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## Review Article

# Phytoconstituents And Pharmacological Activities of *Phyllanthus emblica*

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## ABSTRACT

*Phyllanthus emblica*, commonly referred to as Indian gooseberry or amla, has received a lot of attention recently due to its diverse phytochemical composition and associated pharmacological characteristics. This paper summarizes the phytochemistry, pharmacological characteristics, and historical uses of *Phyllanthus emblica* fruits. Through a careful evaluation of the literature, this review highlights the rich phytochemical profile of *Phyllanthus emblica*, which includes flavonoids, tannins, alkaloids, and polyphenolic compounds. *Phyllanthus emblica* fruits bioactive composition—particularly their high levels of polyphenol and vitamin C—is what gives them their hepatoprotective, anti-inflammatory, and antioxidant properties. *Phyllanthus emblica* is a natural resource that has a lot of potential for use in pharmacological research and complementary and alternative medicine.

## INTRODUCTION

Approximately half of India's higher blooming plant species are medicinal plants, which account for approximately 8000 species. Traditional remedies, which are largely derived from plant sources, have played an important role in the treatment of many chronic conditions, including diabetes, particularly in countries such as India<sup>1-3</sup>.

A survey by the World Health Organisation found that 80% of people in underdeveloped nations get their main medical care nearly entirely from traditional medicine<sup>4</sup>. People have been employing herbal medicines to treat a range of disorders since the beginning of time since plants are regarded to be either nontoxic or less hazardous than manmade drugs<sup>5</sup>.

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*Phyllanthus emblica* Linn., a member of the Euphorbiaceae family, is found in most tropical and subtropical nations<sup>6</sup>. As to the two primary Ayurvedic classic books, Sushruta Samhita and Charaka Samhita, *P. emblica* is considered "the best among the sour fruits" and "the best among rejuvenators". It is a key component of significant medical preparations such as Triphala and Chyawanprash, a general tonic that enhances mental and physical health for people of all ages<sup>7</sup>. Pharmacological activities of *p.emblica* includes anti-cancer, anti-inflammatory, anti-oxidant, anti-diabetic, neuroprotective and hepatoprotective ,etc.. However, the pharmacological properties of *P. emblica* are frequently studied in relation to Triphala, an Ayurvedic preparation consisting of equal parts of three fruits from medicinal plants: *P. emblica*, *Terminellia chebula*, and *T. belerica*<sup>8 9 10</sup>.

**PLANT DESCRIPTION: -**

**SYNONYMS: -**

*Phyllanthus emblica* – Synonyms are Balakka, Amlaki, *Emblica officinalis*, Indian gooseberry, Amla, *Emblic myrobalan*, *UsirikayAdiphala*.

This includes the fresh and dried fruits of the Euphorbiaceae family plant *Emblica officinalis*

Gaerth (*Phyllanthus emblica* Linn.).



**Fig:-An image of Phyllanthus emblica**

**MORPHOLOGY: -**

The amla tree, a small to medium-sized deciduous tree, can grow to be 8 to 18 meters tall. Its thin, light grey bark exfoliates in tiny, irregular flakes, revealing a new, different-colored surface beneath the old bark. The main stem has an average diameter of 70 cm. Usually, the main trunk is separated from the base by two to seven scaffolds<sup>11</sup>. The leaves are closely packed in pinnate fashion<sup>3</sup> and measure 10–13 mm in length<sup>12</sup> and 3 mm in width, giving the branches a fluffy appearance overall. Following fruit setting, leaves begin to grow. The flowers are 4 to 5 mm long, pale green, unisexual, and borne in clusters of 6 to 10 on the leaf axils. Fleshy, nearly globose in shape, the fruits measure 2.1-2.4 cm in diameter, 5.3-5.7 g in weight, and 4.5-5.0 mL in capacity. Fruit has a six-ribbed stone that splits into three segments<sup>[12]</sup>, each of which contains two seeds. The seeds are 4-5 mm long and 2-3 mm wide, and they weigh between 572 and 590m<sup>12 13</sup>.

Colour	When matured, green turns brick red or pale yellow.
Odour	None.
Taste	Sore and Astringent.
Shape	Fruits are depressed, globose.
Size	1.5 – 2.5 cm in diameter.

**TAXONOMICAL CLASSIFICATION:-**

It includes,

Kingdom	Plantae
Division	Angiosperma [flowering plant]



Class	Magnoliopsida
Order	Malpighiales
Family	Phyllanthaceae
Genus	Phyllanthus
Species	emblica

### PHYTOCONSTITUENTS:-

"Phyllembelin" is the active chemical identified by Indian scientists as having a substantial pharmacological impact in amla. The fruit is abundant in quercetin, phyllaemblic compounds, gallic acid, tannins, flavonoids, pectin, and vitamin C, in addition to a range of other polyphenolic compounds. Terpenoids, alkaloids, flavonoids, tannins, and other phytochemical components have been shown to have positive biological properties<sup>14,15</sup>. The fruits, leaves, and bark all have a high tannin content. The root contains lupeol and ellagic acid, whereas the bark contains leucodelphinidin. The seeds yield a steady (16%) oil with a brownish-yellow tint. Its components are linolenic (8.8%), linoleic (44.0%), oleic (28.4%), stearic (2.15%), palmitic (3.0%), and myristic (1.0%) fatty acids<sup>16</sup>.

This plant contains hydrolysable tannins such as eblicanin A, eblicanin B, punigluconin, and pedunculagin<sup>17</sup>. Flavonoids include Kaempferol 3-O-alpha-L-(6-methyl) rhamnopyranoside and Kaempferol 3-O-alpha-L-(6-ethyl) rhamnopyranoside." alkaloids, including phytollantine, phytollantidine Gallic acid, ellagic acid, 1-O-galloyl-beta-D-glucose, 3,6-di-O-galloyl-D-glucose, chebulinic acid, quercetin, chebulagic acid, corilagin, and isostrictinin were isolated from Phyllanthusemblica fruits. A new acylated glucoside was isolated from the methanolic extract of P.emblica leaves<sup>18</sup>. The molecules luteolin 4-O-neohesperidoside, gallic acid, methyl gallate, 1, 2, 3, 4, and 6 penta-

Ogalloylglucose were combined to form apigenin 7-O-(6"-butyryl-beta)-glucopyranoside<sup>19</sup>. P. emblica seeds have phosphatides, fixed oil, and a trace amount of essential oil. Moreover, the leaves include chebulagic, ellagic, gallic, and chebulinic acids. Phyllaemblic acid, a new highly oxygenated norbisabolane, was isolated from P.emblica roots and its structure was fully characterised using chemical and spectroscopic methods. Ellagic acid and lupeol are detected in P.emblica roots<sup>20</sup>.

**Fruit:** Protein 0.5%, fat 0.1%, mineral matter 0.7%, fibre 3.4%, carbohydrates 14.1%, nicotinic acid (0.2 mg/100g), gallic acid, phyllembelin, phyllembelic acid, emblicokellagic acid, pectin 725-277<sup>21-22</sup>, SOD 482<sup>23</sup>, 14 units/g, putranjivain, and quercetin, were all present in the mixture<sup>24</sup>.

**Seeds:** The seeds of the Indian gooseberry contain a fixed oil, phosphatides, and an essential oil. The seeds yields a fixed oil (16%) that is brownish yellow. Linolenic acid (8.8%), linoleic (44.0%), oleic (28.4%), stearic (2.15%), palmitic (3.0%), and myristic acid were also present. There are proteolytic and lipolytic chemicals present<sup>25</sup>.

**Leaves:** The bark and leaves have a high concentration of tannins. The leaves contain the alkaloids phyllantidine and phyllantine, gallic acid, ellagic acid, chebulic, chebulagic, and chebulinic acids, as well as the gallotannin an lie acid<sup>26</sup>.

Constituent	Type	Function/Properties
Vitamin C	Vitamin	Antioxidant, boosts immune system
Tannins	Polyphenols	Antioxidant, antimicrobial, anti-inflammatory properties



Flavonoids	Polyphenols	Antioxidant, anti-inflammatory, supports heart health
Gallic Acid	Phenolic Acid	Antioxidant, antimicrobial, anti-cancer properties
Ellagic Acid	Phenolic Compound	Antioxidant, anti-inflammatory, potential anti-cancer
Beta-Sitosterol	Phytosterol	Cholesterol-lowering effects, anti-inflammatory
Alkaloids	Alkaloids	Various pharmacological effects
Saponins	Glycosides	Antioxidant, immune-boosting properties
Essential Oils	Volatile Compounds	Antimicrobial, aromatic properties

### COLLECTION AND EXTRACTION:-

The plant *Phyllanthus emblica* was harvested for its leaves and branches.

#### Harvesting & Selection of Plant Parts:

*Phyllanthus emblica* is a plant that has received significant study for its therapeutic properties. Its leaves and branches are rich in bioactive substances such as flavonoids, polyphenols, and tannins, which enhance its antioxidant and beneficial properties<sup>27</sup>.

**Drying:** In botanical extraction, drying at moderate temperatures, such as 50°C, is popular because it reduces moisture while maintaining heat-sensitive phytochemicals<sup>28</sup>. By taking this procedure, the extract quality is protected from microbiological contamination and enzymatic deterioration<sup>29</sup>.

**Grinding:** By reducing the dry material to a fine powder, the surface area is increased, which makes it easier to extract chemicals when combined with a solvent<sup>30</sup>. To increase consistency and standardise the extraction procedure, a particle size of 0.5 mm is frequently employed<sup>31</sup>.

**Aqueous Extraction and Heating:** Water is a common solvent since it is safe, economical, and effective at removing polar substances like polyphenols. While temperatures below boiling are usually employed to protect heat-sensitive ingredients, heating to 95°C improves extraction by dissolving cell walls and improving solubility<sup>32</sup>.

**Filtration:** Whatman® No. 1 paper creates a clear solution for additional testing by efficiently removing bigger plant residues while permitting small, dissolved chemicals to flow through<sup>33</sup>.

**Storage:** In order to preserve the extract's bioactivity, it must be kept at -20°C. This is because low temperatures prevent microbial development and chemical degradation, maintaining the extract's quality for in vitro research<sup>34</sup>.

### PHARMACOLOGICAL ACTIVITIES:-

#### 1. Anti cancer Activity:-

Cancer is still a major worldwide health concern, which drives scientists to investigate new drugs and therapies that reduce cancer cell survival, prevent angiogenesis, stop proliferation, and limit metastasis<sup>35</sup>. Several flavonoids and phytochemical compounds have emerged as promising cancer treatments in the recent years.

A thorough analysis of the *Phyllanthus emblica* fruit extract's mode of action was conducted. In relation to cholangiocarcinoma, the ethanolic extract of *Phyllanthus emblica*, the anti-proliferative properties were evaluated<sup>36</sup>. With an IC50 value of 52.2 µg/mL and a notable induction of apoptosis, the results demonstrated the extract's cytotoxic capability on the KKV-452 CCA cell line. In addition, at 25 and 50 µg/mL, the ethanolic extract of *Phyllanthus emblica* bark significantly reduced cell migration, with decreases of 42.5% and 32.9%, respectively, in comparison to untreated cells. *Phyllanthus emblica* bark extract's phenolic acid and flavonoid content were thought to be responsible for these anticancer actions.

#### 2. Immunomodulatory Activity:-

The immune system's activity serves as a powerful defence against both internal and external hazards. Due to their immunomodulatory properties, numerous plants have been utilised to cure human



illnesses from ancient times. It was discovered that medicinal plants improved the function of natural killer (NK) cells and stimulated the immune system. In mice with tumours, FPE extended life expectancy by 35% by doubling the function of splenic NK cells<sup>37-38</sup>. Swiss albino rats given 100 and 200 mg/kg of *P. emblica* fruit extracts for 19 days likewise showed a dose-dependent immunomodulatory response, according to Suja et al. (2009). The fruit extracts dramatically raised the mice's leukocyte count, lymphocyte distribution percentage, hemagglutination antibody titer, and delayed hypersensitivity. Along with macrophage phagocytes, the aqueous extract of FPE also produced humoral and cell-mediated immunity<sup>38</sup>. Because of its immunomodulatory properties, *P. emblica* demonstrated its numerous uses for preventing and treating a range of illnesses.

### **3. Anti oxidant Activity:-**

Natural products derived from food sources contain a variety of free radical scavenging components. The ascorbic acid content of *P. emblica* was thought to be the cause of its antioxidant properties until 1990<sup>39</sup>. In 1996, it was determined that *P. emblica* contained no ascorbic acid at all, and that its antioxidant activities were attributable to hydrolysable tannins such as emblicanins<sup>17</sup>. Components such as ascorbic acid in avoiding oxidative damage. The aqueous extract of FPE considerably increased antioxidant capacity by boosting the levels of GSH and antioxidant system enzymes such as catalase, superoxide dismutase, GSH peroxidase, GSH reductase, and GSH S-transferase.

The antioxidant potential of sesquiterpenoids and diphenyl ether-like compounds from FPE was demonstrated in similar studies conducted by different research groups using *in vitro* and *in vivo* models to determine the antioxidant activity of *P. emblica* polyphenolic constituents including flavonoids and tannins<sup>40</sup>. Gallic acid, ellagic acid,

and corilagin are polyphenolic compounds that have been shown to have the antioxidant ability of FPE. Additionally noted was the antioxidant activity of FPE aqueous and methanolic extracts<sup>41</sup>. FPE seeds have been shown in multiple studies to have antioxidant properties in addition to its fruit.

### **4. Analgesic, Anti-pyretic, Anti-inflammatory Activity:-**

FPE has potent analgesic and antipyretic properties as well. FPE's ethanolic and aqueous extracts significantly decreased the amount of yeast-induced hyperthermia in rats when administered at a high dosage (500 mg/kg, *i.p.*)<sup>42</sup>. The anti-inflammatory activities of the aqueous fraction of the methanolic extract of FPE were tested in rats with carrageenan and dextran-induced hind paw oedema. Both extracts prevented the acetic acid-induced writhing reaction in mice. The production of inflammatory mediators, including platelet-activating factor (PAF), leukotriene B4 (LTB4), and thromboxane B2 (TXB2), was also examined.

This anti-platelet reaction was ascribed to the presence of hydrolyzable tannins of low molecular weight, such as punigluconin, pedunculagin, emblicanin-A, and emblicanin-B. showed that *P. emblica* extract had analgesic effects in the acetic acid-induced writhing response and tail immersion test, as well as antipyretic benefits against hyperthermia generated by brewer's yeast.

The anti-inflammatory activities of the hydroalcoholic extract of FPE at a high dose of 700 mg/kg *b.w.* were revealed in a rodent investigation using carrageenan-induced acute inflammation and cotton pellet granuloma-induced chronic inflammation<sup>43</sup>. The findings suggest that *P. emblica* could be effective in the treatment of inflammatory illnesses such as osteoarthritis. shown that *in vivo*, the ethanolic extract of FPE had analgesic efficacy in both postoperative and neuropathic pain models<sup>44</sup>.

### **5. Anti Diabetic Activity:-**





Diabetes mellitus, a prevalent endocrine metabolic disorder, has caused severe morbidity.

and mortality due to macrovascular complications (heart attack, and peripheral vascular disease) as well as microvascular effects (retinopathy, neuropathy, and nephropathy)<sup>45</sup>. Type 2 diabetes, sometimes referred to as non-insulin-dependent diabetes mellitus, is the most common form of the disease, accounting for 90–95% of cases that are characterised by inadequate insulin synthesis or use<sup>46</sup>. The ethanolic extract of *P. emblica* effectively reduces blood glucose levels. By enhancing insulin sensitivity towards peripheral tissues, tannin, an efficient drug to inhibits adipogenesis and promote glucose uptake, is present in the ethanolic extract of *P. emblica*.

#### **6. Anti Bacterial Activity:-**

The antibacterial activity of *Phyllanthus emblica* was assessed by Jahan and Akter<sup>47</sup>. The disc diffusion approach was used in this investigation. The methanolic extract of *P. emblica* was evaluated against Gram-positive, Gram-negative, and multidrug-resistant pathogens using a standard kanamycin disc at 500 µg/disc concentration. The findings showed that some bacteria, including *Shigella dysenteriae* (17 mm), *Staphylococcus aureus* (20 mm), and *Bacillus subtilis* (25 mm), were significantly inhibited by the ethanolic extract of PE. The disc diffusion method demonstrated the efficacy of *P. emblica*'s aqueous and ethanolic extracts against *Pseudomonas aeruginosa*<sup>48</sup>. When administered at doses of 50 mg/mL and 25 mg/mL, respectively, the methanolic extract of *P. emblica* completely killed AMR (antimicrobial-resistant) *S. Typhi* and *S. Enteritidis*<sup>49</sup>.

#### **7. Hepatoprotective Activity:-**

*P. emblica* exhibited hepatocarcinogenic activities in the amlaki extract. In the rat model, the oral treatment of amla extract decreases the liver tumours caused by nitrosodiethylamine.

The amla plant's quercetin component reduced the liver damage and fibrogenic effects of dimethylnitrosamine<sup>50</sup>. The hepatoprotective potential of the plant extracts and their components was examined. The results showed that WEPE dramatically decreased body weight, peritoneal fat, and epididymal fat in rats given a high-fat diet. It decreased steatosis by elevating adiponectin in adipocytes, lowering SREBP-1c in the liver, and increasing PPAR- $\alpha$  in the liver. This could explain why WEPE can reduce fat formation in the liver. These findings suggested that WEPE could be beneficial in the treatment of steatosis caused by an HFD<sup>51</sup>.

#### **8. Nephroprotective Activity:-**

*P. officinalis*'s nephroprotective effects on oxidative stress-related kidney impairment in the ageing process. When given to aged rats, the plant extract was found to lower their elevated levels of urea nitrogen and serum creatinine<sup>52</sup>. Furthermore, elderly rats showed a considerable reduction in tail arterial blood pressure, serum thiobarbituric acid-reactive chemical levels, mitochondria, and renal homogenate. In another investigation, the plant's ethanol extract was examined for nephroprotective properties on a rat model. In rats fed ethylene glycol and ammonium chloride, the extract was demonstrated to reduce creatinine and urea levels at doses of 50, 100, and 150 mg/kg body weight<sup>53</sup>.

#### **9. Hypo-lipidemic activity:-**

The anti-atherosclerotic and lipid-lowering properties of *P. emblica* fruits have been tested in rabbits given a diet rich in cholesterol. Fresh fruit juice reduced blood cholesterol, triglycerides, phospholipids, and LDL levels when taken at a dose of 5 mL/(kg•day) for 60 days. Phospholipid and cholesterol levels in the animal urine were found to be elevated, indicating that *P. emblica* might have also impacted the mechanism of absorption. According to another study, *P. emblica* also lowers the rabbits hepatic, aortic, and serum, cholesterol<sup>54-55</sup>.



### 10. Gastro-protective activity:-

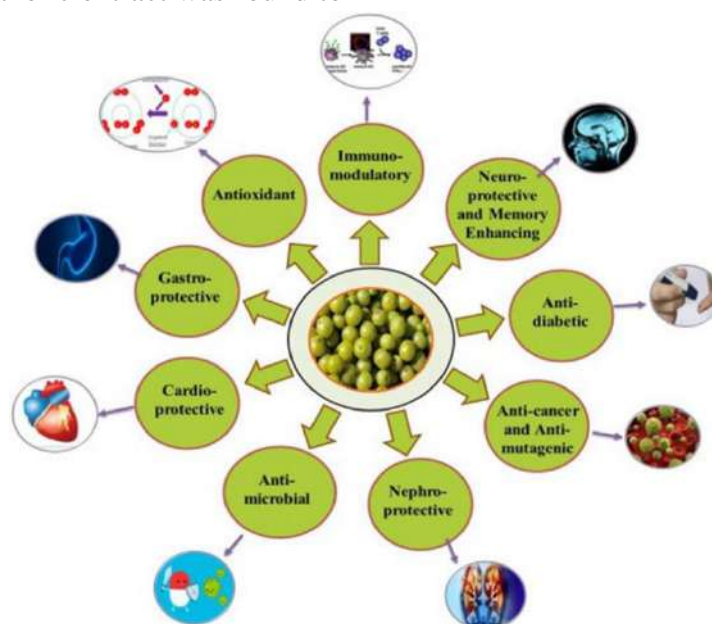
The ethanolic extract of *P. emblica* dried fruit was investigated for its gastroprotective qualities in patients with gastrointestinal disorders. The evaluation included 30 patients in all, ten from each of the three groups. These three groups received 14 days of treatment with omeprazole, lactose (placebo), and ethanolic extract, respectively. 500 mg of the ethanolic extract per day was administered to the test group. Three times a day, participants in the negative control group (placebo) received 500 mg lactose pills. Finally, omeprazole at the suggested dosage of 40 mg per day was administered to the positive control groups. The ethanolic extract was found to

decrease pain, vomiting, sleep disturbances, and the repair of damaged mucosa<sup>56</sup>.

### 11. Anti-Aging activity:-

The polyphenols in *P. emblica* fruit were discovered to have a significant protective effect against the ageing process in the *Caenorhabditis elegans* model. Its anti-aging qualities were demonstrated by increasing heat resistance and significantly lowering the activity levels of butyrylcholinesterase (BuChE) by 45.38% and acetylcholinesterase by 34.71%<sup>57</sup>.

**Other activities include**, *Phyllanthus emblica* act as laxative, anti-diarrhoeal, hair growth promoter, anti-hypertensive agent.



**FIG:-Pharmacological activity of Phyllanthus emblica.**

### TRADITIONAL USES:-

In traditional medicine, balakka is a common ingredient. This plant has traditionally been used in India to treat anaemia, diabetes, liver, heart, and cancer. In several experimental diabetes models, chromium has strong antidiabetic effects. Additionally, chromium compounds can improve diabetic rats' fat metabolism. The balakka fruit is utilised as an anti-aging and TB treatment. Vitamin C, which has antioxidant qualities, and tannin, which has antimicrobial qualities, are both

present in balakka fruit. Furthermore, it has been shown and studied that balakka is an anti-cancer plant. Flavonoids and phenols from balakka plants have antioxidant qualities because they can absorb free radicals. Balakka's medicinal properties include its fruit for autos, candies, and jelly preserves, as well as its leather, which contains colourants that have been used as a blue dye in many kinds of fabrics, tanneries, furniture, agricultural instruments, and wood. According to the Wealth of India, *Phyllanthus emblica* seeds

have been proved to be effective treatments for bronchitis and asthma. Fruit juice released after harvesting is also used to treat eye irritation and as an ocular rinse. Traditionally, the fixed oil present in FPE was utilised as a hair tonic to promote pigmentation and hair development<sup>58</sup>.

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#### **CONCLUSION:-**

*P. emblica* is a well-known Ayurvedic medicinal plant due to its numerous pharmacological applications in treating a variety of human ailments. Its most notable properties, however, are anti-oxidative and anti-inflammatory action. The phytochemical research of *Phyllanthus emblica* found a rich variety of secondary metabolites, including flavonoids, tannins, polyphenols, and ascorbic acid. This indigenous fruit, which is profoundly ingrained in traditional medicine, has been shown to be an extraordinary source of bioactive compounds with great therapeutic features. *Phyllanthus emblica* is a prospective source of bioactive compounds with various pharmacological properties. While this review is useful in understanding its potential benefits, further research and clinical trials are required to fully realise this amazing plant species' therapeutic potential. the significance of *Phyllanthus emblica* in the realm of natural medicine and promotes additional research in the pursuit of improved healthcare solutions.

#### **REFERENCES**

1. Swanston-Flatt SK, Flatt PR, Day C, Bailey CJ. Traditional dietary adjuncts for the treatment of diabetes mellitus. Proceedings of the Nutrition Society. 1991 Dec;50(3):641-51.
2. Grover JK, Yadav S, Vats V. Medicinal plants of India with anti-diabetic potential. Journal of ethnopharmacology. 2002 Jun 1;81(1):81-100.
3. Carlson TJ, King SR, Reaven GM. From plant to patient: an ethnomedical approach to the identification of new drugs for the treatment of NIDDM. Diabetologia. 1997;40:614-7.
4. Mirunalini S, Krishnaveni M. Therapeutic potential of *Phyllanthus emblica* (amla): the ayurvedic wonder. Journal of basic and clinical physiology and pharmacology. 2010 Feb;21(1):93-105.
5. Wagner H. Phytomedicine research in Germany. Environmental Health Perspectives. 1999 Oct;107(10):779-81.
6. Unander DW, Webster GL, Blumberg BS. Usage and bioassays in *Phyllanthus* (Euphorbiaceae). IV. Clustering of antiviral uses and other effects. Journal of Ethnopharmacology. 1995 Jan 1;45(1):1-8.
7. Vasudevan M, Parle M. Effect of Anwala Churna (*Emblica officinalis* G AERTN.): An Ayurvedic preparation on memory deficit rats. Yakugaku Zasshi. 2007;127(10):1701-7.
8. Baliga MS, Meera S, Mathai B, Rai MP, Pawar V, Palatty PL. Scientific validation of the ethnomedicinal properties of the Ayurvedic drug Triphala: a review. Chinese Journal of Integrative Medicine. 2012 Dec;18:946-54.
9. Ashokkumar D. Pharmacognostical investigations on Triphala churnam. Ancient Science of Life. 2007 Jan 1;26(3):40-4.
10. Sandhya T, Lathika KM, Pandey BN, Mishra KP. Potential of traditional ayurvedic formulation, Triphala, as a novel anticancer





- drug. Cancer letters. 2006 Jan 18;231(2):206-14.
11. Kulkarni KV, Ghurghure SM. Indian gooseberry (*Emblica officinalis*): Complete pharmacognosy review. International Journal of Chemistry Studies. 2018;2(2):5-11.
  12. Mandal A, Reddy JM. A review on phytochemical, pharmacological and potential therapeutic uses of *Phyllanthus emblica*. World Journal of Pharmaceutical Research. 2017 May 15;6(7):817-30.
  13. Scartezzini P, Speroni E. Review on some plants of Indian traditional medicine with antioxidant activity. Journal of ethnopharmacology. 2000 Jul 1;71(1-2):23-43.
  14. Kim HJ, Yokozawa T, Kim HY, Tohda C, Rao TP, Juneja LR. Influence of amla (*Emblica officinalis* Gaertn.) on hypercholesterolemia and lipid peroxidation in cholesterol-fed rats. Journal of nutritional science and vitaminology. 2005;51(6):413-8.
  15. Arora S, Kaur K, Kaur S. Indian medicinal plants as a reservoir of protective phytochemicals. Teratogenesis, carcinogenesis, and mutagenesis. 2003;23(S1):295-300.
  16. Thakur RS, Puri HS, Husain A. Major medicinal plants of India. 1989. Central Institute of Medicinal and Aromatic Plants, Lucknow, India.;1.
  17. Ghosal S. Active constituents of *Emblica officinalis*: Part I. The chemistry and antioxidative effects of two new hydrolysable tannins, Emblicanin A and B. Indian J. Chem.. 1996;35:941-8.
  18. Zhang LZ, Zhao WH, Guo YJ, Tu GZ, Lin S, Xin LG. Studies on chemical constituents in fruits of Tibetan medicine *Phyllanthus emblica*. Zhongguo Zhong yao za zhi= Zhongguo zhongyao zazhi= China journal of Chinese materia medica. 2003 Oct;28(10):940-3.
  19. El-Desouky SK, Ryu SY, Kim YK. A new cytotoxic acylated apigenin glucoside from *Phyllanthus emblica* L. Natural Product Research. 2008 Jan 10;22(1):91-5.
  20. Kapoor LD. Handbook of Ayurvedic Medicinal Plants, CRC. Press, LLC. 1990;239.
  21. Nizamuddin M, Hoffman J, Larm O. Fractionation and characterization of carbohydrates from *Emblica officinalis* Gaertn. fruit.
  22. Barthakur NN, Arnold NP. Chemical analysis of the emblic (*Phyllanthus emblica* L.) and its potential as a food source. Scientia Horticulturae. 1991 Jun 1;47(1-2):99-105.
  23. Fengshu L, Kaiwei H, Shaojia L, Chenwu Y, Ping Z. Antisenescence effect of *Phyllanthus emblica* fruits I: analysis of superoxide dismutase activity in fruits. In Chemical Abstract 1992 (Vol. 116, pp. 127-273).
  24. EL-MEKKAWY S, MESELHY MR, Kusumoto IT, KADOTA S, Hattori M, NAMBA T. Inhibitory effects of Egyptian folk medicines on human immunodeficiency virus (HIV) reverse transcriptase. Chemical and pharmaceutical bulletin. 1995 Apr 15;43(4):641-8.
  25. Siddiqui IA, SM O, MR S, KT A. Fatty acid components of seed fats from four plant families.
  26. Khanna P, Bansal R. Phyllantidine and phyllantine from *Emblica officinalis* Gaertn. leaves, fruits and in vitro tissue cultures.
  27. Abinaya R, Nirmala RV, Monika T, Rani RK, Devi MS. ANTICANCER POTENTIALS OF ANCIENT SIDDHA TRADITIONAL PLANTS—AN RECENT UPDATE.
  28. Qasim M, Abideen Z, Adnan MY, Gulzar S, Gul B, Rasheed M, Khan MA. Antioxidant properties, phenolic composition, bioactive

- compounds and nutritive value of medicinal halophytes commonly used as herbal teas. South African Journal of Botany. 2017 May 1;110:240-50.
29. Siracusa L, Ruberto G, Cristino L. Recent Research on Cannabis sativa L.: Phytochemistry, New Matrices, Cultivation Techniques, and Recent Updates on Its Brain-Related Effects (2018–2023). *Molecules*. 2023 Apr 12;28(8):3387.
  30. Uwineza PA, Waśkiewicz A. Recent advances in supercritical fluid extraction of natural bioactive compounds from natural plant materials. *Molecules*. 2020 Aug 24;25(17):3847.
  31. Vedanthan PK, Nelson HS, Agashe SN, Mahesh PA, Katial R, editors. Textbook of Allergy for the Clinician. CRC Press, Taylor & Francis Group; 2014 Feb 21.
  32. Shahryari S, Sadeghi A. Probiotic Yeasts 48. Handbook of Food Bioactive Ingredients. 2023:1533.
  33. Smit PW, Elliott I, Peeling RW, Mabey D, Newton PN. An overview of the clinical use of filter paper in the diagnosis of tropical diseases. *The American journal of tropical medicine and hygiene*. 2014 Feb 2;90(2):195.
  34. Eskin M, Robinson DS, editors. Food shelf life stability: chemical, biochemical, and microbiological changes. CRC Press; 2000 Sep 19.
  35. Mahata S, Pandey A, Shukla S, Tyagi A, Husain SA, Das BC, Bharti AC. Anticancer activity of *Phyllanthus emblica* Linn.(Indian gooseberry): inhibition of transcription factor AP-1 and HPV gene expression in cervical cancer cells. *Nutrition and cancer*. 2013 Jan 1;65(sup1):88-97.
  36. Samatiwat P, Tabtimmai L, Suphakun P, Jiwacharoenchai N, Toviwek B, Kukongviriyapan V, Gleeson MP, Choowongkomon K. The effect of the EGFR-targeting compound 3-[(4-Phenylpyrimidin-2-yl) amino] benzene-1-sulfonamide (13f) against cholangiocarcinoma cell lines. *Asian Pacific Journal of Cancer Prevention: APJCP*. 2021 Feb;22(2):381.
  37. Suresh K, Vasudevan DM. Augmentation of murine natural killer cell and antibody dependent cellular cytotoxicity activities by *Phyllanthus emblica*, a new immunomodulator. *Journal of ethnopharmacology*. 1994 Aug 1;44(1):55-60.
  38. Suja RS, Nair AM, Sujith S, Preethy J, Deepa AK. Evaluation of immunomodulatory potential of *Emblica officinalis* fruit pulp extract in mice. *Indian Journal of Animal Research*. 2009;43(2):103-6.
  39. Kapoor LD. Handbook of Ayurvedic medicinal plants CRC Press Inc.
  40. Reddy VD, Padmavathi P, Paramahansa M, Varadacharyulu NC. Amelioration of alcohol-induced oxidative stress by *Emblica officinalis* (amla) in rats.
  41. Li W, Zhang X, Chen R, Li Y, Miao J, Liu G, Lan Y, Chen Y, Cao Y. HPLC fingerprint analysis of *Phyllanthus emblica* ethanol extract and their antioxidant and anti-inflammatory properties. *Journal of Ethnopharmacology*. 2020 May 23;254:112740.
  42. Perianayagam JB, Sharma SK, Joseph A, Christina AJ. Evaluation of anti-pyretic and analgesic activity of *Emblica officinalis* Gaertn. *Journal of ethnopharmacology*. 2004 Nov 1;95(1):83-5.
  43. Golechha M, Sarangal V, Ojha S, Bhatia J, Arya DS. Anti-Inflammatory Effect of *Emblica officinalis* in Rodent Models of Acute and Chronic Inflammation: Involvement of Possible Mechanisms. *International journal of inflammation*. 2014;2014(1):178408.

44. Lim DW, Kim JG, Kim YT. Analgesic effect of Indian gooseberry (*emblica officinalis* fruit) extracts on postoperative and neuropathic pain in rats. *Nutrients*. 2016 Nov 26;8(12):760.
45. Hussain, S. Z., Naseer, B., Qadri, T., Fatima, T., and Bhat, T. A. (2021b). "Anola(*emblica officinalis*): morphology, taxonomy, composition and health benefits," in *Fruits grown in highland regions of the himalayas: nutritional and health benefits* (Cham: Springer International Publishing), 193–206.
46. Bitew M, Desalegn T, Demissie TB, Belayneh A, Endale M, Eswaramoorthy R. Pharmacokinetics and drug-likeness of antidiabetic flavonoids: Molecular docking and DFT study. *Plos one*. 2021 Dec 10;16(12):e0260853
47. Jahan N, Akter S. Assessment of the antimicrobial activity of the ethanolic extract of *Phyllanthus emblica* in combination with different classes of antibiotics against single and multi-drug resistant strains. *Journal of Pharmacognosy and Phytochemistry*. 2015;4(4):142-55
48. Farhana F, Mosaddek AS, Joynal BJ, Sharmin H, Mosaddek N. Antibacterial effect of Amlaki (*Phyllanthus emblica*) extract against *Pseudomonas aeruginosa*. In *Proceedings The International Allied Health Students Conference (IAHSC) 2022* Oct 31 (pp. 78-82).
49. Nair A, Balasaravanan T, Jadhav S, Mohan V, Kumar C. Harnessing the antibacterial activity of *Quercus infectoria* and *Phyllanthus emblica* against antibiotic-resistant *Salmonella Typhi* and *Salmonella Enteritidis* of poultry origin. *Veterinary world*. 2020 Jul;13(7):1388.
50. Baliga MS, Shivashankara AR, Thilakchand KR, Baliga-Rao MP, Palatty PL, George T, Rao S. Hepatoprotective effects of the Indian Gooseberry (*Emblica officinalis* Gaertn): a revisit. In *Dietary interventions in liver disease 2019* Jan 1 (pp. 193-201). Academic Press.
51. Huang CZ, Tung YT, Hsia SM, Wu CH, Yen GC. The hepatoprotective effect of *Phyllanthus emblica* L. fruit on high fat diet-induced non-alcoholic fatty liver disease (NAFLD) in SD rats. *Food & function*. 2017;8(2):842-50.
52. Yokozawa T, Kim HY, Kim HJ, Tanaka T, Sugino H, Okubo T, Chu DC, Juneja LR. Amla (*Emblica officinalis* Gaertn.) attenuates age-related renal dysfunction by oxidative stress. *J. of Agricultural and Food Chemistry*. 2007 Sep 19;55(19):7744-52.
53. Girsang E, Halima P, Nasution AN, Lie S. Nephroprotective Effect of Ethanolic Extract of Balakka (*Phyllanthus emblica* L.) on Rats Induced Ethylene Glycol and Ammonium Chloride. *Indonesian Journal of Pharmaceutical and Clinical Research*. 2019 Dec 31;2(2):36-42.
54. Thakur CP. *Emblica officinalis* reduces serum, aortic and hepatic cholesterol in rabbits. *Experientia*. 1985 Mar;41:423-4.
55. Mathur R, Sharma A, Dixit VP, Varma M. Hypolipidaemic effect of fruit juice of *Emblica officinalis* in cholesterol-fed rabbits. *Journal of Ethnopharmacology*. 1996 Feb 1;50(2):61-8.
56. Iqbal Z, Asif M, Aslam N, Akhtar N, Asmawi MZ, Fei YM, Jabeen Q. Clinical investigations on gastroprotective effects of ethanolic extract of *Phyllanthus emblica* Linn fruits. *Journal of Herbal Medicine*. 2017 Mar 1;7:11-7.
57. Wu T, Liu X, Sun Z, Xing S, Han L, Li X, Pan X, Chen J, Zhou M, Derkach T, Bielicki JK. Fruit of *Phyllanthus emblica* L. suppresses macrophage foam-cell genesis and vascular lipid deposition using in vivo and in vitro models of early atherosclerosis development.

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2022;28(4):317-28.

58. Vauzour D, Vafeiadou K, Rodriguez-Mateos A, Rendeiro C, Spencer JP. The neuroprotective potential of flavonoids: a multiplicity of effects. *Genes & nutrition*. 2008 Dec;3:115-26.

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