

Determination of Nitrogen Content in Beer by Water-Cooling-Free Fully Automatic Kjeldahl Analyzer

Abstract

Total nitrogen is an important compositional indicator in beer brewing and quality control. This application note presents an optimized Kjeldahl procedure for determining total nitrogen in beer using the N810 Water-Cooling-Free Fully Automatic Kjeldahl Nitrogen Analyzer. A degassing and pre-evaporation pretreatment were used to improve digestion stability for beer samples. Four commercial beers from different origins and brewing styles were analyzed. The measured total nitrogen concentrations ranged from 643.4 to 1081.8 mg/L, with relative standard deviation (RSD) values of 0.13%–0.69%. The two Russian beer samples showed total nitrogen concentrations above the 600 mg/L identification

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threshold specified in GOST 34789-2021. The results demonstrate the applicability of the optimized Kjeldahl procedure for routine total nitrogen determination in beer.

Introduction

Total nitrogen is an important quality parameter for beer brewing and quality control. Nitrogen compounds, including proteins, peptides and amino acids, are essential nutrients for yeast growth during fermentation and have a direct influence on foam stability, mouthfeel, colloidal stability and flavor development. Monitoring total nitrogen is therefore useful for brewing process control and quality evaluation.

Kjeldahl analysis is an established method for determining total nitrogen in brewing products. This application note presents an optimized Kjeldahl procedure for determining total nitrogen in beer using the N810 Water-Cooling-Free Fully Automatic Kjeldahl Analyzer, with reference to GOST 34789-2021, EBC Analytica 9.9.1 and GB 5009.5-2025. The method includes degassing and pre-evaporation pretreatment to minimize foaming and improve digestion stability for carbonated alcoholic beverages. Four commercial beer samples with different origins and brewing styles were analyzed to demonstrate the applicability of the method.

Experimental Instruments and Reagents

Instruments

- Nitrogen analyzer: N810 Water-Cooling-Free Fully Automatic Kjeldahl Nitrogen Analyzer
- Digestion equipment: NDS-20 Kjeldahl N-Digester
- Weighing equipment: Analytical balance with 0.1 mg resolution

Reagents

Unless otherwise specified, reagents were of analytical grade or equivalent.

- Basic reagents: Sulfuric acid (analytical grade), 20 g/L boric acid solution, 400 g/L

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sodium hydroxide solution

- Titration and indicator: 0.1 mol/L hydrochloric acid standard titration solution, bromocresol green-methyl red mixed indicator
- Catalyst: Mixed catalyst tablets, or self-prepared mixed catalyst powder (3 g K_2SO_4 and 0.2 g $CuSO_4$)

Sample:



Details of samples are shown in Table 1 below:

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Table 1. Sample Information

Sample No.	*Type*	*Origin*	*Origin Wort*	*Details*
1	Classic Beer	Russia	11.0°P	Bochkarev Classic Beer, alcohol 4.3% vol
2	Dark Beer	Germany	11.4°P	Kaiserdom Dark Beer, alcohol 4.7% vol
3	Craft Beer	China	12.0°P	Stangen Craft Beer (German- style wheat beer), alcohol 4.5% vol
4	Pale Craft Beer	Russia	12.0°P	Sanshan Pale Craft Beer, alcohol 4.9% vol

Procedure

Sample Pretreatment and Preparation

1. **Degassing: Pour the sample into a conical flask and place it in an ultrasonic cleaner for 30 min to degas. Extend the time if gas bubbles are still evident.**
2. Sampling: Use a volumetric pipette to transfer 10 mL of the sample into a digestion tube.
3. **Pre- evaporation: Place the digestion tube into the digester and heat at 150 °C for 30 min until about 1–2 mL of viscous liquid remains.**
4. After cooling to room temperature, add 3 catalyst tablets and 15 mL of concentrated sulfuric acid into the digestion tube, then place it back into the digester for digestion.

Note: To ensure consistency, add the same amounts of catalyst tablets and concentrated sulfuric acid to the blank digestion tube and digest together with the samples

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Figure 1. Sample state after pre-evaporation

Heating Program

Place the digestion tubes containing samples, catalyst and reagents on the digester, cover the waste exhaust hood or place a bent-neck funnel at the opening of the digestion tube. Set three stages heating procedure, with specific parameters shown in Table 2.

Table 2. Digestion Parameter Settings

Stage	*Target Temperature*	*Time*
1	250°C	40min
2	420°C	90min

Instrumental Analysis

Check if the reagents in the Kjeldahl analyzer are sufficient and run an instrument blank until the blank result is stable, the digested samples can be tested on the instrument. The parameters of the nitrogen analyzer are set as shown in Table 3:

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Table 3. Analyzer parameters

Parameter	*Value*
Boric acid volume	30 mL
Dilution water volume	30 mL
Alkali volume	60 mL
Distillation time	5 min
Titration acid concentration	0.1002 mol/L

Results and Discussion

Results

After digestion, distillation and titration, the results are shown in Table 4.

Table 4. Test Results of Nitrogen Content in Beers

Sample Name	*Sample Volume / mL*	*Blank Volume / mL*	*Titration Volume / mL*	*Nitrogen content (g/100g)*	*Mean Value (mg/L)*	*RSD/%*
1-1	10	0.02007	4.8437	0.0677	678.1	0.13
1-2			4.8562	0.0679		
1-3			4.8521	0.0678		
2-1			6.0547	0.0847	849.3	0.69
2-2			6.0381	0.0845		
2-3			6.1169	0.0856		
3-1			7.7094	0.1079	1081.8	0.47
3-2			7.7011	0.1078		
3-3			7.7674	0.1088		
4-1			4.6157	0.0645	643.4	0.24
4-2			4.5991	0.0643		
4-3			4.5949	0.0642		

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Discussion

- Original wort extract is one of the important compositional parameters in brewing. Although the beers tested in this study had similar original wort values (11.0°P-12.0°P), noticeable differences in total nitrogen were still observed, indicating that beer style and raw material composition also contribute to nitrogen variability.
- The two beer samples originating from Russia contained average total nitrogen concentrations of 678.1 mg/L and 643.4 mg/L, respectively. Both values exceeded the 600 mg/L identification threshold specified for beer in GOST 34789-2021, demonstrating the applicability of the optimized Kjeldahl procedure for determining total nitrogen in beer samples according to this standard.

Conclusion

- The optimized Kjeldahl procedure provided stable determination of total nitrogen in carbonated beer samples after degassing and pre-evaporation pretreatment.
- Excellent repeatability was achieved for all four beer samples, with RSD values between 0.13% and 0.69%.
- The two Russian beer samples contained total nitrogen concentrations above the 600 mg/L identification threshold specified for beer in GOST 34789-2021.
- The method is suitable for routine determination of total nitrogen in commercial beers of different brewing styles and origins, providing a practical solution for brewery quality control and regulatory testing.

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[2] EBC Analytica 9.9.1. Total Nitrogen in Beer — Kjeldahl Method. European Brewery Convention.

[3] GB 5009.5-2025. National Food Safety Standard — Determination of Protein in Food (Kjeldahl Method).

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