



# A comparative study of the chemical compositions of the fruit and seed of *Tetrapleura tetraptera*

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## ABSTRACT

*Tetrapleura tetraptera* is a medicinal plant of the *mimosaceae* family. The fruits have drawn much research attention and to the neglect of the seeds. Therefore, this study was focused on the comparative study of the chemical compositions of the seed and fruit of *Tetrapleura tetraptera*. The results revealed very reasonable values of all the nutrients in both the fruit and seed. However, the seed had higher values of crude fat ( $9.72 \pm 11.1\%$ ), ash ( $8.61 \pm 0.81\%$ ), carbohydrate ( $62.95 \pm 1.15\%$ ) and energy ( $383.92 \pm 6.84\text{g/cal}$ ) than the fruit and lower, but comparable, value of crude protein ( $11.16 \pm 0.3\%$ ). The seed had higher values of calcium, sodium, potassium and all the trace mineral elements than the fruit. However, magnesium and phosphorus were not detected in the seed. The seed and the fruit were found to be very rich in the B-group vitamins but poor in vitamin C. The seed had higher values of riboflavin ( $21.2 \pm 0.05\text{mg/kg}$ ) and niacin ( $3.4 \pm 0.01\text{mg/kg}$ ) while the fruit had higher values of ascorbic acid ( $5.5 \pm 1.5\text{mg/100g}$ ), thiamine ( $10.8 \pm 0.05\text{mg/kg}$ ) and vitamin A ( $115.50\text{IU/100g}$ ). High values of alkaloids, tannins and flavonoids were also revealed in both the seed and fruit. However, the fruit had higher values of alkaloids ( $4.4 \pm 0.02\%$ ), flavonoids ( $8.66 \pm 0.08\%$ ) and oxalates ( $0.56 \pm 0.01\%$ ) while the seed had higher values of tannins ( $2.28 \pm 0.05\%$ ), Saponins ( $1.44 \pm 0.2\%$ ) and HCN ( $0.22 \pm 0.01\text{mg/kg}$ ). The varied biological and pharmacological properties of the fruit have been attributed to the presence of such principles as tannins, phenolic compounds, saponins, alkaloids, steroids and flavonoids. Therefore, the presence of all these principles in the seed, as well, suggests that the seed can equally serve some medicinal as well as food purposes.

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## Introduction

*Tetrapleura tetraptera*, commonly known as Aridan (fruit) is a medicinal plant of the Mimosaceae family. It is generally found in the lowland forest of tropical Africa. In Nigeria, it is dominant in most parts of the eastern states like Abia state, Imo state, Anambra state, Enugu state and Ebonyi state; it is also dominant in some part of the northern states of the country like Kano state, Kaduna state, Taraba state, Kastina state. The Fruit is very persistent, hanging at the ends of branches on stout stalks 25cm long, it is shiny, glabrous, dark, purple – brown, usually slightly curved, 15 – 25cm, long by about 5cm across, with four longitudinal wings like ridges nearly 2cm broad. Two of the wings are woody, the other two are filled with soft, sugary pulp, oily and aromatic [1]. The fruit is deciduous in December, Flowering begins toward the end of February and over in early April. Its leaves are essential for the treatment of epilepsy [2] and present strong molluscicidal activity. The fleshy pulp contains some small, brownish-black seeds and possesses a fragrant, characteristic pungent aromatic odour [3]. It is therefore, used as a popular seasoning spice in Southern and Eastern Nigeria [4]. The fruit is also used for the management of convulsions, leprosy, inflammation, rheumatism [5], flatulence, jaundice and fevers [6]. The anticonvulsant activity of the volatile oil from fresh fruits of *T. tetraptera* in mice has been reported [7]. The fruit is also used traditionally in the management and control of adult-onset type 2 Diabetes mellitus.

The aqueous fruit extract has also been shown to possess hypoglycaemic properties.

The fruits have drawn much research attention and to the neglect of the seeds. Therefore, this research is aimed at comparing the chemical compositions of the seed and fruit of *Tetrapleura tetraptera*. It is expected that the results obtained from this study will arouse further research interest in the seed as well.

## Materials And Methods

### Sample Treatment

Three fruit varieties were obtained from different forest locations in Isuikwuato, Ikwuano and Bende Local Government Areas of Abia Stae. Each fruit was cracked to extract the seeds and cut into smaller pieces. Both the fruit and seeds were air-dried for one month and hammer-milled to reduce them to smaller sizes. The different fruit varieties, as well as the seeds, were mixed and subsequently milled together in a laboratory mill to obtain the representative powdery samples of the fruit and seed used for the study.

### Analyses of Sample

The moisture and crude protein [8], ash, crude fat, crude fibre, sodium and potassium ions as well as total carbohydrate [9] were variously determined. The Vitamins A and C [10], thiamin, riboflavin and niacin [11] were also determined. Calcium and Magnesium ions [12] and phosphorus [13] were determined. The trace elements; Iron (Fe), Zinc (Zn), Copper (Cu), Manganese (Mn) as well as cyanogenic glycoside, as

HCN, were determined [14]. The alkaloids, saponins and flavonoid [15] as well as the oxalate compositions were also determined [16].

### Results And Discussion

The proximate composition of the fruit and seed of *Tetrapleura tetraptera* is presented in table 1. The result shows that both the fruit and seed have very reasonable values of all the nutrients. However, the seed has higher values of crude fat ( $9.72 \pm 11.1\%$ ), ash ( $8.61 \pm 0.81\%$ ), carbohydrate ( $62.95 \pm 1.15\%$ ) and energy ( $383.92 \pm 6.84\text{g/cal}$ ) and lower but comparable value of crude protein ( $11.16 \pm 0.3\%$ ).

Proteins are vital for good health. Fat is important in diets as it is a source of fat – soluble vitamins and promotes their absorption. It is a high energy nutrient and does not add to the bulk of the diet. Fats act as temperature sensors and serve as a substrate for eicosanoids [17]. They also add taste, colour and lubricity to diets. Carbohydrate supplies energy for cells such as the brain, muscles and blood cells. It contributes to fat metabolism and spares proteins as an energy source. Carbohydrate acts as mild natural laxative for human beings and generally adds to the bulk of the diet [18]. The crude fibre contents of the fruit ( $26.20 \pm 0.2$ ) and the seed ( $7.56 \pm 1.08$ ) are high.

Dietary fibre has been known to reduce blood cholesterol level in the body thus promoting cardiovascular health [19]. The ash contents of the fruit ( $6.72 \pm 0.2\%$ ) and seed ( $8.61 \pm 0.81\%$ ) are high. Ash contains essential mineral components which are necessary to nourish the blood and tissue. In addition, food material with high percentage of ash is quite encouraging because it is highly needed by children and pregnant/lactating mothers for substantial supply of calcium and magnesium needed for bone formation [20].

**Table 1: Proximate compositions of the fruit and seed of *Tetrapleura tetraptera***

Proximate (%).	Fruit	Seed
Moisture	$6.00 \pm 0.08$	$7.29 \pm 0.04$
Dry matter	$94.00 \pm 0.08$	$92.71 \pm 0.04$
Crude fat	$4.81 \pm 0.2$	$9.72 \pm 11.1$
Crude fibre	$26.20 \pm 0.2$	$7.56 \pm 1.08$
Ash	$6.72 \pm 0.2$	$8.61 \pm 0.81$
Crude protein	$12.69 \pm 0.6$	$11.16 \pm 0.3$
Carbohydrate	$49.53 \pm 0.7$	$62.95 \pm 1.15$
Food/energy (g/cal)	$265.79 \pm 3.52$	$383.92 \pm 6.84$

The result of the mineral compositions of the fruit and seed of *Tetrapleura tetraptera* is presented in table 2. The seed has higher values of Calcium, Sodium, Potassium and all the trace mineral elements than the fruit. However, Magnesium and phosphorus were not detected in the seed.

The presence of these important mineral elements implies that the seed of *Tetrapleura tetraptera* can serve as a better source of essential minerals needed for effective body physiology than the fruit.

Calcium and phosphorus are important in the diets of children and adults for effective bone development. The deleterious effect of high sodium intake that frequently increases blood pressure has been severally reported. Potassium has a beneficial effect on sodium balance. A high intake of potassium has been reported to protect against increasing blood pressure and other cardiovascular risks [21-22]. The sodium to potassium (Na/K) ratio in the body is of great concern for the prevention of high blood pressure. A Na/K ratio less than one is recommended. Hence, the Na/K ratios of the fruit (0.61) and seed (0.79) have good health implications and would probably

reduce blood pressure disease since they have Na/K ratios less than one.

**Table 2: Mineral Compositions of The Fruit and Seed of *Tetrapleura tetraptera***

Minerals	Fruit	Seed
Calcium	$2.87 \pm 0.07\%$	$3.155 \pm 0.006\%$
Sodium	$0.425 \pm 0.03\%$	$0.58 \pm 0.1\%$
Potassium	$0.695 \pm 0.007\%$	$0.73 \pm 0.003\%$
Magnesium	$0.943 \pm 0.03\%$	Not detected
Phosphorus	Not detected	Not detected
Cu (mg/kg)	54.60	178.60
Se (mg/kg)	2.50	14.40
Co (mg/kg)	0.75	1.33
Zn (mg/kg)	54.64	440.8
Mn (mg/kg)	32.4	38.6
Fe (mg/kg)	1458.9	1676.0
Na/K	0.61	0.79

The vitamin compositions of the fruit and seed of *Tetrapleura tetraptera* is presented in table 3. The result shows that the seed and the fruit are very rich in the B-group vitamins but poor in vitamin C. The seed has higher values of riboflavin ( $21.2 \pm 0.05\text{mg/kg}$ ) and niacin ( $3.4 \pm 0.01\text{mg/kg}$ ) while the fruit has higher values of ascorbic acid ( $5.5 \pm 1.5\text{mg}/100\text{g}$ ), thiamine ( $10.8 \pm 0.05\text{mg/kg}$ ) and vitamin A ( $115.50\text{IU}/100\text{g}$ ).

The various vitamins play specific roles in human nutrition and health. Vitamin C (ascorbic acid) is vital for a general body performance. It acts as natural antioxidant and helps to prevent muscle fatigue and scurvy which is characterized by skin haemorrhage, bleeding gums, fragile bones, anaemia, pain in the joints and defects in skeletal calcification. Riboflavin functions as the precursor of the coenzymes flavin mononucleotide (FMN) and flavin adenine dinucleotide (FAD). Riboflavin catalyzes numerous oxidation – reduction reactions. It is involved in energy production, drug and lipid metabolism. It has been reported that riboflavin has powerful anti-oxidant activity from its role as a precursor of [23]. However, its anti-oxidant potential has not been adequately recognized. Thiamine is required by enzymes involved in the metabolism of carbohydrate, fat and alcohol. Thiamine as the triphosphate (TTP) has an additional function in membrane function and action potentials. It functions in nerve and brain where it activates chloride ion transport [24]. Deficiency of thiamine causes a disease condition known as beriberi. A recent report has suggested that concomitant deficiency may result in increased risk of cerebral complications of malaria [25]. Niacin is essential in the form of the coenzymes; nicotinamide adenine dinucleotide (NAD) and nicotinamide adenine dinucleotide phosphate (NADP) involved in many biological redox reactions. Niacin, as nicotinic acid has been shown to be effective in curing pellagra [26].

**Table 3: Vitamin composition of the fruit and seed of *Tetrapleura tetraptera***

Vitamins	Fruit	Seed
Ascorbic acid (mg/100g)	$5.5 \pm 1.5$	$4.27 \pm 1.5$
Riboflavin (mg/kg)	$2.5 \pm 0.005$	$21.2 \pm 0.05$
Niacin (mg/kg)	$1.7 \pm 1.0$	$3.4 \pm 0.01$
Thiamine (mg/kg)	$10.8 \pm 0.05$	$9.2 \pm 0.05$
Vitamin A (IU/ 100g)	115.50	65.70

Result of the phytochemical compositions of the fruit and seed of *Tetrapleura tetraptera* is presented in table 4. The seed and fruit have high values of alkaloids, tannins, flavonoids. However, the fruit has higher values of alkaloids ( $4.4 \pm 0.02\%$ ), flavonoids ( $8.66 \pm 0.08\%$ ), oxalates ( $0.56 \pm 0.01\%$ ) while the seed has higher values of tannins ( $2.28 \pm 0.05\%$ ), Saponins ( $1.44 \pm 0.2\%$ ), HCN ( $0.22 \pm 0.01\text{mg/kg}$ ). The varied biological and

pharmacological properties of the fruit have been attributed to the presence of such principles as tannins, phenolic compounds, saponins, alkaloids, steroids and flavonoids. Therefore, the presence of all these principles in the seed, as well, suggests that the seed can equally serve some medicinal purposes.

**Table 4: Phytochemical compositions of the fruit and seed of *Tetrapleura Tetraptera***

Phytochemicals	Fruit	Seed
Alkaloids (%)	4.40 ± 0.02	3.87 ± 0.01
Tannins (%)	1.19 ± 0.03	2.28 ± 0.05
Flavonoids (%)	8.66 ± 0.08	7.35 ± 0.4
Saponins (%)	0.60 ± 0.06	1.44 ± 0.2
Oxalates (%)	0.56 ± 0.01	0.25 ± 0.02
HCN (mg/kg)	0.19 ± 0.01	0.22 ± 0.01

Saponins are extremely useful in reducing inflammation of the upper respiratory passage and also as emulsifying agents [27]. Saponins inhibit the growth of cancer cells and cause a depletion of body cholesterol by preventing its re-adsorption, they provide active immunity to the system, serve as natural antibiotics and boost energy [28].

Saponins are also useful in the treatment of cardiovascular diseases and other health-related problems [29]. Toxicity studies indicate that only very low levels of saponin absorption occur. Saponin toxicity is presumably due to their ability to disrupt membranes and cause haemolysis of red blood cells. However, they can be used in medicines.

Most (but not all) alkaloids are toxic to animals. Many have been exploited as drugs. In spite of the medicinal uses of alkaloids, they cause gastro-intestinal upsets and neurological disorders.

Flavonoids have been shown to be the main components of folk remedies used for the treatment of thyroid and other hormonal disorders. Studies have indicated that natural flavonoids are able to induce goitre. Flavonoids act as anti-oxidants and have strong anti-cancer activities, and even help to lower the risk of heart disease [29]. Flavonoid-containing plants have been reported to have diuretic, antibacterial and anti-fungal properties [30].

The tannin content of the fruit (1.19 ± 0.03%) and the seed (2.28 ± 0.05%) of the *Tetrapleura tetraptera* sample used for this study are relatively high when compared to the reported tannin contents of legumes which range from 2000mg/100g (2%) in faba beans to as low as 45mg/100g (0.045%) for soybeans. The very low value of tannin in soybean has been virtually ignored in terms of its possible anti-nutritional significance [31].

The HCN contents of the fruit (0.19mg/kg) and seed (0.22mg/kg) have no toxic significance as the values are quite below the value of 50-60mg/kg considered to be toxic to adult man [32]. The fruit has a higher value of oxalates (0.56%) than the seed (0.25%). Oxalates are a common food chemical. They are indigestible to humans and have no known nutritional importance as consumption of oxalates by humans may result in kidney disease or even death due to oxalate poisoning. However, the presence of *Oxalobacter formigenes* in the gut flora can prevent this.

### Conclusion

The study has revealed that the seed, as well as the fruit, can serve as a good source of food nutrients and other principles that have pharmacological properties.

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