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A review on nutritional and medicinal value of malus domestica with various activity

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Abstract---Apples (*Malus Domestica*) are among the oldest and most popular fruits in the world. China is currently the world's largest apple producer. While apples are mostly eaten fresh, they are processed into beverages, jams, jellies, and other foods. Polyphenols are the bioactive compounds and their stability, bioavailability, and antioxidant and anti-inflammatory effects are influenced by many factors. Eating apple and its processed products or extracts rich in polyphenols has been linked to a reduced risk of cancer, cardiovascular disease, diabetes and many other diseases, although some of these require further confirmation. They're loaded with powerful antioxidants, including quercetin, catechins, phloricin, and chlorogenic acids, which protect against the onset of breast and colon cancer and help prevent kidney stones and balance cholesterol levels. Studies have found that people who eat at least two apples a week can reduce the risk of developing asthma and type 2 diabetes and promote lung health.

Keywords---malus domestica, anti-cancer, antidiabetic, anti-oxidant, anti-inflammatory activity, polyphenol, human health.

Introduction

The apple (*Malus domestica* Borkh.; Rosaceae) is one of the economically and culturally most important nutrient-rich fruit grown in all temperate zones ⁽¹⁾. The

whole fruit is edible except for the seeds; apart from that many other products are made from it: apple wines and juices, jams, compotes, tea, wine, etc dry apples. They are irreplaceable in human nutrition, as they increase immunity, have a positive effect on stress resistance, and they contain many bioactive substances beneficial to humans. There is no doubt that apples are healthy and have many health benefits, but it was modern medicine that based on evidence, not experience, that had to prove their usefulness to human health ⁽²⁾. Research on bioactive substances in apples is mainly focused on the flesh and skin of an apple. In total, a large number of bioactive substances, including polyphenols, polysaccharides, plants Sterols, pentacyclic triterpenes and organic acids have been found and verified in apples that their presence in pulp and skin differs significantly. From a human health perspective in particular polyphenols, polysaccharides, plant sterols and triterpenes together make up the majority of beneficial effects on human health, such as antioxidant, anti-cancer and anti-inflammatory ^(3,4). This overview summarizes the apple's bioactive compounds, including polyphenols, Hydroxycinnamic acid, glycosylated flavonoids, flavan-3-ols, proanthocyanidins (PAC), polysaccharides (pectin), phytosterols, pentacyclic triterpenes, triterpenic acids, dihydrochalcones and vitamin. Many types of antioxidant compounds present in apples and apple peel have also been reported such as catechin, chlorogenic acid, epicatechin, cyanidin-3-galactoside, procyanidin, coumaric acid, gallic acid, phloridzin, quercetin-3-galactoside and quercetin-3-rhamnoside. But in apple flesh there are some compounds that are found in less abundance, e.g. B. epicatechin, catechin, phloridzin and Procyanidin than in the shells. Concentrations of compounds as quercetin have been reported in apple glycosides, 13.2 mg/100 g fruit; phloretin glycosides, 5.59 mg/100 g fruit; Procyanidin B, 9.35 mg/100g Fruit; chlorogenic acid, 9.02 mg/100 g fruit; vitamin C, 12.8 mg/100 g fruit; Epicatechin, 8.65 mg/100 g fruit ⁽⁵⁾; However, chlorogenic acid is found higher in flesh than in peel ⁽⁶⁾. Our main goal was to discuss the functions of these bioactive substances and their use in medicine. Eventually we will throw a future perspective of apple bioactive substances in disease treatment and development of functional health food. We hope this review helps to understand how Apple Bioactive works substances and offer some new insights into drug or functional health food development bioactive substances in apple.

Taxonomical Classification

Domain: Eukarya
Kingdom: Plantae
Phylum: Magnoliophyta
Class: Magnoliopsida
Order: Rosales
Family: Rosaceae
Genus: Malus
Species: Malus domestica.

Geographical Distribution

World -Wide

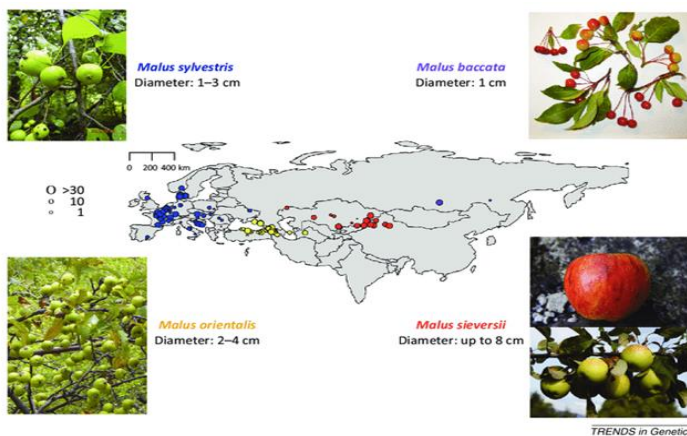


Fig-1(7)

The common apple is native to Central Asia, Chile, France, Iran, Italy, Poland, Russia, Turkey, United States of America and Afghanistan, now grown worldwide for its crisp, crunchy fruit. Many cultivars exist with differences in color, flavor, and recommended food use.

India

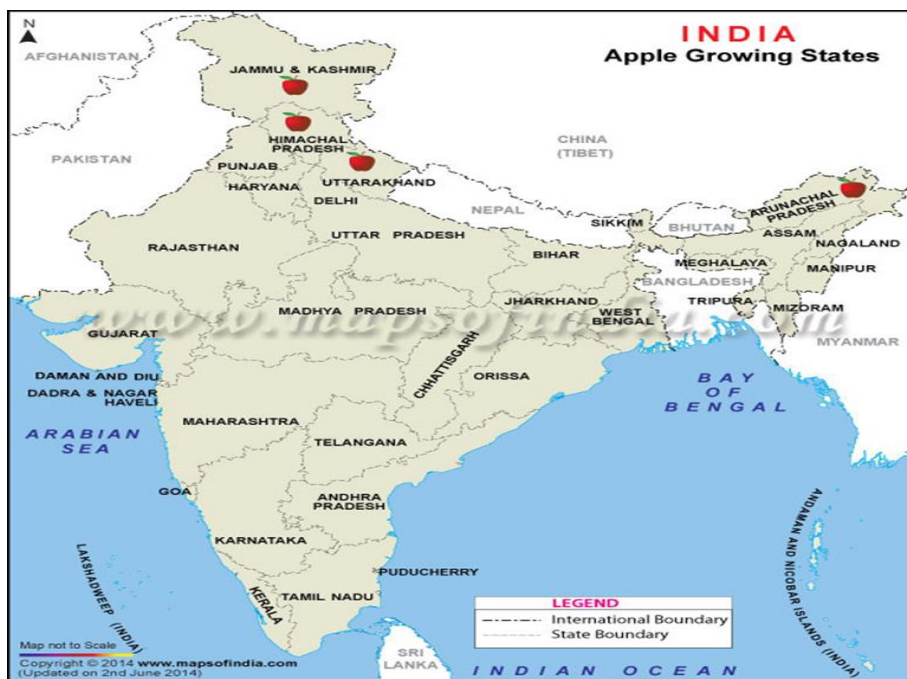


Fig-2 (8)

In India, Apple is primarily cultivated in Jammu & Kashmir; Himachal Pradesh; hills of Uttar Pradesh and Uttaranchal. It is also cultivated to a small extent in Arunachal Pradesh; Nagaland; Punjab and Sikkim.

Phenolic Composition

By HPLC analysis we found 6 phenolic acids (gallic acid, p-coumaric acid, ferulic acid, sinapic acid, syringic acid and p-anisic acid) and 12 flavonoids (catechin, epicatechin, rutin, naringin, myricetin, hesperidin, diosmin, narigenin, luteolin, hesperetin, kamempferol and apigenin) in these extracts. There are five main groups of polyphenolic compounds found in apples: flavanols (catechin, epicatechin and procyanidins), phenolic acids (mainly chlorogenic acid), dihydrochalcones (phloretin glycosides), flavonols (quercetin glycosides) and anthocyanins (cyanidins).

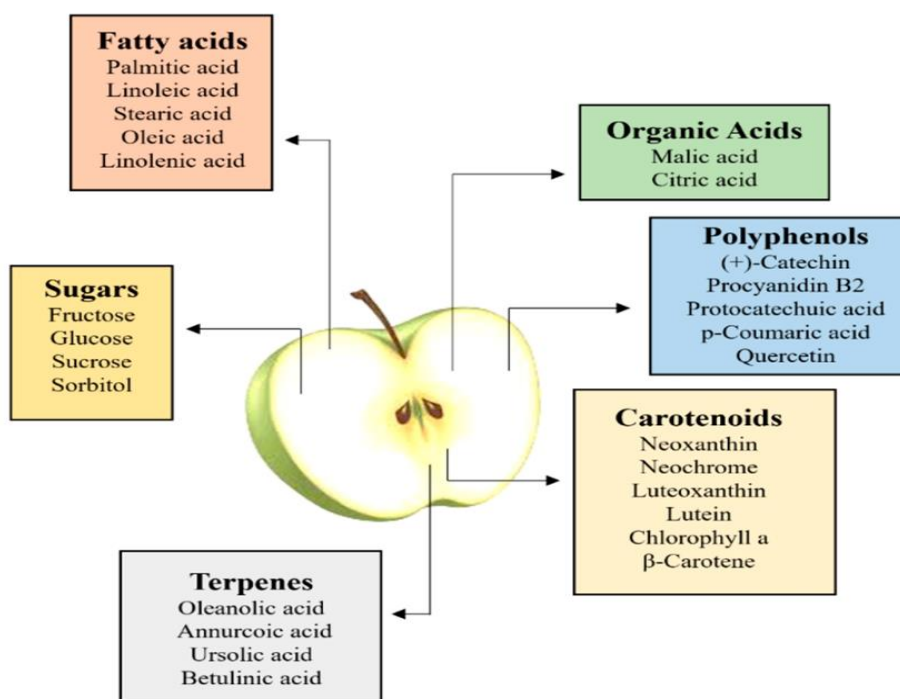


Fig-3⁽⁹⁾

Antioxidant Activity

The flavonoids and phenolic compounds contained in the apple show biological activities as antioxidant, antimicrobial and enzyme-inhibiting effect (against cholinesterase, tyrosinase, amylase, and glucosidase). Studies reported that the apple skins show better activity than the pulp ⁽¹⁰⁾. It has been reported that water, alcohol and polyphenol extracts from *M. domestica* fruits have been found most effective against gram +ve and gram -ve bacteria such as *B. subtilis*, *S. aureus*, *S. epidermidis*, *K. pneumoniae*, *E. coli* or *P. aeruginosa* that could usefully be applied to the food, Pharmaceutical and cosmetics industry ^(11,12). It has been

found that quercetin is compound abundant in apple skins, acts as an antioxidant and the potential antioxidant activity of the apple was about 83 μmol of vitamin C equivalents, which means that the antioxidant activity of 100 g apples are equivalent to about 1500 mg of vitamin C ^(13,14)

Anti-Inflammatory Activity

It has been found that various triterpenic acids such as chlorogenic acid and maslinic acid have potential in anti-inflammatory activity. Maslinic and pomolic acid have anti-inflammatory and antiarthritic effects by NF-kB inactivation. Some researchers found many significant sources such compounds show potential in anti-inflammatory and glycemic control effects. Graziani and colleagues also reported that polyphenol extracts from apples prevent damage to human gastric epithelium cells in vitro and rat gastric mucosa in vivo ⁽¹⁵⁾.

Antidiabetic Activity

Diabetes mellitus, commonly known as diabetes, is a metabolic disorder that mainly affects characterized by insulin resistance, relative insulin deficiency, and high blood sugar levels. Very little information is available on the potential regulatory effects of apples and their polyphenol extracts blood glucose levels and other markers associated with diabetes. It was found that in Apple Extract, two inhibitors at concentrations of 10-fold dilution (I2) showed minimal absorbance, resulting in a reduction in browning at one glucose concentration. So, in diabetes, *M. domestica* is effective and efficient in reducing glycation levels under conditions ⁽¹⁶⁾. Due to the presence of a higher amount of Quercetin, apple consumption may reduce risk of diabetes, and its peels have also been linked to a reduced risk of type II diabetes. Phenolic compounds, including flavonoids, found in apple juice They have been found to significantly affect insulin, plasma concentrations of glucose and two other hormones. Glucose-dependent insulinotropic polypeptide and glucagon-like peptide-1, in volunteers, and the result seemed consistent with delayed intestinal absorption of glucose ⁽²⁾. Flavonoids played an important role in the pharmacological effects in vivo and in vitro ⁽¹⁷⁾. Likewise, these are associated with health-promoting effects and are beneficial in medicinal, nutraceutical and health-promoting effects cosmetic applications ⁽¹⁸⁾. Flavonoids derived from apple peel extracts have been reported to be effective in hypertension and cardiovascular diseases ⁽¹⁹⁾. The main types of flavonoids found in apple and its products are flavonols, flavanols or catechins and anthocyanins with the leading representatives (-)-epicatechin, quercetin glycosides or cyanidin galactoside ⁽²⁰⁾.

Anticancer Activity

It has been suggested that eating one or more apples a day helps reduce the risk cancer compared to eating less than one apple per day ⁽²¹⁾. In animal model studies apples have been shown to be effective in preventing skin, breast and colon cancer epidemiological observations suggested that regular consumption of one or more apples per day could cause this reduce the risk of lung and colon cancer ^(2,22). Jedrychowski and co-workers examined four different ones fruits including berries, stone fruit, citrus fruits and apple in which an apple was more

specifically found and significant in reducing (63%) the risk of colorectal cancer⁽²³⁾. Apple extracts show dose-dependent activity against cell proliferation in Caco-2 colon cancer and Hep G2 liver cancer cells and shows maximal inhibition of 43% and 57%, respectively, at 50 mg/mL. It was also concluded that due to a higher amount of phytochemicals in apple skins, peels alone have greater efficiency in inhibiting Hep G2 cell proliferation than whole apples⁽¹³⁾. In study, it was found that the polyphenols present in apples played a significant role in affecting signaling pathways that control growth, cell survival and proliferation both in vitro and in vivo. Phloretin has the efficiency to through inhibit human hepatoma (Hep G2) and human colorectal cancer cells inhibition of the type 2 glucose transporter (GLUT2). This inhibition of intracellular glucose uptake was the main reason for killing the cancer cell because these cancer cells depend on aerobic glycolysis for energy production. Nuclear factor- κ B (NF- κ B) is also activated in colorectal carcinomas Lipopolysaccharide (LPS) that binds to Toll-like receptor 4 (TLR4). Modification of polysaccharide components present in apple altered the LPS/TLR4/NF- κ B pathway; hence complement of apple polysaccharide significantly inhibited the ability to migrate in vitro on the LPS/TLR4/NF- κ B signaling pathway in colorectal cancer cells (HT-29 and SW620 cells). This consumption was also reported of an apple in a day reduces the risk of colon cancer and eating more than one apple reduce the risk of colorectal cancer by 50% every day⁽²¹⁾.

Health Benefits of Apples

Apples are a delicious and juicy fruit that quench thirst and satisfy a sweet tooth while promoting overall health in a comprehensive way. This pome fruit belongs to the rose family. It is believed to have been grown in Europe and Asia for thousands of years. They came to the Americans with the help of European colonizers and are extensively cultivated in the United States. More than 7500 varieties of apples are available in different colors such as yellow, red and green. Apples have a thin skin with juicy and thick interior flesh that softens as it ripens. Seeds have an inner core that is harmful to health. Nutrients found in skin and meat are a great source of tannins and anthocyanins. The components found in apples are responsible for the health benefits they provide. Apple credits minerals, vitamins, organic compounds and nutrients. Vitamin K, vitamin C, riboflavin and vitamin B6 are important nutrients. In addition, it contains minerals such as copper, potassium, magnesium and manganese. It's loaded with phytonutrients and flavonoids like epicatechin, quercetin, phloridzin, and other polyphenolic compounds. Here are various impressive health benefits of apples⁽²⁴⁾.

Nutritional Value

Nutritious:

Apples are considered a nutrient-dense fruit, meaning they provide plenty of nutrients per serving. A medium-sized 200-gram apple provides the following nutrients

- Calories: 104
- Carbohydrates: 28 grams

- Fiber: 5 grams
- Vitamin C: 10% of the Daily Value (DV)
- Copper: 6% of the DV
- Potassium: 5% of DV
- Vitamin K: 4% of DV

Other nutrients found in apple like – Vitamin A, niacin, pantothenic acid, pyridoxin, folic acid including iron, zinc, magnesium and phosphorus.

Extremely rich in polyphenols

Apples have wide range of polyphenolic chemicals including-catechin, epicatechin, phlorizin, quercetin, anthocyanins and chlorogenic acid. In comparison to apple flesh, the peels have a higher concentration of phenolic chemicals. Each polyphenol has various health benefits, for example, Phlorizin protects against breast cancer, Catechin and Epicatechin are key cholesterol-lowering chemicals and Quercetin may alter thyroid hormone function. Certain medications can harm the stomach lining, cause inflammation, and lower the number of beneficial bacteria in the gut. Apple polyphenols may also help to protect the stomach lining from harm and reduce inflammation ⁽²⁵⁾.

Rich in Antioxidant

Apples and apple peels are both high in Antioxidant and have a high nutritional value. Vitamin C and beta-carotene are 2 key Antioxidant found in apples. Furthermore, many polyphenol found in apples have Antioxidant effects. Apples include Antioxidants that can significantly reduce the activity of cancer cells in the colon and liver. However, the Antioxidant content of different apple varieties varies ⁽²⁵⁾.

Rich in Dietary Fiber

On a dry weight basis, apple contains 10-15% pectin, which is a soluble fiber found in plant foods. Pectin has a gelling property, which means it absorbs water in the intestine and becomes viscous. Such a property of apple prevents a sudden increase in plasma glucose levels after a meal, lowers cholesterol, provides satiety, delays hunger pangs and protects against intestinal problems. The majority of the pectin is present in the peel (skin) of the apple. A study looked at the fiber composition of 13 different apple varieties and found that apples are a great source of both soluble and insoluble fiber. The fiber content varies between 15 to 20 grams per kilogram of apple. Therefore, it is recommended to eat an apple whole, without peeling the skin and without turning it into juice, to maximize the apple's benefits ⁽²⁵⁾.

Medicinal Value

Cure for Obesity

Apples are high in fiber and water, two properties that make them filling. Apples are particularly filling thanks to their high fiber and water content. Their

polyphenols can also act against obesity. Scientific evidence has shown that eating whole apple increases the skeletal mass and brown fat (healthy – burns more calories) and reduces obesity and white fat (unhealthy). This is possible due to the presence of certain antioxidants in the peels. However, if the peel is removed, such a positive effect will not take place. Another mechanism through which eating apples promote weight loss is the presence of dietary fiber in it. On digestion, dietary fiber absorbs water and forms a viscous gel in the gut. Formation of such a viscous gel provides a feeling of fullness and reduces hunger pangs. This will reduce the food intake, which will in turn decrease the overall calorie intake and promote weight loss. Thus, individuals who want to lose weight can replace their snack with an apple ^(24,25,26).

Prevent Cardiovascular Diseases/Heart diseases

An apple a day helps prevent vascular problems such as strokes and heart attacks. The research conducted showed the lower risk of vascular diseases. Small changes in diet and increased use of statins can significantly reduce vascular mortality. The research also reinforces calls for increased use of drugs to prevent cardiovascular problems and aims to improve the nutritional quality of diets. A small change in diet, healthier living, and medication can make a big difference in preventing stroke and heart disease. Lifestyle changes are recommended to prevent heart disease. The study suggests that statins may reduce the likelihood of vascular events, a person's hidden chances for cardiovascular disease. High blood pressure, high levels of total cholesterol and LDL (unhealthy low-density lipoprotein) cholesterol increase the risk of cardiovascular disease. Daily consumption of apple lowers blood pressure due to its high flavonoid content. In addition, the pectin contained in apples reduces cholesterol reabsorption in the intestines and lowers total cholesterol levels. The presence of various polyphenols in the apple provides additional protection for the heart. The research report also showed that eating 2 to 3 apples a day for 28 days reduced platelet aggregation, thus lowering the risk of cardiovascular disease. Therefore, apple can be made a part of a healthy heart diet ^(24,25,27).

Cure Diabetic

Apple has been found to play an important and beneficial role in treating type 2 diabetes mellitus. A recently published 2014 study observed that when consumed with oral hypoglycemic agents (drugs used to lower plasma glucose levels), apple reduced symptoms of type 2 diabetes mellitus such as excessive thirst, increased appetite, and so on. Diabetics need to keep their blood sugar under control. The polyphenols found in apples are associated with reduced absorption of carbohydrates by the body, which lowers the fluctuations in blood sugar levels that occur in the bloodstream and are a key factor in normalizing diabetes. Polyphenols reduce the absorption of glucose in the digestive tract. It stimulates the release of insulin from the pancreas, which is essential for maintaining blood sugar levels. It eliminates sugars from the bloodstream as polyphenols stimulate insulin receptors on cells and support organ function and metabolism. Women who eat an apple a day are 28% less likely to develop type 2 diabetes than women who don't eat an apple. Due to soluble fiber, apples dampen blood sugar fluctuations. In addition, treatment of type 2 diabetes mellitus with apple reduced

plasma glucose levels by 49%. Such a hypoglycemic effect of the apple is attributed to its high fiber content. In addition, apple has also been found to lower glycation levels and reduce the production of “advanced glycation end products.” There is scientific evidence that the formation of advanced glycation endproducts is associated with an increased incidence of diabetic complications, such as: Neuropathy (damage to peripheral nerves), Nephropathy (kidney damage), Retinopathy (damage to the eyes). The high antioxidant content in apples scavenges the free radicals that could otherwise play an important role in the etiology of diabetic complications. Not only that, apple has also been shown to inhibit the activity of the enzyme that converts starch into glucose during the digestive process. Therefore, apple can prevent an increase in plasma glucose levels. This shows that people with type 2 diabetes mellitus can safely consume apple ^(24,25).

Prevent Cancer

Scientific evidence has shown that eating one or more apples a day reduces the risk of cancer compared to eating less than one apple. The risk of lung cancer, prostate cancer and colon cancer decreased significantly in people who consumed apples every day. The fiber (pectin) found in apples and apple peel protects the colonic lining (a tissue that lines the intestinal organs and secretes mucus) from pollutants. Fiber binds to these substances in the large intestine and excretes them from the body. Additionally, the presence of phytochemicals and powerful antioxidants in apple fights oxidative stress by neutralizing harmful free radicals, which play a crucial role in the development of cancer. Vitamin C and beta-carotene are the two powerful antioxidants found in large amounts in apples. Research is identifying natural compounds found in foods like apple peel, turmeric and red grapes that may prevent the growth of prostate cancer, which commonly afflicts US men. The combination of nutrients offers a better effect than existing drugs against prostate cancer. The study was conducted to inhibit the growth of cancer without toxicity in mice. Apple peel, turmeric, and green tea have potential therapies and chemicals that could reduce the risk of inflammation in the body and cancer. People with autoimmune diseases, chronic infections, and obesity are more susceptible to cancer due to damage to normal cells. Natural compounds were tested in mouse and human cell lines to determine inhibition of prostate cancer cell growth. The active ingredients were curcumin, the bright yellow plant found in turmeric; ursolic acid, a waxy natural chemical found in apple peel and rosemary, and resveratrol, a natural compound found in berries and red grapes. These nutrients possess anti-cancer properties. Combine ursolic acid with resveratrol or curcumin to prevent cancer cells from engulfing it ^(24,25,28).

Helpful for Alzheimer's diseases

Apple is rich in antioxidants that help prevent oxidative stress, which is a tissue-damaging process associated with neurodegenerative diseases and Alzheimer's disease. Dietary intervention by increasing the intake of foods rich in antioxidants helps reduce the risk of developing Alzheimer's and other diseases. Fresh apples are high in quercetin, which, compared to other fruits and vegetables, is an antioxidant that effectively counteracts Alzheimer's. Eating one apple a day can be helpful. Quercetin is stable during cooking, but fresh apples have better

quercetin content than processed or cooked apple products because the compound is found in the skin of apples and not in the flesh. Also, red apples have higher levels of antioxidants than yellow or green ones. A very positive effect of the daily consumption of apples on the consequences of Alzheimer's disease has been observed in several studies. Such a beneficial effect of eating apples is attributed to the presence of polyphenols in them. It has further been found that drinking apple juice suppresses the expression of markers of Alzheimer's disease and reduces the rate of cognitive decline, meaning that drinking apple juice improves the mental process of acquiring knowledge and understanding. Therefore, drinking a glass of apple juice or eating whole apples can be associated with improved cognitive function, better concentration levels, and an overall better quality of life ^(24,25,29).

Treat Kidney Problem

Eating a healthy diet that includes nuts, vegetables, fruits, whole grains, and low-fat dairy products helps prevent kidney stones. We should limit consumption of red and processed meat, salt and sweetened beverages. Kidney stones are linked to high rates of high blood pressure, body weight gain, diabetes, and other heart conditions. The study was conducted to determine the effects of a healthy diet on kidney stone formation. The individuals with high DASH scores consumed a diet high in potassium, calcium, magnesium, vitamin C, oxalate and low in sodium. A DASH-style diet influences the development of diabetes, high blood pressure and chronic diseases such as kidney stones. The researchers conducted an analysis to study participants without diabetes and high blood pressure. In this study, the DASH diet lowers the risk of getting kidney stones. Because medications used to treat kidney stones have unpleasant side effects, the study points to a DASH-style diet as an effective alternative ^(24,30).

Assist Asthmatic Patients

An inverse relationship was found between apple consumption and asthma. Daily consumption of apples has been shown to improve overall lung function. The presence of the flavonoid (QUERCETIN) in apples has been shown to reduce the severity of asthma. Individuals who consumed 5 or more apples per week had significantly greater forced expiratory volume (the amount of air a person can exhale in one forced breath) compared to individuals who did not consume apples. In addition, the presence of CATECHIN in apples has been negatively associated with chronic obstructive pulmonary disease (a chronic inflammatory lung disease). Therefore, eating apples has been linked to improved breathing and a reduced incidence of asthma and other lung diseases. The respiratory system is prone to inflammation and various respiratory problems associated with inflammation of cells and membranes in the system. Asthma is a serious problem and in severe cases it can be fatal. This fruit has anti-inflammatory effects, so it is used as a natural treatment. Apples contain complex mechanisms for healing these health conditions due to the presence of potential nutrients responsible for the health benefits ^(24,25).

Helpful for Hypertension/High Blood Pressure

Studies have found that apples are not only a rich source of fiber, but are also high in potassium and flavonoids such as QUERCETIN and PROANTHOCYANIN (potassium levels in apples can vary based on soil content and other factors). In addition, apple is naturally low in sodium (foods high in sodium are well known to raise blood pressure). It has further been observed that certain compounds found in apple and its peel have antihypertensive properties and are beneficial in lowering blood pressure in those with hypertension. QUERCETIN and PROANTHOCYANIN lower blood pressure by blocking "angiotensin converting enzyme" (an enzyme that increases blood pressure by narrowing blood vessels). Therefore, a whole apple (along with peel) can be made part of the DASH diet (dietary approaches to stopping high blood pressure) ⁽²⁵⁾.

Maintain High Cholesterol & Triglycerides Levels

Keeping total cholesterol and triglyceride levels in the normal range is very important for a healthy heart. Eating two whole apples per day has been shown to have a positive impact on overall lipid profile. Apples are a rich source of fiber and contain no cholesterol or saturated fat. The presence of fiber prevents the absorption of LDL - low density lipoprotein (unhealthy cholesterol in the body) in the intestine. One study found a 30% reduction in cholesterol levels in people who consumed 2 apples a day compared to people who didn't consume any apples at all. Another study showed a 52% decrease in triglyceride levels in people who consumed apple daily. Therefore, individuals can safely include whole apples as part of their hypolipidemic diet ⁽²⁵⁾.

Helps for Constipation

Apples and their skins contain fiber and a variety of nutrients. When eating apples, fiber in the intestine swells and becomes viscous. This adds bulk to the chair and aids in easy chair passage without putting much pressure or strain on the system. Therefore, people with constipation should consume at least one apple per day without peeling the skin ⁽²⁵⁾.

Helps in Freshens breath

The study found that eating apples helps decrease garlic respiration. Garlic cloves contain volatiles such as allyl mercaptan, diallyl disulfide, allyl methyl sulfide, and allyl methyl disulfide. After consumption, the levels of volatile components in the breath were analyzed using selected ion flow tube mass spectrometry. Consume raw apple, which helps decrease volatile concentration in the breath by 50%. An apple juice does not lower volatile levels as effectively as chewing a raw apple. Garlic breath deodorizes through two mechanisms. First, the enzymes found in raw foods eliminate odors and others; The phenolic compounds in raw or cooked foods destroy volatiles. Raw food is more effective as it contains both phenolic compounds and enzymes ^(24,31).

Helps to Enhance Memory

Apple supports the brain functions. Research conducted on animals has found that juice extracted from apples increases the production of the essential neurotransmitter acetylcholine in the brain, which leads to the promotion of memory. Acetylcholine is a chemical released by nerve cells that transmit messages to other nerve cells, which is essential for good health. Feeding the mice apple juice increased the production of acetylcholine in their brains. The researchers concluded that the mice fed apple juice performed better on maze tests. The results of the current study showed that eating foods rich in antioxidants, such as apple juice and apples, helps reduce problems associated with memory loss ^(24,32).

Helps to Enhance Immunity

Soluble fiber, found in apples, oats and nuts, helps reduce inflammation associated with obesity-related diseases and boosts the immune system. It changes the personality of immune cells from angry, pro-inflammatory cells to healing and anti-inflammatory cells that help recover faster from an infection. This is because soluble fiber increases the production of interleukin-4, an anti-inflammatory protein. The study shows a positive change in the immune system. Recent studies have shown that adipose tissue has anti-inflammatory components that protect obese people from further inflammation, such as stroke and heart attack. Not all fat is considered bad. Salmon, olive oil, sardines, tuna and trout are rich in omega 6 and 3 fatty acids. Diets high in fat and soluble fiber lower the negative effects of diet such as high triglycerides and high blood sugar. It also delays the likelihood of diabetes. Soluble fiber has anti-inflammatory properties and strengthens the immune system. Not all fibers are the same. Barley, oat bran, seeds, nuts, citrus fruits, lentils, strawberries, apples, and carrots are good sources of soluble fiber. Whole and whole grain products, green leafy vegetables, wheat bran consist of insoluble fiber, which provides bulk and aids in the movement of food in the digestive system, but does not boost the immune system ^(24,33,34).

Traditional uses of Apple

- Fruits are used as a laxative and astringent.
- Use the infusion to treat remitting, intermittent and biliary fever.
- Fruit supports the digestive process and helps regulate bowel movements.
- Apple juice helps reduce acidity in the stomach.
- Eat an apple every day to reduce the risk of skin diseases.
- Use an apple cider vinegar to prevent kidney stone formation.
- It is helpful in obesity, insomnia, bronchial asthma and anemia.
- Apply the pulp of the apple on the face to heal acne.
- To reduce eye strain, place an apple pulp on the eyelids for about 15 to 20 minutes.
- Use the paste made from apple leaves to cure dandruff, promote hair growth and prevent hair loss.
- It also lowers the chance of tooth decay.
- The fruit is used to control constipation and diarrhea.

- It softens the passage and accumulation of gallstones.
- The peel of an apple fruit contains a chemical known as ursolic acid, which plays a role in both muscle building and metabolism ⁽²⁴⁾.

Conclusion

Apple and its peel are related to excellent human fitness and experimental proof from in vitro and in vivo research indicative of its tremendous function within the prevention and remedy of sicknesses. Our assessment helps all of the preceding research which have been said. However, in lots of said assessment articles, the literature may be very insufficient. Our assessment targeted on animal version research, which can be appropriate as consistent with the precise quantity of attention said. In each in vivo and in vitro research, the efficacy of vitamins found in apple towards sicknesses changed into evaluated. At present, there's nevertheless a tremendous prospect for the improvement and usage of bioactive materials in apple. The intake of apple and its processed merchandise or extracts wealthy in polyphenols has been related to decreased danger in cancer, cardiovascular disease, diabetes, and plenty of different persistent sicknesses, inclusive of asthma. Polyphenols exert those fitness outcomes via antioxidant and anti inflammatory sports and via way of means of modulating biomarkers in numerous mobileular signalling pathways. While enough proof has been located for a number of the fitness useful outcomes, lots of them nevertheless require in addition research. Further studies must attention on the extraction of greater apple bioactive materials and the improvement of medication and practical food that may save you tumor, inflammation, and cardiovascular disease. It will now no longer most effective make a contribution to the safety of human fitness, however additionally offer financial benefits.

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