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# ROLE OF OXIDATIVE STRESS IN SKIN DISEASES AN AYURVEDIC APPROACH

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## ABSTRACT

**Background:** All skin diseases are discussed in Ayurveda under the name *Kushtha*, which can be translated as "Ayurveda Dermatology." *Kushtha* is divided into seven *Maha Kushtha* and eleven *Kshudra Kushtha* types. In general, differential diagnosis and identification of a specific *Kushtha* are difficult since original *Ayurvedic* texts lack simple instruments or photographs. To address this issue, a thorough review of the literature on skin diseases was conducted to uncover all of the clinical features that patients exhibit consistently. This article focuses on the skin diseases that are caused by oxidative stress. ROS can be generated as a result of environmental insults such as cigarette smoking and ionizing irradiation, but the majority of ROS are produced by intracellular sources during normal body activity. **Objective:** To understand the concept of oxidative stress in the manifestation of skin disease and the role of Ayurveda in reducing oxidative stress. **Material and Methods:** Relevant materials were searched from sources such as published books, journals, and the internet, and a critical review was done over the same. **Result and Conclusion:** There is a significant role of oxidative stress in the pathology of skin manifestation. The disease manifested by the skin has a significant impact on our quality of life, productivity, and mental health. *Ayurvedic* medicine, the practice of *Yoga, and Rasayan* therapy play an important role to reduce oxidative stress and help in treating skin diseases.

**Keywords:** *Kushtha*, Oxidative stress, ROS.

## INTRODUCTION

The skin, which is the body's outermost layer, is responsible for establishing a barrier between the internal and external environments. Furthermore, having healthy skin is a prerequisite for attractiveness, as is having an appealing personality, all of which are simple human instincts. Oxidative stress is a condition that occurs when there is a mismatch between the development of reactive oxygen species (ROS) and the biological system's ability to quickly detoxify these reactive intermediates or repair the damage they cause.[1] Skin disorders are discussed in Ayurveda under the name *Kushtha*, which can be translated as "Ayurveda Dermatology."[2] It has no connection to allopathic skin diseases, but it can cover all dermatological manifestations under the eighteen subtypes of *Kushtha.* According to Ayurveda, "*Kushtha"* is a disease that tears or takes out the beauty of the body and any form of skin disease. *Kushtha* is a disease in which the skin discolors and, if not treated properly, eventually results in disfigurement. However, it is important to perform a critical study of skin diseases since most patients present with similar clinical symptoms with little differences in the characteristics. As a result, diagnosing the diseases one by one is difficult. Conducting a thorough investigation into skin diseases and the development of diagnostic tools will aid in resolving this problem.[3]

According to Ayurveda *Aam* is the reason behind various diseases. *Aam* is the undigested component of food that is not confined to the gastrointestinal tract and, if present on a long-term basis, can spread throughout the body, causing a variety of diseases and *Agnimandhya* causes *Aam*, which is characterized as a loss of appetite or the inability to metabolize at both the gastrointestinal and cellular levels.[4] *Ama, Agnimandhya*, metabolic dysfunction, and oxidative stress are all linked in this way. Ayurveda treats oxidative stress on various levels, and since it is a holistic science, it is highly personalized.[5]

Chronic inflammatory disorders such as rheumatoid arthritis, lupus erythematosus, psoriatic arthritis, as well as skin diseases, have all been linked to oxidative stress. Excessive development of free radicals and/or an impaired antioxidant defense mechanism causes oxidative stress. Excessive free radicals have been linked to female reproductive tract pathologies in studies.[6] 'Oxidative stress' is described as an imbalance between oxidants and antioxidants that favors the oxidants and may cause harm. The production of oxidants is a natural by-product of aerobic metabolism, but it can be increased in pathophysiological conditions. Antioxidant defense entails a variety of enzymatic and non-enzymatic techniques.[7] Free radicals, which are generated as a result of oxidative stress, are thought to play a role in aging and a variety of diseases, including neurodegenerative diseases, chronic inflammatory diseases, cancer, skin disorders, and cardiovascular diseases.

**What is oxidative stress and how is it counteracted?**

The potential role of oxidative stress in the development of tissue damage is addressed. Oxidative stress is characterized as a disruption in the equilibrium between the production of reactive oxygen species (free radicals) and antioxidant defenses.[8]

The skin serves as a vital shield against ultraviolet (UV) irradiation, contamination, and other harmful factors that cause oxidative stress. Keratinocytes, melanocytes, and fibroblasts, as well as immune cells such as T cells, neutrophils, and macrophages, make up the skin. Skin aging and a variety of skin disorders, including skin cancers, are exacerbated by oxidative stress, which changes signaling pathways in these cell types.[9]

Reactive oxygen species (ROS) from the atmosphere and skin metabolism are the primary causes of oxidative stress in the skin [10]. While endogenous antioxidants reduce the harmful effects of ROS, free radicals can override ROS defense mechanisms and mediate a variety of cellular responses that contribute to the development of a variety of skin disorders. Oxidative stress occurs when the amount of oxidants in the body exceeds the antioxidant defense system's ability, resulting in chronic inflammation, which can lead to collagen fragmentation and disorganization, as well as skin cell functions, and thus contribute to skin diseases such as cancer.[11]

Oxidative stress is linked to skin wrinkling and has been linked to skin disorders in humans. It's been proposed that it's involved in the development of human skin cancers.[12] Reactive oxygen species (ROS) play a role in the pathogenesis of a variety of allergic and inflammatory skin conditions.[13]

One of the main factors in the pathogenesis of atopic dermatitis tends to be oxidative stress. It not only affects the skin's cellular structures directly, but it also increases dermal inflammation, weakens the skin barrier function, and allows microbial pathogens to invade the skin.[14]

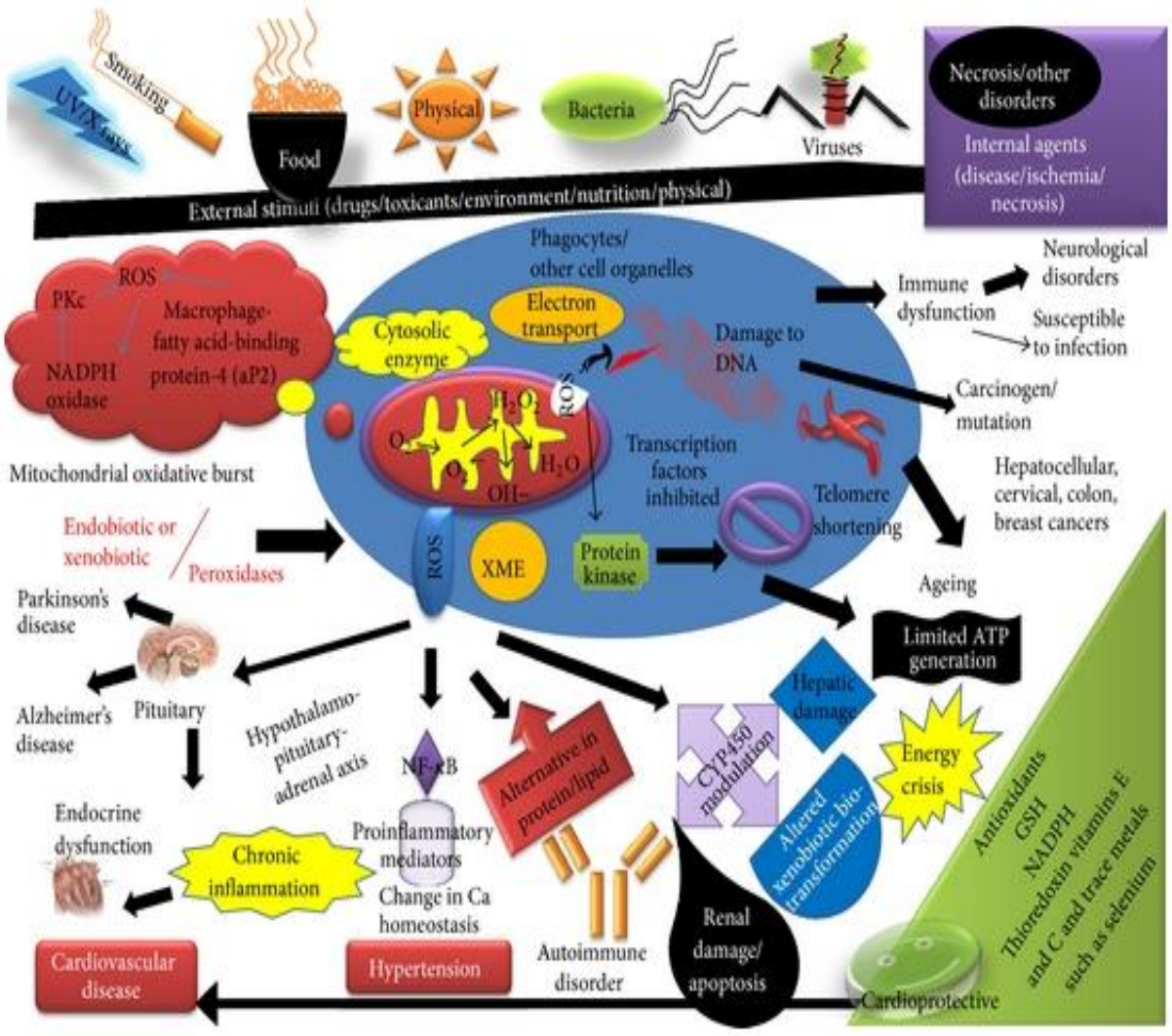
**Oxidants in skin**

Excessive amounts of ROS are produced by skin exposure to ionizing and UV radiation, as well as xenobiotics/drugs, which easily overwhelm tissue antioxidants and other oxidant-degrading pathways. The pathogenesis of a variety of human skin disorders, including cutaneous neoplasia, is linked to the uncontrolled release of reactive oxygen species (ROS).[15]

Gaseous airborne environmental pollutants produced by vehicles and other industrial sources, UV radiation, food contaminants/additives/preservatives, cosmetic goods, medications, and other factors all contribute to oxidative stress in the skin. Furthermore, heme pathway intermediates can have pro-oxidant properties, while heme oxygenase, a degrading enzyme, may act as both an antioxidant and a pro-oxidant.[16] Many of these agents may produce ROS or their metabolites, such as redox-active quinones, which may play a role in the pathogenesis of a variety of skin disorders, allergic reactions, and cancers.[17]

**Role of oxidants in skin diseases**

There is strong evidence that oxidative stress causes the production of oxidation products like 4-hydroxy-2-nonenal or malonaldehyde, which can denature proteins, alter apoptosis, and affect the release of pro-inflammatory mediators like cytokines, all of which may be important in the development of certain inflammatory skin diseases.[18] This is also focused on the fact that ROS can serve as second messengers in the induction of a variety of biological responses, including the activation of NF-kB or AP-1, the production of cytokines, the regulation of signaling pathways, and so forth. The recent discovery that peroxisome proliferator-activated receptors, whose natural ligands are polyunsaturated fatty acids and their oxidation products, may be involved in the pathogenesis of psoriasis and acne, has bolstered the idea that ROS may play a role in the pathogenesis of these diseases.[19]




All pathogens with impaired antioxidant defenses, whether bacterial, viral, or parasitic, are more susceptible to phagocytic killing in the host tissues, suggesting that ROS plays a microbicidal function. Individuals with a deficiency in anti-oxidative mechanisms, on the other hand, are more vulnerable to serious bacterial and fungal infections, according to various reports [20]. Reactive species are important in killing pathogens, but they can also damage host tissues as a side effect (immunopathology). This is especially true during chronic inflammation, which can result in significant tissue damage and a spike in oxidative stress.[21]

To combat invading bacteria, macrophages and neutrophils produce free radicals. The entire process takes place in host cells during phagocyte activation or the reactivity of bacteria, viruses, parasites, and their cell products with unique receptors.[22] The multicomponent flavoprotein NADPH oxidase catalyzes the development of superoxide anion radicals in inflammatory processes, and excessive production of reactive oxygen species (ROS) causes cellular harm. In general, these cellular damages modify immune responses to microbes, resulting in increased vulnerability to bacterial, viral, and parasitic infections.[23]

**Management of oxidative stress**

Treatment goals should include:

(1) Decreasing environmental insults and psychological stress.

(2) Improving skin barrier function by hydration and emollients.

(3) Investigating anti-inflammatory and immune-modulatory agents as second-line therapy.

(4) Using oral antioxidant supplements such as an adequate number of daily vitamins and melatonin as second-line therapy. At this point, well-designed clinical trials are required to thoroughly examine such interventions with the ultimate aim of improving patients' overall quality of life as well as relieving symptoms.

Many chronic diseases, including cancer, are induced and progress by oxidative damage caused by an excess of free radicals and antioxidants. Multiple signaling pathways, growth factors, transcription factors, kinases, inflammatory, and cell cycle regulatory molecules are known to be activated by oxidative stress in cancer cells, causing transformation, survival, proliferation, metastasis, and chemoresistance.[24] Antioxidant pathways triggered by internal or external sources, on the other hand, counteract oxidative stress. Due to a lack of internal antioxidants in the body system, additional antioxidants must be supplemented by dietary or medicinal plants. *Ayurvedic* medicine, which uses a variety of medicinal plants to improve antioxidant activity, has been shown to have a lot of promise. *Ayurvedic* plants have a wide range of well-known properties, including antioxidant, anti-inflammatory, antiviral, antimicrobial, anti-ulcerative, anti-diabetic, anti-genotoxic, anti-carcinogenic, and many more.[25]

Ayurveda lays out a holistic approach to living a long and stable life. Ayurveda experts used complex treatments to combat oxidative stress thousands of years ago.

Mental, emotional, physical, and environmental stress all contribute to the body's natural antioxidant response and circulate free radicals being unbalanced. They've been related to degenerative diseases when they're out of control.

A variety of *Ayurvedic* methods that promote normal antioxidant development are used to balance the number of free radicals and antioxidants. An antioxidant is a molecule that can donate an electron to a free radical, reducing its reactivity and increasing its stability.

**Antioxidant foods from Ayurveda**

Ayurveda recommends a diet of whole, unprocessed, unrefined foods cooked slowly over low heat and a season-appropriate diet. According to one's body type whole foods like fruits and vegetables, as well as spices like turmeric, garlic, and saffron, are high in antioxidants like proanthocyanins, anthocyanins, vitamin E, and vitamin C.[26]

***Rasayanas***

*Rasayanas* are strong free radical scavengers that usually contain polyphenols, bioflavonoids, catechins, carotenoids, and vitamins C and E. Surprisingly, among Ayurveda's major branches, the research of "*Rasayanas*" is mainly concerned with immune system strengthening. In fact, "*Rasayana"* means "that which supports *Rasa" – Rasa* being equivalent to plasma and chyle and said to nourish all bodily tissue.[27] According to Ayurveda, *Amalaki* is considered one of the most nourishing and rejuvenating herbs. In reality, according to Charak, "*Amalaki* is revered as one of the most powerful and nourishing *Rasayanas*; *Amalaki* is the best among rejuvenating herbs." *Amalaki* is a powerful natural antioxidant with high levels of vitamin C that serves as an immune booster. *Amalaki* is one of the best natural sources of vitamin C, with 20 times the vitamin C content of an orange. The Sanskrit word "*Amalika*" means "sour juice of the fruit." *Amalaki* is also known as Indian gooseberry or *Amla*.[28]

***Yoga-*** *Yoga* not only benefits the body and mind, but also boosts the immune system, decreases oxidative stress, and boosts antioxidant levels. Reduced oxidative stress and increased antioxidant levels are all important factors in preventing aging, cancer, heart disease, and a variety of other diseases.[29] Many studies have found that after practicing *Yoga*, oxidative stress markers are reduced, and antioxidants are increased.[30]

**Adaptogens from Ayurveda for oxidative stress**

Finally, adaptogenic herbs are one of Ayurveda's key methods for dealing with oxidative stress. These herbs assist us in dealing with stress without overstimulating the body and causing it to produce more stress hormones. They help the body's stress-response reserves cope with stress more easily and calmly.[31-38]

| Plant | Antioxidant responses | Active antioxidant effects and known or putative compounds |
|---|---|---|
| *Withania somnifera* | Active stimulation and passive antioxidants | Stimulation due to sitoindosides VII–X and withaferin A (glycowithanolides; Bhattacharya et al., 1997; Vimal et al., 2010) |
| *Centella asiatica* | Active stimulation and passive antioxidants | Enhances glutathione levels, thiols, and antioxidant defenses (Shinomol and Muralidhara, 2008; Shinomol et al., 2010). Antioxidant in three pathways: superoxide free-radical activity inhibition of linoleic acid peroxidation and 2,2-diphenyl-1-picryl-hydrazyl (DPPH) radical scavenging activity (Vimala et al., 2003; Pittella et al., 2009). Reduces monamine levels that can spontaneously auto-oxidize to free radicals (Bindoli et al., 1992). Exact compounds remain to be identified |
| *Asparagus racemosus* | Active stimulation and passive antioxidants | Prevents decline in GPX activity and reduction in glutathione (GSH) content and reduces membrane lipid peroxidation and protein carbonyl content (Parihar and Hemnani, 2004). Compensates reduction in the superoxide dismutase, catalase, ascorbic acid, and lactate dehydrogenase levels and lowers the heightened MDA levels (Vimal et al., 2010). Exact compounds remain to be identified |
| *Acorus calamus* | Active stimulation and passive antioxidants | Decrease GSH and GST and increase dopamine receptors (Shukla et al., 2002). Increases the activities of major enzymes of the antioxidant defense system, especially SOD, CAT, and GPX and the levels of GSH and decrease in the formation of MDA (Sandeep and Nair, 2010). Exact compounds remain to be identified |
| *Bacopa monnieri* | Active stimulation and passive antioxidants | *Bacopa monnieri* extracts modulate the expression of certain enzymes involved in the generation and the scavenging of reactive oxygen species in the brain (Govindarajan et al., 2005). Exact compounds remain to be identified |
| *Celastrus peniculatus* | Active stimulation and passive antioxidants | Causes significant decrease in the brain levels of MDA and increases in levels of glutathione and catalase (Kumar and Gupta, 2002). Superoxide dismutase activity is unaffected by extracts but catalase activity is increased and MDA levels are reduced (Godkar et al., 2006). Exact compounds remain to be identified |
| *Convulvulus pleuricaulis* | Known passive antioxidants only | Given the antioxidant effects it is likely that there is likely stimulation of active antioxidant responses too that yet remains to be characterized |
| *Curcuma longa* | Known passive antioxidants only | Given the antioxidant effects it is likely that there is likely stimulation of active antioxidant responses too that yet remains to be characterized |

## CONCLUSION

According to available research, *Ayurvedic* herbs such as *Triphala* and *Ashwagandha* contain a wide range of bioactive compounds (flavonoids, phenolics, carotenoids, etc.) with a variety of pharmacological effects that may help to reduce oxidative stress, boost antioxidant defenses, and promote rejuvenation. The biological effects of herbal rejuvenators are mediated by a variety of signaling pathways (most notably the NF-B pathway), chelating mechanisms, and cytoprotective effects.[39] The antioxidant benefits of *Ayurvedic Rasayana* herbs are undeniable and unstoppable, even though available reports are restricted in depicting the exact mechanistic mechanisms of action of these botanicals. However, more comprehensive in vitro and in vivo research is needed to isolate active concepts and their pharmacological validation, examine herb-drug interactions, conduct safety assessments, and investigate those aspects that are still unknown.

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