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Original Article

# Self microemulsifying formulation of *Lagerstroemia speciosa* against chemically induced hepatotoxicity

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ABSTRACT

Self microemulsifying formulation is an approach used for enhancing the bioavailability of poorly soluble molecules due to their lipidic nature and small particle size. The objective of the present study was to evaluate the hepatoprotective activity of poorly soluble hydroxy- and polyhydroxy-organic phytomolecules rich *Lagerstroemia speciosa* leaves extract in modern formulation i.e. "Self microemulsifying System".

Different doses of SME (Self microemulsifying) formulation of *L. speciosa* leaves extract were evaluated for the hepatoprotective activity against carbon tetrachloride induced liver toxicity in rats. The parameters evaluated were (a) biochemical parameters like serum enzymes: aspartate aminotransferase (AST), serum glutamate pyruvate transaminase (ALT), serum alkaline phosphatase (ALP) and total bilirubin (b) liver antioxidant parameters as estimation of Lipid peroxidation (LPO), catalase (CAT), Superoxide dismutase (SOD) activity and concentration of reduced glutathione (GSH). Oral administration of SME formulation provided the significant protection in marker enzyme of treated group at 100 mg/kg, p.o. as AST ($P < 0.001$), ALT ($P < 0.001$), ALP ($P < 0.001$) and total bilirubin ($P < 0.001$) comparable to the group treated with silymarin. Treatment with SME formulation at the doses of 100 mg/kg, p.o. significantly prevented the rise in levels of LPO significantly ($P < 0.001$). The GSH, SOD and CAT contents had significantly ($P < 0.001$) increased in SME formulation treated groups whereas carbon tetrachloride intoxicated group had shown significant decrease in these parameters compared to control group. Formulation at the dose 100 mg/kg, p.o. has shown maximum protection which was almost comparable to those of the normal control and standard. The histological observations further uphold the results for hepatoprotective activity.



## 1. Introduction

*Lagerstroemia speciosa* (L.) Pers. (Lythraceae) reflects their attractive and colorful flower has common names such as queen's flower, queen of flowers, crepe myrtle and pride of India.[1] The main effective chemical constituents previously reported and found in leaves are ellagitannins, ellagic acid, ellagic acid sulfate and four methyl ellagic acid derivatives, including corosolic acid, gallic acid, 4-hydroxybenzoic acid, 3-O-methyl protocatechuic acid, caffeic acid, p-coumaric acid, kaempferol, quercetin and isoquercitrin.[2] Further monomeric and dimeric ellagitannins (flosin A and B, and reginin A, B, C and D) and three new ellagitannins (lagerstannins A, B and C) were isolated and identified from the leaves.[3–5] There is increasing evidence for the hepatoprotective role of hydroxy- and polyhydroxy-organic compounds and particularly from vegetables, fruits and some herbs.[6]

Free radicals are involved in the development of degenerative diseases. They have been implicated in the pathogenesis of liver damage,[7,8] diabetes,[9,10] nephrotoxicity,[11,12] cancer,[13] cardiovascular disorders, neurological disorders, inflammation[14] and in the process of aging.[15] It is well known that a significant increase in steatosis and fibrosis leads to lethal cirrhosis of the liver in humans. Although the pathogenesis of liver fibrosis is not quite clear, there is

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no doubt that reactive oxygen species (ROS) play an important role in pathological changes in the liver.[16] Biological membranes are particularly prone to the ROS effect. Several endogenous protective mechanisms have been evolved to limit ROS and the damage caused by them.[17,18] However, since this protection may not be complete, or when the formation of ROS is excessive, additional protective mechanisms of dietary antioxidants may be of a great importance.[19] Therefore, many natural and synthetic agents possessing antioxidative properties have been proposed to prevent and treat hepatopathies induced by oxidative stress.[20,21]

A large number of studies have shown that the activity of *L. speciosa* is due to presence of corosolic acid, a potent molecule for diabetes treatment.[22,23] However significant amounts of hydroxy- and polyhydroxy-organic compounds and tannins are also present in the plant as discussed above have shown in a recent studies to increase glucose uptake in rat adipocytes, and could be responsible for its effect in lowering the blood glucose levels, antioxidant activity and other various other pharmacological activities. As the standardized extract of *L. speciosa* contains corosolic acid and other hydroxy- and polyhydroxy-organic compounds which have low solubility in water,[22] the *in-vivo* absorption of it may be hampered, which results in low bioavailability.

Self microemulsifying formulation is an approach for enhancing the absorption of poorly soluble phytomolecules due to their lipidic nature and small particle size.[24] Self microemulsifying formulation is mixtures of water insoluble phytomolecule, oil/lipid, surfactant and cosurfactant. After oral administration, they are diluted in aqueous media of gastrointestinal tract (GIT) and form oil-in-water (O/W) microemulsion/nanoemulsion having globule size in the range of 100–500 nm. The energy required for dispersion is provided by gastric motility. The formed microemulsion presents the phytomolecule in a dissolved form which is a premier requirement for poorly water soluble phytomolecule for absorption. Along with this, the specific lipid excipients of self microemulsifying formulation promote the lymphatic transport of phytomolecules results in increase in bioavailability through reduction in first pass metabolism. Another reason of increase in intracellular concentration of phytomolecule is due to reduction in strength of P-glycoprotein efflux system by used lipid and surfactant.[25–29]

The purpose of this study was to investigate the improved hepatoprotective activity of standardized extract of *L. speciosa* leaves in previously optimized formulation of self microemulsifying system against carbon tetrachloride induced acute liver cirrhosis in experimental animals.

## 2. Material and methods

### 2.1. Plant collection and identification

The leaves of *L. speciosa* were freshly collected from the road side of Lucknow, Uttar Pradesh. The leaves were identified and authenticated taxonomically by Dr. A.K.S. Rawat, Head of Department, Pharmacognosy and Ethnopharmacology Division, National Botanical Research Institute (NBRI), Lucknow, India. The herbarium, (NBRI/CIF/256/2011), was preserved at department for future reference.

### 2.2. Materials

Sefsol-218 was kindly provided as gift sample by Nikko chemicals (Tokyo, Japan) and Diethylene glycol monoethyl ether (Transcutol-P) by Gattefosse Corp. (France). Polyoxyl35 castor oil (Cremophor-EL) was obtained as gift samples from BASF Co. (Germany). All other chemicals and reagents used were of analytical grade and procured from Sigma chemicals Co., USA and Qualigens fine chemicals, Mumbai, India.

### 2.3. Animals

Male albino Wistar rats (200–220 g) were kept in the departmental animal house of National Botanical Research Institute, Lucknow at 27 °C and relative humidity 42–54%, light and dark cycles of 10 and 14 h, respectively, for one week before and during the experiments. Animals were provided with standard rodent pellet diet and the food was with drawn 18–24 h before the experiment though, water was allowed *ad libitum*. All the studies were performed in accordance with the guidelines for the care and use of laboratory animals, as adopted and promulgated by the Institutional Animal Care Committee, CPCSEA, India (Reg. No. 222/2000/CPCSEA). The standard orogastric cannula was used for oral drug administration.[30]

### 2.4. Preparation of extract

The matured leaves were collected, washed with distilled water to remove dirt and soil, and shade dried up-to 20–25 days. Routine pharmacognostic studies including organoleptic tests, macroscopic and microscopic observations were carried out to confirm the identity of the materials. The dried materials were powdered by grinder and passed through a 10-mesh sieve. The coarsely powdered leaves were defatted by immersing the powder into petroleum ether up-to 12 h by regular shaking. Extraction was done by hot continuous soxhlet apparatus using 50% alcohol at 60 °C for 6 h. After extraction the excess solvent was removed by using a rotary evaporator (Buchi, USA) and then freeze-dried (Freezone® 4.5, Labconco, USA) at high vacuum ($133 \times 10^{-3}$ mBar) and at temperature −40 °C.[31] A net yield of 12.8 gm per 100 gm was obtained. The collected *L. speciosa* leaf extract (LSE) was stored in air-tight glass container for future experiments.

### 2.5. Preparation of self microemulsifying formulation

Self microemulsifying formulation (1 ml) was prepared by taking specified quantity of oil (Sefsol-218), surfactant (Cremophor-EL) and co-surfactant (Transcutol-P) in a glass vial in a ration of 1:2:2 (% v/v). Then the LSE (10 mg) was added with gentle stirring. The mixture was vortexed and heated at 40 °C on water bath for 15 min. The prepared formulation was stored in tightly closed container at ambient conditions until further use. The characterization of the prepared self microemulsifying formulation was earlier reported by our research group.[32]

### 2.6. Chemically induced hepatotoxicity

Male albino Wistar rats were divided into five groups, each group had six animals. Group I (control) animals were administered a single daily dose of SME without LSE (1 ml/kg body weight, p.o.). Group II received carbon tetrachloride (1 ml/kg body weight, i.p. 1:1 v/v mixture of $CCl_4$ and liquid paraffin) alone. Group III and IV received the prepared SME formulation of LSE (equivalent to 50 and 100 mg/kg LSE, p.o.) respectively along with carbon tetrachloride. Group V received silymarin, a known hepatoprotective compound (Sigma Chemicals Company, USA), at a dose of 100 mg/kg, p.o., along with carbon tetrachloride. The SME formulation was given daily while carbon tetrachloride was given for every 72 h for 14 days. Animals were sacrificed 48 h after the last dose of the drug. The liver samples were dissected out and blood was collected.[33]

### 2.7. Assessment of hepatoprotective activity

The collected blood was allowed to clot and serum was separated at 2500 rpm for 15 min and the biochemical parameters like

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