Determination of the antioxidant capacity of coffee

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Received: / Accepted: / Published:

Abstract: Coffee (*Coffea arabica*) is one of the most consumed drinks in our society. It is grown in many regions around the world, developing different flavors and aromas. Its active ingredient, caffeine, is sought after for its stimulating properties, and purported therapeutic effects. This study presents the determination of the antioxidant capacity of coffee, and the assessment of those results using a caffeine standard. The Briggs-Rauscher (BR) oscillating reaction was used to determine the antioxidant capacity of the different coffee 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 caffeine (5%), and freshly brewed samples of espresso coffee (1%), decaf (1%), Costa Rican coffee (5%), Cuban Split Pea Blend (1%) and Jamaican Blue Mountain Coffee (5%). All samples show antioxidant capacity. To analyze the results we used the Relative Antioxidant Performance (RAP), where the slopes of the samples were compared to the caffeine standard. Jamaican Blue Mountain Coffee exhibited the highest RAP at the 5% dilution; Cuban blend was the highest RAP at the 1% dilution. To further examine the Cuban blend, we tested roasted split peas (10%), and they showed no antioxidant capacity. These observations suggest that antioxidant properties are present in coffee, and could be an explanation to its attributed health-giving properties. Finally, brewed coffee is a complex mixture of natural ingredients; therefore, we should not dismiss any potential synergistic effects between different ingredients.

Keywords: *antioxidants, oscillatory reaction, Briggs-Rauscher reaction, coffee, and caffeine.*

Introduction

Free radicals (FR) and reactive oxygen species (ROS) been suggested as potentially being important causative agents of aging and several human diseases such as cancer, inflammatory and degenerative diseases, emphysema, central nervous system injury, and autoimmune disease. The use of antioxidants for the prevention of damage caused by free radicals thereby assumes great importance for health and traditional medicine. Currently, there are many products on the market which claim to contain antioxidants. One of those is coffee, widely consumed around the world. Its active ingredient, caffeine, is sought after for its stimulating properties, and purported therapeutic effects.

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 determine antioxidant performance. Furthermore, we determine how the various coffee blends, Costa Rican Coffee, Jamaican Blue Mountain, Cuban Split Pea Blend Coffee, and decaffeinated Coffee, affect the BR reaction. Finally, we determine the Relative Antioxidant Performance (RAP) of coffee using caffeine as standard.

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 coffee solution. Measuring the time from the second blue to the third blue appearance determines the antioxidant performance. All the coffee samples were dark roast, and were brewed using the espresso method.

The different dilutions of the antioxidant containing samples show different levels of antioxidant performance. The Jamaican Blue Mountain Coffee showed the best antioxidant performance at a 5% scale. The Cuban Split Pea Blend coffee showed an antioxidant performance at a 1% scale. Independently we roasted and grounded split peas to discern any antioxidant contributions. The split peas had little effect on the antioxidant performance of the Cuban-Split Pea blended coffee.

The relative antioxidant performance (RAP) of coffee was determined using caffeine as a standard. We measure the time the BR oscillation was delayed as a function of increasing concentration; the higher the concentration, the longer the delay. A best-line fit produced a slope for caffeine and for each of the samples. Our observations suggest that caffeine is probably the main antioxidant species in coffee, but not the only one present.

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

	Slope of Caffeine	Slope of Jamaican Blue Mountain	Slope of Costa Rican	Slope of coffee	Slope of decaf	Slope of Cuban Split Pea	Slope of Split Peas
Trail 1	0.6	6.3	1.3	3.2	0.8	6.74	0.08
Trail 2	0.7	7	4.6	2.1	2.8	6.14	0.22
Trail 3	0.65	7	3.1	4.3	1.4	7.04	0.18
Average	0.65	6.766667	3	3.2	1.666667	6.64	0.16

		Jamaican Blue Mountain	Costa Rican	Coffee	Decaf	Cuban Split Pea	Split Pea
RAP		10.41	4.62	4.92	2.56	10.22	0.25

Conclusions

The Briggs-Rauscher oscillating reaction is effective assessing antioxidant performance. The varieties of coffee tested affect the reaction, confirming their antioxidant activity. Caffeine could be used as a standard to determine the Relative Antioxidant Performance (RAP). Our future aims are to the other ingredients in each coffee to see if they have an impact on the antioxidant performance.

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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