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JOURNAL OF CONTEMPORARY RESEARCH (JOCRES)

RESEARCH ARTICLE VOL. 1 (2) ISSN:2814-2241

Date Accepted: 30th Dec, 2022

Pages 185-194

QUANTIZATION OF PHYTOCHEMICALS IN CURCUMA LONGA TUBER

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Abstract

The phytochemical analysis of the rhizomes of *Curcuma longa* also called turmeric was done using standard procedures to quantitatively and qualitatively determine the presence of the active constituents present in the herb. The presence of alkaloids, flavonoids, anthraquinones, glycosides, tannins, terpenoids, saponins, steroids, and phenols were detected. Tannins were also found to be abundant, with a concentration of 7.258 mg/g, followed by phenols (3.428 mg/g), alkaloids (1.954 mg/g), flavonoids (1.500 mg/g), and saponins (0.878 mg/g).

Keywords: Concentration, Curcuma longa, Phytochemicals, Quantification, Turmeric.

1. Introduction

Plants which are in the classes of spices and herbs are gradually gaining more popularity in their use ethno-medicinally for management of diseases especially those showing resistance to modern medicines (Dawang et al., 2016; Oyemitan et al., 2017). Many of which have shown reliability and relatively less toxicity in their uses as reported by most literatures. Most of these Spices and herbs parts used include their leaves, stems, roots, which are either used as a paste, decoctions or their oils for treatment purposes. Curcuma longa (turmeric), cinnamon, cloves, ginger, nutmeg, and other economically important plants are among them (Dawang et al., 2016). *C. longa* is commonly known as turmeric (Memarzia et al., 2021; Sultana et al., 2021) has been reported to have medicinal, culinary and cosmetic uses, some of its medicinal properties include antioxidant, anticancer, anti-inflammatory, neuro and dermo protective, anti-asthmatic, and hypoglycemic (Ibáñez and Blázquez, 2020). In Chinese and Ajurvedic systems of medicine, it is popularly known for its inflammatory effects for treatment of flatulence, jaundice, and menstrual difficulties (Ajaiyeoba et al., 2018). It is used as a food additive, condiment, and medicine almost all over the world especially in Nigeria (Amadi et al., 2018; Ayilla and Mbanasor, 2022), where it is locally called 'Kurkur' (Hausa) and 'Ata ile pupa' (Yoruba) (Dawang et al., 2016).

C. longa is a shallow-rooted crop with thick, fleshy rhizomes. *C. longa* is a shallow-

rooted crop with thick, fleshy rhizomes. It is a member of the Zingiberaceae family and the genus Curcuma; it is the highest-yielding turmeric of commercial value, with origins in South and Southeast Asia, and is a major component of curry powder (Nwaekpe et al., 2015). The research work is on the estimation of the phytochemical and antioxidant activities of *C. longa* leaves found in Taraba State, Nigeria. This is to enrich the available scientific information provided on the leaves of *C. longa* plant.

2. Materials and Method

Sample Collection and Preparation

Fresh samples of *C. longa* rhizomes were bought from the main market of Wukari Local Government in Taraba state, Nigeria. were washed to remove all visible impurities, cut into smaller pieces for easy and quick drying, and dried for two weeks at room temperature before being crushed into fine powder with a pestle and mortar.

Extraction

Cold maceration was used in the serial exhaustive extraction method, which involves successive extraction with increasing polarity solvents from a non-polar (hexane) to a more polar solvent (methanol) to ensure a wide polarity range of compounds could be extracted (Ushie et al., 2022). The *C. longa* rhizome extract was prepared by soaking 100g of the sample in 250ml hexane for four days with frequent agitation until soluble matter is dissolved. The resulting mixture was filtered using filter paper and the filtrate was concentrated by evaporation using rotary evaporator, kept in a vacuum oven overnight at room temperature to remove all the solvent and weighed. The procedure was repeated on the residue with the following solvents in order of polarity: ethyl acetate, acetone, and methanol (Ushie et al., 2022).

Phytochemical Screening

The qualitative phytochemical screening was carried out on the crude extracts following standard procedures to identify the constituents as described by procedures as reported by Harbone (1988), Ushie, (2019 & 2022) and Perez et al., (2016).

Quantitative Phytochemical Analysis

Using the techniques outlined in Ushie et al. (2018) and Ushie et al. (2022), quantitative analysis of a few discovered secondary metabolites was done on C. longa rhizomes.

Antioxidant Activity

The antioxidant activity of the crude extracts was determined using DPPH (1,1-diphenyl-2-picryl hydrazyl) free radical scavenging assay described by Mahdi-Pour et al., (2012) and Kendeson et al., (2021) with some slight modifications. The extracts/standard (1.5 mL each) at various concentrations of 0.1, 0.3, 0.5, 0.7, and 0.9 mg/L were mixed with 1.5 mL of DPPH solution and incubated at 37°C for 30min. The control solution was prepared containing the same amount of methanol and DPPH. The absorbance of each mixture was measured at 517 nm using a spectrophotometer (V-730 UV-Vis Spectrophotometer, Jasco, USA). The DPPH scavenging activity was calculated as follows:

Percentage (%) inhibition = $[(A_0 - A_1) \div A_0] \times 100$; Where A_0 = the Absorbance of control and A_1 = the Absorbance of standard/sample. All measurements of free radical scavenging activity were performed in duplicate.

3. Results

The results of the phytochemical and antioxidant activities of the rhizomes of *C. longa* are as shown on the Tables 1 and Figure 1.

Table 1: Qualitative Phytochemicals Screening of *C. longa* Rhizomes

Phytochemical	Reagents	Crude Extract
Alkaloids	(a) Mayer	+
	(b) Wagner	+
Flavonoids	NaOH + Dil. HCl	+
Anthraquinones	Extract + HCl (10%) in boiling water + chloroform + ammona (10%) solution	-
Steroids	Extract + Conc, H_2SO_4	+
Glycosides	Extract + Dil. HCl + ferric chloride solution in boiling water + benzene + ammonia solution.	-
Phtobatannis	Extract + (1%) HCl in boiling water	+
Tannins	Extract + distilled water in boing water + ferric chloride	
Terpenoids	Extract + chloroform + conc. H_2SO_4	+
Saponins	(a) Froth	+
	(b) foam	+
Phenols	Extract + distilled water + (1%) ferric chloride	+

+ = Detected - = Not detected

Table 2: Quantitative estimation of Phytochemicals in *C. longa* Rhizomes

Phytochemicals	Concentration (mg/g)
Saponins	0.878
Flavonoids	1.500
Alkaloids	1.954
Tannins	7.258
Phenols	3.428

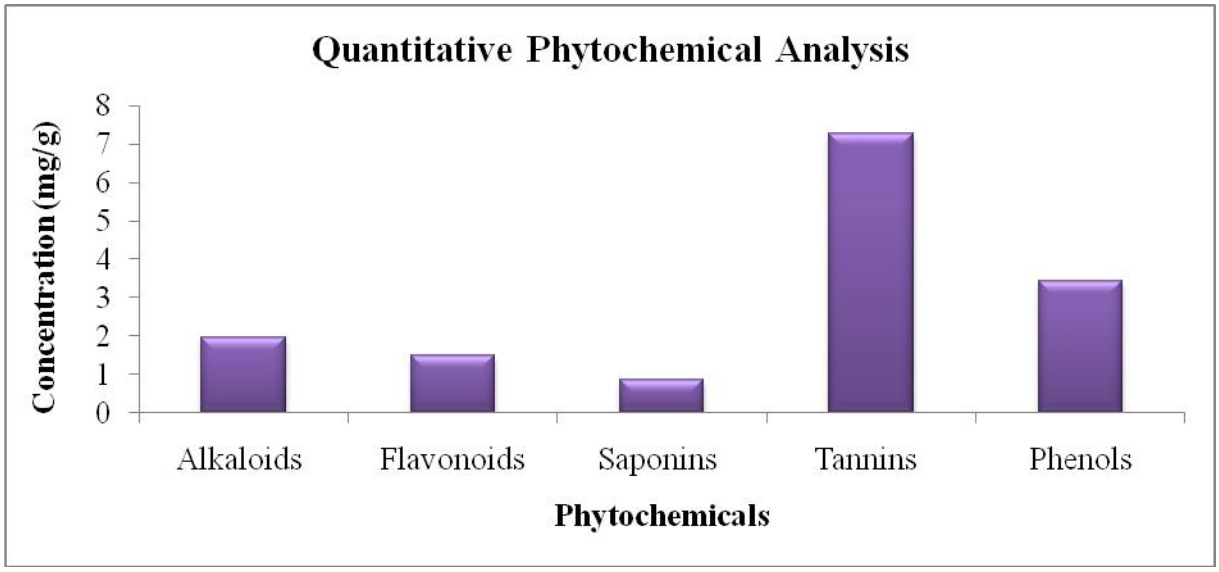

Figure 1: Chart showing the Quantitative Phytochemical Analysis of *C. longa* Rhizomes

Table 3: Antioxidant Activity of the Crude Extracts and Vitamin C

Concentration (mg/L)	% Inhibition				
	Hexane	Ethyl acetate	Acetone	Methanol	Vitamin C
0.1	73.20	78.57	17.68	72.51	66.57
0.3	67.40	70.49	23.20	61.95	67.41
0.5	62.71	63.04	32.32	42.85	71.31
0.7	54.69	57.14	35.64	37.42	76.60
0.9	50.55	50.62	42.54	26.85	85.52

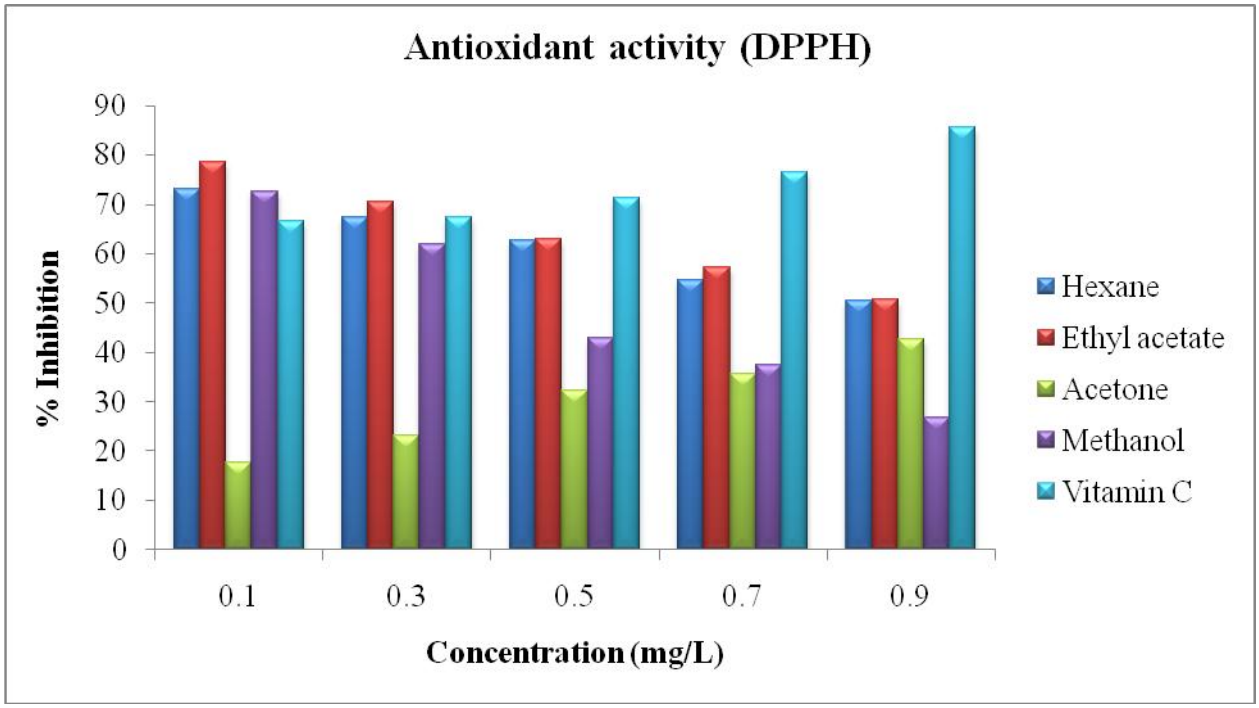

Figure 2: Chat showing the % Inhibition of the Crude Extracts and Vitamin C.

4. Discussion

The phytochemical analysis (Tables 1 & 2; Figure 1) on *C. longa* rhizomes extracts revealed that it contains phytochemical compounds (alkaloids, flavonoids, anthraquinones, glycosides, tannins, terpenoids, saponins, steroids, and phenols) which are known to show therapeutic activity against several bacteria and it is not surprising that these plant extracts are used traditionally by herbalist to cure bacteria related ill-health (Njoku and Obi, 2009). Amongst the quantified phytochemicals (Fig 1), tannins was found to be in abundance with a concentration of 7.258 mg/g, this was followed by phenols (3.428 mg/g), alkaloids (1.954 mg/g), flavonoids (1.500 mg/g), and lastly saponins (0.878 mg/g). This agrees with findings in some literatures (Nwaekpe et al., 2015; Ibáñez and Blázquez, 2020). Saponins are precursors of important therapeutic drugs such as cortisone and contraceptive estrogens (Kareru et al., 2008). Alkaloids have been reported to contain analgesic properties (Harborne, 1988).

To determined the antioxidant activity of a specific solution, there is a significant decreased in the absorbance for sample which contain antioxidant compound (purple colour vanishing coupled with the yellow color build up clearly noticed by naked eye). The intensity of the yellow color was directly proportional to the antioxidant activity in the tested solution, with higher scavenging indicating higher activity (Sagare and Singh 2011). The free-radical scavenging activity was evaluated by accessing its discoloration of 2,2-diphenyl-1-picrylhrozyl radical (DPPH) in methanol by a slightly modified method of Williams *et al.,* 1995. The following concentrations of the extract were tested: 0.1, 0.3, 0.5, 0.7, and 0.9 mg/mL. The decrease in absorbance was monitored at 517 nm. Vitamin C was used

as the antioxidant standard at a concentration of 0.1, 0.3, 0.5, 0.7, and 0.9 mg/mL.

The crude hexane extract of *Curcuma longa* displayed inhibition of DPPH radical scavenging activity at the range of 50.55%, 62.71%, 67.40% and 73.20% with the concentration of 0.1, 0.3, 0.5, 0.7 and 1 µg/ml respectively while vitamin C showed minimum radical scavenging activity of 82.23 % and maximum activity of 73. 20% (Figure 3)

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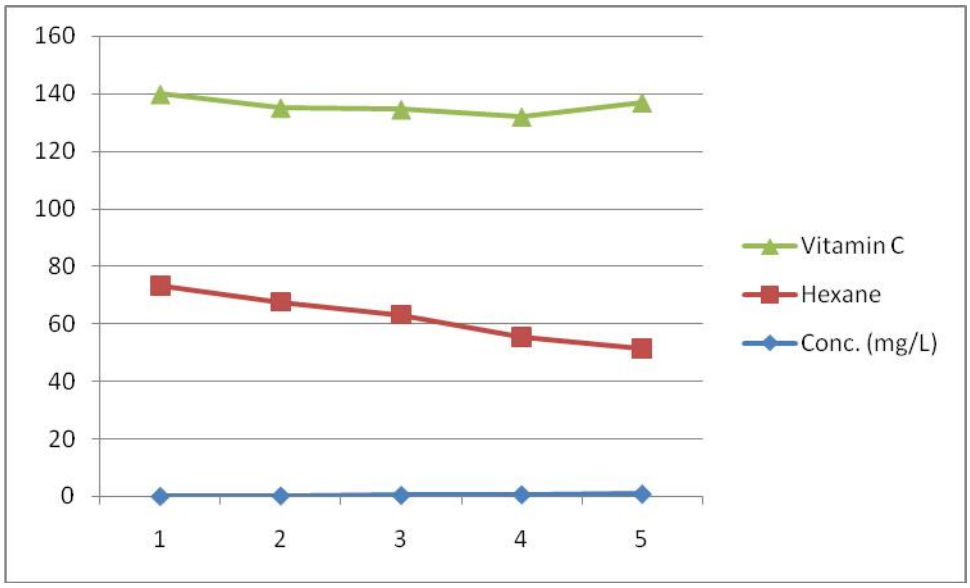

Figure 4: A Plot showing the % Inhibition of the hexane crude extract and Vitamin C.

The crude ethyl acetate extract of *Curcuma longa* displayed inhibition of DPPH radical scavenging activity at the range of 50.62%, 57.14%, 63.04%, 70.49% and 78.57% with the concentration of 0.1, 0.3, 0.5, 0.7 and 1 µg/ml respectively while vitamin C showed minimum radical scavenging activity of 50.62% and maximum activity of 78.5782. 81% (Figure 4).

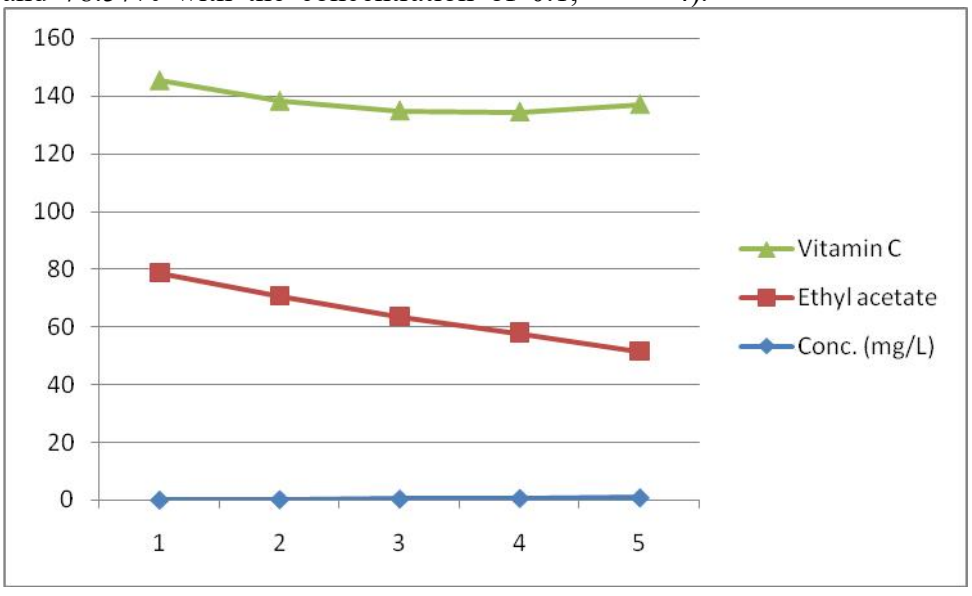

Figure 4: A Plot showing the % Inhibition of ethyl acetate crude extract and Vitamin C.

The crude acetone extract of *Curcuma longa* displayed inhibition of DPPH radical scavenging activity at the range of 17.68%, 23.20%, 32.32%, 32.32% and 42.54% with the concentration of 0.1, 0.3, 0.5, 0.7 and 1 µg/ml respectively while vitamin C showed minimum radical scavenging activity of 17.68 % and maximum activity of 42.541% (Figure 5).

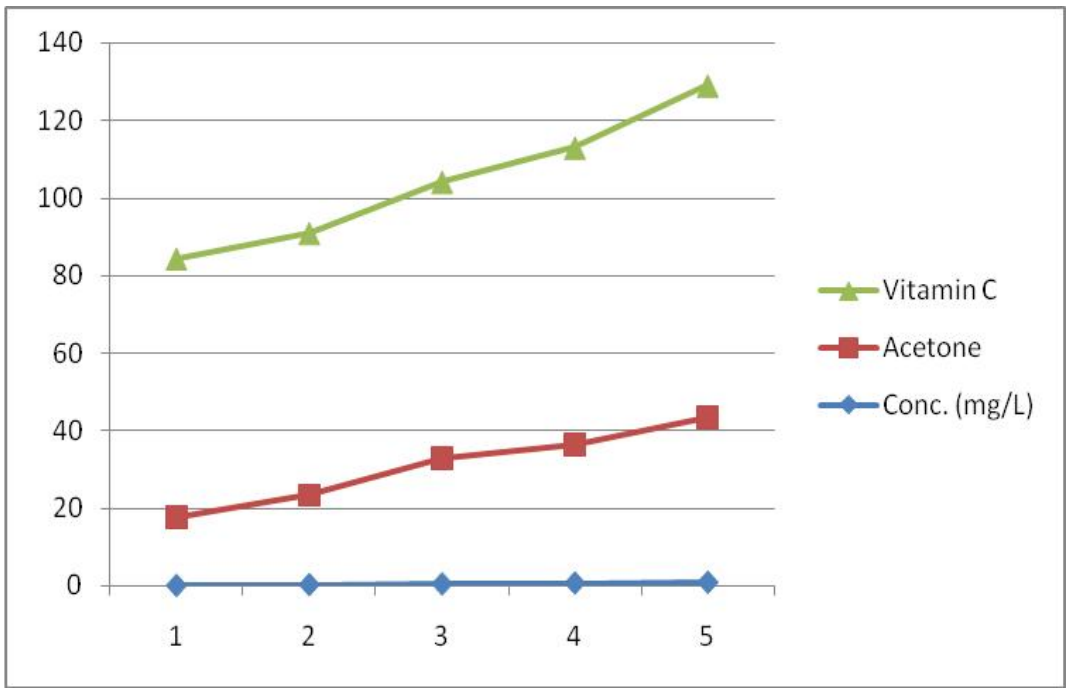

Figure 5: A Plot showing the % Inhibition of acetone crude extract and Vitamin C.

The crude methanol extract of *Curcuma longa* displayed inhibition of DPPH radical scavenging activity at the range of 26.85%, 37.42%, 38.10%, 42.85% and 61.95% with the concentration of 0.1, 0.3, 0.5, 0.7 and 1 µg/ml respectively while vitamin C showed minimum radical scavenging activity of 26.85% and maximum activity of 72.51% (Figure 6).

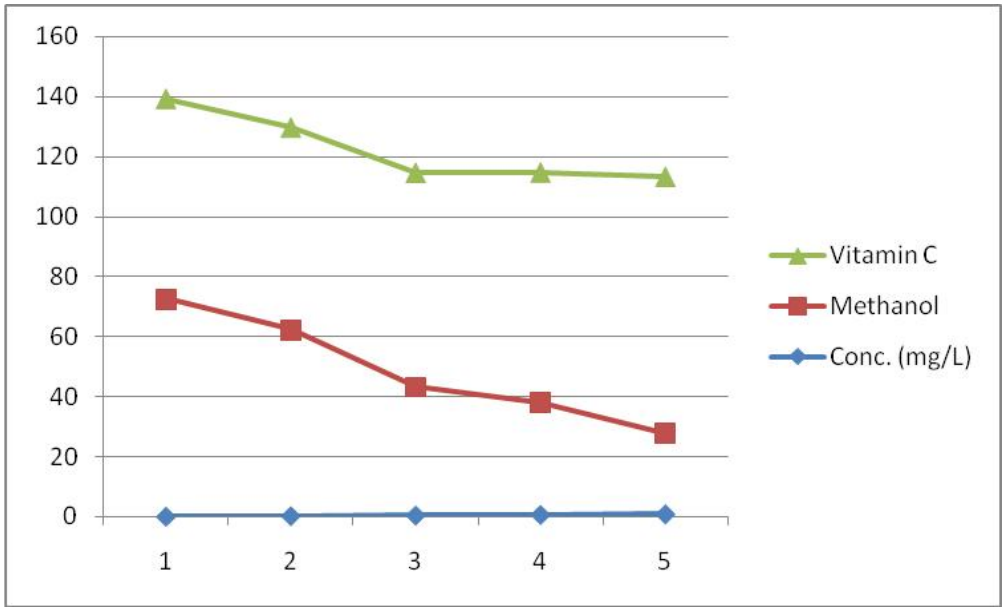

Figure 6: A Plot showing the % Inhibition of the methanol crude extract and Vitamin C.

5. Conclusion

The results have shown that the rhizomes of *C. longa* contains phytochemical compounds which could be attributed to its antioxidant activity and also responsible for its medicinal properties, this may be the reason for its use to prevent certain diseases.

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