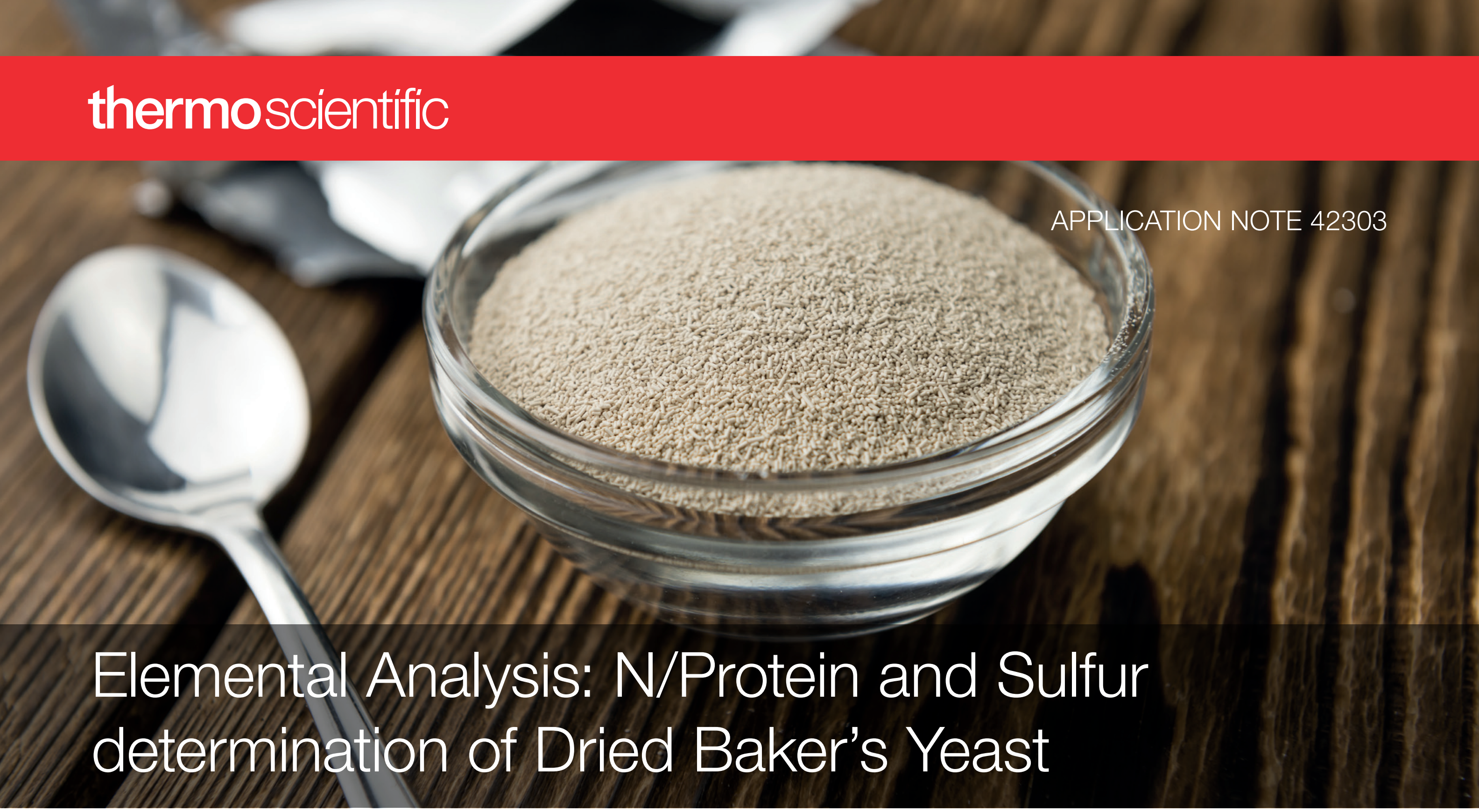

APPLICATION NOTE 42303

Elemental Analysis: N/Protein and Sulfur determination of Dried Baker's Yeast

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Goal

To demonstrate the repeatability of N/Protein and sulfur data of dried baker yeast analysis by the Thermo Scientific Flash*Smart* Elemental Analyzer.

Introduction

Baker's yeast of the species *Saccharomyces cerevisiae* acts as a leavening agent in baking bread and bakery products, where it converts the fermentable sugars in the dough into carbon dioxide and ethanol. Baker's yeast also contributes to the nutritional value and taste of baked goods. Baker's yeast is available in different forms, the main difference being the moisture content. With occasional allowances for liquid content and temperature, the different forms of commercial yeast (cream yeast, compressed yeast, and instant dry yeast) are generally considered interchangeable. Dry yeast forms are good choices for longer-term storage, often lasting more than a year at room temperatures without significant loss of viability, and they are exported over long distances across the world.

The baking industry relies on industrial production of its ingredients, including baking yeasts. Much effort has been put into developing yeasts that will perform reliably in mass production. Since the end of the nineteenth century, baker's yeast has been produced by companies that specialize in its production. The main ingredients for industrial production are yeast cultures, cane and beet. Additionally, minerals, nitrogen and vitamins are also needed.

Baker's yeast is routinely analyzed, and the determination of protein content, through the determination of the nitrogen content, enables determination of the nutritional quality of the product while equally securing that final products are safe for human consumption.

Industries and producers need a robust technique allowing reproducible and automated analysis for the determination of nitrogen in food samples. The Kjeldahl Method is the traditional approach for the analysis of nitrogen. Modern advances in instrumentation for the determination of nitrogen have greatly improved the capabilities of the combustion method, making it faster, safer and more reliable than the traditional Kjeldahl method. The Dumas (combustion) method has been approved and adopted by industry associations (AOAC, AACC, AOCS, ASBC, IDF, IFFO, ISO and others).

The Thermo Scientific™ Flash*Smart*™ Elemental Analyzer (Figure 1), based on the dynamic combustion method (modified Dumas method), provides automated nitrogen determination without use of hazardous chemicals and offers advantages in terms of reproducibility over traditional methods. Considering also the need for cost efficiencies and the likely increase in helium gas cost, due to its possible shortage, an alternative gas to helium, to be used as carrier gas, is needed. Argon which is readily available can be used as alternative to helium in the Flash*Smart* EA.

Furthermore, the importance of sulfur testing in food products has grown in recent years and many of the classical methods are now no longer suitable for routine analysis. Sulfur analysis could be another test to perform to evaluate the yeast quality.

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

This note presents data on nitrogen/protein determination of a dried baker's yeast to show the performance of the Flash*Smart* Elemental Analyzer using argon gas and the reproducibility of the results obtained in comparison with the values obtained using helium as carrier gas. Moreover, sulfur data was included to show the possibility of using the same system for both nitrogen and sulfur determination.

Methods

The Elemental Analyzer operates with the dynamic flash combustion of the sample. Samples are weighed in tin containers and introduced into the combustion reactor via the Thermo Scientific™ MAS Plus Autosampler with oxygen.

For nitrogen determination, after combustion, the produced gases are carried by an argon flow to a second reactor filled with copper, then swept through CO_2 and H_2O traps onto a GC column and finally detected by a Thermal Conductivity Detector (TCD) (Figure 2).

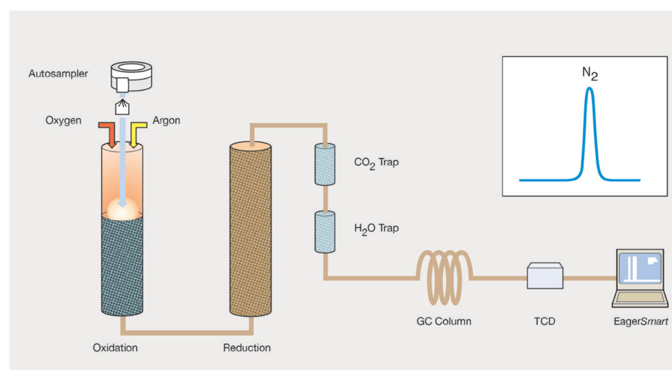

Figure 2. Nitrogen/Protein configuration.

For sulfur determination after combustion the resultant gases are carried by a helium flow to a layer filled with copper, then swept through a GC column which provides the separation of the combustion gases, and finally, detected by a Thermal Conductivity Detector (TCD) (Figure 3).

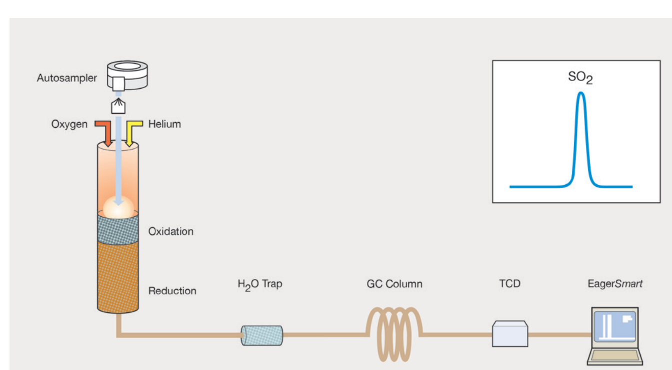

Figure 3. Sulfur configuration.

A complete report is automatically generated by the Thermo Scientific™ Eager*Smart*™ Data Handling Software and displayed at the end of the analysis. The software automatically converts the nitrogen content into protein content using a specific protein factor.

Results

To show the performance of the Elemental Analyzer using helium and argon as carrier gas for N/Protein determination, pure organic standards and the Thermo Scientific Pasta Reference Material were analyzed.

With helium carrier gas, the system was calibrated with 50-80 mg nicotinamide (22.94 N%) using K factor as the calibration method. The yeast was weighed at 260-270 mg. With argon carrier gas, the instrument calibration was performed with about 50-70 mg of nicotinamide standard using K factor as the calibration method. The yeast was weighed at 120-135 mg. In both cases, aspartic acid, nicotinamide and the Pasta Reference Material were analyzed in duplicate as unknowns to evaluate the system. The protein factor 6.25 was used to calculate the protein content.

Table 1 shows the certified nitrogen values, the accepted range according to the technical specification of the Flash*Smart* EA and the average of the experimental data obtained using helium and argon as carrier gas. When using argon as carrier gas, the tests were performed over two days, to validate the stability of the data.

Table 2 shows the Nitrogen/Protein data of the dried baker's yeast analyzed 30 times using helium carrier gas. The sample was weighed at 200–240 mg. Table 3 shows the Nitrogen/Protein data of the dried baker's yeast analyzed 30 times using argon carrier gas in two consecutive days. The sample was weighed at 120-135 mg. Table 4 shows the expected protein value and the comparison of the N/Protein average data using both helium and argon as carrier gas.

Table 2. N/Protein data of dried baker's yeast using helium as carrier gas.

N%	RSD%	Protein %	RSD%
7.24	0.18	45.27	0.18
7.25		45.31	
7.24		45.28	
7.25		45.29	
7.23		45.18	
7.24		45.24	
7.25		45.34	
7.25		45.31	
7.24		45.23	
7.24		45.25	
7.23		45.16	
7.24		45.28	
7.23		45.17	
7.23		45.19	
7.23		45.17	
7.26		45.34	
7.24		45.23	
7.23		45.19	
7.26		45.35	
7.22		45.15	
7.23		45.20	
7.21		45.04	
7.22		45.13	
7.23		45.18	
7.22		45.14	
7.22		45.11	
7.22		45.12	
7.22		4512	
7.23		45.16	
7.26		45.36	

Table 1. Comparison Data of Standards and Reference Materials.

Standard or reference material	Certify values & accepted range	Experimental data					
		Helium as carrier gas		Argon as carrier gas			
		Day 1		Day 1		Day 2	
	N%	N%	Prot.%	N%	Prot.%	N%	Prot.%
Aspartic acid	10.52 ± 0.1	10.57	-	10.51	-	10.52	-
Nicotinamide	22.94 ± 0.22	22.97	-	22.85	-	22.89	-
TFS Pasta	2.138 ± 0.036	2.13	13.28	2.13	13.30	2.12	13.24

Table 3. N/Protein data of dried baker's yeast using argon as carrier gas.

Day 1				Day 2			
N%	RSD%	Protein %	RSD%	N%	RSD%	Protein %	RSD%
7.24	0.23	45.25	0.24	7.20	0.24	45.00	0.25
7.24		45.24		7.21		45.04	
7.24		45.24		7.24		45.27	
7.23		45.19		7.23		45.17	
7.25		45.28		7.24		45.28	
7.22		45.13		7.25		45.30	
7.25		45.32		7.23		45.17	
7.23		45.17		7.26		45.37	
7.24		45.25		7.24		45.27	
7.26		45.39		7.24		45.26	
7.26		45.39		7.26		45.39	
7.25		45.30		7.22		45.12	
7.26		45.39		7.22		45.13	
7.24		45.24		7.25		45.32	
7.23		45.18		7.26		45.35	
7.22		45.14		7.25		45.30	
7.20		45.00		7.22		45.14	
7.26		45.39		7.22		45.14	
7.26		45.35		7.22		45.14	
7.26		45.39		7.22		45.12	
7.21		45.05		7.24		45.27	
7.25		45.31		7.25		45.31	
7.26		45.36		7.23		45.18	
7.26		45.40		7.24		45.26	
7.22		45.11		7.25		45.29	
7.23		45.20		7.25		45.34	
7.22		45.15		7.24		45.24	
7.25		45.33		7.24		45.23	
7.25		45.30		7.22		45.12	
7.25		45.28		7.21		45.08	

Table 4. N/Protein data comparison of dried baker's yeast using helium and argon as carrier gas.

Expected protein %	Helium as carrier gas		Argon as carrier gas			
	Day 1		Day 1		Day 2	
	N%	Prot. %	N%	Prot. %	N%	Prot. %
40 - 50	7.24	45.22	7.23	45.19	7.23	45.22

Finally, the sulfur content was determined by the Flash*Smart* Elemental Analyzer using helium as carrier gas. The system was calibrated with 2 – 3 mg of BBOT (2,5-Bis (5-tert-butyl-benzoxazol-2-yl) thiophene) using K factor as the calibration method and the sample was weighed at about 3 mg. The sample was analyzed 5 times. Table 5 shows the sulfur data obtained.

Table 5. Sulfur data of dried baker's yeast.

S%	RSD%
0.277	0.41
0.278	
0.280	
0.279	
0.278	

Conclusions

For automated and reproducible N/Protein and sulfur analysis of food samples (dried baker's yeast) elemental analysis based on the combustion method (Dumas) proved to be a valuable solution over traditional methods.

For the N/Protein determination, the application showed that the Dumas Method meets manufacturers and laboratories requirements. The Dumas Combustion method has been approved and adopted by Official Organizations such as ASBC, AOAC, AACC, AOCS, IDF, IFFO and ISO, as an alternative to the classical Kjeldahl method.

For sulfur determination, the Flash*Smart* EA is a valuable solution, as low sulfur concentrations were analyzed with excellent repeatability. No memory effect was observed, indicating complete combustion and detection of the element.

The nitrogen data obtained using argon as carrier gas is comparable to the results obtained when using helium as carrier gas, indicating that argon is a viable alternative carrier gas. The Flash*Smart* Elemental Analyzer provides reproducibility and robustness for continued QA/QC tests.

Acknowledgments

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