

TRADITIONAL INDIAN HERB *EMBLICA OFFICINALIS* AND ITS MEDICINAL IMPORTANCE

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ABSTRACT

*Embllica officinalis* (Amla, EO, and *E. officinalis*) is one of the most important herbs in the Indian traditional medicine system, especially Ayurveda and also known as the king of all medicinal plants. EO is famous ayurvedic herb (the name means sour in Sanskrit) is likely one of the most useful drug treatments within the Indian pharmacopoeia, and is considered to be one of the most strongest uvenatives (Rasayana), particularly for the blood, bones, liver, and heart. It is an exceptionally rich source of vitamin C containing 30 times the amount found in oranges. It is one of the oldest oriental medicines mentioned in Ayurveda as potential remedy for various ailments. EO (Amla) is widely used in the ayurvedic medicines and believed to increase defense or immune power against diseases. Several parts of the plant are used to treat a variety of diseases, but the most important is the "fruit." The fruit is rich in quercetin, phyllemblic compounds, gallic acid, tannins, flavonoids, pectin, and vitamin C and also contains various polyphenolic compounds. A wide range of phytochemical components including terpenoids, alkaloids, flavonoids, carbohydrates, and tannins have been shown to possess useful biological activities. Many pharmacological studies have demonstrated the ability of EO as antioxidant, anticarcinogenic, antitumor, antigenotoxic, anti-inflammatory activities, anticancer, anti HIV-reverse transcriptase, antidiabetic, inhibitory effects, antidepressant, antiulcerogenic, hair growth tonic, wound healing activities, cardiovascular diseases, neurodegenerative diseases, cancer, and many other traditional uses of the plant. The present study also includes macroscopy, microscopy, preliminary phytoconstituent, and physico-chemical evaluation.

**Keywords:** Amla, *Embllica officinalis*, Vitamin C, Ayurvedic medicines, Hair growth tonic, Antioxidant, Anticancer, Phytoconstituent, Physico-chemical, Macroscopy, Microscopy, Traditional uses.

INTRODUCTION

At present, approximately 70% of the arena population is depending on medicinal herbs. Medicinal plants contain so many chemical substances which can be the principal supply of therapeutic sellers to healing human diseases [1]. *Embllica officinalis* (EO) or Indian goose berry is also known as the king of all medicinal crops. It is most important drug in Indian ordinary approach, primarily Ayurveda. It has occupied an important location in ayurvedic drugs.

EO has lengthy been and stays greatly preferred in India, and the extract is consumed as a nutraceutical in more than a few meals, two rasayana merchandise, chyawanprash and triphala, contain amla because the predominant ingredient. Chyawanprash is a natural gel or paste that contains as a rule EO berries with other herbal constituents and is used daily via thousands of millions of Asians as a basic panacea tonic for the whole family. Not most effective is EO largely consumed in India, but it surely has been famous to be used in over 20 nations of the world for health advantages [2].

EO (amla) is a deciduous tree belongs to family Euphorbiaceae [3]. It also reward on the hill slopes up to 200 m. It is commercially cultivated within the state of Uttar Pradesh in India. It is also grown in Tamil Nadu, Rajasthan, and Madhya Pradesh. Dried fruits, contemporary fruits, seed, leaves, root bark, and plant life of EO (amla) are regularly used in drug treatments. EO (amla) is the medium measurement deciduous plant. It grows to the peak of 8-18 m with thin, gentle gray bark. Its flower is yellow-greenish in color. The fruit is spherical faded yellow with six vertical furrows enclosing six trigonous seeds in two seeded three crustaceous cocci. The traditional weight of the fruit is 20-25 g. It has a gray bark and reddish wood. Its leaves are feathery, linear rectangular in form, and scent-like lemon. Its wood is difficult in texture.

EO (amla) is particularly nutritious and is among the richest sources of diet C, amino acids, and minerals [4]. It is an especially rich supply

of diet C containing 30 occasions the quantity discovered in oranges. The suitable for eating EO (amla) fruit tissue has three occasions the protein concentration and 160 instances the ascorbic acid awareness of an apple. The fruit additionally includes higher awareness of most minerals and amino acids than apples. EO (amla) fruit ash includes chromium, zinc, and copper. It is considered as adaptogenic that improves immunity. It contains a number of chemical ingredients such as tannins, alkaloids, phenols, and plenty of more [5]. Among all hydrolysable tannins, emblicanin A and B, gallic acid, and ellagic acid are reported to own biological endeavor.

Just about all components possess medicinal properties, notably fruit, which has been used in Ayurveda as a strong rasayana and in customary treatment within the therapy of diarrhea, jaundice, inflammation, and a number of other illnesses [6]. EO (amla) fruit is generally used in the Indian system of medicine as on my own or in mixture with different crops fresh fruit is refrigerant, diuretic, and laxative. Fruit can be carminative and stomachic. Dried fruit is sour and astringent. Bark is act as astringent and containing leukodelphinidin, tannin, and proanthocyanidin. The herb is also aphrodisiac, hemostatic, nutritive tonic, and rejuvenative. It raises red blood mobile count [3]. The fruits are valuable in vitiated stipulations of tridosah, diabetes, cough, bronchial asthma, bronchitis, cephalalgia, ophthalmopathy, dyspepsia, colic, flatulence, hyperacidity, peptic ulcer, erysipelas, skin diseases, leprosy, hematogenesis, inflammations, anemia, emaciation, hepatopathy, jaundice, strangury, diarrhea, dysentery, hemorrhages, leukorrhea, menorrhagia, cardiac problems, intermittent fevers, and grayness of hair or hair loss [7-9]. The fermented liquor from the fruits is used in dyspepsia, jaundice, and cough. Exudation from incision on the fruit is used as an external utility for the infection of the eye. Because of wealthy diet C, EO (amla) is used in the healing of human scurvy. It is also precious in neutralizing snake venom and act as an antimicrobial agent [10]. EO (amla) is utilized in sauces, candy, dried chips, pickle, jellies, and powder. It is even used within the dyeing

industry. Its extract is popularly used within the ink. EO (amla) timber is almost always utilized in firework [3].

#### TAXONOMICAL CLASSIFICATION

- Class: Dicotyledonae
- Division: Angiospermae
- Family: Euphorbiaceae
- Genus: Emblica
- Kingdom: Plantae
- Order: Geraniales
- Species: *Officinalis* Geartn.
- Synonym: *Phyllanthus emblica* Linn.

#### VERNACULAR NAMES OF EO

- Assam: Amlaku, amalaki, amalakhu
- Bengali: Dhatri
- Chinese: An mole
- English: Emblic myrobalan, Indian goose berry
- French: Phyllanthe emblica
- German: Amla
- Gujarati: Ambla
- Hindi: Amla
- Italian: Mirabolano emblico
- Kannada: Nellikayi
- Karnataka: Nellikayi, bela nelli
- Kashmir: Aonla
- Malayalam: Nelli kayi
- Malaysian: Popok melaka
- Marathi: Amla
- Orissa: Anala, Ainla
- Punjabi: Aula, Amla
- Sanskrit: Dhatriphala, amla, amaliki, amalakan, sriphalam, vayastha
- Tamil: Nelli
- Telugu: Usirikaya.

#### DISTRIBUTION AND HABITAT

EO (amla) is observed for the duration of the Deccan, sea-coasts districts, Kashmir and on hill slopes up to 200 m. It is common far and wide tropical and sub-tropical India and likewise observed in Burma. It is abundant within the deciduous forests of Madhya Pradesh. It additionally grows in Pakistan, Sri Lanka, Uzbekistan, Bangladesh, South East Asia, China, and Malaysia [11]. With orchard cultivation, about 200 trees can also be accommodated per acre, and trees endure fruit for up to 65-70 years.

#### PLANT MORPHOLOGICAL DESCRIPTION

EO (amla) is a small- to medium-sized tree with greenish-gray or red bark, growing to a height of about 8-18 m [12]. Flowering in March to May and fruiting from September to November.

##### Bark

Thin light gray bark exfoliating in small thin irregular flakes (Fig. 1) [13].

##### Flowers

Small, inconspicuous, greenish-yellow flowers are borne in compact clusters in the axils of the lower leaves. Male flowers are unisexual and numerous on short, slender pedicels, females few, sub sessile, ovary three celled (Fig. 2) [13].

##### Fruit

Pale yellow, depressed, fleshy, globose, about 2 cm in diameter with 6 obscure vertical furrows enclosing 6 trigonous seeds in 2 seeded 3 crustaceous cocci (Fig. 3) [13].

##### Fresh fruit

It consists of fresh fruit pulp of EO (amla): (a) Macroscopic, (b) microscopic, (c) identity, purity, and strength, and (d) dose (Fig. 3) [14].



Fig. 1: Bark



Fig. 2: Flowers



Fig. 3: Fresh fruit

- Macroscopic: Fruit, globose, 2.5-3.5 cm in diameter, fleshy, smooth with six prominent lines, greenish when tender, changing to light yellowish or pinkish when mature, with a few dark specks: Taste, sour, and astringent followed by delicately sweet taste [14]
- Microscopic: Transverse portion of mature fruit shows an epicarp such as a single layer of skin and pair of four layers of hypodermis, epidermal mobile, tabular. In shape, included externally with a thick cuticle and show up in floor view as polygonal, hypodermal cells tangentially elongated, thick-walled, smaller in dimension than epidermal cells, mesocarp varieties bulk of fruit, consisting of skinny-walled parenchymatous cells with intercellular spaces, peripheral 6-9 layers smaller, ovoid or tangentially elongated even as rest of cells better in dimension, isodiametric and radially elongated, a couple of collateral fibrovascular bundles scattered for the period of mesocarp which include xylem and phloem, xylem composed of tracheal factors, fiber tracheids, and xylem fibers,

tracheal factors show reticulate scalariform and spiral thickenings, xylem fibers elongated with slender lumen and pointed end, mesocarp comprises large aggregates of numerous irregular silica crystals [14].

- c. Identity, purity, and strength [14]:
  - Acid-insoluble ash: Not more than 2%
  - Alcohol-soluble extractive: Not <40%
  - Foreign matter: Not more than 2%
  - Moisture content: Not <80%
  - Total ash: Not more than 7%
  - Water-soluble extractive: Not <50%.
- d. Dose: 20 g of the drug 5-10 ml of fresh juice.

#### Dried fruit

It consists of pericarp of dried mature fruits of EO (amla): (a) Macroscopic, (b) microscopic, (c) identity, purity, and strength, and (d) dose (Fig. 4) [14].

- a. Macroscopic: Drug contains curled pieces of pericarp of dried fruit taking place both as separated single segment, 1-2 cm lengthy or united as three or four segments, bulk color gray to black, portions displaying, a large, particularly shriveled and wrinkled outside convex surface to moderately concave, transversely wrinkled lateral floor, external surface shows a couple of whitish specks, every so often some portions exhibit a portion of stony testa (which must be removed earlier than processing), texture rough, cartilaginous, tough, style, bitter, and astringent [14]
- b. Microscopic: Transverse portion of fruit indicates epicarp including a single layered epidermis, telephone appearing tabular and polygonal in floor view, cuticle present, mesocarp cells tangentially elongated parenchymatous and crushed, differentiated roughly into peripheral eight or nine layers of tangentially elongated smaller cells, leisure consisting of regularly is diametric larger cells with partitions showing irregular thickenings, ramified vascular factors on occasion present, stone cells present either remoted or in small companies closer to endocarp, pitted vascular fiber, walls appearing serrated due to the pit canals, leading into lumen [14]
- c. Identity, purity, and strength [14]:
  - Acid-insoluble ash: Not more than 2.0%
  - Alcohol-soluble extractive: Not <40.0%
  - Foreign matter: Not more than 3.0%
  - Total ash: Not more than 7.0%
  - Water-soluble extractive: Not <50.0%.
- d. Dose: 3-6 g of the drug in powder form.

#### Powder

Fine powder shows hexagonal, thick, straight-walled epidermal cells in surface view embedded with small prismatic crystals of silica, isolated or groups of thin-walled pitted stone cells, fragments of thick-walled fibers and sclereids, fragments of pitted vessels, tracheids and parenchyma, crystals of silica and simple oval to spherical starch grains scattered as such or embedded in the parenchymatous cells of the mesocarp, (a) Identity, purity, and strength and (b) dose (Fig. 5) [14].

- a. Identity, purity, and strength [14]:
  - Acid-insoluble ash: Not more than 2%
  - Alcohol-soluble extractive: Not <40%
  - Foreign matter (including seed and seed coat): Not more than 3%
  - Total ash: Not more than 7%
  - Water-soluble extractive: Not <50%.
- b. Dose: 3-6 g of the drug in powder form.

#### Leaves

They are 3 mm wide and 1.25-2 cm long, alternate, bifarious, pinnate, leaflets numerous, alternate, linear-obtuse, entire, petioles are striated, round (Fig. 6) [13].

#### Seeds

Obovate-triangular, 3 celled, seeds 2 in each cell (Fig. 7) [13].



Fig. 4: Dried fruit



Fig. 5: Powder



Fig. 6: Leaves

#### ORGANOLEPTIC CHARACTERS OF EO

Qualitative evaluation based on the sensory profile by observation of color, odor, taste, and consistency was done (Table 1).

#### PHYSICO-CHEMICAL PROPERTIES OF EO (TABLE 2) [14]

Physicochemical constants were studied in order to evaluate purity parameters of the drug as per pharmacopoeial standard and the



percentage of total ash, acid-insoluble ash, water-soluble ash and extractive values (water soluble, alcohol soluble & organic solvent soluble), pH of extracts, powder microscopy and loss on drying (LOD), etc were calculated as per the Indian Pharmacopoeia and Ayurvedic Pharmacopoeia.

#### Inorganic components present in EO

Prepared ash of the drug material was added with 50% of v/v HCl. The filtrate was then subjected to analyses the inorganic elements (Table 3) [14].

#### Phytoconstituent screening

Qualitative chemical examination of aqueous extract of EO (AEO) (amla) revealed the presence or absence of various plant constituents (Table 4) [15].

#### Nutritive value

EO (amla) has been called the first-rate of the ayurvedic rejuvenating herb, considering by way of the usual stability of tastes (sweet, sour, pungent, bitter, and astringent) multifunction fruit and is well identified for its dietary characteristics. EO (amla) fruit is regularly the richest recognized normal source of vitamin C (200-900 mg per a hundred g of safe to eat component). The fruit juice involves close to 30 instances as so much nutrition C as orange juice, and a single fruit is the same as antiscorbutic value to at least one or two oranges. It also involves



Fig. 7: Seeds

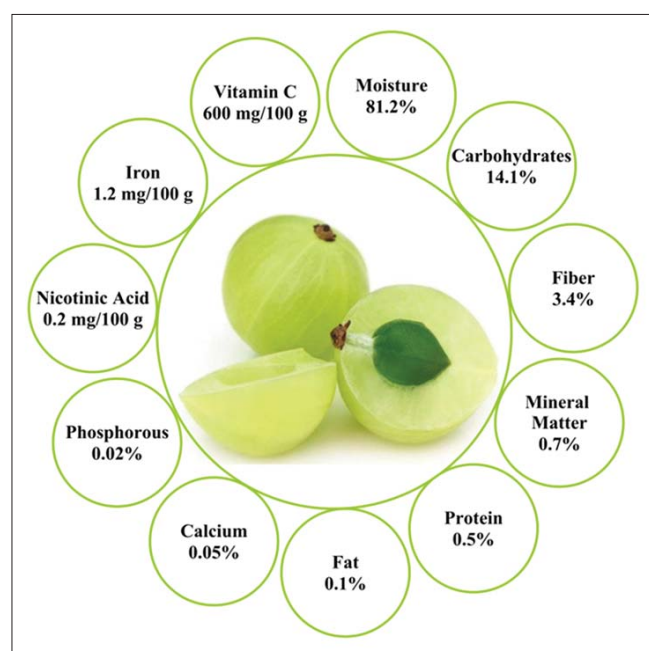


Fig. 8: Nutritional value of fruit of *Emblica officinalis* (amla) (% or per 100 g)

minerals and amino acids akin to calcium, phosphorus, iron, niacin, carotene, thiamine, riboflavin, and nicotinic acid (Fig. 8) [16,17].

#### Chemical constituents

EO (amla) is without doubt one of the most extensively studied plants. The active ingredient that has significant pharmacological motion in EO (amla) is specified through Indian scientist as "Phyllembin." The fruit is wealthy in quercetin (Fig. 9), phyllembic compounds, gallic acid (Fig. 9), tannins, flavonoids, pectin, and vitamin C and likewise involves quite a lot of polyphenolic compounds. An extensive variety of phytochemical accessories including terpenoids, alkaloids, flavonoids, and tannins (Table 4) [18].

The fruits, leaves, and bark are wealthy in tannins. Fruits contain 28% of the whole tannins disbursed in the whole plant. The fruit contains two hydrolysable tannins: Emblicanin A and B, (Fig. 9) [19] which have antioxidant houses, one on hydrolysis offers gallic acid, ellagic acid (Fig. 9), and glucose, wherein the opposite offers ellagic acid and glucose, respectively. The fruit additionally involves phyllembin [20]. Pastime directed fractionation printed the presence of a few phytochemicals such as gallic acid, corilagin, furosin, and geraniin [21]. Flavonoids such as quercetin (Fig. 9) and alkaloids such as phyllantine and phyllantidine (Fig. 9) are located. Along with these, it peculiarly includes amino acids, carbohydrates, and other compounds given in Table 5. Its fruit juice contains the perfect attention of vitamin C (478.56 mg/100 ml). Nutrition or vitamin C phases are more than these in oranges, tangerines, and lemons [22].

Pulpy portion of fruit, after drying found to contain: Gallic acid 1.32%, tannin, gum 13.75%, albumin 13.08%, crude cellulose 17.08%, mineral

Table 1: Organoleptic characters of EO (Amla)

S. No	Parameters	Observations
1.	Color	Yellowish green
2.	Consistency	Hard
3.	Odor	Aromatic
4.	Taste	Sour

EO: *Emblica officinalis*

Table 2: Physico-chemical properties of EO (Amla)

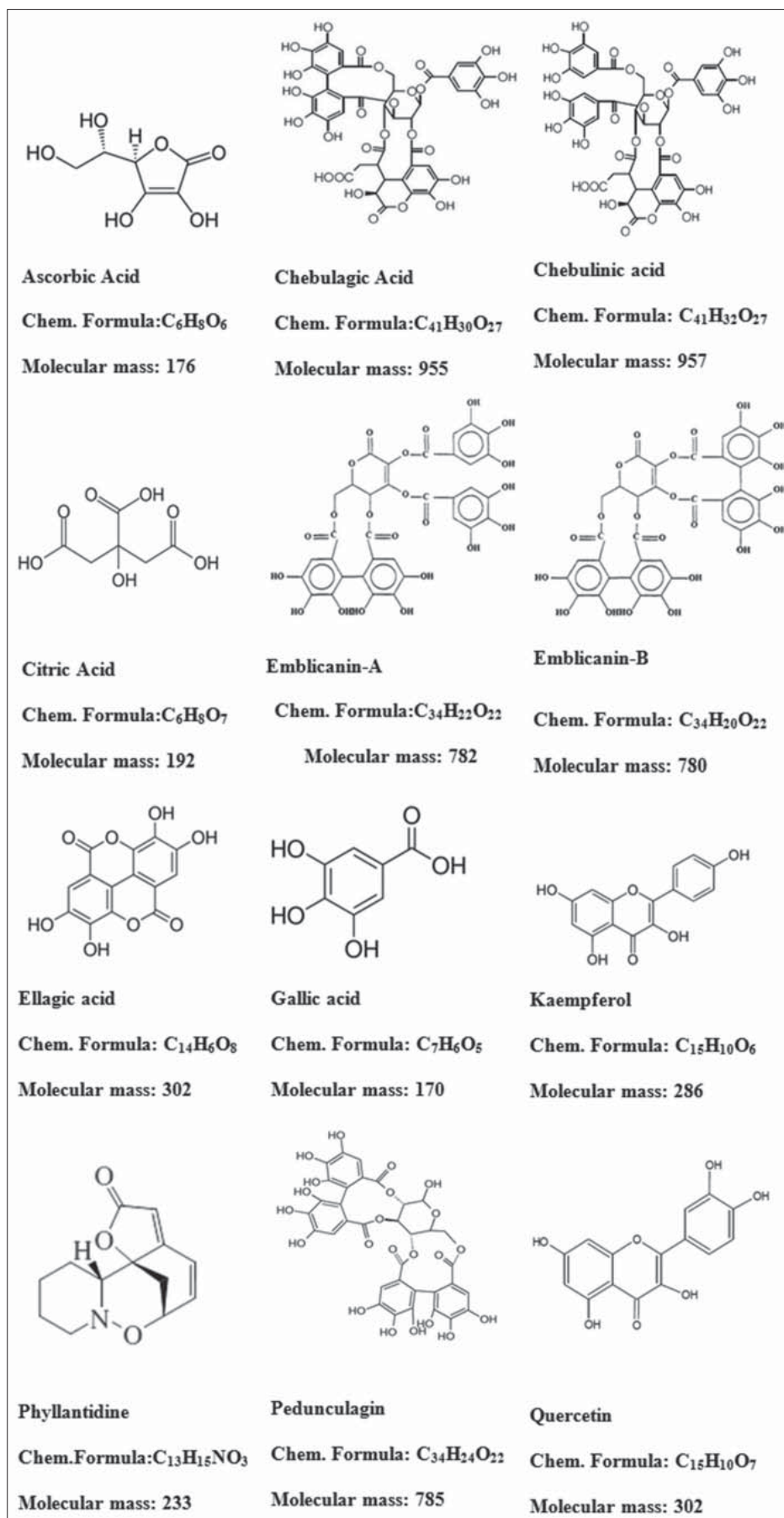
S. No	Parameters	Observations
1.	Acid-insoluble ash (w/w %)	1.90%
2.	Alcohol-soluble extractive (w/w %)	15.5%
3.	Disintegration time	39 minutes
4.	Hardness test	6.9 kg/m <sup>2</sup>
5.	Loss on drying at 110°C (w/w %)	3.4%
6.	pH of 5% aqueous solution	3.37
7.	Powder microscopic	15-20 μ
8.	Total ash (w/w %)	5.33%
9.	Water-soluble extractive (w/w %)	41.30%

EO: *Emblica officinalis*

Table 3: Inorganic components present in EO (Amla)

S. No	Parameters	Observations
1.	Calcium	+
2.	Carbonate	-
3.	Chloride	+
4.	Iron	+
5.	Magnesium	-
6.	Nitrate	-
7.	Potassium	+
8.	Sodium	+
9.	Sulfate	-
10.	Zinc	+

+: Present, -: Absent, EO: *Emblica officinalis*

Fig. 9: Chemical constituents present in *Emblica officinalis* (amla)

matter 4.12%, and moisture 3.83%. EO (amla) fruit ash contains chromium - 2.5 ppm, zinc - 4 ppm, and copper - 3 ppm. Compounds isolated from EO (amla) fruit are gallic acid, ellagic acid, 1-O-galloyl-beta-D-glucose, 3,6-di-O-galloyl-D-glucose, chebulinic acid, quercetin, chebulagic acid (Fig. 9), corilagin, 1,6-di-O-galloyl beta-D-glucose, 3-ethylgallic acid

**Table 4: Phytochemical screening of EO (amla)**

S. No	Plant constituent	Reagent used	Observations
1.	Alkaloids	Hager's reagent	+
		Wagner's reagent	+
		Mayer's reagent	+
2.	Amino acids	Dragendorff's reagent	+
		Ninhydrin test	-
3.	Carbohydrates	Benedict's reagent	+
		Fehling solution	+
		Iodine test	+
		Legal's test	+
		Libermann-Burchard's test	+
		Molisch's reagent	+
		Spot test	-
4.	Fixed oils and fats	Saponification test	-
			-
5.	Flavonoid		+
6.	Glycosides	Cardiac glycosides	-
		Coumarin	-
		Antraquinone	-
7.	Hexose	Seliwanoff's reagent	-
8.	Monosaccharide	Barfords	-
9.	Non-reducing sugar	Benedicts	+
10.	Pentose	Bails	-
11.	Phenolic		+
12.	Polysaccharide	Iodine test	-
13.	Proteins	Millon's reagent	-
		Ninhydrin reagent	-
14.	Reducing sugar	Benedicts	-
15.	Saponins	Foam test	-
16.	Steroids		-
17.	Tannins	Ferric chloride solution	+
		Lead acetate solution	+
18.	Test for organic acid		+
		Citric acid	-
		Oxalic acid	-
		Tartaric acid	-
19.	Test for vitamins		-
		Vitamin A	-
		Vitamin B	-
		Vitamin C	+

+: Present, -: Absent, EO: *Emblia officinalis*

(3-ethoxy 4,5-dihydroxybenzoic acid), and isostrictinin (Table 5) [23]. EO (amla) fruit also contains flavonoids, kaempferol-3-O-alpha L-(6"-methyl) rhamnopyranoside, and kaempferol-3-O-alpha L (6"-ethyl) rhamnopyranoside (Fig. 9) [21]. A new acylated glucoside was isolated from the methanolic extract of the leaves of EO (amla). Their structures were named as apigenin7-O-(6"-butyryl-beta)-glucopyranoside, along with four known compounds gallic acid, methyl gallate, 1,2,3,4,6-penta-Ogalloylglucose, and luteolin-4'Oonehesperidoside [24].

The seeds of EO (amla) include fixed oil, phosphatides, and small wide variety of important oil. The seeds yield a fixed oil (16%) which is brownish-yellow in color. It has the following fatty acids: Linolenic (8.8%), linoleic (44.0%), oleic (28.4%), stearic (2.15%), palmitic (3.0%), and myristic (1.0%) [25]. The leaves contain gallic acid, ellagic acid, chebulagic acid, and chebulinic acid (Fig. 9). Phyllemblic acid, a novel highly oxygenated norbisabolane, was isolated from the roots. The root contains ellagic acid (Fig. 9) and lupeol and bark contain leukodelphinidin [26,27]. Chemical constituents present in various parts of EO (amla) [4,13,28] are proven in Fig. 9 and Table 5.

#### House hold remedies and preparation prepared from EO (amla)

The plant is used in many forms:

Chyavanaprash (CHY)

- Confection
- Decoction
- Fixed and essential oil
- Fresh juice
- Fruit paste
- Infusion
- Liquor
- Oil
- Paste
- Pickles
- Powder
- Shampoo.

#### TRADITIONAL MEDICINAL USES

EO (amla) enhances production of red blood cells and strengthens the teeth, hair [7,9,29], and nails, as well as regulating blood sugar. In addition, it is used in bleeding, hemorrhoids, anemia, diabetes, gout, vertigo, obesity, diabetes-all varieties, hyperacidity, eczema, psoriasis, hoarse voice, sore throat, infection, hiccoughs, hepatitis B, non-specific urethritis, sterility, anemia, gingivitis, glaucoma, diarrhea, constipation, active fistula, hair loss [7,8,30], a couple of voice, and eyes. Seeds used for bronchial asthma, bronchitis, and biliousness. Dried fruit is used for hemorrhage, diarrhea, dysentery, for anemia (with iron), Jaundice, and dyspepsia. For acute bacillary dysentery taken as syrup with lemon juice. As triphala just right for laxative, headache, biliousness, dyspepsia, constipation, piles,

**Table 5: Different chemical constituents present in various parts of EO**

Part	Chemical constituents
Bark	Leukodelphinidin, lupeol, $\beta$ -sitosterol, tannins
Fruit	Alanine, arginine, ascorbic acid, aspartic acid, ash, $\beta$ -carotene, boron, calcium, carbohydrates, chebulagic acid, chebulagic acid, chebulic acid, chebulinic acid, chloride, copper, corilagic acid, corilagin, cystine, d-fructose, d-glucose, ellagic acid, emblicol, emblicanin, ethyl gallate, fat, fiber, flavonoids, gallic acid, gallic acid ethyl ester, gibberellina-1, gibberellin-a-3, gibberellin-a-4, gibberellin-a-7, gibberellin-a-9, glucogallin, glucose, glutamic acid, glycine, glycosides, histidine, iron, isoleukine, leukine, lysine, magnesium, manganese, methionine, myo-inositol, myristic acid, niacin, nitrogen, pectin, phenylalanine, phosphorus, phyllantidine, phyllantine, phyllemblic acid, phyllemblic acid, phyllemblic acid, polysaccharide, potassium, proanthocyanidins, proline, protein, quercetin, riboflavin, rutin, selenium, serine, silica, sodium, starch, sucrose, sulfur, tannin, terchebin, thiamin, threonine, trigalloyl glucose, tryptophan, tyrosine, valine, water, zeatin, zeatin nucleotide, zeatin riboside, zinc
Leaf	Amlaic acid, astrogalin, ellagic acid, gallo-tanin, kaempferol, kaempferol-3-o-glucoside, phyllanthin, rutin, tannin
Pericarp	Ellagic acid, emblicol, gallic acid, phyllemblic acid
Root	Ellagic acid, lupeol
Seed	Linoleic acid, linolenic acid, myristic acid, oleic acid, palmitic acid, phosphatides, stearic acid, $\beta$ -sitosterol
Shoot	Chebulagic acid, $\beta$ -sitosterol, chibulnic acid, corilagin, ellagic acid, gallic acid, glucogallin, lupeol

EO: *Emblia officinalis*

enlarged liver, and ascites. Juice of bark mixed with honey and turmeric for gonorrhoea gastritis, hepatitis, osteoporosis, constipation, biliousness, weak point of liver and spleen, untimely graying or hair loss [8,31], basic debility, tissue loss, palpitation. Amla is also mentioned to have hepato, cardio, nephrology, and neuroprotective results, antioxidant, anti-inflammatory, analgesic, antipyretic, and restorative houses. List of EO (amla) usual purposes [32] is given in Table 6.

## PHARMACOLOGICAL ACTIVITIES AND CLINICAL ACTIVITIES

### Antioxidant

A riskless and feasible high-performance liquid chromatography (HPLC) procedure with diode array deflection has been developed for the determination of ascorbic acid (Fig. 9). EO fruit is processed with the ayurvedic method. The antioxidant results have additionally been evaluated in assessment to the true stages of nutrition C by way of special antioxidant exams the information bought exhibit that the Emblica fruit involves ascorbic acid (0.4%, w/w) and that the ayurvedic procedure of processing raises the healthy characteristics of the fruit due to a higher antioxidant endeavor and a better content material of ascorbic acid (1.28%, w/w). It has additionally been observed that vitamin C debts for approximately 45-70% of the antioxidant pastime [33].

### Anticancer

Anticancer knowledge of six phenolic compounds remoted from amla fruit using *in vitro* proliferation assay. (3-(4,5-Dimethylthiazol-2-yl)-2,5-diphenyltetrazolium bromide (MTT) procedure was used to gain

knowledge of the consequences of those compounds on splenocyte proliferation and the cytotoxicity to each human breast cancer mobile (MCF-7) and human embryonic lung fibroblast cell (HELFL). Isocorilagin exhibited a robust cytotoxicity to HELFL telephone with inhibitory concentration 50% of 51% 4 g/mL, whereas geraniin, quercetin, kaempferol, and their glycosides confirmed susceptible cytotoxicity in opposition to HELFL cells. EO inhibits the progress and unfold of distinct forms of melanoma such as breast, pancreases, liver, uterus, belly, and malignant ascites. It also reduces the aspect outcome triggered using chemotherapy and radiotherapy, which often used for the healing of cancer [34]. EO even has some medicinal houses, including immune stimulator and antitumor recreation [35]. Polyphenolic compounds of EO motive induction of apoptosis in Dalton's lymphoma ascites (DLA) and CeHa mobile lines. It additionally suggests inhibition of DNA topoisomerase I in *saccharomyces cerevisiae*, mutant cellphone culture, and the exercise of cell division cycle 25 (CDC25) tyrosine phosphatase [35]. EO may be very invaluable as an element in combo cure of sufferer beneath cyclophosphamid remedy [36]. Kalpaamruthaa (KA) is a modified Siddha education containing EO, *Semecarpus anacardium* (SA), and honey. The accelerated stages of free cholesterol, whole cholesterol, triglycerides (TGs), phospholipids, and free fatty acids or lowered levels of ester low-density lipoprotein (LDL) cholesterol in plasma, kidney, and liver found in cancer suffering animals were reverted again to near usual levels on therapy with KA and SA [37]. Triphala (amla, bellirica myrobalan, and chebulic myrobalan) has been said to exhibit chemo preventive talents. The presence of triphala in the weight loss program had enormously decreased the benzo caused

Table 6: EO (amla) pharmacological and traditional applications

Pharmacological effect	Part used
Antibacterial activity	Fruit, leaves
Antifungal activity	Fruit
Antiviral activity	Fruit
Antimicrobial activity	Fruit, infusion and decoction of leaves, seeds
Anticancer activity	Fruit, fruit juice, leaves, roots, branches
Antiepileptic	Hydro alcoholic extract of EO
Anti-inflammatory	EO gel, leaves, fruit
Antinociceptive	Fruit
Antipyretic	Roots, decoction of leaves and seeds, fruit
Antioxidant activity	Fresh juice, fruits, seeds
Antiulcerogenic	Fruit, decoction of leaves, bark of the root
Aperient	Fruit, flowers
Astringent	Root, bark, fruit
Antiatherosclerotic	Fruit, fresh juice
Cardioprotective	Fruit
Cytoprotective	Fruit
Dental problems	Root, juice of the leaves
Diabetes	Fruit, decoction of leaves and seeds, infusion of seeds, EO juice mixed bitter gourd juice
Diarrhea	Decoction of fruit, root, infusion of leaves, bark
Dysentery	Dried fruit, paste of leaves mixed with honey
Eye care	Fresh EO juice or capsules
Febrifuge	Infusion of seeds
Gonorrhoea	Juice of the bark combined with honey and turmeric
Hair growth	Dried EO fruit are boiled in coconut oil
Hepatoprotective	Fruit
Hypotensive potential	Fruit
Immunomodulatory	Fruit
Indigestion	Leaves with buttermilk
Jaundice, dyspepsia, and cough	Fruit juice or powder to a glass of warm milk
Lipid lowering	Fruit, fresh juice
Menstrual problems	Mixture of EO with honey and saunf or mixing it with squished banana and consuming
Pruritus	Seeds are burnt, powdered and mixed with oil
Respiratory problems	Fruit, expressed juice of fruit, juice/extract of the fruit mixed with honey and pipli to stop cough
Rheumatism	Dry fruit powder mixed with jaggery
Scurvy	Powder of the dry herb mixed with equal quantity of sugar, taken with milk
Scabies and itch	Seed burnt, powdered and mixed with oil
Skin sores and wound	Milky juice of leaves, Bark
Vaginal complaints	Mixture of fruit juice and sugar
Vermifuge	Juice of fruit with honey
Vomiting	Fruit juice mixed with honey

EO: *Emblica officinalis*



fore-belly papillomagenesis in mice. It was once extra amazing in lowering tumor incidences in comparison with its person components. Triphala additionally tremendously elevated the antioxidant status of animals which might have contributed to the chemoprevention [38].

#### Antibacterial

Investigation is serious about antibacterial capabilities of aqueous infusions and aqueous decoctions of EO (amla) and *Coriandrum sativum* (coriander) against 345 bacterial isolates belonging to six distinctive genera of Gram poor bacterial population isolated from urine specimens by employing well diffusion process. Aqueous infusion and decoction of EO exhibited powerful antibacterial pastime against *Escherichia coli* (270), *Klebsiella pneumoniae* (51), *Klebsiella ozaenae* (3), *Proteus mirabilis* (5), *Pseudomonas aeruginosa* (10), *Salmonella typhi* (1), *Salmonella Paratyphi A* (2), *Salmonella Paratyphi B* (1), and *Serratia marcescens* (2), however, did not show any antibacterial activity in opposition to Gram poor urinary pathogens [39].

#### Antifungal

Antifungal property of EO used to be reported in opposition to *Aspergillus* [40]. Fruit ethanol and acetone extracts confirmed average pastime toward *Fusarium equiseti* and *Candida albicans* where griseofulvin was once used as ordinary antibiotic [41]. Plant methanolic extract of EO did not exhibit antifungal pastime against phytopathogenic fungi *Aspergillus niger* F2723 [42].

#### Antiviral

Antiviral and endocrine results, exercise on mammalian enzymes, ability to modulate immune and inflammatory cellphone operate, affect delicate muscle groups and have also effects on lipid peroxidation and oxyradical construction. Pentagalloylglucose can inhibit influenza a virulent disease replication with a twin mode of motion assessed by way of WST-1 assay, plaque-forming unit assay, time of addition assay, and hemagglutination inhibition assay [43].

#### Antidiabetic

Methanolic extract (75%) of *Terminalia chebula*, *Terminalia bellerica*, EO, and their combo named "Triphala" (equal share of above three plant extracts) are being used greatly in Indian approach of remedy. They were located to inhibit lipid peroxide (LPO) formation and to scavenge hydroxyl and superoxide radicals *in vitro*. The concentration of plant extracts that inhibited 50% of lipid peroxidation precipitated with Fe (2+)/ascorbate have been food to be 85.5, 27, 74, and 69 µg/ml, respectively. The concentration wanted for the inhibition of hydroxyl radical scavenging have been 165, 71, 155.5, and 151 µg/ml and that for superoxide scavenging pastime were located to be 20.5, 40.6, 6.5, and 12.5 µg/ml, respectively. Oral administration of the extracts (100 mg/kg body weight) diminished the blood sugar stage in common and in alloxan (120 mg/kg) diabetic rats tremendously inside 4 hrs. Persisted, day-to-day administration of the drug produced a sustained influence [44].

#### Antidepressant

The antidepressant undertaking of aqueous extract of fruits of EO in inbred grown up male Swiss Albino mice weighing 25-30 g. The experiment was applied using forced swim experiment and tail suspension scan. The outcomes of this test confirmed the antidepressant recreation of EO as comparable to the of usual antidepressant drug imipramine [45].

#### Anti-inflammatory

EO extracts on carrageenan and dextran-brought on rat hind paw edema. Anti-inflammatory exercise was determined within the water fraction of methanol extract of the plant leaves. The effects of the same fraction had been proven on the synthesis of mediators of infection such as leukotriene B4 (LTB4), platelet-activating component, and thromboxane B2 and on LTB4 and N-formyl-L-methionyl-L-leucyl-L-phenylalanine -prompted migration of human polymorph nuclear

leukocytes (PMNs) in-inhibited migration of human PMNs in slightly low concentrations. It did not inhibit LTB4 or PAP human platelets throughout dotting, suggesting that the mechanism of the anti-inflammatory motion found in the rat paw model does now not involve inhibition of the synthesis of the measured lipid mediators [46].

#### Antimicrobial

The antimicrobial hobbies of amla extract had been investigated via Mayachiew and Devasahtin (2008) through two special ways (disc diffusion and agar dilution methods) in opposition to *Staphylococcus aureus*. The minimum inhibitory awareness price of amla used to be observed to be 13.97 mg/mL and the minimum biocidal awareness value used to be 13.97 mg/m. However, the word useful advancement made in microbiology in addition to manage of microorganisms, intermittent occurrences of epidemics as a result of drug resistant microorganisms and earlier unknown disease-inflicting microbes pose a colossal hazard to public well-being. These hostile health tendencies demand a universal initiative for the development of novel tactics for the prevention and healing of infectious sickness. For over 100 years, chemicals isolated from medicinal plants have served as the items for a lot of clinically confirmed medicinal drugs and are now being reassessed as antimicrobial sellers. The reasons for this revival include a cut back in the new antibacterial drugs in the pharmaceutical pipeline, a proliferation in antimicrobial resistance, and the necessity of therapies for brand new evolving pathogens. Factually, thousands of plant species have been tried against hundreds of bacterial traces *in vitro* and plenty of medicinal plants are lively toward an extensive range of Gram-positive as good as Gram-terrible bacteria [47].

#### Antiaging

The effects of EO on the lipid metabolism and protein expression involved in oxidative stress for the duration of the getting old approach sunamla or ethyl acetate (Et Ac) extract of amla, a polyphenol-wealthy fraction, was administered at a dose of 40 or 10 mg/kg physique weight per days for 100 days to younger rats aged 2 months and aged rats aged 10 months. The lipid levels, corresponding to cholesterol and TGs, in serum and liver had been markedly extended in aged manage rats, and at the same time, they had been enormously decreased by way of the administration of EO (amla). The peroxisome proliferator-activated receptor alpha (PPARalpha) is famous to control the transcription of genes involved in lipid and cholesterol metabolism. The PPARalpha protein stage in liver was reduced in aged manage rats. Nonetheless, the oral administration of amla vastly accelerated the hepatic PPARalpha protein degree. In addition, oral administration of amla drastically inhibited the serum and hepatic mitochondrial thiobarbituric acid (TBA)-reactive substance levels in aged rats. In addition, the elevated expression stage of bax used to be drastically reduced after the oral administration of EO (amla) while the level of bcl-2 ended in a massive broaden. In addition, the expressions of hepatic nuclear factor (NF)-kappa B, inducible NO synthase (iNOS) and cyclo-oxygenase-2 (COX-2) protein levels have been also elevated with aging. Nonetheless, EO (amla) extract decreased the iNOS and COX-2 expression phases through inhibiting NF-kappa B activation in aged rats. These results point out that EO (amla) could preclude age-related hyperlipidemia via attenuating oxidative stress within the growing older system [48].

#### Antiatherogenic effects

Oxidized-LDL (ox-LDL) is the main etiologic factor in atherogenesis and antioxidants are accepted as the effective treatment of atherosclerosis. The aim of this study was to clarify whether the mechanism of the antiatherogenic effects of the herb EO (amla), which is widely used to treat atherosclerosis-related diseases, is associated with ox-LDL via its compounds of soluble tannin, corilagin (beta-1-0-galloyl-3,6-(R)-hexahydroxydiphenoyl-d-glucose), and its analog Dgg16 (1,6-di-O-galloyl-bela-d-glucose). Human umbilical vein endothelial cells, ECV-304 were incubated with ox-LDL (50 mg/L), treated with corilagin or Dgg16 at different doses (0.0001-0.1 mmol/L), and then incubated with monocytes malondialdehyde (MDA) in the culture media was



determined and the number of monocytes adhering to ECV-304 cells was counted with cytometry. In another experiment, the rat vascular smooth muscular cells (VSMC) were incubated in media with or without ox-LDL (50 mg/L), and with corilagin or Dgg16 also at different doses (0.0001-0.1 mol/L), the proliferation of which was assayed with MTT. The results showed that both corilagin and Dgg16 were able to decrease MDA, prevented ECV-304 cells from being adhering to by monocytes, and inhibited VSMC proliferation activated by ox-LDL. The results suggest that the two compounds are effective in inhibiting the progress of atherosclerosis by alleviating oxidation injury or by inhibiting ox-LDL-induced VSMC proliferation, which may be promising mechanisms for treating atherosclerosis [49].

#### Antitumor activity

AEO (amla) used to be observed to be cytotoxic to L 929 cells in culture in a dose elegant method. Concentration needed for 50% inhibition was located to be 16.5 µg/ml. EO (amla) and CHY (a non-poisonous natural training containing 50% EO (amla)) extracts were observed to diminish ascites and stable tumors in mice triggered with the aid of DLA cells. Animals handled with 1.25 g/kg between of EO (amla) extract increased existence span of tumor bearing animals (20%) even as animals dealt with 2.5 g/kg between of CHY produced 60.9% increased within the existence span. Each EO (amla) and CHY tremendously decreased the stable tumors. Tumor quantity of manage animals on the 30<sup>th</sup> day was once 4.6 ml, whereas animals handled with 1.25 g/kg between of EO (amla) extract and a 2.5 g/kg between of CHY confirmed a tumor quantity of 1.75 and 0.75 ml. Respectively EO (amla) extract was once found to inhibit mobile phone cycle regulating enzymes CDC25 phosphatase in a dose dependent method. Attention wanted for 50% inhibition of CDC25 phosphatase was found to be 5 µg/ml and that needed for inhibition of CDC2 kinase used to be found to be >100 µg/ml. The results propose that antitumor exercise of EO (amla) extract could in part be as a result of its interplay with mobile phone cycle regulation [35].

#### Antitussive activity

The antitussive undertaking of EO Gaertn. was verified in mindful cats via mechanical stimulation of the laryngopharyngeal and tracheobronchial mucous areas of airways. The outcome confirmed that at a dose of 50 mg/kg body wt. per orally, the cough suppressive outcomes of EO isn't unambiguous. A better dose (200 mg/kg physique wt.) of this substance per orally was more powerful, notably in decreasing the quantity of cough efforts (NE), frequency of cough (NE/min(-1)), and the intensity of cough attacks in inspirium (IA+) and expirium (IA-) was once more stated. These outcomes showed that the cough suppressive exercise of EO is dose based and also proven that the antitussive activity of EO is much less strong than shown using the classical narcotic antitussive drug codeine, however, extra amazing than the non-narcotic antitussive agent dropropizine. It is supposed that the antitussive endeavor of the dry extract of EO is due now not best to antiphlogistic, antispasmodic, and antioxidant efficacy effects, but in addition to, its result on mucus secretion in the airways [50].

#### Antiproliferative activity

A total of 18 most important compounds, together with 4 norsesquiterpenoids (1-4) and 14 phenolic compounds (5-18) remoted beforehand from *P. emblica*, in conjunction with a foremost constituent, proanthocyanidin polymers (19) toward MK-1 (human gastric adenocarcinoma), HeLa (human uterine carcinoma), and B16F10 (murine melanoma) cells utilizing an MTT system. All of the phenolic compounds including the principal 5-8 from the fruit juice, 8, 9, and 12 from the branches and leaves, and 19 from the roots confirmed more desirable inhibition in opposition to B16F10 cell growth than against HeLa and MK-1 phone progress. Norsesquiterpenoid glycosides three and 4 from the roots exhibited colossal antiproliferative events, despite the fact that their aglycon 1 and monoglucoside 2 showed no inhibitory endeavor in opposition to these tumor cells [51].

#### Antimetastatic activity

Five rasayanas and one of the most materials EO were studied for their antimetastatic undertaking making use of B16F-10 melanoma cells in C57BL/6 mice. Simultaneous oral administration (50 mg/animal/dose) of Brahma Rasayana (BR) and Aswagandha Rasayana (AR) tremendously reduced the lung tumor nodule formation by way of seventy 0.23% (p<0.001) and 55.6% (p<0.001), respectively. Similarly, the lung collagen hydroxyproline content and the serum sialic acid phases have been additionally low in BR dealt with (4.8±0.97 µg/m protein. 35.6±2.6 µg/ml serum) and AR handled animals (6.15±0.5 µg/mg protein; 56.3±8.7 µg/ml serum) in comparison with the untreated controls (10.43±0.7 µg/mg protein; 151.3±9.5 µg/ml serum) Narasimha Rasayana (NR), Amnthaprasam. Chyavanaprasam (CP) and Emblica extract EO administration had no tremendous outcome in the discount of lung nodule formation and lung hydroxyproline and serum sialic acid contents which was just like that of untreated controls. Lifestyles span of BR, AR and NR treated animals was once located to be enormously expanded. These outcome points out that BR and AR possess antimetastatic exercise in opposition to melanoma cells [52].

#### Antipyretic and analgesic activity

The study was designed to examine the antipyretic and analgesic exercise of ethanol EO (EEO) and AEO extracts of EO fruits in a number of experimental units. A single oral dose of EEO and AEO (500 mg/kg, i.p.) confirmed huge reduction in brewer's yeast precipitated hyperthermia in rats. EEO and AEO also elicited pronounced inhibitory effect on acetic acid-prompted writhing response in mice in the analgesic test. Both EEO and AEO did not show any giant analgesic pastime in the tail-immersion scan. These findings advocate that extracts of EO fruits possessed potent antipyretic and analgesic activity. Preliminary phytochemical screening of the extracts showed the presence of alkaloids, tannins, phenolic compounds, carbohydrates, and amino acids, which could also be responsible for antipyretic and analgesic activities [53].

#### Antisnake venom activity

The methanolic root extracts of *Vitex negundo* Linn., and EO Gaertn had been explored for the first time for antisnake venom activity. The plant (*V. negundo* and EO) extracts tremendously antagonized the *Vipera russellii* and *Naja kaouthia* venom caused lethal exercise each in *in vitro* and *in vivo* reviews. *V. russellii* venom-caused hemorrhage, coagulant, fibrinogen, and inflammatory undertaking was greatly neutralized via each plant extracts. No precipitating bands had been located between the plant extract and snake venom. The above observations confirmed that the plant extracts possess robust snake venom neutralizing ability and want extra investigation [54].

#### Ameliorating effects

The ethanolic extract from the fruits of EO Gaertn was investigated to evaluate its viable ameliorating results, on the L-thyroxine (L-T4) precipitated hyperthyroidism and on hepatic lipid peroxidation in mice. While an develop in serum T3 (triiodothyronine) and T4 (thyroxine) concentrations, and in a thyroid dependent parameter, hepatic glucose 6-phosphatase (glu-6-pase) pastime was once observed in L-T4 (0.5 mg/kg/day) treated animals, simultaneous oral administration of the plant extract at a dose of 250 mg/kg/day (p.o.) for 30 days. In hyperthyroid, mice lowered T3 and T4 concentrations via 64% and 70%, respectively, as compared to a usual antithyroid drug, propyl thiouradl that reduced the phases of the thyroid hormones by 59 and 40%, respectively. The plant extract also maintained almost typical value of glu-6-pase exercise in hyperthyroid mice. The plant extract also decreased hepatic LPO and accelerated the superoxide dismutase (SOD) and catalase (CAT) events in hyperthyroid mice, exhibiting its hepatoprotective nature. The findings advocate that the experiment material could potentially ameliorate the hyperthyroidism with one more hepatoprotective advantage [55].

### Boils and spots

The pericarp of the fruit is in general utilized in decoctions along with different parts and also applied externally on boils with cow ghee to advertise suppuration [56].

### Body coolant

Despite the fact that amla-berry is excellent for all doshas and seasons, it is particularly effective in the hot season to chill pitta dosha. It is a specifically good rasayana for humans with pitta and vata physique varieties. In Tibetan medication, the fruit were described as having a bitter style with cooling potency [57].

### Chemopreventive activity

Chemoprevention with meals photochemical is presently regarded as some of the important procedures for melanoma manipulate. EO indigenous to India is valued for its unique tannins and flavonoids, which include very robust antioxidant properties. The inhibition of tumor incidences with the aid of fruit extract of this plant has been evaluated on two-stage procedure of dermis carcinogenesis in Swiss albino mice, brought on by a single application of 7, 12-dimethylbenz, (a) Anthracene (a 100 µg/a 100 µl acetone), and 2 weeks later, promoted with the aid of repeated utility of croton oil (1% in acetone/thrice every week) until the tip of the test (16 weeks). The tumor incidence, tumor yield, tumor burden, and cumulative quantity of papillomas had been determined to be higher in the control (without EO healing) as compared to experimental animals (EO). The diversities in the values of the outcome of experimental businesses had been statistically analyzed and determined to be large in comparison to the manipulate group ( $p < 0.05$ ) The present gain knowledge of demonstrates the chemo preventive talents of EO fruit extract on 7,12-dimethylbenz(a) anthracene (DMBA) caused epidermis tumor genesis in Swiss albino mice [58].

### Chelating agent

Photo aging of the skin is a complex biologic process affecting various layers of the skin with major changes seen in the connective tissue within the dermis. EO was shown to reduce ultra violet-induced erythema and had excellent free-radical quenching ability, chelating ability to iron and copper as well as matrix metalloproteinase (MMP-1) and MMP-3 inhibitory activity [59].

### Cardioprotective

An emblicanin-A (37%) and B (33%) enriched fraction of recent juice of Emblica fruits (EOT) used to be investigated for antioxidant undertaking against ischemia-reperfusion (ischemia-reperfusion injury [IRI])-prompted oxidative stress in rat heart vitamin E (VE) was used as the usual antioxidant agent IRI used to be caused in remoted rat heart through perfusing it with modified Krebs-Henseleit's resolution for five min, adopted via a period of ischemia (stoppage of perfusion) for 10 minutes after which restoring the perfusion (reperfusion) for 15 minutes. IRI prompted a gigantic cut back within the routine of cardiac SOD, CAT, and glutathione (GSH) peroxidase (GPx), with a concomitant expand in lipid peroxidation These IRI-induced effects were avoided via the administration of EOT (50 and 100 mg/kg body wt.) and VE (200 mg/kg body wt.) given orally twice day-to-day for 14 days before the sacrifice of the animals and initiation of the perfusion experiments. The study confirms the antioxidant influence of EO and suggests that the fruits of the plant may have a cardioprotective result [60].

### Constipation

Constipation reasons infrequent stool, anal, and peripheral agony and abdominal discomfort. This power straining for the duration of the defecation results in bleeding piles (hemorrhoids). Amla being rich in fibers regulates the bowel action and continues constipation at bay. Juice of amla interested in 250 mg of giloy extract supplies an potent remedy for hemorrhoids. The fruit is every now and then pickled or preserved in sugar. When dry it is stated to be gently laxative, according to some sources the recent fruit is also laxative. The fresh ripe fruits are used greatly in India as a laxative, one or two fruits being adequate for a dose [61].

### Diarrhea

It is used medicinally for the therapy of diarrhea. As a fruit decoction, it is combined with bitter milk and given by means of the natives in cases of dysentery. The bark partakes of the astringency of the fruit. A decoction and evaporation of the foundation resolution produces an astringent extract equal to catechu. An infusion of the leaves with fenugreek seed is given for persistent diarrhea [56].

### Degradation kinetics

The kinetics of ascorbic acid degradation in EO (amla) as good as in pure ascorbic acid solutions at initial concentrations reward in EO (amla) over a temperature range of 50-120°C (regular-state temperature) has been studied. The ascorbic acid degradation followed first-order response kinetics where the fee regular multiplied with broaden in temperature. The temperature dependence of deterioration used to be thoroughly modeled through the Arrhenius equation. The activation energies have been observed to be 4.09 kcal/mole for amla and 4.49 kcal/mole for pure vitamin. The degradation kinetics of ascorbic acid used to be also evaluated in usual open pan cooking, strain-cooking, and a newly developed and patented gasoline-efficient EcoCooker (unsteady state heating method). A mathematical model was developed utilizing the consistent-state kinetic parameters obtained to foretell the losses of ascorbic acid from the time-temperature knowledge of the unsteady state heating processing system. The outcome bought indicates the ascorbic acid degradation is of an equivalent order of magnitude in the entire approaches of cooking [62].

### Dental problems

The roots of EO (10 g) are floor and taken twice day-to-day for 1 day most effective after taking food. However, the leaves of EO are squeezed and the juice extracted. This juice is put in the ear (a few drops) to find relief from toothache. A final replacement is to grind the node of an EO and blend it with water. After full of life stirring, it is filtered by way of a cloth. This water is put drop with the aid of drop in the right ear if the tooth on the left hand face is in agony and vice versa. The remedy is continuing for 3 days [58].

### Fevers

Malays use a decoction of its leaves to deal with fever. The fresh fruit is refrigerant. The seeds are given internally as a cooling relief in bilious affections and nausea, and in infusion make an excellent drink in fevers. The plants are employed via the Hindoo medical professionals for his or her supposed refrigerant and aperient features. Most often after a fever there is a loss of style and a decoction of the emblic seed, dried grapes, and sugar is used for gargling. A decoction of the emblic seed, chitrak root (*Plumbago zeylanica* or Leadwort), chebulic myrobalan, and pipli (*Piper longum*) is given in fevers and there's also a compound powder composed of equal elements of the emblic seed (EO), chitrak root, chebulic myrobalan, pipli, and saindhava (rock salt) which may also be used [63].

### Food absorption

The general use of EO (amla) can enhance digestion, absorption, and assimilation of meals. Persons taking it become aware of that they enjoy the style of food higher. It enhances all 13 digestive fires (agni). However, it works more slowly and gently than ginger or different digestion-enhancing herbs, so it may be taken by way of individuals with quite a few pitta without fear of creating extra belly acid. Furthermore, it improves assimilation of iron for healthy blood [61].

### Gastroprotective effects

An EEO (amla) used to be examined for its antisecretory and antiulcer pursuits using specific experimental units in rats, together with pylorus ligation. Shay rats, indomethacin, hypothermic restraint stress-induced gastric ulcer and necrotizing dealers (80% ethanol 0.2 M NaOH and 25% NaCl). Oral administration of amla extract at doses 250 mg/kg and 500 mg/kg vastly inhibited the progress of gastric lesions in all experiment items used. It also brought on gigantic cut down of the pyloric-ligation brought about basal gastric secretion, titratable acidity,

and gastric mucosal injury. Besides, amla extract supplied defense against ethanol-triggered depletion of stomach wall mucus and reduction in non-protein sulfhydryl concentration. Histopathological analyses are in excellent agreement with pharmacological and biochemical findings. The outcome point out that amla extract possesses antisecretory, antiulcer and cytoprotective properties [64].

#### Hair growth promoting activity

EO (amla) act as normal and world's oldest hair conditioner and provide excellent nourishment and in addition support in normalizing the blood deliver. EO (amla) is wealthy in nutrition C, tannins, and minerals similar to phosphorus, iron, and calcium, which presents diet to hair and likewise explanations darkening of hair [7,8]. A fixed oil is acquired from the berries that are used to reinforce and promote the development of hair [8]. The dried fruits have a good result on hair hygiene and have lengthy been respected as an ingredient of shampoo and hair oil [29]. Indian gooseberry is a permitted hair tonic in natural recipes for enriching hair growth and in addition pigmentation. A fixed oil bought from the berries strengthens and promotes the growth of hair. The fruit, reduce into pieces, is dried, preferably in color after which boiled in coconut oil, the resulting oil is claimed to be fine for stopping hair graying, a basic sign of excess pitta dosha. The water where dried amla portions are soaked overnight act as detergent, so it is an active ingredient of shampoo and likewise utilized in hair oil which offers nourishing to the hair [30].

Natural hair oil formulated from EO (amla), *Bacopa monnieri*, and *Cyperus rotundus* alcoholic extract or as an entire drug. The hair oil used to be prepared individually and in a various awareness of all three herbs and a blend of the entire three herbs in constant proportion utilizing coconut oil as base [9]. The formulated oil in various attentions was evaluated bodily, chemical, and hair progress homes of formulated oil using applying it topically on shaved skin of albino rats. Fundamental dermis infection test and hair size test were carried out, and the hair growth was in comparison with typical minoxidil 2% ethanolic resolution making use of healthful albino rats. It used to be found that hair oil method confirmed the pleasant outcome among the many other systems evaluated using displaying an enlargement of follicular dimension and prolongation of the anagen segment [7,29,31].

#### Hypolipidemic

EO (amla) fruit has been reported to have enormous antihyperlipidemic, hypolipidemic, and antiatherogenic [65]. Healing with EO-induced enormous discount of complete cholesterol, LDL, TG, and very LDL and a giant develops in high-density lipoprotein levels in patients with form II hyperlipidemia. Both treatments from EO (amla) and simvastatin produced a gigantic reduction in blood pressure; nonetheless, this useful influence was once more marked in sufferers receiving EO (amla). Histopathological gain knowledge of thoracic aorta of EO (amla) handled workforce has proven lessen in atherogenicity compared to untreated excessive cholesterol food plan fed rats. The info verified that EO (amla) formulation used to be related to hypolipidemic results on the experimentally brought on hypercholesterolemic rats. It is usually visible that EO (amla) dealt with rat confirmed extra hypoglycemic and hypolipidemic endeavor than *Phyllanthus acidus* dealt with diabetic rats [66].

#### Hepatoprotective activity

Hepatoprotective recreation of EO (amla, EO) and CHY extracts had been studied utilizing carbon tetrachloride (CCl<sub>4</sub>) brought on liver harm model in rats. EO and CHY extracts had been determined to inhibit the hepatotoxicity produced by way of acute and persistent CCl<sub>4</sub> administration as obvious from the diminished levels of serum and liver LPOs, glutamate-pyruvate transaminase, and alkaline phosphatase. Chronic CCl<sub>4</sub> administration used to be also found to provide liver fibrosis as obvious from the accelerated phases of collagen hydroxyproline and pathological analysis. EO and CHY extracts were discovered to reduce these increased stages vastly, indicating that the extract might inhibit the induction of fibrosis in rats [67].

#### HIV-reverse transcriptase (RT) inhibitory

Inhibition of HIV-RT by way of EO (amla) plant extract fractions was once proven on peripheral blood mononuclear cells. From this test, it was found that aqueous fraction and n-hexane fraction have perfect inhibition of recombinant HIV-RT (91% and 89%, respectively) at 1 mg/ml concentration. Chloroform fraction confirmed highest inhibition of HIV-RT at 0.5 mg/ml and CCl<sub>4</sub> fraction at 0.12 mg/ml concentration. At 0.12 mg/ml and 0.5 concentrations 50% of the HIV-RT endeavor is inhibited in n-hexane fraction and CCl<sub>4</sub> fraction, respectively [68].

#### Hypercholesterolemia activity

The effects of EO (amla) on LDL oxidation and cholesterol phases had been investigated *in vitro* and *in vivo* using Cu (2+) prompted LDL oxidation and cholesterol-fed rats sunamla and Et Ac extract of EO (amla) significantly inhibited TBA-reactive substance stage in the Cu (2+)-precipitated LDL oxidation and the effects had been greater than those of probucol. Furthermore, the administration of sunamla (at a dose of 20 or 40 mg/kg physique weight/day) or Et Ac extract of amla (at a dose of 10 or 20 mg/kg physique weight/day) for 20 days to rats fed 1% cholesterol weight loss plan enormously lowered and LDL cholesterol stages in a dose-dependent manner, and Et Ac extract of amla exhibited extra amazing serum cholesterol-decreasing effect than sunamla in the equal quantity. Moreover, the ox-LDL stage in serum was once markedly improved in cholesterol-fed control rats as in comparison with usual rats, even as it used to be vastly lowered by way of the administration of sunamla or Et Ac extract of EO (amla). In addition, the serum TBA-reactive substance stage was additionally drastically lowered after oral administration of sun amla or Et Ac extract of amla. These results advocate that amla may be powerful for hypercholesterolemia and prevention of atherosclerosis [69].

#### Hyper-locomotor activity

A panchagavya ayurvedic system containing EO (amla) and cow's ghee used to be evaluated for its influence on pentobarbital-prompted dozing time, pentylenetetrazol-triggered seizures, maximal electroshock-triggered seizures, spontaneous motor activity, rota-rod performance (motor coordination), and antagonism to amphetamine in mice. The system (300, 500 mg/kg, po) produced a colossal prolongation of pentobarbital-induced napping time and decreased spontaneous locomotor endeavor. The formulation also vastly antagonized the amphetamine prompted hyper-locomotor pastime (500, 750 mg/kg, po) and covered mice toward tonic convulsions caused using maximal electroshock (500, 750 mg/kg, po). The system reasonably extended the phases of seizure recreation but did not guard mice against lethality triggered through pentylenetetrazole. The components did not show neurotoxicity. The result means that the panchagavya components are sedative in nature [70].

#### Immunomodulation

Immunomodulatory properties of fruit extracts of EO (amla) were evaluated utilizing chromium (VI) as an immunosuppressive agent. It additionally inhibited apoptosis and DNA fragmentation and relieved the immunosuppressive effects of (chromium) Cr on lymphocyte proliferation [71]. Lymphocyte proliferation exercise and histopathological severity of synovial hyperplasia had been used to learn the anti-inflammatory response of each the extracts, which confirmed a marked reduction in infection and edema or brought on immunosuppression in adjuvant precipitated arthritic (antigen-induced arthritis) rats, indicating that these medications may just provide a substitute process for the healing of arthritis [72]. Albino rats had been used to check the immunomodulatory routine of triphala on quite a lot of neutrophil capabilities such as adherence, phagocytic index, avidity index, and nitro blue tetrazolium. Oral administration of triphala appears to stimulate the neutrophil services within the immunized rats, and stress triggered suppression within the neutrophil features have been tremendously prevented using triphala [73]. Immu-21 is the ayurvedic polyherbal system containing extracts of EO (amla), *Ocimum sanctum*, *Withania somnifera*, and *Tinospora cordifolia*. Its



immunomodulatory undertaking used to be studied on the proliferative response of splenic leukocytes to T-cell mitogens, concanavalin (Con)-A, phytohemagglutinin and B phone mitogen and lipopolysaccharide (LPS) *in vitro* by way of [3H]-thymidine uptake assay in mice. Pretreatment with Immu-21 selectively increased the proliferation of splenic leukocyte to B-cell mitogen, LPS and cytotoxic exercise in opposition to ok 562 cells in mice. EO (amla) has been said to inhibit Cr induced free radical construction and also restored the antioxidant popularity back to manipulate level. It relieved the immunosuppressive results of Cr on lymphocyte proliferation and even restored the interleukin 2 and gamma-interferon construction [74]. Extracted amla powder extended the hemagglutination antibody titer, sheep crimson blood cells in dose stylish method and in addition brought on the delayed sort of hypersensitivity response, macrophage migration index, and respiratory burst recreation of the peritoneal macrophages, complete leukocyte count, percentage lymphocyte distribution, serum globulin, and relative lymphoid organ weight.

#### Insecticidal activity

Saponins that are fundamental parts of EO (amla) have insecticidal or cytotoxic residences to distinctive insects. Although saponins which had proven insecticidal endeavor was once amassed from typical sources rather than EO (amla). However, as saponins are bioactive compounds located in EO (amla) too, it is apparent that EO (amla) might have insecticidal activity, and additional evaluation can be performed to get more detailed analysis [75].

#### Inhibitory effects

Influence of EO extract administration on the *in vivo* genotoxicity CP used to be studied making use of bone marrow chromosomal aberration and micronucleus induction tests in mice. Three doses (50, 250, and 500 mg/kg body weight) of the plant extract had been administered orally for 7 consecutive days before the administration of single dose of mutagens (CP 40 mg/kg i.p). It used to be located that administration of 250 and 500 mg/kg of EO extract tremendously inhibited the genotoxicity of as well as CP in both the assay programs. Administration of 50 mg/kg of the plant extract had no inhibitory effect. Diet G, a primary constituent of EO when administered at dose stage of 9 mg/kg b.w. (the approximate estimated amount gift within the highest dose of plant extract, i.e., 500 mg) for 7 days did inhibit chromosomal aberrations and micronuclei induction but now not in a significant manner. Influence of administration of the abovementioned effective doses (250 and 500 mg/kg oral for 7 days) of plant extract and vitamin C (9 mg/kg oral for 7 days) on the hepatic activation and cleansing enzymes used to be additionally studied. Colossal induction in the stages of GSH content and of antioxidant and detoxification enzymes, viz., GPx, GSH reductase, and GSH-S transferase (GST) resulted from plant extract medication to animals. However, cytochrome P 460 level was once drastically reduced in the plant-extract-dealt with animals. There was once no massive alternate in cytochrome P 450 GSH contents and movements of enzymes on treatment with diet C. The data indicate that the possible mechanism of inhibition using plant extract is mediated using its modulatory outcome on hepatic activation and disposition procedures [76].

#### Indigestion

In indigestion, the gentle shoots of amla given in buttermilk therapy indigestion and it is recognized that green fresh leaves mixed with curds have similar outcome. Fruit is carminative and stomachic [38]. The gentle shoot given in butter-milk therapy indigestion and it is recognized that green recent leaves mixed with curds have a similar outcome. EO fruit has tannins as its important factor and really a lot astringent in nature, and tannins have excessive talents treating intestinal disorders equivalent to diarrhea and dysentery. The methanol extract of EO confirmed gigantic inhibitory outcomes on castor oil and magnesium sulfate precipitated diarrhea and reduction in gastrointestinal motility in charcoal meal assessments in rats. It also inhibited prostaglandin E2 -caused in the rat. Amla is often used as a laxative to relieve constipation in piles [77].

#### Larvicidal and mosquitocidal

In a mosquitocidal property, analysis test observed larvicidal and pupicidal routine of methanol extract of EO (amla) against the malarial vector, *Anopheles stephensi* showing 98% mortality fee at 100 ppm. The EEO and methanol extracts of EO (amla) additionally exerted 100% mortality (no hatchability) at 400 ppm and above mentioned that the larvicidal recreation of EO (amla) Et Ac leaf extracts. The gain knowledge of concluded that the Et Ac extract of EO (amla) exhibited the highest larvicidal recreation 99.6%) with lethal concentration 50% (lethal awareness brings out 50% mortality) worth of 78.89 ppm in opposition to the larvae of *Aedes aegypti* [78].

#### Memory enhancing activity

The learn was once geared toward investigating the consequences of EO (amla) powder an ayurvedic education on reminiscence, total serum LDL cholesterol levels, and brain cholinesterase exercise in mice EO (amla) powder was administered orally in three doses (50, 100, and 200 mg/kg) for 15 days to exceptional corporations of young and aged mice. Multiplied plus maze and passive avoidance apparatus served as the exteroceptive behavioral units for trying out memory. Diazepam-scopolamine and aging-caused amnesia served as the interoceptive behavioral items. Total serum cholesterol stages and mind cholinesterase pastime additionally estimated. EO (amla) powder (50, 100, and 200 mg/kg, p.o.) produced a dose-dependent improvement in memory scores of young and aged mice. Furthermore, it reversed the amnesia prompted using scopolamine (0.4 mg/kg, i.p.) and diazepam (1 mg/kg, i.p). Apparently, mind cholinesterase pastime and total LDL cholesterol phases were diminished using EO (amla) powder administered orally for 15 days EO (amla) powder may just prove to be a useful comfort for (he management of Alzheimer's ailment due to its multifarious precious effects akin to, memory improving property, LDL cholesterol lowering property, and anticholinesterase exercise [79].

#### Nitric oxide radical scavenging activity

An activity-directed fractionation and purification procedure were once used to identify the nitric oxide (NO) scavenging add-ons of EO (amla). Dried fruit rind of EO (amla) used to be extracted with methanol and then separated into hexane, Et Ac, and water fractions. Among these handiest, the Et Ac phase confirmed powerful NO scavenging exercise *in vitro*, compared with water and hexane phases. The Et Ac fraction was then subjected to separation and purification using Sephadex LH-20 chromatography. Five compounds displaying powerful NO scavenging pastime were identified using spectral approaches (1H nuclear magnetic resonance [NMR], 13C NMR, and MS) and via evaluation with literature values to be gallic acid, methyl gallate, corilagin, furosin, and geraniin. In addition, HPLC identification and quantification of isolated compounds have been also carried out gallic acid used to be observed to be a predominant compound within the Et Ac extract and geraniin showed easiest NO scavenging recreation among the isolated compounds [80].

#### Ophthalmic disorders

It is valuable in the remedy of conjunctivitis and glaucoma. It reduces intracular anxiety in a remarkable manner. An open potential multicenter clinical trial was conducted in sufferers suffering from quite a lot of ophthalmic disorders, particularly conjunctivitis, conjunctival xerosis (dry eye), degenerative stipulations (pterygium or pinguecula), and post-operative cataract patients with a natural eye drop practice (Ophthacare) containing common concepts of one-of-a-kind herbs which have been conventionally used in the ayurvedic process of treatment when you consider that time immemorial. These comprise *Carum copticum*, *Terminalia bellirica*, EO, *Curcuma longa*, *Ocimum sanctum*, *Cinnamomum camphora*, *Rosa damascena*, and *meldespumapum*. The reward study was once undertaken to explain the position of this natural product in a kind of eye illnesses. An improvement used to be observed with the treatment of the herbal eye drop treatment by and large. There have been no aspect effects observed for the duration of the

course of the study and the eye drop was good tolerated with the aid of the sufferers. The herbal eye drop ophthacare has a useful role in a type of infective, inflammatory, and degenerative ophthalmic issues. EO (amla) is commonly used in opposition to many continual illnesses together with diabetic cataract. Tannins gift in its aqueous extract produced inhibition in opposition to rat lens, purified recombinant human aldose reductase, and sugar caused osmotic alterations [81].

#### Prophylactic effect

Result of lively tannoid concepts of EO (amla), comprising of emblicanin A (37%), emblicamn B (33%), punigluconin (12%), and pedunculagin (14%), was once investigated on a rat mannequin of tardive dyskinesia (TD) induced with the aid of as soon as every day administration of haloperidol (1.5 mg/kg, ip) for 28 days. Involuntary orofacial actions (chewing actions, buccal tremors, and tongue prolusion) had been assessed as TD parameters. The tannoid principles of EO (amla) have been administered concomitantly with haloperidol within the doses of 10, 20, and 50 mg/kg. po, for 28 days Sodium valproate (200 mg/kg, po), a Gaba-mimetic agent, and diet E (400 mg/kg, po), an antioxidant, were used as the commonplace medicines and administered for the equal period. EO (amla) precipitated a dose-associated inhibition of all the three TD parameters assessed, as did diet E. The outcomes of sodium valproate remained statistically insignificant. The results advocate that EO (amla) exerts a prophylactic effect toward neuroleptic triggered TD which is likely to be due to its earlier said antioxidant effects in rat brain areas, including striatum [82].

#### Regulates elimination

EO (amla) pacifies apana vata, as a consequence helping with the downward waft of vigor in the body. They hold perform of removing standard and ease constipation. The fruit is sometimes pickled or preserved in sugar. When dry it is said to be gently laxative, according to a few sources, the recent fruit is also laxative. The recent ripe fruits are used widely in India as a laxative, one or two fruits being adequate for a dose. They have been exported to Europe, preserved in sugar, and are valued as a satisfactory laxative for youngsters and made into a confection including the pulp of the de-seeded fruit. Drury, Colonel Heber: The valuable vegetation of India; with notices of their chief medicinal price in commerce, treatment, and the arts [38].

#### Radio protective activity

Mice had been treated with 2.5 g/kg between of Emblica for 10 consecutive days earlier than irradiation and exposed to a single dose of 700 rads (7Gy) of radiation after the final dose. One group was once given Emblica regularly for a different 15 days after irradiation. Changes in the whole leukocyte rely, bone marrow viability, and hemoglobin were studied after entire physique irradiation. Administration of Emblica significantly accelerated these levels that have been lowered with the aid of irradiation. Animals were sacrificed at more than a few time facets after irradiation and the events of the antioxidant enzymes CAT, SOD, GPx, and GST, and stages of GSH were assayed in the blood. The harm to the phone membrane after whole body Irradiation was studied via measuring the tissue LPOs phases. Administration of Emblica greatly more suitable the recreation of the various antioxidant enzymes and GST as good as GSH system in the blood therapy with Emblica additionally lowered the elevated levels of LPOs within the serum the information naturally indicated that the extract significantly reduced the bioeffects of radiation. Emblica extract is also valuable in lowering the facet effects produced for the period of therapeutic radiation [83].

#### Skin sores and wounds

For a character with low vitamin C degree remedy of wounds and fractures is a sluggish method. For quick healing, one needs to devour amla. The milky juice of the leaves is good software to sores. Grind the bark of EO (10 g) into a paste and practice to reduce or wound area once day-to-day for 2-3 days. Then again, squeeze EO leaves and extract the juice to the cut once daily for 3-4 days. Cure occurs when the dynamic concord of the doshas is restored [84].

#### Skin whitening

Epidermis lightening retailers have been widely used to both lighten and depigment the skin within the Asia, a long way East and Middle East international locations, whereas within the European market products tend to be employed for age spots and freckles. The effectiveness of a standardized antioxidant fraction of EO (amla) fruits as a skin lightener and likewise as an antioxidant was proven [85].

#### Source of vitamin C

EO (amla) is essentially the most centered form of vitamin C located in the plant kingdom and when the entire fruit is used rather than an energetic ingredient, the vitamin C is effectively assimilated via the human physique. The vitamin C in the amla fruit is bonded with tannins that protect it from being destroyed by heat or mild. The vitamin C in amla helps in dilating the blood vessels and thereby decreasing the blood stress [63,86].

#### Vitality

Considering it has five tastes and helps all of the doshas and plenty of our bodies' services and cleanses the blood and the micro channels of the physique, EO (amla) increases energy and removes fatigue. It supports regeneration of cells-the system through which worn out historic cells are replaced by central, new ones [87].

#### Cultural importance

EO (amla) has been viewed as the sacred tree in India. The tree was once worshipped as Mother Earth and is believed to nurture humankind since the fruits are very nourishing. The leaves, fruits, and residences are utilized in worship in India. Kartik Mahatma and Vrat Kaumudi order the worship of this tree. The leaves are provided to the lord of Shri Satyanarayana Vrata, Samba on Shri Shani Pradosha Vrata, and Shiva and Gowri on Nitya Somvara Vrata. In Himachal Pradesh, this tree is worshipped in the month Kartik as propitious and chaste [88].

#### CONCLUSION

About 70% of the world's people depend largely on traditional plant derived drugs for their primary health care. Natural product research can often be guided by ethnopharmacological knowledge and it can make substantial contributions to drug innovation by providing novel chemical structures and mechanisms of action.

EO scientifically is the most widely used herb in the ayurvedic system of medicine. EO (amla or Indian gooseberry) has been playing a significant role from ancient times in traditional medicine, Ayurveda, and in tribal medicine. EO (amla) has said to be useful against many severe diseases, including cancer, diabetes, hepatic disorders, and heart diseases. Different biological activities of amla include antioxidant, immunomodulatory, anticancer, cytoprotective, analgesic, antimicrobial, antipyretic, antitussive, hair growth and hair care, and hepatoprotective. EO (amla) is one of the richest natural sources of vitamin C.

Several researchers revealed that various extracts and herbal formulations of EO (amla) showed potential therapeutic benefits against various diseases, and the results are similar to standard drugs. Even though EO (amla) has various medicinal properties since ages, there is a colossal necessity to scientifically explore and evident its medicinal values at the molecular level with the help of various latest biotechnological tools and techniques.

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