Journal of Plantation Crops 16 (Supplement): 103-106

CURCUMIN FROM TURMERIC OLEORESINS

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ABSTRACT

A process for the isolation of volatile oil and curcumin from turmeric powder is described. Curcumin assay extracted by this process is estimated to be >95%. Economic viability of this process indicated that multiple recovery of curcumin and essential oil should be attempted by the enterprenuer.

INTRODUCTION

The main colouring principles in turmeric rhizomes are curcumin and its analogues. Curcumin belonging to dicinnomyl methane class bears an empirical formula $C_{12}H_{20}O_6$, is 1,7 bis (4-hydroxy 3 methoxy phenyl) 1,6 dione 3,5 dione. Its melting point is in the order of 184-186°C. It is insoluble in hexane but readily soluble in alcohol. Curcumin is synthesised by two stage condensation reaction between carbomethoxy feruloyl chloride and ethyl acetoacetate (Mayer, 1943). Besides synthesis many workers (Srinivasan, 1953, Khalique and Amin, 1967; Janaki and Bose, 1967; Sair and Klee, 1967 and Sastri, 1978) resorted to the retrieval of curcumins from its native spices *Curcuma longa* L. Each of these above processes were either uneconomical or contained solvents prohibited for use as food additives. Lead salt precipitation of this pigment (Perkin and Philps, 1943) is also not suitable, due to the stringent conditions laid down by WHO and FAO (Anon., 1961) on the levels of lead in food products.

Due to increased tendency to change over from synthetic colours to natural ones, the utility value of natural colouring principles of turmeric is gaining ground. Curcuminoids besides being safe possess an added advantage of anti-oxidant property, (Hirhara, 1975, Sethi and Agarwal, 1950).

In the present paper a new approach has been attempted towards recovering curcumin from deoiled turmeric oleoresin (>95% assay ratings). The price of this product is adjusted as $68 per Kg by local trade representative (personal communication).

MATERIALS AND METHODS

Turmeric powder preferablly ground to pass through 200 mesh is depleted by its volatile oil by steam distillation. The deoiled spices is air dried and filled in a column and alcohol is percolated. After a contact time of 12 hours, this percolate is desolventized and alcohol free resinous mass is added with equal quantities of hexane and decanted out to remove fats

*CPCRI contribution No. 526.

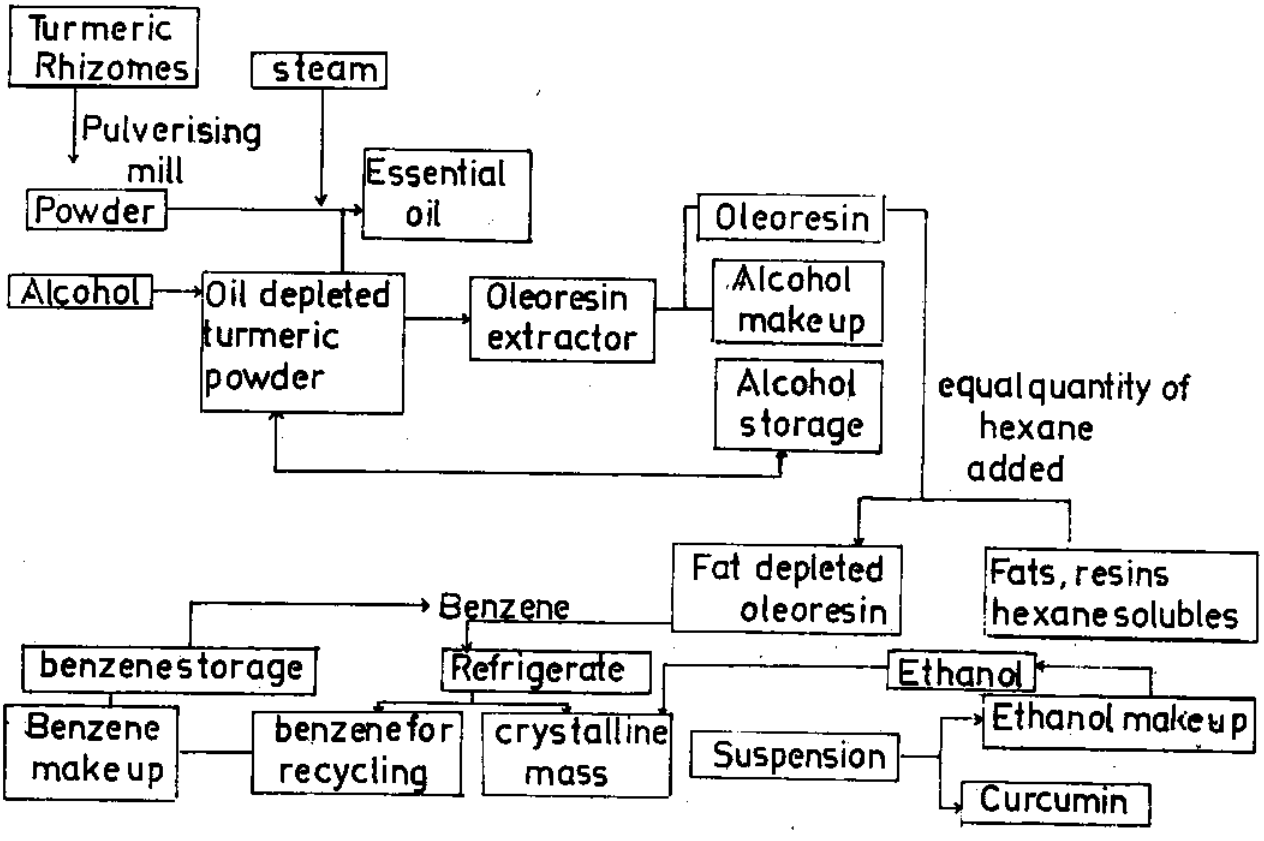

Fig. 1. Process for the isolation of curcumin from Turmeric oleoresin

and other hexane solubles (Fig. 1). The hexane extracted oleoresin is now treated with equal volumes of benzene and thoroughly mixed. The contents are positioned in a refrigerator at 4°C for facilitating crystallization. The crystallization mass is cold centrifuged and purified further by suspending the centrifuged mass in limited quantity of ethanol. The ethanolic suspension is vacuum concentrated by removing ethanol resulting in yellow crystal mass with curcumin assay ratings of 95%. Curcumin is estimated by spectrophotometry as per the method of ASTA (1978). Thin layer chromatography is used to monitor the presence of oxidation products of curcumin. TLC plates (0.25 mm thickness) are developed with a solvent system containing benzene and ethyl acetate (7:3 v/v) and analogues are estimated by spectrophotometry.

RESULTS AND DISCUSSION

Two batches of deoiled turmeric oleoresin having two levels of curcumin content (Table I) have been processed for the isolation of pure curcumin (>95% assay). The unprocessed oleoresin had 36% curcumin. The yield percentage is around 15% with a recovery of the chemical during hexane and benzene extraction. When the curcumin recovery at the intermediate stages is also taken into account, the process appears to be more economical. Attempts have been made to avoid hexane extraction but abundant quantities of resinous matter in the oleoresin warrants the use of a high

Table I. *Curcumin recovery from turmeric oleoresin.*

Batch No.	Turmeric oleoresin	Curcumin content	Curcuminoid concentrate		% Yield	% recovery of chemical
			Quantity	% Curcumin content		
1	80	36	15	96	18.75	52.08
2	500	34	78	95	15.60	45.88

polar solvent like hexane and benzene. Benzene extraction facilitates an easy removal of fatty acids, resin acids and other resinoids.

An important limitation of this extraction process is the loss of appreciable quantities of curcuminoids in benzene and alcoholic extracts. Assay of solvent depleted benzene and alcohol extracts contained 60-70% curcumin content. The loss of active ingredient during this process is negligible if this quantity is also taken into account, vice its commercial value. Thin layer chromatography of different solvent extractives and pure curcumin sample indicated that these extracts gave three distinct yellow coloured spots along with appreciable quantities of base material.

Srinivasan (1953) extracted curcuminoids from *Curcume longa* L. with light petroleum ether followed by boiling benzene extraction. The subsequent chromatographic resolution makes the process too cumbersome for industrial adoption. The process outlined by Janaki and Bose (1967) used a soxhlet extraction for initial extraction. Sastry (1970) suggested throwing the alcohol extract into pure kerosene and later recovering the ethanol by crystallisation. The use of kerosene does not appear to be a suitable

Table II. *Tentative cost benefit estimate for curcumin recovery process.*
Basic treatment of 100 kg of turmeric oleoresin and production of 90 kg volatile oil and 15 kg of curcumin.

Raw material cost	Quantity	Rate Rs.	Cost Rs.
Turmeric rhizomes	15000 kg	1550/ton	23250
Alcohol (industrial grade)	1500 l	9.50/l	14250
Hexane	250 l	7.50/l	1875
Benzene	200 l	8.0/l	1600
		Total	40975
			or 41000
Sale price of the products			
Curcumin concentrate of 95% assay ratings	15 kg	$68/kg	12780.6
Volatile oil	90 kg	360/kg	34280.0
		Total	46,980
			or 47,000

process for the end product is to be used as a food additive.

Economic viability of this process depends upon the multiple recovery of solvents and essential oil components. Tentative cost benefit estimates of this process are presented in Table II. On the basis of the recovery of curcumin and volatile oil the cost benefit implications appear to be attractive. The difference between the costs of raw material and proceeds of the sale is substantial to absorb other overhead expenses like service, labour, maintenance of equipment and return on capital etc. leaving large margin of profit.

Any solvent extractor can easilty adopt the process provided supply of essential raw material i.e. turmeric rhizomes is ensured. An extension of refrigeration plant is necessary for recovering the curcumin with high assay ratings.

ACKNOWLEDGEMENTS

The author is grateful to Dr. M.K. Nair, Joint Director, CPCRI (RS), Calicut for providing the necessary facilties for conducting this study.

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*Original not seen.