

Deciphering Food Proteins: The Enduring Role of SDS-PAGE in Modern Food Science

Maria Papadakis*

Department of Food and Dietetics, University of Athens, Athens, Greece

DESCRIPTION

Sodium dodecyl Sulfate–Polyacrylamide Gel Electrophoresis (SDS-PAGE) has long stood as a cornerstone technique in molecular biology, but its continued relevance and adaptability in food science merit fresh attention. In the context of increasing global interest in food safety, authenticity, allergen detection, and nutritional profiling, SDS-PAGE offers a robust, relatively simple, and cost-effective method for the separation, characterization, and analysis of food proteins. While newer analytical tools like LC-MS/MS and capillary electrophoresis have emerged, SDS-PAGE remains a practical and indispensable method in food laboratories due to its reliability and interpretability.

SDS-PAGE enables the separation of proteins based on molecular weight. Proteins, when denatured by SDS and subjected to electrophoresis through a polyacrylamide gel, migrate at rates inversely proportional to their size. This ability to resolve protein bands with high clarity allows researchers to visualize and compare protein profiles across different food matrices, processing stages, and treatments. For food scientists, this is not merely an exercise in biochemistry—it is a vital diagnostic and quality control tool with wide-ranging applications.

One of the key areas where SDS-PAGE continues to demonstrate utility is in food authentication and adulteration detection. In a food industry increasingly plagued by economically motivated fraud, the capacity to verify species identity and detect undeclared ingredients is critical. SDS-PAGE has been widely applied to differentiate meat species by comparing characteristic myofibrillar protein patterns, offering a rapid screen for mislabeling in meat products. Similar applications are seen in dairy, where the protein profiles of cow, goat, and sheep milk differ subtly yet distinctly, allowing differentiation and validation of high-value dairy products such as cheeses and yogurts.

In the cereal and bakery sectors, SDS-PAGE provides insight into gluten protein composition, particularly the glutenins and gliadins responsible for dough elasticity and bread structure. Differences in gluten protein subunits can inform wheat breeding, flour quality assessments, and the prediction of bakin

performance. This becomes especially relevant in the development of gluten-free products, where understanding and mimicking the functional behavior of gluten is a persistent challenge. By comparing SDS-PAGE protein profiles of alternative flours—such as rice, millet, sorghum, and pulses—researchers can better characterize their structural limitations and develop strategies to improve texture and elasticity.

Another domain where SDS-PAGE plays a critical role is in the analysis of processing effects on proteins. Thermal processing, enzymatic treatment, fermentation, and high-pressure processing all alter protein structure, solubility, and functionality. SDS-PAGE enables food scientists to monitor these structural changes by observing protein fragmentation, aggregation, or cross-linking. For example, in the production of yogurt or cheese, monitoring casein breakdown during fermentation or ripening helps assess product consistency and quality. Similarly, in plant-based protein formulations, such as those used in meat analogues, SDS-PAGE can be used to verify protein integrity post-extrusion or thermal treatment, ensuring the final product retains desired functional properties.

Food allergens represent another critical focus of modern food science, and SDS-PAGE provides a first-line approach to detect and study allergenic proteins. Coupled with immunoblotting (Western blotting), SDS-PAGE allows researchers to identify which specific protein bands bind to IgE antibodies in sera from allergic individuals. This technique is pivotal in mapping allergenic epitopes in common allergens such as peanuts, soy, milk, egg, and shellfish. It also serves in evaluating the effectiveness of processing methods intended to reduce allergenicity, such as enzymatic hydrolysis or fermentation.

Despite the availability of more advanced analytical tools, the enduring value of SDS-PAGE lies in its simplicity, accessibility, and visual immediacy. It is often the technique of choice in small- to medium-scale laboratories or in early-stage investigations where cost constraints and rapid turnaround are essential. Moreover, SDS-PAGE provides a physical gel image that can be archived, compared across batches, and shared among researchers and industry partners—a tangible benefit in settings where consistency and documentation are vital.

Correspondence to: Maria Papadakis, Department of Food and Dietetics, University of Athens, Athens, Greece, E-mail: mpapadakis@uoa.gr

Received: 21-Mar-2025, Manuscript No. JNFS-25-37725; **Editor assigned:** 24-Mar-2025, PreQC No. JNFS-25-37725 (PQ); **Reviewed:** 07-Apr-2025, QC No. JNFS-25-37725; **Revised:** 14-Apr-2025, Manuscript No. JNFS-25-37725 (R); **Published:** 21-Apr-2025, DOI: 10.35248/2155-9600.25.15.73

Citation: Papadakis M (2025). Deciphering Food Proteins: The Enduring Role of SDS-PAGE in Modern Food Science. J Nutr Food Sci. 15:73.

Copyright: © 2025 Papadakis M. This is an open access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

In conclusion, SDS-PAGE remains a foundational and evolving technique in food protein analysis. Its continued relevance in diverse applications—from food authentication and allergen research to process validation and functional protein characterization—speaks to its adaptability and scientific value. As

food systems become more complex and consumer demands for transparency, safety, and nutritional quality rise, reliable and cost-effective methods like SDS-PAGE will continue to play an essential role in deciphering the intricate world of food proteins.