METHODS OF DETERMINATION OF BUTYRIC ACID CONTENT

Shen Qian,
master's student VSU named P.M. Masherov, Vitebsk, Republic of Belarus
Scientific supervisor – Buyevich A.E., Candidate of Engineering Sciences, Docent

Butyric acid (butanoic acid) is an important organic compound that is widely used in the food, agriculture and chemical industries. Its determination in various products such as vegetable oils, fats, dairy products and biological samples is of key importance for product quality control, regulatory compliance and consumer safety.

Purpose of the study. The aim of this study is to investigate and comparatively analyse methods for the determination of butyric acid content in various products in order to select the most effective approaches that ensure accuracy, speed and cost-effectiveness of analysis.

Material and methods. The work is based on the results of analyses of scientific and technical information, normative documents (GOST 23637-90) and studies devoted to methods of analysis of butyric acid, its physical and chemical properties and application of modern technologies such as spectroscopy and machine learning.

Results and their discussion. The classification of methods for the determination of butyric acid content has been carried out in this work. Based on the analysis performed, the methods for determination of butyric acid content can be divided into the following groups:

1) Classical methods:

– titrimetric method – based on neutralisation of free organic acids with a standard alkali solution;

– chromatographic method – uses the separation of sample components based on their interaction with the column filler.

2) Modern methods:

– spectrophotometric method – analysis of light absorption by molecules of butyric acid;

– electrochemical methods – measuring pH or electrical potential;

– machine learning methods – acid content prediction based on input parameters (spectral data, physical properties).

General characteristics of the methods. All the methods considered are aimed at the quantitative determination of butyric acid content, but differ in principle of operation, speed of analysis, cost and destructiveness (destruction of the test sample).

According to GOST 23637-90, the precision of methods is assessed through repeatability and reproducibility of results. For example, for the titrimetric method, the allowable differences between the results of parallel determinations should not exceed 0.03%.

Formula for calculating the content of butyric acid for the titrimetric method:

$$C = \frac{V \cdot N \cdot M}{m}, \quad (1)$$

where: C – content of butyric acid (% or mg/g), V – volume of alkali solution used, – N – normality of alkali solution, – M – molar mass of butyric acid, m – mass of original sample.

Influence of factors on measurement uncertainty

Major sources of uncertainties include:

– Equipment uncertainties: for example, an error of ± 0.001 g on a weighing scale can significantly affect the results of the analysis.

– Human error: operator error during sample preparation or reagent addition.

– Variations in sample composition: sample heterogeneity can lead to different results with different parts of the sample.

– Conditions of analysis: changes in temperature, air humidity or pressure.

To account for these factors, formulae for calculating Type A and B standard uncertainty, as well as total and expanded uncertainties, were used. For example, for the chromatographic method, the overall uncertainty u_c was calculated as:

$$u_c = \sqrt{u_A^2 + u_B^2}, \quad (2)$$

where u_A is the Type A standard uncertainty, u_B is the Type B standard uncertainty.

Practical application of methods

– The titrimetric method is most suitable for laboratories with limited budgets as it requires minimal equipment costs.

– The chromatographic method is recommended for large production plants where high precision of analysis is important.

– The spectrophotometric method allows rapid and accurate determination of butyric acid content in complex samples.

– Machine learning techniques can be useful for automating the analysis process in industrial settings, but require large amounts of data to train models.

Conclusion. Based on the analysis performed, it can be concluded that the choice of method for the determination of butyric acid content depends on the type of product, required accuracy, equipment availability and budget. Classical methods remain relevant for small laboratories, while modern technologies such as spectroscopy and machine learning offer new opportunities for automation and improved accuracy of analysis.

1. Буевич, А.Э. Разработка программ для автоматизации расчетов содержания веществ с учетом неопределенности измерений / А.Э. Буевич, Т.В. Буевич // Материалы докладов 57-й Международной научно-технической конференции преподавателей и студентов: в 2 т. / УО «ВГТУ». – Витебск, 2024. – Т. 2. – С. 364–367.

2. Буевич, А.Э. Алгоритм определения массовой доли сырой клетчатки с учетом неопределенности измерений / А.Э. Буевич, Т.В. Буевич // Наука - образованию, производству, экономике: материалы 77-й Региональной научно-практической конференции преподавателей, научных сотрудников и аспирантов, Витебск, 28 февраля 2025 г. – Витебск: ВГУ имени П.М. Машерова, 2025. – С. 15–18. – Библиогр.: с. 18 (4 назв.). – URL: https://rep.vsu.by/handle/123456789/46180.

EDUCATIONAL AND METHODOLOGICAL COMPLEX ON THE SUBJECT “DIFFERENTIAL GEOMETRY”

Tian Yu,

master’s student VSU named after P.M. Masherov, Vitebsk, Republic of Belarus

Scientific supervisor – Podoksenov M.N., Ph.D. physics and mathematics Sciences, Associate Professor

The purpose of this work: to tell about the development of electronic educational and methodological complex on the discipline “Differential Geometry” in English, intended for work with Chinese master students. These teaching materials will be a part of the author’s master thesis.

Material and methods. The main source is the lectures of the scientific supervisor and the textbook published under the stamp of the educational and methodological association for pedagogical education, one of the authors of which is the scientific supervisor [1].

Findings and their discussion. The subject "Differential Geometry" is studied by foreign students of the specialty “Physics and Mathematics Education”. For the successful