Polysaccharide fractions, in particular, have shown antitumor, anti-inflammatory, immune-regulatory, antioxidant, thermoregulatory, and metabolic-regulatory potential, with possible applications extending beyond medicine to food and cosmetic industries (Zhou et al., 2022).

Despite its high medicinal and economic value, the resource base of *T. hemsleyanum* faces significant pressure. Multiple reviews note that wild populations have been overexploited because of increasing demand, narrow habitat requirements, and the long-standing preference for wild medicinal materials, leaving this species on the verge of extinction in some areas and even placing it among preferentially protected crop germplasm resources in Zhejiang Province (Ji et al., 2021; Hu et al., 2021). More broadly, medicinal plant research in China shows that wild herbal resources are increasingly unable to meet market demand, making artificial cultivation the most feasible and inevitable route for conservation and stable supply (Rao et al., 2004). At the same time, the quality and clinical efficacy of Chinese medicinal materials depend directly on cultivation processes, and ecological planting, under-forest economy, intercropping, and industrialized production have become major research hotspots in recent years (Miao et al., 2024). For *T. hemsleyanum* specifically, current bottlenecks remain clear: its active material basis is not fully resolved, quality control standards are still imperfect, backward processing and storage problems persist, and physiological cultivation studies have focused mainly on light and fertilizer, leaving many production mechanisms insufficiently understood. These constraints limit industrial scaling, product standardization, premium branding, and the conversion of local germplasm advantages into a stable characteristic industry (Xia et al., 2023).

Against this background, developing local characteristic resources of *T. hemsleyanum* has clear practical significance at the ecological, economic, and regional development levels. Understory cultivation of medicinal plants makes fuller use of land, light, and heat resources, is based on forest-medicine symbiosis, and contributes to sustainable utilization of forest resources, plant diversity conservation, and ecological improvement (Li et al., 2025). Agroforestry more generally is well suited to shade-tolerant medicinal plants, offering a practical strategy for simultaneous cultivation and conservation while also creating remunerative alternative crops for smallholders (Rao et al., 2004). Chinese ecological agriculture research likewise argues that underwood planting and imitation-wild habitat cultivation are important pathways to achieve high-quality, efficient, and sustainable medicinal material production while increasing mountain-area incomes and reducing pressure on wild resources (Wang et al., 2020). Experimental evidence from forest-medicinal plant systems further suggests that understory planting can improve soil nutritional status, enrich rhizosphere microbial communities, and enhance soil carbon utilization, indicating that the forest-medicine compound model can generate both ecological and economic benefits (Yu et al., 2023). However, understory industries also face real constraints, including mismatches between canopy density and crop light demand, unstable input-output relationships, weak technical systems, insufficient regulation, and high trial-and-error costs, so optimization must be grounded in species traits, local forest conditions, and market demand (Wen et al., 2025).

This study will explore the development of local characteristic resources of *Tetrastigma hemsleyanum* and the optimization of its under-forest industrial development pathways by comprehensively analyzing its medicinal resource endowment, local ecological conditions, and current industrial development needs. Particular attention will be given to the intrinsic relationships among resource conservation, ecological cultivation, standardized production, and industrial utilization of *T. hemsleyanum* within the framework of the under-forest economy. On this basis, the study will systematically summarize the characteristics and development foundations of local germplasm resources, analyze the effects of different ecological conditions and under-forest production models on resource utilization and industrial development, identify the key constraints limiting the transformation of local resource advantages and the large-scale development of the under-forest industry, and propose corresponding optimization pathways in terms of elite germplasm utilization, selection of ecologically suitable forest sites, standardization of cultivation technologies, quality evaluation, deep processing of products, and brand development. By establishing a development framework of "resource conservation-ecological cultivation-processing and value addition-industrial integration," this study aims to provide a reference for the