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Efficacy of Plant Extracts in Treating Oxidative Stress and Associated Diseases: A Potential for Anti-Aging Remedies

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Abstract: Aging is a natural process that affects all living organisms including humans. It is characterized by a decline in physiological functioning and physical efficiency, resulting in visible signs such as wrinkles, loss of skin suppleness, and hyperpigmentation. Free radicals play a significant role in the aging process by altering the oxidative properties of structural proteins and activating pro-inflammatory enzyme systems. Plants and herbs have been used for centuries as beneficial tools for supplementary therapy. This study focused on the potential anti-aging properties of three plants: Annona squamosa, Carica papaya, and Aloe vera. A. squamosa leaves are rich in flavonoids, acetogenins, and polyphenols, which have antioxidant properties and enhance collagen production and cellular proliferation. C. papaya contains physiologically active substances, such as papain and chymopapain, and has strong antioxidant and free radical scavenging capacity. Aloe vera has been widely used in traditional remedies, cosmetics, and health foods, and its extracted compounds have been shown to have anti-inflammatory, anti-oxidative, anti-aging, anti-cancer, and immunomodulatory effects. This study aimed to evaluate the efficacy of these plant extracts in treating oxidative stress and associated diseases, with the potential to develop anti-aging remedies that can delay signs of aging.

Keywords: *Aging, Free Radicals, Anti-Aging, Antioxidants, Annona Squamosal, Carica Papaya, Aloe Vera.*

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I. INTRODUCTION

Aging is a natural phenomenon that affects all living things, including humans. Age has an impact on one's physical state and is visible to the naked eye. The aging process is commonly associated with several problems, including wrinkles, loss of skin suppleness, and hyperpigmentation. On human skin, wrinkles are a typical indication of aging.[2] The proteins that give skin its strength and flexibility, collagen and elastin, are produced less frequently, which is the reason behind it. The skin becomes less flexible as a result, and wrinkles or creases start to show. A common consequence of aging is also the loss of skin suppleness. With aging comes a decline in skin suppleness brought on by a decrease in skin cell activity and the generation of collagen and elastin.[1,30]

Dry, pale skin with wrinkles results from keratinocytes losing their ability to generate a functioning stratum corneum and a slowing down of neutral lipid synthesis.

However, excessive exposure to UV radiation from sunshine is what causes photoaging. It is distinguished by shallow, pale, and dry skin that has deep creases and fine wrinkles from the disarray of dermal and epidermal components linked to heliodermatitis and elastosis. Plants and herbs have been shown to be beneficial tools in supplementary therapy.[3,4]

A reduction in physiological functioning brought on by accumulated tissue damage greater than the body's capacity for repair, is the hallmark of aging in mammals.

Once the body reaches a mature state, ageing is the stage of progressive weariness of metabolic processes and physical efficiency. Inducing polymerization reactions, free radicals alter the oxidative properties of collagen, elastin, and membrane materials.[10,12]

Age spots, more precisely dyschromia, melanomas, and wrinkles, are signs of aging skin that are primarily caused by tissue damage by free radicals, which causes structural protein glycation and cross-linking as well as activation of pro-inflammatory enzyme systems.

Anti-aging formulas must contain natural antioxidants that neutralize free radicals. They might be able to provide

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defense against environmental and other agents' harmful effects as well as tissuedamage.[22,6]

Inflammatory processes are the source of biochemical responses that quicken the aging process of the skin because inflammation produces microscopic scars that eventually turn into wrinkles or blemishes. Diverse categories of mediators of inflammation.[23]

Different inflammatory mediators can impact melanocyte proliferation and function, pigment-producing skin cells, and normal cutaneous blood circulation, which can all have an impact on melanin formation. Consequently, natural "anti-inflammatory" ingredients are added to anti-aging products to protect and balance the tone and integrity of the skin. Scientific research has demonstrated the ability of polyphenols to support skin integrity and tone.[32]

There is historical evidence dating back centuries of the use of plants and plant derivatives as remedies. The applications of many herbs, shrubs, and plants have been covered in countless volumes of literature. There is compelling evidence to support the medical benefit of natural chemicals that have been extracted and separated from various plant components, including leaves, fruits, stems, roots, and seeds.[20]

Examples of these sources include green tea, turmeric, red raspberry (Resveratrol), grapes (anthocyanins), grape seed (proanthocyanins), and Indian gooseberry (gallotannins).

A. Annona Squamosal

Within the Annonaceae family, Annona squamosa is a significant medicinal plant that is also referred to as "custard apple." It has several different pharmacological effects and is applied in conventional ways. A. squamosa leaves are a rich source of flavonoids including rutin and hyperoside, which are naturally occurring compounds with a variety of biological characteristics linked to the antioxidant process.[19] Acetogenins and other polyphenols found in A. squamosa leaves likely have an action as free radicle scavengers. Collagen production and cellular proliferation are both enhanced by A. squamosa extract. Given the exceptional antioxidant content of custard apples, it makes sense to use them in pharmaceutical and cosmetic product development.[5]

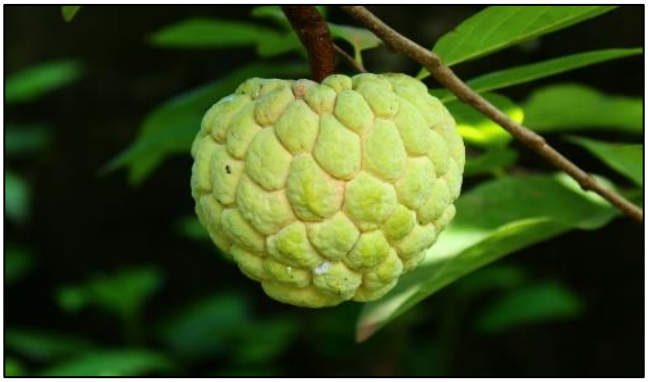

Fig 1: Annona Squamosal

B. Papaya

The scientific name for the delicious and luscious papaya fruit, Carica papaya L., is a member of the Caricaceae family. It is grown all throughout the world, particularly in Europe, tropical America, and India. In essence, papaya trees are short-lived Indian trees. Papaya carica contains a lot of physiologically active substances. Papain and chymopapain are two crucial substances that support digestion. Arthritis can also be treated with papain.Papaya carica has a strong antioxidant and free radical scavenging capacity. Papaya fruit extract from carica is used to evaluate its efficacy in treating oxidative stress and associated illnesses. The cream made from papaya fruit extract has the potential to be an anti-aging remedy that can be applied to postpone the signs of aging.[9,31].

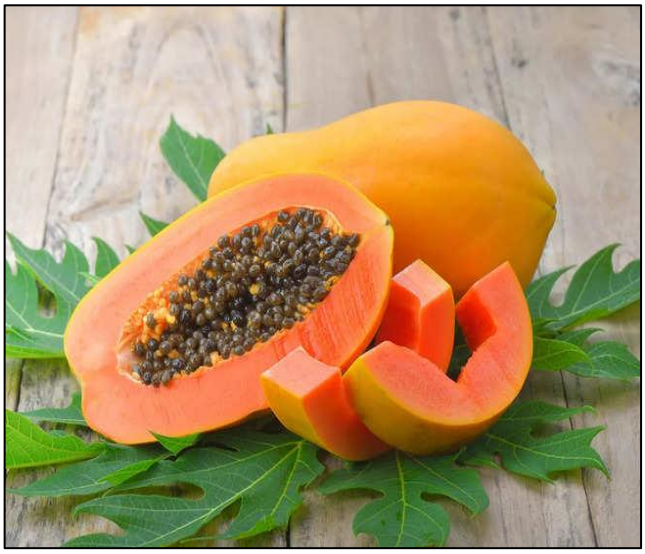

Fig 2: Papaya

C. Aloe

In traditional remedies, cosmetics, and health foods, aloe vera has been widely utilized. Many research have shown that compounds extracted from aloe have a wide range of pharmacological properties, including anti-inflammatory, anti-oxidative, anti-aging, anti-cancer, and immunomodulatory effects, all of which are mediated by ROS levels. Active and stable antioxidants derived from natural sources are being screened in large quantities due to growing concerns regarding the safety of synthetic commercial antioxidants. Considerable research has been done on the possible antioxidant activity of aloe vera leaves, which are historically employed for their medicinal benefits. The growth period was found to be a significant factor in the content and antioxidant capacity of ethanol extracts made from in our prior laboratory investigation.

Aloe is effective at healing burns and wounds and treating stomach ulcers. It also has anticancer, antidiabetic, and anti-tyrosinase qualities.[21,11].

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Fig 3: Aloe

D. Grapes

Numerous foods, such as blueberries, peanuts, and grapes, contain naturally occurring phenolic compounds like resveratrol. Most of the resveratrol in grapes is created in their skin, especially in those impacted by Botrytis cinereal. Its concentration peaks just before the fruits are ready to be harvested, meaning that grape skin and seeds contain the most resveratrol.[15] Resveratrol has been shown to have a wide range of biological advantages, including the capacity to function as an antioxidant to fight inflammation, cancer, immune suppression, hypertension, and high cholesterol. It has also shown promise in the management and prevention of cardiovascular diseases, cancer, obesity, and neurological problems.[27]

Resveratrol, also known as 3,5,4'-trihydroxystilbene, is a polyphenol group that functions as an antioxidant in the environment and is produced by a variety of plants in reaction to oxidative stress, UV light, ozone exposure, and fungal infection**.**[17]

Fig 4: Grapes

E. Pomegranate

Pomegranates, or Punica granatum L., are a type of tiny tree that are native to Asia and Africa and are grown in many nations worldwide. Pomegranates include vitamins and minerals as well as secondary active metabolites such alkaloids, tannins, and polyphenolic chemicals. All plant components have been shown to have astringent, antidiabetic, and hemostatic properties. The bark of the plant is used as an anthelmintic agent. Depending on the climate where the plant grows, the plant yields huge, edible fruits that ripen between September and May.[14] These days, it's thought that pomegranate fruit is one of the primary sources of antioxidant agents with advantageous effects on health and medicine. Each of the many seeds found in pomegranate fruits is encased in a transparent membrane that holds the bright to dark crimson juice within. Because of its potent antioxidant properties, pomegranate juice contains compounds called anthocyanins, lignans, and cinnamic acid derivatives.[16]

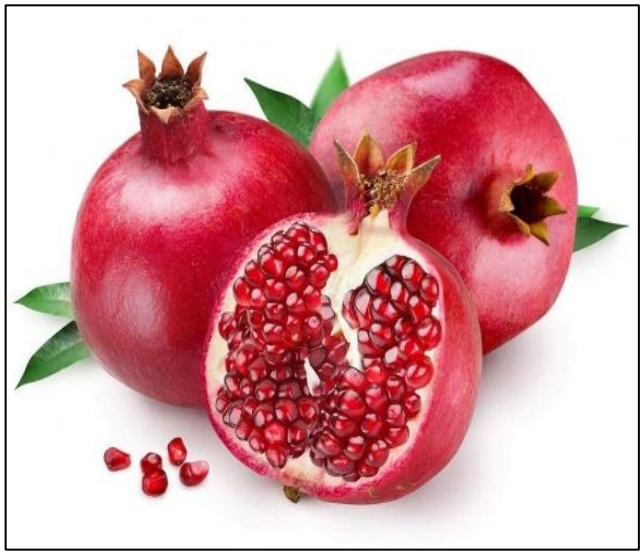

Fig 5: Pomegranate

F. Rosemary

An aromatic member of the Lamiaceae family of plants is Rosmarinus officinalis, L., which is native to the Mediterranean area. One of the main importers and processors of rosemary is the province of Murcia in southeast Spain. One unusual spice that is commercially available for use as an antioxidant is rosemary, which is found in both Europe and the United States. The hepatoprotective, antiangiogenic, and therapeutic properties of rosemary extracts have led to its usage in the treatment of several ailments. Conversely, food preservation has employed them as they avert oxidation and microbiological contamination.

The cyclic diterpene diphenols, carnosolic acid, and carnosol have been found to be the most potent antioxidant components of rosemary. Furthermore, carnosic acid, isorosmanol, methylcarnosate, rosmanol, and epirosmanol are present in its extract.[7]

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Fig 6: Rosemary

G. Tulsi

Tulsi, or Ocimum sanctum in Urdu, is a member of the Lamiaceae family of plants. Its many medical qualities have allowed it to make significant contributions to science both in the ancient and contemporary eras. There are two types of ocimum sanctum: vanya, which grows wild, and gramya, which grows in houses. Ocimum sanctum is prized for its ability to heal the mind, body, and soul and has been utilized for around 5000 years in India.[33] Since ancient times, using plants as human material sources for remedies has been popular. Since ancient times, many different medical systems in India and regional health customs have used a wide variety of plants to treat human ailments.[8] In addition to several nutrients and other biologically beneficial substances, tulsi has a very complicated chemical makeup. These ingredients change considerably over time, depending on how they are cultivated and stored. The overall effects of tulsi cannot be fully replicated using isolated compounds or extracts because the nutritional and pharmacological qualities of the whole herb in its natural state arise from the synergistic interplay of numerous distinct active phytochemicals.[24]

Fig 7: Tulsi

H. Clove

Commonly referred to as clove, Syzygium aromaticum (S. aromaticum) is a medium-sized tree (8–12 m) that is endemic to the east Indonesian Maluku islands and belongs to the Mirtaceae family. Eugenia caryphylata is another name for this species. Clove is one of the primary plant sources of phenolic chemicals, along with flavonoids, hydroxybenzoic acids, hydroxycinnamic acids, and hydroxyphenyl propens. Eugenol is the principal bioactive constituent of cloves. It was discovered that butylated hydroxytoluene (BHT), a synthetic substance frequently used as a food preservative, had antioxidant activity similar to that of clove and caraway. This came about after a range of in vitro models, such as b-carotene linoleate, ferric thiocyanate, 1,1-diphenyl-2-picryl hydroxyl (DPPH) radical, hydroxyl radical, and reducing power model systems, were used to screen for the antioxidant activity of the two plants.[18]

Fig 8: Clove

I. Thyme

Thyme (Thymus vulgaris) is one of the active antimicrobial herbs used in herbal therapy, belonging to the Lamiaceae family of plants. It is more effective against a wider range of bacteria and can inhibit the growth of microorganisms, including Lactobacillus plantarum, Brochothrix thermosphacta, and Brevibacterium linens.[7] Thyme extracts and essential oils include significant concentrations of carvacrol, thymol, and phenols, which are the main sources of this herb's potent antibacterial effects. Thyme extracts and essential oils have demonstrated numerous pharmacological effects, including antibacterial, antioxidant, antitussive, spasmolytic, anticancer, and anti-inflammatory properties. This plant extract has long been used as an anticancer drug because it has antioxidant qualities.[25]

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Fig 9: Thyme

J. Cinnamon

Among the plants that are members of the Lauraceae family are cinnamon (Cinnamomum verum and Cinnamomum zeylanicum). From Asia and Australia, this traditional herbal remedy originated.[13,26]

This plant has several applications in the medical field because of its antibacterial, antioxidant, and anticarcinogenic properties. Previous studies have revealed that cinnamon possesses antibacterial properties. The antibacterial, antioxidant, and antimicrobial qualities of cinnamon have long been recognized. Many microorganisms, including Bacillus and E. coli, have been the subject of previous research on cinnamon's antibacterial properties. Salmonella typhimurium, Bacillus, Enterococcus faecalis, E. Coli, Pseudomonas aeruginosa, Yersinia enterocolitica, and Staphylococcus aureus are among the microorganisms that cinnamon oil has been shown to interact with antibacterially.[28]

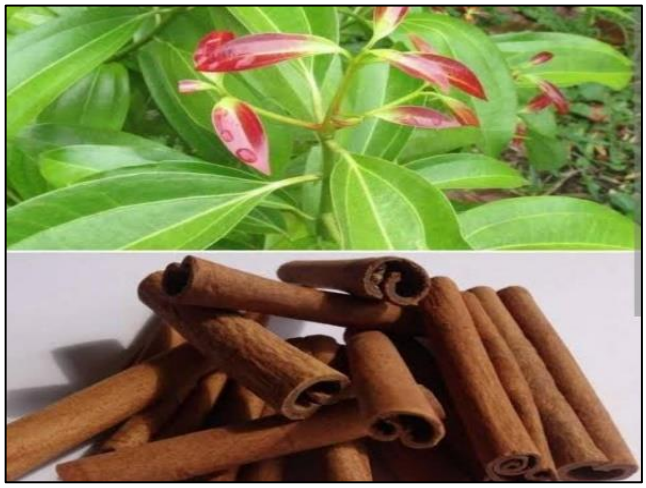

Fig 10: Cinnamon

Table 1: Medicinal Plants and their Antioxidant Activities

Sr no.	Botanical Name of herbs	Common name	Activity of constituent	constituent
1	*Annona squamosa*	Custard apple	Antioxidant	beta- carotene – linoleic acid, vitamin c
2	*Carica Papaya*	papaya	Antioxidant	Vitamin c, gallic acid, terpenoids, alkaloids, flavonoids
3	*Vitis vinifera*	Grapes	Antioxidant	Resveratrol
4	*Punica granatum*	Pomegranate	Antioxidant	Anthocyanins
5	*Aloe barbadensis*	Aloe	Antioxidant	vanillic acid
6	*Salvia rosmarinus*	Rosemary	Antioxidant	Cyclic diterpene diphenols, carnosolic acid, and carnosol
7	*Ocimum tenuiflorum*	Tulsi	Antioxidant	Vitamin A,vitamin c,
8.	*Syzygium aromaticum*	Clove	Antioxidant, antimicrobial, Anti-inflammatory.	Eugenol,eugenylacetate,-humulene,2-heptanone, and caryophyllene
9	*Cinnamomum verum*	Cinnamon	Antioxidant, antimicrobial, anti-inflammatory	Cinnamaldehyde and eugenol
10	*Thymus vulgaris*	Thyme	Antioxidant, antimicrobial,	Carvacrol, thymolandphenols

II. CONCLUSION

Natural anti-aging properties of Annona squamosa, Carica papaya, Vitis vinifera, Punica granatum, Salvia rosmarinus, Ocimum tenuiflorum, Syzygium aromaticum, Cinnamomum verum, Thymus vulgaris, and Aloe vera are highlighted by this study.

The results indicate great potential for creating anti-aging treatments using these plant extracts. They provide a natural substitute for traditional anti-aging treatments by addressing oxidative stress and boosting skin healing mechanisms. To confirm these advantages and investigate their usefulness in cosmetics and wellness products, future research should concentrate on formulating better products and running clinical trials.

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