Detecting Deception in Dietary Supplements: The Pivotal Role of Advanced Analytical Techniques

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Abstract

The surging popularity of dietary supplements highlights a growing interest in proactive health management. However, this expanding market faces substantial challenges related to product quality and authenticity. A primary concern is the adulteration of dietary supplements, where products may contain undisclosed ingredients, inaccurate dosages, or be falsely represented in their composition. Ensuring the safety and trustworthiness of these products necessitates robust and precise detection methods. Standard analysis techniques such as high-performance liquid chromatography (HPLC), gas chromatography-mass spectrometry (GC-MS), and liquid chromatography-mass spectrometry (LC-MS) are indispensable for identifying these issues. Analytical methodologies are crucial in this endeavor, providing the means to meticulously examine the chemical makeup of dietary supplements and pinpoint instances of adulteration. Beyond these established techniques, other analytical approaches like nuclear magnetic resonance (NMR) spectroscopy, various spectroscopic methods (UV-Vis, FTIR, Raman/SERS), electrophoretic techniques such as capillary electrophoresis (CE), immunochemical assays like ELISA, X-ray powder diffraction (XRPD), and DNA-based methods are also utilized. These are often employed for specific types of adulteration or as supplementary analyses. Notably, DNA barcoding is also employed to uncover adulteration in food supplements, particularly those of herbal and botanical origin. This method can confirm if the stated ingredient is indeed present and is the correct species. Certain categories of dietary supplements, notably those marketed for weight loss, sexual enhancement, and muscle building, exhibit a higher prevalence of adulteration. Adulteration frequently involves the incorporation of undeclared substances, which can include synthetic pharmaceuticals or their analogs, to bolster the perceived effects of the supplement. If DNA barcode analysis reveals plant species not listed on the label, it signals adulteration. This could signify substitution with a less expensive plant, the addition of fillers, or contamination. Our analyses of dietary products available in the Turkish market, as well as studies reporting adulteration in dietary supplements from numerous global regions, indicate a significant rate of adulterated or mislabeled products.

Keywords: Adulteration, dietary supplements, analysis, analytical methods, chromatography.