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AUTOMATED NITROGEN/ PROTEIN DETERMINATION ACCORDING TO THE DUMAS METHOD

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INTRODUCTION

Determining the protein content in food is of enormous importance. In this context, Kjeldahl analysis has been regarded as the reference method [1]. In this process, the sample to be analysed is first digested using sulphuric acid. The solution produced is then distilled using steam. In a final step, the nitrogen contained in the sample is quantitatively determined using titration. This method is considered to be very accurate and, in addition to the total nitrogen content, also allows the selectively bound fractions to be determined. The disadvantages are the high costs, the comparably long measuring time and the necessary handling of harmful chemicals. Against this background, the Dumas method has been increasingly used in recent years.

DUMAS METHOD

This method was named after the French chemist Jean-Baptiste Dumas (1800-1884) and is used to quantitatively determine the nitrogen or protein content in mostly organic samples. First, the sample is completely burned in an oxygen atmosphere. Nitrogen oxides are then reduced to elemental nitrogen with the aid of copper. In a further step, H_20 and CO_2 produced during combustion are removed before the nitrogen content can be analysed using thermal conductivity detectors.

The measured nitrogen content of the sample can be easily converted into the protein content using materials-specific conversion factors:

Protein content [%] = Nitrogen content [%] · conversion factor

The conversion factors required for this are specified in the respective standards; exemplary values can be found in Table 1:

Foods	Conversion factor
Milk	6.38
Barley, oats and rye	5.83
Rice	5.95
Wheat flour, refined	5.70
Wheat, whole-kernel	5.83
Almonds	5.18
Peanuts, Brazil nuts	5.46
Soybean	5.71
Nut and seeds, others	5.30

Table 1: Different conversion factors[2] Compared to the Kjeldahl method described above, the Dumas method only allows the total nitrogen content to be determined. In contrast, measurements with the Dumas method are very fast, efficient and cost-effective. Furthermore, no hazardous chemicals are required. Based on this, a high degree of automation is possible, which is particularly important for measurement projects with a high sample throughput. Another advantage is that this method can be easily combined with carbon determination in the sample material.

NEW ELEMENTRAC CN-r ANALYZER

The new Elementrac CN-r was developed based on the Dumas method described above, providing an ideal solution for high-throughput laboratories that require fast and reliable nitrogen, protein and carbon detection. The innovative autosampler of the ELEMENTRAC CN-r ensures clear sample identification, preventing mix-ups even in a busy laboratory environment and making it easier to handle a large number of samples.

Fig. 1: New Elementrac CN-r Dumas combustion analyser

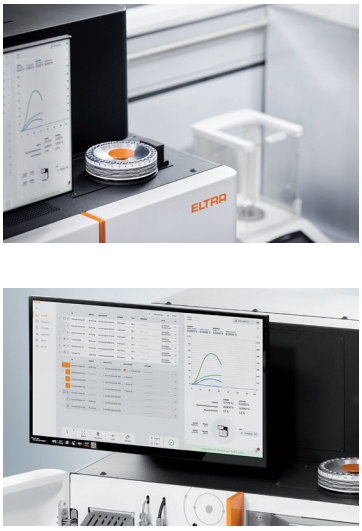

Fig. 2.: Autoloader (above), User interface with touch-resistant touchpad

The instrument delivers precise protein results for a wide range of sample, whether liquid or solid. Thereby the average analysis time is less than 3 minutes due to intelligent processing allowing simultaneous combustion of the current sample and analysis of the previous sample. In this way, measurement data can be generated up to 70 times faster than with the classic Kjeldahl method. In addition, economical use of resources, intelligent gas-saving functions, and optimized use of consumables lead to low costs per sample compared to other devices. All consumables can be replaced in less than 20 minutes, keeping the system always ready for use. An optimized workflow with quick and effortless maintenance ensures smooth operation with minimal downtime.

The Elementrac CN-r analyser fulfils or exceeds the requirements of all current international standards for nitrogen or carbon analysis.

PROTEIN DETECTION IN MILK POWDER

The analyser described above was used for the protein analysis of milk powder. The measurement tolerance was analysed in accordance with DIN EN ISO 14891:2002. The calibration of the instrument was performed using EDTA. The samples were loaded with the help of tin foil. Five samples with a weight of approx. 200 mg were measured. The corresponding results are summarized in Table 2.

Sample ID	Sample mass [g]	N content [%]	Protein content [%]
1	200.3	3.956	24.725
2	199.6	4.031	25.194
3	200.1	3.987	24.919
4	199.6	4.079	25.495
5	199.9	4.081	25.506

Table 2: Measurement results, protein detection of milk powder

On average, the analysed milk powder has a nitrogen content of 4.027%. Considering the applicable conversion factor, the average protein content amounts to 25.168%. The tolerances are within the limits required by the standard abovementioned.

In conclusion, the Elementrac CN-r analyzer represents a significant advancement in automated nitrogen and protein determination. Combining speed, accuracy, and environmental sustainability, it is ideally suited for high-throughput laboratories and industries requiring reliable quality control. Its innovative features, such as the autosampler and efficient consumable management, set a new standard in nitrogen and carbon analysis."

REFERENCES

[1] Kjeldahl, J., Z. Anal. Chem. 22, 366 (1983)
[2] Factors for converting percentages of N in foods and feeds in percentage of protein, U.S. Dept. Agric, Cir. 183, 22 p