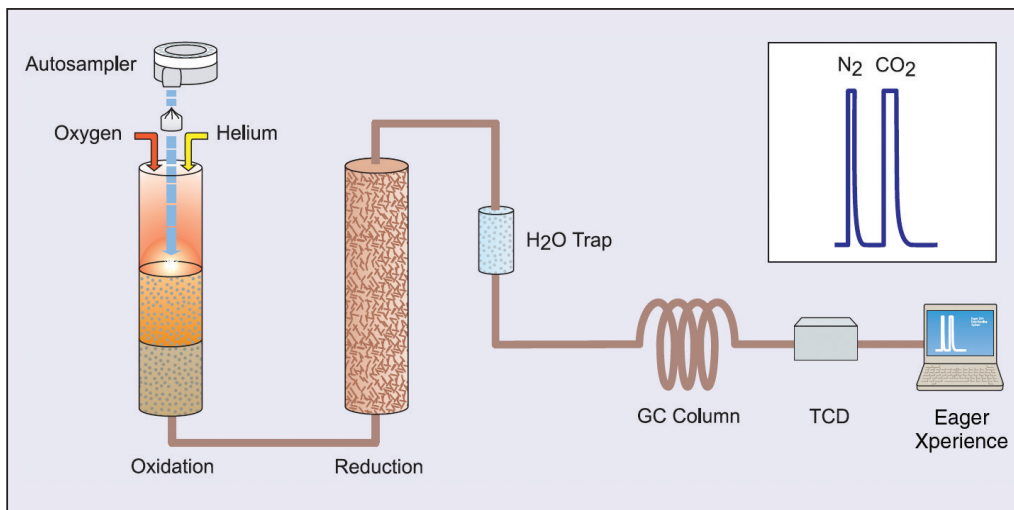Figure 2. FLASH 2000 CHNS configuration

Figure 3. FLASH 2000 NC configuration

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

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

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

Conclusions

The FLASH 2000 analyzer allows the quantitative recovery of the elements from any matrix with no memory effect observed when changing the sample. The advantage of the FLASH 2000 analyzer 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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