Antioxidant and antibacterial activity of tea and mate extracts

Kadrin Meremäe[1], Piret Raudsepp[1], Linda Rusalepp[1], Mati Roasto[1]

[1]Estonian University of Life Sciences, Institute of Veterinary Medicine and Animal Husbandry, Chair of Veterinary Biomedicine and Food Hygiene, F. R. Kreutzwaldi 62, 51006 Tartu, Estonia
*Correspondence: piret.raudsepp@emu.ee

Abstract. Consumers are increasingly interested in natural, plant-based additives as alternatives to synthetic compounds in food products. This study investigated the polyphenolic profiles, total polyphenol content (TPC), total antioxidant capacity (TAC), and antibacterial activity of aqueous and 30% ethanolic extracts of green tea, matcha tea, black tea, and yerba mate. Commercial teas (Camellia sinensis) and mate (Ilex paraguariensis) were purchased in Tartu, Estonia. The tea and mate leaves were powdered (< 1 mm), and extracts prepared with water or 30% ethanol. Polyphenolic compounds were analysed using HPLC-DAD-MS, TPC was quantified as gallic acid equivalents, and TAC was determined spectrophotometrically using the Folin-Ciocalteu method. Minimum inhibitory concentrations (MICs) against Listeria monocytogenes, Staphylococcus aureus, Escherichia coli, and Campylobacter jejuni were determined by broth microdilution according to the EVS-EN ISO, 20776–1:2020 standard. In total, 28 polyphenolic compounds were detected, including hydroxybenzoic acids, hydroxycinnamic acids, flavanols, flavonols, and tea pigments. Mate extracts were rich in chlorogenic acids, while tea extracts contained higher proportions of flavanols, particularly epigallocatechin, epicatechin gallate, and epigallocatechin gallate. Ethanolic extracts of mate (5.16 ± 0.02 mg GAE/mL) and green tea (4.68 ± 0.08 mg GAE/mL) had the highest TPC, wheras matcha tea (5.50 ± 0.01 mg GAE/mL) and green tea (5.82 ± 0.00 mg GAE/mL) showed the strongest TAC. In aqueous extracts, mate and green tea had the highest TPC (3.02 ± 0.34 and 1.77 ± 0.03 mg GAE/mL, respectively), and the strongest TAC (4.05 ± 0.01 and 3.48 ± 0.10 mg GAE/mL). All extracts inhibited the growth of S. aureus, with MIC values ranging from 0.06 to 0.27 mg GAE/mL, and green tea extracts showed the strongest antibacterial activity. Mate extracts showed similar TAC and antibacterial activity in both aqueous and ethanolic extracts. TAC correlated most strongly with TPC (rS = 0.8), and among individual compounds, epicatechin gallate showed the strongest correlation (rS = 0.6). A moderate negative correlation (rS = − 0.6) between TPC and MICs indicated that higher polyphenolic content was linked to stronger antibacterial activity. In summary, ethanolic extracts of green tea were the most promising for further application in food composition due to their strong antioxidant and antibacterial properties. These findings highlight the potential of tea and mate extracts as natural alternatives to synthetic additives in the food industry.

Keywords: polyphenols, antioxidant, antibacterial, tea, mate.

Acknowledgements. This work was supported by the Estonian Research Council grant (PRG 1441) project “Effects and mechanisms of plant bioactive substances in foods of animal origin“, and by the EU and Ministry of Education and Research via Project (TEM-TA52) „Safety and quality of high-risk plant-based foods and meat alternatives”.