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Review article

A CONCISE REVIEW ON THERAPEUTIC POTENTIAL OF AMLA (*EMBLICA OFFICINALIS* GAERTN.)

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ABSTRACT

Indian gooseberry or Amla or *Emblica officinalis* Gaertn. or *Phyllanthus emblica* Linn, one of the most important medicinal plant in the Ayurveda which is the world's most ancient traditional medicine system. Various parts of this plant are used in different diseases, but the most important and potent part is the fruit which contains majority of active constituent. Amla or *Emblica officinalis* is used either alone or in combination with other plants to treat several ailments like cancers, chronic inflammotary diseases like hypertension, high Cholesterol, Diabetes, influenza, Chronic cough, cold, Chronic infections, Chronic fatigue, liver problems, heart disease, ulcer, anemia and various other diseases. The major properties of Amla are Anti-inflammatory, Antioxidant, free radical scavenging , Antidepressant, Antifungal, Anti-diabetic, hypoglycemic, Anti ulcerogenic, Antimutagenic, Anti-cancer,anti-proliferative, Cytotoxic effects, Insecticidal, Larvicidal, mosquitocidal , Immunomodulatory, Hepato-protective, Radioprotective, Hypolipidemic and several other activities as demonstrated in numerous preclinical studies. This review summarizes the results related to these properties and also emphasizes the aspects that warrant future research establishing its activity and utility in different disease conditions specially in humans.

Key Words:-Amla, *Emblica officinalis*, Ayurveda, Active constituent, Preclinical studies.

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INTRODUCTION

Emblica officinalis commonly known as Indian gooseberry or Amla, family Euphorbiaceae, is a main herbal drug utilized in ayurvedic and unani systems of medicine. 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 and Malaysia. In India, Amla trees are found throughout the forests of tropical area ascending up to 4500ft on hills (Thilaga *et al.*, 2013 and Rai *et al.*, 2012). Amla is rich in fiber, carbohydrate, iron and vitamin C. (Singh *et al.*, 2011) The fruit is also used in a combination formknown as Triphala, A very famous ayurvedic formulation composed of *Emblica officinalis*, *Terminalia belerica* and *Terminalia chebula* (Phetkate *et al.*, 2012). Many herbal and patent drugs of Ayurveda and unani system of

medicine have been formulated by the use of different part of this plant (Rai *et al.*, 2012). *E. officinalis* plant contains tannins, flavonoids, phenolic compounds, saponins, terpenoids, ascorbic acids, carbohydrates and many other compounds (Khan and Khan, 2009).

The whole part of this plant is used for medicinal purposes, particularly the fruit, which has been used in Ayurveda as a rasayana and in the form of VayahSthapana. Amla is also described in the treatment of diarrhea, jaundice, and inflammation. The fruit is used either alone or in combination with other plants to treat many ailments of body such as common cold, fever; urinary problems, constipation, liver problems, allergy, stomach pain, chronic inflammatory conditions, hair fall, peptic ulcer, acidity etc. Moreover, plant parts show Anti-inflammatory, Antioxidant, free radical scavenging , Antidepressant, Antifungal, Anti-diabetic, hypoglycemic, Anti ulcerogenic, Antimutagenic, Anti-cancer,anti-proliferative, Cytotoxic effects, Insecticidal, Larvicidal, mosquitocidal, Immunomodulatory, Hepato-protective, Radioprotective, Hypolipidemic and several other activities (Hasan *et al.*, 2016).

Emblica officinalis

Indian gooseberry or *Emblica officinalis* was also known as and Avala or Amla in India It is a precious gift of nature to human health and vividly described in all ancient ayurvedic text of India. It belongs to family Euphorbiaceae found almost in all part of India. In Ayurveda, it is also known as "Dhatriphala", "Amalaki", "Vayasya" (Chunekar, 2004) etc. As per Ayurveda *Emblica officinalis* possesses Chakshusya (Eye tonic), Pittashamaka (Antacid), Balya (General tonic), Pramehaghna (Antidiabetic), Vrishya (Aphrodisiac) and Rasayana (Antiaging) properties*. *Emblica officinalis* (Amla) fruits are an integral part of most of the ayurvedic formulations, the most famous formulation of this fruit is known as Chvyanaprash.

Scientific Classification

Kingdom: Plantae
Order: Malpighiales
Family: Euphorbiaceae
Genus: Phyllanthus
Species: P. Emblica
Botanical name: ***Emblica officinalis Gaertn.***

Pharmacological properties

Astringent, antihaemorrhagic, anti-diarrhoeal, antiemetic, digestive,carminative, laxative, hepatoprotective, cooling, stomachic, tonic, anabolic, diuretic, antidiabetic, antioxidant, resistance building properties,immunomodulator, anti- ageing, restorative, anti-inflammatory, antipyretic, analgesics, antitumor, anticarcinogenic, antibacterial, antiviral, antifungal, expectorant, antispasmodic anti sclerotic, hypolipidemic, antiulcerogenic, adaptogenic, cardiac stimulant (Prajapati *et al.*, 2009 and The Unani Pharmacopoeia of India, 2007)

Common Uses

ophthalmic diseases, nausea, vomiting, jaundice, dysentery, as a cooling drink, urinary diseases, asthma, bronchitis, diabetes, general tonic, aphrodisiac, headache, dizziness, expectorant, as an antidote to poison, cough, hiccough etc. (Nadkarni, 2005).

Chemical constituent

An active ingredient that has significant pharmacological action in amla is discovered by Indian scientists as name "Phyllemblin" (Singh *et al.*, 2011). Other phytoconstituents are Hydrolysable tannins (Emblicanin A, Emblicanin B, punigluconin, pedunculagin), flavonoids (Kaempferol-3-O-alpha-L(6" methyl) rhamnopyranoside, Kaempferol 3-O-alpha-L 6"ethyl rhamnopyranoside, alkaloids (Phyllantidine and phyllantine), tannins, alkaloids, phenoliccompounds, amino acids and carbohydrates. Fruit juice contains the highest vitamin C (478.56mg/100mL). Compounds isolated from EO were gallic acid, ellagic acid,1-O-galloyl-beta-D-glucose, 3,6-di-O-galloyl D-glucose chebulinic acid, quercetin, chebulagic acid, corilagin, 1,6-di-O - galloyl beta D glucose, 3 Ethyl gallic acids (3 ethoxy 4,5 dihydroxy benzoic acid) and isostrictiniin. Amino acids-Glutamic acid, proline, aspartic acid, alanine, and lysine. Amla fruit ash contains chromium, 2.5 ppm; zinc 4 ppm; and copper, 3 ppm (Khan, 2009 and Kumar *et al.*, 2012).

Table 1. Probable mechanism of action of *Emblica officinalis*

	Liver	Insulin sensitivity↑ Lipid Peroxidation↓ Gluconeogenesis↓ Glycolysis↑ Glycogenesis↑
	Muscle	Glycolysis↑ Glycogenesis↑
	Eyes	Cataractogenesis↓ AGE formation↓ Aldol Reductase↓

Emblica officinalis (D'souza *et al.*, 2014)	Blood	Blood Glucose↓ HbA1C↓ Insulin, HDL↑ TG, Cholesterol, LDL↓
	Blood Vessel	Atherogenesis↓
	Kidney	Diabetic Nephropathy↓ Oxidative Stress↓ Apoptosis↓ Inflammation↓
	Neurons	Oxidative Stress↓ Neuropathy↓
	Pancreas	Apoptosis↓ Preserve & Regenerate beta cell↑ Insulin Secretion
	Testis	Sperm Viability↑ Sperm motality↑ Testosterone level↑

Table 2.Pharmacological Properties:

Anti-inflammatory activity	Muthuraman *et al.*, 2011	*E. officinalis* showed anti-inflammatory activities in carrageenan induced acute and cotton pellet induced chronic inflammation in Sprague-Dawley rats .
	Jaijoy *et al.*, 2010	*E. officinalis* aqueous extract has reported to have inhibitory effect on the synthesis and release of inflammatory mediators in rats.
Antioxidant and free radical scavenging activity	Prakash *et al.*, 2012	*E. officinalis* seed has excellent antioxidant proper-ties and play an important role as free radical scavengers due to the presence of Galic acid.
	Priya *et al.*, 2012	The methanolic seed extract of *Emblica officinalis* has promising free radical scavenging activity.
	Mehrotra *et al.*, 2011 Hazra *et al.*, 2010 Majumdar *et al.*,2010	Methanolic extract of *E. officinalis* fruit pulp showed potent antioxidant and free radical scavenging activity.
	Shivaji *et al.*, 2010	Methanolic extracts of dried leaves of *E. officinalis* exhibit good antibacterial and antioxidant activity.
	Charoenteeraboon *et al.*, 2010	Extract of *E. officinalis* fruit prepared as per Thai Herbal Pharmacopoeia has a strong potential for free radical scavenging activity.
Antidepressant activity	Pemminati et al. 2010	The antidepressant activity of aqueous extract of fruits of *E. officinalis* showed the antidepressant activity in adult male Swiss Albino mice.
Antifungal activity	Satish *et al.*, 2007	Reported antifungal property of *E. officinalis* against Aspergillus fungus.
	Hossain *et al.*, 2012	Ethanol and acetone extracts of *E. officinalis* fruit showed moderate activity against Fusariumequiseti and Candida albicans.
Anti-diabetic and hypoglycemic activity	Deep *et al.*, 2011	Herbal compound formulations prepared by extracts of *Tinospora cordifolia*, *Trigonella foenum* and *Emblica officinalis* were evaluated for hypoglycemic effect in alloxane induced diabetic rats. Results showed that they possess very less amount of hypoglycemic property.
	Satyanarayana *et al.*, 2010	The polyherbal combination of extracts *E. officinalis* (fruit), *Momordica charantia* (fruit) and *Trigonella foenum*- graecum (leaves and seeds) decreased blood sugar more significantly as compared to the individual extract in streptozotocin induced diabetic rats. It had shown their synergistic activity.

	Qureshi *et al.,* 2009	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
	Modilal and Pitchai, 2011	Another study reports that *Phyllanthus emblica* treated rat showed more hypoglycemic and hypo lipidemic activity than *Phyllanthus acidus* treated diabetic rats.
Anti ulcerogenic activity	Mehrotra *et al.,* 2011	The ethanolic extract of *E. officinalis* contains phenols, reducing power, flavanoids and different antioxidant which are responsible for controlling the growth of H. pylori in-vitro with minimum inhibitory control ranging from 0.91 to 1.87 µg/µl. All the phytoconstituent make *E. officinalis* (amla) a proper remedial use against H. pylori infection and gastric ulcer
Antimutagenic	Agrawal *et al.,* 2012	Investigated that methanolic extract of Emblica fruit can protect mice against the chromosome damaging effects of the well-known mutagen cyclophosphamide
Anti-cancer and anti-proliferative activity	Mahata *et al.,* 2013	*E. officinalis* extract exhibits its anticancer activities in human papillomavirus-induced cervical cancers by the inhibition of activator protein-1 and targets transcription of viral oncogenes.
	Verma *et al.,* 2012	An in vitro cytotoxicity was performed against different human cancer cell lines like human cancer cell lines, lung (A-549) cell line, liver cell line (Hep-2), colon 502713 cell line, IMR-32 neuroblastima cell line and HT-29 liver human cancer line by using *E. officinalis* fruit extract exhibit significant cytotoxicity against all cancer cell lines.
	Ngamkitidechakul *et al.,* 2010	*E. officinalis* fruit extract 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).
	Pinmai *et al.,* 2008	HepG2 and A549 cells were treated *E. officinalis* and *T. bellerica* 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 in cancer.
	Zhang *et al.,* 2004	*E. officinalis* extracts are cytotoxic and restrain the invitro proliferation of two tumor cell lines such as MK-1 (human gastric adenocarcinoma) and B16F10 (murine melanoma)
Cytotoxic effects	Phetkate *et al.,* 2012	In a study on human with ayurvedic formulation Triphala shown excellent immunostimulatory effect. The result revealed significant immunostimulatory effects on cytotoxic T cells (CD3−CD8+) and natural killer cells (CD16+CD56+). However, no significant change in cytokine secretion was detected also the volunteers were free from any side effect during entire study.
	Sharma *et al.,* 2010	The research concluded that flavonoids from *E.officinalis* and some other medicinal plants posseess good amount of nutraceutical & chemotherapeutics agents which are responsible for their good antioxidant, cytoprotective and intestinal absorptive property
	Rahman *et al.,* 2009	Ripe fruits *of E.officinalis* (Amlaki) contain some specefic alkaloids which have both antimicrobial and cytotoxic activity.
Insecticidal activity	Chaieb, 2010	*E. officinalis* contains some saponins which have insecticidal or cytotoxic properties to certain insects
Larvicidal and mosquitocidal activity	Murugan et al. 2012	Observed that methanolic extract of *E. officinalis* have larvicidal and pupicidal activities against the malarial vector.

	Murugan *et al.*,2012 Jeyasankar et al. 2012	The ethanolic and methanolic extracts of *E. officinalis* exerted 100% mortality of malarial paracite at 400 ppm and above.
Immunomodulatory activity	Srikumar *et al.*, 2005	Reported that an ayurvedic preparation triphala can stimulate the neutrophil functions in the immunized albino rats.
	Suja *et al.*, 2009	There was considerable dose dependent rise reported 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 Emblica treated albino mice.
Hepato-protective activity	Malar and Bai, 2009	The histopathological study of liver cells of rats was assessed by administering *E. officinalis* extract in paracetamol induced hepatotoxicity. It has been observed that fruits extracts have potancy to reverse the process of Hepatic damage.
	Mir *et al.*, 2007	Another histopathological study was undertaken to examine the protective effect hydroalcoholic extract of the fresh fruit of *E. officinalis* against chronic toxicity induced by carbon tetrachloride and thioacetamide in rats. It has been found in the study that *E. officinalis* extract have all the ability to reverse the heaptotoxicity.
Radioprotective activity	Singh et al., 2006	It has been reported that *Emblica officinalis* extract treatment can reduce the severity of symptoms of radiation sickness and mortality before exposure to different doses of gamma radiation in mice.
	Jagetia *et al.*, 2002	Similar reduction in mortality and radiation sickness symptoms in the mice treated with triphala prior to irradiation.
Hypolipidemic activity	Santoshkumar *et al.*, 2013	*Emblica officinalis* fruit showed significant hypolipidemic, antihyperlipidemic and anti-atherogenic property.
	Gopa *et al.*, 2012	Administration of *Emblica officinalis* in the patients with type II hyperlipidemia 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.
	Kumar and Kalaivani, 2011	In another Histopathological study on experimental rats shown decrease in atherogenicity compared to untreated high cholesterol diet fed rats by the treatment with *Emblica officinalis*. The data showed that *Emblica officinalis* formulation was associated with potent hypolipidemic effects.
	Modilal and Pitchai, 2011	*E. officinalis* treated rat showed more hypogly-cemic and hypolipidemic in diabetic rats

CONCLUSION

Amla or Indian gooseberry has been integral part of indian medical system specially Ayurveda and in tribal medicine. *Emblica officinalis* or Amla used by Ayurvedic physicians since a long time as a single herbal medicine or as an ingredient of medicinal preparations for the treatment of diabetes, obesity, liver disorders, acid peptic disorders, hair, skin disorders and fever showed its immense therapeutic values. Amla contains several phytoconstituents of like flavonoids, terpenoids, tannins and other polyphenolic compounds. Some important phytochemicals of amla are gallic acid, quercetin, phyllantine, ellagic acid, emblicanin A and B and phyllantidine have been confirmed as having different biological activities like antioxidant, antidiabetic, antitissuive, anti, radioprotective, antimicrobial, anti-inflammatory, chemopreventive, wound healing activities and so on. Apart from above mentioned phytochemicals several other bioactive ingredients are still unexplored and there is only limited knowledge of mechanisms of action of bioactive compounds present in *Emblica officinalis*. Hence, extensive preclinical and clinical studies are required to find out the exact mechanisms of action and bioactivity of the various phytochemicals to re-establish the traditional therapeutic potential on the scientific ground to serve the mankind.

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