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Effect of Protease and Cellulase-Assisted Sugar Germination and Freeze Drying on The Quality Attributes of Robusta Instant Coffee

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Structured Abstract

Background: Arabica coffee is generally regarded as superior to Robusta, prompting efforts to improve the powder quality attributes of Robusta instant coffee. Enzymatic modification during sugar-assisted germination using protease and cellulase has been explored as a potential approach to enhance bean characteristics, while freeze-drying may further influence the physical and functional properties of instant coffee powders.

Methods: Robusta coffee beans were subjected to protease and cellulase-assisted sugar germination before roasting, with untreated Robusta and Arabica used as reference samples. All samples were processed into instant coffee powders under roasted ground and freeze-dried conditions and analysed for particle size, moisture content, solubility, total soluble solids, and colour parameters (L*, a*, b*).

Results: Particle size distributions indicated slightly larger particles for treated Robusta compared with Arabica and untreated Robusta, as reflected by higher D50 and D90 values in roasted ground powders (59.97 and 250.39 µm, respectively). Freeze-dried powders exhibited finer particle sizes, with D10, D50, and D90 values of 2.70, 18.69, and 47.92 µm for Arabica, 3.88, 23.41, and 61.11 µm for Robusta, and 4.41, 27.15, and 85.60 µm for treated Robusta. Moisture contents remained low across all samples, ranging from approximately 1.9–2.2% in roasted ground powders and 2.4–2.9% in freeze-dried powders. Solubility and total soluble solids were higher in freeze-dried samples, with solubility values of 56.22%, 60.78% and 48.33% and total soluble solids of 10.40, 9.67 and 10.00 °Brix for Arabica, Robusta and treated Robusta, respectively. Colour measurements showed higher lightness in freeze-dried powders, with L* values of approximately 33–34 compared to 31–33 in roasted ground samples, while a* (2.66–3.04) and b* (3.06–3.63) values remained within narrow ranges across all samples.

Conclusion: Overall, enzymatic sugar germination caused only minor changes in Robusta instant coffee quality, whereas freeze-drying had a greater influence on powder characteristics. This indicates that the processing method plays a more dominant role than the enzymatic treatment in determining instant coffee quality.

Keywords: Instant coffee, robusta coffee, enzymatic treatment, sugar germination, freeze drying

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