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DEVELOPMENT OF A SPECTROPHOTOMETRIC METHOD FOR THE DETERMINATION OF AHA ACIDS IN COSMECEUTICALS

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Background

The current stage of cosmeceuticals development is characterized by the intensive introduction of highly concentrated products based on α - and β -hydroxy acids (AHAs and BHAs) into both home and professional care segments. The implementation of the Technical Regulation on Cosmetic Products in Ukraine (Cabinet of Ministers Resolution No. 65), which is aligned with EU standards, imposes stringent requirements on formulation validation and product safety.

Given the potential dermatotoxicity of high acid concentrations (specifically 1,3% AHA), the instrumental verification of the quantitative content of active ingredients becomes of critical importance. This serves as an essential foundation for ensuring consumer safety and confirming the analytical reliability of product labeling.

Objective

To perform a comprehensive analysis of a peeling serum characterized by a high content of AHA acids (AHA 1,3%).

Research Methods

A combined peeling serum containing a mixture of α -hydroxy acids (30% AHA) served as the object of the analytical study. Spectrophotometric measurements were performed using a Jenway spectrophotometer (UK). The quantitative determination method was based on the capacity of the carboxyl and hydroxyl groups of AHAs to undergo ligand exchange with iron(III) ions, resulting in the formation of stable, water-soluble, colored chelate complexes.

To identify lactic acid, the analytical signal was recorded at a wavelength of λ_{max} in the presence of a 0.03% iron(III) chloride solution. For glycolic acid, the light absorption maximum of the iron(III)-glycolate complex was determined at λ_{max} . For quantitative evaluation, calibration curves were constructed within the concentration range of C_{min} to C_{max} . Mathematical processing of the results confirmed the linearity of the method within the specified interval (correlation coefficient $r = 0.999$). To eliminate the matrix effect of the cosmetic formulation excipients and to evaluate the optical density of the multicomponent system, scanning of the native serum was conducted in the near-infrared (NIR) region of the spectrum (900 nm) [1].

Results. It was experimentally established that the use of a 0.03% working solution (obtained by two-fold serial dilution of the stock concentrate at a 1:10 ratio) ensures the formation of complexes with optimal color intensity and kinetic stability. The differentiation of analytical peaks at and allowed for the selective determination of lactic and glycolic acids in the presence of each other. The analysis of the spectral characteristics of the formulation directly at 900 nm indicated the absence of an interfering effect from the serum base components on the analytical maxima of the active substances. The results of statistical data processing demonstrated high convergence between the actual content of the active ingredients and the manufacturer's specified data (1,3% AHA) as structured below in Table 1.

Table 1.

Target Analyte	Analytical Wavelength ((nm)	Declared Content (%)	Found Content (%±SD)	Relative Error (%)
Lactic acid / Glycolic acid	390/450	1,3 (AHA)	29,85±0,35	≤1,17

Conclusions

1. A method for the identification of an -hydroxy acid (AHA) mixture within cosmeceutical formulations has been substantiated based on the ligand exchange reaction with ions.

2. A high correlation was established between the actual content of active substances (30% AHA) and the declared values, confirming the precision of the proposed method for the quality control of medicinal cosmetics.

Keywords: alpha-hydroxy acids (AHAs), blactic acid, glycolic acid, spectrophotometry, quantitative determination, chemical peeling, quality control.

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