



Methanolic extraction and phytochemical characterisation of mature fruits of *Emblica officinalis*[#]

T. R. Sreelekshmi ¹, K.S.Prasanna^{1*}, I. S. Sajitha ¹, S. S. Devi ²,
 S. Suja Rani ³ and M. D. Pratheesh⁴

¹Department of Veterinary Pathology, College of Veterinary and Animal Sciences, Mannuthy, ²Bioscience Research and Training Centre, Thonnakkal, Thiruvananthapuram, ³Department of Veterinary Pharmacology and Toxicology, College of Veterinary and Animal Sciences, Mannuthy, ⁴Department of Veterinary Physiology, College of Veterinary and Animal Sciences, Mannuthy, Kerala Veterinary and Animal Sciences University, Pookode, Wayanad, Kerala

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Abstract

The study focused on the methanolic extraction of mature fruits of *Emblica officinalis* (amla) using the Soxhlet extraction method followed by a preliminary screening of its phytochemical content. Methanol was chosen as the solvent due to its ability to extract a wide range of polar phytochemicals. The analysis of the extract revealed the presence of several key compounds, including phenols, steroids, saponins, and tannins. These compounds are recognised for their antioxidant, anti-inflammatory and immune-modulating properties, contributing to therapeutic potential of amla. Phenols and tannins are known for their strong antioxidant activities, helping to reduce oxidative stress and prevent cellular damage. Steroids and saponins play vital roles in immune regulation and maintaining cholesterol levels. The results of this study highlight the effectiveness of methanolic extraction using the Soxhlet method in isolating these bioactive compounds from amla, supporting its use in traditional medicine and modern herbal formulations. The findings further validate the therapeutic properties of *Emblica officinalis* and emphasise its importance as a natural source of health-promoting substances.

Keywords: *Emblica officinalis*, methanolic extraction, phytochemicals

Emblica officinalis, commonly known as amla or Indian gooseberry, is found in a medium-sized deciduous tree belonging to the family Euphorbiaceae (Nemmani *et al.*, 2002). Morphological characters of mature fruits of Gooseberry are round, fleshy appearance with a pale-yellow colour. Singh *et al.* (2015) emphasised the utility of the anti-inflammatory and antioxidant attributes of *E. officinalis*, while, Javale and Sabnis (2010) confirmed the effectiveness of *E. officinalis* as an antimicrobial agent.

Phytochemicals are bioactive compounds produced by plants, found in various foods such as fruits, vegetables, nuts, and herbs. They are classified into primary and secondary metabolites, with secondary metabolites playing a crucial role in plant survival and ecosystem dynamics. Phytochemicals including polyphenols, flavonoids, and carotenoids, are known for their health benefits, such as antioxidant, anti-inflammatory, and antimicrobial

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*Corresponding author: prasanna@kvasu.ac.in, Ph. 9495014780

properties (Thacker and Ram, 2024). These compounds contribute to disease prevention, particularly in cancer and cardiovascular diseases, by enhancing immune responses and reducing oxidative stress (Roy and Datta, 2019; Goswami *et al.*, 2024). Understanding the phytochemical composition of *E. officinalis* provides insights into its potential applications in pharmacology, nutraceuticals, and overall health benefits.

Fresh fruits of *E. officinalis* (Indian gooseberry) were procured locally and were authenticated by the Department of Botany at University College, Thiruvananthapuram. The fruits were left to dry in the shade for 15 days to preserve their natural properties. The coarse fruit powder was subjected to extraction using Soxhlet apparatus. The extraction process was carried out using 100 per cent methanol over a period of four days. The obtained extract was placed in a petri dish and left at room temperature overnight to facilitate the evaporation of any residual methanol. This setup allowed for controlled and complete vaporisation of the solvent. The concentrated extract was stored in refrigeration for future use (Panchal *et al.*, 2019). The per cent yield of extract was determined using the formula provided by Tiwari *et al.* (2016).

$$\text{Percentage yield} = \frac{\text{extract obtained}}{\text{powdered material packed}} \times 100$$

The methanolic extract derived from *E. officinalis* was subjected to preliminary phytochemical analysis to ascertain the existence of various bioactive chemical constituents. The extract was screened for the presence of steroids (Salkowski test, Lieberman Burchardt test), tannins (Ferric Chloride test, Gelatin test), phenolic compounds (Ferric Chloride test), flavonoids (Ferric Chloride test, Lead Acetate test), saponins (Foam test) and alkaloids (Mayer's test, Wagner's test) (Harborne, 1991; Prakash *et al.*, 2021).

Table 1. Per cent yield of extract

Thimble No.	Initial weight (g)	Final weight of extract (g)	Percentage yield (w/w %)
1	232	80.7	34.7
2	227	78.4	34.5
Average percentage yield			34.6

The results of various tests for active principles in the sample are as follows: The Ferric chloride (10%) test indicated the presence of phenols, yielding a positive result. Both the Salkowski test and the Lieberman Burchardt test showed positive results for steroids. Tannins were detected with positive outcomes in both the Ferric chloride and gelatin tests. The presence of flavonoids was confirmed by a positive result in the lead acetate test. Saponins were also identified with a positive result in the foam test. However, the Mayer's and Wagner's tests, conducted for alkaloids,

returned negative results, indicating their absence in the sample.

The pharmacological properties associated with *E. officinalis* may result from the presence of bioactive compounds inherent within the plant (Govind and Pandey, 2011). Phenolic compounds are classified as secondary metabolites, synthesised via the shikimic acid pathway and the pentose phosphate pathway through phenylpropanoid metabolism (Randhir *et al.*, 2004). Numerous investigations have elucidated the benefits of phenolic compounds, including their roles as anti-aging, anti-inflammatory, antioxidant and antiproliferative agents (Shukitt-Hale *et al.*, 2008). The chemical constituents derived from plants, specifically phenolic compounds, possess the capability to inhibit the enzymatic activity of amylase, thereby influencing carbohydrate absorption, particularly in the context of diabetes management (Sales *et al.*, 2012). Plant steroids exhibit a fundamental architecture consisting of four interconnected carbon rings, referred to as the steroid nucleus (Patel and Savjani, 2015). Plant steroids demonstrate a multitude of intriguing medicinal, pharmaceutical and agrochemical properties, including but not limited to immunosuppressive, hepatoprotective, antibacterial, regulation of plant growth hormones, modulation of sex hormones, anthelmintic, cytotoxic, and cardiostimulant activities (Patel and Savjani, 2015). Each subtype of plant steroids has been thoroughly examined for its anti-cancer, immunomodulatory, anti-inflammatory, and antiviral efficacies (Yerlikaya *et al.*, 2023). Tannin is a polyphenolic compound found in vascular plants, with a molecular weight ranging between 500 and 3000 kilodaltons (Govindarajan *et al.*, 2016). Tannins exhibit significant antioxidant activity, with studies indicating that extracts from plants like *Ximenia americana* demonstrate antioxidant power superior to vitamin C (Kabran *et al.*, 2021). They are recognised for their anti-inflammatory properties, particularly hydrolysable tannins, which have been linked to the management of diseases such as rheumatoid arthritis and inflammatory bowel diseases (Piazza *et al.*, 2022). Tannins also possess astringent and local anti-inflammatory effects (Kubasova *et al.*, 2022).

Flavonoids are secondary metabolites characterised by a polyphenolic framework and are extensively prevalent in diverse fruits, vegetables, and particular beverages (Panche *et al.*, 2016). These compounds exhibit a diverse array of beneficial biochemical and antioxidant properties that are implicated in the pathophysiology of numerous diseases, including cancer and Alzheimer's disease, as well as atherosclerosis (Burak and Imen, 1999). Significance of flavonoids arises from their antioxidative, anti-inflammatory, anti-mutagenic, and anti-carcinogenic characteristics, in conjunction with their ability to modulate critical cellular enzymatic activities. Additionally, they are recognised as potent inhibitors of various enzymes, including xanthine oxidase (XO), cyclooxygenase (COX), lipooxygenase, and phosphoinositide



Fig. 1. Mature fruits of *E. officinalis*

Fig. 2. *E. officinalis* fruits in coarsely ground form

Fig. 3. Methanolic extract of *E. officinalis* obtained following Soxhlet extraction and evaporation

Fig. 4. Preliminary phytochemical screening of the extract; (From left): Tannins, phenol, steroid, flavonoids, saponins

3-kinase (Metodiowa *et al.*, 1997). Saponins are group of heterogeneous compounds comprising triterpenoid or steroidal aglycones that are covalently bonded to oligosaccharide moieties with antioxidant and anti-inflammatory properties by inhibiting pro-inflammatory cytokines and inducing pro-apoptotic mechanisms via the activation of caspases (Santiago *et al.*, 2021). They are known to possess immunostimulatory effects in rheumatoid arthritis, particularly affecting fibroblast-like synoviocytes (Liu *et al.*, 2019).

Summary

The methanolic extraction of mature fruits of *E. officinalis* resulted in an extract yield of 34 per cent. Initial phytochemical analyses of the extract uncovered the existence of various phytochemicals, including phenols, flavonoids, tannins and saponins, thereby underscoring its medicinal attributes and potential therapeutic applications.

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Conflicts of interest

The authors declare that they have no conflict of interest.

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