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Evolution of antioxidant properties in green tea, black tea and edible flower infusion: A comparative analysis

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Abstract

Tisanes, often known as herbal teas, are caffeine-free concoctions prepared from a variety of plant parts, including leaves, flowers, seeds, and roots. Using DPPH assay, this study examines the antioxidant activity of several herbal teas, such as Hibiscus, Aparajita, Moringa, Rose, Kanchnar, Green tea and Black tea. These tea's antioxidant capacity was examined at various followed by Rose and Black tea, according to the results. Moringa and Kanchnar have relatively modest activity, Although Hibiscus and Aparajita function well at lower doses. The study emphasize how different herbal teas have varying levels of antioxidant potential and how exposure time and concentration have a big impact on how effective they are. As the most powerful antioxidant sources, Green tea is a good option for customers who are concerned about their health.

Keywords: Herbal teas; Antioxidant activity; DPPH assay; Infusion Time

1. Introduction

1.1. Herbal tea

Tisanes are the correct term for herbal teas, which are infusions: Since tisanes are not made from *Cammellia sinensis*, they are not truly tea, even if they are similar to tea and are prepared similarly. Herbal teas are prepared using blends of dried leaves, seeds, grasses, flowers, nuts, or other botanical components that can contribute to their distinct flavor and taste as well as their health advantages. Herbal teas are frequently drunk for their therapeutic or physical effects, particularly their sedative, relaxing, and stimulating qualities. (Aoshima et al., 2007; Naithan et al., 2006).

The substances are mostly found in herbal teas, and over the past few decades, both consumers and researchers have become more aware of the possible health benefits they pose. As a result, herbal teas have become a popular substitute for caffeinated beverages in the pursuit of a healthy lifestyle. Their acceptance was enhanced by their lack of caffeine and health-promoting qualities, particularly their antioxidant capabilities. Additionally, these qualities are complemented by the presence of several polyphenols that have been shown to have anti-inflammatory, diuretic, and antioxidant properties (Lasekan et al., 2012).

It also critical to realize that the market offers a vast array of herbal teas, each of which is intended to provide a distinct therapeutic or medicinal advantage (Ravikumar, 2024).

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2. Material and Method

2.1. Preparation of herbal tea

Extraction is liquid preparations extemporaneously prepared by boiling herbal substances with water on the whole or reduced to a suitable size and allowing too steep for a defined period, usually 5 to 15 minutes as they have a beautiful fragrance and are very appealing when not otherwise specified. The extraction of tea is determined by various factors, such as the tea-to-water ratio, length of infusion, temperature of infusion, type of infused water, and type of tea.

2.1.1. Infusion Preparation

DPPH assay:

Antioxidant activity of all the herbal tea samples was performed using DPPH free radical followed the method of Joshi et al., 2020

The radical scavenging activity of different extracts was determined by using DPPH assay according to (Chang et al., 2001).

This assay is based on spectrophotometric measurements of the capacity of antioxidants to scavenge DPPH radicals (Bondet et al., 1997)

Procedure

The free radical scavenging activity was observed by 2,2-diphenyl-1-picrylhydrazyl (DPPH) assay. The freeze-dried extracts were used and dissolved in the respective solvents. The stock solution was prepared (1mg/ml). The DPPH solution (4mg/100ml methanol) was freshly prepared and taken in the aluminum foiled test tubes, followed by the addition of plant extracts. Series is prepared at different concentrations and incubated for 30 mins in the dark. The absorbance is measured at 517nm in UV-VIS spectrophotometer. Ascorbic acid, a well-known antioxidant was used as standard. The controlled sample follows the same value without any plant extract and methanol was used as blank. Measurements were recorded in the triplicate manner. The decrease in the value of absorbance was compared with positive control.

Calculation

$$\%\text{inhibition} = \frac{\text{absorbance of control} - \text{absorbance of sample}}{\text{absorbance of control}} \times 100$$

3. Result

Table 1 Concentration of antioxidant activity

Herbs ↓	**Conc. →**	**25 µg/mL**		**50 µg/mL**		**100 µg/mL**		**200 µg/mL**	
	Time ↓	**OD**	**%**	**OD**	**%**	**OD**	**%**	**OD**	**%**
Hibiscus	5 min	0.671	13.08	0.643	16.70	0.608	21.24	0.256	66.83
	10 min	0.766	0.77	0.751	2.72	0.565	26.81	0.392	49.2
Aparajita	5 min	0.76	1.68	0.707	8.41	0.637	17.48	0.556	27.97
	10 min	0.712	8.29	0.702	9.18	0.631	18.38	0.519	32.72
Moringa	5 min	0.752	2.59	0.855	10.75	0.679	12.04	0.631	18.26
	10 min	0.771	0.12	0.739	4.27	0.718	6.99	0.672	12.95
Rose	5 min	0.708	8.29	0.647	16.19	0.507	34.32	0.327	57.64
	10 min	0.584	24.35	0.516	33.16	0.250	67.61	0.179	76.81
Kachnar	5 min	0.699	9.45	0.695	9.97	0.688	10.88	0.372	51.81

	10 min	0.705	8.68	0.722	6.56	0.732	5.24	0.752	2.86
Green tea	5 min	0.134	82.64	0.119	84.58	0.102	86.78	0.138	82.12
	10 min	0.101	86.91	0.097	87.43	0.089	88.47	0.106	86.26
Black tea	5 min	0.377	51.16	0.215	72.27	0.200	74.18	0.18	76.78
	10 min	0.363	52.97	0.194	74.87	0.180	76.68	0.166	78.49
Green tea	5 min	0.134	82.64	0.119	84.58	0.102	86.78	0.138	82.12

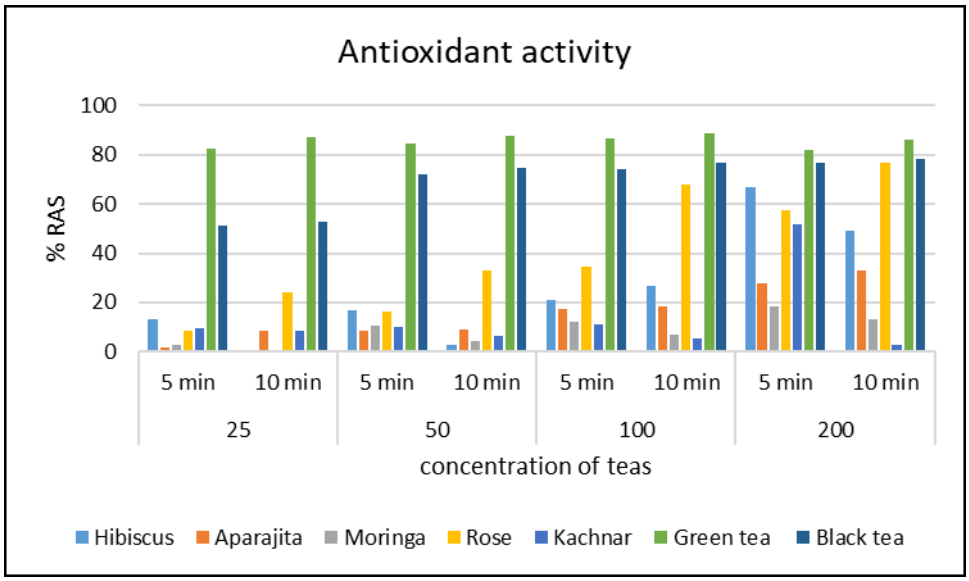

Figure 1 Comparison of antioxidant activity of all plants

4. Discussion

4.1. Hibiscus

The quantity of antioxidant activity in Hibiscus plants is shown in Table 1. As the concentration rises, the antioxidant activity falls. Hibiscus exhibits a considerable rise in antioxidant activity at 5 minutes, with the lowest percentage 13.08% at 25µg/mL and the, maximum percentage 66.83% at 200µg/mL. In general, the antioxidant activity is lower at 10 minutes than it is at 5 minutes. The percentage at 200µg/mL is 49.2%, indicating that continuous exposure, particularly at higher concentrations, reduce antioxidant capability. Similar to the 5 min trend, there was a minor uptick at 50 and 100 (about 2-9%) before a sharp decline at 200(49.2%). Hibiscus showing the best performance at lower doses.

4.2. Aparajita

The level of antioxidant activity in Aparajita is shown in Table 1. Aparajita exhibits the maximum level of antioxidant activity at 5 min. At 200µg/mL, Aparajita exhibit a range of percentages from the lowest at 1.68% to the greatest at 27.97 at 5 min. It has increased slightly at a larger percentage. At 10 minutes, displays the highest percentage 32.72% at 200µg/mL, with a minor drop as concentration rises. Although the overall levels are still comparatively lower than those of other plants, the activity gradually improves after 10 min, peaking at 200µg/mL. At lower doses the aparajita shown the best performance.

4.3. Moringa

Table 1 contain the strong antioxidant activity for 5 min, with a peak at 50µg/mL with percentage 10.75% and a slow decline as concentration rise 18.26% at 200µg/mL. At 10 min, after stabilizing with modest fluctuation, the activity peaks at 200µg/mL at percentage 12.95% and exhibits minor declines at 25 and 50µg/mL. In contrast to other plants, such as Hibiscus or Green tea, the overall level of activity is lower. The antioxidant avtivity of Moringa varies from

moderate to high. Even though their activity tends to decline as concentration rises, they continue to retain noteworthy levels at 200µg/mL.

4.4. Rose

The amount of antioxidant activity of Rose in Table 1 . At 5 min, the activity significantly drops as concentration rises, going from 8.29% at 25µg/mL to 57.64% at 200µg/mL. At 10 min, increasing doses, antioxidant activity sharply declines, dropping from 24.35% at 25µg/mL to 76.81% at 200µg/mL. Rose shows substantial antioxidant activity at 5 min, particularly at 200 µg/mL. The antioxidant potential rises sharply at 10 min, reaching its maximum activity (78.81%) at 200µg/mL, suggesting a powerful antioxidant impact with extended exposure. Significant antioxidant qualities are also displayed by rose, particularly after 10 min of exposures.

4.5. Kachnar

The amount of antioxidant activity of Kachnar in Table 1. Kachnar exhibits the moderate antioxidant activity at 5 min, peaked at 200µg/mL at percentage 51.81% and at 10 min, antioxidant activity declines at all doses, peaking at 25µg/mL at 8.68%. This implies a gradual loss of potency.The least amount of antioxidant activity is displayed by Kachnar, especially over extended periods of time. Kachnar has a somewhat lower level of antioxidant activity, particularly in the 10 min assessment, when larger dosages cause a fairly noticeable decline.

4.6. Green Tea

The level of antioxidant acitivity in green tea shown in Table 1 . At 5 min, display the highest level of antioxidant activity, peaking at 84.58% at 50µg/mL and above 80% at all doses. At 10 min, the activity remain extremely high, increasing slightly at 50µg/mL (87.43%) and decreasing at higher concentration at 200µg/mL (86.26%). All doses and time points, green tea exhibits the strongest antioxidant activity. It has a remarkable 86.78% activity at 100µg/mL at 5 min, and it gets even better after 10 min, reaching 88.47% at 100 µg/mL. Green tea's robust and steady capacity to scavenge free radicals is demonstrated by its consistently high antioxidant activity. at both 5 and 10 min time intervals, green tea continuously exhibits the highest antioxidant activity. Its antioxidant activity strong antioxidant is exceptionally high, with levels close to 85%, even at varying doses. With consistently strong antioxidant activity across doses and time points, the data clearly reveal that green tea is the most potent antioxidant sources among the plants evaluated.

4.7. Black Tea

The quantity of antioxidant activity in black tea is shown in Table 1 . At 5 min, the antioxidant activity peaks at 76.78% at 200µg/mL, having a begun at about 51% at 25µg/mL. At 10 min, shows a comparable pattern, peaking at 200µg/mL at 78.49%. With the greatest activity (76.78%) at 200 µg/ml at 5 min, Black tea exhibits moderate antioxidant activity. At 10 min, the antioxidant activity increases significantly to reach at 200 µg/mL, suggesting good potential, albeit marginally less than Green tea. Black tea have strong antioxidant activity, particularly at higher concentration, but their activity declines more precipitously tham that of Green tea.

5. Conclusion

When it comes to antioxidant activity, green tea is the most reliable and potent herbal tea. Strong antioxidant qualities are also displayed by rose and black tea, however their potency diminishes with increasing concentration. The outcomes of the remaining herbal teas—Hibiscus, Aparajita, Moringa, and Kachnar—vary, with Aparajita and Hibiscus showing the best performance at lower doses.

In conclusion, the antioxidant activity of the different plants that were examined varied significantly depending on exposure duration and concentration. Green tea continuously has the highest antioxidant activity of any plant, and its potency gradually increase, especially at 100µg/mL. This implies that the study's most effective antioxidant sources is green tea.

Additionally, Rose has remarkable antioxidant activity, particularly at greater doses and after 10 min of exposure, suggesting that it possesses potent antioxidant qualities throughout time.

Conversely, Hibiscus and Black Tea exhibit moderate antioxidant activity, with Black Tea exhibiting a gradual rise over time and Hibiscus reaching a peak of 200µg/mL after 5 min. But compared to Green Tea and Rose, their activity is neither as steady nor as high.

Aparajita and moringa exhibit comparatively less antioxidant activity, and over time, especially at lower doses, their potential diminishes, Of all the plants evaluated, kachnar exhibit the lowest antioxidant activity, and little variation is seen over time.

In summary, kachnar has the least amount of antioxidant potential, whereas Green tea and Rose are the best at scavenging free radicals. Both concentration and exposure duration typically affect how effective the plants are; in many situations, higher concentartion and longer exposure durations increase antioxidant activity.

Compliance with ethical standards

Disclosure of conflict of interest

The author declare that they have no conflict of interest.

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