

Stability of compounds underlying the functional potential of green tea beverages

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Abstract

Green tea (*Camellia sinensis* (L.) Kuntze) is among the richest natural sources of epigallocatechin gallate (EGCG), epicatechin gallate (ECG), epigallocatechin (EGC), and epicatechin (EC) – flavonoid polyphenols of significant biological importance. Despite their widespread consumption, the physiological benefits of green tea beverages remain unclear, partly due to the low stability of epicatechins during gastrointestinal digestion and their susceptibility to degradation during aqueous extraction.

To address these challenges, two technological approaches were investigated: (i) low-temperature extraction of green tea infusion (5 °C and 20 °C), aimed at maximizing EGC and EC yields compared to optimized high-temperature extraction (85 °C), and (ii) fermentation of green tea infusion using a symbiotic culture of bacteria and yeast (SCOBY) to improve epicatechin stability under simulated *in vitro* digestion. Extraction studies demonstrated that the yields of epicatechins are influenced not only by temperature but also by leaf particle size and the chemical characteristics of the water, including pH and mineral content, with optimal conditions for EGC and EC observed during extraction of whole leaves with distilled water at 20 °C for 12 hours. The applied technological parameters revealed microbiological concerns related to contamination of green tea infusions with *Bacillus cereus*, which justified the search for natural stabilizing agents. Therefore, berry fruit juices were evaluated for their antibacterial activity against *B. cereus*, with effectiveness ranked as follows: black chokeberry (*Aronia melanocarpa*) > blackcurrant (*Ribes nigrum*) > cranberry (*Vaccinium macrocarpon*) > elderberry (*Sambucus nigra*). The anthocyanin fractions isolated from these juices also exhibited variable antibacterial activity, which provided new insights into the susceptibility of *B. cereus* and the potential of selected compounds as stabilizing agents. Finally, fermentation of green tea infusion with a consortium comprising acetic acid bacteria (*Komagataeibacter rhaeticus*, *Gluconobacter oxydans*), yeast (*Brettanomyces bruxellensis*), and lactic acid bacteria (*Levilactobacillus brevis*) caused only a marginal loss of total epicatechin content (~5 %), which was approximately twofold higher in the fermented beverage (kombucha) than in the non-fermented beverage following simulated gastrointestinal digestion ($p < 0.05$). The obtained data confirm greater *in vitro* digestive stability of epicatechins in a green-tea-based kombucha matrix compared with the non-fermented beverage.

This doctoral research addresses the need to develop food processing and preservation technologies for the stabilization of bioactive compounds and aligns with current research trends in the field of Nutrition and Food Technology.