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The impact of pear on nutrition and health: A review

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Abstract

India ranks second in the world for producing fruits and vegetables, contributing 10% and 15%, respectively, of the overall production. The traditional Indian way of life favors freshly picked produce or that that has been prepared at home. Europe, sections of Asia, South America, and North America are all countries where pears are grown. Pears are high in fiber, vitamins, and minerals such as vitamin C, potassium, and copper. They are also low in calories and fat, making them a perfect snack for individuals trying to lose weight. Consuming pears on a daily basis can aid digestion, enhance immunity, and lower the risk of chronic illnesses such as heart disease, diabetes, and cancer.

Pears are a versatile fruit that may be enjoyed in a variety of ways, aside from their nutritional advantages. They can be eaten fresh, baked, poached, grilled, or used to make salads, pies, jams, and chutneys. Pears are also a popular ingredient in many alcoholic beverages, including wine and cider. Pears are high in water and sugar, like the majority of fruit. Dietary fiber is also abundant in pears. However, like any other fruit, pears also have their drawbacks. They are prone to bruising and can soon become mushy if not properly preserved. Therefore, it is important to handle them with care and store them in a cool, dry place.

Keywords: Pear, shelf life, quality, post-harvest, bioactive, antioxidant

1. Introduction

Pear is one of the world's oldest cultivated plants. About 20 of the 2,000 varieties that are available worldwide are produced in India. Over the course of 28 years, its cultivation area expanded 2.2 times, from around 19000 hectares in 1991 to 42000 ha in 2019. Pears are grown in India from the low hills to the high hills, and they receive between 500 and 1,500 chilling hours per year. Pear ranks third among temperate fruits in India by the area under cultivation and output levels. In India, the area dedicated to cultivating pears is rising significantly. (A. Wani *et al.*, 2016) [14] It is frequently discovered in processed goods including beverages, candies, jam, and preserved fruits. Pears include a wide range of vitamins and minerals, including vitamin C, as well as healthy amounts of dietary fiber, phytochemicals, and antioxidants (Reiland H, 2015) [6]. It is frequently used to make canned or other processed pears. Raw pears are frequently eaten. Despite having red-skinned derivative varieties, the fruit has a bell shape and is recognized as having a traditional pear form in the west. Its originally green skin ultimately becomes yellow as it ripens.

Pears can grow in severe climatic conditions. It can withstand freezing temperatures of -25 °C as well as high temperatures of more than 40 °C. The chilling period is different for each variety of pear (Silva, 2014) [9]. Lowlands do not suit pear cultivation as the spring frost can hamper the flowering process. Pear cultivation does not need a soil plan to grow pear grows best in neutral and slightly acidic soil and a pH not more than 7.5. Common varieties found in India are Williams, Kashmiri Nakh, Vicar Wakefield, Burre D Amanlis, Goshbagu and Keifer. It can even grow in severe conditions like the temperature of -25 °C to even 40 °C but spring frost can hamper the flowering process.

Pears work best when prepared either raw or cooked, such as by baking, boiling or grilling. They can be eaten raw, out of hand, chopped into wedges and added to salads for sweetness, or mixed into granita to put on top of ice cream. These pears can also be blended with yoghurt and oatmeal, used as a pizza topping, or stacked in sandwiches like grilled cheese. The pears can be sliced to give a sweet flavour to drinks with tequila and mezcal or smoked over a charcoal barbecue for more flavour. Pears can be dried and baked into cakes, muffins, crisps, and quick bread, and they also make great preserves, syrups, and chutneys.

They will keep up to three weeks when stored in the refrigerator and a little over one year when stored in the freezer. Pears are beneficial for maintaining skin health. It very effectively treats oily skin if used with fresh cream and honey. Pears help to get acne-free skin and are also effective as a natural scrub.

However, it is important to note that pears are a delicate fruit that requires careful handling. They can bruise easily and can quickly turn mushy if not stored properly (Reiland H, 2015)^[6]. To ensure that your pears stay fresh, it is best to store them in a cool, dry place and avoid stacking them on top of one another. Additionally, some people may be allergic to pears, so it is important to be aware of any symptoms and seek medical attention if necessary.

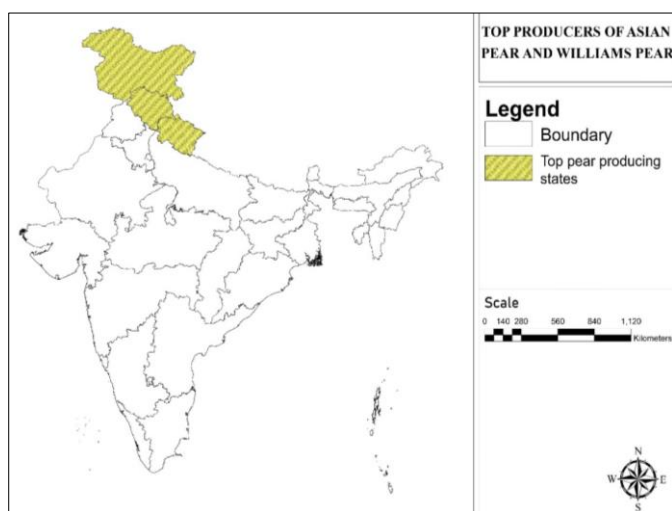


Fig 1: Top pear producer states in India

Table 1: Nutritional composition of various varieties of Pear (James-Martin, 2015)^[4].

	Pear Brown (Unpeeled raw)	Pear Nashpati (Unpeeled raw)	Pear Packhams Triumph	Pear William Bartlett
Energy (kJ)	264	209	227	230
Protein (g)	0.3	0.4	0.3	0.3
Total fat (g)	0	0.1	0	0
Carbohydrate (g)	14.3	11.1	12.5	11.7
Sugars (g)	10.4	10.6	9.1	8.9
Glucose (g)	1.7	4.4	2.1	1.4
Fructose (g)	6.3	6.0	6.8	6.7
Sucrose (g)	2.4	0.2	0.3	0.8
Starch (g)	0	0.5	0	0
Water (ml)	81	86.7	83.8	84.2
Dietary fibre (g)	3.4	2.1	2.4	4.3
Vitamin C (mg)	4	2	4.0	6.0
Potassium (mg)	100	130	102	115
Magnesium (mg)	7	8	6	7
Calcium (mg)	6	5	6	6

The role of various nutrients in the quality fruit production as well as their relationship to physiological disorders and other effects, such as decreased respiration, delayed ripening, and increased fruit firmness, have made nutrition of pears one of the production factors that has received a lot of attention in recent years. This has extended fruit storage and shelf life. Lack of these nutrients causes a drop in fruit output and worse fruit quality, whereas an excess of these nutrients has the opposite effect and reduces fruit production quality. Nutrient imbalance results in a number of illnesses that ultimately have an impact on pear quality and production (Dar *et al.*, 2015)^[16].

2. Nutritional Composition

Pears are a source of many nutrients, including fiber, vitamin C, and potassium. Additionally, pears contain phytochemicals, particularly antioxidants. Fructose and sorbitol, which are found in pears, have been associated with children's diarrheal problems. Vitamin C is the sole vitamin present in pome fruit, and it is concentrated greater in the skin.

Kevers *et al.* investigated how the pear's phenolic and ascorbic acid levels and antioxidant capacity were affected by cultivar, harvest time, storage conditions, and peeling. More than 25% less phenolic and ascorbic acid were present after peeling. The influence of harvest timing was minimal, although substantial year-to-year variance was seen. Compared to other fruits, Pears are notably high in fructose and sorbitol. Pears and Apples contain 70% fructose while the majority of fruits contain sucrose, however this information is not readily available in standard nutritional databases. 4.5% fructose, 4.2% glucose, 2.5% sucrose, and 2.5% sorbitol are all present in pears. When apples and pears are compared, it is discovered that pears have higher levels of fructose and sorbitol whereas apples have higher levels of glucose and sucrose.

Arbutin and catechin are the predominant polyphenol compounds found in pear variations, followed by chlorogenic acid, quercetin, and rutin. These chemicals are responsible for the chemical constitution and antioxidant properties of the majority of pear varieties (James-Martin, 2015)^[4]. The antioxidant and anti-inflammatory properties of the pears with high total phenolic and total flavonoid levels were considerably greater. In pears, anthocyanins and antioxidant capacity were associated, but total triterpenoids and anti-inflammatory activity were highly connected.

The organic matter content of soils, which is larger at high altitude soils than at low and mid altitude soils, is responsible for the variance in accessible Sulphur at various elevations. The influence of climate variables and vegetation is primarily responsible for the high organic matter at high elevations. Through its impact on sulphate adsorption, the creation of organic Sulphur, and the mobilization of Sulphur through microbial activity, organic matter has a substantial positive association with the amount of Sulphur that is readily accessible in soils. It follows that the status and availability of secondary nutrients in soils are influenced by the variables present at various elevations. The soils in pear orchards range

from clay loam to silty clay loam and are alkaline in composition. This study also demonstrated the differences in some physicochemical properties and secondary nutrients in pear orchard soils along different altitudes (Dar *et al.*, 2014)^[15].

3. Post-harvest methods

Post-harvest techniques are the treatments that pears receive after they have been harvested. These procedures are intended to maintain the fruit's flavour and freshness while preventing spoiling. Pears are a popular fruit that is processed using a range of post-harvest methods. These methods are designed to ensure that the fruit is of high quality, safe for consumption, and can be transported and stored efficiently (Reiland H, 2015)^[6]. The following are some of the most common post-harvest methods used in the processing of pears:

Sorting and grading are the first post-harvest method used in the processing of pears. Pears are classified according to their size, shape, and color, ensuring that only high-quality fruits are selected for subsequent processing. This process assists in the identification and removal of damaged or diseased fruits, ensuring that only the best pears are processed.

Washing is another important post-harvest method used in the processing of pears. After being harvested, pears may have dirt, debris, and other pollutants on their surface. These contaminants can be removed by washing the pears thoroughly using water, ensuring that the fruit is clean and safe for consumption.

Cooling is also an essential post-harvest method used in the processing of pears. Pears are usually chilled shortly after harvesting to minimize respiration rate, which delays ripening. By slowing down the ripening process, the shelf life of the fruit can be extended, allowing for longer periods of storage and transportation.

Ripening is another crucial post-harvest method used in the processing of pears. Pears are usually harvested when they are mature but not yet fully ripe. To ripen pears, they are exposed to ethylene gas, which triggers the production of enzymes that convert starch to sugar, leading to softening and sweetening of the fruit. This process ensures that the pears are ripe and ready for consumption.

Finally, packaging is a crucial post-harvest method used in the processing of pears. Pears are packaged in appropriate containers such as crates, baskets, or cartons. The packaging materials should be well-ventilated to facilitate optimum air circulation and to avoid moisture buildup. This ensures that the pears are transported and stored safely and efficiently, maintaining their quality and freshness.

4. Post-Harvest shelf life

Pear fruits are picked at a very early stage of ripeness. Without packing, pear fruits only last 7–10 days at room temperature (25–30 °C). Pear fruit has a relatively limited shelf life and is prone to deterioration, mechanical harm, moisture loss, and nutrient loss when in storage.

Pears are harvested in August, a month with comparably high temperatures that prevents them from being transported or kept for extended periods of time. Moreover, pear fruit has a limited shelf life due to the quick ripening process, which poses a significant obstacle to effective handling and transportation (Parle, 2016)^[11].

Over time, a variety of storage methods have been created to increase the shelf life of fruits. Controlled environment

storage has also been shown to extend shelf life. However, anaerobic respiration has been linked to taste issues, increased ethanol generation, and CO₂ damage.

The shelf life of pears is determined by several factors, such as variety, ripeness at harvest, storage temperature, and humidity. Understanding these factors is essential to ensure that pears remain fresh and edible for as long as possible after harvest. Below is the post-harvest shelf life of pears under various storage conditions

Pears can be kept at room temperature for 5-7 days. However, the fruit should be inspected frequently for signs of spoiling, such as mould, rot, and shriveling. It is recommended that pears be consumed within this time frame to avoid any spoilage or loss of quality.

For longer-term storage, pears can be stored in a refrigerator at a temperature between 0-2 °C and 90-95% relative humidity. Under these conditions, pears can be preserved for up to 3-4 weeks. Refrigeration slows down the ripening process, which helps to maintain the quality of the fruit.

Another storage method is controlled environment storage (CA), which is a specialized storage system that allows the adjustment of temperature, humidity, and gas composition. Pears can be kept under these conditions for up to 6 months or longer, depending on the storage circumstances. CA storage is particularly useful for long-term preservation of pears without affecting their quality.

Finally, pears can be frozen for longer-term preservation, although freezing can alter the texture and flavor of the fruit. Pears can be frozen for up to 6-8 months, but it is recommended to consume them within this time frame to avoid any loss of quality. Freezing is an excellent option for preserving excess pears for later use, such as in baked goods or smoothies.

By giving energy, boosting acid neutralization, and enhancing sugar synthesis, phosphorus participates in several of the most important metabolic processes, resulting in less acidic but more sweet fruits. Pear length, weight, firmness, TSS, and total sugars showed a positive and substantial association with the amount of potassium that was available. Being a high-quality nutrient, it plays a function in enhanced enzyme activation, photosynthate transfer for effective utilization, encouraging cell division, and meristematic tissue growth. These findings are consistent with those showing that potassium directly affects fruit development, preserves cell turgidity, and is linked to excellent acid-sugar balance, good ripening, and high eating quality. (S. A. Wani *et al.*, 2018)^[21]

The natural fertility state of the soil has a significant impact on the health of the tree and fruit output in addition to the other parameters necessary for sustainable pear production. The physicochemical characteristics and the ability of the soils to deliver nutrients are strongly influenced by physiographic factors such as slope aspect, relief, altitude, and depth, which in turn affect growth and production. Water table (soil depth) and drainage characteristics are the most crucial soil factors for pear cultivation. Numerous aspects of soil fertility, such as organic matter content, pH, cation exchange capacity, and the availability of phosphorus, exhibit large altitudinal fluctuations. By regulating soil water balance, soil erosion, geologic deposition processes, species, biomass, climatic conditions (temperature, precipitation, and solar radiation) and differences in altitude together produce a diverse composition of soil organic matter. (Kashmir *et al.*, 2017)^[17].

5. Long-run and short-run elasticities

The calculation of supply elasticity aids in the prediction of the short- and long-term effects of price variation on production, allowing for the implementation of the proper price policies. The short- and long-run elasticities for pears in Jammu & Kashmir, which have an impact on the country market, may be estimated. With an R² value of greater than 95%, all explanatory variable estimates were mainly significant and showed the predicted signals. In the short- and long-term, respectively, the estimated own-price elasticities for pears were 0.03 and 0.28, and all were determined to be extremely significant. The findings showed that a one-degree drop in the minimum temperature might lower apple prices by 0.56 and 0.57 percent in the short- and long-term, respectively. It's because a further drop in the minimum temperature might negatively affect apple output, which would have a direct impact on price. In the short- and long-term, an increase in fruit output of 1% would result in a rise in the price of 15% for apples and 10% and 11% for pears, respectively.

The price of the pear has been positively and significantly impacted by the price of the rival crop apple, with short-term and long-term coefficients of the apple price being 0.30 and 0.31, respectively. Both the short-run and long-run coefficients for pears were 0.20, indicating that if the price of apples rises, consumers may choose a different fruit crop. Therefore by the application of salicylic acid and oxalic acid, the shelf life of the pear is enhanced. (M. H. Wani *et al.*, 2015) ^[20] Pear production in India is now restricted despite the enormous area of production and rising consumer demand. As a result, pear farmers are unable to meet India's domestic demand. Additionally, pests and other illnesses that result in reduced yield of pears owing to improper management of them provide a difficulty for Indian pear producers. Indian customers prefer fresh pears, and processing still accounts for just approximately 2% of domestic production. There don't seem to many research on managing diseases and increasing productivity in the pear industry. The development of bilateral agricultural agreements between India and Korea will be aided by recent trends in research and development and the rising demand for pears in India, particularly through ongoing academic research exchanges between agricultural universities and organizations dedicated to the pear industry (Sawant *et al.*, 2021) ^[19].

6. Health benefits

Pears are a tasty and healthy fruit that has been consumed for generations. They are high in vitamins, minerals, dietary fibre, and antioxidants, making them an important part of a balanced diet. Pears are low in calories and rich in water content, making them an excellent snack for people attempting to lose weight or maintain a healthy weight. They also promote digestive health, lower the risk of chronic illnesses, support heart health, increase immunity, promote skin health, support bone health, reduce inflammation, and improve cognitive function (Hong, 2021) ^[10]. In this article, we will discuss the health benefits of pears in detail and explore how they can improve your overall health and well-being.

6.1 Promotes Digestive Health

Pears are high in dietary fibre, which is essential for good

digestive health. Fiber helps to bulk up the stool, making it simpler to travel through the intestines. This can aid in the prevention of constipation and other digestive problems. Furthermore, the high water content of pears can assist to keep the digestive tract hydrated and lubricated, preventing bloating, gas, and cramps.

6.2 Lower the risk of chronic diseases

Pears are high in antioxidants, which can protect the body from oxidative stress and chronic illnesses. Antioxidants such as vitamin C, flavonoids, and phenolic compounds assist the body neutralise dangerous free radicals that may cause cellular damage and contribute to chronic illnesses such as cancer, heart disease, and Alzheimer's disease.

6.3 Supports Heart Health

Pears are an excellent source of potassium, a mineral that is essential for heart health. Potassium aids in blood pressure regulation by counteracting the effects of salt in the diet. While high blood pressure is a key risk factor for heart disease, eating potassium-rich foods like pears can help lessen the risk of heart disease.

6.4 Boosts immunity

Pears are high in vitamin-C, a vital nutrient that plays an important role in immune system support. Vitamin-C stimulates the formation of white blood cells, which are the cells in the body that fight infections and disorders. Pears, which are high in vitamin C, can aid to boost the immune system and minimizes the risk of illness.

6.5 Helps with weight management

Pears are a low-calorie fruit that is high in fibre, which can aid with weight reduction and control. Pears' high fibre content makes you feel fuller for extended periods of time, which can help you minimize your overall calorie consumption. Pears' low calorie count also makes them a good snack choice for people seeking to reduce weight or maintain a healthy weight.

6.6 Promotes skin health

Pears are an excellent source of vitamin C, which is a vital ingredient needed for collagen formation. Collagen is a protein that is responsible for the skin's strength and suppleness. Pears, which are high in vitamin C, can aid to enhance skin health and minimize the indications of ageing such as wrinkles and fine lines.

6.7 Supports bone health

Pears are a rich source of calcium, which is a mineral that is essential for bone health. Calcium is required for bone growth and development, and a lack of this mineral can lead to osteoporosis and other bone-related illnesses. Calcium-rich foods, such as pears, can assist to enhance bone health and lower the risk of bone-related disorders.

6.8 Reduces inflammation

Pears are high in flavonoids, which are antioxidants with anti-inflammatory effects. Inflammation is a natural immune system reaction to damage or infection, but persistent inflammation can lead to a variety of health problems such as heart disease, cancer, and arthritis. Eating foods high in flavonoids, such as pears, can help decrease inflammation in

the body and lessen the risk of chronic illnesses.

6.9 Antioxidant effect

A similar underlying process of oxidative damage, which is brought on by an imbalance between the production of reactive oxygen species and the body's defence mechanisms, underlies many chronic diseases. Antioxidant-rich diets strengthen the body's antioxidant defences and guard against oxidative harm. Numerous phenolic compounds with antioxidant properties can be found in pears. *In vitro* experiments to evaluate pears' antioxidant capacity were described in a number of publications. Research in animal models showed that ingestion of European pear peel and pulp extract and Asian pear peel and pulp extract improved *in vivo* antioxidant activity.

7. Bioactive Compounds

Pears are not only tasty, but they are also high in bioactive substances that are helpful to human health. These substances can be found in the flesh as well as the skin of the pear. Fruits like pears are great providers of sugars, carbs, dietary fibre, and vitamin C. Malic acid, citric acid, quinic acid, -ketoglutaric acid, succinic acid, lactic acid, glycolic acid, shikimic acid, glyceric acid, and mucic acid are only a few of the many organic acids that have been discovered in pears. Due to the little amounts of salicylates and benzoates that are contained in pears, they are known to have pharmacological effects including anti-inflammatory, anti-tumor, antiallergic, etc. (Parveen *et al.*, 2014) [18]

7.1 Arbutin

Arbutin, also known as hydroquinone--D-glucopyranoside, is a well-known antibacterial and skin-whitening agent. It degrades into hydroquinone, a skin bleaching agent, and is used in cosmetics as a scent, reducing agent, and inhibitor of melanin polymerization. A Chinese study found that the peel of imported Korean pears contained 1.5- 20 times more arbutin than other 9 pear cultivars. The peel contained the highest concentration of arbutin, which was 3-5 times higher than the core and 10-45 times higher than the pulp. Arbutin has the potential to be a biomarker for pear ingestion (Hong, 2021) [10].

7.2 Chlorogenic acid

Chlorogenic acid, also known as 5-O-caffeoylquinic acid, is the second-most prevalent phenolic compound in the flesh and peel of pears. In particular, premature Korean pears had chlorogenic acid levels of 106.7–247.5 mg/100 g of fresh weight. According to research, chlorogenic acid has biological properties like anti-inflammatory and antioxidant activity. Chlorogenic acid appears to inhibit inflammation *in vivo* by decreasing TNF- α , downregulating IL-8 production in Caco-2 cells and RAW264.7 cells, protecting neurons, and improving wound healing. According, to mechanistic studies on its therapeutic function (Hong, 2021) [10]. Additionally, by enhancing the signaling pathways for NOS, COX, and endothelium-derived hyperpolarizing factor, chlorogenic acid demonstrated the ability to directly induce an endothelium-dependent vasodilation. A recent Japanese study revealed that taking chlorogenic acid for six months.

7.3 Caffeic acid

Caffeic acid content is a least compound in the flesh and peel

(56.2 vs. 73.5 mg/kg). Caffeic acid and caffeine have been shown to have neuroprotective properties even though they are structurally unrelated. Caffeic acid enhanced collagen production, according to some studies. Caffeic acid demonstrated chemopreventive potential in colon cancer cells like the HCT 15 by inducing apoptosis, ROS production, and a decrease in the mitochondrial membrane potential.

7.4 Malaxinic acid

One of the main glucosides in Korean pears is malaxinic acid, also known as 4-(O-d-glucopyranosyl)-3-(3'-methyl2'-butenyl) benzoic acid. Premature Korean pears contained 0.76 to 5.86 mg of malaxinic acid per 100 g of fresh weight, though as the pears grew older, the amounts of malaxinic acid decreased significantly (Hong 2021) [10]. Malaxinic acid, found in Korean pears, has been linked to a number of health benefits, including the prevention of blood clots and the slowing of the growth of cancer cells like BAEC, HT1080, HeLa, and B16/BL6. Malaxinic acid's isoprenyl side chain may help to inhibit a 21–26 kDa protein involved in the growth of cancer cells. Malaxinic acid can therefore be an applicant for one of the main active components of pears, but more evidence needs to be gathered.

7.5 Triterpenoids

In European pear cultivars (*P. communis*), ursolic, oleanolic, and betulinic acids have been identified. They are 17 times more prevalent in the peels than the flesh (3460.5 1255.9 vs. 201.4 77.1 g/g of dry weight). Triterpenoids are thought to have endocrine-related functions because of their chemical structures that resemble steroid hormones. For instance, ursolic acid stimulated lipolysis in rat adipocytes grown in primary culture, inhibited the enzyme that turns androgens into oestrogens (aromatase), and increased energy expenditure (Hong, 2021) [10]. These effects reduced obesity, enhanced glucose tolerance, and decreased hepatic steatosis. Oleanolic acid, one of its isomers, has been linked to claims that it has anti-oxidant, anti-tumor, anti-inflammatory, anti-diabetic, and anti-microbial properties.

7.6 Flavonoids

Flavonoids are plant chemicals with anti-inflammatory and antioxidant effects. They are found in a variety of fruits and vegetables, including pears. Flavonols and flavanols are the two primary forms of flavonoids present in pears. Flavonols found in pear skin, such as quercetin and kaempferol, have been found to have anti-inflammatory and anti-cancer characteristics. Flavanols, such as catechins, have been proven to offer anti-cancer and cardiovascular effects in both the flesh and skin of the pear.

7.7 Vitamin C

Pears are high in vitamin C, an important component that functions as an antioxidant in the body. Vitamin C is essential for immune system function as well as skin health. It also aids in the manufacturing of collagen, which is essential for the health of connective tissues such as skin, tendons, and ligaments.

7.8 Fiber

Fiber Pears are high in dietary fibre, which is beneficial to digestive health. Fiber aids in the regulation of bowel motions and the prevention of constipation. It can also help to lower

cholesterol levels and increase feelings of fullness, both of which can assist with weight control (James-Martin 2015) ^[4].

7.9 Phenolic compounds

Plant chemicals with antioxidant capabilities are known as phenolic compounds. Pears are one of several fruits and vegetables that contain them. Chlorogenic acid, which has been found to have anti-cancer and anti-inflammatory effects, and epicatechin, which has been shown to have cardiovascular benefits, are two phenolic chemicals present in pears.

7.10 Carotenoids

Carotenoids are an antioxidant-rich class of plant chemicals. They are in charge of the vibrant hues of fruits and vegetables. Pears are high in carotenoids, such as beta-carotene, which is essential for eye health, and lutein, which has been linked to cardiovascular benefits.

7.11 Copper

Pears are a good source of copper, a mineral that is important for the health of connective tissues like skin and tendons. Copper is also necessary for the creation of red blood cells and the proper functioning of the immune system.

7.12 Potassium

Pears are high in potassium, a mineral that is essential for heart health. Potassium aids in blood pressure regulation by counteracting the effects of salt in the diet. While high blood pressure is a key risk factor for heart disease, eating potassium-rich foods like pears can help lessen the risk of heart disease.

7.13 Vitamin k

Pears are high in vitamin K, a vitamin essential for blood clotting and bone health. A lack of vitamin K can cause excessive bleeding and an increased risk of bone fractures.

8. Potential Industrial applications

8.1 Food Industry

Pears are widely used in the food business. Pears may be used to make jams, jellies, pies, cakes, and bread, among other things. Pears may also be used to season yoghurt, ice cream, and other dairy products. Pears are a common ingredient in morning cereals and snack bars due to their high fibre content. Pear juice is a natural sweetener that may be utilised in a range of food products.

8.2 Cosmetics Industry

Pears are utilized in the cosmetics business as well. Because of its antioxidant effects, pear extract is a popular component in skincare products. Pear extract can aid to protect the skin from free radical damage while also reducing irritation. Pear extract is commonly found in cleansers, toners, and moisturizers for the face.

8.3 Pharmaceutical industry

Pears have the potential to be used in the pharmaceutical industry. Pear extract contains anti-inflammatory effects and may be effective in the treatment of diseases such as arthritis (Reiland, 2015) ^[6]. Pears are also high in vitamin C, which is essential for immune system function. Vitamin C pills including pear extract may help increase immunological function.

8.4 Textile industry

Pears may be utilised in the textile industry as well. Tannins found in pear leaves are utilised in the manufacturing of leather. Tannins are used to tan leather and give it a long-lasting polish. Pear leaves may also be used to make a pale yellow dye for textiles.

8.5 Biofuel industry

Pears have the potential to be used in the biofuels business. Pears have a high sugar content that may be turned into ethanol. Ethanol is a renewable fuel source that can be used as a substitute for gasoline in vehicles.

9. Application of byproducts

Pears are a tasty and healthful fruit that is frequently consumed around the world. Pear production, on the other hand, creates a substantial number of byproducts, including as peels, seeds, and pulp, which are often dumped as trash. Lately, there has been a surge in interest in using these byproducts for a variety of purposes, including those in the culinary, agricultural, and industrial sectors (James-Martin, 2015) ^[4].

9.1 Animals Feeds

Animal feed may be made from pears' byproducts like as peels, seeds, and pulp. These byproducts are high in fibre, vitamins, and minerals and can be utilised as an animal feed supplement. Adding pear byproducts to animal feed has been found in studies to increase animal health and performance.

9.2 Agricultural Sector

Pear byproducts can be utilised as a soil supplement to increase crop production and soil fertility. Pear peels and pulp are high in nutrients that plants require, such as nitrogen, phosphate, and potassium. By incorporating pear wastes into the soil, you may increase soil structure and water retention.

9.3 Industrial sector

Byproducts from pears can also be employed in the industrial sector. Pear seeds contain oil, which may be extracted and utilised for a variety of purposes, including lubricant, cosmetics, and biodiesel manufacturing. Pear seeds may also be utilised to generate renewable energy through burning.

9.4 Biodegradable Packaging materials

Pear pomace, which is made up of peels, seeds, and pulp, may be used to make biodegradable packaging. The pomace may be processed to extract cellulose, which can then be utilised to manufacture biodegradable films, coatings, and packaging. These biodegradable materials are good to the environment and can help to minimise the quantity of plastic waste created by the packaging sector.

10. Conclusion

In conclusion, pears are a highly nutritious and delicious fruit that has been loved for ages. In this review study, we looked into pears' nutritional content, post-harvest procedures, post-harvest shelf life, health advantages, bioactive substances, prospective industrial applications, and byproduct applications.

Pears are high in fibre, vitamins, minerals, and antioxidants, making them a nutritious complement to any diet. Pears have also been shown to provide a variety of health advantages,

including lowering the risk of chronic illnesses and increasing digestive health. Post-harvest techniques and shelf life are crucial in preserving pear quality and safety during transit and storage. Appropriate post-harvest management practises, such as temperature and humidity control, can considerably increase pear shelf life.

Pears contain a number of bioactive chemicals, including phenolic compounds, flavonoids, and carotenoids, all of which have antioxidant, anti-inflammatory, and anti-cancer activities. These chemicals may find use in the food and pharmaceutical sectors.

Byproducts of pear manufacturing, such as peels, seeds, and pulp, have a variety of possible applications, including animal feed, food industry, agricultural sector, industrial sector, and biodegradable packaging material. These applications not only minimize waste, but they also improve the economy and the environment

Pears are a valuable fruit with several applications in a variety of sectors. We can improve health and nutrition while also contributing to a more sustainable future by exploiting and leveraging the potential of pears.

11. References

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