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Evaluation of Antioxidant and Anti-Aging Potential of Haritaki (*Terminalia Chebula* Retz) in Rats

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Abstract: ***Aging is a biological process caused by progressive functional decline, increased oxidative stress, mitochondrial dysfunction, and accumulation of cellular damage. Oxidative stress is considered one of the major contributors to aging and age-associated disorders. Haritaki l(Terminalia chebula Retz.), a medicinal plant widely used in Ayurveda, possesses abundant phenolic compounds including chebulagic acid, chebulinic acid, gallic acid, ellagic acid, and tannins that exhibit potent antioxidant activity. The present study aims to evaluate the antioxidant and anti-aging potential of Haritaki fruit extract in Wistar rats. Experimental animals may be divided into normal control, aging control, standard treatment, and Haritaki-treated groups. Parameters such as lipid peroxidation, superoxide dismutase, catalase, glutathione peroxidase, reduced glutathione, inflammatory markers, and histopathological alterations can be assessed. Haritaki treatment is expected to reduce oxidative damage, improve endogenous antioxidant defense systems, and attenuate age-associated biochemical alterations. The findings may support the traditional use of Haritaki as a natural anti-aging agent and provide scientific evidence for its potential application in age-related disorders.***

Keywords: Haritaki, *Terminalia chebula*, Antioxidant, Aging, Oxidative stress, Rats, Anti-aging, Ayurveda

1. Introduction

Aging is a progressive biological process characterized by the gradual decline of physiological functions and increased vulnerability to disease. Throughout life, cells and tissues are continuously exposed to endogenous and environmental stressors that cause molecular and cellular damage. Under normal conditions, repair and regenerative mechanisms maintain tissue homeostasis by replacing damaged cellular components and promoting recovery. However, with advancing age, the efficiency of these repair processes gradually declines, resulting in the accumulation of cellular damage and functional deterioration of organs. Increasing evidence suggests that strategies capable of reducing oxidative stress, protecting cellular structures, and supporting endogenous repair mechanisms may contribute to healthy aging and preservation of organ function.

Aging is associated with progressive deterioration of physiological functions resulting from oxidative stress, mitochondrial dysfunction, genomic instability, and chronic inflammation. The free radical theory of aging proposes that reactive oxygen species (ROS) generated during metabolism damage cellular macromolecules including DNA, proteins, and lipids.

Natural antioxidants have gained considerable attention for delaying aging processes. Haritaki (*Terminalia chebula* Retz.), known as the "King of Medicines" in Ayurveda, is rich in hydrolysable tannins and polyphenolic compounds possessing strong free-radical scavenging activity. Several studies have demonstrated antioxidant, anti-inflammatory, neuroprotective, cardioprotective, hepatoprotective, and radioprotective activities of *Terminalia chebula*. These biological effects suggest its potential role in preventing oxidative stress-mediated aging.

The present study proposes evaluation of antioxidant and anti-aging effects of Haritaki in experimentally induced aging models in rats.

2. Objectives

Primary Objective

- To evaluate the antioxidant and anti-aging potential of Haritaki fruit extract in rats.

Secondary Objectives

- To determine effects on oxidative stress markers.
- To evaluate endogenous antioxidant enzymes.
- To assess lipid peroxidation levels.
- To study histopathological changes in major organs.
- To investigate protective effects against age-related tissue damage.

3. Materials and Methods

Experimental Animals

- Adult Wistar rats
- Weight: 180–220 g
- Both sexes
- Standard laboratory conditions

Plant Material

Dried fruits of *Terminalia chebula* authenticated by a qualified taxonomist.

Extraction

Hydroalcoholic extraction using Soxhlet apparatus.

Experimental Design

Group I – Normal Control
Group II – Aging Control
Group III – Standard Antioxidant (Vitamin E)
Group IV – Haritaki Low Dose
Group V – Haritaki High Dose

Parameters Evaluated

Oxidative Stress Markers
- Malondialdehyde (MDA)
- Lipid Peroxidation (LPO)

Antioxidant Enzymes on
- Superoxide Dismutase (SOD)
- Catalase (CAT)
- Glutathione Peroxidase (GPx)
- Reduced Glutathione (GSH)

Histopathology
- Liver
- Brain
- Kidney
- Heart

4. Expected Results

Haritaki-treated rats are expected to demonstrate:
- Reduced lipid peroxidation
- Increased antioxidant enzyme activities
- Improved tissue architecture
- Reduced oxidative stress
- Delayed aging-related biochemical changes

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