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(Research Article)

Polyphenol content, antioxidant and anti-inflammatory activities of Georgian wine and green Tea

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Abstract

This comprehensive study explores the health-promoting properties of Georgian green tea and red wine, focusing on their antioxidant and anti-inflammatory activities, as well as polyphenol content. Utilizing the DPPH and FRAP methods, we observed impressive results, with green tea showcasing a remarkable FRAP activity of 61.2 % of *ascorbic acid* activity set as 100 %, surpassing red wine at 18.2 %. Comparative assessments against *ascorbic acid* for antioxidant activity and *Sodium diclofenac* for anti-inflammatory effects further underscored green tea's prowess. Intriguingly, green tea exhibited a substantial anti-inflammatory activity of 20 % of *Sodium diclofenac* also set as 100 %, outshining red wine at 3.7 %. Polyphenol content, a key contributor to health benefits, revealed green tea's concentration at 7.5 % (w/w), red wine's - 4.4 % g/l. These findings highlight the potential of green tea and red wine as a potent source of bioactive compounds with implications for cellular health, inflammation mitigation, and chronic disease prevention. The results prompt a closer look at dietary choices, advocating for the incorporation of green tea to harness its multifaceted health benefits. As we delve into the molecular richness of these beverages, our findings provide valuable insights into the potential therapeutic avenues offered by these popular and culturally significant drinks.

Keywords: Antioxidants; Anti-inflammatory activity; DPPH; FRAP; Polyphenol content

1. Introduction

In an era where health-conscious choices steer lifestyles, the exploration of natural sources brimming with antioxidants and anti-inflammatory compounds has become a scientific pursuit of great significance. Among the potential candidates, green tea and red wine, especially Georgian red wine, stand out for their historical use and health benefits.

Green tea, derived from *Camellia sinensis* leaves, has been celebrated for centuries in traditional medicine for its significant health-enhancing properties [1]. Rich in polyphenols, green tea has become the subject of extensive research, with evidence suggesting potential benefits ranging from cardiovascular health to cancer prevention [2].

Antioxidants play a crucial role in neutralizing free radicals, which are unstable molecules that can cause damage to cells and contribute to various chronic diseases. Green tea and red wine have been widely studied for their potential health benefits due to their rich content of polyphenolic compounds [3].

The present study delves into the antioxidant activity assessed through the DPPH and FRAP methods, anti-inflammatory properties, and total polyphenol content of these beverages, aiming to shed light on their potential health benefits.

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2. Materials and Methods

2.1. Extraction of green tea and wine materials

2 g commercially available Georgian green tea lives were added to 80 ml of boiling water and were steeped for 15 min. The infusion was cooled to room temperature in an ice bath and then centrifugated. The tea leaves were extracted a second time with 80 ml of boiling water and centrifugated again. Both fractions were combined.

The Georgian homemade red dry wine of *Saperavi* variety (harvested in Kakheti region, left bank of riv. Duruji) fermented with whole skin for two weeks was used in the experiment.

2.2. Determination of antioxidant activity by DPPH- scavenging assay

The free radical scavenging activity of the green tea extract and Georgian red wine and also of standard solution (ascorbic acid) were investigated using 1,1-diphenyl-2-picrylhydrazyl (DPPH) radical scavenging method. The free RSA of the diluted leaf extract of green tea and red wine was tested using a 1,1-diphenyl-2-picryl hydrazyl (DPPH) technique. A total of 24 milligrams of DPPH were dissolved in 100 mL of methanol for making the stock solution. In a test tube, 3 mL DPPH workable solutions were combined with 200 µL of wine and 1 ml of green tea extract and record. After that, the tubes were kept in complete darkness for 30 min. The absorbance was therefore measured using UV/Vis Spectrophotometer at 517 nm. The following formula was used to compute the percentage of antioxidants or RSA [4]:

$$\% \text{ of antioxidant activity} = [(Ac - As) \div Ac] \times 100$$

where: Ac—Control reaction absorbance; As—Testing sample absorbance.

2.3. Determination of antioxidant activity by FRAP (Ferric Reducing Antioxidant Power) method

Reagent - the FRAP reagent should be made immediately before use by mixing 2.5 mL of the 10 mM TPTZ stock solution, 25 mL of acetate buffer (300 mM, pH 3.6), and 2.5 mL of 20 mM $FeCl_3$ solution (1:10:1 v/v).

Instruction for FRAP method: Prepare Frap Reagent and warm up to 37^0C in water bath for 15 min. Add 30µL of sample to 3ml reagent blank, record absorbance at 593 nm on the UV/Vis Spectrophotometer. Add 30 µL ascorbic acid to FRAP reagent and record absorbance at 593 nm. Compare FRAP values of samples to the ascorbic acid values [5].

2.4. Determination of anti-inflammatory activity

2.4.1. Albumin denaturation inhibition

The anti-inflammatory effect of green tea and red wine were tested using a modified form of the standard method [6]. The protocol was followed for inhibiting albumin denaturation. The reaction mixture was made up of an equal volume of green tea extract and red wine and 1 % aqueous egg albumin. The sample was incubated at 37^0C for 20 min before being heated to 51^0C for another 20 min. Finally, % inhibition of protein denaturation was calculated according the formula below:

Percent inhibition of protein denaturation = (Absorbance of control – Absorbance of test) x100/Absorbance of control.

The assay involved testing the samples against a known anti-inflammatory agent, Sodium diclofenac, as a reference.

2.5. Determination of polyphenol content in wine and green tea

Determination of total phenolics as gallic acid equivalent expressed in g/l was carried out using Folin-Ciocalteau method with minor modifications. Sample of wine or green tea (400 µL), distilled water (1.8 µL), Folin-Ciocalteau reagent (200 µL) was placed into the conical tube, after 3 min of incubation sodium carbonate (600 µL) was added, mixed and incubated at room temperature. After 2h of incubation, optical absorbance was read at 760 nm using UV/Vis Spectrophotometer, and the amount of total phenol calculated using gallic acid calibration curve [7]. For calibration per Gallic acid, we used 10 mg Gallic acid diluted in 1 ml MetOH. For different points appropriate volume from stock solution was taken out and diluted to definite amount. Further dilutions were done with the double distilled or deionized water. The next dilutions were done: 0.1, 0.05, 0.025, 0.0125, 0.005 mg/ml.

2.6. Determination of dry matters.

Dry matter in green tea leaves was determined by express moisture meter.

2.7. Standards and reagents

All standards and reagents were of analytical grade.

2.8. Statistical analyses

The results are mean of three measurements ± standard deviation.

3. Results and Discussion

3.1. Polyphenol Content

Georgian red wine boasted a polyphenol content of 4.4 ± 0.1 g/l, signifying a rich concentration and high quality of wine. Green tea, on the other hand, exhibited polyphenol content of 7.5 ± 0.2 % w/w, that corresponds to 0.94 ± 0.25 g/l in achieved extract. Polyphenols are bioactive compounds abundant in both green tea and red wine. Polyphenols are known for their anti-inflammatory, antioxidant, and cardiovascular health benefits.

3.2. Antioxidant Activity

Green tea exhibited a robust FRAP result of 61.2 ± 1.2 % comparing with ascorbic acid set as 100 %, surpassing Georgian red wine at 18.2 ± 0.5 %. DPPH result for green tea was 8.4 ± 0.5 % of ascorbic acid, showcasing its substantial radical scavenging capacity, whereas wine displayed a lower but still significant antioxidant activity 3.7 ± 0.1 %. The high FRAP result for green tea indicates its potent ability to reduce ferric ions, highlighting its superior antioxidant potential compared to Georgian red wine. Antioxidants play a crucial role in neutralizing free radicals, preventing oxidative stress, and reducing the risk of chronic diseases. Although red wine's FRAP result is lower, its DPPH result of 3.7 ± 0.1 % suggests a commendable radical scavenging capacity. Both beverages exhibit antioxidant activity crucial for maintaining cellular health and preventing oxidative damage. According to scientific literature, Georgian red wines exhibited significantly higher antioxidant activity compared to West and Central European samples when assessed using the DPPH method. The highest antioxidant effect was particularly notable in wines derived from the Georgian cultivar *Saperavi*. These results underscore the exceptional antioxidant potential of Georgian red wine, highlighting their potential health-promoting properties [8].

3.3. Anti-inflammatory Activity

Upon conducting the experiments, we observed significant anti-inflammatory activity in both green tea and Georgian red wine. Paixão et al., showed that green tea exhibited a substantial anti-inflammatory effect, demonstrating a reduction in inflammation comparable to that of Sodium diclofenac [9]. Conversely, while red wine also showed anti-inflammatory activity, its efficacy was comparatively lower than that of green tea [10].

These results highlight the potential of both green tea and Georgian red wine as natural agents for mitigating inflammation. Further research into the specific mechanisms underlying their anti-inflammatory effects could provide valuable insights into their therapeutic applications for inflammation-related conditions.

Table 1 Polyphenol content, antioxidant, radical scavenging and anti-inflammatory activities of Georgian green tea and red wine

Material	**Polyphenols g/l**	**FRAP mmol AAE/l**	**Radical scavenging activity by DPPH mmol AAE/L**	**Anti-inflammatory activity mg of SDF/L**
Georgian Green ea extract	0.94 ± 0.05	9 ± 0.2	1.2 ± 0.02	510 ± 5
Georgian Red wine	4.40 ± 0.10	43	0.52 ± 0.01	923 ± 8

Green tea demonstrated a substantial anti-inflammatory activity, 20 % of Sodium diclofenac set as 100 %, outshining red wine at 3.7 %. Green tea's substantial anti-inflammatory activity underscores its potential in mitigating inflammation-related conditions. This surpasses the anti-inflammatory effect of red wine and even competes with Sodium diclofenac, a standard anti-inflammatory drug.

We expressed antioxidant, radical scavenging and anti-inflammatory activities of Georgian green tea and red wine in mmoles of ascorbic acid equivalents (AAE) and mg of Sodium diclofenac (SDF) equivalent per liter and the results are summarized in Table 1.

The results underscore the remarkable antioxidant potential of green tea, outperforming Georgian red wine in both DPPH and FRAP methods. This emphasizes green tea as a potent source of radical scavengers, potentially contributing to oxidative stress mitigation [11] In terms of anti-inflammatory activity, green tea exhibited a substantial effect, surpassing the efficacy of Georgian red wine and even competing with Sodium diclofenac. This suggests a promising role for green tea in addressing inflammation-related conditions [12].

Total polyphenol content revealed that wine boasts a higher concentration compared to green tea. According to the data obtained, green tea with a lower content of polyphenolic compounds compared to wine, shows greater antioxidant and anti-inflammatory activity. This phenomenon is apparently associated with the content of different phenolic compounds in the products studied, as well as with differences in the activity of specific substances and also with their concentration. It is also worth taking into account the polymerization reactions of phenolic compounds that take place in wine depending on its aging. It is known that dimers and polymers are characterized by lower antioxidant activity than monomers of the same phenolic compounds.

Polyphenols are known for their health-promoting properties, and this disparity may contribute to the divergent effects observed in antioxidant and anti-inflammatory activities.

4. Conclusions

The obtained results suggest that both green tea and Georgian red wine exhibit health-promoting properties. Green tea stands out with its remarkable antioxidant and anti-inflammatory activities, as well as also significant polyphenol content. However, the higher polyphenol content does not suggest a greater activity potential for promoting health. These findings support the inclusion of green tea in a balanced and health-conscious diet. However, individual preferences and health goals should guide the choice between these beverages. The reasonable amounts of mentioned products for daily human consumption should be also taken into the account. Further research is needed to unravel the specific polyphenolic compounds responsible for these observed effects, paving the way for targeted nutritional interventions.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

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