Powerful plants: Antioxidant capacity of selected plants

Christine Curiac, Jason Alvarodiaz, Langeda Bontemps, Luis Castellar, Jennifer Cerda, Ana Figuereo, Chelsea Trost, Luis C. Fernandez-Torres*

School of Science, St. Thomas University, Miami Gardens, FL 33054, USA

***Author to whom correspondence should be addressed; E-Mail: Lfernandez-torres@stu.edu

Tel.: +1-305-474-6014; Fax: +1-305-628-6706.

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Abstract: Different cultures from around the world have used plants from their natural surroundings to treat different ailments. The action mechanisms of these natural remedies are diverse, yet many studies suggest their antioxidant properties bring about their effectiveness. This project presents the determination of the antioxidant capacity of selected plants, and comparing those results to a Trolox 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 and ethanolic extracts from the leaves of *Annona muricata, Moringa oleifera, Petiveria alliacea, Hamelia patens,* and *Gynura bicolor*. To analyze the results we used the Relative Antioxidant Performance (RAP), where the slopes of the samples were compared to the Trolox standard. Since most of these leaves are traditionally used in teas, we hypothesized that the aqueous extracts would exhibit the highest antioxidant capacity. Except for the aqueous extracts of *Moringa oleifera* and *Petiveria alliacea*, our hypothesis was proven correct, with *Hamelia patens* showing the highest RAP. These results were attributed to the solubility in water of the active antioxidant molecules versus their solubility in ethanol. These observations suggest that antioxidant properties are present, and could be a plausible pathway to their therapeutic properties. Furthermore, these extracts 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, natural products, Annona muricata, Moringa oleifera, Petiveria alliacea, Hamelia patens, and Gynura bicolor.*

Introduction

Many plants that are used as natural remedies possess antioxidant properties. These plants contain phytochemicals, which are non-nutritive plant chemicals that have protective or disease preventive properties. Most phytochemicals have antioxidant activity and are suspected to reduce the risk of developing certain types of cancer and other diseases related to reactive oxygen species (ROS). ROS have been suggested as causative agents of aging and several human diseases such as cancer, inflammatory and degenerative diseases, emphysema, and autoimmune disease. The use of antioxidants for the prevention of damage caused by ROS thereby assumes great importance for health and traditional medicine.

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 the antioxidant capacity of aqueous and ethanolic extracts from the leaves of *Annona muricata, Moringa oleifera, Petiveria alliacea, Hamelia patens,* and *Gynura bicolor*. Finally, we determined their Relative Antioxidant Performance (RAP) using Trolox as a standard.

Methods and Results

A typical preparation of the Briggs Rauscher reaction was utilized.[3] When all stock solutions were prepared the samples were tested as follows. Take 5mL of the sodium iodate solution, 5mL of

starch solution, and 10mL 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 sample solution. Measuring the time from the second blue to the third blue appearance determines any solvent effects. All samples were dissolved in water or ethanol. Therefore, we had an aqueous and an ethanolic solution for each sample. Using ethanol does not affect the BR oscillations.[4]

Excluding *Moringa oleifera* and *Petiveria alliacea*, all of the plants' antioxidant potency was exhibited in the aqueous solution. *Hamelia patens* was shown to have the highest RAP value, translating into containing the highest levels of antioxidant capacity compared to the other plants. The aqueous solutions of *Hamelia patens* and *Gynura bicolor* showed a marked difference in antioxidant capacity when compared to their ethanolic extracts. This observation suggests a high water solubility of its antioxidant molecules. *Annona muricata* showed about the same antioxidant capacity for both solvents. Both *Annona muricata* and *Petiveria alliacea* are currently studied by other groups for potential cancer treatment alternatives. From our study we can suggest that antioxidants are part of their promising effectiveness, but antioxidants are not the only pathway. We cannot discard the presence of some phytochemicals in both water and ethanol extracts, while some are shown to be exclusive to one or the other. Flavonoids are shown to be present in both extracts while tannins are present solely in ethanol extracts. Rutin is an example of tannin present in *Moringa oleifera*, making the ethanolic extract stronger in antioxidant activity.

The relative antioxidant performance (RAP) of the different plants was determined using Trolox as a standard (table below). 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 each of the samples.

Extract	RAP *Annona muricata*	RAP *Moringa oleifera*	RAP *Petiveria alliacea*	RAP *Hamelia patens*	RAP *Gynura bicolor*
aqueous	0.00381	0.00238	0.00152	0.0450	0.00647
ethanolic	0.00348	0.00378	0.00378	0.0218	0.000533

Conclusions

In general, aqueous solutions exhibited more antioxidant capacity than ethanolic solutions. The water solubility of the antioxidant species affects the antioxidant capacity. In the future we would like to test aqueous and ethanolic extracts for anticancerous activities, and produce more concentrated extracts through a freeze-dry process.

Conflicts of Interest

The authors declare no conflict of interest.

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