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Emblica officinalis (Amla): A comprehensive review of the miracle berry

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Abstract

Plants have played an important part in the advancement of humans from ancient times, serving as an exceptional source of natural medicine. Medicinal plants are nature's gift to humans which foster a healthy and disease-free life. *Emblica officinalis* (Euphorbiaceae family), also known as Indian gooseberry or amla is an important herbal plant which has been widely used. Though the plant's entire structure is employed for therapeutic purposes, the fruits in particular have a wide range of pharmacological benefits. They are used as a medication as well as a tonic to re-establish lost vitality and stamina. Amla is nutrient-dense and a good source of vitamin C, amino acids, and minerals and other micro-nutrients in the diet. The fruits are used to cure diarrhoea, jaundice, and inflammation in traditional medicine. Bioactive compounds found in *E. officinalis* include tannins, flavonoids, saponins, terpenoids, ascorbic acids, and many others that have been shown to have antimicrobial, antioxidant, anti-inflammatory, hepatoprotective, anticancer, and other pharmacological activities. This review includes pharmacological properties, traditional use, geographical distribution, commercialization and therapeutic characteristics of this very valued medicinal plant are mostly discussed in this article.

Keywords: Amla, Nutrients, Chemical constituents, Health benefits, Medicinal usage

Introduction

Emblica officinalis or Amla is a fruit of deciduous tree which belongs to family Euphorbiaceae. (Newman *et al.* 2000) [23]. This fruit is widely distributed in tropical and sub-tropical areas of India. It is known as Amalki in Sanskrit, Avala in Marathi, Nelli in Kannada and Nellikai in Tamil. It is a well known Indian medicinal herb which provides numerous health benefits. The active constituents present in amla are gallic acid, ellagic acid and rutin. It possesses analgesic, anti-inflammatory, anti-oxidant and several other pharmacological properties (Khan *et al.*, 2002) [16]. Almost all parts of this fruit possess medicinal properties, particularly fruit, which is used in Ayurveda as a powerful rasayana and in medicine in the treatment of diarrhoea, jaundice, inflammation and several other ailments (Dasaroju and Gottumukkala, 2014) [10]. Amla shows heart protective, antioxidant and free radical scavenging properties (Patel and Goyal, 2011) [44]. Soluble fibre in amla helps in regulating the blood glucose levels and regulating the bowel movement and thus reduces the risk of irritable bowel syndrome. Vitamin- A content reduces the risk of age-related macular degeneration. Amla prevents aggregation and insolubilization of lens proteins which results from hyperglycemia. (Suryanarayana *et al.*, 2007) [40]. The anti-oxidant and phytonutrients help in fighting against free radicals. Amla possesses anticancer properties because of high concentration of polyphenol constituents in it. Polyphenols involve the mechanisms associated with anti-carcinogenic effect and inflammation (Priego, *et al.*, 2008) [33]. High concentration of vitamin-C helps the body in producing norepinephrine neurotransmitter which improves brain function in people with dementia. Moreover, it is best for anti-aging and is used for the production of cosmetics for skin care (Datta, Paramesh, 2010) [11]. It helps in the synthesis of collagen protein which favours youthful and flexible skin by preventing damage caused by harmful ultra radiations. It enhances immune activity by stimulating immune cells and antibodies (Kumar *et al.*, 2008). Amla helps in preventing fat formation and also in flushing out toxins. It is used as a home remedy to enhance hair growth. Amla fruit is being in use as a remedy from neuropathy development, for diabetic patients (Srinivasan, 2005) [39]. It maintains hormonal balance which improves fertility and helps in relaxation of abdominal muscles due to its anti-spasmodic property. Keeping in view the importance of Amla, the present report was designed to explore the bioactive potential of fruit.

Morphology of Amla

Amla fruit is widely distributed in tropical and sub-tropical countries. It grows in parts of Pakistan, Sri Lanka, China, India, Indonesia and Malaysia (Newman *et al.*, 2000) [23]. It is indigenous to tropical India and south east Asia. Leaves of tree are linear oblong and possess rounded base. Fruit is green, globose, depressed, smooth, fleshy and shining. Stem

is six lobbed which splits into 3 segments. The stone of the fruit is 6 ribbed which splits into three segments and each contains two seeds (Rehman *et al.*, 2007). Skin is thin, translucent and possess crisp, juicy and concolorous flesh. Flowers are unisexual and 4 to 5 mm in length (Rehman *et al.*, 2007). The average weight of fruit is 5-6 gm. Mesocarp is edible part of fruit and endocarp engages the seed.

Table 1: Vernacular names of *E. Officinalis*

Sr. No.	Language	Vernacular Names
1.	Sanskrit	Amla, Amaliki, Dhatriphala, Amalkan, Sripalam, Vayastha
2.	Hindi	Amla
3.	Punjabi	Aula
4.	Gujarati	Amla
5.	Urdu	Aavnlaa, Amlaj
6.	Bengali	Amloki
7.	Marathi	Avala
8.	Odiya	Anla
9.	Kashmiri	Aonla
10.	Assamese	Amlakhi
11.	Maithili	Dhatric
12.	Malyalam	Neilli
13.	Telugu	Usiri kaay
14.	Tamil	Nelli
15.	Manipuri	Heikru
16.	Kannada	Bettada neilkkayi
17.	Nepalese	Amba, Amala
18.	French	Phyllanthe emblica
19.	Chinese	Anmole
20.	Persian	Aamlah
21.	Italian	Mirabolano emblico
22.	Tibetan	Skyu-ru-ra
23.	Malaysian	Popok Melaka
24.	Portuguese	Mirabolano emblico
25.	German	Amla
26.	Arabic	Halilaj or Ihliilaj
27.	English	Indian Gooseberry
28.	Indonesia	Balakka
29.	Lao	Mak kham bom
30.	Thai	Mak kham pom
31.	Konkani	Aavalo

Reference: (Lanka, 2018; Variya *et al.*, 2016; Baliga and Dsouza, 2010; Khan, 2009) [19]

Table 2: Taxonomic Classification of *E. Officinalis*

Kingdom	Plantae (Plant)
Sub-kingdom	<i>Tracheobionta</i> (Vascular plant)
Super-division	<i>Spermatophyta</i> (Seed containing plant)
Division	Angiospermae (Flowering plant)
Class	Dicotyledonae (Dicotyledons- two cotyledons)
Sub-class	Rosidae
Order	Geraniales
Family	Euphorbiaceae
Genus	<i>Emblica</i>
Species	<i>officinalis</i> Geartn.

Reference: (Lanka, 2018; Baliga and Dsouza, 2010) [19]

Ayurveda, Siddha, Unani systems of India, utilize amla for a variety of ailments. It is considered as rasayana (rejuvenator) and helps in delaying the degenerative and senescence related processes (Maurya *et al.*, 2011). In folk medicine, the fruits, which are sour, astringent, bitter, acrid, sweet and anodyne exert several beneficial effects which includes ophthalmic, carminative, digestive, stomachic, laxative, dyspepsia, aphrodisiac, rejuvenative, diuretic, thermoregulation, antipyretic and tonic (Vasudevan *et al.*, 2007). They are

useful in vitiated conditions of tridosha, diabetes, cough, asthma, bronchitis, cephalalgia, ophthalmopathy, dyspepsia, colic, flatulence, hyperacidity, peptic ulcer, erysipelas, skin diseases, leprosy, haematogenesis, inflammations, anemia, emaciation, hepatopathy, jaundice, diarrhoea, dysentery, haemorrhages, leucorrhoea, menorrhagia, cardiac disorders, intermittent fevers and premature graying of hair. Amla is also stated to have hepato-protective, cardio-protective, nephron-protective and neuroprotective effects; antioxidant, anti-inflammatory, analgesic, antipyretic and restorative properties.

The Ayurvedic description of amla

According to the Ayurvedic classifications, amla fruit exert certain properties (Bajracharya 1979), (Singh *et al.*, 2011) that are mentioned below:

- Rasa (taste): There are two dominant tastes in the fruit that are sour and astringent, but it has five tastes, including sweet, bitter, and pungent.
- Veerya (nature): Amla helps in thermoregulation, treatment of burning sensation in inflammation and fever which are considered to be manifestations of pitta (fire)

agitation (Linda 1994).

- Vipaka (taste developed through digestion): Sweet
- Guna (qualities): Light, dry
- Doshas (effect on humors): Amla helps in quietens all three doshas: vata, kapha, pitta, and is especially effective for pitta (fire). Based on this, amla has been considered as one of the best Ayurvedic rejuvenative herbs. Inimitably, amla exerts natural balance of tastes (sweet, sour, pungent, bitter and astringent), that stimulates brain to rebalance the three main components (water, fire and air in the body) of all physiological functions (Bajracharya 1979). Refer table 5.

Nutritional composition of amla (*Emblca officinalis*)

Amla (*Emblca officinalis*) is one of the most widely studied as well as highly beneficial fruit that is gifted to us by Mother Nature. The amla fruit contains carbohydrate (82.91 gm/100g), protein (6.04 gm/100g), fiber (2.78 gm/100g), ash (2.3%/100g), fat (0.51 gm/100 gm) and high moisture content (82.76 g/100 gm) (Variya *et al.*, 2016; Longvah *et al.*, 2017; Yadav *et al.*, 2020) [20]. A fresh fruit of amla contains several water soluble vitamins like Biotin (1.42 µg/100 gm), thiamine (0.01 mg/100 gm), riboflavin (0.03 mg/100 gm), niacin (0.12 mg/100 gm), pantothenic acid (0.35 mg/100 gm), pyridoxine (0.27 mg/100 gm), and fat soluble vitamins like ergocalciferol (0.27 mg/100 gm), phyloquinones (1.64 µg/100 gm), α-tocopherol (0.11 mg/100 gm), γ-tocopherol (0.01 mg/100 gm), δ-tocopherol (0.06 mg/100 gm) and α-tocotrienol (0.05 mg/100 gm) (Longvah *et al.*, 2017; Sachan *et al.*, 2013) [20]. According to various studies it has been revealed that amla is a rich source of vitamin C having about 478.56 mg ascorbic acid per 100 g of serving (Variya *et al.*, 2016).

It is a rich source of various major minerals like potassium (282.0 mg/100 gm), phosphorous (21.85 mg/100 gm), calcium (20.14 mg/100 gm), magnesium (6.50 mg/100 gm), and sodium (1.37 mg/100 gm) which are also classified as electrolytes in our body. Furthermore, trace minerals like iron (1.2 mg/100 gm), chromium (0.82 mg/100 gm), zinc (0.23 mg/100 gm), copper (0.22 mg/100 gm), manganese (0.11 mg/100 gm), aluminium (0.08 mg/100 gm), nickel (0.010

mg/100 gm) lead (0.001 mg/100 gm), lithium (0.001 mg/100 gm), and molybdenum (0.001 mg/100 gm), are also present in amla, needed in small amounts but are very essential for proper growth and development of body (Sachan *et al.*, 2013; D'souza *et al.*, 2014; Longvah *et al.*, 2017) [20]. The fruit is also a rich source of various essential, semi-essential and non-essential amino acids. The major essential amino acids present in amla fruit are, lysine (23.6 mg/100 gm), phenylalanine (4.85 mg/100 gm), leucine (4.25 mg/100 gm), threonine (3.30 mg/100 gm), valine (2.99 mg/100 gm), histidine (2.40 mg/100 gm), isoleucine (1.49 mg/100 gm), tryptophan (0.75 mg/100 gm), and methionine (0.73 mg/100 gm). Moreover, amla serves as a great source of many semi-essential and non-essential amino acids like proline (65.2 mg/100 gm), glycine (19.8 mg/100 gm), arginine (3.87 g/100 gm), tyrosine (2.60 g/100 gm), and cysteine (0.62 g/100 gm) (Young, 1994; D'souza *et al.*, 2014; Longvah *et al.*, 2017) [20]. The fruit is also a rich source of various phyto-chemicals such as β-Sitosterol (11.50 mg/100 gm), quercetin-3-Orutinoside (7.81 mg/100 gm), quercetin-3-β-D-glucoside (1.37 mg/100 gm), 3,4-Dihydroxy benzoic acid (1.34 mg/100 gm), gallic acid (1.32%/100 gm), quercetin (1.26 mg/100 gm), kaempferol (0.84 mg/100 gm), coumaric acid (0.66 mg/100 gm), chlorogenic acid (0.56 mg/100 gm), protocatechuic acid (0.47 mg/100 gm), ferulic acid (0.30 mg/100 gm), apigenin-6-C-glucoside (0.23 mg/100 gm) and caffeic acid (0.20 mg/100 gm) (Thilakchand *et al.*, 2013; D'souza *et al.*, 2014) [42].

However, amla also possesses certain antinutrients like tannins (245.49 ± 6.69 mg GAE/g) that may affect the digestion of various nutrients or may prevent the body from absorbing valuable nutritional components. Tannins possess the property of binding and shrinking proteins and the complexes formed between protein and tannins can cause the inactivation of digestive enzymes and reduction in digestibility of proteins. Saponins (1.1% per 100 g) are also present in amla which can affect the nutrient absorption by inhibiting metabolic and digestive enzymes as well as can bind with nutrients like zinc (Dasaroju *et al.*, 2014; Kumari *et al.*, 2019; Popova *et al.*, 2019) [10, 30].

Table 3: Traditional therapeutic applications of *Emblca officinalis*

Sr. No	Treatment for	Parts used	Preparation /Dose	References
1	Boils and spots	Fruit pericarp	Decoction with cow ghee.	Maurya <i>et al.</i> , (2011)
2	Constipation	Fruit	Amla fruit is pickled or preserved in sugar. Fruit is also dried and is consumed every day.	Hasan <i>et al.</i> ,(2016) [14]
3	Dental problems	Root, leaves, node	The Amla roots are collected and ground and can be taken twice a day after dinner.	Yokozawa <i>et al.</i> ,(2007)
4	Diabetes	Fruit	One tablespoon of amla juice mixed with one cup of bitter gourd juice can be taken for two months every day.	Islam <i>et al.</i> , (2016)
5	Diarrhoea	Fruit, bark, root, leaves	Fruit decoction is combined with acid or bark of the fruit's astringency. Decoction and development of the root solution create a catechu-like astringent extract. The leaves are additionally infused with fenugreek seed.	Vasudevan <i>et al.</i> ,(2006)
6	Diuretic	Fresh fruit	Fruit paste mixed with Saffron rose water and <i>nelumbium speciosum</i> (lotus).	Fairuz <i>et al.</i> , (2005)
7	Fever	Leaves, fresh fruit, seed	The leaves and seeds of amla are mixed and applied, also dried grapes and sugar are applied, or fresh fruits and compounds comprising equal amounts of <i>emblca</i> , <i>chitrak</i> , <i>chebulic myrobalan</i> , and <i>pipli</i> are decocted.	Hasan <i>et al.</i> , (2016) [14]
8	Gonorrhoea	Bark	Bark of the fruit is grounded and combined with honey and turmeric.	Chatterjee <i>et al.</i> , (2010)
9	Hair growth and prevent	Fruit	Fresh or dried amla fruit boiled in coconut oil prevents graying of hair, also if dried amla is soaked overnight in water and consumed prevents	Khan <i>et al.</i> ,(2009) [16]

	graying		nourishment to hair.14	
10	Headache	Fruit	Fruit mashed and mixed with buttermilk	Vasant, <i>et al.</i> , (2012)
11	Sleep disorder, body coolant	Fruit	Regular consuming raw fruits before sleep.	Anjum <i>et al.</i> , (2020)
12	Eye disorder	Seed	Seed infusion can applied externally.	Islam, <i>et al.</i> , (2019) [14]
13	Mouth ulcers	Root Bark, leaf	Root bark and leaf are mashed and combined together and used for oral irritation. Also root bark is used to massaged and treat aphthous stomatitis	Bhide <i>et al.</i> ,(2014)
14	Nose bleed	Seed	As a lep for forehead amla seeds are cooked in ghee and crushed in conjee and is applied to stop nose bleeding.	Nitave <i>et al.</i> ,(2014)
15	Respiratory problem	Fruit	Regular consuming fruit juice cures respiratory problem due to cigarette smoking.	Vasudevan <i>et al.</i> , (2007)
16	Piles	Fruits	Fresh Amla juice mixed with 100gms of milk one teaspoon of honey and half teaspoon of ghee if consumed after lunch or dinner cures chronic piles.	Vasant <i>et al.</i> , (2013)
17	Skin whitening	Fruit	Fresh or dried amla fruit or leaves mixed with neem can be used on skin.	Nitave <i>et al.</i> , (2014)
18	Gout	Fruit	Amla juice mixed with ghee helps softening of joints.	Fairuz <i>et al.</i> , (2019)

Table 4: Nutritional composition of Amla (*Embllica officinalis*)

S. No.	Nutrient	Value per 100 g
1	Energy (Kcal)	41±6.5
2	Carbohydrate (g)	82.91
3	Protein (g)	6.04
4	Fat (g)	0.51
5	Total fibre (g)	2.78
6	Soluble fibre (g)	1.55±0.43
7	Insoluble fibre (g)	6.20±0.43
8	Ash (%)	2.3±0.2%
9	Moisture (g)	82.76±1
Water Soluble Vitamins (mg)		
10	Thiamine	0.03±1.9
11	Riboflavin	0.03±0.012
12	Niacin	0.12±0.02
13	Pantothenic acid	0.35±0.04
14	Pyridoxine	0.27±0.054
15	Biotin (µg)	1.42±0.35
16	Total folates (µg)	7.86±1.27
17	Total Ascorbic Acid	478.56
Fat soluble vitamins (mg)		
18	Vitamin A (I.U)	10.5-65.3
19	Ergocalciferol	0.27±0.02
20	α- Tocopherol	0.11±0.01
21	γ-Tocopherol	0.01±0.00
22	δ-Tocopherol	0.06±0.01
23	α- Tocotrienol	0.05±0.01
24	Phylloquinones (µg)	1.64±0.31
Carotenoids (µg)		
25	Lutein	38.7±2.27
26	Zeaxanthin	2.86±1.61
27	β – Carotene	1.58±0.09
28	Total Carotenoids	62.01±6.45
Minerals (mg)		
29	Aluminum (Al)	0.08±0.02
30	Calcium (Ca)	20.14±2.51
31	Chromium (Cr)	0.82
32	Copper (Cu)	0.22
33	Iron (Fe)	1.2
34	Lead (Pb)	0.001±0.02
35	Lithium (Li)	0.001±0.001
36	Magnesium (Mg)	6.50±0.93
37	Manganese (Mn)	0.11±0.02
38	Molybdenum (Mo)	0.001±0.000
39	Nickel (Ni)	0.010±0.003
40	Phosphorus (P)	21.85±1.87
41	Potassium (K)	282.0
42	Sodium (Na)	1.37±0.09
43	Zinc (Zn)	0.23

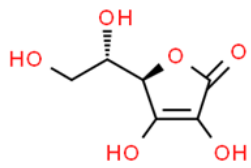
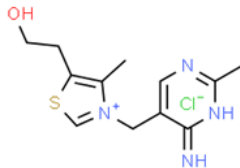
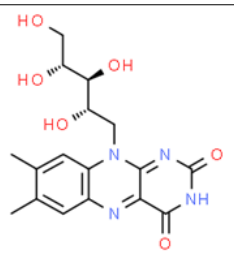
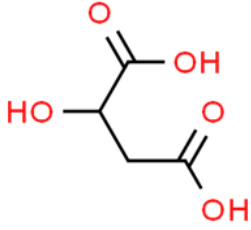
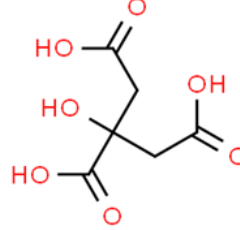
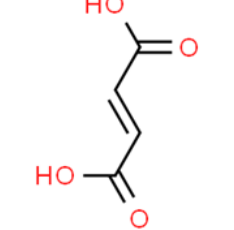
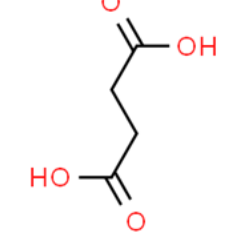
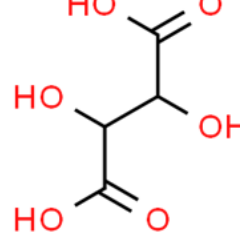
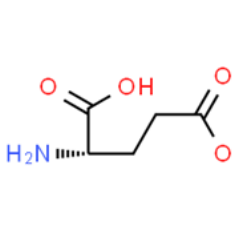
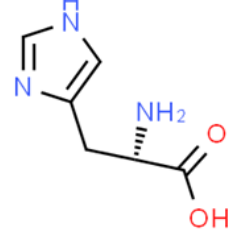
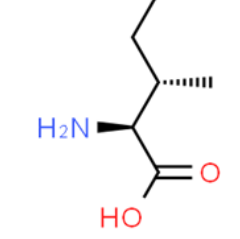
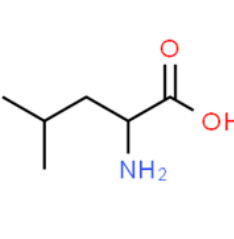
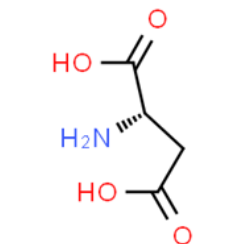
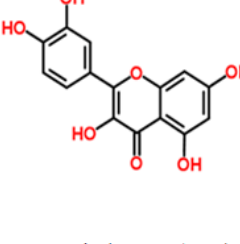
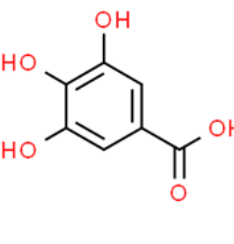
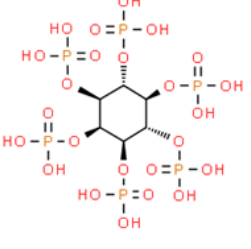
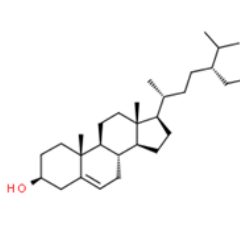
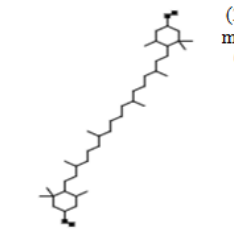
Fatty Acid Profile (mg)		
44	Palmitic Acid	3.0%
45	Steric Acid	2.15%
46	Oleic Acid (%)	28.4%
47	Linolenic Acid (%)	8.8%
48	α - Linolenic acid	27.83 \pm 2.51
49	Total Saturated Fatty Acids	38.48 \pm 3.26
50	Total Mono Unsaturated Fatty Acids	23.93 \pm 1.89
51	Total Poly Unsaturated Fatty Acids	75.24 \pm 4.62
Amino Acid Profile (mg)		
Essential Amino Acids		
52	Valine	2.99 \pm 0.39
53	Isoleucine	1.94 \pm 0.34
54	Leucine	4.25 \pm 0.42
55	Lysine	23.6
56	Methionine	0.73 \pm 0.17
57	Threonine	3.30 \pm 0.69
58	Phenylalanine	4.85 \pm 2.04
Non-Essential Amino Acids		
59	Cysteine	0.61 \pm 0.16
60	Tryptophan	0.75 \pm 0.08
61	Histidine	2.40 \pm 0.26
62	Alanine	6.47 \pm 1.67
63	Arginine	3.87 \pm 0.45
64	Aspartic Acid	36.1
65	Glutamic Acid	23.90 \pm 2.39
66	Glycine	19.8
67	Proline	65.2
68	Serine	4.95 \pm 0.23
69	Tyrosine	2.60 \pm 0.39
Organic Acids (mg)		
70	Total Oxalate	7.96 \pm 0.91
71	Soluble Oxalate	5.4 \pm 0.74
72	Insoluble Oxalate	2.81 \pm 1.28
73	Citric Acid	751 \pm 8.5
74	Fumaric Acid	1.65 \pm 0.28
75	Mallic Acid	7.58 \pm 1.17
76	Succinic Acid	44.33 \pm 6.23
77	Tartaric Acid	14.06 \pm 1.11
Phyto-chemicals (mg)		
78	Gallic Acid (%)	1.32
79	Quercetin	1.26 \pm 0.05
80	Quercetin-3- β - Dglucoside	1.37 \pm 0.03
81	Quercetin-3- Orutinoside	7.81 \pm 0.80
82	β - Sitosterol	11.50 \pm 0.27
83	Phytate	49.34 \pm 3.36
84	Tannin (mg GAE/g)	245.49 \pm 6.69
85	Saponins (%)	1.1

Source: Paul *et al.* (2004)^[29], Variya *et al.* (2016)^[44], Longvah *et al.* (2017)^[20], Charmkar *et al.* (2017)^[8], Rahman *et al.* (2018)^[34], Pathak *et al.* (2018), Yadav *et al.* (2020)^[23].

The chemical components of amla like ascorbic acid (478.56 mg/100 gm), phytate (49.34 mg/100 gm), succinic acid (44.33 mg/100 gm), lutein (38.7 mg/100 gm), aspartic acid (36.1 mg/100 gm), glutamic acid (23.90 mg/100 gm), tartaric acid (14.06 mg/100 gm), β -sitosterol (11.50 mg/100 gm), malic acid (7.58 mg/100 gm), leucine (4.25 mg/100 gm), histidine (2.40 mg/100 gm), isoleucine (1.94 mg/100 gm), fumaric acid (1.65 mg/100 gm), gallic acid (1.32% per 100 gm), quercetin (1.26 mg/100 gm), thiamine (0.03 mg/100 gm), and riboflavin (0.03 mg/100 gm) are present in higher quantities which

increase the therapeutic uses of amla. Due to the presence of such components in amla, it is having the property like analgesic, anti-atherogenic, adaptogenic, cardio-protective, gastro-protective, nephro-protective and neuro-protective in addition to anti-cancerous properties. All these properties of amla are effectual in the prevention and treatment of various diseases like cancer, atherosclerosis, diabetes, peptic ulcer, anemia, liver, heart diseases and various other disorders (Sachan *et al.*, 2013; Thilakchand *et al.*, 2013; Dasaroju, *et al.*, 2014)^[10, 42].

Table 5: Chemical structures of various constituents of amla

 <p>scorbic Acid (478.56 mg/100g)^A</p>	 <p>Thiamine (0.03 mg/100g)</p>	 <p>Riboflavin (0.03 mg/100g)</p>
 <p>allic Acid (7.58 mg/100g)^M</p>	 <p>tric Acid (751 mg/100g)^{Ci}</p>	 <p>maric Acid (1.65 mg/100g)^{Fu}</p>
 <p>ccinic Acid (44.33 mg/100g)^{Su}</p>	 <p>rtaric Acid (14.06 mg/100g)^{Ta}</p>	 <p>Glutamic Acid (23.90 mg/100g)</p>
 <p>stidine (2.40 mg/100g)^{Hi}</p>	 <p>oleucine (1.94 mg/100g)^{Is}</p>	 <p>ucine (4.25 mg/100g)^{Le}</p>
 <p>spartic Acid (36.1 mg/100g)^A</p>	 <p>ercetin (1.26 mg/100g)^{Qu}</p>	 <p>allic Acid (1.32 % per 100g)^G</p>
 <p>ytate (49.34 mg/100g)^{Ph}</p>	 <p>Sitosterol (11.50 mg/100g)^{β-}</p>	 <p>Lutem (38.7 mg/100g)</p>

Pharmacological Properties and Health Benefits of *Emblica officinalis*

E. officinalis is a medicinal and nutritional tonic that contains essential amino acids and vitamins. When compared to other citrus fruits, it is a particularly great source of vitamin C and minerals. Although all parts of *E. officinalis* are used medicinally, the fruits are more extensively utilised for the treatment of numerous infectious and non-infectious disorders, either alone or in combination with other traditional herbs (Variya *et al.*, 2016) [44]. *E. officinalis* is one of the most researched plants, and findings indicate that it includes tannins, phenolic compounds and alkaloids (Bhandari & Kamdod 2012) [7]. Fruits of *E. officinalis* have been shown to have greater levels of vitamin C, as well as higher amounts of most minerals, protein, and amino acids such as glutamic acid, proline, aspartic acid, alanine, cystine, and lysine. The hydrolysable tannins emblicanin A and B, punigluconin, and pedunculagin are more abundant in the fresh pericarp of *E. officinalis* (Hasan *et al.*, 2016; Variya *et al.*, 2016; Bhandari & Kamdod, 2012) [14, 44, 7].

Reports of pharmacological research on amla reveals its anti-tussive, analgesic, anti-atherogenic, adaptogenic; gastro, cardio, nephro, anticancer properties and neuro protective. Amla is also reported to possess immunomodulatory, free radical scavenging, chemo-preventive, anti-inflammatory, anti-mutagenic and antioxidant properties. These properties are effective in the treatment and prevention of numerous diseases like atherosclerosis, cancer, peptic ulcer, diabetes anemia, heart diseases, liver disorders and various others. (Dasaraju and Gottumukkala, 2014) [10].

Antioxidant properties of *Emblica*

Free radicals are the building blocks of any biochemical reaction which are continually created by the body's routine utilisation of oxygen. Naturally, there is a dynamic balance between the number of free radicals produced in the body and the amount of anti-oxidants available to quench, scavenge, and shield the organism from their harmful effects. (Khan, 2009) [16]. In India, a traditional medication including *Emblica officinalis* was developed and utilised as a health tonic, and it exhibited strong antioxidant activity. *Emblica officinalis* contains antioxidants that are heat stable and water soluble, but only partly extractable with ether (Almatroodi *et al.*, 2020) [1]. Though oxidative processes are necessary for survival, they can harm the body's basic cells. Amla promotes cell viability by lowering free radical generation and increasing antioxidant levels (Yadav *et al.*, 2014) [48]. To combat oxidative damage, nature has provided sophisticated antioxidant defence systems such as vitamin A, C, and E, as well as numerous enzymes such as superoxide dismutase (SOD), glutathione (GSH), catalase (CAT), peroxidase, and others. (Variya *et al.*, 2016) [44]. In a research that incubated *E. officinalis* for 24 hours, significant reductions in lipid hydroperoxide and reactive oxygen species (ROS) were reported. *E. officinalis* also boosted glutathione peroxidase (GSH) levels, antioxidant enzyme activities and antioxidant capacity. Furthermore, when given once daily for seven days, the active tannoids of *E. officinalis* increased the activity of catalase (CAT), Superoxide dismutase (SOD), and GSH peroxidase (GPX) in the frontal and striatal cortex, as well as a reduction in lipid peroxidation in these brain regions (Bhandari & Kamdod 2012) [7]. The complete fruit of *E. officinalis* is recognised for its antioxidant properties,

however the pulp and seed each have their unique phytopharmacological functions (Variya *et al.*, 2016) [44]. The pulp of *E. officinalis* has more antioxidant capacity than the seeds, with IC50 values (shows the lowest drug concentration necessary to achieve 50% inhibition *in vitro*) of 6 g/ml and 13 g/ml for DPPH radical scavenging activity, respectively (Variya *et al.*, 2016) [44]. Fruit of amla which constitutes emblicanin A and B are reported to have potent antioxidant effects. Amla increases cell viability by decreasing free radical production and raising antioxidant levels (Ghurchure, 2019) [13]. The findings also suggest that the antioxidant activity of *E. officinalis* may be found in the tannoids found in the plant's fruits, which have vitamin C-like qualities but are not vitamin C (Mandal and Reddy, 2017) [22]. Another investigation claims that phytochemicals included in amla can act as an excellent metal ion chelator, preventing oxidative cascades (Gaire and Subedi, 2014) [12]. In a rat model, the antioxidant activity of tannoid active components of Amla was evaluated: emblicanin A and B (37% & 33% respectively), punigluconin (12%), and pedunculagin (14%) (Nafees, 2020).

Anti-diabetic properties of *Emblica*

Diet has a crucial role in the treatment of diabetes and its consequences. Numerous classical herbs have been documented to have anti-hyperglycaemic and hypoglycaemic action in varied degrees. These actions appear to be achieved by higher insulin production via pancreatic cell stimulation, interfering with dietary glucose absorption, or insulin sensitization (Variya *et al.*, 2016) [44]. On normal and alloxan (120 mg/kg) diabetic rats, oral treatment of the extracts (100 mg/kg body weight) dramatically lowered blood sugar levels in 4 hours. In rats, *E. Officinalis* and a concentrated portion of its tannoids are efficient at delaying the onset of diabetic cataract. Aldose reductase (AR) plays a role in the development of diabetes' secondary consequences, such as cataracts. *E. Officinalis* has been shown to be an effective AR inhibitor (Khan, 2009) [16]. Diabetic neuropathy is one of the most frequent microvascular consequences of diabetes, affecting more than half of all diabetic patients. In a study, the effects of a high flavonoid extract of *E. officinalis* in male Sprague-Dawley rats with diabetic neuropathy from due to type 2 diabetes. In diabetic rats, administration with *E. officinalis* extract (EOE) increased tail flick latency in a hot immersion test and pain threshold level in a hot plate test when compared to the control group of rats (Bhandari & Kamdod 2012) [7]. The anti-diabetic activity of *E. Officinalis* was tested in diabetic rats. When compared to the metformin-treated group, the plant extract-treated group showed a substantial drop in blood glucose. Furthermore, extracted dosages of 200 and 400 mg/ kg resulted in significant reductions in blood glucose and lipid levels, similar to the metformin-treated group (Almatroodi *et al.*, 2020) [1]. In uremic diabetic patients, oral treatment of a 1:1 combination of Epigallocatechin gallate (EGCG) and Amla extract (AE) (EOE) for three months increased antioxidant defence as well as diabetic and atherogenic indices (Bhandari & Kamdod, 2012; Almatroodi *et al.*, 2020) [7, 1].

Cardio protective properties of *Emblica*

Low density lipoprotein (LDL) cholesterol is primary contributor in the development of atherosclerosis. Antioxidants are regarded as an excellent therapeutic therapy

for atherogenesis due to oxidative stress. *E. officinalis* has been shown in several preclinical investigations with laboratory animals to have cardio-protective and anticoagulant properties, suggesting that it might be a beneficial medication for delaying and/or preventing different cardio-related diseases. The presence of tannoids in *E. officinalis*, notably ellagic acid, emblicanin-A and -B, gallic acid, and corilagin, is thought to be responsible for this protective effect (Variya *et al.*, 2016) [44]. Oxidised- LDL (Ox-LDL) is the primary causative factor in atherogenesis, therefore antioxidants are often used to treat atherosclerosis. The findings imply that *E. Officinalis* can slow the progression of atherosclerosis by reducing oxidative stress or suppressing ox-LDL-induced vascular smooth muscle cell proliferation, both of which could be attractive therapeutic targets for atherosclerosis (Bhandari & Kamdod, 2012) [7]. Supplementing with extracts reduced the oxidative damage caused by a high-fat diet. According to the findings, *E. Officinalis* extract has a cardioprotective effect in rats fed in a high-fat diet (Almatroodi *et al.*, 2020) [1]. In rats, the effects of prolonged oral administration of fresh Amla fruit homogenate on myocardial antioxidant system and oxidative stress generated by ischemic-reperfusion damage (IRI) were studied. Chronic *E. Officinalis* treatment causes myocardial adaptation and protects rat hearts from oxidative stress caused by IRI by increasing endogenous antioxidants (Khan, 2009) [16]. The ethanolic extract of *E. Officinalis* was studied for its cardiovascular preventive and lipid-lowering qualities. The lipid profile of rats fed a high-fat diet was shown to be changed, but it was found to be reversible when extract was supplied. After supplementing with *E. Officinalis*, a group of high dietary fat fed rats showed improvement in cardiac autonomic malfunctions, and electrophysiological assessment indicated changed heart rate (HR) and sympathovagal balance (Almatroodi *et al.*, 2020) [1].

Anticancer properties of Emblica

Natural medicines derived from plants now make up a significant share of commercial anticancer treatments (Variya *et al.*, 2016) [44]. Medicinal plants or active compounds of medicinal plants have a function in cancer care by altering the activation of numerous genes. (Almatroodi *et al.*, 2020) [1]. One of the most frequent malignancies in women is breast cancer. Breast cancer risk has been linked to lipid-metabolizing enzymes, lipids, and lipoproteins. Kalpaamruthaa (KA) is a Siddha formulation that includes EO, Semecarpus anacardium (SA), and honey. On treatment with KA and SA, the raised levels of free cholesterol, total cholesterol, triglycerides, free fatty acids and phospholipids, as well as the lowered levels of ester cholesterol, detected in cancer-stricken animals, were reduced to near-normal levels in kidney, plasma, and liver (Khan, 2009) [16]. The effect of amla fruit extract on tumour incidence was tested in a process involving two stages of skin carcinogenesis in Swiss albino mice, which was triggered by a single administration of 7, 12dimethylbenz(a)anthracene and then enhanced by recurrent application of croton oil until the experiment's completion (16 weeks). Tumor incidence, tumour burden, tumour production, and cumulative number of papillomas were all greater in control (*E. officinalis* extract, untreated) mice than in experimental animals (*E. officinalis* extract, treated) (Hasan *et al.*, 2016; Bhandari & Kamdod, 2012) [14, 7]. Another study discovered that the antimetastatic efficacy of *Emblica*

officinalis extract is essential in lowering cancer migration, cell invasion, proliferation and adhesion in a time and dose dependent way. Both MMP2 and MMP9 expression decreased in this example, indicating a biological mechanism for anti-metastasis (Almatroodi *et al.*, 2020) [1]. In addition, many studies have shown that *E. officinalis* may protect against chemo- and radiotherapy side effects (Variya *et al.*, 2016) [44].

Antimicrobial properties of Emblica

Infectious illnesses are a leading cause of morbidity and death throughout the world. Despite significant advances in microbiology and the management of germs, periodic outbreaks of epidemics caused by drug-resistant bacteria and newly identified disease-causing microbes constitute a significant threat to public health. These alarming health trends necessitate a global effort to discover creative ways to the prevention and treatment of infectious illness. Chemical compounds derived from medicinal plants have been used as models for several therapeutically established medications for more than a century, and are currently being re-examined as antimicrobial agents (Bhandari & Kamdod, 2012) [7]. Various research imply that *E. officinalis* has substantial antibacterial action, which might be a valuable lead for the creation of cost-effective and safe treatments (Variya *et al.*, 2016) [44]. Antimicrobial activity was tested in aqueous and sequential extracts of *E. Officinalis* fruit pulp and *Ocimum sanctum* leaves and stems extracts. The results were linked to the conventional antibiotics amoxicillin and amphotericin B. The methanolic extract of *E. Officinalis* was shown to be more effective than the leaf and stem extracts of *Ocimum sanctum* in preventing all pathogenic microorganisms (Almatroodi *et al.*, 2020) [1]. *E. Officinalis* extracts, both alcoholic and aqueous, were shown to be effective against a variety of human diseases, including bacteria, viruses, and fungus. Activity against gram-positive bacteria appears to be greater, with just minimal efficacy against fungi. Induced *Klebsiella pneumoniae* in mice reacted to powdered fruit nutrition in the long term (30 days). In the near term, however, colonisation was not avoided (15 days). The phenolic content has been linked to action against herpes simplex viruses 1 and 2, while phyllaemblicin B isolated from the plant's roots has been linked to activity against the coxsackie virus (Lanka, 2018) [19]. From the methanolic extract of *E. Officinalis* alkaloids are extracted which showed strong antimicrobial activity against gram-positive bacteria such as *Staphylococcus aureus*, *Bacillus cereus*, *Sarcina luteasome*, *Bacillus subtilis*, as well as gram negative pathogenic bacteria *viz. Salmonella typhi*, *Escherichia coli*, *Salmonella paratyphi*, *Shigella boydii*, *Pseudomonas aeruginosa*, and some strains fungi, *Sacharomyces cerevisiae*, *Candida albicans* and *Aspergillus niger* (Variya *et al.*, 2016) [44].

Anti-inflammatory properties of Emblica

Many plant-derived substances have been demonstrated to have significant anti-inflammatory properties. As a result, they represent potential compounds for the creation of novel medications, especially for the treatment and/or management of chronic inflammatory conditions such as asthma, rheumatism, atherosclerosis, inflammatory bowel illnesses, and so on (Bhandari & Kamdod, 2012) [7]. The application of intraperitoneal of *E. Officinalis* hydroalcoholic extract at varied dosages, i.e., 700, 500, and 300 mg/kg, resulted

in reduced granuloma formation and significantly prevented rat paw oedema against all phlogistic agents. Though extract caused entire-out anti-inflammatory responses in research models at larger doses, such as 700mg/kg, and demonstrated equivalent benefits to typical anti-inflammatory medicines (Almatroodi *et al.*, 2020) [1]. The aqueous fraction of *E. Officinalis* methanolic extract identify activity against carrageenan- as well as dextran-induced hind oedema in rats, and then the same fraction was tested on the formation of inflammatory mediators, specifically platelet-activating factor (PAF), thromboxane B2 (TXB2), leukotriene B4 (LTB4), and

N-formyll- me (human-PMNs) and on LTB4 and N-formyll- me (human-PMNs). Human PMNs were inhibited by an aqueous fraction of *E. Officinalis*, but inflammatory mediator production, such as LTB4, TXB4 and PAF, was unaffected during blood clotting, suggesting that anti-inflammatory effect does not entail suppression of lipid mediator synthesis (Hasan *et al.*, 2016; Variya *et al.*, 2016) [14, 44]. *In vitro* investigations utilising bronchial epithelial cells taken from a cystic fibrosis patient, on the other hand, showed that pro-inflammatory cytokine expression was inhibited (Lanka, 2018) [19].

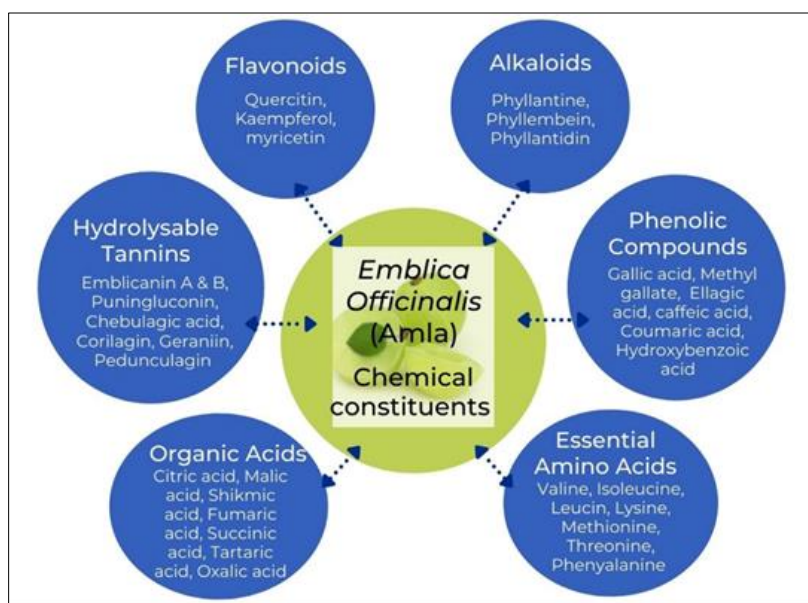


Fig 1: Potential chemical constituents of *Emblica officinalis*

Table 6: Commercialization of amla

S. No	Amla based products	Company	link
1.	Kapiva amla juice	Kapiva	https://www.kapiva.in/immunity/kapiva-amla-juice-1-l/?utm_campaignname
2.	Amla patanjali candy	Patanjali	https://www.amazon.in/dp/B01KTSBSU8/ref=cm_sw_r_apan_glt_fabc_XRYKS4G0NJRAADPZWWN1?_encoding=UTF8&psc=1
3.	Vitro dried sweet amla candy	Vitro	https://vitronaturals.com/products/amla-candy-i-am-tasty?variant=39372764217533&gclid=Cj0KCQiA7oyNBhDiARIsADtGRZbUW-kpec14WUDURZqV_QC8Ixd0ImAw-rBINhmmhjJN-BcyAhmfiHEaAiPWEALw_wcB
4.	Sri sri tattva amla candy	Sri sri	https://m.netmeds.com/non-prescriptions/srisri-tattva-amla-candy-400-gm
5.	Dr morepen amla candy	Dr. Morepen	https://www.1mg.com/otc/dr.-morepen-amla-candy-healthy-chatpata-for-adults-otc686932
6.	Vedic wellness sweet amla candy	Vedic	https://dl.flipkart.com/s/oQ9TkUuuuN
7.	Amlamrut amla pachak	Amlamrut	https://www.amazon.in/dp/B01N8X0MHE/ref=cm_sw_r_apan_glt_fabc_6X7F0SCSRW HZMW0EE3NJ?_encoding=UTF8&psc=1
8.	Baidyanath amla juice	Baidyanath	https://www.baidyanath.com/amla-juice-pack-of-2.html
9.	Dabur amla juice	Dabur	https://dl.flipkart.com/s/6g0yeANNNN
10.	Kapiva aleo +amla juice	Kapiva	https://www.kapiva.in/skin-hair/kapiva-aloe-amla-juice-1l/?utm_campaignname
11.	Kapiva ayurveda wild amla juice	Kapiva	https://www.corahealth.in/products/kapiva-amla-juice
12.	Neuherbs amla juice	Neuherb	https://www.neuherbs.com/products/amla-juice
13.	Bold fit boldveda pure natural amla juice	Boldfit	https://www.snapdeal.com/product/boldveda-amla-flavour-fruit-juice/685447153231
14.	Alps goodness health juice amla	Alps	https://www.purple.com/product/alps-goodness-health-juice-amla-300-ml
15.	Himalaya amalaki	Himalaya	https://himalayawellness.in/products/amalaki
16.	Jiva amla juice	Jiva	https://store.jiva.com/products/amla-juice-500-ml-pack-of-2/

Conclusion

Amla (*Phyllanthus emblica*) is a well-known Indian medicinal herb which provides numerous health benefits. Amla fruit is widely distributed in tropical and sub-tropical countries. All parts of this fruit possess medicinal properties, particularly

fruit, which is used in Ayurveda as a powerful rasayana and in medicine in the treatment of diarrhoea, jaundice, inflammation and several other ailments. The anti-oxidant and phytonutrients help in fighting against free radicals. Amla possesses anticancer properties because of high concentration

of polyphenol. The amla fruit contains carbohydrate (Pectin), protein, fiber with high moisture content. Amla is a rich source of Vitamin C (200-900 mg per 100 g). The juice extracted from the amla fruit is observed to contain the highest amount of vitamin C (478.56 mg/100 ml). The main components of amla fruit are: Gallic acid, Ellagic acid, Chebulinic acid, Chebulagic acid, Emblicanin-A, Emblicanin-B, Punigluconin, Pedunculagin, Ellagotannin, Trigallayl glucose, Corilagin and Isostrictiniin and many more. It is also a rich source of organic acids like Citric Acid, Fumaric Acid, Mallic Acid, and Tartaric Acid. Amla is a rich source of various minerals like aluminum, calcium, zinc, iron, chromium, copper, lead, lithium, magnesium, manganese, molybdenum, nickel, phosphorous, potassium and sodium. It helps to control digestive problems, strengthens cardio vascular activities, makes our immune system strong, improves eye sight, makes our hair shine and strong, by massaging amla oil to head we can get better and proper sleep, and also it will regulate the grown of hair follicles and helps to prevent from premature greying of hair. By socking amla in water and washing eyes with that water improves the eyesight and drinking that water early in the morning will remove constipation. Amla is available in the market in different form like amla juice, amla candy, amla jam, amla bar, amla chutney, amal pickles, amla sauce, etc.

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