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EXPLORING THE MULTIFACETED BENEFITS OF *TERMINALIA CHEBULA*: AN IN-DEPTH REVIEW

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Abstract: In traditional Ayurvedic medicine, Terminalia chebula, also referred to as Haritaki, is a well-known medicinal herb. With a focus on its possible uses in contemporary health and wellness contexts, this abstract examines the many health advantages ascribed to Terminalia chebula. The plant's pharmacological qualities, such as its antibacterial, anti-inflammatory, antioxidant, and anticancer effects, are summarized in this study based on current research. Further investigation is done into the effects of Terminalia chebula on cardiovascular health, metabolic diseases, and gastrointestinal health. The plant's promise as a versatile medicinal agent is highlighted in this abstract, which also emphasizes the need for more research to fully clarify its clinical applications and mechanisms of action. Traditional knowledge is integrated with modern scientific results.

Keywords: *Terminalia chebula*; Phytoconstituents; Biological and Pharmacological conditioning; Clinical studies; Medicinal uses; Safety evaluation.

INTRODUCTION:

Medicinal plants have been an essential part of human society since the dawn of civilization. They are a useful and reasonably priced source of unique phytoconstituents, which are commonly employed in the production of drugs to treat a variety of disorders.[1] The several hundred genera of plants that are used medicinally, mostly as herbal medicines, in the traditional medical systems of many nations that have endured the test of time cannot be fully replaced by modern drugs. Eighty percent of the world's population, according to data from the World Health Organization, mostly uses traditional remedies that contain plant extracts or their active constituents. Estimates suggest that while the percentage of plant-based pharmaceuticals in developed countries like the US may be as high as 25%, it may be as high as 80% in developing countries like China and India.[2] As a result, nations like India place a far larger economic value on medicinal herbs than do other nations. Over the past few decades, herbal medicine has become more and more popular in both developed and developing countries. This is because herbal treatments are inexpensive, natural, have higher safety margins, and have minimal to no negative side effects.[3] The Combretaceae family includes the flowering evergreen tree Terminalia chebula (T. chebula). Some common names for it include black myrobalan, ink tree, or chebulic myrobalan; other names are harad in Hindi, harataki in Sanskrit and Bengali, harada in Marathi and Gujrati, Karkchettu in Telugu, and Kadukkaya in Tamil. In Tibet, T. chebula is known as the "King of Medicine".[4] It is dedicated to the god Siva (Hara) and is known as "haritaki" since it

heals all ailments. 'Abhaya' (meaning it instills fearlessness), 'amrta' (meaning ambrosia), 'divya' (meaning a divine herb),'medhya' (meaning a nerve tonic), 'pranada' (meaning it saves lives), 'jivaniya' (meaning a vitalizing herb), 'vayahstha' (meaning one that maintains youth and promotes longevity), 'rasayana phala' (meaning a fruit), and so on are some of the fascinating synonyms for haritaki. Indian mythology states that this plant was formed from the ambrosa (Amrita) droplets that fell to Earth after the god Indra consumed them.[5]

BOTANICAL DESCRIPTION:

Taxonomy

Kingdom: Plantae
Division: Magnoliophyta
Class: Magnoliopsida
Order: Myrtales
Family: Combretaceae
Genus: Terminalia
Species: chebula

1. HABIT AND HABITAT:

The large to medium-sized, heavily branched deciduous tree T. chebula can grow up to 30 m in height and 1–1.5 m in diameter. The long, elliptic leaves have a cordate base and a pointed tip, measuring 10 to 30 centimetres. The vasculature of leaves consists of six to eight pairs of veins. Simple terminal spikes or short panicles of short-stalked, monoecious, dull white to yellow flowers with an overpowering stench are present. The fruits are ovoid, yellowish-green drupes with one oval seed that are 3-6 cm long and 1.3-1.5 cm broad.[6] Soils that are clayey or shaded are both good for T. chebula growth. When the temperature is between 0 and 17 degrees Celsius and there is 100 to 150 centimetres of yearly rainfall, trees can thrive up to 2000 meters above sea level. Despite being native to Asia, T. chebula is also found in Egypt, Iran, Turkey, Yunnan, Tibet, Guangdong, and Guangxi province in China, as well as Pakistan. It is found growing in India's deciduous woods in West Bengal, Uttar Pradesh, Kerala, Karnataka, Himachal Pradesh, and Andhra Pradesh. [7]

2. PLANT FRUITS:

Varieties

Depending on the type of fruits, T. chebula (haritaki) is classified into seven types. Of these seven types, Vijaya is considered to be the best:

1) Vijaya, located in Vindhya, is oval-shaped.
2) Rohini - found everywhere, circular in shape.
3) Pootana, Sindh - tiny and less bulky.
4) Amruta - Champaranya - large.
5) Abhaya - Champadesha: The fruit has five lines (eye disorders).
6) Jeevanti, Saurashtra - yellow in color.
7) Chetaki, situated in the Himalayas, has three lines on it.

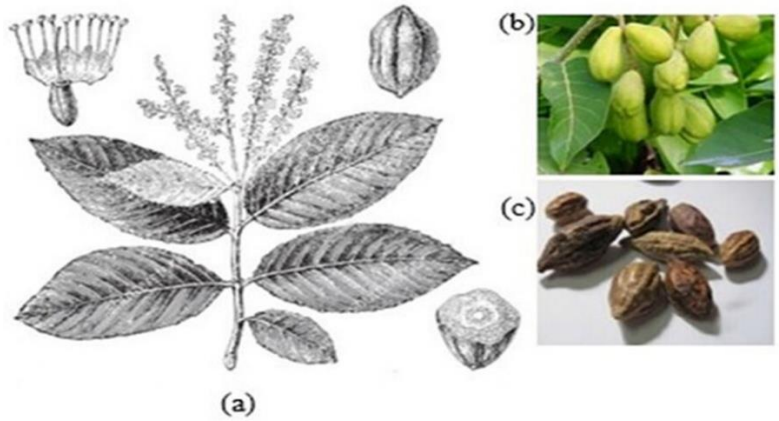
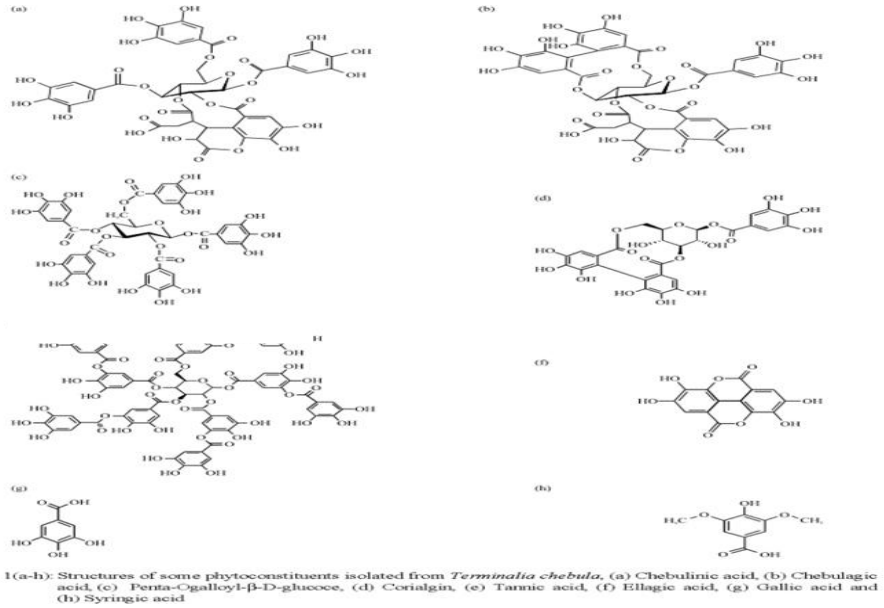


Figure 1 Anatomical structure of T. chebula (a) flower and fruit (b) unripe fruite (c) ripe fruit.[8]

In actuality, though, there are three different kinds of haritaki: Survari, Chambhari (rangari), and Bala haritaki. The haritaki fruit falls off the tree, leaving behind a hard seed known as "bala haritaki." Sometimes, while the seeds have not yet hardened, the fruits are picked and dried; these are also known as "bala haritaki." The fruit of haritaki that has not fully matured is termed "survari haritaki," while the immature fruit is known as "chambhari haritaki." A haritaki fruit that is at least 26 g in weight, smooth, round, and fresh, and that sinks in water is thought to be the best kind to utilize medicinally. The haritaki fruit has five different types of rasas(1) The pulpy, sweet madhur; (2) The bulky, sour amla; (3) Tikta (bitter) - seed; (4) Katu - the fruit's covering; and (5) Kashaya (astringent) - the hard part of the seed. Thus, haritaki is a pancharasatmak. Ayurvedic literature emphasize the daily usage of haritaki to regulate all of the body's basic processes. [9]

3. PHYTOCHEMICAL PROPERTIES:

However, *T. chebula* is fairly rich in many phytoconstituents, including tannins (about 32% tannin content), flavonoids, sterols, amino acids, fructose, resin, fixed oils, and so on. Furthermore, the geographic location of *T. chebula* has a significant impact on its tannin content. Chebulic acid, chebulinic acid, chebulagic acid, gallic acid, corilagin, and ellagic acid are the main constituents of tannin. *T. chebula* contains pyrogallol, or hydrolyzable, tannins. [10-12]



g. 1(a-h): Structures of some phytoconstituents isolated from *Terminalia chebula*, (a) Chebulinic acid, (b) Chebulagic acid, (c) Penta-Ogalloyl-β-D-glucose, (d) Corialgin, (e) Tannic acid, (f) Ellagic acid, (g) Gallic acid and (h) Syringic acid

Figure 2: (a-h):Structures of some phytoconstituents isolated from *Terminalia chebula*, (a) Chebulinic acid, (b) Chebulagic acid, (c) Penta-Ogalloyl-β-D-glucose, (d) Corialgin, (e) Tannic acid, (f) Ellagic acid, (g) Gallic acid and (h) Syringic acid[13]

4. TRADITIONAL VALUES OF HARITAKI:

While the Samhitas of Charaka and Sushrusha include detailed descriptions of many medicinal plants, T. chebula, or haritaki, is the most often used medicinal herb not only in India but also in other Asian and African nations. In India, it is widely utilized in siddha, unani, ayurvedic, and homeopathic medications. It is one of the top-listed herbs in the Ayurvedic Materia Medica for treating gout, vomiting, sore throats, bleeding piles, and asthma. It is an astringent, expectorant, and carminative in traditional Thai medicine. It is the recommended medication for treating "vata-kapha" disorders, according to Vagbhata. As a colon detoxifier, food additive, and laxative for persistent constipation, the herbal preparation "Triphala" is made from the "three fruits" of the plants Terminalia chebula, Terminalia bellerica, and Emblica officinalis.[14-17]

In medicine, haritaki fruits are applied topically and sometimes taken internally. On the outside, fruit paste works well to minimize edema, speed up the healing process, and clean cuts and ulcers. Haritaki keeps pus from accumulating in erysipelas and other skin conditions. Haritaki oil is very beneficial for healing wounds, particularly burns.When applied topically, the decoction of it helps a lot with throat issues and stomatitis. Triphala decoction can be applied externally to wash chronic, nonhealing sores and ulcers, as well as to brush teeth in cases of pyorrhea or bleeding gums. Haritaki is ground into a fine powder and used as a tooth powder to help strengthen the gums.[18]

Precautions: Haritaki should be used with caution by lean people, those suffering from acute weakness, fasting, mental depression, pitta disorders, or during pregnancy.

Contraindications: pregnancy, emaciation, and dehydration. In cases of poor digestion, exhaustion from heavy sexual activity, alcohol consumption, hunger, thirst, and heat stroke, Terminalia chebula should not be taken.

Safety evaluation: The ethyl acetate-soluble portion of T. chebula ethanolic extract containing 29.4% chebulic acid was tested for in vitro mutagenicity assay, and in a single- and 14-day repeated dose oral toxicity study to find out the safety in use of the plant extract. In the bacterial mutation assay, up to 5000µg/ml concentration of the ethyl acetate-soluble portion, the numbers of colonies did not increase whether with or without metabolic activation. In the oral toxicity study, the single oral dose of the extract at 2000 mg/kg body weight did not produce mortality or abnormal lesions in the internal organs of rats. The results of a 14- day orally repeated dose showed that T. chebula extract had no adverse effects at 2000 mg/kg body weight in rats. [19]

Popular ayurvedic preparations: Triphala curna, Abhayamodaka, Abhayarista, Pathyadi curna/vatl/kvatha, Vyaghn haritaki, Gandharva haritaki etc.

5. PHARMACOLOGICAL PROPERTIES:

5.1. Antibacterial activity:

From the ethyl alcohol extract of T. chebula fruits, two antibacterial substances have been isolated: gallic acid and ethyl ester against methicillin-resistant Staphylococcus. Numerous T. chebula extracts have antibacterial action against different types of bacteria. Helicobacter pyroli, the bacteria that causes ulcers, gastritis, and stomach tumors, is effectively combated by T. chebula. Testing T. chebula's ether, alcoholic, and aqueous extracts against Helicobactor pylori revealed that the plant's aqueous extract, at 1-2.5 mg/ml, reduced the urease activity of H. pylori. After being separated from the butanol portion of the T. chebula fruit extract, many physiologically active ingredients were examined in tests against six gut bacteria. Strong and moderate inhibitory activity was demonstrated by ethanedioic acid against Clostridium perfringens and Escherichia coli, respectively, with no negative effects.[20-24]

5.2. Antifungal activity:

According to reports, T. chebula's aqueous extract exhibits antifungal efficacy against a variety of yeasts and dermatophytes, including Candida albicans and Microsporumgypseum and Tricophyton rubrum. Additionally, using the paper disc method, extracts of T. chebula leaves (aqueous, alcoholic, and ethyl acetate) were tested against five pathogenic fungi (Aspergillus flavus, A. niger, Alternaria brassicicola, A. alternata, and Helminthosporium tetramera) and were found to be effective in comparison to the reference standard Carbendazim.[25-27]

5.3. Antiamoebic and immunomodulatory activities:

The antiamoebic effect of a crude drug formulation of T. chebula was investigated in experimental caecal amoebiasis in rats with a curative rate of 89% at 500 mg/kg body weight due varying degrees of inhibition of enzyme activities such as DNase, RNase, aldolase, alkaline phosphatase, acid phosphatase, αamylase and protease in axenically cultured amoebae. In another study, T. chebula was evaluated in experimental amoebic liver abscess in golden hamsters and in immunomodulation studies. The formulation had a maximum cure rate of 73% at 800 mg/kg body weight in hepatic amoebiasis. In immunomodulation studies, humoral immunity was enhanced where T-cell counts remained unaffected in the animals, but cell-mediated immune response was stimulated.[28-29]

5.4. Antiviral activity:

The extract of fruits of T. chebula showed inhibitory effects on human immunodeficiency virus-1 reverse transcriptase 35. Hot water extract of T. chebula showed anti-herpes simplex virus (HSV) activity in vivo and anti-cytomegalovirus (CMV) activity both in vitro and in vivo in a study. Ledretan-96 and each of its 23 individual components were tested on an epithelial tissue culture cell line for their protective activity against cytotoxic effects caused by influenza A virus. Of the 23 components tested, only one component showed a significant protective effect when applied to the epithelial cells individually. A study proved that T. chebula fruits contain four human HIV-type 1 integrase inhibitors such as gallic acid and three galloyl glucoses, and suggested that galloyl moiety had a major role for inhibition of the 3′ -processing of HIV-1 integrase by these compounds. T. chebula can also be used in sexually transmitted diseases and AIDS.[30-32]

7.5.Antimutagenic/Anticarcinogenic activity:

It has been shown that the hydrolyzable tannins from Terminalia chebula exhibit antimutagenic action against Salmonella typhimurium. Researchers have shown how the phenolics in Terminalia chebula Retz fruit hinder the growth of cancer cells. They discovered that the main growth inhibitory phenolics in Terminalia chebula were chebulinic acid, tannic acid, and ellagic acid . Additionally, Terminalia chebula fruit powder and bark acetone extract contain ingredients that show promise for their antimutagenic and anticarcinogenic properties. [33-35]

7.6.Antioxidant activity:

The fruit of Terminalia chebula showed antioxidant activity in six extracts and four compounds, varying in strength . In rats, its fruit has radioprotective and antioxidant properties . There have also been reports of the protective effects of an aqueous extract of Terminalia chebula fruit on the oxidative damage caused by tert-butyl hydroperoxide (t-BHP) in rat liver and primary hepatocyte cultures . The primary phenolic components found in it are flavonol aglycones and their glycosides, hydroxybenzoic acid derivatives, and hydroxycinnamic acid derivatives, as revealed by HPLC analysis with diode array detection. Its antioxidant activity is greater than that of alpha-tocopherol.[36-38]

7.7.Hepatoprotective activity:

In a sub-chronic model, Terminalia chebula extract was observed to reduce the hepatotoxicity caused by the administration of pyrazinamide (PZA), isoniazid (INH), and rifampicin (RIF) .[39]

7.8.Radioprotective Activity:

Prior to the mice being exposed to radiation throughout their body, the injection of Terminalia chebula extract decreased both the amount of radiation-induced DNA damage and the peroxidation of membrane lipids in the liver of the mice. In vitro DNA exposure to gamma radiation was also prevented in human lymphocytes by it.[40]

7.9.Antidiebetic and Retinoprotective activity:

In both the short- and long-term studies, the fruit of Terminalia chebula demonstrated a dose-dependent decrease in the blood glucose of streptozotocin-induced diabetic rats, along with retinoprotective properties.[41,42]

7.10.Atispasmodic activity:

Many investigations on Terminalia chebula have shown that the plant has "anti-vata" or "anti-spasmodic" qualities, as seen by the lowering of aberrant blood pressure and intestinal spasms. This demonstrates its long-standing benefit for intestinal problems such as spastic colon.[43]

7.11.Wound healing activity:

When Terminalia chebula leaves were applied topically to rat dermal wounds, the healing process was observed to be accelerated, as evidenced by increased contraction rates and a shorter epithelialization duration.[44]

7.12. Adaptogenic and antianaphylactic activities:

Six Ayurvedic herbs were given to animals in order to evaluate their adaptogenic ability, including the fruit of Terminalia chebula. The animals were helped by all six of the traditional rasayana herbs, each of which provided support in a distinct manner, against an array of diverse stresses . Furthermore, investigations on animals have demonstrated that when Terminalia chebula extract was given after anaphylactic shock was induced, blood histamine levels decreased, suggesting that the extract had a potent antianaphylactic effect.[45,46]

7.13. Gastrointestinal motility improving and anti-ulcerogenic activity:

Terminalia chebula fruit has been demonstrated to lengthen the time it takes for the stomach to empty, despite its long history of usage as a laxative . The improvement in Brunner's gland secretory status, which is linked to protection against duodenal ulcers, seems to counterbalance this impact and have a protective effect on the gastrointestinal mucosa.[47,48]

Clinical studies:

It was discovered that rinsing saliva samples with an extract of Terminalia chebula would considerably lower the counts of streptococcal and total bacteria. A possible function for Terminalia chebula in the prevention of dental caries is indicated by the preventive effect that persisted for up to three hours following rinsing . Patients suffering from mild constipation were the subjects of a brief clinical experiment. The bowel can be fully evacuated by Terminalia chebula, which also enhances stool production . Additionally, clinical trials have examined the benefits of various Ayurvedic medications, which include Terminalia chebula as one of their ingredients, on a variety of conditions, including allergic rhinitis, mental stress, physical and mental impairment, and constipation. Every instance where medicines were present in Terminalia chebula demonstrated positive without showing any adverse effects in the treated groups when compared to their normal control patients.[49,50]

CONCLUSION:

In spite of the overwhelming influences and our dependence on modern medicines and tremendous advances in synthetic drugs, a large segment of the world population still likes drugs of plants origin. Of the 2,50,000 higher plant species on earth, more than 80,000 are medicinal. However, only 7000-7500 species are used for their medicinal values by traditional communities. Terminalia chebula

(haritaki) is one of the most important medicinal plants used in medicines of ayurveda, siddha, unani and homeopathy because of having a number of pharmacological properties. It is the source of a variety of biologically active phytoconstituents such as chebulic acid, chebulinic acid, chebulagic acid, gallic acid, corilagin ellagic acid and other related compounds which are responsible for antimicrobial, antioxidant, antihyperglycemic, anticancer and protective effects on various vital organs such as nerves, heart, kidney and liver. Traditionally, this plant is used to treat a huge variety of health problems. Therefore, there is an urgent need to investigate the biological activity of its phytoconstituents for development of an effective, safe and cheap herbal drug.

References:

1. Sarasa D, Sridhar S, Prabakaran E. "Effect of an antidiabetic extract of Trigonella foenum-graecum on normal and alloxan induced diabetic mice." *Int J Pharmacy Pharmaceutical Sci* **2012**;4(1):63-65.
2. Agarwal M, Sharma P, Kushwaha S. "Antifertility efficacy of 50% ethanolic extract of Calendula officinalis in male rats." *Int J Pharmacy Pharmaceutical Sci* **2011**;3(5):192-196.
3. Gupta PC. "Withania coagulans Dunal- An Overview." *Int J Pharmaceutical Sci Review Research* **2012**;12(2):68-71.
4. Naik GH, Priyadarsini KI, Naik DB, Gangabhagirathi R, Mohan H. "Studies on the aqueous extract of Terminalia chebula as a potent antioxidant and a probable radioprotector." *Phytomedicine* **2004**;11:530-38.
5. Aneja KR, Joshi R. "Evaluation of antimicrobial properties of fruit extracts of Terminalia chebula against dental caries pathogens." *Jundishapur J Microbiol* **2009**;2(3):105-11.
6. Ayyanara M, Ignacimuthu S. "Ethnobotanical survey of medicinal plants commonly used by Kani tribals in Tirunelveli hills of Western Ghats in India." *J Ethnopharmacol* **2011**;134:851-64
7. Kumar KJ. "Effect of geographical variation on contents of tannic acid, gallic acid, chebulinic acid and ethyl gallate in Terminalia chebula. Natural Products." **2006**;2(3-4):170-75.
8. Juang LJ, Sheu SJ, Lin 11. TC. "Determination of hydrolyzable tannins in the fruit of Terminalia chebula Retz. by high-performance liquid chromatography and capillary electrophoresis." *J Sep Sci* **2004**;27(9):718–24.
9. Srivastava A, Chandra A, Singh M, Jamal F, Rastogi P, Rajendran SM, Bansode FW, Lakshmi V. "Inhibition of hyaluronidase activity of human and rat spermatozoa in vitro and antispermatogenic activity in rats in vivo by Terminalia chebula, a flavonoid rich plant." *Reproductive Toxicol* **2010;**29:214–24.
10. Kundu AP, Mahato SB. "Triterpenoids and their glycosides from 13. Terminalia chebula. Phytochemistry" **1993** ;32(4):999- 1002.
11. Saleem A, Husheem M, Harkonen P, Pihlaja K. "Inhibition of cancer cell growth by crude extract and the phenolics of Terminalia chebula Retz. Fruit." *J Ethnopharmacol* **2002**;81:327- 36.
12. Kaur S, Michael H, Arora S, Harkonen PL, Kumar S. "The in vitro cytotoxic and apoptotic activity of Triphala-an Indian herbal drug." *J Ethnopharmacol* **2005**;97:15–20.
13. Rathinamoorthy, R., and G. Thilagavathi. "Terminalia chebula-review on pharmacological and biochemical studies." *International Journal of PharmTech Research* **2014** 6.1: 97-116.
14. Panunto W, Jaijoy K, Lerdvuthisopon N, Lertprasertsuke N, Jiruntanat N, Soonthornchareonnon N, Sireeratawong S. "Acute and chronic toxicity studies of the water extract from dried fruits of Terminalia chebula Rezt. in rats." *Int J Applied Research in Natural Products* **2011**;3(4):36-43.
15. Prasad L, Khan TH, Jahangir T, Sultana S. "Chemomodulatory effects of Terminalia chebula against nickel chloride induced oxidative stress and tumor promotion response in male Wistar rats." *J Trace Elements in Medicine and Biology* **2006**;20:233– 39.
16. Kaur S, Michael H, Arora S, Harkonen PL, Kumar S. "The in vitro cytotoxic and apoptotic activity of Triphala-an Indian herbal drug." *J Ethnopharmacol* **2005**;97:15–20.
17. Usha C, Satyanarayanan R and Velmurugan A. "Use of an aqueous extract of Terminalia chebula as an anticaries agent: A clinical study." *Indian J Dent Res* **2007**;18(4):152-56.

18. Kirtikar KR, Basu BD. "Terminalia chebula In: Indian Medicinal Plants," *2nd eds, Allahabad, India: Lolit Mohan Basu Pub* **1935**.p. 1020-23.
19. Kim JH, Koo YC, Hong CO, Yang SY, Jun W, Lee KW. "Mutagenicity and oral toxicity studies of Terminalia chebula." *Phytotherapy Res* **2011** May 2 [Epub ahead of print].
20. Sato Y, Oketani H, Singyouchi K, Ohtsubo T, Kihara M, Shibata H and Higuti T. "Extraction and purification of effective antimicrobial constituents of Terminalia chebula Retz. against methicillin-resistant Staphylococcus aureus." *Bio Pharm Bull* **1997**;20(4): 401-04.
21. Ahmad I, Mehmood Z, Mohammad F. "Screening of some Indian medicinal plants for their antimicrobial properties." *J Ethnopharmacol* **1998**;62:183-93.
22. Malekzadeh F, Ehsanifar H, Shahamat M, Levin M, Colwell RR. "Antibacterial activity of black myrobalan (Terminalia chebula Retz) against Helicobacter pylori." *J Antimicrobial Agents* **2001**;18:85–88.
23. Kim HG, Cho JH, Jeong EY, Lim JH, Lee SH, Lee HS. "Growthinhibiting activity of active component isolated from Terminalia chebula fruits against intestinal bacteria." *J Food Prot* .**2006**;69(9):2205-9.
24. Kannan P, Ramadevi SR, Hopper W. "Antibacterial activity of Terminalia chebula fruit extract." *African J Microbiol Res* **2009**;3(4):180-84.
25. Dutta BK, Rahman I, Das TK. "Antifungal activity of Indian plant extracts." *Mycoses* **1998**;41(11-12):535-36.
26. Mehmood Z, Ahmad I, Mohammad F, Ahmad S. "Indian medicinal plants: A potential source for anticandidal drugs." *Pharmaceutical Biology* **1999**;37(3):237–42.
27. Vonshak O, Barazani P, Sathiyomoorthy R, Shalev D, Vardy A Golan-goldhirsh. "Screening of South-Indian medicinal plants for antifungal activity." *Phytotherapy Res* **2003**;17(9):1123-25.
28. Sohni YR, Bhatt RM. "Activity of a crude extract formulation in experimental hepatic amoebiasis and in immunomodulation studies." *J Ethnopharmacol* **1996**;54(2-3): 119-24.
29. Sohni YR, Kaimal P, Bhatt RM. "The antiamoebic effect of a crude drug formulation of herbal extracts against Entamoeba histolytica in vitro and in vivo." *J Ethnopharmacol* **1995**;45(1): 43-52.
30. A.H.N. Jeong, C.Y. Kim, J.S. Lee, T.G. Kim, S.H. Kim, C.K. Lee, B. Lee, C.G. Shim, H. Hoon, J. Kim. "Inhibition of HIV-1 integrase by galloyl glucoses from Terminalia chebula and flovonol glycoside gallates from Euphorbia pekinensis." *Planta Medica*. **2002** 68 : 457-9.
31. Suthienkul et al. "Retroviral reverse transcriptase inhibitory activity in Thai Herbs and Species. Screening with moloney murine leukemia viral enzyme." *South-East Asian Journal Trop. Med., Public Health*. **1993** 24 (4) : 751-5.
32. V. Badmaev, M. Nowakowski. "Protection of epithelial cells against influenza A virus by plant derived biological response modifier Ledretan-96." *Phytother. Res*., **2000** 44(4) : 245-9.
33. S. Kaur, I.S. Grover, M. Singh, S. Kaur. "Antimutagenesity of hydrolyzable tannins from Terminalia chebula in Salmonella typhimerium." *Mutagen Res*., **1998** 419(1-3) : 169- 79.
34. Saleem, M. Hushum, P. Harkonen, K. Pihlaja. "Inhibition of cancer cell growth by crude extract and phenolics of Terminalia chebula fruit." *J. Ethnopharmacol*., **2002** 81: 327- 36.
35. S. Arora, K. Kaw, S. Kaur. "Indian Medicinal Plants as reserver of protective phytochemicals. Tetragenesis, Carcinogenesis and Mutagenesis", **2003** 23(1) :295-300**.**
36. H. Y. Cheng, T.C. Lin, K.H. Yu, C.M. Yang, C.C. Lin. "Antioxidant and free radical scavenging activities of Terminalia chebula." *Biol. Pharm.Bull*. **2003** 26(9) :1331-5.
37. G.H. Naik, K.I. Priyadarshini, D.B. Naik, R. Gangabhagirathi, H. Mohan. "Studies on the aqueous extract of Terminalia chebula as a potent antioxidant and the probable radioprotector." *Phytomedicine*, **2004** 11 (6) : 530-8.
38. H.S. Lee, N.H. Won, K.H. Kim, H. Lee, W. Jun, K.W. Lee. "Antioxidant effects of aqueous extract of Terminalia chebula in vivo and in vitro." *Biol. Pharm. Bull*. **2005** 28(9) : 1639-44.
39. S.S. Tasduq, A.K. Singh, N.K. Salti, D.K. Gupta, K. Suri. "Terminalia chebula fruits prevent liver toxicity caused by sub-chronic adminstration of refampicin, isoniazid and pyrazinamide (PZA) in combination." *Human and Exp. Toxicol*. **2006** 25(3) : 11-18.

40. N.M. Gandhi, C.K.K. Nayar. "Radiation protection by Terminalia chebula some mechanistic aspects." *Molecular and Cellular Biochemistry*. **2005** 277(1-2) : 43-8.
41. N.K. Rao, N. Srinavas. "Antidiabetic and retinoprotective effects of the chloroform extract of Terminalia chebula Retz. seeds in streptozotocin-induced diabetic rats*." BMC Complement Altern. Med*. **2006** 6 : 127-32.
42. M.C. Sabu, R. Kuttan. "Antidiabetic activity of medicinal plants and its relationship with their antioxidant properties." *J. Ethnopharmacol*. **2002** 81 : 155-60.
43. S.K. Candhipuram Perasamy, A. Palanisams, S.K. Durairaj, P.S. Sovimuthu. "Antidiabetic activity of Terminalia chebula on streptozotocin-induced diabetic rats." *J. Health Sci*., **2006** 52(3) : 283-91.
44. L. Sugana, S. Singh, P. Shivakumar, P. Sampath, G. Chandrakasan. "Influence of Terminalia chebula on dermal wound healing in rats." *Phytother Res.,* **2002** 16(3) : 227-31.
45. N.N. Rege, U.M. Thatte, S.A. Dahanukar. "Adaptogenic properties of six Rasayana Hebrs used in Ayurvedic medicines." *Phytotherapy Res*. **1999** 13 : 275-91.
46. T.Y. Shin, H.G. Jeong, D.K. kim, S.H. Kim, J.K. Lee, B.S. Chae, J.H. Kim, H.W. kong, C.M. Lee, K.C. Lee, S.T. Park, E.J. Lee, J.P. Lin, H.M. Kim,Y.M. Lee. "Inhibitory action of water soluble fraction of Terminalia chebula on systematic and local anaphylaxis*." J. Ethnopharmacol*. **2001** 74 : 133-40.
47. M.D. Tamhane, S.P. Thorate, N.N. Rege, S.A. Dahanukar. "Effect of oral adnministration of Terminalia chebula on gastric emptying : An experimental study." *J. Postgrad. Med*., **1997** 43 (1) : 12-13.
48. T.S. Nadar, M.M. Pillai." Effect of Ayurvedic medicines on beta-glucuronidase activity of Brunner's glands during recovery from cysteamine-induced duodenal ulcers in rats." *Indian J. Exp. Biol*. **1989** 27(11) : 959-62.
49. V.N. Tripathi, S.K. Tiwari, J.P. Gupta, G.N. Chaturvedi. "Clinical trials of Haritaki in treatment of simple constipation*." Sachitra Ayur.* **1999** 35(11) : 733-40**.**
50. A.G. Jagpat, S.G. Karkera. "Potential of the aqueous extract of Terminalia chebula as an anticaries agent." *J. Ethnopharmacol*. **1999** 68(1-3) : 299-06 **.**