

# Food Resources in The Gambia: Nutrition and Herbal Medicine

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## ABSTRACT

The Gambia, 'The smiling Coast' of Africa, is a strip of low lying country located between latitudes 13° 00' and 13° 50' N and longitudes 16° 50' and 13° 45' W, with a total land boundary of 740 km, and dense population of 1,857,181. The two distinct climates are the rainy and dry seasons. The dry season which lasts from October till May is characterized by dry dusty wind; while the wet season lasts from June till early October, with total annual rainfall that varies from the coastline inwards. Based on the rainfall pattern, the three major agroecological zones include Sahelian, Sudan-Sahelian and Sudan-Guinean which favour the cultivation of some cash crops, food crops, and herbal plants. Foods, in the form of liquid or solid, are sources of nutrition and medicine for good health; malnutrition, or poison. Foods and nutrition are essential for maintaining good health and preventing disease. Not only is malnutrition prevalent in The Gambia, but most of the populace also seemed unaware of the content, quality, composition, the nutritive, or medicinal value of the foods consumed. In this review, the chemical, medicinal, and nutritive values of some commonly consumed or traditional foods and drinks and the names of some herbal plants and their uses in The Gambia are reported.

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## I. INTRODUCTION

### A. Location

The Gambia, the Smiling Coast of Africa, is a strip of low-lying country located between latitudes 13° 00' and 13° 50' N and longitudes 16° 50' and 13° 45' W and completely surrounded by Senegal except at the sea where the coastline is about 80 km long. Its total land boundary is 740 km while its area is 11,295 km<sup>2</sup> of which 1,295 km<sup>2</sup> comprises water [1]. The two distinct climate seasons are the rainy season (from June till early October) and dry season (from October to May) which is characterized by dry dusty wind. Total annual rainfall varies from the coast line inward, from 1,100 mm in the South West to 700 mm in the North East of the country [2].

The Gambia has eight local government areas (Banjul, Kanifing, Brikama, Mansankonko, Kerewan, Kuntani, Janjanbureh, and Basse) and total population of 1,857,181. The prominent ethnic groups include Mandika (34%), Fulla (24.1%), Wolof (14.8%), Jola/Karoninka (10.5%), Serahule (8.2%), Serrere (3.1%), Manjago (1.9%), Balanta (1.3%), and Aku, (0.5%) [3].

### B. Agriculture And Agro-Ecological Zones

There has been little or no modification to the structure of agriculture since the colonial times. Grain crops (sorghum and maize) are cultivated in almost half of the traditional farmlands; while groundnuts account for almost a quarter. Subsistence farming is widely practiced (rice, sorghum, maize, cotton, cassava/manioc and vegetables); while some produce is retailed. Animal husbandry and fishing also contribute to feeding the indigenes, but contribute an insignificant proportion towards the economy (fishing: 2.1% of GDP). Across the country, market gardening is practiced by women who farm the floodplains of extinct rivers. Half of the food needs of the country are satisfied from local agricultural produce. It is of note that only half of the arable land is under cultivation while the remaining half remain fallow. A major problem plaguing agriculture in the country is flood and drought. In 2011/2012 agricultural produce was adversely affected by drought while in 2015, excessive rainfall took a toll of the harvests [2].

The three main agro-ecological zones in The Gambia based on the rainfall pattern are Sahelian, Sudan-Sahelian and Sudan-Guinean zones. The Sudan- Guinean Zone lies within the 900 to 1200 mm rainfall isohyets. The growing season is 120-150 days and in normal seasons full crop water requirements are met

throughout the growing season. In some lowland areas the long dry season results in increased salinisation of The Gambia River and an emphasis on saline tolerant cereal and legume crops varieties, such as rice, millet, groundnut, sesame, and cowpea [2]. The Sudan-Sahelian Zone lies within the 600 to 900 mm rainfall area. With a longer growing season, 79 to 119 days, the up-land areas are well suited to groundnut, cotton and sorghum. The flood plains along The Gambia River and associated lowland valley systems are an excellent rice growing catchment under tidal swamp irrigation [2]. The Sahelian Zone has a Sahelian micro-climate with open dry season savannah vegetation. Rainfall is unpredictable and less than 600 mm total annually, with an effective crop-growing season of less than 79 days. Soils have low water retention capacity thereby creating high-risk for long-duration crops. Thus early maturing, short-duration and drought tolerant crops are cultivated in this zone. Cassava, sesame and cowpea are the main produce with millet grown only occasionally because of the risk that birds would consume the crop.

### C. Food and Nutrition in The Gambia

Food becomes nutrition if it nourishes the body else, it is a poison. Any substance or matter ingested as liquid or solid and which provides the body with its needs for energy, building, regulation and protection is food. In short, food is the raw material from which nutrients enter into the body. Intake of the right kinds and amounts of food can ensure good nutrition and health, which may be evident in appearance, efficiency, mental IQ, and psychological and emotional well-being. Nutrition has been defined as food at work in the body. Nutrition includes everything that happens to food from the time it is eaten until it is used for various functions in the body. Nutrients are components of food that are needed by the body in adequate amounts in order to grow, reproduce and lead a normal, healthy life [4].

Foods and/or drinks could be sources of nutrition (for good health), medicine (to prevent or fight disease), or malnutrition. Although food remains at the apex in the hierarchy of man's needs, ignorance of adequate nutrition still abounds in human societies. Consequently, various nutritional disorders for which there are simple remedies such as blindness (caused by lack of/insufficient vitamin A) and scurvy (caused by lack of (or, inadequate) vitamin C) still persist. Good nutrition is a derivative of education (or, knowledge) and economics (priority, purchasing power, etc). In many countries, the most serious form of nutritional disorder is undernutrition arising from inadequate purchasing power. Moreover, even when purchasing power is adequate to access good nutrition, other forms of imbalance in dietary intake occur due to misplaced priority, and ignorance.

Nutrition is critical to health and development, as "health is wealth", and "a healthy nation, is a wealthy nation". Better nutrition is related to improved infant, child and maternal health, stronger immune systems, safer pregnancy and childbirth, lower risk of non-communicable diseases (such as diabetes and cardiovascular disease), longevity, productive work force and healthy nation. Healthy children learn better. People with adequate nutrition are more productive and can create opportunities to gradually break the cycles of poverty and hunger. Malnutrition, in every form, presents significant threats to human health. Today the world faces a double burden of malnutrition that includes both under-nutrition and overweight, especially in low- and middle-income countries. Malnutrition in general and micronutrient deficiencies particularly, remain prevalent in The Gambia [5].

In The Gambia, the commonly consumed foods and beverages include afra, tapalapa bread, coose, mbahal, benachin, domoda, black coffee, baobab juice, palm wine, attaya, julbrew, and wonjo juice, among others.

### D. Purpose of the Study

Careful observations have shown that many Gambians consume foods and beverages but without concern to their medicinal or nutritive contents. This review is on some commonly consumed or traditional foods and drinks in The Gambia and their chemical, medicinal, and nutritive values. Many medicinal plants abound in The Gambia. But, there is paucity of scientific information or database of these herbal plants, and many practitioners or "marabouts" do not know the scientific (or, botanical) names of the plants they use. This work provides information of the scientific (or, botanical) names of some herbal plants in the country.

## II. HERBAL PLANTS AND TRADITIONAL MEDICINE IN THE GAMBIA

Herbal plants have medicinal and pharmaceutical effects; their sources in traditional medicine are well known and widely reported [6], [7]. Medicinal plant usage in traditional medicine has gained worldwide economic importance [8]–[10].

In The Gambia, herbal medicine infused in traditional medicine is part and parcel of the life and culture of the people. The people rely on it more than they rely on Western remedies. And in most cases, combine both traditional and Western medicine for therapy.

TABLE I: SOME HERBAL PLANTS AND THEIR USES IN THE GAMBIA

S/N	Plant	Botanical Name	Part Used	Uses in The Gambia
1.	Kalkato	NA	Roots	Treatment of chest infection
2.	Seno	NA	Bark	Treatment of skin rashes Treatment of Pruritus vulvae
3.	Wonko	NA	Leaf, Roots Bark	Treatment of abdominal pain Treatment of skin rashes
4.	Kunjunboro	Sodom Apple	Bark	Polio
5.	Bitter Kola	<i>Garcinia cola</i>	Nut	Male sexual dysfunction
6.	Kinkiliba (Sekhew)	<i>Combretum micranthum</i>	Leaf, Roots	Detoxicant, antimalarial

NA = not available

However, most healers (or, marabouts, as they are popularly called) have a specialty, such as the ability to cure malaria or broken bones, dysentery, or tuberculosis. If these healers are good enough, their reputations spread among neighboring villages, and when people have ailments in the specialties of a nearby healer, they may seek out that healer to cure them. The best healers have reputations spanning hundreds of miles, throughout The Gambia and into Senegal and Mali; patients some times travel for days to find a certain healer. Healers work in a variety of ways. Although, most of the healers sometimes overvalue their competences with herbal medicine and claim to cure all manner of sicknesses and diseases, including AIDS. To avoid such excesses, but without losing the beneficial aspects of herbal and traditional medicine, the Ministry of Health has been trying to consolidate it with the conventional medicine [11], [12]. Table I shows some of the medicinal plants in The Gambia and their uses in herbal and traditional medicine.

Natural products from medicinal plants have greatly aided the vital sources and models of structural moieties in the search for new medicines, safe and effective novel drugs [13], [14]. With the snag in synthetic molecules due to the problems they pose [15], herbal medicines remains good alternatives in the prevention and cure of ailments [16]. Phytochemistry has been identified to play key roles as phytochemicals, such as flavonoids, provide the protective strategy against various diseases, including nephrotoxicity and CKD [17], [15]. Natural antioxidants such as phenolic compounds are efficient in inhibiting reactive oxygen species (ROS) that induce organ pathologies, and are preferred to their synthetic analogs because they are safer, natural, cheaper, and environment friendly [18]–[20].

The major challenge in The Gambia is the over-harvesting of vegetation, including herbal plants. Deforestation and the loss of both plant and animal species in the area have all greatly increased over the past thirty years as a result of climatic variables and population explosion. Some plants have become very difficult to find and more often than not, many marabouts (the herbalists or traditional healers) did not know the scientific (or, botanical) names of the plants they used [21], which otherwise could have been resuscitated by plant breeding.

#### A. Wonjo (or Wanjo)

The Wonjo (or, wanjo) is a popular drink in The Gambia. It is a dark cranberry-coloured juice, made from boiling the dark red flower/calyx of the sorrel plant (*Hibiscus sabdariffa*). *H. sabdariffa* is a genus of the Malvaceae family. The calyces of *H. sabdariffa* are prolific in many modern commercial blends of cold and hot drinks due to its pleasing taste, decorative, culinary and medicinal uses. Having originated from Angola, the shrub is now cultivated in many parts of the tropical and non-tropical regions of the world, including Sudan, Nigeria, Egypt, Thailand, Mexico, The Gambia, China, India and Iran.

The Roselle plant is mainly cultivated for its calyx, which is of three varieties: green, red and dark red. The red and dark-red calyces are more appealing, mostly used, and have high contents of anthocyanin. Delphinidin, 3-Sambubioside and Cyanidin, 3-Sambubioside are the major anthocyanin. The calyces, leaves and seeds of Roselle are also rich in organic acids, minerals, amino acids, carotene, vitamin C and total sugar at variable levels depending on the variety and geographical area [22]. Approximately 15% to 30% of the plant is made up of plant acids, including citric, malic, tartaric acid and allo-hydroxycitric acid lactone (i.e. hibiscus acid) which is specific to this plant. Other chemical constituents include alkaloids, L-ascorbic acid, anthocyanin,  $\beta$ -carotene,  $\beta$ -sitosterol, citric acid, polysaccharides arabins and arabinogalactans, quercetin, gossypetin and small amounts of galactose, arabinose, glucose, xylose, mannose and rhamnose. Mishra [23] reported the isolation of flavonoids, anthocyanidins, triterpenoids, steroids and alkaloids from the Roselle plant. Table II shows the nutritional composition of different parts of *Hibiscus sabdariffa*.

Roselle has been used for relief of sour throat and healing wounds in Sudan traditional healthcare [25]. The leaves of Roselle are not only rich in Vitamin A and calcium as shown in Table II, but are also used for antimicrobial, emollient, antipyretic, body temperature lowering, spasmolytic, treat cardiac conditions, diuretic, anthelmintic, sedative properties, a soothing cough remedy, and poultice on abscesses in African folk medicine and elsewhere [26]–[28].

TABLE II: NUTRITIONAL COMPOSITION OF *HIBISCUS SABDARIFFA* (PER 100 G)

Nutrients	Calyxes	Seeds	Leaves
Protein [g]	2	0.9	3.5
Carbohydrates (g)	10.2	25.5	8.7
Fat (g)	0.1	21.4	0.3
Vitamin A (I.E)	–	–	1000
Thiamine (mg)	0.05	0.1	0.2
Riboflavin (mg)	0.07	0.15	0.4
Niacin (mg)	0.06	1.5	1.4
Vitamin C (mg)	17	9.0	2.3
Calcium (mg)	150	350	240
Iron (mg)	3.0	9.0	5.0

Source: Naturland [24].

The uses and applications of *H. sabdariffa* in folk medicine are for the treatment of high blood pressure, liver diseases and fevers, relaxation effect on the uterus due to its content of alkaloids, anthocyanins and quercetin. In large amounts, hibiscus tea acts as a mild laxative. In Iran, it is a traditional treatment for high blood pressure which presupposes its cholesterol reduction, as the antioxidant and diuretic effects of the plant are its most important mechanisms in lowering blood pressure. Many studies involving animal and human samples have revealed that extracts or infusions of *H. sabdariffa* affect atherosclerosis mechanisms, blood sugar, lipids, and blood pressure [29]–[33].

#### 1) The effect of roselle on blood pressure lowering

Many investigations have reported the effectiveness of an aqueous extract of Roselle on mild to moderate hypertension. Aqueous extract of Roselle was as effective as  $\text{Captopril}$  in treating mild to moderate hypertension and there is no adverse effect with the treatment, confirming the effectiveness and safety of the extract [33]. Even though the possible mechanism(s) of action of Roselle extract is not investigated, daily consumption of an aqueous Roselle extract resulted in a decrease in systolic and diastolic blood pressure [34]. A clinical trial by Lin *et al.* [35] on Hibiscus showed cholesterol reduction by 8.3% to 14.4% after just one month. A total of 42 subjects were randomized to 3 groups for the study, conducted in Taiwan. The hibiscus extract capsules contained 500 mg of dried herb by macerating 150 g of hibiscus flowers in 6 L of hot water for 2 hours and then drying and filtering the extract. Group 1 received 1 capsule of extract 3 times daily (1,500 mg/day), group 2 received 2 capsules 3 times daily (3,000 mg/day), and group 3 received 3 capsules 3 times daily (4,500 mg/day).

#### B. Ginger Drinks/Beer

In The Gambia, local ginger drinks are made by mixing crushed ginger with lots of sugar and water then chilled in bottles. Ginger (*Zingiber officinale*) is a flowering plant whose rhizome, ginger root or ginger, is widely used as a spice and in folk medicine, food, pharmaceuticals, cosmetics, and household necessities. The chemical constituents of *Zingiber officinale* Roscoe (ZOR) has been reported to contain 28 types of diarylheptanoid compounds, 85 types of gingerol, and 194 types of volatile oils [36]. The ginger essential oils vary based on the locality of the ZOR and give the plant a unique aromatic smell [37]. In medicine, the many functions of ginger are antioxidant, anti-inflammatory, antimicrobial, anticancer, antiobesity, antidiabetic, antinausea, antiemetic, antiallergic, neuroprotective, hepatoprotective, cardiovascular protective, and respiratory protective activities [38]. Current studies of the bioactive components of ginger focus on ginger essential oils, gingerol, shogaol, and zingerone compounds. Ginger essential oils can effectively improve the antioxidant capacity of the liver, reduce the inflammatory response, and protect against fatty liver [39]. The antioxidant compounds in ginger are primarily gingerol and diarylheptanoid that contribute to free radical scavenging and oxidation inhibition of lipids [40]. Antioxidant activity is typically derived from gingerols, shogaols, and some related phenolic ketone derivatives [41]. Gingerols are spicy ingredients in which 6-gingerol shows the highest biological activity, so 6-gingerol is often used as an indicator of ginger quality [42]. 6-Gingerol inhibits angiogenesis in vivo and in vitro [43], has anticancer and antigastric ulcer properties and suppresses central nervous stimulation and various pharmacological activities [44], [45]. 6-Gingerol, 8-Gingerol, and 10-Gingerol have been used to treat tumors, regulate the apoptosis gene, and reverse the abnormal expression of tumor cell genes. It also affects the apoptosis signal transduction pathway and induces apoptosis [45], [46].

#### C. Teas

“Attaya” and “kinkiliba” are very popular among the several types of herbal infusions taken as teas in The Gambia. Kinkiliba is *Combretum micranthum* whose leaves are sold in dry form in some local markets or tea stands in The Gambia in the mornings. Kinkiliba means the “health tree” and the French import kinkiliba and calls it “tisane de longue vie” or infusion of long life, as it pre-supposes that consumption of

the tea enhances long life. *Combretum micranthum* is a species of flowering plant in the large Combretaceae family of herbs, shrubs and trees, comprising about 20 genera and 600 species with tropical distribution around the globe and centers of diversity in tropical and subtropical areas of Africa and Asia [47]. Common in Benin, Burkina Faso, Senegal, Mali, and The Gambia across multiple regional dialects, the plant habitat is often in tiger bush and hills. Tea from this plant is made by steeping the leaves in boiling water and is used in traditional medicine, and by many West African Muslims, especially Wolofs, Fulas, and Mandikas (of The Gambia) during Ramadan to break the fast. The name kinkiliba is believed to come from the Fulani language. It is referred to as “sekhew” in the Wolof language and “nolobe” in the Bambara language. In Burkina Faso, a decoction of the leaves is used as a medication for malaria [48]. The family Combretaceae is widely known as a medicinal plant [49]–[51]. *Combretum micranthum* is used in traditional medicine for the treatment of wounds and sores [52]–[54], malaria fever, cough and bronchitis [53], [55]. The leaves extract of the plant has been reported to contain a range of polyphenols known for antioxidant activities and potentialities for the prevention of diabetes [56]. Ethanol, chloroform, methanol or water has been used as solvents in evaluating the antibacterial activity *C. micranthum*. Extracts were active against different micro-organisms such as bacteria [57], [58], fungi [57], and virus [59]. Ethanolic extract was toxic on the brine shrimp [57], anti-malarial against *Plasmodium falciparum* [60], [61], but no reported activity against THP1 cells with the methanolic extract [62].

#### 1) Phytochemicals isolated from *combretum* species

From the *Combretum* genus have been isolated some interesting chemical compounds, including Combretastatins, a group of stilbenes [63]. 9,10-dihydrophenanthrenes and a substituted bibenzyl were isolated from *C. molle* [64]. Also isolated were 11 triterpenes and their glycosides [65]; cycloartane dienone lactone from *C. quadrangulare* and alkaloids (combretine and betonicine) from the leaves of *C. micranthum* [66]; some flavonoids from *C. erythrophyllum* [67]. From *C. apiculatum*, quercetrin, kaempferol, pinocembrin (flavanone), and Cardamonin (chalcone) have been isolated [68] while, ellagic acid derivatives have been isolated from *C. kraussii* [69]. Table III further shows the biochemical effects of *Combretum micranthum*.

Flavonoids, terpenoids, steroids, alkaloids, and non-protein amino acids, among others, are responsible for the phytochemical and biological activity of *C. micranthum* [47] and could justify the use of this plant in traditional medicine in The Gambia. Mabozou *et al.* [92] reported the content of some phytochemicals in *C. micranthum* extract (Table IV).

TABLE III: SOME BIOCHEMICAL EFFECTS OF *COMBRETUM MICRANTHUM*

Biochemical Activity	References
Antimalarial	Welch [70], Eloff <i>et al.</i> [71]
Antiviral	Chinsebu [72], Diarra <i>et al.</i> [73]
Anti-inflammatory	Esimone <i>et al.</i> [74]
Wound healing	Chinsebu and Hedimbi [75]
Antioxidant	Ndhlala <i>et al.</i> [76], Olajide <i>et al.</i> [77]
Antibacterial	Karou <i>et al.</i> [78], Beda <i>et al.</i> [79]
Nueroprotective	Osonnwa <i>et al.</i> [80]
Antihyperglycaemic	Banfi <i>et al.</i> [81]
Anti-diabetic	Ibrahim <i>et al.</i> [82], Kantati <i>et al.</i> [83]
Antiradical	Toure <i>et al.</i> [84]
Antifungal	El Sayed [85]
Anti-trypanosomal	Chika and Bello [86]
Anti-Ebola	Balde <i>et al.</i> [87], Rao <i>et al.</i> [88]
Anti-Obesity	Pare <i>et al.</i> [89]
Anti-hypotensive	Seck <i>et al.</i> [90], Ibrahim <i>et al.</i> [91]

TABLE IV: TOTAL PHENOLS, FLAVONOIDS AND TANNINS CONTENT OF *COMBRETUM MICRANTHUM* EXTRACT

Tests	Amount in Extract
Total phenols (mg gallic acid/100 g of extract)	154.27± 3.31
Flavonoids (mg Rutin/100 g of extract)	333.23 ± 5.02
Tannins (mg gallic acid/100 g of extract)	21.88 ± 0.01

Source: Mabozou *et al.* [92].



#### D. Bitter Cola (*Garcinia kola*)

*Garcinia kola* is a traditional plant often eaten as snacks and belongs to the tropical rain forests of Africa especially in Benin, Cameroon, The Gambia, Democratic Republic of the Congo, Ivory Coast, Mali, Gabon, Ghana, Liberia, Nigeria, Senegal and Sierra Leone. *Garcinia kola* has been reported to have several ethno-medicinal uses for the plant treatment of abdominal discomfort, headache, cough, throat infections, vomiting and impotence [93]–[95]. Efficacy of the plant in the local treatment of liver diseases, diarrhea, microbial infections and as a general antidote has also been recorded in literature [96] – [98]. Even though most of the folkloric uses of *G. kola* have been authenticated, but its aphrodisiac effect in the treatment of male sexual dysfunction is still controversial. *Garcinia kola* is traditionally used by African folk healers who believe that it has purgative, antiparasitic, and antimicrobial properties [99]. The seeds are used for treatment of liver disorders, bronchitis, throat infections, colic, head or chest colds, and cough. It is also used as a chewing stick [99], and reportedly used for sexual dysfunction in The Gambia (Table I). *Garcinia kola* is claimed to possess aphrodisiac effects and as such is used traditionally in the treatment of erectile dysfunction, a common problem in men. *G. kola* seeds were prepared and used for treating male Wistar rats (n=8 /group); two doses of *G. kola* (200 and 400 mg/kg body weight) were used for the human treatment. All the treatments were orally administered daily for 28 days. On day 28, mounting frequency (MF), intromission frequency (IF) and ejaculation frequency (EF) were quantified using sexual behaviour tests to determine body and organ weights, gastric ulceration and cauda epididymal sperm counts. Serum was collected for determination of testosterone levels. Dose showed marked aphrodisiac activity with significantly increased sexual behaviour parameters in the group treated with *G. kola* compared to controls. However, lower doses of *G. kola* were more effective than the higher doses. Testosterone levels were higher in both treatment groups compared to controls. Sperm counts were similar to controls, but testes weights were higher in *G. kola* treated people compared to controls [100], [101].

Aprioku *et al.* [102] evaluated the influence of *G. kola* seed on sexual behavior and testis physiology in Wistar rats. In the report, adult male rats were gavaged with 0, 50, 100, 200 or 300 mg/kg day of extract for 30 days and mated with female rats after sexual behavior characteristics were carefully evaluated.

Serum concentrations of testosterone, LH, FSH, and epididymal sperm indices were analyzed after mating, while pregnancy rate and litter size of female rats were recorded. Extract (50 mg/kg) treatment produced no effect on sexual activities, but higher doses caused reduction relative to control. Additionally, except at 50 mg/kg, extract treatment caused reduction in sperm count ( $p < 0.0001$ ), sperm viability ( $p = 0.0011$ ), testosterone and FSH ( $p < 0.0001$ ). LH was unaltered, while abnormal sperm morphology was elevated ( $p < 0.05$ ). Furthermore, pregnancy rate and litter size in extract (100 to 300 mg/kg) treated rats were lower when compared to control.

TABLE V: NUTRITIONAL AND HEAVY METAL CONTENTS OF *GARCINIA KOLA* (%)

Parameters	<i>Garcinia kola</i> Seed Eleyinmi <i>et al.</i> [103]	Etonihu <i>et al.</i> [104]
Moisture	–	60.50 ± 1.00
Ash	11.42	2.50 ± 0.01
Fat (g)	0.1	21.4
Crude Protein	39.52	2.94 ± 0.07
Crude Fibre	114.02	1.73 ± 0.07
Crude Fat	43.25	6.23 ± 0.02
Carbohydrate	–	26.10 ± 1.06
Na	86.4	–
K	335	–
Ca	34.1	–
Mg	28.1	–
P	243	–
Cu	38.4	–
Co	102	–
Cr	ND	0.34 ± 0.02
Mo	ND	–
Mn	ND	–
Zn	–	0.23 ± 0.01
Ni	ND	0.14 ± 0.01
Se	ND	–
Pb	ND	ND
Cd	–	ND
Hg	ND	–
[K]/[Na]	3.87	–
[Ca]/[Mg]	1.21	–
[K]/([Ca+Mg])	5.39	–

ND = Not Detected

The results suggested that low doses of *G. kola* seed did not affect sexual activity, whereas high doses affected fertility by negatively altering sexual behavior, testosterone level and sperm indices. The percentage chemical composition of *G. kola* seeds determined using standard methods showed varied contents of crude protein, lipid extract, ash, and crude fibre (Table V), which could be because of geographical location, varieties, and species.

Potassium and phosphorus were the most abundant mineral elements in *G. kola* seed (334.82 and 242.61 %, respectively). The seed had significantly higher values for sodium, potassium, and copper [103]; among the heavy metals, levels ranged from 0.14 (Ni) to 0.34 (Cr) [104]. Cadmium, lead and mercury were not detected. The dominant saturated, monosaturated, and polyunsaturated fatty acid, in the seed are palmitic (31.55 and 276.01 mg/kg), oleic (38.36 and 52.77 mg/kg) and linoleic acids (36.16 and 235.83 mg/kg) respectively.

Glutamic acid is the dominant non-essential amino acid in seed (6.80 g/kg) while lysine (2.40 g/kg) is the dominant essential amino acid [103]. These proportions of nutritional contents in the seed of *G. kola* may find use in food and feed formulations. The phytochemical composition of ethanolic extract of a sample of *Garcinia kola* from Nigeria showed comparatively low content of tannin (0.0267 g/L). Etonihu *et al.* [104] reported the presence of alkaloids, glycosides, and phenols but absence of saponins and flavonoids. Tannins have been reported to have biological activities that may help in the treatment of many diseases [105], as they prevent the development of microorganisms [106]. Generally, tannin-containing plants can be used to treat diarrhea, inflammations of mouth, sore throat and slightly injured skins [106], soft wounds, burn wounds and skin infections due to the presence of tannin and it may have astringent property [107]. The tannins in these plants may be responsible for their use in herbal and traditional medicine for wound healing and local antiseptic agents [108], [109].

#### E. The Kunjunboro Plant

The plant Kunjunboro (Mandika language in The Gambia) is *Calotropis procera*. The plant also has other common names as Apple of Sodom/*Solanum incanum*, stabragh, king's crown, rubber bush or rubber tree, calotrope, giant milkweed, Indian milkweed, wild cotton, or, ushar in different parts of the world). The name Apple of Sodom and Dead Sea Apple comes from the fact that the ancient authors Josephus and Tacitus described it as growing in the area of the biblical Sodom [110]. The genus *Calotropis*, of the Apocynaceae family, is an evergreen xerophytic flowering plant that grows in arid and semi-arid habitats in Indochina, North America, tropical Africa, Western Asia, and South Asia. The green fruits contain a toxic milky sap that is extremely bitter and turns into a gluey coating which is resistant to soap [110]. This plant has several applications in medicine, fodder, fuel, timber and fiber production, phytoremediation, nano-synthesis, and decoration/ornamental. Its use in traditional medicine cuts across North Africa, Middle East Asia, and South-East Asia. These medicinal, pharmacological, socio-economic values, morpho-physiological adaptations and tolerance of the plant to various abiotic stresses have enabled its naturalization as an obnoxious environmental weed in several parts of the world. This ubiquity of the plant has enhanced its spread to South America, the Caribbean Islands, the Hawaiian Islands, Mexico, Seychelles, Pacific Islands, and Australia where it has invaded almost 3.7 million hectares of land [111].

From the leaf extracts of *C. procera* are fatty acid ethyl esters (21.4%), palmitic acid esters (10.2%), linoleic acids (7.4%), and amino acids (8.1%) [112]. Using high performance liquid chromatography (hplc) analysis of the leaves and bark, Mehmood *et al.* [113] ascertained the presence of total phenolic content (20.41 to 100.18 gallic acid equivalent mg/g dry weight), total flavonoid content ( $IC_{50}$  18.33 to 92.92 catechin equivalent mg/g dry weight), sinapic acid ( $17.3 \pm 2.11$  to  $9586.44 \pm 0.78$  mg/kg), vanillic acid ( $9.43 \pm 0.21$  to  $5051.7 \pm 18.47$  mg/kg) and protocatechuic acid ( $2.46 \pm 0.40$  to  $139.05 \pm 1.37$  mg/kg). Kinda *et al.* [114] reported higher ratio of phenolic compounds and terpenoids in leaves but lower in the root-bark of the plant, as cardenolide-type terpenoids are mainly responsible for the phytotherapeutic abilities of the root-bark of the plant. A total of 80% of the laticifer fluid of *C. procera* corresponds to rubber and the rest 20% is rich in basic proteins (anti-oxidant enzymes, cysteine proteases, and tryptophan) with molecular masses in the range of 5 to 95 kilodaltons [115].

A recent study [116], deduced amino acid sequences of five previously identified cysteine peptidases from the latex of *C. procera* (procerain, procerain B, CpCP1, CpCP2, and CpCP3) that possess similar biochemical characteristics and high sequence homology with several other papain-like cysteine peptidases. Al-Rowaily *et al.* [110] reported the presence of 90 chemical compounds in the essential oil of *C. procera* from Saudi Arabia and Egypt, which contained mainly terpenes and some other hydrocarbons, aromatics and carotenoids.

#### 1) Pharmacological Applications

The bark of Kunjunboro (*C. procera*) is used for treatment of polio in The Gambian local medicare. Elsewhere, *C. procera* have been applied for the cure of cold, fever, leprosy, asthma, rheumatism, eczema, indigestion, diarrhea, elephantiasis, skin diseases, and dysentery [110]. Similarly, the decoction of ground

stem and leaf are used to treat fever, joint pain, muscular spasm, and constipation in Saudi Arabia [117]. Kinda *et al.* [114] reported the efficacy of the plant for treatment of neuropsychiatric disorders in Burkina Faso. The pharmacological and medicinal applications of *C. procera* have been attributed to the rich presence of secondary metabolites and cardiogenic substances in the plant [118], [113]. Extracts of the ground stem and leaf exhibited strong antipyretic, analgesic, antidepressant, and neuromuscular blocking activity [117], [119]. Extracts from bark and leaves of the plant showed a broad-spectrum activity against gram-positive and gram-negative bacteria such *Klebsiella pneumoniae*, *Pseudomonas aeruginosa*, *Bacillus subtilis*, *Bacillus siamensis*, and *Escherichia coli* [113], [118]. Leaf extract of *C. procera* has been reported for its antihyperglycemic potential as it significantly reduces blood glucose [120]. In addition, information on the anti-inflammatory and gastromucosal protective effect of the stem bark of *C. procera* is known in the literature [121]. Ibrahim *et al.* [122] reported that the root bark consists of oxypregnane oligoglycosides, which has cytotoxic potential against U373 glioblastoma and PC-3 prostate cancer cell lines. An earlier retrieval of sensorimotor activities, reduced ROS, increased total antioxidant activity (particularly, the enhanced activities of arylesterase and paraoxonase), suggested a positive impact of roots of *C. procera* on functional recovery upon a nerve injury [123].

### III. CONCLUSION

The Gambia has thriving food resources from the agro-sector of the economy, some of which are rapidly dwindling due to recurring climatic conditions. These food resources which provide the commonly consumed foods and drinks of the people are invariable sources of medicine and nutrition for the malnourished population. Herbal medicine is a valuable part of Gambian culture that needs more attention in order to achieve preservation and sustenance. Although ignorant of their scientific names and chemical compositions, the traditional healers and patients strongly believe in the efficacy of herbal cure, which derives from the secondary metabolites inherent in the plant drugs. Consequently, there is a need for further studies on the identification of the numerous medicinal plants in The Gambia including extraction, standardization, chemical characterization, phytochemistry, and pharmacological analyses for integrated herbal and orthodox health care system and quality of life. There is a great possibility for traditional and modern medicine to move in the same direction as it has in countries like China and India, in the bid to provide reliable and affordable health care in the country. The government and State for Department of Health in The Gambia must encourage and promote scientific research in the vast herbal plants in The Gambia, some of which have been destroyed or become extinct.

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### CONFLICT OF INTEREST

This manuscript is my original research work and has no Conflict of Interest, whatsoever.

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