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Research Article

COMPARATIVE STUDIES ON CURCUMIN AND CURCUMINOIDS CONTENT IN 26 CULTIVARS OF *CURCUMA LONGA*

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ABSTRACT
In India Turmeric rhizome and its powder have been utilized for medicinal purposes since ancient time. Turmeric contains several medicinal properties due to the presence of curcumin and curcuminoid. In the present investigation the curcumin and curcuminoid contents have been estimated in 26 cultivars of *Curcuma longa* by HPTLC using methanolic extract. It was found that contents of curcumin and curcuminoid varies from cultivar to cultivar under different type of treatment. Fresh infrared dried rhizome of Sonia Rajinder sample has more curcumin (3.21%) and fresh sunlight dried Sonia Rajinder sample has more curcuminoids (9.28%).

Keywords: *Cultivars, Curcuma Longa, Curcumin, Curcuminoid*

INTRODUCTION
Ayurveda and Charak samhita (transcripts of Indian Traditional Medicine System) wrote nearly 3500 years ago, have mention of turmeric as an important medicinal and spice plant. Turmeric rhizomes are commonly sold as powdered spice and also used as domestic remedy for several diseases such as wounds, bruises, skin eruptions and leech bites etc (Khanna, 1999). Presently quantification and qualification of active ingredients of plants has become easier with the help of advance technologies like HPTLC, HPLC, GC, MS, Capillary electrophoresis etc. Therefore scientists and researchers can now present reproducible and internationally standardized phytochemical preparations. Some important curcuminoids found in turmeric are curcumin, curcumene, curdione, curlone, bisdesmethoxy curcumin, camphene, a-phellandrene, 1, 8-cineole, a-zingiberene etc (Dewick, 2001). Several studies has shown that curcumin, a major curcuminoid, acts as a potent anti-inflammatory (Ghatak and Basu, 1972), anti-diabetic (Babu and Srinivasan, 1997), anti oxidant (Krishnan and Menon, 2001), anti-bacterial (Bhavani and Srinivasa, 1979) and anticarcinogenic agent (Aggarwal *et al.,* 2003; Punithavathi *et al.,* 2000; Baldwin, 2001). Rhizomes (bulbs and fingers) consist of major amount of total curcuminoids found in turmeric plant. A wide range of turmeric varieties and phytoclones are available in Indian markets, for example Alleyppe, Kedram, Suvarna, Roma, Sonia Rajinder, Vallabh Priya, CL-68, and NDH-18 etc. The present investigation has been carried out to study the effect of post harvest treatment on phytochemical contents of various *Curcuma longa* varieties.

MATERIALS AND METHODS
Sample Collection
Some 26 named varieties of turmeric were collected and 21 varieties were cultivated in open fields and were planted in earthen pots of 18 inches diameter. Varieties were collected and procured from government garden, Saharanpur and Sardar Vallabh Bhai Patel Agricultural University, Meerut (India). For turmeric cultivation field was prepared by ploughing, digging and turning over the soil to a depth of 30cm. Mother rhizomes were planted and good quantities of organic manure were also applied. All studied varieties are recorded in table no. 1.

Post Harvest Treatment of Turmeric Rhizomes
- Boiling and curing – turmeric rhizomes were boiled in water till they become tender and emits specific aroma. Some rhizomes were boiled in water containing 1% $NaHCO_3$.
- Drying process – during commercial production of phytochemicals some advance techniques may be beneficial, so we tried infrared and microwave oven drying.

Infrared, microwave and sunlight drying techniques were used for fresh, water boiled and alkali treated water boiled rhizomes of all 26 varieties under study. Rhizomes were grinded with methanol prior to extraction.

Preparation of Extract of Authentic Samples and Phytochemical Analysis

50 mg rhizome samples of each variety were extracted with methanol (15x3) on water bath. Extracts were filtered through filter paper. Filtrates were collected and volume was made up to 50ml with methanol. These samples were applied for High Performance Thin Layered Chromatography (HPTLC) analysis. A camag's HPTLC system with Linomat IVR, TLC scanner, twin trough chamber and Cats V4.05 evaluation software was used for sample analysis.

Formulae Used

$$\% \text{ of Curcumin} = \frac{\text{Conc. of std. (microgram) x Area of test sample}}{\text{Area of std. x Conc. of test sample}} \times 100$$

$$\% \text{ of total Curcuminoids} = \frac{\text{Conc. of total curcuminoid in std. sample x Area of test sample}}{\text{Area of std. x Conc. of test sample}} \times 100$$

From these formulae we have calculated curcumin and curcuminoids percentage (w/w) in a given sample.

RESULTS AND DISCUSSION

Observations and Results

It is evident that fresh IR (infrared) dried Sonia Rajinder sample has more curcumin (3.21%) and fresh sunlight dried Sonia Rajinder sample has more curcuminoids (9.28%). Fresh IR dried samples of Alleyppe, Kedaram and Vallabh Priya have 3.01%, 2.97% & 2.21% curcumin respectively and fresh sundried samples of these varieties have 7.98%, 7.48% and 5.11% curcuminoids respectively. The results of phytochemical analysis 26 varieties are summarized in table no. 2. Samples of boiled rhizomes dried under infrared, microwave and sunlight yield fewer amount of curcumin and other curcuminoids. Similarly rhizome samples boiled with alkali and dried under three different conditions yield lesser amount of curcumin and curcuminoids Table-2 & Figure 1 & 2.

Discussion

Although fresh infrared and sunlight dried rhizomes yield more curcumin and curcuminoids respectively but these rhizomes show loss in weight and shape.

Table 1

S. no.	Turmeric variety	S. no.	Turmeric variety
1	CL-8	14	CEL-324
2	CL-67	15	NH-5
3	CL-68	16	NDH-18
4	CL-69	17	ALLEYPPE
5	CL-70	18	VALLABH PRIYA
6	CL-72	19	KEDARAM
7	CL-73	20	MANGO GINGER
8	CL-315	21	PRABHA
9	CL-320	22	ROMA
10	CL-321	23	ROMA PAHARI
11	CLS-16	24	SONIA RAJINDER
12	CEL-6	25	SUVARNA
13	CEL-318	26	VAYAMA

Table 2: Effect of post harvest treatment on phytochemical contents of various curcuma longa varieties

S. No	Name	FRESH								WATER BOILED						$NaHCO_3$ TREATED			
		FRESH		SUN DRY		MW		IR		SUN DRY		MW		IR		MW		IR	
		CM	CMD	CM	CMD	CM	CMD	CM	CMD	CM	CMD	CM	CMD	CM	CMD	CM	CMD	CM	CMD
1.	CL-8	0.09	0.34	0.27	2.80	0.78	2.90	0.79	3.01	0.37	1.71	0.41	1.15	0.61	1.51	0.30	1.34	0.58	1.46
2.	CL-67	0.06	0.26	0.44	4.41	1.20	2.56	1.60	3.84	0.28	1.51	0.28	0.88	0.42	1.01	0.32	1.55	0.40	0.95
3.	CL-68	0.16	0.63	0.26	3.69	0.52	1.97	0.67	2.89	0.14	1.10	0.98	2.32	0.58	1.83	0.50	1.10	0.42	1.71
4.	CL-69	0.10	0.30	0.40	1.87	0.98	1.02	1.41	1.08	0.31	1.58	0.94	2.79	1.18	3.01	1.04	2.67	1.25	3.11
5.	CL-70	0.13	0.47	0.51	5.19	1.56	4.70	1.29	3.55	0.62	2.68	0.72	1.65	1.31	3.50	0.68	1.95	1.15	3.21
6.	CL-72	0.18	0.64	0.20	1.66	0.40	2.00	0.65	2.01	0.80	3.98	1.02	2.28	1.50	2.98	0.77	2.53	0.64	1.69
7.	CL-73	0.11	0.41	0.55	2.69	1.01	1.60	1.56	1.88	0.37	1.93	1.63	4.56	2.02	5.13	1.79	4.52	1.47	1.67
8.	CL-315	0.06	0.23	0.42	1.85	1.18	1.01	1.58	1.20	0.63	1.76	1.09	1.01	1.52	1.91	0.92	0.99	1.02	1.18
9.	CL-320	0.06	0.27	0.57	4.46	1.20	3.90	1.54	4.01	0.30	1.89	0.91	1.66	1.02	1.99	0.52	1.42	0.99	1.52
10.	CL-321	0.05	0.25	0.09	2.75	0.25	0.98	0.30	1.95	0.29	1.99	0.62	0.85	0.87	1.20	0.25	0.72	0.28	1.03
11.	CLS-16	0.05	0.21	0.58	4.46	1.01	3.78	1.40	4.20	0.35	1.89	0.05	1.31	0.74	2.27	0.15	0.86	1.10	2.02
12.	CEL-6	0.13	0.46	0.30	1.97	0.47	1.21	1.07	1.04	0.46	2.31	0.52	1.82	0.64	2.23	0.90	2.84	0.52	1.01
13.	CEL-318	0.30	1.29	0.33	2.03	0.99	1.66	1.01	2.00	0.31	1.89	0.23	0.61	0.54	1.66	0.97	2.13	0.40	1.50
14.	CEL-324	0.13	0.51	0.26	1.65	0.61	0.88	0.78	1.10	0.16	1.15	0.84	2.01	0.99	3.21	0.43	1.37	0.67	1.01
15.	NH-5	0.16	0.52	1.34	5.39	1.98	3.34	2.05	4.30	1.20	4.92	1.13	2.89	1.31	3.75	1.05	3.25	1.19	3.13

16.	NDH-18	0.13	0.54	0.21	1.59	0.32	0.86	0.39	1.20	0.23	1.65	0.19	0.84	0.25	0.97	0.35	1.36	0.18	0.81
17.	ALLEY PPE	0.63	2.19	1.78	7.98	2.20	4.07	3.01	6.95	1.95	7.30	1.87	3.85	2.59	5.01	0.97	1.07	1.09	1.92
18.	VALLABH PRIYA	0.67	2.26	1.47	5.11	1.98	3.97	2.21	4.70	1.61	6.35	1.02	2.67	1.97	3.54	0.87	1.92	0.94	1.03
19.	KEDARAM	0.65	2.12	1.74	7.48	2.00	4.01	2.97	6.57	1.88	6.27	1.55	3.61	1.91	5.75	1.14	1.12	1.28	1.91
20.	MANGO GINGER	Traces	Traces	Traces	Traces	Traces	Traces	Traces	Traces	Traces	Traces	Traces	Traces	Traces	Traces	Traces	Traces	Traces	Traces
21.	PRABHA	0.66	2.12	1.68	6.89	1.87	3.98	2.24	4.55	1.92	6.39	1.01	2.19	2.01	4.01	0.98	1.08	1.10	1.55
22.	ROMA	0.09	0.37	0.50	4.64	1.30	3.89	1.52	4.25	0.21	1.33	0.29	0.86	0.28	1.01	0.27	1.01	0.27	0.86
23.	ROMA PAHARI	0.07	0.30	0.49	4.61	0.42	1.36	1.66	4.28	0.46	1.95	0.87	2.18	0.79	2.47	0.13	0.83	0.77	2.10
24.	SONIA RAJENDRA	0.12	0.47	1.93	9.28	2.01	6.37	3.21	7.08	1.22	4.51	0.63	1.62	0.68	2.17	0.91	2.62	0.62	2.01
25.	SUVARNA	0.08	0.29	0.76	3.33	1.09	2.60	1.50	2.81	0.55	2.78	1.72	3.59	2.01	4.01	1.26	3.64	1.49	2.11
26.	VAYAMA	0.15	0.68	0.44	3.55	0.99	2.18	1.08	3.20	0.47	1.75	1.10	3.06	1.28	3.76	0.70	2.49	0.98	3.01

CM=Curcumin, CMD=Curcuminoids. IR=Infra red, MW= Microwave dried

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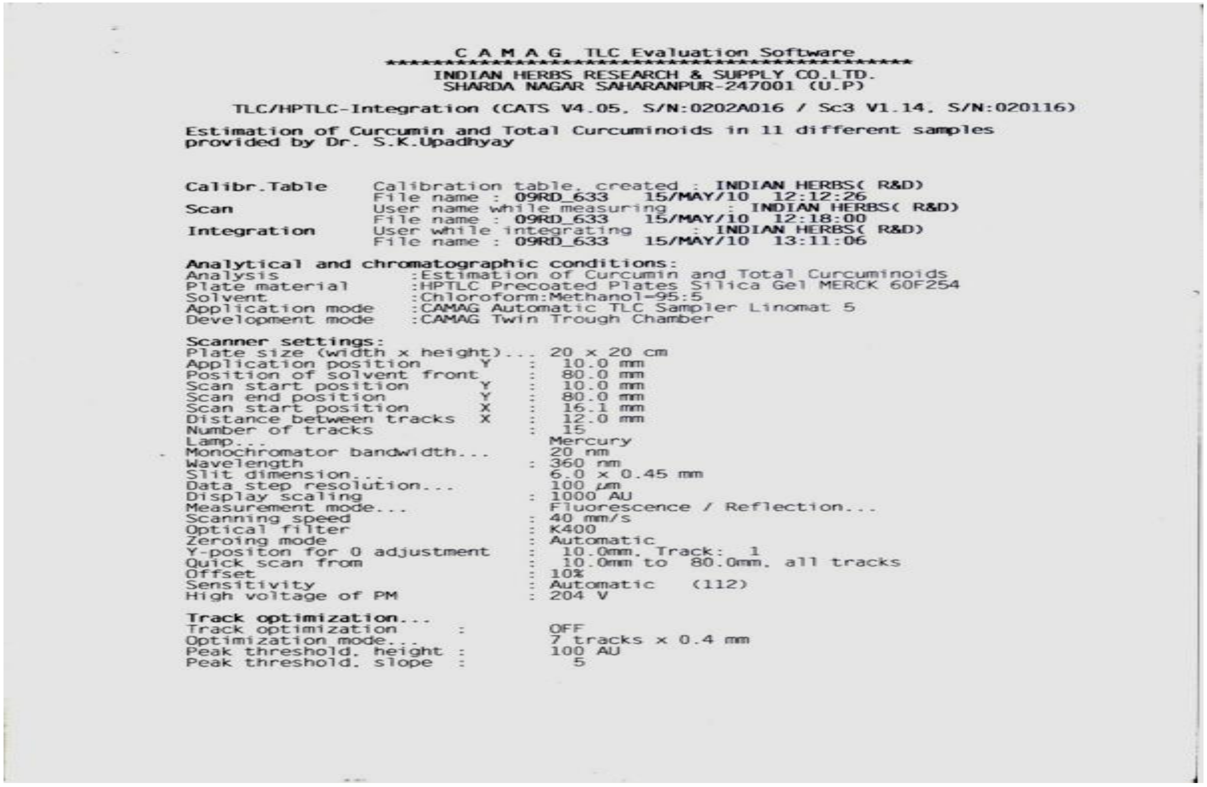

C A M A G TLC Evaluation Software
INDIAN HERBS RESEARCH & SUPPLY CO.LTD.
SHARDA NAGAR SAHARANPUR-247001 (U.P)

TLC/HPTLC-Integration (CATS V4.05, S/N:0202A016 / Sc3 V1.14, S/N:020116)

Estimation of Curcumin and Total Curcuminoids in 11 different samples provided by Dr. S.K.Upadhyay

Calibr.Table — Calibration table, created : INDIAN HERBS(R&D)
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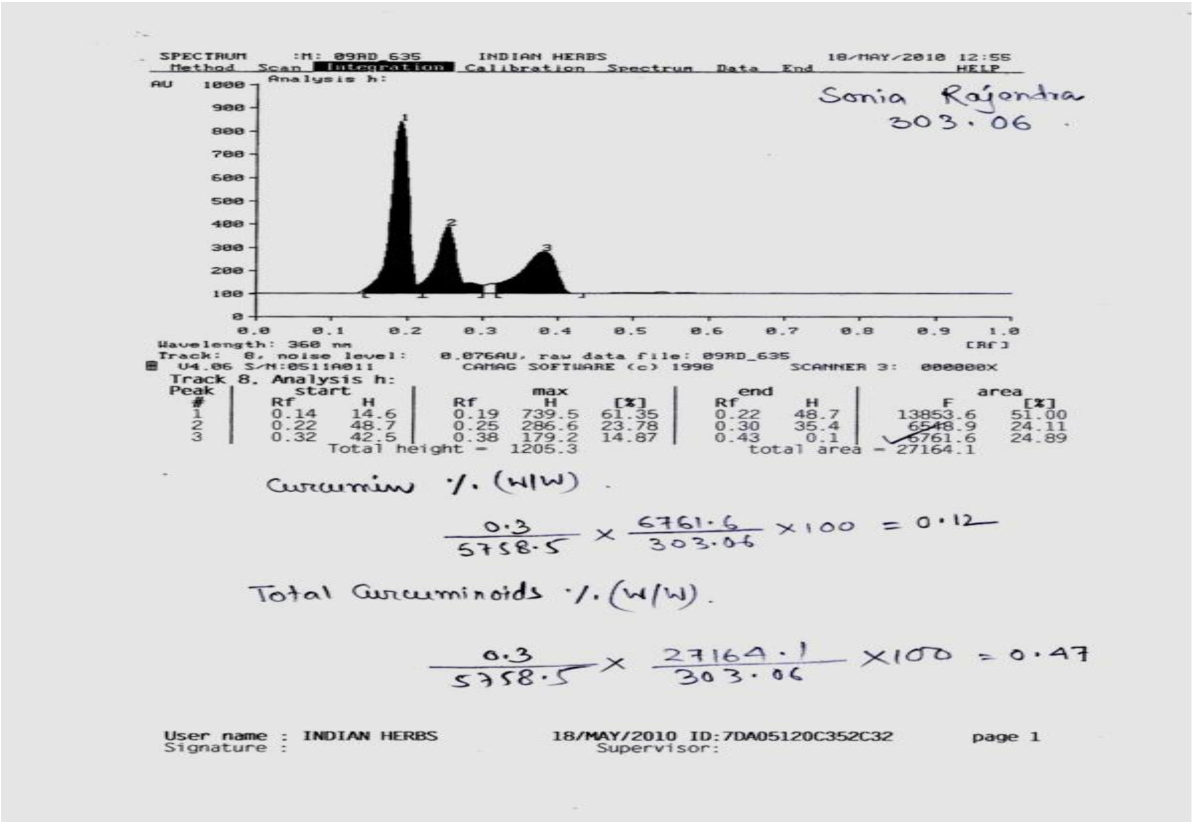
Scan — User name while measuring : INDIAN HERBS(R&D)
File name : 09RD_633 15/MAY/10 12:18:00
Integration — User while integrating : INDIAN HERBS(R&D)
File name : 09RD_633 15/MAY/10 13:11:06

Analytical and chromatographic conditions:
Analysis :Estimation of Curcumin and Total Curcuminoids
Plate material :HPTLC Precoated Plates Silica Gel MERCK 60F254
Solvent :Chloroform:Methanol=95:5
Application mode :CAMAG Automatic TLC Sampler Linomat 5
Development mode :CAMAG Twin Trough Chamber

Scanner settings:
Plate size (width x height)... 20 x 20 cm
Application position Y : 10.0 mm
Position of solvent front : 80.0 mm
Scan start position Y : 10.0 mm
Scan end position Y : 80.0 mm
Scan start position X : 16.1 mm
Distance between tracks X : 12.0 mm
Number of tracks : 15
Lamp... Mercury
Monochromator bandwidth... 20 nm
Wavelength : 360 nm
Slit dimension... 6.0 x 0.45 mm
Data step resolution... 100 µm
Display scaling : 1000 AU
Measurement mode... Fluorescence / Reflection...
Scanning speed : 40 mm/s
Optical filter : K400
Zeroing mode : Automatic
Y-positon for 0 adjustment : 10.0mm, Track: 1
Quick scan from : 10.0mm to 80.0mm, all tracks
Offset : 10%
Sensitivity : Automatic (112)
High voltage of PM : 204 V

Track optimization...
Track optimization : OFF
Optimization mode... 7 tracks x 0.4 mm
Peak threshold, height : 100 AU
Peak threshold, slope : 5

Figure 1: Analytical and chromatographic conditions set of HPTLC



Peak #	start Rf	start H	max Rf	max H	max [%]	end Rf	end H	area F	area [%]
1	0.14	14.6	0.19	739.5	61.35	0.22	48.7	13853.6	51.00
2	0.22	48.7	0.25	286.6	23.78	0.30	35.4	6548.9	24.11
3	0.32	42.5	0.38	179.2	14.87	0.43	0.1	6761.6	24.89

Total height = 1205.3 total area = 27164.1

Curcumin %. (W/W).

$$\frac{0.3}{5758.5} \times \frac{6761.6}{303.06} \times 100 = 0.12$$

Total Curcuminoids %. (W/W).

$$\frac{0.3}{5758.5} \times \frac{27164.1}{303.06} \times 100 = 0.47$$

User name : INDIAN HERBS 18/MAY/2010 ID:7DA05120C352C32 page 1
Signature : Supervisor:

Figure 2: HPTLC analysis of fresh sample of Sonia Rajinder rhizome

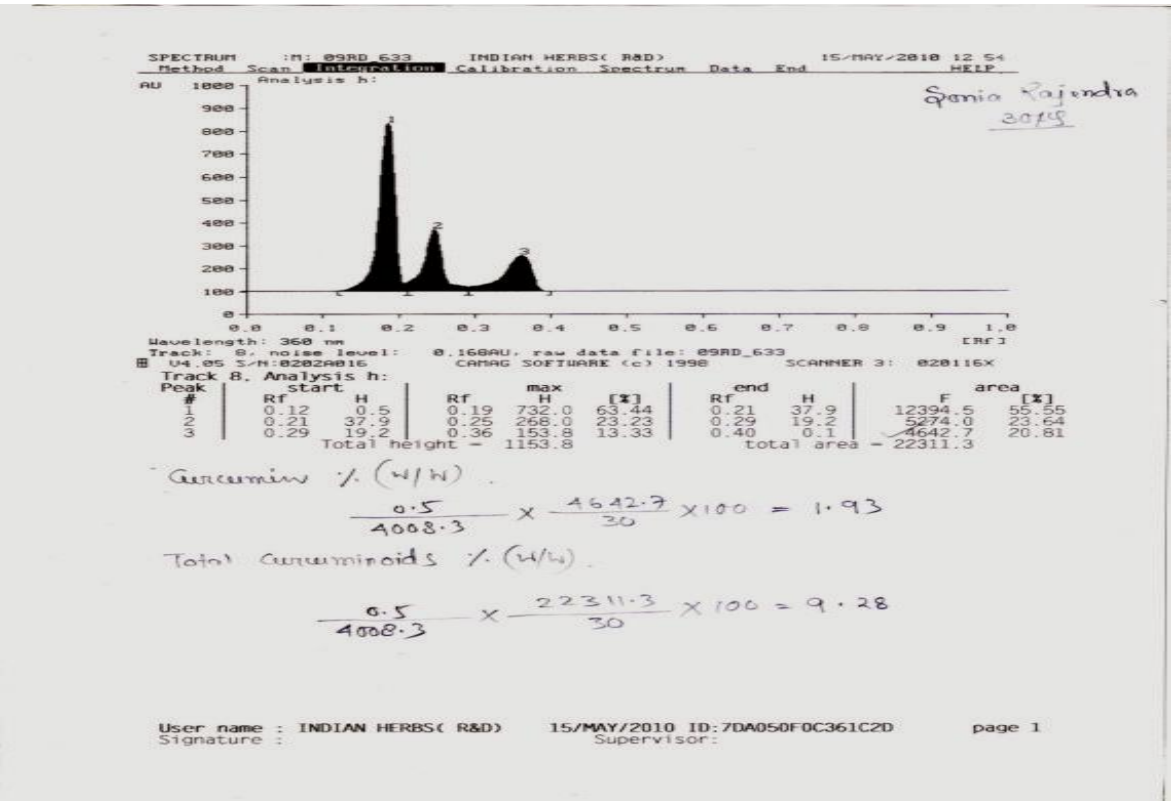


Figure 3: HPTLC analysis of sun dried sample of fresh Sonia Rajinder rhizome

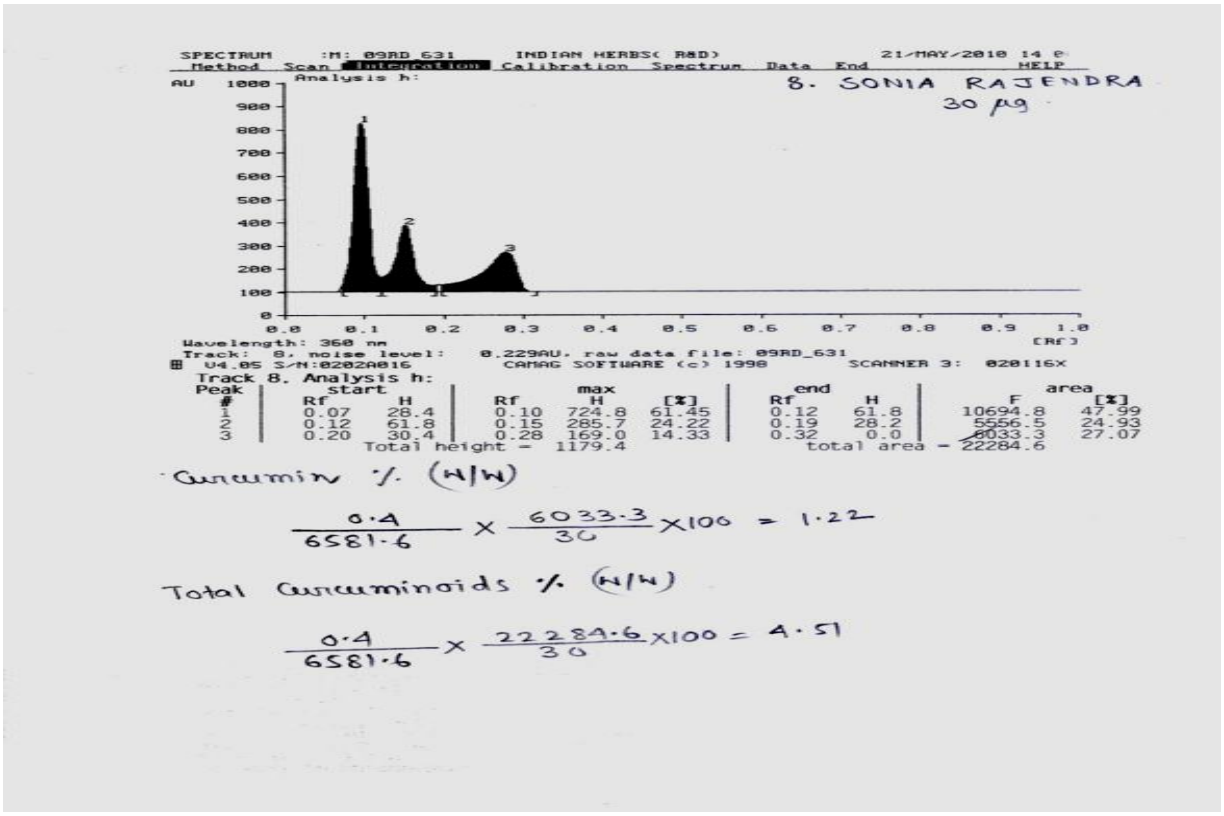


Figure 4: HPTLC analysis of sun dried sample of water boiled Sonia Rajinder rhizome

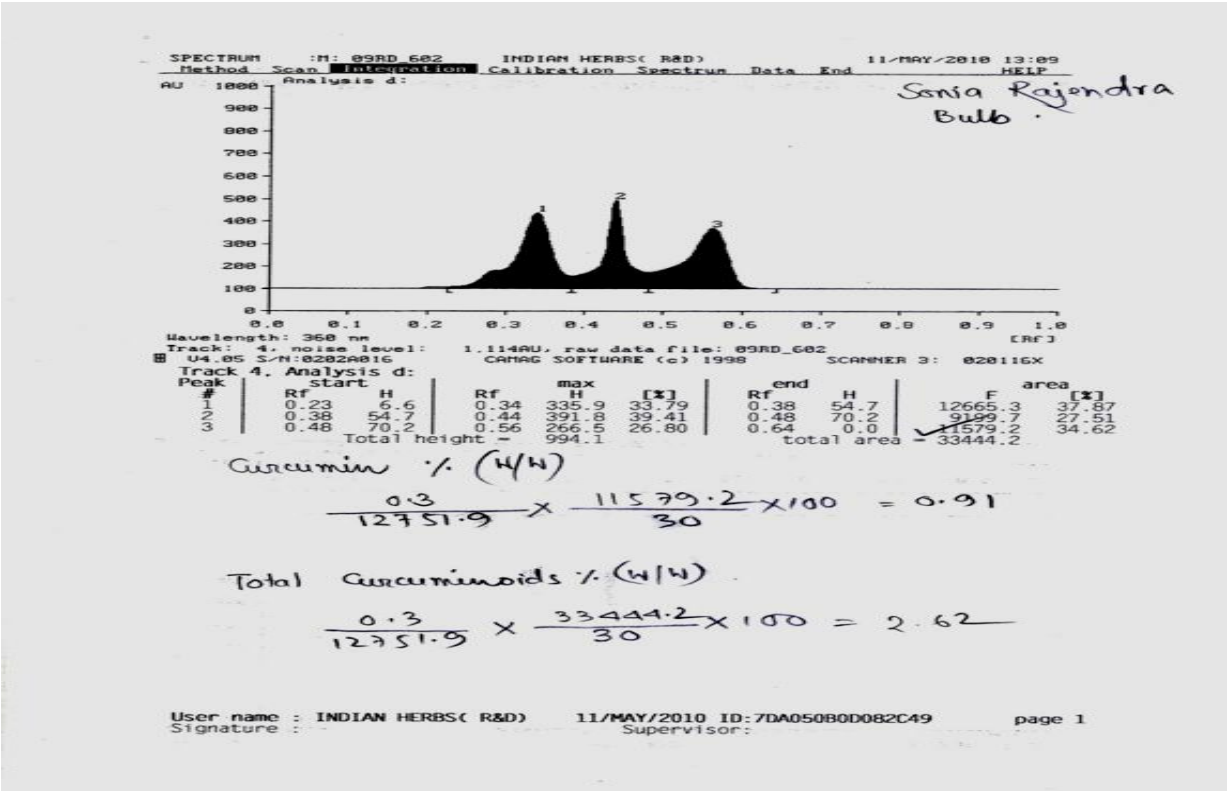


Figure 5: HPTLC analysis of microwave dried sample of nahco3 treated Sonia Rajinder rhizome

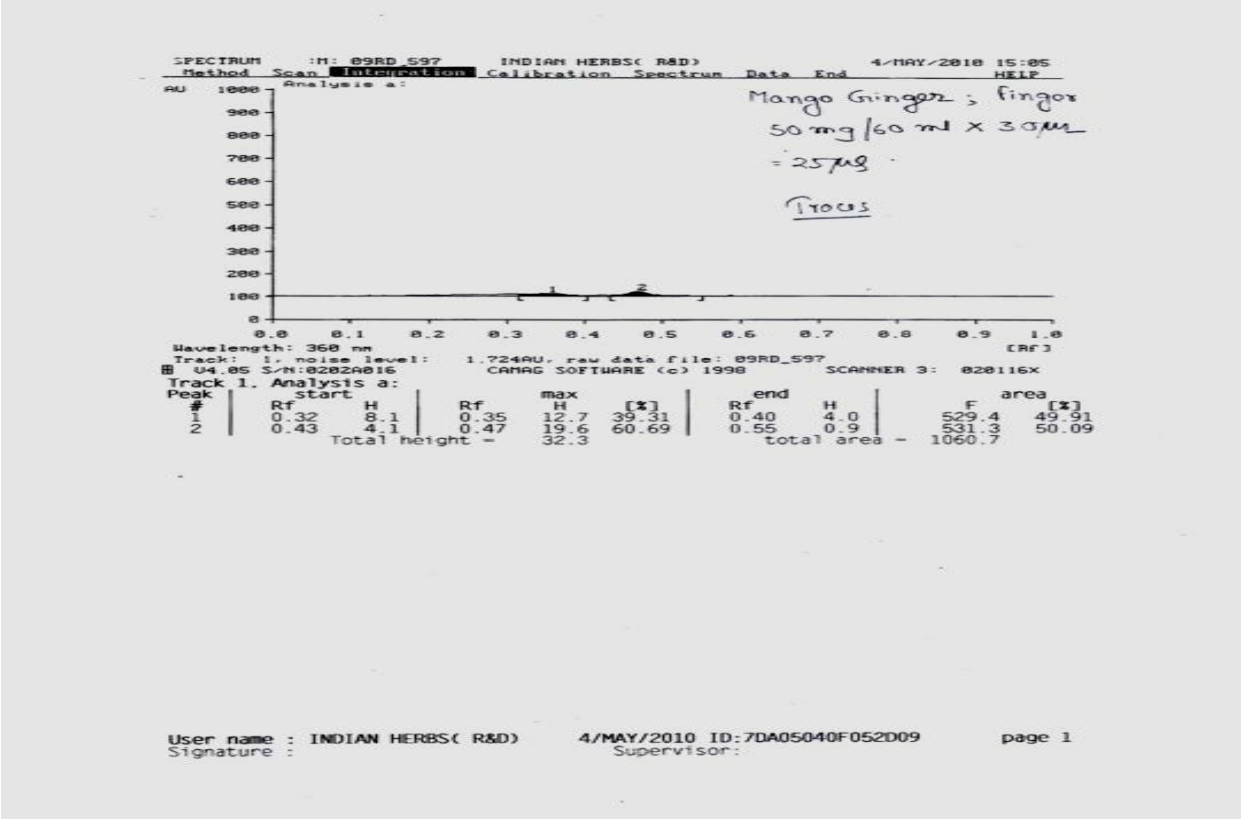


Figure 6: HPTLC analysis of nahco$_3$ treated Mango Ginger rhizome

It is evident that in fresh sunlight dried rhizomes there is loss in curcumin but other curcuminoids remain stable. The process of boiling rhizomes in water results in loss of curcuminoids and aromatic oils however loss in weight and shape may be significantly reduced due to denaturing of catabolic enzymes. Fresh dried deformed rhizomes may not attract high price therefore farmers may usually boil and then dry the rhizomes to sell in markets. However for use in pharmaceutical industry adequate postharvest treatment of rhizomes may be required. Boiling of rhizomes in alkali added water should also be discouraged as it enhances the colour of turmeric but phytochemicals content reduces considerably. So boiling of rhizomes is an undesirable process and for drying the fresh rhizomes infrared or sunlight drying techniques should be adopted. Microwave drying may highly reduce the curcumin and curcuminoids content. Sonia Rajinder, alleyppe, Kedaram, Prabha and Vallabh Priya are some good varieties of turmeric as these yield more amount of curcumin and curcuminoids when adequate curing and drying techniques were adopted.

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Our great thanks are due to Mr Sudhakar Aggrawal (MD, M/S Indian Herbs Research and Supply Co Ltd, Saharanpur) and his R&D team not only for facilities extended to us so generously but also for help in handling of modern sophisticated analytical instruments like HPLTC & HPLC etc.

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