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Comparative Study on Conventional and Novel Methods for the Extraction of *Curcuma longa*

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ABSTRACT:

Extraction is an important step for separation, identification and use of valuable components from different plants. It is necessary to optimize extraction methodology so as to achieve maximum extraction efficiency. Quality of extract is influenced by several factors such as particle size of plant material, time, solvent choice, solvent/solute ratio and time of extraction. In the present study effect of various parameters studied in order to obtain highest yield of *Curcuma longa* (rhizomes) using conventional and novel methods of extraction. The parameters sets were particle size of #10, #20, #40, time 30min, 60min (maceration), 10min, 20min (ultrasound assisted extraction), 5min, 10min (microwave assisted extraction), choice of solvent was methanol, ethyl acetate and solvent/solute ratio of 10/5 and 20/5. The Result indicates: In maceration, solvent Methanol with particle size of #20 and solvent/solute ratio of 20/5 at 60 min has shown highest % yield of 21.67%. In ultrasound assisted extraction, a highest yield of 21.81% was reported in solvent Ethyl acetate with particle size of #20 and solvent/solute ratio of 20/5 at 20 min. In microwave assisted extraction, a highest yield of 22.38% was reported in solvent Methanol with particle size of #10 and solvent/solute ratio of 20/5 at 3 min.

KEYWORDS: *Curcuma longa*, solvent/solute ratio, ultrasound assisted extraction, microwave assisted extraction, TLC.

INTRODUCTION:

The process in which active constituents are selectively removed from liquid or solid mixture by means of suitable solvent is called extraction.¹ In extraction the wanted components are dissolved in by the use of selecting solvent known as menstruum and dissolved part is called as marc, after extraction the unwanted solvent is removed, extracts are prepared by using suitable solvent.

Steps involved in extraction process:

1. Drying the plant material which can be done by shade drying or drying in oven.
2. Followed by grinding of plant material (leaves, flowers, bark, etc.) using mixture.
3. Selection of solvent.
4. Suitable extraction method.

Factors affecting extraction process²:

The effect of factors varies depending upon the method of extraction used. Various factors may affect the yield of extraction in different manner. The factors may include solvents, particle size, temperature, pH, solvent / solute ratio or yield of extraction.

Plant Profile- *Curcuma longa*:

Description of plant 10:

Turmeric consists of dried, as well as, fresh rhizomes of the plant known as *Curcuma longa* Linn. (*C. domestica*), belonging to family Zingiberaceae. It contains not less than 1.5 per cent of curcumin.⁹

Vernacular names⁹:

Sanskrit: Haridra, Marmarii

English: Turmeric

Hindi: Haldi

Distribution¹⁰:

India, China, Sri Lanka, Indonesia, Jamaica, and Peru

Phytochemical investigation^{10, 11}:

1. **Curcuminoids**- Non-volatile colouring matter
2. **Curcumin**, α diferuloylmethane; desmethoxy dicinnarmoylmethane; bidesmethoxy curcumin

3. **Volatile oil:** 1-cycloisoprenmyrcene, zinziberene, turmerone, α -atlantone, γ -atlantone, phallandrane, sabinene, cineole, borneol, Curcumone
4. **Sugars:** arabinose, fructose and glucose
5. **Bitter substances and Fixed oil and acids:**

Traditional Uses^{12, 13,14}:

1. Anti-inflammatory
2. Antioxidant
3. Analgesic
4. Anti-cancer activity
5. Anti-Alzheimer
6. Anti-Depressant
7. Anti-Fertility

METHODOLOGY:

Selected plants were *Curcuma longa* (rhizomes) collected from Bhatwadi, Sawantwadi in month of December. Collected materials were shade dried for several days at room temperature. After drying they were subjected to grinding using household mixer. The defatting of powder is carried out with help of n-Hexane and powder was stored in tightly sealed polythene pouches and then in plastic bottles to protect it from moisture. Authentication was done. Two different solvents used in extraction process were methanol and Ethyl acetate. All chemicals were analytical grade quality. Ultrasonic bath (citizens) was used for ultrasonic assisted extraction. Microwave unit of Catalyst was used for microwave assisted extraction. UV Chamber was for analysis of TLC.

Parameters analysed:

Effect of various parameters has been studied for better yield of extract in shortest period of time for volatile oil from curcuma longa. The different parameters selected for study include;

1. Particle size:

Different sieves having mesh no. of #10, #20, #40 were selected. Sieves were washed and dried in oven and then were placed in ascending order. Sieving was carried out and powder was separated from individual sieves and placed in well labelled container.³

2. Time:

The time parameter was taken to ensure less time consumption for extraction and also to find out saturation time, the extraction process was performed at room temperature.

For different methods different time period was selected.^{22,26}:

- Simple maceration: 30 mins, 60 mins
- Ultrasonic assisted extraction: 10 mins, 20 mins

- Microwave assisted extraction:5 mins, 10 mins

3. Solvents:

Different solvents were used to choose best solvents for complete extraction and the extraction was carried out at room temperature for given period of time. Solvents used were methanol and ethyl acetate.⁵

4. Solvent/Solute ratio (ml/mg):

Different Solvent/Solute ratio were selected as 10/5 and 20/5. It was kept in constant for traditional as well as novel methods.¹⁶

Extraction:

Maceration⁶:

Powder of drug was individually weighed (5gms) and was added to 250ml of conical flask. Solvent was added to it and it was kept in dark for a suitable period of time. The flask was shaken after every 10 minutes. Then the extract was filtered and the marc was pressed. Then it was dried at room temperature. After completion of drying process, the extract was scrapped off and was stored in pre-weighed glass vials.

Ultrasound assisted extraction⁸:

The Ultrasound assisted extraction was carried out using rhizomes of *Curcuma longa* Linn. and 10ml and 20ml of methanol and ethyl acetate. Extraction was carried out at the same ultrasound frequency of 50 Hz and extraction period of 10 mins and 20 mins. After extraction, the solution was cooled to room temperature for 10 mins and then it was filtered using filter paper. The extract was then dried and scrapped off and then kept in pre-weighed glass vials.

Microwave assisted extraction⁹:

A round bottom flask containing rhizome powder (5 gms) and solvent was placed in a microwave unit. Experiment was carried out using microwave power of 300 W, solid/liquid ratio 5:10 and 5:20, particle size of particle was 10, 20 and 40 and microwave time was 3 and 5 mins. After extraction, the mixture was filtered. The liquid obtained was then evaporated at RT and the effect of MAE on the yield was determined. The extract was then scrapped off and was stored in pre-weighed glass vials.

% yield of extract = $\frac{\text{Weight of empty vials (x)} + \text{Weight of extract (y)}}{\text{Weight of empty vials (x)}}$ x 100

Weight of empty vials (x)

RESULTS AND DISCUSSION:

Method		Solvent	Particle size	Time(sec)	Solvent/solute ratio	%yield (%)
Maceration	Lowest	Ethyl acetate	20	20	20/5	20.04
	Highest	Methanol	20	60	20/5	21.67
UAE	Lowest	Methanol	40	20	10/5	20.17
	Highest	Ethyl acetate	20	20	20/5	21.81
MAE	Lowest	Methanol	40	3	20/5	20.43
	Highest	Methanol	10	3	20/5	22.38

THIN LAYER CHROMATOGRAPHY (TLC)^{17,18,19}:

Mobile phase: n-hexane: ethyl acetate (7:3)

- Stationary phase: Precoated silica gel G-plates
- UV chamber wavelength: 254 nm
- Curcuminoids complex found in rhizomes contains:
 1. Curcumin (curcumin I)
 2. Demethoxycurcumin (curcumin II)
 3. Bisdemethoxycurcumin (curcumin III)

Distance travelled by solute front

Retention Factor =-----

Distance travelled by solvent front

Retention factor (R_f) values:

EXTRACTION METHODS	Curcumin I		Curcumin II		Curcumin III	
	STD.	SAMPLE	STD.	SAMPLE	STD.	SAMPLE
Maceration	0.12	0.083	0.58	0.58	0.8	0.8
UAE	0.12	0.12	0.78	0.78	0.88	0.88
MAE	0.08	0.083	0.6	0.6	0.68	0.68

CONCLUSION:

- In maceration, solvent Methanol with particle size of 20 and solvent/solute ratio of 20/5 at 60 min has shown highest % yield of 21.67%.
- In ultrasound assisted extraction, highest yield of 21.81% was reported in solvent Ethyl acetate with particle size of 20 and solvent/solute ratio of 20/5 at 20 min.
- In microwave assisted extraction, a highest yield of 23.38% was reported in solvent methanol with particle size of 10 and solvent /solute ratio of 20/5 at 3 min.

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