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PHYTOPHARMACEUTICAL POTENTIAL AND MICROSCOPIC ANALYSIS OF RHIZOMES OF *CURCUMA LONGA* AND *ZINGIBER OFFICINALE* (ZINGIBERACEAE)

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ABSTRACT

Turmeric and ginger are spices derived from the rhizomes of Curcuma longa and Zingiber officinale respectively. The rhizomes of C. longa and Z. officinale were extracted in hexane, ethyl acetate, methanol and water. Phytochemical screening was carried out on each of the extracts. Proximate analysis to determine the extractive values, moisture content, total ash, crude fibre, acid insoluble ash and water soluble ash were carried out on the rhizomes of fresh and dried turmeric and ginger. The rhizomes of C. longa revealed alcohol extractive value 22.79%, water extractive value 26.44%, moisture content 11.56 ± 0.04%, total ash 13.24±0.03%, crude fiber 6.40±0.20%, acid insoluble ash 1.02±0.02% and water soluble ash 4.32±0.07%. Extractive values for ginger were recorded as alcohol 2.7% and water 2.1%, fresh and dried ginger rhizomes afforded, moisture content 72.63 ±0.09%, 10.03±0.09%, total ash 2.50 ±0.06%, 7.30±0.10%, acid insoluble ash 0.57±0.03%, 2.03±0.09%, and water soluble ash 1.23±0.03%, 3.87±0.09% respectively. Observations on the microscopic studies of the fresh rhizomes of turmeric and ginger revealed possession of oil duct and spiral xylem vessels. Similarly phytomorphology of the powdered rhizomes of ginger and turmeric revealed the presence of tracheid and compartment of vessels. Presence of similar anatomical features in both the fresh and ground samples confirmed the authenticity or adulterous of the powdered samples.

KEY WORDS: *adulteration, authentication, drug plants, Curcuma longa, Zingiber officinale, pharmacognosy*

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INTRODUCTION

Plants had been used for medical purposes long before recorded history. At the present time, according to the WHO reports, about 80% of the world's population use herbal medicines for some aspects of their primary health care (Duţu, 2012). The use of plants and plant extracts for medicinal purposes has been going on for thousands of years and it has been the source of much useful therapy in both herbalism and folk medicine (Bubayero, 1998). Although modern biomedicine to a significant degree employs synthetic drugs as therapeutic agents, plants still occupy a prominent place in contemporary pharmacy, either as sources of pharmaceutical drugs in the form of

isolated plant compounds, as sources of precursors to drugs, or as sources of compounds that have served as models for synthetic drugs. It has been estimated that about one-half of all drugs in current use are natural compounds or derivatives of plant material (Iwu, 2002). For the majority of people, many of whom live in miserable poverty, crude plants preparations are still the main form of medicine. In acknowledgment of this situation, the World Health Organization (WHO) is actively promoting the development of traditional medicine (Anon., 2002).

Many plants belonging to the ginger family Zingiberaceae have a history of medicinal use in systems of traditional medicine. Both ginger (*Zingiber officinale*) and turmeric (*Curcuma longa*) had been the subject of substantial pharmacological and clinical investigations over the last three decades. Ginger, the rhizome of *Z. officinale*, is one of the most widely used species of the ginger family and is a common condiment for various foods and beverages. It has a long history of medicinal use dating back to 2,500 years in China and India for conditions such as headaches, nausea, rheumatism, and colds. Ginger is native to Southern Asia, but it is now extensively cultivated in Jamaica, Nigeria, China, India, Fiji, Sierra Leone and Australia (Shipra *et al.,* 2012; Toader, 2014). Turmeric on the other hand, is an Indian spice derived from the rhizomes of the plant and has a long history of use in Ayurvedic medicine as a treatment for inflammatory conditions (Jurenka, 2009). Turmeric grows wild in the forests of South and Southeast Asia. It is one of the key ingredients in many Asian dishes. Indian traditional medicine, called Ayurveda, has recommended turmeric in food for its potential medicinal value, which is a topic of active research (Jurenka, 2009).

Over 80% of the medicinal plants used are predominantly collected from the wild or local markets where they are adulterated; collectors often rely on their experience in identifying the species of plants being collected. Services of specialists such as taxonomist are rarely availed for authentication. Thus, it is common to find admixtures of related plant species and unrelated genera. The reasons attributed for species admixtures include the confusion in vernacular names, non-availability of authentic plants, similarity in morphological features (Mitra & Kannan, 2007). Frequently, admixtures could also be deliberate in order to maximized profit (Mitra & Kannan, 2007). The consequence of species admixtures can range from reducing the efficacy of the drug to lowering the trade value, causing damage to human body (Jordan *et al*., 2010), besides threatening the safety of herbal medicines (Song *et al*., 2009).

Considering the adverse consequence of such species admixture may have on the eventual drug efficacy. It is imperative that the admixtures are avoided in raw herbal trade and where existing, methods should be developed to identify the admixtures. In recent years, efforts have been made to accurately identify medicinal

plants used in treating ailments to ensure the purity, quality, and safety (Jayasinghe *et al*., 2009).

Powdered forms of these two plants are sold in the market for treatment of a number of diseases. The aim of this research work, therefore, is to identify the various metabolites and determine the proximate content present in the rhizomes of *Z. officinale* (ginger) and *C. longa* (tumeric). Microscopic investigations of both fresh and powdered forms of the two plants were also carried out with aim of investigating the authenticity to avoid adulterations.

MATERIALS AND METHODS

Fresh rhizomes of *C. longa* were collected from National Institute for Pharmaceutical Research and Development (NIPRD) Forestry at Idu, Abuja, Nigeria. The rhizomes of *Z. officinale* were gotten from Kappa Laboratory, Bodija, Ibadan, Nigeria. The plants were ground and stored, and were oven dried (Fig. 1).

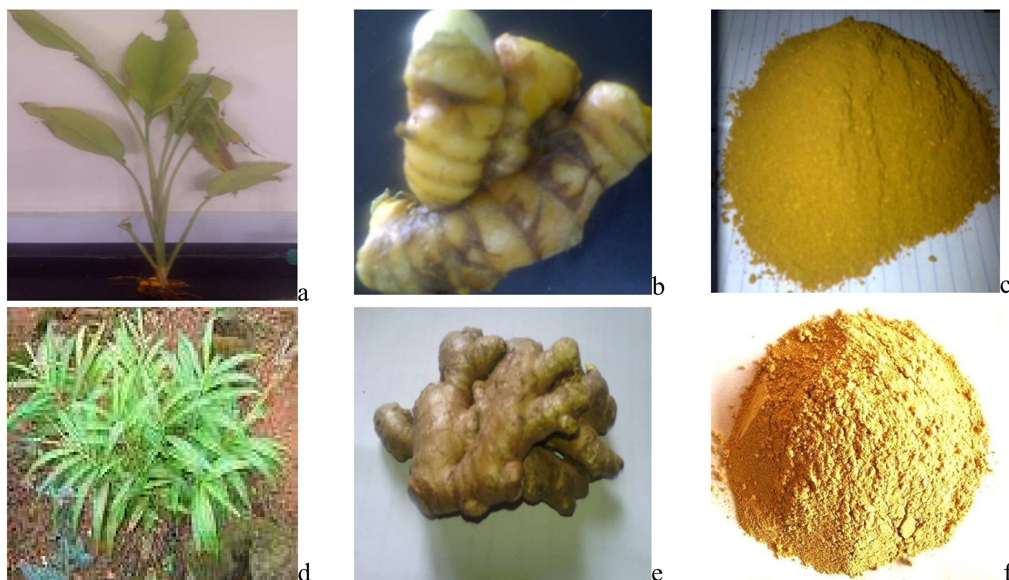

FIG. 1. Leaves and stem (a), rhizome (b) and powder (c) of *Curcuma longa*; leaves and stem (d), rhizome (e) and powder (f) of ginger

Preparation of plant extract. The powdered materials were macerated using hexane, ethyl acetate, methanol and water. The extracts were prepared by soaking 20g each of the dried powdered plant materials in 200ml of each solvent at room temperature for 48h. The extracts were filtered after 48h, first through a Whatmann filter paper No 42 (125mm) and then through cotton wool. The extracts were concentrated by gentle evaporation on a heating mantle.

The concentrated extracts were subjected to preliminary qualitative phytochemical analysis with reference to standard procedures (Trease & Evans, 1996; Harborne, 1998; Edeoga *et al*., 2005; Ayoola *et al.,* 2008).

Test for flavonoids. A portion of the extract was heated with 10ml of ethyl acetate over a steam bath for 3 min. The mixture was filtered and 4 ml of the filtrate of the extract was shaken with 1ml of dilute ammonia solution. A yellow colouration indicates the presence of flavonoids (Trease & Evans, 1989; Sofowora, 1993; Ayoola *et al*., 2008).

Test for tannins. A 0.5 g of the extract was boiled in 10ml of water in a test tube and then filtered. A few drops of 0.1% ferric chloride were added. A brownish green, dark green or a blue-black colouration indicated the presence of tannins (Trease & Evans, 1989; Sofowora, 1993; Ayoola *et al*., 2008).

Test for saponins. To 0.5 g of the extracts were added 5ml of distilled water each in a test-tube. The solution was shaken vigorously and observed for a stable persistent froth for 20 min. The frothing was mixed with 3 drops of olive oil and shaken vigorously. The formation of an emulsion indicates the presence of saponins.

Test for alkaloids. A 0.5g of the extract was diluted to 10ml with acid alcohol, boiled and filtered. To 5ml of the filtrate was added 2ml of dilute ammonia. 5ml of chloroform was added and shaken gently to extract the alkaloidal base. The chloroform layer was extracted with 10ml of acetic acid. This was divided into three portions. Mayer's reagent was added to one portion, Wagner's reagent was added to another one and Drangendorff's reagent was added to the last portion (Trease & Evans, 1989; Sofowora, 1993; Evans, 1997; Ayoola *et al*., 2008).

Test for phytosterols (Liebermann-Burchard's test). A 0.5g extract was dissolved in 2ml of acetic anhydride. To this 2 drops of concentrated H_2SO_4 were added slowly along the side of test tubes. An array of colour changes shows the presence of phytosterols (Finar, 1986).

Test for carbohydrates (Reducing sugars). A 0.5g of the extract was added to 5ml of water and 20 drops of boiling Fehling's solutions (A and B) in a test tube was also added. The formation of a precipitate red-brick in the bottom of the tube indicates the presence of reducing sugars (Ramakrishman & Rajan, 1994).

Test for sugars (Fehlings test). Two mole (2ml) of extract (0.5g dissolved in 5ml of water) was added to 5ml of a mixture of equal volumes of Fehling's solutions 1(A) and 1(B) and boiled on a water bath for 2 minutes. A brick-red colour solution indicates the presence of reducing sugars.

Test for cardiac glycosides (Keller-Killiani test). To 0.5g of extract was diluted to 5 ml in water to which was added 2 ml of glacial acetic acid containing one drop of ferric chloride solution. This was under laid with 1 ml of concentrated sulphuric acid. A brown ring at the interface indicated the presence of a deoxysugar characteristic of cardenolides. A violet ring may appear below the brown ring, while in

the acetic acid layer a greenish ring may form just above the brown ring and gradually spread throughout this layer (Evans, 1997).

Test for Terpenoids (Salkowski test).0.5g of extract was mixed in 2ml of chloroform and 3ml of concentrated H_2SO_4 was carefully added to form a layer. A reddish brown colouration at the interface indicates the presence of terpenoids (Ayoola *et al.,* 2008).

Test for chlorogenic acid. A 0.5g of the extract was boiled in 10ml water and then filtered**.** To 1ml of the filtrate was added 2 drops of 10% ammonia solution. The mixture was heated over a flame and then exposed to air. A green colour indicates the presence of chlorogenic acid (Sofowora, 1993).

Test for Resins. 5ml of petroleum ether extract was made using 0.1g of extract and filtered into a test tube. An equal volume copper acetate solution was added and shaken vigorously then allowed to separate. A green colour indicates the presence of resins (Evans, 1997).

Test for Balsams. 2 drops of alcoholic ferric chloride solution were added to 5ml extracts of the sample. A dark green colour indicates the presence of balsams (Evans, 1997).

Proximate Analysis carried out were based on standard procedures (AOAC, 1996: Onwuka, 2005: Agrawal & Paridhavi, 2007).

Determination of moisture content was carried out using the air oven method. Crucibles were washed and dried in an oven. They were allowed to cool in the desiccators and weight was noted (W1). A known weight of samples was then transferred into the weighed crucibles and weight of the crucible plus that of the undried sample was taken (W2). The crucible together with sample was dried at a temperature of 105°C to constant weight (Clarke & McCaig, 1982; Datcu, 2014). The dried samples were cooled in a desiccators and the weight of the sample with the crucible was taken (W3). Calculation:

$$\% \text{ Moisture content} = W2 - W3/W2 - W1 \text{ X } 100$$

where W1 = initial weight of empty crucible, W2 = weight of crucible + sample before drying, W3 = weight of crucible+ sample after drying

Determination of alcohol extractive value. Five gram (5g) of the powdered material was weighed into a 250ml stopper conical flask. 90% ethanol was prepared and 100ml of it was added to the plant sample and the stopper was replaced firmly. The flask and its content was shaken for 6hrs on a mechanical shaker and allowed to stand for 18hours. At the end of 18 hours, the extract was quickly filtered. A clean and heated flat bottomed evaporating dish is weighed and 200ml of the filtrate was poured into the evaporating dish and evaporated to dryness on a water bath. The constant weight of the residue was obtained from the 20ml extract by subtracting the weight of the evaporating dish from the final weight (Agrawal & Paridhavi, 2007). The alcohol

extractive value is calculated in % with reference to the initial weight of the powdered sample. (Wt of extract = final wt of dish + extract – wt of dish).

$$\% \text{ alcohol extractive value} = \frac{wt\ of\ extract}{initial\ wt\ of\ sample} \times 100$$

Determination of water extractive value. Five gram (5g) of the powdered material was accurately weighed into a 250 ml stopper conical flask. 0.25% chloroform in water was prepared and 100ml of it was added to the plant sample and the stopper was replaced firmly. The flask and its content was shaken for 6hrs on a mechanical shaker and allowed to stand for 18hours. At the end of 18 hours, the extract was quickly filtered. A clean and heated flat bottomed evaporating dish is accurately weighed and 200 ml of the filtrate was poured into the evaporating dish and evaporated to dryness on a water bath. The constant weight of the residue was obtained from the 20 ml extract by subtracting the weight of the evaporating dish from the final weight (Agrawal & Paridhavi, 2007). The alcohol extractive value is calculated in % with reference to the initial weight of the powdered sample. (Wt of extract = final wt of dish + extract – wt of dish).

$$\% \text{ water extractive value} = \frac{wt\ of\ extract}{initial\ wt\ of\ sample} \times 100$$

Determination of total ash value. A tarred silica crucible was heated to a constant weight at 105°C (W1). A know weight of the powder sample was transferred into the crucible and weighed (W2). The crucible with content was firstly charred on a heater inside a fume cupboard to drive off the smoke. This was then transferred into a pre-heated muffle furnace at 550°C and left for until a white ash was observed. This was continued until the residue became black in colour. The residue was moistened with a small amount of water to dissolve the salt present. This was dried in the oven and the procedure continued in the furnace. The heating was continued until a constant weight was observed. The crucible together with content was then cooled in desiccators and weighed (Onwuka, 2005; Oboh & Masodje, 2009; Ianovici, 2011).

$$\% \text{ ash value} = \frac{\text{weight of ash}}{initial\ weight\ of\ plant\ sample} \times 100$$

$$= \frac{W3\text{-}W1}{W2\text{-}W1} \times 100$$

where: W1 = weight of empty crucible, W2 = weight of crucible + plan sample before drying and/or ashing, W3 = weight of crucible + ash

Determination of acid insoluble ash value. After determining the ash value, the crucible with the ash was transferred into a beaker containing 25 ml of dilute HCl acid. This was boiled for 5mins and filtered through the ash-less filter paper. The beaker and crucible were washed with water and passed through the filter paper in a manner so that the residue was collected at the tip of the cone of the filter paper. The

funnel along with the filter paper was dried in the oven at 105°C. The constant weight of the clean crucible was accurately taken. The filter paper was folded into a small cone and transferred into a tarred crucible. The crucible was heated gently until the filter paper was completely ashed and heated strongly for few minutes. The crucible and its content was cooled and weighed to note the final weight (Onwuka, 2005). The weight of the residue = final weight of crucible + ash – weight of crucible.

$$\text{Acid insoluble ash value \%} = \frac{\text{weight of ash}}{\textit{initial weight of plant sample}}\ x\ 100$$

Determination of water soluble ash value. After determining the ash value, the crucible with the ash is transferred into the beaker containing 25ml of distilled water. This was boiled for 5mins and filtered through and the ash less filter paper. The beaker and crucible were washed with water and passed through the filter paper in a manner so that the residue was collected at the tip of the cone of the filter paper. The funnel along with the filter paper was dried in the oven at 105°C. The constant weight of the clean crucible was accurately taken. The filter paper was folded into a small cone and transferred into a tarred crucible. The crucible was heated gently until the filter paper was completely ashed and heated for few minutes. The crucible and its content were cooled and weighed to note the final weight (Agrawal & Paridhavi, 2007). The weight of the residue =final weight of crucible +ash – weight of crucible.

$$\text{Water soluble ash value\%} = \frac{\text{weight of ash}}{\textit{initial weight of plant sample}}\ x\ 100$$

Determination of crude fibre. Two hundred (200ml) freshly prepared 1.25% H_2SO_4 was added to a known weight of the residue obtained from fat extraction and this was boiled under reflux for 30 minutes. The mixture was filtered through linen and residue washed until it was free from acid. The residue was transferred quantitatively into a digestion flask, 1.25% NaOH was added and brought to boiling point quickly. Boiling was continued for 30 minutes. The mixture was filtered and residue washed free of alkali. The residue was then washed with methylated spirit, thrice with petroleum ether using small quantities. It was allowed to properly drain and the residue was transferred to a silica dish (previously ignited at 600°C and cooled). The dish and its content were dried to constant weight at 105°C. The organic matter of the residue was burnt by igniting for 30 minutes in a muffle furnace at 600°C. The residue was cooled and weighed. The loss on ignition was reported as crude fibre.

Microscopy and anatomical studies were done by preparing a thin hand section of the rhizomes of ginger and turmeric. The sections were cleared with distilled water in a clean dish then placed on a glass slide, stained with safranin and mounted with glycerin. The powder of dried rhizomes of turmeric and ginger were used for the observation of powder microscopical character. Little amount of powder was placed on

a glass slide, moist with little amount of water and mounted with glycerin. The results were reported with photographs using digital camera (Eastman Kodak Company).

RESULTS AND DISCUSSIONS

Phytochemical analysis

As observed from the Table 1, saponins and carbohydrate are present in all solvents used in the extraction process of turmeric. The extractive values (Table 2) revealed water extractive value of 22.44% to be higher than alcohol extractive value 22.79% making water the best solvent for extracting *C. longa.* The results of proximate analysis presented in Table 3 showed moisture content of 11.56 ± 0.04 %, total ash 13.24±0.03%, crude fiber 6.40±0.20 %, acid insoluble ash 1.02±0.02% and water soluble ash 4.32±0.07%. The phytochemical screening (Table 1) revealed the rhizomes of *C. longa* to contain saponins, carbohydrates, tannins, flavonoids, alkaloids, pentose, resins, phytosterols and absence of free reducing sugar, balsam, chlorogenic acid, phytosterols in hexane extract. Saponins, carbohydrates, tannins, alkaloids, free reducing sugar, pentose, resins, phytosterols are present in ethyl acetate extract while flavonoids, balsam and chlorogenic acid are absent. The methanolic extract revealed the presence of saponins, carbohydrates, tannins, free reducing sugar, pentose, resins, phytosterols and absence of flavonoids, alkaloids, balsam and chlorogenic acid. Aqueous (water) extract showed the presence of saponins, carbohydrates, flavonoids and alkaloids while chlorogenic acid, balsam, phytosterols, resins, pentose, free reducing sugar, and tannins are absent. From the result showed in Table 1, saponins and carbohydrates are present in all solvent used in extraction while balsam and chlorogenic acid are absent.

From Table 5, carbohydrates, alkaloids, flavonoids, saponins, tannins, phenolics and terpenoids are present in all solvents. Chlorogenic acid was absent in all solvent used while cardiac glycoside was absent only in the aqueous extract. Phytosterols was showed to be present in all extract except in the ethyl acetate extract where it is absent. Table 5 revealed the absence of balsam in both ethyl acetate and aqueous extracts but present in hexane and methanolic extracts. The extractive value presented in Table 6 revealed alcohol extractive value (2.7%) and water extractive values (2.1%). From these values, water and alcohol are best solvent for extracting *Z. officinale.* It was observed that moisture content was higher in fresh ginger compared to dried ginger (Table 6). It was also observed that the values for total ash, crude fiber, acid insoluble ash and water soluble ash were higher in dried ginger compared to fresh ginger. The overall mean for fresh ginger was higher than the dried ginger. As a result of this observation, it could be concluded that fresh ginger have more proximate content than dried ginger.

Microscopic results. Transverse sections of rhizomes of turmeric (Fig. 2a – c) and ginger (Fig 3a – c) showed evidences of presence of structures such as cortex,

wide central cylinder, thin walled endodermoidal layer, vascular bundles, scattered starch granules, oil cells, xylem vessels. Observations on the microscopic studies of powdered rhizomes of turmeric (Fig 2d) and ginger (Fig. 3d) revealed fringes of vessels and a distinct drop of starch granules. These observations clearly translated to the fact that, the powdered materials are original.

TABLE 1. Qualitative phytochemical analysis of the rhizomes of *Curcuma longa* (Key: + = present - = absent)

CONSTITUENT	HEXANE	ETHYLACETATE	METHANOL	WATER
Saponnins	+	+	+	+
Carbohydrate	+	+	+	+
Tannins	+	+	+	_
Flavonoids	+	_	_	+
Alkaloids	+	+	_	+
Free reducing sugar	_	+	+	_
Pentose	+	+	+	_
Resin	+	+	+	_
Balsam	_	_	_	_
Chlorogenic acid	_	_	_	_
Phytosterol	+	+	+	_

TABLE 2. Extractive values for *Curcuma longa*

PARAMETERS	RESULT (%)
Alcohol	22.79
Water	26.44

TABLE 3. Physicochemical constituent of the rhizomes of *Curcuma longa.* Values expressed as Standard Error of Means of three assays (± S. E.M).Values represented by the same superscript along the column are not significantly different at $p<0.05$.

PARAMETER	RESULT (%)
Moisture content	11.56 ± 0.04^{b}
Total ash	13.24 ± 0.03^{a}
Crude fibre	6.40 ± 0.20^{c}
Acid insoluble ash	1.02 ± 0.02^{e}
Water soluble ash	4.32 ± 0.07^{d}
Mean	7.31±0.07
p-value	< 0.001

TABLE 4. Qualitative phytochemical analysis of the rhizomes of *Zingiber officinale* (Key: + = present, - = absent)

CONSTITUENT	HEXANE	ETHYLACETATE	METHANOL	WATER
Carbohydrate	+	+	+	+
Alkaloids	+	+	+	+
Flavonoids	+	+	+	+
Saponins	+	+	+	+
Tanins	+	+	+	+
Phenolics	+	+	+	+
Terpenoids	+	+	+	+
Phytosterols	+	-	+	+
Cardiac Glycosides	+	+	+	-
Balsams	+	-	+	-
Chlorogenic Acids	-	-	-	-

TABLE 5. Extractive values for *Zingiber officinale*

PARAMETER	RESULT (%)
Alcohol	2.7
Water	2.1

TABLE 6. Physicochemical constituent of the rhizomes of *Zingiber officinale*. Values expressed as Standard Error of Means of three assays (± S. E.M). Values represented by the same superscript along the column are not significantly different at p<0.05

PARAMETER	RESULT (%)	
	FRESH GINGER	DRIED GINGER
Moisture content	72.63 ±0.09 [a]	10.03±0.09 [a]
Total ash	2.50 ±0.06 [c]	7.30±0.10 [c]
Crude fibre	2.97±0.07 [b]	9.63±0.09 [b]
Acid insoluble ash	0.57±0.03 [e]	2.03±0.09 [e]
Water soluble ash	1.23±0.03 [d]	3.87±0.09 [d]
Mean	15.98±0.06	6.57±0.09
P-Value	<0.001	<0.001

Phytochemical compounds possessed by the studied materials where previously observed by other workers (Keramat *et al*., 2001; Pruthi, 2001; Rezaul *et al*., 2012; Nilanjana *et al*., 2013; Sawant & Godghate, 2013; Shipra *et al*., 2012). The chemical compositions are more abundant in the fresh samples than the dried ones. The dried samples, however, could be stored for a very longer periods than the fresh materials, hence, it is advisable to use the two plant samples for both medicinal and food purposes (Omale & Emmanuel, 2013). Medicinally majority of the phytochemicals observed in the two studied plants are richly medicinal ingredients. For instance, flavonoids are widely distributed in all vascular plant (Harborne, 1973). They have potentials in the management of several diseases like malaria, hypertension and diabetes (Thompson, 1994). Also, alkaloids are the single largest secondary plant substances that exist naturally and specific to definite plant families (Harborne, 1973) which could be of potential usefulness in medicine. Some useful alkaloids of plant origin which are widely known in medicine include quinine, caffeine and nicotine (Robinson, 1981). Tannins are natural chemical constituents of plant and are known to be useful in wound healing (Trease & Evans, 1996) as astrigents and antimicrobial (Singhal, 2001). Similarly, glycosides are used for the sanitary and protective purpose in the body (Sim, 1969). Carbohydrates are plant products which are synthesized as the by-product of photosynthesis process. This is consumed by man and animal as the major source of energy.

Fibers are part of fruit, grains and vegetable which can neither be digested nor absorbed by the human system (Agarwal & Rastogi, 1974). Generally, dietary fibers function in the body to show the rate of glucose absorption into the bloodstream there by reducing the risk of hyperglycaemia (Bouttwell, 1998). They also reduce the level of plasma cholesterol and prevent colon cancer and cardiovascular diseases (Davidson *et al.,* 1975, Bouttwell, 1998). Ash content of a plant based food is the function of the

mineral elements present (Dutta, 1981). Dietary ash has proved helpful in establishing and maintaining acid-alkaline balance of the body system (Barboka, 1970; Hawkin, 1979), as well as in controlling hyperglycaemic condition (Gokani & Shah*,* 1992). This study therefore established the fact that *C longa* and *Z. officinale* can either be used as a source of drug or food depending on the method of extraction, solvent of extraction and the process involved in the preparation. This is because the results of this study have shown that *C. longa* and *Z. officinale* possess abundant phytochemicals and nutrient contents.

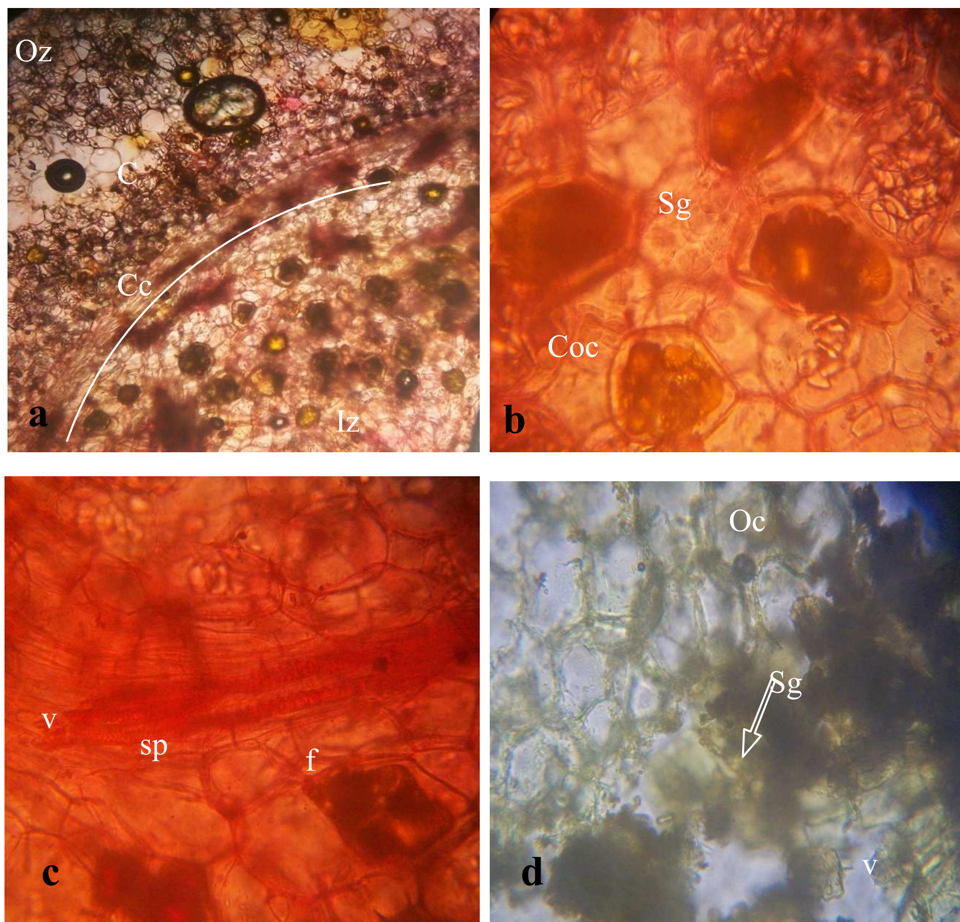

FIG. 2a-d: a: Transverse section of turmeric rhizome showing a cortex and a wide central cylinder, x100. b: Transverse section of turmeric rhizome showing starch granules, oil cell and calcium oxalate crystals, x400. c: Longitudinal section of turmeric rhizome showing tracheids with spiral thickening x400. d: Powdered turmeric rhizome showing compartment of vessels and starch grain x400. (Cc= central cylinder, C= cortex, Coc= calcium oxalate crystals, f= fusiform initial, Oc= oil cells, Oz= outer zone, Iz= inner zone, Sg= starch granules, v= vessel, sp= spiral xylem vessel)

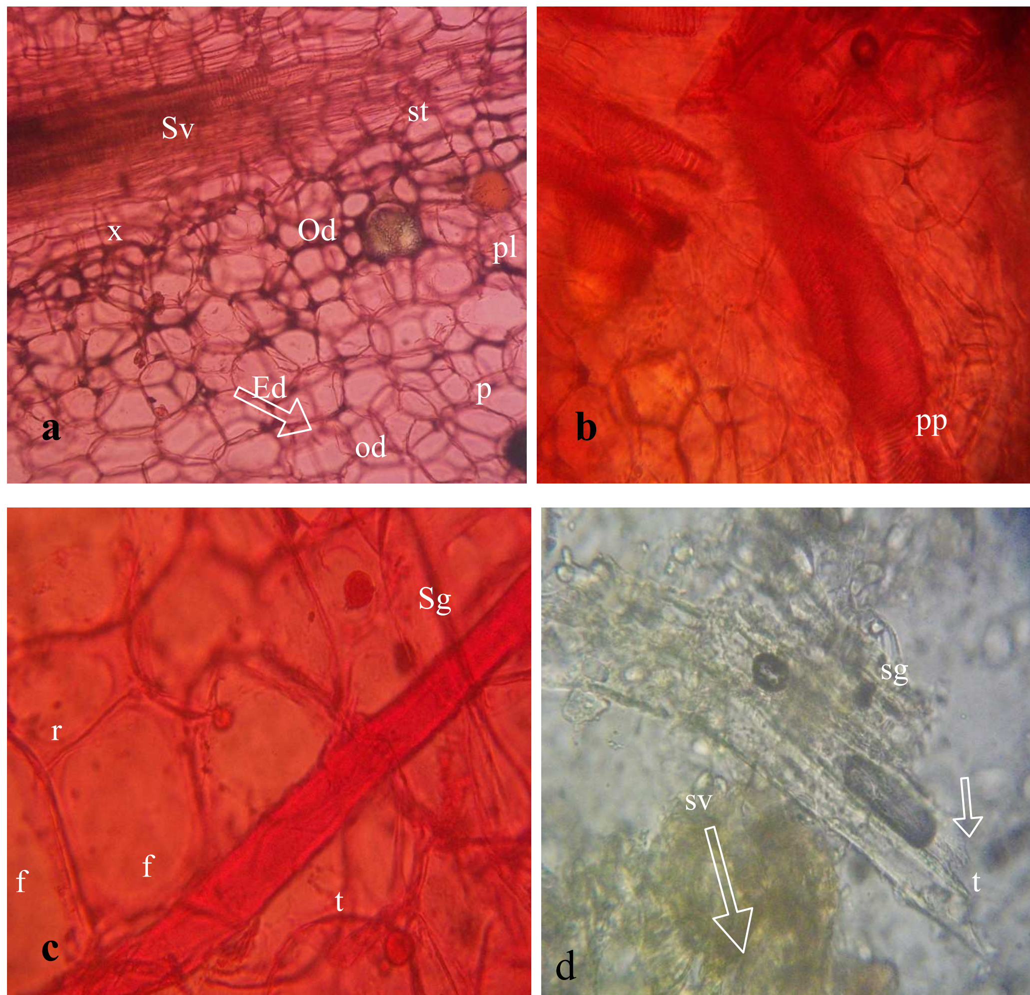

FIG. 3a-d a: Transverse section of ginger rhizome showing compartments of spiral xylem vessels, oil duct and endodermoidal layer x100. b: Longitudinal section of ginger rhizome showing sieve tube, perforated plate, oil duct, xylem and phloem elements x400. c: Longitudinal section of ginger rhizome showing starch grain, ray initial, fusiform initial and tracheid x400. d: Powdered ginger rhizome showing spiral xylem vessel and tracheid x400. (ed= endodermoidal layer, f= fusiform initial, od=oil duct, sg=starch grain, t=tracheid, x= xylem, r= ray initial, sv= spiral vessel, pp= perforated plate, st= sieve tube, pl= phloem, p= parenchyma)

The general approach to herbs identification is dependent on morphological, anatomical, chemical and molecular techniques (Li *et al*., 2010). According to World Health Organization (1998), the macroscopic and microscopic determination of the drug plants is the first step towards establishing the correct identity and purity of the

source materials. Microscopic analysis of the rhizomes and powdered materials acts as a reliable source for detecting adulteration. Authenticity of the powdered materials of these plants microscopically studied showed that there are similarities in the anatomical or microscopical features of both fresh and dry, powdered samples of *C. longa* and *Z. officinale* which is the basis of comparison to avoid adulteration of the drug plants. Other means of identification could also be used or employed.

Curcuma longa and *Z. officinale* are potential and functional food ingredients, herbs and natural ingredient for our daily needs. Food supplementation with both *Z. officinale* and *C. longa* may be considered as a novel nutritional approach to reduce chronic diseases as well as mineral deficiency. Experimental data from the literatures and as revealed herein, indicates plenty of information about the use of turmeric and ginger as spices with vast number of chemical component apart from their multiple medicinal uses. Large scale clinical studies are required to justify these plants as suitable phytopharmaceutical drug although initial data and results from this work seem to be promising.

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