



## Effect of boiling and roasting on the antioxidants concentrations in extracts of fresh ginger (*Zingiber officinale*) and turmeric (*Curcuma longa*)

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### ABSTRACT

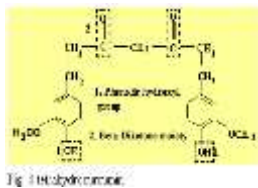
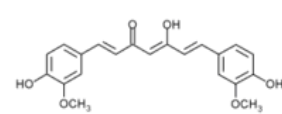
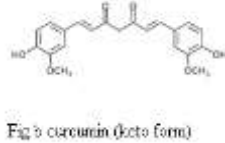
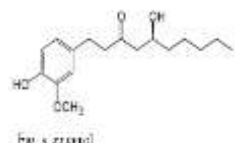
Spices show potential health benefits, as they possess antioxidant activity. Ginger and turmeric are major spices used in Indian cooking. Effects of cooking processes on the levels of antioxidants in ginger and turmeric extracts were studied. Water and acetone extracts of raw, boiled and roasted ginger and turmeric were analyzed using FRAP assay. In the case of ginger, antioxidant activity was found to be lower in extracts prepared after boiling and higher after roasting. The antioxidant activities in turmeric extracts prepared after boiling as well as roasting were higher.

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### Introduction

Ginger (*Zingiber officinale*) and turmeric (*Curcuma longa*) are very integral part of Indian cooking both in vegetarian and nonvegetarian cooking. These spices are common food adjuncts that impart colour, flavour and aroma. The active ingredient in ginger is gingerol (Fig. a) and in turmeric is curcumin (Fig. b and c). Both these compounds prevent oxidation of fats and oils (1). Tetrahydrocurcuminoid (Fig. d) is derived from curcumin. It is an antioxidant and scavenges the free radicals like tertiary butoxyl radical and peroxy radical efficiently (2). As these spices are added as flavoring agents to food preparations as crushed paste or dry powder and the food is cooked at high temperature, the present work was done to evaluate effect of cooking like boiling and roasting on the antioxidant level of these two spices by Ferric Reducing Antioxidant Power assay (FRAP). We analyzed the water and acetone extracts of raw, boiled and roasted ginger and turmeric using FRAP assay which shows the antioxidant activity of given sample in terms of  $\text{Fe}^{2+}$  equivalents.

Structure:



### Materials and methods:

Rhizomes of ginger were obtained from the local market and the mature and young rhizomes of turmeric were taken from departmental garden. 2, 4, 6-tripyridal-1, 3, 5-triazine (TPTZ) was purchased from Sigma-Aldrich. All other chemicals were of laboratory grade.

### Extraction of Antioxidants:

Fresh rhizomes of ginger and turmeric were collected. After washing and cutting, equal amount of each were homogenized under nitrogen in a high-speed blender. A precisely weighed amount of the homogenized sample (~1 gm) was extracted with 4 ml of water under agitation for 15 minutes at room temperature, centrifuged at 1000Xg for 10 minutes then the supernatant was collected. The extraction was repeated with 2 ml of water, and two supernatant were combined.

The pulp residue was reextracted by the addition of 4 ml of acetone under agitation for 15 minutes at room temperature; centrifuged at 1000Xg for 10 minutes and the supernatants were combined. In the same way, extracts of boiled and roasted ginger and turmeric should prepared. All extracts were adequately diluted in the appropriate solvents and immediately analyzed in duplicate for their antioxidant capacity.

### FRAP assay:

Ferric Reducing Antioxidant Power was assessed according to Benzie and Strain (3) using spectrophotometer. This method is based on reduction of ferric TPTZ complex to ferrous form at low pH. This reduction was monitored by measuring the absorption change at 593 nm. Briefly, 3 ml of working FRAP reagent prepared daily was mixed with 100 $\mu\text{l}$  of diluted sample of fresh, boiled, and roasted extract of ginger and turmeric. FRAP working solution was prepared by mixing 25 ml acetate buffer (300 mmol, pH 3.6), 2.5 ml TPTZ (10 mmol/l in 40 mmol HCl) and 2.5 ml  $\text{FeCl}_3 \cdot 6\text{H}_2\text{O}$  (20 mmol/l) just before use. The absorbance at 593 nm was recorded after 30 minutes incubation at 37°C. The FRAP values were obtained by comparing the absorption change in the test mixture with those obtained from increased concentration of ferrous and is expressed as mmol of  $\text{Fe}^{2+}$  equivalent / gm dry weight. Aqueous solution of known  $\text{Fe}^{2+}$  concentration was used for calibration (in range of 100 $\mu\text{M}$  – 1000 $\mu\text{M/L}$ ) (4). Values in terms of mmol of  $\text{Fe}^{2+}$  of all the samples are given in table1.

**Results and Discussion:**

Ginger and turmeric are very commonly used dietary spices in Indian cooking both in vegetarian and non-vegetarian food preparations. Both of them are cooked at higher temperature. The main objective of this study is to evaluate antioxidant potential of raw ginger or turmeric extract and to detect the changes in their antioxidant level during process of cooking like boiling and roasting.

Sample	Raw nmol of Fe <sup>2+</sup> /gm dry weight			Boiled nmol of Fe <sup>2+</sup> /gm dry weight			Roasted nmol of Fe <sup>2+</sup> /gm dry weight		
	Water Extract	Acetone Extract	Total	Water Extract	Acetone Extract	Total	Water Extract	Acetone Extract	Total
Ginger (1 Tender)	88% ± 0.02	0.0279 ± 0.01	0.0329	0.0229 ± 0.06	0.006 ± 0.01	0.029	0.015 ± 0.04	0.006 ± 0.01	0.021
Ginger (2)	91% ± 0.00	0.0812 ± 0.01	0.119	0.0299 ± 0.04	0.017 ± 0.03	0.0479	0.0812 ± 0.00	0.043 ± 0.1	0.124
Ginger (3)	91% ± 0.01	0.0759 ± 0.04	0.1	0.0519 ± 0.02	0.0153 ± 0.00	0.0672	0.078 ± 0.01	0.0462 ± 0.02	0.125
Turmeric (1 Mature)	88% ± 0.01	0.04 ± 0.05	0.126	0.129 ± 0.05	0.06 ± 0.03	0.189	0.057 ± 0.02	0.0675 ± 0.08	0.125
Turmeric (2 Tender)	87% ± 0.00	0.033 ± 0.00	0.0638	0.04 ± 0.1	0.0439 ± 0.00	0.085	0.039 ± 0.05	0.049 ± 0.00	0.088
Turmeric (3 Tender)	86% ± 0.03	0.0307 ± 0.06	0.0542	0.0393 ± 0.1	0.0324 ± 0.05	0.0718	0.0239 ± 0.00	0.0324 ± 0.05	0.057

Table 1. Antioxidant levels (in terms of mmol of Fe<sup>2+</sup>/gm dry weight) of fresh, boiled and roasted extracts (water and acetone) of three samples of ginger and turmeric.

We evaluated antioxidant level of raw, boiled and roasted ginger and turmeric extracts. The values obtained are shown in table 1. Water and acetone extracts of ginger and turmeric analyzed separately. The results show that, in case of water extracts of raw ginger, boiling results into reduction while roasting has no significant effect on the antioxidant levels (Fig. 1).

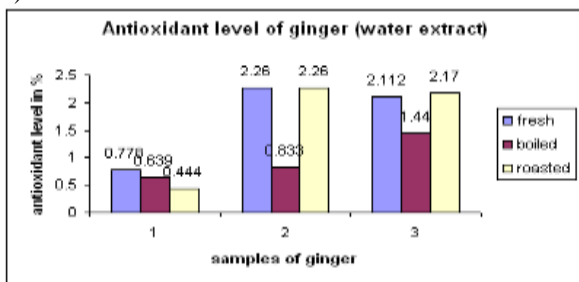


Fig. 1 first, second and third group of bars show and compare antioxidant levels in water extracts of ginger sample 1, 2 and 3.

In case of acetone extracts, the antioxidant level of raw ginger is reduced on boiling and increased on roasting (Fig. 2).

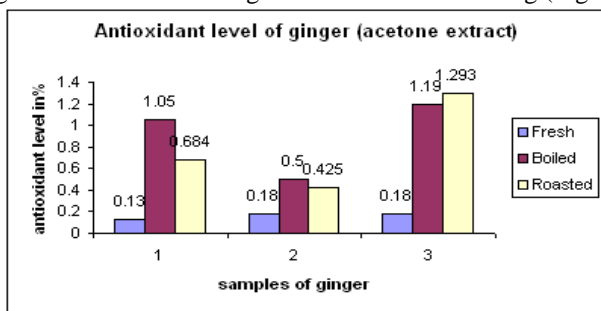


Fig. 2 first, second and third group of bars show and compare antioxidant levels in acetone extracts of fresh, boiled and roasted ginger sample 1, 2 and 3.

In water extracts of turmeric the antioxidant level of raw turmeric get significantly increased on boiling and slightly increased on roasting (Fig. 4).

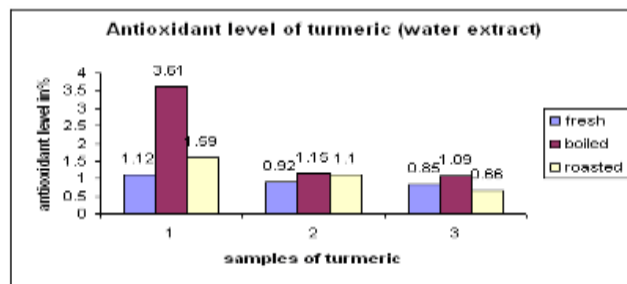


Fig. 4 first, second and third group of bars show and compare antioxidant levels in water extracts of turmeric sample 1, 2 and 3.

In acetone extracts the antioxidant level increases on boiling and roasting (Fig. 5).

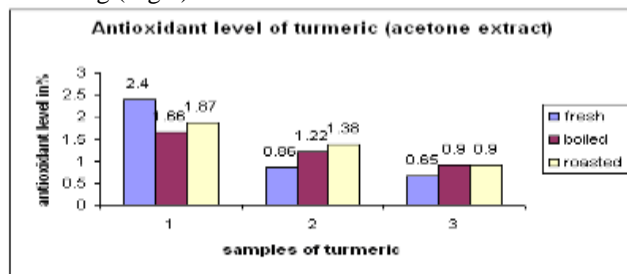


Fig. 5 first, second and third group of bars show and compare antioxidant levels in acetone extracts of fresh, boiled and roasted ginger sample 1, 2 and 3.

Finally the above results indicate that, cooking process like boiling show reduction in the total antioxidant level of raw ginger whereas increases on roasting (Fig. 3).

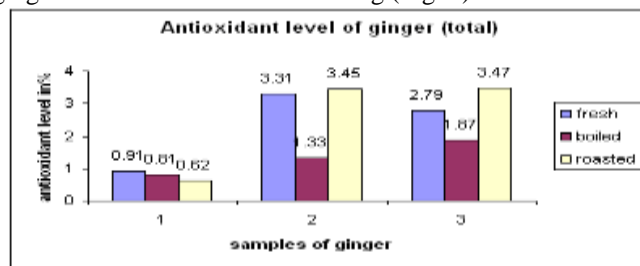


Fig. 3 first, second and third group of bars show and compare the total antioxidant levels of fresh, boiled and roasted extracts of ginger sample 1, 2 and 3.

In case of turmeric, boiling and roasting significantly increase its total antioxidant activity (Fig. 6).

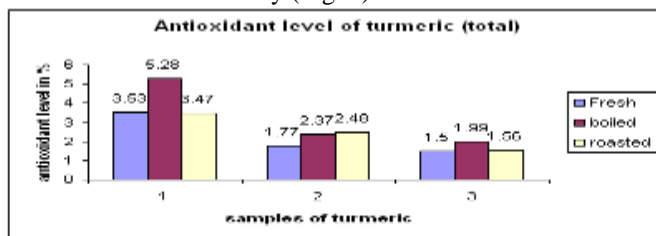


Fig. 6 first, second and third group of bars show and compare the total antioxidant activity of fresh, boiled and roasted extracts of turmeric sample 1, 2 and 3.

Often it is difficult to detect which factors affect the concentration of antioxidants in ginger and turmeric while cooking, this study helps to decide which form of ginger and turmeric is beneficial to eat in order to achieve more antioxidants. The conclusion of this study is that roasted ginger and boiled turmeric are better to eat as they have fullest antioxidant level.

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