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Bridging sustainability and industry through resourceful utilization of pea pods- A focus on diverse industrial applications

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ABSTRACT

The focus on sustainable utilization of agricultural waste is currently a leading area of scientific research, driving significant advancements in technology and circular economy models. The fundamental capacity of bio-based products, bioprocessing techniques, and the crucial involvement of microbial treatments are opening opportunities for efficient solutions in various industries. One of the most popular green vegetables, peas are members of the Fabaceae family and have a pod-like structure. Every year, a significant amount of pea pods is discarded as waste products of peas that have negative impacts on our environment. In this comprehensive review, we explore innovative methods for utilizing pea pods to minimize their environmental footprint and optimize their viability across multiple industries. A large portion of the pea processing industry's output consists of pea pods. Variety of proteins, with major classes being globulin and albumin (13%), dietary fiber (43–58%), and minerals are abundant in these pods. Because of their diverse physiochemical properties, they find applications in many diverse fields. The porous pea pods comprised cellulose (61.35%) and lignin (22.12%), which could make them superior adsorbents. The components of these byproducts possess valuable attributes that make them applicable across treatment of wastewater, production of biofuels, synthesis of biocolors, development of nutraceuticals, functional foods, and enzymes for the textile industry, modification of oil, and inhibition of steel corrosion.

1. Introduction

Vegetable waste is produced in large amounts every year all across the world, especially in developing nations like Pakistan. These losses include important qualitative losses, such as critical nutrients and different bioactive substances, in addition to quantitative losses. The effective management of waste becomes essential to addressing these issues, allowing the extraction of essential nutrients for later use (Ahmad et al., 2023; Akbar et al., 2023; Akhtar et al., 2023; Bangulzai et al., 2022; Mohammad, Kamil, Tawfeeq, & Ahmed, 2023; Nawaz et al., 2022; Okonkwo & Achilike, 2022; Sultan, 2023). These beneficial waste byproducts act as natural sources of phenolic chemicals and antioxidants (Abbas & Alkheraije, 2023; Ahouangninou et al., 2022; Ara, Arshad, Faheem, Khan, & Shakir, 2022; Mickdam, Alwaleed, Madany, & Sayed, 2022; Moseri, Umeri, Onyemekonwu, & Belonwu, 2023; Rossi & Efendi, 2022; Tahir, Khan, Ashraf, & RDN, A.I., Mubarik, U., 2023; Widowati et al., 2022).

Peas are among the earliest domesticated plants and the world's second-most-cultivated legume. Their low cost, extensive global distribution, and ease of growing are some of their advantages. It is worth mentioning that around 35–40% of the total pea weight comes from the outer pod. Large amounts of residual pea material are produced worldwide, and a large portion of it is used as animal feed (Nasir, Zaidi, Siddiqui, & Sirohi, 2023). It is noteworthy that out of the annual global pea production that is approximately 11.7 million tons, a substantial 4 million tons consist of pea pods, which are typically discarded as waste

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