Chapter

Vegetable and Herbal Extracts: A Way towards Preventive and Therapeutics Regimen

Tanya Sharma, Vinika Tyagi and Megha Bansal

Abstract

The traditional and herbal medicines play significant role in the treatment of several diseases. These medicines are the outcome of extensive research on therapeutic and preventive activity of various plant species and their specific parts. Administration of various plant parts, vegetables, fruits and other herbal constituents have significant impact on reduction of clinical, carcinogenic and genotoxic effects of various environmental toxicants. Various parts of plant such as wood, bark, stem, leaf and pod are rich in antioxidants which are known for their free radical scavenging activity. Currently, the treatment options rely significantly using natural anti-oxidants which are extracted from plant products because these are largely available, cost effective and non-toxic as compared to the synthetic drugs. Some potent natural anti-oxidants include tocopherol, ascorbic acid, flavonoids, quercetin, carotene, cinnamic acid, peptides and phenolic compounds which are extensively available in various herbal extracts. The present chapter will focus upon availability of various antioxidants in vegetables and other medicinal plants and their potential activities against xenobiotics.

Keywords: vegetables, flavonoids, antioxidants, medicinal plants, therapeutic

1. Introduction

The traditional health care system of India known as Ayurveda, is considered as the oldest medical system. Throughout history, plants (vegetables and fruits) have been used as a medicine to treat and prevent diseases on both a traditional and popular level. In India, Ayurveda has been practiced for decades as a natural method of preventing and curing diseases, and plants have a significant role to play in this process [1]. Ayurveda, the science of longevity is a collection of multiple therapeutic measures and defines various conditions of illness and measures to combat them with natural practices. It is estimated that traditional herbal medicines have existed for at least 3000 years. The medicines or extracts prepared using whole plant or some specific parts of the plant are usually termed as phytomedicines or phytoextracts.

These compounds possess potent antioxidant properties. Antioxidants are the molecules or compounds that delay the process of oxidation. The important constituents present in plant products are flavonoids, alkaloids, terpenes, bisbenzyls and coumarins that have potential medicinal value [2]. Nowadays a great attention has been focused on natural anti-oxidants containing plant products due to their easy availability, cost effective and non-toxic nature as compared to the synthetic drugs [3]. Various plants

products are recommended for their antioxidative, anticarcinogenic, anti-tumorigenic, healing and chelating property [4]. It has been shown that populations consume food rich in natural antioxidants have a lower incidence of diseases related to oxidative damage and cancer [5].

Various plant species have been studied with promising results. Many vitamins and minerals are found in plant products. They are also naturally rich in antioxidants, which protect the body against aging and illnesses such as cancer and heart disease. Alkaloids, flavonoids, glycosides, lactones, resins, sterols, and sterol derivatives are among the secondary metabolites that medicinal plants synthesize naturally. A wide range of bioactive compounds have been identified in modern science, allowing the development of new drugs from plants. Numerous plant compounds have shown potential efficacy against life threatening diseases which further requires study of mechanisms of action, pre-clinical research and clinical trials. Around 80% of Africa's population is dependent on these traditional medicines for their health care. Research has shown utilization of medicinal plants in the treatment and prevention of chronic diseases [6].

In this chapter, we have discussed the beneficial aspects of few medicinal plants and their special parts. Medicinal plants and Ayurvedic medicines are becoming increasingly popular due to the skyrocketing price of allopathic drugs [7]. The most valuable part of aloe vera is its gel and latex of its leaves, whereas, in turmeric, the rhizome shows most of the medicinal properties [8, 9]. The leaves of tea tree are used, while the leaves, flowers and seeds of Ashwagandha plant are useful for medicinal purposes whereas the whole plant of *Centella asiatica* is useful and from Holy Basil the leaves are found to be beneficial for treatment of many diseases [10–13]. In Moringa oleifera, many phytoconstituents are found in its leaves, flower, seeds, roots and stem bark [14]. The berries and seeds of Sea Buckthorn are very useful however, in Amla, the fruit is most useful [15, 16]. Garlic is a bulbous plant whose bulb is very useful. These plant parts can either directly be used as medicines or for the synthesis of therapeutic compounds. Thus, present chapter focus on the use of herbal products against adverse effects of various xenobiotics. It is essential to explore and identify the importance of natural system of medicines and modify it as per the current need.

2. Aloe vera (*Aloe barbadensis miller)*

Aloe vera is a perennial succulent plant native to the plant family Asphodelaceae (**Figure 1**). Ayurveda, Siddha, Unani, and homeopathy are just a few indigenous systems of medicine that use homeopathic remedies. Among the 250 species of Aloe, Aloe vera is one of the 250 species of Aloe barbadensis miller [17]. Aloes grow in various climates, including deserts, grassland, coastal, and even alpine areas. They are often thought to only increase in hot, dry climates.

Figure 1.
Aloe Vera.

2.1 Phytochemistry

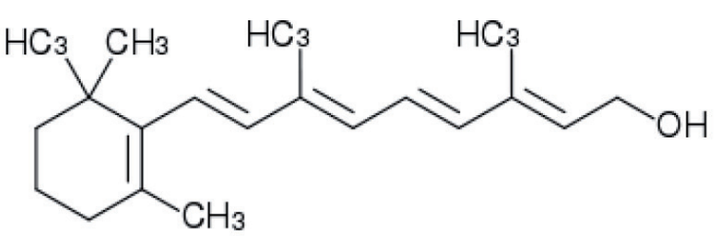
There are 75 active compounds in aloe vera which falls under vitamins, enzymes, minerals, sugars, lignin, saponins, salicylic acids, and amino acids. It contains antioxidant vitamins A, E and C. Furthermore, it contains folic acid, vitamin B_{12}, and choline (**Figure 2a** and **b**).

The system includes eight enzymes: alkaline phosphatase, brady kinase, catalase, carboxypeptidase, cellulase, amylase, lipase, and peroxidase [18]. Excessive inflammation is reduced by topically applied brady kinase, whereas the others aid in breakdown of sugars and fats.

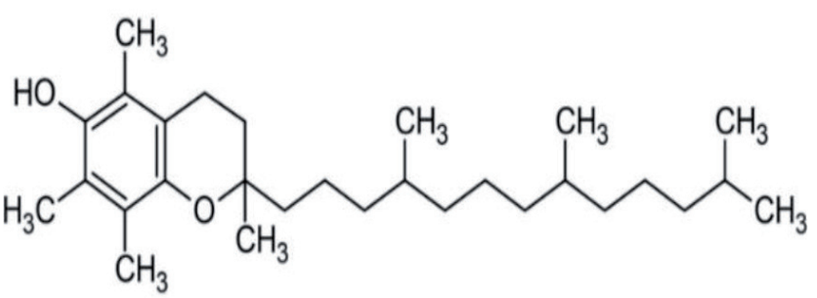
It has high concentrations of various minerals as calcium, chromium, copper, selenium, magnesium, manganese, potassium, sodium, and zinc [19, 20]. The plant provides polysaccharides glucomannan and polymannose as well as monosaccharides glucose and fructose. Mucopolysaccharides originate in the plant's mucilage layer. Monosaccharides that dominate are mannose-6-phosphate and glucomannans [beta (1,4)-acetylated mannan] [20]. Aloe vera gel has been shown to contain anti-inflammatory glycoprotein and a novel anti-allergic substance, C-glucosyl chromone [19]. It comprises 12 anthraquinones, which are phenolic compounds traditionally used as laxatives. Aloin and other hydroxy anthracene derivatives such as emodin are responsible for the laxative effect of Aloe vera. It also contains four fatty acids, cholesterol, campesterol, sitosterol and lupeol. Lupeol is also antiseptic, and analgesic and all of these compounds have anti-inflammatory properties [20].

2.2 Medicinal and nutritional value

Aloe vera has long been used to treat burns, commonly known as the burn tree and first aid plant. Aloe vera is anti-inflammatory, antibacterial, antiviral, increases immune activity, and has a lower histamine activity than other organic compounds, which accelerates burn wounds' healing. The medicinal properties of Aloe vera



Vitamin A (a)



Vitamin E (b)

Figure 2.
Structure of potent vitamins. Vitamin A (a). Vitamin E (b).

have led to its increased popularity. It contains amino acids essential to wound healing [21]. Additionally, it contains several inorganic electrolytes, such as iron, potassium, magnesium, chromium, copper, sodium, calcium, and zinc, essential for wound healing [22]. By releasing growth factors, it produces antibodies and promotes wound healing. Aloe vera gel, has anti-inflammatory properties, healing effects, stimulation of mucus, and regulates gastric secretions, which can help prevent and treat gastric ulcers [22]. As a result of the presence of anthraquinones and chromone, aloe vera gel has strong anti-inflammatory properties [23]. Aloe vera also relieves joint pain because it has an anti-inflammatory effect. Inflammation is caused by the body's response to various injuries, which produces bradykinin (a mediator of inflammation). Aloe vera extracts stored for three to 10 days in the dark produce active compounds prostanoids from the glycoprotein and polysaccharide fractions. Chronic bronchial asthma can be effectively treated with these compounds. Several types of cancer are non-resistant to the chemo-preventive power of aloe vera due to its glycoproteins and polysaccharides [24]. These agents stimulate the immune system to fight cancer [22]. Researchers examined the cytotoxicity of barbarol, aloe-emodein, and aloesin extracted from Aloe vera against acute myeloid leukemia (AML) and acute lymphocytic leukemia (ALL) [21].

3. Turmeric (*Curcuma longa)*

It is one of the most useful herbal medicinal plants which belongs to Zingiberaceae family (**Figure 3**). It is known for its medicinal properties for 4000 years [25].

It is used widely as a spice all over the world but mostly in eastern region. It is broadly cultivated in Asian countries like India and China. In ancient times, it was used in many ways including its presence in ointments due to its great healing properties, it is used to improve digestion, intestinal problems, to strengthen organs such as gall bladder and liver [26]. In 1870s, chemists found that the yellow-orange color of turmeric changes to reddish brown in alkaline medium. This led to the formation of turmeric paper which is used to test alkalinity [9].

3.1 Phytochemistry

Turmeric powder contains 69.4% carbohydrates, 6.3% protein, 5.1% fat and 3.5% minerals. The yellow color is due to the presence of curcumin (3–4%), which consists of curcumin I (94%), curcumin II (6%) and curcumin III (0.3%) (**Figure 4**) [27]. Curcumin derivatives such as dimethoxy and bis-dimethoxy have also been isolated from turmeric. Several substances occur in the rhizomes, including tumerone a,

Figure 3.
Turmeric.

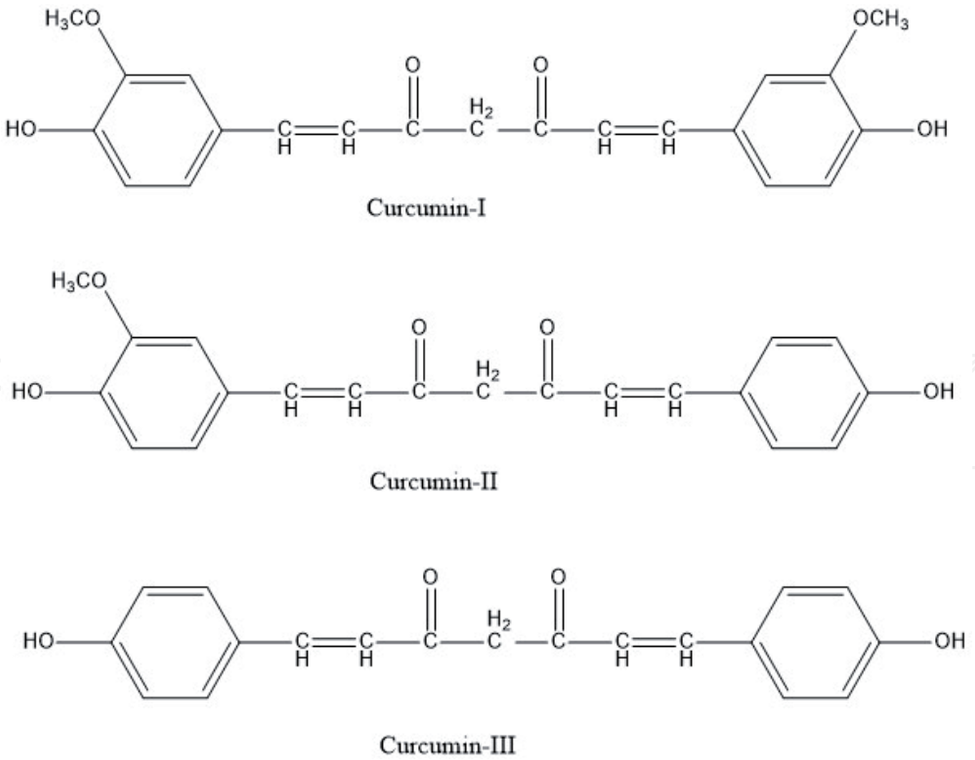


Figure 4.
Curcumin derivatives.

tumerone b, curzerenone, curdione, monoethoxycurcumin, and diethoxycurcumin. Its essential oils are derived from its leaves [28].

Turmeric has been reported to contain multiple chemical compounds such as linalool, caryophyllene, geraniol, sabinene, myrcene, and α-phellandrene.

3.2 Medicinal and nutritional value

Although turmeric has been around for thousands of years, it has recently become popular due to its medicinal properties. Traditionally, turmeric was used for its digestive and carminative properties [29]. Free radicals generated by oxygen can be scavenged by curcumin. In terms of antioxidant activity, it is comparable to vitamins C and E [30]. It prevents oxidative damage to lipids and hemoglobin. Macrophages that are activated by it are significantly less likely to produce reactive oxygen species such as H_2O_2, superoxide ions, and nitrite radicals [31]. Antioxidant properties are also present in its derivatives, bisdemethoxycurcumin and demethoxycurcumin. Researchers have shown that curcumin pre-treatment decreases the oxidative stress and improves ischemic conditions [32]. In an in vitro study, curcumin was found to enhance cellular resistance to oxidative stress in response to an inducible stress protein [33]. Researchers have found that turmeric can treat a number of diseases, and it can also prevent certain forms of cancer [34]. Skin cancers and precancerous conditions can also be treated with turmeric [34]. Turmeric is antispasmodic and can reduce digestive cramps, menstrual cramps and pains caused by osteoarthritis due to its ability to reduce pain and disability [35]. Curcumin shows strong potential for scavenging free radicals such as superoxide radicals, hydrogen peroxide and nitric oxide [36]. It reduces iron complex and inhibit lipid peroxidation [37].

Turmeric contains curcumin, a powerful anti-inflammatory ingredient that works by inhibiting inflammatory molecules in the body [35]. Researchers have shown that curcumin is beneficial to people suffering from conditions, including

rheumatoid arthritis, inflammatory bowel disease. Several studies have suggested applicability of curcumin against cancer of many organs [38]. It induces apoptosis, inhibit progression of cell cycle and prevent growth of cancer cells [39]. curcumin induces apoptosis in different cell types such as human bladder cancer cells and arrests cancer cells [40]. It takes part in various signaling pathways and inhibit signaling through NF-κB which regulates expression of many genes responsible for malignancy [41]. Owing to its anti-inflammatory and anti-oxidant property it was also used against Alzheimer's disease [42]. It is also known to have metal chelating properties thus may reduce amyloid aggregation and reduce oxidative neurotoxicity [43]. Curcumin can be a future drug for the therapy of various neurological disorders especially depression and diabetic neuropathy [44].

4. Garlic (*Allium sativum)*

Garlic (Fam. Liliaceae) is widely distributed and grown around the world (**Figure 5**). It is considered to be a valuable preventive remedy, folk food and spice. As the primary antidote to an epidemic, garlic has been used as a remedy throughout history for typhus, dysentery, cholera and influenza [45].

Garlic has long been appreciated by physicians from different nations as a remedy in the ancient and Middle Ages as well as during the modern period [46]. Garlic has been used as a remedy in ancient China since 2700 BC. The ancient Indians used garlic as a tonic, to treat cases of lack of appetite, skin problems, rheumatism, hemorrhoids, and more. In addition to being known as Russian penicillin, garlic was also used for years as a remedy for children with respiratory tract diseases via inhalation [47].

4.1 Phytochemistry

Garlic contains various sulfur compounds, vitamins (A, B_1), enzymes and minerals (germanium, calcium, copper, iron, potassium, magnesium, and selenium). Total 17 amino acids are found in garlic, and major are glutamine, glycine, lysine, cysteine, valine, methionine, isoleucine, leucine, tryptophan, and phenylalanine [48].

The pungent odor of garlic and many of its therapeutic effects are caused by the high levels of sulfur compounds present in this species of Allium. Allicin (diallyl thiosulfinate or diallyldisulfide) is a highly biologically active compound in garlic (**Figure 6**) [49]. In fresh and dry garlic, alliin (S-allyl cysteine sulfoxide) is the compound producing the highest levels of sulfur. Garlic is commonly prepared by cutting, mincing, crushing, which disturbs S-allyl cysteine sulfoxide and exposes it to the allinase enzymes, which then convert it into diallyl thiosulfinate, the aromatic constituent [48]. Below a pH of 3.5 or upon heating, the allinase enzyme responsible for diallyl thiosulfate conversion becomes inactive. Recent studies have shown that other compounds may play a greater role in anti-oxidant function than allicin [50].

Figure 5.
Garlic.

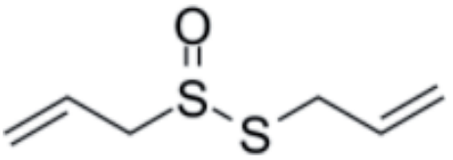


Figure 6.
Allicin.

4.2 Medicinal and nutritional value

There have been several studies showing possible cancer-preventive effects of garlic preparations and their constituents in vitro and in vivo. In garlic, a number of potent anticancer compounds have been found, including allylsulfide derivatives. Different garlic derivatives are shown to modulate various cellular mechanisms for promoting cancer, such as DNA adduct formation, mutagenesis, and free radical scavenging. They may also contribute to angiogenesis [46]. A number of studies have concluded that garlic protects liver cells from some toxic compounds [49].

Organosulfur compounds derived from garlic are known to inhibit cancer in various animal models by modifying cytochrome P_{450} which is responsible for the activation of nitrosamines, hydrazine and benzene [51]. The chemical present in garlic extract diallyl sulfide and its oxidation products diallyl sulfoxide and diallyl sulfone inhibit chemical carcinogenesis and mutagenesis [52]. These compounds restrict development of chemically induced cancers by blocking the phase-1 enzymes. These organo sulfur compounds also induce phase-2 enzymes such as glutathione S-transferase, quinone reductase and glucuronate transferase which eventually regulate removal of toxic compounds. Garlic extract is also known to modify -SH containing enzymes and increases their activity via formation of disulfide bond between protein thiol and thiol group of cysteine [53]. This type pf bond formation with proteins is an effective redox method to regulate protein activity.

5. Sea Buckthorn (*Hippophae rhamnoides L.*)

A native plant of Asia and Europe, sea buckthorn is a hardy winter shrub that flourishes throughout the year (**Figure 7**). This species is divided into eight subspecies, which are economically valuable [54]. These subspecies are abundant and commercially cultivated mainly in Asia, where sinensis and Mongolia are found. In addition to drought, salinity and alkalinity, sea buckthorn can also withstand extreme temperatures and salinity.

Figure 7.
Sea Buckthorn.

5.1 Phytochemistry

The fatty acid content of sea-buckthorn fruit oil makes it unique compared to other vegetable oils. This oil contains rare palmitoleic acid (omega-7), a component of skin lipids that helps stimulate regenerative processes in skin cells and promotes wound healing. Sea-buckthorn oil also contains numerous active substances, resulting in multiple effects. There are exceptionally high vitamins A, C, E, F, P, and B complex in the oil [55]. Its regenerative and anti-wrinkle properties are attributed to vitamin A in carotenoids (200 mg/100 g). The vitamin C content of orange fruit (approximately 695 mg/100 g) is 15 times higher than in oranges. Vitamin C has antioxidative and protective properties against ultraviolet A and UVB rays. The walls of capillary blood vessels are strengthened by vitamin E, which is present in the form of tocopherols (approximately 200–600 mg/100 g) and minerals [56]. It also contains sterols, fruit acids (malic acid, citric acid), phenolic compounds, tannins, sugars, synthecanthins, phospholipids, ascorbic acid, selenium, copper, and zinc mineral salts.

5.2 Medicinal and nutritional value

Sea Buckthorn contains important phytochemicals like flavonoids, carotenoids, fatty acids etc. Studies have shown that sea buckthorn has high antioxidant activity. This plant can be used as a natural remedy for cardiovascular diseases and in diseases of skin, liver and stomach as well [56]. There are a lot of phytopharmaceuticals present, mainly phenolic compounds such as curcumin, resveratrol and proanthocyanidins which are known for cancer chemoprevention [57]. It is found that the seed oil of this plant enhances non-specific immunity and has anti-tumor effects. However, clinical studies with Sea Buckthorn need to validate the effects and mechanism on human cancer patients [15]. Sea Buckthorn helps in reducing cholesterol and improve cardiovascular health. It increases the blood circulation and relaxes cardiac muscle tissues which helps in restoring cardiac function [58]. To protect the cells of immune system and balance the inflammation, antioxidants are very important. There are a lot of antioxidants, isorhamnetin, quercetin, kaempferol in Sea Buckthorn. It has carotenoids, vitamin C and E as well which makes this fruit rich in anti-inflammatory properties as well [59]. Furthermore, it prevents gastrointestinal ulcers as it reduces inflammation. Researches have also shown that Sea Buckthorn helps in balancing liver enzymes and protects the liver from harmful effects of toxic chemicals [60]. The oil of this fruit contains palmitoleic acid which is a component of skin. It helps in the treatment of burns and healing of wounds. Sea Buckthorn oil has UV- blocking and emollient properties which help in regeneration of tissues [60].

6. Tea tree (*Melaleuca alternifolia*)

Tea tree oil (TTO) is also known as Melaleuca alternifolia (**Figure 8**). The volatile essential oil derived from the Australian native plant offers a variety of medicinal properties. Many cutaneous infections are treated using TTO as its active ingredient due to its antimicrobial properties. There are over-the-counter versions of Melaleuca alternifolia available in Australia, Europe, and North America.

Herbal products and medicinal uses of this plant are very important [61]. To treat sore throats and skin ailments, tea tree leaves infusions were made from the leaves of the tea tree, which were also used for cough treatment. Traditional medicine of the Aboriginal Bundjalung people of eastern Australia relies on Melaleuca alternifolia leaves crushed and its oil to cure coughs, colds, and to treat wounds [62]. After its anti-microbial properties were reported in a series of papers in the

Figure 8.
Tea tree.

1920s and 1930s, Melaleuca alternifolia oil became widely known for its benefits. It was Melaleuca alternifolia which was reported to be 11 times more potent than phenol in its antimicrobial properties that led to tea tree oil being used in industry for the first time. In the 1950s, the introduction of antibiotics prompted a decline in the use of natural products in medicine, which had a negative effect on the production of tea tree oil [63]. During the 1970s, there was a general renaissance of interests in natural products such as tea tree oil. A large-scale production of consistent essential oils was achieved through commercial plantations established in the 1970s and 1980s. Melaleuca alternifolia is typically used to extract tea tree oil commercially, but Melaleuca *dissitiflora* and Melaleuca *linariifolia* can also be used to extract tea tree oil [10]. Tea tree oil has been extensively studied for its antibacterial, antifungal and antiviral properties.

6.1 Phytochemistry

The active ingredients in Melaleuca alternifolia are terpene hydrocarbons, which comprise monoterpenes, sesquiterpenes, and their alcohols. Tea Tree Oil has a relative density of 0.885 to 0.906, and is soluble in water and insoluble in non-polar solvents [64]. There is an international standard for tea tree oil that sets maximum and minimum specifications for 14 components of the oil, one of which is terpinen-4-ol (**Figure 9**).

There are six varieties of M. *alternifolia*, each producing oil with a different chemical composition [62]. There are four 1,8-cineole chemotypes as well as a terpenen-4-ol chemotype and a terpinolene chemotype. Tea tree oil produced commercially contains about 30 to 40% of the terpinen4-ol chemotype, which has antimicrobial properties [63].

6.2 Medicinal and nutritional value

Tea Tree oil is added to many products including moisturizers, body lotions, foot sprays, face cleansers, and shaving powders. It helps in treating dermal infections by inhibiting the growth of a fungi named Malassezia [62]. Tea tree oil shows antiseptic and anti-inflammatory properties as well which helps in the treatment of gingival infections. It kills the bacteria which causes dental problems. Hence, it is used in mouthwashes as well. Tea tree oil is also used for the treatment of acne as it reduces inflammation [64]. In cases of vaginal candidiasis, tea tree oil is found to be a good alternative to be active against both gram positive and negative bacteria. Similarly, it is also effective for the treatment of athlete's foot which is again a fungal infection [62]. Tea tree oil is an essential oil which has a lot of medicinal properties. However, it can be toxic if ingested. It can cause drowsiness, confusion, coma,

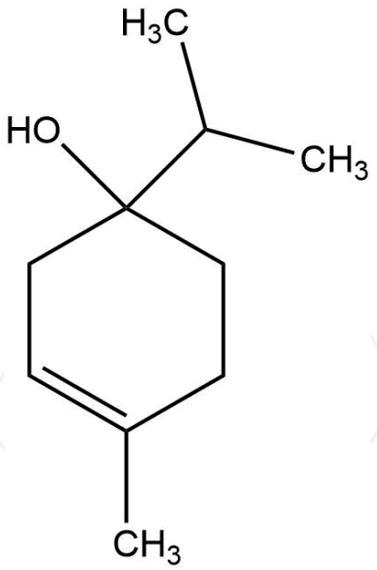


Figure 9.
Terpinen-4-ol.

blood cell abnormalities, diarrhea, severe rashes etc. High doses of tea tree oil can also cause side effects. Hence, it should be used carefully [61].

7. Amla (*Emblica officinalis*)

The Amla fruit is a natural gift to humanity (**Figure 10**). Ayurveda and Unani consider it an essential part of their systems with amazing medicinal properties. It is known as Amalaki or Dhatriphala in Sanskrit. In the Ayurvedic literature "Charak Samhita" (500 BC), amla is perhaps the most frequently mentioned herb [65]. Amlaki means sustainer of fruit, or the place where the Goddess of Prosperity resides in Sanskrit.

As it provides so much nourishment to mankind that this tree is worshipped as the Earth Mother in Hindu mythology. In addition to cultivated (gramya), there are

Figure 10.
Amla.

wild (vanya) varieties of Amla. It is smaller and rougher in wild varieties, whereas cultivated amla is bigger, smoother, and juicier. Its trunk is crooked and its branches tend to spread out in a crooked pattern. It reaches heights of 8 to 18 m. Usually deciduous, small branchlets are glabrous or finely pubescent, 10–20 cm long. It has simple, tightly set leaves that resemble pinnate leaves, which are subsessile and subsedile along branches [65]. Berry harvesting is done in autumn, when the berries reach their mature stage. Despite its fibrous texture, Indian gooseberries have a sharp and bitter flavor and are bitter and astringent [66].

7.1 Phytochemistry

Approximately 80% of the amla fruit's chemical composition is water. Besides protein, carbohydrate, fiber, and mineral contents, it also contains gallic acid, which is an important polyphenol. Amla contains tannins, alkaloids, and phenols. In the whole plant, 28% of the tannins are present in the fruits. Two of the tannins in the fruit, Emblicanin A and B, when hydrolysed yield gallic acid, ellagic acid and glucose. Phyllaemblic compounds, tannins, flavonoids, pectin, and vitamin C, along with polyphenolic compounds, are abundant in this fruit [67]. Vitamin C is reported to be 20 times as abundant in amla fruit as in orange juice.

Ascorbic acid concentration is 160 times higher in the amla fruit tissue than in an apple. Minerals and amino acids are also found in higher concentrations in the fruit than in apples. The ash from amla fruit contains chromium, zinc, and copper. It has been demonstrated that a wide range of phytochemical components, including terpenoids, alkaloids, flavonoids, and tannins, possess useful biological activity. Tannins are abundant in the fruits, leaves, and bark. Ellagic acid and lupeol are found in the root, and leucodelphinidin is found in the bark. Oil is extracted from the seeds (16%) and is brownish-yellow in color. It contains Linolenic Acid (8.8%), Linoleic Acid (44.0%), Oleic Acid (28.4%), Stearic Acid (2.15%), Palmitic Acid (3.0%) and Myristic Acid (1.0%) (**Figure 11**) [68]. It contains a small amount of essential oil, fixed oil, and phosphides in its seeds. It also contains gallic acid, ellagic acid, chebulagic acid and chebulinic acid in their leaves. P. emblica roots provide Phyllaemblic acid, a novel, highly oxygenated norbisabolane.

7.2 Medicinal and nutritional value

Every part of this plant is useful due to its medicinal properties. E. officinalis is known to have antioxidant, anticancerous, anti-inflammatory, anti-diabetic and antimicrobial properties [69]. The extract of its fruit prevents hyperlipidemia, osteoporosis and several other disorders [70]. It shows strong antioxidant properties similar to ascorbic acid due to the presence of various tannins such as emblicanin A,

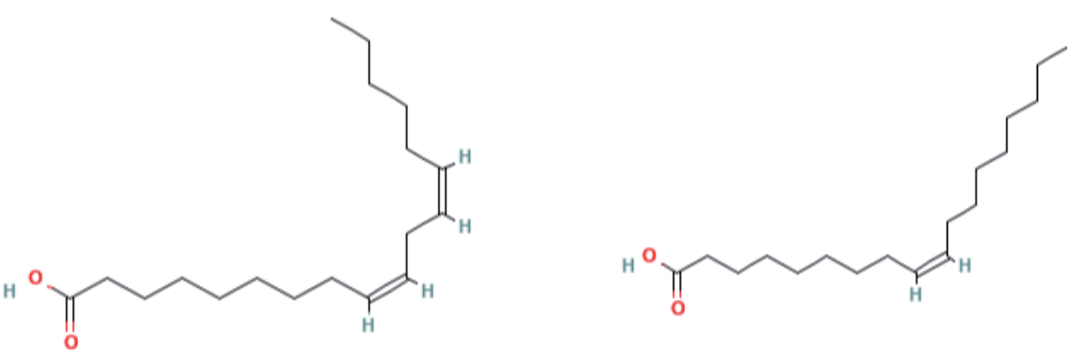


Figure 11.
Linoleic acid. Oleic acid.

emblicanin B, punigluconin, gallic acid [71]. It quenches various free radicals such as hydroxyl, superoxide and reduces DPPH free radical by reducing Fe^{+3} ions [72]. The antioxidative effect of fruit extracts was investigated against alcohol induced toxicity and it was suggested that the efficacy is due to the presence of polyphenols, flavonoids, and other ascorbic acid related compounds [73]. It strengthens antioxidant defense system by increasing level of GSH and various antioxidant enzymes like superoxide dismutase, catalase, GSH peroxidase, GSH reductase and GSH S-transferase [74]. The anti-diabetic or hypoglycemic potential involves inhibition of α-amylase and glucosidase owing to the presence of high concentration of ellagic acid, ascorbic acid and flavonoids in fruit extract [75]. Significant reduction in serum glucose and triglyceride levels have been reported in STZ-induced diabetic male Long-Evans rats [76]. These fruit extracts are also known to reduce significantly total cholesterol, LDL and VLDL-cholesterol level [77]. It is also reported to improve ischemia–reperfusion induced oxidative stress conditions by reducing myocardial lipid peroxidation and augmenting antioxidant enzymes activity in rat heart [78]. Stress related oxidative damage is a major factor in various physiological disorders. Administration of E. officinalis extracts have been reported to lower down oxidative stress conditions in brain frontal cortex and striatum due to certain external shocks [79]. Its antidepressant activity is also reported due to inhibition of brain biogenic amines, and affinity with serotonin receptors, dopaminergic D2-receptor and GABA-B receptors [80]. Fruits extracts has antiviral properties and also functions as an antibacterial and antifungal agent. *Emblica* significantly reduced UV induced erythema, had excellent free-radical quenching capabilities and chelating properties for iron and copper [68].

8. Conclusion

There are several studies to support medicinal properties of plant derived phytochemicals. These plant extracts are extensively utilized to prevent serious ailments and as a constituent of heath care regimen. There are multifaceted advantages with herbal products, in addition to being non-toxic they offer affordability as well. It is evident that plant derived chemicals possess various properties thus research is needed to have combination of desired phytochemicals to address complex issues of healthcare. Incorporation of herbal ingredients in the diet will offer longevity and prevention against threatening xenobiotics.

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Author details

Tanya Sharma[1], Vinika Tyagi[2] and Megha Bansal[1*]

1 Department of Chemistry, Manav Rachna University, Faridabad (HR), India

2 University of Strathclyde, UK

*Address all correspondence to: megha@mru.edu.in

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