The Vayasthapan Karma (Age Sustaining Action) Of Haritaki (Terminalia Chebula Retz.)- A Review

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Abstract
Ageing is a natural ongoing process of unfavourable progressive changes correlated with deterioration in vitality and ending in death. Haritaki (Terminalia chebula Retz.) belonging to the family Combretaceae is the main herb used in Ayurvedic system of medicine since ages. The chapter 4 of Charak Samhita Sutrasthan deals with 50 different groups of 10 herbs with common action. The last of these groups is Vayasthapan Mahakashay i.e. the plants that prevent aging process and maintain the youth. One of the constituents of this group is Abhaya i.e. Haritaki which has an immense therapeutic significance. The plant is also documented to possess beneficial effects such as Rasayana (rejuvenating), Medhya (brain tonic) and Deepan (appetizer). It is very effective in the treatment of various ailments. By the virtues of Agnideepan (stimulating Agni), Aampachan(digesting Aam) and Srotas-shodhana i.e. cleaning the channels by detoxifying the metabolic waste, it supports the nourishment of Dhatus and mind as well as boosts energy. It performs the functions of Dhatwagnideepan in addition to Dhatwagniposhan and helps to improve physical and mental health. It prevents degeneration, extends youth and delays aging or rather reverse the aging process. Following various claims for management of several diseases, efforts have been made by researchers to validate the efficiency of this plant regarding anti-aging potential through scientific biological screening. A analysis of literature in this regard exposed distinguished pharmacological activities of Haritaki like Anti-oxidant, Free radical-scavenging, Cyto-protective, Immuno-modulatory, Anti-mutagenic, Anti-carcinogenic, Radio-protective, Chemo-preventive, Chemo-modulatory, Cardio-protective, Hepato-protective, Nephro-protective, Adaptogenic, Anti-bacterial, Anti-amoebic, Anti-protozoal, Anti-fungal, Anti-viral, Anti-inflammatory and Anti-allergic activity. Its chemical investigation has also shown the presence of important medicinal virtues. The present attempt is to emphasize data about Ayurvedic aspect and phytochemical and relevant pharmacological study for justification of Anti-aging property of Haritaki. The interpretation of phyto-chemical and pharmacological study of this plant confirms the submissions made in the Ayurvedic classics about its Vayasthapan i.e. age sustaining action. The future research on the basis of this compiled information with the use of radiotracers and nuclear imaging techniques to know the action of this marvel drug at the molecular level can pinpoint unexplored potential of it for the treatment of degenerative disorders and give a key for the existing problem of premature aging.

Key words: Vayasthapan, Mahakashay, Haritaki, anti-aging

Introduction
Living long healthy youthful lifespan is a cherished wish of an every individual. Our natural health, happiness and internal sense of comfort are cloaked by the accumulation of impurities due to sedentary lifestyle, stressful mental conditions, excess use of pesticides, chemicals, preservatives and augmented use immunosuppressive drugs. These impurities or toxins lead to deterioration of normal body functioning and which affects the quality of life as well as lifespan. Ayurveda stands as an answer to solve this issue and provide healthful longevity including mental development and resistance against diseases. Ayurveda and other ancient Indian literature describe the use of plants in prevention and treatment of diseases of mankind since the time immemorial. Plants are used in traditional herbal medicines, which are being acknowledged in today’s society as an important source of health due to their wide range of benefits including low cost of production, higher safety margins, non-toxic property and minimal risk of side effects.1,2 An inevitable physiological process in which the progressive losses of biological functions occur along with declining fertility and rising mortality with advancing age is called aging. Ayurveda mentions herbs that are believed to detoxify the body and mind; restore health; prevent degeneration and postpone aging or rather reverse the
aging process. And one of them is Haritaki (Terminalia chebula Retz., Family: Combretaceae) which possesses a great therapeutic value. It is used in traditional medicine due to the wide spectrum of pharmacological activities associated with the biological active chemicals present in this plant. It is one of the constituents of numerous Ayurvedic formulations like Triphala churna, Abhayarishta, Pathyadi Kwath, Chitrakharitaki avleha, Agastharitaki avleha etc. which are used in day to day practise.

According to Ayurveda there are three parts of the lifespan of a person called as Vaya. They include Balavastha (childhood), which lasts up to the age of 16 years and Kapha is the predominant Dosha during this period which is responsible for growth and development; Madhyavastha (young and middle age), which lasts from the age of 16 years to 60–70 years and is governed by Pitta Dosha which is accountable for the vigour and vitality of youth.; and Vriddhavastha or Jirnavastha (old age), which is the period after 60 or 70 years and Vata is the predominant Dosha during this phase of life and which is responsible for most of the manifestations of aging. This process of aging generally begins at the age of about 60 years and progress gradually and the effects are fairly noticeable at the age of 70 years. Natural Aging (Kalaja) occurs at or after the age i.e. 60 years but premature Aging (Akalaja) occurs before 60 years of age. The improper food and life habits lead to premature ageing. The process of aging leads to the progressive physiological changes in physical health such as deterioration in functions of body tissues (Dhatu), senses (Indriya), strength (Bala), virility (Virya), digestion and metabolism (Agni), and enthusiasm (Utsaha) together with wrinkled skin (Vali), grey hair (Paliya) and baldness (Khalita); attack of various diseases like cough (Kasa), dyspnoea (Shwas), tremors (Vepathu) and unable to carry out work. The physiological changes in mental health comprise decline in mental functions like perception (Grahan), retention (Dharana), retrieval abilities (Smarana), speech (Vachana) and general knowledge (Vigyana).

According to modern scientist aging is unavoidable and every living organism has a finite life span. Ageing in individuals is affected to a greater extent by several factors like genetic factors, diet, social and environmental factors, the occurrence of age related disorders etc. Kanungo (1960) has described the causative factors of aging viz. Biological (decline of function of various organs), Medicinal (due to different types of diseases especially after 60 years) and Psychosocial. Biologically aging begins after the age of 21–22 years. After attainment of adulthood, the process of decline in functions of various organs are begins. Fallia (1958) has explained Somatic mutation theory in late fifties. Many theories have been stated related to ageing. Only a few could provide possible mechanisms of ageing. But, the most popular theory is 'Theory of free radicals' put forth by Dr. Denham Harmen which is still considered all over the world. According to Harmen D (1971) and Pacific RE and Davis K J A (1991) during biological reaction generally there is formation of free radicals like super oxide, hydroxyl ion etc. leading to progressive damage to macromolecules, protein and DNA and it is the primary cause of aging. For occurrence of lots of chronic and degenerative diseases like atherosclerosis, ischemic heart disease, cancer, diabetes mellitus, neurodegenerative diseases and ageing; oxidative stress caused by reactive oxygen species plays a vital role.

The Vayasthapans drugs are those drugs which maintain the youth phase and hold-up the process of aging. Aacharya Sushruta mentions that Rasayana (rejuvenating) is Vayasthapan (sustains youth), gives long life, intellect and strength and also eliminates diseases. Aacharya Gangadhar states that Vayasthapan drugs stabilize youth, the supreme part of the age by their Prabhav (specific action of a drug). According to Aacharya Dalhana Vayasthapan drugs aid to live healthy life irrespective of its span. In the chapter 4 of Charak Samhita Sutrasthan, Aacharya Charak has specified and described 50 Mahakashay with 10 herbal drugs in each group with common action to combat the particular disease or disorder or help contribute to positive health. Likewise there is a mention of the last group, named Vayasthapan Mahakashay i.e. group of herbs having age-sustaining action which include the plants like Dhatri (Emblica officinalis Gaertn), Amrta (Tinospora cordifolia (Willd) Miers ex Hook & Thems), Atirasas (Asparagus racemosus Willd), Punarnava (Boerhaavia diffusa Linn) etc. Haritaki (Abhaya i.e. Terminalia chebula Retz.) is the second plant of this group. It is a well known Rasayana which prevents ageing and imparts longevity, immunity and body resistance against diseases. It is an endeavour on the part of this review paper to highlight not only an overall out line of Haritaki used in Ayurvedic drug scenario but also the recent as well as previously published information on phyto-chemical, toxicological and pharmacological actions of this amazing drug for validation of anti-aging property of Haritaki. The aim of this review is to promote further scientific researches to understand potential image of Haritaki as anti-aging drug because of its multi-dimensional therapeutic effect. The traditional knowledge with its unique and holistic approach supported by scientific experimental base can serve as an innovative and potent discovery engine for newer, safer drug.
The relevant data regarding Haritaki’s Ayurvedic aspect from Ayurvedic Samhitas and Nighantus was obtained. Thorough review about the research work done by scholars on its phyto-chemical, toxicological and pharmacological actions were taken from various text-books, research journals and by surfing internet. All the compiled information was documented and critically analyzed for the discussion and attempt has been made to draw some fruitful conclusion.

**Relevant Ayurvedic data**

‘Abhayamalakiyarasayanapada’ is the very first quartet of first chapter of Cikitsasthan of Carakasamhita where the term Abhaya denotes Haritaki. In Bhavprakash Nighantu (Ayurvedic material medica) Haritaki is listed first because of its therapeutic significance. *T. chebula* is called as the ‘King of Medicine’ in Tibet.

It has several common names such as Black Myrobalan, Ink tree or Chebulic Myrobalan (English), Haritaki (Sanskrit and Bengali), Harad (Hindi), Harada (Marathi and Gujarati), Karkchettu (Telugu) and Kadukkaya (Tamil). Haritaki denotes ‘a fruit having dark greenish yellow colour, which drives away diseases’ or it is sacred to God Siva (Hara). It is the best wholesome substance and safe for bodily passages (Haritaki pathyanaam).

Haritaki has several interesting synonyms like ‘Pathya’ (it removes obstructions from the pathways and channels in the body); ‘Abhaya’ (it gives fearlessness from diseases); ‘Avyatha’ (it cures pain); ‘Amruta’ (an ambrosia); ‘Divya’ (a divine herb); ‘Medhya’ (a brain tonic); ‘Pranada’ (life saving); ‘Jivanti’ (a vitalizing herb); ‘Vayastha’ (it promotes longevity and maintains youth); ‘Rasayanaphala’ (a rejuvenating fruit); ‘Kayastha’ (which provides strength to body); ‘Putana’ (eliminates waste); ‘Haimavati’ (as its variety grows on Himalayas); ‘Chetaki’ (helps to attain clear mind by cleansing channels); ‘Shreyasi’ (takes care of the person who ingests it) and ‘Shiva’ (provides all good things) etc. The mythological origin of the plant represents the immortal nature of therapeutic attributes in the human body.

*T. chebula* is a medium to large highly branched deciduous tree with a height up to 30 m and girth 1-1.5 m. It grows widely in India, Myanmar, Bangladesh, Iran, Egypt, Turkey, China etc. In India, it grows in deciduous forests of Himachal Pradesh, Tamil Nadu, Kerala, Karnataka, Uttar Pradesh, Andhra Pradesh and West Bengal and it is found throughout India up to an altitude of 1500 m. The best variety of dried fruit of *Haritaki* has smooth texture and it is bulky, heavy, dwarfs in water and weighs approximately 20 grams equivalent to two *Karsha*. This *Haritaki* viz. *Survari Haritaki* is considered as excellent for medicinal usage and should be used for *Rasayana* (rejuvenating) and *Vayasthapan* (age-sustaining) purpose.

The fruits of tree possess diverse health benefits and have been used as traditional medicines as house hold remedy. It is used extensively in several *Ayurvedic* formulations prescribed for infectious diseases such as chronic ulcers, leucorhoea, pyorrhoea and fungal infections of the skin. It is used as an ingredient of different formulations which are used in day to day practise for treating various disorders. It is used commonly in many *Ayurvedic* preparations as diuretic and cardiotonic. It is used to prevent aging and impart longevity, immunity. According to *Aacharya Vagbhata*, when *Haritaki* powder fried in ghee is regularly consumed with sufficient ghee during meals, it promotes longevity and boosts energy. *Aacharya Bhavaprakash* has mentioned its use in the treatment of lots of diseases like *Shwas* (Asthma), *Kasa* (Cough), *Prameha* (Diabetes), *Arsha* (Piles), *Kushtha* (Skin disorders), *Udar* (Ascitis), *Krimi* (Worms infestation), *Visarpa* (Herpes), *Jwara* (Fever), *Chhardi* (Vomiting), *Hridayog* (Cardiac diseases), *Kamala* (Jaundice), *Yakritvikar* (Liver disorders), *Ashmar* (Calculi) etc. He has also mentioned the beneficial effects of *Haritaki* on the health of eyes (*Chakshushya*), life (*Ayushya*) in addition to mental health (*Medhya*). Its *Rasayana* effect has been noted in many *Nighantus* viz. *Madanpal Nightntu*, *Raj Nighantu*, *Kaiyadev Nighantu*, *Bhavprakash Nighantu* and *Shaligram Nighantu*. For various medicinal purposes like laxative, carminative, astrigent, expectorant and tonic effects, fruit of this herb is widely used in Thai traditional medicine. It is routinely used as traditional medicine by tribes of Tamil Nadu to cure several ailments such as fever, cough, diarrhoea, gastroenteritis, skin diseases, candidiasis, urinary tract infection and wound infections. *Haritaki* is extensively prescribed in therapeutic as well as preventive use and process of restorative indication (*Rasayana karma*), and in *Ayurvedic* classics description about *Ritu Haritaki* occurs which gives guidelines regarding use of this drug during the phase of different seasons along with specific Anupan (advantageous vehicle drug) viz., *Varsha Rutu* (Rains)- *Saindhavalavana* (Rock salt), *Sharad Rutu* (Autumn)- *Sarkara* (sugar), *Hemanta* (Cold/winter)- *Shunthi* (Dry Ginger), *Sishira* (late winter /early
spring)- *Pippali* (long pepper), *Vasanta* (Spring)- *Madhu* (honey) and *Grishma* (Summer)- *Guda* (Jaggery) 30.

**The Rasapanchaka of Haritaki is as follows:**

**Rasa:** Kashay (predominant), Katu, Tikta, Amla, Madhura  
**Virya:** Ushna  
**Vipaka:** Madhur  
**Guna:** Ruksha, Laghu  
**Action on Doshas:** Tridoshashmaka (pacify to all the Doshas)

**Phytochemical properties**

*Haritaki* is recognized to possess a wide range of phyto-chemical constituents. *T. chebula* have a number of phytoconstituents like tannins, flavonoids, sterols, amino acids, fructose, resin, fixed oils etc. and it is fairly loaded with different tannins (approximately 32% tannin content). The chebulic acid, chebulinic acid, chebulagic acid, gallic acid, corilagin and ellagic acid are the chief components of tannin. 31 The studies showed that Phytochemicals such as anthraquinones, ethaedioic acid, sennoside, 4,2,4 chebulyl-d glucopyranose, terpinenes and terpinenols have also been present. 32, 33 Recent studies demonstrates that *T. chebula* contains more phenolics than any other plant.

**Toxicological studies on Haritaki:**

The herbs in the Ayurvedic materia medica have been established to be safe and effective, through many hundred to many thousand years of use. 34 The acute toxicity study of the 50% alcoholic extract 35, sub-chronic toxicity study of both powder and water extract 36, acute and chronic toxicity studies of water extract given orally 37 from dried fruits of *Haritaki* demonstrated no toxic effects in mice.

**Pharmacological actions**

**1. Anti-oxidant and Free radical-scavenging activity**

- *T. chebula* is an excellent anti-oxidant. It exhibited anti-lipid peroxidation, anti-superoxide radical formation and free radical-scavenging activities. 38, 39, 40, 41 In a study, 6 extracts and 4 pure compounds of *T. chebula* exhibited anti-lipid peroxidation, anti-superoxide radical formation and free radical-scavenging activities at different magnitudes of potency 39. The ethanolic extract of the fruits of *T. chebula* decreased the level of lipid peroxidase in albino rats 39. Both treatment and pretreatment of the cultured rat primary hepatocytes with *T. chebula* aqueous fruit extract (500 or 1000 mg/kg body weight for 5 days) significantly reversed the t-BHP-induced cell cyto-toxicity and lactate dehydrogenase leakage.

- In addition, *T. chebula* extract exhibited in vitro ferric-reducing anti-oxidant activity and 2,2-diphenyl-1-picrylhydrazyl free radical-scavenging activities. Histopathologic examination of the rat livers showed that *T. chebula* extract reduced the incidence of liver lesions including hepatocyte swelling and neutrophilic infiltration, and repaired necrosis induced by t-BHP 42.

- *T. chebula* (aqueous extract) has strong anti-oxidant activity due to inhibition of radiation induced lipid peroxidation, which is observed in rat liver microsomes at different doses 42.

- *T. chebula* (methanolic extract) found to inhibit lipid peroxide formation and to scavenge hydroxyl and superoxide radicals in vitro 43.

- Further, a hepatoprotective compound, isolated from the ethanolic extract of the fruits of *T. chebula*, was identified as a mixture of chebulic acid and its minor isomer, neochebulic acid that also reduced the tert-butyl hydroperoxide (t-BHP)-induced cell cyto-toxicity in isolated rat hepatocyte experiment 43.

- In vitro evaluation of *T. chebula* shows that tri-ethyl chebulate is a strong anti-oxidant and free radical- scavenger, which might contribute to the anti-oxidative ability. 44 An aglycone isolated from the fruits of *T. chebula*, triethylchebulate, significantly inhibited FeSO4 /Cys-induced microsomes lipid peroxidation and protected both H2O2-induced RBCs hemolysis and RBCs auto-hemolysis in a dose-dependent manner.

- Furthermore, triethylchebulate demonstrated potent DPPH free-radical-scavenging ability and moderately suppressed azide-induced mitochondria ROS formation. The results demonstrated that
triethylchebulate was a strong anti-oxidant and free radical-scavenger, which might contribute to the anti-oxidative ability of *T. chebula*.

- The aqueous extract of *T. chebula* seems to be able to protect cell organelles from radiotherapy-induced damages. The aqueous extract of *T. chebula* protected the anti-oxidant enzymes from reactive oxygen species (ROS) produced by gamma radiation in the rat liver microsomes and mitochondria. *T. chebula* (Aqueous extract) exhibited xanthine/xanthine oxidase inhibition, 2,2-diphenyl-1-picrylhydrazyl (DPPH) radicals-scavenging activity.
  - The leaves, bark and fruit of *T. chebula* demonstrated high anti-oxidant activity due to presence of phenolics.
  - *T. chebula* (aqueous extract) inhibits free radical-induced hemolysis, nitric oxide release from lipopolysaccharide stimulated murine macrophages.
  - *T. chebula* (Gallic acid and chebulagic acid, isolated from fruit extract) blocked cyto-toxic T lymphocyte (CTL)-mediated cyto-toxicity. Granule exocytosis in response to anti-CD3 stimulation was also blocked by the above phytochemicals at the equivalent concentrations. *T. Chebula* (Acetone extract) has stronger anti-oxidant activity than alpha.
  - *T. chebula* (ethanol extract) inhibited oxidative stress and the age-dependent shortening of the telomeric DNA length.
  - *T. chebula* gall were tested for anti-oxidative and tyrosinase inhibition activities as well as for proliferative and MMP-2 inhibition activities on early aging human skin fibroblasts to evaluate in vitro anti-aging activity. The cold water extract of *T. chebula* gall indicated the highest stimulation index (SI) on normal human fibroblast proliferation. The extract also demonstrated MMP-2 inhibition on fibroblasts 1.37 times more potent than ascorbic acid. The study confirmed the traditional use of *T. chebula* gall in many Thai medicinal plant recipes for longevity.

2. **Cyto-protective activity**

- In the peroxidation model using t-butanol, *T. chebula* extract showed a notable cyto-protective effect on HEK-N/F cells. In addition, the *T. chebula* extract exhibited cyto-protective effect against UVB-induced oxidative damage. The life-span of the HEK-N/F cells was elongated by 40% as a result of the continuous administration of 3 μg/ml of *T. chebula* extract compared to controls. The oxidative stress and inhibitory effect on cellular aging of its fruits have also been documented.
- Gallic acid and chebulagic acid, isolated from fruit extract of *T. chebula*, blocked cyto-toxic T lymphocyte (CTL)-mediated cyto-toxicity.
- It exhibited the development of duodenal ulcers and appeared to exert a cyto-protective effect on the gastric mucosa in vivo.
- *T. chebula* extract on the age dependent shortening of the telomere length as shown by the Southern Blots of the terminal restriction fragments of DNA extracted from sub-culture passages.

3. **Immuno-modulatory activity**

- Aqueous extract of *T. chebula* produced an increase in humoral antibody titer and delayed type hypersensitivity in mice.
- *T. chebula* found effective against the progression of advanced glycation end products-induced endothelia cell dysfunction.
- Crude extract of *T. chebula* stimulated cell mediated immune response in experimental amoebic liver abscess in golden hamsters.
- The formulation showed highest cure rate of 73% at 800 mg/kg body weight in hepatic amoebiasis. In immune-modulation studies, humoral immunity was improved where T-cell counts remained unaffected in the animals, but cell-mediated immune response was stimulated.

4. **Anti-mutagenic and Anti-carcinogenic activities**

- Crude extract of *T. chebula* fruit have chebulinic acid, tannic acid and ellagic acid, which are found to be the most growth inhibitory phenolics of *T. Chebula*. The effect of 70% methanolic
fruit extract of *T. chebula* was investigated for growth of some malignant cell lines including a human (MCF-7) and mouse (S115) breast cancer cell line, a human osteosarcoma cell line (HOS-1), a human prostate cancer cell line (PC-3) and a non-tumorigenic, immortalized human prostate cell line (PNT1A) using assays for proliferation (3H-thymidine incorporation and coulter counting), cell viability (ATP determination) and cell death (flow cytometry and Hoechst DNA staining). In all cell lines revealed that the extract decreased cell viability, inhibited cell proliferation, and induced cell death in a dose dependent manner.  

- Acetone extract of *T. chebula* has been reported to contain phytochemicals with promising anti-mutagenic and anti-carcinogenic properties.  
- The chebulagic acid, one of the fractionated compounds from ethanolic fruit extract of *T. chebula*, showed potent dual inhibition against COX and 5-LOX. It also demonstrated anti-proliferative activity against HCT-15, COLO-205, MDA-MB-231, DU-145 and K562 cell lines.  
- A recent study has shown the ability of Triphala to inhibit cytochrome P450.  
- *T. chebula* (aqueous extract and hydrolyzable tannins) demonstrated Anti-mutagenic activity in *Salmonella typhimurium*.  

### 5. Radio-protective, Chemo-preventive and Chemo-modulatory activity  
- In an experiment, aqueous extract of the fruit of *T. chebula* (50μg) was able to neutralize 1,1-diphenyl-2-picrylhydrazyl, a stable free radical by 92.9% and protected the plasmid DNA pBR322 from undergoing the radiation-induced strand breaks.  
- *T. chebula* reduces irradiation effects in mice, human lymphocytes while undergoing the gamma radiation- *in vitro*. *T. chebula* extract in dose of 80 mg/kg body weight prior to whole body irradiation of mice resulted in reduction of peroxidation of membrane lipids in the liver and decrease in radiation-induced damage to DNA.  
- Treatment of mice with aqueous extract of Triphala in different doses consecutively for five days before irradiation delayed the onset of mortality and reduced the symptoms of radiation sickness compared to controls.  
- *T. chebula* showed chemo-preventive effect on nickel chloride -induced renal oxidative stress, toxicity and cell proliferation response in male Wistar rats. *T. chebula* extract could be used as therapeutic agent for cancer prevention as it blocked or suppressed the events associated with chemical carcinogenesis.  

### 6. Cardio-protective activity  
- Cardio-protective effect of ethanolic extract of *T. chebula* fruits (500 mg/kg body weight) was demonstrated in isoproterenol-induced myocardial damage in rats. It was reported that pre-treatment with *T. chebula* extract had cardio-protective effect due to the lysosomal membrane stabilization preventing myocardial necrosis and inhibition of alterations in the heart mitochondrial ultrastructure and function in the experimental rats.  
- Pericarp of *T. chebula* has also been shown cardio-protective activity in isolated frog heart model.  

### 7. Hepato-protective activity  
- Protective effects of an aqueous extract of *T. chebula* fruit on the tert-butyl hydroperoxide-induced oxidative injury was observed in cultured rat primary hepatocytes and rat liver. *T. chebula* fruits showed strong hepato-protective activity through anti-oxidant effect in isolated rat hepatocytes.  
- The similar property of its 95% ethanolic extract was observed against anti-tuberculosis drugs *i.e.* Rifampicin, Isoniazid and Pyrazinamide (combination)-induced toxicity in sub-chronic model (12 weeks) due to its prominent anti-oxidative and membrane stabilizing activities.  

### 8. Nephro-protective activity
The chloroform extract of *T. chebula* seeds (100, 200 and 300 mg/kg body weight) produced dose-dependent reduction in blood glucose of streptozotocin-induced diabetic rats in both short term and long term study (300 mg/kg body weight for 8 weeks). Further, remarkable renoprotective activity was also observed in *T. chebula* treated rats.

Oral administration of ethanolic extract of fruits of *T. chebula* (200 mg/kg body weight for 30 days) reduced the levels of blood glucose and glycosylated hemoglobin in streptozotocin (STZ)-induced experimental diabetic rats.

In a similar study, aqueous extract of *T. chebula* (200 mg/kg body weight for two 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 decreased serum insulin levels.

The *in vitro* studies with pancreatic islets showed that the insulin release was nearly two times more than that in untreated diabetic animals. The treatment did not have any unfavourable effect on liver and kidney function tests.

The fruit extract of *T. chebula* is helpful to alleviate the cadmium-induced nephro-toxicity in rats.

**9. Adaptogenic activities**

- *T. chebula* along with several other medicinal plants helps to resist against a number of stressors in different ways.

**10. Anti-bacterial activity**

- *T. chebula* exhibited anti-bacterial activity against various Gram positive, Gram negative bacteria such as *Salmonella typhi*, *Staphylococcus epidermidis*, *Staphylococcus aureus*, *Bacillus subtilis* and *Pseudomonas aeruginosa* suggesting its broad spectrum anti-microbial activity. Thus various extracts of *T. chebula* exhibit anti-bacterial activity against a number of bacterial species.

- Another study revealed that gram positive organisms inhibited on larger extent as compare to gram negative organisms.

- Two antibacterial compounds, gallic acid and ethyl ester against methicillin-resistant *Staphylococcus*, have been isolated from ethyl alcohol extract of fruits of *T. chebula*.

- *T. chebula* is well effective against *Helicobacter pylori*, a bacterium responsible for gastritis, ulcer and stomach cancers. The ether, alcoholic and aqueous extracts of *T. chebula* were tested against *Helicobacter pylori*, but aqueous extract of the plant, at a concentration of 1-2.5 mg/ml, inhibited urease activity of *H. Pylori*.

- In a study some biologically active components were isolated from butanol fraction of fruit extract of *T. chebula* and tested against six intestinal bacteria. The strong and moderate inhibitory activity was observed against *Clostridium perfringens* and *Escherichia coli* by Ethanedioic acid respectively, with no adverse effects on the growth of the four tested lactic acid-producing bacteria. The study demonstrated Ellagic acid’s potent inhibitory effect against *C. perfringens* and *E. coli*, but little or no inhibition was seen for behenic acid, β-caryophyllene, eugenol, isoquercitrin, oleic acid, α-phellandrene, β-sitosterol, stearic acid, α-terpinene, terpinen-4-ol, terpinolene, or triacontanoic acid.

**11. Anti-amoebic and Anti-protozoal activity**

- The drug formulation of *T. chebula* was investigated for anti-amoebic effect in experimental caecal amoebiasis in rats and result showed 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, α-amylase and protease in axenically cultured amoebae.

- The acetone extract of *T. chebula* seeds showed anti-plasmodial activity against *Plasmodium falciparum*. 
In another study, T. chebula was evaluated in experimental amoebic liver abscess in golden hamsters and in immune-modulation studies. The formulation had a maximum cure rate of 73% at 800 mg/kg body weight in hepatic amoebiasis.  

12. Anti-fungal activity
- The anti-fungal activity an aqueous extract of T. chebula was observed against a number of dermatophytes and yeasts. It is effective against the pathogenic yeast Candida albicans and dermatophytes Epidermophyton, Floccosum, Microsporum gypseum and Trichophyton rubrum.  

13. Anti-viral activity
- Herpes simplex virus 1 (HSV-1) is the cause of lifelong latent infection of sensory neurons. Hot water extract of T. chebula showed anti-herpes simplex virus (HSV) activity in vitro and anticytomegalovirus (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 cyto-toxic 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.  
- T. chebula can also be used in sexually transmitted diseases and AIDS. The extract of fruits of T. chebula showed inhibitory effects on human immunodeficiency virus-1 reverse transcriptase. 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.  
- The aqueous extract of T. chebula executed the most prominent Anti-HBV activity by decreasing the level of extracellular HBV virion DNA at concentration ranging from 64 to 128 μg.  
- Two hydrolyzable tannins, chebulagic acid and punicalagin, isolated from the dried fruits of T. chebula inhibited HSV-1 entry at non-cytotoxic doses in A549 human lung cells by preventing binding, penetration, and cell-to-cell spread, as well as secondary infection.  
- Recently, acetone extract of T. chebula has emerged as a new alternative to treat pandemic swine influenza A infection due to its low cost, easy preparation and potential effect.

14. Anti-inflammatory activity
- Aqueous extract of dried fruit of T. chebula showed anti-inflammatory activity by inhibiting inducible nitric oxide synthesis. Chebulagic acid extracted from tender fruit of T. chebula significantly suppressed the onset and progression of collagen-induced arthritis in mice.  
- T. chebula in a polyherbal formulation (Aller-7) exhibited anti-inflammatory effect against arthritis in rats.

15. Anti-allergic activity
- T. chebula, ingredient of a polyherbal formulation (Aller-7), showed potent in vitro anti-allergic activity.  
- Hydro-ethanol extract of T. chebula exhibit anti-histamine and anti-spasmodic in guinea pig ileum.  
- Oral administration of an aqueous extract of fruit significantly suppressed histamine release from rat peritoneal mast cells and also significantly increased production of tumour necrosis factor (TNF) by anti-dinitrophenyl IgE.

Discussion
The advance age leads to occurrence of functional and structural changes in nearly all organ systems which results in gradually loss of some of their attributes in human beings. Vayasthapan is a group of herbs which are immune-stimulants and able to lessen the virulence of ageing and help to get better quality of life. Ayurveda mentions ageing as Jaivika Swabhava (biological nature of the living being).
Ayurvedic classics mention that the physical structure consists of seven Dhatus starting from Rasa (Rasadi Dhatus). The health of other successives Dhatus (tissues) of the body depends on the qualities of the ‘Rasadhatu’. As these Dhatus develop sequentially and nourish further Dhatus, the medicine that improves the quality of ‘Rasa’ promotes or strengthens the health of all tissues of the body. Rasayana herbs act on the fundamental factors of the body viz. Dhatus, Agni and Srotasas and help to stabilize aging. Thus all the body tissues are well nourished by Rasayana. The Rasayana medicines cause enrichment of Rasa (essence), ensuring promotion of health and strength of the tissues. Thus Rasayana help regeneration, replenishment and revitalization of Dhatus. Haritaki possesses these Rasayana properties.

According to Ayurveda Tridoshas regulate all the metabolic processes in the human body and carry out their action through Dhatus. The equilibrium of Doshas keeps person healthy and the disturbance in the equilibrium of Doshas results in a diseased condition. Thus Doshas, maintain homeostasis (Dhatusamya). Vata Dosha deals with Karshana i.e. all catabolic activities (tissue wear and tear) that takes place in the body, Pitta Dosha is responsible for Pachana i.e. the process of nutrients assimilation into tissues and Kapha Dosha deals with Brihana i.e. synthesis of newer tissues. Agni has a key role in bio-transformation and Saptadhatwagni are accountable for tissue metabolism. The hypo-functioning of Agni results in the formation of the toxic waste of metabolism known as Aam which causes obstruction of the Srotasas (channels of micro-circulation). For tissue perfusion clear Srotasas are required. The clear channels aid in Dhatu-Poshana (Tissue Nutrition) by nourishing Dhatus which ultimately lead to formation of excellence of tissues and boosts Ojas (immunity). Thus for proper Nutrition, unimpaired tissue perfusion is an essential thing and Ojas is required for healthy regeneration of tissues.

By Rasayana drugs one can attain superior quality Dhatu (body tissues). Aacharya Shushruta defines Rasayana Tantra as the measure which delays the ageing process, increases intellect and strength, prolongs life and cures the disorders. Aacharya Sharangdhara mentions that Rasayana is the means by which old age and diseases are averted. Ayurvedic Samhita and Nighantu states Rasayana action of Haritaki. According to Ayurveda the action of drugs is interpreted on the basis of properties (Gunas) and Rasapanchaka is an indicator of drug action. The Rasapanchaka of Haritaki are very useful for Agnideepan (stimulating Agni), Amapachan (digesting toxic waste of metabolism) and Srotas-shodhana (clearing the channels of micro-circulation), hence by means of these actions, it normalizes the functions of Jatharagni and thereby it regularizes digestion and tissue metabolism. As a result restoration of Agni at the Dhatu level (Dhatwagnideepan), removal of excessive Kleda takes place which results in proper nourishment of Dhatus and production of excellence of Dhatu.

Role of Rasapanchaka can be explained as follows:

**Rasa: Kashay, Tikta, Katu, Amla and Madhur**

- **Haritaki posses**s predominant Kashay Rasa. Kashay Rasa is the known for its Stambhana (Astringent) action. But Haritaki is an exceptional drug for this act as it has got Madhur Vipaka and Ushna Veerya along with Kashay Rasa which conducts Anuloman Karma i.e. it digests, breaks the adhesions and removes wastes through lower route. Vayu Mahabhoota in Kashay Rasa absorbs Kleda.
- **Tikta and Katu Rasas** are Srotas-shodhak i.e. channel cleaning. Due to Vayu and Agni predominance, Katu Rasa absorbs the fluid and stimulates Agni, digests Aam and vilayan property of Agni helps to expel the obstrucutive material.
- **Tikta rasa** acts in likewise by absorbing the fluid and slimy material owing to Vayu Mahabhoota and thus vacating space on account of Aakash Mahabhoota. Because of Sookshma Guna it permeates even to minute channels, thus helping the drug to reach at cellular level and depleting the accumulated Kleda.
- **Amla Rasa** help to stimulate Agni and Madhur Rasa is vitaliser and tonic.
- **Haritaki is devoid of Lavan Rasa. According to Aacharya Vagbhata, excess consumption of Lavana Rasa causes wrinkled skin (Vali), grey hair (Palitya) and baldness (Khaliitya) which is manifestations of aging.**
Veerya: Ushna

- It is dominated by Agni Mahabhoota. The speciality of Haritaki is that it has Ushna Veerya instead of Sheet Veerya although it is having Kashay Rasa. It stimulates Agni consequently corrects the Dhatvagnimandya and improves digestion and metabolism. It opposes any increment of unwanted Kapha by the vilayana property and helps in Srotas-shodhan. It alleviates Vata which is the predominant Dosha in an old age. Agni is the part and parcel of all bio-transformations in the body. According to Aacharya Charak, any principle which is responsible for action is considered as Veerya. In his commentary Aacharya Shivdasa states that Veerya is the potency which is situated in a particular portion of the drug where the potency lies in concentrated form. This opinion more or less synchronises with the modern concept of active chemical fractions of the drugs which are accountable for action.

Vipaka: Madhur

- Vipaka has got systemic effect after metabolism. Haritaki has Madhur Vipaka in the place of Katu Vipaka. Therefore predominance of Prithvi and Jala Mahabhoothas cause alleviation of Vata and Pitta which prevents Catabolism.

Guna: Ruksha and Laghu

- These Gunas help Rasas and thereby potentiates their action by way of synergism. They absorb Kleda and regulate Jatharagni.

Thus by the virtue of Deepan, Pachan and Srotas-shodhan Karma Haritaki increases Agni at all levels and reduces Aam, clears the channels resulting in correction of Dhatvagnimandya. Thus the actions of Dhatwagnideepan as well as Dhatuposhan (by Madhur Vipaka) make Haritaki the extraordinary drug. Because of these actions, the nutrients / essence reaches the Dhatus traversing through the minutes Srotasas. It improves the nourishment to Dhatus, thereby improvement in the defence system, Agnibala, Dehabala and Satvabala. Its Medhya (brain tonic) activity helps to combat the mental health problems of aging like decline in perception (Grahana), retention (Dharana), retrieval abilities (Smarana) as it improves higher integrative brain functions like memory, learning, thinking, understanding. Thus Haritaki restores physical as well as mental health and helps to delay the ageing process by Rasayana effect. It is interesting to note that it possesses Tridoshashamaka activity i.e. it alleviates all the three Doshas. References related to Rasayana are available such as turning old subjects to young, delaying the ageing process, prolonging the lifespan and increasing the strength of the individuals. Aacharya Sharangdhara has clearly mentioned that Rasayana are certain dravyas like Rudanti, Guggulu, Haritaki etc. which prevent early aging (Jara) and also guard against diseases or opportunistic infections. The same kind of description occurs in Bhadrayanavali.

Some of the causes of aging are unavoidable such as ultraviolet radiation, free radicals and genetic effects, social, environmental and behavioural influences. Free radicals are highly reactive and can cause great damage to the cell. They are able to attack healthy cells of the body leading them to lose their structure and the function. It appears to be the most important contribution to ageing and degenerative disorders in ageing. Haritaki has been investigated in terms of modern pharmacology for its Anti-oxidant, Free radical-scavenging, Cyto-protective, Immuno-modulatory, Anti-mutagenic, Anti-carcinogenic, Radio-protective, Chemo-preventive, Chemo-modulatory, Cardio-protective, Hepato-protective, Nephro-protective, Adaptogenic, Anti-bacterial, Anti-amoebic, Anti-protozoal, Anti-fungal, Anti-viral, Anti-inflammatory and Anti-allergic activity and observations of which overall indicate significant results of Rasayana and anti-aging action. Apart from this there are several other therapeutic potentials of this wonder drug T. chebula.

Knowledge of the phytochemical constituent is very necessary to facilitate investigation of the actual effectiveness of the plant in medicine. The current research stress on health benefits of phytochemicals, especially anti-oxidant and anti-microbial properties of phenolic compounds, which exert protective activity against degenerative disorders, inflammation, allergies, infections by means of antioxidant, antimicrobial
and proteins/enzymes neutralization/modulation mechanisms. Phenolic compounds are reactive metabolites in a wide range of plant-derived foods and divided in four groups: phenolic acids, flavonoids, stilbenes and tannins. They work as terminators of free radicals and chelators of metal ions that are able to catalyze lipid oxidation.

Until now epidemiological knowledge bring to light that polyphenols show important functions such as inhibition of pathogens, anti-inflammation and anti-allergic activity, decompose microorganisms, prevent deposition of triglycerides, decrease the incidence of non-communicable diseases like diabetes, cancer, cardiovascular diseases and stroke which occur due to the factors like inflammation, allergy and reactive oxygen species. These protective effects are attributed, partially, to phenolic secondary metabolites. Polyphenols are considered to display their antioxidant capacity, depending on the hydroxylation status of their aromatic rings, including actions like scavenging of free radicals, chelation and stabilization of divalent cations, and modulation of endogenous anti-oxidant enzymes

The anti-carcinogenic and anti-mutagenic potentials of tannins may be associated with their anti-oxidative property, which is important in preventing cellular oxidative damage, including lipid peroxidation. Tannins have also been reported to show other physiological effects, such as to reduce blood pressure, decrease the serum lipid level, modulate immunoresponses etc. Phenolic acids, hydrolysable tannins, and flavonoids have anti-carcinogenic and anti-mutagenic effects in view of the fact that they act as protective agents of DNA against free radicals, by inactivating carcinogens, inhibiting enzymes involved in pro-carcinogenesis activation and by activating of xenobiotics detoxification enzymes. In particular flavonoids and L-ascorbic acid have a synergistic protective effect towards oxidative damages of DNA in lymphocytes. High flavonoid intakes lead a decrease in LDL oxidation. Thus the above mentioned data shows therapeutic efficacy of Haritaki regarding anti-aging action which has been verified by using the modern pharmacological experimental models. The significance of Haritaki has been recognized and documented since ancient time due to virtue of its variety of chemical compounds, which possess important medicinal properties that can be used to cure diverse diseases. Therefore use of Haritaki promotes a youthful state of physical and mental health, postpones aging and expands happiness.

Conclusion

It is an attempt to emphasize the Vayasthapan action of Haritaki on the basis of Ayurvedic as well as modern scientific aspect The Rasapanchaka of Haritaki help it to conduct Agnideepan, Aampachan and srotas-shodhana actions i.e. it stimulates Agni, digests Aam and cleans the channels by detoxifying the metabolic waste and supports the nourishment of Dhatu moreover mind and makes the body more energetic. Haritaki performs the functions of Dhatwagnideepan as well as Dhatwagniposhan and improves physical along with mental health. Consequently it guards against degeneration, prolong youth and delays aging. The observations of phyto-chemical and pharmacological study of this plant validate the submissions made in the Ayurvedic classics regarding its Vayasthapan i.e. age sustaining action. This herb merits advance research as it may be a source of potential anti-aging agent. In future study, the isolated principles from Haritaki needs to be evaluated in scientific manner by means of specific experimental animal models and clinical trials to know the molecular mechanism of action, in search of lead molecule from natural resources. This can open new avenue for the treatment of degenerative, autoimmune and metabolic diseases and provide a solution for the current issue of premature aging.

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