The Annals of the University Dunarea de Jos of Galati
Fascicle VI – Food Technology (2018), 42(2), 137-152

REVIEW PAPER

INSIGHT INTO THE ETHNOPHARMACOLOGY, PHYTOCHEMISTRY, PHARMACOLOGY OF *Launaea taraxacifolia* (Willd) AMIN EX C. JEFFREY AS AN UNDERUTILIZED VEGETABLE FROM NIGERIA: A REVIEW

OLUWASESAN M. BELLO[1, 2*], OGBESEJANA B. ABIODUN[1], STEPHEN O. OGUNTOYE [2]

[1]*Dept. of Applied Chemistry, Federal University Dutsin-Ma, Katsina State, Nigeria.*
[2]*Dept. of Chemistry, University of Ilorin, Kwara State, Nigeria.*
*Corresponding author: *obello@fudutsinma.edu.ng*

Received on 20th April 2018
Revised on 17th September 2018

Launaea taraxacifolia (Willd) is a perennial herb, commonly known as wild lettuce, assumed the position of wild and underutilized. It is common in Asia, North America, Europe and North Africa. Various parts of L. taraxacifolia have ethnomedicinal importance as they are employed against various ailments and diseases in humans and its traditionally use in ruminant animals. Arguments on its family is presented in this study, so far only five compounds were identified i.e. caffeic acid (1), chlorogenic acid (2), ellagic acid (3), quercetin (4) and kaempferol (5), from this neglected vegetable and an extensive range of pharmacological effects such as antioxidant, antidiabetic and hypolipidemic, antibacterial, antimalarial, anticancer effects and drug-herb interaction of this medicinal plant with recombinant human enzymes i.e. CYP1A2, CYP2C9 and CYP3A4 was stated in this review. This study was carried out with a reason to highlight its importance and discusses its ethnomedicinal, phytochemical, pharmacological, toxicological and states its relevance beyond conventional nutritional gains. Furthermore, this review reiterates the needs to isolate constituents and carry out clinical studies to justify the scientific efficacy accrues to this medicinal plant from traditional uses and give it the due recognition as therapeutic supplement.

Keywords: *Launaea taraxacifolia*, drug-herb, phytochemistry, ethnomedicinal

Introduction

All over the globe, large number of herbs and botanicals are planted and grown for culinary uses, most of these are neglected and underutilized but these plants may possess important functions in the food security, health, nutrition and economy empowerment for rural dwellers. The country which is the most populated in Africa is Nigeria, with an approximate of 184 million citizens, is behind India, China, U.S.A and some other countries, taking the seventh position of the most populous nation in the world. About 60 million inhabitants of the North western region of Nigeria are mostly agrarian with about 65 % resource-poor population living in less-dense (rural)

areas i.e. villages. Most of this populace rely on under-exploited or neglected indigenous edible vegetables for day to day provisions of nutrients, vitamins and other nutraceutical. The importance and values of these plants are diminishing through low demand for them in the market, these vegetables are been tagged "poor man food hence many are yet to enjoy or see their immense gains (Assogbadjo *et al.*, 2005; Dansi *et al.*, 2012; Magbagbeola *et al.*, 2010). Most of these indigenous vegetables had not been the goal of most studies and researches. There is a need to give more awareness to these edible but neglected vegetables, through conceited efforts and reviews such as this that will emphasize their needs beyond the ordinary nutritional uses. Little is known about the healthy importance of the underutilized plants species, their health promoting constituents, research gaps in their study and how to maximize their economic value (Abubakar *et al.*, 2012; Bello *et al*., 2017).

Launaea taraxacifolia is mostly found in the tropic regions of Ethiopia, Senegal and Tanzania, but it occurs in West Africa regions also. The highlands of Ethiopia have been proposed as its possible place of origin, from where it spread elsewhere and grow as a weed. The wild vegetable has been domesticated as a vegetable in Nigeria, and is also cultivated locally in Senegal and Benin, various cultures use this medicinal plant in managing different ailments (Adebisi, 2004). This medicinal plant has been labelled a wild underutilized and neglected vegetable by many authors though many cultures all over the world use in for culinary purposes (Abubakar *et al.*, 2012; Dansi *et al.*, 2012; Dickson *et al.*, 2012; Sanoussi *et al.*, 2015). It is known as 'yanrin' among the Yorubas of the South-Western part of Nigeria, and 'nononbarya' among the Hausas of the Northern part of Nigeria (Koukoui *et al.*, 2015).

Botanical Description, Distribution and Cultivation

Many authors argued that *Launaea taraxacifolia* belongs to the *Asteraceae* family, this family is one of the most important families of flowering plants (angiosperm) in size and use. It contains about 12-17 tribes, roughly 1100 genera, and 20,000 species (Cronquist, 1981; Adebisi, 2004; Kuatsienu, 2012; Adetutu *et al.*, 2016; Koukoui *et al*., 2017; Borokini and Labunmi *et al.*, 2017; Kuatsienu *et al.*, 2017; Owoeye *et al.*, 2017). Burkill, (1985) also attest that *L. taraxacifolia* belongs to the *Asteraceae* family. But according to *the Plant list* (2010) this medicinal plant belongs to the *Compositae* family which contained about 1,911 plant genera. This includes 108,003 scientific plant names of species rank for the family *Compositae* but 32,913 are accepted species names. Though few authors subscribe to *L. taraxacifolia* belonging to the family *Compositae* (Soelberg *et al*., 2015, Adinortey *et al.*, 2012; Koukoui *et al.*, 2015). Furthermore, the *Plant list* (2010) assuredly gave its accepted name as *Launaea taraxacifolia* (Willd.) Amin ex C. Jeffrey and listed some of its synonyms as *Lactuca taraxacifolia* (Willd.) Hornem., *Lactuca pentaphylla* Sch. Bip., *Sonchus pentaphyllus* Sch. Bip., *Sonchus serratus* Perr. ex DC. and *Sonchus taraxacifolius* Willd.

It grows rigidly straight and yearly, with about 1–3 m in height; its stem stands individually mostly from an arboreal rhizome, branching in the distal segment of the plant and displayed about 26-32 blossom flowers with creamy corollas in an arched

receptacle at the zenith but marginally constricted (Burkill, 1985). The leaves of *L. taraxacifolia* are in basal rosette form of 3–5, pinnately lobed with ultimate margins dentate. Achenes grey, fusiform, 2.5–3 mm long, with 4 main ribs and 8 thinner ones, all muricate, the apex slightly narrowed; pappus white, 7–8 mm long, of mixed setae and downy hairs. The stem produces a white 7–8 mm long pappus air-borne seeds. The plant is found in the Tropical West Africa, Mexico, West Indies, Central and South America, Europe, North Africa, Atlantic Islands, South, West and Central Asia (Burkill, 1985). It grows in an open habitat and is considered as weed because it invades fields and farmlands (Kuatsienu, 2012).

This medicinal plant has a thread of names by which it is called around the world as illustrated in Table 1. L. taraxacifolia is commonly referred to as wild lettuce, dandelion leaves in English language.

Table 1. Other names of *L. taraxacifolia* in other cultures

Country	Name	Language	References
Nigeria	*Yarin, Yamurin, Odundun-Odo*	Yoruba	Amujoyegbe *et al.*, 2015, Owoeye *et al.*, 2017
Nigeria	*Nononbarya, namijin dayii*	Hausa	Amujoyegbe *et al.*, 2015, Kuatsienu, 2012
Nigeria	*Ugu*	Igbo	Amujoyegbe *et al.*, 2015, Kuatsienu, 2012
Ghana	*Abloge Ablogé*	Ashanti	Soelberg *et al*., 2015
Ghana	*Agbloge*	Ga/Fante	Soelberg *et al*., 2015
Ghana	*Nne-Noa*	Twi	Soelberg *et al*., 2015
Benin	*Yantotoé or yantoto*	Fon	Sanoussi *et al.*, 2015
Benin	*Lantoto or yantotoé*	Mahi	Sanoussi *et al.*, 2015
Benin	*Odôdô or Odôdôlodôdô*	Idaacha	Sanoussi *et al.*, 2015
Benin	*Awonto*	Cotafon; Watchi	Dansi *et al.*, 2012
Benin	*Wonto, Lanto*	Saxw`e	Dansi *et al.*, 2012
Benin	*Katakpa*	Tchabe	Dansi *et al.*, 2012
Benin	*Wountou*	Adja	Dansi *et al.*, 2012
Benin	*Loˆto*	Pe´da; Xwla	Dansi *et al.*, 2012
Benin	*Wontou*	Adja	Sanoussi *et al.*, 2015
France	*Langue De Vache*	French	Kuatsienu, 2012
Sierra Leone	*Bekuhoa-Pomboe*	Kissi	Kuatsienu, 2012

Ethnomedicinal Uses

Amujoyegbe *et al.*, (2015) mentioned *L. taraxacifolia* as one of the medicinal plants employed in the management of sickle cell anemia when an ethnomedicinal survey of medicinal plants used in the management of sickle cell disorder in Southern Nigeria (Amujoyegbe *et al.*, 2015). The seed oil is supposedly used for 'hardening of the arteries' (atherosclerosis) and as a substitute for wheat germ oil while other people apply wild lettuce latex directly to the skin to kill germs. Some people inhale wild lettuce for a recreational 'high' or hallucinogenic effect (Aboderin *et al.*, 2017). In Ghana, the Ga and Ashanti people use the expressed sap for alleviation of pain in

fresh wounds. They use its decoction from the leaves or the leaves are prepared as cabbage are used in dysentery (blood flux). Leaves mixed with ash rubbed in the sores of yaws and also other external uses. It is a well-known wild vegetable and as one used against general body weakness, high blood pressure and for well-being. This medicinal plant is consumed raw for diabetes and its leaves' decoction for high cholesterol, to "purify blood" and for malaria (Soelberg *et al*., 2015). *L. taraxacifolia* leaves aid milk production in lactating cows, this is a practice in the northern part of Nigeria; it is employed in ruminant animals i.e. sheep and goats to aid and boost multiple birth rates (Burkill, 1985). The leaves' decoction of *Launaea taraxacifolia* is used traditionally against ulcers in Benin (Yemoa *et al*., 2008; 2011). It is used in some parts of Nigeria (Southern) against malaria and related symptoms (Bello et al., 2017). One of the medicinal plants used in Togo traditionally in the management of diabetes mellitus is *L. taraxacifolia*, this was discovered by Kpodar *et al.,* (2015). Some authors further reported that its leaves possess hypolipidaemic properties and the potential to management water retention disorder (Wichtl, 1994; Adebisi, 2004).

Nutrients and Bioactive Compounds Composition

In outlining the quality of food, the nutritional facts and figures should be one of the major concern. Though *L. taraxacifolia* is renowned for its traditional uses, its leaves and stem are being eaten by some people as salad, cooked in soups and sauces for centuries. Many authors have examined the nutritional and dietary properties of the leaves and stem; they concluded that this wild vegetable have the prospect of creating a niche in the food industry or better serve as a functional food which can curb hunger and disease- two major problems confronting the developing countries (Adinortey *et al.,* 2012; Dairo *et al.,* 2015; Gbadamosi *et al.,* 2012). Adinortey *et al.,* (2012) reported the absence of cyanogenic glycosides and anthraquinones, these secondary metabolites are reportedly poisonous to humans, their absence make *L. taraxacifolia* safe for eating i.e. sauces and soups. Many authors confirmed the presence of phytochemicals like phenolic glycosides, flavonoids, saponins and tritepenoids in *L. taraxacifolia* which possesses huge therapeutic advantage for humans (Adinortey *et al.,* 2012; Dairo *et al.,* 2015; Gbadamosi *et al.,* 2012; Olugbenga *et al.,* 2015; Koukoui *et al.,* 2015; Ruffina *et al*., 2016). The reported health benefits of this medicinal plant may be attributed to the presence of these phytoconstitutents. *Launaea taraxacifolia* leaves are rich sources of potassium, iron, copper, manganese and zinc as well as high energy values essential in human and animal nutrition. Kuatsienu, (2012) reported for 100 g of *L. taraxacifolia* leaves, the total energy value: 287.47 kcal/100 g (1202.78 kJ/100 g) and Dairo *et al.,* (2015) reported a similar value also (280.70 ± 0.80 kcal/100 g) of the dry sample, it has low calorific value and high protein content (26.67 %), other author reported a high protein content of 17.67 ± 120 kcal/100 g, may be recommended to individuals suffering from overweight and obesity. Adinortey *et al.* (2012) stated that the moisture content of *L. taraxacifolia* is 22.18 % while 23.14 % by Dairo *et al.* (2015), this is higher than some of the common leafy vegetables eaten i.e. *Adansonia digitata* (9.5 %), *Vernomia amygdaline* (27.4 %) (Ladan *et al.,* 1996), *Xanthosem sagittifolium* (14 %). The moisture content suggests the presence of water soluble vitamins which is very beneficial to human health (Adinortey *et al.,* 2012; Dairo *et al.,* 2015). The

crude fiber content is 15.05 % (Adinortey *et al.*, 2012) and 16.05 % (Dairo et al., 2015) in the leaves of *L. taraxacifolia* suggest that it can provide enough fiber for human body which will help digestion and further aid in the reduction of serum and cholesterol risk, hypertension risk and all related coronary heart diseases (Ganong, 2003). Its high antioxidant activity has been established by many authors which will be discussed later in this review. Investigation on *Launaea taraxacifolia* revealed that it contains appreciable amount of macro and micro-nutrients, phytochemicals like alkaloids, flavonoids, glycosides, saponins, steroids tannins and tritepenoids (Dairo *et al.*, 2015; Adinortey *et al.*, 2012). Borokini and Labunmi reported some phenolic compounds were identified in the leaves extracts of *L. taraxacifolia*, these are caffeic acid (1), chlorogenic acid (2), ellagic acid (3), quercetin (4) and kaempferol (5) (Figure 1). These were the compounds identified so far from the plant.

Biological Evidences and Properties

In topical times, many biological/pharmacological evidences have surfaced that validate the traditional uses of extracts prepared from leaves, seeds and roots of *L. taraxacifolia*. This review focus on the published studies associated with this wild vegetable.

Antioxidant Properties

Koukoui *et al.*, (2015) reported the antioxidant effect of ethanol-aqueous extracts of *Launaea taraxacifolia* leaves, this was verified by determining the production of free radicals by the PLB985 cells in the presence of 100 nM PMA alone or '100 nM' PMA with altered dilutions of extracts. It is a common knowledge that NADPH oxidase activities in human neutrophils is partial caused by PMA. The concentration of the extracts ranging from '1 µg/µl' to '20 µg/µl' were employed. It was reported that leaves' extract of *L. taraxacifolia* displayed a significant antioxidant activity (Koukoui *et al.*, 2015). Borokini and Labunmi, (2017) compared the *in vitro* investigation of antioxidant activities of aqueous, ethanol and methanol extracts of the leaves of *Launea taraxacifolia.* This activity was evaluated employing three different assays (*in vitro)* to assess the scavenging properties of 2, 2-diphenyl-1-picryl hydrazyl, nitric oxide and hydroxyl ion. The aqueous extract of this plant showed significant activity compared to the others. The study showed that antioxidant activities of all the extracts are concentration dependent and there is a strong correlation with total flavonoid contents (r = 0.926 - 0.997 and r = 0.432 - 1.000) and total phenolic contents (r = 0.825 - 0.999 and r = 0.473 - 0.994) for *L. taraxacifolia* (Borokini and Labunmi, 2017). Gyingiri *et al.*, (2012) evaluated for their antioxidant potential ten traditional leafy vegetables commonly consumed by Ghanaians based on their polyphenolic (PC) and flavonoid contents (FC). Each of these vegetable was partitioned into two using water and methanol, for the FC of the aqueous extracts the order was; *A. incurvatus* > *H. sabdariffa* > *Talinum triangulare*> *Colocasia esculenta* > *M. esculenta* > *V. amygdalina*> *O. basilicum* > *Solanum macrocarpon* > *Launaea taraxacifolia* > *Corchorus olitorius* while the methanol extracts of the plants displayed the highest polyphenolic content. Methanol extract of the leaves of *L. taraxacifolia* gave a good PC and FC hence the authors

concluded that leafy vegetables consumed by Ghanaians are potentially rich sources of dietary polyphenolic compounds and antioxidants, and might contribute important health and nutraceutical benefits to consumers (Gyingiri *et al.,* 2012).

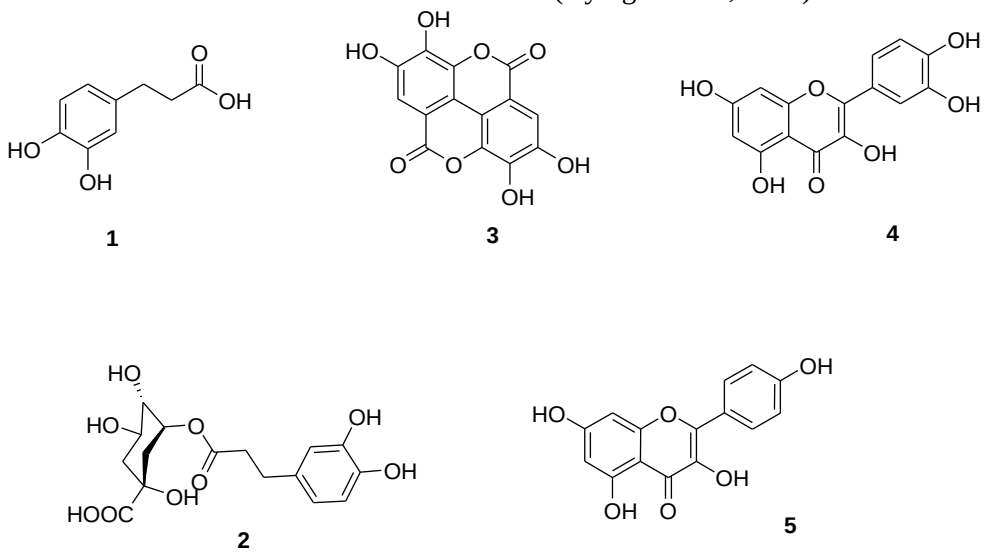

Figure 1. Isolated compounds from *L. taraxacifolia*

Hypolipidemic and Antidiabetics Properties

Kpodar *et al.,* 2015 selected *L. taraxacifolia* during a survey of ethnopharmacological plants used in the treatment of diabetes mellitus in south of Togo (Kpodar *et al.,* 2015). The hypolipidemic activity from leaf extract of *L. taraxacifolia* was evaluated by determining the outcome of lipid build-up induced by oleic acid on HepG2 cells. It was showed that oleic acid 1 mM, in the absence of the extract, induced lipid accumulation in HepG2 cells. The '20 µg/µl' of extracts showed the most promising activity as reported by Omedine *et al.* (2017). Koukoui *et al.,* (2015) reported the hypolipidemic activity of the leaf extracts of *Launaea taraxacifolia*, this was performed on HepG2 cells. The result from the study showed that hydro-ethanolic extract of the leaves of *L. taraxacifolia* inhibited lipid accumulation in HepG2 cells due to the presence of the polyphenols present in the leaves (Koukoui *et al.,* 2015). Koukoui *et al.* (2017) discussed the *in vivo* effect of the hydro-ethanolic extract of the plant on blood sugar, cholesterol and triglycerides levels in Wistar rats. The study showed there was a significant lowering effect on cholesterol and triglycerides levels by comparing the blood lipids levels in the control and treated rats. Considering the direct link between cholesterol, triglycerides and heart diseases, regular consumption of *Launaea taraxacifolia* leaves may help to prevent cardiovascular diseases (Koukoui *et al.,* 2017). Wallace *et al.,* (2001) assessed the nutritive value and cholesterol-lowering effect of wild lettuce (*Launaea taxaracifolia*) leaf when fed as a source of protein by using male albino rats (*Rattus norvegicus*). The rats fed with the wild lettuce leaf diets gained comparatively lower

growth response in terms of weight gain, protein efficiency ratio (PER) and feed efficiency ratio (FER) when compared with animals on the respective control diets ($p < 0.05$), total plasma protein was reduced. This study assumed the cholesterol-lowering property of this medicinal plant (Wallace *et al*., 2001). Salisu *et al.,* (2016) investigated the antilipidaemic potentials of five selected leafy vegetables in South West, Nigeria, including *Launaea taraxacifolia* Amin Ex. C. Jeffrey in experimentally-induced myocardial infarction (MI) in male Wistar rats. The authors discovered that the vegetables pre-treated groups normalized the lipid profile thereby suggesting that the extracts from these medicinal plants may be used as functional foods for effective prevention of hyperlipidemia (Salisu *et al.,* 2016).

Antibacterial Properties

It was reported that the ethanol leaves extract of *L. taraxacifolia* showed inhibitory effects on bacterial species. The ethanol leaves extract at a concentration of 25 µl showed no effect on *Bacillus subtilis* but inhibited *Streptococcus mutans* (Ruffina *et al.,* 2016). At this concentration, the extract showed an inhibition zone of 13 mm against *Escherichia coli* and *Candida albicans* (Ruffina *et al.,* 2016). Gbadamosi and Okolosi, (2013) reported the antibacterial activity of ten indigenous medicinal plants. They discovered that four of the ten extracts were active against *P. aeruginosa*, the highest activity of 17.0 mm zone of inhibition was observed for *L. taraxacifolia* (Gbadamosi and Okolosi, 2013).

Antimalarial Properties

Bello *et al.,* (2017) evaluated *in vitro* the antiplasmodial, antileishmanial and anti-trypanosomal activities of fractions of 18 medicinal plants belonging to 14 different families. At concentrations of 15.8667 µg/mL, chloroform extract of *Launaea taraxicifolia* was one of the most active fractions for antimalarial activity with (IC_{50}=21.55 µg/mL (D6) S.I >2.2, 18.0 µg/mL (W2) S.I > 2.6). The methanol extract of *L. taraxacifolia* displayed a significant inhibition *in vivo* against *T. brucei brucei* with an IC_{50} 16.78 µg/mL, this shows the antileishmanial effect of this medicinal plants (Bello *et al.,* 2017). Further, the inhibition of the *in vivo* growth of malaria parasite in *Plasmodium berghei* (*P. berghei*) by the methanol extracts of *L. taraxacifolia* was reported (Adetutu *et al.,* 2016). Methanol fraction of *L. taraxacifolia*, significantly showed antimalarial activity against chloroquine sensitive *P. berghei* infection in mice highlighted by the percentage of parasite inhibition. The percentage of parasite clearance was very low during the first week of treatment with the methanolic extract of *L. taraxacifolia*, but higher during the last week of treatment. It is interesting to note that the inhibition by the extracts was better than the positive control- an established drug (chloroquine) used for treatment of malaria. The study showed that the *L. taraxacifolia* had *in vivo* antimalarial activity and did suppress the multiplication of *P. berghei* parasites in mice, an indication that these extracts are a potential source for new antimalarial drugs (Adetutu *et al.,* 2016).

Anti-clastogenic Activity

Cisplatin, one of the most widely used anticancer drugs for the treatment of testicular and a host of other tumours of man and animal, undergoes intracellular hydrolysis

and form cytotoxic complexes with DNA, RNA, sulphur-containing enzymes and mitochondria. The results of these interactions are DNA damage, mutagenesis, carcinogenesis, or apoptotic cell death. It was however reported that leaf extract of *L. taraxacifolia* leaf extract protect against this cisplatin- induced genotoxic effect in bone marrow erythrocytes of rats (Adejuwon *et al.*, 2014). *L. taraxacifolia* supplementation is therefore strongly recommended before cancer treatment.

Antiviral Activity

It was showed that the extract of *L. taraxacifolia* showed dose-dependent antiviral activities (Obi *et al.*, 2006). As reported, when the extract was treated with the measles virus and the HEP-2 cell line, a marked antiviral activity was exhibited at 15 mg/ml while there was no activity at low concentrations of 5 mg/ml and 10 mg/ml. Similarly, there was no antiviral activity at 5 and 10 mg/ml, but there was a mild antiviral activity at 15 mg/ml when the cell was treated with the extract before the virus stock was added.

Anticancer Activity

Thomford *et al.*, (2016) carryout an investigation on the anticancer nature of polar part of the leaves' extract of *L. taraxacifolia*. Antiproliferative and apoptotic effects were evaluated using the MTT [3-(4,5-dimethylthiazol-2-yl)-2, 5-diphenyltetrazolium bromide] assay and flow cytometry, while examining, in parallel, the genes regulating apoptosis and cell cycle in this cell culture model. The leaves extract of *L. taraxacifolia* displayed a major inhibitory effect on the WHC01 cancer cells. Many of the cell cycle genes were downregulated (Thomford *et al.*, 2016). This work suggests the anticancer effects of *L. taraxacifolia* leaves gives a hand in validating the traditional use of leaves of *L. taraxacifolia.*

Neuro-protective Activity

Kuatsienu *et al.*, 2017 reported the neuro-protective nature of ethanolic extract from the leaves of *L. taraxacifolia* (LTE) against kidney injury induced by gentamicin using rat model. Histological studies of kidney tissues of the tested rats displayed an insignificant change in tubular epithelium in LTE, this suggest that *L. taraxacifolia* leaves extract have the ability to guard and shield against gentamicin-induced kidney damage in rats at a dose of 300 mg/kg body weight (Kuatsienu *et al.*, 2017). Owoeye and Arinola *et al.* (2017) carried out the effect of *L. taraxacifolia* against mercuric chloride (MC), which is a common environmental pollutant that affects the nervous systems of mammals, intoxication in the brain of rats. Thirty male Wistar rats were employed in this study. The authors discovered the protective effects against MC-induced behavioral parameters and alteration of microanatomy of rats' cerebral cortex, hippocampus, and cerebellum of ethanolic extract of the leaves of *Launaea taraxacifolia* and concluded that the medicinal plant may be a valuable agent for further investigation in the prevention of acute neuropathy caused by inorganic mercury intoxication (Owoeye and Arinola *et al.*, 2017). Many authors gave strong evidences of the hepato-renal and neuro-protective nature of the leaves of the aqueous and ethanolic extract of the leaves of *L. taraxacifolia* through *in vivo* and *in vitro* methods (Adejuwon *et al.*, 2014; Owoeye and Onwuka, 2016; Owoeye *et al.*, 2015).

Anti-blastocystis

Christensen *et al.,* (2015) validated the anti-Blastocystis activity of twenty-four (24) plant parts from twenty-one (21) medicinal plants historically used to treat or alleviate several types of stomach disorders manifested by e.g. stomachache, diarrhea or dysentery from Ghana. *L. taraxacifolia* was part of the medicinal plants evaluated but it is unfortunate its activity was very poor as reported by the authors (Christensen *et al.,* 2015).

Anti-ulcer

The decoction from the leaves of *Launaea taraxacifolia* is employed traditionally in Benin against Buruli ulcer (BU), this Buruli Ulcer is the third most common mycobacterial infection in the world, after tuberculosis and leprosy and has recently been recognized as an important emerging disease (Yemoa *et al*., 2008; 2011). Ninety-eight (98) plant species belonging to forty-eight (48) families have been identified from three West African countries as having anti-BU effect but only thirteen (13) plant species were discovered to have significant anti-BU activity and *L. taraxacifolia* was not one of them (Fokou *et al.,* 2015). Adediji *et al.,* (2017) carried out a study to evaluate the larvicidal and ovicidal activities of leaves extracts of eighteen (18) medicinal plants, one of these plants is *L. taraxacifolia*, these were tested against *Aedes aegypti* Linn. eggs and larvae. Twenty each were counted into each of the various concentrations of the eighteen aqueous plant extracts: 62.5, 125, 250, 500, and 1000 mg/L. They were each put in a labeled transparent bowl (300ml). The hatch rates were assessed at 48 h post-treatment while the percentage mortality of 2nd instar larvae was determined 24 hours post treatment. The study suggested that the aqueous leaf extracts of only *Spilanthes filicaulis*, *Bidens pilosa* and *Acanthospermum hispidum* were very effective against eggs and larvae of this important vector species, other plants including *L. taraxacifolia'* s extract showed little or no mortality (Adediji *et al.,* 2017).

Anthelmintic Activity

William *et al.,* (2016) screened ethanolic extracts from twenty-nine medicinal plants traditionally used in Africa (Ghana) and the Caribbean (US Virgin Islands) against related diseases for *in vitro* anthelmintic properties against *Ascaris suum*, a swine parasite that is very closely related to the human *A. lumbricoides*. *L. taraxacifolia* was one of the plants chosen for this study. A wide variety of activities were seen in the extracts, from negligible to potent, *L. taraxacifolia* displayed a negligible anthelmintic effect (William *et al.,* 2016).

Toxicology

The periods when studies are being taken determines the toxicity and toxicity studies may be acute, chronic or sub-acute. Short periods of studies are mostly for acute toxicity studies, this is usually employed when there is need to quickly establish the safety and efficacy precis of the drug or product. Acute toxicity studies carry out on the ethanolic extract of *L. taraxacifolia* was not lethal on the animals used at all tested doses, this may imply that the extract is safe in the acute toxicity stage. The results of the haematological studies showed that *L. taraxacifolia* has little or no

adverse effect on red blood cell, haemoglobin, platelet number, haematocrit and lymphocyte. The extract appears to induce constipation. It was found out that no significant differences were found in the organ to body ratio and this supports the non-toxic nature of the extract (Lydia, 2012). The results indicated that the ethanol-aqueous extracts from leaves of *L. taraxacifolia* were toxic only at very high concentrations. Koukoui *et al*., (2017) examined further the effect of hydroethanolic extract of the leaves of *L. taraxacifolia* on liver and kidney histology of treated rats to detect possible cytotoxic effects. The hepatic and renal histology showed no visible atypia, they concluded that only at very high doses of *L. taraxacifolia* could be toxic (Koukoui *et al.,* 2017). Other authors confirm the toxicity of this wild vegetable at higher concentration through *in vivo* or *in vitro* studies but concluded that the leaves of this plant can be eaten and taken as concoction without dangers associated with toxicity (Aboderin *et al*., 2017; Koukoui *et al.,* 2015; Dairo *et al*., 2015; Kuatsienu *et al.,* 2017; Kuatsienu, 2012).

Herb–Drug Interaction

The effect of herbs on the activity of Cytochrome P450 isoenzymes (CYP) is vital to evade herb–drug interactions (Park *et al*., 1995). One of the primary apprehension in medical pharmacology is likely herb–drug interactions, developing from the co-administration of drug/herb resulting to therapeutic unsuitability, also toxicity effects which will consequently affect the liver. Thomford *et al.,* (2016) evaluate the effects of extracts of selected commonly used medicinal plants on CYP2B6 enzyme activity. *Hyptis suaveolens* extract displayed the most significant inhibition against CYP2B6 with IC_{50} of 19.09 ± 1.16 g/mL while *Newbouldia laevis* extract showed weak inhibitory effects with IC_{50} = 100 ± 8.71, followed by *Launaea taraxacifolia* extract which displayed a moderate inhibition with IC_{50} = 33.87 ± 1.54 g/mL. The enzyme kinetic effects and inhibitory activity of aqueous leaves extract of *L. taraxacifolia* was reported by Thomford *et al*., (2016b) in another study, they employed recombinant human CYP450 isozyme model i.e. CYP1A2, CYP2C9, and CYP2C19. The enzyme kinetic effects of the extract were reversible and the authors reported that the effects were dose and time-dependent but the extract treatment caused a regression in the expression levels of CYP1A2 ($p < 0.0005$) and CYP2C19 ($p < 0.003$) by 50–70 % (Thomford *et al.,* 2016b). Other authors further confirm the inhibition of various recombinant human enzymes i.e. CYP1A2, CYP2C9 and CYP3A4 by the extract of *L. taraxacifolia* (Appiah-Opong *et al.,* 2007; Mccrea *et al.,* 1999; Martin *et al.,* 2001; Seedat & Rayner 2011; Nishio *et al.,* 2005). The consequence of these is that drugs that are metabolized by CYP2B6 when co-administered with medicinal plants i.e. *L. tataxacifolia* and when adequate amounts of these extracts reach the liver, there is a high likelihood of standard doses of drugs taken affecting drug plasma concentrations which could lead to toxicity (Thomford *et al.,* 2016; 2016b)

Other Applications

Insecticides

In the quest for other ways to control the spread of mosquitoes beyond chemicals, the use of insecticides from biological source is increasing in demand. The extracts

from medicinal plants are becoming promising in this modern trend. Fagbohoun *et al.* (2015) determined the efficacy of extracts *Launaea taraxacifolia* as larvicidal agent as well as its possible use in the control of malaria vectors. It shows that the hydro-methanol extract was the most active with lethal concentrations LC_{50} of 469.7 ppm and 12.2 ppm in 24 and 48 h of exposure for strain Kisumu; 270.7 ppm and 166.7 ppm in 24 h and 48 h, respectively, for the wild population. Strong lethal doses (LC_{50} > 2668 ppm) extracts on larvae of *Artemia salina*, denote their innocuousness on shrimp. The authors concluded that *L. taraxacifolia* is a good candidate for the development of an antibio-larvicide agent for the integrated fight against malaria vectors (Fagbohoun *et al.*, 2015). The three different extracts (varying polarities) from the leaves of two medicinal plants namely *Elaeis oleifera* and *Launaea taraxacifolia* were obtained and evaluated on 3rd stage larvae from two genotypes of *Anopheles gambiae*. The Kisumu strain of Kenyan origin and the wild strain from the breeding sites of Cotonou. The hydro-methanol extract of *L. taraxacifolia* displayed a significant but identical activities on the two larval origins with LC50 of 182.68 ppm and 135.13 ppm respectively in 24 h and 48 h for Kisumu larvae and 157.36 ppm in 24 h then 116.88 ppm in 48 h for wild larvae. The authors then concluded that the methanolic fraction of this medicinal plant can be used for antibio-larvicide production (Ayide *et al.*, 2017).

Conclusion and Future Considerations

L. taraxacifolia (Willd) Linn. is widely distributed throughout West Africa, mostly Benin Republic and Nigeria. The plant appears to be traditional in managing an array of diseases and ailments. Many parts of the medicinal plant have been explored and confirmed that it ameliorates cisplatin induced hepatorenal, neuroprotective and antiatherogenic potential, inhibit $HgCl_2$-induced brain tissue damage, bio-larvicidal action, antibacterial activity, anticancer effects and Herb–Drug Interaction potential by CYP1A2, CYP2C9, and CYP2C19, antioxidant activity, antiancer activity and many other sundry activities. There is no established phytochemistry on the plant so far, this bringing attention the need of isolation of bioactive compounds from the plant. However, the phytochemical screening done by some authors reportedly appears to indicate the presence of sesquiterpene lactone, sterol glycoside, polyphenols and essential oil. The pharmacological studies reported in this review confirm the therapeutic value of *L. taraxacifolia*. However, less information is available regarding the clinical, phytochemistry, phytoanalytical properties and functional food assessments of this plant. Clinical evaluation should be carried out to ascertain these preliminary studies.

Funding. This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Conflicts of interest statement. No potential conflict of interest was reported by the authors.

References

Aboderin, F.I., Olajide, J.S., Adesiyan, A.A. 2017. Toxicity effect of *Launaea taraxacifolia* aqueous extract on vital organs of albino rat. *International Journal of Biochemistry, Biophysics and & Molecular Biology*, **2** (2), 47-50.

Abubakar, S., Ogbadu, G.H., Usman, A.B, Segun, O., Olorode, O., Samirah, I.U. 2012. The underutilized vegetable plants of the federal capital territory (FCT) Abuja of Nigeria. *International Journal of Development and Sustainability,* **1**, 634-643.

Achel, D.G., Mills, R., Otchere, J., Seyram, E., Achoribo, E., Nana Adu-Kobi Adu-Bobi, Donkor, S., Boatin, R., Adom, T., Adaboro, R. M., Yahuza G. 2012. Evaluation of the antioxidant potentials of ten leafy vegetables extracts commonly consumed by the Ghanaian population. *Electronic Journal of Environmental, Agricultural and Food Chemistry,* **11**, 85-95.

Adebisi, A.A. 2004. *Launea taraxacifolia* (wild) Amin ex C. Jeffrey. In: Grubben GJH and Denton OA Eds, PROTA 2: Vegetables/Legumes.

Adediji, D.A., Agbedahunsi, J.M., Adewoyin, F.B. 2017. Larvicidal and ovicidal properties of some plants from asteraceae family against zika virus, dengue and chikungunya vector, *Aedes aegypti* Linn. (diptera: culicidae). *Nigerian Journal of Natural Products and Medicine,* **20**, 200-216.

Adejuwon, A.S., Femi-Akinlosotu, O., Omirinde, J.O., Owolabi, O.R., Afodun, A.M. 2014. *Launaea taraxacifolia* ameliorates cisplatin-induced hepato-renal injury. *European Journal of Medicinal Plants*. **4** (5), 528-541.

Adejuwon, S.A., Aina, O.O., Femi-Akinlosotu, O.M., Omirinde, J.O. 2014. Anti-clastogenic effects of *launaea taraxacifolia* leaf extract on cisplatin-induced micronuclei in bone marrow erythrocytes, *Journal of. Biological. Innovation,* **3**, 86-92.

Adetutu, A., Olorunnisola, S. O., Owoade, A. O., Adegbola, P. 2016. Inhibition of *in Vivo* Growth of *Plasmodium berghei* by *Launaea taraxacifolia* and *Amaranthus viridis* in Mice. *Malaria Research and Treatment*. Article ID 9248024.

Adewale, A., Ayoade, A.A., Alani, E.A. 2013. Determination of vitamins in few selected West African. *Journal of Medicinal Plants*, **6**, 171 – 179.

Adewale, A., Olubukola, S.O., Abiodun, O.O., Peter, A. 2016. Inhibition of *in Vivo* Growth of *Plasmodium berghei* by *Launaea taraxacifolia* and *Amaranthus viridis* in Mice. *Malaria Research and Treatment*, Article ID 9248024.

Adimonyemma, N.R., Chukwuma, O. M., Akachukwu, E. E., Iroka, F. C. 2016. Phytochemical Analysis and Antibacterial Activity of *Launaea taraxacifolia* Ethanolic Leave Extract. *Scholar Academics Journal Bioscience*, **4**, 193-196.

Adinortey, M.B., Sarfo, J.K., Quayson, E.T., Weremfo, A., Adinortey, C.A., Ekloh, W., Ocran, J. 2012. Phytochemical screening, proximate and mineral composition of *Launaea taraxacifolia* leaves. *Research Journal of Medicinal Plants*, **6**, 171-179.

Ahouansou, C.A., Fagbohoun, L., Sèdami, M. F., Alban, H.G., Siméon, K., Fernand G.A. 2017. Inhibition Effects of *Elaeis oleifera* (Arecaceae) and *Launaea taraxacifolia* (Asteraceae) on Two Genotypes of *Anopheles gambiae* Larvae. *International. Journal of. Current. Research. Bioscience and. Plant Biology*, **4**, 39-46.

Amujoyegbe, O.O., Idu, M., Agbedahunsi, J.M., Erhabor, J.O. 2016. Ethnomedicinal Survey of medicinal plants used in the management of sickle cell disorder in Southern Nigeria. *Journal of Ethnopharmacology*, **185**, 347-360.

Appiah-Opong, R., Commandeur, J.N.M., van Vugt-Lussenburg, B., Vermeulen, N. P. E. 2007. Inhibition of human recombinant cytochrome P450s by curcumin and curcumin decomposition products. *Toxicology*, **235,** 83–91.

Assogbadjo, A.E., Sinsin, B., Codjia, J.T.C., van Damme, P. 2005. Ecological diversity and pulp, seed and kernel production of the baobab (*Adansonia digitata*) in Benin. *Belgian Journal of Botany*, **138**, 47–56.

Bello, O.M., Zaki, A.A., Khan, I.S., Fasinu, P.S., Ali, Z., Khan, I.A., Usman, L.A., Oguntoye, O.S. 2017. Assessment of selected medicinal plants indigenous to West Africa for antiprotozoal activity. *South African Journal of Botany* **113**, 1200-211.

Borokinia B.F., Labunmi L. 2017. *In vitro* investigation of antioxidant activities of *Launea taraxacifolia* and *Crassocephalum rubens. International Journal of Food Studies*, **6**: 82-94.

Burkill, H.M. 1985. The useful plants of West Tropical Africa. 2nd Edition. Volume 1, Families A–D. *Royal Botanic Gardens*, Kew, United Kingdom. Pp 960.

Christensen, C.B., Soelberg, J., Stensvold, C.R., Jäger, A.K. 2015. Activity of medicinal plants from Ghana against the parasitic gut protist Blastocystis Charlotte Bremer. *Journal of Ethnopharmacology*, **174**, 569–575.

Cronquist, A. 1981. An Integrated System of Classification of Flowering Plants, Columbia Univ. Press, New York, 1020-1028.

Dairo, J.O., Ukpanukpong, R.U., Uyabeme R.N. 2015. Phytochemical screening, proximate analysis and acute toxicity study of *Launaea Taraxacifolia* ethanolic extract on albino rats. *The International Journal of Science and Technology*, **3**, 199-202

Dansi, A., Vodouh`e, R., Azokpota, P., Yedomonhan, H., Assogba, P., Adjatin, A., Loko, Y.L., Dossou-Aminon, I., Akpagana, K. 2012. Diversity of the neglected and underutilized crop species of importance in Benin. *The Scientific World Journal*, Article ID 932947.

Dickson, R.A., Annan, K., Fleischer, T.C., Amponsah, I.K., Nsiah, K., Oteng, J.A. 2012. Phytochemical investigations and nutritive potential of eight selected plants from Ghana. *Journal of Pharmacy and Nutrition Sciences*, **2**, 172-177.

Funk, V.A. 2005. Everywhere but Antarctica: Using a Super-tree to understand the diversity and distribution of the *Compositae*. *Biologiske Skrifter*, **55**, 343-374.

Ganong, W.F. 2003. Circulating body fluids: *Review of Medical Physiology*. 21st Edition. Typo Press, Lebanon.

Gbadamosi, I.T., Okolosi, O. 2013. Botanical galactogogues: nutritional values and therapeutic potentials. *Journal of Applied Biosciences*, **61**, 4460– 4469.

Koukoui, O., Agbangnan, P., Boucherie, S., Yovo, M., Nusse, O., Combettes, L., Sohounhloué, D. 2015. Phytochemical study and evaluation of cytotoxicity,

antioxidant and hypolipidemic properties of *Launaea taraxacifolia* leaves extracts on cell lines HepG2 and PLB98. *American Journal of Plant Sciences,* **6**, 1768-1779.

Koukoui, O., Senou, M., Agbangnan, P., Seton, S., Koumayo, F., Azonbakin, S., Adjagba, M., Laleye, A., Sezan A. 2017. Effective *in Vivo* cholesterol and triglycerides lowering activities of hydroethanolic extract of *Launaea Taraxacifolia* leaves. *International Journal of Pharmaceutical Sciences and Research*, **8**, 2040-2047.

Kpodar, M.S., Lawson-Evi, P., Bakoma, B., Eklu-Gadegbeku, K., Agbonon, A., Aklikokou, K., Gbeassor M. 2015. Ethnopharmacological survey of plants used in the treatment of diabetes mellitus in south of Togo (Maritime Region). *Journal of Herbal Medicine*, **5**, 147–152.

Lydia. E.K. 2012. Safety Assessment of the ethanolic leaf extract of *Launaea Taraxacifolia* (Willd) of the family asteraceae in rodents. M. Sc. Thesis, *Kwame Nkrumah University of Science & Technology*, Kumasi, Ghana, 110.

Ladan, M.J., Bilbis, L.S., Lawal, M. 1996. Nutrient composition of some green leafy vegetables consumed in Sokoto. *Nigeria. Journal of. Basic Applied Science,* **5**, 39-44

Louis, F., Ayidé, A.C., Fagla Sèdami, M.R., Jules, T.M., Siméon, K., Fernand, G.A. 2015. Phytochemical analysis of *Launaea taraxacifolia* (Asteraceae) on Anopheles gambiae, a malaria vector. *Photon Journal* **23** (3), 123-127

Magbagbeola, J.A.O., Adetoso, J.A., Owolabi, O.A. 2010. Neglected and underutilized species (NUS): a panacea for community focused development to poverty alleviation/poverty reduction in Nigeria. *Journal of Economics and International Finance*, **2**, 208–211.

Martin, J., Registrar, C. P., Fay, M. 2001. Cytochrome P450 drug interactions: Are they clinically relevant. *Drug Safety*,. **26**, 13–21.

Mccrea, J., Cribb, A., Rushmore, T., Osborne, B., Gillen, L., Lo, M., Waldman, S., Bjornsson, T., Spielberg, S., Goldberg, M.R. 1999. Phenotypic and genotypic investigations of a healthy volunteer deficient in the conversion of losartan to its active metabolite E-3174. *Clinical Pharmacology Therapy*, **65**, 348–352.

Nishio, S., Watanabe, H., Kosuge, K., Uchida, S., Hayashi, H., Ohashi, K. 2005. Interaction between amlodipine and simvastatin in patients with hypercholesterolemia and hypertension. *Hypertension Research*, **28**, 223–227.

Obi, R.K, Iroagba, I.I., Ojiako, O.A. 2006. Virucidal potential of some edible Nigerian vegetables. *African Journal of Biotechnology*, **5**, 1785-1788.

Olugbenga, D.J., Undigweundeye, U.R., Ngozi, U.R. 2015. Phytochemical screening, proximate analysis and acute toxicity study of *Launea taraxacifolia* ethanolic extract on albino rats. *Interrnational Journal of Science and Technology*, **3**, 199 – 202.

Omédine, K., Pascal, A., Sylviane, B., Mahudro, Y., Oliver, N., Laurent, C., Dominique, S. 2015. Phytochemical Study and Evaluation of Cytotoxicity,

Antioxidant and Hypolipidemic Properties of *Launaea taraxacifolia* Leaves Extracts on Cell Lines HepG2 and PLB985. *American Journal of Plant Sciences*, **6**, 1768-1779.

Owoeye, O., Arinola, G.O. 2017. A Vegetable, *Launaea taraxacifolia*, Mitigated mercuric chloride alteration of the microanatomy of rat brain. *Journal of Dietary Supplements*, **4**, 613-625.

Owoeye, O., Femi – Akinlosotu, M., Adejuwon, S.A. 2015. *Launaea taraxacifolia* acqueous extract attenuates cisplatin – induces neurotoxicity by decreasing oxidative stress and neurol cell death in rats. *Archives of Basic and Applied Medicine*, **3**, 71 – 78.

Owoeye, O., Gbadamosi, I.T., Alia, A. E., Okolosi, O. 2012. *In – vitro* antimicrobial activities and nutritional assessment of roots of ten Nigerian vegetables. *New York Science Journal*, **5**, 234 – 240.

Owoeye, O., Onwuka, S. K. 2016. Lead toxicity. Effect of *Launaea taraxacifolia* on the histological and oxidative alterations in rat region II cornu ammonis and cerebellum. *Anatomy Journal for Africa*, **5**, 783 – 7S94.

Park, B.K., Pirmohamed, M., Kitteringham, N.R. 1995. The role of cytochrome P450 enzymes in hepatic and extrahepatic human drug toxicity. *Pharmacology and Therapeutics*, **68**, 385-424.

Ruffina A.N., Chukwuma O.M., Akachukwu E.E., Iroka F.C. 2016. Phytochemical analysis and antibacterial activity of *Launaea taraxacifolia* ethanolic leave extract. *Scholar Academia Journal of Bioscience*, **4**, 193-196.

Salisu G., Titilola F., Okpuzor, J., Jaja, S.I. 2016. Antilipidaemic studies of aqueous extracts of five selected nigerian local edible vegetables in experimentally-induced myocardial infarction in male wistar albino rats. Organization for women in science for the developing world (OWSD). *Fifth General Assembly and International Conference on Women in Science and Technology for the Developing World*, Kuwait.

Sanoussi, F., Ahissou, H., Dansi, M., Hounkonnou, B., Agre, P., Dansi, A. 2015. Ethnobotanical investigation of three traditional leafy vegetables [*Alternanthera sessilis* (L.) DC. *Bidens pilosa* L. *Launaea taraxacifolia* Willd.] widely consumed in southern and central Benin. *Journal of Biological and Environment Science*, **6** , 187-198.

Seedat, Y.K., Rayner, B.L. 2011. South african hypertension guideline 2011. *South. Africa. Medicine. Journal*, **102**, 57–88.

Soelberg, J., Asase, A, Akwetey, G., Jäger, A.K. 2015. Historical versus contemporary medicinal plant uses in Ghana. *Journal of Ethnopharmacology*, **160**, 109–132

The Plant List. 2010. Version 1. Published on the Internet; http://www.theplantlist.org/ (accessed 1st January, 2018).

Thomford, N.E., Awortwe, C., Dzobo, K., Adu, F., Chopera, D., Wonkam, A., Skelton, M., Blackhurst D., Dandara C. 2016. Inhibition of CYP2B6 by

Medicinal Plant Extracts: Implication for Use of Efavirenz and Nevirapine-Based Highly Active Anti-Retroviral Therapy (HAART) in Resource Limited Settings. *Molecule,* **21**, 211-221

Thomford, N.E., Mkhize, B., Dzobo, K., Mpye, K., Rowe, A., Iqbal Parker, M., Wonkam, A., Skelton, M., September, V.A., Dandara, C. 2016. African lettuce (*Launaea taraxacifolia*) displays possible anticancer effects and herb–drug interaction potential by CYP1A2, CYP2C9, and CYP2C19 inhibition. *Journal of Integrative Biology*, **20**, 35-43.

Tsouh Fokou, P.V., Nyarko, A.K., Appiah-Opong, R., Tchokouaha Yamthe, L.R., Addo, P., Asante, I.K., Boyom, F.F. 2015. Ethnopharmacological reports on anti-Buruli ulcer medicinal plants in three West African countries. *Journal of Ethnopharmacology*, **172**, 297–311

Wallace, P.A., Marfo, E.K., Timpoh, G., Wisdom, A., Plahar, W.A. 2001. Nutritional value and cholesterol-lowering effect of wild lettuce (*Laucaea taxaracifolia*) leaf as a source of protein. *Journal of Applied Science and Technology,* **6**, 94-100.

Wichtl, M. 1994. Herbal drugs and phytopharmaceuticals. CRC Press, Boca Raton, FL., USA, 486 - 489.

Williams, A.R., Soelberg, J., Jäger, A.K. 2016. Anthelmintic properties of traditional African and Caribbean medicinal plants: identification of extracts with potent activity against *Ascaris suum in vitro. Parasite,* **23**, 23-35

Yemoa, A., Gbenou, J., Affolabi, D., Moudachirou, M., Bigot, A., Anagonou, S., Portaels, F., Leclercq, J.Q., Martin, A. 2011. Buruli-ulcer: a review of *in vitro* tests to screen natural products for activity against Mycobacterium ulcerans. *Planta Medica*, **77**, 641–646.

Yemoa, A.L., Gbenou, J. D., Johnson, R.C., Djego, J. G., Zinsou,C., Moudachirou, M., Quetin-Leclercq, J., Bigot, A., Portaels, F. 2008. Identification et étude phyto- de Buruli au Bénin. Chimique de plantes utilisées dansle traitement traditionnel del'ulcère de Buruli au Bénin. *Ethnopharmacologia,* **42**, 50–57.