

Experimental and Modelling Equation of Chebulinic Acid from the Composition of Medicinal Herbs by Using Soxhlet Extractor

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ABSTRACT: Chebulinic acid is the phenolic compound in the medicinal herbs like *Terminalia chebula*, Amla fruits and longan seeds. The objectives of this work were extraction of Chebulinic acid from the composition of medicinal herbs and to develop a modelling equation to quantitatively describe the extraction phenomena. The extraction was carried out by employing various organic solvents using Soxhlet extractor method. Ethanol was found to be the best solvent for the extraction of Chebulinic acid from the composition of medicinal herbs. Soxhlet extractor was carried out using ethanol at different extraction times to verify the mathematical model proposed in this work. The final form of the proposed models were $E_s = 73.33(1 - e^{-0.3423t})$ for Chebulinic acid where E_s = yield extract (milligrams of Chebulinic acid per gram of dried sample) and t = extraction time (hr). The model showed good agreement with the experimental data by generating Average absolute relative deviation (AARD) of about $50.201 \pm 23.23\%$ for milligrams of Chebulinic acid per 1 gram of dried sample.

KEYWORDS: Chebulinic acid, *Terminalia chebula* fruit, Amla fruit, longan seed, Soxhlet extractor.

I. INTRODUCTION

Chebulinic acid is a phenolic compound [1,2] commonly found in the fruits of *Terminalia chebula*, leaves and fruits of *Phyllanthus emblica* and seeds of *Dimocarpus longan* species, which has many potential uses in medicine. It is also found in the leaves of *Dendrophthoe falcata*, *Lumntzera racemosa*, *Terminalia macroptera* species. It is a faint yellowish crystalline powder and sparingly soluble in water, soluble in ethanol, methanol and ethyl acetate. *Terminalia chebula* is extensively used in unani, ayurveda and homeopathic medicine. This is used in traditional medicine due to the wide spectrum of pharmacological activities associated with the biologically active chemicals present in this plant. It shows several pharmacological activities like anti-oxidant [3], anti-cancer [4], anti-diabetic, anti-microbial etc. It contains various biochemical compounds such as tannins, chebulinic acid [5], chebulic acid, chebulagic acid [6], ellagic acid, gallic acid and flavonoids etc. *Phyllanthus emblica* is one of the best rejuvenating herbs in the ayurveda, an Indian traditional medicinal system. Traditionally, the fruit is useful as an astringent, cardiac tonic, diuretic, laxative, liver tonic, stomachic, and digestive medicine. It shows antioxidant activity [7], antitumor activity, anti-inflammatory activity [8], antimicrobial activity [9], cytoprotective activity etc. The fruit of amla contains a wide variety of compounds such as tannins, phyllembelic acid, phyllembin, vitamin C, chebulinic acid, corilagin, alkaloids, flavonoids etc. *Dimocarpus longan* is widely distributed in Southeast Asia, such as China, Taiwan, Vietnam and Thailand, southwestern India and the forests of upper Assam and the Garo hills in Meghalaya. This fruit is used as a traditional Chinese medicine for different treatments, such as promoting blood metabolism, soothing nerves and relieving insomnia etc. Longan seeds have long been used as a folk medicine in China for treatment of acariasis, hernia, wound hemorrhages, eczema and scrofula etc. These seeds have been found to be a rich source of poly phenolic compounds such as gallic acid, corilagin, chebulinic acid, chebulagic acid, ellagic acid etc. Longan seeds [10] extract showed strong scavenging activities of free radicals, inhibition on the proliferation of human colorectal carcinoma cells, antifatigue effect, hypoglycemic effects etc.

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II. MATERIALS AND METHODS

Chemicals and Reagents

Folin-Denis reagent, sodium carbonate (Na_2CO_3), ethanol and distilled water.

Materials

The dry fruits of *Terminalia chebula*, Amla and seeds of longan collected from local market in Visakhapatnam, Andhra Pradesh, India. Clean the fruits and seeds and dried under sunlight for 1 day. These fruits and seeds were cut into small pieces and powdered and stored in the air tight container. It is finely grounded to 120 mesh size.

Solvent extraction using Soxhlet Extractor:

The pulverized powders of the *Terminalia chebula* fruit, the *Phyllanthus emblica* fruit and the *Dimocarpus longan* seed are mixed in the ratio of 3:1:2. About 200 ml of 80% (v/v) ethanol was taken as a solvent in the round bottom flask and the pH was set at 6. About 24 grams of mixed powder (12.0 g of *Terminalia chebula* fruit, 4.0 g Phyllanthus embilica and 8.0 g of Longan seeds) was placed in thimble and fixed to the condenser. Now the total apparatus was placed in the heater. Using the soxhlet apparatus, continuous extraction was done for 9 hrs hrs where 1.0 ml crude extract is collected for every 1hr for the determination of chebulinic acid.

Determination of Chebulinic acid by Colorimeter

By Folin-Denis Method:

In Soxhlet extraction process, take 1ml of ethanolic extract (every 1hr) was withdrawn in a 10 ml volumetric flask. 0.5ml of FD reagent and 1ml of Sodium carbonate were added and volume is made up to 10ml with distilled water. The mixture kept for 30 min at room temperature. The absorbance of the reaction mixture was measured at 700 nm using colorimeter. The chebulinic acid was determined by using calibration curve.

Modelling of extraction of Chebulinic acid using Soxhlet extractor apparatus:

In order to describe the Chebulinic acid transfer from Composition of Medicinal herbs to the bulk of the solvent the following hypothesis were used. The mass transfer coefficient is constant. The solvent in the extractor is perfectly mixed, while the transfer resistance in the liquid phase is negligible and the Chebulinic acid concentration in the solvent depends only on time. The transfer of the Chebulinic acid was a diffusion phenomenon and independent of time. The final form of the modelling equation [11] was obtained from the extraction of Chebulinic acid by using Soxhlet extractor.

$$E_s = B (1 - e^{-Dt})$$

Where

E_s = milligrams of Chebulinic acid per gram of dried sample (mg/g),

t = extraction time (hr) and B & D = equation constants.

III. RESULTS AND DISCUSSION

In comparison to non – polar solvents, polar solvents could extract Chebulinic acid at higher yield except water, where hydrolysis and thermal degradation might occur. Non – polar solvents were almost unable to extract Chebulinic acid. Ethanol (80% v/v) was the best solvent for chebulinic acid extraction. The highest chebulinic acid concentration was observed to be 8.8 mg/ml. The final form of the proposed model equation for Chebulinic acid was $E_s = 73.33(1 - e^{-0.3423t})$ where E_s = yield extract (milligrams of Chebulinic acid per gram of dried sample) and t = extraction time (hr). The model showed good agreement with the experimental data by generating Average absolute relative deviation (AARD) of about $50.201 \pm 23.23\%$ milligrams of Chebulinic acid per 1 gram of dried sample. The results were showed in table and figure for the effect of extraction yield with extraction time for Chebulinic acid component.

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Time (hr)	Yield Extract (mg of CBA/gm of dried sample)
1	29.99
2	35.83
3	41.66
4	46.66
5	52.49
6	59.16
7	64.99
8	70.83
9	73.33
10	68.33
11	62.49

Table: Effect of Extraction yield with Extraction time for Chebulinic acid (CBA)

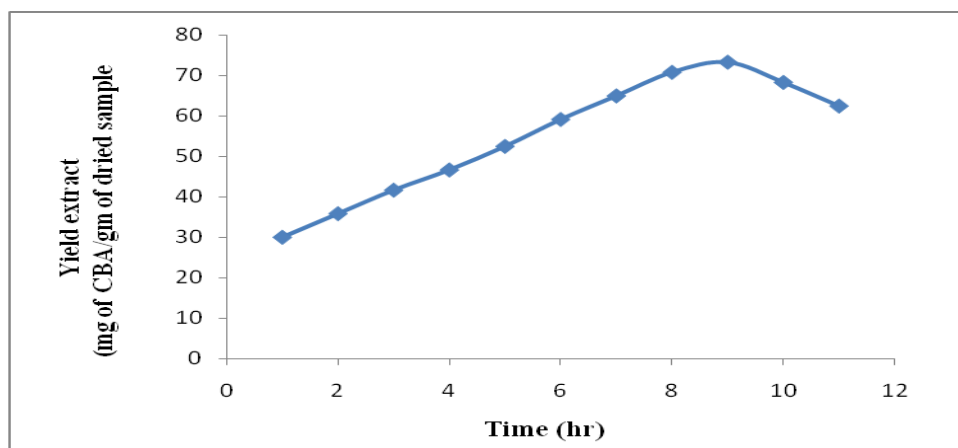


Figure: Effect of Extraction yield with extraction time for Chebulinic acid (CBA)

IV. CONCLUSION

Ethanol was found to be the best solvent for the extraction of Chebulinic acid from the composition of medicinal herbs by Soxhlet Extractor. Among the different concentrations, 80% Ethanol shows highest yield. The final form of the

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