

## **PUBLICATIONS**

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### **VALORIZATION OF AGRO-INDUSTRIAL WASTES FOR THE SUSTAINABLE PRODUCTION OF BIOACTIVE COMPOUNDS**

**Nazim Sekeroglu**

*Gaziantep University, Faculty of Art and Sciences, Department of Biology, 27310,  
Gaziantep, Türkiye, e-mail: [nsekeroglu@gmail.com](mailto:nsekeroglu@gmail.com); [nazimsekeroglu@gantep.edu.tr](mailto:nazimsekeroglu@gantep.edu.tr)*

Medicinal and aromatic plants (MAPs) are primary natural sources of bioactive compounds widely utilized in pharmaceutical, nutraceutical, and cosmetic industries. While nearly eighty percent of MAPs are obtained through wild collection from natural resources, a small portion of them are cultivated in agricultural areas. The main challenges to the conservation and sustainability of naturally grown medicinal plants are the destruction of natural resources and the risk of extinction due to uncontrolled wild harvesting. Another significant problem is the high input costs required for the agricultural production of medicinal plants. Therefore, the sustainable production of biologically active compounds from agricultural and industrial waste is a valuable resource for pharmaceuticals, nutraceuticals, cosmetics, and biomaterials, aligning with global zero waste policies and the circular economy. Agro-industrial by-products, including seeds, fruit peels, pomace, husks, bran, and wastewater, are rich in valuable bioactive molecules. These compounds can be incorporated into existing formulations or developed into value-added medicinal products. Major sources of agro-industry waste and common waste streams include: fruit and vegetable peels, grape pomace from wine industries, citrus processing residues, olive mill wastewater, rice bran and husks, sugarcane bagasse, coffee pulp and spent coffee grounds, coconut shells and coir, cocoa pod husks, and more. These wastes are rich in secondary metabolites and functional biomolecules like rare fatty acids, polyphenols, flavonoids, phenolic acids, tannins, anthocyanins, and resveratrol. They also contain essential oils, terpenoids (such as limonene, menthol, eugenol, and carvacrol), alkaloids (recovered from coffee husks, cocoa waste, tea residues like caffeine, theobromine, and nicotine analogs), and other high-value compounds like pectin, cellulose, hemicellulose, proteins and bioactive peptides obtained from oilseed cakes and brewery spent grain. Modern green extraction techniques, such as supercritical fluid extraction, ultrasound-assisted extraction and microwave-assisted extraction, can improve yield and sustainability. The post-extraction residues, as the secondary by-products of the primary crop by-products, can be utilized in a biorefinery concept, converting waste into multiple high-value products like biofuels, chemicals, pharmaceuticals, and biomaterials through integrated systems. This approach helps protect the environment by conserving natural resources, preserving plant biodiversity, and supporting the circular bioeconomy.