



Antioxidant Activities of Forest Trees of Agroforestry Importance

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Abstract: Antioxidants are the defense system of the body against the destructive effects of reactive oxygen species (ROS). They are produced during physiological processes in the body. Antioxidants are produced endogenously in the body or exogenously through foods and forest products. Polyphenols are the significant plants compounds that elicit antioxidant activities. They function mainly as anticarcinogenic, antimutagenic, anti-allergic and anti-ageing substances. This review aimed to examine forest trees (*Garcinia kola*, *Vitex doniana*, *Blighia sapida* and *Moringa oleifera*) with high polyphenolic contents which can be recommended as a good source of antioxidants

Keywords: Agroforestry, Tree plants, Antioxidants, Phytochemical, Phenolic compounds.

1. Introduction

Plants are potential sources of natural antioxidants. In the past few years, the antioxidant properties of plants have been extensively studied (Halvorsen et.al, 2002, Ou et.al, 2002). Among the various medicinal and culinary plants, some endemic species are of particular interest because they may be used for preparations as they contain Phytochemicals with significant antioxidant activities and health benefits (Exarchou et.al, 2002). Leaves shows the highest antioxidant potentials, which coincided with the positive signals, obtained for polyphenolic and flavonoid compounds. They are probably responsible for such antioxidant activity. (Gardner et. al, 2000).

Molecular and cellular damage due to reactive oxygen species (ROS) is widely believed to be the major cause of aging, neural disorders, diabetes, atherosclerosis, inflammatory injury, cancer, and cardiovascular disease (Halliwell,1997). Thus, a potential scavenger of ROS may serve as a possible preventive intervention for free-radical-mediated diseases (Ames et.al, 1995). Therefore, the intake of natural antioxidants from plants has been associated with low incidence of cancer, cardiovascular disease, diabetes, and other diseases associated with aging (Kuo, 1997). The medicinal value of plant lies in the phytochemical (bioactive) constituents of the plant which shows various physiological effects on human body. Therefore, through Phytochemical screening one could detect the various important compounds which may be used as the bases of modern drugs for curing various diseases (Sheikh et al, 2013).

Chemical compounds produced as a result of metabolic reaction during plant growth are known as Phytochemical Metabolic chemicals are “secondary metabolites” which include alkaloids, flavonoids, coumarins, tannins, terpenes, terpenoids, phenols, gums, polysaccharides, and glycosides (Hareborne, 1973 & Okwu, 2004). Phenolic compounds are secondary plant metabolites which are important determinants in the sensory and nutritional quality of fruits, vegetables, and other plants (Luqman *et.al*, 2009, Ignat *et.al*, 2011). Several studies have shown that phenolic compounds are the major bioactive phytochemicals that confer human health benefits. In fact, a direct relationship between antioxidant activity and the total phenolic content of numerous seeds, fruits, and vegetables has been reported (Carvalho *et.al*, 2010).

Agroforestry is viewed as land-use practices which involve the combination of trees, agricultural crops and/or animals on the same land management unit (Lundgren & Raintree, 1982). Agroforestry systems have help preserve most trees of biomedical importance. Main agroforestry practices include improved fallows, taungya farming, home gardens, alley cropping, growing multipurpose trees and shrubs on farmland as well as boundary planting, (Nair,1993).

Human bodies under stress condition produce less enzymatic antioxidants (e.g., superoxide dismutase (SOD), glutathione peroxidase (GPx), and catalase) and nonenzymatic antioxidants (e.g., ascorbic acid (vitamin C), Tocopherol (vitamin E)) but more reactive oxygen species (ROS) (e.g., superoxide anion radicals, hydroxyl radicals, and hydrogen peroxide) (Manjula & Ammani, 2012). Plants are endowed with phytochemicals which are rich sources of antioxidants. Most phytochemicals are antioxidant agents which essentially reduce the damages caused in tissue during physiological processes. Usually, antioxidant properties of plant extracts have been attributed to the presence of polyphenolic compounds, which have great potential as antimicrobial agents. Measurement of antioxidant activity is the most widely accepted analysis to attribute the several benefits of phenolic compounds (Yemis *et al*, 2008).

2.0 Selected Tree Plants of Medicinal Importance in Nigeria

Nigeria is richly endowed with indigenous plants, which are used in herbal medicine to cure diseases and heal injuries. Some of these plants are used as food or medicine. These plants exhibit a wide range of biological and pharmacological activities such as anti cancer, anti-inflammatory, diuretic, laxative, antispasmodic, anti-hypertensive, anti-diabetic and anti-microbial functions. It is generally assumed (Okwu and Ekeke, 2003; Okwu, 2004) that the active medicinal constituents contributing to these protective effects are the phytochemicals, vitamins and minerals. Phytochemicals, which posses many ecological and physiological roles are widely distributed as plants constituents (Okwu, 2005). Woody plants and herbs can synthesize and accumulate in their cells a large reservoir of phytochemicals including flavonoids, alkaloids, terpenoids, phenolic compounds, tannins, cynogenic glyco saponins, lignins and lignans (Okwu, 2004; 2005). It has been highlighted that the additional role of flavornoids and other polyphenolic compounds of higher plants may act as antioxidants or agents of other mechanisms that contribute in their anti-carcinogenic or cardioprotective actions (Herlog *et. al*, 1993). Extracts from the roots, barks, seeds and fruits of these plants are used in the preparation of syrups, infusions, teas and as cough suppressants and in the treatment of liver cirrhosis and hepatitis (Iwu, 1989; Okwu, 2003; 2005). These plants include *Garcinia kola*, *Vitex doniana*, *Blighia sapida*, *Moringa oleifera*. They are used in herbal medicine in Nigeria. Figure 1 shows the regional distribution of plants with Antioxidant potentials, and it reveals that West Africa has a vast array of plants with antioxidants activities.

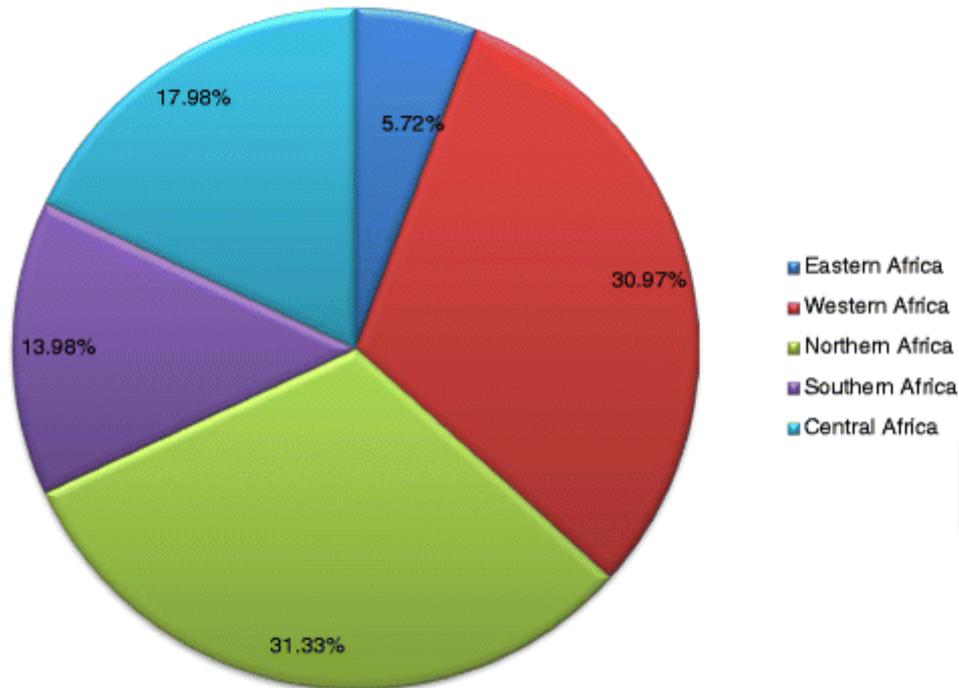


Fig 1: Regional distribution of investigated African plants with Antioxidant potentials.

3.0 Antioxidant Properties of Selected Agroforestry trees

3.1 Antioxidant Properties of *Vitex doniana*

Vitex doniana (Verbenaceae), commonly called black plum, is widely distributed in the eastern and western parts of Nigeria. Various parts of the plant are used by traditional medicine practitioners in Nigeria in the management and treatment of several disorders which include rheumatism, hypertension, cancer, and inflammatory diseases (Sofowora, 1993). The antioxidant activity of the *V. doniana* may be attributed to the presence of the identified phytochemicals. Flavonoids and tannins are phenolic compounds and plant phenolics are a major group of compounds that act as primary antioxidants or free radical scavengers (Potterat, 1997). Similarly, terpenoids, as vitamins, act as regulators of metabolism and play a protective role as antioxidants (Soetan, 2008). The antioxidant property of the extracts may be a strong contributing factor to the applications of the plants in the management and treatment of various diseases. *Vitex doniana* can be found throughout tropical Africa (Ruffo *et al.*, 2002). Earlier reports have shown that the plant extracts can be used for medicinal purposes like treatment of anaemia, gonorrhoea (root), dysentery, jaundice, liver disorder, and leprosy (Babalola, 1993). Antioxidants of aqueous extract of the leaves stem bark, and root bark of *V. doniana* in CCL₄-induced oxidative stress in rats have been reported (Kadejo *et al.*, 2013). The report of (Dorcias *et al.*, 2015) shows that *V. doniana* has a free radical scavenging activity which probably provides organ protection from hypercholesterolemia. Antioxidants prevent oxidative stress, caused by free radicals, which damage cells and vital biomolecules. They terminate chain reactions triggered by free radicals by removing free radical intermediates and inhibiting other oxidation reactions.

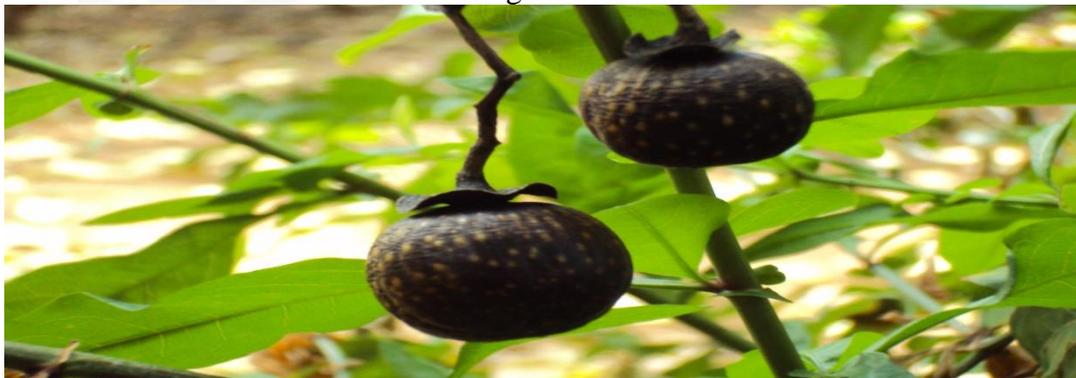


Fig 1: *Vitex doniana* seed and flower.

3.2 Antioxidant Properties of *Garcinia kola*

Garcinia kola (Heckel), an angiosperm, belonging to the family Guttiferae, is known in commerce as bitter cola. On chewing, *G. kola* seed has a bitter astringent and resinous taste, somewhat resembling that of raw coffee, followed by a slight sweetness. Bitter cola is a highly valued ingredient in African ethno medicine because of its varied and numerous uses which are social and medicinal; thus making the plant an essential ingredient in folk medicine. Medicinal plants such as *G. kola* are believed to be an important source of new chemical substances with potential therapeutic benefits (Eisner, 1990). An important constituent of *Garcinia kola* is flavonoid having anti-inflammatory properties and a natural antioxidant. Industrially, *Garcinia kola* is being investigated for possible hop substitution in beer production. The bitterness and microbial actions were suspected to be as a result of the presence of some phenolic compounds. *G. kola* has been found to contain *Garcinia* biflavonones (GB -1, GB-2), kolaflavonone, benzophenone and xanthenes and studies have also shown the ability of these compound in protecting against hepatotoxicity induced by phalloidin, amanita, 2 acetylaminofluorene, carbon tetrachloride, paracetamol, aflatoxin, dimethyl nitrosamine in rodents (Sanchez et al., 2009). *G. kola* also possesses other pharmacological properties like: Hepatoprotective effects (Wegwu and Didia, 2007), hypoglycemic and antioxidant properties (Omage et al., 2011), antimicrobial effects (Antwi-Boasiako and Abubakari, 2011), antitrichomonal activity (Ibikunle and Ogbadoyi, 2011), and antioxidative and chemopreventive properties (Farombi and Owoeye, 2011).



Fig 2: *Garcinia kola* seeds.

3.3 Antioxidant Properties of *Blighia sapida*

Blighia sapida K. D. Koenig is a member of the Sapindaceae family (Adams, 1972). Commonly known as “ackee”. Various parts of the ackee tree are employed in traditional medicine for the treatment of fever, malaria, internal haemorrhage, dysentery, yellow fever, diabetes and constipation in West Africa. The roots, bark, leaves, capsules and seeds were identified in the treatment of 22 diseases in Benin (Ekue *et.al*, 2010). The reported high level of total phenol content of ackee arils indicate that ackee is a good source of phenols and can be used for reducing blood pressure, lowering of cancer and cardiovascular diseases, for level free radical adsorption and neutralization, as anticancer and antibacterial agents.

Ackee arils could serve as an appreciable source of natural antioxidants which could play a key role in health maintenance and prevention of the chronic and degenerative diseases, such as, cardiac and cerebral ischemia, carcinogenesis, neurodegenerative disorders, diabetic pregnancy, rheumatic disorder, DNA damage and ageing (Uddin *et.al*, 2008; Jayasri, 2009). These natural plant phenolics in ackee fruit aril have the potential for application in food systems to maintain food quality.



Fig 3: *Blighia sapida* seeds

3.4 Antioxidants Properties of *Moringa oleifera*

The "Moringa" tree is considered one of the world's most useful trees, as almost every part of the Moringa tree can be used for food or has some other beneficial properties (Devendra *et.al*, 2011). *Moringa oleifera* also known as drumstick in India belongs to family Moringaceae is a well-documented world renowned plant herb for its extraordinary nutritional and medicinal properties. It is a natural antihelmintic, antibiotic, detoxifier, outstanding immune builder and is used in many countries to treat malnutrition and malaria. In Senegal and Haiti, health workers happen to be healing malnutrition within babies, pregnant and also nursing ladies together with Moringa leaf powdered ingredients (Prince, 1985). Moringa leaves are known to have a high content of essential amino acids, proteins, minerals and vitamins, hence an ideal nutritional supplement (Fletcher, 1998). Phytochemicals are present in virtually all plant tissues of *Moringa oleifera* e.g. leaves, roots, stem and fruits (Sazada *et. al*, 2008). These secondary metabolites appear to be involved in plant defense mechanisms (Clark, 1981, Chuang *et. al*, 2007; Doughari *et. al*, 2007; Mashiar *et. al*, 2009).

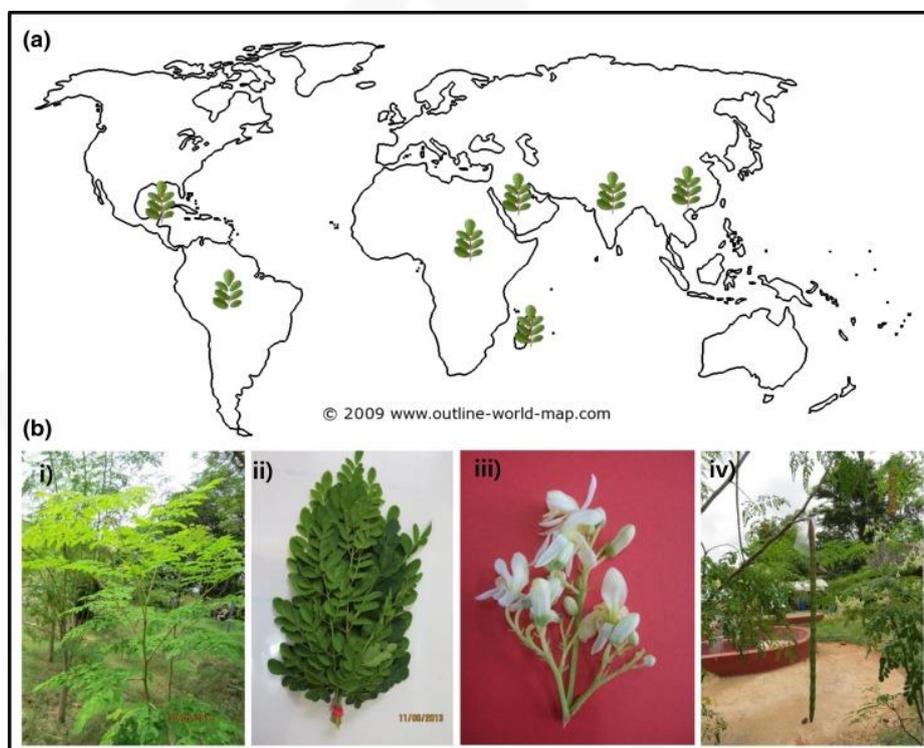


Fig 4: A. The distribution of *Moringa oleifera* in the World. The image of world map was obtained from www outline-world-map com (royalty free). B. Different vegetative and reproductive parts of *M. oleifera* tree; i field grown tree, ii bundle of foliage, iii flowers, and iv fruit (pod)

4. Conclusion

The free-radical scavengers (antioxidants) have potential to prevent, delay or restructure many of human chronic and ageing diseases such as cancer, diabetes, heart disease, stroke, malaria, rheumatoid arthritis symptoms. The seeds and most importantly the leaves of most of this forest trees have been discovered to possess phenolic extracts and Phytochemical which act as antioxidants.

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