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QUALITATIVE AND BIOCHEMICAL ANALYSIS OF FRESH, DRY RHIZOMES AND PACKED DRY POWDER OF TUMERIC (*CURCUMA LONGA)* FROM NORTH INDIA

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ABSTRACT
India has rich history of using plants for medicinal purposes. *Curcuma longa* is a rhizomatous herbaceous perennial plant of the ginger family, Zingiberaceae. The deep orange-yellow powder known as turmeric is prepared from boiled and dried rhizomes which have found its use in modern pharmaceuticals. In the present study, different phytochemical analysis were performed to detect the presence of carbohydrates, proteins, starch, steroids, tannins, glycosides in fresh rhizomes and dry turmeric rhizomes of the local variety grown in North India and powdered turmeric from 3 branded companies. The total phenolic, flavanoid content and the total antioxidant capacity was also estimated. The extracts (fresh rhizome, dry rhizome, packed powdered turmeric of 3 locally available brands) of *Curcuma longa* revealed the presence of proteins, carbohydrates, starch, tannins and steroids. In fresh rhizomes, the phenolics (0.7416 ±0.56 mg TAE/g) were significantly higher as compared to dry rhizome (0.6095 ±0.15 mg TAE/g) and powdered turmeric (0.4004 ±0.156 mg TAE/g). The flavanoids were highest in fresh rhizome (5.5793 ±0.34 mg AAE/g) followed by dry rhizome (2.234 ±0.10 mg AAE/g), and powdered turmeric (0.5957 ±0.24 mg AAE/g). There were significantly high amount of antioxidants present in fresh rhizome as compared to dry rhizomes and packed turmeric powder.

KEYWORDS: fresh rhizome, dry rhizome, powdered turmeric, antioxidants, phytochemicals, North India.

INTRODUCTION

Turmeric (*Curcuma longa*) is an ancient and sacred spice and medicine of India known as 'Indian Saffron' or the 'Golden Spice of life". In fresh state, the rhizome has an aromatic and spicy fragrance which on drying gives more medicinal aroma. In India, Turmeric is the most commonly used ingredient in curries and other ethnic meals integrating the medicinal properties of herbs with food. India is the world's largest manufacturer of turmeric contributing to 78% of world's total production. In traditional Indian medicine, turmeric is extensively used for the treatment of sprains and swelling, biliary disorders, anorexia, coryza, cough, diabetic wounds, hepatic disorders, rheumatism and sinusitis. Dry turmeric contains 69.43% carbohydrates, 6.3% proteins, 5.1% oils, 3.5% minerals, and other elements. Various bioactive chemical constituents in turmeric especially phenolics and terpenoids, have been identified which include diarylheptanoids and diarylpentanoids, phenylpropenes as well as other phenolics (Tanvir *et al*., 2017).

Curcuminoids (mostly curcumin) and essential oils (primarily monoterpenes) are the major bioactive constituents showing different bioactivities. Calebin-A, vanillic acid, vanillin, quercetin, and other phenolic compounds have also previously been identified from turmeric (Gupta *et al*., 2013). Curcumin has antioxidant, anti-inflammatory, antiviral and antifungal actions (Ammon and Wahl, 1991) and exhibits free radical scavenging /antioxidant property which acts as an inhibitor for cyclooxygenase, 5-lipoxygenase and glutathione S-transferase (Jayaprakashan *et al*., 2006). It possess therapeutic activities and has been used by medical practitioners as an anti-diabetic**,** hypolipidemic anti-inflammatory, anti-diarrhoeal, hepatoprotective, anti-asthmatic and anti-cancerous drug (Chunekar, 2010; Krup *et al*., 2013). Curcumin also possesss anti-cancer activities and anti-proliferative effect in multiple cancers as it act as an inhibitor of the transcription factor NF-B and downstream gene products including c-myc, Bcl-2, COX-2, NOS, Cyclin D1, TNF-a, interleukins and MMP-9. It plays a significant role in biological pathways involved in mutagenesis, oncogene expression, cell cycle regulation, apoptosis, tumorigenesis and metastasis. Curcumin is also a potent drug resistance preventer and exhibits novel ability to prevent the up-regulation of P-glycoprotein and its mRNA.

In India, 80% of turmeric produced is consumed in various forms such as fresh rhizomes, dried rhizomes and most commonly as dry powdered. Arutselvi *et al*. (2012) have done the phytochemical screening of leaves and rhizomes of turmeric varieties from Tamil Nadu. However, very few studies have been done to compare the antioxidant levels in turmeric variety from North India and commercially available packed turmeric powder. The present study aimed at comparing phyochemicals and the antioxidant levels in fresh rhizomes and dry rhizomes of turmeric of the local variety grown in North India and packed powdered turmeric from 3 branded companies available in the supermarket of Chandigarh.

MATERIALS & METHODS

Extraction of soluble protein from rhizomes

Fresh rhizome, dry rhizome powder, powdered turmeric (3 local brands) (10g) was extracted twice with distilled water. The solution was centrifuged at 10,000xg for 30minutes and the clear supernatant was precipitated with 3 volumes of acetone. The precipitate was air dried and then extracted with cold 10% TCA and centrifuged at 10000xg for 15min. The supernatant containing polysaccharides was decanted and the protein residue was collected, washed with acetone until acid free and then air dried. The protein concentration determination was done by the Lowry protein assay method (Lowry *et al*., 1951)

Identification tests

Test for carbohydrate: To 2ml of test solution added two drops of Molish reagent (a solution of α-napthol in 95% ethanol). The solution was poured slowly into a tube containing 2ml f concentrated sulphuric acid so that two layers form. Of the formation of purple product at the interface of two layers showed the presence of carbohydrates.

Test for protein: To 3ml of test sample added 3% of NaOH and few drops of 1% CuSO4. The solution turns from blue to violet (purple) or pink showrd the presence of proteins.

Test for starch: Mixed 3ml of test solution and few drops of dilute iodine solution. Blue color appeared. It disappeared on boiling and reappears on cooling.

Test for steroids: To 2ml of extract add 2ml of chloroform and 2ml of concentrated sulphuric acid. Shake well. Chloroform layer appears red and acid layer shows yellow greenish florescence in the presence of steroids.

Test for glycoside: To the solution of extract added glacial acetic acid. Few drops of 5% ferric chloride and concentrated sulphuric acid was added and observed for a reddish brown coloration at the junction of two layers and the bluish green colour in the upper layer.

Test for tannin: To 0.5 ml of extract solution, 1ml of water and 1-2 drops of ferric chloride solution was added. The blue and green black colour confirmed the presence of tannins.

Total sugar content: The sugar content was estimated at 620nm using glucose as a standard. α-amylase activity was determined using a colorimetrically method with 3, 5-dinitrosalicylic acid (DNS) reagent (Dubois *et al*., 1951).

Estimation of Total Phenolics by modified Folins-Ciocalteau method: The hydroxyl (-OH) group of phenolic compounds reduce the phosphomolybdic acid to molybdenum blue in the presence of an alkaline medium (present in Folin's reagent). The blue coloured complex was then spectrophotometrically measured at wavelength 760nm.

Estimation of Flavonoids by Aluminium Chloride method: Flavonoids present in the extract formed a charge transfer complex with several heavy metals to give a pink colored complex that was spectrophotometrically measured at wavelength 510nm.

Estimation of Antioxidant activity by FRAP assay: The antioxidants present in the sample reduce Fe^{3+} to Fe^{2+}. This ion conjugated with the ferricyanide ion to form a Prussian blue coloured product, which was spectrophotometrically measured at wavelength 700nm.

Statistical analysis: Statistical analysis was based on one-way analysis of variance (ANOVA) and was considered statistically significant when $p \leq 0.05$.

RESULTS & DISCUSSION

In the present study, there was significant amount of carbohydrates, proteins, tannins, flavanoids in fresh turmeric, dry rhizome and powdered turmeric (Table 1). Islam *et al*. (2002) have reported that dry turmeric (*Curcuma longa*) contains 69.43% carbohydrates, 6.3% proteins, 5.1% oils, 3.5% minerals, and other elements. There was significant high protein content in turmeric in the order fresh turmeric (2.2686 mg/ml)>dry rhizome (2.0065 mg/ml)>powdered turmeric (0.9942 mg/ml) as reported earlier by Das *et al*. (2014). Various proteins isolated from turmeric are water soluble peptide turmerin, Turmeric Antioxidant Protein (TAP), antifungal protein which are powerful antioxidants inhibiting lipid peroxidation and scavenge free radicals (Petnual *et al*., 2010). Smitha *et al.* (2009) have reported the 34 kDa antioxidant protein b-turmerin which exhibits potential antioxidant and free radical scavenging activities making it an efficient antioxidant, DNA protectant and antimutagen agent. Tumerin also have antidiabetic properties due to the ability to inhibit enzymes linked to type 2 diabetes and its antioxidant capacity (Singh *et al*., 2010a).

TABLE 1-Phytochemical screening of turmeric (Curcuma longa Linn.) samples

Estimations	Fresh rhizome	Dry rhizome	Powdered Turmeric (3 locally Available brands
Carbohydrates	+	+	+
Proteins	+	+	+
Tannin	+	+	+
Steroids	+	+	+
Glycoside	-	-	-
Starch	+	+	+

The presence of flavonoids in the all the three forms (fresh, dry, powdered) turmeric confirms that turmeric contains natural flavonoids which contribute to its antioxidant activity, free radical-scavenging capacity, coronary heart disease preventive activities, and anticancer activities (Tanvir *et al*., 2017). The flavonoids were highest in fresh rhizome (5.5793 ±0.34 mg AAE/g) followed by dry rhizome (2.234 ±0.10 mg AAE/g), and powdered turmeric (0.5957 ±0.24 mg AAE/g) (Table 2). Tilak *et al*. (2004) reported a TFC of turmeric from India ranging from 3.58 to 7.86 mg/g of turmeric. The flavanoid levels were significantly higher in fresh ($p \leq 0.05$) and dry

rhizome ($p \leq 0.05$) of turmeric as compared to powdered turmeric. There was significant amount of tannins in fresh, dry, powdered turmeric as found in turmeric from Bangladesh (Tanvir *et al*., 2017). Tannin exerts antimicrobial activities by iron deprivation, hydrogen bonding or specific interactions with vital proteins such as enzymes in microbial cells (Scalbert, 1991). The phenolics present in fresh turmeric were in significantly higher amount (0.7416 ±0.56 mg TAE/g) ($p \leq 0.05$) as compared to dry rhizome (0.6095 ±0.15 mg TAE/g) and powdered turmeric (0.4004 0.156 mg TAE/g) (Table 2). These phenolics contribute to the functional quality, color, and flavor of turmeric and also act as singlet oxygen quenchers and free radical scavengers (Tanvir *et al*., 2015). The phenolic compounds including curcumin and curcuminoids contribute to its antioxidant activity (Zaeoung *et al*., 2005). Curcuminoids hinder the biosynthesis of leukotriene antineoplastic, antiangiogenic, anti-apoptotic, cytotoxic, through lipoxygenase pathway and it also decreases the antithrombotic, immune modulatory, wound healing and anti- formation of prostaglandin. The higher antioxidant activity in fresh rhizomes reported in our study as compared to dry one could be due to presence of essential oil (ar-Turmerone and alpha-turmerone) and oleoresin present in fresh rhizomes as compared to dry ones (Singh *et al*., 2010b). The presence of significantly low antioxidant level in powdered turmeric could be attributed to the reduction of curcuminoid content by 20–50 % after drying (Suresh *et al*., 2007). Tiwari and Vankar (2008) have also reported loss of antioxidant properties during the dry spice preparation which signifies that drying reduces beneficial pharmacological activities of tumeric. Buescher and Yang (2000) have reported that decrease in antioxidant activity and phenolics could be due to vaporization or thermal degradation through the heating process damage to Curcumin and its relative compounds. The significant differences in antioxidant levels in fresh rhizomes and dry rhizomes could also be attributed to different chemical composition. The major components were alpha-turmerone (53.4%), beta-turmerone (18.1%) and aromatic-turmerone (6.2%) in fresh rhizome and aromatic-turmerone (9.6%), alpha-santalene (7.8%) and alpha-turmerone (6.5%) in dry rhizome. The significantly less amount of alpha-turmerone and beta-turmerone in dry rhizome could contribute to its low antioxidant activity.

The present study confirmed that the turmeric showed great antioxidant activity and can be used as beneficial nutraceutical spice to be used commercially in teas, milk shakes, snacks, and ready-to-drink smoothies.

TABLE 2: Table depicting total phenolics content and total flavonoid content present in fresh turmeric, dry turmeric rhizome and dry powdered turmeric.

	Fresh rhizome	Dry rhizome	Powdered Turmeric (3 locally available brands
Total Phenolics (mgTAE/g)	0.7416±0.56	0.6095±0.1	0.4004±0.156 mg
Total flavonoid (mg AAE/g)	5.5793±0.34	2.234 ±0.10	0.5957 ±0.24

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REFRENCES

Ammon, H.P., Wahl, M.A. (1991) Pharmacology of *Curcuma longa*. *Planta Med*. 57: 1-7.

Buescher, R., Yang, L. (2000) Turmeric. In: Lauro GL, Fancis FJ (eds) Natural food colorants. Science and technology. Marcel Dekker, New York, 205–226.

Arutselvi, R., Balasaravanan, T., Ponmurugan, P., Muthu Suranji, N, Suresh P. (2012) Phytochemical Screening and comparative study of antimicrobial activity of leaves and rhizomes of Turmeric varieties. *Asian Journal of Plant Science and Research* 2(2):212-219.

Chunekar, K.C. (2010) Editor Bhavpraakash Nighantu of Bhava Misra. Chaukhambha Bharti Academy, Varanasi: 110.

Das, R., Ashish, S., Asaduz, Z., Muhammed, M. (2014) Amino acids composition and pepsin digestibility of protein isolated from turmeric (*Curcuma longa l.*) produced in bangladesh. *World Journal of Pharmaceutical Research* 3(10): 1634-16416

Dubois, M., Gilles, K., Hamilton, J.K., Rebers, P.A. and Smith, F. (1951) A colorimetric method for the determination of sugars. *Nature* 168: 167.4-41.

Gupta, S.C., Sung, B., Kim, J.H., Prasad, S., Li, S., Aggarwal, B.B. (2013) Multitargeting by turmeric, the golden spice: From kitchen to clinic. *Mol. Nutr. Food Res*. 57: 1510-1528.

Islam, F., Karim, M., Shahjahan, M., Hoque, M., Alam, R and Hossain, M.A. (2002) Study on the Effect of plant spacing on the production of turmeric at farmers field. *Asian Journal of Plant Sciences*. 1(6): 616-617.

Jayaprakasha, G.K., Rao, L.J., Sakariah, K.K. (2006) Antioxidant activities of Curcumin, demethoxycurcumin and bisdemythoxy curcumin. *Food Chem*. 98: 720-724.

Krup, V., Prakash, L.H., Harini, A. (2013) Pharmacological Activities of Turmeric (*Curcuma longa linn*): A Review. *J. Homeop. Ayurv. Med.* 2:133.

Lowry, O.H., Rosebrough, N.J., Farr, A.L., Randall, R.J. (1951) Protein measurement with the Folin phenol reagent. J. Biol. Chem. 193:265.

Petnual, P., Sangvanich, P., Karnchanatat, A.A. (2010) Lectin from the rhizomes of turmeric (*Curcuma longa L.*) and its antifungal, antibacterial, and α-glucosidase inhibitory activities. *Fd. Sci. Biotechnol*., **19**: 907-916.

Scalbert A. (1991) Antimicrobial properties of tannins. *Phytochemistry*, 30: 3875–3883.

Singh, G,, Arora, S., Kumar, S. (2010a) Effect of mechanical drying air conditions on quality of turmeric powder. J Food Sci Tech. 47(3):347–350.

Singh, G., Kapoor, I.P., Singh, P., de Heluani, C.S., Catalan, C.A. (2010b) Comparative study of chemical composition and antioxidant activity of fresh and dry rhizomes of turmeric (Curcuma longa Linn.). *Food. Chem. Toxicol*. 48: 1026–1031.

Smitha, S., Dhananjaya, B.L., Dinesha, R. and Srinivas, L. (2009) Purification and characterisation of a ∼34 kDa antioxidant protein (β-turmerin) from turmeric (*Curcuma longa*) waste grits. *Biochimie*. 91: 1156–1162.

Suresh, P., Manjunatha, Srinivasa. K. (2007) Effect of heat processing of spices on the concentrations of their bioactive principles: Turmeric (*Curcuma longa*), red pepper (*Capsicum annum*) and black pepper (*Piper nigrum*). Journal of Food Composition and Analysis, 20(3-4): 346–345.

Tanvir, E. M., Afroz, R., Karim, N., Mottalib, Md. A., Hossain, Md. I., Islam, Md. A., Gan, S. H., Khalil, Md. I. (2015) Antioxidant and Antibacterial Activities of Methanolic Extract of BAU Kul (*Ziziphus mauritiana*), an Improved Variety of Fruit from Bangladesh. *Journal of Food Biochemistry* 39: 139–147.

Tanvir, E.M., Hossen, Md. S, Hossain, Md. F. Afroz, R., Gan, S.H., Khalil, Md. I., Karim, N. (2017) Antioxidant properties of popular turmeric (*Curcuma longa*) varieties from Bangladesh. *Journal of Food Quality*

Tilak J.C., Banerjee, M., Mohan, H., Devasagayam, T.P.A. (2004) Antioxidant availability of turmeric in relation to its medicinal and culinary uses. *Phytotherapy Research* 18(10): 798–804.

Tiwari, V., Vankar, P.S. (2008) Effectiveness of Antioxidant Properties of Fresh and Dry Rhizomes of Curcuma longa (Long and Short Varieties) with Dry Turmeric Spice. International Journal of Food Engineering - *Int J Food Eng*. 4.

Zaeoung, S., Anuchit, P., Niwat, K. (2005) Cytotoxic and free radical scavenging activities of Zingiberaceous rhizomes. Songklanakarin. *Journal of Science, Technology*, 27: 799–812.