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# A COMPREHENSIVE BIOLOGICAL, ETHNO- PHARMACOLOGICAL and PHYTOCHEMICAL UPDATE REVIEW ON AYURVEDIC PLANT OF *TERMINALIA CHEBULA* (HORTOKI) OF BANGLADESH

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## ABSTRACT

In the new era of Biotechnology, modern medicine system is so so advanced but still now, some of the common diseases are successfully and easily treated with the ayurvedic or herbal medicinal treatment; which is a major and important part of the modern treatment system. *Terminalia chebula* is termed the "king of medicine" in the ayurvedic land of science (medicinal harbal science), due to its huge quantity of pharmacological, biological and phytochemical rich constituents. HORTOKI is the Bengali term of this plant. The demand for herbal therapeutics is now increasing in modern biological science gradually worldwide. *Terminalia chebula* is one of the most commonly used plants in traditional systems of medicine in Bangladesh. It is a mild, safe and effective laxative in traditional medicine. It is reported to contain various pharmacological activities including antioxidant, antidiabetic, antibacterial, antiviral, antifungal, anticancerous, antiulcer, antimutagenic, wound healing, immunomodulatory, cardioprotective effect, anti-aging, cytoprotective and hepatoprotective activities. It has been reported to contain various biochemical constituents including tannins, chebulinic acid, ellagic acid, gallic acid, punicalagin and flavonoids. Several pharmacological investigations for different biological activities of *Terminalia chebula* in various in vivo and in vitro test models have been carried

out based on the presence of biochemical ingredients and pharmacological findings. This update review gives a bird's eye view on the biological and ethno- pharmacological properties of various phytoconstituents and the biological uses of *Terminalia chebula (*HORTOKI) to enrich our knowledge about this plant.

**KEYWORDS:** *Terminalia chebula*, Pharmacological studies, Phytoconstituents, King of medicine, chebulinic acid, antimutagenic, antidiabetic.

## 1. INTRODUCTION

*Terminalia chebula* ((HORTOKI) is a moderate tree used in traditional ayurvedic medicinal uses. it is a popular traditional medicine not only used in Bangladesh but also in other countries of Asia and Africa. This is used in ayurvedic medicine due to the wide spectrum of pharmacological, phytochemical and biological activities associated with the biologically active chemical compounds present in this plant.[15] It is used for the treatment of number of diseases like cancer, paralysis, cardio vascular diseases, ulcers, leprosy, arthritis and gout etc. It has been reported as antioxidant[1], antidiabetic[2], antiviral [3], antiulcerogenic[4], antinociceptive[5],hepatoprotective [6], antibacterial[7], antimutagenic[8], immunomodulatory[9], cardioprotective[10], anticancer[11], antifungal[12] radioprotective[13] activities etc. In developing countries more than 80% peoples are dependent on medicinal plants which were estimated by world health organization (WHO).[14] It is a well known fact that the demand for the ayurvedic drug treatment of various ailments is increasing day by day and plant drugs from the ayurvedic system are being explored more, not only in Bangladesh but also globally around the world. As a result, many research studies and findings are being undertaken and there is a need for an update and to put them together.That's why in this article an attempt has taken to recapitulate available pharmacological, phytochemical and biological studies for *Terminalia chebula.*This gives a wide knowledge about the ayurvedic plants and their importance in personal healthcare and hygiene products. It is considered a valuable source of unique natural products for development of drugs against various diseases and also for the development of industrial products.[16] It is good to increase the appetite, as digestive aid liver stimulant, as stomachic, as gastrointestinal prokinetic agent and mild laxative. It is stimulates the liver and perform by protecting expelling the waste excretory products from the intestines. It increases the frequency of stools, prevent aging, and provide immunity and body resistance against disease form.[17] Active phytochemical constituents contain the triterpenes glucoside 1, arjungenin and the chebulosides 1&2. Other constituents contains tannins up to

30%, chebulic acid 3-5%, chebulinic acid 30%, tannic acid 20-40%, ellagic acid, 2,4-chebulyi–β-D-glucopyranose, gallic acid, ethyl gallate, punicalaginterflavin A, terchebin, anthraquinone , flavonoids like luteolin, rutins, and quercetin.[18, 19,20] This phytochemical constituent's act as a various immunomodulatory functions in the human body with medicinal treatments.

## 2. TAXONOMY

Scientific name: *Terminalia chebula*

Bengali name: HORTOKI

**Botanical description**

Kingdom: Plantae

Division: Magnoliophyta

Class: Magnoliopsida

Order: Myrtales

Family: Combretaceae

Genus: Terminalia

Species: chebula

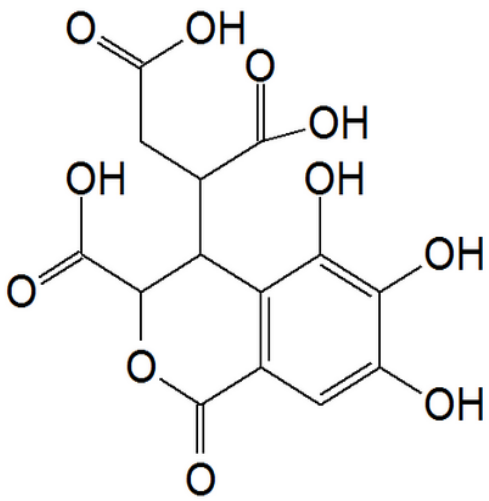
### 2.1 Botanical Description

The botanical description of *terminalia chebula* contains, it is a medium-sized, deciduous tree up to 25m tall, 60-80cm in diameter, crown rounded, spreading branches, dark brown branches with woody scales; leaves are thin- coriaceous, ovate, rounded at base, petiole up to 2cm long, 5-7cm long spikes flowers, 5 lobed calyx, absent corolla, 10 stamens, celled-1, ellipsoid drupe fruit, yellow to orange-brown when ripe.[21-24]

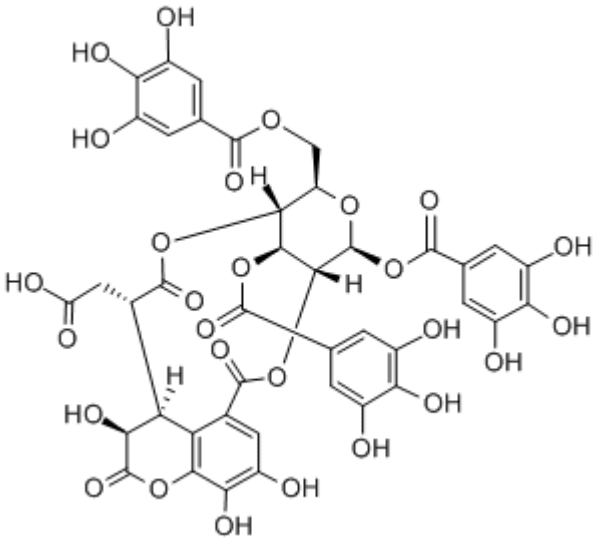
### 2.2 Phytochemistry of *Terminalia chebula*

Biologically active phytochemical constituents are includes chebulic acid[25], chebulinic acid[26], ellagic acid[27], gallic acid[27], chebulagic acid[28],1,6 di-*O*-galloyl-β-D-glucose, 3,4,6 tri-*O*-galloyl-β-D-glucose, 2,3,4,6 tetra-*O*-galloyl-β-D-glucose, 1,2,3,4,6 penta-*O* galloyl-β-D-glucose, ellagitanin contains punacalagin, casurarinin, corilagin, terchebulin, chebulanin, neochebulinic acid, chebulagic acid and phenolic compounds.[30,31,32] High phenolic content, especially hydrolyzable tannins, anthraquinone, flavonol, carbohydrates, glucose and sorbitol[29], with pharmacological studies from reverse phase chromatography there are some valuable active phytoconstituents has been reported including gallic acid, methyl gallate,

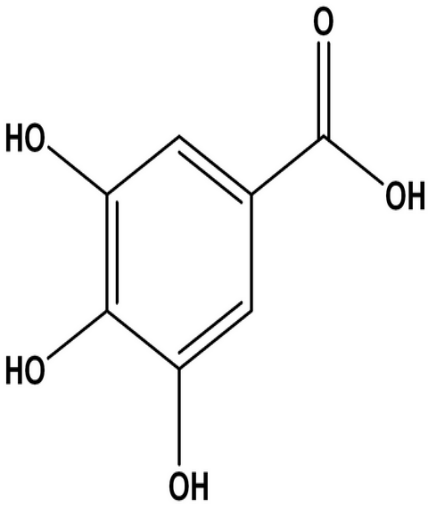
ethyl gallate, chebulagic acid, tetra-*O*-galloyl-*β*-D-glucose, ellagic acid, chebulinic acid and penta-*O* galloyl-*β*-D-glucose.[33] It also contains nutrients such as vitamin C, protein, amino acids and minerals.[34]



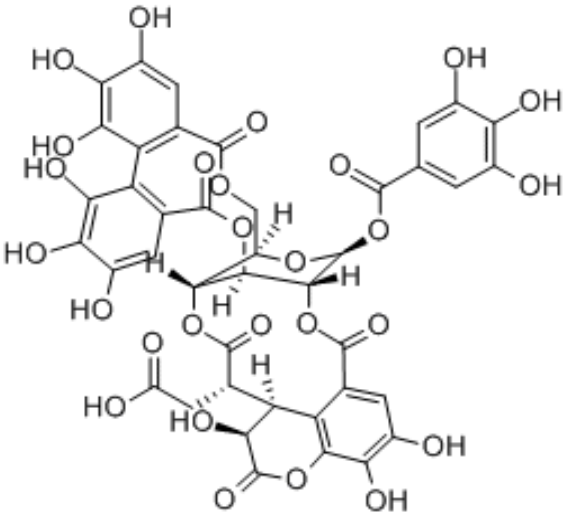
**Chebulic acid**



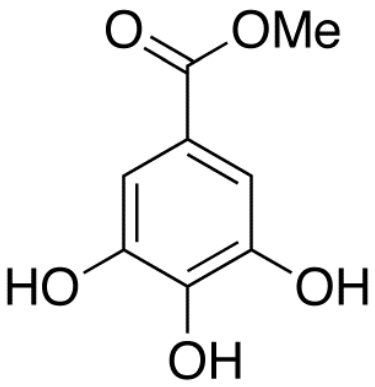
**Chebulinic acid**



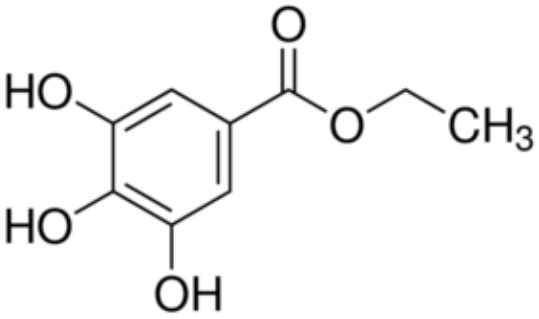
**Gallic acid**



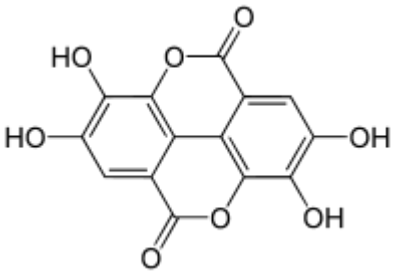
**Chebulagic acid**



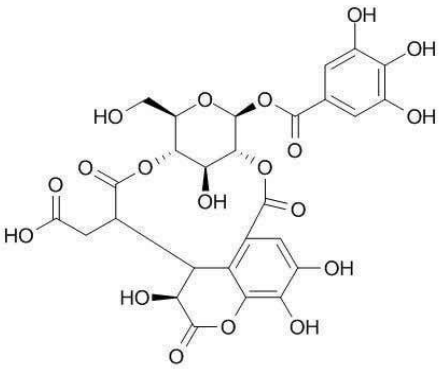
**Methyl gallate**



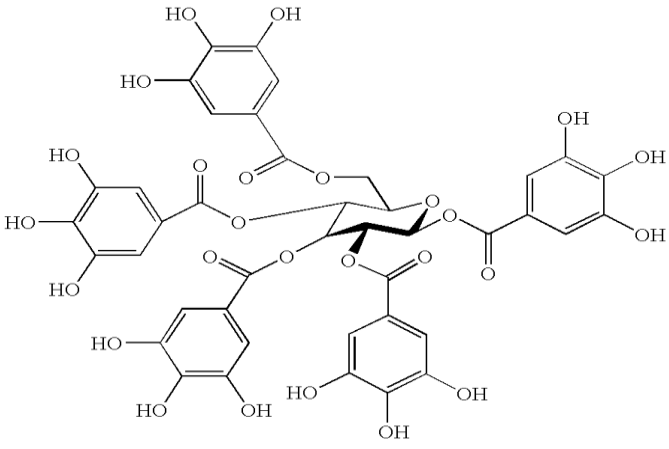
**Ethyl gallate**



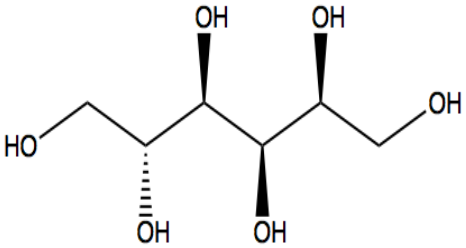
**Ellagic acid**



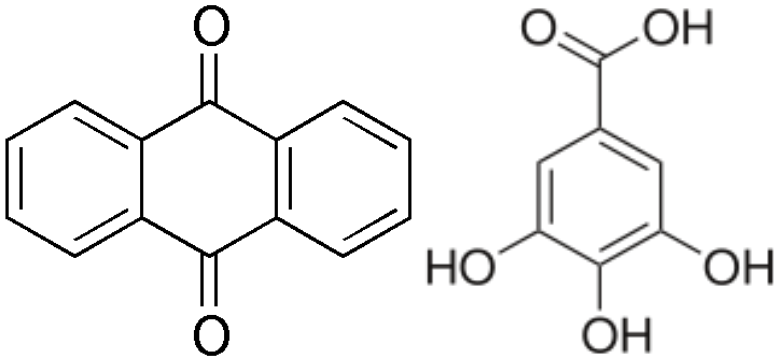
**Chebulanin**



**Penta-O-galloyl-β-D-glucose**



**Sorbitol**




**Anthraquinone** **Tannins**

**Figure1: phytochemical constituents of *Terminalia chebula***

**Table 1: pharmacological studies of *Terminalia chebula***

| Serial | Pharmacological activity | Phytochemical compounds | Mode of Extraction | Organism | References |
|---|---|---|---|---|---|
| 1 | Anticancer | Chebulic acid | Methanol extract | *Salmonella typhi* | [7,25] |
| 2 | Antibacterial | Gallic acid | Ethanol extract, Ether, alcoholic, water extract | *Salmonella typhi*, *Staphylococcus aureus*,*Helicobacter pylori*, *Bacillus subtilis* etc. | [37,38,39,64] |
| 3 | Anticaries | chebulinic acid | Aqueous extract | *Streptococcus mutans* | [37,26, 40] |
| 4 | Anticonvulsant | ellagic acid | Ethanolic, chloroform, Petroleumether aqueous Extract | Rats | [37,27, 41] |
| 5 | Antidiabetic | chebulagic acid | Chloroform extract, Ethanol extract | Streptozotocin induced Diabetic rats, Adult albino male rats | [28,37,42,43] |
| 6 | Antifungal | 1,6 di-*O*-galloyl-β-D-glucose | Aqueous, alcoholic, Ethyl acetate extract, 70%of methanol, Ethylacetate, hexane, Chloroform Extract | *Aspergillus niger*, *Aspergillus flavus*, | [30,37,44,45] |
| 7 | Antimutagenic | penta-*O* galloyl-*β*-D-glucose | Acetone,aqueous chloroform extract Chloroform, aqueous Extract | *Salmonella typhimurium* | [33,37,46,47] |
| 8 | Antioxidant | Sorbitol | Water, methanol & 95% of ethanol extract | Fermented products Adult male albino rats | [29,37,48,49] |
| 9 | Antiulcer | Anthraquinone | Methanolic extract | Wistar albino male rats | [29,37,50] |

| | | | | | |
|---|---|---|---|---|---|
| 10 | Antiviral | Chebulanin | Acetone extract, Aqueous extract | Swine influenza A virus, Hepatitis B virus | [30,37,51,52] |
| 11 | Cardio protective | phenolic compounds | 95% of ethanol extract | Adult albino male rats | [30,31,37,53] |
| 12 | Cytotoxic | chebulagic acid and | Acetone extract | Cancer cell lines | [31,32,37,54] |
| 13 | Immunodulatory | neochebulinic acid | Alcohol extract | Male wistar rats | [31,32,37,55] |
| 14 | Radioprotective | Punacalagin | Aqueous extract | Rats | [32,37,56] |
| 15 | Wound healing | Casurarinin | Hydroalcoholic extract, 90% of ethanol extract | Induced diabetic rats, Wistar albino rats | 31,[37,57,58] |
| 16 | Dermal Wounds | Corilagin | Dry powder mixed With water | Rabbit | [30,32,59,60] |
| 17 | Anti-hyperglycemic Effect | Terchebulin | Water extract of dry fruits | Diabetic rats | [32,59,61] |
| 18 | Anticlastogenic Effect | | Methanolic Extracts | Mouse bone marrow cells | [59,62] |
| 19 | Typhoid Fever | | Aqueous extract | | [59,63] |
| 20 | Antiplasmodial activity | | Acetone seed extract | | [64] |
| 21 | Inhibits free radical induced hemolysis | | Aqueous extract | | [65] |
| 22 | Xanthine/xanthine oxidase inhibition, 2,2-diphenyl-1-picrylhydrazyl (DPPH) radicals scavenging acitivity | | Aqueous extract | | [66] |
| 23 | Stronger antioxidant activity than alpha | | Acetone extract | | [67] |
| 24 | Gastrointestinal motility improving, Increase gastric emptying time, Protection against duodenal ulcer | | Fruit extract | | [68], [69] |
| 25 | Anti-oxidative and membrane stabilizing activities | | (95% ethanolic extract | | [70] |
| 26 | Reduces irradiation effects, Breaks Gamma radiation induced strand in | | Aqueous extract) | Mice | [71], [72] |

| | | | | | |
|---|---|---|---|---|---|
| | plasmid PBR322 DNA | | | | |
| 27 | Renoprotective activity,<br><br>Reduction in blood glucose | | Fruit, seed | Rats | [73], [74] |
| 28 | Hypocholesterolemi c acivity,<br><br>Induced atherosclerosis | | Aqueous extract | | [75], [76] |
| 29 | Cytoprotective activity,<br><br>Development of duodenal ulcers,<br><br>Inhibitory effect on cellular aging | | | | [77], [78] |
| 30 | Free radical scavenging activity,<br><br>Inhibited oxidative stress | | Ethanol extract | | [79] |
| 31 | Anti-microbial activity | | Methanol extract | | [80] |
| 32 | Radio Protecting Ability and Phytochemical analysis | | Aqueous extract | | [81] |
| 33 | Antinociceptive activity | | Petroleum ether (PE), chloroform (CH), ethanol (ETH) and water Extracts | | [82] |
| 34 | The Molluscicida L activity | | Ethanolic extract | | [83] |
| 35 | Spasmogenic Activity | | Aqueous extract | | [84] |
| 36 | Hepatoprotective Activity | | Leaf powder Mixed with 1% Gum accai Suapension | | [85] |
| 37 | Inhibition of HIV 1 Integrase | | Hot water Extract | | [86] |
| 38 | Antidiabetic And renoprotective | | Chloroform Extract | | [87] |

| | | | | | |
|---|---|---|---|---|---|
| 39 | Biochemical Studies | | Ethanol extract | | [88] |
| 40 | Hepatocellular carcinoma | | Aqueous extract | | [89] |
| 41 | Anti lithiatic Activity | | Aqueous extract | | [90] |
| 42 | Anti-aging Activities | | Methanol extract | | [91] |
| 43 | Potent Sources of natural antioxidant. | | Methanol extract | | [92] |
| 44 | Using DPPH, deoxyribose, reducing power, chelating power | | Hexane extracts | | [93] |
| 45 | Exhibit antioxidant activity at different magnitude of potency | | Warm water Extract | | [94] |
| 46 | Improves glucose tolerance and brings down Fasting blood Glucose in | | Water extract of Dry fruits | Rats | [95] |
| 47 | Against multi drug resistant diabetic foot ulcer isolates. | | Methanol, Isopropanol, Chloroform, Diethyl ether and Hexane | | [96] |
| 48 | Against gram-positive Bacteria than against gram-negative bacteria. | | Aqueous extracts | | [97] |
| 49 | Potential bactericidal Activity. | | Methanol, Ethanol, ethyl Acetate water and Chloroform extract Of leaf | | [98] |
| 50 | The antibacterial activity | | Ethanol extract | *Salmonella typhi, Staphylococcus aureus, Bacillus subtilis* Etc. | [99] |
| 51 | Alkaloids from all plant Parts showed good antimicrobial activity | | Alkaloids Extracted from Different parts (leaf, stem, stem Bark, and fruits) | | [100] |
| 52 | Potential bactericidal and | | Methanol and Aqueous extracts | | [101] |

| | | | | | |
|---|---|---|---|---|---|
| | potent Antioxidant | | | | |
| 53 | Significant response in wound Types | | Ethanolic extract | | [102] |
| 54 | Dry powder mixed With water | | Significant improvement On Maturation | Rabbit | [103] |
| 55 | Powerful anti-bacterial and angiogenic Activity | | Extracted with Warm water | | [104] |
| 56 | Acceleration of the Healing process | | Alcoholic extract Of the leaves | | [105] |
| 57 | Performed against common pathogenic bacterial and fungal strains | | Crude ethyl Acetate and ether Extract | *Staphylococcus aureus*, *proteus vulgaris* and *Escherichia coli* | [106] |

**2.3 pharmacological and biological uses**

*Terminalia chebula* is called "The king of medicines" because of its high content of alkaloids, secondary metabolites, flavonoids and the astonishing power of healing with a wide range of biological and pharmacological uses.[16] Important biological uses by this plant includes antibacterial, antifungal, antiviral, antimutagenic, adaptogenic, anti-anaphylacatic, hypocholesterolemic, gastrointestinal motility improving, anti-ulcerogenic, hepatoprotective, cardioprotective, radioprotective, antidiabetic and retinoprotective, antispasmodic, wound healing, purgative, immunomodulatory and chemopreventive activities.[16] Gallic acid acts as an anti-inflammatory response binding with receptors.[35] It is used as a blood purifier.[36] Several pharmacological investigations for different biological activities of *Terminalia chebula* in various in vivo and in vitro test models have been carried out based on the presence of chemical ingredients. A summary of the findings of some of these pharmacological studies is presented below in Table 1.

**CONCLUSION**

We are now living in a modern era as a result medical science are developing day by day inspite of this a large segment of the world population still now depends on the plants origin medicine. T*erminalia chebula* is one of the world most valuable ayurvedic plants having a wide variety of pharmacological and medical activities. From the ancient time, plants have been widely used as curative agents for variety of ailments. *Terminalia chebula* serves as a great source of a variety of biologically active phytoconstituents as for example chebulic acid, chebulinic acid, gallic acid, chebulagic acid and other related compounds that

compounds are result to antimicrobial, antitoxidant, antihyperglycemic, anticancer, and protective effects on various vital organs those are includes nervous, heart, kidney, liver. To treat a large number variety of health problems *Terminalia chebula* plant is generally used.By showing the biodiversity of both nutritional as well as medicinal components *Terminalia chebula* is known as the root of medicine. Day by day the investigation on medicinal plants are rising so fast as a result herbal products are becoming safe and effective to the people . We wish this work will help to create awareness about medicinal plant research and their future possibility.

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