Enhancing menopause supplements by phytoestrogens' screening in soybeans

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Soybeans, known for their versatility across human consumption, livestock feed, biofuel production, and chemical industries due to their rich protein content, fibre, vitamins, and minerals, hold untapped potential. Recent interest has surged in enhancing soybeans' protein, fatty acids and isoflavones' content due to their nutritional benefits and health advantages, bringing them at the forefront of precision agriculture. Isoflavones, the natural marvels embedded within soybeans, possess remarkable phytoestrogenic properties; these compounds have demonstrated unparalleled health benefits, particularly in women's health, offering relief from menopausal symptoms, mitigating cancer risks, lowering cholesterol, fortifying heart health, and even impacting cognitive function and mental well-being. Their multifaceted health benefits have propelled their utilization in numerous dietary supplements. Harnessing the potential of precision agriculture, our research fuses traditional agricultural expertise with state-of-the-art high-performance liquid chromatography (HPLC) and chemometric techniques for rapid and efficient assessment of isoflavones. The primary objective is to swiftly and accurately assess the isoflavones' content in diverse soybean genotypes, crucial for selecting optimal raw materials in the production of dietary supplements targeting menopausal health. Genistein, glycitein, daidzein, daidzin, glycitin, and genistin were the isoflavones targeted in twenty soybean genotypes sourced from the Research & Development Station for Agriculture, Turda, Romania. Sample preparation involved milling seeds, defatting with hexane, extraction using ethanol and membrane filtration. HPLC analysis using a Flexar system (Perkin Elmer) enabled baseline separation of isoflavones using a Kinetex column and gradient elution with acetonitrile and water, both with 0.1% H_3PO_4, in a total run time less than 8 min.; quantification was based on the external standard method. The results revealed distinct isoflavones fingerprints influenced by genetic factors. Daidzin and genistin emerged as major isoflavones, showcasing variability among genotypes. Principal component analysis lead to a model in which the first two principal components explained 90.19% variance, unveiling genotypes rich in glycitin, daidzin, and genistin, alongside those sharing similar isoflavones profiles. This study's significance lies in the development of a swift and precise HPLC method, uncovering distinct isoflavone fingerprints influenced by genetic factors but also lays the groundwork for precision agriculture in supplement development. These findings augment existing knowledge, aiding future nutrition studies and functional product development. Moreover, this approach can serve as a pivotal tool for quality control and guiding breeding programs to attain the desired isoflavone profiles in soybeans. The integration of HPLC and chemometrics presents an efficient pathway for evaluating isoflavones' content in soybean genotypes, essential for advancing dietary supplements particularly tailored for menopausal health and supporting on-going nutrition research.

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