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A Review on Pharmacological Activities of Terminalia chebula and Their Applications in Cosmetic Formulations

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Abstract
Terminalia chebula, a cornerstone of traditional Ayurvedic medicine from ancient India, has been used for centuries to address a variety of health issues, including burns, digestive disorders, diabetes, eye problems, poor eyesight, fever, and kidney ailments. Often used alone or in combination with other herbs, this potent remedy contains hydrolysable tannins, which constitute 20-50% of its composition. These tannins are believed to be responsible for many of Terminalia chebula's medicinal effects, although their concentration can vary depending on the geographic location where the plant is grown. The continued use of Terminalia chebula throughout history underscores its enduring significance in both historical and modern healing practices. Traditional remedies like this have not only survived the test of time but also gained attention in contemporary medicine, where recent advances have begun to explore and validate their therapeutic potential. As research progresses, the integration of traditional wisdom with modern scientific methods may pave the way for new insights and applications, further enhancing our understanding of this ancient remedy's benefits. This review highlights both the historical importance of Terminalia chebula in traditional medicine and its evolving role in modern healthcare, reflecting a growing appreciation for the depth and efficacy of ancient healing practices.

Key word: *Terminalia chebula*, Pharmacological activity, cosmetic formulation.

INTRODUCTION

Terminalia Chebula:

Medicinal plants have been used in the treatment of diseases since time immemorial. The WHO estimates that about 80% of basic health care relies on traditional plant medicines; this is mainly due to issues with conventional treatments [1]. Ayurveda is one of the oldest traditional healing arts, which originated from ancient India. It has been termed the "Mother of all healing" and has been receiving attention in recent times from Western researchers. They are investigating it for new treatments due to the problems associated with modern medical methods, which can be invasive, expensive, and risky [2]. It is a kind of evergreen tree with flowers; in English, it is known as the black myrobalan. It goes by different names in various languages: Haritaki in Sanskrit and Bengali, Harad in Hindi, Karkchettu in Telugu, Kadukkaya in Tamil, and Harada in Marathi and Gujarati [3]. T. chebula is called the "King of Medicine" and is widely known as 'haritaki'. This name comes from the belief that it can cure all diseases and its association with the god Siva (Hara) [4]. In Indian mythology, it is believed that Terminalia chebula came into existence from the drops of ambrosia (Amrita) that fell to earth while Indra was drinking it [5]. Terminalia trees are found in many places and are well-known for having a lot of secondary metabolites. These include flavonones and chalcones, which are types of plant compounds [6]. Research shows that the herb is used as a laxative and has effects that help balance the body, increase urine production, and support heart health [7]. It also claimed for the treatment of burn, gastrointestinal disorders, diabetes, eye diseases, loss of vision, fever, and kidney diseases alone or in combination with other herbs [8]. Dried fruits powder of Terminalia chebula used for the medicinal purpose [9]. In triphala also the dried fruit powders are used for treatment of various diseases. Most research studies have so far been conducted with only the dried fruits of the said plant.

GEOGRAPHICAL SOURCES

Haritaki is a medium-sized tree that is found extensively in countries like India, Myanmar, Bangladesh, Iran, Egypt, Turkey, and China [10].

BOTANICAL DESCRIPTION

The tree is medium-sized, growing up to 25 meters tall, with a short, cylindrical trunk 5-10 meters long and 60-80 cm in diameter. It has a rounded crown, spreading branches, and dark brown bark that cracks longitudinally. The leaves are leathery, ovate or elliptic, 7-12 cm by 4-6.5 cm, with a pubescent underside and 2 glands at the leaf base. The yellowish-white flowers, about 4 mm wide, have an unpleasant smell and grow in 5-7 cm long spikes. The fruit is a smooth, yellow to orange-brown drupe, 2.5-5 cm long, and slightly angular when ripe [11].

MORPHOLOGY OF TERMINALIA CHEBULA [12]:
Terminalia chebula is a medium-sized tree that can grow up to 30 meters tall, with wide, spreading branches and a broad, round crown. It typically grows at altitudes between 1500 and 2000 meters, usually in clayey or shady soils. The tree's stem is dark brown.

Leaves:
The leaves of Terminalia chebula are typically oval or oblong, 8-20 cm long, and fall off during the cold season. You can recognize this tree by its dark brown bark, which flakes off in irregular wooden pieces, and by the pair of large glands at the end of the leaf stems.

[Figure 1]

Fruits:
The fruit of Terminalia chebula is yellow and elliptical, with five long ridges running lengthwise. It measures about 2-4 cm in length and 1-2.5 cm in width. Large, mature fruits are valued and are oval-shaped, ranging from 25 to 38 mm long. Unripe fruits are shriveled, black, oval-shaped, and brittle.The flowers are yellowish-white and fragrant, appearing in large clusters. They grow on spikes emerging from the upper axils or in small bunches.

[Figure 2]

Flowers:
The flowers are yellowish-white and have a pleasant scent. They grow in large clusters and are found on spikes coming from the upper part of the plant or in small bunches.

[Figure 3]

Seeds:
The seed is round and 2-6 cm long, sometimes narrowing at the bottom. It has 5 or 6 sides that are slightly ridged and is covered with a smooth yellowish-brown skin. Inside, there's astringent pulp surrounding a large, rough, single-chambered hard shell.

[Figure 4]

TAXONOMICAL CLASSIFICATION [13]

Kingdom	Plantae
Subkingdom	Angiosperm
Division	Phanerogams
Class	Monocotyledons
Subclass	Epigynae
Order	Scytaminiales
Family	Combretaceae
Genus	Terminalia
Species	Chebula

VERNACULAR NAMES [14]

- Tamil: Kadukkai, Kadu, Arabi
- Sanskrit: Haritaki, Abhaya
- Hindi: Harara
- Chinese: Xi-Qin-Ge or Zhang-Qin-Ge
- Assamese: Hilikha
- Bengali: Haritaki
- Gujarati: Hirdo
- Kannada: Aralaikai, Halli, Arile
- Oriya: Horida, Horiroki
- Punjabi: Halela, Har
- Telugu: Karakkaya
- Urdu: Haegarad
- Thai: Samo That

CHEMICAL CONSTITUENTS

Terminalia chebula contains hydrolysable tannins (20-50%) that drive its medicinal effects, with tannin levels varying by location. It also includes flavonol glycosides, triterpenoids, coumarin compounds, and phenolic compounds. Eight specific compounds, such as gallic acid and chebulagic acid, were identified using reverse phase chromatography. There are seven varieties of Terminalia chebula, used similarly but differing in specific uses and quality [15].

EXTRACTION METHODS:

The extraction methods to extract terminalia chebula are maceration, titrimetric method [16] **,** solvent extraction [17], decoction [18], cold water extraction [19].

Solvent Extraction:

The dried and ground plant material (10 grams each) was mixed with 100 millilitres of petroleum ether, chloroform, dimethylformamide, ethanol, and water in separate sealed flasks. These flasks were shaken for 24 hours. After shaking, the mixtures were filtered and spun at 5,000 rpm for 15 minutes. The liquid on top was collected and dried out to produce a crude extract.

TRADITIONAL USES

- Fruits efficiently decrease swelling, speed up healing, and help clean wounds and ulcers.
- Stops pus from building up in skin problems.
- Helps wounds heal, especially in burns.
- The fruit is used to soothe conjunctivitis because it reduces inflammation.
- When used as a mouth rinse, it helps prevent cancer.
- Uses as anti-astringent [20].
- It has been reported that this plant is used to treat burns, digestive problems, diabetes, eye issues, poor eyesight, fever, and kidney problems, either on its own or as part of a mix of herbs [21].

THERAPUTIC USES

- It helps with piles, epilepsy, diarrhoea, dysentery, bleeding and sores in the mouth, leprosy and feeling very sad [22].
- It also makes the brain, eyes, and gums stronger [23].
- The leaves and fruits of T. chebula are also used as a fixing agent [24].
- It also helps lessen the negative effects of fatty, creamy, and oily foods. Additionally, it can support cholesterol-lowering medications [25].

- Dried ripe fruits have been commonly used to help with sore throats, vomiting, hiccups, bleeding piles, gout, bladder problems. When mixed with water, their paste can reduce inflammation, relieve pain [26].
- Water extract of T. chebula fruits and its effects on skin cancer, which involves DNA damage and inflammation. While T. chebula has antioxidant and anti-inflammatory benefit [27,28].

PHARMACOLOGICAL ACTIVITY OF TERMINALIA CHEBULA

Anti -bacterial activity:

Terminalia chebula is known to be good at fighting bacteria. Of the different extracts tested—ether, alcohol, and water—the ether extract was the most effective, with the lowest amounts needed to stop and kill bacteria [29]. Terminalia has shown it can fight off bacteria effectively by creating a zone that prevents the growth of various bacteria like Pseudomonas aeruginosa, Pseudomonas fluorescens, Bordetella bronchiseptica, Staphylococcus aureus, Staphylococcus epidermidis, Bacillus cereus, and Bacillus pumilis [30]. It works well against both types of bacteria—gram-positive and gram-negative. Tests confirm it is a strong antimicrobial agent, successfully battling bacteria such as Bacillus subtilis, Proteus vulgaris, Salmonella typhimurium, Pseudomonas aeruginosa, Escherichia coli K-12, and Staphylococcus aureus [31].

Anti- oxidant activity:

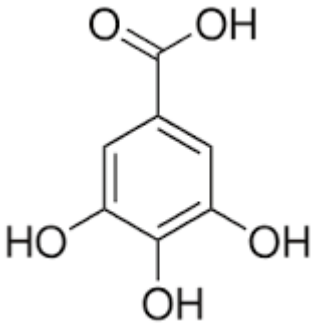
T. chebula is found to be an excellent anti-oxidant T. chebula can help protect against damage caused by photosensitization. It does this by preventing Fe(II)-induced lipid peroxidation, which could be useful for reducing iron toxicity caused by light exposure [32].

Wound healing activity:

The survey showed that T. chebula greatly helps with wound healing. When applied to skin wounds in rats, T. chebula's alcoholic extract speeds up healing. It seems to boost fibroblasts, which increases the production of important substances like glycosaminoglycans and collagen, making wounds heal faster. [33].

Gallic acid

Gallic acid is a phenolic compound occurring naturally in plants, either as free or bound form. Gallic acid apparently possesses several potential health benefits due to its antioxidant, anti-cancer, anti-inflammatory, and hepatoprotective properties. In metabolic processing within the body, gallic acid gets oxidized to 4-O-methylgallic acid, the most significant metabolite product, along with other products such as 3-O-methylgallic acid and pyrogallol. Glucocorticoids are potent medications used to minimize the inflammation caused by a wide array of stimulants; their mode of action is by attachment to certain receptors in the body, which then take over control of the activity of some genes. Gallic acid and its related metabolites have also shown attachment to these receptors, hence helping to reduce the inflammation. [34].



Antiviral activity:

he fruits of Terminalia chebula contain four substances that can inhibit HIV-1 integrase: gallic acid and three types of galloyl glucoses. The galloyl part of these substances is crucial for blocking the HIV-1 integrase enzyme [35]. Terminalia chebula also has activity against retroviral reverse transcriptase [36] helps protect epithelial cells from the influenza A virus, and may aid in treating acute respiratory infections [37]. It has been shown to be effective against the herpes simplex virus in both lab tests and living organisms [38]. These results led Japanese researchers to explore its effects on human cytomegalovirus (CMV), finding that Terminalia chebula extract can inhibit CMV replication and help prevent CMV-related diseases in AIDS.

Cosmetic uses

Melanin inhibition

Kojic acid, a substance used to lighten skin, might cause cancer. So, it is better to use safer options like plant extracts from T. chebula for skin lightening in cosmetics. T. chebula extract is promising because it is both safe and effective. In tests, the methanol extract from T. chebula was able to reduce melanin by more than 90% at a concentration of 100 ppm [39].

Anti-inflammatory activity
Inflammation is a key part of the body's defence system, helping to protect us from harmful things. Anti-inflammatory agents stop certain processes that cause inflammation, reducing symptoms like redness, swelling, and pain. Scientists tested the anti-inflammatory effects of T. chebula using different methods. In one experiment, Bag et al. used a model where they caused inflammation in rats' paws and found that a 70% ethanol extract from T. chebula fruit was able to reduce inflammation by about 70%. [40].

Used as astringent:
The extract of T. chebula is used to help tighten tissues, aid digestion, prevent infection, improve overall health, relieve constipation, increase urine production, and reduce gas [41].

Cellular Aging Effect:
T. chebula and T. arjuna, which have a lot of phenolic compounds, are very good at fighting free radicals and slowing down aging [42]. The ethanol extract of T. chebula has been shown to significantly prevent cells from aging.

Dermatologic effects
Myrobalan can help improve pale skin, slow down the greying of hair, and acts as a hair-strengthening remedy when chewed. It is also effective in treating leprosy [43,44].

Safety evaluation:
Non-Toxic to Cells:
The active crude alcoholic extract of Terminalia chebula was tested for its effects on fresh sheep red blood cells and was found to be non-toxic to them. It also showed no toxic effects in the Allium test. These results indicate that Terminalia chebula does not harm cells [45].

Non-Damaging to DNA:
Terminalia chebula does not cause genetic damage, as shown by its results in both the VITOTOX test and the Ames test [46].

Marketed Formulation of Terminalia chebula:

Sr. no.	Product name	Methods
1	**Terminalia chebula cream [47]**	Water-in-oil emulsions were made by mixing heated paraffin oil (14%) and Abil® EM90 (5%) with T. chebula extract (5%). The mixture was stirred at 2,000 rpm for 15 minutes, then slowly at lower speeds until blended and cooled. A base emulsion was created without the extract.
2	**Haritaki Churna [48]**	A new HPLC method with diode array detection was developed to measure seven key compounds in Haritaki churna, including gallic acid. The analysis was done at 272 nm using a specific column and a triethyl amine-acetonitrile mixture. This method provided clear results and compared three samples (HC1, HC2, and HC3).
3	**Herbal gel for skin irritation [49]**	1 gram of Carbopol 940 was mixed with 50 ml of distilled water and left to swell for 30 minutes, then stirred to form a gel. A solution of methyl and propyl paraben was prepared, cooled, and combined with Propylene glycol 400 and Terminalia chebula extract, adjusting the total volume to 100 ml. This mixture was added to the Carbopol gel, and triethanolamine was used to adjust the pH to 6.8-7. A control sample was made without the extract.
4	**Terminalia chebula tablets [50]**	To extract compounds from Terminalia chebula leaves, 100 grams of powdered leaves were placed in a Soxhlet extractor. Ethanol was heated to 68°C and cycled through the leaves for three hours, evaporating, condensing, and dripping back onto the leaves. This process was repeated nine times.

[Table 1]

Formulation available in market:

Sr. no.	Company name	Product name	Use
1	True Botanicals	Chebula active serum	: This silky serum firms, plumps, and evens skin tone, maintaining a radiant and youthful appearance
2	Forest Essentials	Advanced eternal youth formula night cream	Anti-aging, nourishes & plumps skin.
3	Patanjali	Haritaki churna	Digestion.
4	Aaryanveda	Harad shampoo	Control hair loss & promote hair growth
5	USTRAA	Ayurvedic hair oil	Control dandruff, promote healthy scalp, long hair

[Table 2]

Conclusion

In conclusion, traditional plant-based medicines like Terminalia chebula have long been integral to various cultures due to their reputed healing properties. These ancient remedies have survived the test of time, demonstrating their significance in historical and contemporary healing practices. As modern medicine grapples with emerging challenges, including antibiotic resistance and the search for sustainable treatments, there is a renewed interest in exploring these traditional remedies. Research into plants like Terminalia chebula offers promising opportunities to uncover novel therapeutic compounds that could complement or enhance current medical treatments. By integrating traditional knowledge with modern scientific techniques, we have the potential to unlock new avenues for health and wellness. This approach not only respects the wisdom of ancient practices but also provides a pathway to innovative solutions in medicine, bridging the gap between historical efficacy and contemporary scientific validation. As the field progresses, ongoing research will be crucial in validating and optimizing these traditional medicines for modern healthcare applications.

REFERNCES

1) Boadu AA, Asase A. Documentation of herbal medicines used for the treatment and management of human diseases by some communities in southern Ghana. *Evidence-Based Complementary and Alternative Medicine*. **2017**;2017(1):3043061.
2) Bag A, Bhattacharyya SK, Chattopadhyay RR. The development of Terminalia chebula Retz.(Combretaceae) in clinical research. *Asian Pacific journal of tropical* b*iomedicine*. **2013** 1;3(3):244-52.
3) Chattopadhyay RR, Bhattacharyya SK. PHCOG REV: plant review. Terminalia chebula: An update. *Pharmacognosy Reviews*. **2007**;1(1):151-6.
4) Gupta PC. Biological and pharmacological properties of Terminalia chebula Retz.(Haritaki)-An overview. *Int J pharm Sci*. **2012**;4(3):62-8.
5) Srikanthmurthy KR. Bhavaprakasha of bhavamishr. Krishnanda Academy, Varanasi. **2000**;160.
6) Cao S, Brodie PJ, Callmander M, Randrianaivo R, Rakotobe E, Rasamison VE, Kingston DG. Saponins and a lignan derivative of Terminalia tropophylla from the Madagascar Dry Forest. *Phytochemistry*. **2010** 1;71(1):95-9.
7) Saleem A, Husheem M, Härkönen P, Pihlaja K. Inhibition of cancer cell growth by crude extract and the phenolics of Terminalia chebula retz. fruit. *Journal of Ethnopharmacology*. **2002** 1;81(3):327-36.
8) Lee HS, Koo YC, Suh HJ, Kim KY, Lee KW. Preventive effects of chebulic acid isolated from Terminalia chebula on advanced glycation endproduct-induced endothelial cell dysfunction. *Journal of Ethnopharmacology*. **2010** 5;131(3):567-74
9) Raju D, Ilango K, Chitra V, Ashish K. Evaluation of Anti-ulcer activity of methanolic extract of Terminalia chebula fruits in experimental rats. *Journal of Pharmaceutical Sciences and research.* **2009** 1;1(3):101
10) Aruna DS, Nandakishore DL. Haritaki a boon to herbalism-a review. *Scholars Acad. J. Biosci*. **2014**;2:132-.
11) Rathinamoorthy R, Thilagavathi G. Terminalia chebula-review on pharmacological and biochemical studies. *International Journal of PharmTech Research*. **2014**;6(1):97-116.
12) Srivastava RK. Approach grafting-a new approach for the formation of clonal bank of Terminalia chebula.**2000**
13) Asif M, Ahmed MW, Khair S, Murugeswaran R, Meena R, Alam M, Ansari SA, Tariq M, Negi RK. Pharmacognostical studies of Halela Siyah (Terminalia chebula Retz.): An important Unani medicinal plant. *Research Journal of Pharmacognosy and Phytochemistry.* **2019**;11(4):205-11.
14) Ashwini R, Gajalakshmi S, Mythili S, Sathiavelu A. Terminalia chebula-a pharmacological review. *J Pharm Res*. **2011**;4(9):2884-7.
15) Basha SJ, Code QR. A review on Terminalia chebula. IJPR. 2017;7(10).

16) Anu V, Akhila S, Kumar IA, Antony S. In-vitro antiurolithiatic activity of macerated aqueous extract of Terminalia chebula by using titrimetry method. *Int J Pharmacogn*. **2020**;7(6):144e7.
17) Parekh J, Chanda S. Evaluation of antimicrobial activity of Terminalia chebula Retz. Fruit in different solvents. *Journal of herbs, spices & medicinal plants*. **2008** 14;13(2):107-16.
18) Pellati F, Bruni R, Righi D, Grandini A, Tognolini M, Prencipe FP, Poli F, Benvenuti S, Del Rio D, Rossi D. Metabolite profiling of polyphenols in a Terminalia chebula Retzius ayurvedic decoction and evaluation of its chemopreventive activity. *Journal of Ethnopharmacology.* **2013** 20;147(2):277-85.
19) Amudan R, Kamat DV, Kamat SD. Amylase: Its application in the extraction of phytochemicals. *International Journal of Research in Biosciences* **(2016)**: 44-51.
20) Rathinamoorthy R, Thilagavathi G. Terminalia chebula-review on pharmacological and biochemical studies. *International Journal of PharmTech Research*. **2014**;6(1):97-116.
21)] Reddy DB, Reddy TC, Jyotsna G, Sharan S, Priya N, Lakshmipathi V, Reddanna P. Chebulagic acid, a COX–LOX dual inhibitor isolated from the fruits of Terminalia chebula Retz., induces apoptosis in COLO-205 cell line. *Journal of ethnopharmacology*. **2009** 30;124(3):506-12.
22) Akhtar H, Husain SZ. A descriptive review on traditional herbal drug-terminalia chebula. *Journal of Advanced Research in Biochemistry and Pharmacology*. **2019** 1;2(1):21-8.
23) Nadkarni K, Nadkarni AK. Indian Materia Medica, *Popular Prakashan Pvt. Ltd*., Bombay. **1976**; 1:799
24) Kumar JK, Sinha AK. Resurgence of natural colourants: a holistic view. *Natural product research*. **2004** 1;18(1):59-84.
25) Sharma P, Prakash T, Kotresha D, Ansari MA, Sahrm UR, Kumar B, Debnath J, Goli D. Antiulcerogenic activity of Terminalia chebula fruit in experimentally induced ulcer in rats. *Pharmaceutical Biology.* **2011** 1;49(3):262-8.
26) RAI AK, Joshi R. Evaluation of antimicrobial properties of fruit extracts of Terminalia chebula against dental caries pathogens **.(2009**): 105-111.
27)] Chemat F, Abert Vian M, Ravi HK, Khadhraoui B, Hilali S, Perino S, Fabiano Tixier AS. Review of alternative solvents for green extraction of food and natural products: Panorama, principles, applications and prospects. Molecules. **2019** 19;24(16):3007.
28) Yang MH, Ali Z, Khan IA, Khan SI. Anti-inflammatory activity of constituents isolated from Terminalia chebula. *Natural product communications.* **2014**;9(7):1934578X1400900721.
29) Malekzadeh F, Ehsanifar H, Shahamat M, Levin M, Colwell RR, Antibacterial activity of black myrobalan (Terminalia chebula Retz) against Helicobacter pylori, *International Journal of Antimicrobial Agents*,18, **2001**, 85–88.
30) Shahidi Bonjar GH, Antibacterial screening of plants used in Iranian folkloric medicine, Fitoterapia, 75**, 2004**, 231–235.
31) Iqbal Ahmad, Zafar Mehmood, Faiz Mohammad, Screening of some Indian medicinal plants for theirantimicrobial properties, *Journal of Ethnopharmacology*,62, **1998**,183- 193.
32) Bhattacharya S, Kamat JP, Bandyopadhyay SK, Chattopadhyay S. Comparative inhibitory properties of some Indian medicinal plant extracts against photosensitization-induced lipid damage. *Food chemistry*. **2009** 15;113(4):975-9.
33) Sawant R, Binorkar SV, Bhoyar M, Gangasagre NS. Phyto-constituents Bio-efficacy and Phyto-pharmacological activities of Terminalia chebula-A Review. *Int. J. Ayu. Alt. Med*. **2013**;1(1):1-1.
34) Feng-lin H, Li-ming Y, Shwu-fen C, Li-hsuan W, Chung-yi W, Pan-chun L, Shwu-jian L. Biotransformation of gallic acid by Beauvenia sulfurescens. *Appl Microbiol Biotechnol.* **2007**; 74:659-6.
35) Jeong AHN, Kim CY, Lee JS, Kim TG, Kim SH, Lee CK. Inhibition of HIV-1 integrase by galloyl glucoses from Terminalia chebula and flovonol glycoside gallates from Euphorbia pekinensis. *Plant Med.* **2002**;68(5):457-9.
36) Lee D, Boo K, Woo J, Duan F, Lee K, Kwon T. Anti-bacterial and Anti-viral activities of extracts from Terminalia chebula barks. *J Korean Soc Appl Biol Chem*. **2011**;52(2):295-8.
37) Badmaev V, Nowakowski M. Protection of epithelial cells against influenza A virus by plant derived biological response modifier Ledretan-96. *Phytother Res*. **2000**;44(4):245-9.
38) Kurowa M, Nagasaka K, Hirabayashi T, Uyama S, Sato H, Kagiyama T. Efficacy of traditional herbal medicines in combination with acyclovir against Herpes Simplex Virus-1 infection in vitro and in vivo. *Anti-viral Res*. **1995;**27(1-2):19
39) JIN YZ, LI GH, AHN SY, ROW KH, KIM EK. Extraction and purification of depigmenting agents from Chinese plants. *Chemical Research in Chinese Universities. **2006** 1;22(2):162-7.*
40) Bag A, Chattopadhyay RR. Efflux-pump inhibitory activity of a gallotannin from Terminalia chebula fruit against multidrug-resistant uropathogenic Escherichia coli. *Natural product research*. **2014** 18;28(16):1280-3.
41) Wadkar HS, Pinjari RM. The morphology, extractions, chemical constituents and uses of Terminalia chebula: A review. *International Journal of Forest, Animal and Fisheries Research*. **2023**;6(29):4772-5.
42) Afshari AR, Sadeghnia HR, Mollazadeh H. A review on potential mechanisms of Terminalia chebula in Alzheimer's disease. *Advances in Pharmacological and Pharmaceutical Sciences.* **2016;**2016(1):8964849.

43) Jokar A, Masoomi F, Sadeghpour O, Nassiri-Toosi M, Hamedi S. Potential therapeutic applications for Terminalia chebula in Iranian traditional medicine. *Journal of Traditional Chinese Medicine*. **2016** 1;36(2):250-4.
44) Chaghmini M. Little canon in medicine (Ghanoonche). *Tehran: Iran University of Medical Sciences.* **2004**:81-90.
45) Arora S, Brits E, Kaur S, Kaur K, Sohi RS, Kumar S, Verschaeve L. Evaluation of genotoxicity of medicinal plant extracts by the comet and VITOTOX® tests. *Journal of Environmental Pathology, Toxicology and Oncology*. **2005**;24(3).
46) Rathore HS. A study on the cytological effects of Myrobalan (fruit of Terminalia chebula) in Allium tests. *Ethnobotanical Leaflets*. **2006**;2006(1):9.
47) Akhtar N, Khan AB, Muhammad S, Ahmed M, Khan HM, Rasool F, Saeed T. Formulation and characterization of a cream containing terminalia chebula extract. *Forschende Komplementärmedizin/Research in Complementary Medicine*. **2012**;19(1):20-5.
48) Garg S, Mishra A, Gupta R. Fingerprint profile of selected ayurvedic churnas/preparations: An overview. *Altern Integr Med*. **2013** 28;2(06):1.
49) Bhramaramba R, Babu IS, Deepthi CD. Formulation and evaluation of herbal gel containing Terminalia chebula Retz., leaves extract. (**2015**): 172-176.
50) Suruse PB, Gawali MB, Kalkotwar RS, Bhabad RB, Bagdane SB, Barde LG. Design, Development and Optimization of Buccal Tablet Containing Extract of Terminalia chebula Retz. for the Treatment of Asthma. *Ind. J. Pharm. Edu. Res*. **2023**;57(4):993-1001.