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E-BOOK OF EXTENDED ABSTRACTS

# OXIDATIVE STABILITY OF MOIST CAKE FORMULATED WITH GREEN TEA EXTRACT AS AN ACTIVE INGREDIENT, MOISTEA CAKE

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**ABSTRACT**

The demand of the natural food preservatives by the consumers has increased in recent years, as there are some questions raised in the safety of synthetic additives like butylated hydroxyanisole (BHA), which are widely being used in bakery products to inhibit lipid oxidation process. This study was done to investigate the possibility of tea extracts as a natural antioxidant in enhancing the oxidative stability of moist cakes. It aimed at comparing and evaluating the antioxidant activity of the green tea extract and to determine how effective the green tea extract would be in retention of the quality of the moist cakes during storing. The antioxidant properties of the samples were determined using total phenolic content (TPC) and ferric reducing antioxidant power (FRAP) analysis whereas the cake samples were analysed regarding oxidative stability considering peroxide value (PV) and thiobarbituric acid (TBA) levels. Antioxidant tests showed that green tea extract had slightly lower TPC and FRAP values than BHA, but the difference was minimal. Cakes made with green tea extract had lower PV and TBA values than that of the control, indicating their delayed oxidation. Nonetheless, cakes with BHA showed the highest stability in general. The findings indicated that the green tea extract could impart as high an antioxidant effect at 246 ppm as compared to 200 ppm of BHA, which means that it could be used as an additional natural preservative. To sum up, this study points out that green tea extract has a potential to be a functional ingredient in the bakery formulations to increase its shelf life and cut dependence on synthetic antioxidants.

***Keywords: Green Tea Extract, Antioxidant Activity, Oxidative Stability, Moist Cakes, Natural Preservatives***

## INTRODUCTION

Antioxidants, oxidative stability, and the use of green tea are closely related concepts that enhance the nutritional and sensory quality of cakes. Antioxidants are molecules that inhibit oxidation caused by free radicals, which can damage cells and lead to illnesses such as cancer, heart disease, and neurological disorders (Constantinescu & Mihis, 2023). In foods, lipid oxidation causes rancidity, off-flavours, and reduced shelf life, making antioxidants essential for maintaining freshness. Alongside natural antioxidants, synthetic ones like butylated hydroxyanisole (BHA) are widely used to delay lipid oxidation, preserve flavour, and extend shelf life, though their use is debated due to consumer preference for natural additives. Oxidative stability refers to a product's resistance to oxidation, which is critical in cakes where lipids are highly susceptible to rancidity, colour changes, and off-flavour formation (Domínguez et al., 2019).

Green tea provides natural antioxidants, particularly catechins such as epigallocatechin gallate (EGCG), which reduce oxidative stress in the body and improve food stability (Musial et al., 2020). These compounds help maintain cake quality by slowing fat oxidation, while also contributing to colour, shelf life, and health benefits. Incorporating green tea into bakery products not only improves oxidative stability but also adds functional value, enriching nutritional quality and supporting chronic disease prevention. With strong antioxidant properties, green tea offers a natural means to extend shelf life, preserve flavour and texture, and reduce dependence on synthetic preservatives (Halim et al., 2024).

## RESULTS AND DISCUSSION

***Total Phenolic Content***

The results obtained in Table 1 through this study demonstrated that the Total Phenolic Content (TPC) present in green tea extract (4.58 ± 0.28 mg GAE/g).

Table 1: Total Phenolic Content of green tea extract.

| Samples | TPC (mg GAE/g) |
|---|---|
| Green Tea Extract | 4.58 ± 0.28$^{a}$ |

All values are shown as mean ± standard deviation of three replicates analysis. The values with different alphabet were significantly different ($p < 0.05$) between samples.

This finding indicated that green tea extract contained a considerable amount of phenolic compounds (4.58 ± 0.28 mg GAE/g), which are known as the main source of antioxidant potential. The presence of these compounds suggests that green tea has strong antioxidant capacity, making it valuable for functional use in food and health-related products. However, TPC values may vary depending on factors such as extraction method, solvent polarity, and the source of tea leaves. Similar results were also reported by Luo et al. (2023), reinforcing that processing degree and leaf maturity play crucial roles in determining the final phytochemical profile of green tea.

***Ferric Reducing Antioxidant Power***

Table 2: FRAP of BHA and green tea extract.

| Samples | | | Concentration (ppm) | | |
|---|---|---|---|---|---|
| | 200 | 400 | 600 | 800 | 1000 |
| Green Tea | 0.41 ± 0.00$^{hi}$ | 0.80 ± 0.04$^{e}$ | 1.05 ± 0.04$^{d}$ | 1.23 ± 0.04$^{b}$ | 1.30 ± 0.06$^{a}$ |
| BHA | 0.60 ± 0.02$^{g}$ | 0.73 ± 0.01$^{f}$ | 1.03 ± 0.02$^{d}$ | 1.16 ± 0.06$^{c}$ | 1.28 ± 0.06$^{ab}$ |

*All values are shown as mean ± standard deviation.
*There is a significant difference between the two samples at $P < 0.05$.

Based on Table 2, the Ferric Reducing Antioxidant Power (FRAP) of BHA and green tea extract showed a significant increase across all tested concentrations (200–1000 ppm) with $p < 0.05$. Green tea extract consistently exhibited slightly higher antioxidant activity than BHA, indicating comparable reducing capacities. The FRAP absorbance of 246 ppm green tea was nearly equal to 200 ppm BHA, hence 246 ppm was selected for moist cake development. FRAP assay measures the ability of antioxidants to reduce $Fe^{3+}$ to $Fe^{2+}$, producing a blue complex with $FeCl_3$, where intensity reflects antioxidant power (Langley-Evans, 2000). These results confirm that green tea has reducing capacity similar to BHA, likely due to its high catechin content, especially EGCG, as also supported by Nain et al. (2022).

***Peroxide Value Test***

Table 3: Peroxide value of control, BHA and green tea extract.

| Samples | PV (meq/kg) |
|---|---|
| Control | 2.10 ± 0.03a |
| BHA | 0.97 ± 0.04c |
| Green Tea Extract | 1.40 ± 0.03b |

All values are shown as mean ± standard deviation of three replicates analysis. The values with different alphabet were significantly different ($p < 0.05$) between samples.

F1: Control; F2: added BHA; F3: added green tea.

Table 3 shows the Peroxide Value (PV) of three moist cake formulations: control (F1), cake with BHA (F2), and cake with green tea extract (F3). Significant differences ($p < 0.05$) were observed, with the control having the highest PV (2.10 ± 0.03 meq/kg), indicating greater lipid oxidation. Cakes with green tea extract (1.40 ± 0.03 meq/kg) and BHA (0.97 ± 0.04 meq/kg) showed much lower PV, confirming that both antioxidants effectively delayed primary lipid oxidation. The PV test measures hydroperoxides formed from oxygen reacting with unsaturated fats, where fewer titrations with sodium thiosulfate indicate higher peroxide levels (Kontogianni & Gerothanassis, 2022). These results suggest green tea extract is a promising natural antioxidant, though less effective than BHA, in protecting moist cakes. Similar findings by Mokra et al. (2022) attributed this effect to green tea catechins, especially EGCG, which stabilize lipids via hydrogen donation and metal binding. The lower PV values demonstrate that antioxidants maintained cake quality during storage. Since rancidity occurs above 20 meq/kg (Ahmadi et al., 2024), all values reported here were far below this threshold, confirming product acceptability and antioxidant efficacy.

***Thiobarbituric Acid Value***

Table 4: TBA value of control, BHA and green tea extract.

| Samples | TBA (mg MDA/kg) |
|---|---|
| Control | 0.34 ± 0.03[a] |
| BHA | 0.27 ± 0.03[c] |
| Green Tea Extract | 0.30 ± 0.02[b] |

All values are shown as mean ± standard deviation of three replicates analysis. The values with different alphabet were significantly different ($p < 0.05$) between samples.
F1: Control; F2: added BHA; F3: added green tea.

Table 1.4 presents the TBA values (mg MDA/kg) of moist cakes with BHA, green tea extract, and the control. All samples differed significantly ($p < 0.05$), with the control showing the highest secondary lipid oxidation (0.34 ± 0.03 mg MDA/kg), indicating more malondialdehyde (MDA) formation as a rancidity marker. Cakes with BHA (0.27 ± 0.03 mg MDA/kg) and green tea extract (0.30 ± 0.02 mg MDA/kg) had lower TBA values, confirming effective suppression of secondary oxidation. In the TBA test, MDA reacts with thiobarbituric acid to form a pink complex measured at 532 nm; higher values indicate greater oxidation and lower quality. According to Ma et al. (2021), TBA values above 1.5 mg MDA/kg render products rancid, but all values here were well below this threshold, confirming stability and acceptability. The antioxidant effect of green tea extract is attributed to polyphenols, especially catechins like EGCG, which scavenge free radicals and stop lipid oxidation (Nain et al., 2022). Both treatments extended cake stability during storage, proving their effectiveness in preventing quality loss.

## CONCLUSION

In conclusion, the Moistea Cake is an innovative bakery product that successfully integrates the health-promoting properties of green tea extract into a moist cake formulation. It demonstrates that natural ingredients can effectively replace synthetic additives, offering both functional benefits and consumer appeal. By providing a product that is indulgent, health-oriented, and eco-friendly, the Moistea Cake addresses key industry challenges related to food quality, shelf life, and consumer trust. This innovation highlights the potential for tea extracts to transform the bakery sector and aligns with global trends toward sustainable, clean-label, and functional foods.

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