Phytochemistry, pharmacological activities and traditional uses of *Emblica officinalis*: A review


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**ABSTRACT**

From the ancient time, plants have been playing a key role for the betterment of mankind presenting as an extraordinary source of natural medicine. The complexity in formulating chemical based drugs as well as their health related side effects and uprising cost has led worldwide researchers to focus on medicinal plant research. Bangladesh has a vast repository of diverse plant species where about five thousand plants species have been claimed as having significant medicinal values. The researched papers on medicinal plants published from last few decades mention the activities of different plant bioactive compounds in the treatment of various human ailments. *Emblica officinalis* is reported to possess bioactive compounds like tannins, flavonoids, sapopins, terpenoids, ascorbic acids and many other compounds which are confirmed to have diverse pharmacological activities like antimicrobial, antioxidant, anti-inflammatory, radio-protective, hepatoprotective, antitussive, immunomodulatory, hypolipidemic and many other activities. This medicinal plant is also reported to have antitumor, anti HIV-reverse transcriptase, anti diabetic, antidepressant, antiulcerogenic, wound healing activities and so forth. The current review paper summarizes the phytochemical constituents, pharmacological activities and traditional uses of the plant *Emblica officinalis*.

**Key Words**: Euphorbiaceae, Amla, Bangladesh.

**INTRODUCTION**

*Emblica officinalis* Gaertn. (Family–Euphorbiaceae) also known as *Phyllanthus emblica*, is commonly known as ‘Amla’ or ‘amla’ in Bengali and ‘Indian gooseberry’ in English. This species is medium sized deciduous tree with 8-18 meters height and is native to tropical southeastern Asia, particularly in central and southern India, Pakistan, Bangladesh, Sri Lanka, southern China, the Maccarense Islands and Malaysia (Table 1). In India, Amla trees are found throughout the forests of tropical area ascending up to 4500 ft on hills (Rai et al., 2012; Thilaga et al., 2013). Amla is rich in fiber, carbohydrate, iron and is reported as the richest source of vitamin C (Singh et al., 2011) (Table 2). The fruit is also used in a combination form known as Triphala meaning three fruits which is a Thai traditional herbal formulation composed of *Emblica officinalis*, *Terminalia belerica* and *Terminalia chebula* (Phetkate et al., 2012).

Many herbal and patent drugs have been formulated by the constituents of this plant (Rai et al., 2012). *E. officinalis* primarily contains tannins, flavonoids, phenolic compounds, saponins, terpenoids, ascorbic acids, carbohydrates and many other compounds (Khan, 2009). Supplements of fresh amla fruit is very favorable to individuals suffering from anemia. The juice of fresh amla fruit is given as diuretic, anti-bilious remedy and as a tonic. It is also helpful in over thirst, dyspepsia, burning sensation and other complaints of digestive system (Kumar et al., 2012b).

**Taxonomy**

Taxonomical classification of *E. officinalis* is summarized in table 3.

**PHYTOCHEMISTRY**

This herb has many bioactive compounds including apigenin, gallic acid, ellagic acid, chebulinic acid, quercetin, chebulagic acid, corilagin, isooricitrin, methyl gallate, luteolin and so on. Emblicin A, emblicin B, phyllaemblicin B, punigluconin and pedunculagin are tannins present in *Emblica officinalis* (Table 4). Glutamic acid, proline, aspartic acid, alanine, and lysine are 29.6%, 14.6%, 8.1%, 5.4% and 5.3% respectively of the total amino acids. The pulpy portion of fruit, dried and freed from the nuts contains: gallic acid 1.32%, tannin, gum 13.75%; albumin 13.08%; crude cellulose 17.08%; mineral matter 4.12% and moisture 3.83%. Amla fruit ash contains chromium, 2.5 ppm; zinc 4 ppm; and copper, 3 ppm (Kumar et al., 2012a). Nickel and lead metals were not found in leaves of *Emblica officinalis*. The level of copper was found higher in the sample leaves of *Emblica officinalis* followed by chromium, manganese and zinc (Kumar et al., 2013). Chemical constituents from different plant parts are illustrated below:

*Leaves*: It contains gallic acid, chebulic acid, ellagic acid, chebulinic acid, chebulagic acid, amlic acid, alkaloids phyllantine and phyllantidine (Khan, 2009).

*Seeds*: A fixed oil, phosphtates and a small quantity of essential oil. The fixed oil (acid value 12.7; saponification value 185; iodine value 139.5; acetyl value 2.03; unsaponifiable matter 3.81%; sterol 2.70%; saturated fatty acid 7%). Contains linolenic acid (8.78%), linoleic (44%), oleic (28.40%), steric (2.15%), palmitic (2.99%) and miristic acid (0.95%) (Khan, 2009).

*Barks*: Contain leukodelphinidin, tannin and proanthocyanidin (Khan, 2009).

*Roots*: Contain ellagic acid and lupeol (Khan, 2009).
Table 1: Botanical description of *E. officinalis*.

<table>
<thead>
<tr>
<th>Feature</th>
<th>Description</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Habitat</td>
<td>Central and southern India, Pakistan, Bangladesh, Sri Lanka, Malaysia, southern China, the Mascarene Islands, South East Asia and Uzbekistan.</td>
<td>Rai et al., 2012; Thilaga et al., 2013; Khan, 2009</td>
</tr>
<tr>
<td>Appearance</td>
<td>Medium sized deciduous tree, 8-18 meters height with thin light grey bark exfoliating in small thin irregular flakes.</td>
<td>Meena et al., 2010</td>
</tr>
<tr>
<td>Used parts</td>
<td>Dried fruits, fresh fruit, seed, leaves, root bark, flowers.</td>
<td>Khan, 2009; Kumar et al., 2012b</td>
</tr>
<tr>
<td>Leaves</td>
<td>Simple, sub sessile, closely set along the branchlets, light green having the appearance of pinnate leaves.</td>
<td>Meena et al., 2010</td>
</tr>
<tr>
<td>Fruits</td>
<td>15-20 mm long and 18-25 mm wide, nearly spherical or globular wider than long and with a small and slight conic depression on both apices. Mesocarp is yellow and endocarp is yellowish brown in ripened condition</td>
<td>Khan, 2009</td>
</tr>
<tr>
<td>Flowers</td>
<td>Greenish yellow, in axillary fascicles, unisexual, males numerous on short slender pedicels, females few, sub sessile, ovary 3-celled.</td>
<td>Meena et al., 2010; Rai et al., 2012</td>
</tr>
<tr>
<td>Seeds</td>
<td>Four-Six, smooth, dark brown</td>
<td>Khan, 2009</td>
</tr>
<tr>
<td>Barks</td>
<td>Thick to 12 mm, shining grayish brown or grayish green</td>
<td>Khan, 2009</td>
</tr>
<tr>
<td>Flowering and fruiting</td>
<td>February - May and December - January</td>
<td>Rai et al., 2012</td>
</tr>
<tr>
<td>Edible part</td>
<td>Mesocarp and endocarp that forms the hard stone which encages the seed</td>
<td>Patel and Goyal, 2011</td>
</tr>
</tbody>
</table>

**PHARMACOLOGICAL INVESTIGATIONS**

**Antibacterial activity**
Antibacterial activities of different solvent extracts and isolated compounds from *Emblica officinalis* are shown in Table 5.

**Antifungal activity**
Antifungal property of *E. officinalis* was reported against *Aspergillus* (Satish et al., 2007). Fruit ethanol and acetone extracts showed moderate activity against *Fusarium equiseti* and *Candida albicans* where Grisofulvin was used as standard antibiotic (Hossain et al., 2012). Plant methanolic extract of *E. officinalis* did not show antifungal activity against phytopathogenic fungi *Aspergillus niger* F2723 (Bobbarala et al., 2009).

**Antioxidant and free radical scavenging activity**
Gallic acid equivalent as total phenolic content from fruit and seed of *E. officinalis* has excellent antioxidant properties and play an important role as free radical scavengers required in the maintenance of “redox homeostasis” responsible for diverse degenerative diseases (Prakash et al., 2012). The methanolic seed extract of *Emblica officinalis* has promising free radical scavenging activity of 1,1-Diphenyl-2-picryl-hydrazil (DPPH) in a concentration dependant manner (Priya et al., 2012). Methanolic extract of fruit pulp also have antioxidant and free radical scavenging activity (Mehrotra et al., 2011; Liu et al., 2008a; Liu et al., 2008b, Hazra et al., 2010, Majumdar et al., 2010).

Methanolic extracts of dried leaves of *Phyllanthus emblica* was used for the comparative study of antibacterial and antioxidant activity and the research work was ended positively showing the extract has both these activities (Shivaji et al., 2010). In a separate research work, it is seen that the water extract of *E. officinalis* fruit prepared according to Thai Herbal Pharmacopoeia has a strong potential for free radical scavenging, ferric reducing as well as inhibiting ROS (reactive oxygen species) production (Charoentearaboon et al., 2010).

**Insecticidal activity**
Saponins which are important constituents of *E. officinalis* have insecticidal or cytotoxic properties to certain insects (Chaieb, 2010). Although saponins which had shown insecticidal activity was collected from natural sources other than *E. officinalis*. But as saponins are bioactive compounds found in *E. officinalis* too, it is obvious that *E. officinalis* might have insecticidal activity and further evaluation can be conducted to get more precise evaluation.

**Larvicidal and mosquitoctidal activity**
In a mosquitocidal property evaluation test Murugan et al. (2012) observed larvicidal and pupalic activities of methanol extract of *E. officinalis* against the malarial vector, *Anopheles stephensi* showing 98% mortality rate at 100 ppm. The ethanol and methanol extracts of *E. officinalis* also exerted 100% mortality (no hatchability) at 400 ppm and above (Murugan et al., 2012). Jeyasankar et al. (2012)
reported that the larvicidal activity of *Phyllanthus emblica* ethyl acetate leaf extracts. The study concluded that the ethyl acetate extract of *P. emblica* exhibited the maximum larvicidal activity (99.6%) with LC50 (lethal Concentration brings out 50% mortality) value of 78.89 ppm against the larvae of *Aedes aegypti* (Jeyasankar et al., 2012).

Antidepressant activity
Pemminati et al. (2010) has checked the antidepressant activity of aqeous extract of fruits of *E. officinalis* in inbred adult male Swiss Albino mice weighing 25-30g. The test was carried out by forced swim test (FST) and tail suspension test (TST). The result of this test showed the antidepressant activity of *E. officinalis* as comparable to the of standard antidepressant drug imipramine.

Immunomodulatory activity
Reports suggest that triphala can stimulate the neutrophil functions in the immunized albino rats (Srikumar et al., 2005). There was considerable dose dependent raise in haemagglutination antibody titre, macrophage migration index, hypersensitivity reaction, respiratory burst activity of the peritoneal macrophages, total leukocyte count, percentage lymphocyte distribution, serum globulin and relative lymphoid organ weight in *Emblca* treated albino mice indicating its ability to stimulate humoral and cell mediated immunity along with macrophage phagocytosis (Suja et al., 2009).

Anti-inflammatory activity
*E. officinalis* showed anti-inflammatory activities in carrageenan induced acute and cotton pellet induced chronic inflammation in Sprague-Dawley rats by reducing paw volume in acute inflammation and by decreasing cotton pellet induced granulomas tissue lipid peroxidation, the granulomatous tissue mass, myeloperoxidase activity and plasma extravasation in chronic inflammatory condition (Muthuraman et al., 2011). *E. officinalis* water extract has reported to have inhibitory effect on the synthesis and release of inflammatory mediators in rats (Jajoy et al., 2010).

Radioprotective activity
It has been reported that mice treated with *Emblca officinalis* extract before exposure to different doses of gamma radiation can reduce the severity of symptoms of radiation sickness and mortality (Singh et al., 2006). Similar delayed onset of mortality and reduction in the symptoms of radiation sickness in mice were seen in consecutively triphala treated mice before irradiation when compared with the non-drug treated irradiated controls (Jagettia et al., 2002).

Hypolipidemic activity
Amla fruit have been reported to have significant anti-hyperlipidemic, hypolipidemic, and anti-atherogenic effect (Santoshkumar et al., 2013). Treatment with *Emblca officinalis* caused significant reduction of Total Cholesterol (TC), Low Density Lipoprotein (LDL), triglyceride (TG) and Very Low Density Lipoprotein (VLDL), and a significant increase in High Density Lipoprotein (HDL) levels in patients with type II hyperlipidemia. Both treatments from *E. officinalis* and simvastatin produced significant reduction in blood pressure; however, this beneficial effect was more marked in patients receiving *E. officinalis* (Gopa et al., 2012). Histopathological study of thoracic aorta of *Emblca officinalis* treated group has shown decrease in atherogenicity compared to untreated high cholesterol diet fed rats. The data demonstrated that *Emblca officinalis* formulation was associated with hypolipidemic effects on the experimentally induced hypercholesteremic rats (Kumar and Kalaivani, 2011). It is also seen that *E. officinalis* treated rat showed more hypoglycemic and hypolipidemic activity than *Phyllanthus acidus* treated diabetic rats (Modilal and Pitchai, 2011).

Cytotoxic effects
To evaluate the immunostimulatory and side effects of *Triphala* in a clinical phase I, all the volunteers took *Triphala* for two weeks (3 capsules per day). As complete physical examinations, routine laboratory analysis and immunological studies were performed before ingestion and after initial meeting for 4 consecutive weeks. The result revealed significant immunostimulatory effects on cytotoxic T cells (CD3–CD8+) and natural killer cells (CD16+CD56+). Both of them increased significantly when after initial meeting for 4 consecutive weeks. All volunteers were healthy and showed no adverse effects throughout the duration of the study (Phetkate et al., 2012). Flavonoids, a group of essential bioactive secondary metabolites of *Emblca officinalis*, were evaluated for antioxidant potential, cytotoxicity and intestinal absorption. The research concluded that flavonoids from *E. officinalis* and some other medicinal plants hold a good prospective as nutraceutical & chemotherapeutics agents because of their antioxidant potential, no cytotoxicity and good intestinal absorptive property (Sharma et al., 2010). But it is confirmed that the chloroform soluble fraction of the ripe fruits of Amlaki containing alkaloids have both antimicrobial and cytotoxic activity (Rahman et al., 2009).
evaluated for hypoglycemic effects and Oral Glucose Tolerance Test (OGTT) in normal and Alloxan induced diabetic rats and significant, marginal and very less decrease in blood glucose level was observed when different herbal combinations were used (Deep et al., 2011).

The polyherbal combination of extracts E. officinalis (fruit), Momordica charantia (fruit) and Trigonella foenum-graecum (leaves and seeds) has shown synergistic activity, as the glucose levels were decreased more significantly by the combination of extracts compared to the individual extract when used separately in streptozotocin induced diabetic rats (Satyanarayana et al., 2010). The aqueous fruit extract of Phyllanthus emblica was evaluated on type-II diabetes, triglycerides (TG) and liver-specific enzyme, alanine transaminase (ALT). This study showed that in a dose of 200mg/kg body weight the aqueous fruit extract can significantly reduce the blood glucose level in alloxan-induced diabetic rats (Qureshi et al., 2009). Another study reports that Phyllanthus emblica treated rat showed more hypoglycemic and hypo lipemic activity than Phyllanthus acidus treated diabetic rats when the effect of orally administered aqueous extracts (350 mg/kg body weight) of fruits of Phyllanthus emblica and Phyllanthus acidus on serum glucose, glycosylated hemoglobin, insulin, cholesterol, triglycerides, HDL-cholesterol, protein, urea and creatinine were examined in control and extract treated diabetic rats (Modilal and Pitchai, 2011).

Hepato-protective activity
The histopathological study of liver cells of rats was examined by administering E. officinalis as a preventative agent to reduce paracetamol induced hepatoxicity and it has been observed that fruit extract has the ability to rectify toxicity or hepatic damage (Malar and Bai, 2009). Another histological study was undertaken to demonstrate the protective effect of 50% hydroalcoholic extract of the fresh fruit of E. officinalis against chronic toxicity induced by carbon tetrachloride and thioacetamide in rats. From the liver sections of the tested rats, it was observed that E. officinalis reversed the abnormal histopathology by accelerating the regenerative activity and in a few cases, the hepatocytic injury was found negligible in E. officinalis treated group of rats (Mir et al., 2007).

Anti-cancer and anti-proliferative activity
E. officinalis exhibits its anticancer activities through inhibition of activator protein-1 and targets transcription of viral oncogenes responsible for development of cervical
cancer thus demonstrating its potential efficacy for treatment of human papillomavirus-induced cervical cancers (Mahata et al., 2013).

An in vitro cytotoxicity was performed against five human cancer cell lines and the activity was done using 100 µg/mL of the ethanolic whole plant extract of E. officinalis. Against lung (A-549) cell line plant extract showed 82% growth inhibition. In case of liver cell line (Hep-2), it showed no activity, whereas in colon 502713 cell line, the plant extract displayed maximum activity. In case of IMR-32 neuroblatima cell line and HT-29 liver human cancer line, the plant extract showed 97% and 98% activity, respectively (Verma et al., 2012). E. officinalis fruit extract at 50-100 µg/mL can significantly inhibit cell growth of six human cancer cell lines, A549 (lung), HepG2 (liver), HeLa (cervical), MDA-MB-231 (breast), SK-OV3 (ovarian) and SW620 (colorectal). (Ngamkitidechakul et al., 2010). HepG2 and A549 cells were treated with P. emblica and T. bellirica extracts alone or in combination with doxorubicin or cisplatin and effects on cell growth were determined using the sulforhodamine B (SRB) assay. Both the plant extracts demonstrated growth inhibitory activity against the two cancer cell lines tested (Pinnai et al., 2008). Studies also demonstrated that amla extracts are cytotoxic and restrain the in vitro proliferation of some tumor cell lines such as MK-1 (human gastric adenocarcinoma) and B16F10 (murine melanoma) (Zhang et al., 2010). HepG2 and A549 cells were treated with P. emblica and T. bellirica extracts alone or in combination with doxorubicin or cisplatin and effects on cell growth were determined using the sulforhodamine B (SRB) assay. Both the plant extracts demonstrated growth inhibitory activity against the two cancer cell lines tested (Pinnai et al., 2008).

Table 5: Antibacterial activity of different solvent extracts and isolated compounds from Emblica officinalis.

<table>
<thead>
<tr>
<th>Used extracts/other compounds</th>
<th>Used organisms</th>
<th>Extract conc.</th>
<th>Max. zone of inhibition (mm)</th>
<th>Organism(s) showed highest activity</th>
<th>Extract or extract conc. showed highest activity</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ethanol, Acetone (Fruit extract)</td>
<td>V. cholerae, S. aureus, P. aeruginosa, B. subtilis, Shigella dysenteriae, S. pyogenes, E. coli, B. megaterium</td>
<td>0.5 mg/disc 100 µg/ml</td>
<td>12.7</td>
<td>Shigella dysenteriae</td>
<td>Ethanol</td>
<td>Hossain et al., 2012</td>
</tr>
<tr>
<td>Hexane, Chloroform, Methanol (Fruit extract)</td>
<td>E. coli, K. pneumoniae, P. vulgaris, M. luteus, B. subtilis, E. faecalis, S. faecalis</td>
<td>50 mg/ml 100 µg/ml</td>
<td>34 36</td>
<td>E. faecalis E. faecalis, K. pneumoniae</td>
<td>Methanol</td>
<td>Jyothi and Rao, 2011</td>
</tr>
<tr>
<td>Petroleum ether, Chloroform, Alcohol (Fruit extract)</td>
<td>E. coli, P. aeruginosa, S. aureus, B. subtilis</td>
<td>10 mg/ml 20 mg/ml</td>
<td>12 22</td>
<td>S. aureus S. aureus</td>
<td>Alcohol</td>
<td>Dhale and Mogle, 2011</td>
</tr>
<tr>
<td>Methanolic seed extract</td>
<td>E. coli, S. aureus, K. pneumoniae, P. aeruginosa, Enterococcus</td>
<td>50 mg/ml 100 µg/ml 150 mg/ml 200 mg/ml</td>
<td>14 17 18.5 21</td>
<td>P. aeruginosa E. coli S. aureus S. aureus</td>
<td>200 mg/ml extract conc.</td>
<td>Priya et al., 2012</td>
</tr>
<tr>
<td>Polar flavanoids (Leaf extract)</td>
<td>P. vulgaris, S. aureus, E. coli, S. typhi</td>
<td>100 mg/ml 500 mg/ml 1000 mg/ml</td>
<td>17 18 19</td>
<td>S. typhi S. aureus, E. coli, S. typhi E. coli, S. typhi</td>
<td>No significant differences</td>
<td>Bansod, 2012</td>
</tr>
<tr>
<td>Non-polar flavanoids (Leaf extract)</td>
<td>P. vulgaris, S. aureus, E. coli, S. typhi</td>
<td>100 mg/ml 500 mg/ml 1000 mg/ml</td>
<td>16 19 19</td>
<td>S. aureus, E. coli E. coli P. vulgaris</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tannin (isolated from leaves of E. officinalis)</td>
<td>E. coli, Pseudomonas aeruginosa, B. subtilis, Shigella boydii, Shigella flexneri, S. aureus, S. epidermidis</td>
<td>0.5 mg/ml 1 mg/ml 1.5 mg/ml 2 mg/ml 2.5 mg/ml 3 mg/ml 3.5 mg/ml 4 mg/ml 4.5 mg/ml 5 mg/ml</td>
<td>Negligible 4.2 8.5 9.5 10.7 11.5 12.9 15.2 17.9 18</td>
<td>NA S. subtilis E. coli, S. subtilis E. coli E. coli E. coli E. coli E. coli E. coli E. coli</td>
<td>5 mg/ml</td>
<td>Shinde et al., 2010</td>
</tr>
<tr>
<td>Tannin (isolated from fruits of E. officinalis)</td>
<td>E. coli, Pseudomonas aeruginosa, B. subtilis, Shigella boydii, Shigella flexneri, S. aureus, S. epidermidis</td>
<td>0.5 mg/ml 1 mg/ml 1.5 mg/ml 2 mg/ml 2.5 mg/ml 3 mg/ml 3.5 mg/ml 4 mg/ml 4.5 mg/ml 5 mg/ml</td>
<td>Negligible Negligible 2.2 3.1 5.3 6.2 6.8 8.3 8.3 10.1</td>
<td>NA E. coli E. coli E. coli E. coli S. boydii S. boydii S. boydii E. coli</td>
<td>5 mg/ml</td>
<td>Shinde et al., 2010</td>
</tr>
</tbody>
</table>
that aqueous fraction and n-hexane fraction have highest inhibition of recombinant HIV-RT (91% and 89%, respectively) at 1 mg/ml concentration. Chloroform fraction showed highest inhibition of HIV-RT at 0.5 mg/ml and carbon tetrachloride fraction at 0.12 mg/ml concentration. At 0.12 mg/ml and 0.5 concentrations 50% of the HIV-RT activity is inhibited in n-hexane fraction and carbon tetrachloride fraction respectively (Estari et al., 2012).

**Anti ulcerogenic activity**

The ethanolic extract of *E. officinalis* has found highly effective in controlling growth of *H. pylori in-vitro* with minimum inhibitory control ranging from 0.91 to 1.87 µg/ml. The result concluded that the plant ethanolic extract is well retained with total phenolics, reducing power, flavanoids and the antioxidant properties which make amla a proper remedial use against *H. pylori* infection and gastric ulcer (Mehrotra et al., 2011).

**Antimutagenic and wound healing activity**

An investigation on Swiss albino mice showed that 50% methanolic extract of Emblica fruit can protect mice against the chromosome damaging effects of the well-known mutagen cyclophosphamide (Agrawal et al., 2012). Ascorbic acid and tannins of *E. officinalis*, namely emblicanin A and emblicanin B have strong antioxidant action and it is proposed that the addition of these antioxidants support the repair process of cells. Emblica

| Table 6: Traditional uses of *Emblica officinalis*. |
|---------------------------------|-----------------|-----------------|-----------------|-----------------|
| **Used part**                  | **Preparation/Administration** | **Dose**        | **Activity**     | **Treatment**    | **References**   |
| Fruit                          | The fruit or fresh fruit is pickled or preserved in sugar. Used when dry. | One or two fruits daily | Laxative         | Constipation     | Kumar et al., 2012b; Baliga and Dsouza, 2010 |
| Leaves, fresh fruit, seed      | Decoction of leaves or decoction of seed, dried grapes and sugar (for gargling) or decoction of fresh fruit and compounds containing equal part of Emblica seed, chirtrak root, chebulic myrobolan and pipili is given. | Not confirmed | Refrigerant and aperient | Fever            | Kumar et al., 2012b; Patel and Goyal, 2011; Srivasuki, 2012 |
| Fruit                          | Tablespoon of juice is mixed with a cup of bitter gourd juice | taken daily for two months | Antidiabetic activity | Diabetes, eye complication in diabetes | Kumar et al., 2012a; Singh et al., 2011 |
| Fruit, bark, root, leaves      | Fruit decoction is mixed with sour milk or, bark partakes of the astrigency of the fruit. Decoction and evaporation of the root solution produces an astringent extract equal to catechu. An infusion of the leaves with fenugreek seed is also given. | Not confirmed | Anti-diarrheal activity | Diarrhoea, chronic diarrhea | Kumar et al., 2012b; Srivasuki, 2012 |
| Root, leaves, node             | 10 gm roots are taken and ground. | Taken twice after meal per day. | Pain killing, anti-inflammatory activity | Dental problems | Kumar et al., 2012b; Srivasuki, 2012 |
|                                | Leaves are squeezed and the juice extracted | A few drops of juice is put in the ear. | Only few drops | |
| Bark                           | The juice of the bark combined with honey and turmeric is given. | Not confirmed | Antimicrobial activity | Gonorrhoea | Kumar et al., 2012b; Srivasuki, 2012 |
| Fruit                          | Fresh fruits or crushed fruits | Not confirmed | Growth promoting effects | Hair growth | Singh et al., 2011; Patel and Goyal, 2011; |
| Fruit                          | A paste of the fruit is a useful application to | Not confirmed | Headache, nausea or vomiting inhibitory effect | Cephalalgia (headache) | Kumar et al., 2012b; Patel and Goyal, 2011 |
| Leaves, root bark              | Decoction of the leaves or root bark mixed with honey is applied to inflammations of the mouth | Not confirmed | Anti-inflammatory, bactericidal activity | Treatment of aphthae or aphthous stomatitis | Kumar et al., 2012b |
| Fruit                          | One teaspoonful of powder of the dry fruit mixed with two teaspoon full of jaggery | Taken twice daily for a month | Anti-rheumatic activity | Rheumatism | Kumar et al., 2012a |
increases cellular proliferation at the wound site, as supported by a raise in the action of extracellular signal-regulated kinase 1/2, along with an increase in DNA, type III collagen, acid-soluble collagen, aldehyde content, shrinkage temperature and tensile strength (Sumitra et al., 2009).

**In vitro propagation**

A simple and one step reproducible protocol was developed by Thalaga et al. (2013) for induction of high frequency somatic embryogenesis from juvenile leaf tissues of *Emblica officinalis* in vitro. Highest percentage of callus (67.5%) was obtained on media containing 0.45 µM 2, 4-dichlorophenoxyacetic in combination with 22 µM 6-benzylaminopurine. Somatic embryogenesis and plantlet regeneration of *Emblica officinalis* was performed by using *in vitro* germinated seeds derived cotyledon explants to produce proembryos directly in MS media (Al-Sahab et al., 2012). Another efficient protocol for *in vitro* shoot proliferation of *Emblica officinalis* has been evaluated by using nodal explants where MS medium was found the best for shoot proliferation (Goyal and Bhadauria, 2007).

**TRADITIONAL USES**

Traditionally *E. officinalis* have been used for the ailments of different diseases in different countries for ancient periods. Traditional uses of *E. officinalis* are summarized in table 6.

**CONCLUSION**

Amla or Indian gooseberry has been playing a significant role from ancient times in traditional medicine, Ayurveda and in tribal medicine. The major group of phytochemicals of like tannins, flavonoids, terpenoids, lannins and other polyphenolic compounds extracted from Amla has been screened for diverse biological and biopharmaceutical investigations from last few decades. Some important Amla phytochemicals like gallic acid, ellagic acid, emblicanin A, emblicanin B, quercetin, phyllantine, phyllantidine and so forth have been confirmed as having different biological activities like antioxidant, antimicrobial, anti-inflammatory, anti-diabetic, antitussive, anti-radioprotective, chemopreventive, wound healing activities and so on. From the current investigation, it has been seen that some bioactive compounds from *Emblica officinalis* are also common in other medicinal plant species. These phytochemicals extracted from other plants has been investigated for different bioscreening showing significant results but have not been researched from *Emblica officinalis* solvent extraction yet. Therefore, further evaluation of unexplored bioactive compounds of Amla, is needed which can reveal more and more new biological activities of this potent medicinal plant.

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