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Studies on evaluation of physicochemical and nutritional properties of fresh turmeric rhizome

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Abstract
The present investigation was carried out to study the physicochemical and nutritional properties of fresh turmeric rhizome. Results obtained indicated that colour of turmeric rhizome was yellowish brown to deep brown in colour, thickness and weight 2.60cm and 74.80g. respectively. Further, chemical and mineral composition was reported and results showed that moisture content was found to be 84.25 per cent, carbohydrate 9.10 per cent, Protein 1.20 per cent, fat 1.08 per cent and curcumin content of rhizomes was recorded to be 5.1 per cent. The other parameters such as ash, fiber, acidity and pH of turmeric rhizome were indicated 0.66 per cent, 0.72 per cent, 0.70 per cent and 5.7 respectively. The mineral showed highest of zinc 22.9, calcium 8.2 followed by iron 2.3 mg/100g. Finally, it can be concluded from the results that fresh turmeric rhizome is highly nutritious and can be a good source of curcumin content make it potentially useful in preparation and value addition of food products.

Keywords: curcumin, fresh rhizome, mineral composition, chemical composition

Introduction
Turmeric is a product of *Curcuma longa*, a rhizomatous herbaceous perennial plant belonging to the ginger family *Zingiberaceae*, which is native to tropical South Asia. As many as 133 species of *Curcuma* have been identified worldwide. Most of them have common local names and are used for various medicinal formulations. The turmeric plant needs temperatures between 20°C and 30°C and a considerable amount of annual rainfall to thrive. Individual plants grow to a height of 1 m, and have long, oblong leaves. Plants are gathered annually for their rhizomes and are reseeded from some of those rhizomes in the following season. The rhizome, from which the turmeric is derived, is tuberous, with a rough and segmented skin. The rhizomes mature beneath the foliage in the ground. They are yellowish brown with a dull orange interior. The main rhizome is pointed or tapered at the distal end and measures 2.5–7.0 cm (1–3 inches) in length and 2.5 cm (1 inch) in diameter, with smaller tubers branching off. When the turmeric rhizome is dried, it can be ground to a yellow powder with a bitter, slightly acrid, yet sweet, taste.

India produces nearly all of the world's turmeric crop and consumes 80% of it. With its inherent qualities and high content of the important bioactive compound curcumin, Indian turmeric is considered to be the best in the world. Erode, a city in the South Indian state of Tamil Nadu, is the world's largest producer of and the most important trading center for turmeric. It is also known as "Yellow City," "Turmeric City," or "Textile City." Sangli, a city of Maharashtra, is second only to Erode in size and importance as a production and trading site for turmeric (Prasad and Aggarwal, 2011) [16]

Turmeric is used as an herbal medicine for rheumatoid arthritis, chronic anterior uveitis, conjunctivitis, skin cancer, small pox, chicken pox, wound healing, urinary tract infections, and liver ailments (Dixit *et al.* 1988) [8]. It is also used for digestive disorders; to reduce flatus, jaundice, menstrual difficulties, and colic; for abdominal pain and distension (Bundy *et al.* 2004) [3]; and for dyspeptic conditions including loss of appetite, postprandial feelings of fullness, and liver and gallbladder complaints. It has anti-inflammatory, choleretic, antimicrobial, and carminative actions (Mills and Bone 2000) [14]. The main clinical targets of turmeric are the digestive organs: in the intestine, for treatment of diseases such as familial adenomatous polyposis (Cruz *et al.* 2006) [5]; in the bowels, for treatment of inflammatory bowel disease (Hanai and Sugimoto 2009) [12]; and in the colon, for treatment of colon cancer (Naganuma *et al.* 2006) [15]. For arthritis, dosages of 8–60 g of fresh turmeric root three times daily have been recommended (Fetrow and Avila 1999) [9].

Curcumin in turmeric have some promising effects have been observed in patients with various pro-inflammatory diseases including cancer, cardiovascular disease, arthritis, uveitis, ulcerative proctitis, Crohn's disease, ulcerative colitis, irritable bowel disease,

tropical pancreatitis, peptic ulcer, gastric ulcer, idiopathic orbital inflammatory pseudotumor, oral lichen planus, gastric inflammation, vitiligo, psoriasis, acute coronary syndrome, atherosclerosis, diabetes. Dose-escalating studies have indicated the safety of curcumin at doses as high as 12 g/day over 3 months (Gupta *et al.* 2013) [11].

Curcumin has antioxidant, anti-inflammatory, antiviral and antifungal actions. Studies have shown that curcumin is not toxic to humans. Curcumin exerts anti-inflammatory activity by inhibition of a number of different molecules that play an important role in inflammation. Turmeric is effective in reducing post-surgical inflammation. Turmeric helps to prevent atherosclerosis by reducing the formation of bloods clumps (Akram *et al.* 2010) [2].

Materials and Methods

The fresh turmeric rhizomes were obtained from local village market, Parbhani. The proposed research was carried out in Department of Food Engineering, College of Food Technology, VNMKV, Parbhani.

Physical properties

The weight (g), diameter (mm), thickness (mm) and percent peel were measured by using Vernier calliper and electronic weighing balance.

Proximate composition

Proximate Analysis

Different chemical properties of samples were analysed for moisture content, ash, fat, protein and total carbohydrate. All the determinations were done in triplicate and the results were expressed as the average value.

Moisture content

Moisture content was determined adopting AOAC (2005) [1] method as following:

$$\% \text{ Moisture content} = \frac{\text{Loss in weight}}{\text{Weight of sample}} \times 100$$

Fat

AOAC (2005) [1] method using Soxhlet apparatus was used to determined crude fat content of the sample. The percent of crude fat was expressed as follows:

$$\% \text{ Crude Fat} = \frac{\text{Weight of dried ether soluble material}}{\text{Weight of sample}} \times 100$$

Protein

Protein content was determined using AOAC (2005) [1] method. Percentage of nitrogen and protein calculated by the following equation:

$$\% \text{ Nitrogen} = \frac{T_S - T_B \times \text{Normality of acid} \times 0.014}{\text{Weight of sample}} \times 100$$

Where, Ts = Titre volume of the sample (ml), TB = Titre volume of Blank (ml), 0.014= M eq. of N_2.

$$\% \text{ Protein} = \text{Nitrogen} \times 6.25$$

Total carbohydrate

Total carbohydrate content of the samples was determined as total carbohydrate by difference, that is by subtracting the measured protein, fat, ash and moisture from 100 phenol sulphuric acid method as given by AOAC (2005) [1]

Curcumin

Curcumin content of fresh turmeric rhizome was determined as per method given by FSSAI (2016) [10].

Ash

Drying the sample at 100^0 C and charned over an electric heater. It was then ashed in muffle furnace at 550^0 C for 5 hrs by AOAC (2005) [1]. It was calculated using the following formula:

$$\% \text{ Ash content} = \frac{AW}{IW} \times 100$$

Where, AW = Weight of Ash and IW= Initial weight of dry matter

Result and Discussion

Physical properties of turmeric rhizome

Different physical properties such as length, width, thickness, weight and peel percent of fresh turmeric rhizome were evaluated and results obtained are presented in Table 1.

Table 1: Physical Parameters of Fresh Turmeric Rhizome (Var. Selam)

Physical Parameters	***Observation***
Colour	Yellowish brown
Length (cm)	9.84
Width (cm)	2.83
Thickness (cm)	2.60
Peel Percent	8.70
Weight (gm)	74.80

*Each value represents the average of three determinations

The physical characteristics of fresh turmeric rhizome of Selam variety observed to be yellowish brown to deep brown in colour. The variation in colour was due to difference in curcumin content of rhizome. The length and breadth of rhizome was recorded 9.84 and 2.83cm respectively. The values shown for thickness of rhizome were 2.60cm. The average weight of rhizome was observed to be 74.80gm. The peel percentage was recorded to be 8.70 per cent. Which revealed that suitability of turmeric rhizome for further processing. Similar results were obtained by (Dhineshkumar and Anandakumar, 2016) [7].

Chemical properties of fresh turmeric rhizome

Data pertaining to various chemical properties like moisture, fat, carbohydrates, protein, ash, curcumin and crude fiber were investigated and results obtained are depicted in Table 2

Table 2: Chemical composition of fresh turmeric rhizomes (*Selam*)

Chemical Parameters	Mean Value*
Moisture (%)	84.25 ± 0.23
Total Fat (%)	1.08 ± 0.13
Total carbohydrates	9.10 ± 0.10
Total Protein (%)	1.20 ±0.07
Ash	0.66 ± 0.01
Crude Fiber	0.72 ± 0.03
Curcumin	5.1 ± 0.17
TSS (^{0}Bx)	7.8 ± 0.13
pH	5.7 ± 0.28
Acidity	0.70 ± 0.01

*Each value represents the average of three determinations

The data in the above table showed that the moisture content 84.25 per cent, carbohydrate 9.10 per cent, protein 1.20 and fat 1.08 per cent respectively. The TSS of fresh turmeric rhizomes was noted 7.8^{0}Bx. The other parameters such as ash, fiber, acidity and pH of turmeric rhizome were recorded like 0.66 per cent, 0.72 per cent, 0.70 per cent and 5.7 respectively. The most important proximate component of fresh turmeric rhizome was its curcumin content with respect to processing and preparation of value added products. The curcumin content of *Selam* variety rhizomes was recorded to be 5.1 per cent. The results obtained are good in accordance with (Mathai, 1976) [13].

Mineral composition of fresh turmeric rhizomes

The results given with respect to various minerals such as Ca, P, K, Na, Mg, Fe and Zn were determined and accordingly results presented in Table 3.

Table 3: Mineral content in fresh turmeric rhizomes

Minerals	Average value (mg/100g)
Calcium	8.2
Phosphorus	0.12
Sodium	0.06
Magnesium	0.19
Potassium	1.70
Iron	2.4
Zinc	22.9

*Each value is an average of three determinations

The table 3 showed that the zinc content of turmeric rhizome was found to be highest (22.9mg) than the rest of other minerals; calcium content 8.2mg/100g and iron 2.4 mg/100g. The study showed that turmeric rhizome was good sources of iron, zinc and calcium. However, differences in their mineral availability for absorption were observed and may be due to its mineral content and/or mineral-mineral interaction (Cook *et al.* 1991) [4] and (Davidsson *et al.* 1994) [6].

Conclusion

Overall it can be concluded that as fresh turmeric rhizomes exhibit good nutritional and mineral composition that may be of great use for the development and value addition in food products. It was observed from the results that fresh turmeric rhizomes had high amount of curcumin content (5.2%). Curcumin, a potent antioxidant is believed to be the most bioactive and soothing portion of the herb turmeric and possess the antioxidant, anti - inflammatory, anti - platelet, cholesterol lowering, antibacterial and antifungal effects.

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