A Review on Antioxidants Obtained from Natural Sources

Mohit L. Patil[1] , Divakar R. Patil [2], Akash S. Jain[3], Azam Z. Shaikh [2], Sameer R. Shaikh [2], S. P. Pawar [4] .

[1] B. Pharm. Student, Department of Pharmaceutics, P.S.G.V.P. Mandal's College of Pharmacy, Shahada, Maharashtra, India.

[2] Assistant Professor, Department of Pharmaceutics, P.S.G.V.P. Mandal's College of Pharmacy, Shahada, Maharashtra, India.

[3] Assistant Professor, Department of Quality Assurance, P.S.G.V.P. Mandal's College of Pharmacy, Shahada, Maharashtra, India.

[4] Principal, P.S.G.V.P. Mandal's College of Pharmacy, Shahada, Maharashtra, India.

Abstract

The body uses antioxidants as a defensive mechanism against reactive oxygen species, which are typically formed during the body's numerous physiological functions. These antioxidants come from a variety of sources, including exogenous dietary sources and endogenous antioxidants found in the body. The substitution of natural food antioxidants with synthetic ones in recent decades has increased interest in vegetable sources and the screening of low-cost raw materials, especially from agriculture, to find new antioxidants. The important plant chemicals with antioxidant action, albeit not the only ones, are polyphenols. Both natural and synthetic antioxidants have been shown to exhibit biological qualities, including but not limited to anticarcinogen city, antimutagenicity, antiallergen city, and antiaging action. The most significant natural antioxidants come from regularly eating fruits and vegetables, although antioxidants from other plants and agricultural waste should also be taken into consideration.

Keywords- Antioxidants, Ascorbic acid, Cranberries, Phytochemical, Natural Resources.

INTRODUCTION

Ultimately, the features of flavour, scent, and appearance that consumers can tolerate are what determine the quality of food. The ready-to-eat product sector has grown quickly as a result of consumers' growing desire for quick meals. This is why there is a greater effort being made to decrease oxidation. Adding antioxidants is usually the best course of action. [1]. Natural antioxidants are primarily phenolics that may occur in all parts of plants [2] fruits, vegetables, roots, nuts, seeds, leaves, and barks, among other things.. According to these results, researchers should concentrate their efforts on identifying natural sources that offer a respectable amount of antioxidant potential[3].

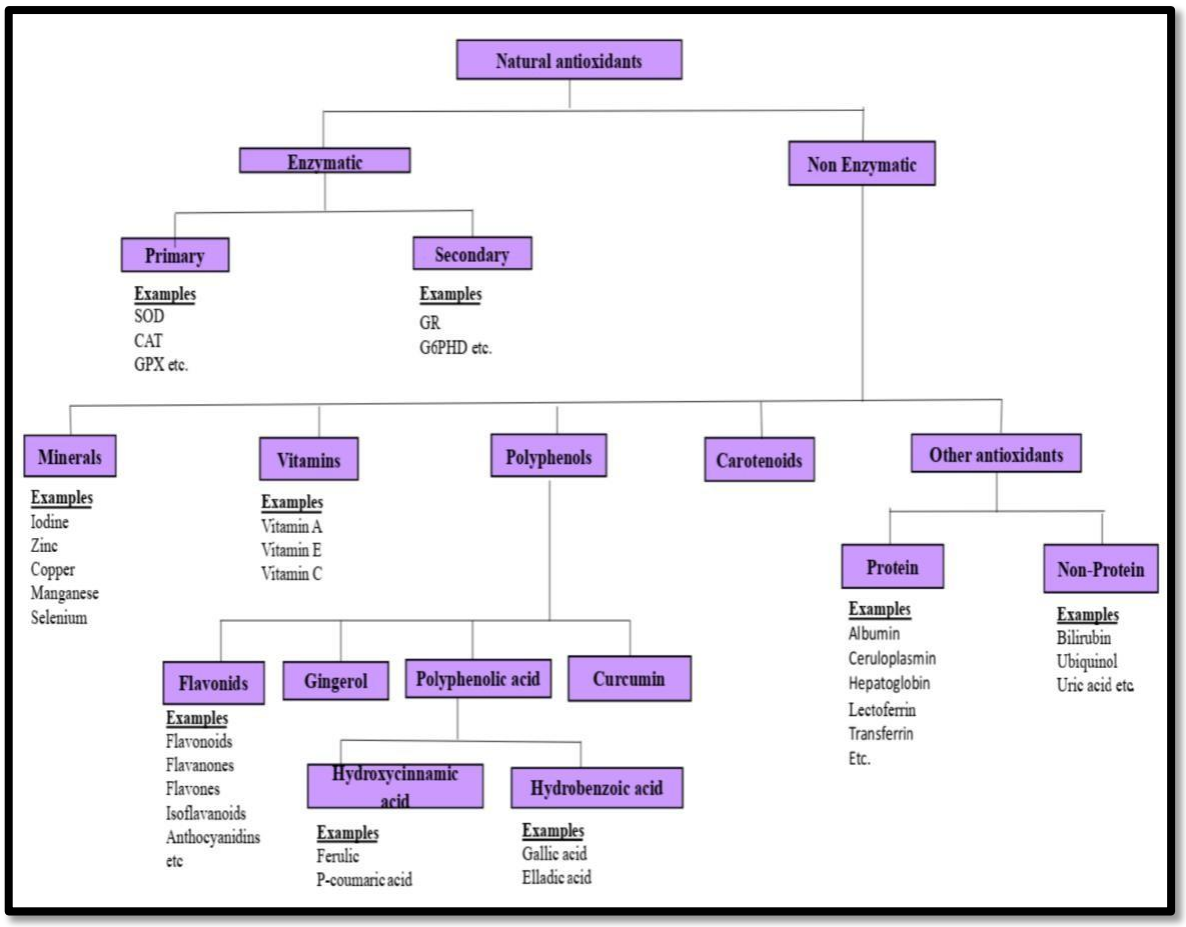


Fig-1 Classification and sub classification of antioxidants found in natural sources

Antioxidants found in nature can be divided into a number of smaller groups. Nonetheless, there are two main types of antioxidants: first, those found in regularly consumed natural diets (vegetables, fruits, cereals, and beans); second, those found in plants The individuals who regularly consume. Including these fruits and vegetables in their regular diet has been shown to reduce the risk of developing a number of chronic illnesses[4]. Citrus fruits, which are known to be high in vitamin C, include oranges, lemons, blueberries, contain a good amount of antioxidants, as do red beans, spinach, kale, broccoli blossoms.[5] The synthetic form of this vitamin is made up of α-tocopherol, a common dietary supplement. This vitamin's natural form has nearly eight isomeric forms of α-tocopherol due to the mixture of tocopherols present. The Business Insight research predicted that the US vitamin and mineral business will expand by 4.5% annually, or nearly $30 billion, in the first half of this decade[6].To date, researchers from all over the world have focused on finding affordable, naturally occurring sources of antioxidants.[7] . Due to their high concentration of minerals, particularly electrolytes, and vitamins, particularly C and E, they have played a significant role in history as conventional foods. Moreover, some recent research have revealed their phytochemical contents, which have antioxidant properties[8]. These antioxidants scavenge the free radicals or oxidants that are generated as a result of several disease processes, including diabetes, cancer, and cardiovascular conditions. [9]. Three primary categories can be used to group natural antioxidants derived from plants: Carotenoids, vitamins, and phenolic substances[10].The primary plant chemicals with antioxidant properties, certain phenolic compounds also exhibit

antibacterial and antifungal properties, and they significantly impact the tastes and textures of food items[11].

This article's primary goal is to provide an overview and summary of the natural sources that may contain antioxidants.

MECHANISM OF ACTION;

For antioxidants, two main modes of action have been suggested. The first is a chainbreaking process, whereby the system's free radical (such as a lipid radical) receives an electron from the main antioxidant.By quenching chain-initiating enzymes, the second mechanism eliminates ROS/RNS initiators (secondary antioxidants). The mechanism of action of primary and secondary antioxidants as well as compounds that, in some circumstances, can also act as co-antioxidants by preventing other pro-oxidants[77].

Here are some examples of sources of antioxidants obtained from natural sources such as;-

1. Apple
2. Red cabbage
3. Grapes
4. Cranberries
5. Peas

1] Apples

The most popular fruit is apples (Malus domestica), which are rich in phenolic compounds like flavonols, dihydrochalcones,as well as pectins,[12-13]. After cranberries, apples are the second-highest fruit in terms of vitamin C concentration[14].Ascorbic acid and its oxidised form, dehydroascorbic acid, are the two forms of vitamin C found in apples[15-16]. According to reports, vitamin C has the ability to scavenge free radicals with an EC50 value of 0.35. Conversely, the majority of vitamin E can be found in apple seeds. Vitamin B12 and vitamin D are additional vitamins that can be found in apples, although only in minimal levels[14].Apples include five primary families of polyphenolic compounds: dihydrochalcones, flavan-3-ols, antho-cyanidins, flavonols, and hydroxycinnamic acids. However, due to the polymerisation of flavan-3-ols and the glycosylation of other polyphenolics, the phenolic profile is considerably more complex.. Galactose, glucose, rhamnose, arabinose, and xylose are the main sugars that are involved in glycosylation; rutinose, a disaccharide, has also been identified in apples. [17-18]. Only one of the major apple flavonols, quercetin and its derivatives, has been used in the various in Vivo experiments.Quercetin was found to inhibit human prostate and lung cancer cell growth[19-20]. as well as to lower the prevalence of cardiovascular illnesses[21 Quercetin derivatives are not the predominant polyphenolic component found in apples, nor are they always the most potent antioxidants within the apple polyphenolic composition[22]. Procyanidins and other substances exhibited much higher levels of antioxidant activity[22-23].

- **APPLE CONSTITUENTS AND POTENTIALS' PHARMACOLOGICAL IMPACT IN PREVENTING CHRONIC DISEASES**

Nevertheless, a few clinical trials, in vitro, and in vivo investigations have mostly demonstrated..these..advantages.

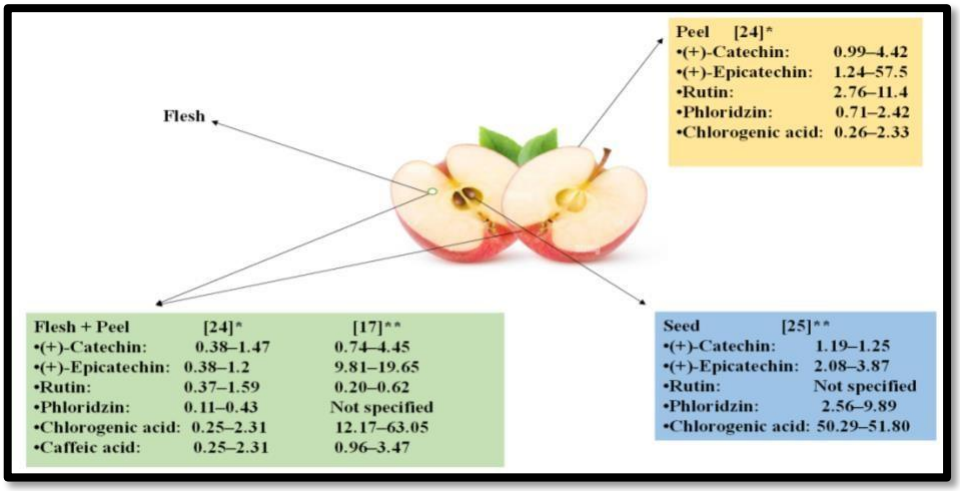
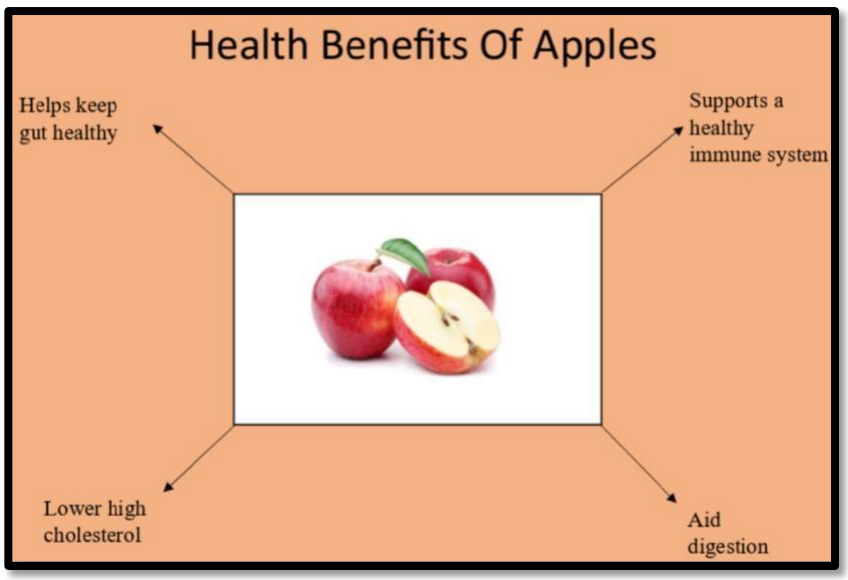


Fig- Antioxidant present in apple.

❖ ANTIOXIDANT PROPERTIERS OF APPLE

The development of numerous chronic diseases, including as diabetes, obesity, cancer, hypertension, and cardiovascular disorders, is primarily linked to oxidative stress[25].. The



production of ROS is typically tightly regulated by intrinsic cellular antioxidants, which function by diverse mechanisms and at different stages to preserve cellular redox homeostasis. ROS can be generated endogenously, as in normal metabolism and mitochondria, or exogenously, as a result of exposure to xenobiotics and the environment . [26-27] The first step is to stop or inhibit the production of excess reactive oxygen species (ROS). For instance, the enzyme superoxide dismutase (SOD) changes intracellular superoxide anions into hydrogen peroxide, which catalase (CAT) or glutathione peroxidase (GPx) then transforms to water[27]. The second method involves directly scavenging surplus reactive oxygen species (ROS) to stop oxidative chain propagation. Reduction of glutathione and vitamins C and E are prominent examples of antioxidants that use this mechanism[28]. Because of the strong relationships found between polyphenol concentrations and antioxidant values, apples have been identified as the primary source of their antioxidant characteristics.

[29]. Because of their chemical compositions, polyphenols are made up of many groups of antioxidants that function at varying degrees of antioxidant activity. [30-31].

Fig- Health benefits of apples.

2] RED CABBAGE

Brassica oleracea L., or red cabbage, is one of the most well-known, nutrient-dense, and healthful vegetables consumed and eaten worldwide. Red cabbage is a highly marketable vegetable due to its abundance of phytochemicals, vitamins (A, K, B, C, E), antioxidants, minerals.[32]. Furthermore, the greatest quality of red cabbage is its high anthocyanin content. it's commonly used in food industries as a natural colour additive. At the same time, these anthocyanins aid in improving vision, lowering the prevalence of chronic diseases, preventing diabetes and obesity, and preventing cardiovascular diseases[33]. Numerous studies have concentrated on the advantageous phytochemicals found in cabbage, including its sulforaphane, indoles, r. Vegetables high in antioxidant phytochemicals may be strongly protective against major degenerative diseases like cancer and cardiovascular disease, [34].

❖ Antioxidant activity of red cabbage extract

Vegetables in the Brassicaceae family are naturally rich in antioxidants, which may lower the risk of both acute and chronic illnesses. [35-36]. The primary antioxidants in red cabbage are phenolic chemicals, which have the ability to prevent or regulate food oxidation [37]. One of the main categories of natural pigments found in fruits and flowers are anthocyanins, which also have antioxidant properties. The high nutritional value of red cabbage stems from its abundance in minerals, vitamins, oligosaccharides,[38]. Due to its abundance of anthocyanins, including cyanidin-3-diglucoside-5-glucoside derivatives with different linked acylated groups to the diglucoside, primarily sinapoyl esters, red cabbage is also frequently used as a dietary supplement [39]. With increasing concentration, the antioxidant action becomes more pronounced. This is particularly noticeable for the red cabbage extract at a concentration of 2500 µg/ml, where the highest percentage of inhibition is determined. At doses of 375 and 750 µg/ml, respectively, ascorbic acid and BHT showed the most percentage of inhibition. The quantity of extract needed to scavenge 50% of DPPH radicals is known as the IC50 value, and for red cabbage extract, ascorbic acid, and BHT, it was 700, 150, and 170 µg/ml, respectively. [40].Brassica vegetables have numerous health benefits for people due to a complex combination of phytochemicals and their antioxidant activity[41].Red cabbage extract was found to have 39.55 mg of polyphenol components per 100 grammes of the extract. In a study aimed at characterising the phenolic components and antioxidant activity of traditional. The findings indicate that phenolic compounds are the predominant antioxidant compounds.[42].

Fig:-Health Benefits of Red Cabbage.

3] Grapes

Today's consumers make many dietary decisions based on maintaining their health and preventing disease, and the demand for "healthier" or "functional foods" is rising. Functional foods are, by definition, "foods or parts of foods" that offer health or medical benefits above and beyond the needs for basic nutrition In this regard, it has been proposed that modifying one's lifestyle, particularly improving one's eating habits, can positively impact the development of disease and favourably modify several disease risk variables.[43-44].And in this trend of being healthy the grapes also plays an vital role .Grapes (Vitis vinifera) are also a rich source of vitamins, phytochemicals and phenolic compounds In fact, phenolic compounds—the main phytochemicals found in berries and grapes—as well as the fruits' high vitamin, mineral, fat, and fibre content contribute to their considerable health advantages[45].For the 2019–2020 marketing year, there were roughly 23.38 million metric tonnes of grapes produced worldwide[46].The prevalence of cardiovascular diseases has increased recently as a result of several causes such as smoking, inactivity, and lifestyle changes[47].One of the main risk factors for cardiovascular disease and early human death worldwide is hypertension[48].Finding new approaches is vital because, even with the success of anti-hypertensive drugs, hypertension and its complications continue to be one of the biggest

costs to the health and the economy. A recent meta-analysis which reviewed the impact of different antihypertensive strategies in human clinical trials summarized that the use of functional foods and dietary supplements could be as effective as anti-hypertensive medications[49].Bioactive compounds are abundant in grapes, but how these compounds build up in the fruit depends on a number of variables, [50-51]such as the variety, maturity, post-harvest storage, and environmental aspects like location, light, temperature, water, nutrition, and microorganisms[52-53].Bioactive compounds found in grape extracts, such as quercetin and resveratrol, have an impact on heart damage and hypertension[54-55].

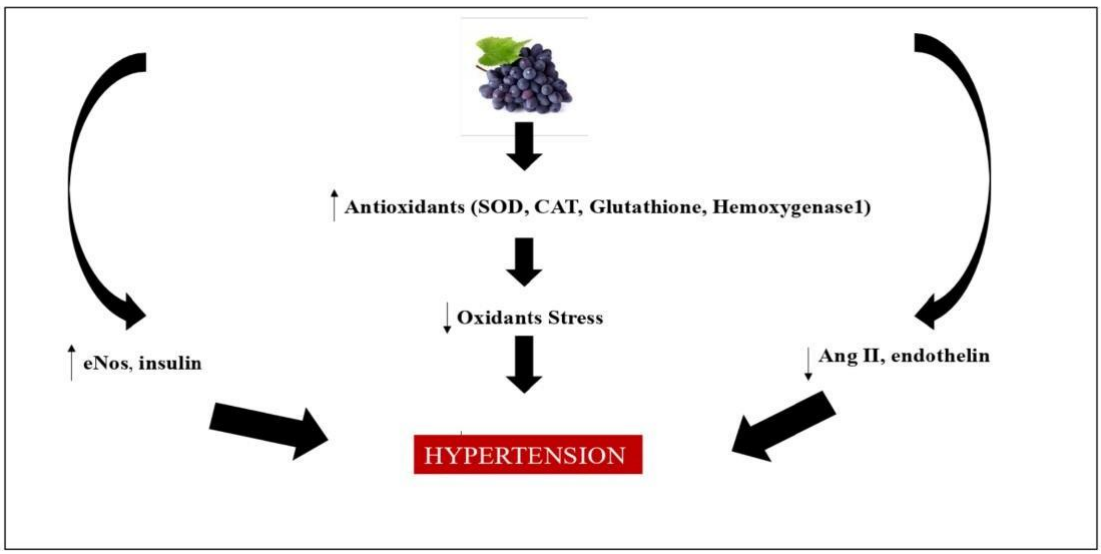


Fig:-Bioactive phenolic compounds and lipids in grapes that may have beneficial roles in hypertension.

Study has revealed that there is evidence to suggest that foods high in a range of bioactive components, such as polyphenols, phenolics, peptides, and polyunsaturated fatty acids, can lower blood pressure[56].Fruit-derived phenolic chemicals may have a positive impact on the four cardiovascular disease risk factors of hyperlipidemia, vascular dysfunction, increased blood pressure, and platelet aggregation Research indicates that fruit phenolic chemicals influence the four cardiovascular disease risk factors of hyperlipidemia, increased blood pressure, vascular dysfunction, and platelet aggregation[57].Phenolic acids have a larger role in the benefits to human health, such as their anti-inflammatory, therapeutic, antidiabetic, anti-cancer, anti-apoptotic, anti-ageing, neuroprotective, radioprotective, pulmonary protective, s[58].Proanthocyanidins from grapes, particularly the seeds, have demonstrated a wide range of pharmacological and therapeutic health effects against conditions linked to inflammation and oxidative stress, such as cancer, diabetes mellitus, obesity, and cardiovascular disease[59]. According to studies the patients with moderate hypertension, a 4-week grape juice supplementation was found to reduce blood pressure at rest[60].A It is unknown if the benefits of grape in hypertension are due to a particular molecule or collection of compounds that act in concert to exert their benefits, but future developments in pharmacokinetics may provide some insight into this matter[61].

4] CRANBERRIES

North American cranberries (Vaccinium macrocarpon) are grown and processed into sauce, juice, and some therapeutic goods. Dried cranberries are sweetened.[62]. They contain lots of phenolic compound. These phenolics are well known to have several health advantages, including anticancer action.[63-64].Berries are a major source of naturally occurring phenols in the human diet and are linked to the benefits of fruits and vegetables for health. Cranberry's bioactive ingredients have been well studied.[65-66].These phytochemicals prevent damage from free radicals by acting as antioxidants. Due to its anti-adhesion qualities, cranberries were used to treat gum disease, stomach ulcers, and urinary tract infections.[67-68].Numerous water soluble and fat-soluble vitamins are present in cranberries .Cranberries are primarily rich in antioxidants due to their high content of vitamins C, E, and K.The major active form of vitamin C, ascorbic acid, is found in tiny cranberries in amounts ranging from 15.3 to 30%. There was a greater quantity (47.5%) found in the larger cranberry.[69]Ascorbic acid has significant antioxidant activity, neutralizing free radicals and reactive oxygen species that cause tissue damage and illness.According to the studies done on the three types of species of canberries

HEALTH BENEFITS OF CANBERRIES

Cranberries have several health benefits and it also contain many helpful nutrient and fphtochemical which help in prevention and curation of many diseases. Cranberries include proanthocyanidins (PACs), which have been linked to their ability to treat urinary tract infections. Tannins prevent E. coli bacteria from developing infections in the urinary tract. Cranberries include phytochemicals such as anthocyanins, PACs, and flavonols, which have been linked to numerous health benefits.

.Antibiotics are also used to treat women who have persistent cystitis. [70].

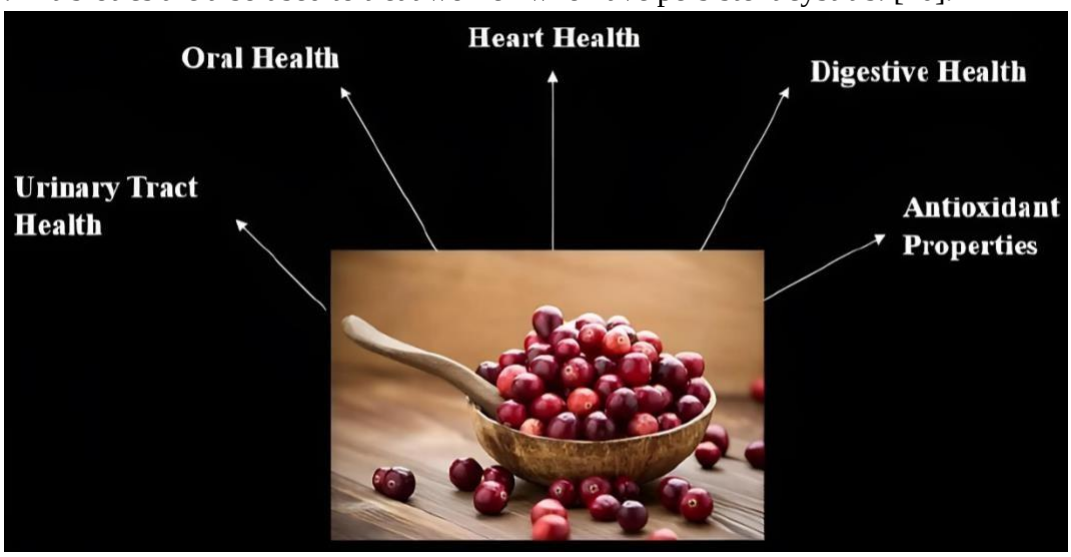


Fig:-Health Benefits of Cranberries.

5]Peas

A nutrient-dense agricultural product, peas (Pisum sativum L.) are members of the Leguminosae family The yearly production of dry pea and green pea seeds worldwide is estimated to be 22 million and 14.5 million tonnes, respectively.Crucial nutrients found in pea seeds include soluble and insoluble fibres, proteins, Threonine, cysteine, methionine, lysine, glycine, alanine, leucin, and phenylalanine amino acids are abundant in pea seeds. It is rich in vitamin B and is followed in order of importance by phosphorus, magnesium, and calcium, which are 0.39%, 0.10%, and 0.08%, respectively. A range of extraction techniques were employed to separate distinct vitamin and mineral forms, with the E group of vitamins consisting solely of β and γ tocopherols.[70]

Antioxidants and Phytochemical's In Peas

Bioactive chemicals known as antioxidants have an inhibitory effect that lessens the damage that reactive species like free radicals can cause.Pea byproducts contain a variety of non-nutritive . In storage trials (26 and 37 7C, 9 months) of soy and sunflower oils, navy bean hull extracts shown better antioxidant activity than a combination of butylated hydroxyanisole (BHA) and butylated hydroxytoluene (BHT) when employed at similar concentrations [72].Tannin crude extract from the pea seed coat was used to test the antioxidant capabilities using a phosphatidylcholine (PC) liposome system..These fatty acids must to be included in diets since they are vital for human consumption.[71].

Health Benefits Of Peas In Cardiovascular Disease and Cancer Prevention

Peas have high amount of dietary fibres and Reduced incidence of cardiovascular illnesses is linked to increased dietary fibre consumption the average daily intake of dietary fibre was about 29g. Individuals who drank less than 29 grammes of DF per day were shown to have higher risks of hypercholesterolaemia by 38% and higher LDL cholesterol levels by 43%

In addition to its anticancer properties, pea extracts have demonstrated pharmacological action. When ingested at specific amounts, peas, which are often rich in biologically active compounds, may have significant effects that reduce the chance of cancer development.. Because pea contains a number of bioactive minerals and phytochemicals, it can help maintain a balanced diet and reduce the risk of cancer[72].

The antioxidants activity depends upon the concentration i.e; its (ORAC VALUE).Greater the ORAC VALUE Greater is the concentration of antioxidant.

Sr no.	English name	Antioxidant Contents	Concentration (ORAC VALUE)
1	Apple	Proanthocyanidins, flavonoids (kaempferol, quercetin, and naringenin derivatives); phenolic acids (protocatechuic, caffeoylquinic, and hydroxycinnamic acid derivatives); hydroxychalcones (phloretin and 3-hydroxyphloretin derivatives); and isoprenoid glycosides (vomifoliol derivatives) Flavanols,	16.78 a ± 0.25 (mmol TE/g) 1508 ± 44 (μmol/100 g)

		flavonols, dihydrochalcones, and hydroxycinnamate	
2	Red cabbage	Vitamins C and E, carotenoids, flavonoids, and thiol (SH) compounds	61 (μmol TE/g)
3	Grapes	Resveratrol, anthocyanins, catechins, and epicatechin	1000-3000/100 Grams
4	Cranberries	Phenols, flavonoids, and proanthocyanidins	9,584/100g
5	Peas	Vitamins C and E, carotenoids, flavonoids, and thiol (SH) compounds	19 (μmol TE/g)

Table1; Comparative analysis of various antioxidants on the basis of concentration (ORAC VALUE)[26].

Medicinal plants and species having antioxidant property

1] Allium sativum

A. sativum, or garlic, is a plant that is widely cultivated in India and is a member of the Alliaceae family. It is a perennial herb that can reach a height of three feet on an upright, tall blooming stem. Throughout history, people have used garlic for both medicinal and gastronomic purposes. It has been shown that a plant's potential for antioxidants increases with age.[73].One of the world's oldest medicinal plants, garlic (Allium sativum L.) is used as a flavoring as well as a medicinal herb due to its wide range of biological properties, which include anti-inflammatory, anti-thrombotic, anti-carcinogenic, anti-atherosclerotic, antibacterial, and antioxidant properties.

Its function as an antihypertensive and cardiovascular system protector is the more significant clinical use. Studies using epidemiological data revealed a negative relationship between the development of cardiovascular disease and the consumption of garlic.even In addition, dietary fibers, polyphenols, and microelements particularly selenium are associated with antioxidant activity.[74].

2] Capsicum annuum

Red pepper, or capsicum annuum, is indigenous to southern and northern North America. It was brought to Asia in the sixteenth century from South America. With its ability to scavenge radicals, it contains a broad range of phytochemicals. Carotenoids, flavonoids, tocopherols, organic acids, free sugars, capsaicinoids are all present in the spice. [73]

Fig.Health Benefits of Capsicum Annum

The diverse range of carotenoid pigments, which are unique to this species and have been demonstrated to be potent free radical scavengers, are responsible for the appealing red colour. These pigments include β-carotene, which has pro-vitamin A activity, and oxygenated carotenoids including capsanthin, capssorubin, and cryptocapsin. The green pepper showed undetectable levels of β-carotene, while the yellow pepper had the lowest at 0.2 μg/g.[75].

3]Leea Indica

Leea indica is a member of the Vitaceae family and has long been used as a natural folk medicine in Malaysia. L. indica leaves contain 23 recognized chemical components. The substances detected are 11 hydrocarbons, 3 phthalic acid esters, phthalic acid, gallic acid, ursolic acid, solanesol, farnesol, β-sitosterol, lupeol, and 1-eicosanol. Among them, total phenolic compounds have antioxidant action.[73].Three distinct L. indica extracts were investigated for antioxidant properties This finding supports future research into the methanolic extract's antimalarial effectiveness. [76]

2]ANTIOXIDANTS OBTAINED FORM MARINE SOURCES

It has been suggested that the marine ecosystem may be a source of chemical activity and biodiversity.The pharmaceutical, nutraceutical, and cosmetic sectors are becoming more interested in marine creatures due to their diverse range of intriguing and practical chemical compounds.. The cosmeceutical and antiaging businesses also use algae antioxidants as antiaging agents The microalga Haematococcus pluvialis contains a carotenoid pigment called astaxanthin, which has been shown to have anti-inflammatory, immunomodulatory, and antioxidant properties. [73].

Fig;-Antioxidant obtained from marine sources

Conclusion

Researchers from throughout the globe have discovered a variety of antioxidants in foods and their uses, concentrating on less manufactured sources that are safer and more practical to include in diets. Even though no such negative effects have been found in relation to the usage of synthetic antioxidants, consumers' desire in natural goods is still strong. Furthermore, lipid peroxidation and a decline in food quality and flavor may result from the artificial antioxidants and preservatives used in the meal. Natural herbs, spices, and plant ingredients have been used for centuries and are still used today in traditional food preparation as flavourings, aromas, and preservatives. An review of the potentials of several natural sources with respectable antioxidant potential is attempted in this chapter. The literature reviews gathered here will help determine the importance of different natural sources according to their active components, antioxidant capacity, and accessibility. Because 70–80% of the world's population cannot afford current supplements and medications, this chapter illustrates that people can prioritize their food habits depending on the antioxidant capacity and cost-effectiveness of the accessible supply.

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