

Qualitative and Quantitative Phytochemical Screening of Some Plants Used in Ethnomedicine in the Niger Delta Region of Nigeria

Mercy Gospel Ajuru^{1,*}, Light Femi Williams¹, Gospel Ajuru²

¹Department of Plant Science and Biotechnology, Faculty of Science, Rivers State University of Science and Technology, Nkpolu-Oroworukwo, Port Harcourt, Nigeria

²Department of Chemical Pathology, University of Port Harcourt, Port Harcourt, Nigeria

Email address:

ajurumercygospel@yahoo.com (M. G. Ajuru)

*Corresponding author

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Abstract: Qualitative and quantitative phytochemical screening of six plants used in ethnomedicine in the Niger Delta region of Nigeria was carried out to identify and quantify the bioactive compounds present in these highly medicinal plants. The plants studied were *Phyllanthus amarus* Schum and Thonn, *Euphorbia heterophylla* Linn., *Senna occidentalis* L., *Piper nigrum* L., *Ageratum conyzoides* L. and *Gongronema latifolium* Benth. Ethanolic and aqueous extracts of leaves of the plant species were screened for the presence of alkaloid, anthraquinone, coumarin, flavonoid, phenol, quinone, saponin, tannin, sugar and glycoside and quantitative study was also carried out using Standard method. Qualitative study indicated the presence of all the phytochemicals in the ethanolic extracts of *P. amarus* and *E. heterophylla*, and absence of anthraquinone in *S. occidentalis*, *P. nigrum*, *A. conyzoides* and *G. latifolium*. Also, absence of coumarin in *S. occidentalis*, and phenol in *G. latifolium*. The aqueous extract indicated the presence of all the phytochemicals in *A. conyzoides* and presence of alkaloid, tannin, sugar and glycoside in other plant species studied. Quantitative analysis showed variable amounts of pharmacologically important secondary metabolites such as alkaloids, tannins, flavonoid, saponins and phenol in all the plants investigated. The different phytochemicals are shown to perform different biological activities in humans and animals. These compounds can be harnessed for industrial and pharmaceutical utilization.

Keywords: Bioactive Compounds, Ethnomedicine, Medicinal Plants, Quantitative Study, Qualitative Study, Ethanolic Extract, Aqueous Extract

1. Introduction

Phytochemicals are non-nutritive plant chemicals that have protective or disease preventive properties. They are non-essential nutrients, meaning that they are not required by the human body for sustaining life. It is well-known that plants produce these chemicals to protect themselves but recent research demonstrates that they can also protect against diseases [1]. There are more than thousand known phytochemicals. Some of the well-known phytochemicals are lycopene in tomatoes, Isoflavones in soy and flavonoids in fruits.

Phytochemicals are naturally present in many foods but it is expected that through bioengineering new plants will be developed, which will contain higher levels of phytochemicals. This would make it easier to incorporate enough phytochemicals with our food [1-3].

Ethnobotany is the scientific study of the relationship that exists between people and plants. It is the study of plant resources by indigenous societies and includes plants used for food, timber, medicine and ceremony. Ethnomedicine is concerned with the indigenous uses of plants and plant products for medicine by the indigenous people in societies [4].

Medicinal plants have been identified and used throughout human history. Plants have the ability to synthesize a wide variety of chemical compounds that are used to perform important biological functions, and to defend against attack from predators such as insects, fungi and herbivorous mammals [5, 6]. At least 12,000 such compounds have been isolated so far, a number estimated to be less than 10% of the total [4, 7]. Chemical compounds in plants mediate their effect on the human body through processes identical to those already well understood for chemical compounds in conventional drugs; thus herbal medicines do not differ greatly from conventional drugs in term of how they work. This enables herbal medicine to have beneficial pharmacology, but also gives them the same potential as conventional pharmaceutical drugs to cause harmful side effects [8-11].

The use of plants as medicine predates written human history. Many of the herbs and species used by humans to season food also yield useful medicinal compounds. The use of herbs and spices in cuisine developed in plants as a response to the threat of food-borne pathogens. Studies show that in tropical climates where pathogens are the most abundant, recipes are highly spiced. Further, the spices with the most potent antimicrobial activity tend to be selected. In all cultures vegetables are spiced less than meat, presumably because they are more resistant to spoilage. Angiosperms (flowering plants) were the original source of most plants medicines. Many of the common weeds that populate human settlements, such as nettle, dandelion and chickweed, have medicinal properties.

Plants have been used both in the prevention and cure of various diseases of humans and their pets with the advent of human civilization, many systems of therapy have been developed primarily based on plants. The plant-based traditional medical systems continue to provide the primary health care to more than three-quarters of the world's populace.

Senna occidentalis (Eczema plant) is a species of the Fabaceae family. Coffee senna as it is also known is a very leafy, malodorous annual to shrubby plant that can grow up to 2 meters tall but is usually smaller. The plant is often annual, at least in seasonal climates. Leaves are made into a tea for treating afterbirth problems, fever, cough and cold, headache, haemorrhage and thrush. An ointment prepared from the leaves is applied as a remedy for ringworm and other affections of the skin. The flowers are used in a preparation to reduce stomach acid in children. The seed is febrifuge and sedative. An infusion is drunk to calm ones nerves and as a treatment for kidney problems, haemorrhage, worms and cleaning womb and tubes [12-14].

Gongronema latifolium (*Utazi*) is a climbing shrub with broad heart-shaped leaves that has a characteristic sharp, bitter and slightly sweet taste, especially when eaten fresh. It belongs to the family of plants known as Asclepiadaceae and it is widespread in tropical rainforest of west African countries such as Nigeria Cote d'Ivoire, Sierra Leone, Ghana and Senegal, etc.

Among the people of Southeast and South-South (Niger Delta), the leaves of this herb are used commonly for nutritional purposes, including as a spice and vegetable to garnish some special local delicacies such as *Isiewu*, *nkwobi*, *abacha/ugba* (African salad) *ofensala* (white soup), unripe plantain porridge, etc because of its sharp-bitter and sweet taste.

The leaves are believed to neutralize the intoxicating properties of alcohol and its harmful effects on the liver. An infusion or decoction of the whole plant (the leaves and stems) is used in the home treatment for digestive problems, such as loss of appetite dyspepsia, colic and stomach ache, constipation, dysentery and intestinal worms [15-17].

Piper nigrum (*Uziza* or black pepper) is a flowery vine in the family Piperaceae, cultivated for its fruits, which is usually dried and use as a spice and seasoning.

Piper nigrum or black pepper oil can be used to help in the treatment of pain relief, rheumatism, Chills, flu, colds, increase circulation, exhaustion, muscular aches, physical and emotional coldness nerve tonic and fevers. It furthermore increases the flow of saliva, stimulates appetite, encourages peristalsis, tones the colon muscles and is a general digestive tonic. Externally it is used for its rube facient properties and as a local application for relaxed sore throat and some skin diseases [18, 19].

Ageratum conyzoides (Goat weed) belongs to the family Asteraceae. It is an annual herbaceous plant with a long history of traditional medicinal uses in several countries of the world and also has bioactivity with insecticidal and nematocidal activity.

A. conyzoides is widely utilized in traditional medicine by various cultures worldwide. It is used to treat pneumonia, but the most common use is to cure wounds and burns. Traditional communities in India use this species as a bactericide, antidysenteric, antilithic, and in Asia, south America and Africa aqueous extract of this plant is used as a bactericide. In Cameroon and Congo, traditional use is to treat fever, rheumatism, headache, and colic [20-22]. Aqueous extracts of leaves and whole plants have been used to treat colic, colds and fevers, diarrhea, rheumatism, spasms or as a tonic. *A. conyzoides* has quick and effective action in burn wounds and is recommended by Brazilian Drugs central as an antirheumatic.

Euphorbia heterophylla (Pintado, Mexican fireplant) is of the family Euphorbiaceae. Pintado is an erect, branched, smooth, half-woody herb or shrubby plant, 0.5 to 1.5 meters high.

Studies have suggested that *E. heterophylla* has wound healing, antimicrobial, antinociceptive, anti-inflammatory, antioxidant and anthelmintic properties. It is used for the treatment of constipation, bronchitis and asthma, cough, catarrh, insect bites, and purgative. Decoction of leaves is used in massaging the breast to induce milk flow in nursing mothers [23-25].

Phyllanthus amarus (Gulf leaf flower) is from the family Euphorbiaceae. It is said to have originated from tropical

America and has spread as a weed throughout tropics and subtropics. *P. amarus* is widely used as a medicinal plant [26-28]. An infusion is considered a good tonic, diuretic and antipyretic. A decoction of the aerial parts or only of the leaves is taken to treat gonorrhoea, diarrhea, dysentery, and stomach-ache, pain in the sides, haemorrhoids and absence of menstruation or female sterility. A suppository of the leaf paste is applied to the vagina to treat absence of menstruation and polyps. Leaf sap, mixed palm oil or not, is applied as ear drops to treat otitis and applied to abscesses, sores and wounds.

The plant species used in this study are employed in the treatment of several diseases in the Niger Delta; therefore this work is carried out to analyze the phytochemical content of these plants that enable them to be effective in treatment of these various ailments. The result of this work shall be beneficial to the natives of the Niger Delta Regions as they will gain insight into the benefits of using these plants. It will also benefit pharmaceutical firms who may undergo further studies in a bid to make drug substances using these phytochemicals.

2. Materials and Methods

2.1. Collection of Plant Material

Some of the plants were collected at a building site at Rumuagholu, in Obio/Akpor Local Government Area. *E.*

heterophylla was collected behind biology new building, while *G. latifolium* and *P. nigrum* were purchased at mile 3 market in Port Harcourt City Local Government Area, all in Rivers State. The plants were identified and authenticated at the Herbaria of the Department of Plant Science and Biotechnology, Faculty of Science, Rivers State University of Science and Technology, Port Harcourt, and Department of Biology, Ignatius Ajuru University of Education, Rumuolumeni, Port Harcourt. Reference was also made to the Flora of West Tropical Africa [29].

2.2. Phytochemical Investigation

2.2.1. Plant Extraction and Analysis

The leaves of the six different species were washed, air dried and later oven dried at room temperature (26°C) for seven days. The dried leaves were pounded into a homogenous powder using mortar and pestle. The plant materials were stored in specimen bottles for future use.

Two different solvents (ethanol and distilled water) were used for extraction. 10g each of the dry plant materials were soaked in 120ml of ethanol and water at room temperature for two days. The extracts were filtered using a Whatmann filter paper No. 42 (125mm), and then through cotton wool. The extracts were evaporated into dryness using a hot water bath for 72 hours, and were then stored in the refrigerator for further use.

Table 1. Ethnomedicinal Uses and Different Biological activities of the Plant Materials Investigated.

Taxa	Ethnomedicinal/biological activities	References
<i>Phyllanthus amarus</i> Schum & Thonn.	Anti-inflammatory, antiviral, antioxidant, Anticancer, antifungal, antiplasmodial, stomach Ache, menorrhagia, diarrhea, dysentery, fever, Genitourinary system, liver, kidney, spleen, Ulcers, wounds, gonorrhea, syphilis, malaria, jaundice, skin diseases, scabies	[30-34]
<i>Senna occidentalis</i> L.	Purgative, stomachache, hiccups, vomiting, Laxative, febrifuge, typhoid, jaundice, gout, Female fertility, rheumatism, tumours, Leprosy, wounds, bronchitis, antibacterial, Hepatoprotective, antiplasmodial, anti- Hepatoprotective, antiplasmodial, anti- 2009; Inflammatory, antimalarial	[12-14] [35-38] 2015; Panda, 2004; Jain <i>et al.</i> ; 2010; Tona <i>et al.</i> ; 2004; Yadava <i>et al.</i> ; 2009; Jain <i>et al.</i> ; 2010;
<i>Piper nigrum</i> L.	Anti-inflammatory, anti-thyroidal, cold, Ahmad <i>et al.</i> ; 2012, Fever, asthma, antioxidant, antimutagenic, Antifungal, pesticidal, indigestion, gastric Parganiha <i>et al.</i> ; 2011, Problems, hepatoprotective	[18, 19, 39, 40]
<i>Ageratum conyzoides</i> L.	Gastroprotective, antibacterial, anti-inflammatory, Antianalgesic, antipyretic, anticonvulsant, colic, Anticancer, fever, rheumatism, headache, Colds, diarrhea, spasm, tonic.	[20-22, 41]
<i>Gongronema latifolium</i> Benth.	Hypoglycemic, hypolipidemic, antioxidative, anti-inflammatory, antimicrobial, malaria, Essien <i>et al.</i> ; 2007, hypertension, nausea, diabetes, anorexia, asthma, vemifuge, cough, dysentery, colic, Ugochukwu & intestinal worms, stomachaches, laxative, Babady, 2002, constipation, anticancer	[16, 17, 42—45]
<i>Euphorbia heterophyllum</i> Linn.	Antibacterial, purgative, respiratory tract Okeniyi <i>et al.</i> ; 2012, infections, asthma, anti-inflammatory, Falodun <i>et al.</i> ; 2006, laxative, migraine, wart cures, eczema, Erden <i>et al.</i> ; 1999	[23-25]
	antigonorrheal, insecticide, cough, malaria, anticonvulsant, anti tumor, anti-HIV	

2.2.2. Qualitative Screening of the Phytochemicals in the Plants Investigated

The ethanolic and aqueous extracts were used to perform the phytochemical screening using standard methods [46-48], for the detection of the following:

(i). Screening for Alkaloids (Mayer's Test)

1ml of the extract was measured into a watch glass and little amount of dilute hydrochloric acid and Mayer's reagents were added to the solution; the formation of a white

precipitate indicated the presence of alkaloids.

(ii). Screening for Anthraquinone (Borntrager's Test)

Few drops of magnesium acetate solution were added to 1 ml of the extract; the formation of pink colour showed the presence of anthraquinone.

(iii). Screening for Coumarin

1.5ml of the extract was mixed with few drops of alcoholic sodium hydroxide in the watch glass; the appearance of yellow colour indicated the presence of coumarin.

(iv). Screening for Flavonoid (Shindo's Test)

1.3ml of the extract was mixed with 0.5g of magnesium turnings; the mixture was boiled for 5 minutes; the appearance of orange to red colour indicated the presence of flavonoid.

(v). Screening for Phenol

A few drops of ferric chloride solution were added to 2ml of the extract in a watch glass; the appearance of bluish green colour indicated the presence of phenol.

(vi). Screening for Quinone

1ml of the extract was mixed with concentrated sulphuric acid. The appearance of the colour formation signified that quinone was present.

(vii). Screening for Saponin (Frothing Test)

2.5ml of the extract was mixed with a few drops of distilled water and the mixture was shaken vigorously, a cupious lather formation was noticed which indicated the presence of saponin, and the absence of the cupious lather meant the absence of saponin.

(viii). Screening for Tannin (Wohler's Test)

A few drops of basic lead acetate solution was added to 1.6ml of the extract; the appearance of a white precipitate indicated the presence of tannin in some of the plant extracts.

(ix). Screening for Sugar

2.5ml of the extract was measured into a 150ml beaker, and a small quantity of anthrone and a few drops of concentrated sulphuric acid were added to the mixture which gave off a green coloration, indicating the presence of sugar.

(x). Screening for Glycoside

2.5ml of the extract was mixed with a little quantity of anthrone on a watch glass, one drop of concentrated sulphuric acid was added and made into a paste, and heated gently over a water bath; a dark green colouration indicated the presence of glycoside.

These same procedures were applicable to both the ethanolic and aqueous extracts.

2.2.3 Quantitative Determination of the Chemical Constituents**(i). Alkaloid Determination**

5g of the sample were weighed into a 250ml beaker and 200ml of 20% acetic acid in ethanol was added and covered to stand for 4 hours. This was filtered and the extract was concentrated using a water-bath to one quarter of the original volume. Concentrated ammonium hydroxide was added drop wise to the extract until the preparation was complete. The whole solution was allowed to settle and the precipitate was collected by filtration and weighed.

(ii). Tannin Determination

500 mg of the sample was weighed into 100 ml plastic bottle. 50 ml of distilled water was shaken for one hour in a mechanical shaker. This was filtered into a 50 ml volumetric

flask and made up to the mark. Then 5 ml of the filtrate was pipette out into a tube and mixed with 3 ml of 0.1M FeCl_3 in 0.1N HCl and 0.008M potassium ferrocyanide. The absorbance was measured in a spectrophotometer at 120nm wavelengths, within 10 minutes. A blank sample was prepared and the colour also developed and read at the same wavelength. A standard was prepared using tannin acid to get 100 ppm and measured.

(iii). Flavonoid Determination

100g of the plant sample were extracted repeatedly with 100 ml of 80% aqueous methanol at room temperature. The whole solution was filtered through Whatman filter paper No. 42 (125mm). The filtrate was later transferred into a crucible and evaporated to dryness over a water bath and weighed.

(iv). Saponin Determination

The samples were ground. 20g of each plant samples were dispersed in 200 ml of 20% ethanol. The suspension was heated over a hot water bath for 4 hours with continuous stirring at about 55°C. The mixture was filtered and the residue re-extracted with another 200 ml of 20% ethanol. The combined extracts were reduced to 40 ml over water bath at about 90°C. The concentrate was transferred into a 250 ml separator funnel and 20 ml of diethyl ether was added and shaken vigorously. The aqueous layer was recovered while the ether layer was discarded. The purification process was repeated. 60 ml of n-butanol was added. The combined n-butanol extracts were washed twice with 10 ml of 5% aqueous sodium chloride. The remaining solution was heated in a water bath. After evaporation, the samples were dried in the oven to a constant weight. The saponins content was calculated in percentage.

(v). Phenol Determination

For the extraction of the phenolic component, the fat free sample was boiled with 50 ml of ether for 15 minutes. 5 ml of the extract was pipette into a 50 ml flask, and then 10 ml of distilled water was added, 2 ml of ammonium hydroxide solution and 5 ml of the extract was pipette into a 50 ml flask, and then 10 ml of distilled water was added, 2 ml of ammonium hydroxide solution and 5 ml of concentration amyl alcohol were also added. The samples were left to react for 30 minutes for colour development. The absorbance of the solution was read using a spectrophotometer at 505 nm wavelengths.

3. Results and Discussion***Phytochemical Screening of Plants Extracts***

Phytochemical constituents of the plants studied was investigated for the following metabolites: alkaloid, anthraquinone, coumarin, flavonoid, phenol, quinone, saponin, tannin, sugar and glycoside. Qualitative screening using ethanolic extract indicated the presence of all the phytochemical constituents in *P. amarus* and *E. heterophylla*, and the absence of anthraquinone in *S. occidentalis*, *P.*

nigrum, *A. conyzoides* and *G. latifolium*. Coumarin was also absent in *S. occidentalis* and *G. latifolium* lacked phenol in the ethanolic extract (Table 2).

Qualitative screening using aqueous extract indicated the presence of all the phytochemicals in *A. conyzoides*, and absence of alkaloids in *P. amarus*; there was absence of

flavonoid in *P. amarus*, *S. occidentalis*, *P. nigrum* and *G. latifolium*. Saponin was not present in *P. amarus* and *S. occidentalis*. *E. heterophylla* and *P. nigrum* lacked anthraquinone; coumarin and quinine were absent in *E. heterophylla* and *S. occidentalis* and phenol was also absent in *S. occidentalis* and *G. latifolium* (Table 2).

Table 2. Qualitative phytochemical screening of the plant species studied using ethanolic and aqueous extracts.

Plants	Extraction	Alkaloid	Anthraquinone	Coumarin	Flavonoid	Phenol
<i>Phyllanthus amarus</i> (Gulf leaf flower)	Ethanol	+	+	+	+	+
	Water	-	+	+	-	+
<i>Euphorbia heterophylla</i> (Pintado)	Ethanol	+	+	+	+	+
	Water	+	-	-	+	+
<i>Senna occidentalis</i> (Eczema plant)	Ethanol	+	-	-	+	+
	Water	+	+	-	-	-
<i>Piper: nigrum</i> (Uziza)	Ethanol	+	-	+	+	+
	Water	+	-	+	-	+
<i>Ageratum conyzoides</i> (Goat weed)	Ethanol	+	-	+	+	+
	Water	+	+	+	+	+
<i>Gongronema latifolium</i> (Utazi)	Ethanol	+	-	+	+	-
	Water	+	+	+	-	-

Table 2. Continued.

Plants	Extraction	Quinone	Saponin	Tannin	Sugar	Glycoside
<i>Phyllanthus amarus</i> (Gulf leaf flower)	Ethanol	+	+	+	+	+
	Water	+	-	+	+	+
<i>Euphorbia heterophylla</i> (Pintado)	Ethanol	+	+	+	+	+
	Water	-	+	+	+	+
<i>Senna occidentalis</i> (Eczema plant)	Ethanol	+	+	+	+	+
	Water	-	-	+	+	+
<i>Piper: nigrum</i> (Uziza)	Ethanol	+	+	+	+	+
	Water	+	+	+	+	+
<i>Ageratum conyzoides</i> (Goat weed)	Ethanol	+	+	+	+	+
	Water	+	+	+	+	+
<i>Gongronema latifolium</i> (Utazi)	Ethanol	+	+	+	+	+

Present----- +ve

Not Present ----- -ve

Quantitative analysis of the pharmacologically important phytochemicals in the plants indicated that all the species contain these phytochemicals in varying amounts in the leaves. The quantity of all the phytochemicals was particularly high in *A. conyzoides*, followed by *S. occidentalis*, *E. heterophylla*, *P. amarus*, *G. latifolium* and *P. nigrum* respectively. The phytochemical with the highest quantity was phenol, followed by alkaloids, flavonoids, tannins, and saponins respectively, as shown in Table 3.

Table 3. Quantitative estimation of pharmacologically important secondary metabolites in the taxa studied.

Taxa	Alkaloids %	Tannins%	Flavonoids%	Saponins%	Phenols%
<i>Phyllanthus amarus</i>	1.56 ± 0.50	1.43 ± 0.03	1.62 ± 0.03	0.85 ± 0.01	0.09 ± 0.01
<i>Euphorbia heterophylla</i>	7.15 ± 0.81	2.08 ± 0.04	0.28 ± 0.03	0.30 ± 0.01	4.03 ± 0.12
<i>Senna occidentalis</i>	2.95 ± 0.07	2.10 ± 0.05	1.16 ± 0.01	3.41 ± 0.04	0.74 ± 0.02
<i>Piper nigrum</i>	0.67 ± 0.01	0.15 ± 0.08	0.57 ± 0.03	0.36 ± 0.08	0.45 ± 0.01
<i>Ageratum conyzoides</i>	9.40 ± 0.20	8.45 ± 0.01	8.50 ± 1.22	6.51 ± 0.08	29.05 ± 1.01
<i>Gongronema latifolium</i>	0.75 ± 0.01	0.80 ± 0.08	0.50 ± 1.02	0.75 ± 0.04	0.07 ± 0.15

Phytochemicals are non-nutritive plant chemicals that have protective or disease preventive properties which are considered to be beneficial to human health. The presence of bioactive ingredients and the quantitative determination of the percentage crude yield of chemical constituents of the different plant species studied showed that the leaves are rich in alkaloids, tannins, flavonoids, saponins and phenols.

Alkaloids have a wide range of pharmacological properties including antimalarial, antiasthma, anticancer properties as

reported by [49]. They are used in medicine especially the steroidal alkaloids and also show considerable pharmacological activity [50].

It was also reported to have cholinomimetic, vasodilatory, antiarrhythmic, antihyperglycemic activities [51], analgesic and antibacterial properties [52-54], though they can be toxic too [55]. Studies have shown that all the plants studied have the tendency to treat these ailments and they all contain alkaloids.

The plants have antioxidant, anti-inflammatory, anti

allergic, anti carcinogenic, anti microbial, hepatoprotective and anti viral abilities properties due to the presence of flavonoids, which was reported to have the above mentioned properties [56]. Flavonoids help to prevent platelets sickness and hence platelets aggregation [57].

The presence of coumarin in *P. amarus*, *E. heterophylla*, *P. nigrum*, *A. conyzoides* and *G. latifolium* enable these plants to carry out various pharmacological activities such as edema modification, faster reabsorption of edematous fluids, treatment of lymphedema, etc [58].

Secondary metabolites in plants such as phenolic compounds are essential for plant growth, reproduction, as protecting agents against pathogens, prevent chronic illnesses such as cardiovascular disease, certain type of cancers, neurodegenerative disease, and diabetes [59]. Plants that contain phenol could be used as anti inflammatory, immune enhancers and hormone modulators [60]. Phenols are reported to possess the ability to block specific enzymes that cause inflammation and to prevent disease [61].

It has been reported that tannins possess physiological astringent and haemostatic properties, which hasten wound healing and ameliorated inflamed mucus membrane. They have important roles such as stable and potent anti-oxidants [62-65]. Tannins also have been reported to form complexes with digestive enzymes thus reducing the digestibility of proteins in foods [66].

Saponins are active as expectorant and is very useful in the treatment of upper respiratory tract inflammations; they also have anti-diabetic and anti-fungal properties [67, 62, 68]. Saponins, often referred to as natural detergent due to their foamy nature, also possess anti carcinogenic properties, immune modulation activities and regulation of cells proliferation as well as inhibition of the growth of cancer cells and cholesterol lowering activity [69].

The six plant species studied are involved in saponin expectorant action which is very useful in the management of upper respiratory tract inflammation; saponins present in plants are cardiogenic in nature and are reported to have anti-diabetic and anti-fungal properties.

The ethanolic and aqueous extraction methods used in this study revealed that ethanolic extraction is more effective and reliable as it enabled easy filtration and contained more phytochemicals than the aqueous extract which was difficult to filter due to inability of the plant materials to completely dissolve in it. Also, the aqueous extract had the tendency to easily go bad which was suspected to have led to the loss of some of the phytochemicals which were present in the ethanolic extract.

4. Conclusion

All the plant species used in this study have been discovered to possess promising medicinal potentials. This study has revealed that the ethanolic extract contain more of the phytochemicals, compared to the water extracts. Therefore, ethanol is recommended for the extraction of plant materials for better result. In view of all the medicinal importance

associated with the phytochemicals found in these plant species, further investigation should be carried out in order to isolate, identify, characterize and elucidate the structures of these bioactive principles and enhance their potentials for industrial and pharmaceutical utilization. Further investigation should be carried out on the diversity of chemical constituents, level of toxicity and the physiology of these plants.

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