Sulfur determination in food by the Thermo Scientific Flash*Smart* Elemental Analyzer coupled with FPD Detector

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Goal

This application note shows the reproducibility of the Thermo Scientific Flash*Smart* EA coupled with FPD Detector for the analysis of low concentration of sulfur in foods.

Introduction

Sulfur is an essential component of living matter. Sulfur deficiency has a negative influence on the quality of proteins through the synthesis of amino acids such as cysteine, cystine and methionine and the synthesis of vitamins. There is also a link between sulfur intake and some pathologies such as ulcerative colitis.

The importance of sulfur testing in foods has grown in the last years and many of the classical methods are now no longer suitable for routine analysis.

Analytical instruments based on the combustion of samples improve the reliability of the data, without the use of hazardous chemicals.

Total sulfur content can be accurately determined by using the Thermo Scientific™ Flash*Smart*™ Elemental Analyzer coupled with a Flame Photometric Detector (FPD). The method combines the advantages of an elemental analyzer with the sensitivity, selectivity and robustness of a FPD. The coupling is simple and it allows the determination of total sulfur at low concentrations (5-10 ppm) in the same instrument without matrix effect.

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Figure 1. Thermo Scientific Flash*Smart* Elemental Analyzer coupled with Flame Photometric Detector (FPD).

Methods

The Flash*Smart* EA operates according to the dynamic flash combustion of the sample. Samples are weighed in a tin containers 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 to a trap filled with anhydrone and swept through a GC column separating the combustion gases. Finally they are detected by the Flame Photometric Detector (FPD) (Figure 2). Total run time is 5-6 minutes. A complete report is automatically generated by the Thermo Scientific™ Eager*Smart*™ Data Handling Software.
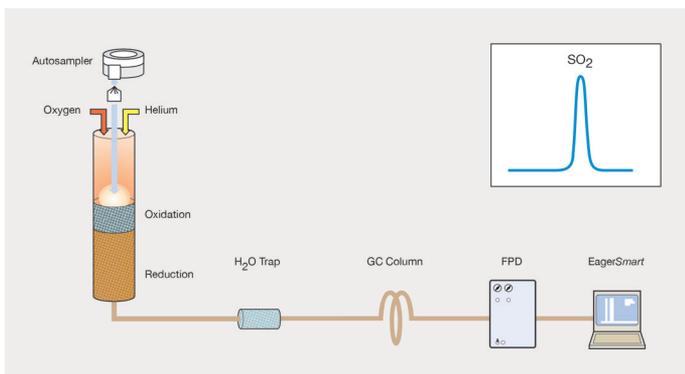

Figure 2. FPD Detector sulfur determination configuration.

Results

Different food samples were chosen to show the reproducibility obtained with the system. Pasta Reference Material, Pasta 2, Chocolate and Maize starch were analyzed without any pre-treatment or homogenization while diet food, spiked food and rice were analyzed after homogenization by a ball mill.

Table 1 shows a typical sequence of analysis. Instrument calibration was performed with Thermo Scientific Pasta Reference Material (0.135% S) using Quadratic Fit as the calibration method (runs 3 to 6). Figure 3 shows the relative calibration curve obtained. The accuracy of the system was verified by analyzing the same Pasta Reference Material four times as unknown (runs 7 to 10) in which data will be accepted if it is in the range 0.131-0.139% S as showed in Table 2.

Table 1. Typical sequence.

Run	Sample	Type	Weight (mg)
1	Pasta Reference Material	Bypass	-
2	Pasta Reference Material	Bypass	-
3	Pasta Reference Material	Standard	3.085
4	Pasta Reference Material	Standard	2.107
5	Pasta Reference Material	Standard	1.079
6	Pasta Reference Material	Standard	0.457
7	Pasta Reference Material	Unknown	2.321
8	Pasta Reference Material	Unknown	2.094
9	Pasta Reference Material	Unknown	2.102
10	Pasta Reference Material	Unknown	2.104
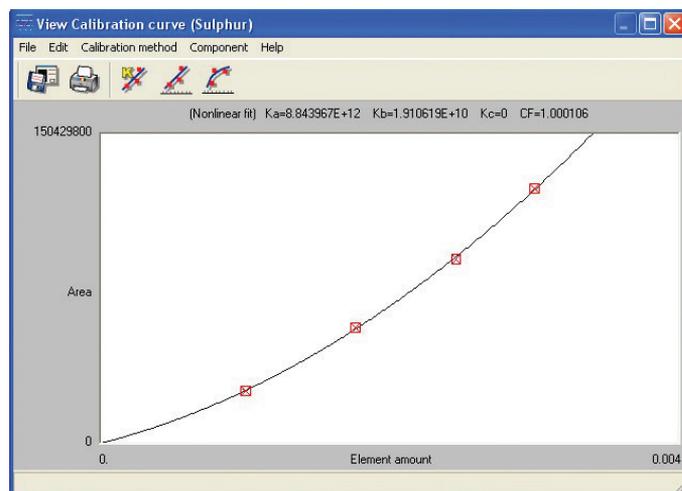
Figure 3. Typical calibration curve.

Table 2. Test of accuracy.

Pasta Reference Material	S%	Average S%	RSD%
Run 7	0.1308	-	-
Run 8	0.1321	0.1322	1.2043
Run 9	0.1316	-	-
Run 10	0.1345	-	-

The stability of the system was demonstrated by analyzing on different days. Table 3 shows the excellent day by day reproducibility obtained by analyzing a Pasta 2 sample.

Table 3. Day-by-day reproducibility.

Pasta 2	S%	Av S%	RSD%
Day 1	0.1099 0.1131 0.1147 0.1154 0.1185	0.1143	2.76
Day 2	0.1169 0.1160 0.1183 0.1141 0.1156	0.1162	1.34

Table 4 shows the sulfur data obtained analyzing different types of rice. The samples were analyzed in duplicate.

Table 4. Sulfur determination in rice samples.

Rice	S%	Av S%	RSD%
1	0.1109 0.1149	0.1129	2.5053
2	0.0867 0.0860	0.0864	0.5732
3	0.0686 0.0666	0.0676	2.092
4	0.0910 0.0914	0.0912	0.3101
5	0.0920 0.0897	0.0908	1.7901

Table 5 shows sulfur determination in various food samples analyzed several times. All data were obtained with a good reproducibility and no matrix effect was observed when changing sample nature.

Table 5. Reproducibility of sulfur determination in food samples.

Sample	S%	Av S%	RSD%
Chocolate	0.3565 0.3648 0.3551 0.3551 0.3589	0.3585	1.14
Maize Starch	0.0065 0.0063 0.0065 0.0064 0.0067	0.0065	2.28
Dried fruit	0.0549 0.0524 0.0548 0.0547 0.0525	0.0538	2.39
Diet food	0.1535 0.1535 0.1491	0.1520	1.67
Spiked diet	0.3449 0.3362 0.3417	0.3409	1.29

Conclusion

The Thermo Scientific FlashSmart EA coupled with FPD Detector is the ideal solution for the analysis of low concentration of sulfur in foods in terms of stability, accuracy, reproducibility, sensitivity and automation without matrix effect.

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