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Antioxidant activity and total phenolic content of some nuts commonly consumed in South-Western Nigeria

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Abstract

Improved health associated with frequent eating of nuts as one of the most unexpected nutritional discovery of the 1990s formed the basis of this study. Hence, the evaluation of some selected nuts commonly consumed as snacks in the South West of Nigeria for antioxidant activity (AA) and total phenolic content (TPC) using ferric-ion reducing antioxidant potential (FRAP) assay and Folin-Coicalteau method. Results show that AA of nuts such as kola nuts (Cola acuminata; Cola nitida), coconut (Cocos nucifera), bitter kola (Garcina cola), African walnut (Plukenetia conophora), and cashew nut (Anacardium occidentale) ranged from 13.0 to 53.21 µmol Trolox Equivalent/100 g dry weight while the total phenolic content ranged from 204.95 to 1955.14 mg Gallic acid Equivalent/100 g of dry sample. Statistical analysis of the relationship between AA and TPC showed a random, nonlinear relationship between the two parameters, suggesting that the antioxidant activity of the nuts is not dependent on phenolics. The result also indicates that the nuts can be utilized as scavenger/mopping agents of free radicals, which are usually generated by essential metabolic processes in the body and environmental pollutions; thereby alleviating the symptoms of chronic and degenerative diseases such as cancer, diabetes, hypertension and any other age-related diseases reported to be on the increase in developing countries.

Keywords: Nuts, Phytochemicals, Free-radicals, Diseases, Antioxidant

Introduction

One of the cardinal goals of millennium development goals (MDGs) is the quest to combat the incidence of diseases such as malaria, HIV/AIDS and chronic diseases such as age-related degenerative diseases, cancer and cardiovascular diseases. This has led to an in depth research into the dietary habits of man. One of the important parts of the human diet for thousands of years is edible nuts, which are hunted and eaten by people as snacks. Many epidemiological studies show that consumption of fruits, nuts and vegetables is able to reduce the risk for some major human chronic diseases due to the presence of phytochemicals and antioxidants such as ascorbic acid, tocopherols, phenolic compounds and anthocyanins.[1-3] Aside being rich sources of vitamins such as ascorbic acid, thiamine, niacin, pyridoxine, folic acid, and vitamin E, fruits, nuts and vegetables are also sources of minerals and dietary fibers[1, 2] and therefore play a significant role in human nutrition. These phytochemicals possibly act by directly reacting with and quenching free radicals, chelating transition metals, reducing peroxides, and/or stimulating the antioxidative defense enzyme system[4], therefore promoting health.

Nuts are recommended constituents of the daily diet. They are concentrated food used as an integral part of daily meals. They are one of the natural plant foods that are very rich in oil, second only to vegetable oils in their fat content. [5] Nearly half of the total fat in nuts is made up of monounsaturated and polyunsaturated fatty acids while saturated fatty acid content is low (4-16%). [5] The fatty fraction of nuts also contains sterols with antioxidant and cholesterol-lowering properties. [6, 7] Thus the fatty acid composition of nuts is not harmful. In addition, nuts are an excellent source of protein and dietary fiber. They also contain sizable amounts of folate, antioxidant vitamins such as tocopherols and phenolic compounds[8] and when compared with other common foods, they have an optimal nutritional density in salutary minerals such as calcium, magnesium and potassium.[5]

The increasing rate of population growth and dwindling available food sources coupled with a reported high incidence of chronic and degenerative diseases calls for novel sources of food in order to cope with the issue of food insecurity. Epidemiological studies have shown a consistent and remarkable cardioprotective effect associated with increases nut consumption. [9] Hence some nuts commonly eaten by the generality of people either as snacks, food/food adjuncts and additives are evaluated for their antioxidant capacity. Such nuts include kola nuts (*Cola acuminata* and *Cola nitida*) which are chewed as a ceremonial greetings, stimulant, food flavor, medicine. *Cola acuminata* is commonly called 'obi abata' in Nigeria and *Cola nitida* is commonly referred to as 'goro' and 'obi gbanja' in Nigeria. Coconuts (*Cocos nucifera*), a native of Malaysia and Southern Asia, are reported to have many food uses for its water, milk, meat, sugar and oil which serve as important raw material in soaps and cosmetics manufacture. Bitter kola (*Garcina cola*) seeds, popularly known as 'orogbo' in Southwestern Nigeria, are eaten off for their medicinal value. Groundnut (*Arachis hypogaea*), a dual purpose crop, originated from Brazil, which can be eaten when subjected to processing such as boiling and frying. It is known to be rich in oil, protein and carbohydrate.[10] Cashew (*Anacardium occidentale*) is one of the most delicious nuts after being roasted. It is rich in protein, fiber and mono-unsaturated fat with high commercial and industrial value.[11]

This study is set to evaluate the antioxidant capacity and phytochemical content of these commonly consumed nuts using ferric-ion reducing antioxidant potential (FRAP) assay and Folin-Ciocalteu method.in order to establish their reported health potential.

Materials and Methods

The selected nuts were purchased from Atakumosa market, Ilesa, Osun State, Nigeria. They were dried and milled. One gram of each nut was extracted with 20 ml of methanol and filtered with Whatmann filter paper no 1. The filtrate obtained was used for subsequent analysis.

Determination of antioxidant activity

The determination of antioxidant activity of the nuts by ferric reducing antioxidant power (FRAP) assay was carried out according to Szeto *et al.*[12] The assay is based on the reduction of Fe^{3+} TPTZ to a blue colour Fe^{2+} TPTZ (2,4,6-tripyridyltriazine).[13] In the assay, antioxidants in the reduced Fe (III) tripyridyltriazine complex present (as reductants) in excess to the ferrous form was monitored at 593 nm. Change in absorbance is proportional to the FRAP value of antioxidants in the sample. The results were expressed as µmole Trolox equivalent (TE) /100 g dry weight.

Determination of total phenolic content

Total phenolic content (TPC) was determined using Folin-Ciocalteu reagent according to the method of Singleton *et al.*[14] An aliquot of 0.25 ml Folin-Ciocalteu reagent diluted to 50% with distilled water was added to 0.25 ml of the filtrate. Saturated Na_2CO_3 (0.5 ml) was added to the mixture and allowed to stand for 30 minutes at room temperature. Absorbance was measured at 750 nm and expressed as milligrams of gallic acid equivalent per g of dry weight (mg GAE/100 g dry weight).

Statistical analysis

Three replicates of each sample were used for statistical analysis. Correlation analyses of antioxidant activity (y) against the total phenolic content (x) were carried out using the correlation and regression program in Microsoft Excel 2003.

Results and Discussion

The result of antioxidant activities and total phenolic contents of the nuts are as presented in figures 1 and 2 respectively.

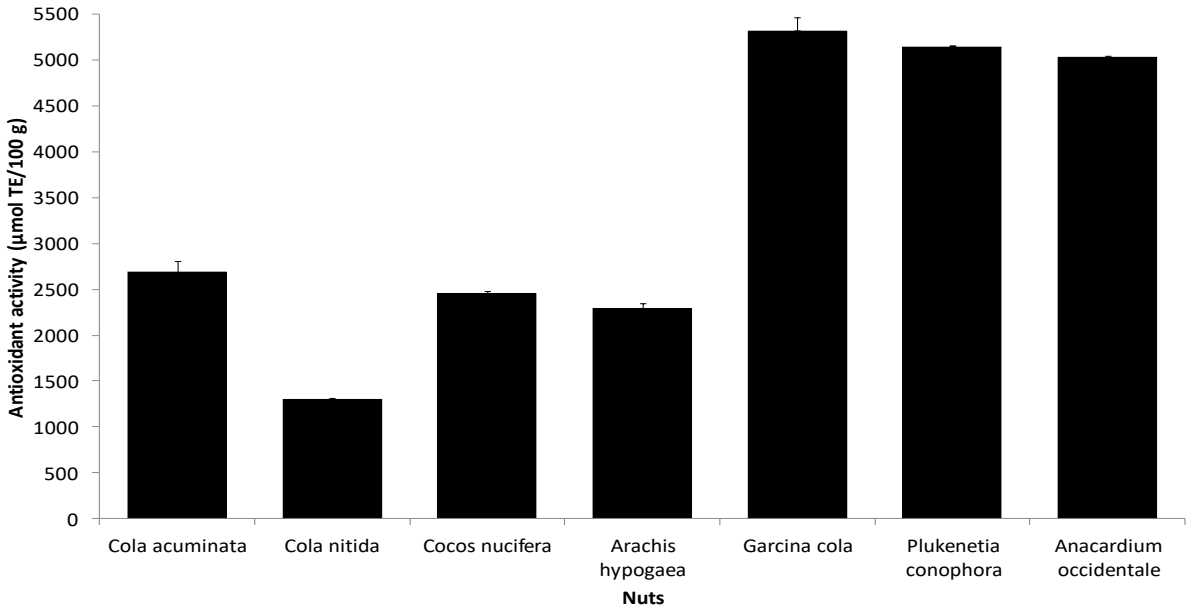

Figure 1: Antioxidant activity of some selected nuts

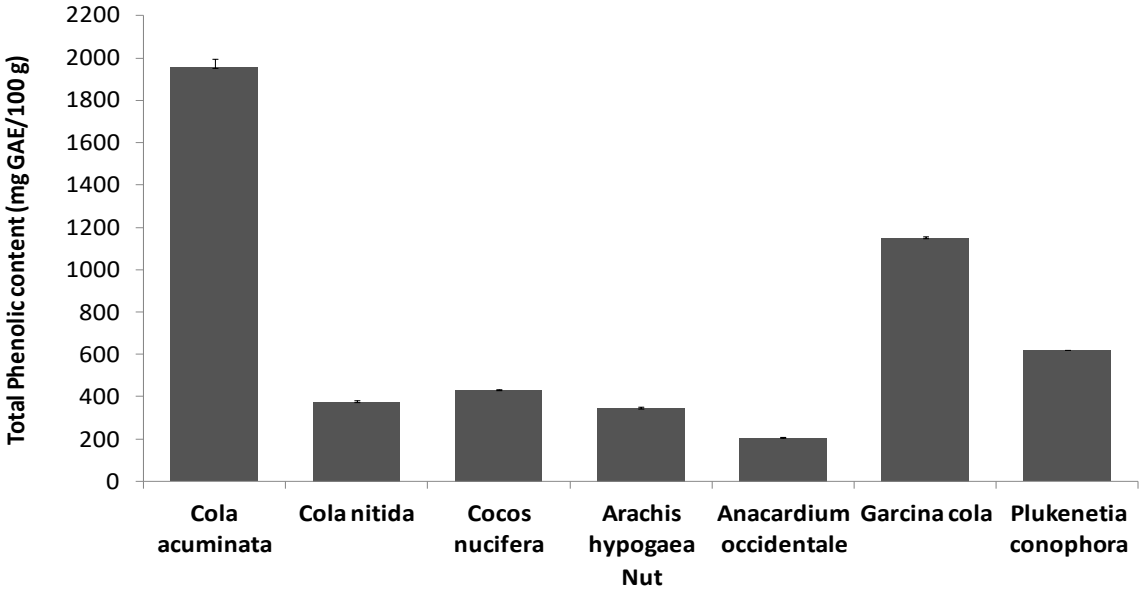

Figure 2: Total phenolic content of some selected nuts

There is increasing evidence that consumption of whole foods is better than isolated food components such as dietary supplements and Nutraceuticals. [15-17] Therefore, people are now looking for plants to obtain their dietary requirements instead of dietary supplements. Antioxidant activity is a basic function important for life from which biological functions such as antimutagenicity, anticarcinogenicity and antiaging originated, thereby preventing the incidence of chronic diseases in man.[18] Ferric reducing antioxidant power (FRAP) was used to determine the antioxidant activity of nuts in this study because it measures both water- and fat-soluble antioxidants.[19] FRAP assay is the only antioxidants assay that measure antioxidants or reductants in a sample directly and can thus be used to quantify the amounts of toatal antioxidants or reductants in foods.[8] Values generated by the FRAP method can be used to calculate the total intake of antioxidants and the contributions by various food groups to total dietary intake. As shown in Figure 1, bitter cola (*Garcina cola*) had the highest antioxidant activity of 53.21 ± 1.48 µmole TE/100 g dry weight while *Cola nitida* had the least antioxidant activity with a value of 13.00 ± 0.19 µmole TE/100 g dry weight. The descending order of antioxidant activity by FRAP

assay of the nuts used for the study was: *Garcina cola* > *Plukenetia conophora* > *Anarcardium occidentale* > *Cola acuminata* > *Cocos nucifera* > *Arachis hypogaea* > *Cola nitida*. The values obtained are consistent with the reported health potentials of these nuts. African walnut (*Plukenetia conophora*) had the second highest antioxidant activity of the nuts used for this study.

Plant phenols, which include simple phenolic acids, flavonoids, stilbenes and other polyphenolic compounds, have hydroxyl groups conjugated to an aromatic hydrocarbon group. The biomechanisms such as antioxidation, anti-inflammation, carcinogen detoxification and cholesterol reduction of plant phenols have been shown to cause reduction in risk of several chronic diseases.[20] Tree nuts contain many phenolic compounds, including ellagic acid, resveratrol and flavonoids.[21] Total phenolic content trend slightly differs from that of the antioxidant activity with *Cola acuminata* recording the highest TPC with a value of 1955.14 ± 2.20 mg GAE/ 100 g dry weight and *Anacardium occidentale* showing lowest TPC with a value of 204.95 ± 1.4 mg GAE/ 100 g dry weight as shown in Figure 2. The descending order of total phenolic content of the nuts is as follows: *Cola acuminata* > *Garcina cola* > *Plukenetia conophora* > *Cocos nucifera* > *Cola nitida* > *Arachis hypogaea* > *Anacardium occidentale*. Most phenolics are located in the outer pellicle of nuts and the peeled product loses much of its antioxidant capacity.[8] This should be taken into consideration on nut intake for a healthy diet.

Interestingly, of the two varieties of kola nut assayed, *Cola acuminata* had higher antioxidant activity and total phenolic content than *Cola nitida*. This is comparable with the results of Atolaye *et al.*[22]

The correlation between antioxidant activity (y) and total phenolic content (x) of the nuts had a correlation coefficient of R^2=0. 003 (y=0. 146x+3355) (Figure 3). This result suggests that only about 0.3% of the antioxidant capacity of the nuts results from the contribution of phenolic compounds. Thus, phenolic compounds were not a major contributor to the antioxidant capacities of these nuts. This non-relationship is in agreement with other literature which reported no correlation between total phenolic content and antioxidant capacities of some medicinal plants. [23-25] The lack of correlation between total phenolic content and antioxidant capacity of the nuts used in this study suggests the presence of other antioxidant compounds and phytochemicals such as ascorbic acid, tocopherol, pigments etc. in these nuts. This meets the general agreement that the extracts of nuts often contain complex mixtures of different kinds of active compounds, and the contribution from these compounds should not be neglected. However, phenolic compounds can be principal antioxidant compounds in many plant species like vegetables, fruits and medicinal plants. [26, 27]

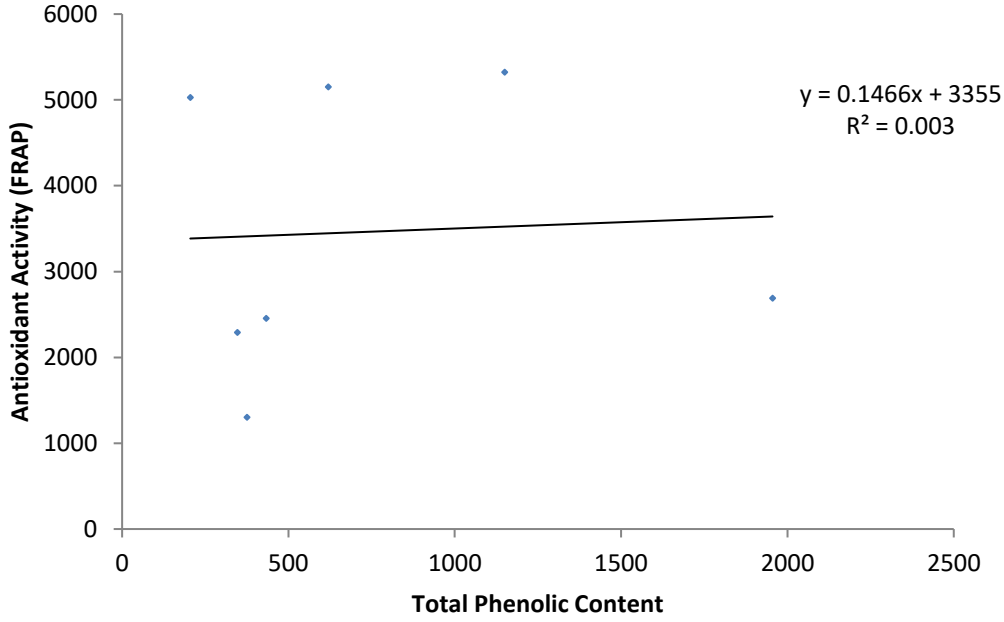

Figure 3: Relationship between antioxidant activity and total phenolic content of some selected nuts

Conclusion

The present study however showed that the nuts are strong radical scavengers and can be considered as good sources of natural antioxidants for side dishes, medicinal and commercial uses. Thus, nuts can be eaten as part of a diet to alleviate the symptoms of chronic and degenerative diseases reported to be on the increase in developing countries.

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