Comparative evaluation of various extraction methods of curcuminoids from C*urcuma longa*

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ABSTRACT

Extraction is the very essential step for the preparation of plant formulations. Modern and simple convention methods are available for the analysis of components present in plants and herbs. Sample Preparation from biological components is often tedious and time consuming process. In addition, the complete extraction of pigments often requires several steps, and may use a mixture of several solvents. In this present study, Crude extracts of Curcuminoids were extracted from turmeric by different methods such ashomogenization, single extraction, sequential extraction, soxhlet extraction, maceration and hot water extraction. This study results were evidences that maceration and soxhlet extraction were suitable for the extraction of bioactive compounds from plant material. It was found that, the yield of maceration extraction was approximately two times higher than the other extraction methods. The TLC analysis of acetone extract of Curcuminoids in Chloroform: Methanol solvent system revealed a compound of R_F value 0.36. The absorbance of acetone extracted Curcumin shows maximum absorbance at 420 nm the same condition as the standard Curcumin and was confirmed by chromatographic analysis. The functional group present in the acetone extract were analysed by FT-IR.

Keywords: Curcuminoids, *Curcumalonga*, Homogenization, Single, Sequential, Maceration, Hot water extraction.

INTRODUCTION

Turmeric (*Curcuma longa*) is a medicinal plant used in ayurveda, unani and siddha medicine as home remedy for various diseases. *Curuma longa* botanically related to ginger (zingiberaceae family), is a perennial plant having a short stem with large oblong leaf and bears ovate, pyriform or oblong rhizomes, which are often branched and brownish- yellow in colour (Pierce,1999).Component of turmeric are named Curcuminoids, which include namely curcumin, demethoxycurcumin, and bisdemethoxycurcumin (Chainani-Wu, 2003). Its chemical structure, was determined by Roughley and Whiting (1973). Curcumin, the main yellow bioactive component of turmeric have been shown to have a wide spectrum of biological actions (Chattopadhyay et al, 2004).Turmeric is used as a food additive, preservative and colouring agent in Asian countries (GovindarajanV.S, 1980). It is also considered as auspicious and is a part of religious rituals .In old Hindu medicine, it is extensively used for the treatment of sprains and swelling caused by injury.

In traditional Indian medicine uses turmeric powder for the treatment of biliary disorders, anorexia, coryza, cough, diabeticwounds, hepaticdisorder, rheumatism, sinusitis (Amman,H.P *et al* 1991). It has been found to be a rich source of phenolic compounds, namely Curcuminiods,Curcumin,demethoxycurcumin and bisdemethoxycurcumin (RouhaniSh *et al* 2009).

The colouring principle of turmeric is the main component of this part and is responsible for the anti inflammatory property. Curcumin (diferuloyl methane), the main yellow bioactive component of turmeric has been shown to have a wide spectrum of biological actions (Chottopadhyay *et al* ,2004). Literature reveals that acetone has been frequently used for extraction of Curcumin from *C.longa* because of its greater solubilising capacity for curcumin (A.P.Gupta *et al* 1999).

Clinically Curcumin has already been used to reduce post operative inflammation. Its antitiinflammatory (Higaki.s *et al* 1999), antioxidant (Das and Das 2002; Ruby et al ,1995), anticarcinogenic, antiangiogenic (Dong liu,2008), antidiabetic, antibacterial (Negi *et al*,1999), antifungal (Apisariyakul *et al* ,1995) antiviral, antimicrobial, antiparasitic, antimutagenic, (Srimal1997), antifibrotic, antivenom, antiulcer, (Shishodia *et al*,2005) and antioxidant (E.Kunchandy,M.N.A.Rao (1990) roles may be clinically exploited to control rheumatism, carcinogenesis and oxidative stress-related pathogenesis.

EXPERIMENTAL METHODS

Plant materials: The commercial turmeric roots were washed under running tap water to remove surface pollutants and shadow dried. The dried sample was powdered were stored in dark sealed glass bottles to protect from humidity and light and used for further studies.

Solvent used: Different organic solvents chosen with high polar, medium polar, low polar such as water, acetone, methanol and petroleum ether were used. Suitable solvent for extraction were analysed.

Conventional extraction techniques: Six conventional extraction techniques as given below were used to evaluate the suitable extraction method of Curcuminoids from C*urcuma longa*.

Homogenization: 1 gram of turmeric was weighed accurately and was ground well in a mortor & pestle along with different organic solvents such as water, acetone, methanol and petroleum ether. The solvents were filtered through whatmann filter paper and the filterate was collected and kept in dark overnight. Solvent was evaporated and the dried extract was calculated and solubilised in DMSO.

Single extraction: 1 gram of turmeric from *Curcuma longa* was weighed accurately and extracted using different polar solvents. The resultants were centrifuged at 10,000 rpm for 5 minutes at room temperature and the supernatants were collected. This procedure was repeated until the residue become colourless. The supernatant was collected and kept in dark overnight. The dried extract was weighed, yield was calculated and solubilised in DMSO and stored.

Sequential extraction: About 1 gram of turmeric was extracted with 10 ml of distilled water centrifuged at 10,000rpm for 10 minutes and the supernatant was collected. After extraction, the residue was reextracted by the addition of 10 ml of methonal, centrifuged at 10,000rpm for 10 minutes and the supernatant was collected after the methonal extraction the residue was reextracted by the addition

of 10 ml of acetone, centrifuged at 10,000rpm of 10 minutes and the supernatant was collected after the acetone extraction the residue was reextracted by the addition of 10 ml of petroleum ether, centrifuged at 10,000rpm for 10 minutes and the supernatant was collected.

Soxhlet extraction: Soxhlet apparatus was used for the extraction of Curcuminoids (ShaguftaNaz *et al*., 2010). The extract was prepared by extracting 1 gram of turmeric powder with 70 % methonal (100 ml) using a soxhlet apparatus until the extract was colourless. The extract was filter and the filterate was concentrated and evaporated. The same procedure was repeated for distilled water, petroleum ether, and acetone. Thus the yield for the above solvents was calculated.

Maceration: 1 gram of dried powder with 30 ml of different organic solvents in a shaker with 210 rpm at room temperature for 2 days. The extract was filtered through wattmann no.1 filter paper. Other portions of the solvent were added to the solids and the extraction was repeated until the reactant was colourless. The extracts were combined and filtered.

Hot water extraction: 1 gram of dried powder with 10 ml of different organic solvents was heated in a heating mantle for 40^0c for 5-7 minutes and the supernatants were collected and stored.

Characterisation of the extracted curcumin:

Spectral analysis: 1ml of the extract was diluted with acetone to an appropriate concentration and acetone was used as a blank. Its absorbance was measured in the range of 200-1100 nm wavelengths in UV-1800 spectrophotometer for the acetone extract and commercial Curcumin (Himedia) that was used as a standard for extracts and visible absorption spectra were obtained.

Chromatographic analysis: Thin Layer Chromatography analysis was carried out on silicagelchromatoplates develop and activated. 1 cm above the lower edge of chromatoplates, sample was placed. The used solvent systems are Chloroform: Methanol in the ratio of 9.5:0.5 v/v). The presence of curcuminoids was detected with ninhydrin by the appearance of yellow colour spots. The Retention Factor was calculated using formla, R_f= Distance travelled by the solute/ Distance travelled by the solvent.

FT-IR: The FT-IR spectrum of the acetone extract of Curcuminiods was recorded on a Shimadzu FT-IR 8000 series instrument.The sample was grounded with IR grade KBr(1:10) pressed in to discs under vacuum using spectra lab pelletiser. The IR spectrum was recorded in the region 400-4000 cm^{-1} and the typical stretching frequency of the sample was recorded for further characterization analysis.

RESULT AND DISCUSSION

In all the conventional extraction approaches used in this work, maceration and soxhlet extraction was suitable for extraction of plant material. However, maceration is the most effective method to extract compounds from plants. It was shown that the maceration extraction of Curcuminiods has about two times higher yield than the other extraction methods (Fig.1&2).Soxhlet extraction can be quite time-consuming than maceration, taking from a few hours up to days, and consume large volumes of solvent. Its main advantage is that the material is extracted continuously. Disadvantage is that the extract is constantly heated at the boiling point of the solvent used, which can damage thermo labile compounds.

The best organic solvents for extracting the pigments are acetone and methanol. Acetone extracted significantly higher Curcumin from turmeric than other solvent extraction regimes tested in this study. Statistically water and petroleum ether yield were insignificant. It have been found that most antimicrobial active components are not water soluble and organic solvent extracts produces more yield.

Spectral analysis: The absorption spectra of acetone extract showed its maximum absorption wavelength at 420 nm (Kunwar , 2007), which identically matches the spectrum of the standard Curcumin(Table 1).

Wavelength(nm)	Optical density values	
	Standard curcumin	Acetone extracted sample
400	2.090	1.940
420	2.179	1.951
440	2.144	1.929
460	2.082	1.878
480	1.526	1.832
500	0.365	1.699
520	0.056	0.261

Table: 1 Complementary wavelength of standard and Acetone extracted curcuminoids

Chromatographic analysis: In TLC analysis, we have separated Curcuminoids on silica gel. Chromatograms obtained from the pigments extracted from turmeric and standard curcumin. $R_f$was calculated 0.36 (simaycikrikci et al., 2008) was the same for acetone extract and standard curcumin.

FT-IR: In acetone extract of Curcuminiods, FTIR spectrum shows strong absorption peak at 3448.72 cm-1 which shows strong absorbency for primary and secondary amines. The major functional groups include alkanes, carbonyl, alkenes, primary amines, nitro compounds, aromatics, aromatic amines in the wave number 2924.09 & 2854.65, 1747.51, 1654.92, 1514.12, 1423.47, 1321.24 respectively(Fig:3)

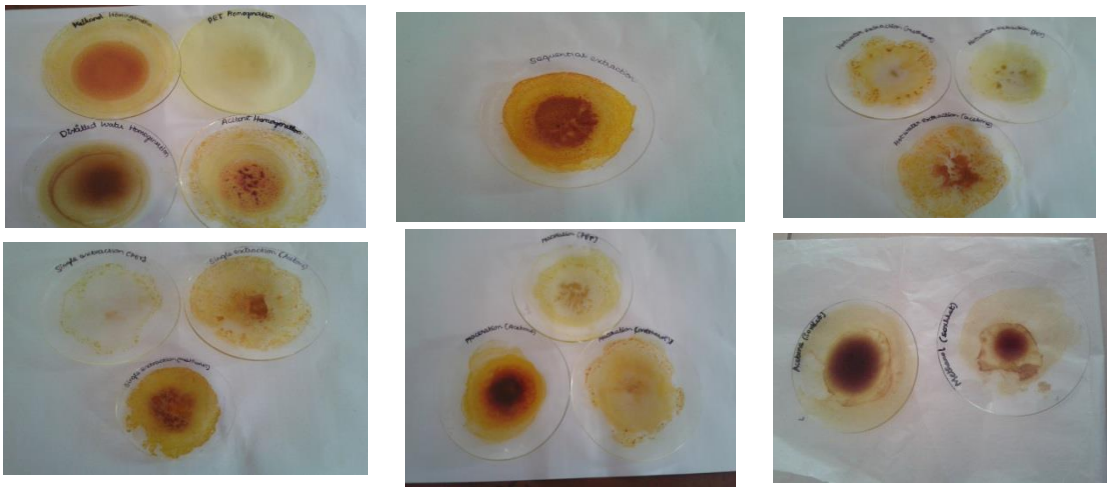
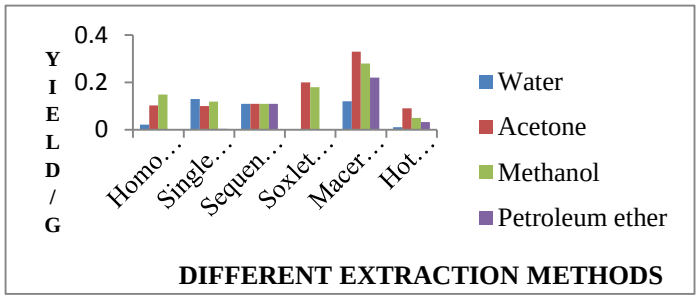


Figure.1.Yield of curcuminoids extraction using different methods



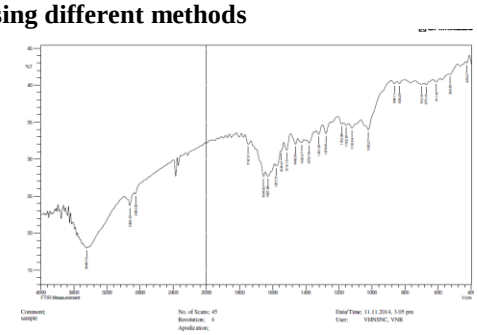


Figure.2.Yield of curcuminoids extraction using different methods **Figure.3.FT-IR Spectra of Acetone extracted curcumin**

CONCLUSION

From this study, it was concluded that Curcuminoids was extracted by maceration Showed increased yield when compared to other conventional extraction methods. The suitable organic solvent for extracting the pigments was acetone. Maceration can prove to be applicable to an efficient tool for the extraction of natural compounds from sample preparation and large scale industrial application.

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REFERENCES

ApisariyakulA,VanittanakomN,Buddhausukh D, Antifungal activity of turmeric oil extracted from *Curcuma longa*,J.Ethnopharmacol.,49, 1995, 163-169.

Amman H P and Wahl M A, Pharmacology of *Curcuma longa*. planta.Med, 57, 1991, 1-7.

Chainani Wu N, Safety and antiinflammatory activity of curcumin:a component of turmeric.J.Altern.Complement Med.,9,2003,161-168.

Chottopadhyay I, Biswas K, BandyopadhyayU,Banerjee R K,Turmeric and Curcumin:Biological action and medicinal applications.Current science, 87, 2004, 44-53.

Das KC,DasCK,Curcumin ,a singlet oxygen Quencher.BiochemBiophys Res Commum.295, 2002, 62-66.

Gupta A P,Gupta M M , kumar S J.Liq.Chromatogr.Related Technology.22,1999, 1561-1569.

Govindarajan V S, Turmeric-Chemistry, technology and quality.CRCCritical Reviews in food science and nutrition,12, 1980,199-301.

Higaki S, Akazawa A, Nakamura H,Yauai H, Yoshido T, Okita K.J.Gast.Hep.14,1999,709.

KunchandyE ,Rao M N A, Oxygen radical scavenging activity of Curcumin. International journal of pharmaceutics, 58, 1990, 237-240.

Negi P S,Jayaprakasha G K,Jagan Mohan rao L,Sakariah K K, Antibacterial activity of turmeric oil:A byproduct from curcumin manufacture, J.Agric Food Chem, 47, 1999, 4297-4300.

Pierce A, The American Pharmaceutical Association Practical Guide to Natural Medicines,New York, The StonesongPress,Inc, 1999,638-641.

Rasmusen, H.B.,Christensen,S.B.,Kuist,L.P.,Karazami,A.M.A simple and efficient separation of the curcumins.The antiprotozoal constituents of curcuma longa. .Plant Med.66, 2000, 396-398.

RouhaniSh,AlizadehN,SalimiSh,HajiGhasemi, Ultrasonic assisted extraction of natural pigments from Rhizomes of *Curcuma Longa*.,progress, 2, 2009,103-113.

Srimal R C,Tuemeric:A brief review of its medicinal properties, Fitoterapia, 68,1997,483-493.