Trends in

Applied Sciences Research

ISSN 1819-3579

Academic
Journals Inc.

www.academicjournals.com

Trends in Applied Sciences Research 6 (2): 190-197, 2011
ISSN 1819-3579 / DOI: 10.3923/tasr.2011.190.197

Chemical Composition and Antioxidant Activities of *Aframomum sceptrum*

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ABSTRACT

The seeds of *Aframomum sceptrum* were studied with the aim to ascertain the chemical properties; phytochemical properties and antioxidant activities of the seeds of *Aframomum sceptrum*, in order to provide data, either for practical use or for basic research needs. Proximate compositions and phytochemical properties were evaluated using standard procedures, while antioxidant activities were evaluated using *in vitro* assays which utilized the DPPH scavenging method and the ability of the sample extract to reduce $FeCl_3$ solution (reducing power). Statistical significance was established using One-Way Analysis of Variance (ANOVA). Proximate analysis showed a high percentage of crude fibre and crude protein contents, NFE had a higher percent, with Dry matter having the highest percent. Phytochemical screening of the spice showed the presence of alkaloids, flavonoids, phenols, tannins and saponins. A significant difference ($p<0.05$) was observed between the reducing ability of the spice ethanolic extract and gallic acid with the highest reducing ability observed at the highest concentration of the extract. There was a significant difference ($p<0.05$) between the scavenging ability of the spice ethanolic extract and gallic acid with the highest scavenging activity observed at the highest concentration of the extract. The presence of bioactive compounds is an affirmation of the use of this spice in the management of various ailments. The total phenolic and flavonoids contents may be responsible for its high antioxidant activity. Consumption of this spice can therefore act as primary and/or secondary antioxidants.

Key words: Spices, flavonoids, phenol, reducing ability, scavenging ability

INTRODUCTION

Spices have been reported to play a non-negligible role in human diet. Their antioxidant properties are well known (Shobana and Naidu, 2000). These properties seem to be related with their total phenolic content (Sánchez-Moreno, 2002). Antioxidants protect the body against adverse effects of free radical or Reactive Oxygen Species (ROS) generation (Pavana *et al.*, 2009). Reactive Oxygen Species (ROS) and other free radicals are characterized by their ability in causing oxidative damage to the body. ROS are involved in various related physiological processes and diseases such as aging (Finkel and Holbrook, 2000), cancer (Senthil *et al.*, 2004) and atherosclerosis (Upston *et al.*, 2003). Antioxidants can also be used for food quality preservation as they prevent oxidative deterioration of lipids (Ademiluyi and Oboh, 2008). Plant-based antioxidants are now preferred to those that are synthetic due to safety reasons (Akinmoladun *et al.*, 2007). These have led to the extensive screening of plants for possible medicinal and antioxidant properties, the isolation and characterization of diverse phytochemicals and the development and utilization of antioxidants of natural origin (Gulcin *et al.*, 2002; Ademiluyi and Oboh, 2008).

Aframomum sceptrum (Oliv. and Hanb.) K. Schum. is among the local spices consumed in south-south Nigeria. It is commonly known as Guinea grains, grains of paradise, or black amomum in English (Burkill, 1985). It is known as *Oroma* among the Urhobos of South-South Nigeria. *Aframomum sceptrum* belongs to the family of *Zingiberaceae*, which constitute a family of terrestrial rhizomal herbs with over 1400 species distributed in over 50 genera (Hepper, 1996). They are mostly found in tropical areas (Asia and Africa) (Koechlin, 1965). They are closely allied to the *Amomum* of Asia and indeed some species of *Amomum* are used ethnomedicinally in South-East Asia (Perry, 1980). Several species from the genus *Aframomum* are major food plants and their antiparasitic, antifungal, antibacterial and antiviral properties have been reported (Cousins and Huffman, 2002). Bioassays of the extract of *A. danielli* have revealed active growth inhibitors of *Salmonella enteriditis, Pseudomonas fragi, P. flourescens, Proteus vulgaris, Streptococcus pyogens, Staphylococcus aureus, Aspergillus flavus, A. parasiticus, A. ochraceus* and *A. niger* (Adegoke and Skura, 1994). *Aframomum sceptrum* is wide-spreading, inflorescences at foot of leafy shoots or at some distance away. The whole plant has been reported to be used for ethno dietary, medicinal and spiritual purposes (Burkill, 1985). Locally the pods are crushed to remove the seeds which are then fermented. The fermented seeds are dried, then blended and used as spices in cooking.

Bioactive metabolites from other *Aframomum* species have been reported, but there exist little or no information on that of *Aframomum sceptrum*. Therefore, the aim of the present study is to ascertain the chemical properties; phytochemical properties and antioxidant activities of the seeds of *Aframomum sceptrum*, in order to provide data, either for practical use or for basic research needs. This study will contribute to the knowledge of the spice that could improve its uses.

MATERIALS AND METHODS

Plant material: Fruits of *Aframomum sceptrum* were purchased from a local market in Benin City, Nigeria. They were identified and authenticated at the Botany department, University of Benin, Benin-City, Nigeria. The seeds were removed from the pod and fermented for 3 days. The fermented seeds were air-dried at room temperature and grounded to fine powder, using a laboratory mill and stored in air-tight containers for laboratory analysis. This study was carried out at the Biochemistry department, University of Lagos, Lagos, Nigeria from November 2009 to January 2010. All analysis was carried out in triplicates.

Proximate analysis: Proximate analysis was carried out using the standard procedures of the AOAC (1997).

Extraction: The powdered samples were extracted at room temperature by percolation with ethanol. All extracts were concentrated over a rotary vacuum evaporator.

Phytochemical analysis: The qualitative and quantitative phytochemical properties of the dried powdered sample were determined using standard methods described by Harborne (1993), Boham and Kocipai (1994), Ebrahimzadeh *et al.* (2008) and Nabavi *et al.* (2008).

Determination of total antioxidant capacity: The total antioxidant capacity was determined according to standard method (Miller *et al*., 1993).

Determination of reducing property: The reducing property was determined by assessing the ability of the sample extracts to reduce $FeCl_3$ solution as described by Pulido *et al.* (2000).

Free radical scavenging assay: The free radical scavenging ability of the sample extract against DPPH (1,1-diphenyl-2 picrylhydrazyl) free radical was evaluated as described by Urisni *et al.* (1994).

Statistical analysis: Statistical significance was established using One-Way analysis of variance (ANOVA) and data were reported as Mean±SD. Statistical analyses were carried out using SPSS for Windows, version 14.0 (SPSS Inc. Chicago, IL.USA).

RESULTS

The results of proximate analysis showed a high percentage of crude fibre content; a moderate percent of crude protein content; NFE had a higher percent, with Dry matter having the highest percent. The lipid content was low, while the ash content was the lowest (Fig. 1).

The phytochemical analysis showed a high concentration of tannin (15.69 g/100), this was followed by flavonoids (9.20 g/100) and saponins (6.89 g/100). A low concentration was observed in phenol (2.94 g/100), while alkaloid had the lowest concentration (0.83 g/100) (Table 1).

The total antioxidant capacity analysis revealed a total antioxidant capacity of 60.25 mg GAE^{-1}.

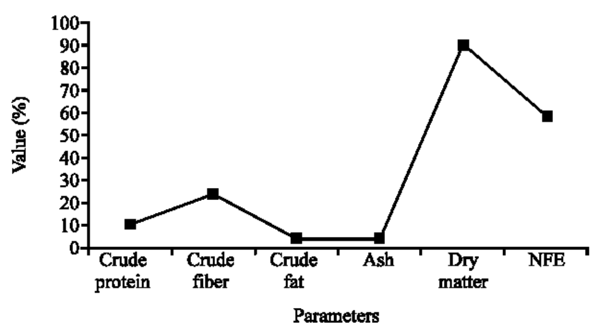

Fig. 1: Proximate analysis of *Aframomum sceptrum*. Values are mean of triplicates

Table 1: Phytochemical analysis of *Aframomum sceptrum*

Phytochemicals (g/100)	Screening	Quantity (%)
Flavonoids	+	9.20
Tannin	+	15.69
Cardiac glycosides	+	NQ
Steroids	+	NQ
Terpenoids	+	NQ
Saponin	+	6.89
Alkaloids	+	0.83
Phlobatannins	-	
Phenol	+	2.94

+: Present; -: Absent; NQ: Not quantified; Values are mean of triplicates

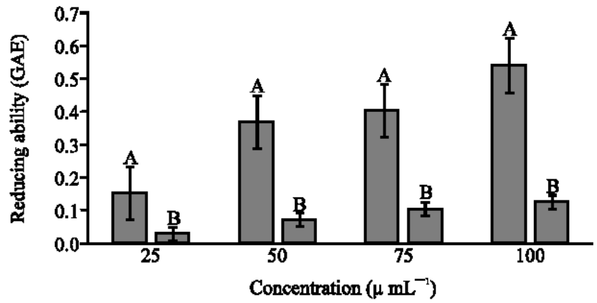

Fig. 2: Reducing ability of *Aframomum sceptrum*. A: Gallic acid, B: *A. sceptrum*

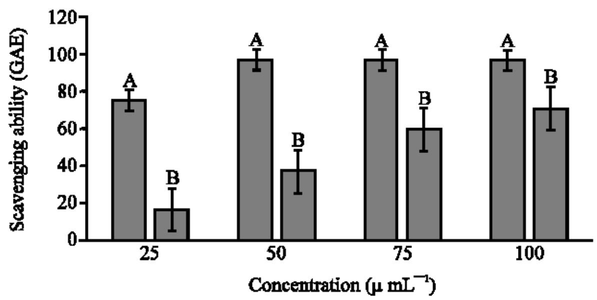

Fig. 3: Scavenging ability of *Aframomum sceptrum*. A: Gallic acid, B: *A. sceptrum*

A significant difference ($p<0.05$) was observed between the reducing ability of the spice extract and gallic acid with the highest reducing ability observed at the highest concentration of the extract i.e., 0.126% GAE at 100 μ mL^{-1} (Fig. 2).

The scavenging ability of the ethanolic extract against stable DPPH in ethanolic solution showed a significant difference ($p<0.05$) between the scavenging ability of the spice extract and gallic acid. A dose like pattern was observed in the scavenging activity with increase in concentration, with the highest scavenging activity observed at the highest concentration of the extract i.e., 71.15% GAE at 100 μ mL^{-1} (Fig. 3).

DISCUSSION

This study reports the chemical composition and the antioxidant activities of *Aframomum spectrum*. Spices have been acknowledged not only to have properties that make food more pleasant but also important preservative and antioxidant properties (Shobana and Naidu, 2000).

The observed high DM value correlated favorably to values obtained for most raw seeds of legumes like *Milletia obanensis*, *Lablab purpuresus* and *Phaseolus aureus* (Khattab *et al*., 2009). This will be of great benefits to rural communities which lack access to basic storage facilities and electricity as it will reduce the cost of handling and ensure long term storage. The RDA of dietary fibre for children and adults is reported to be between the ranges of 19-25 and 21-38% (Amarachi and Abii, 2007). The high crude fibre content of *A. sceptrum* can therefore meet the daily fibre needs of children and adults, thus serves as a good source of dietary fibre in meals. The crude protein content was high compared to other spices like *T. Tetraptera*, 5.6% (Amarachi and Abii, 2007). Plant foods, when rightly combined with other foods can be of high biological value and satisfactorily meet the protein needs of adults (Fevrier and Viroben, 1996). Owing to the fact that spices are major ingredients in both local and foreign cuisines, the crude protein of this spice would therefore be of great benefits in meeting the daily protein requirement in combination with other foods.

Phytochemical screening of the spice showed the presence of alkaloids, flavonoids, phenols, tannins and saponins (Table 1). Alkaloids, comprises of a large group of nitrogenous compounds and widely used as cancer chemotherapeutic agents. Alkaloids have also been reported to interfere with cell division (Valero and Salmeroj, 2003). The flavonoid content was relatively high compared to fresh thyme, but lower than those of dried parsley and fresh dill weed (USDAARS, 2003). The best-described property of almost every group of flavonoids is their capacity to act as antioxidants. The flavones and catechins seem to be the most powerful flavonoids for protecting the body against ROS (Nijveldt *et al*., 2001). Studies have revealed that consumption of flavonoids can be used in the management of coronary heart disease (Knekt *et al*., 1996). The presence of flavonoids in the spice may be the reason for its antioxidant activities and healing effects. Dietary tannins have been reported to affect protein digestibility and metal ion availability, but recent studies suggests that free or protein-complex condensed and hydrolysable tannins are more effective than small phenolics (Hagerman, 2002). Tannin imports an astringent taste that affects palatability of food. The tannin content of *A. sceptrum* may contribute to its antioxidant activities. The phenolic content was much lower than reports by Arabsashi-D *et al*. (2005) on the phenolic content of *M. spicata* extracted with 50:50 water-methanol. It was also much lower than those observed by Unver *et al*. (2009). The relationship between total phenol contents and antioxidant activity has been widely studied in different foodstuffs (Jayaprakasha *et al*., 2008). Antioxidant activity of foodstuff significantly increases with the presence of high concentration of total phenol and flavonoid contents.

A dose-dependent relationship was observed in the reducing ability of the ethanolic extract of *A. sceptrum*. There was a corresponding increase in the reducing ability with increase in concentration of the extracts. This corresponded to reports by Gong *et al*. (2009) that the reducing 9 Year, 8 Month 9 Day power of pu-erh tea extract increased with the concentration. Reducing ability is a measure of the ability of the ethanolic extracts to reduce Fe^{3+} to Fe^{2+}; a measure of their antioxidant properties, i.e., the higher the reducing property the higher the antioxidant activity (Ademiluyi and Oboh, 2008).

The DPPH scavenging method was applied to evaluate the antioxidant properties of *A. sceptrum* in comparison with a known antioxidant, Gallic Acid. Therefore, compared to a compound (Gallic acid) with a strong antioxidant activity, the ethanolic extract of *A. sceptrum* showed a significant scavenging activity (Jukic *et al*., 2006). The observed scavenging ability of the ethanolic extract of *A. sceptrum* against stable DPPH followed a dose-dependent pattern, with the highest activity observed at the highest concentration. This however contradicts the reports by Gong *et al*. (2009) that the DPPH radical scavenging activity decreased in an order of the ethanol precipitation extract. The model of scavenging the stable DPPH radical is a widely used method to assess the free radical scavenging ability of various samples (Lee *et al*., 2009). The total phenolic and flavonoid contents of *A. sceptrum* may be responsible for the observed high scavenging activity of this spice. This supports by Zhou and Yu (2006) that total phenolic content of tested vegetable extracts correlated with the DPPH radical scavenging activity, suggesting that total phenolics can play a major role in the antioxidant activity of plant materials. This is an indication that *A. sceptrum* promises to be an excellent dietary source of antioxidant that can be used in the prevention and management of various ROS-related ailments such as Parkinson and Alzheimer diseases (Ademiluyi and Oboh, 2008).

CONCLUSION

Results of present study reveal that *Aframomum sceptrum* is rich in crude protein and crude fibre. The presence of bioactive compounds is an affirmation of the use of this spice in the management of various ailments. The total phenolic and flavonoids contents may be responsible for its observed antioxidant activities. Consumption of this spice can therefore act as primary and/or secondary antioxidants. To satisfactorily meet nutritional needs, combination with other foodstuffs is recommended. However, the processing of this spice before consumption will help reduce the anti-nutritional properties of some of the phytochemicals.

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