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Review on Antioxidant potentials And Nutritional value of commonly consumed Wild edible leafy vegetables

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ABSTRACT

The study of green leafy vegetables highlights their significant nutritional and medicinal value, emphasizing the benefits of incorporating these vegetables into daily diets. Green leafy vegetables are rich in essential nutrients such as proteins, dietary fibres, vitamins, and minerals, which are vital for human health and development. Oxidative stress, a major contributor to various diseases, is effectively countered by the antioxidants found in green leafy vegetables. These antioxidants inhibit oxidation processes, neutralize free radicals, and protect against cellular damage, thereby reducing the risk of cardiovascular diseases, cancer, reproductive disorders, aging, foetal damage, and diabetes. the integration of green leafy vegetables into diets is not only beneficial for their nutritional content but also for their medicinal and pharmacological properties.

Keywords: - green leafy vegetables, antioxidants, oxidative stress, medicinal value, nutritional content, free radicals.

INTRODUCTION

Since ancient times, people have used green leafy vegetables as a food source because they are rich in minerals and nutrients that support human health. One of the most impending difficulties facing the world's population growth is nutrition and health, particularly in developing nations. In addition to providing calories and vital micronutrients, plants meals also include phytochemical that have additional health benefits like glycemic management immune stimulation, and antioxidant activity. (Banerjee et al.,2015).

Consuming green leafy vegetables (GLV) has been shown to help reduce the risk of cataract development associated with ageing. These are known to include antioxidants, which are important for scavenging free radicals, which are recognized chemical risks to humans. (Mosha et al.,1999).

It has been determined that natural antioxidants including tocopherols, Vitamin C, and polyphenols, which support good health and offer protection against cancer and coronary heart disease, which support good leafy vegetables. GLV are the main sources of lutein and not withstanding problems with absorption, significantly aid in the fight against retinol deficiencies in developing nations where access to animal products is restricted. This is because they are rich sources of beta carotene, a pro-vitamin A (Banerjee et al., 2015). The plants have significant ethnomedicinal value and are used as a stand-in for true spinach (*Spinacea oleracea* L.) (Deshmukh et al.,2014).

Innovation and Integrative Research Center Journal
ISSN: 2584-1491 | www.iircj.org
Volume-2 | Issue-6 | June-2024 | Page 214-222

Distribution of a variety of wild leafy vegetables.

Human consumption of fruits and vegetables varies greatly depending on location and culture. (Welbaum., 2015). About 800 types of wild plants are thought to be consumed in India, primarily by tribal tribes. (Bandyopadhyay and Mukherjee,2009). These are mostly classified as domestically grown native vegetables, such as *Chenopodium album, Amaranthus sp., Trigonella foenum graecum, Raphanus sativus, Allium cepa, Chenopodium album, Cucurbita maxima, Momordica charantia , Largenaria siceria, non cultivated naturally growing leafy vegetables like plebeium, paederia foetida, oxalis corniculate, Marselia minute, Leucas aspera, Ipomea aquatica, Glinus oppositifolius, Enydra fructans Lour, Commelina benghalensis, Brassica juncea, Bauhinia purpurea, Murraya koenigii etc.* (Sahu et al.,2020).

Nutrition content in wild leafy vegetables.

Food is fundamental to human necessity and a requirement for a healthy existence. As a branch of science, it examines the myriad components of food and how appropriate sustenance is achieved. The agricultural industry and government organizations increasingly utilize nutritional data to market fresh products. From a very young age, a healthy diet is crucial for growth, development, and an active life. Consumers seek diversity in their meals and are aware of the health advantages of produce, especially foods high in antioxidant vitamins (C, A, and E), calcium (Ca), magnesium (Mg), and potassium. Generally speaking, fruits and green vegetables are valued for their high-water content and as a moderate source of trace elements (Gibson, 1994).

In a nutritional analysis of various leafy vegetables, the protein content observed in different wild species ranged from 19.03 ± 0.26% to 31.16 ± 0.26%. Portulaca oleracea exhibited the highest ash content, while Polygonum plebeium had the highest crude Fiber content. Iron content varied from 11.88 ± to 397.66 mg/100g, with *Trianthema monogyna* showing the greatest concentration. Calcium content varied from 441.62 ± 12.70 to 4200 ± 5.77 mg/100g, with Sesbania grandiflora exhibiting the highest level, followed by *Cassia tora*. In terms of protein, carbohydrate, and fat, the nutritional value of certain wild species was greater than that of cultivated species such as spinach and fenugreek leaves. These wild species were also found to have higher levels of crude Fiber, minerals, calcium, iron, and vitamin C (Sinha, 2018).

Protein

Proteins are large, complex molecules composed of various amino acids. They are essential for the structure, operations, and control of cells' metabolic processes in every living organism. Consequently, protein plays a central role in consumers' daily meals. Green leafy vegetables are among the most affordable and highest-quality sources of protein due to their ability to produce and accumulate amino acids with the help of abundant light, water, oxygen, and nitrogen (Aletor et al., 2002).

Dietary Fiber

Dietary Fiber, a component of plant cell walls, is divided into soluble Fiber (SDF) and insoluble Fiber (IDF), which together constitute total dietary Fiber (TDF). Historically, green leafy vegetables have been recognized as excellent providers of dietary Fiber (Gopalan et al., 2000). Studies demonstrate the high nutritional value and good sources of soluble dietary Fiber and antioxidant potentials found in Indian green leafy vegetables (shown in figure 1) such as *Momordica indica* L., *Murraya koenigii* L., *Ipomoea batatas var. batatas, Cordia*

Innovation and Integrative Research Center Journal
ISSN: 2584-1491 | www.iircj.org
Volume-2 | Issue-6 | June-2024 | Page 214-222

dichotoma, *Carthamus oxyacantha* M. Bieb., *Colocasia antiquorum var.* typica Engl., *Moringa oleifera* Lam, *Coriandrum sativum* L., *Brassica oleraceae var. gongylodes* L., and *Ipomoea aquatica* forssk. etc. Increased consumption of vegetable fiber is linked to a decreased risk of cardiovascular diseases and possibly colon cancer (Jenkins et al., 2001).

Vitamins

Green leafy vegetables are rich in β-carotene. Vitamin A is present in leaves in the form of non-provitamin A carotenoids like lutein (about 45%), violaxanthin (about 15%), and neoxanthin (about 15%), as well as provitamin A carotenoids like β-carotene (about 25–30%), α-carotene, γ-carotene, and β-cryptoxanthin. Retinol equivalents (RE) are used to express the amount of vitamin A, where one RE equals 6 µg of β-carotene and 12 µg of other provitamin carotenoids. The term "retinol activity equivalent" (RAE) has recently replaced RE according to the U.S. Institute of Medicine (IOM, 2001). The dietary recommendation intake suggested by the Institute of Medicine is 900 µg RAE for adult males and 700 µg RAE for adult females (Trumbo et al., 2001). Increased consumption of commonly available green leafy vegetables in poorer nations can help combat widespread vitamin A deficiency, especially where pharmaceuticals and supplements are scarce. Boiling, steaming, and other processing methods significantly impact the carotenoid content in green leafy vegetables (Cheynier, 2005).

Minerals

According to the WHO (1996), micronutrient status and overall malnutrition are closely related and cannot be separated. Efforts to improve growth and function will not be fully effective if vitamin deficiencies are not addressed alongside protein-energy malnutrition (Baudoin & Louise, 2002). Metal ions are essential to human health and normal function because they preserve protein structures and act as cofactors in enzyme processes. A lack of iron causes anaemia, particularly in women and children, while zinc deficiency leads to immune system and gastrointestinal problems (Welch, 1993).

Essential Fatty Acids

Omega-3 fatty acids are crucial for healthy growth and development, as well as for the prevention and management of coronary artery disease, cancer, diabetes, rheumatoid arthritis, and other autoimmune and inflammatory diseases (Hamazaki & Okuyama, 2001). Green leafy vegetables contain α-linolenic acid, a precursor to omega-3 fatty acids, which has been linked to positive health effects (Simopoulos, 2002).

Figure 1 – Some commonly consumed wild leafy vegetables (A) *Chenopodium album* L(B)*Allium cepa* L. (C) *Coriandrum sativum* L(D)*Chorchorus olitorius* L. (E) *Moringa oleifera* Lam. (F) *Brassica oleraceae var. capitata* L. (G) *Hibiscus sabdariffa* L. (H) *Murraya koenigii* L. (I) *Ipomoea aquatica* forssk. (J) *Tamarindus indica* L. (K) *Trigonella foenumgracecum subsp. gladiata* (L) *Cucurbita maxima* Lam. (M) *Brassica juncea* L. (N) *Cassia tora* L. (O) *Brassica olearacea var. botrytis* L. (P) *Raphanas raphanistrum subsp. sativas* L. (Q) *Carthamus oxyacantha* M. Bieb. (R) *Lathyrus sativas* L. (S) *Colocasia antiquorum var. typica* Engl. (T) *Colocasia fontanesii* schott (U) *Cordia dichotoma* G. Forst. (V) *Amaranthus tricolour* L. (W) *Ipomoea batatas var. batatas* (X) *Amaranthus viridis* L. (Y) *Partulaca oleracea var. trituberculata* (Z) *Momordica indica* L. (A1) *Coccinia grandis* L. (B1) *Bauhinia ungulate var. ungulata*

Medicinal uses of wild leafy vegetables

Since ancient times, therapeutic plants, also known as medicinal herbs, have been utilized in traditional medical practices. This discovery has been made for many years. Plants produce hundreds of chemical and biological compounds for various purposes, such as protection against insects, herbivorous mammals, diseases, and fungi (Ahn, 2017). Of the approximately 30,000 plant species known to have some use, the Royal Botanic Gardens, Kew conservatively estimated that 17,810 species have medicinal applications (Royal Botanic Gardens, 2016).

Green leafy vegetables, specifically wild species, are known for their medicinal properties. For instance, seeds of *Amaranthus hybridus, A. spinosus, and A. viridis* have been used to treat ocular vision issues (Tene et al., 2007; Marwat et al., 2011). *Commelina benghalensis* roots are utilized for treating epilepsy and stomach issues, while the leaves are beneficial for liver issues, and snake and scorpion stings, among other ailments (Parveen et al., 2007; Marwat et al., 2011). *Silene conoidea* leaf paste is traditionally used to treat skin infections, backaches, and pimples (Ali & Qaiser, 2009). Additionally, a leaf decoction of *Polygonum amplexicaule* has been found to be effective against fever, joint discomfort, and flu. Moreover, the leaves and shoots of the same plant are used to treat ulcers, sore throats, and tongue and mouth irritation (Hazrat et al., 2011). These examples highlight the significant medicinal value of green leafy vegetables, which have been used in various traditional medical practices across different cultures and time periods.

Pharmacology of wild leafy vegetables

Drug-related research has identified hundreds of useful compounds by utilizing ethnobotany to discover naturally occurring chemicals with pharmacological activity. These include well-known medications such as quinine, digoxin, opium, and aspirin. Wild leafy vegetables, known for their diverse array of phytochemicals, contain compounds that primarily fall into four major biochemical classes: terpenes, alkaloids, glycosides, and polyphenols (Awuchi, 2019).

One such wild leafy vegetable, *Launacea taraxacifolia* (wild lettuce), is a perennial herb known for its pharmacological properties. This herb contains five key compounds: caffeic acid, chlorogenic acid, ellagic acid, quercetin, and kaempferol. These compounds exhibit a wide range of pharmacological effects, including anticancer, antibacterial, antimalarial, and antioxidant activities. Additionally, they have been shown to interact with recombinant human enzymes, indicating potential drug-herb interactions (Bello et al., 2018). These findings underscore the significant pharmacological value of green leafy vegetables, highlighting their potential as sources of bioactive compounds for drug development and therapeutic applications.

Free radicals

Reactive chemical entities known as free radicals have one unpaired electron in their outer orbit (Relay, 1994). We are in constant contact with potential chain reactions involving free radicals, which can be produced by various sources such as smoking, prolonged sun exposure, psychological or emotional stress, and poor eating practices. These free radicals cause healthy cells to become dysfunctional due to structural disruption, leading to damage to lipids, proteins, and nucleic acids (Percival, 1998).

Free radicals are extremely reactive molecules containing oxygen and fall into several categories: superoxide, hydroxyl, and hypochlorite radicals (Percival, 1998). They originate from the enzymatic processes involved in intra- and intercellular signaling. Additionally, Reactive Oxygen Species (ROS) include non-radical molecules such as hydrogen peroxide, lipid peroxides, and singlet oxygen (Bansal & Bilaspur, 2010). Understanding the role of free radicals and ROS in biological systems is crucial, as their imbalance can lead to oxidative stress, contributing to various diseases and aging processes.

Oxidative stress

When ROS concentrations are high enough, they can destroy the structural integrity of lipids, proteins, nucleic acids, membranes, and cells. This destruction is accompanied by a shift in metabolism toward pro-oxidants, leading to cellular stress. Various factors can cause this state of stress, including pollutants, infections, diseases, radiation, drugs, long-term inflammation, strenuous exercise, alcohol and pesticide exposure, smoking, and poor eating habits.

Cells produce oxidants through several processes. These include xenobiotic metabolism, which detoxifies hazardous compounds; regular aerobic metabolism, which uses about 10% of the oxygen available to the cell; and the oxidative burst from phagocytes, which release foreign material. Proteins can become damaged and denatured through these oxidative processes (Percival, 1998).

Disease caused by Free Radicle

Free radicals' oxidative damage rises with ageing and leads to a deterioration in the immune system, chronic illnesses, and numerous other potentially fatal disorders. (Percival M.,1998).

Cardiovascular disease

Congestive heart failure is associated with the generation of free radicals. In addition to causing vascular damage and organ malfunction, they can also happen in the blood circulation. (Fukai et al.,2002). These radicals can be produced by particular inflammatory cells, such as neutrophils and macrophages, which happen during reperfusion, or by specific enzymes, such as mitochondria or xanthine oxidase. due to excessive levels of oxidative damage and lipid peroxidation, which can lead to stroke. (Mariani et al.,2005). Even neurons may die as a result of these radicals. When ROS build up in the arterial wall, low density lipoprotein gets oxidized and deposits in plaques, which triggers an inflammatory response. This plays a major role in the pathophysiology of atherosclerosis, the process that leads to the accumulation of plasma lipoproteins. A core of lipid and necrotic cell debris is formed by lipid-engorged macrophage foam, fatty streak lesions that drive the development of complicated plaques. This starts to obstruct the arteries' ability to carry blood. The integrity of vascular cells is impacted by the increased expression of the endothelial cell surface adhesion molecule caused by the oxidation of low-density lipoprotein lipids. (Tribble DL.,1999).

Cancer

Free radicals destroy cancerous tissues by causing mutations and modifications to genetic material. It has been discovered that the size of the tumour and the DNA oxidized product may be related. (Loft Poulsen HE.,1996). By reacting with DNA's constituents, free radicals cause damage to the bases and the deoxyribose backbone of the molecule. (Dizdaroglu et al.,2002). which could lead to chromosomal abnormalities and oncogene activation, both of which would encourage malignancy. These radicals can even create hydroxylated bases in DNA, which change how a gene is normally transcribed. Additional alterations consist of breaks in the strands, lesions in sugar, and the creation of crosslinks between DNA and proteins. Division of a cell containing a broken DNA strand modifies cell metabolism and influences the duplication pattern. (Percival M.,1998).

Reproduction disorder and infertility

Male infertility is linked to the imbalance that occurs between the scavenging activity and ROS formation, which damages the sperm and alters its physiology. When added to cryopreservation extenders, the antioxidants may enhance sperm motility, semen parameters, and human sperm quality. (Bansal.,2010). Oxidative stress can damage the intracellular environment, putting cell viability in jeopardy. It can also have an impact on female reproduction, which is linked to pre-eclampsia and abortion pathologies. It could be an essential connection between endometriosis and the puzzle of infertility. Conversely, the oocyte is shielded by the antioxidant enzymes, which prevent reactive oxygen species from being produced. (Agarwal et al.,2005).

Ageing

As people age, their body produces more reactive oxygen species, which raises the possibility of oxidative mitochondrial damage. (Percival M.,1998). Dietary components with antioxidant activity may be able to modify oxidative stress and other chronic illnesses, which may ultimately lead to a decrease in age-related diseases (Meydani.,2001).

Foetal damage

It has been discovered that oxidative stress contributes to increased embryo fragmentation brought on by free radicals. The oxidants can alter important transcription factors as well as gene expression, which can have an impact on embryonic development in its early stages. (Agarwal et al.,2005). They play a significant part in the mechanisms underlying the foetus's growth limitation. (Hua He et al.,2008).

Diabetes

Free radical damage plays a major role in ß-cell dysfunction, insulin resistance, dysglycemia, the pre-diabetic state, and type 2 diabetes. (Wright et al.,2006). Some factors that contribute to high concentrations of ROS include leptin and free fatty acids, which are shown to be present in higher concentrations in people with diabetes. (Jay et al.,2006).

Antioxidant

Antioxidants play a crucial role in the body by inhibiting oxidation processes even at

Innovation and Integrative Research Center Journal
ISSN: 2584-1491 | www.iircj.org
Volume-2 | Issue-6 | June-2024 | Page 214-222

relatively low concentrations (Mandal et al., 2009). They prevent damage caused by pollutants to plants, protect against diseases in both animals and plants, and are integral to the body's defence mechanisms (Ahmed & Beigh, 2009). These substances are increasingly recognized as nature's solution to mitigating aging, physiological and environmental stresses, atherosclerosis, and cancer by inhibiting oxidation chains in vivo and neutralizing harmful free radicals (Maestri et al., 2006). Many consumers believe that a diet rich in antioxidants can help protect the body from the harmful effects of free radicals, defending against processes that lead to nucleic acid damage and cardiovascular disorders (Yanishlieva-Maslarova & Heinonen, 2001).

Antioxidants can be categorized into two types: synthetic and natural (Gupta & Sharma, 2006).

Natural Antioxidants

Plants are the primary source of natural antioxidants for human consumption. Plant phenolics serve multiple functions, including singlet oxygen quenching, metal chelation, free radical termination, and acting as reducing agents. Although present in smaller concentrations and dependent on diet (e.g., carotenoid content in milk lipids and eggs), fat-soluble vitamins and selenium are found in animal-derived foods such as milk, fish lipids, and eggs. However, these foods are not significant sources of antioxidants in the human diet (Mathew & Abraham, 2006).

Synthetic Antioxidants

Synthetic antioxidants must meet specific criteria: they must be non-toxic, highly active at low concentrations (0.01–0.02%), and effective at the surface of the oil or fat phase (Belitz et al., 2009). Due to their non-protein origin, synthetic antioxidant chemicals are generally able to penetrate cells and are very durable, making some suitable for oral consumption (Li, 2011).

Plants and their byproducts, rich in phytochemicals, exhibit various biological activities, including acting as antioxidants. Both endogenous and exogenous antioxidants are necessary to eliminate excess reactive oxygen species (ROS) and mitigate their harmful effects (Verma et al., 2009). Antioxidants are essential for healthy living, protecting the body from oxidative damage linked to diseases such as cancer, diabetes, and neurological conditions. They are also used to reduce illness risk by controlling oxidative processes that can degrade food quality due to the body's production of ROS and free radicals (Kurnia et al., 2021).

CONCLUSION

As previously indicated, antioxidants are thought to be healthful substances and come in both natural and synthetic forms. Research indicates that natural Antioxidants are safer and benefit people more. In this survey, we talked about green leafy vegetables. The involvement of free radicals is significant in the physiology of several chronic and fatal diseases. It also highlights the urgent requirement for a safe, long-term treatment that works. A healthy diet that includes enough antioxidants can help avoid several illnesses. Such diets should be encouraged because they are extremely beneficial in avoiding numerous illnesses and show a potential treatment strategy. We can conclude that incorporating these substances and items into our diet will improve our health.

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