
N/Protein Determination in Beer according to the Dumas combustion method

Reference: **AOAC 997.09** Nitrogen in Beer, Wort, and Brewing Grains Protein (Total)

Tested with **VELP Scientifica NDA 701 Dumas Nitrogen Analyzer** (Code F30800070)



Introduction

Beer is the product of the alcoholic fermentation by yeast of extracts of malted barley. The production of alcohols other than ethanol is linked with nitrogen uptake by yeast. The yeast requires nitrogen in order to make protein and other nitrogenous cell components. For this reason the monitoring of the protein content during the brewing process is important to ensure the survival, growth, and productivity of the yeast used to convert sugars to ethanol and carbon dioxide. Moreover the protein content is an important criteria in evaluating the quality of beer: water-soluble barley proteins play a major role in the formation, stability, and texture of head foams.

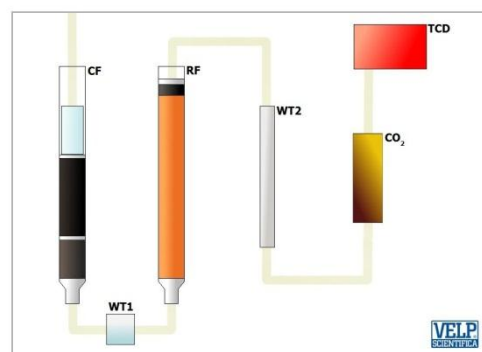
Protein Determination in Unfiltered Italian Beer

The Dumas method starts with a combustion furnace (CF) to burn the sample, obtaining elemental compounds.

Water is removed by a first physical trap (WT1 - **DriStep™**), placed after the combustion, and a second chemical one (WT2). Between the two, the elemental substances passed through a reduction furnace (RF).

The auto-regenerative CO₂ adsorbers (CO₂) let pass only the elemental nitrogen that is detected by the **LoGas™** innovative Thermal Conductivity Detector (TCD) with no requirement for a reference gas.

The NDA 701 is controlled via PC through the intuitive **DUMASoft™**.



NDA 701 Preliminary Operations (daily)

Follow the operating manual to start the NDA 701 and check that the following parameters are set:

Temperature Combustion reactor (Code A00000158): 1030 °C

Temperature Reduction reactor (Code A00000226): 650 °C

Flow rate MFC1 He: 195 ml/min

Flow rate MFC2 He: 200 ml/min

Condition the system by testing 2 EDTA standard (Code A00000149) and 3 to 5 empty tin foils (Code A00000153) as Check up.

Verify the calibration curve with one or more tests as Standard by testing the same standard used for the curve creation.

Sample Preparation

Mix under stirring an aliquot of beer in order to remove the CO₂, following *AOAC 920.49*.

Put into the tin foil 70-100 mg of Chromosorb (Code A00000148).

Fill the tin foil with around 200 mg of beer (~ 200 µl) with an accuracy of 0.1 mg, taken under stirring.

Close the tin foil, obtaining a capsule.

Load the capsule into the autosampler.

Analysis Procedure


Fill the following fields in the database: **Sample name, Weight, Method, Sample type, Calibration number**

The BEER method shows the following parameters:

Protein factor: 6.25

O₂ flow rate: 300 ml/min

O₂ factor: 0.5 ml/mg

Press  to start the analysis.

Analysis time: from 3 minutes for one run.

Typical Results on Unfiltered Italian Beer

| Sample quantity (mg) | Nitrogen % | Protein % |
|----------------------|----------------------|----------------------|
| 202.10 | 0.083 | 0.521 |
| 190.20 | 0.084 | 0.523 |
| 200.00 | 0.082 | 0.513 |
| 197.10 | 0.083 | 0.519 |
| 193.00 | 0.084 | 0.527 |
| 193.70 | 0.083 | 0.518 |
| 200.70 | 0.084 | 0.522 |
| 190.60 | 0.084 | 0.525 |
| 194.30 | 0.084 | 0.525 |
| 199.80 | 0.084 | 0.527 |
| 191.80 | 0.083 | 0.519 |
| 189.60 | 0.084 | 0.524 |
| Average ± SD% | 0.084 ± 0.001 | 0.522 ± 0.004 |
| RSD% * | 0.807 | 0.819 |

Protein Labeled Value: 0.5%

Protein Factor: 6.25

* RSD% = (Standard Deviation * 100) / Average

Conclusion

The obtained results are reliable and in accordance with the labeled value.

The combustion method, relying on the Dumas principle, for the determination of total nitrogen in barley and malt, has been included as an official alternative to the Kjeldahl method.

Results have been obtained with the following calibration curve: in a range of 0 - 1.8 mg N with 5 measurements (from 30 to 120 mg) of Glycine standard solution, 1% in distilled water (nitrogen concentration: 0.1866%).

Benefits of Dumas combustion method are:

- High productivity, non-stop performance
- Time saving, few minutes required
- Moderate running costs
- Totally unsupervised, fully automated
- Omission of harsh and toxic chemicals
- Eco-friendly, low amount of residues and wastes

Several organizations working with standardization and recommendation of chemical methods have approved combustion methods for the determination of nitrogen.

Of those related to brewing, The American Society of Brewing Chemists (ASBC) has approved combustion methods for nitrogen determination in brewing grains as well as in wort and beer.

Thanks to development in sophisticated instrumentation, the Dumas principle, became a practical alternative for the determination of nitrogen in beer samples.