Antioxidant capacity of selected teas and cocoa

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Received: / Accepted: / Published:

Abstract: Diverse teas are consumed around the world for their calming, soothing effects. Many people attribute curative properties to tea. The same can be said for cocoa, and its processed form chocolate. Furthermore, these attributed health-giving properties are suggested to come from their antioxidant properties. This study presents the determination of the antioxidant capacity of selected teas (*Camellia sinensis*) and cocoa (*Theobroma cacao*), and comparing those results to a caffeine standard. The Briggs-Rauscher (BR) oscillating reaction was used to determine the antioxidant capacity of the samples. The antioxidant species scavenge free radicals formed in the BR reaction, lengthening the time intervals of the reaction's oscillations; the higher the antioxidant capacity, the longer the oscillation delays. The samples consisted of aqueous preparations of Green tea, Black tea, Cocoa (pure powder), and Dark chocolate. To analyze the results we used the Relative Antioxidant Performance (RAP), where the slopes of the samples were compared to the caffeine standard. We hypothesized that the aqueous preparations of the samples would exhibit antioxidant capacity. Our hypothesis was proven correct, with green tea showing consistently higher RAP than decaffeinated green tea, and dark chocolate exhibiting slightly more antioxidant capacity than pure cocoa powder. Black tea proved to be less antioxidant than green tea. These observations suggest that antioxidant properties are present, and could be a plausible pathway to their attributed health-giving properties. Finally, these preparations are complex mixtures of natural ingredients; therefore, we should not dismiss any potential synergistic effects between different ingredients.

Keywords: *antioxidants, oscillatory reaction, Briggs-Rauscher reaction, tea, and cocoa.*

Introduction

Antioxidants are speculated to positively affect the health of humans in regards to certain reactions that take place within the body. Tea (*Camellia sinensis*), such as Green Tea and Black Tea, is speculated to have antioxidants present, which help remedy certain ailments. Certain health benefits have been attributed to consuming cocoa (*Theobroma cacao*) and dark chocolate due to its purported antioxidant presence. Antioxidants help control the production of free radicals. Free Radicals are blamed as the cause of many diseases, such as heart disease, cancer, and diabetes. Lacking antioxidants in the body can become very dangerous because the production of free radicals will increase and the chances of developing these diseases will also increase.

The Briggs-Rauscher (BR) reaction is an oscillating reaction that changes between two cycles back and forth until it reaches equilibrium. The two cycles the reaction oscillates between correspond to a radical state and a non-radical state. The BR reaction is mostly used as demonstration.[1] Recently, Cervellati reported its use as a method to assess antioxidant capacity.[2] In this method, the presence of an antioxidant increases the oscillation time in the BR reaction. In this short communication we test if the Briggs-Rauscher oscillating reaction can detect presence of antioxidants. Furthermore, we determine the Relative Antioxidant Performance (RAP) of chocolate and tea.

Methods and Results

A typical preparation of the Briggs Rauscher reaction was utilized.[3] When all stock solutions were prepared the solvents were tested as follows. Take 5mL of the sodium iodate solution, 5mL of starch solution, and 10mL 3% hydrogen peroxide. Once a stir bar has been placed in a 100mL beaker, start to mix the sodium iodate solution and starch solution in the beaker over a stirring plate. Then add the peroxide; the solution turns amber yellow then dark blue. Start the timer when the first dark blue color appears until the next dark blue appears. This is the oscillation time (usually 13-18 seconds).

This is also the control time for each trial. Repeat the step above and when the second deep blue color appears, add 1mL of tea or chocolate solution. Measuring the time from the second blue to the third blue appearance determines the antioxidant performance.

The different dilutions of the antioxidant containing samples show different levels of antioxidant performance. Certain brands of Black teas and green teas also exhibited remarkable antioxidant presence. Green tea consistently showed higher antioxidant capacity than black tea. We ascribe this observation to the higher degree of oxidation of black tea (less antioxidants present). Dark chocolate showed better antioxidant capacity than cocoa. This is plausible due to the processing and addition of ingredients to make chocolate.

The relative antioxidant performance (RAP) of tea was determined using caffeine as a standard. Our observations also suggest that caffeine is not the only antioxidant species in green tea, as the RAP for green tea is greater than 1. The observation of a higher RAP for decaffeinated black tea versus regular black tea is somewhat confusing. We attribute this result to using two different brands of tea.

$$\mathrm{RAP} = \frac{\text{slope of sample}}{\text{slope of standard}}$$

	Slopes of Caffeine	Slope of Black Tea	Slope of Green Tea	Slope of Decaf Tea
Trial 1	7	4.5	13	12.4
Trial 2	6	4.5	14.5	12.4
Trial 3		4.1	15.5	12.3
Average	6.5	4.4	14.3	12.4

RAP of Black Tea	RAP of Decaf	RAP of Green Tea
.67	1.90	2.2

Conclusions

The Briggs-Rauscher oscillating reaction is effective assessing antioxidant performance. Chocolate, cocoa, and tea affect the reaction, confirming their antioxidant activity. Determining the Relative Antioxidant Performance (RAP) of the green tea using caffeine as a standard showed the green tea has consistently better antioxidant performance than decaffeinated black tea and regular black tea. Using the RAP of cocoa in comparison to caffeine as the standard, the dark chocolate showed to have a better antioxidant performance than the cocoa. Our future aims are to perform additional runs with new samples in order to corroborate the decaffeinated tea data, and isolate and test the other active ingredients in tea and cocoa.

Conflicts of Interest

The authors declare no conflict of interest.

Acknowledgments

Authors want to thank St. Thomas University SRI 2016, and STEM-TRAC grant P03C110190.

References and Notes

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