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A Review Study on Apple Phytochemicals & its Health Benefits

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ABSTRACT: ***Evidence suggests that a diet rich in fruits and vegetables may reduce the risk of chronic diseases such as cardiovascular disease and cancer, and phytochemicals found in fruits and vegetables, such as phenolic, flavonoids, and carotenoids, may play a key role in chronic disease risk reduction. Apples are a popular fruit that are high in phytochemicals, and epidemiological studies have linked apple intake to a lower risk of some malignancies, cardiovascular disease, asthma, and diabetes. Apples have been shown in the laboratory to have high antioxidant activity, prevent cancer cell growth, reduce lipid oxidation, and lower cholesterol. Apples are high in phytochemicals such as quercetin, catechin, phloridzin, and chlorogenic acid, which are all powerful antioxidants. The phytochemical content of apples varies significantly across various kinds, and there are also minor variations in phytochemicals as the fruit matures and ripens. Apple phytochemicals are little to no affect by storage, but they are significantly affected by processing. While there is a lot of data out there, there hasn't been a comprehensive assessment of the health benefits of apples and their phytochemicals. The goal of this article is to examine the most current research on the health benefits of apples and their phytochemicals, as well as phytochemical bioavailability and antioxidant behavior, as well as the impacts of variety, ripening, storage, and processing on apple phytochemicals.***

KEYWORDS: ***Antioxidant, Apple, Health, Phytochemical, Phenolic.***

1. INTRODUCTION

Many of us were taught as youngsters that "eating your veggies is healthy for you," and the adage "an apple a day keeps the doctor away" is still prevalent. Many recent research have given scientific support for both of these widely used expressions. In the early 1990s, researchers looked at over a hundred epidemiological studies on food and cancer, and found that fruits and vegetables had a substantial protective impact against a range of malignancies in 128 of 156 dietary studies. They discovered that those who ate little fruits and vegetables were twice as likely to get cancer as those who ate a lot of fruits and vegetables. A recent research in China found a connection between fruit and vegetable consumption and a lower risk of breast cancer in women. Pre-menopausal women who ate more dark yellow-orange veggies and citrus fruits had a reduced risk of breast cancer in this population-based, case-control study of women in Shanghai[1]–[4].

Consumption of fruits and vegetables seems to protect against coronary heart disease. A total of 84,000 women and 42,000 males were tracked for 14 years and 8 years, respectively. They discovered that individuals who ate the most fruits and vegetables had a 20% reduced risk of coronary heart disease, and those who ate the most green leafy vegetables and vitamin C-rich fruits had the lowest risk. A diet rich in fruits and vegetables may help guard against not just heart disease and cancer, but also a range of other diseases. A diet rich in fruits and vegetables, for example, may help prevent cataracts, diabetes, Alzheimer's disease, and even asthma.

Flavonoids are a kind of phytochemical frequently found in fruits and vegetables. In the United States and Europe, apples constitute a major source of flavonoids in people's diets. Apples account for 22% of all phenolics eaten in the United States, making them the most abundant source of phenolics. Apples and onions are the primary sources of dietary flavonoids in Finland, whereas apples are in third place after tea and onions in the Netherlands. Flavonoid

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consumption was linked to a reduced overall death rate in a Finnish study of 10,000 individuals[5]–[9]. Apples were one of the primary sources of dietary flavonoids with the greatest links to lower mortality.

1.1.Apples provide the following health benefits:

1.1.1. Evidence from epidemiology Cancer:

Several studies have shown a connection between apple intake and a lower risk of cancer, particularly lung cancer. Fruit and vegetable consumption was linked to a 21% lower risk of lung cancer in women in the Nurses' Health Study and the Health Professionals' Follow-up Study, which included approximately 77,000 women and 47, 000 men. This link was not observed in males. Only a handful of the specific fruits and vegetables studied had a significant impact on lung cancer risk in women, although apples were one of the fruits linked to a lower lung cancer risk. Lung cancer risk was decreased in women who ate at least one dish of apples and pears each day. There was no link between any specific fruit or vegetable and the risk of lung cancer in the men who took part in the study[10].

In a case-control research conducted in Hawaii, it was shown that eating apples and onions was linked to a lower risk of lung cancer in both men and females. 582 patients with lung cancer and 582 control individuals without lung cancer had their smoking history and dietary consumption evaluated. When compared to individuals who ingested the least quantity of these fruits, those who consumed the most apples, onions, and white grapefruit had a 40–50 percent lower risk of lung cancer. Lung cancer risk was shown to be lower in both men and women, and in nearly all ethnic groups. There were no correlations with red wine, black tea, or green tea. Flavonoids are abundant in both onions and apples, particularly quercetin and quercetin conjugates.

A significant negative relationship was found between flavonoid consumption and lung cancer development in a Finnish research including 10,000 men and women and a 24-year follow-up. The average flavonoid consumption in the studied population was 4.0 mg per day, with quercetin accounting for 95% of total flavonoid intake. Apples and onions accounted for 64% of total flavonoid consumption. The link between higher flavonoid intake and a lower risk of lung cancer was particularly significant in younger individuals and nonsmokers. The only food that was shown to be inversely linked to lung cancer risk was apples. Because apples were the primary source of flavonoids in the Finnish population, it was determined that flavonoids from apples were most likely to blame for the lower lung cancer risk.

1.1.2. Cardiovascular disease (CVD) is a condition that affect:

Apple intake has been linked to a lower risk of cardiovascular disease. The Women's Health Study looked into the link between flavonoids and cardiovascular disease in almost 40,000 women over a 6.9-year period. The study found that women who consumed the most flavonoids had a 35% lower risk of cardiovascular events. Flavonoid consumption was not linked to a higher risk of stroke, myocardial infarction, or mortality from cardiovascular disease. There was no link between quercetin and cardiovascular disease, cardiovascular events, myocardial infarction, or stroke in this study. Apple and broccoli consumption, on the other hand, were linked to a lower risk of cardiovascular disease and cardiovascular events. The risk of cardiovascular disease was reduced by 13–22% in women who ate apples.

Total flavonoid consumption was shown to be substantially inversely related with coronary mortality in women, but not in men, in a Finnish research looking at flavonoid intake and

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coronary mortality. Apple and onion consumption were also shown to be inversely related to coronary mortality, particularly in women. The effects of quercetin and apple consumption on cerebrovascular disease were also discovered in this cohort research. When compared to individuals who consumed the least quantity of apples, those who consumed the most had a reduced risk of thrombotic stroke. Consumption of onions and quercetin was not linked to thrombotic stroke or other cerebrovascular disorders.

1.1.3. Asthma and pulmonary function are two terms that are often used interchangeably:

Apple intake has been shown to be inversely related to asthma and favorably related to overall lung health. In a recent Australian research including 1600 people, apple and pear consumption was linked to a lower risk of asthma and a reduction in bronchial hypersensitivity, but overall fruit and vegetable consumption was not linked to asthma risk or severity. Vitamin E, vitamin C, retinol, and -carotene, among other antioxidants, were not linked to asthma or bronchial hypersensitivity. Apple consumption, as well as selenium consumption, has previously been linked to a lower risk of asthma in people in the United Kingdom. Nearly 600 people with asthma and 900 people without asthma were questioned about their food and lifestyle in this research.

The total amount of fruits and vegetables consumed was marginally linked to asthma, while apple consumption had a greater negative association with asthma. This impact was particularly noticeable in those who ate at least two apples each week. Consumption of onions, tea, and red wine was not linked to the development of asthma, indicating that apple flavonoids had a particularly protective impact. Carotene consumption was marginally, but favorably, linked with asthma. Vitamin C and vitamin E intake were not correlated with asthma incidence.

In a Finnish research including 10,000 men and women, apple and orange consumption were both linked to a lower risk of asthma. Flavonoid consumption was linked to a reduced incidence of asthma in general, with quercetin, hesperitin, and naringenin being the major culprits. Onions, grapefruit, white cabbage, and juices, among other fruits and vegetables, were not linked to a lower incidence of asthma.

1.1.4. Weight loss and diabetes:

Apple intake may help reduce the risk of heart disease, cancer, and asthma, but it may also be linked to a reduced risk of diabetes. Apple intake was linked to a lower incidence of Type II diabetes in the previously mentioned 10,000-person Finnish research. Higher consumption of quercetin, a key component of apple peels, was likewise linked to a lower risk of type 2 diabetes. Myrectin and berry consumption were also linked to a reduced incidence of type 2 diabetes, whereas consumption of onions, oranges, grapefruit, and white cabbage was not.

1.2.Animal and in vitro research on the health benefits of apples:

1.2.1. Antioxidant properties:

Apples, particularly apple peels, have been shown to have strong antioxidant action, inhibiting the development of liver cancer and colon cancer cells significantly. Apples with the peel had a total antioxidant activity of about 83 mol vitamin C equivalents, which means that the antioxidant activity of 100 g apples (roughly one serving of apple) is equivalent to about 1500 mg vitamin C. However, 100 g of apples only contain approximately 5.7 mg of vitamin C. Although vitamin C is a strong antioxidant, this study found that a range of other chemicals account for almost all of the antioxidant activity in apples. Vitamin C made up less than 0.4 percent of overall antioxidant activity in apples.

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1.2.2. Antiproliferative properties:

Several investigations have demonstrated that apples have strong antiproliferative action. Cell proliferation was inhibited in a dose-dependent manner when Caco-2 colon cancer cells were treated with apple extracts, with a maximum inhibition of 43 percent at a dose of 50 mg/mL. In Hep G2 liver cancer cells, the same trend was observed, with maximal inhibition reaching 57 percent at a dose of 50 mg/mL. There has been some concern that apple antioxidants do not directly inhibit tumor cell proliferation, but rather inhibit cell proliferation indirectly by producing H2O2 in reaction with cell culture media. Apple extracts did not produce H2O2 in WME, DMEM, or DMEM/Ham F12 media, and H2O2 addition to culture medium did not inhibit Hep G2 cell proliferation or Caco-2 colon cancer cell proliferation, according to a recent study. Furthermore, catalase had no effect on the antiproliferative activity of apple extracts.

1.2.3. Lipid oxidation inhibition:

In a dose-dependent manner, adding apple phenolics to human serum reduced diphenylhexatriene-labeled phosphatidylcholine (DPHPC) oxidation. DPHPC is an oxidation indicator that is found in low-density lipoprotein (LDL), high-density lipoprotein (HDL), and very low-density lipoprotein (VLDL) fractions. DPHPC oxidation was reduced after eating an apple, indicating the fruit's antioxidant action in vivo. The preventive effects of apples on LDL oxidation peaked three hours after intake and then reverted to baseline after 24 hours. DPHPA (diphenylhexatriene labeled propionic acid) binds to serum albumin and is an excellent indicator of oxidation in human serum's aqueous phase. Mayer et al. (2001) discovered that eating apples reduced albumin DPHPA oxidation, with maximal activity occurring after 3 hours.

1.2.4. Effects on cholesterol levels:

The apple's possible cholesterol-lowering capabilities may account for some of the fruit's cardiovascular disease protection. There was a substantial decrease in plasma cholesterol and liver cholesterols and an increase in high-density lipoproteins when cholesterol-fed rats were supplemented with lyophilized apples (HDL). They also discovered that cholesterol excretion rose in the feces of rats given apples, indicating that cholesterol absorption was decreased. In a second research, cholesterol-fed rats were given apples, pears, and peaches, which had a similar cholesterol-lowering impact. Apples were shown to decrease cholesterol levels more effectively than the other two fruits. The antioxidant capacity of plasma was also enhanced by the three fruits, with the apple having the highest impact. Apples, pears, and peaches all showed comparable fiber content, but apples had higher phenolic compounds, suggesting that phenolics in apples may play a role in this impact.

1.3.Other negative health consequences:

Aside from chronic illness, apples may also be utilized to fight other common diseases throughout the globe. It was recently shown that crude extracts from immature apples suppressed cholera toxin enzymatic activity in a dose-dependent manner. Furthermore, apple extract decreased fluid buildup caused by cholera toxin in a dose-dependent manner. The apple extracts were separated, and each fraction was evaluated for its ability to suppress cholera toxin enzymatic activity. The cholera toxin mediated ADP-ribosylation was suppressed by 95 percent and 98 percent in the two apple extract fractions that contained highly polymerized catechins. The fraction containing non-catechin polyphenols inhibited the enzyme by only 3.5 percent, whereas the fraction comprising monomeric, dimeric, and trimeric catechins inhibited the enzyme by 39 percent.

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1.4.Effects of storage and processing on the storage of apple phytochemicals:

Storage has little effect on the phytochemical composition of apples. Jonagold, Golden Delicious, Red Delicious, Elstar, and Cox's Orange apples' quercetin glycosides, phloridzin, and anthocyanin levels were not altered after 52 weeks of storage under controlled atmospheric circumstances. In Jonagold apples, chlorogenic acid and total catechins dropped somewhat. In Golden Delicious, total catechin concentrations dropped significantly, while chlorogenic acid quantities remained constant. There was no reduction in chlorogenic acid after 25 weeks of cold storage in any apple type, although catechin concentration dropped somewhat in Golden Delicious, Elstar, and Cox's Orange apples. Antioxidant activity was unaffected by either method of storage in any of the apple varieties studied. Another group studied the effects of storage on apple peel phenolics and found that 9 months of storage at 0°C had no impact on phenolic concentration.

2. DISCUSION

Apples have been linked to a lower risk of chronic illnesses including cardiovascular disease, cancer, and asthma in many epidemiological studies. Apples have strong antioxidant activity, may inhibit cancer cell growth, reduce lipid oxidation, and lower cholesterol, according to in vitro and animal studies, which might explain their involvement in lowering chronic disease risk. Apples contain a diverse range of phytochemicals, several of which have been shown to have potent antioxidant and anticancer properties. As researchers try to understand the mechanism underlying the apple's potential to decrease chronic disease risk, further research into the interplay of the numerous apple phytochemicals is needed.

3. CONCLUSION

Apples do contain bioavailable phytochemicals, according to recent study, but additional research is required to better understand the bioavailability of phytochemicals inside the apple matrix vs pure phytochemicals. Many variables influence the phytochemical profile of apples and must be taken into account while attempting to comprehend and optimize the health benefits of apples. Phytochemical contents vary significantly between cultivars. Phytochemical levels vary throughout fruit maturity in response to available light, stage of fruit development, and certain kinds of fertilization. In general, apple storage does not seem to have a major impact on apple phytochemicals, however apple juice processing results in a considerable reduction in phenolic content. Processed apple peels maintain the activity of phenolic and flavonoid components, allowing them to be utilized as a value-added product with strong antioxidant properties. Apples provide a plethora of possible health advantages. Fruits and vegetables, including apples, should be consumed regularly as part of a balanced diet to help avoid chronic illness and maintain good health.

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