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SHORT COMMUNICATION

Thermal stability of natural antioxidants extracted from *Annona muricata* flowers, *Zingiber officinale* roots and *Camellia sinensis* leaves

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Abstract

The objective of this study was to evaluate the thermal stability of the natural antioxidants extracted from *Annona muricata* flowers, *Zingiber officinale* roots and *Camellia sinensis* leaves. The plant materials were extracted with methanol heated at 180 °C for 0, 20, 40, 60 and 80 min in an electric air-dried oven. The stability of their antioxidant was measured by testing their radical scavenging activity, ferric reducing antioxidant power and metal chelation ability. Results showed that the activity of the extracts significantly reduces with heating time, but still remain interesting.

Practical Applications

The natural antioxidants present in these extracts have good thermal stability and can then be used to preserve foods during processing at high temperature.

Keywords: Thermal stability, Antioxidant, *Annona muricata*, *Zingiber officinale*, *Camellia sinensis*.

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1. Introduction

There has recently been a considerable increase of interest in finding naturally occurring antioxidants from plants in order to replace synthetic antioxidants which are gradually prone to be toxic for consumers, as they have been proven to be implicated in many health risks such as carcinogenesis, mutagenesis, cardiovascular diseases… (Diaz-Garcia *et al.*, 2013; Massodi *et al.*, 2018; Kingne Kingne *et al.*, 2018). Special attention has been given to the extraction of antioxidants from different raw plant materials (herbs,

spices, vegetables, agrowaste, fruits…) and on the exploration of their ability to prolong the shelf-life of foods, especially vegetable oils during storage at high temperature or frying (Anwar *et al.*, 2010; Womeni *et al.*, 2016a; Iqbal *et al.*, 2008, Iqbal & Bhanger 2007). It is well known that temperature is one of the factors that significantly affect the antioxidant activity of antioxidants by destroying them or eliminating them from foods through evaporation (Pokorný, 1986), thus leaving the food unprotected.

Amongst the natural antioxidants already explored for their ability to preserve oil quality and prolong the shelf-life of foods are *Annona muricata* flowers, *Zingiber officinale* roots and *Camellia sinensis* leaves (Womeni *et al.*, 2016a; Djikeng *et al.*, 2017). These authors showed that the methanolic extracts of the above mentioned plants delay palm olein oxidation during accelerated storage at 70 °C and 180 °C. They attributed the activity of the extracts to the phenolic antioxidants present. They heated the palm olein samples containing *Annona muricata* flowers, *Zingiber officinale* roots and *Camellia sinensis* leaves extracts at 70 and 180 °C discontinuously for 30 and 6 days respectively (at least 3 hours of heating per day) and the plants still had good activity. It was important to understand the behavior of these extracts when heated continuously at very high temperature (180 °C). The objective of this study was therefore, to evaluate the effect of continuous heating on the antioxidant activity of *Annona muricata* flowers, *Zingiber officinale* roots and *Camellia sinensis* leaves.

2. Material and Methods

2.1. Material

Reagents and chemicals used in this study were of analytical grade. Fresh ginger roots (*Zingiber officinale* R) were collected from Santchou in April 2013; Fresh soursop flowers (*Annona muricata* L) from Dschang in march 2013 and finally fresh tea leaves (*Camellia sinensis* L) from the Cameroon Tea Estate industry's farm, based in Djuttitsa in April 2013. They were all collected in the West region of Cameroon.

2.2. Methods

2.2.1. Extraction of natural antioxidants

Fresh Tea leaves, Soursop flowers and Ginger roots were cleaned and dried to constant weight in an electric oven at 50 °C for 48 h. After this, they were individually grounded to pass through a 1 mm diameter sieve. 100 g of each power was extracted with 800 mL of methanol with regular shaking during 48 h.After filtration using the No. 1 Whatman filter paper, the residues were again macerated in 400 mL of methanol, this in order to maximize the extraction of phenolic antioxidants. Each combined filtrates was subjected to rotary evaporation at 40 °C under reduced pressure for the removal of the solvent. The dried extracts were used for the evaluation of their thermal stability.

2.2.2. Thermal processing

The stability of the antioxidants present in the plants was evaluated by heating the samples at 180 °C for 80 min. 0.1 g of each extract was weighed and respectively introduced in five different crudibles. The fisrt crudible served as control and the others were heated in the oven for 20, 40, 60 and 80 min respectively. After 20 min, one crudible per extract was removed from the oven, cooled at room temperature and

kept in the dessicator. The experiment was conducted during 80 min. The thermal stability of the extracts was determined by evaluating through various tests the antioxidant activity of all samples.

2.2.3. Thermal stability of the extracts

The thermal stability of the processed and unprocessed extracts was determined by measuring their radical scavenging activity using the 2,2-diphenyl-1-picryl hydrazyl (DPPH) method, as described by Braca *et al.* (2002); their ferric reducing antioxidant power using the method described by Oyaizu (1986); and their metal chelation activity as described by Benzie & Szeto (1999).

2.3. Statistical analysis

The obtained results were subjected to one-way analysis of variance (ANOVA) with Student-Newman-Keuls tests using Graphpad-InStat version 3.05, to evaluate the statistical significance of the data. A probability value at $p<0.05$ was considered statistically significant.

3. Results and discussion

Figure 1, 2 and 3 show the evolution of the radical scavenging activity, ferric reducing antioxidant power and metal chelation ability of the methanolic extracts of *Annona muricata* flowers, *Zingiber officinale* roots and *Camellia sinensis* leaves during heating for 80 min at 180 °C. It is clearly observed that the extract of *Annona muricata* and *Camellia sinensis* exhibited significantly higher ($p<0.05$) antioxidant activity compared to *Zingiber officinale* extract. The activity of all the extracts significantly decreased ($p<0.05$) with heating time, but still remain interesting. The radical scavenging activity varied between 94-87%, the ferric reducing power between 1.4-0.5 (Absorbance) and the metal chelation ability between 100-40%. The good antioxidant activity obtained with these extracts is in agreement with the results reported by Djikeng *et al.* (2017) and Womeni *et al.* (2016a; 2016b). The significant decrease in antioxidant activity observed during heating can be attributed to the destruction and volatilization of bioactive compounds present. These results are in accordance with those of Xu *et al.* (2007) who demonstrated that the antioxidant activity of flavonoids reduces during processing at temperatures above 100 °C. This is an interesting fact because the recent works of Womeni *et al.* (2016a; 2016b) and Djikeng *et al.* (2017) the methanolic extracts of *Annona muricata* flowers, *Zingiber officinale* roots and *Camellia sinensis* leaves as are rich sources of phenolic antioxidants, mostly vanillic acid, caffeic acid, ferulic acid, quercetin, gallic acid, epicatechin gallate, gallocatechin and epigallocatechin gallate. They also showed that these extracts were able to preserve palm olein during accelerated storage on Rancimat (110 °C) and Schaal oven (70-180 °C).

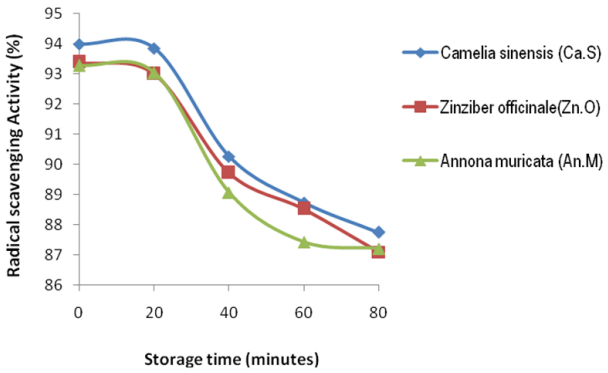

Figure 1: Effect of heating time on the Radical scavenging activity of the extracts

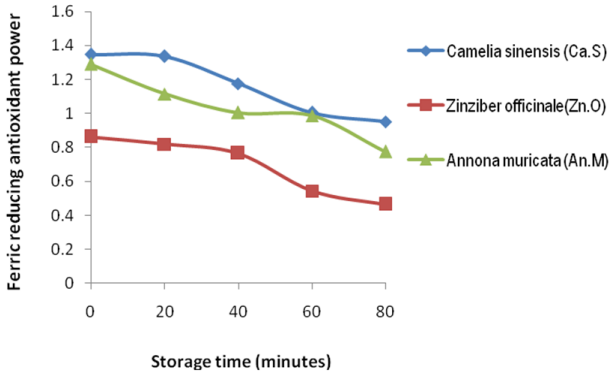

Figure 2: Effect of heating time on the ferric reducing antioxidant power of the extracts

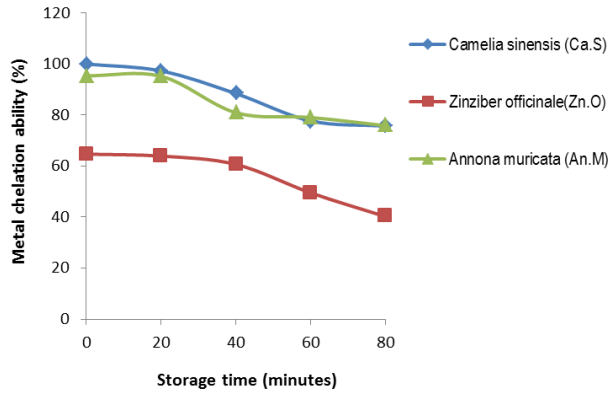

Figure 3: Effect of heating time on the metal chelation ability of the extracts

4. Conclusion

This study aimed at evaluating the effect of continuous heating on the antioxidant activity of *Annona muricata* flowers, *Zingiber officinale* roots and *Camellia sinensis* leaves. Results indicated that heating times significantly reduces the antioxidant activity of the studied extracts. However, even with the thermal treatment, their activity was still good. They can be suitable as natural preservative in foods during processing at high temperatures.

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