ANTI-AGING INTERVENTIONS BASED ON TRADITIONAL INDIAN PLANT-BASED MEDICINE

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ABSTRACT

Aging causes significant physical changes that make the cardiovascular, nervous, excretory, pulmonary, and other systems susceptible to certain diseases even without typical risk factors. Aging causes many cell and tissue changes that increase disease and death risks. As antioxidative and repair mechanisms decline with age, oxidative damage increases. Numerous research studies indicate that polyphenolic compounds which are present on fruits and vegetables may possess anti-aging, antioxidant and anti-inflammatory characteristics. Fruit colors come from anthocyanins, which suppress lipid peroxidation, cyclo-oxygenase (COX)-1 and -2, and oxidative stress. While aging cannot be reversed, it

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is possible to delay its progression. The "nourishing of life" acknowledges some traditional Indian herbs and compounds from plant extracts for their anti-aging, antioxidant, and phytotherapeutic characteristics. This includes amla, ashwagandha, tulsi, allicin, Aloe vera, Syzygium cumini (Jamun), Ginkgo biloba, curcumin, and othes. Therefore, it is crucial to gain knowledge of the molecular mechanisms and search for therapeutic effects that can increase lifespan and improve healthspan.

KEYWORDS: Aging, Anti-oxidant, Indian medicinal Plant, Oxidative stress.

INTRODUCTION

Human aging is basically linked to a lots of pathological conditions, for example as cancer, heart problems, metabolic disorders including type II diabetes, and neurodegenerative conditions such as Alzheimer's and Parkinson's.and dementia (1-2). Aging is a degenerative process that is conserved in all living things. It is characterized by a steady decline in cellular elements and functions, which almost always results in death (3-4).

According to a United Nations report, there will be nearly twice as many people worldwide over the age of 60 by 2050, rising from 962 million to 2.1 billion 6. Thus, it is essential to learn about the molecular mechanisms behind the aging process and to look for therapeutic approaches that can lengthen lifespan and improve health span.

Even in the absence of typical risk factors, aging brings about significant physical changes that make the cardiovascular, nervous, excretory, pulmonary, and other systems vulnerable to a certain disease. Although aging cannot be stopped, it is feasible to slow down the rate of aging. The "nourishing of life" recognizes some traditional herbs from India such as amla, ashwagandha, tulsi, allicin, Aloe vera, Syzygium cumini (Jamun), Ginkgo biloba and curcumin for their anti-aging, antioxidant, and phytotherapeutic properties.

We have used PubMed to locate and critically evaluate 30 years' worth of studies that concentrate on antiaging and related conditions involving active ingredients from plant-based products. Though many plant-based substances are reported to have anti-aging properties, flavonoids, terpenoids, saponins, and polysaccharides which specifically include hesperidin, baicalein, fisetin, berberine, resveratrol, vitamin C, curcumin, capsaicin, ginsenoside, and genocide are reported to have the possible anti-aging effects. These properties of plant-based/derived compounds will be specifically reviewed in this review for their purported anti-aging effects.

Pathogenesis of Aging

Several mechanisms contribute to cellular aging, but the three most well-known ones can result in irreparable cellular damage through:

(A) The rise in mtDNA fragment insertions into nDNA brought on by mitROSp during old age.

These fragments can cause chromosome missegregation at mitosis, which can result in aneuploidies 7, corruption of structural genes, cessation of cell division, modification of regulatory sequences, and promotion of genomic instability are all factors that have the potential to decrease chronological life expectancy.

- (B) An increase in lipid peroxidation in cell membranes, particularly those that contain a lot of mitochondria and are located close to the mitROS generator, and are important for aging 8. The most severe oxidative damage that takes place inside cells is lipid peroxidation of cellular membranes. The mutagenic and hazardous byproducts of lipid peroxidation, such as hydroxynonenal and malondialdehyde, are shortchain aldehydes that are produced through an exponential reaction chain. The nucleus, characterized by a low lipid content, is capable of preventing the occurrence of harmful lipid peroxidation within its interior, where the vast majority of genetic material and the remainder of the genome are located. It is able to distribute the aldehydes generated by membrane lipid peroxidation throughout the cell. The aldehydes have the ability to permeate the nucleus and engage in chemical reactions with unbound amino groups present in DNA and proteins, thereby leading to DNA impairment in both nuclear and mitochondrial DNA.
- (C) The diminished process of autophagy results in the buildup of extensively peroxidized and crosslinked lipids and proteins, the delayed elimination of damaged mitochondria from reactive oxygen species, and the eventual accumulation of cellular debris.

The best-known tissue-level indicator of aging is the accumulation of lipofuscin granules in the cytosol, which are made up of components that autophagy is unable to break down and remove.

Role of Plant Polyphenols and their Anti-aging Property

Indian traditional medicine is very old and our ancient books, ayurveda (Charaka Samhita, Sushruta Samhita, and Ashtanga Hridaya), and literature provide us with very interesting information. In the Ramayana, a plant-based product called Sanjeevani booty which is known as Selaginella bryopteris is a lithophytic plant that is native to India. Sanjeevani grows on the hilly reason of tropical areas. In ancient time there are various uses of its on the treatment of various diseses including relief from heat stroke, dysuria, irregular menstruation, and jaundice.

	Aging Highlights
٠	Imbalanced Metabolism
•	Genomic instability
•	Telomere shortening
•	Epigenetic alterations

Fig. 1: Aging Highlights

The antioxidant properties of plants and their inherent constituents, including carotenoids, flavonoids, and vitamins, are widely acknowledged for their potential in mitigating chronic illnesses associated with reactive oxygen species (ROS)9. The supplements in question display contrasting impacts on the inflammatory and degenerative mechanisms within the human body, while also demonstrating favorable outcomes on the immunological and digestive systems, thereby fostering general well-being 10.

Several plant-based anti-aging supplements are frequently utilized in India, and their mechanisms of action

Tulsi

Tulsi, a member of the Lamiaceae family, is an aromatic shrub indigenous to the tropical regions of the eastern continent. The prevailing belief is that its origin can be traced back to the north-central region of India approximately 11 centuries ago. According to Ayurveda, Tulsi is bestowed with the titles of "The Incomparable One," "Mother Medicine of Nature," and "The Queen of Herbs." The substance in question is commonly acknowledged as an unparalleled "elixir of life" due to its exceptional therapeutic and spiritual properties. 12. Tulsi has been integrated into spiritual rituals and cultural practices in India, where it is believed to provide a diverse array of health benefits that contemporary scientific research is only recently beginning to substantiate. Recent studies on tulsi have demonstrated its potential as a holistic remedy for physical, mental, and spiritual ailments, thereby corroborating the principles of Ayurvedic medicine.

Garlic

Garlic, belonging to the family Amaryllidaceae, is widely recognized as a popular seasoning agent utilized in various culinary and medicinal practices across diverse cultural contexts. Garlic has been utilized by a significant number of individuals for the purpose of preventing and treating various ailments. 13,14. Garlic is recognized for its diverse cardioprotective properties, primarily attributed to its ability to decrease endogenous cholesterol synthesis. It results in a more advantageous ratio of HDL to LDL 15. Garlic comprises diverse components, including organosulfur and steroidal saponins. The medicinal benefits of the Panax ginseng or ginseng plant (family Araliaceae) are well-known. The plant's roots are a source of the bioactive molecule ginsenoside. This bioactive compound enhances the body's resistance to stress, fatigue, anxiety, and trauma through altering immune function. Garlic contains organosulfur compounds and numerous steroidal saponins, both of which have been linked to its cholesterol-lowering effects (16). Moreover, garlic's anti-aging properties have been established in a number of research. (17).

Neem

Azadirachta indica is a member of the Meliaceae family. The Indian Ayurvedic medicinal system has employed it for numerous years to manage and treat various ailments, including skin rashes, fever, and diabetes. The utilization of various parts of the neem tree, such as its bark, leaves, seeds, fruits, and flowers, in medical therapy is attributed to the presence of active secondary metabolites, particularly limonoids and tetranortriterpenoids, among which azadirachtin is prominent due to its biological effects. A. indica has been examined for its potential as an agent with anticancer, antimicrobial, anti-inflammatory, anti-fugal and chemopreventive properties (18,19).

Ashwagandha

Withania somnifera (L.), known as Rasayana in Ayurvedic medicine, have been found to promote overall health, bolster immunity, augment physical strength and endurance, extend lifespan, and confer stress resistance. Ashwagandha, a member of the Solanaceae family, is considered the primary regulator in Ayurvedic medicine and is commonly known as Indian ginseng. Ashwagandha root is a widely recognized and commonly employed Ayurvedic remedy that is believed to promote vitality, fortify immune system performance, bolster cognitive function, and augment overall well-being and longevity. Research indicates that ashwagandha can facilitate the restoration of energy levels and mitigate the adverse impact of stress on mood. This is supported by scientific studies.

Brahmi

Brahmi (fam. Plantaginaceae), commonly known as B. monnieri, is a herb characterized by its unique morphology such as small oblong leaves and purple flowers. The pharmacologically active constituents of this herb are bacosides 22, which possess significant therapeutic potential. This herb yields two principal phytochemical compounds, namely brahmine and herpestine 23. Neuroprotection against free radicals and enhanced cognitive performance and learning have both been attributed to the phytochemicals extracted from brahmi. Applying brahmi oil regularly has been shown to reduce the risk of multiple diseases and conditions, including dementia and memory loss. 24. The antioxidant enzymes catalase, glutathione peroxidase, and superoxide dismutase were shown to have increased in activity after administration of B. monnieri extracts, according to research by Bhattacharya et al. in 25.

Amla

Phyllanthus emblica, also known as Emblica officinalis and belonging to the family Phyllanthaceae, is a deciduous tree that produces edible fruits. It is commonly referred to as Indian gooseberry or amla. The therapeutic properties of various parts of the P. emblica tree, including its fruits, bark, leaves, seeds, flowers, and roots, have been acknowledged. Phyllanthus emblica is a significant constituent in numerous Ayurvedic pharmacological preparations. The Amla Churna, in its powdered form, is widely recognized for its potential to reduce cholesterol levels and improve cognitive function. 26. Incorporating amla into one's dietary regimen has been demonstrated to be efficacious in decreasing both blood and cerebral cholesterol levels by 27. Furthermore, it has been promoted as a beneficial functional food for managing Alzheimer's disease 28.

Turmeric

Curcuma longa L., commonly known as turmeric, is a perennial plant species. C. longa, a member of the Zingiberaceae family, is capable of biologically synthesizing curcumin, a chemical compound. In India, it is generally known as haldi. Turmeric has been utilized in traditional Indian home remedies to treat a variety of ailments and injuries. The compound in question is widely recognized for its diverse range of biological properties, which encompass antioxidative, anti-inflammatory, and anticancer effects. 29. The natural properties of curcumin render it a potential therapeutic agent for the treatment of numerous malignancies. 30. Research has indicated that curcumin has the ability to impede the expression or activity of tumor necrosis factor, prostaglandin E2, and cyclooxygenase 2, as evidenced by various studies. The antioxidant properties of curcumin have been found to be effective in reducing the generation of reactive oxygen species, scavenging free radicals, and preventing lipid peroxidation, as reported in reference 32. The efficacy of curcumin in improving cystic fibrosis and inhibiting tumor growth has been demonstrated in mice through oral administration.

Nevertheless, ongoing human trials are currently underway to further investigate this matter.

Aloe vera

The source of the commercially available Aloe is the dried leaf juice of A. vera (syn. Aloe barbadensis Mill.), which belongs to the family Asphodelaceae. The leaves of Aloe are commonly used in anti-aging and anti-wrinkle creams and moisturizers 33. In the treatment of aging and wrinkles, the constituents of A. vera, such as aloin A and B, have been shown to inhibit the activity of collagenase, the enzyme which causes the degradation of collagen fibers 34. Currently, many pharmaceutical and beauty industries use Aloe products to produce a wide range of cosmetics, including anti-wrinkle creams, and weight loss therapies.

Mulaithi

Mulaithi/ Licorice or Yashtimadhu is a little perennial herb that belongs to the Fabaceae family. It has been used for centuries to treat a variety of illnesses, including hyperdipsia, hypertension, epilepsy, fever, sexual impotence, paralysis, stomach ulcers, rheumatism, skin conditions, hemorrhagic diseases, and jaundice 35. The extract of G. glabra was tested by studying the inhibition of radiation-induced lipid peroxidation in rat liver microsomes. The bioactive constituents present in G. glabra are glycyrrhizin, flavones, and coumarins. It has also been shown to have free radical scavenging properties, helpful in preventing aging phenomena 36.

Maidenhair trees

Maidenhair trees also known as Gingko is used as a functional food that increases the tissues' ability to absorb oxygen 37. Ginkgo leaves have been shown to considerably sustain cerebral blood flow and glucose levels. Furthermore, it enhances cognitive capacity and promotes higher-order thinking in the brain 38. The leaf extract of Ginkgo contains several flavone glycosides that act as potent free radical scavengers 39.

Ginseng

Panax ginseng, also referred to as ginseng and classified under the Araliaceae family, is widely recognized for its medicinal attributes (40). The roots of this plant contain the bioactive compound known as ginsenoside. The bioactive substance in question alters immunological function and enhances the body's capacity to endure stress, fatigue, anxiety, and trauma. Furthermore, it demonstrates anti-stress properties and improves cognitive functions such as learning and memory by 40%. According to a study, the administration of ginseng resulted in an extension of the lifespan of mice afflicted with juvenile leukemia. According to a separate investigation on P. ginseng, it was discovered that it has the ability to decrease oxidative stress, resulting in a reduction of lipid peroxidation and an increase in antioxidant capacity 41.

Grapes and Peanuts

The skin of grapes and peanuts contains resveratrol (also known as stilbenes), a naturally occurring polyphenolic molecule with possible antioxidant properties 42. Due to its use as an anti-aging component, it has been a focus of intensive research for the past twenty years 42,43. It also has anti-inflammatory effects, can scavenge free radicals, and can operate as a chelating agent 44. It is effective in the treatment of many illnesses. Resveratrol also has antioxidant, anti-aging, antilipidemic, and cancer chemo-preventive properties. Rizvi et al. 44,45 also published various important activities of resveratrol regarding these phenomena.

Apple

Apples (fam. Rosaceae) are particularly rich in polyphenols, which have an enormous antioxidant potential 46. Apples contain a variety of polyphenolic substances, including rutin, epicatechin, catechin phloretin, chlorogenic acid, and proanthocyanidin B2 47. According to certain studies, eating apples every day can lower the risk of developing hypercholesterolemia and cardiovascular diseases. Consuming apples may significantly reduce the risk of developing lung cancer, especially in women. According to numerous studies, apples are beneficial in preventing low-density lipoprotein oxidation 48.

Blueberry

Blueberries (fam. Ericaceae) contain a higher concentration of polyphenols than other fruits and vegetables. The reduction of signs of aging has been linked to the strong antioxidant potential of blueberry extracts 49. According to studies, regular eating of blueberries may make senior populations more susceptible to memory-related problems 50. Consuming blueberry extract has been said to delay age-related functional and physiological decline. Blueberry extract administration was observed to restore the age-related reduction in the hippocampus heat shock protein in rats 49. In older rat models, blueberries have also been shown to effectively improve motor and cognitive performance 51.

Tea Catechins and Theaflavins

In the Asian continent, tea (Camellia sinensis (L.) Kuntze, fam. Theaceae) has risen to become the beverage of choice. Theaflavins and catechins are two major components responsible for the health benefits of tea 52. Studies have demonstrated that drinking green or black tea regularly can prevent the oxidation of DNA molecules 53. Theaflavins and catechins have been shown to extend the average lifespan in other in vivo investigations on Drosophila. According to numerous published studies, oral tea polyphenol ingestion and topical green tea application prevent UV radiation- or chemical-induced skin carcinogenesis in a variety of animal models 54.

Quercetin

Quercetin is found in many fruits and vegetables. Phytochemicals employed in complex diseases, such as cancer, hepatic disorders, and NDs, have been published 21,55,56. Researchers have been interested in quercetin over the past ten several years due to its antioxidant and free radical scavenging properties, and it is currently undergoing comprehensive testing for its antiproliferative capacity 57. The catechol group at position 3 have been used to explain the antioxidant capacity of quercetin. At the maximum concentration of 30 M and the lowest concentration of 10 M, this has excellent neuroprotective properties. During neuroinflammation in ND (Neuro-degeneration) pathogenesis, quercetin treatments regulate NF- κ B activity and show an anti-inflammatory effect 58.

Fisetin

Apples, grapes, kiwis, strawberries, onions, persimmons, and cucumbers are a few examples of fruits and vegetables that contain the flavonoid fisetin, which is also a bioactive ingredient 59. Several studies have suggested that fisetin has potential medicinal benefits against various diseases such as cancer, oxidative stress, inflammatory bowel disease, and neurological illnesses 60. In a different study, fisetin activates ERK in the ALS animal model, exhibiting antioxidant and neuroprotective properties 61.

Genistein

A member of the isoflavonoid class, known as genistein (4',5,7-trihydroxyisoflavone) is a phytoestrogen. It comes from soy and has antiinflammatory and neuroprotective properties 62. Genistein has a low oral bioavailability, according to several pharmacokinetic studies 63. Interestingly, genistein structurally resembles estrogen and acts as an agonist to the estrogen receptor (ER). ERs in the brain are associated with memory and learning. Moreover, genistein interacts directly with the ERs and has a neuroprotective effect that may exacerbate memory loss in individuals with neurodegenerative disorders.

Baicalein

The root of Scutellaria baicalensis Georgi (fam. Lamiaceae) contains a major bioactive compound called baicalein (5,6,7-trihydroxyflavone), which is a member of the flavone family (synonym mentioned in the parenthesis makes it clear that the compound is a 'flavone') 64. In traditional Chinese medicine, the root of S. baicalensis is used in a decoction to treat central nervous system illnesses as part of herbal therapy. Baicalein possesses a variety of pharmacological effects, such as antioxidant, anti-inflammatory, neuroprotective, neurogenesis, and differentiating activities, which are proved by pharmacokinetic investigations. These qualities suggest that baicalein has therapeutic potential for treating old age diseases (64-65).

Hesperidin

The primary flavonoid in citrus fruits, primarily in sweet oranges lemon, and consequently in the juices generated from these citrus fruits, is hesperidin. Several researchers have investigated the antioxidant and radical scavenging capabilities of hesperidin using various experimental methods 64,66. Hesperidin lowers superoxide ions in an in vitro reaction involving both concerted proton transfer and electron transfer. Hesperidin was also discovered to be successful in preventing liposomes from ultraviolet irradiationinduced peroxidation (67). Many investigations demonstrated that hesperidin has strong biological effects, such as hyperlipidemia and anti-aging 68.

Black Rice

Black rice, belonging to the Poaceae family, is a variety of rice that is recognized for its elevated concentration of antioxidants, specifically anthocyanins like Oglucoside. Antioxidants have been associated with various health advantages, including their potential to aid in the prevention or management of specific ailments such as Alzheimer's disease 69. According to Zuo et al.'s research, it has the capacity to anti-aging effect on fruit flies 70. Their findings indicate that these compounds possess anti-aging, anti-fatigue, and anti-hypoxic properties, Huang et al., 71.

Carotenoids

Lycopene and α -carotene are examples of carotenoids, which are vitamin A derivates with significant antioxidant potential and photoprotective properties. Lycopene and α -carotene can slightly enhance the skin texture 72. Many plant sources, including carrots, mangoes, papaya, and pumpkins, among others, contain α -carotene. The β -carotene exhibits provitamin A activity, which means it can be converted to vitamin A in the body. Carotenoids also have antioxidant properties that enable them to scavenge lipid radicals and quench single oxygen, which can cause cellular damage. α -Carotene has been found to have photoprotective properties, which can help protect the skin from damage caused by ultraviolet radiation 73. There have been reports linking low plasma levels of α -carotene to cellular aging. A study conducted on sixty-eight elderly participants suggested that higher levels of alpha-carotene may help reduce cellular aging by increasing telomerase activity and thus preventing telomere shortening 74.

Vitamin C

Ascorbic acid, commonly referred to as vitamin C, is a hydrophilic vitamin that serves a crucial function in numerous physiological processes. The robust reducing capacity of vitamin C is a fundamental characteristic that facilitates its ability to transfer electrons to other molecules and counteract the effects of free radicals, as evidenced by scholarly sources (75). The aqueous milieu provides an optimal setting for the light-sensitive compound ascorbic acid to perform its biological activities. Vitamin C is a vital dietary component that performs a pivotal function in sustaining optimal health and mitigating diverse health conditions, such as cardiovascular ailments and scurvy. The robust antioxidant and free radical scavenging properties of ascorbic acid play a pivotal role in protecting tissues, macromolecules, DNA and proteins, from oxidative damage caused by free radicals (76).



Fig. 2: Representative Plant-polyphenols and their Molecular Pathways: Protection against Age-Associated Disease

Conclusion and Future Prospects

The aging process is a complex biological phenomenon that is influenced by both genetic and environmental factors. Unhealthy diet and poor nutrition can accelerate this process, but several recent researches indicate that Indian plant products, rich in antioxidants and polyphenols, can potentially slow down the aging process and enhance overall health. These plant-based supplements have various health benefits. However, more clinical research is required to understand the therapeutic relevance of these metabolites. Further human trials are needed to validate and confirm the anti-aging effects of these plant-based products.

The active substances under consideration exhibit a wide range of preferred targets, which include but are not limited to telomeres and telomerase, SIRT1/AMPK, NF- κ B, and glucose metabolic pathways/insulin-like growth factor-1 pathways. However, the precise mechanism of action of numerous plant-derived compounds remains incompletely comprehended. Furthermore, there is a need for further research to explore the potential of these botanical compounds to function as antioxidants and offer safeguard against DNA harm.

While it is currently believed that conventional herbal treatments are devoid of harmful side effects, welltolerated, and safe, comprehensive randomized controlled trials are required to assess the effectiveness and both short- and long-term impacts of these botanical medicines. The establishment of standardized protocols for the preparation and administration of plant-based supplements is imperative, as is the verification of the purity and potency of these compounds.

REFERENCES

- 1. Hou Y, Dan X, Babbar M, et al. Ageing as a risk factor for neurodegenerative disease. Nat Rev Neurol. 2019;15(10):565-581.
- 2. Wyss-Coray T. Ageing, neurodegeneration and brain rejuvenation. Nature. 2016; 539(7628): 180-186.
- 3. Guo J, Huang X, Dou L, et al. Aging and agingrelated diseases: from molecular mechanisms to interventions and treatments. Sig Transduct Target Ther. 2022; 7(1): 391.
- 4. Rodríguez-Rodero S, Fernández-Morera JL, Menéndez-Torre E, et al. Aging genetics and aging. Aging Dis. 2011; 2(3): 186-195.
- 5. Maxfield M, Stelzer EM, Greenberg J. The final challenge of aging: Death and dying. In: Handbook of the Psychology of Aging. Elsevier; 2021: 119-135.
- 6. World Population Ageing 2019 Highlights. United Nations; 2019.
- 7. Potapova T, Gorbsky G. The Consequences of Chromosome Segregation Errors in Mitosis and Meiosis. Biology. 2017;6(4):12.
- Giorgi C, Marchi S, Simoes ICM, et al. Mitochondria and Reactive Oxygen Species in Aging and Age-Related Diseases. In: International Review of Cell and Molecular Biology. Elsevier. 2018; 340: 209-344.
- 9. Kasote DM, Katyare SS, Hegde MV, et al. Significance of Antioxidant Potential of Plants

and its Relevance to Therapeutic Applications. Int J Biol Sci. 2015; 11(8): 982-991.

- 10. Chen L, Deng H, Cui H, et al. Inflammatory responses and inflammation-associated diseases in organs. Oncotarget. 2018; 9(6): 7204-7218.
- 11. Bast F, Rani P, Meena D. Chloroplast DNA Phylogeography of Holy Basil (Ocimum tenuiflorum) in Indian Subcontinent. The Scientific World Journal. 2014; 2014: 1-6.
- 12. Cohen M. Tulsi Ocimum sanctum: A herb for all reasons. J Ayurveda Integr Med. 2014; 5(4): 251.
- 13. Bayan L, Koulivand PH, Gorji A. Garlic: a review of potential therapeutic effects. Avicenna J Phytomed. 2014; 4(1): 1-14.
- 14. Mikaili P, Maadirad S, Moloudizargari M, et al. Therapeutic uses and pharmacological properties of garlic, shallot, and their biologically active compounds. Iran J Basic Med Sci. 2013; 16(10): 1031-1048.
- Banerjee SK, Maulik SK. Effect of garlic on cardiovascular disorders: a review. Nutr J. 2002; 1(1):4.
- Zugaro S, Benedetti E, Caioni G. Garlic (Allium sativum L.) as an Ally in the Treatment of Inflammatory Bowel Diseases. CIMB. 2023; 45(1): 685-698.
- Kim SR, Jung YR, An HJ, et al. Anti-Wrinkle and Anti-Inflammatory Effects of Active Garlic Components and the Inhibition of MMPs via NFκB Signaling. Harhaj EW, ed. PLoS ONE. 2013; 8(9): e73877.
- 18. Alzohairy MA. Therapeutics Role of Azadirachta indica (Neem) and Their Active Constituents in Diseases Prevention and Treatment. Evidence-Based Complementary and Alternative Medicine. 2016; 2016: 1-11.
- 19. Sujarwo W, Keim AP, Caneva G, et al. Ethnobotanical uses of neem (Azadirachta indica A.Juss.; Meliaceae) leaves in Bali (Indonesia) and the Indian subcontinent in relation with historical background and phytochemical properties. Journal of Ethnopharmacology. 2016; 189: 186-193.
- 20. Singh N, Bhalla M, De Jager P, et al. An Overview on Ashwagandha: A Rasayana (Rejuvenator) of Ayurveda. Afr J Trad Compl Alt Med. 2011; 8(5S): 22-25.
- 21. Aguiar S, Borowski T. Neuropharmacological Review of the Nootropic Herb Bacopa monnieri. Rejuvenation Research. 2013; 16(4): 313-326.
- 22. Gubbannavar J, Chandola H, Harisha C, et al. A

Bacopa monnieri (L.) Pennel and Bacopa floribunda (R.BR.) Wettst. Ayu. 2013; 34(1): 95.
23. Vinholes J, Vizzotto M. Synergisms in alpha-

 Vinholes J, Vizzotto M. Synergisms in alphaglucosidase inhibition and antioxidant activity of Camellia sinensis L. Kuntze and Eugenia uniflora L. Ethanolic Extracts. Phcog Res. 2017; 9(1): 101.

comparative pharmacognostical and preliminary

physico-chemical analysis of stem and leaf of

- 24. Simpson T, Pase M, Stough C. Bacopa monnieri as an Antioxidant Therapy to Reduce Oxidative Stress in the Aging Brain. Evidence-Based Complementary and Alternative Medicine. 2015; 2015: 1-9.
- 25. Bhattacharya SK, Bhattacharya A, Kumar A, et al. Antioxidant activity of Bacopa monniera in rat frontal cortex, striatum and hippocampus. Phytother Res. 2000; 14(3): 174-179.
- Jacob A, Pandey M, Kapoor S, et al. Effect of the Indian gooseberry (amla) on serum cholesterol levels in men aged 35-55 years. Eur J Clin Nutr. 1988; 42(11): 939-944.
- 27. Gopa B, Bhatt J, Hemavathi KG. A comparative clinical study of hypolipidemic efficacy of Amla (Emblica officinalis) with 3-hydroxy-3-methylglutaryl-coenzyme-A reductase inhibitor simvastatin. Indian J Pharmacol. 2012; 44(2): 238-242.
- 28. Rajakumari SB, Jeyaraj DrSS. Review on the Hypolipidemic Effects of Amla (Emblica officinalis) Extract Supplementation. IJRASET. 2022; 10(11): 830-839.
- 29. Sharifi-Rad J, Rayess YE, Rizk AA, et al. Turmeric and Its Major Compound Curcumin on Health: Bioactive Effects and Safety Profiles for Food, Pharmaceutical, Biotechnological and Medicinal Applications. Front Pharmacol. 2020; 11:01021.
- Jyotirmayee B, Mahalik G. Traditional Uses and Variation in Curcumin Contentin Varieties of Curcuma-the Saffron of India. Ambient Science. 2022; Vol. 09(1): 06-12.
- 31. Tomeh MA, Hadianamrei R, Zhao X. A Review of Curcumin and Its Derivatives as Anticancer Agents. Int J Mol Sci. 2019; 20(5): 1033.
- 32. Barzegar A, Moosavi-Movahedi AA. Intracellular ROS protection efficiency and free radical-scavenging activity of curcumin. PLoS One. 2011; 6(10): e26012.
- 33. Razia S, Park H, Shin E, et al. Synergistic effect of Aloe vera flower and Aloe gel on cutaneous wound healing targeting MFAP4 and its associated signaling pathway: In-vitro study. J Ethnopharmacol. 2022; 290: 115096.

- 34. Ruiz-Noa Y, Ibarra-Reynoso LDR, Ruiz-Padilla AJ, et al. Use of herbal medicine for diabetes mellitus in adults from the central-western region of Mexico. Prim Care Diabetes. 2021; 15(6): 1095-1099.
- 35. Pastorino G, Cornara L, Soares S, et al. Liquorice (Glycyrrhiza glabra): A phytochemical and pharmacological review. Phytother Res. 2018; 32(12): 2323-2339.
- 36. Das D, Agarwal SK, Chandola HM. Protective effect of Yashtimadhu (Glycyrrhiza glabra) against side effects of radiation/chemotherapy in head and neck malignancies. Ayu. 2011; 32(2): 196-199.
- 37. Chen SL, Yu H, Luo HM, et al. Conservation and sustainable use of medicinal plants: problems, progress, and prospects. Chin Med. 2016;11:37.
- 38. Mashayekh A, Pham DL, Yousem DM, et al. Effects of Ginkgo biloba on cerebral blood flow assessed by quantitative MR perfusion imaging: a pilot study. Neuroradiology. 2011; 53(3): 185-191.
- 39. Van Beek TA. Chemical analysis of Ginkgo biloba leaves and extracts. Journal of Chromatography A. 2002; 967(1): 21-55.
- 40. Rokot NT, Kairupan TS, Cheng KC, et al. A Role of Ginseng and Its Constituents in the Treatment of Central Nervous System Disorders. Evid Based Complement Alternat Med. 2016; 2016: 2614742.
- 41. Hou W, Wang Y, Zheng P, Cui R. Effects of Ginseng on Neurological Disorders. Front Cell Neurosci. 2020; 14: 55.
- 42. Rocha-González HI, Ambriz-Tututi M, Granados-Soto V. Resveratrol: a natural compound with pharmacological potential in neurodegenerative diseases. CNS Neurosci Ther. 2008; 14(3): 234-247.
- Koushki M, Amiri-Dashatan N, Ahmadi N, et al. Resveratrol: A miraculous natural compound for diseases treatment. Food Sci Nutr. 2018; 6(8): 2473-2490.
- 44. Kumar R, Bhoumik S, Rizvi SI. Redox modulating effects of grape juice during aging. Journal of Basic and Clinical Physiology and Pharmacology. 2019; 31(3): 2019-0144
- 45. Pandey KB, Rizvi SI. Role of resveratrol in regulation of membrane transporters and integrity of human erythrocytes. Biochem Biophys Res Commun. 2014; 453(3): 521-526.
- 46. Boyer J, Liu RH. Apple phytochemicals and their health benefits. Nutr J. 2004;3:5.

- 47. Wojdyło A, Oszmiański J. Antioxidant Activity Modulated by Polyphenol Contents in Apple and Leaves during Fruit Development and Ripening. Antioxidants. 2020; 9(7): 567.
- 48. Rana S, Bhushan S. Apple phenolics as nutraceuticals: assessment, analysis and application. J Food Sci Technol. 2016; 53(4): 1727-1738.
- 49. Wilson MA, Shukitt-Hale B, Kalt W, et al. Blueberry polyphenols increase lifespan and thermotolerance in Caenorhabditis elegans. Aging Cell. 2006; 5(1): 59-68.
- 50. Kalt W, Cassidy A, Howard LR, et al. Recent Research on the Health Benefits of Blueberries and Their Anthocyanins. Adv Nutr. 2020; 11(2): 224-236.
- 51. Devore EE, Kang JH, Breteler MMB, et al. Dietary intakes of berries and flavonoids in relation to cognitive decline. Ann Neurol. 2012; 72(1):135-143.
- 52. Hernández Figueroa TT, Rodríguez-Rodríguez E, Sánchez-Muniz FJ. The green tea, a good choice for cardiovascular disease prevention?. Arch Latinoam Nutr. 2004; 54(4): 380-394.
- 53. Fatima M, Kesharwani RK, Misra K, et al. Protective effect of theaflavin on erythrocytes subjected to in vitro oxidative stress. Biochem Res Int. 2013; 2013: 649759.
- 54. Prasanth M, Sivamaruthi B, Chaiyasut C, et al. A Review of the Role of Green Tea (Camellia sinensis) in Antiphotoaging, Stress Resistance, Neuroprotection, and Autophagy. Nutrients. 2019; 11(2): 474.
- 55. Godoy JA, Lindsay CB, Quintanilla RA, et al. Quercetin Exerts Differential Neuroprotective Effects Against H2O2 and Aβ Aggregates in Hippocampal Neurons: the Role of Mitochondria. Mol Neurobiol. 2017; 54(9): 7116-7128.
- 56. Mishra N, Rizvi SI. Quercetin modulates Na(+)/K(+) ATPase and sodium hydrogen exchanger in type 2 diabetic erythrocytes. Cell Mol Biol (Noisy-le-grand). 2012; 58(1): 148-152.
- 57. Rezaei-Sadabady R, Eidi A, Zarghami N, Barzegar A. Intracellular ROS protection efficiency and free radical-scavenging activity of quercetin and quercetin-encapsulated liposomes. Artif Cells Nanomed Biotechnol. 2016; 44(1): 128-134.
- 58. Bardestani A, Ebrahimpour S, Esmaeili A, et al. Quercetin attenuates neurotoxicity induced by

iron oxide nanoparticles. J Nanobiotechnol. 2021; 19(1): 327.

- 59. Arai Y, Watanabe S, Kimira M, et al. Dietary Intakes of Flavonols, Flavones and Isoflavones by Japanese Women and the Inverse Correlation between Quercetin Intake and Plasma LDL Cholesterol Concentration. The Journal of Nutrition. 2000;130(9):2243-2250.
- 60. Yousefzadeh MJ, Zhu Y, McGowan SJ, et al. Fisetin is a senotherapeutic that extends health and lifespan. EBioMedicine. 2018;36:18-28.
- 61. Hassan SSU, Samanta S, Dash R, et al. The neuroprotective effects of fisetin, a natural flavonoid in neurodegenerative diseases: Focus on the role of oxidative stress. Front Pharmacol. 2022; 13: 1015835.
- 62. Shyong EQ, LuY, Lazinsky A, et al. Effects of the isoflavone 4',5,7-trihydroxyisoflavone (genistein) on psoralen plus ultraviolet A radiation (PUVA)-induced photodamage. Carcinogenesis. 2002;23(2):317-321.
- 63. Yang Z, Kulkarni K, Zhu W, et al. Bioavailability and pharmacokinetics of genistein: mechanistic studies on its ADME. Anticancer Agents Med Chem. 2012; 12(10): 1264-1280.
- 64. Hu Z, Guan Y, Hu W, et al. An overview of pharmacological activities of baicalin and its aglycone baicalein: New insights into molecular mechanisms and signaling pathways. Iran J Basic Med Sci. 2022; 25(1): 14-26.
- 65. Liang S, Deng X, Lei L, et al. The Comparative Study of the Therapeutic Effects and Mechanism of Baicalin, Baicalein, and Their Combination on Ulcerative Colitis Rat. Front Pharmacol. 2019; 10: 1466.
- 66. Gattuso G, Barreca D, Gargiulli C, et al. Flavonoid composition of Citrus juices. Molecules. 2007;12(8):1641-1673.
- 67. Agrawal PK, Agrawal C, Blunden G. Pharmacological Significance of Hesperidin and

Hesperetin, Two Citrus Flavonoids, as Promising Antiviral Compounds for Prophylaxis Against and Combating COVID-19. Natural Product Communications. 2021;16(10):1934578-2110425.

- 68. Kumar R, Akhtar F, Rizvi SI. Protective effect of hesperidin in Poloxamer-407 induced hyperlipidemic experimental rats. Biol Futur. 2021; 72(2): 201-210.
- 69. Lee AY, Choi JM, Lee YA, et al. Beneficial effect of black rice (Oryza sativa L. var. japonica) extract on amyloid β -induced cognitive dysfunction in a mouse model. Exp Ther Med. 2020; 20(5): 64.
- 70. Zuo Y, Peng C, Liang Y, et al. Black rice extract extends the lifespan of fruit flies. Food Funct. 2012; 3(12): 1271-1279.
- 71. Hwang SN, Kim JC, Bhuiyan MIH, et al. Black Rice (Oryza sativa L., Poaceae) Extract Reduces Hippocampal Neuronal Cell Death Induced by Transient Global Cerebral Ischemia in Mice. Exp Neurobiol. 2018; 27(2): 129-138.
- 72. Offord EA, Gautier JC, Avanti O, et al. Photoprotective potential of lycopene, betacarotene, vitamin E, vitamin C and carnosic acid in UVA-irradiated human skin fibroblasts. Free Radic Biol Med. 2002; 32(12): 1293-1303.
- 73. Tan BL, Norhaizan ME. Carotenoids: How Effective Are They to Prevent Age-Related Diseases? Molecules. 2019; 24(9): 1801.
- 74. Fiedor J, Burda K. Potential Role of Carotenoids as Antioxidants in Human Health and Disease. Nutrients. 2014; 6(2): 466-488.
- 75. Naidu KA. Vitamin C in human health and disease is still a mystery? An overview. Nutr J. 2003;2:7.
- 76. Marino A, Battaglini M, Moles N, et al. Natural Antioxidant Compounds as Potential Pharmaceutical Tools against Neurodegenerative Diseases. ACS Omega. 2022; 7(30): 25974-25990.

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