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A REVIEW: ANTIOXIDENTS PROPERTIES FOUND IN HERBAL PLANTS

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ABSTRACT:

Many of the therapeutic plants that have been utilized for thousands of years are found in the Rasayana family of herbal remedies from the Indian traditional medical system (Ayurveda), which is named for its intriguing antioxidant properties. Some of the medicinal plants utilized in Ayurvedic Rasayana have undergone extensive research on their antioxidant qualities, as part of their therapeutic activity.. Antioxidants play a crucial role in neutralizing harmful free radicals, which are associated with various diseases and aging. This review explores the diverse range of herbal plants known for their antioxidant effects and the underlying compounds responsible for these properties.

INTRODUCTION

Herbal plants: Both ancient and modern societies rely heavily on medicinal plants for their well-being. Because plant-based formulations have therapeutic potential, Ayurveda, an Indian medical system, primarily uses them to treat a variety of human diseases[1]. In comparison to modern medicine, plant-based pharmaceuticals are a valuable source of therapeutic agents due to their non-toxic nature, abundant availability, and relative affordability[2].In recent years, there has been a significant surge in demand for items made from medicinal plants. The health advantages of plants' antioxidant properties are receiving increased attention. Antioxidant molecules, found in many herbs, shield cells from the destructive effects of free radicals.[3]

Oxidative stress has been identified as a fundamental cause of several chronic and degenerative illnesses, including immunosuppression, cancer, diabetes mellitus, atherosclerosis, and others.. Foods, medications, and even living systems can produce free radicals through the crucial pathways provided by the oxidative process [4].

At least 5% of the oxygen (O2) breathed is reduced univalently to produce reactive oxygen species (ROS), such as $O2^{-}$, H2O2, and OH (ref.1).Antioxidants have several ways to deal with reactive oxygen species (SOD removing $O2^{-}$). They can scavenge them, inhibit their formation (by blocking phagocyte activation, for example), bind transition meta ions and prevent OH formation and/or lipid hydroperoxide decomposition, or repair damage (by repairing peroxyl radicals and so terminating the chain reaction, for example, or by any combination of the above2[5].

Reactive oxygen species (ROS), another name for free radicals, are atoms or groups of atoms that have one or more unpaired electrons. They are created when oxygen combines with specific chemicals. Because free radicals are so reactive, as soon as they are created, they can start a chain reaction5. They possess the power to damage biological constituents like proteins, DNA, and cell membranes when they interact with them. Human aging is mostly caused by the buildup of free radicals, which can be stopped by using antioxidants to slow down the growth of free radicals.

In vivo-formed reactive oxygen species (ROS) include H2O2, hydroxyl radicals, and superoxide anion are extremely powerful yet transitory entities that have the ability to do harm. The human body produces them constantly because it needs them for immune system function, chemical signaling, detoxification, and energy provision. But these free radicals, which are created by the sun, UV light, ionizing radiation, chemical reactions, and different metabolic processes, have a wide range of harmful effects, the most well-known of which is Alzheimer's disease. Meningoencephalitis, Creutzfeldt-Jacob disease, and multiple sclerosis are other neurodegenerative illnesses linked to oxidative stress. Significant increases in the particular and long-lasting lipid peroxidation marker F2-isoprostane have been linked to all of these disorders[6].

Antioxidant properties in herbal plants:

Herbal plants are known for their rich content of phytochemicals, many of which possess antioxidant properties. These antioxidants help combat oxidative stress and reduce the risk of various diseases. Some common types of antioxidants found in herbal plants include:

1. **Polyphenols:** These compound are abundantin herbs like green tea (Camelliasinensis), grapes, and berries. They are known for their ability to neutralize harmful free radicals in the body[18]].

2. **Flavonoids:** Found in a wide range of herbs and vegetables, flavonoids contribute to antioxidant activity. Examples include quercetin in onions and catechins in herbs like cocoa and green tea[19].

3. **Carotenoids:** Herbal plants like carrots ,spinach, and sweet potatoes contain carotenoids like beta-carotene, which is a potent antioxidant and precursor to vitaminA[20].

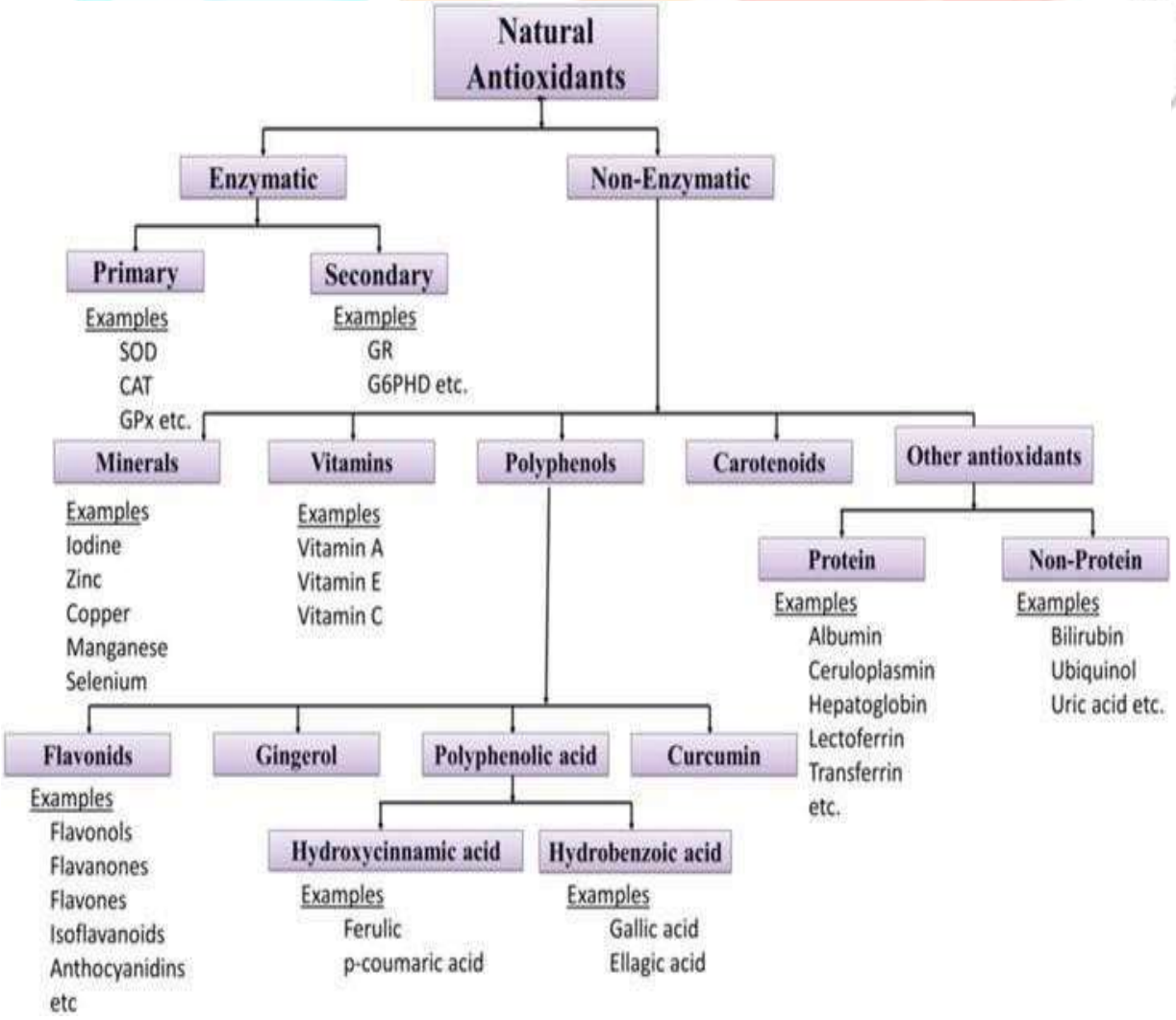
4. **Vitamins:** Herbs like rose hips (rich in vitamin C) and wheatgrass (rich in vitamin E) provide essential vitamins with antioxidant properties[21].

5. **Glutathione:** Some herbs, such as milk thistle, help support the body's production of glutathione, a powerful endogenous antioxidant[22].

6. **Curcumin:** Turmeric contains curcumin, a potent antioxidant and anti-inflammatory compound known for its health benefits[23].

7. **Resveratrol:** Found in grapes and red wine, resveratrol has antioxidant properties and may contribute to heart health.[24].

Flow chart.



Roles of anti oxidants in food and human health:

Eating plant foods rich in antioxidants, such as vitamins C and E, as well as naturally occurring antioxidants including flavonoids, tannins, coumarins, phenolics, and terpenoids, has been shown in recent decades to help prevent oxidative stress and some human diseases.Dietary antioxidants function as oxidative enzyme inhibitors, anti-oxidant enzyme cofactors, metal chelators, and free radical scavengers. As a result, there's been a growing interest in broadening the spectrum of antioxidants that might be supplemented into diets to prevent food from oxidizing. Furthermore, phenolic compounds derived from plants, such as those found in grape seeds, green tea, and fragrant herbs, possess antibacterial properties that guard against illnesses transmitted through food.

Antioxidants which include extracts of plants, BHT, and BHA are commonly utilized as food additives, supplements, or preservatives. Ou et al. (2002) suggest that raising the intake of antioxidant-rich foods could potentially maintain the body's typical physiological processes and antioxidant condition. Although antioxidants are acknowledged as vital phytonutrients, here is at present no suggested daily "total antioxidant" use due to their diversity and complexity. To properly comprehend the antioxidant qualities and health advantages of foods like vegetables and fruits, additional in vitro and in vivo research is thus needed.

Cellular oxidative damage is a factor in a number of diseases, such as diabetes, cancer, heart disease, and macular degeneration. The ways in which antioxidants work and whether or not they can eliminate or inhibit free radicals from human body cells are subjects of further research. Ames et al. (1993) reported that antioxidants protect DNA from oxidative damage, which causes cancer, reduce the risk of Alzheimer's and cardiovascular disease, and improve blood flow to the heart and brain. According to Jo et al. (2006), antioxidants can also prevent or lessen oxidative damage, which is connected to a number of disorders, including cancer, atherogenesis, and aging. Furthermore, it has been documented that the flavan-3-ols in cocoa have a vasodilatory action that enhances blood flow. Studies have shown that coffee contains large amounts of chlorogenic acid.

Protective compounds that can chelate metals, lower the generation of reactive oxygen species (ROS), and scavenge free radicals may be able to delay or perhaps prevent all of these disorders. Enzymatic and non-enzymatic groups make up the body's inherent endogenous antioxidant mechanisms, which work to prevent the synthesis of free radicals. Vitamin C, vitamin E, and β-carotene are nonenzymatic antioxidants, whereas glutathione peroxidase, catalase, and superoxide dismutase are examples of enzymatic antioxidants. Antioxidant phytochemicals such as lutein, lycopene, and polyphenols can shield the body against oxidative damage.

While the antioxidant properties of phytochemicals have garnered a lot of attention, it is also acknowledged that non-antioxidant effects, such as those on gene expression and cell signaling, are critical for general health.[25]

Common Herbal Plants with Antioxidant Properties:

1. Green tea (Camellia sinensis): Green tea has powerful antioxidants called catechins, namely epigallocatechingallate (EGCG), which have been connected to a number of health advantages.
2. Turmeric (Curcuma longa): The active ingredient in turmeric, curcumin, is a potent antioxidant with anti-inflammatory qualities.
3. Ginkgo Biloba (Ginkgo biloba): Antioxidants including flavonoids and terpenoids are present in ginkgo biloba extract and may help prevent oxidative damage.
4. Milk Thistle (Silybummarianum): Milk thistle contains silymarin, a potent antioxidant with liver-protecting qualities.
5. Aloe Vera (Aloe barbadensis miller): Antioxidants including vitamins C and E are present in aloe vera gel, which helps the plant heal skin.
6. Rosemary (Rosmarinusofficinalis): Antioxidants carnosic acid and rosmarinic acid, which are found in rosemary, can shield against oxidative stress and inflammation.
7. Ginger (Zingiberofficinale): The active ingredient in ginger, gingerol, has anti-inflammatory and antioxidant qualities.
8. Ginseng (Panax ginseng): Studies are being done on the antioxidant qualities of ginsenosides in ginseng and their potential to lessen oxidative stress.It has been demonstrated that ginseng polysaccharides have immune-boosting and antioxidant qualities.
9. Amla (Emblicaofficinalis): Often referred to as Indian gooseberry, amla is a powerful antioxidant that boosts immunity and general well-being. It is also a rich source of vitamin C.
10. Bilberry (Vacciniummyrtillus): Rich in antioxidants called anthocyanins, bilberries may improve circulation and eye health.
11. Grapes and Vitisvinifera Grape Seed Extract: Resveratrol is one of the many antioxidants found in grapes. Due to its possible benefits for the cardiovascular system and its role inresveratrol its role in combating oxidative stress.[26]

Table1. A brief discussion on some antioxidant plants:

Botanical/ Familyname	**Common/ English name**	**Partused**	**Chemical Constituents**	**BiologicalActivities**
(Zingiberaceae) Curcuma longa	Turmeric	Leaf	Eugenol, camphene, curcumin, bpinene, and B-sitoserol	For blood purification, managing hsponoea and cough, as a fertility aid, treating malaria, acting as an efetor for senile pruritis, treating gastrointestinal issues, and preventing fungal growths .
Convolvulaceae: CuscutareflexaRoxb.	Akashabela	Stem	Comarins, dulcitol, bergenin, gycosides, lactone, and flavonoids	anthelmintic, expectorant, carminative, purgative, diureic, used in bilious illnesses, jaundice, and as an antifertility medication
DaucuscarotaLinn (Apiaceae)	Carrot	Root	Sugars, glucose, alkaloids, glycosides, carotenoids, and quatemary bases	piles, leprosy, tumors, jaundice, bronchitis, chest problems, urinary issues, aphrodisiac, piles, .

Eugenia officinalis Gaertn., syn. Phyllanthusemblica Linn. (Euphorbiaceae)	AmlaEmblic Myrobalan	Fruit	Pyhphenols (galic acid, tannins, ellagic acid), vitamin C (ascorbic acid), and	beneficial for piles, anemia, burning feelings, vomiting, diarrhea, leprosy, constipation, and inflammations.It is said that amla possesses greater antioxidant power than vitamin C.
Foeniculum vulgare (Apiaceae)	Saunf Fennel	Fruit oil	volatile oil, limonene, anisaldehyde, anethole, fenchone, and estragole	stimulant, fragrant, carminative, purgative, diuretic, beneficial in treating kidney and spleen problems, vermicide, and in venereal disorders. As reference antioxidants, burylated hydroxytoluene (BIT) and atocopherol have antioxidant activity similar to that of fennel oil.
Mangifera indica Linn. (Anacardiaceae)	Mango	RootLeaf, Fruit	Vitamins A and C, polyphenols, and oyanogenetic glycosides ,	gastrointestinal tract hemorrhage, diarrhea, bronchitis, biliousness, and urine discharges .

Glycyrrhizaglabra Linn. (Fabaceae)	Mulathi Liquorice	Root	Flavonoids, rhamnoliquiritin, 2-methyl isoflavones, glycyrhizin, and lichiditin	Diuretic, emmenagogue; used in peptic ulcer, acute conjunctivitis, bronchitis, asthma, and wound healing.

Anti-oxidant role in disease:-

1. **Alzheimer-related disease:-** A neurological ailment that progresses over time and for which there is no recognized cause is Alzheimer's disease, or AD. Particularly in older adults, it is typified by memory loss and neuronal degeneration [27]. The pathophysiology of AD has been linked to OS [28], based on the discovery of several features, including increased lipid peroxidation, in particular brain regions during postmortem investigations [29]. Elevated activity of superoxide dismutase, glutathione reductase, glutathione peroxidase, and catalase in the hippocampus and amygdale has been documented by several researchers.

2. Cognitive impairment in the elderly: As the most severe type of clinical dementia, Alzheimer's dementia, can develop from cognitive impairment, which affects approximately 5% of people over 65 [30]. Healthy individuals who are 60 years of age or older have blood that is high in vitamin C and has memory function, according to Goodwin [31].Perry concluded that there was a positive relationship between memory performance and plasma levels of β-carotene and vitamin C that were evaluated twice [32].

3. **Parkinson disease (PD):** Data from postmortem analyses of PD patients' brains indicate that OS plays a critical role in the degeneration of pigmented dopaminergic neurons in the substantianigra pars compacta (SNpc) [33]. During dopamine metabolism, one theory proposed for OS in the SNpc is the formation of ROS. Dopamine oxidation products in the human SNpc may polymerize to generate neuromelanin, which may also be dangerous [34, 35]. Postmortem investigations have shown that individuals with Parkinson's disease had large reductions in GSH (60%) and small increases in oxidized glutathione (GSSG) (29%) in their SNpc [36].

4**. Huntington's illness**: Parkinson's disease is characterized by movement issues and is caused by a polyglutamine tract formed at the N terminus of the gene encoding the protein huntingtin [38]. A number of postmortem investigations have found elevated iron levels in the striatum of people with Huntington's disease [39].

5. Amyotrophic lateral sclerosis (ALS): ALS is a disease that often manifests in middle age and is defined by a gradual and distinct degeneration of both upper and lower motor neurons in the cerebral cortex and spinal cord. Any kind of ALS could be caused by OS [40]. In mutant CuZnSOD animals, levels of vitamin E and malondialdehyde (MDA), a measure of lipid oxidation, increased with time.

6.**Schizophrenia and tardive dyskinesia**: Excessive ROS levels have been reported in both neuroleptic-induced tardive dyskinesia and schizophrenia [42]. Changes in the levels of enzymatic and nonenzymatic antioxidants in chronic naïve first-episode patients and higher levels of lipid peroxidation products in plasma and CSF imply that oxidative damage may play a role in the pathophysiology of schizophrenia [43, 44].

7 Materials that are neurotoxic: Research has demonstrated that several neurotoxic materials accelerate the production of reactive oxygen species (ROS) in lab animal brains. Other organic solvents, methylmercuric chloride, toluene, and cadmium are a few examples [45, 46]. The intracellular calcium ion levels can all be increased by these drugs [47].
8. Brain aging: Graying hair, delayed wound healing, and an increased risk of disease and mortality appear to be brought on by normal metabolic and developmental processes in mammals. Extant literature has indicated that oxidative stress can cause damage to macromolecules such as proteins, lipids, and DNA, particularly in the brains of the aged [48–50]. The hypothesis that oxidative damage is the main cause of aging is supported by these results.

9. **Diabetes mellitus:** The bodies of diabetics are more reactive to oxidative stress. Activation of NADPH oxidase, auto-oxidation of glucose, and direct enzyme inhibition due to hyperglycemia are some of the explanations proposed, while the exact mechanism remains unknown. Oxidative stress manifests as elevated amounts of peroxidation of lipid products, erythrocyte fragility, and decreased levels of the antioxidants enzyme systems (CAT, GSH-PX, and SOD)[51–53].

10. **Asthma:** It is well-known that oxidative stress is a contributing factor in both human and feline asthma. The pathophysiology of asthma is influenced by the ROS produced by these cells [54, 55].

11. Atherosclerosis: This is a well-known condition in which LDL is oxidized by a variety of oxidants via various routes and mechanisms. One enzyme that is secreted by phagocytes and linked to the pathophysiology of atherosclerosis is MPO. Additional organisms that may play a role in atherosclerosis are species of reactive nitrogen. Nitric oxide (NO) is not an oxidant with much power.Nevertheless, it quickly combines with O2 to form peroxide, which converts LDL to a state linked to atherosclerosis [56].

12 Heart failure: An expanding corpus of studies suggests that reactive oxygen species (ROS) play a significant role in the development and progression of heart failure.

13. Hemorrhagic shock: Acute hemorrhagic shock decreases cardiac contractility and function and is associated with a rise in PMN leukocytes' capacity to produce oxygen free radicals (OFR) [57].

14 **Trauma resulting from ischemia**-reperfusion: It is widely accepted that reactive oxygen species-derived metabolites and radicals influence the pathophysiology of anoxia/reoxygenation and

ischemia-reperfusion trauma. When ischemia cells receive blood flow again after being depleted of oxygen (O2), free radicals are created.

15 **Lung disease**: Because of the endothelium's broad surface area, the lung is continuously exposed to many air contaminants, including fuel emissions, tobacco smoke, ozone, and nitrogen dioxide. Furthermore, the lung is constantly vulnerable to oxidative damage due to the naturally oxidizing nature of the environment (21% O2) [58].

16. Aging: The free radical theory of aging encompasses the following: phenomenological assessments of age-related oxidative stress; interspecies comparisons; dietary restriction; metabolic activity and oxygen tension manipulation; pharmacological and dietary antioxidant treatment; in vitro senescence; classical and population genetics; molecular genetics; transgenic organisms; research on aging-related human diseases; epidemiological investigations; and the continuing deciphering of the biologic function of active oxygen [59].

17. Cancer and free radicals: Oxygen (dioxygen)-reduction intermediates affect DNA's deoxyribosyl backbone as well as its bases, causing endogenous damage. Other cellular constituents including lipids have also been demonstrated to be targets of OFR, which results in reactive species that can attach to DNA bases [60].

18. **Inflammation:** Phagocytosis, often called the respiratory burst, increases the amount of oxygen that cells take up. In rheumatoid arthritis, hexose monophosphate shunt activation increases the production of NADPH, as well as O2, H2O2, OH, and hypochlorous acid (HOCI), as well as reactive oxygen species (ROS), hypoxanthine concentration, and xanthine oxidase activity [61].

19. **Ocular disease**: Oxidative stress has been linked to cataracts and age-related macular degeneration by producing photochemical or nonphotochemical changes in several cell types in the eye [62]. Cataracts can occur as a result of crystalline protein clumping and cross-linking in the lens due to free radical activity [63, 64].

20. **Fetus:** Oxidative stress is implicated in several processes leading to preeclampsia and fetal growth restriction, according to prenatal medicine. ROS/RNS may play a role in the pathophysiology of both intrauterine development retardation and preeclamptic pregnancy, according to certain study that shows higher blood levels of lipid peroxidation products (F2-isoprostanes, MDA) in both circumstances [65]. NADPH oxidase 1 and 5 isoforms, the primary enzymatic generators of superoxide in the placenta, are observed to be expressed more frequently in preeclamptic pregnancies [66].

Conclusion:

Herbal plants are an excellent source of antioxidants, with numerous phytochemicals contributing to their beneficial benefits on health. Incorporating these plants into dietary and therapeutic practices may offer protection from oxidative stress-related health problems. More research is required to explore the full potential of herbal plants in preventing and treating oxidative stress-related diseases.

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