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NUTRITIONAL AND MEDICINAL IMPORTANCE OF *TETRAPLEURA TETRAPTERA* FRUITS (ARIDAN).

Akintola O.O, Bodede A.I and Ogunbanjo, O.R
Federal College of Forestry, Ibadan, Nigeria.
Email:toyinakintola73@gmail.com

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Abstract

Tetrapleura.Tetraptera, one of the indigenous fruit specie has served as food and traditional medicine in the management of human ailments. However, knowledge of its active component is scanty. This study investigated the nutritive and medicinal importance of the fruits in Ibadan, southwestern Nigeria. Ten fruits of tetrapleura tetraptera obtained from Oje market in Ibadan, Oyo state were analyzed for phytochemical, proximate, mineral and vitamin composition using standard instrumentation techniques. Data were analyzed using descriptive statistics. Phytochemical composition values (%) in the fruits were saponin (16.33-17.78), alkaloids (1.88-2.22), tannins (0.16-0.25), phenols (0.04 -0.13) and sterols (0.06-0.12). The proximate composition (%) values were protein (5.61-6.69), moisture (5.06-8.22), fat (11.19-24.71), carbohydrate (58.48-63.86), ash (2.65-4.02) and fiber (3.14-4.11). Mineral composition (mg/100g)) values in the fruits were Manganese (322.00-342.00), potassium (251.22-288.62), calcium (182.11-200.02), magnesium (92.56-98.66), sodium (19.95-26.80), phosphorus (36.22-43.11), iron (16.11-18.22), zinc (10.75-16.24) and cu (8.22-10.11) while vitamin composition values (%) were vitamin A (3.22-4.69), vitamin E (2.66-3.69), vitamin C (0.88-1.20), niacin (0.11-0.12), thiamine (0.01-0.04) and riboflavin (0.01-0.03).The appreciable saponins content in T. tetraptera fruits contribute to medicinal usage of the studied plant while low values of tannin content suggest the nutritional values of this plant. Thus, the presence of naturally occurring compounds (phytochemicals) is largely responsible for the protective health benefits of the fruits of Tetrapleura tetraptera.. The higher ash content in the fruits indicate the presence of high mineral contents while the appreciable amount of the vitamins in the fruits suggest their antioxidant functioning.This study showed that T. tetraptera fruits have ability for secondary metabolites, nutrient supply and medicinal constituents.

Keywords: *Metabolites, Nutritive value, Protective benefits, Medicinal usage, Ibadan.*

INTRODUCTION

Many developing countries of the world are endowed with vast resources of natural products. The priceless heritage which includes indigenous fruits has served as food and medicine by rural people for centuries. Nigeria is blessed with a lot of indigenous fruit species with high nutritional, medicinal and economic importance to the society. One of these indigenous fruits is *Tetrapleura tetraptera* commonly known as Aridan (fruit) in Yoruba, belongs to Fabaceaa family. It is common on the fringe of West African rainforest belt. Trees are widespread in tropical Africa, in forest and at their best in rainforest (Orwa *et al*, 2009). It is a singled stemmed, robust, perennial tree of about 30m long. It is generally found in the low land forest and its fruits are green when tender, dark red-brown when fully ripe and are about 22–27 cm long. Its pod is 4–5 cm wide and has four longitudinal wing-like rather fleshy ridges about 2 cm broad of which two are hard and woody. The hard, heavy and reddish wood is used for firewood, building poles, pestles, tool handles and carvings.

The economic and medicinal important of *T. tetraptera* are many. The fruits have been widely used in Nigeria for manufacturing of seasoning spices, pomades and soaps due to its pleasant aroma characteristics (Essien et al, 1990 and Okwu, 2004) while it is use in Ghana as vitamin. It is also commonly used in soups of nursing mothers to prevent post partum contractions (Nwanu and Alah, 1996, Nwairu and Akali, 1996). An infusion of the whole fruit is usually taken by convalescents for bathing in order to be relief from feverish conditions, for constipation and as an emetic. The soft parts of the fruit and the bark are known to contain sugars, tannins, traces of saponin and amino acids (Adesina et.al., 1980). The plant has many traditional medicinal uses mainly in the management of convulsion, leprosy, inflammation and rheumatic pains. Infusion of the whole fruit can be taken as a recuperative tonic (Ojewole and Adewunmi, 1993 and Oyewole and Adewunmi, 2004). Due to the presence of caffeinic acid content in the fruits (Adesina, et al, 1980), the fruit is reported to have antitumor activity, anti-inflammatory properties and also inhibit HIV replication.

Many work has been done on the plants of *tetrapleura tetraptera* (Adesina et al 1980, Daiziel,1984, Adewunmi et al, 1980, Aka and Nwabie, 1992 and Abi and Elegalam, 2007) but little has be reported on the chemical composition of fruits. This study investigated the mineral, vitamin, phytochemical and proximate content of the fruits and its health benefit in general.

MATERIAL AND METHOD

Study area description

Ibadan city is located between longitude 7°2' and 7°40'E and latitude 3°35' and 4°10'N on the geographical map of Nigeria. It enjoys two distinct seasons namely, the rainy season between April to October and dry season between November and March. The rainy season is characterized by high rainfall with a mean annual rainfall of about 1237mm (Olayinka *et al*, 1999) while dry season is also characterized by dry dust laden winds originating from the Sahara' desert and experiences occasionally low rainfall. The average temperature reaches a peak of 28.8°C in February and reaches a low of 24.5°C in August. The study area falls within the tropical rain forest belt of Nigeria characterized by bush, herbs, shrubs, trees, grasses, palm vegetation and comparatively high temperature/plenty of sunshine and rainfall throughout the year. Most of the precipitation is received during the wet season and all the streams are perennial in nature. Geologically, the study area fall within the Crystalline Basement Complex rocks of Nigeria. They comprise igneous and metamorphic units such as gneisses, migmatites including older granite ridges and pegmatite. These rocks either directly exposed or

covered by the shallow mantle of superficial deposits (Rahaman, 1988).

Sample collection and preparation

Ten fruits of *tetrapleura tetraptera* were obtained from Oje market in Ibadan, Oyo state, southwestern Nigeria.

The dry fruits were washed with distilled water and oven dried at temperature of 60°C. The dried fruits were ground into fine powder using mortar and pestle and then sieved through 20 mesh sieves and stored in a tight air bottle for laboratory analysis,

Phytochemicals and Proximate Analysis

The dried fruits of *Tetrapleura tetraptera* were analyzed for Flavonoids, alkaloids, saponins, phenols, sterols and Tanins were determined using the method described by Harborne (1973); Trease and Evans (1989) and Edeoga et al. (2006). Proximate analysis (oil, ash, moisture, fiber crude protein and carbonhydrate contents) were determined according to the standard method of AOAC, 1980.

Mineral and Vitamin Analysis

Minerals such as Fe, Zn, Ca, Mg and Cu were analyzed using Atomic Absorption Spectrophotometer (AAS), Na and K were determined by flame photometer while phosphorus was analyzed using spectrophotometry method of AOAC (2000). Vitamin A and E contents were determined by the methods given by Pearson (1976); vitamin C was described by the method of Kirk and Sawyer (1998) and B- complex (riboflavin, niacin and thiamine) were determined by the method described by James (1995).

RESULTS AND DISCUSSION

The basic statistical results of the ten fruits of *Tetrapleura tetraptera* from the analyses conducted were presented in table 1, 2, 3 and 4

Phytochemical Composition

Phytochemicals referred to as phytonutrients found in fruits, vegetables, whole grains, herbs, spices, seed and many more (Densie,2013). They are non- nutritive plant chemicals that have protective and disease preventive property (Arts and Hollman, 2008).They are non essential nutrients that are not required by human body for sustaining life but studies have shown that they can protect humans against diseases. The results of determined phytochemicals in the fruits of *Tetrapleura tetraptera* are presented in table 1

Table(1)Summary of phytochemical compositional values of the studied fruits

PHYTOCHEMICAL (%)	MINIMUM	MAXIMUM	MEAN
Saponin	16.33	17.78	16.78
Alkaloids	1.88	2.22	2.01
Tannins	0.16	0.25	0.21
Phenols	0.04	0.13	0.09
Sterols	0.06	0.12	0.08

Saponin

Saponin content in this study are discussedts in the studied fruits ranged from 16.33 to 17.78 % and this is higher compared to the findings of Uyoh et al (2013) and lower than the reports given by Abii and Elegalam (2007) in the same plants, The differences in the values and the previous studies may be due to the variation in the soil type and location of the study area.

Saponins occur in many plants food and get their name from their soap like qualities. Eating fruits containing saponins may help lowering the cholesterol since the body uses cholesterol to make bile acids needed for proper digestion. So, when you eat, bile acids are released into the intestines and the detergent qualities of saponins allow them to bind to bile and prevent its reabsorption, thus lowering the cholesterol level and lessing the risk of heart attack. Saponins may also boost the immune functions and fight against fungi infections. It can cause death of fungal cells such as Candida albicins which is responsible for yeast infection, thrush. Thus, enhance the immune system's ability to fight off viruses as well as parasites. The health benefits of saponins are lowering of the cholesterol levels in the body, stimulation of immune system, reduce bone loss and cancer risk and can acts as anti-oxidant (Podolak, et al, 2010). The appreciable saponins content in *T. tetraptera* fruits may contribute to medicinal usage of this plant.

Flavonoids

Flavonoids are water soluble polyphenolic molecules, responsible for colouring of fruits, vegetable and herbs. Flavonoids contents in the fruit ranged from2.52 to 3.89% and this is similar to the findings of Abii and Elegalam (2007) and Uyoh et al (2013). Flavonoids are found in most plant material. It has been found to have many antioxidant activities and some of these are; anti-allergic, anti-microbial, anti-diarrheal, anti-cancer, anti-inflammatory and antiviral (Yamamoto and Gaynor, 2001; Cushnie and Lamb, 2005; Cazarolli et al, 2008; Cushnie and Lamb, 2011 and Mamers et al, 2013). Studies have shown that flavonoids prevent oxidation of low density lipoprotein thereby reducing the risk for the development of atherosclerosis (Schuier et al, 2005 and Friedman, 2007).

Alkaloids

Alkaloids are a member of large group of chemicals that are made by plants and have nitrogen in them. Alkaloids content in the fruits ranged from1.88 - 2.22 % and this is higher when compared with the findings of Abii and Elegalam (2007). Alkaloids have a wide range of pharmacological activities including anti- malarial,, analgesic, anti-asthma, anti- spasmodic, cholinomimetic, vasolidatory, anti-bacterial and anti-hyperglycemic activities (Rhoades, 1979; Stay, 1998; Harisaranraj et al. 2009; Raymond et al, 2010; Cushnie et al, 2014; Kittakoop, et al, 2014 and Qiu, et al, 2014). The presence of appreciable contents of alkaloids coupled with its numerous pharmacological activities in the studied fruits suggests its use in tradition medicine.

Tannins

Tannins are water soluble polyphenols that are present in many plant foods. They have been reported to be responsible for decreases in feed intake, growth rate, feed efficiency, net metabolizable energy and protein digestibility in experimental animal, therefore food rich in tannins are considered to be of low nutritional value (Katie et al, 2006). Tannins content in the studied soil is very low and it ranged from 0.16 to 0.25%. Tannins' power comes mainly from the property of astringency; the feeling inside the mouth on consumption of improper ripened fruits is due to tannins (Mcciee, 2004). The astringent property of tannins is responsible for its usage as base for several herbal treatments. Plant fruits containing tannins can be used to stop diarrhea, nausea and treat inflammation intestine (Fahey, 2005). Thus, this may explain the traditional usage of this plant in the treatment of inflammation intestines and diarrhea. The low values of tannin content in the studied fruits suggest the nutritional values of this plant.

Phenols and Sterols

Phenols and Sterols contents in the studied fruits are low and their values ranged from 0.04 to 0.13% and 0.06 to 0.12 % respectively. Plant sterols are substances that occur naturally in small amounts in grains, vegetable, fruits, nuts and seed. They have powerful cholesterol lowering property (Oshund et al, 2003).

The anti- oxidant capacity of phenols play an important role in chronic disease prevention, due to their ability to prevent oxidative damage caused by reactive oxidant species to vital molecule such as DNA, lipids and protein (Hollman,2001).

Generally, the studied fruits have high values for saponin, flavonoid and alkaloid but low values were obtained for sterol, phenol and tannins (fig, 1). The variation in the values of phytochemicals determined in the fruits of T. *tetraptera* to the other similar study of the same plant may be due to the fact that plants typically produce numerous phytochemicals that can act as a protective mechanism against environmental stressors, the more environmental stressors, the more phytochemicals a plant produces (chalker,1999). As a result, phytochemical contents can vary with growing condition. Thus, the presence of naturally occurring compounds (phytochemicals) is thought to be largely responsible for the protective health benefits of the fruits of *Tetrapleura tetraptera.*

Table(2) Summary of Proximate compositional values of the studied fruits

Proximate content (%)	MINIMUM	MAXIMUM	MEAN
Protein	5.61	6.69	5.99
Moisture	5.06	8.22	7.89
Fat	11.19	14.21	13.25
Carbohydrate	58.49	63.86	60.01
Ash	2.65	4.02	3.76
Fibre	3.14	4.11	3.56

Proximate Composition

Proximate analysis is used to estimate the relative amounts of protein, lipid, moisture, ash, fiber, carbohydrates in the fruits of *T. tetraptera* (Table 2). The proximate compositions in the studied fruits are: protein (5.61- 6.69%), moisture (5.06 -8.22%), Fat (11.19 - 14.71%), carbohydrates (58.48 -63.86%), Ash (2.65 - 4.02) and fiber (3.14-4.11%). The results obtained showed that *T. tetraptera* has high carbohydrates and fat contents while ash, protein and moisture content were low (fig. 2). Protein, ash, moisture and fat contents in the studied fruits were higher than the reports given by Abi and elegalam(2007) while fiber content is lower than his report in the same plant. Protein, fiber, carbohydrate, moisture and fat contents in the *T. tetraptera* fruits were within the range values given by Uyoh et al (2013), while the ash content is higher than their report in the same plant (Table 2). Generally, the difference in these values may be attributed to variation in the availability of soil micronutrient to plants in different locations and environmental conditions while higher ash content in the fruits may indicate the presence of high mineral contents. Minerals help in water balance, bone and body metabolism. High carbohydrate content in the fruits suggests the ability of this fruits in stability of plasma level and preventing easy degradation of body protein to obtain energy. Fibre, as an essential body nutrient, helps in lowering constipation, high blod pressure, diabetes, cardiovascular disease and cancer (Ishu, 2013). Thus, its appreciable amounts in this fruits buttress its usefulness as spice and flavouring agent. The amount of moisture in a food is an indication of the water activity, thus it is used to determine food susceptibility and stability of spoilage microorganisms. Low moisture content in the fruits supports its seeming resistance in nature to antimicrobial degradation, thus improving its shelf -life (Aruah, et al, 2012). Fat in any food give palatability, serves as storage and transport metabolic fuel form, serve as electrical insulators for subcutaneous tissues and emulsifier for drug preparation (Antia, et al, 2006). Thus, the moderate amount of fat in the fruits further promotes its importance for medicinal and other usage.

Mineral Composition

Mineral elements are essential constituents in human nutrition. They are skeletal structures and serves as essential components of many enzymes, vitamins, hormones and respiratory pigments or as cofactors in metabolism, catalysts and enzyme activators. The compositions of the mineral elements determined in the studied fruits are discussed as follows:

Table(3) summary of Mineral compositional values of the studied fruits

Minerals (Mg/100g)	MINIMUM	MAXIMUM	MEAN
Mn	322.00	342.00	333.75
K	251.22	288.62	278.11
Ca	182.11	200.02	199.66
Mg	92.56	98.66	97.22
Na	19.95	26.80	25.16
P	36.22	43.11	41.45
Fe	16.11	18.22	17.47
Zn	10.25	16.24	15.88
Cu	8.20	10.11	9.85

Manganese (Mn) helps in the formation and activation of enzymes. It also works as antioxidant, helps in developing of bones and in the healing of wounds by increasing collagen production (Sukhsaley Batra, 2015). Manganese concentrations in the *T. tetraptera* fruits range from 322-342 mg/100g.

Potassium

Potassium (K) is essential for water and electrolyte balance and the normal functioning of cells, including nerves. It also decreases blood pressure by promoting the loss of sodium in the urine. It helps to protect cardiovascular health (British Nutrition Foundation, 2005). Concentrations of K in the studied fruits range from 251.22 to 288.62mg/100g. These values are high and agreed with the findings of Bouba, et al (2012) and Uyoh, (2014) in the same plants.

Calcium

Adequate calcium is needed alongside with vitamin D and K to the development and maintenance of healthy bones and teeth. It also plays a vital role in many systems including intracellular signaling to enable the integration and regulation of metabolic processes (British Nutrition Foundation, 2005). The values of Ca in the fruits of *T. tetraptera* range from 182.11 to 200.02 mg/100g. These values are high and this may explain the reason why this fruits are often used for nursing mothers after delivery.

Magnesium

Magnesium (Mg) is an essential mineral present in all human tissues, especially in bone. It has both physiological and biological function such as muscle and nerves functioning, activation of many enzymes and for parathyroid hormone secretion (British Nutrition

Foundation, 2005). It also has important interrelationships with Ca, K and Na. The values of Mg in the studied fruits range from 92.56 – 98.66 mg/100gand this is higher than those reported for medicinal plants (1.15- 1.82mg/100g) by Edeoga et al, (2000) and 2.44mg/100g by Abi and Elegalam (2007) in the same plants. The high values of Mg content in the studied fruits strengthen its usage in the treatment of heart diseases.

Sodium

Sodium (Na) is responsible for regulating body water content and electrolyte balance. It is also required for the absorption of certain nutrients and water from the gut. The control of blood sodium levels depends on a balance between sodium excretion and absorption at the kidney which is regulated by nerves and hormones (British Nutrition Foundation, 2005). The values of sodium in the fruits of *T. tetraptera* range from 19.95 to 26.80 mg/100g.

Phosphorus

The major role of phosphorus is in the formation with calcium, of the bone component. It is essential for healthy bone and tooth structures. It is also important for the structure of cell membrane and contributes to a number of processes associated with energy metabolism. Phosphorus concentrations in studied fruits are moderate and range from 36.22 to 43.11 mg/100g. This is higher than 1.13mg/100g given by George et al, (2004) cited in Abi and elegalam, (2007) for the maintenance of healthy bones and teeth; energy metabolism and acid base balance in the body. This further suggests the medicinal uses of this fruit for a healthy living.

Iron

As a component of hemoglobin in the blood, iron transports oxygen from the lungs to different parts of the body. It is also part of many enzymes and essential for growth, healing, immune function and synthesis of DNA (Sukhsaley Batra, 2015). Iron concentrations in studied fruits are moderate and range from 16.11 to 18.22 mg/100g. These values are higher than those reported by Bouba et al, (2004); Abi and Elegalam, (2007) and Uyoh, (2014). The difference in the values may be attributed to the soil types and environmental factors associated to the different location of the studies. The high values of these fruits also further strengthen its usage by lactating mother to regenerate their lost blood (Abi and Elegalam, 2007).

Zinc

In addition to its role in the formation of enzymes, Zn improves immune function, helps blood clotting, maintain seen of taste and smell, keep skin healthy and enable normal growth and development (Sukhsaley Batra, 2015). Zinc concentrations in studied fruits range from 10.75 to 16.24 mg/100g and higher that the reports given by Abi and Elegalam, (2004) and Uyoh, (2014) in the same fruits. The difference may be attributed to the soil types and environmental factors associated to the different location of the studies. As important medicinal trace minerals in human body, Zn provides a natural protective mechanism against virus especially those causing respiratory tract infections (Rowland, 2004). Also, Mocheiglari et al, (1995); Sadler (2004) and Raynolds (2005) stated that Zn is used extensively in the fight against HIV by delaying the integration of HIV virus in the blood. Thus, the high content of zinc in the studied fruits also buttresses the traditional usage of this fruits to cure HIV and cold. The important of Zn in the development and functioning of pituitary gland, the gonards and the reproductive organs (George, 2004), also further explains its medicinal use for pregnant women and lactating mothers. The high values of Zn content in the fruits strengthen the medicinal usage of the fruits to treat diarrhea and mental fatigue; since its deficiency causes diarrhea, apathy, sensitivity of immune and mental depression (WHO, 1996 and Strausel and Salman, 2000).

Copper

Copper prevents damage to cell due to its antioxidant action and as a component of many enzymes. It helps in production of energy, from carbohydrates, protein and fat. It is essential for the formation of bone, connective tissues and red blood cells (Sukhsaley Batra, 2015). Copper concentrations in studied fruits range from 8.20 to 10.11 mg/100g. The appreciable amount of Cu content in the fruits also strengthens its various medicinal usages.

General, the high values in the mineral composition of the fruits agreed with the high values in the ash content of the fruits in this study; since high ash content in plants indicate the presence of high mineral contents. Also, manganese, calcium, potassium and magnesium concentrations are high while sodium, phosphorus, iron, Zinc and copper concentrations are moderate.

Table(4) Summary of Vitamin compositional values of the studied fruits

Vitamins (%)	MINIMUM	MAXIMUM	MEAN
Vitamin A	3.22	4.69	4.21
Vitamin B	2.66	3.69	3.35
Vitamin C	0.88	1.24	1.01
Niacin	0.11	0.12	0.11
Thiamine	0.01	0.04	0.03
Ribloflavin	0.01	0.03	0.02

Vitamin Composition

Vitamins are essential for the normal growth and development of the body. The vitamin compositions in the fruits are: Vitamin A (3.22 – 4.69%), Vitamin E (2.66- 3.69%), Vitamin C (0.88 – 1.24%), Niacin (0.11-0.12%), Thiamine (0.01 -0.04) and Riboflavin (0.01- 0.03%). Generally, the result obtained showed that composition of vitamin A and E in T. *tetraptera* are slightly higher while that of vitamin C, Niacin, Thiamine and Riboflavin are low (table 4) and this agreed with the findings of Uyoh,(2014) in the same plant.

Vitamin A is important in the body for vision, healthy skin, mucus membranes, immune system, and bone and tooth growth. It is also needed for vision, healthy skin, mucous membranes, bones and tooth growth and immune system. Vitamin E is an antioxidant for protecting cell walls. Vitamin C (Ascorbic) is an antioxidant enzyme needed for protein metabolism, important for immune system, healing of wounds and aids in iron absorption. Niacin (vitamin B_3) is needed for energy metabolism, important for skin health, nervous and digestive system. Thiamine (vitamin B_1) is part of an enzyme needed for energy metabolism and important in nerves functioning. It helps to break down carbohydrate, fat and alcohol. Riboflavin (vitamin B_2) is needed for energy metabolism, important for normal vision and skin health. The presence of these vitamins in the fruit may buttress the use of this fruit as vitamin in Ghana.

CONCLUSION

The variation in the values of phytochemicals determined in the fruits of T. *tetraptera* to the other similar study of the same plant may be due to the fact that plants typically produce numerous phytochemicals that can act as a protective mechanism against

environmental stressors (the more environmental stressors, the more phytochemicals a plant produces). As a result, phytochemical contents can vary with growing condition. Thus, the presence of naturally occurring compounds (phytochemicals) is thought to be largely responsible for the protective health benefits of the fruits. The appreciable amount of ash content in the fruits indicated the presence of high mineral contents. Thus, the presences of appreciable mineral contents in the fruit buttress its medicinal usage while the vitamin content suggests its antioxidant functions.

This study confirmed that T.*tetraptera* fruits are potential for secondary metabolites, nutrient supply and medicinal constituents.

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