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IMPACT OF GOOD AGRICULTURAL PRACTICES ON THE ANTIOXIDANT LEVELS IN MEDICINAL PLANTS

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ABSTRACT

Background: Oxidative stress and free radicals are known to be harmful to human health. A large number of studies demonstrates that in fact free radicals contribute to initiation and progression of several diseases, ranging from CVD to cancer. Antioxidants can be very useful in preventing, managing, or treating human diseases, they are not generating any adverse effects. Due to toxic nature of synthetic oxidants preferences have shifted to the natural antioxidants. Trend toward the use of natural substance present in medicinal plants as therapeutic antioxidants is increased. In order to ensure the sustainability of high-quality Antioxidant rich medicinal plants good agricultural practices should be followed. **Aim:** To study good agricultural practices and their impact on production of plants rich in antioxidant levels. **Materials and Methods:** A comprehensive literature search was conducted to identify relevant studies and articles on the Impact of Good Agricultural Practices on the Antioxidant levels in Medicinal Plants. The data used in current study was gathered from databases such as PubMed, Google Scholar, and indexed – non indexed, peer review journals and widely dispersed research e-publications. **Discussion:** Good Agricultural Practices like use of authenticate medicinal plants, Seeds and other propagation materials, Cultivation practices, fertile soil and proper plant maintenance and protection enhances plant growth and productivity. these leads increase the levels of health-promoting bioactive compounds like Antioxidants in plants. **Conclusion:** This review shows that Good Agricultural Practices

should be adopted to ensure the sustainability of high-quality medicinal plants rich in bioactive compounds like Antioxidants.

KEYWORDS: Good Agricultural Practices, Antioxidant, Medicinal Plants.

INTRODUCTION

The overproduction of ROS by metabolic reactions that use oxygen and shift the balance between oxidant/antioxidant statuses is called oxidative stress. ROS are produced by cellular metabolic activities and environmental factors, such as air pollutants or cigarette smoke and different toxins.[1] oxidative stress leads to many diseases including metabolic syndrome, atherosclerosis, cardiovascular disease, cancer, neurodegenerative disorders, diabetes, infertility, renal diseases, gastrointestinal and hepatic diseases.[2] Antioxidants are substance which protect the body against oxidative stress.[3] Antioxidants are substances that delay/prevent the autoxidation process of other compounds or neutralize free radicals to hinder oxidation. The major types of antioxidants include synthetic and natural ones, and others as endogenous, exogenous, dietary antioxidants etc. Natural antioxidants are products of natural synthesis occurring in plants, animals, and also in bacteria Whereas synthetic antioxidants are products of artificial synthesis,[4] synthetic antioxidants have different side effects and responsible for many diseases. Hence Currently there has been an increased interest globally to identify natural antioxidant compounds that are pharmacologically potent and have low or no side effects for use in preventive medicine.[5] plants produce number of antioxidants to prevent the oxidative stress, they represent a potential source of new compounds with antioxidant activity. Herbal medicines are important part of the healthcare system of India. Over the past two decades Interest in traditional systems of medicine particularly in herbal medicines is increased all over the world.

Herbal Medicine markets is growing rapidly leads to significant economic growth. Safety and quality of herbal medicines is equally important along with increased demand. The High-quality finished drugs should use in therapeutics for good results.[6] The poor quality of finished products, clearly results from the use of low quality raw medicinal plant materials. The safety and quality of raw medicinal plant materials and finished products depend on certain factors which is classified into intrinsic (Genetic) or extrinsic (Environment, collection methods, cultivation, harvest, post-harvest processing, transport and storage practices).[7] Inadvertent use of Agriculture practices during any of the herbal drug lead to deterioration in safety and quality of drugs. Good agricultural practices are crucial tool to

grow medicinal plants with rich bioactive compounds like Antioxidants. The quality and effectiveness of medicinal plants can be achieved through these practices. This review deals with significance of good agricultural practices in production of medicinal plant with rich antioxidant activities.[8]

MATERIALS AND METHODS

A comprehensive literature search was conducted to identify relevant studies and articles on the Impact of Good Agricultural Practices on the Antioxidant levels in Medicinal Plants. The data used in current study was gathered from databases such as PubMed, Google Scholar, and indexed – non indexed, peer review journals and widely dispersed research e-publications.

Conceptual review

Free radicles

The molecular species capable of independent existence that contains an unpaired electron in an atomic orbital is called free radical. The presence of an unpaired electron is one of reason for common properties of free radicals. Many radicals are unstable and highly reactive. They can either donate an electron to or accept an electron from other molecules, therefore behaving as oxidants or reductants.[9] Free radicals and other ROS are derived either from normal essential metabolic processes in the human body or from external sources such as exposure to X-rays, ozone, cigarette smoking, air pollutants, and industrial chemicals.[10]

Oxidative stress

The imbalance between free radical production and antioxidant defences, is associated with damage to a wide range of molecular species including lipids, proteins, and nucleic acids is called as Oxidative stress.[11] It leads to atherosclerosis, inflammatory condition, certain cancers, and the process of aging. Oxidative stress is leads to all inflammatory diseases (arthritis, vasculitis, glomerulonephritis, lupus erythematous, adult respiratory diseases syndrome), ischemic diseases (Heart diseases, stroke, intestinal ischemia), hemochromatosis, acquired immunodeficiency syndrome, emphysema, organ transplantation, gastric ulcers, hypertension and preeclampsia, neurological disorder (Alzheimer's disease, Parkinson's disease, muscular dystrophy), alcoholism, smoking-related diseases, and many others.[12] The ROS is byproducts of normal cellular metabolism. Reactive oxygen species (ROS) are chemically reactive molecules that contain oxygen atoms with one unpaired electron. it act as signalling molecules to regulate various cellular processes and cell death, important for plant growth, development, and stress responses. However, ROS can also cause damage to plant

cells if they accumulate in excess, the structure and function of lipids, nucleic acids, and proteins, leading to oxidative stress. Therefore, plants must maintain a delicate balance between ROS production and removal in order to avoid oxidative stress. Plants have evolved a complex antioxidant system to scavenge excess ROS and protect cellular components from oxidative damage. when ROS production exceeds the capacity of a cell's antioxidant system to neutralize them, which leads to oxidative stress and it can impair the photosynthesis, respiration, and nutrient uptake of plants and reduce their growth and yield.[13]

Antioxidants

A molecule stable enough to donate an electron to a free radical and neutralize it, thus reducing its capacity to damage is called as antioxidant. These antioxidants inhibit cellular damage mainly through their free radical scavenging property.[14] Antioxidants works in two ways; The first way is a chain- breaking mechanism through which the primary antioxidant donates an electron to the free radical present in the systems. The second way involves removal of ROS by quenching chain-initiating catalyst. The different mechanisms through which antioxidants works are electron donation, metal ion chelation, co-antioxidants, or by gene expression regulation.[15] There are a number of synthetic antioxidants like BHA, BHT which have been widely uses as antioxidants in food industry, cosmetics, and therapeutic industry.[16] Due to toxic nature of synthetic oxidants preferences have shifted to the natural antioxidants. Trend toward the use of natural substance present in medicinal plants and dietary plats as therapeutic antioxidants is increased. The use of natural antioxidants would be promising alternative for synthetic antioxidants in respect of low cost, highly compatible with dietary intake and no harmful effects inside the human body.[17] Many naturally occurring compounds in plant sources have been identified as free radical or active oxygen scavengers. The Free radicals are responsible for many chronic health problems such as cardiovascular and inflammatory disease, cataract, and cancer.[18] Antioxidants prevent the formation of radicals, scavenge them, or by promoting their decomposition. The recent reports shows that Synthetic antioxidants are dangerous to human health. Hence, the search for effective, nontoxic natural antioxidative compounds with has been intensified in recent years. consumption plant-derived antioxidants appear to be a suitable alternative. The plants form a major source of antioxidants. The traditional Indian medicinal plants are rich sources of natural antioxidants is gaining importance.[19]

Good agriculture practices for production of antioxidant medicinal plants

Good agricultural practices are general principles which provides technical details for the cultivation and quality control measures of medicinal plants. Following Good agricultural practices should be done for quality production of medicinal plants rich in antioxidants.

1. Identification/Authentication of cultivated medicinal plants

The species selected for cultivation should be the same as that specified in the national pharmacopoeia or recommended by other authoritative national documents. It should be verified and recorded.[20]

2. Seeds and Other propagation materials

Seeds and other propagation materials should be specified. Necessary information relating to the identity, quality and performance of their products, as well as their breeding history should be provided by suppliers. Planting materials should be free from contamination and diseases in order to promote healthy plant growth. Seeds and other propagation materials used for organic production should be certified as being organically derived.[21]

3. Cultivation

Medicinal plants require intensive care and management. The conditions and duration of cultivation required vary depending on the quality of medicinal plant materials required. The principles of good plant husbandry, including appropriate rotation of plants selected according to environmental suitability, should be followed.[22]

4. Site selection

Sowing to the influence of soil, climate and other factors. Medicinal plant materials can show significant differences in quality when cultivated at different sites. The differences may occur in physical appearance or to variations in their constituents, the biosynthesis of which may be affected by extrinsic environmental conditions, including ecological and geographical variables. The contamination of pollution of the soil, air or water by hazardous chemicals should be avoided.[23]

5. Ecological Environment and Social impact

The cultivation of medicinal plants may be responsible for disturbing ecological balance. Surrounding habitats, other plants, other living organisms and human activities hampers

quality and growth of medicinal plants. Local communities should get benefit from cultivation.[24]

6. Climate

The different Climatic conditions like day, rainfall (Water supply) and field temperature, influences the physical, chemical and biological qualities of medicinal plants. The duration of sunlight, average rainfall, average temperature, including daytime and night-time temperature differences, also influence the physiological and biochemical activities of plants.[25]

7. Soil

The soil should contain appropriate amounts of nutrients, organic matter and other elements for quality medicinal plant growth. Optimal soil conditions, including soil type, drainage, moisture retention, fertility and pH, will be dictated by the selected medicinal plant species. The indiscriminate use of fertilizers is often done for large yields of medicinal plants. The correct organic i.e. Animal manure or approved chemical fertilizer should use. Overuse of fertilizers should be avoided to prevent soil erosion. The level of antioxidants in soil and plants is affected by agrochemical residues and heavy metals. Excessive amounts of heavy metals transferred to plants from the soil adversely affect the level of antioxidants in plant products, and through consumption of these plants have a detrimental effect on human health. During the decomposition of soil organic matter, phenolic compounds known for their antioxidant properties are generated. Phenolic compounds present in the soil environment include a broad spectrum of chemical compounds, such as phenol or chlorophenols.[26]

8. Irrigation and Drainage

Water used for irrigation should comply with quality standards. Irrigation and drainage should be given in accordance with the needs of the individual medicinal plant species. Care should be taken that plants are neither over- nor under-watered. Due to increase risks of vector-borne disease transmission, irrigation must be done in proper manner.

9. Plant Maintenance and Protection

The timely application of measures such as topping, bud nipping, pruning and shading may be used to control the growth and development of the plant, which improves quality and quantity of the medicinal plant material. Agrochemicals Should use according to condition of medical plants. pesticides and herbicides should be applied according to requirements. The limited use of pesticide and herbicide should be done to avoid their residue in different foods.

10. Harvest

Medicinal plants should be harvested after finished herbal products of the best possible quality is prepared. The concentration of biologically active constituents varies with plant growth and development. The best time for harvest (quality peak season/time of day) should be determined according to the quality and quantity of biologically active constituents. During harvesting, no foreign matter, weeds or toxic plants should be mixed with the harvested medicinal plant materials. wet conditions, dew, rain or high humidity have deleterious effects like microbial fermentation and mould. All devices and machines should be kept clean to reduce damage and contamination. Plants should store in an uncontaminated, dry, insects, rodents, birds and other pest's free place. Soil contamination should be avoided. The harvested raw medicinal plant materials should be transported in clean baskets, dry sacks, trailers, hoppers or other well-aerated containers. In case of plastic containers retention of moisture that could lead to the growth of mould. containers should keep in dry conditions. Any mechanical damage or compacting of the raw medicinal plant materials, should avoided. post-harvest inspections should be done to avoid microbial contamination and loss of product quality.[27]

11. Post-harvest processing

Raw medicinal plant materials should be inspected for cross-contamination, foreign matter. organoleptic evaluation of drugs should be done. Medicinal plant materials that are to be used in the fresh state harvested early to prevent microbial fermentation and thermal degradation. The proper preservation of medicinal plants should be done. All processed medicinal plant materials should be protected from insects, rodents, birds and other pests, and from livestock and domestic animals. moisture content of the material should be kept low for dry drugs. Plants should be dry in the open air (shaded from direct sunlight); placed in thin layers on drying frames, wire-screened rooms or buildings; solar dryers; by indirect fire; baking; lyophilization; microwave; or infrared devices. These should be done to avoid damage to the active chemical constituents. Common specific processing practices include pre-selection, peeling the skins of roots and rhizomes, boiling in water, steaming, soaking, pickling, distillation, fumigation, roasting, natural fermentation, treatment with lime and chopping. Facilities should preferably be located in areas that are free from objectionable odours, smoke, dust or other contaminants. Buildings should be designed in proper way to avoid contamination. Proper supply of water, under adequate pressure and at suitable temperature, should be available with appropriate facilities for its storage, where necessary, and

distribution, and with proper protection against contamination. Disinfection, lighting, ventilation facilities should be in adequate form. packaging and labelling should be done in proper manner. Standard operating procedures should be adopted and documented. All processes and procedures involved in the production of medicinal plant materials and the dates on which they are carried out should be documented. Standard operating procedures should be adopted and documented. Research is greatly needed to improve the agronomy of cultivated medicinal plants, promotion the exchange of information on agricultural production and investigation of the social and environmental impact of medicinal plant cultivation and collection.[28]

DISCUSSION

Several lifestyle, stress, and environmental factors leads to free radical formation and oxidative stress, Oxidative stress is one of reason for all inflammatory diseases, ischemic diseases, hemochromatosis, acquired immunodeficiency syndrome, emphysema, organ transplantation, gastric ulcers, hypertension and preeclampsia, neurological disorder, alcoholism, smoking-related diseases, and many others. Antioxidants are our body's protectors and help to neutralize these free radicals and stop them from causing damage to our bodies. Due to toxic nature of synthetic oxidants preferences have shifted to the natural antioxidants. Trend toward the use of natural substance present in medicinal plants and dietary plats as therapeutic antioxidants is increased. The use of natural antioxidants would be promising alternative for synthetic antioxidants in respect of low cost, highly compatible with dietary intake and no harmful effects inside the human body. In order to ensure the sustainability of high-quality medicinal plants in our society, which is undergoing rapidly changing climate and social upheaval, further research is required on various cultivation and application methods to enhance the growth and bioactive content of plant foods. Good Agricultural Practices like use of authenticate medicinal plants, Seeds and other propagation materials, Cultivation practices, fertile soil and proper plant maintenance and protection enhances plant growth and productivity. this leads to increase the levels of health-promoting bioactive compounds like Antioxidants in plants. The concept of antioxidant agriculture i.e. concept refers to practical field applications that minimize excessive ROS accumulation caused by stresses will also be helpful for enhancing growth. To date, numerous studies shows that impact of good agricultural practices produced plants with enhanced antioxidant properties. Therefore, it can be concluded that Good Agricultural Practices tends to produce foods with more nutritional value, based on their enhanced antioxidant content and activity.

CONCLUSION

Good Agricultural Practices enhances plant growth and productivity this leads to increase in the levels of health-promoting bioactive compounds like Antioxidants, accumulate nutrients and phytochemicals, enhancing their biological value and thus increasing the quality of plants. Hence Good Agricultural Practices in herbal farming is necessity of time. Although more and more well-documented studies are still required to improve our understanding of good Agricultural Practices in medicinal plants production, promotion the exchange of information on their production and investigation of impact of medicinal plants in therapeutics as antioxidant.

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