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Research Article

TERMINALIA CHEBULA: A REVIEW PHARMACOGNISTIC AND PHYTOCHEMICAL STUDIES

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ABSTRACT

Terminalia Chebula is an important plant in pharmaceutics, its importance is generally due to number of therapeutic uses. It is commonly called Hritaki. It is known as black myroban in English and harad in Hindi Traditional medicine system in India Ayurved has ranked this plant as an essential herb. In ayurveda *Terminalia chebula* is known to cure all dosas, stimulates digestive capacity, rasayana and vriseya and shows immunomodulatory properties and thus help in improving body's defense system. In Tibet it is known as "king of the medicines". This herb has a special mention in various traditional medicine systems due to its extraordinary power of healing. The wide application of this herb in traditional medicine systems is attributed to presence of tannins ,alkaloida and other phytochemicals present in this herb. This review gives a vivid account of *Terminalia chebula* product.

INTRODUCTION

Since the dawn of the civilization medicinal plants are used in treatment of various diseases. Traditional Indian system of medicines like Ayurveda and other traditional medicine systems like Siddha, Unani emphasize on the use of medicinal plants. Number of researches and ancient knowledge of these medicinal plants show their efficacy and effectiveness these evidences has led to increased use of homeopathic medicines. This increased use of herbal medicines in today's era is credited to the fact that these are obtained naturally and is reliable, cheap and have higher safety margins with very less reported side effects (Sharma, 2009). The harmfull side effects of allopathic drugs which patients have to suffer as a necessary evil thus herbal products's demand has increased not only in developing countries but also in developed contries as well as these are non narcotics ,easily biodegradable,pose minimum environmental degradation .

It is chiefly used Unani, Sidha, Ayurveda and overall in homeopathy. It is a popular traditional medicine. Its widespread use in homeopathy and other traditional medicinal system is due its wide spectrum of pharmacological activities associated with its biologically active chemical components present in this plant (Parkash *et al*, 2012). It is not only used in India but also in other countries of Asia and Africa. The fruits of terminalia chebula possess diverse health benefits and have been used as traditional medicine as house holds remedy. It is an important ingredient in one of the most commonly used Ayurvedic preparations 'Triphala', together with *Terminalia chebula Terrminalia bellerica* (bihitaki) and *Emblica officianallis* (amalaki) constitute the preparation called Triphala. Triphala has been described in ancient Ayurvedic text as Tridoshic rasayna, a therapeutic agent with balancing the rejuvenating effects on three humors or constitutional elements in Ayurveda vata pitta and kapha **(**Chattopadhyay, 2007)**.**

Antibacterial activity of *Terminalia chebula* extracts against severe bacterial strain is reported in extracts from different parts of diverse plant species of plants like roots, flower, leaves, seeds etc. Its other reported activities like antioxidants , antifungal, antineoplastic, antiviral, antidaibetic, cardioprotective, immune-modulatory etc, puts the plant in the higher prospect for the researchers across the globe .Terminalia consists of 250 species and are widely distributed in tropical areas of the world. The health benefits that are provided by this plant are credited the presence of various phytochemicals like polyphenols terpenes, anthocynanins, flavanoids, alkaloids and glycosides. This article provides an information on all the phytochemical and pharmacognistical studies carried out on *Terminalia chebula* (Sandeep, 2009).

Habitat

The *Terminalia chebula* tree may grow at places about 2000m from sea level and in areas with an annual rainfall 100-150cm

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and temperature 0.17 degrees terminalia chebula is mainly found in Nepal, sri lanka, Myanmar, Bangladesh and in Pakistan, Tibet, Guangaon, Guangxi (province of china) apart from Asia it is also found in countries like Egypt,Turkey and Iran. In India terminalia chebula or haritaki tree grows in deciduous forests of Himachal Pradesh, Tamil Nadu, kerala, Karnataka, Uttar Pradesh, Andhra Pradesh, West Bengal (Fundter *et al*, 1992) .

Rohini: It is round in shape used in vrana and is found mainly in Jhansi area but can be generally obtained from anywhere.

Pootana: Mesocarp of this variety is less developed. It is small in size and is less bulky than other variety. Seeds are large and rigid. It is mainly found in Sind region and is generally used externally.

Figure 1 Geographical location of *Terminalia chebula*

Botanical Description

Taxonomy:
Kingdom: Plantae
Subkingdom: Tracheobionta
Division: Magnoliophyta
Subdivision: Spermatophyta
Class: Magnliophyta
Subclass: Rosidae
Order: Myrtals
Family: Combretaceae
Genus: Terminalia
Species: Chebula
Binomial name: *Terminalia Chebula*

Synonym (Aneja, 2009)
China: Zhang-qin-ge hezi
France: Myrobalan in dien
Germany: Myrobalane
India: Shilikha, haritaki, hirdo, hamija, harad, alale, katukka, manali, hirda, karadha, har, katak-k-kay, karaka, harejarad.
Sri lanka: Aralu
Tibet: Harro
English: Black Myrobalan
Cambodia: Sa Mao tchet
Filipino: Chebulic myrobalan
Malay: Manj puteri
Thai: Lamo thai
Veitanamese: Cheire lieu xanth

Types of Haritaki

Vijayan: It is used in almost every diseases and this variety is found in vindhya mountain ranges in south India. It has an alabu shape and also occur in gourd shape**.**

Abhayan: It is found generally in Champadesha. This variety has fine lines on its fruit. It is mainly used externally. It is used for eye diseases.

Amrutha: It is found in Champarna region. It is more bulky than pootna variety. Mesocarp is present and is used for shodhanakarma habituate. It is mainly used for cleansing.

Jeevant: It is found in Himalaya region. Fruit in this variety is golden yellow in color. It is mainly used in all diseases.

Chetaki: It is found in Himalaya. Suit in this variety has three lobes. It has a profound laxative effect and is generally used as churna. It has two varieties white and black.

In practice, however there are three varieties of haritaki which are commonly used

Bala: In this seeds are hard. This is the smallest of all varieties. Colour of the fruit is deep brown or black in colour. Epidermis is dark or brown with dark and homogeneous pulp. The seeds are hard.

Chambari: In this fruit is immature. Fruit is small in size with less wrinkles and furrows. Epidermis is yellow. Pulp is yellow dried and a stone is present and it is slightly astringent than that of survare harad.

Survari: Fruit is fully mature. Fruit is large and bulky and is about two inches long. Fruit is yellowish brown in colour. Pulp in the fruit is yellow to dark brown in colour with a stone.

Macroscopic Features

Taste: There are seven types of taste except for salt, outer skin tastes pungent, ridge tastes sour, seed has astringent taste and stem has bitter taste and endosperm has sweet taste.

Tree: A medium sized tree up to 25m tall with younger stem glabrescent. Stem is dark brown usually longitudinally cracked with woody scales and usually short cylindrical bole of 5-10m in length ,60-80cm in diameter , crown rounded with spread out branches.

Leaves: Leaves are alternate or opposite, thin coriaceous ovate or elliptic-obovate, 7-12cm×4-6.5cm, rounded at base, obtuse to sub acute at apex, pubescent beneath, petiole upto 2cm long.

Flower: Flowers are yellowish-white and emit a strong offensive odour. They occur in spikes arising from upper axils or in small terminal panicles. Fruit (drupe) is yellowish-green, obovoid or ellipsoid, hard, and five to six ribbed when dry. Flowering occurs in May–June, while fruiting occurs in winter (November–March). These are 2mm long, 3-4mm in diameter, bracts nearly glabrous, 1.5-2.0mm long, calyx-segments triangular, stamens 10 in number, 3-4mmlong, ovary glabrous, ovoid, 1mm long; style glabrous, 2.5-3.0mm long (Boer *et al*, 1995).

Fresh fruit: A glabrous, shining ellipsoidal, or broadly ovoid or obovoid; obscurely or faintly five-angled and shallowly furrowed; greenish-yellow drupe from 25–50 mm long and about 25 mm or less wide.

Figure 2 *Terminalia chebula* leaves, flower, and fruit

Dry fruit: The surface of the dry fruit is somewhat wrinkled and shows five slightly thick but well-defined longitudinal ridges that are 2–3 mm wide and 2 mm thick. The surface color varies from light yellowish-brown to a nearly uniform brown with yellowish markings or patches. In some fruits the basal Portion is narrower and somewhat elongated or tapering**.**

Seed: One rough ellipsoid 1.0-2.0cm by 0.2-0.7cm and without ridges. Seed is globose, generally 2–6 cm long, and pale yellow in colour (Chattopadhyay, 2007).

Microscopic Characteristics

Fruit: Transverse section of the fruit shows epicarp and composed of a layer of epidermal cells, the outer tangential walls and upper portion of the thick radial walls. Mesocarp consists of 2 or 3 layers of chollenchyma followed by a broad zone of parenchyma with fibres and sclereids in groups and vascular bundles with scattered fibres, simple pitted walls; porous parenchyma, sclerieds are mostly elongated, tannins and

Figure 3 T.S of *Terminalia chebula* fruit indicating the presense of tannins

Figure 4 sclereids present in stem of *Terminalia chebula*

aggregate crystals of calcium oxalate are found in parenchyma , starch grains simple rounded or oval in shape, measuring 2-7micrometer in diameter. Endocarp consists of thick walled sclerieds of various shapes and sizes and mostly elongated. Fibres sclereid and vessels lignified, one layer of large cubical cells followed by a zone of reticulate parenchymya and vessels, tegmen consists of collapsed parenchyma. Cotyledon folded and containing aleurone grains oil globule and some rosette aggregated crystals.

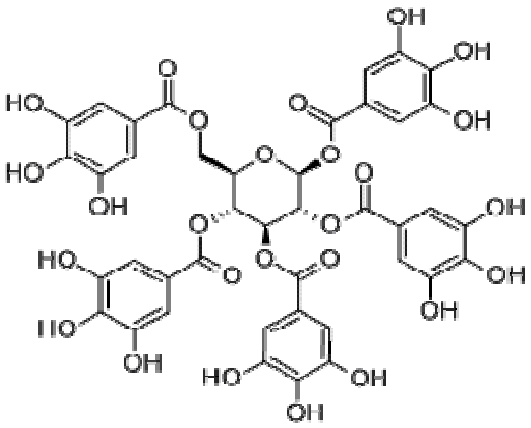
Leaves: leaves are generally polygonal, uneven shaped with undulate and straight walls. The cell walls were thin. The walls on both adaxial and abaxial surfaces were undulate. The epidermal cells on adaxial surface were large, stomata is hypostomatic and anomocytic, the stomata number in *terminalia chebula* is 23.66 and stomatal index is 25.16.

Seeds: The presence of primary and secondary metabolites like starch grains tannins were observed under microscope. The sections cleared with chloral hydrate to observe various ergastic cellcontents like crystals of calcium oxalate crystals, calcium carbonate and silica. It was observed that tannins starch grains and lignins were present in section (Gupta, 2012).

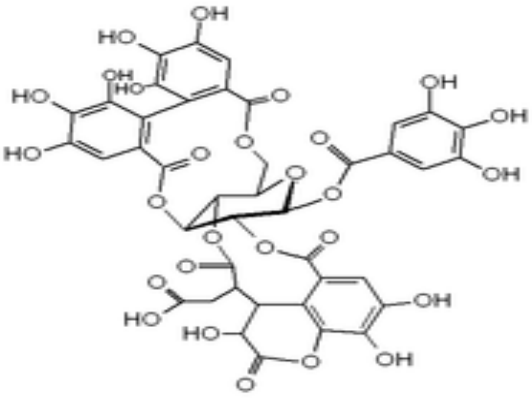
Cultivation, Collection & Prpogation

Cultivation

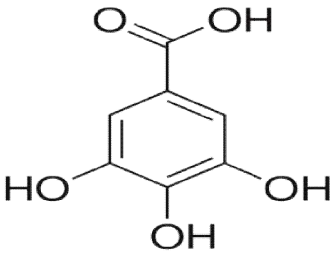
Terminalia chebula grow generally in tropical and subtropical areas upto an elevation of 1500 meters and exceptionally 2000 meters.



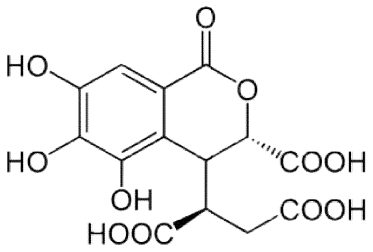
1,2,3,4,6-penta-orgalloyl-β-D-glucose



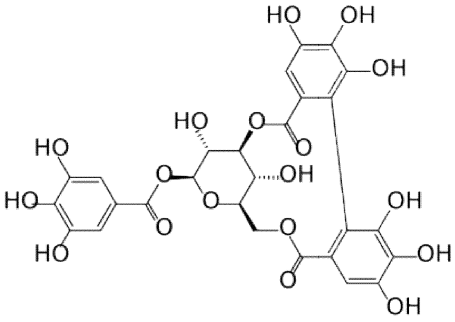
Chebulagic acid



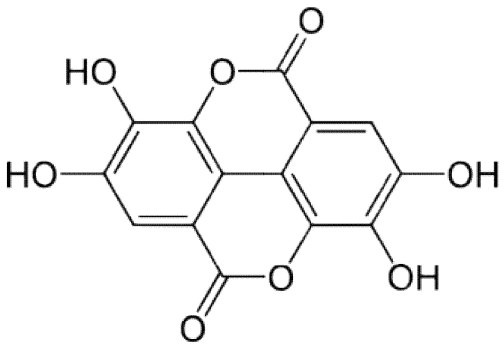
Gallic acid



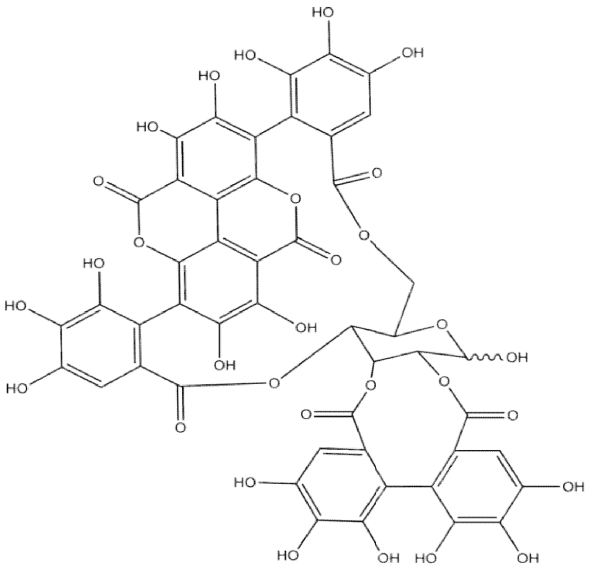
Chebulic acid



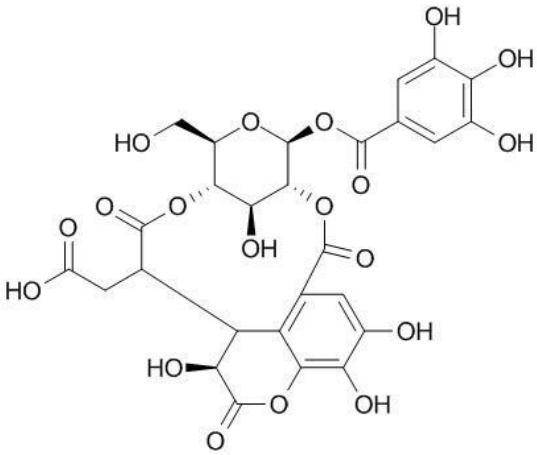
Coralagin



Ellagic acid



Punicalagin

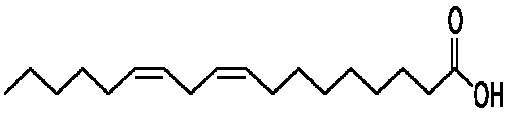


Chebulanin

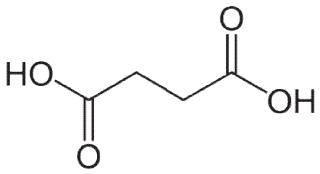
The best temperature conditions for cultivation of *Terminalia chebula* is 22-35 degrees Celsius, though it can tolerate 5-47 degrees and is killed by temperatures below -5degrees Celsius. Preferrable annual rainfall for growth of *Terminalia chebula* is 1000-1700mm generally it can grow in annual rainfall of 750-3300mm. plant demands direct sunlight overhead though younger plants can tolerate certain amount of shade. In moist regions the trees grow well. Moderately fertile well drained soil varying from sandy to clayey is well suited for the growth of *Terminalia chebula*. The ph in the range of 5.5-5.6 is suitable for the growth of the plant. Growth rate of seedlings and young trees is quite slow. Regeneration of natural strands is poor. It regrows well after burning and also after coppicing producing new shoots 2-3 m long after 5 years. Per year 10 kilos of fruits are collected per tree from trees growing wild.

Propogation

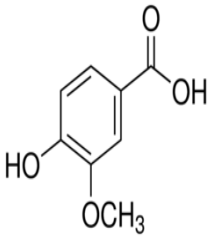
The fallen fruits are collected and then dried thoroughly, after sometime the hardened flesh is removed , fermentation of the stones provides the best germination, but clipping the broad end of the stone without damaging the embryo, then this step is followed by soaking it in the water for 36 hours. The seed is generally sown in the nursery bed or container as direct sowing increases the risk of predation and also seeds germinate poorly. The germination rate of the seed is 50%. Early growth is comparatively slow with seedlings 10-20cm tall by the end of the first season and 20-50cm tall by the end of the second season.



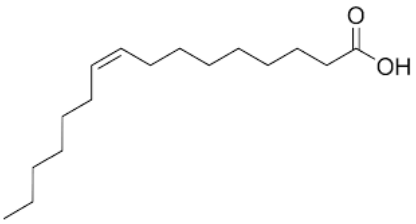
Linoleic acid



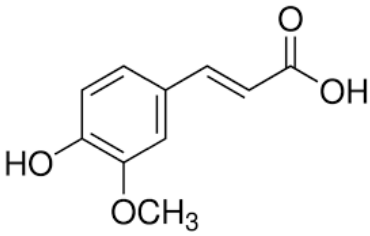
Succinic acid



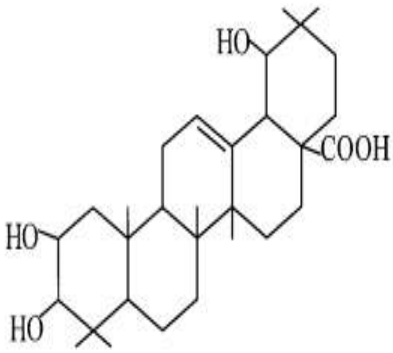
Vanillic acid



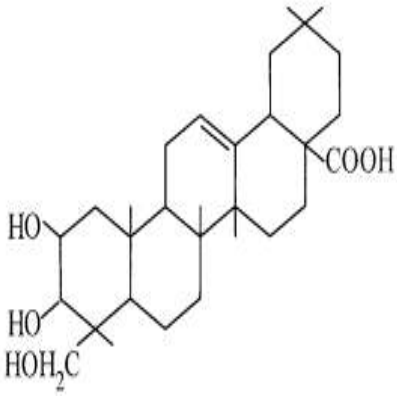
Palmitic acid



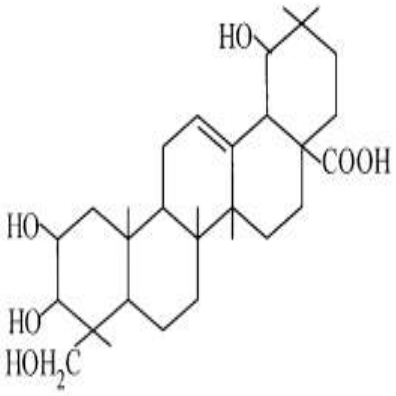
Ferulic acid



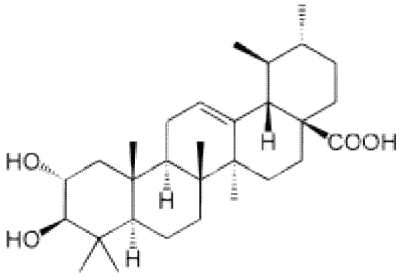
Arjunic Acid



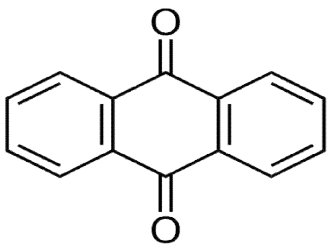
Arjunolic Acid



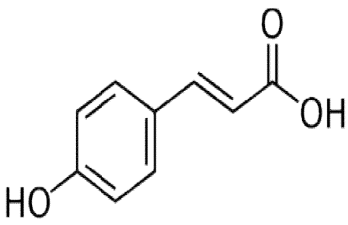
Arjugenin



2α-hydroxy ursolic acid



Anthraquinone



p-coumeric acid

Other methods for its propogation are

Natural propogation: germination takes up in the rainy season. For this propogation better/good drainage is considered essential. Seedlings are often killed by heavy and continuous rain. Regeneration is facilitated by forming a canopy, and can be supplemented by sowing seeds in the gap.

Artificial regeneration: different methods for artificial regeneration are

1. Direct sowing of seeds.
2. Transplanting the seeds.
3. Planting roots and shoot cuttings

Seeds are clipped without damaging the embryo and thus are soaked in cold water for 36 hours and are then sown in the nursery beds under shade.

Vegetative propogation

This technique reduces the juvenile period thereby subsequently facilitates early maturing.

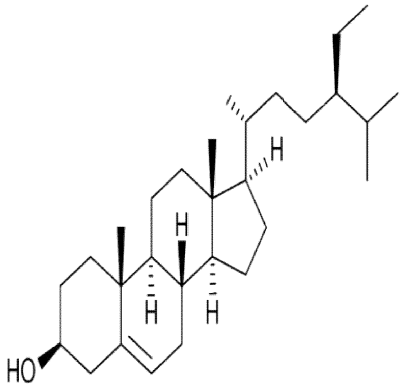
Collection

For the collection of the fruit Jan-March is the best period. In the first half of January the fruit should be collected from the ground as soon as they have fallen. January is considered the best time for collection of the fruit for optimum tannin content. Freshly collected and dried fruit contains optimum tannin content. Freshly collected and dried fruit have yellowish colour and a fetch a better price. The fruits on the ground if left have darker color and sometimes mould attacks can also occur.

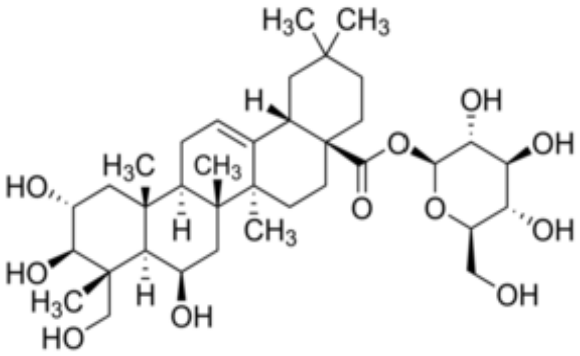
Collection of fruit is generally done by shaking the trees and picking up from the ground. Then the fruit are dried in the sun with arrangements for avoiding contamination within 3-4 weeks. For the drying purpose contractors generally erect temporary sheds to store myrobalans in the event of rain as rains destroy the valuable properties of fruits. The raw myrobalan is graded under different trade names, selection being based upon their solidness, color and freedom from insect attack. Grading generally consists of separating inferior fruits, which constitute a second grade, the remainder being the first grade. The dried myrobalan were graded at the premises of the wholesale merchants into different grades based on color, solidity of nuts and freedom from insect attack. In the trade, myrobalan were usually known by the place of origin. Myrobalan of fair quality from any area were marketed without grading (FAQ) fair average quality which consists of 75% of solid and 25% of hollow and decayed nuts.

Chemical Constituents

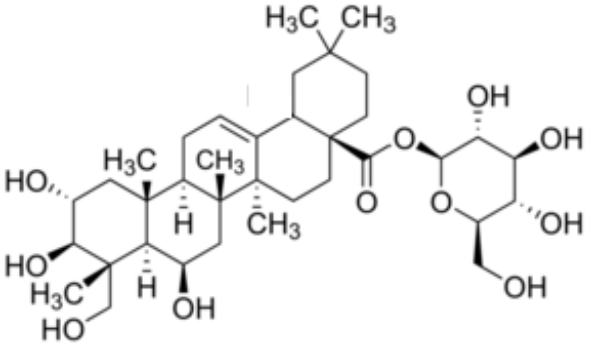
In *Terminalia chebula*, the main phytoconstituents in it are hydrolysable tannins(which may vary from 32-34%) other phytoconstituents present in *Terminalia chebula* are flavanoids, steroids, amino acids, fructose, resins, fixed oils, anthraquinone, carbohydrates, glucose, sorbitol etc. the plant is fairly rich in hydrolysable tannins. In various researches, researchers found that *Terminalia chebula* contain 14 components of hydrolysable tannins like gallic acid, chebulic acid, punicalagin, chebulanin, corilagin, neochebulinic, ellagic acid, chebulagic acid, 1,2,3,4,6-penta-orgalloyl-β-D-glucose, 1,6-di-o-galloyl-D-glucose and Terchebulin (Kumar, 2006)(Juang, 2004).



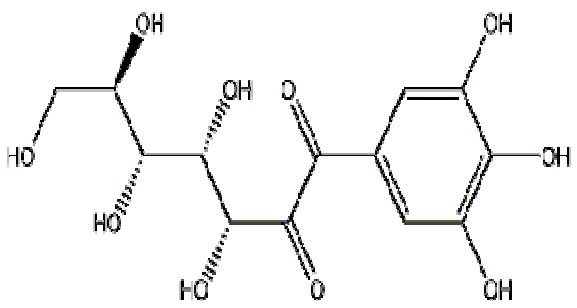
Beta sitosterol



Chebuloside 2



Chebuloside 1

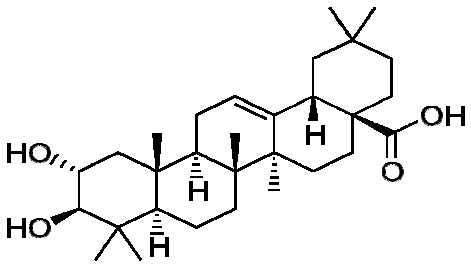


Galloyl glucose

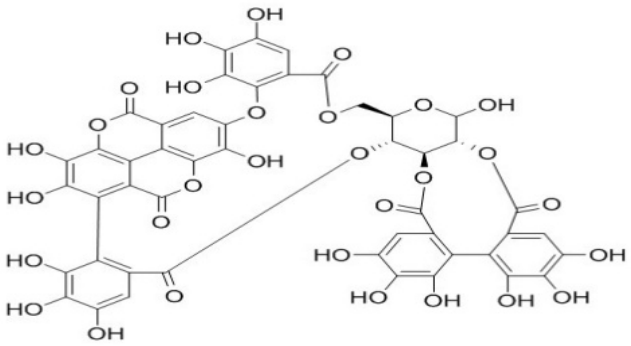
Phytochemicals like anthraquinone ethadioic acid, sennoside, 4.2.4-chebylyl-d-glycopyranose terpenes and terpinols have also been reported. The tannin content varies with geological variations. Some other minor chemical constituents were polyphenols such as corilagin, gallolyl glucose, punicalagin, terflavinA, maslimic acid. Fructose, amino acid, succinic acid, betasitosterol, resin and purgative principle of anthraquinone are also present (Quanbin *et al*, 2006).

12 fatty acids were isolated from *Terminalia chebula*, of which palmitic, linoleic acid and oleic acid were main constituents. Triterpenoid glycosides such as chebulosides 1 and 2, arjunenin glucoside, 2α-hydroxymicromiric acid and 2α-hydroxyursolic acid also have been reported. The leaves were found to contain polyphenols such as punicalin, punicalagin, terflavins B, C and D (Patel, 2010)(Creencia, 1996).

The plant is also is also found to contain phloroglucinol and pyragallol, along with phenolic acids such as ferulic, p-coumeric, caffeic and vanillic acids. Recent studies show that *Terminalia chebula* contains more phenolics than other plants **(**Mahajan, 2010)**.**



Masilinic acid



Terchebulin

Traditional Values of Haritaki

Charaka Samhita and Sushrusha Samhita, though, extensively describe various medicinal plants, *T. chebula* (haritaki) enjoys the prime place among medicinal plants not only in India but also in other countries like Asia and Africa. It is extensively used in Ayurveda, Siddha, Unani and homeopathic medicines in India. It is a top listed plant in Ayurvedic Materia medica for treatment of asthma, bleeding piles, sore throat, vomiting and gout. It is used in Thai traditional medicine as a carminative, astringent and expectorant (Malik *et al*, 2012). According to Vagbhata, it is the drug of choice in the therapy of 'vata-kapha' diseases. The 'Triphala', a herbal preparation of 'three fruits' from plants *Terminalia chebula*, *Terminalia bellerica*, *Emblica officinalis*, is used as laxative in chronic constipation, detoxifying agent of the colon, food digestive problems (poor digestion and assimilation) and rejuvenator of the body. Certain studies have shown that 'Triphala' stimulates apetite, and is useful in treating cancer and detoxification. Triphala is considered as the most versatile of all herbal formulations and is prescribed as a cardiotonic and for candid infection (Kadian, 2016).

The fruits of haritaki are used both externally as well as internally for medicinal purposes. Externally, the paste of fruits effectively reduces the swelling, hastens the healing and cleanses the wounds and ulcers. In erysipelas and other skin disorders, it prevents accumulation of pus in skin diseases. The oil of haritaki is extremely helpful in healing of wounds especially in burns (Kaur *et al*, 2005). The paste of fruit is also applied in conjunctivitis for relief due to its anti-inflammatory property. The gargles with its decoction give excellent results in stomatitis and problems of the throat. Triphala can be used externally for hair wash, for brushing the teeth in pyorrhea or bleeding gums, and its decoction for washing the chronic, non-healing wounds and ulcers. A fine powder of this can be used as a tooth powder to strengthen the gums. Aqueous extract of it, is used as a mouth rinse, which is an anticaries agent. Internally, it is used to cure a vast variety of diseases. It is recommended with rock salt in 'kapha' diseases, with sugar in 'pitta' diseases and with the ghee in 'vata' diseases. It acts as a rejuvenator when taken with various supportive dravyas in different seasons. There is a specific reference of the 'anupana' (a substance that serves as a medium for the herbs to be taken with) with which haritaki should be combined, with reference to the season. In varsa ritu (July- August), it should be taken with rock salt, in sarad ritu (September-October) with sugar, in hemanta ritu (November- December) with sunthi, in sisira ritu (January-February) with pippali, in vasanta ritu (March-April) with honey and in grisma ritu (May-June) with jaggery. According to Vagbhata, when haritaki powder fried in ghee is regularly consumed with sufficient ghee in food, it promotes longevity and boosts energy. Common gastrointestinal ailments, tumours, ascites, piles, enlargement of liver and spleen, worms, colitis can be treated well with haritaki. The bark of haritaki, if eaten after chewing, improves digestion. 'Bala haritaki' is useful in haemorrhoids and in clearing the bowels. The mixture of Triphala powder and haridra is a well known adjunct in diabetes. Bronchospasm is mitigated effectively with the combination of haritaki and bibhitaka powders with honey. In abdominal pain due to flatulence, it is given with jiggery and ghee. The most popular combination of haritaki, musta, sunthi and jaggery is an effective panacea for diarrhoea, dysentery, flatulence *etc*. 'Haritaki siddha ghrta' is beneficial in chronic fever. The decoction of haritaki or Triphala is given along with honey in hepatitis. Haritaki powder with honey and ghee is also effective remedy for anemia. In obesity, its decoction with honey reduces the excessive body fats. Regular use of haritaki improves memory due to beneficial effects on the nerves of brain. It is also valuable in dysuria and urinary stones. Its paste with water is found to be anti-inflammatory analgesic and having purifying and healing capacity for wounds. They are used as astringent in

hemorrhoids. It has a ability to increase the appetite as digestive aid. It is used as supplement to cholesterol normalizing drugs (Usha, 2007).

Pharmacological Properties

Anti-bacterial activity: Reported antibacterial property of *Terminalia chebula* shows activity against various gram positive and gram negative bacteria such as salmonella typhi, staphylococcus epidermidisis, staphylococcus aureus, bacillus subtilis and pseudomonas aeruginosa suggesting that it is a broad spectrum antibacterial remedy. Gallic acid and ethyl ester, these two antibacterial compounds have been isolated from ethyl extract of fruits of *Terminalia chebula*, these two acts against hcelicobacter pylori. Ether and alcohol extract of *Terminalia chebula* were tested against helicobacter pylori. The aqueous extract of the plant, at a concentration of 1.2-5mg/ml, inhibited urease activity oh helicobacter pylori. Ethanedioic acid present in *Terminalia chebula* showed strong inhibitory activity against clostridium perfringens and it showed moderate inhibitory activity against Eischerechia coli. In both the cases there is no adverse effects on the growth of these four tested lactic acid producing bacteria. Ellagic acid exerted a potent inhibitory effect against clostridium perfringens and E.coli, but little or no inhibition was observed for behenic acid; β-caryophullene, eugenol, isoquercetin, oleic acid, α phellendone, β-sitosterol, stearic acid, α terpinene, terpinolene or triacontanoic acid. *Terminalia chebula* fruit extract had strong antibacterial activity against intestinal bacteria, clostridium perfringens and E.coli. Overall studies prove that ethanol extract is effective against salmonella typhi, staphylococcus aureus, bacillus subtilis. Ether, alcoholic and aqueous extract has potent activity against helicobacter pylori (Kannan, 2009).

Anti-fungal properties: Aqueous extract of *Terminalia chebula* exhibited antifungal activity against a number of dermatophyte and yeasts. The alcoholic ethyle acetate extract shows the activity against Aspergillus niger, aspergillus flavus, alternate. 70% of methanol ethylacetate, hexane, chloroform extract shows activity against fusarium oxysporum, phytopthora capsici, fusarium solani etc (Dutta, 1998)(Mehmood, 1999).

Immunomodulatory activity: Aqueous extract of *Terminalia chebula* produced an increase in humoral antibody, titre and delayed type of hypersensitivity in mice. Alcoholic extract of *Terminalia chebula* shows immunomodulatory activity in male wistar rats. *Terminalia chebula* stimulated cell mediate immune response in experimental amoebic liver abscess in golden hamsters. *Terminalia chebula* found to be effective against the progression of advanced glycation end products induced endothelial dysfunction (Sohni, 1996).

Antioxidant activity: Prominent antioxidant property is reported in *Terminalia chebula*. The activity is reported in the leaves, bark and fruit of *Terminalia chebula*. Analysis of the fruit of *Terminalia chebula* extract shows that it contains phenolic compound which are good scavengers of free radicals. It also exhibit anti lipid peroxidation, antisuperoxide radical formation and free radical scavenging activity. It is found that the methanolic extract has the greatest triterpenoid content and exhibited good antioxidant activity in HRP-luminal-H2O2 assay, on the other hand aqueous extract has the greatest phenolic and tannin content and showed good antioxidant activity in both copper sulphate phen-VC-H2O2 and luminal H202 assays. *Terminalia chebula* when used in a polyherbal formulation (Alter-7/NR-AZ) inhibited free radical induced hemolysis and also significantly inhibited NO release from lipopolysaccharide stimulated murine macrophages. Acetone extract shows stronger antioxidant activity than alpha tocopherol. An aglycone isolated from the fruit of *Terminalia chebula*, significantly inhibited ferrous shulphate /cyst-induced microsomal lipid peroxidation and protect both H2O2 induced hemolysis and auto RBC hemolysis in dose dependent manner. The results demonstrated that triethylchebulate was a strong antioxidant and free radical scavengers, which might contribute to the antioxidant property (Cheng *et al*, 2003)(Suchalatha, 2005).

Anti-mutagenic and anti-carcinogenic activities: The 70% methanolic extract of fruit of *Terminalia chebula* was studied on the growth of several malignant cell lines including a human (MCF-7) and mouse(S11S) breast cancer cell line, a human esteosarcoma cell lines(HOS-1), a human prostate cancer cell line(PC-3) and a non tumorigenic immortalized human prostate cell line (PNTIA) using array for proliferation (3H-thymidine incorporation and counter counting, cell viability (ATP determination and cell death flow cytometery and horchst DNA staining). The chloroform extract, acetone, and aqueous extract of *Terminalia chebula* shows activity against salmonella typhimurium. All the extracts studied in several cell lines shows a decreased cell viability, inhibited cell proliferation and induced cell death in dose dependent manner. Chebulagic acid showed potent dual inhibition against COX and 5-LOX. It also show antiproliferative activity against HCT-15, COLO-205, MDA-MD-231 DU-145 and K562 cell lines. In another study acetone extrcact of bark and fruit powder of *Terminalia chebula* exhibit anticarcinogenic activity (Reddy *et al* 2009)(Lee *et al*, 2010).

Anti-amoebic and anti-protozoal activity: *Terminalia chebula* showed antiamoebic activity against entamoeba histolytica in experimental caecal amoebiasis in vivo. The extract of *Terminalia chebula* seeds showed anti plasmodial activity against plasmodium falciparum (Sohni, 1995)(Pinmai *et al*, 2010).

Anti-arthritic activity: *Terminalia chebula* could be used as a disease modifying agent in treatment of rheumatoid arthritis. Studies show that acetone extract of fruit of *Terminalia chebula* have better effect on controlling CFA induced arthritis showing the definite effect in reducing the inflammatory components. Aqueous extract of dried fruit of *Terminalia chebula* showed anti-inflammatory by inhibiting inducible NO synthesis. Chebulagic acid isolated from the ethanolic extract of fruit of *Terminalia chebula* significantly suppressed the onset and progression of collagen induced arthritis in mice. The hydrochloric extract of *Terminalia chebula* produced a significant inhibition of joint swelling as compared to control in both formaldehyde induced and CFA induced arthritis. Polyherbal formulation of *Terminalia chebula* (Alter-7) exhibited anti-inflammatory effect against arthritis in rats (Nair, 2010).

Anti-Diabetic activity: 75% methanolic extract of *Terminalia chebula* reduced the blood sugar level in normal and alloxan induced diabetic rats significantly within 4 hours when administered orally. Dose dependent reduction in blood glucose

of streptozotocin induced diabetic rats both in short term and long term study is reported in ethanolic extract of *Terminalia chebula* seeds (200mg/kg body weight). The choloform extract of *Terminalia chebula* seeds (100,200and300mg/kg body weight) produced dose dependent reduction in blood glucose of diabetic rats in both short term and long term. The aqueous extract of *terminalia chebula* (200mg/kg body weight for 2 months) reduced the elevated blood glucose and increase in glycosylated hemoglobin. The same dose also showed a marked improvement in controlling the elevated blood lipids as well as decrease in serum insulin levels. The in vitro studies with pancreatic islets showed that the insulin release was nearly 2 times more than that in the untreated diabetic animals (Rao, 2006)(Kumar *et al*, 2006).

Wound healing property: An alcoholic extract of the leaves of *Terminalia chebula* caused much faster healing of rat dermal wounds which when applied topically. Studies revealed increase in total protein DNA and collagen content in the granulation tissues of treated wounds. Hydroalcoholic extract of *terminalia chebula* showed effective wound healing property in alloxan induced diabetic rats. 90% of the ethanolic extract of *Terminalia chebula* showed wound healing property in wistar albino rats. The levels of hexosamine and uronic acid also increased upto day 8 post wounding. Tannins extracted from immature fruits of *terminalia chebula* inhibited staphylococcus aureus, klebsiella and pneumonia in vitro and promoted cutaneous wound healing in rats due to a powerfull antibacterial and angiogenetic activity of the extract. The wound healing activity of ethanolic extract of fruits terminalia chebula in the form of an ointment with 2 concentrations (5%and 10%w/w ointment of bark extract in simple ointment base) showed significant response in excision and incision models in albino rats compared to controls (Sugun, 2006)(Singh, 2009).

Anti-viral activity: A study proved that Terminalia chebula fruits contain 4 human HIV type I integerase inhibitors such as gallic acid and 3 galloyl glucose. The aqueous extract of *Terminalia chebula* exhibited the most prominent anti HBV activity by decreasing the level of extracellular HBV virion DNA at concentration ranging from 64-128µg. The extracts of fruit of *Terminalia chebula* showed inhibitory effect on human immunodeficiency virus reverse transcriptase. Acetone extract of *Terminalia chebula* shows antiviral activity against swine influenzaA virus and aqueous extract of *Terminalia chebula* showed antiviral extract against hepatitis B virus (Mekaway *et al*, 1995) (Yuhan *et al*, 1996).

Anti-convulsant activity: The ethanolic extract of *Terminalia chebula* significantly reduced the duration of seizures induced by maximal elctro shock. Ethanolic extract conferred protection on the mice. Ethanolic extracts posses anticonvulsant activity since it reduces the duration of seizures produced by maximal electro shock and delayed the latency of seizures produced by pentylenetetrazole and picrotoxin (Hogade, 2010).

Cytoprotective activity: The ethanolic extract exhibited significant cytoprotective effect against UV-B induced oxidative damage. The observation were attributed to the inhibitory effect of the Terminalia chebula on the age dependent shortening of the telomere length as shown by southern blots of the terminal restriction fragments of DNA extracted from subculture passages. The gallic acid and chebulagic acid isolated from fruit extract of *Terminalia chebula*, blocked cytotoxic lymphocyte-mediated cytotoxicity (Na *et al*, 2004)(Manosroi *et al*, 2010).

Anti-anaphylactic action: The extract of *Terminalia chebula* was administered into the animals followed by induction of anaphylactic shock, the serum histamine levels were reduced, indicating its strong antianaphylactic action. Aqueous extract of *Terminalia chebula* showed a significant increased effect on TNFα production from rat peritoneal mast cells representing its strong anti-anaphylactic action (Shin *et al*, 2001).

Cardioprotective activity: 95% of ethanol extract of *Terminalia chebula* (500mg/kg body weight) was investigated in isoproterenol induced myocardial damage in rats. Pretreatment with *terminalia chebula* extract has cardioprotective effect due to lysosomal membrane stabilization prevents the myocardial necrosis and inhibits alterations in the heart's mitochondrial structure and functions in the experimental rats. Its pericarp has also been reported to have cardioprotective activity in isolated frog heart model (Suchalatha, 2005)(Suchalatha, 2007).

Hypolipidemic and Hypocholesterolemic activity: Extract of *Terminalia chebula* showed hypolipidaemic activity against experimentally induced atherosclerosis. Extract also showed hypocholesterolemic activity against cholesterol induced hypercholesterolemic and atherosclerosis in rabbit. Triphala *(Terminalia chebula, Terminalia bellerica, Embelica officianalis)* formulation is found to have hypolipidemic effect on the experimentally induced hypercholesteremic rats (Thakur *et al*, 1988)(Shaila, 1998).

Hepatoprotective activity: The 95% ethanolic extract of *Terminalia chebula* fruit show strong hepatoprotective activity. It also shows similar property against anti-tubercular drug rifampin, isoniazid and pyrazinamide induced toxicity due to its prominent antioxidative and membrane stabilizing activity. Aqueous extract of fruit of *Terminalia chebula* tert-butyl hydroperoxide induced oxidative injury was observed in cultured rat primary hepatocytes and rat liver has also been documented (Tasduq *et al* 2006).

Radioprotective acticity: *Terminalia chebula* extract in dose of 80mg/kg body weight prior to whole body irradiation of mice resulted in reduction of peroxidation of membrane lipids in liver and decrease in radiation induced damage to DNA. In vitro studies showed the protective activity towards human lymphocytes from undergoing the γ radiation induced damage to DNA. (Jagetia *et al*, 2002)

Gastroenteric activity: The methanolic extract of *Terminalia chebula* show significant reduction in gastric volume, free acidity and ulcer index in pylorus ligation and ethanol induced ulcer model in wistar rats. *Terminalia chebula* increase the percent of gastric emptying in the Charles foster rats. Intragastric administration of the crude drug to rat, at a dose of 1.5g/l for 15 days, decreases the number of gastric ulceration induced by pentagastrin and carbacol (Sharma *et al*, 2011).

Anti-plasmodial activity: Aqueous extract of *Terminalia chebula* show antiplasmodial activity, in vitro in MDR strain of plasmodium falciparum and in vitro studies of Terminalia chebula acetone extract of seed of the plant show anti-plasmodial activity in a study (Pinmai, 2010).

Anti-caries property: Sucrose induced adherence and glucan induced aggregation of streptococcus mutant's growth were inhibited strongly by the aqueous extract of *Terminalia chebula*. The 10% solution of the extract used in mouth rinsing show inhibition of the salivary bacterial count and glycolysis of salivary bacteria for upto 90 minutes post rinsing (Aneja, 2009).

Nephroprotective: The extract of fruit of *Terminalia chebula* helps to alleviate the cadmium induced nephrotoxicity. Its decoction showed significant reduction in hyper lipidemia in increased fat died induced hyperlipidemic rats (Anju *et al*, 2011).

Anti-spermatogenic: The 50% ethanolic extract of bark of *Terminalia chebula* show histological alterations in seminiferous tubules in testes of mice at dose of 300 mg/kg for 28 days. The extract of fruit of *Terminalia chebula* given at dose of 100 mg/kg show significant decrease in motility count, and in morphological abnormalities in spermatozoa (Srivastava *et al* , 2010).

CONCLUSION

All the traditional system of medicines in India such as ayurved, sidha, unani has documented several plants to be of high therapeutic value thus giving them medicinal importance. The use of the herbal medicines has increased due to number of benefits. Herbal medicine's recognition is gradually increasing in the world as they are safe and all natural. *Terminalia chebula* consists of number of phytochemical constituents which are found to be associated with the plant extract that include mainly chebulic acid, gallic acid, ellagic acid, tannins acid, amino acid, flavanoids, like luteolin, rutins and quercetin etc. All these compounds are found to be responsible for many of pharmacological activities. *Terminalia chebula* is an important herbal drug as it is used for treating many diseases including diseases such as cancer. Many pharmacological investigation have been carried out based on its chemical constituents. This review shows some pharmacological and pharmacognistical studies on haritaki. I hope that this article provides an insight to the studies, and hope this review provides a generalization that will help the students who search for the information on *Terminalia chebula* which is considered the most important medicinal herb in all system of medicines.

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