



## **Ethnomedicinal Use, Phytochemical Constituents and Bioactivity of Wild Edible Fruits Commonly Consumed in Burkina Faso**

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### **Authors' contributions**

*This work was carried out in collaboration between all authors. Author AR reviewed the literature and wrote the first draft of the manuscript. Author MC reviewed the literature, helped in preparing first draft of manuscript, checked and corrected the grammar. Author MK corrected and validated the final report. All authors read and approved the final manuscript.*

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### **ABSTRACT**

The screening of bioactive phytochemical constituents in edible fruits and vegetable is interesting to researchers owing their benefit property on consumer's health. Fruits are used ethnomedicinally to treat numerous diseases including metabolic and microbial diseases. They are also used in human or animal nutrition because of their high energy value and their mineral contents. The pharmacological proprieties of fruits include antioxidant, anticancer, anti-mutagenic, antimicrobial, anti-inflammatory and anti-neurodegenerative properties. These bioactive compounds are among others flavonoids, phenolic, anthocyanin, phenolic acids, stilbenes, tannins, as well as sugars, essential oils, carotenoids, vitamins, and minerals. This review summarizes the ethnomedicinal use, the phytochemical constituents and the bioactivity of wild edible fruits commonly consumed in Burkina Faso.

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## 1. INTRODUCTION

Fruits have been extensively consumed since the primers of human civilization, due to their unique and delicate flavor, being rich sources of minerals and having high amounts of water, protein, fiber, and carbohydrates. Lipids are present in low values, which make them excellent to be included in low fat diets. Wild edible fruits which have been identified to possess high nutritional value play an important role in the rural poor and tribal communities in the form of food fortification or food supply [1]. Beyond the nutritional characteristics, fruits have been also extensively studied for their medicinal properties, mainly due to their richness in bioactive compounds. Several epidemiological, experimental and clinical studies suggested that dietary intake of fruits rich in antioxidant compounds reduces the risk of the development of diseases associated to stress oxidative such as cancer, diabetes, neurodegenerative disorders or cardio-vascular diseases. These pharmacological properties of fruits have been attributed to common molecules present in fruits such as vitamins, carotenoids, tannins, flavonoids and polysaccharides [2]. In Africa, researches on wild edible plants promote the preservation of these species under threat by human daily activities and strong anthropic pressure associated with ecosystem degradation caused by soil infertility and climatic changes. The importance of wild edible fruits in the rural population's nutrition is widely recognized in the tropics and subtropic areas. Wild edible fruits are safe to consume owing to their dietary fiber, vitamins, mineral, sugar, proteins, fat and other dietary compounds such as anthocyanin, flavonoids and carotenoids [3].

In Burkina Faso, wild edible fruit sales sector constitutes a potential resource for the country's economy. These fruits are directly consumed freshly, cooked, used to extract oils or drink juice [4]. Moreover, they are traditionally used to treat numerous diseases including metabolic and microbial diseases. Wild fruits are receiving increasing interest from researchers because of their medicinal properties, nutritional value, vitamin and mineral contents. Their pharmacological properties commonly studied are antioxidant, anti-cancer, anti-inflammatory and antimicrobial potency [5]. This

review summarizes the ethnomedicinal use, the phytochemical constituents and the bioactivity of wild edible fruits commonly and frequently consumed in Burkina Faso.

## 2. ETHNOMEDICINAL USES OF WILD EDIBLE FRUITS

Medicinal plants have been used in various ways for the treatment of diversified diseases. For many years, researchers have developed interest in the use of different medicinal plant from folklore system of medicine for the treatment of numerous ailments. The folklore system of medicine consists of several plants with a variety of medicinal, pharmacological and therapeutic importance and therefore represents a priceless reservoir of novel and potential bioactive ingredients [6,7]. In African folklore system of medicine, wild edible fruits are used to treat a large variety of diseases (Table 1). Fruit derived drugs are used mainly as food additive, purgative, pomade or drink. The diseases treated include microbial diseases, nutritional diseases and metabolic diseases. So, fruits of *A. digitata*, *B. aethiopicum*, *D. microcarpum*, *D. mespiliformis* and *F. sycomorus* trees are used to treat dermatitis, dysentery, leucoderma, malaria, tuberculosis and meningitis [8,9,10,11]. Fruits of *G. erubescens*, *V. doniana*, *S. birrea*, and *Z. mauritiana* are used to treat metabolic diseases such as cancer, obesity, diabetes and hypertension [2,12]. Wild edible fruits such as fruits of *A. senegalensis*, *T. indica* and *D. microcarpum* are used in avitaminosis or in diet deficiency to remedy some nutritional diseases such as scorbutic, goiter, kwashiorkor and marasmus [7]. Fruits of *A. digitata*, *D. guineense*, *F. sycomorus* and *X. americana* are used in human reproduction to improve lactation, to treat inflammation of uterus and ovaries and to treat sterility and infertility [13,14]. Fruits of *A. senegalensis* are used as antidote against venomous bite [6]. These multiple uses of fruits in folklore system of medicines are due to their bioactive phytochemical constituents like, vitamins, polysaccharide, triterpenes, anthocyanin, coumarins, flavonoids and alkaloids. These phytochemical constituents are now recognized in literature to have pharmacological properties such as anti-inflammatory, anti-microbial, enzymes inhibitory and anti-cancer properties [2].

**Table 1. Ethnomedicinal use of wild edible fruits**

<b>Plant names</b>	<b>Country</b>	<b>Uses</b>	<b>References</b>
<i>Adansonia digitata</i> L. (Bombacaceae)	Malawi, Burkina Faso, Nigeria	Bronchial asthma, dermatitis, microbial disease, dysentery, diarrhea, galactagogue, diabetes	[11,15,16,10]
<i>Annona senegalensis</i> Pers. (Annonaceae)	West African countries	Venomous bites, Kwashiorkor and marasmus	[6,7]
<i>Balanites aegyptiaca</i> (L.) Del. (Balanitaceae)	Senegal, Mali	Sore throat, constipation, eye irritation, leucoderma, whooping cough, antidiabetic, purgative	[17,18,19]
<i>Borassus aethiopum</i> Mart. (Arecaceae)	Nigeria, Burkina Faso	Diarrhea, minor injuries, mouthwash, antimalarial	[20,21]
<i>Detarium microcarpum</i> Guill. et Perr. (Caesalpiniaceae)	Niger, Togo, Burkina Faso	Skin infection, tuberculosis, meningitis, itching, diarrhea	[22,9]
<i>Dialium guineense</i> Willd (Caesalpiniaceae)	Nigeria	Diarrhea, palpitation, fever, to improve lactation, to check genital infection	[13]
<i>Diospyros mespiliformis</i> Hochst.(Ebenaceae)	Burkina Faso, Namibia	Malaria, diarrhea, toothaches, hemorrhoid, to increase nutritional value of infant porridge	[8,23]
<i>Ficus sycomorus</i> L.(Moraceae)	Boswana	Fungal infection, jaundice, dysentery, cough, diarrhea, skin infection, epilepsy, tuberculosis, sterility, infertility, chronic joint pains	[24, 14]
<i>Gardenia erubescens</i> Stapf.et Hutch.(Rubiaceae)	Burkina Faso	Obesity	[12]
<i>Vitex doniana</i> SWEET (Verbenaceae)	Benin, Guinea	Rheumatism, cancer, diarrhea, constipation, hypertension	[25,2]
<i>Lannea microcarpa</i> Engl. et K. Krause.(Anacardiaceae)	Burkina Faso, Mali	Scurvy, rickets, cough, wound	[26,27,28]
<i>Parkia biglobosa</i> (Jacq.) R. Br. (Anacardiaceae)	Burkina Faso	Stomach ache, jaundice	[29,8]
<i>Saba senegalensis</i> (A.Dc) Pichon var.(Apocynaceae)	Mali	Wound, to stop inflammation	[28]
<i>Sclerocarya birrea</i> (A. Rich.) Hochst. (Anacardiaceae)	West African countries	Hypertension, goiter	[30]
<i>Tamarindus indica</i> L. (Caesalpiniaceae)	Nigeria	Swelling, sore throat, rheumatism, blood tonic, fever, bile disorder, antiscorbutic	[31,32]
<i>Vitellaria paradoxa</i> C.F. Gaertn. (Sapotaceae)	Burkina Faso, Ghana	Diarrhea, skin revitalizer	[8,33]
<i>Ximenia americana</i> L. (Olacaceae)	Nigeria	Antiulcer, anti-inflammation of uterus and ovaries, anemia, cancer	[34]
<i>Ziziphus mauritiana</i> Lam. (Rhamnaceae)	India	Digestive disorder, weakness, obesity, diabetes, bronchitis, anemia	[35]

### 3. NUTRITIONAL VALUES OF WILD EDIBLE FRUITS

Fruits from natural forest trees constitute a good food supply for many people during food shortage. In several African countries, natural tree products constitute an important part of human diets and are also a potential source of vitamins, minerals, water, carbohydrates, fats, proteins, dietary fibers (Table 2). Mainly crudely consumed, they improve the daily food ration as an energy source and their content in micronutrients [36]. The common minerals found in wild edible fruits are calcium, potassium, copper, magnesium, manganese, iron; selenium, sodium, zinc, phosphorus. These minerals play a crucial role in human health. Potassium is a systemic electrolyte and is essential for co-regulating ATP with sodium. Potassium is a major intracellular cation that maintains intracellular osmotic pressure. The depolarization and contraction of heart require potassium [37]. Phosphorus is a component of bones and teeth. As phosphate ion, it is required for the formation of teeth and bones or for the production of high energy compounds such as ATP, creatine phosphate. It is also required for synthesis of coenzymes such as NAD<sup>+</sup> and NADP<sup>+</sup>, DNA and RNA synthesis and activation enzymes by phosphorylation [38]. Magnesium is an activator of enzymes requiring ATP alkaline phosphatase, hexokinase and phosphofructokinase. Iron is a component of many proteins or enzymes, notably cytochrome P450 and hemoglobin. Deficiency of iron could lead to iron deficiency anemia which is more common in menstruating females and pregnant women [30]. Calcium is a very important mineral. It is a structural component of bones and teeth. It contributes to physical strength of bones and teeth. Calcium is also required in muscle contraction, blood coagulation and nerve impulse transmission [37]. Zinc is a component of metalloenzymes like carbonic anhydrase; alkaline phosphatase. Zinc is also a component of Zn – Cu superoxide dismutase which destroys superoxides and free radicals. Deficiency of zinc has been associated with poor wound healing, poor growth, impairment of sexual development and decreased acuity [30]. Sodium is an electrolyte present in extracellular fluid and is essential for co-regulating ATP with potassium. Sodium (sodium bicarbonate) is also important in the regulation of acid-base balance [38]. Iodine is required for synthesis of thyroid hormones, thyroxine and triiodothyronine, needed to prevent goiter. Iodine deficiency has been associated with mental retardation and

stunted growth in children [38]. Moreover, wild edible fruits contain a high level of primary metabolites such as carbohydrate, fat, proteins, dietary fiber and vitamins. They improve the daily food ration as an energy source. The medicinal properties of fibers are well known. Liberal consumption of dietary fiber from a variety of foods helps protect against colon cancers and helps normalize blood lipids and thereby reduces the risk of cardiovascular disease. Certain types of fibers slow down glucose absorption and reduce insulin secretion, this is of great importance to diabetics and non-diabetics. Dietary fibers help to prevent constipation and diverticular disease [37]. Carbohydrates and proteins are energetic compounds and their presence in high level in wild edible fruits justify the high nutritional value of these fruits. Among the consumed wild edible fruits in Burkina Faso, fruits which contain a most level of calories are *A. digitata*, *D. microcarpum*, *B. aegyptiaca*, *B. aethiopum*, *P. biglobosa*, *S. senegalensis*, *T. indica*, *V. paradoxa* and *Z. mauritiana* with calorie values range from (212,25 to 379,32 Kcal/100g of fruits. Moreover essential amino acids and non-essential amino acids were found in the wild edible fruit. Fruits pulp of *B. aegyptiaca* contains essential amino acids such as Leucine, Valine, Lysine, Isoleucine, Threonine, Histidine, Methionine as well as non-essential amino acids such as Glutamic acid, Aspartic acid, Alanine, Tyrosine, Arginine, Serine, Serine and cysteine [17]. Concerning vitamins, they are solicited by the living organisms in low level for the normal metabolism. Vitamins commonly found in wild edible fruits are vitamins C, E, B1, K. The pharmacological role of vitamins is well known such as antioxidant, neuroprotective and anti-cancer [3]. Wild edible fruits are a potent source of vitamins justifying their ethnomedicinal use in avitaminosis. Variations observed between different reported data pertaining to the observed phytochemical, mineral and nutritional content could be attributed to the biotic and abiotic factors such as a diversity in genetic material, the nature of soil and the type of climate. According to the dietary recommendation for mineral elements [51], the daily dietary intake of 100 g of pulp of some wild edible fruit such as *B. aegyptia*, *B. aethiopum*, *D. microcarpum*, *P. biglobosa* and *D. guineense* may satisfy the need of daily mineral ration notably sodium, calcium, magnesium, phosphorus and potassium of children, adult and pregnant women. These funding suggest that some wild edible fruits could be exploited as food supplements to fight against mineral deficiency.

Table 2. Nutritional values of fruits

Plants	Mineral content (mg/Kg) of fruits	Proximate composition (g/100 g of fruits) and Vitamin content (mg/100 g of fruits)	Energy value (Kcal/100 g of fruits)
<i>A. digitata</i>	Ca:14,34-6580; Mg:4,14-2550; P:2,31-3054; Na:23; Mn:21-95,44; Fe:100-401,98; Zn:12,22-25,7; Cu:5,36-15 [15,36,39]	Moisture:13,5-91,31; Ash:5,27-7,8; Protein:2-6,3; fat:0,27-2,1; Carbohydrate:72,3-75; Fiber:27,89-52; Vitamin C:138-280 [15,36,39,16]	311,15 [36]
<i>A. senegalensis</i>	Not available	Moisture:68,21; Protein:8,88; fat:10; Carbohydrate:593 [40]	
<i>B. aegyptiaca</i>	Ca:1410-1640; Mg:440-730; K:11100-22200; P:480-510; Na:480; Mn:3,3; Fe:49,4-138; Zn:6,5-17,7; Cu:3,9-4,3 [17,41]	Moisture:17,7; Ash:4-16,31; Protein:4,2-9,51; fat:0,41-0,6; Carbohydrate:42,7-68,6; Fiber:5,3; Vitamin C:1,86-6,87 [17,19,41]	212,25 [17]
<i>B. aethiopicum</i>	Ca:418,1-6200; Mg:677,7-2029; K:1424-4574; Na:178-14060; Mn:65; Fe:31,5-218; Zn:8,2-322; Cu:13-541 [20,42]	Moisture: 6,88-65; Ash:3,3-6,53; Protein:3,94-6,33; Fat:1,19-7,73; Carbohydrate: 7,87-43,5; Fiber: 4,5-32,56; VitaminC: 89,9 [20,42,43]	367 [42]
<i>D. microcarpum</i>	Ca:430-709,7; Mg:840-1135; K:9801-10170; P:0,63-2045; Na:150,9-1120; Mn:39,65-59,5; Fe:61,5-787,1; Zn:3,2-317; Cu:1,8-5,9; S:445,4; Nitrate:150,9-1120; Ammonium:1998,9 [36,38,37]	Moisture:11,06-95,07; Ash:3,1-4,47; Protein:2,86-4,68; Fat:0,7-2,23; Carbohydrate:65,38-81,21; Fiber:12,19; Vitamin K1;32,23; vitamin E :12.44; vitamin B2: 4.20, and folic acid 0.17 [36,38,37]	335,5 36
<i>D. guineense</i>	Ca:1990-5671; Mg:874,2-910,1; K:6190; Cl:205,4; I:0,28; Na:46,53-332,95; Mn:23,43 [44,45]	Moisture:10,6; Ash:2,82; Protein:3,12; Fat:0,4; Carbohydrate: 90,02; Fiber:3,64 44,45]	41,9 [36]
<i>D. mespiliformis</i>	Not available	Not available	
<i>F. sycomorus</i>	Not available	Not available	
<i>G. erubescens</i>	Ca:9775; Mg:4055; K:4755; Na:1165; Mn:123,7; Fe:472,6; Zn:277,8; Cu:3,69-113,7 [46,45]	Moisture:19,13-23,7; Ash:2,54-2,94; Protein:1,1-5,68; Fat:1,19-1,54; Carbohydrate:6,7-70,69; Fiber:14,57 [46,36]	
<i>V. doniana</i>	Ca:75-302,7; Mg:53-201; K:157-1272; P:165; Na:14-104; Fe:7,8-52; Zn:0,43; Cu:27 [47,48]	Moisture:16,66-30; Ash:3,33-11,5; Protein:3,24-8,24; Fat:2,67-34,62; Carbohydrate:28,4-58,56; Fiber:0,58-4,4; Vitamin A:0,27; Vitamin B6:20,45; Vitamin B1:18,33; Vitamin B2: 4,8; Vitamin C:35,58 [43,47]	
<i>L. microcarpa</i>	Ca:3,56; Mg:2,38; K:11,73; K:0,3; Mn:9,07; Fe:91,61; Zn:10,57; Cu:2,93 [36]	Not available	

Plants	Mineral content (mg/Kg) of fruits	Proximate composition (g/100 g of fruits) and Vitamin content (mg/100 g of fruits)	Energy value (Kcal/100 g of fruits)
<i>P. biglobosa</i>	Ca:11650; Mg:7000; K:3945; Na:1795; Mn:661,96; Fe:1814,5; Zn:437,52; Cu:447,48 [46]	Moisture:4-90,06; Ash:2,4-4,98; Protein:3,78-6,64; Fat:0,13-18; Carbohydrate:68,75-79,73; Fiber:8,75-12 [46,36]	351,25 [36]
<i>S. senegalensis</i>	Ca:810; Mg:47,5; P:357,5 [49]	Ash:2,8; Protein:0,53; Fat:8,92; Carbohydrate:74,23, Vitamin C:16,41; Malic acid:47,7; Fiber:13,52 [49]	379,32 [49]
<i>S. birrea</i>	Ca:350; Mg:190; K:3250; P:310; Fe:34; Zn:3,1; Cu:1,6 [41]	Moisture:86,3; Protein:0,7; Fat:0,5; Vitamin C:167 [41]	
<i>T. indica</i>	Ca:215,7-4547,4; Mg:250-1605,4; K:389,3-2300; P:163,4-1877,3; Na:273-1127,6; Mn:1,3-2; Fe:10,5-273,6; Zn:8-296; Cu:14,5-30 [50,51,52]	Moisture:11,19-42,7; Ash:1,69-6,9 ; Protein:2,4-9,15; Fat:0,14-7,4; Carbohydrate:51,5-69,9 ; Fiber:4,5-18,83 ; Vitamin C: 11,3-44,26 ; Caretonoid:0,025 [50,51,52,53]	216,86-502,84 [52,31]
<i>V. paradoxa</i>	Ca:2,33; Mg:0,94; K:11,73; P:0,16; Mn:3,68; Fe:88,9; Zn:5,75; Cu:2,93 [36]	Moisture:9,5-15,54; Ash:6,2-6,9 ; Protein:5,7-8,29; Fat:1,4-19,01; Carbohydrate:42,7-58,22; Fiber:17,4-44,5 [54,55]	198,5 [55]
<i>X. americana</i>	Not available	Not available	
<i>Z. mauritiana</i>	Ca:238; Mg:92; K:2133; P:145; Na:198; Mn:1,6; Fe:2,1; Zn:0,6; Cu:0,9 [56]	Moisture:24,1; Ash:3,6 ; Protein:8; Fat:1,5; Carbohydrate:79,5 ; Fiber:5,3; Vitamin C:28,6 [56]	362,91 [56]

Ca: Calcium; Mg: Magnesium; K: Potassium; P: Phosphorus; Na: Sodium; Fe: Iron; Cu: Copper; Mn: Manganese; Zn: Zinc; Cl: Chloride; S: Sulphur.

**Table 3. Bioactive compounds and bioactivities of fruits**

<b>Plants</b>	<b>Bioactive compounds</b>	<b>Bioactivities</b>	<b>References</b>
<i>A. digitata</i>	Total phenolic contents: 50,1 ± 5,5 mgGAE/mL	DPPH: 1132,3 ± 251,6 µmol/L; FRAP: 1539,2 ± 733,3 µmol/L; ABTS: 1766,2 ± 234,03 µmol/L	[57]
	Aqueous and Methanol extracts	Anti-apoptosis role by restoring P <sub>53</sub> and Bcl-2 gene expression in Ehrlich ascites carcinoma	[58]
	Aqueous extract	Hepatoprotection against CCl <sub>4</sub> toxicity in rats	[70]
	Pulp powder	Reduction of the levels of total cholesterol in hyperlipidic patients	[63]
	Procyanidines B2: 533 ± 22,6 mg/100g; Vitamin C: 466 ± 2,5 mg/100g; Gallic acid: 68,5 ± 12,4 mg/100g; (-)-epicatechin: 43 ± 3 mg/100g	FRAP: 2810 ± 92,8 mgTEAC/100g; ABTS: 1520 ± 17,1 mgTEAC/100g; DPPH: 50,9 ± 0,49 %	[71]
<i>A. senegalensis</i>	Saponin; steroid, Flavonol glycoside	Anti-sickling	[64]
	Sabinene, α-humulene; Germacrene D; 1,8 cineole; E-β-caryophyllene ; β-selinene ; linaleol ; Terpinel-4-ol ; α-terpineol ; β-hydroxy-16-kaurene; Germacrene A; β-eudesmol; car-3-ene; δ-cardinene-γ-eudesmol	Antimicrobial	[6]
<i>B. aegyptiaca</i>	Balanitin-1; Blانيتin-2 ; Balanitin-3	Molluscidal	[69]
	Rutin; Isorhamnetin	Antidiabetic	[60]
	Pregnan-5-ene-3β,16β,20(R)-triol-3O-(2,6-di-O-α-L-rhamnopyranosyl) –β-D-glucopyranoside		[72]
	Trigonelline	Hypoglycemic	[73]
	Saponin [26-(O-β-D-glucopyranosyl-3β,22,26-trihydroxyfurost-5-ene O-β-D-glucopyranosyl-(1,4)-[α-rham-nopyranosyl-(1,2)]-β-D-glucopyranoside	Larvicidal activity against <i>A. aegypti</i>	[68]
	26-(O-β-D-glucopyranosyl)-22-O-methylfurost-5-ene-3β,26-diol-3-O-β-D-glucopyranosyl-(1,4)-[α-L-rham-nopyranosyl-(1,2)]-β-D-glucopyranoside	Antidiabetic activity by α-glucosidase and aldose reductase inhibition	[61]
	Total phenolic content: 212 ± 2,6 mgGAE/g; Total flavonoid: 11,5 ± 1,3 mgAE/g; Vitamin C: 0,98 ± 0,44%	Antimicrobial, Antiradicalaire: DPPH (88,2%); Anticancer on stomach cancer cell line SGC7901	[19,74]
	Ethanol 80 % extract	Hypocholesterolemic action in albinos rats	[75]

<i>B. aethiopum</i>	Total phenolic contents: 73,65 mg ETA/g	Total antioxidant activity: 329,4mgEAA/g; anti-inflammatory activity on carrageenan induced oedema in chicks	[66]
	Ethanol extract	Antioxidant activity: 39,81 ± 18,06 %	[43]
	Aqueous extract	Anti-radical activity DPPH: IC50 = 0,98 ± 0,05 mg/mL	[20]
	Methanol extract	Antidiabetic in alloxan induced diabetic rats	[76]
<i>D. microcarpum</i>	Diterpenes clerodane [3,4-epoxyclerodan-13E-en-15-oic acid ; 5R,8R-(2-oxokolavenic acid) ; 3,4- dihydroxyclerodan-13E-en-15-oic acid; 3,4-dihydroxyclerodan-13Z-en-15-oic acid] and 2-oxokolavenic acid; copalic acid	Anti-radical DPPH, Anti-acetylcholinesterase and antifungal ( <i>Cladosporium cucumerinum</i> ) activities	[65]
	Total phenolic contents: 5978,33 ± 87,5 mgGAE/100g; Total flavonoids contents: 155,9 ± 1,89 mgQE/100g	DPPH: 10729,41 mgAEAC/100g; FRAP: 48,85 mmol AEAC/100g; ABTS: 528 µmol AEAC/100g	[77]
	Powder	Increase red blood cells and white blood cells and hemoglobin concentration in rat	[78]
<i>D. guineense</i>	Total phenolic content: 1,16 ± 0,049 mgGAE/g	DPPH: IL=14,99 mg± 0,11 of fresh fruit; ABTS: 23,27 ± 1%	[79]
	Phenolic extract	Enhances reactive oxygen species detoxification in aflatoxin B <sub>1</sub> hepatocarcinogenesis	[80]
	Saponins, Flavonoids, Tannins	Antimicrobial on <i>Candida albicans</i>	[13]
	Triterpenoid Glycoside : 3-O-[ $\alpha$ -D-xylopyranosyl]oleanolic acid	Molluscicidal	[81]
<i>D. mespiliformis</i>	Methanol/water soluble phytochemicals	Potent antioxidant on DPPH, Superoxide anion radicals	[82]
<i>F. sycomorus</i>	Total flavonoids: 0.527 ± 0.15mgQE/100g; Total phenolic .75±0.23mgGAE/100g	Antimicrobial activity on <i>E. coli</i> , <i>Proteus SPP</i> , <i>S. aureus</i> and <i>H. infleunza</i>	[24]
<i>G. erubescens</i>	Anthraquinones, Tanins, Stérols et Triterpènes	Not available	[83]



<i>V. doniana</i>	Methanol extract Alkaloid, Saponin, terpenoid and flavonoid	Stall protein oxidation, lipid peroxidation and DNA fragmentation in acetaminophen-induced hepatotoxicity, Antioxidant 18,25 ± 8,18 %	[84] [43]
<i>L. microcarpa</i>	Antocyanin extract	Stall Aflatoxin B1-mediated oxidative rout on cellular protein, lipid and DNA	[59]
	Total phenolic content: 5,53 ± 0,12 mGAE/100g; Total flavonoid: 2,46 ± 0,02 mgQE/100g	Antioxidant DPPH: IC <sub>50</sub> =46,67 ± 2,05 µg/mL; <i>S. aureus</i> MIC= 0,63 mg/mL	[26]
<i>P. biglobosa</i>	Total phenolic contents: 104,66 ± 2mg/100g; Total flavonoid: 73,06 ± 0,02 mg/100g	B-carotene/linoleic acid inhibition: 79,4 ± 0,2%	[85]
<i>D. mespiliformis</i>	Methanol/water soluble phytochemicals	Potent antioxidant on DPPH, Superoxide anion radicals	[82]
	Phenolic extract	Stall Aflatoxin B1-mediated oxidative rout in the liver of male rats	[29]
<i>S. senegalensis</i>	b-carotene: 1559 µg/100 g of fruits		[83]
<i>S. birrea</i>	Aqueous/methanol extract	Potent antioxidant on DPPH, Superoxide anion radicals and lipid peroxidation inhibition	[86]
	Juice: total phenolic contents:56 mg of pyrogallol equivalent dl <sup>-1</sup>	Potent antioxidant:382 mg of vitamin C equivalent.dl <sup>-1</sup> ; Hypocholesterolemic action in healthy volunteer	[62]
<i>T. indica</i>	Aqueous extract	Increase crustacean larvae lethality with LC <sub>50</sub> =27 µL/mL	[53]
<i>V. paradoxa</i>	Tanin: 1.2 ± 0.01 mg/g, Phenol : 55.6 ± 0.03 mg/g ; Saponin: 7 ± 0.05 mg/g; Flavonoid: 64.8 ± 0.01 mg/g	Inhibition of lipid peroxidation <i>in vitro</i>	[87]
<i>X. americana</i>	Yellow flavonoids content: 22,07mg/100g; Anthocyanin content:1,92mg/100g; Polyphenol content: 3051,62 mg/100g	DPPH:481,4 g fruit/g DPPH	[88]
<i>Z. mauritiana</i>	Maslinic acid	Prevent oxidative stress induced by CCl <sub>4</sub> in liver slice culture cell	[35]
	Methanol extract	Antibacterial potent and anticancer on HeLa cell	[89]

#### 4. BIOACTIVITY OF WILD EDIBLE FRUITS AND HEALTH BENEFIT

Wild edible fruits are receiving increasing interest from researchers because of their medicinal properties, nutritional value, vitamin and mineral contents. Numerous fruits have been screened for their bioactive compounds. Common bioactive compounds found in wild fruits are flavonoids, carotenoid, coumarins, tannins, anthocyanin and vitamins. These phytochemical constituents have crucial pharmacological properties including antioxidant, anti-cancer, antimicrobial, enzymes inhibition, gene expression modulator and anti-inflammatory (Table 3). The presence of various antioxidant compounds in fruits is very promising according to their health benefits. Flavonoids in wild edible fruits such as *A. digitata* fruit are free radical scavengers and anticancer on stomach cancer cell line SGC7901 [57,58]. Anthocyanins from *L. microcarpa* reduce oxidative rout mediated by aflatoxin B1 on cellular protein, lipid and DNA [59]. The flavonoids rutin and isorhamnetin isolated from the fruit of *B. aegyptiaca* are antidiabetic [60]. Moreover, a pregnant glucoside 26-(O-β-D-glucopyranosyl)-22-O-methylfurost-5-ene-3β,26-diol-3-O-β-D-glucopyranosyl-(1,4)-[α-L-rhamnopyranosyl-(1,2)]-β-D-glucopyranoside isolated from this fruit has antidiabetic property by α-glucosidase and aldose reductase inhibition [61]. Phenolic compounds of *S. birrea* have a hypocholesterolemic action in healthy volunteer [62]. Maslinic acid isolated from fruit of *Z. mauritiana* prevents oxidative stress induced by CCl<sub>4</sub> in liver slice culture cell [35]. The pulp powder of fruit of *A. digitata* reduces the levels of total cholesterol in hyperlipidic patients probably due to the presence of procyanidines [63]. Saponin, steroid, and flavonol glycoside from the fruit of *A. senegalensis* are anti-sickling [64]. Diterpenes clerodane [3,4-epoxycyclohexan-13E-en-15-oic acid; 5R,8R-(2-oxokolavenic acid); 3,4-dihydroxycyclohexan-13E-en-15-oic acid; 3,4-dihydroxycyclohexan-13Z-en-15-oic acid] and, 2-oxokolavenic acid and copalic acid isolated from the fruit of *D. microcarpum* are anti-acetylcholinesterase and antifungal (*Cladosporium cucumerinum*) potent compounds [65]. An anti-inflammatory activity on carrageenan induced oedema in chicks was observed when a phenolic rich extract of fruit from *B. aethiopicum* was applied [66]. A group of odour-active compounds were quantified in *D. guineense* fruit such as linalool, limonene, 4-hydroxy-2,5-dimethyl-3(2H)-furanone, nonanal, (Z)-3-hexenal, cis-linalool oxide (furanoid),

geranyl acetone, and cinnamyl acetate [67]. Phenolic compounds of *S. birrea* fruits have anti-atherogenic effects in healthy humans [62]. The various biological properties of bioactive compounds of fruits are due to their capacity to reduce free radical or to stop lipid peroxidation by one electron or hydrogen atom transfer and to modulate enzyme activity or gene expression. Other bioactivities of tropical wild edible fruits are antimicrobial, insecticidal and molluscidal [68,69].

#### 5. CONCLUSION

This review demonstrates that tropical wild edible fruits are a source of variety of bioactive compounds including therapeutic and dietary compounds. The presence of these bioactive compounds in fruits justify their ethnomedicinal uses in all parts of African regions. The health benefit of fruits are mainly ascribed to phenolic compounds and vitamins, which result mostly from antioxidant, anticancer, anti-mutagenic, antimicrobial, anti-inflammatory and neuroprotective properties. Bio guided fractionation of fruit might promote the development of alternative therapeutic compounds for the prevention and treatment of various diseases and disorders.

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#### COMPETING INTERESTS

Authors have declared that no competing interests exist.

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