COMPARATIVE ANTIOXIDANT COMPOSITION OF LOCAL SPICES IN NIGERIA.

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Abstract

Complex biochemical reactions of the body and increased exposure to environmental toxicants and dietary xenobiotic results in the generation of free radicals leading to oxidative stress manifesting as different pathophysiological conditions. Antioxidants prevent oxidative damage through reactions with free radicals. A balance between free radicals and antioxidants concentration is therefore necessary to maintain proper physiological functions. This work investigated and compared the antioxidant properties of *Curcuma longa* (Turmeric), *Zingiber officinale* (Ginger) and *Allium sativum* (Garlic), spices commonly used in Nigeria diets. The antioxidants were determined using standard spectrophotometric methods. The results revealed that the mean compositions for the antioxidant B-carotene, Lycopene, Ascorbic acid, Tocophenol, and Total Phenolic contents of the spices were 44.05 ±0.06 mg/L, 13.2±0.01mg/L, 24.6±0.00 mg/L, 0.16 ± 0.00mg/L and 13.2± 0.02mg/L respectively for turmeric; 1.47±0.06mg/L, 0.31± 0.00mg/L, 3.85±0.20mg/L, 1.6± 0.07mg/L and 1.8±0.30mg/L respectively for ginger and 9.0±0.1mg/L, 5.5±0.1mg/L, 0.00±0.01mg/L, 0.01±0.02mg/L and 0.24±0.1mg/L respectively for garlic. The varying composition of the antioxidants in these spices is an indication that they can be used either singly or in their combined form in the fight against oxidative stress.

Keywords: *Curcuma longa, Zingiber officinale Allium sativum,* Antioxidants.

Introduction

Plants are the source of essential nutrients for growth and maintenance. They are also the source of other bioactive compounds that promote health. Natural plant products have been used throughout human history for various purposes. Most of these plant products are produced as secondary metabolites for natural defense mechanism against diseases and infections. Many of those natural products can be exploited on pharmaceutical drug discovery and design (Rocha *et.al.* 2008). Plants yielding such natural products include spice plants. Amarachi Ezeike K.

Common spices in Nigeria include garlic, ginger, turmeric etc.

Allium sativum (Garlic) is a cultivated food highly regarded throughout the world. Originally from Central Asia, garlic is one of the earliest cultivated plant (Londhe *et al.,* 2011). It is a plant used throughout history for both culinary and medicinal purposes. It is an annual plant with adventitious roots and condensed flattened stem and narrow flat leaves. The bulb consists of 6-35 bulblets called cloves with a transparent covering. Many parts of the plant can be used in cooking, however, the bulb of the plant is

most commonly used. Garlic cloves are either consumed cooked or raw, and have considerable medicinal purposes. They have a pungent and spicy flavor which gradually sweeten with cooking (Lin and Tee, 2005).

Ginger is the rhizome of the plant *Zingiber officinale,* consumed as a delicacy, medicine or spice. Ginger belongs to the family Zingiberaceae which encompasses 47 genus and 140 species (Ravindian and Babu, 2016). It is a herbaceous rhizomatous perennial, reaching up to 90cm in height. Ginger rhizome is valued as a spice for its combination of pungent and aromatic qualitatives. It is as flavouring in a vast array of foods especially savory dishes as curries and sweets. Ginger is not only one of the frequently used spices to enhance the taste and flavor of food but also contain numerous number of potential bioactive constituents that possess health promoting properties (Keter, 2006).

Turmeric is a plant that has a very long history of medicinal properties. Turmeric scientifically called *Curcuma longa* is a rhizomatous herbaceous perennial plant of the ginger family Zingiberaceae. It is native to tropical South Asia but is now wildly cultivated in the tropical and subtropical regions of the world (Funk *et al*., 2015). It has been used since ancient times as a spice, in medicine and for colouring and flavoring food. The part of turmeric used in food and medicine is the rhizome. The rhizome is harvested and cleaned and boiled until it becomes soft. It is cut into small pieces and then dried in the sun for about two weeks. Dried product is milled to a very fine powder. Turmeric is used mostly in savory dishes. It is a principal ingredient in curry powders.

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Although typically used in its powdered form, turmeric is also used fresh, like ginger. Antioxidants are compounds capable of delaying or preventing the oxidative damage of lipids, proteins and nuclei acids by reactive oxygen species such as superoxide, hydroxyl, peroxyl, alkoxyl, and ion radicals such as Hydrogen peroxide and hypochlorous (Lawson and Tee, 2007). Antioxidants have gained numerous attention in recent years especially within the food and biological fields. (Silva *et al.,* 2004, Nikolai, 2013; Lawson and Weng, 2005).

Complex biochemical reactions of the body and increased exposure to environmental and dietary xenobiotics results in the generation of Reactive Oxygen Species (ROS) and Reactive Nitrogen Species (RNS) that adversely affect cellular lipids leading to oxidative stress. These stress can give rise to different pathophysiological conditions. Therefore a balance between free radicals and antioxidants concentration is necessary to maintain proper physiological functions. This research was carried out to determine the composition of antioxidants in three different spices commonly used in Nigeria.

Materials and Methods
Collection and Preparation of Plant Materials
The spices for this study were bought from markets in Southeastern Nigeria. They were authenticated by a botanist at the Biology option of Science Laboratory Technology, Federal Polytechnic, Oko. The plant materials were weighed and ground to powder form. The ground powder was stored in dry nylon bags and kept in a cool and dry place until needed for analysis.

Antioxidant Screening

Garlic, ginger and turmeric were subjected to titrimetric and spectrophotometric analysis to determine the composition of ascorbic acid, B-carotene, lycopene, phenol and tocopherol in these spices.

Determination of Total Phenol (TPC)

The total phenolic content of all the extracts were determined according to the Folin Cocalteu method described by Chew *et al,* (2009). To 200ul of each extract, 1.0ml of Folin-Cocalteu reagent and 8.0ml of sodium bicaronate (7.5%) was added and incubated for 1hr at $30^{o}C$. The absorbance of the solution was measured at 765nm and TPC was measured using the equation:

$$C = cV/M.$$

Where C is the total phenolic content expressed in mg/l, c is the concentration of garlic acid obtained from the calibration curve mg/ml, V is the volume of extracts in milliliters and M is the weight of the extract in grammes. All tests were carried out in triplicates. Garlic acid was used as standard.

Determination of Ascorbic Acid

Ascorbic acid composition was determined using the method described by Amadi, Agomuo and Ibegbulem (2004). Ten gram of sample was macerated with 20ml of distilled water and filtered. Five milliliters of acetone was added to the filtrate and the volume

diluted to 100ml using distilled water. Five milliliter of the diluted solution was transferred to a testtube and 1ml of glacial acetic acid was added to it. Chloroform was added to the solution if highly coloured. The blank and standard solution were prepared with water and ascorbic acid. These solutions were titrated with blue 2,6-dichlorophenolindophenol to a permanent faint pink colour. The ascorbic acid concentration is calculated from the equation:

$$\frac{T-BL}{ST-BL} \text{ X concentration of standard}$$

Where T= titer value for test solution

BL= titer value for blank

ST = titer value for standard

Determination of B-carotene

The B-carotenoid content was determined using the method described by Amadi and Agamuo (2004).

Five gram of the sample was weighed. The oil was extracted with 10ml alcoholic potassium hydroxide and 5ml of diethyl ether for 30minutes in a water bath. The extinction of the sample against a solvent blank was measured. The standard solution was treated in the same way and the B-carotene concentration of the sample was calculate thus:

$$\text{B-carotene concentration of sample} = \frac{\text{Absorbance of sample x concentration of standard}}{\text{Absorbance of standard}}$$

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Determination of Lycopene

The lycopene was determined by the method described by Bangalore *et al.* (2005). One gram of samples were each placed in a conical flask and one milliliters of distilled water was added and shaken slowly. Another five milliliter of distilled water was added and the solution was placed in a water bath and allowed to boil for 30 minutes, then cooled. Then, 8ml of n-hexane, 8ml of acetone and 8ml of ethanol were added to the solution and shaken vigorously for about 3-5 minutes. The solution was then incubated in a dark place (away from bright light) for 10mins. The solution was again treated with 1ml of water and shaken slowly. The resultant solution was allowed to stand for 10mins at room temperature for the phase to separate and air bubbles to disappear. The absorbance was determined at 503nm and lycopene concentration calculated from the equation.

Lycopene (mg/L) = A_{503} X molecular

Determination of Tocopherol

The tocophenol content was determined by the method described by Takenu and Einar (2005). One gram of the plant extract was dissolved in 20ml of ethanol. Then, 1ml of 0.2% ferric chloride and 0.5% 2, 2-dipyridyl was added to the solution. The solution was diluted to 50ml with distilled water and the absorbance was measured at 520nm. The tocopherol content was calculated using the formula.

$$\text{Tocopherol mg/L} = \frac{\text{Absorbance of sample x concentration of standard}}{\text{Absorbance of standard}}$$

Results

The result of the antioxidant composition of the three natural spices commonly used in Nigeria is given in the table. The results reveal the presence of Ascorbic acid, B-carotene, lycopene, phenol and Tocopherol in varying amounts. The results for the comparative antioxidant composition of *Allium sativum* shows that the Ascorbic Acid, β- Carotene, Lycopene and Phenol to be 0.001±0.0 mg/L, 9.0±0.10 mg/L, 55±0.1 mg/L, 0.24±0.1 mg/L and 0.008±0.2 mg/L respectively. Curcuma *longa* (Tumeric) shows that the Ascorbic Acid, β- Carotene, Lycopene and Phenol to be 24.6±0.50 mg/L, 44.05±0.06 mg/L, 13.2±0.05 mg/L, 13.2±0.00 mg/L and 0.16±0.00 mg/L respectively. *Zingier officinale* (Ginger) shows that the Ascorbic Acid, β- Carotene, Lycopene and Phenol to be 3.85±0.20 mg/L, 1.47±0.00 mg/L, 0.31±0.01 mg/L, 1.8±0.3 mg/L and 1.6±0.00 mg/L respectively.

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Tocopherol

Table 1.1:   Antioxidant Composition of Local Nigerian Spices

Antioxidants(mg/L)	*Allium sativum* (Garlic)	*Curcuma longa* (Tumeric)	*Zingiber* officinale (Ginger)
Ascorbic Acid	0.001±0.0	24.6±0.50	3.85±0.20
β- Carotene	9.0±0.10	44.05±0.06	1.47±0.00
Lycopene	55±0.1	13.2±0.05	0.31±0.01
Phenol	0.24±0.1	13.2±0.00	1.8±0.3
Tocopherol	0.008±0.2	0.16±0.00	1.6±0.00

Discussion

The current study analysed the antioxidant properties of *Allium sativum*, *Curcuma longa* and *Zingiber officinale,* three spices extensively used in several diets in Nigeria. The study revealed that these spices are good sources of antioxidant which can be harnessed and utilized for their biological activities. Ascorbic acid in humans must be ingested for survival. It is an electron donor and this properly accounts for all its known functions. Ascorbic acid is a water soluble antioxidant which functions as a redox buffer which can reduce and thereby neutralize reactive oxygen species. The composition of ascorbic acid in *Allium sativum*, *Curcuma longa* and *Zingiber officinale* is 0.001±0.0, 3.85 ±0.2 and 24.6 ±0.5. This result clearly shows that while *Curcuma longa* and *Zingiber officinale* can be good sources of ascorbic acid, *Allium sativum* is a poor source of this antioxidant.

B-carotene is the most abundant carotenoid in human diet. It is an antioxidant that has greater efficacy against the reactive oxygen species and is found in yellow, orange and green leafy vegetables and fruits. The B-carotene content of (*Curcuma longa*)

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(turmeric) is highest in this research (44.05±0.1mg/L), followed by *Allium sativum (*Garlic) (9.0 ±0.1mg/L) and *Zingiber officinale* (Ginger) (1.47 ±0.00).

Phenol is an aromatic compound known to reduce the rate of oxidation of organic matter by transferring a hydrogen atom from a hydroxyl group to the chain carrying reactive oxygen radicals. This mechanism most likely involves a concerted transfer of the hydrogen as a portion and of one electron between the two oxygen forms (Halliwell, 2008). The result of this research shows that the phenol content of *Allium sativum, Curcuma longa and Zingiber officinale* is 0.24 ±0.1mg/l, 13.2 ±0.0mg/l and 0.31 ±0.01mg/l respectively putting *Curcuma longa* as the spice with the highest phenol.

Lycopene is a powerful antioxidant with many health benefits including sun protection, improved heart health and a lower risk of certain type of cancer. Lycopene antioxidant activity include of singlet oxygen and scavenging of peroxyl radicals (Yan Lin and Man, 2002)

Tocophenol is also known as Vitamin E. it is a vitamin that is important in vision and

reproduction. It possesses antioxidant properties that fight against free radicals. Lawson and Wang, (2005) stated that vitamin E provide membrane repair by preventing the formation of oxidized phospholipids that might interfere with the membrane fusion event. The tocophenol content of *Allium sativum*, *Curcuma longa* and *Zingiber officinale* for this research is 0.01 ±0.2mg/l, 0.16 ±0.00 and 1.60 ±0.1mg/l, respectively.

Our findings suggest that the presence of these antioxidant in these spices is a strategic tool for sustainable health improvement in Nigeria as a strategic developing country.

Conclusion

This study show that *Allium sativum*, *Curcuma longa* and *Zingiber officinale* are good sources of antioxidants that could be exploited in food, beverages and pharmaceutical products .

Recommendations

The result of this research has shown the great diversity of bioactive antioxidants in these Nigerian spices. The following are our recommendations;

- Dieticians and health workers should devise a campaign to educate the public on the healthy habit of using these natural spices instead of their synthesis spices.
- There is need to do a toxicity study on these spices to ascertain their long time effects.
- Pharmaceutics can continue research on these spices and provide the active components as food supplements/complements.

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