

## Review Article

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# Variation in Quality Traits Among Different Tea Cultivars Used for Longjing Tea

Jinfeng Zhou ✉

Hangyu Tea Studio, Hangzhou Hangyu Cultural &amp; Creative Co., Ltd., Hangzhou, 310059, Zhejiang, China

✉ Corresponding email: [1481455658@qq.com](mailto:1481455658@qq.com)Plant Gene and Trait, 2026, Vol.17, No.2 doi: [10.5376/pgt.2026.17.0006](https://doi.org/10.5376/pgt.2026.17.0006)

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**Abstract** This study investigates different tea plant cultivars used for Longjing tea processing, focusing on their quality trait differences and underlying formation mechanisms. First, the typical quality characteristics of Longjing tea are summarized from aspects such as appearance, aroma, taste, liquor color, and infused leaves, and the synergistic effects of cultivar, environment, and processing techniques on quality formation are clarified. Furthermore, differences among cultivars in key chemical components, including amino acids, tea polyphenols, caffeine, and volatile aroma compounds, are compared to reveal their contributions to freshness, bitterness-astringency balance, and aroma profiles. The results indicate that cultivars determine the flavor type and quality level of Longjing tea by regulating metabolite composition and processing response pathways. In addition, this study discusses differences in processing suitability and quality stability among cultivars, and highlights recent advances in molecular biology and multi-omics technologies for elucidating quality traits and breeding new cultivars. In response to current limitations such as incomplete evaluation systems and insufficient multi-factor studies, it proposes strengthening multidimensional evaluation and integrated research on cultivar-environment-processing interactions, providing references for the selection of high-quality cultivars and the development of the Longjing tea industry.

**Keywords** Longjing tea; Tea plant cultivars; Quality traits; Chemical composition; Processing suitability

## 1 Introduction

Longjing tea, one of the most representative pan-fired flat green teas in China, is produced in Hangzhou, Zhejiang Province. It is renowned both domestically and internationally for its typical quality characteristics of “green color, rich aroma, mellow taste, and beautiful shape,” and has been granted geographical indication protection (Shen et al., 2024). Its distinctive sensory quality and profound cultural heritage place it at the core of China’s premium green tea system, while its limited early-spring yield and well-established grading system confer significant economic value (Yu et al., 2023; Zhao et al., 2024). In recent years, with the shift toward premium and health-oriented consumption, demand for high-quality green tea—particularly Longjing tea with strong geographical identity—has continued to increase, promoting industrial expansion and making it a key pillar of the tea industry in Zhejiang and across China (Huang et al., 2024; Teng et al., 2024).

Against this background, the formation mechanism and stability of Longjing tea quality have become important research focuses. Previous studies have shown that Longjing tea quality depends not only on processing techniques but also on the combined effects of cultivar, growing environment, and harvesting period (Yu et al., 2023). With the advancement of metabolomics, sensory science, and genomics, researchers are now able to systematically elucidate, at the molecular level, the dynamic changes of amino acids, catechins, phenolic acids, and volatile compounds during processing, as well as their contributions to key quality attributes such as freshness, bitterness-astringency balance, and chestnut-like aroma (Huang et al., 2024; Teng et al., 2024; Zeng et al., 2024). Meanwhile, techniques such as stable isotope analysis, near-infrared spectroscopy, and chemometric modeling have been applied to authenticity identification and quality grading, reflecting increasing industry demands for quality stability and traceability (Zhao et al., 2024; Wu et al., 2025).

Among the various influencing factors, tea plant cultivars are considered one of the core determinants of quality differences in Longjing tea. Significant variations exist among cultivars in genetic background, physiological