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# Effects of Sun and Oven Drying on Selected Micronutrients and Antioxidant Properties of Turmeric (*Curcuma longa*)

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**Abstract**

*Curcuma longa*, also known as turmeric, is commonly preserved using drying method. This study was therefore designed to assess the effects of two drying methods on some nutrients and antioxidant properties of turmeric. Standard procedures were used to prepare turmeric flours, and the parameters of interest were analysed using standard methods. The result showed that calcium (Ca) (19.78 – 26.37mg/100g), potassium (K) (1402 – 1522mg/100g), sodium (Na) (85.43 – 90.25mg) and beta carotene (2450 – 2970mcg/100g) were significantly higher in sun-dried and oven-dried samples. Other element found in significant amounts in the dried samples was selenium (Se) (0.045 – 0.054mg/100g). Values of vitamin C (13.39mg/100g), DPPH (52.39%) and FRAP (48.12%) were significantly higher in fresh turmeric. The study showed that drying (particularly oven drying) concentrates the minerals and beta-carotene contents of turmeric but reduces the vitamin C and its antioxidant properties.

***Keywords:*** *Turmeric, sun drying, oven drying, micronutrinets, antioxidants*

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## 1. Introduction

*Curcuma longa* commonly known as 'turmeric' is an herbaceous perennial plant that belongs to the ginger family, *Zingiberaceae* family (Gupta *et al.*, 2013). Turmeric is extensively cultivated in China, India and other countries with tropical climate including Nigeria (Paramasivam *et al.*, 2009; Singh and Jain, 2012). Turmeric is used as dietary spice, food preservative and colouring material in foods, herbal, medicine and textile industries all over the world (Neeta *et al.*, 2007). Nutritionally, dried turmeric contains 69.48% carbohydrate, 6.3% protein, 5.1% oil, 3.5% minerals and other elements (Tanvir *et al.*, 2017). It also contains curcuminoids, a compound believed to have medicinal values (Naz *et al.*, 2010). Like tomatoes Cooking enhances the bioavailabilty of the bio-active substance present in turmeric rhizome (Ijeomah and Nzelu (2024)

Turmeric can be utilized as either fresh or in the dried powdered form. Traditional open sun drying is a common method used by rural farmers in Nigeria to dry turmeric, this method of drying is usually weather dependent and often requires up to 20 to 30 days drying (Pradeep *et al.*, 2016). Studies have shown that during this drying period turmeric is prone infestation and losses due to lack of proper drying and fungi attack. Drying may also affect the nutrients, phytochemicals and the antioxidant properties of turmeric. This study was therefore designed to assess chemical composition of turmeric and the effect drying on the nutrients, phytochemicals and antioxidant properties retention of turmeric.

## 2. Materials and Methods

### Collection and Preparation of sample

Fresh matured turmeric rhizomes were purchased from Orie-ugba Market in Umuahia North Local Government Area of Abia State, Nigeria. Healthy turmeric rhizomes were selected and washed thoroughly under running tap. Undesirable portions were manually removed using a kitchen knife and the samples were rinse in clean tap water. The rhizomes were air dried before been manually sliced to about 2.5cm in length

with a kitchen knife. The sample was divided into three equal parts of 500g each, one part was places in sample container and taken immediately for chemical analyses while the other two portions were sun and oven dried respectively.

**Drying, Grinding and Packaging**

**Sun Drying of turmeric**

Five hundred (500) grams of the sliced samples were spread uniformly on the plastic trays and exposed to the sun on elevated platforms. The sliced rhizomes were turned over, hourly to enhance uniform drying.

**Oven drying of samples**

Hot air Oven (Model DHG-9030 SN 42) was used to dry the sample (500g). The oven was kept running for 15min for the temperature to gradually reached the desired temperature of 60ºC. The sample was then spread on the wire meshes in the oven and allowed to dry. The sample was dried until a constant weight was obtained. Drying of the sample lasted for a period of one hour, fifteen minutes (1hr 15mins).

**Grinding and packaging of samples**

The samples were ground using a grinding mill petrol engine with trigmax Gx 200-6.5hp/GX 160-5.5hp.The ground samples were sifted using an MCS stainless steel sifter of50 Mesh0.355mm Aperture. The samples were then properly packaged in air tight sample bottles Model DHG-9030 SN 42 and taken to the laboratory for chemical analysis.

**Chemical analyses of the samples**

Mineral elements were determined using wet-acid digestion method for multiple nutrients determination as described by the method of AOAC (2006). The digest was used for the determinations of calcium (Ca) using the ethylamine ditetra acetic acid (EDTA) Versanate complexiometric titration method. Potassium (K) and sodium (Na) were evaluated using flame photometry method. Selenium was determined using Atomic Absorption Spectrophotometer (Model 3030 Perkin Elmer, Norwalk USA). β – carotene was determined spectrophotometrically as described by AOAC (2006), while ascorbic acid was determined as described by AOAC (2006) using titration method. The spectrophotometric method (Gyamdi, 1999) was employed in the determination of the free radical scavenging ability of turmeric. The reducing property of turmeric was determined by assessing the ability of the extract to reduce $FeCl_3$ as described by Oyaizu (1986).

## 3. Results and Discussion

The mineral composition of the turmeric on Table 1 showed that turmeric is good source of potassium and calcium. Sodium and selenium were found in moderate amounts. The values of each mineral varied with drying. Drying appears to have concentration effect on the mineral composition of turmeric. Calcium (19.98 - 26.37mg/100g), potassium (1402 – 1522mg/100g), sodium (85.43 – 90.25mg/100g) and selenium (0.045 – 0.015mg/100g) values obtained for the sundried and oven dried turmeric were significantly higher than the calcium (10.09mg/100g), potassium (935.1mg/100g), sodium (36.41mg/100g), and selenium (0.015mg/100g) values obtained for fresh turmeric. Increment in mineral values were expected because study has shown that drying does not only prevent the growth and reproduction of microorganisms but also concentrate most nutrients (Mohammed *et al.*, 2009). It was however noted that oven drying method had significantly higher mineral concentration than sun drying techniques. Increased in mineral concentration with drying was also in similar work done by Güneri, (2021). Ijeomah and Nzelu (2024), however reported otherwise. Though spices are eaten in small quantity compared to other food source, their consumption along with other nutrients will contribute to cumulative intake in individuals.

**Table 1:** Effects of sun drying and oven drying the mineral and vitamin contents of Turmeric (*Curcuma longa)* in mg/100g

| Samples | Fresh turmeric | Sun dried turmeric | Oven dried turmeric |
|---|---|---|---|
| Calcium | $10.09^{c}$±0.05 | $19.78^{b}$±1.45 | $26.37^{a}$±0.25 |
| Potassium | $936.1^{c}$±16.63 | $1402.0^{b}$±14.00 | $1522.7^{a}$±27.01 |
| Sodium | $36.41^{c}$±0.01 | $85.43^{b}$±0.68 | $90.25^{a}$±1.40 |
| Selenium | $0.015^{c}$±0.01 | $0.045^{b}$±0.01 | $0.054^{a}$±0.03 |

Values show means ± standard deviation of triplicate analysis

$^{a-c}$Means with different superscripts across same rows are significantly different at ($P < 0.05$)

The beta carotene content of fresh, oven-dried and sun-dried turmeric were significantly different ($P<0.05$) from each other. The beta carotene (2970$\mu$g/100g) content oven dried turmeric was significantly higher than values obtained for sun dried (2450$\mu$g/100g) and fresh (1330$\mu$g/100g) turmeric samples. Increment in beta carotene value with drying was observed in a similar work (Ijeoma and Nzeh, 2024) but values in the current work cannot be compared with the ones obtained from that work due to differences in the mode of expression. It was however observed that unlike this study, sun dried value of beta carotene obtained in that study was significantly higher than value obtained in the oven dry. The differences could be as a result of the effect differences in sun intensity due effect seasonality.

The vitamin C content of dried turmeric (7.09 – 9.97mg/100g) were significantly lower than value (13.39mg/100g) obtained for fresh turmeric. Though Harbor (2020) reported increase in vitamin C with drying, the decrease in vitamin C in this study was not surprising because vitamin C is susceptible to heat and alkalinity (Rice-Evans *et al*., 1997; Szeto *et al*., 2002). Vitamin C is an important water soluble vitamin, it functions as an anti-oxidant (Wardlaw and Hampl 2007). As an antioxidant vitamin C is capable of neutralizing reactive oxygen species (ROS) in the aqueous phase before lipid peroxidation is initiated (Bello *et al*., 2008).

**Table 2:** Effects of Drying on the vitamin retention ability of Turmeric (*Curcuma longa)*

| Sample | Fresh turmeric | Sun dried turmeric | Oven dried turmeric |
|---|---|---|---|
| Beta carotene ($\mu$g/100g) | $1330^{c}$±0.08 | $2450^{b}$±0.02 | $2970^{a}$±0.17 |
| Vitamin C (mg/100g) | $13.39^{a}$±0.35 | $9.67^{b}$±0.19 | $7.09^{c}$±0.13 |

Values means ± standard deviation of triplicate analysis

$^{a-c}$Means with different superscripts across same rows are significantly different at ($P < 0.05$)

Table 3 revealed the result obtained for DPPH scavenging antioxidant abilities of turmeric present. There was a significant difference (P<0.05) between the DPPH scavenging ability of the fresh and dried forms of turmeric samples. The % DPPH scavenging ability of fresh turmeric (52.39%) was higher that of sun dried (50.77%) and oven dried (49.94%). There was no significant difference (P>0.05) in the % DPPH scavenging abilities of the sun dried and oven dried turmeric. Variation in their scavenging capacity of the dried and fresh turmeric may be due to the effect of drying. Antioxidant scavengers have been associated with the inhibition of cancer, atherosclerosis, as well as for age-related degenerative brain disorder (Chang *et al*., 2006). Significant reduction in FRAP reducing antioxidant abilities of turmeric with drying was also observed in the samples. The fresh turmeric sample showed higher (48.12%) FRAP reducing ability than the sun dried (43.51%) and oven dried (33.96%). Antioxidants act as reducing agents because their molecules are stable enough to donate an electron to a rampaging free radical and neutralize it, thus reducing its capacity to damage (Lobo *et al.* 2020).

**Table 3:** Effects of sun drying and oven drying on the antioxidant properties of Turmeric (*Curcuma longa)* in percentage

| Sample | Fresh turmeric | Sun dried turmeric | Oven dried turmeric |
|---|---|---|---|
| DPPH Scavenging Activity (%) | $52.39^{a}$±0.04 | $50.77^{b}$±0.95 | $49.94^{b}$±0.36 |
| FRAP (%) Reducing Activity | $48.12^{a}$±0.98 | $43.51^{b}$±0.71 | $33.96^{c}$±0.13 |

values show means ± standard deviation of triplicate analysis

$^{a-c}$Means with different superscripts across same rows are significantly different at P < 0.05

**KEY**;

DPPH: 2, 2-diphenyl-1-picrylhydrazyl

FRAP: Ferric Reducing Antioxidant Power.

## 4. Conclusion

Significantly higher values of beta carotene, calcium, potassium, sodium, and selenium were obtained in oven dried sample compared to sun dried sample. While vitamin C, and FRAP were significantly lower in oven dried sample compared to sundried turmeric sample.

### Author Declaration

All authors contributed equally to the success of the work.

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