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AN OVERVIEW OF ETHNOBOTANICAL, MEDICINAL AND PHARMACOLOGICAL POTENTIAL OF *TELFAIRIA OCCIDENTALIS* HOOK.F. (CUCURBITACEAE) IN CAMEROON

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ABSTRACT

Telfairia. occidentalis commonly known as fluted pumpkin belongs to the Cucurbitaceae family and widely distributed in regions of West and Central Africa. In Cameroon, the vegetable has become an economic crop of non-timber forest product mostly cultivated and used as staple food primarily for soups and herbal cocktails, essential oils for aromatherapy and in most cases exported out of the country. Although the fruit is not edible, the seeds have high protein and fat content, and can contribute significantly to a well-balanced diet. *T. occidentalis* constitute a staple and traditionally used by an estimated 2 million people in Cameroon, and more in neighbouring countries like Nigeria and Ghana. It is mainly consumed by the population in the forest savannah zones of Cameroon. Ethnobotanic studies in Cameroon and elsewhere has demonstrated that in the South West Regions of Cameroon, the crop is noted to have healing properties and has been used as a blood tonic, to be administered to the sick. The high nutritional value complimented by its antidiabetic, hepatoprotective, anticonvulsant antiplasmodial, anxiolytic, sedative antioxidant, antimicrobial, anticancer, anti-inflammatory, and testiculoprotective properties of the leave and seed of the plant, has increased its consumption potential. This review paper attempts to give an overview of the ethnobotanic, medicinal and pharmacological uses of the plant. It also attempts to explore the issues on toxicity, medicinal values, pharmacological actions and morphological effects (on some organs/systems) of the plant.

KEYWORDS: Vegetables, *Telfairia occidentalis*, ethnobotany, nutrition, Toxicity, Pharmacological actions, Morphological effects, fluted pumpkin.

1-INTRODUCTION

Charles Telfair (1778-1835), an Irish botanist living in Mauritius Island, was the first to discover the plant used by the indigenes. He decided to send the African genus from Mauritius to Sir Williams Jackson Hooker (1785-1865) for taxonomic identification. The plant was named after him as *Telfairia occidentalis* by Sir Hooker.[1] However, the earliest reference to Telfairia was developed by Oliver in 1871 and it was later identified in Upper Guinea areas of Sierra Leone, Fernando Po, and Abeokuta (Nigeria).[1,2] The ethno botanical uses of *Telfairia occidentalis* in Asia Pacific Islands has also been reported.[3] The leaves when compared with other tropical vegetables have high nutritive value with a protein content.[4] higher than those of other commonly used leafy vegetables. The leaves are rich in vitamins and minerals such as P, Fe, Ca,[2,3-5] and the seeds eaten as food, with the oil obtained from the seed used in cooking.[2]

1.1. Taxonomu of *Telfairia occidentalis*

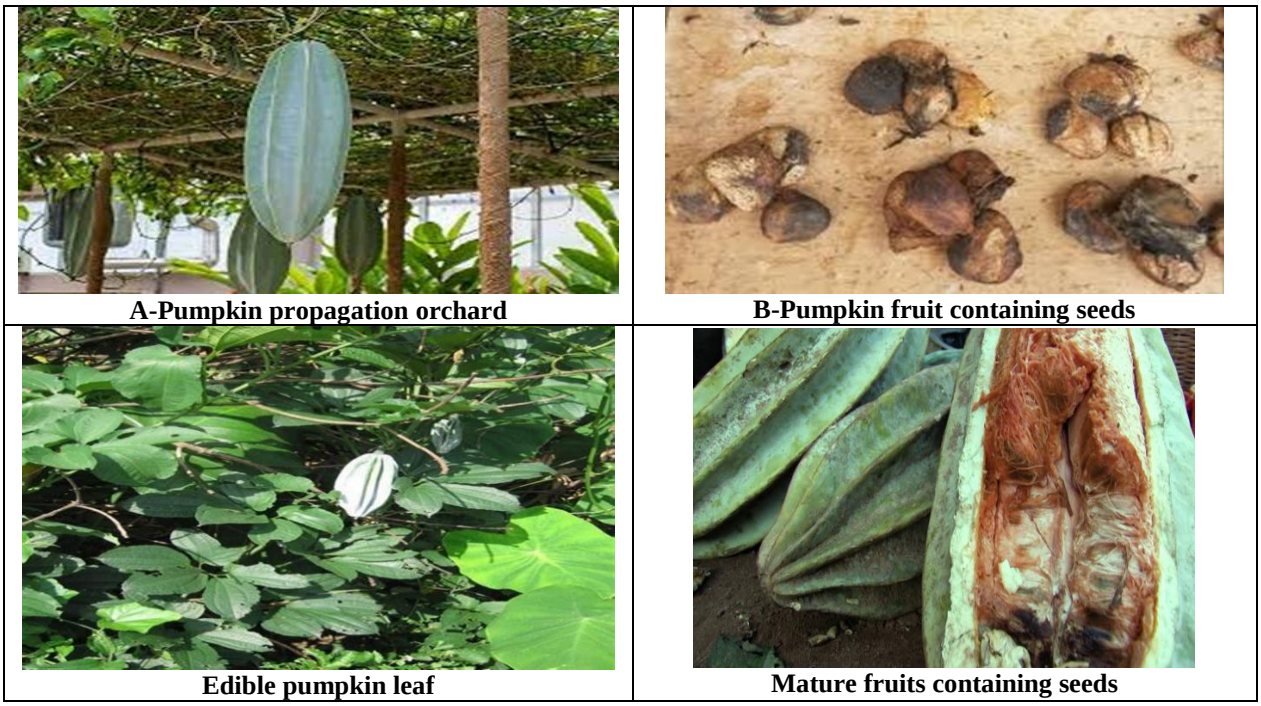
T. occidentalis of the family of Cucurbitaceae, is a dioceous, perennial shrub vine, partially drought-tolerant.[6] The plant consists of a root, a branching stem with tendrils, leaves, fruit and seed. The leaves are divided into 3-5 leaflets, the fruits are pale green weighing between 3 and 10 kg and the seeds are 3-5 cm wide.[7-10] Studies show that *T. occidentalis* contains nutrients such as carbohydrates, proteins, vitamins, oils, minerals and fiber.[11] The taxonomic hierarchy of *T occidentalis* are given as;[24] Kingdom - Plantae

Subkingdom - Viridiplantae Infrakingdom - Streptophyta Superdivision - Embryophyta Division - Tracheophyta Subdivision - Spermatophytina Class - Magnoliopsida Superorder - Rosanae Order - Cucurbitales Family - Cucurbitaceae Genus - Telfairia Hook. Species - *Telfairia occidentalis* Hook. F.[11]

The vegetable shows bioactive molecules such as oxalates, saponins, glycosides, flavonoids, alkaloids and resins.[9,11] The toxicity of *T. occidentalis* has been associated to alkaloids and saponins present in the roots and leaves,[12] while the chemo preventive and protective effects, free radical scavenging activity of the plant have been associated to the presence of high number of flavonoids and phenolic compounds.[11,13]

1.2. Traditional Uses of *Telfairia occidentalis*

The edible seeds are consumed boiled and eaten whole, or fermented and added to other cooked leafy vegetable and stew sources, or made into egusi puddings.[14] The crop has been locally used by indigenous as a blood tonic, due to its high protein content. Flour produced from the seeds are used in Cameroon for high-protein breads. In addition, the shoots and leaves are consumed as vegetables. The *T. occidentalis* herbal cocktail is prepared for local oral administration to treat many common illnesses link to bacteria and parasitic infections in Gastro intestinal tracts.[15] The plant biodiversity and conservation are shown in figure 1.



A-Pumpkin propagation orchard | **B-Pumpkin fruit containing seeds**

Edible pumpkin leaf | **Mature fruits containing seeds**

Figure 1: *Telfairia occidentalis* medicinal plant showing propagation, mature fruits and seeds (Photo Tamanji Virginia).

1.3. Phytochemical analysis

The root, stem, leaves of *Telfairia occidentalis* has been reported by many researchers on the phytochemical compounds, nutritional composition to show the presence of, saponins,sterol, triterperoids, tannins, reducing sugars, and glycosides in the root of the plant,[3,8,15] while the presence of its bioactive components in the root include alkaloids, saponins, and resins.[13,15] The high alkaloid content of the root and their extracts are mostly used as biopesticides.[15,16] The stem and leaves of *T. occidentalis* have also been reported to contain tannins, flavonoids, alkaloids, saponins, steroids, anthraquinones and reducing sugars.[3,17] The leaves showed the presence of phenolic compounds, tannins, saponins, glycosides flavonoids, and phytosterols, which have been reported to exhibit chemo suppressive activity.[12,18] Others have reported that both the ethanolic and aqueous extracts of leaves contain saponin, alkaloid and tannins.

Researchers using 2,2-diphenyl-1-picryl hydrazyl (DPPH) radical and employing Gas Chromatograph Mass Spectrometry (GCMS) analysis, 2 Dimensional Nuclear Magnetic Resonance (2D NMR).[19,20] and Fourier transform infrared (FTIR) spectroscopy mostly reported a high free radical scavenging activity, two pure compounds (9- octadecenoic acid and 10-hydroxyoctadecanoic acid) and four oily isolates from the seed of *T. occidentalis* leading to a conclusion that the seed can be consumed for its antioxidant property.[21,23]

2.0. Toxicity Issues of *Telfairia Occidentalis*

The use of medicinal plants in the treatment and management of diseases has been reported in more than

70% of the world's population and the popularity is still on the rise.[24,25] Herbal preparations have been reported as a good source of natural products. However, even with the claim of being natural and safe, their usage is without side effects and toxicity issues, which have been attributed to contamination by heavy metals, microorganisms during preparation and hepatic toxicity of the main constituents.[26,27] Acute toxicity test on *T. occidentalis* up to 5000 mg/kg orally, showed no mortality and signs of toxicity within the 14 days post-treatment observation period.[28,29] However, the LD50 of intraperitoneal administration of *T. occidentalis* in mice was calculated as 3200 mg/kg and for this study, the mice showed decreased in locomotion, calmness, writhing and increased breathing at the higher doses (3000-5000 mg/kg).[4,30] Reports show that the root aqueous extracts of *T. occidentalis* has toxic effects on Clarias *gariepinus* fingerlings and the percentage mortality was concentration dependent.[31,32] The highest mortality of 100% was recorded in 75 mg/L treated group when compared to the other groups. The researchers also reported that there is gap in literature on the toxicity of root of *T. occidentalis* on *Clarias gariepinus or* other fish species.[19,33] The erratic swimming behaviour, loss of balance and discoloration observed in the behaviour of the test animal was linked to possible nervous disorder. From this study, the conclusion was that aqueous root extract of *T. occidentalis* could interfere with the haematological parameters of *Claria gariepinus* fingerlings and become detrimental to survival in nature.[34]

The roots of *Telfairia occidentalis* are not edible, and are potent human poisons due to the presence of high alkaloid and saponins contents,[20,34] and as such the root extract is used for controlling pest and rodents,[27,35] and as potential antibacterial agent.[36] Other studies indicate that the toxicity of the fruit extract of *T. occidentalis*, can cause significant increase in serum concentrations of cholesterol, triglycerides and total proteins when administered to rats at 100, 500 and 1000 mg/kg body doses.[37,38,39] The toxic effect suggests that the hyperproteinaemic, hypertriglyceridaemic, hypercholesterolaemic, and hyperconjugated bilirubinaemic effects of the aqueous fruit extract can render the fruit unsafe for consumption.[40]

The aqueous extract of the root also demonstrated a potent detrimental action on the mucosa lining of the stomach.[3,41] The report on a significant reduction in weight of the animals, loss of appetite and death of some rats may be linked to the lethal effect of the alkaloids, saponin and glycoside content of the crude extract of the root of *T. occidentalis*.[42] Saponins when taken orally are relatively less toxic as they are only slightly absorbed by the digestive tract.[43] On the other hand, saponins have haemolytic properties and when injected into the blood stream it is highly toxic to cold blooded animals supporting the fact that many saponins are used as fish poisons.[44,45,46] Further reports show that the crude extract of the root of *T. occidentalis* is hepatotoxic and require its use with great caution and indicates that the root may be nephrotoxic when administered intraperitoneally at doses of 0.38 mg/kg and 0.75 mg/kg although when administered orally at doses of 0.38 mg/kg and 0.75 mg/kg, the ethanolic extract of the root may not be as toxic as claimed.[19,27,47]

Histologically, renal corpuscles, proximal and distal convoluted tubules are shown to be adversely affected by the oral and intraperitoneal administration of the crude extract of root of *T.occidentalis* on rats.[3,48] The morphological sites for the adverse effect of drugs include, the tubules, interstitium, glomeruli and blood vessels. The dilation of the tubules and enlarged glomeruli observed in animals exposed to the crude extract of the root of *T. occidentalis* orally and intraperitoneally may be due to increased tubular secretion, a mechanism employed to clear harmful toxins and drugs from the blood.[49,50] Observation of distortion and degeneration of glomeruli and total distortion of the kidney cytoarchitecture in some study may have been due to the effect of some components of the root of *Telfairia occidentalis* like the anthraquinone.[9,48]

Anthraquinone is not excreted by the kidney, on reabsorption stimulates calcium-binding proteins in the kidney to bind calcium. This therefore deposits calcium in the renal interstitium causing lithiasis which destroys the interstitium, blood vessels and nephrons.[15,51] The death of rats observed when exposed to anthroquinone may be due to renal failure. Studies also reported that toxins and drugs may cause small but cumulative injury to the tubules; and may take years to be manifested, resulting in chronic renal insufficiency. Renal failure is a manifestation of cumulative effect of injury to the morphological sites of the kidney and could eventually lead to death.[52] The conclusion from research findings, show that the crude extract of the root of *Telfairia occidentalis* is nephrotoxic, with the effects being more pronounced in studied animal models, which are administered intraperitoneally.[31,53]

2.1. Reproductive toxicity activity

Evaluation of the effects of oral administration of graded doses of *T. occidentalis* leaf extracts at dose (200, 400 and 800 mg/kg/day) on testis of Sprague Dawley rats showed poor histo-morphometric profiles,[11,54] low sperm characteristics and increased evidence of testicular oxidative stress in the groups of rats treated with 400 and 800 mg/kg/day. The conclusion was that, while the lower dose of *Telfairia occidentalis* leaf extract (200 mg/kg/day) was testiculo-protective, the higher doses (400 and 800 mg/kg/day) demonstrated testiculo-toxicity in the rat models.[55] This indicates that the dose of application of the extract in herbal medicine should be regulated to reduce any possible reproductive impairment. Studies on a dose-dependent basis reported the testiculotoxic effects of *T. occidentalis* leaf extract in rats and there was an indication of testicular basement

membrane distortions.[56] hemorrhage, cellular degeneration, interstitial space exudations and cellular necrosis when the dose of 100 and 200 mg/kg body weight of aqueous extract was administered orally to adult male Wistar rats for 4 weeks. The conclusion from this study was that *T. occidentalis* had a reducing effect on sperm quality, plasma testosterone values and with the potentials for testicular cell damage in a dose dependent manner.[31,56] Other researchers have confirmed the roots and leaves of *T. occidentalis* contain highly toxic alkaloids and saponins,[20,57] even though *Telfairia occidentalis* extract contains tannins which are classified as antioxidants, at a high dose, and they could become pro-oxidant leading to an increased in lipid peroxidation and inducing oxidative stress.[58]

2.2. Medicinal Uses of *Telfairia Occidentalis*

The World Health Organization (WHO) estimates that up to 80% of world's population have used or still rely mainly on traditional medicine and for thousands of years, medicinal plants have been an important source of medicine.[3,22] The role of medicinal plants in disease prevention and management has been associated with antioxidant properties of their bioactive metabolites.[58] *T. occidentalis* leaf and seed is of high nutritional value with the leaves rich in minerals such as iron, potassium, sodium, phosphorus, calcium and magnesium, and contain antioxidants such as thiamine, riboflavin, nicotinamide, ascorbic acid. They contain amino acids such as alanine, aspartate glycine and leucine.[19,59] Research has shown that *T. occidentalis* leaf and seed extracts can be used for the treatment of convulsion, atherosclerotic cardiovascular disorders, arthritis, liver problems, inflammatory, anemia, high blood pressure, hyperglycemia, dyslipidemia, conditions.[4,17,60]

The bioactive compounds include flavonoids, a potent antioxidant compound that scavenges for free radicals and reducing oxidative stress,[61] tannins, hence it purgative, anti-asthmatic, antitussives (cough suppressants) and anti-hay fever effect.[35,44,62] *Telfairia occidentalis* extracts also contain terpenoids, an antifeedant with insecticidal activity.[63,64]

2.3. Antidiabetic property of *Telfairia occidentalis*

Diabetes is a metabolic disease with one of the biggest challenges of public health concern globally and the fourth leading cause of death in low middle income countries (LMIC).[31,65] Diabetes cause an abnormally high level of glucose in the blood due to carbohydrate metabolism which is linked to low blood insulin level or insensitivity of target organs to insulin.[3,66,67] The consequences of untreated diabetes include neurodegenerative disease, cardiovascular disease, blindness (retinopathy), kidney disease, among others. The current antidiabetic therapies (insulin, sulfonylureas, biguanides and glinides, DPP4-inhibitors, etc) have been reported to produce serious adverse effects such as cataract, neuropathy and nephropathy,[68] hence, the need for a more effective and relatively safe hypoglycaemic agents.

Hypoglycaemia property of *Telfairia occidentalis* leaf extractwas first reported in mice,[69] showing that aqueous extract of leaves decreased blood glucose level significantly in streptozotocin-induced diabetic and glucose-induced hyperglycaemic rats.[69,70] Other research has shown that ethanolic leaf extract of *T. occidentalis* significantly lowered blood glucose level in alloxan-induced diabetic rat when compared with the standard antidiabetic drug, glibenclamide. The conclusion drawn indicates that the leaves possess hypoglycemic activity in normoglycemic and alloxan-induced diabetic rats, and could be a potential source of antidiabetic plants for diabetics.[27,38,71]

2.4. Anxiolytic/sedative properties

Studies done to investigate the anxiolytic and sedative activities of the hydroethanolic leaf extract of *Telfairia occidentalis* in mice used the hole-board, elevated plus maze, open-field, light-dark and social interaction tests and reported that *T. occidentalis* at doses of 50 and 100 mg/kg, increased the number of sectional crossings, duration of head dips, increased number of entries into open arms, and increased number of central squares.[72] At a dose of 400 mg/kg, leaf extracts reduced the number of head dips and sectional crossings, reduced time spent in open arms and increased time spent in closed arms, while at doses of 200 and 400 mg/kg, reduced number of assisted rearing, increased latency of entry into and time spent in dark box and reduced number of social interactions.[2,73] The researchers suggested that *T. occidentalis* possess anxiolytic property at doses of 50 and 100 mg/kg, and sedative activity at dose range of 200 and 400 mg/kg.

2.5. Antinociceptive/Analgesic properties

The analgesic and anti-inflammatory properties of the leave of *Telfairia occidentalis* have been reported.[55,62] The seeds are known to possess different biological properties and are used in traditional African pharmacopoeia and in Asia to treat many diseases. Studies has been done on the antinociceptive property of methanolic seed extract of *T. occidentalis* in Wistar rats to demonstrate its ethnomedicinal use.[74] The analgesic property was illustrated using formalin-induced paw licking test in the rats at doses 100, 200 and 400 mg/kg body weight of seed extract. The outcome showed a significant reduction in formalin-induced paw licking in both neurogenic and inflammatory phases of formalin-induced paw licking test in a dose dependent manner and suggested that seed extract could be used as an analgesic for treatment of pain.[75]

2.6. Hepatoprotective property of *Telfairia occidentalis*

Studies on the investigation of the effect of lyophilized aqueous leaf extracts of *T occidentalis* on cyanide on (3 mg/kg body weight)-induced toxicity in kidney, liver,

and brain of 3 weeks old albino rats reported that *T. occidentalis* improved cyanide toxicity by increase in average body weight of the rats, reduction of ocular lesion, and nasal discharge, with a decrease in elevated levels of ALP and AST.[77] Morphology evaluation showed that *T. occidentalis* caused multifocal degeneration and necrosis of the liver, with mild congestion of blood vessels in the kidney and brain induced by cyanide ingestion in the rat model.[78] It was concluded that, lyophilized aqueous leaf extracts showed promising potential as a safe antidote for cyanide toxicity when administered at same time or immediately after ingestion of sublethal dose of cyanide. It was then recommended that, extended bioassay guided fractionation and analytical studies should be conducted in order to identify the bioactive compound or molecule in the plant responsible for the observed effects.[14,78] Studies showed that *T. occidentalis* leaf extracts induced cadmium chloride-induced hepatic injury by improving the liver cell architecture, a decrease in hepatocellular degeneration and necrosis.[11,23,79] The aqueous extract of *T. occidentalis* exhibited hepatoprotection by scavenging free radicals, reversing and inhibiting oxidative stress pathways and protecting the structural architecture of the liver.

2.7. Nephroprotective property.

There are still gaps of information on the safety potential despite of the highly researched and documented medicinal uses and pharmacological activity of *Telfairia occidentalis*, of aqueous extract in conditions of renal failure.[80] Research on the aqueous leaf extracts on gentamycin-induced renal damage.[23,81] and that *T. occidentalis* leave extract can decreased elevated levels of creatinine and uric acid levels, indicating that *Telfairia occidentalis* extracts could be nephroprotective in renal impairment.[82] Reports also show that methanolic leaf extracts of *T. occidentalis* restored disrupted renal functionality in rats treated with copper intraperitoneally by decreasing elevated levels of urea and creatinine, and increasing the decreased concentration of serum electrolytes, thus suggesting the nephroprotective activity.[47]

2.8. Reproductive activity

Reent report shows that a high dose of (800 mg/kg body weight) of *T. occidentalis* leaf extracts is testiculotoxic but less toxic at low doses of (200 mg/kg body weight),[83] and testiculoprotective.[15] The study on the reproductive activity of aqueous leaf extracts of *T. occidentalis* in adult male Wistar rats also shows an increased sperm count, sperm viability and sperm motility.[28,84] Reported increased in spermatozoa in the lumina of the seminiferous tubules and epididymis has been documented and improved spermatogenesis with increased levels of testosterone, linked to increased levels of luteinizing and follicle stimulating hormones. The conclusion is that the aqueous leaf extracts of *Telfairia occidentalis* show promising pro-fertility activities.[67,70,85] Other studies have reported on the testiculoprotective effects of *T. occidentalis* seed extract on sperm morphological characteristics, biochemical markers and epididymal histo-pathology in adult male rats exposed with cyclophosphamide, an anti-cancer chemotherapy bioactive molecule, applied to suppress the immune system, and reported that the co-administration of dose 300 mg/kg body weight *T. occidentalis* seed extract could give a significant increase in the total antioxidant capacity level, reversed the histopathological modifications (vacuolization, disorganization and the separation of epididymal epithelium), induced by cyclophosphamide.[52,86,87] Suggestions indicates that *T. occidentalis* seed extract might have promising potential as protective agent against cyclophosphamide-induced reproductive toxicity.

2.9. Neuroprotective property

The nervous system is very susceptible to oxidative stress due to limited antioxidant capacity, and has the potential to consume 20% of the metabolic oxygen, thus the neurons are not able to synthesize glutathione and contains more of polyunsaturated fatty acids.[56,88] Investigation of the *in-vitro* inhibitory effect of some tropical green leafy vegetables like *Telfairia occidentalis, Amarantus cruentus* and *Struchium sparganophora*, on the key enzymes like acetylcholinesterase and butyrylcholinesterase that are linked to Alzheimer‟s disease and some prooxidant-(iron sulphate, sodium nitroprusside and quinolinic acid) have been shown to induce in a dose dependent manner lipid peroxidation in rats‟ brain, and have with indication that all the vegetables inhibited acetylcholinesterase (AChE) and butyrylcholinesterase (BChE) activity, and also the pro-oxidant-induced lipid peroxidation in rat brain.[3,7,56,89] Some of the possible mechanism by which green leafy vegetables exert their neuroprotective activities could be associated to the inhibition of acetylcholinesterase and butyrylcholinesterase activities and prevention of lipid peroxidation in the brain.[70,90] The assessment of the protective property of *T. occidentalis* leaf extracts has been done at doses of 400, 800 and 1600 mg/kg body weight in irradiation-induced oxidative stress in rat brain.[41,57] Report also indicates that *T. occidentalis* leaf extracts at doses of 400 and 800 mg/kg body weight, enhanced increased levels of MDA and hydrogen peroxide induced by radiation, and increased the decreased levels of GSH, SOD, GPx and GST properties in the rat brain and concluded that *T. occidentalis* leaf extracts could reduce radiation-induced biochemical disorders in brain tissues.[17,58] More assessment of the promising protective potential of aqueous leaf extracts of *T. occidentalis* has been demonstrated against mercuric chloride ($HgCl_2$)-induced behavioural, biochemical and morphological modifications in rat brain.[59] *Telfairia occidentalis* leaf extract can induce the increased MDA levels, catalase and SOD activities, increased grooming and locomotor frequencies with an in increased GSH levels.[9,59]

3.0. Pharmacological and biological activities

3.1. Antioxidant activity

Telfairia occidentalis show a promising antioxidant property. The aqueous extract contains a high total phenol, reducing power and free radical scavenging ability (12.2 %, 1.9 OD700 and 92 %, respectively) than the ethanolic extract with a total phenol, reducing power and free radical scavenging ability of 5.5 %, 1.5 OD700 and 25 %, respectively.[8,63,91] The free soluble polyphenols content in the leaf of the plant that are higher than the bound polyphenols show stronger antioxidant property as exemplified by their higher reducing power and free radical scavenging property than the bound polyphenols.[9,65] *T. occidentalis* leaf contained a high vitamin C content, total flavonoids and phenolic phytochemicals than *Psidium guajava* stem bark.[15,20,91] The leaf shows stronger inhibition of free radicals than *Psidium guajava* stem bark.[10] The n-hexane fraction identified contain the very high flavonoid content and free radical scavenging activity with respect to that of the commercial antioxidant BHT.[11,67,92] The potential of the leaf of *Telfairia occidentalis* to reduce iron (III) to iron (II) has also reported and the antioxidant potential of *T. occidentalis* is associated to the high polyphenols content, especially with the flavonoids.[19,68]

3.2. Anticancer property

Cancer is a general term for a large group of diseases affecting any part of the body. One characteristic feature of cancer is metastasis.[12] According to WHO, cancer is a leading cause of death worldwide, accounting for 7.6 million deaths (around 13 % of all deaths) in 2019.[2,17,93] Deaths from cancer globally are anticipated to continue to rise to over 13.1 million in 2030.[5] Studies show that *Telfairia occidentalis* contains bioactive compounds with anticancer properties and the crude extract of the seed have shown anticancer activity by a significant inhibition of oxidative burst activity in whole blood, isolated polymorphonuclear cells (PMNs) and mononuclear cells (MNCs).[21,72,94] The potency order was rated as hexane fraction > dichloromethane fraction > ethyl acetate fraction > butanol fraction > aqueous fraction > crude extract.[31] The seed of *T. occidentalis* lowered serum prostatic acid phosphatase concentrations, increased testosterone: estradiol ratio, and reduced the mass and secretory activity of the enlarged prostate, with confirmation to have a promising potential in controlling benign prostatic hyperplasia in rats.[32,33,73] It reduced the mean relative prostate weight, protein content (mg/tissue) of the rats' prostates and serum prostatic acid phosphatase, lowering the induction of BPH in rats,[33] through increase in the level of serum testosterone while simultaneously lowering the level of serum estradiol. The leaves of *T. occidentalis* contains phenolic compounds, flavonoids, phytosterols, tannins, saponins, chlorophyll and glycosides with strong strong chemosuppressive potential activity.[95]

3.3. Anti-inflammatory and analgesic activity

The leaf of *T. occidentalis* significantly reduced Carrageenan-induced oedema in the sub-planar hind paw with vegetable extracts.[34] The seed extract showed significant anti-inflammatory potential on egg albumin and xylene-induced oedema by a dose-dependent inhibition of pains in acetic acid-induced writhing, formalin-induced hind paw licking and thermal induced pain models. The inhibition of neurogenic and non-neurogenic pains as well as narcotic pains by the extract may be linked to the mechanism of action of the bioactive compounds that is still to be studied.[35,97]

3.4. Spermatogenic Property

Male fertility potential of *Telfairia occidentalis* produced a dose-dependent enhancement of the seminal fluid analysis and the histology of the testes, showing a near complete morphological regeneration and increased spermatogenesis.[73] The leaf extract of *T. occidentalis* showed a significant rise in sperm motility, sperm viability and sperm count in rat.[37,98] The seed oil at a dose range of 400 mg/kg can improved semen parameters but show no activity on testicular histology, testosterone and luteninizing hormone level in rat.[38,74] The essential oil extract increased the level of testosterone, luteinizing hormone, sperm count, sperm motility and testicular weight when compared with alcohol treated rats. *T. occidentalis* has also shown a promising prophylactic potential on alcohol induced testicular damage and improved semen quality in rat models, and also an increased in serum testosterone and luteinizing hormone levels.[39,75,99] *Telfairia occidentalis* seeds mixed with formulated animal diet demonstrated some levels of modest lowering of biochemical castration and an increase in secretory capacity of the testes in rats, thus supporting its inhibiting activity and the induction of andropause in rats.[40,76]

The spermatogenic activity of *T. occidentalis* may be linked to the carbohydrate content which could increase sperm motility and viability by increasing glucose metabolism leading to the generation of energy and pyruvate which is the preferred substrate necessary for the activity and survival of sperm cells.[78] Other metabolites of the plant such as arginine, vitamin C and zinc could play a vital role as studies have shown that nutritional therapies with zinc, vitamin C, vitamin E and arginine have a promising medicinal potential in the treatment of male infertility.[79] The beneficial effect of the plant bioactive metabolites on male fertility may be linked to the effect of antioxidant phytochemicals identified in the plant as antioxidants such as vitamins A, C and E, known to have good protective properties on the testis.[39,80,100]

3.5. Antimalaria activity

Malaria is an endemic tropical disease affecting more than 40 % of the world's global population.[15,94,100] It is widely distributed in sub-Saharan Africa where over 90 % of cases have been reported, accounting for over 2

million deaths annually.[23,95] The problem of drug resistance to the plasmodium parasite to chloroquine which until the discovery of artemisinin has been the main source of antimalarial drug is responsible for the significant increase in death from malaria in Africa.[11,19,101] However, resistance to the recommended artemisinin-based combination therapy has also been reported in some agro climatic settings of the world, but most of the antimalarial drugs in use today such as quinine and artemisinin were either derived directly from plants or are derivatives of plant bioactive compounds.[3,17,102] Therefore, plants are considered to be a possible alternative and rich source of new chemical entities for malaria alternative and complementary treatment option.[98] The root of *Telfairia occidentalis* are known to express high blood schizonticidal potential activity both in 4-day early infection test and in well-established infection with a considerable survival time when compared to that of standard referenced drug, chloroquine (5 mg/kg).[45,103] Furthermore, the leaf extract possesses antiplasmodial activity both in the 4-day early infection test and in established infection with a marked rise in survival time, which, however, was lower than that reported with the standard drug, chloroquine (5 mg/kg/day).[98] The seed extract has also demonstrated a promising blood schizontocidal potential in early and established infections.[46] The plant showed very high *in vitro* synergistic activities in combination with chloroquine, and also against chloroquine (CQ)-tolerant *Plasmodium. berghei* isolates.[47,99] These studies generally, have shown that *T.occidentalis* plant extracts have a promising antiplasmodial activities, which may be exploited for malaria alternative and complimentary treatment and control of malaria parasites.[104]

3.6. Antimicrobial activity

The antibacterial potential of the leaf of *Telfairia occidentalis* against selected intestinal pathogens has been reported using the method of agar diffusion technique.[14] The extract showed an increase in antibacterial activity on *Escherichia. coli, Salmonella faecalis and Salmonella typhii* at minimum inhibitory concentration (MIC) of 0.5, 5.0 and 500 mg/ml for *E. coli, S. typhi and S. faecalis,* respectively.[48] Furthermore, the ethanolic leaf extract had a higher inhibitory effect on some of the commonly encountered Enterobacterioceae in reported in Nigeria, namely *Escherichia coli* (4.0 nm), *Pseudomonads aeruginosa* (8.0 nm) and *Proteus sp* (4.0 nm), except for *Salmonella typhii* (2.0 nm), with the aqueous extracts showing a higher inhibition of the mycelial growth. The crude extract inhibited the growth of 93.1 % of the tested microorganisms and showed synergistic effects at MIC/2 and MIC/5 with seven of the tested antibiotics on more than 70 % of the tested bacteria.[49,105] The plant extracts showed a dose-dependent paralysis and death of the worms, with the aqueous extracts showing higher worm inhibitory and destructive activities when compared with the methanol extracts.[52]

For the toxicity and biochemical activities, it was reported that the root of T. *occidentalis* was poisonous and more toxic,[51] while the aqueous extract of the root demonstrated a potent toxic effect on the mucosa lining of the stomach.[52,101] Other researchers have suggested that the root of *Telfairia occidentalis* may have nephrotoxic potential.[53] However, when administered orally, ethanolic extract of the root may less toxic than as earlier reported.[102]

4.0. Chemical Composition of *Telfairia occidentalis*

The composition of the different minerals varies with the age, time of harvest, soil conditions and environmental condition of the plant.[21,48] The anti-nutrient potential of the young stems and leaves of the plant have been shown to be higher than that identified in the older leaves and stems.[2,106,107] The high content of iron in the young tender fluted pumpkin leaves supported the basis for which the leaf extract is used in folk medicine as blood tonic in the treatment of anemia and applied to convalescing patients.[108] The crude fibre content of 20.17 ± 0.12 % in the leaves of *T. occidentalis* showed that the leaves of this plant are potential sources of dietary fibers. Higher carbohydrate content of 39.64 % gives an increase in energy value recorded as 290.16 kcal/100g which supports the fact that the plant leaves could serve as a good source of energy. The leaves are good sources of K, Cu, Fe and Mn, promising sources of Mg and Zn which are necessary in human and animal nutrition.[55] Total amino acid in *T. occidentalis* was 455.3 mg/g with a total essential amino acid of 256.1 mg/g or 56.3 %, showing that the plant proteins are high in essential amino acids.[55] The proximate analysis of leaf and stem has been summarized in table 1.

Table 1: Leaf and stem proximate chemical analysis of *Telfairia occidentalis.*[2,102,103]

Elements	Analysis quantity (%)
crude protein	21.31
Cabohydrate	39.64
Total amino acid	455.3 mg/g
Total essential amino	256.1 mg/g or 56.3%
crude fibre	20.17 ± 0.12
leaf extract ether extract	5.50
Ash	10.92,
nitrogen free extracts	55.56
Ca	0.40
P	0.15
K	3.41
N	0.43
Mg	0.02
Na	0.67),
metabolizable energy	3121.00 kcal/kg)
gross energy	4420.00 kcal/kg
Zn	7.50 mg/100g
Fe	18.5 mg/100g)
Mn	1.18 mg/100g
Phytate	(510.51 mg/100g
Tannin	(0.184 mg/100g)
Oxalate	0.0034 mg/100g)
Vitamin E	5.07 mg/100ml
Vitamin C	40 mg/100ml

4.1. Seed proximate analysis

The seed moisture content has been estimated to be around 6.30%, with the presence of sucrose, glucose, fructose, and about sixteen amino acids.[52,109] The moisture content analysis of (6.30 %), ash (3.44 %), carbohydrate-Starch-(16.5- (62.5), crude protein (16.0 %) has been documented. Other bioactive molecules reported are glucose, fructose, sucrose and sixteen amino acids with glutamic acid (16.4 g/100g) being the highest, with lysine (2.6 g/100g) being the lowest.[104] The chemical compositions of phospholipids, glyco-lipids and neutral lipids were recorded as follows: phosphatidyl ethanolamine (6.5 %), phosphatidyl inositol (4.4 %), phospholipids (58.0%), phosphatidyl choline (26.2 %), phosphatidyl serine (5.3 %), phosphatidylglycerine (1.6 %), glycolipids (26.0 %), monogalactosyldiglyceride (11.7 %), digalactosyldiglyceride (8.2 %), Steryl glycoside (3.6 %), cerebroside (0.8 %), lysophosphatidyl choline (14.0 %), unidentified (0.5 %), unidentified (0.8 %), unidentified (0.4 %), neutral lipids (16.0 %), triglycerides (5.6 %), diglycerides (3.8 %), sterylesters (2.5 %), Free sterols (1.1 %) and monoglycerides (3.0 %).[56,110] The oleic acid was identified as the main fatty acid, with about 36 % of the total fraction of fatty acid.

The seed proximate analysis has also been summarized in table 2, giving the main elements and quantity analysis.

Table 2: of Seed proximate composition analysis.[17,29]

Elements	Analysis quantity (%)
Moisture content	6.30 %
Ash	3.44 %,
Carbohydrate-Starch	16.5- 62.5%
Crude protein	16.0 %
Lysine	2.6 g/100g
Compositions of phospholipids, glyco-lipids and neutral lipids	
Phospholipids	58.0%,
phosphatidyl ethanolamine	6.5%
phosphatidyl inositol	4.4%
phosphatidyl choline	26.2 %%,
phosphatidyl serine	5.3 %,
lysophosphatidyl choline	14.0%
phosphatidylglycerine	1.6 %
glycolipids	26.0 %,
monogalactosyldiglyceride	11.7%
digalactosyldiglyceride	8.2 %,
Steryl glycoside	3.6 %
cerebroside	0.8 %,
unidentified	0.5 %,
unidentified	0.8 %
unidentified	0.4 %,
neutral lipids	16.0 %,
triglycerides	5.6 %
diglycerides	3.8 %
Free sterols	1.1 %
monoglycerides	3.0 %
Oleic acid	36 %

4.2. Nutritional content

The essential oil from seeds of *T occidentalis* is high in oil (30%), and shoots contain high potassium and iron contents, while the seeds alone contains 27% crude proteins and 53% fats. The leaves contain a high composition of antioxidants and hepatoprotective and antimicrobial properties.[54,111] The young shoots and leaves of the female plant are the main ingredients of popular egusi soup. The large dark-red seed is rich in fat and protein and generally eaten whole, ground into powder for a kind of soup, or made into a fermented porridge or mixed in bitter leaf soup called *ndole* or other leafy vegetable.[87] High levels of vitamins A and C have been documented to be present in seed and the high content of unsaturated fatty acids in the seed contributes to its high nutritive property.[21,47,106] The younger seeds are nutritionally popular as food since they contain fewer anti-nutrients and have sweeter taste than the mature seeds.[2] The amino acids, content indicates that glutamic acid is high in value (13.65 mg) followed by aspartic acid (10.78 mg) and leucine (10.26 mg) respectively. Methionine are shown to be the lowest (1.12 mg).[112] Other nutritional parameters recorded are as follows: weight per milliliter (1.755), specific gravity (0.7227), refractive index, acid value (3.65), iodine value (7.12), saponification value (12.2), ester value (8.55), viscosity (0.0035),[19,57,106]

4.3. Root Composition

Composition of fluted pumpkin also varies with the age of the plant. The highest mineral elements in older roots have been found to be potassium, calcium, magnesium and sodium. Generally, the highest concentrations of all the anti-nutrients (almost 100-fold for oxalates) have been reported in the root.[16,106] Oxalate content are very high in both young (1083 mg/100g) and old roots (2600 mg/100g).[2] Little information is available on the pod and pulp chemical composition. However, the pod and pulp composition indicate that they may contain the following: moisture (91.3 and 92.8), crude protein (1.4 and 1.3), crude fibre (0.85 and 0.46), ether extract (0.50 and 0.30), ash (0.40 and 0.30), and nitrogen free extract (5.60 and 4.84), respectively.[58,107]

4.4. Phytochemical constituents of *Telfairia occidentalis*

The reported presence of tannins, reducing sugars, glycosides, saponins and sterol and triterperoids in the root, and only tannins, flavonoids, alkaloids, saponins, steroids, anthraquinones, and reducing sugars are found in the stem and leaves.[3,23,108] The long chain n-3-unsaturated fatty acid have been isolated from the leaf using an arginated silica gel column (8 cm, 0.5 mm diameter) eluted with n-hexane.[109] Palmitoleic acid (16.62 %) and elaidic acid (0.85 %) are the most identified omega 9 fatty acid present in the leaf.[59,110]

GC-MS analysis of hexane and dichloromethane fractions of the seed have indicated that the seed contained compounds such as pentadecanoic acid, hexadecanoic acid; hexadecanoic acid, methyl ester; αphellandrene; α-campholene aldehyde;terpinen4-ol Octadecadienoic acid (Z)-, 2, 3-dihydroxypropyl ester, 16- octadecenoic acid methyl ester; 9, 12-octadecadienoyl chloride (Z,Z); 9-; Octadecanoic acid ; hexadecanoic acid, 2,3-bis[(trimethylsilyl)oxy] propyl ester in the hexane fraction and 2,4-heptadien-6-ynal,(E,E); benzoic acid ; dodecanoic acid ; linoleic acid ethyl ester ; trans-β-ocimene; borneol ; stigmastan-3- ol, in the dichloremethane fraction.[4,71,75,110]

Ethnobotanical databases show that some of the bioactive compounds isolated from the seeds have the following biological properties: palmitoleic acid (5-alpha reductase inhibitor); benzoic acid (allergenic, anesthetic, antibacterial, antipyretic, antiseptic, choleretic); Linoleic-acid (5-AlphaReductase-Inhibitor, antialopecic, Antiarteriosclerotic, Aelaidic acid (antiinflammatory and antileukotriene-D4). Pentanoic acid (antioxidant property); ntiarthritic, Anticoronary, Antifibrinolytic, Antihistaminic, Antiinflammatory, Antileukotriene-D4, Hypocholesterolemic, Immunomodulator). Terpinen-4-ol (Antiacetylcholinesterase, Antiallergic, Antiasthmatic, Antibacterial, Antioxidant, Antiseptic, Antispasmodic; Antimenorrhagic, Antiprostatitic, Cancer-Preventive, Carcinogenic, Comedolytic, Hepatoprotective, Antitussive, Antiulcer, Bacteriostatic, Diuretic, Fungicide, Herbicide, Herbicide); Borneol (Analgesic, Antiacetylcholine, Antibacterial, Antibronchitic, Antiescherichic, Antifeedant, Antiinflammatory, Antiotitic, Antipyretic, CNS-Stimulant, Hepatoprotective, Myorelaxant, Nematicide, Sedative, Tranquilizer) Antispasmodic, Antistaphylococcic, Anti-yeast,[11,27,38,69] The categorization of the pharmacological properties of *T. occidentalis* has been summarized in table 3.

Table 3: Categorization of the pharmacological properties of *Telfairia occidentalis* based on studies retained.

No	Category of Pharmacological activity	Therapeutic Disease area/Biologicalcondition	References
1	Hypercholesterolemic	Hyperlipidemia	
2	Andidiabetic	Hyperlipidemia Type 2 diabetic	[41, 67]
3	Free radical scavenging and antioxidant	Free radical and Reactive oxygen species induced tissue damage	[4,15, 103]
5	Antiplasmodial	Malaria	[7, 45]
6	Antimicrobial	Disease caused by certain bacterial infections (Salmonella typhi, Escherichia coli, Pseudomonas aeruginosa and Proteus spp	49, 83]
7	Profertility	Oligospermia, reduced sperm motility and testicular antioxidant activity,alcohol-inducedtesticular damage, low sperm quality and imbalance in gonadotropic hormones	[3, 55]
8	Hepatoprotective	Liver damage	[8, 102]
9	Antianemic and haematological improvement	Anemia and hematological anomalies	[5, 66, 70]
10	Anticancer	Tumorogenesis (Malignant and benign)	[12, 37, 59]
11	Anticonvulsant	Convulsion	[20, 33, 89]
12	Anxioloytic and sedative	Anxiety and depression	[7]
13	Renal protection	Kidney damage	[102, 112]
14	Antinociceptive and antiinflammatory	Pain and inflammation	[11, 26, 44]

4.5. Pest and pathogen problems of the biodiversity and conservation of *Telfairia occidentalis*

A major concern of buyers and sellers of fluted pumpkin as an economic crop is the constraints of pod rot infection. Infection occurs at post-harvest, during transportation, although cases have been reported on crops before harvest. The infection starts as a small lesion that creates an avenue for pathogens to penetrate the fruit.[9, 29] The lesion develops and generally appear brown in colour, which is an indication of infection by *Rhizoctonia. stolonifer* or *Erwinia sp*. In some cases, the infected area may also appear black (indicating the presence of *Aspergillis niger*) or grey (*Botrytis. theobromae*).[12, 46] Other symptoms linked with the presence of these pathogens include softening of the pod tissue that gives a pungent odour, or watery fluid in the fruit. Pod rot incidence and severity can be reduced and controlled by avoiding damage to the fruit during harvest and transport.

5. 0. Discovery and Development Of Improve Traditional Medicine From *Telfairia Occidentalis*

Natural products since the ancient times have always been a great source for new medicines. Although products from natural sources may not be necessary active bioactive molecules in their final form, many commercial new chemical entities have their origins from plant natural products. It is estimated that at least

25% of new drugs are derived, either directly or indirectly, from medicinal plants, such as Artemisinin, paclitaxel, vincristine, to name a few.[6,18] Drug discovery involves the identification of new chemical entities (NCEs) of potential therapeutic potential, that may be obtained through isolation from natural sources, through chemical synthesis or a combination of both.[35]

According to WHO,[46] traditional medicine is considered as any finished, labelled medicinal product that contains as its active ingredient(s) aerial or underground parts of plants, or other plant materials, or combinations thereof, be it in the form of crude state or as plant preparations.[53] Plant material includes juices, gums, fatty oils, essential oils and any other substances of this nature. Traditional medicines may contain conventional excipients in addition to the plant-based active molecules. In other conditions, they may also contain, natural organic or inorganic ingredients which are not plant based. Four categories of traditional medicines have been developed based on their mode of preparation, the indication, and extent of the development of the traditional medicine relative to the traditional remedy used.[46] This classification has been developed by WHO in collaboration with the African Organization for Intellectual property (OAPI). The OAPI nations have developed these categories to aid in registration and homologation of traditional medicines in the subregions.

In order to support and promote research in traditional medicine (TM), WHO in collaboration with organization OAPI has elaborated strategies recommendation for the verification and validation of improved traditional medicine. Traditional medicine is categorized into four standard groups as indicated in figure 2 and the regulatory requirements summarized in table 4.

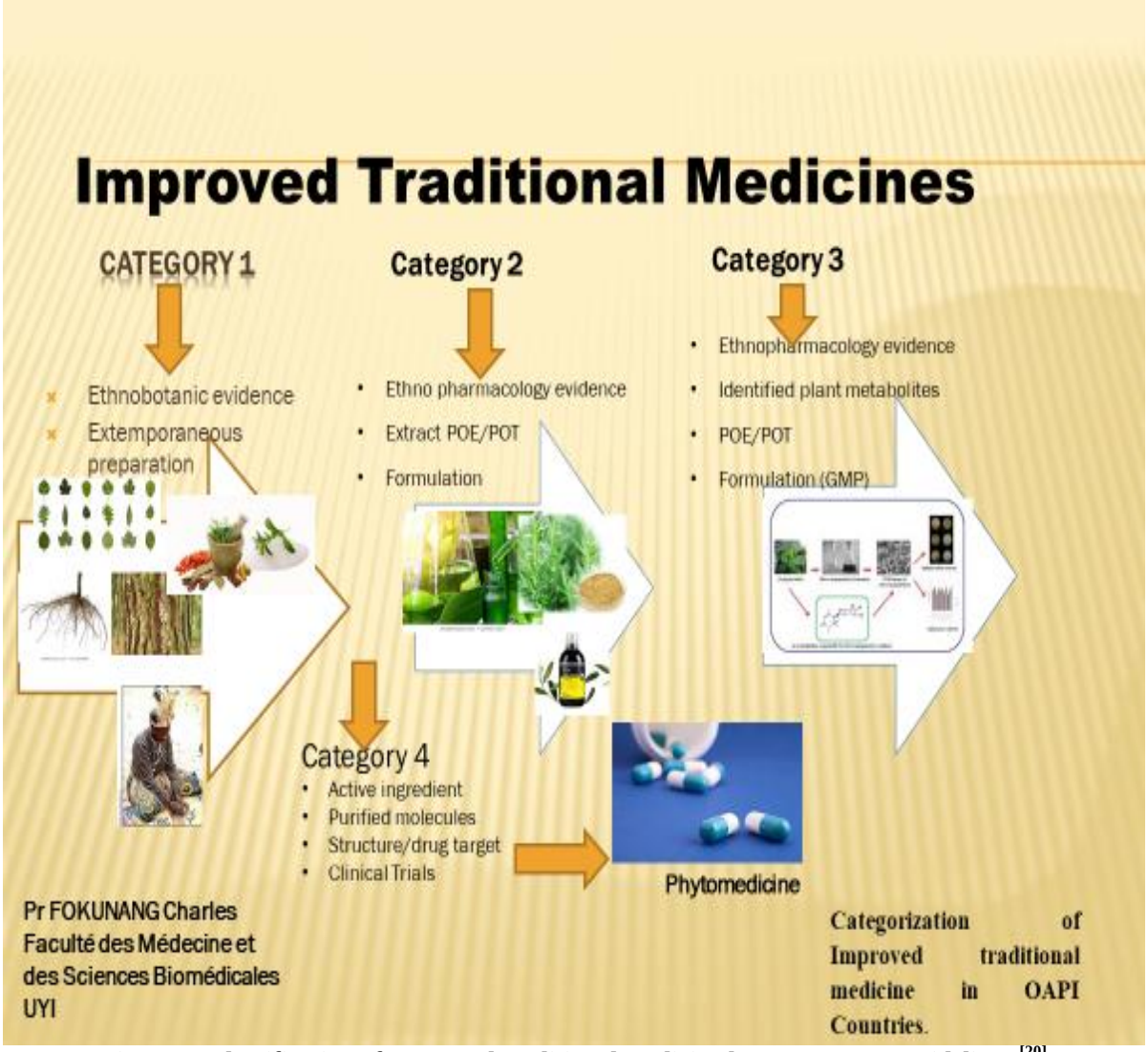


Figure 2: Classification of Improved traditional medicine by OAPI/WHO guidelines.[20]

Table 4: Categories and regulatory requirement of improved traditional medicine (ITM), Phytomedicines.[20]

Plant Category	Preparation	Data	Marketing authorization
1	Extemporaneous preparation using traditional methods of preparation Safety/Quality and Efficacy are guaranteed by experience over three **generations of use**. Raw materials are identified by the traditional doctor (fresh/dry). Short duration of storage	No data	None required. Traditional practitioner is authorized
2	Its safety and efficacy are guaranteed by ethno medical evidence and the long experience of use or by clinical trials evidence The active ingredient is from **extra-dry raw materials**. The **primary functional groups** of raw materials is known. Stability studies shelf-life.	Toxicology Clinical data (unspecified)	MA based on pharmaceutical quality, efficacy and safety.
3	Active ingredient is from a standardized extract. Its efficacy and safety should be demonstrated by preclinical and clinical studies conducted through standard protocols.	Pharmaceutical Pharmacology Toxicology (acute and subacute) Pharmacodynamic Clinical trials Phases 1 & II	MA authorization on quality, safety and efficacy
4	Active ingredient is purified molecules. Its efficacy and safety should be demonstrated by preclinical and clinical studies conducted through standard protocols. Good Manufacturing Practices	Pharmaceutical Safety pharmacology Toxicology Drug metabolism/PK. Clinical trials Phases 1, II, III	Drug regulation in this category as expected for conventional medications

5.1. Phytomedicine preformulation and formulation development of *Tefairia occidentalis*

Phytomedicine reformulation and formulation development is defined as the phase of drug discovery and development research whereby scientist characterize physical and chemical properties of new chemical entities in order to develop safe, effective, and stable dosage form in compliance to the route of administration.[32,112]

Preformulation gives direction for development of formulation in choice of dosage form, excipients, composition, physical structure, helps in the adjustment of pharmacokinetics and biopharmaceutical properties. Support for process development of drug substance (yield, filtration), and produce necessary and useful data for development of analytical methods. The preformulation and formulation development process for phytomedicine/improved traditional medicine for *Telfairia occidentalis* from the reception of plant material to pharmaceutical forms can be summarized in figure 3

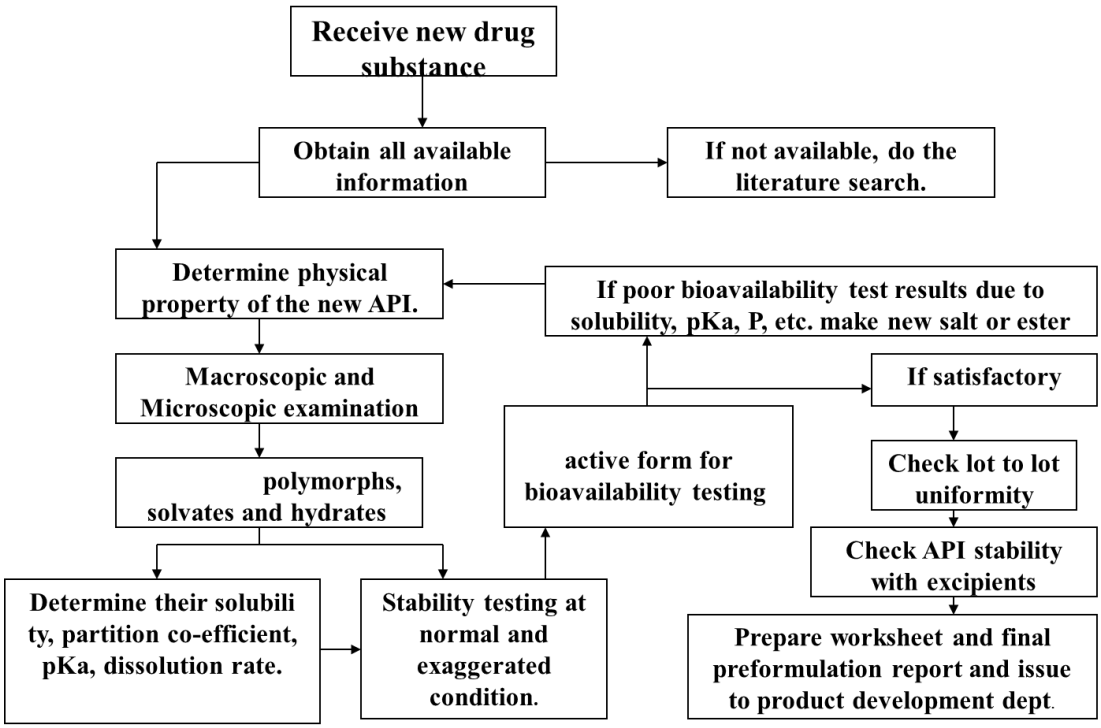


Figure 3: Preformulation development process for phytomedicine/improved traditional medicine.[47]

Drugs are commonly given in solution in cough/cold remedies and in medication for the young and elderly. In most cases absorption from an oral solution is rapid and complete, compared with administration in any other oral dosage form,[66] The rate limiting step is often the rate of gastric emptying. In theory a capsule dosage form should be quite efficient. The hard gelatin shell should disrupt rapidly and allow the contents to be mixed with the gastrointestinal tract contents.[25] The capsule contents should not be subjected to high compression forces which would tend to reduce the effective surface area, thus a capsule should perform better than a tablet. This is not always the case if a drug is hydrophobic a dispersing agent should be added to the capsule formulation. These diluents will work to disperse the powder, minimize aggregation and maximize the surface area of the powder.[45,47,84]

6. 0. CONCLUSION

The medicinal potential of the leaf and seed essential oil of *Telfairia occidentalis* has been well documented. The plant has been shown to possess important antiinflammatory, anxiolytic, haematological, antiplasmodial antioxidant, antidiabetic, hepatoprotective, antimicrobial, testiculoprotective, anticancer, and sedative properties. Most of the activities validates the medicinal claims of tradi-practitioners, although clinical trials studies, using human subject, still requires future research. Many researchers have also attributed some of the medicinal potential of the plant to the high level of antioxidant components and phytochemicals. However, the presence of other phytochemicals such as saponins may also play valuable roles in the activities of the plant. As researchers continue to focus their investigation on this plant, it is expected that more of the medicinal properties of the plant will be elucidated. However, not much has been done on the chemistry of the plant, especially the leaf. Therefore, researchers need to focus their investigation on the isolation and identification of bioactive components of the plant. It is worth noting that the identity of the components that are responsible for each of the identified medicinal properties of the plant needs to be elucidated and linked to structure activity relationship of the compounds. This may provide a "lead "to the discovery of novel drugs from the plants. The biosafety, biodiversity and conservation of the plant is very important for any sustainable crop production. The safety, efficacious preclinical studies done so far on *Telfiaria occidentalis in vitro* and *in vivo*, in animal models coupled with toxicity studies prospects for galenic formulation and quality testing for the development of an improved traditional medicine from this plant of great pharmaceutical potential.

Authors contributions: This work was carried out in collaboration among all authors. 'Author TVL, MJO and FCN designed the study, and wrote the first draft of the manuscript. 'Author TFEA, BEB, BHN, NBN and AET, managed the analyses of the study and the literature searches. All authors read and approved the final manuscript.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

Authors' contributions

This work was carried out in collaboration between all authors. Authors TVL, MJO and FCN designed the study, TEA, KGY, AMA, AET, Data mining, performed the statistical analysis, TVL, FCN wrote the protocol and wrote the first draft of the manuscript. All authors read and approved the final manuscript.

REFERENCES

1. Oluwadurotimi SA, Oluwakemi AB, Jacob OP, Olawole OO. Pharmacotherapeutic Properties of *Telfairia occidentalis* Hook F.: A Systematic Review. Pharmacogn. Natural Products. DOI: 10.4103/phrev.phrev_12_18. www.phcogrev.com | www.phcog.net, 2018.
2. Imosemi IO. Review of the toxicity, medicinal benefits, pharmacological actions and morphological effects of *Telfairia occidentalis* Hook. F.Eur. J. Pharmaceut. Med Res, 2018; 5(7): 22-32.
3. Slavin JL, Lloyd B. Health benefits of fruits and vegetables. Advances in Nutrition, 2012; 3: 506-516.
4. Adejuwon SA, Imosemi IO, Ebokaiwe PA, Omirinde JO, Adenipekun AA. Protective role of Telfairia occidentalis in irradiation-induced oxidative stress in rat brain. International Journal of Biological and Chemical Sciences, 2014; 8(3): 843-853.
5. Owoeye O, Gabriel MO. Protective effects of aqueous extract of *Telfairia occidentalis* on mercury-induced histological and oxidative changes in the rat hippocampus and cerebellum. African Journal of Biomedical Research, 2016; 19(3): 241-247. Imosemi. European Journal of Pharmaceutical and Medical Research www.ejpmr.com, 29.
6. Imosemi IO, Adekanmbi AJ, Atiba FA. *Telfairia occidentalis* leaf extract protects the cerebellar cortex against cisplatin-induced oxidative damage in Wistar rat. Archives of Basic and Applied Medicine, 2017; 5(2): 119-124.
7. Nwozo SO, Adaramoye OA, Ajayioba EO. Antidiabetic and hypolipidemic studies of Telfairia occidentalis on alloxan-induced diabetic rats. Nigeria Journal of Natural Products and Medicine, 2004; 8: 45-47.
8. Kayode AAA, Kayode OT. Some medicinal values of *Telfairia occidentalis*: A review. American Journal of Biochemistry and molecular biology, 2011; 1(1): 30-38.
9. Badifu GI, Akpapunan MA, Mgbemere VM. The fate of betacarotene in processed leaves of fluted pumpkin, a popular vegetable in Nigerian diet plant foods. Human Nutrition, 1995; 48: 141-147.
10. Saalu LC, Kpela T, Benebo AS, Oyewopo AO, Anifowope EO, Oguntola JA. The dose dependent testiculoprotective and testiculotoxic potentials of *Telfairia occidentalis* Hook f. leaves extract in rat. International Journal of Applied Research in Natural Products, 2010; 3(3): 27-38.
11. Horsfall MJr, Spiff IA. Equilibrium Sorption Study of Al, Co, and Ag in Aqueous solutions by fluted pumpkin (*Telfairia Occidentalis* Hook f). Waste Biomass. Acta Chimica Slovenica, 2005; 52: 174-181.
12. Fasuyi AO, Nonyerem AD. Biochemical, nutritional and haematogical implications of *Telfairia occidentalis* leaf meal as protein supplement in broiler starter diets. African Journal of Biotechnology, 2007; 6: 1055-1063.
13. Oluwadurotimi SA, Oluwakemi AB, Jacob OP, Olawole OO. Pharmacotherapeutic Properties of *Telfairia occidentalis* Hook F.: A Systematic Review. Pharmacogn. Natural Products. DOI: 10.4103/phrev.phrev_12_18. www.phcogrev.com | www.phcog.net, 2018.
14. Nwanna E, Oboh G. Antioxidant and hepatoprotective properties of polyphenol extracts from *Telfairia occidentalis* (Fluted Pumpkin) leaves on acetaminophen induced liver damage. Pakistan Journal of Biological Sciences, 2007; 10(16): 2682-2687.
15. Oboh G, Nwanna E, Elusiyan C. Antioxidant and antimicrobial properties of *Telfairia occidentalis* (Fluted pumpkin) leaf extracts. Journal of Pharmacology and Toxicology, 2010; 5(8): 539-547.
16. Kayode AAA, Kayode OT, Odetola AA. Telfairia occidentalis ameliorates oxidative brain damage in malnourished rats. International Journal of Biological Chemistry, 2010; 4: 10-18.
17. Tembe EF, Fonmboh DJ, Ngono MR, Banin AN, Fokunang LB, Kaba N, Abong BT, Duerr R, Ejoh R, Abena MTO, Fokunang CN. 2020. Pharmacovigilance of Natural Herbal Medicines Research for Efficacy, Safety and Quality Assurance of Phytomedicine Products; Journal of Complementary and Alternative Medical Research, 2020; 12(1): 21-37. ISSN: 2456-6276; DOI: 10.9734/JOCAMR/2020/v12i130198.
18. Dobgima JF, Ejoh RA Tembe EF, Bayaga H, Teke NG, Ngono MR, Njinkio NB, Fokunang LB, Banin NA, Nubia K, Ngameni B, Fokunang CN. An Overview of Methods of Extraction, Isolation and Characterization of Natural Medicinal Plant Products in Improved Traditional Medicine Research Asian Journal of Research in Medical and Pharmaceutical Sciences, 2020. Accepted Article no. AJRIMPS.61961 ISSN: 2457-0745.

19. Mogue I, Njinkio LBN, Tembe Fokunang EA, Mbacham WF, Fokunang CN. Évaluation de la Toxicité Aigüe des Extraits Aqueux de Combretum micranthum (Combrétacée) et Essai de Mise en Forme Galénique d'un Phytomédicament pour le Traitement de la Fièvre Typhoïde Health Sciences and Disease, 2020; 21(8): 1-15.
20. Fokunang CN, Tembe EA, Eric Baaboh, EF, Duidje MN et al. An insight into the prevention and management of severe adverse respiratory syndrome sars cov-2 (covid 19) from modern medicines and antivirals alternatives from natural productsin low middle income countries. European journal of pharmaceutical and medical research ejpmr, 2020; 7(8): 72-101. www.ejpmr.com.
21. Tembe FEA, Fokunang CN, Ndikum VN, Kaba NC, Banin AN, Fokam J, NanfackA, Duerr R, Gorny MK. Clinical Pharmacokinetics Concepts In The Drug Discovery And Development Process Of Phytomedicines In Some Developing Countries. World Journal Of Pharmaceutical And Life Sciences, 2018; 4(7): 22-32. .www.wjpls.org , SJIF Impact Factor: 5.088.
22. Djimeli NM, Fodouop SPC, Njateng GSS, Fokunang CN, Tala DS, Kengni F, Gatsing D. Antibacterial activities and toxicological study of the aqueous extract from leaves of *Alchornea cordifolia* (Euphorbiaceae). BMC Complementary and Alternative Medicine, 2017; 17: 349. DOI 10.1186/s12906-017-1854-5.
23. Tsafack DN, Kodjio N, Singor Njateng GSS, Fankam AG, Fokunang CN, Tala DS, Gatsing D. *In vitro* antisalmonella and antioxidant effects of various extracts from leaves and stem of *Tristemma mauritianum* (Melastomataceae) Research Journal of Pharmaceutical, Biological and Chemical Sciences 2017 RJPBCS, 2017; 8(3): 1916. ISSN: 0975-8585.
24. National Plant Data Center database (version 4.0.4) NRCS, USDA. Baton Rouge, LA 70874- 4490 USA. http://plants.usda.gov, 1996.
25. Ajibesin KK, Bala DN, Ekpo BAJ, Adesanya SA. Toxicity of some plants implicated as poisons in Nigerian ethnobotany to rat. Nigerian Journal of Natural Products and Medicine, 2002; 6: 7-9.
26. Inuwa HM, Aimola IA, Muhammad A, Habila N, Okibe P, Latayo M, Ahmed Z. Isolation and determination of omega-9 fatty acids from *Telfairia occidentalis*. International Journal of Food Nutrition and Safety, 2012; 1(1): 9-14.
27. Eseyin OA, Sattar MA, Rathore HA, Ahmad A, Afzal S, Lazhari M, Ahmad F, Akhtar S. Hypoglycemic potential of polysaccharides of the leaf extract of *Telfairia occidentalis*. Annual Research and Review in Biology, 2014; 4(11): 1813-182.
28. Oboh G, Nwanna EE, Elusiyan CA. Antioxidant and antimicrobial properties of *Telfairia occidentalis* (Fluted pumpkin) leaf extracts. Journal of Pharmacology and Toxicology, 2006; 1: 167-175.
29. Usunobun U, Egharebva E. Phytochemical analysis, proximate and mineral composition and in vitro antioxidant activities in *Telfairia occidentalis* aqueous leaf extract. Journal of Basic and Applied Sciences, 2014; 1(1): 74 – 87.
30. Osukoya OA, Adegbenro D, Onikanni SA, Ojo OA, Onasanya A. Antinociceptive and antioxidant activities of the methanolic extract of *Telfairia occidentalis* seeds. Ancient Science Life, 2016; 36(2): 98–103.
31. Eseyin OA, Akaninyene DA, Paul TS, Attih E, Emmanuel E, Ekarika J, Zubaid A, Sattar MA, Ashfaq A, Afzal S, Ukeme A. Phytochemical analysis and antioxidant activity of the seed of *Telfairia occidentalis* Hook (Cucurbitaceae). Journal Natural Product Research, 2017; 32(4): 444-447.
32. Akoroda MO. Ethnobotany of *Telfairia occidentalis* (Cucurbitaceae) among Igbos of Nigeria. Economic Botany, 1990; 44(1): 29-39.
33. Idris S. Compositional studies of *Telfairia occidentalis* leaves. American Journal of Chemistry, 2011; 1(2): 56-59.
34. Enujiugha VN, Oluwole TF, Talabi JY, Okunlola AI. Selected bioactive components in fluted pumpkin (*Telfairia occidentalis*) and Amaranth (*Amaranthus caudatus*) leaves. American Journal of Experimental Agriculture, 2014; 4(9): 996-1006.
35. Ladeji O, Okoye ZSC, Ojobe T. Chemical evaluation of the nutritive value of leaf of fluted Pumpkin (*Telfairia occidentalis*). Food Chemistry, 1995; 53: 353-355.
36. Kuku A, Etti UJ, Ibironke IS. Processing of fluted pumpkin seeds, *Telfairia occidentalis* (hook f.) as it affects growth performance and nutrient metabolism in rats. African Journal of Food, Agriculture, Nutrition and Development, 2014; 14(5): 9192-9214.
37. White CE, Campbell DR, GE. Combs Effect of moisture and processing temperature on activities of trypsin inhibitors and urease in soybeans fed to swine. In J Huisman, TFB van der Poel and IE Imosemi. European Journal of Pharmaceutical and Medical Research www.ejpmr.com 30 Liener (Eds.). Recent advances in anti-nutritional factors in legume seeds. Wageningen: Puduc., 1989; 230-234.
38. Barret B, Kelfer D, Raabago D. Assessing the risks and benefits of herbal medicine: An overview of scientific evidence. Alternative Therapy in Health and Medicine, 1999; 5: 40-49.
39. Bateman J, Chapman RD, Simpson D. Possible toxicity of herbal remedies. Scottish Medical Journal, 1998; 43: 7-15.
40. Akindele AJ, Oladimeji-Salami AJ, Oyetola RA, Osiagwu DD. Sub-chronic toxicity of the hydroethanolic leaf extract of *Telfairia occidentalis*

Hook. f. (Cucurbitaceae) in male rats. Medicine, 2018; 5(4): 1-22.
41. Agwu EJ, Odo, GE, Uwagbae M, Onuawueke CC. Acute toxicity of aqueous extract of the root of *Telfairia occidentalis* on *Clarias gariepinus* fingerlings. International Journal of Agriculture, Forestry and Fisheries, 2016; 4(1): 1-6.
42. Odemena CS, Essien JP. Antibacterial activity of the root extract of *Telfairia occidentalis* (fluted pumpkin). West African Journal of Biology and Applied Chemistry, 1995; 40(1-4): Oyewole O, Abalaka M. Antimicrobial activities of *Telfairia occidentalis* (fluted pumpkins) leaf extract against selected intestinal pathogens. Journal of Health Sciences, 2012; 2(2): 1-4.
43. Eseyin OA, Ekpo A, Idem I, Igboasoiyi AC, Edoho EJ. Effects of the fruits of *Telfairia occidentalis* on some biomolecules in rat. Pakistan Journal of Biological Sciences, 2007b; 10(18): 3240-3242.
44. Morcos A, Sarkis T. Histo-pathological alterations of the stomach of guinea pigs following administration of root aqueous extract of *Telfairia occidentalis*, European Journal of Medical Sciences, 2013; 11(2): 15.
45. Tyler V, Vans N, Bradt R, Lynno O. "Pharmacognosy" 5th ed. Philadelphia. Tee and Febiyer, 1981.
46. Ekanem TB, Ekwere PA, Eluwa MA. The effect of crude extract of root of *Telfairia occidentalis* (fluted pumpkin) on the histology of the liver of Wistar rats. Journal of Biomedicine Africa, 2005; 3(2): 30-33.
47. Ekanem TB, Ekeoma, AO, Eluwa, MA, Akpantah, AO. Influence of crude extract of root of *Telfairia occidentalis* (fluted pumpkin) on the cytoarchitecture of the rat kidney and body weight. Global Journal of Pure and Applied Sciences, 2010; 16(3): 353-358.
48. Samter M, Parker WC. International Encyclopaedia of Pharmacology and Therapeutics. 9 th ed. New York. Pergamon Press Ltd., 1972; 243-249.
49. Guyton AC, Hall JE. Textbook of medical physiology (9th ed.). Philadelphia, PA W.B. Saunders Company, 1996.
50. Robbins JD, Kunkel HO, Crookshank HR. Relationship of dietary mineral intake to urinary mineral excretion and the incidence of urinary calculi in lambs. Journal of Animal Sciences, 1965; 24: 76.
51. Adisa WA, Okhiai O, Bankole JK, Iyamu OA, Aigbe O. "Testicular damage in *Telfairia Occidentalis* extract treated Wistar rats." American Journal of Medical and Biological Research, 2014; 2(2): 37-45.
52. Taitzoglou A, Tsantarliotou M, Zervos I, Kouretas D, Kokolis NA. Inhibition of human and ovine acrosomal enzymes by tannic acid in vitro. Journal of the Society for Reproduction and Fertility, 2001; 121: 131-137.
53. Nworgu FC, Ekemezie AA, Ladele AO, Akinrolabu BM. Performance of broiler chickens served heat treated fluted pumpkin (*Telfaria occidentalis*) leaves extract supplement. African Journal of Biotechnology, 2007; 6(6): 818-825.
54. Fasuyi AO, Nonyerem AD. Biochemical, nutritional and haematological implications of *Telfairia occidentalis* leaf meal as protein supplement in broiler starter diets. African Journal of Biotechnology, 2007; 6: 1055-1063.
55. Alada AR. The haematological effect of *Telfairia occidentalis* diet preparation. African Journal of Biomedical Research, 2000; 3(3): 185-186.
56. Ajayi AI, Ajayi TC, Omoaro EU, Halim NK. Erythropoietic value of pumpkin leaf extract in rabbits - a preliminary study. Nigerian Journal of Physiological Sciences, 2000; 16: 1-3.
57. Oluwole FS, Falode AO, Ogundipe OO. Antiinflammatory effect of some common Nigerian vegetables. Nigerian Journal of Physiological Sciences, 2003; 18: 35-38.
58. Eseyin OA, Ebong P, Eyong E, Awofisayo O, Agboke, A. Effect of *Telfairia occidentalis* on oral glucose tolerance in rats. African Journal of Pharmacy and Pharmacology, 2010; 4(6): 368-372.
59. Akindele AJ, Oladimeji-Salami JA, Usuwah BA. Antinociceptive and anti-inflammatory activities of Telfairia occidentalis hydroethanolic leaf extract (Cucurbitaceae) Journal of Medicinal Food, 2015; 18: 1157–63.
60. Giami SY. Effect of germination on bread-making properties of wheat-fluted pumpkin (*Telfairia occidentalis*) seed four blends. Plant Foods for Human Nutrition, 2003; 58: 1-9.
61. Li S, Tan HY, Wang N, Zhang ZJ, Lao L, Wong CW, Feng Y. The role of oxidative stress and antioxidants in liver diseases. International Journal of Molecular Sciences, 2015; 16: 26087–26124.
62. Cooke MS, Evans MD, Dizdaroglun M, Lunec J. Oxidative DNA damage: mechanisms, mutation, and disease. Federation of American Societies for Experimental Biology (FASEB) Journal, 2003; 17: 1195–1214.
63. Cadenas E. Basic mechanisms of antioxidants activity. Biofactors, 1997; 6: 391-397.
64. Pharm-Huy LA, He H, Pharm-Huy C. Free radical. Antioxidants in disease and health. International Journal of Biomedical Sciences, 2008; 4(2): 89-96.
65. Fu L, Xu BT, Xu XR, Gan RY, Zhang Y, Xia EQ, Li HB. Antioxidant capacities and total phenolic contents of 62 fruits. Food Chemistry, 2011; 129: 345–350.
66. Deng GF, Xu XR, Guo YJ, Xia EQ, Li S, Wu S, Chen F, Ling WH, Li HB. Determination of antioxidant property and their lipophilic and hydrophilic phenolic contents in cereal grains. Journal of Functional Foods, 2012; 4: 906-914.
67. Deng GF, Lin X, Xu XR, Gao LL, Xie JF, Li HB. Antioxidant capacities and total phenolic contents

of 56 vegetables. Journal of Functional Foods, 2013; 5: 260-266.
68. Li AN, Li S, Li HB, Xu DP, Xu XR, Chen F. Total phenolic contents and antioxidant capacities of 51 edible and wild flowers. Journal of Functional Foods, 2014; 6: 319–330.
69. Zhang JJ, Li Y, Zhou T, Xu DP, Zhang P, Li S, Li HB. Bioactivities and health benefits of mushrooms mainly from China. Molecules, 2016; 21: 938.
70. Aminu M, Bello MS, Abbas O, Aliyu M, Malam BS, Auwalu G, Muhammad HA, Shafi"u M, Hussaina NN, Hasiya A, Sani A. Comparative *in vitro* antioxidant studies of ethanolic extracts of *Psidium guajava* Stem Bark and *Telfairia occidentalis* leaf. International Journal of Modern Biochemistry, 2012; 1(1): 18-26.
71. Nkereuwem AO, Eseyin OA, Udobre SA, Ebong A. Evaluation of antioxidant activity and chemical analysis of the leaf of *Telfairia occidentalis*. Nigerian Journal of Pharmaceutical and Applied Science Research, 2011; 1(1): 21-28.
72. Eseyin OA, Igboasoiyi AC, Oforah E, Nkop N, Agboke A. Hypoglycaemic activity of *Telfairia occidentalis* in rats. Journal of Pharmacy and Bioresources, 2005; 2(1): 36-42.
73. James SA, Efe R, Omwirhiren M, Joshua IA, Dutse I. Anti-diabetic properties and phytochemical studies of ethanolic leaf extracts of *Murraya koenigii* and *Telfairia occidentalis* on alloxan-induced diabetic albino rats. Advances in Life Science and Technology, 2016; 49: 57-66.
74. Oboh G, Akinyemi A, Ademiluyi A. Inhibition of αamylase and α-glucosidase activities by ethanolic extract of Telfairia occidentalis (fluted pumpkin) Imosemi. European Journal of Pharmaceutical and Medical Research www.ejpmr.com 32 leaf. Asian Pacific Journal of Tropical Biomedicine, 2012; 2(9): 733-738.
75. Ajao MY, Akindele JA. Anxiolytic and sedative properties of hydroethanolic extract of *Telfairia occidentalis* leaves in mice. Brazilian Journal of Pharmacognosy, 2013; 23(2): 301-309.
76. Bolaji OM, Olabode OO. Modulating effect of aqueous extract of *Telfairia occidentalis* on induced cyanide toxicity in rats. Nigerian Journal of Physiological Sciences, 2011; 26(2): 185-191.
77. Owoade AO, Aborisade AB, Adetutu A, Olurunnisola OS. Evaluation of the effectiveness of *Telfairia occidentalis* leave extracts in the amelioration of carbon tetrachloride-induced liver injuries and oxidative damage in rats. Journal of Advances in Medical and Pharmaceutical Sciences, 2016; 10(2): 1-11.
78. Oladele JO, Oyewole OI, Bello OK, Oladele OT. Hepatoprotective effect of aqueous extract of *Telfairia occidentalis* on cadmium chloride-induced oxidative stress and hepatotoxicity in rats. Journal of Drug Design and Medicinal Chemistry, 2017; 3(3): 32-36.
79. Ogunka-Nnoka CU, Amagbe R, Amadi BA, Amadi PU. Biochemical effects of *Telfairia occidentalis* leaf extracts against copper-induced oxidative stress and histopathological abnormalities. Journal of Advances in Medical and Pharmaceutical Sciences, 2017; 12(2): 1-15. 98. Maduka SO, Ugwu CE, Onwudinjo OJ. The effect of aqueous leaf extract of *Telfairia occidentalis* (Cucurbitaceae) on gentamycin-induced renal damage. Journal of Basic and Clinical Physiology and Pharmacology, 2016; 28(1): 11-17.
80. Sakpa LC, Onovughakpo-Sakpa OE, Okhimamhe AF. Profertility effects of aqueous leafextract of Telfairia occidentalis in adult male Wistar rats. Journal of Experimental and Clinical Anatomy, 2015; 14(2): 88-94.
81. Aghaei S, Nikzad H, Taghizadeh M, Tameh AA, Taherian A, Moravveji A. Protective effect of Pumpkin seed extract on sperm characteristics, biochemical parameters and epididymal histology in adult male rats treated with Cyclophosphamide. Andrologia, 2014; 46(8): 927-935.
82. Akang EN, Oremosu AA, Osinubi AA, Dosumu OO, Kusemiju TO, Adelakun SA, Umaru ML. Histomorphometric studies of the effects of *Telfairia occidentalis* on alcohol-induced gonado-toxicity in male rats. Toxicology Reports, 2015; 2: 968–975.
83. Jiofack RTB, Fokunang CN, Guedje NM, Kemeuze V, Fongnzossie E, Nkongmeneck BA, Mapongmetsem PM, Tsabang N. Ethnobotanical uses of medicinal plants of two ethnoecological regions of Cameroon. Int. J. Med. and Medical Sc; 2010; 2(3): 60-79. http://www.academic journals.org/ijmms ISSN 2006-9723
84. Olorunfemi A, Eseyin AS and Hassaan AR. A Review of the Pharmacological and Biological Activities of the Aerial Parts of Telfairia occidentalis Hook.f. (Cucurbitaceae). Tropical J. Pharmaceutical Res, 2014; 13(10): 1761-1769. ISSN: 1596-5996; http://www.tjpr.org http://dx.doi.org/10.4314/tjpr.v13i10.28.
85. Umeoka N. Antifungal effect and phytochemical screening of *Telfairia occidentalis* (hook f.) Leaf extracts. J Plant Biotechnol Microbiol, 2018; 1(1): 1-24.
86. Eseyin OA, Akaninyene DA, Paul TS, Attih E, Emmanuel E, Ekarika J, Zubaid A, Sattar MA, Ashfaq A, Afzal S, Ukeme A. Phytochemical analysis and antioxidant activity of the seed of Telfairia occidentalis Hook (Cucurbitaceae). Journal Natural Product Research, 2017; 32(4): 444-447.
87. Akoroda MO. Ethnobotany of Telfairia occidentalis (Cucurbitaceae) among Igbos of Nigeria. Economic Botany, 1990; 44(1): 29-39.
88. Idris S. Compositional studies of Telfairia occidentalis leaves. American Journal of Chemistry, 2011; 1(2): 56-59.

89. Enujiugha VN, Oluwole TF, Talabi JY, Okunlola AI. Selected bioactive components in fluted pumpkin (Telfairia occidentalis) and Amaranth (Amaranthus caudatus) leaves. American Journal of Experimental Agriculture, 2014; 4(9): 996-1006.
90. Ladeji O, Okoye ZSC, Ojobe T. Chemical evaluation of the nutritive value of leaf of fluted Pumpkin (Telfairia occidentalis). Food Chemistry, 1995; 53: 353-355. 36. Kuku A, Etti UJ, Ibironke IS. Processing of fluted pumpkin seeds, Telfairia occidentalis (hook f.) as it affects growth performance and nutrient metabolism in rats. African Journal of Food, Agriculture, Nutrition and Developmen, 2014; 14(5): 9192-9214.
91. White CE, Campbell DR, GE. Combs Effect of moisture and processing temperature on activities of trypsin inhibitors and urease in soybeans fed to swine. In J Huisman, TFB van der Poel and IE Liener (Eds.). Recent advances in anti-nutritional factors in legume seeds. Wageningen: Puduc., 1989; 230-234.
92. Nworgu FC, Ekemezie AA, Ladele AO, Akinrolabu BM. Performance of broiler chickens served heattreated fluted pumpkin (Telfaria occidentalis) leaves extract supplement. African Journal of Biotechnology, 2007; 6(6): 818-825.
93. Demiray S, Pintado ME, Castro PML. Evaluation of phenolic profiles and antioxidant activities of Turkish medicinal plants: Tilia argentea, Crataegi folium leaves and Polygonum bistorta roots. International Journal of Pharmacological and Pharmaceutical Sciences, 2009; 3(6): 74-79.
94. Fasuyi AO, Nonyerem AD. Biochemical, nutritional and haematological implications of Telfairia occidentalis leaf meal as protein supplement in broiler starter diets. African Journal of Biotechnology, 2007; 6: 1055-1063.
95. Alada AR. The haematological effect of Telfairia occidentalis diet preparation. African Journal of Biomedical Research, 2000; 3(3): 185-186.
96. Ajayi AI, Ajayi TC, Omoaro EU, Halim NK. Erythropoietic value of pumpkin leaf extract in rabbits - a preliminary study. Nigerian Journal of Physiological Sciences, 2000; 16: 1-3.
97. Oluwole FS, Falode AO, Ogundipe OO. Antiinflammatory effect of some common Nigerian vegetables. Nigerian Journal of Physiological Sciences, 2003; 18: 35-38.
98. Eseyin OA, Ebong P, Ekpo A, Igboasoiyi, A Oforah, E. Hypoglycemic effect of the seed extract of Telfairia occidentalis in rats. Pakistan Journal of Biological Sciences, 2007a; 10: 498-501.
99. Eseyin OA, Ebong P, Eyong E, Awofisayo O, Agboke, A. Effect of Telfairia occidentalis on oral glucose tolerance in rats. African Journal of Pharmacy and Pharmacology, 2010; 4(6): 368-372.
100. Edeoga HO, Okwu DE, Mbaebie1 BO 2005. Phytochemical constituents of some Nigerian medicinal plants. Afr J Biotechnol 4: 685-688.
101. Ehiagbonare JE 2008. Conservation studies on Telfairia occidentalis Hook .f. A. indigenous plant used in enthnomedicinal treatment of anemia in Nigeria. Afr J Agric Res 3: 74-77.
102. Emamghoreishi M, Heidari-Hamedani G 2006. Sedative-hypnotic activity of extracts and essential oil of Coriander seeds. Iran J Med Sci 31: 22-27.
103. Eseyin OA, Ebong P, Ekpo A, Igboasoiyi A, Oforah E 2007. Hypoglycemic effect of the seed extract of Telfairia occidentalis in rats. Pak J Biol Sci 10: 498-501.
104. Fasuyi AO 2006. Nutritional potentials of some tropical vegetable leaf meals: Chemical characterization and functional properties. Afr J Biotechnol 5: 49-53.
105. Oboh G, Nwanna EE, Elusiyan CA 2006. Antioxidant and antimicrobial properties of Telfairia occidentalis (Fluted Pumpkin) leaf extracts. J Pharmacol Toxicol 1: 167-175.
106. Okokon JE, Ekpo AJ, Eseyin OA 2007. Antiplasmodial activity of ethanolic root extract of Telfairia occidentalis. Res J Parasitol 2: 94-98.
107. Okoli BE, Mgbeogu CM 1983. Fluted pumkin, Telfairia occidentalis: West African vegetable crop. Econ Bot 37: 145-149.
108. Oluwole FS, Falode AO, Ogundipe OO 2003. Anti-inflammatory effect of some common Nigerian vegetables. Nig J Physiol Sci 18: 35-38.
109. Salman TM, Olayaki LA, Oyeyemi WA 2008. Aqueous extract of Telfairia occidentalis leaves reduces blood sugar and increases haematological and reproductive indices in male rats. Afr J Biotechnol 7: 2299-2303.
110. Sofowora EA 1993. Medicinal Plants and Traditional Medicine in Africa. Spectrum Books Ltd., Ibadan, Nigeria, p. 191- 289.
111. Vogel HG, Vogel WH 1997. Elevated plus maze test. In: Drug discovery and evaluation. Springer-Verlag Berlin Heidelberg, New York, 1997, p 234. Xu Y, Wang Z, You W, Zhang X, Li S, Barish P, Vernon M, Du X, Li G, Pan J, Ogle WO 2010. Antidepressant-like effect of trans-resveratrol: involvement of serotonin and noradrenaline system. Eur Neuropsychopharmacol 20: 405-413.
112. Zhang CG, Kim SJ 2007. Taurine induces anti-anxiety by activating strychnine-sensitive glycine receptor in vivo. Ann Nutri Metab 51: 379-386.
113. Akubue P, Kar A, Nnachetta F. Toxicity of extracts of roots and leaves of *Telfairia occidentalis*. Planta Medica, 1980; 38(4): 339-343.