International Journal of Traditional and Natural Medicines, 2018, 8(1): 13-22

*International Journal of Traditional and Natural Medicines* **ISSN: 2167-1141**

Journal homepage: www.ModernScientificPress.com/Journals/IJTNM.aspx *Florida, USA*

*Article*

# Extractive Value and Phytochemical Screening of Ginger (*zingiber officinale*) and Turmeric (*curcuma longa*) Using Different Solvents

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*Article history*: Received 6 June 2018, Revised 12 July 2018, Accepted 20 July 2018, Published 31 July 2018.

**Abstract:** Ginger and turmeric were obtained from local farms located along Laje Road, Ondo-City, Ondo State. The rhizomes of the plants were cut, sundried, ground and sieved. The powdered samples were separately extracted with water, chloroform, acetone, ethylacetate and ethanol. The percentage yield of each extract in each of the solvent was calculated and each extract was qualitatively screened for flavonoids, tannin, reducing sugar, volatile oil, resin, chalcone, balsam, amino acid, acid test, phlobatannin, saponins and vitamin C. The result showed that the extractive value of ginger using water, ethylacetate, ethanol, acetone and chloroform were 16.62±0.05%, 11.98±0.02%, 13.88±0.04%, 10.14±0.05% and 10.18±0.01% respectively while the extractive value of turmeric using water, ethylacetate, ethanol, acetone and chloroform were 3.30±0.02%, 13.34±0.08%, 15.24±0.10%, 12.50±0.07% and 7.48±0.03% respectively. There is significant difference at $P < 0.05$ in all the solvents' extractive values for ginger and turmeric. It was observed that volatile oil and vitamin C were present in all the solvent extracts. Ethanol, chloroform and ethylacetate were able to extract more phytochemicals in turmeric than water and acetone. While ethanol, water and acetone were more effective in extracting phytochemicals from ginger than chloroform and ethylacetate. The extractable bioactive ingredients from plant material is primarily dependent on the type of solvent used for extraction.

**Keywords:** Ginger; turmeric; extractive value; phytochemicals; solvents

## 1. Introduction

Phytochemicals are bioactive non-nutritive plant chemicals that have protective or disease preventive properties and they act as antioxidants, enzymes stimulant, anti-bacterial agents, anti-cancer agents as well as possessing hormonal action (Akinmoladun *et al*., 2007). Most plants that contain high proportion of these phytochemicals are often referred to as medicinal plants. Medicinal plants have been known to contain some organic compounds having definite physiological action on the human body (Yadav and Agarwala, 2011).The availability of plant secondary metabolites phytochemicals present in leaves, stems, bark or roots of vegetables and other plants is not unrelated to their antioxidant potentials and medicinal properties of the plants and their extracts (Arawande *et al*. 2012). For couples of decades, serious attentions have been paid to the use of traditional medicines and plant drugs against numerous diseases (Satya *et al*., 2013; Kala, 2006) since they are safer with little or no side effect (Abu-Rabia, 2005; Parvath and Brindha, 2003).

Ginger or ginger root is the rhizome of *Zingiber officinale* plant and it is a slender herbaceous perennial herb. Ginger is cultivated in the tropics and it requires warm and humid climate flourishing in a well-drained friable soil, though it can also be grown in a light soil rich in humus. It has variety of names from different continents and countries and such names are Zingiberis rhizome, Shen jiany, Cochin, Asia ginger, Africa ginger and Jamaican ginger. In addition to its food usage, ginger root has been found in aiding in lowering the cholesterol level, pain relief from arthritis, digestive issue, expectorant and gesture-intestinal stimulation (Wikipedia, 2018). Ginger is the underground rhizome of the ginger plant with firm striated texture. The flesh of the ginger rhizome can be yellow, white or red in colour depending upon the variety. It is covered with a brownish skin that may either be thick or thin and it is consumed as delicacy, medicine or spice. The characteristics odour and flavour of ginger is caused by a mixture of zingerone, shogaol and gingerol (Kikuzaki and Nakatani, 2006; Haksar *et al*., 2006). Ginger produces clusters of white and pink flower buds that bloom into yellow flower and due to its aesthetic appeal and the adaption of the plant to warm climates, ginger is often used as landscaping around subtropical homes. It is a perennial reed-like plant with annual leafy stems about a meter (3 or 4 feet) tall (Lee and Shibamato, 2002).It was found that ginger contained 1.5% - 3% essential oil, 2-12% fixed oil, 40-70% starch, 6-20% protein, 3-8% fibre, 8% ash 9-12% water, pungent principles, other saccharides, cellulose, colouring matter and trace minerals (Peter, 2000).

Turmeric is the rootstalk of a tropical plant in ginger family and it is botanically known as *Curcumin longa* (Chan *et al*., 2009). The root has been in used for thousands of years in India and China as a spice, and medicine for conditions including heartburn, diarrhoea, stomach bloating, colds, fibromyalgia and depression. It is sometimes applied on the skin for ringworm and infected woods as it is said to have anti-bacterial properties. It is the spices responsible for the yellow colour of curry. One

of the main component of the spice is a substance called curcumin which has potential healing properties as a result of its powerful anti-inflammatory and antioxidant properties. The presence of curcumin in turmeric has made it useful in preventing and curing some inflammatory conditions such as tendonitis and arthritis, disinfecting cuts and burns, preventing prostrate and breast cancer and stop the growth of existing ones, reducing the risk of childhood leukaemia and it is a natural liver detoxifier (Nagpal and Sood, 2013). Turmeric is a powerful anti-inflammatory that works well without side effects and it is a natural painkiller and cox-2 inhibitor. It aids in fat metabolism and helps in weight management (CWMM, January 2018).

The usefulness of ginger and turmeric and the phytochemicals they contained are well documented but no research work has been found on the use of different solvents in extracting the bioactive ingredients and the extractive yield in different solvents. Therefore, the focus of this research are to obtain extract of ginger and turmeric using ethanol, chloroform, acetone, ethyl acetate and water, to know the extractive value of plant samples in each solvent and to qualitatively identify the phytochemical constituents of ginger and turmeric in each solvent extract with a view of establishing the most potent solvent having highest extract with more bioactive ingredients.

## 2. Materials and Methods

### *2.1. Source and Preparation of Plant Materials*

Fresh rhizomes of ginger and turmeric were collected from local farms located along Laje Road, Ondo-City, Ondo State, Nigeria. The plant materials were taxonomically identified and authenticated in the Environmental Biology laboratory at the Department of Science Laboratory Technology, Rufus Giwa Polytechnic, Owo, Nigeria. The rhizomes were shade dried until all the water molecules evaporated and the rhizomes became dried for grinding. The foreskin of the rhizomes were removed and it was later ground using electrical laboratory blender into a very fine powder and kept in an airtight container with proper labelling prior to analysis.

### *2.2. Source of Reagents*

The chemicals and reagents used for these analyses were analytic grade.

### *2.3. Preparation of Plant Extracts*

The method described by Amir *et al*., 2005 and modified by Arawande *et al*., 2013 was used. Ten gram of the powdery sample was weighed into each of the five cleaned and dried 250 mL reagent bottles and 100 mL of each solvent (ethanol, chloroform, ethyl acetate, acetone and water) was separately added to each of the bottle and left for 72 h during which it was intermittently shaken on a shaking orbit

machine. The mixture was filtered through a 0.45 μm nylon membrane filter. The extracts were evaporated to dryness under reduced pressure at 40ºC by a rotary evaporator. The obtained extract was weighed and the extractive value of each solvent was calculated thus:

$$\%\ \text{Extractive Value of Solvent} = \frac{Weight\ of\ extract}{\text{Weight of Sample}} \times 100$$

*2.4. Qualitative Phytochemical Screening of Ginger and Turmeric Extracts*

Phytochemical screening was carried out ethanol, chloroform, ethyl acetate, acetone and water extracts of ginger and turmeric extracts using standard procedures as described by Sofowora, 2008; Trease and Evans 1989; Odebiyi and Sofowora 1978 and Harborne 1973.

*2.4.1. Test for tannin*

0.5 g of plant extract was mixed with 2mL of water and heated on water bath. The mixture was filtered and 1mL of 10% $FeCl_3$ solution was added to the filtrate. A blue-black solution indicates the presence of tannin.

*2.4.2. Test for flavonoid*

5 mL of distilled water and about 0.2 g of plant extract were mixed thoroughly. And 1 mL of 1% $AlCl_3$ solution was added and shaken. A light yellow precipitate indicates the presence of flavonoids.

*2.4.3. Test for phenol*

About 0.5 g of plant extract was added to 1 mL of 10% $FeCl_3$ solution. A deep bluish green colouration was an indication for the presence of phenol.

*2.4.4. Test for saponin*

About 0.2 g of plant extract was shaken with 4 mL of distilled water and then heated to boil on a water bath. Appearance of creamy miss of small bubbles (Frothing) shows the presence of saponin.

*2.4.5. Test for ascorbic acid*

About 0.5 g of plant extract was added to 2 mL of acetic acid and it was shaken for 3 minutes, and then filtered. Few drops of 2, 6-Dichlorophenolinddophenol solution were added to the filtrate. The presence of faint pink colour confirms that ascorbic acid is present.

*2.4.6. Test for reducing sugar*

2 mL of distilled water and 0.2 g of plant extract were mixed together and thoroughly shaken in a test tube. 1 mL each of Fehling solution A and B were added to the mixture. A brick-red precipitate at the bottom of the test tube confirms the presence of reducing sugar.

*2.4.7. Test for resin*

0.2 g of plant extract and 2 mL of acetic anhydride were mixed together. A drop of concentrated sulphuric acid was added to the mixture. A purple or violet colour indicate the presence of resin.

*2.4.8. Test for balsams*

0.2 g of plant extract and 2 mL of ethanol were mixed together and two drops of alcoholic ferric chloride solution was added. A dark green colouration indicates the presence of balsams

*2.4.9. Test for chalcone*

0.2 g of plant extract and 2 mL of 1% ammonium hydroxide were mixed together. The appearance of reddish colour shows the presence of chalcone.

*2.4.10. Test for glycoside*

0.2 g of plant extract and 2.5 mL of dilute sulphuric acid were mixed together and boiled for 15 minutes, cooled and neutralized with 5 mL each of Fehling solution A and B. The formation of brick red precipitate confirmed glycoside.

*2.4.11. Acidic test*

0.2 g of plant extract and sufficient distilled water were mixed together and warmed on hot water bath and cooled. A wet litmus paper was dipped inside the solution

*2.4.12. Test for volatile oil*

0.2 g of plant extract and 2 mL of ethanol were mixed together and few drops of ferric chloride solution was added. A green colouration indicates volatile oil.

*2.4.13. Test for amino acid (protein)*

0.2 g of plant extract and 5 mL of distilled water were mixed together and left for 3 h. The mixture was later filtered. To 2 mL of the filtrate, 0.1 mL million reagent was added. A yellow precipitate indicates the presence of protein (amino acid)

*2.4.14. Test for phlobatannins*

0.2 g of plant extract and 2 mL of 10% aqueous hydrochloric acid solution were mixed together and boiled. A deposition of red precipitate indicates the presence of phlobatannins.

*2.4.15. Test for anthraquinones*

0.2 g of plant extract and 5 mL of chloroform were mixed, shaken together for 5 minutes. The mixture was filtered. 2.5 mL of 10% ammonium hydroxide was added to the filtrate. A bright pink, red or violet colour at the upper layer indicates free anthraquinones.

*2.4.16. Test for steroids (Salkowski test)*

0.2 g of plant extract and 2 mL of chloroform were added together, 2 mL of concentrated sulphuric acid was added to form a layer. The formation of a violet/blue/green/reddish-brown ring at the interface indicates the presence of steroidal ring.

*2.5. Statistical Analysis*

The result of the extractive value was compared by one-way analysis of variance (one-way ANOVA) to test for significant difference. Means of the group were compared using Duncan Multiple Range Test (DMRT) (SAS, 2002).

## 3. Results and Discussion

*3.1. Extractive Values of Solvents for Ginger and Turmeric*

The extractive value of solvent for ginger and turmeric is presented in Table 1. It was obvious that water extract for ginger was the highest and this was followed by ethanol extract and the least value was in acetone extract. The extractive value for turmeric was highest in ethanol and this was followed by ethylacetate while the least value was in water extract. The extractive value of any solvent is a measure of the ability of the solvent to obtain a bioactive material from a given sample (Arawande *et al*., 2015; Amir *et al*., 2005). Solvents with high extractive is expected to be efficient in extracting bioactive ingredients. There is significant difference at $P < 0.05$ in all the solvents' extractive values for ginger and turmeric. Polar solvents are expected to possess high extractive values since most of the active ingredients are polar in nature but the lowest extractive value of turmeric in water needs to be further probed.

**Table 1.** Extractive values of solvents for ginger and turmeric

| Solvents | *% Extractive value of solvent | |
|---|---|---|
| | Ginger | Turmeric |
| Water | $16.62^{a}$±0.05 | $3.30^{e}$±0.02 |
| Ethylacetate | $11.98^{c}$±0.02 | $13.34^{b}$±0.08 |
| Ethanol | $13.88^{b}$±0.04 | $15.24^{a}$±0.10 |
| Acetone | $10.14^{d}$±0.05 | $12.50^{c}$±0.07 |
| Chloroform | $10.18^{d}$±0.01 | $7.48^{d}$ ±0.03 |

NOTE: Within column, mean values followed by the same superscript are not significantly different at $P < 0.05$ level according to Duncan Multiple Range Test (DMRT).; *Mean Value of triplicate determination ± Standard Deviation.

*3.2. Qualitative Phytochemical Screening of Solvent-extracts of Ginger*

Table 2 depicts the qualitative phytochemical screening of solvent-extracts of ginger. The solvents used for extraction are acetone, chloroform, ethylacetate, ethanol and water. It was found that 62.50%, 50.00% and 50.00% of phytochemical examined were present in ethanol, water and acetone respectively while only 43.75% and 31.25% of phytochemical considered were present in chloroform and ethylacetate accordingly. It was only water extract of ginger that contained flavonoid. Phenol, tannin and acid test were absent in all the solvent extracts of ginger. Saponin was present in acetone, ethanol and water extracts. It was only ethylacetate extract that contained anthraquinone. All the solvent extracts except that of water contained volatile oil and glycoside. Steriod was present in acetone and water extract of ginger. Ascorbic acid and balsams were present in all the solvent extracts. Reducing sugar was found in all the solvent extract except that of ethylacetate. Amino acid was present in acetone and ethanol extracts. Both ethanol and water extracts of ginger contained phlobatannin. Resin was found in chloroform and ethanol extracts of ginger. Chalcone was present in chloroform, ethanol and water.

**Table 2.** Qualitative phytochemical screening of solvent-extracts of ginger

| Constituents | Solvent- extracts of Ginger | | | | |
|---|---|---|---|---|---|
| | Acetone | Chloroform | Ethylacetate | Ethanol | Water |
| Flavonoids | - | - | - | - | + |
| Phenol | - | - | - | - | - |
| Tannin | - | - | - | - | - |
| Saponin | + | - | - | + | + |
| Anthraquinone | - | - | + | - | - |
| Volatile oil | + | + | + | + | - |
| Steroid | + | - | - | - | + |
| Ascorbic acid | + | + | + | + | + |
| Glycoside | + | + | + | + | - |
| Reducing sugar | + | + | - | + | + |
| Phlobatannin | - | - | - | + | + |
| Amino acid | + | - | - | + | - |
| Resin | - | + | - | + | - |
| Balsams | + | + | + | + | + |
| Acid test | - | - | - | - | - |
| Chalcone | - | + | - | + | + |
| % Present | 50.00 | 43.75 | 31.25 | 62.50 | 50.00 |

+ = Present - = Absent

*3.2. Qualitative Phytochemical Screening of Solvent-extracts of Turmeric*

Qualitative phytochemical screening of solvent-extracts of turmeric is shown in Table 3. Flavonoids, volatile oil and balsams were present in all the solvent extracts of turmeric. Phenol, anthraquinone, reducing sugar and chalcone were identified in all the solvent extracts except that of water extract of turmeric. Tannin, resin and saponin were absent in all the solvent-extracts of turmeric.

Among all the solvent-extracts, only water-extract contained steroid. Glycoside was present in the ehylacetate and water extracts of turmeric. Acetone, chloroform and ethanol extracts contained phlobatannin. Amino acid was present in all the solvent-extracts except in acetone extract. It was found out that all the solvents used were capable in 50% of turmeric active ingredients examined. 68.57%, 62.50%, 62.505, 56.25% and 50.00% of phytochemicals examined were extractable by ethylacetate, ethanol, chloroform, acetone and water respectively.

The presence of these phytochemicals in the solvent extracts of both ginger and turmeric shows that the extracts have some medicinal and physiological activity, though this varies from solvent to solvent and from plant to plant as can be observed from the results obtained in the above tables and this fact was supported by Rahman *et al*., 2013 and Sofowora, 2008.

**Table 3.** Qualitative phytochemical screening of solvent-extracts of turmeric

| Constituents | Solvent- extracts of turmeric | | | | |
|---|---|---|---|---|---|
| | Acetone | Chloroform | Ethylacetate | Ethanol | Water |
| Flavonoids | + | + | + | + | + |
| Phenol | + | + | + | + | - |
| Tannin | - | - | - | - | - |
| Saponin | - | - | - | - | + |
| Anthraquinone | + | + | + | + | - |
| Volatile oil | + | + | + | + | + |
| Steroid | - | - | - | - | + |
| Ascorbic acid | + | + | + | + | + |
| Glycoside | - | - | + | - | + |
| Reducing sugar | + | + | + | + | - |
| Phlobatannin | + | + | - | + | - |
| Amino acid | - | + | + | + | + |
| Resin | - | - | - | - | - |
| Balsams | + | + | + | + | + |
| Acid test | - | - | + | - | - |
| Chalcone | + | + | + | + | - |
| % Present | 56.25 | 62.50 | 68.75 | 62.50 | 50.00 |

+ = Present - = Absent

## 4. Conclusions

The phytochemicals extractable from ginger and turmeric is a function of solvents used for extraction and these solvents have varying extractive values. Different solvent-extracts of the same plant have different medicinal and therapeutic usefulness since they contain different bioactive ingredients. Further research can be conducted by examining the anti-microbial activities of the solvent-extracts of ginger and turmeric so that the therapeutic usefulness of these extracts can be established.

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