

Multifaceted Analyses Reveal Sugar and Organic Acid Metabolism Affecting the Palatability in Mulched *Phyllostachys violascens* Shoots with Varied Sheath Colors

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Abstract: The color of bamboo shoot sheaths influences both appearance and palatability in mulched *Phyllostachys violascens* shoots, but the mechanisms linking sheath color to flavor and texture are unclear. This study combined metabolomics and transcriptomics to investigate the relationship between sheath color and palatability, focusing on sugar and organic acid metabolism. We identified 5,698 metabolites and 33 differentially expressed genes across bamboo shoots with different sheath colors. Darker shoots (black-brown, BSD) exhibited enhanced organic acids and flavor amino acid synthesis, contributing to moderate sweetness. In contrast, as the sheath color lightens (bright-red, BSM; yellow-green, BSL), sugar degradation and cell wall metabolism (*e.g.*, lignin, pectin, cellulose) became more pronounced. BSL shoots, with the lightest sheath color, demonstrated reduced sugar degradation and increased synthesis of pectin and cellulose, resulting in greater sweetness and improved texture.

These findings demonstrate that variations in sheath color are closely linked to metabolic shifts that influence both flavor and texture, offering valuable insights for targeted breeding programs aimed at enhancing bamboo shoot quality.

Keywords: mulched bamboo shoot, sheath color variation, palatability, sugar metabolism, organic acid metabolism, cell wall components