

Bioactivity of Green Tea Kombucha: Polyphenol-Rich Ferment for Oxidative and Inflammatory Stress Modulation

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INTRODUCTION & AIM

Oxidative stress and chronic inflammation are major drivers of tissue damage in several diseases, particularly those affecting the gastrointestinal tract. While conventional anti-inflammatory drugs are commonly prescribed, their prolonged use is often associated with side effects, limited efficacy, and poor patient tolerance. As a result, there is a growing need for natural therapeutic alternatives with multifunctional properties and improved safety profiles.

Kombucha is a fermented tea beverage produced by a symbiotic culture of bacteria and yeast (SCOBY), yielding a complex matrix rich in polyphenols, flavonoids, and organic acids. Previous studies suggest its potential antioxidant, anti-inflammatory, and antimicrobial effects. In this study, we aimed to assess the biological activities of green tea kombucha fermented for 14 days, using *in vitro* biochemical and functional assays.

METHODS

Green tea kombucha was prepared by infusing 5 g of tea leaves in 1 L of boiling water for 15 minutes. After adding 60 g of sucrose, the solution was cooled and inoculated with a SCOBY and 100 mL of starter culture (figure1). Fermentation was carried out at room temperature for 14 days.

Total polyphenols, flavonoids, tannins, and flavonols were quantified using spectrophotometric methods. Antioxidant activity was evaluated by DPPH, ABTS and TAC assays. Anti-inflammatory activity was assessed by inhibition of BSA denaturation, and antibacterial effects were tested using agar well diffusion against four bacterial strains.



Figure 1 : ingredients of green tea kombucha

CONCLUSION

Green tea kombucha demonstrated significant biological activities, notably strong antioxidant and moderate anti-inflammatory effects. Its polyphenol-rich composition and selective antibacterial action against *P. aeruginosa* and *B. subtilis* support its potential as a natural functional beverage. These findings highlight kombucha's promise as a bioactive dietary agent warranting further investigation.

FUTURE WORK / REFERENCES

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- Antolak, H.; Piechota, D.; Kucharska, A. Kombucha Tea—A Double Power of Bioactive Compounds from Tea and Symbiotic Culture of Bacteria and Yeasts (SCOBY). *Antioxidants* 2021, 10, 1541. <https://doi.org/10.3390/antiox10101541>

RESULTS & DISCUSSION

Table 1 shows the levels of major phenolic compounds in the green tea kombucha extract after 14 days of fermentation. The total phenolic content reached 4.97 ± 0.12 mg GAE/mL, while the total flavonoid content was 258.48 ± 0.01 mg QE/mL. Significant amounts of tannins (172.82 ± 0.04 mg EC/mL) and flavonols (33.4 ± 0.02 mg QE/mL) were also measured. These results highlight the presence of a rich polyphenolic profile, which likely contributes to the biological activity of the extract

Table 1 : Quantification of polyphenols, flavonoids, tannins, and flavonols in green tea kombucha.

Extract	TPC (mg GAE/ml of extract)	TFC (mg QE/ml of extract)	TTC (mg EC/ml of extract)	Flavonols mg QE/ml of extract)
Kombucha	4.972 ± 0.123	258.48 ± 0.011	172.82 ± 0.038	33.4 ± 0.015

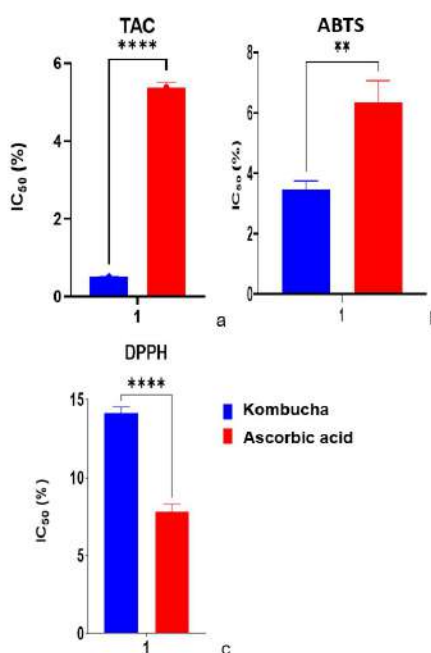


Figure 2 : IC₅₀ values of green tea kombucha and ascorbic acid in TAC (a), ABTS (b), and DPPH (c) antioxidant assays.

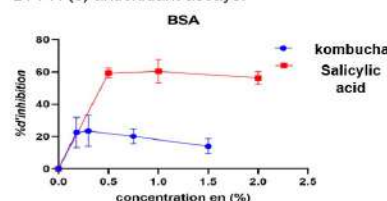


Figure 3 : Anti-inflammatory activity of kombucha

Green tea kombucha was tested against *E. coli*, *S. aureus*, *P. aeruginosa*, and *B. subtilis* using the agar well diffusion method. No inhibition was observed for *E. coli* and *S. aureus*. In contrast, moderate activity was detected against *P. aeruginosa* and *B. subtilis*, with stronger inhibition after 30 days of fermentation

Figure 2 presents the IC₅₀ values of green tea kombucha and ascorbic acid across three antioxidant assays, ranked from strongest to weakest activity. In the TAC assay (panel a), kombucha exhibited a remarkably low IC₅₀ (0.52%) compared to ascorbic acid (5.37%), indicating superior total antioxidant capacity. In the ABTS assay (panel b), kombucha also outperformed the control, with IC₅₀ values of 3.44% versus 6.46%. However, in the DPPH assay (panel c), kombucha was less active, showing an IC₅₀ of 14% compared to 7% for ascorbic acid. These findings highlight the selective yet potent antioxidant profile of the extract.

Figure 3 shows that kombucha inhibited BSA denaturation most effectively at 0.18%. Higher concentrations reduced activity, possibly due to increased acidity, suggesting an optimal anti-inflammatory effect at lower doses.