

Short communication

Phytochemical Property and Effect of Temperature on Proximate and Mineral Composition of *Curcuma longa* Linn. Rhizomes Ethanolic Extract

ABSTRACT

Aims: Is to investigate the phytochemical property of fresh *Curcuma longa* rhizomes and the effect of temperature on proximate and mineral composition of dried *C. longa* rhizomes.

Study design: Activity directed antioxidant and phenolic content investigation of *C. longa* rhizomes using *in vitro* methods.

Place and Duration of the Study: Institute of Agricultural Research and Technology, Ibadan, Nigeria between August and October, 2016.

Methodology: Fresh *C. longa* rhizomes was washed and divided into five portions (A-E). Portion A-D was dried (at room temperature, 40 °C, 50 °C and 60 °C respectively) and used for proximate and mineral composition investigation while portion E (fresh *C. longa* rhizomes) was used for screening the phytochemical composition of the rhizomes.

Results: The results showed that the rhizome have appreciable amount of alkaloid, tannin, saponin, phenol and cardiac glycosides; moderate amount of phlobatannin, flavonoids, anthraquinones and steroids; and trace amount of terpenes and cardenolides. Also there was a significant ($P < 0.05$) increase in crude protein, crude fat and ash at 50 °C and a significant ($P < 0.05$) increase in crude fat and carbohydrate at 60 °C when compared with room temperature and 40 °C. Also, at 40 °C there was a significant ($P < 0.05$) decrease in sodium, calcium and phosphorus when compared with room temperature while at 50 °C there was a significant ($P < 0.05$) increase in sodium, potassium, magnesium, calcium, phosphorous and iron when compared with room temperature and 40 °C.

Conclusion: In conclusion, the use of *C. longa* rhizomes in ethno-medicine for the treatment/management of a lot of diseases may be due to the presence of some phytochemicals, nutrients and minerals found in the plant and also, the concentration of these nutrients may be affected by temperature.

Keywords: *Curcuma longa*, rhizomes, mineral analysis, temperature, phytochemistry.

1. INTRODUCTION

Curcuma longa Linn. belonging to the Zingiberaceae family has a lot of report in literature about the use of the rhizomes in ethno-medicine for the treatment of diseases such as cough, bronchitis, diabetes, arthritis and Cancer [1]. The plant is cultivated worldwide for its rhizomes including Asia, China, India, Malaysia, Nigeria and Thailand because of its medicinal effects, its use as spice in food and for its flavor in tea [2, 3, 4]. The plant has a short stem with large oblong rhizomes, which are often branched and brownish yellow in colour [5]. *C. longa* rhizome is added to the composition of many traditional remedies for the treatment of diseases and it is also locally applied to wound as an antiseptic for skin abrasions and cuts [6]. Also, the fiber in *C. longa* cleanses the digestive tract by removing potential carcinogens from the body. It was also reported by [7], that the fiber in *C. longa* rhizome adds bulk to the food and prevents the intake of excess starchy food and may hence prevent metabolic conditions like hypercholesteremia and diabetes mellitus [1]. There are also reports from literature that *C. longa* could be a good source of protein, carbohydrate and minerals including calcium, sodium, potassium and phosphorus [8]. Storage of *C. longa* rhizomes at a lower moisture level is paramount to increasing its shelf life hence supporting post-harvest handling. Also, the temperatures at which moisture is reduced in *C. longa* could affect the proximate and mineral composition. It is for this reason therefore, that this study investigated the effect of temperature (room temperature, 40 °C, 50 °C and 60 °C) on proximate and mineral composition of *C. longa* rhizomes ethanolic extract. The phytochemical properties of the extract was also investigated.

2. MATERIALS AND METHODS

2.1. Plant Material

The rhizomes of *Curcuma longa* Linn. were obtained from Teaching and Research Farm, Obafemi Awolowo University, Ile-Ife, Osun State, Nigeria. The plants were identified and authenticated at the Department of Botany, Obafemi Awolowo University, Ile-Ife, Osun State, Nigeria. *Curcuma longa* Linn. specimen with voucher number: IFE-17577 was deposited at Ife Herbarium, Obafemi Awolowo University, Ile-Ife, Nigeria.

2.2. Preparation of *Curcuma longa* Linn. Rhizomes Ethanolic Extract

Fresh *Curcuma longa* rhizomes were washed and divided into five portions (A-E). Portion A-D was 18 g each of *C. longa* rhizomes cut into tiny pieces and dried at room temperature, 40 °C, 50 °C and 60 °C respectively while portion E was 10 g of fresh *C. longa* rhizomes. The dried rhizomes at different temperatures (portion A-D) were separately pulverized into powder and 10 g each was macerated in 20 mls of absolute ethanol for 72 hours at room temperature on a flask shaker and filtered with Whatman No. 1 filter paper [9]. The filtrates obtained were used for screening the proximate and mineral composition of the extracts (portion A-D). The fresh *C. longa* rhizome (portion E) was also chopped into tiny pieces, grounded and macerated in absolute ethanol for 72 hours. It was then filtered and the filtrate was used for investigating the phytochemical properties of *C. longa* fresh rhizomes.

2.3. Phytochemical Screening

10 g of fresh *Curcuma longa* rhizome ethanolic extract was screened for the presence of plant secondary metabolites using standard procedures described by [10, 11, 12]. In summary:

Test for Tannins: 0.5 g of grounded fresh *C. longa* was boiled in 20 mls of water in a test tube and filtered. Few drops of 0.1% ferric chloride were added. A green or blue black coloration confirms the presence of tannins.

Test for Phlobatannins: Deposition of red precipitate when 0.5 g of grounded fresh *C. longa* was boiled with 1% hydrochloric acid was taken as evidence for the presence of phlobatanins.

Test for Saponins and Flavonoids: 2.0 g of grounded fresh *C. longa* was boiled in 20 mls of distilled water in a water bath and filtered. Filtrate (10 mls) was mixed with 5 mls of distilled water and shaken vigorously. The formation of froth was taken as evidence for the presence of saponin. Aluminium chloride (3 mls of 1 %) was added to 5 mls of the sample. A yellow coloration observed indicates the presence of flavonoids. Also, diluted ammonia solution (5 mls) was added to a portion of the ethanol extract followed by the addition of concentrated H₂SO₄. A yellow coloration which disappeared on standing was taken as evidence for the presence of flavonoids.

Test for Steroids: Acetic anhydride (2 mls) was added to 0.5 g of grounded fresh *C. longa* with 2 mls of concentrated H₂SO₄. The colour change from blue to violent indicated the presence of steroids.

Test for Cardiac Glycoside: 5 mls of *C. longa* ethanolic extract was treated with 2 mls of glacial acetic acid containing one drop of ferric chloride solution. This was underplayed with 1.0 ml of sulphuric acid. A brown ring at the interface indicates a deoxy sugar characteristic of cardiac glycoside.

Test for Alkaloids: *C. longa* ethanolic extract was tested with the alkaloidal reagents Mayer's and Wagner's as follows; Mayer's reagent (2 drops) was added to 1.0 ml of the ethanolic extract. Presence of a creaming precipitate indicated the presence of alkaloids in the extract. Wagner's reagent (2 drops) was added to 1.0 ml of the ethanolic extract. Presence of a reddish brown precipitate indicates the presence of alkaloids.

Test for Phenolics: Two drops of 5% w/v of FeCl₃ was added to 1.0 ml of the plant extract. A greenish precipitate indicates the presence of phenolics.

Test for Anthraquinones: 3.0 cm³ grounded fresh *C. longa* ethanolic extract was shaken with 10.0 cm³ of benzene, filtered and 5.0 cm³ of aqueous ammonia solution (10% v/v) was added to the filtrate. A pink colour in the ammonical (lower) phase indicates the presence of free hydroxyl anthraquinones.

Test for Cardenolides and Dienolides: 1.0 cm³ of grounded fresh *C. longae* thanolic extract was added to 2.0 cm³ of glacial acetic acid containing one drop of 5 % w/v FeCl₃ solution. This was then

underplayed with 1.0 cm³ of the concentrated H₂SO₄. A brown ring at the interface indicated the presence of a deoxy sugar characteristic of cardenolides.

Test for Triterpenes: 1.0 cm³ of grounded fresh *C. longa* ethanolic extract was added to 5 drops of acetic acid anhydride followed by a drop of concentrated H₂SO₄. The mixture was steamed for 1 hour and neutralized with NaOH followed by the addition of chloroform. A bluish-green colour indicates the presence of triterpenes.

Test for Chalcones: Ammonia solution (2 mls) was added to 5 mls of grounded fresh *C. longa* ethanolic extract. Formation of a reddish colour confirmed the presence of chalcones.

2.4. Proximate Analysis

Chemical composition of the pulverized samples were determined according to [13] for crude protein (method 988.05), crude fat (method 2003.06), total ash (method 942.05), crude fibre (method 958.06), dry matter and moisture (method 967.08), while carbohydrate was obtained by difference.

2.5. Mineral Elements Compositions Determination

The percentage sodium and potassium composition were determined [13] using the Jenway Digital Flame Photometer (PFP7 Model) with filters corresponding to each mineral element. The magnesium, iron and calcium composition of the samples were determined on aliquots of the solutions of the ash by established atomic absorption/emission spectrophotometer model 200-A produced by Buck Scientific. Phosphorus was determined spectrophotometrically using the Vanado-molybdate (yellow) method 975.16 [13].

2.7. Statistical analysis of data

Data for each group were collected and summarized in a tabular and graph forms for each treatment group. Data were represented as the mean $\pm$ standard error of mean (SEM) for the number (n) of animals in the group. One-way analysis of variance (ANOVA) was first used followed by Bonferroni t-test *post hoc* comparisons to determine the significant differences at 95% ($P < 0.05$) using Primer (version 3.01).

3. RESULTS AND DISCUSSION

The result of this study showed that *C. longa* rhizome has appreciable amount of alkaloids, tannin, saponin, phenol and cardiac glycosides; moderate amount of phlobatannin, flavonoids, anthraquinones and steroids; and trace amount of terpenes and cardenolides (Table 1). Alkaloids present in *C. longa* rhizomes shows that they can be used in curing headache associated with hypertension, management of cold, chronic catarrh and migraine [14]. The presence of tannin in *C. longa* rhizomes shows that the plant could be used as antioxidant in the treatment of intestinal disorder like dysentery [15]. Also, saponin and flavonoid present in this plant shows that it has a strong antioxidant property [16]. Thus, the plant could be used to lower cholesterol, to improve sex hormone and also in the management of inflammations [17]. The presence of saponins in *C. longa* rhizome could probably be responsible for the use of the rhizome in ethno-medicine as an expectorant in the treatment of cough. Flavonoids also exhibit anti-inflammatory, antiangiogenic, anti-allergic effects analgesic and antioxidant properties [14, 1].

There was a significant ($P < 0.05$) increase in crude protein, crude fat and ash at 50 °C and a significant ($P < 0.05$) increase in crude fat and carbohydrate at 60 °C when compared with room temperature and 40 °C (Table 2). Also, there was a significant ($P < 0.05$) increase in ash content at 60 °C when compared with 40 °C (Table 2). A statistical significant increase in crude protein, crude fat, ash and carbohydrate values was observed across the different drying temperatures of *C. longa*. In this study, there was a significant increase in crude protein, crude fat, ash and carbohydrate with increase in temperature (Table 2). The values obtained in this study were found to be higher than values reported in previous studies [18]. The result of this study also showed a decrease in moisture content with increasing temperature. The results obtained were similar to other studies that observed a decrease in moisture with increased drying temperature which ultimately have an overall effect on the shelf life and stability of the plant [19, 20]. At 40, 50 and 60

°C, there was a significant decrease in ($P < 0.05$) in moisture content when compared with room temperature (Table 2).

At 40 °C there was a significant ($P < 0.05$) decrease in sodium, calcium and phosphorus when compared with room temperature while at 50 °C there was a significant ($P < 0.05$) increase in sodium, potassium, magnesium, calcium, phosphorous and iron when compared with room temperature and 40 °C (Tab. III). At 60 °C, there was a significant ($P < 0.05$) increase in magnesium, calcium and iron when compared with room temperature and an increase in sodium and phosphorus when compared with 40 °C (Table 3). Mineral analysis of *C. longa* rhizomes dried at different temperatures showed the presence of sodium, potassium, magnesium, calcium, phosphorous and iron. There was a significant ($P < 0.05$) increase in sodium, potassium, magnesium, calcium, phosphorous and iron with increasing temperature (Table 3). These observed increases could probably be explained by the increase in total amount of soluble solids that results from decreased moisture content [21]. The iron content of samples dried at room temperature was much higher than values reported by [20] and [18]. However, the results were similar to values reported by [22] and [23] in similar studies.

Table 1. Phytochemical Property of *Curcuma longa* Rhizome

Phytochemical	Observation	Remark
Alkaloids	+++	AA
Tannin	+++	AA
Phlobatannin	++	MA
Saponin	+++	AA
Flavonoids	++	MA
Anthraquinones	++	MA
Steroids	++	TA
Terpenes	+	TA
Cardenolides	+	TA
Phenol	+++	AA
Chalcones	-	CA
Cardiac Glycosides	+++	AA

AA = Appreciable Amount; MA = Moderate Amount; TA = Trace Amount; CA = Completely Absent.

Table 2. Proximate Analysis on *Curcuma longa* Rhizome Ethanolic Extract (%)

	Room temperature	40 °C	50 °C	60 °C
Crude Protein	9.43 ± 0.04	9.33 ± 0.06	9.93 ± 0.04 ^{ab}	9.64 ± 0.06
Crude Fat	3.13 ± 0.01	3.08 ± 0.01	3.26 ± 0.01 ^{ab}	3.21 ± 0.01 ^{ab}
Crude fibre	8.29 ± 0.02	8.24 ± 0.02	8.39 ± 0.03 ^b	8.33 ± 0.02
Ash	6.71 ± 0.03	6.61 ± 0.03	7.01 ± 0.03 ^{ab}	6.90 ± 0.03 ^b
Moisture	10.91 ± 0.00	10.64 ± 0.03 ^a	9.73 ± 0.02 ^{ab}	9.54 ± 0.04 ^{ab}
Carbohydrate	61.80 ± 0.02	61.84 ± 0.01	61.88 ± 0.01	62.19 ± 0.03 ^{ab}

Values are mean ± SEM; n = 2; ^a Significantly different from room temperature at $P < 0.05$; ^b Significantly different from 40 °C at $P < 0.05$

Table 3. Mineral Composition of *Curcuma longa* Rhizome (%)

	Room temperature	40 °C	50 °C	60 °C
Sodium	0.06 ± 0.00	0.05 ± 0.00 ^a	0.07 ± 0.00 ^{ab}	0.06 ± 0.00 ^b
Potassium	1.70 ± 0.02	1.64 ± 0.01	1.81 ± 0.02 ^{ab}	1.74 ± 0.01
Magnesium	0.19 ± 0.00	0.19 ± 0.00	0.22 ± 0.00 ^{ab}	0.21 ± 0.00 ^{ab}
Calcium	0.08 ± 0.00	0.07 ± 0.00 ^a	0.10 ± 0.00 ^{ab}	0.09 ± 0.00 ^{ab}
Phosphorous	0.12 ± 0.00	0.11 ± 0.00 ^a	0.13 ± 0.00 ^{ab}	0.12 ± 0.00 ^b
Iron	0.22 ± 0.00	0.21 ± 0.00	0.25 ± 0.00 ^b	0.23 ± 0.00 ^a

Values are mean ± SEM; n = 2; ^a Significantly different from room temperature at $P < 0.05$;
^b Significantly different from 40 °C at $P < 0.05$

CONCLUSION

In conclusion, the use of *C. longa* rhizomes in ethno-medicine for the treatment/management of a lot of diseases may be due to the presence of some phytochemicals, nutrients and minerals found in the plant and also, the concentration of these nutrients may be affected by temperature.

REFERENCES

- Jaggi L. Turmeric, curcumin and our life: A review. *Bulletin of environment, pharmacology and lifesciences*. 2012; 1(7): 11-17.
- Olojede AO, Iluebbey P, Dixon AGO. IITA/NRCRI collaborative germplasm and data collection on minor root and tuber crops in Nigeria. In: Annual report. *National Root Crops Research Institute, Umudike*. 2005; 77- 81.
- Olojede AO, Nwokocha CC. A decade of research on minor root and tuber crops at NRCRI: The contribution towards food sufficiency and economic empowerment in Nigeria: Root and tuber crops for food security and empowerment. 2011; 387- 396.
- Nwaekpe JO, Anyaegbunam HN, Okoye BC. *et al.* Promotion of Turmeric for the food/ pharmaceutical industry in Nigeria. *American Journal of Experimental Agriculture*. 2015; 8(6): 335- 341.
- Ishita CA, Kaushik BN, Uday B J. *et al.* *Current Science*. 2004; 87: 44-53.
- Narayana DBA, Brindavanam NB, Dobriyal RM. *et al.* Indian spices: An overview with special reference to nutraceuticals. *Journal of medicinal and aromatic plant sciences*. 2000; 22(1B): 236- 246.
- Bamishaiye EJ, Olayemi FF, Awagu EF. *et al.* Proximate and phytochemical composition of *Moringa oleifera* leaves at three stages of maturation. *Advance Journal of Food Science and Technology*. 2011; 3(4): 233- 237.
- Kamal M, Youssef E, Amira M. *et al.* Assessment of proximate chemical composition, nutritional status, fatty acid composition and antioxidants of curcumin and mustard seeds powder. *Food and public health*. 2012; 4(6): 286- 292.
- Das K, Tiwari RKS, Shrivastava DK. Techniques for evaluation of medicinal plant products as antimicrobial agent: Current methods and future trends. *Journal of Medicinal Plants Research*. 2010; 4(2): 104-111.
- Harborne JB. *Phytochemical Methods: A Guide to Modern Techniques of Plant Analysis*. Chapman A and Hall: London. 1973.

- 241 11. Sofowora A. Medicinal Plants and Traditional Medicines in Africa. Chichester John, Willey and
242 Sons: New York. 1993.
- 243 12. Trease GE, Evans WC. A Text-book of Pharmacognosy. Bailliere Tindall Ltd: London. 1989.
- 244 13. Association of Official Analytical Chemist. Official Methods of Analysis (18th Ed.). The
245 Association of Official Analytical Chemists, Washington DC: USA. 2005.
- 246 14. Gills LS. Ethno medical uses of plants in Nigeria. African press: Benin City. 1992.
- 247 15. Okwu DE, Josiah C. Evaluation of the chemical composition of two Nigeria medicinal plants.
248 *African Journal of Biotechnology*. 2006; 5(4): 3357-361.
- 249 16. Masuda Y, Kikuzaki H, Hisamoto M. *et al*. Antioxidant properties of gingerol related compounds
250 from ginger. *Biofactors*, 2004; 21(1-4):292-296.
- 251 17. Bylka W, Matlawska I, Witkowska-banaszczak E. Expectorant herbal medicines in respiratory
252 tract diseases in tobacco smokers. 2005; 62(10):1182-1184.
- 253 18. Ogbuewu IP, Jiwuba PD, Ezeokeke CT. *et al*. Evaluation of Phytochemical and Nutritional
254 Composition of Ginger Rhizomes Powder. *International Journal of Agriculture and Rural*
255 *Development*. 2014; 17(1):1663-1670.
- 256 19. Oluwalana IB, Ayo JA, Idowu MA. *et al*. 2011. Effects of Drying Methods on the Phytochemical
257 Properties of Waterleaf (*Talinum triangulare*). *International Journal of Biological and Chemical*
258 *Sciences*. 2011; 5(3):880-889.
- 259 20. Alkali JS, Kucha CT, Rabi IA. Effect of Drying Temperature on the Nutritional Quality of
260 *Moringa oleifera* Leaves. *African Journal of Food Sciences*. 2015; 9(7): 395-399.
- 261 21. Gamman PM, Sherrington KB. The Science of Food: An Introduction to Food Science, Nutrition
262 and Microbiology, 3rd Edition, Pergamon Press Oxford: New York. 1990.
- 263 22. Ajayi OB, Akomolafe SF, Akinyemi FT. Food Value of Two Varieties of Ginger (*Zingiber*
264 *officinale*) Commonly Consumed in Nigeria. *International Scholarly Research Notes (ISRN)*
265 *Nutrition*. 2013.
- 266 23. Trinidad TP, Sagum RS, Leon MP. *et al*. *Zingiber officinale* and *Curcuma longa* as Potential
267 Functional Foods/Ingredients. *Food and Public Health*. 2012; 2(2):1-4.