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## Curcuminoid profiling of Indian turmeric

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### ABSTRACT

Curcumin, an orange yellow pigment of turmeric (*Curcuma longa* L.) consists of three curcuminoids namely curcumin (curcumin I), demethoxy curcumin (curcumin II) and bis demethoxy curcumin (curcumin III). The curcuminoid profile of three export grade Indian turmeric and three popular varieties was estimated using HPLC. HPLC was performed on an amino column using chloroform and ethanol. Highest levels of curcumin I and curcumin III were recorded in the popular variety 'Prathibha' (3.34 and 1.30%, respectively) and least level was recorded in the traded variety 'Wynadan' turmeric (1.31 and 0.19%).

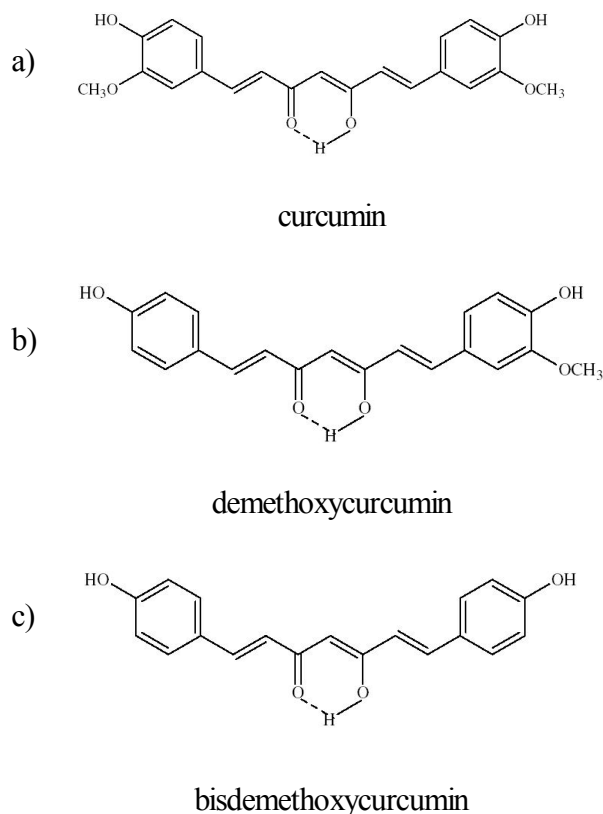
**Key words:** Curcumin, curcuminoid profiling, HPLC, Indian turmeric, traded turmeric.

### INTRODUCTION

Turmeric (*Curcuma longa* L.), Family Zingiberaceae, is an important spice and a cure for a number of ailments [15]. It is considered to have originated in the Indo Malayan region and has a widespread occurrence from Asia to Africa and Australia [2]. At present turmeric is grown in India, China, Pakistan, Bangladesh, Vietnam, Thailand, Myanmar, Japan, Philippines, Korea, Sri Lanka, Nepal, South Pacific Islands, East and West Africa, Malagasy, Caribbean Islands and Central America [10].

Three major curcuminoids (Figures 1a, b and c) give yellow colour of turmeric. Curcuminoids are regarded as having antioxidative, anti-diabetic and anti-inflammatory effects and have been used as a chemopreventive agent for cancers of colon, breast,

prostate, oesophagus, lung and oral; inhibition of atherosclerosis and inhibition of viral and bacterial growth [8, 12, 13, 16]. The proportion of different curcuminoids in turmeric is known to have a bearing on the therapeutic effect of turmeric [19].



**Figure 1. Structure of curcuminoids**

Several methods have been reported for the estimation of curcuminoids viz., fluorimetric, HPLC, HPTLC, GC, LC/MS and spectrophotometric methods [1-7, 9, 17, 18, 20]. However, HPLC methods are found to be most suitable for the determination of individual curcuminoids [7].

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India being the major exporter of turmeric globally, the present work is undertaken to study the curcuminoid profile of three important traded turmeric varieties of India along with three popular commercial varieties grown in the country.

## MATERIALS AND METHODS

### *Turmeric rhizomes*

Export grade rhizomes of traded turmeric ('Alleppey Finger Turmeric' (AFT), 'Rajapuri' and 'Wynadan') were procured through Spices Board (Government of India), Cochin, Kerala and the dried rhizomes of the popular genuine varieties ('Prabha', 'Prathibha', and 'Alleppey Supreme') were obtained from the Experimental Farm of the Indian Institute of Spices Research, Calicut, Kerala, India.

### *Preparation of standard solution*

Standard solutions were prepared by dissolving standard curcumin (95% purity, Sigma Aldrich, USA) in methanol in different concentrations.

### *Sample preparation*

Accurately weighed 100 mg of powdered turmeric samples were added 30 ml of ethyl alcohol (95%) and refluxed for 2½ hours. The extract was cooled and filtered quantitatively into a 100 ml volumetric flask and made up with alcohol. One ml of sample from 100 ml stock solution was diluted to 10 ml (1:10) using methanol and filtered just before loading the samples in HPLC.

### *Chromatographic conditions*

Curcuminoids were separated from the total curcumin using a Shimadzu LC-10 AT VP high performance liquid chromatographic system and detected using a fluorescence detector RF-10 A-XL. The stationary phase was reverse phase Nucleosil NH<sub>2</sub>, particle size 5 µm, pre packed in a 250 x 4.6 mm I.D column. A rheodyne injector with a 20 µl loop was used for injecting the sample. The analysis was carried out at ambient temperature. The method of detection was fluorimetric, the excitation and emission wavelengths were 420 nm and 470 nm, respectively [18].

### *Validation of the HPLC method*

The HPLC method for isocratic elution and separation of curcuminoids was validated by altering the mobile phase, changing the proportions of the mobile phase (chloroform: ethanol) used and by changing the flow rate. Chloroform: ethanol in varying proportions (50:50 – 85:15) was used with a flow rate of 0.75 - 2 ml min<sup>-1</sup>. The minimum detection limit was also recorded by injecting different concentrations of the standard.

## RESULTS AND DISCUSSION

The percentage compositions of curcuminoids in the traded turmeric and in the genuine commercial varieties are given in Table 1 and the chromatogram is represented in Figures 2 a, b, c, d, e and f.

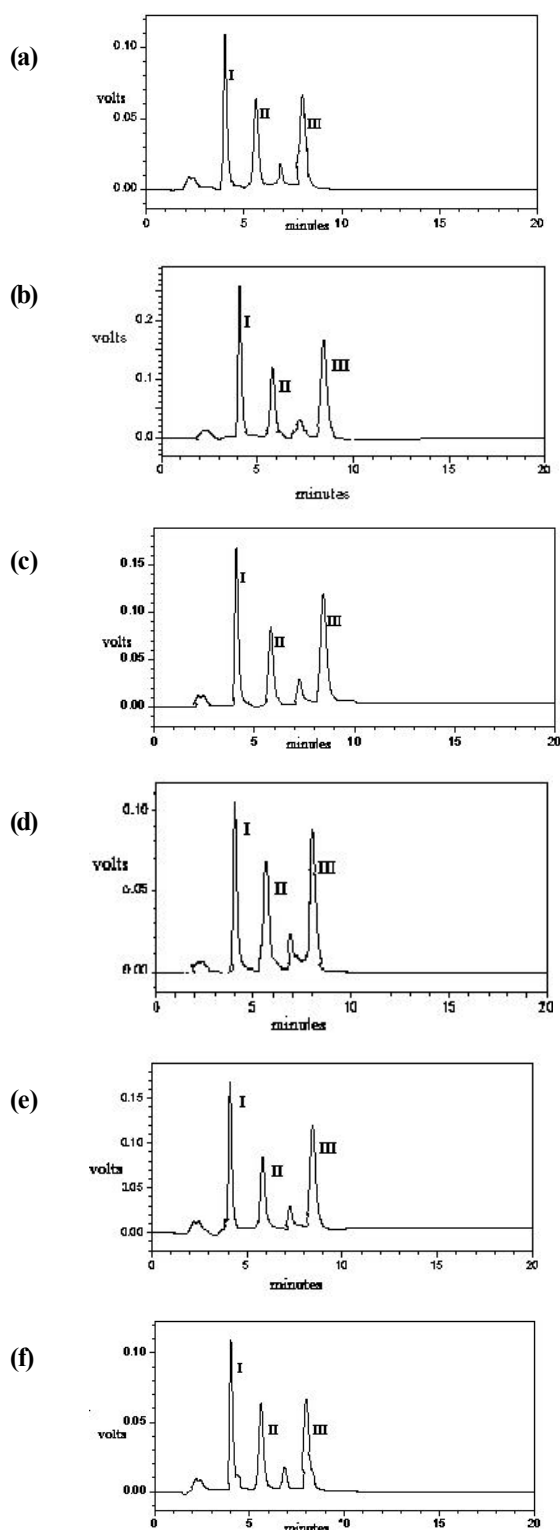
**Table 1. Percentage of curcumin I, curcumin II, curcumin III and total curcuminoids in traded turmeric and genuine varieties**

S. No.	Turmeric variety	Curcumin I (%)	Curcumin II (%)	Curcumin III (%)	Total curcuminoids* (%)
1	'Prabha'	1.64	1.27	0.76	3.67
2	'Prathibha'	3.34	0.82	1.30	5.46
3	'Alleppey Supreme'	1.65	1.35	1.15	4.15
4	'Alleppey finger turmeric'	2.76	1.19	0.87	4.82
5	'Rajapuri'	1.36	0.47	0.65	2.48
6	'Wynadan'	1.31	0.90	0.19	2.40

\*Sum of three major curcuminoids

Highest levels of curcumin I and curcumin III were recorded in the genuine commercial variety 'Prathibha' (3.34, and 1.30%, respectively) and curcumin II in the variety, 'Alleppey Supreme' (1.35%). The least levels of curcumin I and curcumin III were recorded in the traded 'Wynadan' turmeric (1.31 and 0.19%) and curcumin II in 'Rajapuri'. Total curcuminoids were also maximum in 'Prathibha' followed by 'Alleppey Finger Turmeric' (AFT).

Indian turmeric is regarded as the best in the world market because of its high curcumin content. Currently,



**Figure 2.** Chromatogram of curcuminoids in turmeric rhizomes. (a) ‘Prabha’ (b) ‘Prathibha’, (c) ‘Alleppy Supreme’ (d) ‘Alleppey finger turmeric’ (e) ‘Rajapuri’ and (f) ‘Wynadan’. Peaks indicating curcumin I, II and III eluted at 4, 6 and 8 minutes intervals. X axis representing time and Y axis representing the volt.

in the international market, Alleppey Finger Turmeric (AFT) with over 6.0% curcumin is preferred for curcumin extraction [15] and no reports are available on the curcuminoid profile of this commodity. However, AFT being a traded variety need not be a distinct genetical entity. But, ‘Prathibha’ being a distinct genotype bred for high yield and good quality it would be prudent to incorporate this variety in the traded turmeric being exported from India.

Not many reports are there on the curcuminoid profile of traded Indian turmeric barring the reports by Jayaprakasa *et al.* (2002) [7] and Paramasivam *et al.* (2009) [9]. Jayaprakasa *et al.* (2002) analysed the curcuminoid profile of the traded varieties like ‘Salem’, ‘Erode’ and ‘Balasore’ using HPLC [2] whereas Paramasivam *et al.* (2009) described an HPTLC method for the determination of curcuminoids of *Curcuma longa* germplasm [9]. The result suggested that two Indian varieties of *Curcuma longa*, viz., ‘Nimbarg’ and ‘Kalimpong’ have higher amounts of curcuminoids, 6.18 and 5.37%, respectively.

Wichitnithad *et al.* (2009) reported an isocratic HPLC method for the determination of curcuminoids in commercial turmeric extracts [21]. The limits of quantification were 2.73 µg/mL for curcumin, 2.53 µg/mL for demethoxycurcumin and 0.23 µg/mL for bisdemethoxycurcumin.

In future, turmeric may be priced for its curcuminoids content as the proportion of curcuminoids has a bearing on the biological activity of turmeric as a medicine [19]. Individual turmeric varieties/cultivars rich in one or other of these curcuminoids may fetch a premium price. ‘Prathibha’ a variety evolved through open pollinated progeny selection and released for commercial cultivation in India in the year 1996 [14] appears to be thus better than the famed ‘Alleppey Finger Turmeric’.

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