JHER Vol. 32 (2) December 2025, pp. 209 - 218

Evaluation of Nutrient Composition of Spice Product from Turmeric Root (*Curcuma Longa*)

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Abstract

The study evaluated nutrient composition of spice produced from turmeric (*Curcuma longa*) root. Specifically, it analysed proximate composition, mineral, vitamin, antinutrients and phytochemicals contents of turmeric root spice. One hundred gram of fresh turmeric roots was sorted, cleaned and washed, then divided into two parts. One part was oven dried and processed into fine flour while the second portion was wet milled. The samples were analysed chemically using standard methods. Data were analysed using mean and standard deviation and ANOVA at 0.05 level of significance. Result indicates that dry sample had higher protein (7.83%), ash (11.50%), fibre (6.48%), fats (7.80%) and carbohydrates (53.93%) than the fresh sample. Fresh turmeric sample had higher moisture (63.50%) than the dry sample. Dry turmeric sample had significantly higher ($p<0.05$) micronutrients than the fresh root except in phosphorus and thiamin but no significant difference was observed in copper values of both samples. Both samples had traces of antinutrients analysed. Dry turmeric spice had higher saponin (1.18mg/100g), alkaloid (3.00mg/100g) but lower flavonoid (4.01mg/100g) values more than the fresh sample.

Keywords: Turmeric, Roots Evaluation, Spices Composition, Phytochemical, Vitamin, Mineral, Antinutrient.

Introduction

Turmeric (*Curcuma longa*), a member of the Zingiberaceae family, is a perennial herbaceous plant native to South Asia but widely cultivated in tropical and subtropical regions such as India, Indonesia, and China—the largest global producers (Chattopadhyan et al., 2014). Turmeric is traditionally used in medicine as well as culinary spice and coloring agent, and has played a vital role in cultures worldwide (Prasad & Aggarwal, 2011; Luthra et al., 2021). It is known locally in Nigeria as *Atale pupa* (Yoruba), *Gangamau* (Hausa), *Nwandumo* (Ebonyi), *Ohu bobochi* in Enugu, *Gigir* in Tiv, *Maginain* Kaduna, *Türi* in Niger State and *Onjonigho* in Cross River (Meo tribe) (Jilani et al., 2012). The plant grows up to two feet tall, with broad leaves and a pungent, bitter root commonly used in folk medicine and household remedies for ailments such as diabetes, high cholesterol, menstrual disorders, skin

diseases, inflammation, and cancerous symptoms as blood purifier (Nwaekpe et al., 2015). The antioxidant properties of turmeric are harnessed in food preservation and functional foods, underscoring its importance in both nutrition and food science (Restrepo-Osorio, et al., 2020).

The health benefits of turmeric are largely attributed to its bioactive compounds called curcuminoids, the most prominent being curcumin. Curcumin is noted for its anti-inflammatory, antioxidant, and anticancer properties and is a key focus in both traditional medicine and modern scientific research (Peter, 2022; Prasad & Aggarwal, 2011). Curcumin in turmeric helps to modulate cellular pathways associated with inflammation and oxidative stress, making it relevant in the management of chronic diseases like arthritis, cardiovascular conditions, and neurodegenerative disorders.

Nutritionally, turmeric roots contain significant levels of macronutrients and bioactive compounds. The rhizomes typically comprise 60–70% carbohydrates, 6–8% protein, 5–10% fats, 3–7% dietary fiber, and 3–7% minerals such as potassium, calcium, and iron (Nelson et al., 2017). They also contain moisture (6–13%), trace vitamins including vitamin C and B-complex, beta-carotene, polyphenols, fatty acids, and essential oils. These nutrients support various physiological functions including metabolism, immune function, and tissue repair. However, the nutritional composition of turmeric may vary depending on soil conditions, farming methods, and postharvest processing (Prasad & Aggarwal, 2011).

Spices are indispensable components of cuisines used mainly for flavouring to improve palatability of foods (Ogbuewu et al., 2014). Spices can be derived from various plant parts such as leaves (e.g., bay leaf), roots (e.g., turmeric), barks (e.g., cinnamon), seeds (e.g., cumin), and buds (e.g., cloves) (Viuda-Martos et al., 2011). The U.S. Food and Drug Administration defines spices as aromatic, flavor-enhancing plant substances that retain their natural volatile oils and are free from adulterants and artificial coloring (Peter, 2022). Turmeric's unique phytochemicals contribute to its potential in disease prevention, including cancer and cardiovascular illnesses (Ogbuewu et al., 2014).

Despite its traditional uses and health potential, turmeric remains underutilized in industrial food and pharmaceutical production. Limited data exist on its full nutrient profile, particularly regarding the influence of various processing and cultivation techniques (Lee et al., 2014). Understanding how geographic origin, soil type, and postharvest handling affect its composition is critical. Thus, scientific exploration into turmeric's nutritional and medicinal properties is necessary to maximize its value beyond household and traditional use.

Objective of the study

The broad objective of the study was to evaluate the nutrient composition of spice product from turmeric (*Curcuma longa*)

root. Specifically, the study determined the following features of spice produced from turmeric root:

1. proximate composition.
2. vitamin content.
3. mineral content.
4. phytochemical content.
5. antinutrient content.

Materials and Methods

***Design of the Study*:** the study design is an experimental design.

Materials: The turmeric root (*Curcuma longa*) was used for the study. They were procured from Ogige local market Nsukka, Enugu State, Nigeria. They were identified in the Department of Plant Science and Biotechnology, University of Nigeria, Nsukka

***Sample Preparation for Chemical Analysis*:** One hundred grams of the fresh turmeric roots were sorted by hand picking and cleaned to remove debris and defects. The rhizomes were carefully washed with distilled water to remove dirt and sand, then allowed to drain in a plastic sieve. Fifty grams of fresh turmeric roots were peeled and cut into small sizes. They were dried in an oven at a temperature of 55˚C to 96% dry matter to obtain dry turmeric root. The dried rhizomes were polished to remove rough surface by handpicking. They were ground into flour using a laboratory hammer mill (70mm mash screen). They were labeled, packaged and stored in a plastic air tight container under refrigeration for analysis. The remaining fiftygram fresh turmeric root was also milled into paste a laboratory hammer mill (70mm mash screen). They were properly labelled, packaged and stored in a plastic air tight container under refrigeration for analysis.

***Chemical Analysis*.** Proximate**,** vitamins, minerals, antinutrients and phytochemical compositions of the samples were determined. All the analyses of the sample were done in triplicates using standard methods. Proximate composition of the spice products were analyzed using the Association of Official Analytical Chemists (AOAC) (2012) method to determine moisture, ash, protein, fat, and fiber contents. Mineral content were determined using the atomic absorption spectrophotometer (AAS) method as described by AOAC (2012). The methods described by Onwuka (2005) were employed in the determination of vitamin contents of the spices. The AOAC (2012) spectrophotometric method was used for the determination of phytate and tannin contents of the spices. Total flavonoids (TF) content of the spices was determined using the modified method of Onwuka (2018). The alkaloids content of the samples were determined using the method described by Harborne (1973). Total saponin content was estimated using the method of Obadoni and Ochuko (2001). The alkaline picrate method described by Jonathan and Funmilola (2014) was employed for the determination of cyanide content. These analyses were done in the Analytical Laboratory in the Department of Home Science and Management University of Nigeria, Nsukka.

***Statistical Analysis*:** The data generated was analyzed using mean and standard deviation. Results of three replicates were used. Analysis of variance (ANOVA) at 0.05 level of significance, was used to determine statistically significant differences between the means.

Results

Table 1: Proximate Composition of Turmeric from Fresh and Dry Roots (%/100g).

Nutrient (100g)	FTR (%)	DTR (%)
Protein	1.37±0.06	7.83±0.19
Ash	5.66±0.57	11.50±0.50
Fibre	0.76±0.05	6.48±0.01
Fats	4.63±0.40	7.80±0.03
Moisture	63.50±0.13	12.44±0.05
Carbohydrate	24.05±0.36	53.93±0.31

Values are means ±standard deviation of triplicate determination. Means on the same row with different superscript are significant at p<0.05. FTR = Fresh turmeric rootsDTR = Dry turmeric roots Mean ± Standard Deviation (SD).

Table 1 shows the proximate composition of turmeric from fresh and dry turmeric roots. The crude protein was significantly higher in dry turmeric root with the percentage of 7.83%. There was a significant difference in the ash content of the samples analysed. The dry turmeric root was found to have a higher value (11.50%) than the fresh turmeric root (5.66%). The crude fibre content of the dry turmeric root was higher (6.48%) than the fresh turmeric root with 0.76%. The fat content of the dry turmeric root was observed to be higher (7.80%) in the dry sample. The moisture content of the fresh turmeric root was observed to be higher (63.50%) than the dry turmeric. The carbohydrate content was significantly higher (53.93%) in dry turmeric root than the fresh turmeric root.

Table 2: Mineral Composition of Turmeric from Fresh and Dry roots (mg/µg)

Nutrient 100g sample	FTR	DTR
Iron (mg)	4.84±0.07	9.79±0.46
Phosphorus (mg)	285.51±74.62	161.98±3.95
Magnesium (mg)	96.90±3.30	569.23±14.41
Calcium (mg)	174.40±0.13	285.09±1.92
Copper (mg)	0.04±0.43	0.90±0.10
Sodium (mg)	29.18±0.32	59.30±0.10
Zinc (mg)	0.41±0.03	3.08±0.15

Values are means ±standard deviation of triplicate determination. Means on the same row with different superscript are significant at p<0.05. FTR = Fresh turmeric roots DTR = Dry turmeric roots Mean ± Standard Deviation (SD).

Table 2 presents the mineral compositions of the fresh and dry turmeric root samples. The iron content of the dry sample is higher (9.79mg/100g) than the fresh turmeric root. The phosphorus (P) content of the fresh sample was seen to be higher (285.51mg/100g) than the dry turmeric root sample. The magnesium (Mg) contents of the dry turmeric root was observed to be higher (569.23mg/100g) than the fresh sample. Dry turmeric root spice was found to have higher Calcium (Ca) contents (285.09mg/100g) than the fresh turmeric roots. There was no significant difference observed in the Copper (Cu) values of both the fresh and dry turmeric root samples. The Sodium (Na) contents of the dry turmeric was seen to be higher (59.30

mg/100g) than the fresh turmeric root. The zinc (Zn) content of the dry turmeric had a higher (3.08 mg/100g) significant difference than fresh turmeric root.

Table 3: Vitamin Composition of Turmeric from Fresh and Dry roots (mg/μg).

Nutrient/100g	FTR	DTR
Thiamin (mg)	0.30±0.00	0.05±0.02
Riboflavin (mg)	1.11±0.01	1.73±0.13
Ascorbic acid (mg)	2.97±0.15	3.94±0.47

Values are means ±standard deviation of triplicate determination. Means on the same row with different superscript are significant at p<0.05 FTR = Fresh turmeric roots, DTR = Dry turmeric rootsMean ± Standard Deviation (SD).

Table 3 shows the vitamin composition of fresh and dry turmeric root spices. A higher value (0.30mg/100g) was recorded in the fresh turmeric root than the dry turmeric root. The riboflavin (Vit B_2) content of the dry turmeric was significantly higher (1.73mg/100g) than the fresh turmeric. Dry turmeric root sample had higher value (3.94mg/100g) of ascorbic acid (Vit C) content than the fresh turmeric sample.

Table 4: Antinutrient composition of Turmeric from fresh and dry roots (mg/100g).

Antinutrient	FTR	DTR
Cyanide	2.95±0.04	0.87±0.01
Tannin	0.051±0.06	0.080±0.00
Phytate	0.205±0.02	0.175±0.00

Values are means ±standard deviation of triplicate determination. Means on the same row with different superscript are significant at p<0.05. FTR = Fresh turmeric rootsDTR = Dry turmeric roots Mean ± Standard Deviation (SD).

Table 4 shows that cyanide content was observed to be higher (2.95mg/100g) in fresh turmeric sample than the dry turmeric sample. Tannin contents of both the dry and fresh turmeric has no significant difference (p>0.05). The phytate contents of the fresh turmeric was found to be higher (0.205mg/100g) than the dry turmeric sample.

Table 5: Phytochemical composition of Turmeric from fresh and dry roots (mg/100g)

Sample phytochemical (%)	FTR	DTR
Saponin	0.69±0.13	1.18±0.15
Alkaloid	1.31±0.1	3.00±0.01
Flavonoid	9.66±0.57	4.01±0.01

Values are means ±standard deviation of triplicate determination. Means on the same row with different superscript are significant at p<0.05. ***FTR*** *= Fresh turmeric roots;* ***DTR*** *= Dry turmeric roots*

Table 5 shows that saponin contents of the dry turmeric was observed to be higher (1.18mg/100g) than the fresh turmeric. The alkaloid contents were found to be higher (3.00mg/100g) in the dry turmeric sample. The flavonoid contents of fresh turmeric were observed to be higher (9.66mg/100g) in the fresh turmeric sample than the dry turmeric sample.

Discussion of Findings

The protein value (7.83%) of the dry turmeric sample were lower than the value (9.34%) obtained by Youssef (2014). The difference in the protein content could be as a result of regional soil differences, climatic and genetic

variations (Li et al., 2021). The finding also agrees with the literature reports made by Okwu and Josiah (2014) that the high crude protein content of the dried turmeric may be due to the presence of active portentous metabolites such as alicin, ajoene and capsaicin. The ash content (11.50%) were higher than value (5.06 %) obtained by Olayinka, (2023). This finding shows that it has a reasonable amount of mineral while the low ash content in the fresh turmeric sample is an indication of low inorganic mineral content. The crude fibre content (6.48%) was found within the range (4.0-14.5%) documented by Restrepo-Osorio et al., (2020). This is in line with the report of Ikpeama et al., (2014) and literature report by Dashak et al., (2012), that fibre is known for its bulkiness to food and is an advantage to human as it can help in digestive tract cleansing and as well help in preventing the absorption of excess cholesterol. The reduced moisture content in the dried turmeric sample is an indication that their shelf life would be prolonged and that deterioration due to microbial contamination would be limited.

The mineral and vitamin analysis of fresh and dried turmeric samples indicates that they add to the micronutrient content of dishes they are prepared with. The result is in line with that of Kubmarawa et al., (2017), who reported that high Ca and Fe content of the turmeric plant suggest that it could be important in sustaining strong bone, muscles contraction and relaxation, blood clothing, reduced blood pressure and help in haemoglobin formation. The result of the preset study is in agreement with Ikpeama et al., (2014) which stated that higher minerals and vitamins content in the dry turmeric sample were due to lower moisture levels of the turmeric root, however, the dry turmeric root sample were richer in mineral than in fresh sample. This could be attributed to the reduction in moisture content during drying process which lead to the concentration of more nutrients and varietal differences. In this study, there was a rather increase in the thiamine contents of turmeric during drying. To further support this result, Hassan et al., (2010) stated that during dehydration, some nutrients increases their concentration, making them more available. This was the reason for increase in magnesium and riboflavin contents in the dry turmeric root.

In this study, traces of antinutrient (phytate, tannin and cyanide) were observed in the dry roots. This suggests that dry turmeric spice may be better source of nutrient than fresh roots. Phytates value (0.175mg/100g) was found to be relatively lower than values (0.51mg/100g) documented by Ibrahim et al., (2022). Phytates bind strongly with minerals such as calcium, copper, iron, zinc, magnesium and molybdenum to form insoluble complexes (Adebiyi, Soetan & Olayemi, 2015). The complexes formed lower the bioavailability of minerals in the body. The absence of phytate in the fresh and dried turmeric root were comparable to the literature report of Oboh, (2016) that it was due to

the structure of phytate with high density of negatively charged phosphate groups. Traces of tannins was found in this study. Tannins hinders the digestion of many food substances such as protein to form complexes resulting to poor absorption and low availability of proteins (Hendek & Bektaş 2018). This study shows low level of cyanide in dry turmeric spices (0.87mg/100g) and were comparable with values (0.79 mg/100g) obtained by Aftab & Vieira, (2010), however, it was seen to be higher (2.95mg/100g) in the fresh spice sample. High level of cyanide has toxic effects on cardiovascular, respiratory and the central nervous system thereby is linked with cerebral damage and lethargy. (Gemede & Ratta, 2014).

Phytochemical analysis is useful to detect the presence of the bioactive principle constituents in plants which subsequently may lead to the discovery and development of medicinal drugs (Harshal et al., 2014). The dry turmeric roots are rich in alkaloid and saponin while the fresh turmeric roots are rich in flavonoid. Alkaloid content in both the fresh (1.3mg/100g) and dry (3.00mg/100g) turmeric samples were within the moderate level thus supports the findings of Okoye and Ebeledike (2013) that moderate levels of alkaloids are powerful pain relievers and are known to stimulate the central nervous system (CNS). High level of alkaloid has been proven by Zhu et al. (2020) to exert toxicity and adverse effects to humans' physiological and neurological activities. This support the literature report (Evans et al., 2012) that observed high content of saponnin in dry turmeric root and the high flavonoid content in the fresh turmeric could be responsible for their much acclaimed medicinal values, Therefore, the appreciable amount of saponin in turmeric root could be good sources for the antimicrobial properties. This present study shows that turmeric root spice contains flavonoids. Flavonoids exhibit a range of biological activities by scavenging free radicals and thus has ability to promote health (Zhang *et al.*, 2015). Flavonoids also exhibits anti-inflammatory, anti-allergic, analgesic and antioxidant properties. In general, the results of these phytochemicals is in line with the literature reports of Kaur and Arora, (2017) noted that the presence of these phytochemicals could account for the much hyped medicinal properties of turmeric roots in various disease conditions such as atherosclerosis, arthritis, bacterial infections and cancer.

Conclusion

The study provided some information on the proximate, mineral, vitamin, antinutrient and phytochemical composition of spice product from turmeric root (*Curcuma longa).* The dry turmeric sample had higher nutrient composition than fresh sample except for moisture. The lower moisture level of the dry turmeric root, which led to the higher concentration of the nutrients is an indication that it has higher resistance to microbial growth than the fresh sample. The findings also show that turmeric spices is nutritionally rich in essential vitamins and minerals needed for body

growth. The data obtained revealed that turmeric contains potential phytochemical components that may be of great use in Dietetic or pharmaceutical industries as a therapy against various disease condition.

Recommendation

Base on the present study, the following recommendation were made:

1. The baseline information on the nutrient, anti-nutrient and phytochemical composition of the dry and fresh turmeric should be included in the food composition tables.
2. Use of turmeric spice should be recommended especially to people suffering from degenerative diseases in managing their condition.
3. Incorporation of the spice into various food preparations, flour cookery and beverage products as a means of enriching the food products.
4. Sensory evaluation of food products prepared using the fresh and dry spices should be look into for the organoleptic attributes.

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