

Meta Analysis

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Analysis of the Integrated Development Pathways between Medicinal and Edible Utilization of *Polygonatum* and Understory Cultivation Industry

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Abstract *Polygonatum* spp. are important medicinal-and-edible plant resource in China, with abundant nutritional components and considerable potential for functional development. With the increasing demand for health-oriented products and the transformation of the traditional Chinese medicine industry, the utilization pattern of *Polygonatum* resources is shifting from conventional medicinal material production toward medicinal-food product development and ecological cultivation. However, the sustainable development of the *Polygonatum* industry is restricted by several challenges, including the decline of wild resources, weak germplasm foundations, incomplete cultivation technology systems, and insufficient integration across the industrial chain. This study explores the integrated development of medicinal-and-edible utilization and understory cultivation of *Polygonatum*, analyzing its major nutritional components and bioactive compounds, the current status of medicinal-food product development, and the limitations affecting industrial development. Considering the biological characteristics of *Polygonatum*, including its perennial growth habit, shade tolerance, and adaptation to forest ecosystems, this study further discusses understory cultivation models and the effects of ecological factors on yield formation and quality improvement. Based on these analyses, strategies are proposed to enhance resource utilization and industrial value through the selection and genetic improvement of high-quality germplasm, establishment of green standardized cultivation systems, advancement of processing technologies, construction of an integrated industrial chain of “understory cultivation-product processing-brand marketing”, and integration with forest wellness tourism and ecological industries. In the future, the *Polygonatum* industry should develop toward high-value product innovation, ecological industrial system construction, and digital precision management to promote resource conservation, industrial upgrading, and sustainable utilization.

Keywords *Polygonatum*; Medicinal and edible utilization; Understory cultivation; Industrial integration; Resource utilization

1 Introduction

Polygonatum is an important medicinal-and-edible plant genus with long-standing ethnomedicinal use and growing industrial value. Across Eurasian medical traditions, *Polygonatum* species have been used for more than 2 000 years as tonic herbs for fatigue reduction, metabolic disorders, age-related conditions, and digestive or respiratory complaints, while several species are also consumed as vegetables, teas, functional foods, and famine-relief starch resources (Shu et al., 2026). This dual-use value is rooted in a rich chemical basis: *Polygonatum* contains polysaccharides, steroidal and triterpenoid saponins, flavonoids, lectins, alkaloids, and related metabolites, and current reviews link these components to immunomodulatory, hypoglycemic, hypolipidemic, antioxidant, anti-inflammatory, anti-fatigue, neuroprotective, and anti-osteoporotic activities (Liu et al., 2024). Several reviews therefore identify *Polygonatum* as a promising raw material for pharmaceuticals, functional foods, cosmetics, and preventive health products, with relatively low toxicity after appropriate processing and strong market utilization potential (Yang et al., 2025). At the same time, recent scholarship emphasizes that research attention is shifting from traditional medicinal use alone toward integrated development in the food sector and broader bio-based industries, indicating a clear industrialization trend for *Polygonatum* resources (Li et al., 2023).

Against this background, the industrial development of *Polygonatum* has accelerated, but it also faces a resource and supply constraint that makes cultivation-based expansion necessary. Multiple studies note that rising