more water-soluble peptides, whereas Longjing 43 has higher theanine and glutamine contents, and these jointly affect umami, kokumi, and mellowness formation (Yan et al., 2025). Research on differently colored cultivars also indicates that green and purple cultivars generally exhibit stronger bitterness and astringency because of higher flavan-3-ol and anthocyanin levels, while yellow or albino cultivars usually have a milder flavor due to higher free amino acid contents (Zeng et al., 2024). Therefore, cultivar differences do not simply determine a single flavor attribute, but rather shape distinct sensory styles by altering the balance among freshness, sweetness, astringency, body, and aftertaste. For this reason, aroma and taste are regarded as the core indicators for distinguishing different Longjing tea cultivars and their product types (Yu et al., 2023; Ao et al., 2025).

4.3 Differences in liquor color and infused leaf performance

Liquor color and infused leaves are important components of the visual quality of Longjing tea and are also the result of the combined effects of cultivar traits and processing suitability. High-quality Longjing tea usually has a tender bright green or yellow-green, clear liquor with high transparency, while the infused leaves are soft, uniform, and consistent in color. Due to differences in soluble substances, tea polyphenol and catechin composition, pigment background, and leaf structure, cultivars vary in liquor brightness, overall hue, and the unfolding state of infused leaves (Teng et al., 2024). Studies have shown that cultivars with higher water extract and tea polyphenol contents tend to have deeper-colored liquor with a stronger sense of concentration, whereas cultivars with lower internal compounds produce lighter and brighter liquor with a thinner mouthfeel (Zhang et al., 2024), indicating that liquor color not only reflects processing outcomes but also the chemical basis of the cultivar.

Further studies have found that the overall color of tea liquor is closely related to various metabolites, such as catechin dimers, phenolic acids, organic acids, and galloyl glucose, which play important roles in liquor brightness and yellow-green balance (Teng et al., 2024). Because the accumulation of these compounds varies among cultivars, even under the same processing and brewing conditions, significant differences may still be observed in liquor brightness and overall tone. For example, albino and low-chlorophyll cultivars tend to produce brighter, more yellow-green or pale-yellow liquor, whereas purple cultivars rich in anthocyanins may present darker or mixed hues (Shan et al., 2023; Zeng et al., 2024).

The performance of infused leaves reflects leaf structural characteristics and processing response. Differences among cultivars in bud-leaf tenderness, leaf thickness, and cell structure affect the unfolding, softness, and integrity of leaves after brewing. High-quality cultivars usually have tender leaves with relatively uniform structure, resulting in soft, bright, and even infused leaves. In contrast, cultivars with thicker leaves or higher maturity are more likely to show rough, broken, or unevenly colored infused leaves (Li et al., 2025). In addition, clonal cultivars such as Longjing 43 generally show better consistency in infused leaves because of their uniform buds and leaves, whereas population varieties often show greater variation (Yan et al., 2025). Overall, liquor color and infused leaf performance are important comprehensive manifestations of cultivar differences and the degree of match between cultivar and processing method (Zeng et al., 2024; Zhang et al., 2024).

5 Differences in Chemical Components and Their Roles

5.1 Differences in major quality components

Amino acids, tea polyphenols, and caffeine are the core chemical bases determining the taste characteristics of Longjing tea. Significant differences in their contents and proportions among cultivars directly affect freshness, bitterness–astringency, and overall taste balance (Zeng et al., 2024). Among these, amino acid differences are particularly prominent. Studies have shown that “Baie No.1” is rich in L-glutamic acid and L-glutamine, whereas “Longjing 43” contains higher levels of flavonoids (Shan et al., 2023). Comparative analyses between Longjing 43 and population varieties indicate that the former has higher theanine and glutamine contents, while total catechin levels are similar, suggesting that differences in freshness mainly arise from amino acids and related peptides (Huang et al., 2024). Therefore, high amino acid accumulation is a key basis for the formation of a fresh and mellow taste.

Tea polyphenols, especially catechins, are the main contributors to bitterness, astringency, and the structural backbone of taste. Cultivars with higher polyphenol content generally exhibit stronger body and aftertaste