



A comprehensive review on phytochemical, pharmacological and traditional applications of Jamaican pepper plant A.K.A. all spice (*Pimenta dioica* (L.) Merr.)

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Abstract

Pimenta dioica (L) Merr. also known as Jamaican pepper, is a spice recognized and utilized worldwide. Renowned for its unique flavor profile, the spice is characterized by a flavor reminiscent of a combination of cloves, nutmeg and cinnamon. It contains several vitamins, which include Vitamin A, vitamin C, Vitamin B3, Vitamin B6 and Vitamin B9. It contains numerous important trace elements such as Ca, P, Na, K, Fe, Se, Zn, Mg etc. The focal phenolic compound occurring in *P. dioica*'s essential berry oil is eugenol, a volatile aromatic compound can be found in appreciable amounts equivalent to 60-90% of the total essential oil content extracted from the *P. dioica* plant (fruits or leaves). Most of the chemical extractions of *P. dioica* have been reported for its leaves and berries. To date, the most common ingredients tested are polyphenols, lignins and terpenoids. Phytochemical analyses of *P. dioica* leaf extract report the presence of glycosides, alkaloids, carbohydrates, flavonoids, tannins, and proteins. Methyl eugenol, eugenol, myrcene, β -caryophyllene, cineole, and limonene have also been reported. Presence of greater amount of eugenol in essential oil, Total Antioxidant Capacity, Total Phenolic Content and Total Flavonoid Content in leaf extracts undoubtedly demonstrated potential of *Pimenta dioica* essential oil and leaf material as a fabulous raw material for food, perfumery and cosmetic industries. The biological properties exhibited by Allspice extracts can be loosely classified as oxygen scavengers (antioxidants), vasodilators (antihypertensive) and antiproliferative agents with potential for application in cancer chemoprevention and therapies. The purpose of this review is to highlight compounds that have shown significant medicinal potential as validated by controlled studies involving either biochemical experiments or control animals studies.

Keywords: eugenol, essential oil, polyphenols, antihypertensive, antiproliferative, chemoprevention

Introduction

The dried unripe berries of *Pimenta Dioica* [(L)Merr] are termed Allspice. It is also called Jamaican pepper, Pimenta or Newspice. A native plant from the Caribbean island Jamaica, *P. dioica* belongs to the family Myrtaceae. Small whitish flowers grow on the allspice tree in the summer that produces the berries. The berries are picked while still green and dried in the sun. The berries (Allspice) become brown when they're dried and look like large peppercorns. Allspice was originally native to the tropical forests of South and Central America, southern Mexico and the West Indies. Allspice is grown commercially in Mexico, Honduras, Trinidad, Cuba and in Jamaica. Commercial Allspice is also obtained from the fruits of another related species, *Pimenta racemosa* (Myrtaceae, L) mostly found in Central America. However, the fruits are larger and are known to be less aromatic^[1]. Allspice is said to have discovered by Christopher Columbus in Jamaica during his second voyage to the new world. During 17th century, it was named allspice spice traders identified it with mixture of flavors of clove and cinnamon, and nutmeg. Gradually it spread throughout the world because of its unique flavor as well as its healthy quality. Normally berries are picked when they're ripe and allowed to dry in the sun, ending up as the somewhat shrunken, hard berries known as allspice. Later these are ground up into spice for culinary use, or the essential oil can also be extracted. Allspice is found used in baking, mostly mincemeat and mixed pickling spice since ancient times till now. Pimenta trees are dispersed around the world with Allspice spelled in over 50 languages from Arabic to Vietnamese. It has a pale silvery brown bark and oblong to elliptical clustered leaves with pellucid glands, aromatic when crushed. It is also utilized in the tanning industry for aromatherapeutic purposes, within perfumery compositions and cosmetic products as well as a key ingredient in the formulation of natural repellents^[2-4].

Allspice extract has been used for neuralgic pain. Allspice essential oil, when added to massage oils and baths, is known to promote circulation so as to relieve pain from muscle cramps and strains. Also, it is used for headache, to combat stress and depression and to overcome fatigue because of its comforting scent. Allspice blends well with ginger, lavender and other spices, making it diversified when it comes to the choices for aromatherapy. It is used as an effective therapeutic agent for preventing indigestion. It has seen that it is closely associated with stimulating the functions of digestive enzymes hence promotes digestion. Its consumption is also very beneficial for reducing the prevalence of vomiting, diarrhoea, bloating and constipation. It acts as an immune booster too.

It also helps to protect the body from developing infectious diseases as it exhibits potent antimicrobial activity. It is comparatively effective against some microbes like *Listeria monocytogenes*, *E. coli* and *Salmonella enterica* hence helps to destroy them [5-6].

Phytochemical Constituents

Systematic investigation of aromatic constituents of *Pimenta* leaves and its unripe berries, Allspice, have resulted in discovery of many and novel aromatic compounds, mostly glycosides and polyphenols that show antibacterial, hypotensive, anti-neuralgic and analgesic properties. The focal phenolic compound within *P. dioica*'s essential berry oil is eugenol. Eugenol, a volatile aromatic compound can be found in appreciable amounts equivalent to 60-90% of the total essential oil content extracted from the *P. dioica* plant (fruits or leaves). Most of the chemical extractions of *P. dioica* have been reported for its leaves and berries. To date, the most common ingredients tested are polyphenols, lignins and terpenoids. Interestingly, none of the characterized compounds isolated is an alkaloid. Recent studies have shown two of the known compounds isolated from Allspice, Eugenol (A), Quercetin (B) and Gallic acid (C) have selective antiproliferative and anti-tumor properties on human cancer cells and their animal models. New characterization of novel compounds such as Ericifolin (D) from the aqueous extract of Allspice berries show potent anti-prostate cancer and anti-breast cancer properties that can be verified *in vitro* as well as *in vivo*. [7-8] Four new phenolic glycosides, (2-hydroxy-3-methoxy-5-allyl)phenyl β -D-(6-*O*-sinapoyl)glucopyranoside (1), (1'*R*,5'*R*)-5-(5-carboxymethyl-2-oxocyclopentyl)-3*Z*-pentenyl β -D-(6-*O*-galloyl)glucopyranoside (2), (*S*)- α -terpinyl [α -L-(2-*O*-galloyl)arabinofuranosyl]-(1 \rightarrow 6)- β -D-glucopyranoside (3), and (*R*)- α -terpinyl [α -L-(2-*O*-galloyl)arabinofuranosyl]-(1 \rightarrow 6)- β -D-glucopyranoside (4), were isolated from the berries of *Pimenta dioica* together with eight known flavonoids. Presence of greater amount of eugenol in essential oil, Total Antioxidant Capacity (TAC), Total Phenolic Content (TPC) and Total Flavonoid Content (TFC) in leaf extracts undoubtedly demonstrated potential of *Pimenta dioica* essential oil and leaf material as a fabulous raw material for food, perfumery and cosmetic industries. Further harvesting of immature leaves could be suggested for better therapeutic benefits. In *Pimenta*, leaf oil contain eugenol, methyl eugenol, β -caryophyllene and myrcene as the major constituents. In addition to this acetyleugenol, β -caryophyllene, humulene are also present in it. Eugenol derived from the Allspice has been in therapeutic use in dentistry as a local anaesthetic, antiseptic for teeth and gum. [9-11]

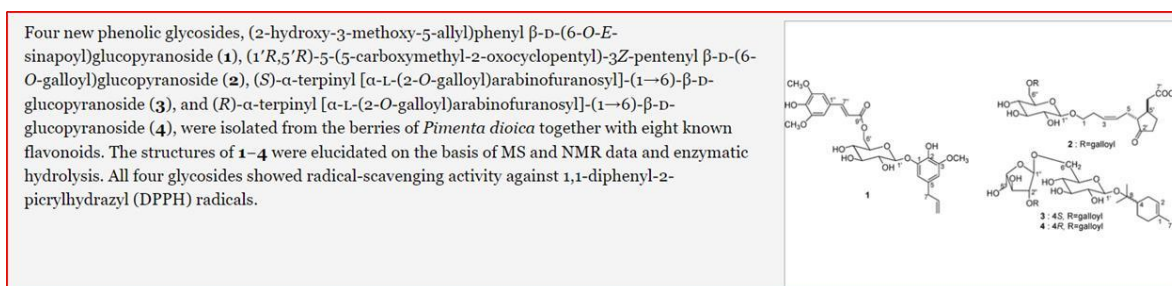


Fig 1

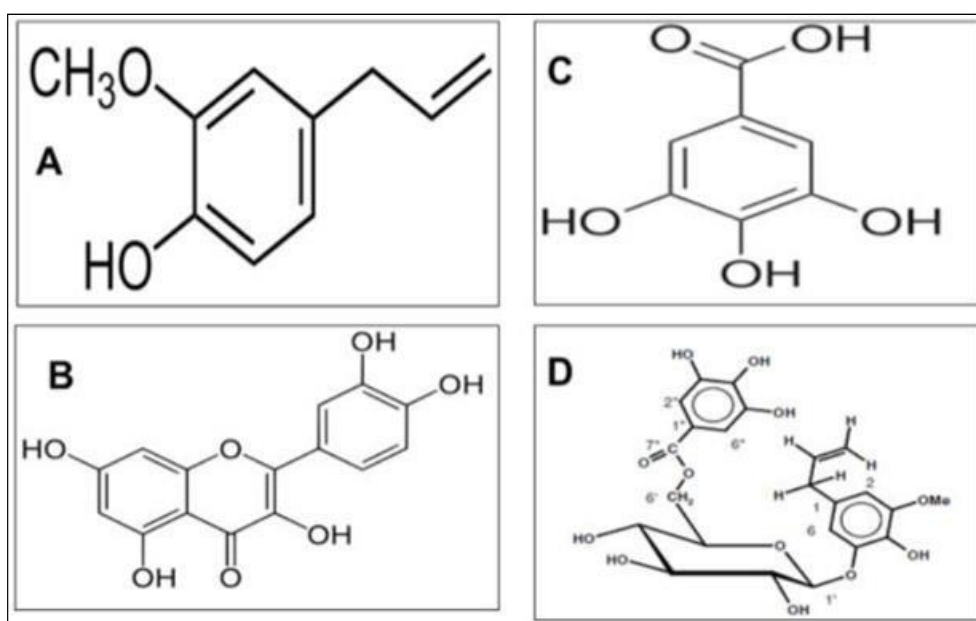


Fig 2: Structures of some common phenolic compounds isolated from *P. dioica* – (A) Eugenol: 4-Allyl-2-methoxyphenol; (B) Quercetin: 2-(3, 4-dihydroxyphenyl)-3, 5, 7-trihydroxy-4H-chromen-4-one); (C) Gallic acid: 3,4,5-trihydroxybenzoic acid; (D) Ericifolin: Eugenol 5-O-b-(6'-O-galloyl)glucopyranoside).

Nutritional Value

Apart from their strong spicy and pungent smell and slightly peppery taste, allspice is a good source of nutrients, vitamins and minerals. Consuming 100 gram of allspice offers 2.943 mg of Manganese, 7.06 mg of Iron, 661 mg of Calcium, 0.553 mg of Copper, 21.6 g of Total dietary Fiber, 72.12 g of Carbohydrate, 39.2 mg of Vitamin C, 135 mg of Magnesium, 8.69 g of Total Fat and 1044 mg of Potassium.



Fig 3



Fig 4

Therapeutic Attributes and Traditional uses

Pimenta dioica is a type of aromatic plant, and its essential oil is rich in eugenol, a phenolic compound with wide antimicrobial spectrum. Other bioactive compounds in *P. dioica* extract include glycosides, alkaloids, carbohydrates, proteins, flavonoids, and tannins. The incorporation of essential oils into food is limited because they have an intense aroma, and might affect consumer acceptance. The EO of *Pimenta dioica*, which is an aromatic plant, has also been reported to have antimicrobial and antioxidant properties due to the abundance of eugenol, a phenolic compound with a wide spectrum antimicrobial property, in its EO. It has been traditionally used by dentists for curing various dental and gum related diseases as it contains eugenol, which has potent antiseptic and anesthetic properties. Essential oil of allspice is widely used for providing relief from numerous conditions like headache, sprains, common colds, sinusitis, insect bites etc. [12-13] Tannin content of allspice is responsible for dilating blood vessels, which is closely related with making the surrounding area relatively warmer. This feature makes it an effective poultice, which helps to relieve soreness and inflammation. It has been seen that having bath with hot water containing allspice significantly reduces arthritic pain and muscle soreness. It is also used in aromatherapy. Inhalation of allspice essential oil is responsible for providing a cooling and relaxing effect hence it is widely used as an effective remedial action for insomnia. It is also used for reducing menstrual cramp. It has been used for centuries as an imperative homemade remedy for treating the post menopausal symptoms. Currently, Jamaica produces 70% of the world's production of *P. dioica*, and the remaining 30% is produced by Brazil, Mexico, Honduras, Guatemala, and Belize combined. Ripe berries, due to their oleoresin content, are commercially important in the pharmaceutical, cosmetic, and food industries. Allspice extract has been used for neuralgic pain. Allspice essential oil, when added to massage oils and baths, is known to promote circulation so as to relieve pain from muscle cramps and strains. Also, it is used for headache, to combat stress and depression and to overcome fatigue because of its comforting scent. [14-16] Allspice blends well with ginger, lavender and other spices, making it diversified when it comes to the choices for aromatherapy. It is used as an effective therapeutic agent for preventing indigestion. It has been seen that it is closely associated with stimulating the functions of digestive enzymes hence promotes digestion. Its consumption is also very beneficial for reducing the prevalence of vomiting, diarrhoea, bloating and constipation. It acts as an immune booster too. It also helps to protect the body from developing infectious diseases as it exhibits potent antimicrobial activity. It is comparatively effective against some microbes like *Listeria monocytogenes*, *E. coli* and *Salmonella enteric* hence helps to destroy them. Application of allspice essential oil on some area is associated with providing a

warming effect and also helps to increase blood circulation in that respective area, which ultimately helps to provide quick relief from swelling or pain. It is also used for strengthening the skeletal system. Its magnesium, calcium and phosphorus contents are accountable for improving bone mass. It has been seen that its consumption is very effective for decreasing spinal bone weakening especially among postmenopausal women. Its iron content plays significant role in synthesizing hemoglobin and RBC hence reduces the prevalence of anemia. It is also utilized as an imperative therapeutic substance for boosting up the energy level of body as it helps in cellular respiration. ^[17-18] It helps to prevent general weakness as its Vitamin B2 content is associated with inhibiting fatigue. It helps to prevent ageing as well thus it extensively used for promoting skin health. Its Vitamin C and copper contents are responsible for promoting collagen synthesis, which help to improve skin elasticity. It is very effective for enhancing skin glow as well and also reduces wrinkles as well as age spots. Depending upon the different geographical and ethnicity it leads to various the local practices of using any therapeutic flora where its herb, shrub or tree, same likely happen in the case of allspice also that native Jamaican use Allspice in their hot tea for dyspepsia, for cold and dysmenorrhea. Whereas people of Guatemalans treat bruises, sore joints and for myalgia (muscle ache). Few other herbal mixtures along with allspice were used to relieve indigestion by Cuban people. According to Ayurveda to relieve respiratory congestion and assorted odontalgia. (Toothache was used by Indians). In Turkey, it is used as an aphrodisiac when taken along with honey. Caribbean people use Allspice berries for folk healing. Costa Ricans are known to use Allspice to treat dyspepsia and diabetes. In Europe, anecdotal uses of Allspice extract for dyspepsia and as purgative exist. All parts of *P. dioica* are used in Folk medicine, the kind of medicine developed over centuries by empirical and in oftentimes by anecdotal evidences and other approaches. Costa Ricans are known to use Allspice to treat dyspepsia and diabetes. Guatemalans are known to apply crushed Allspice berries to bruises, sore joints and for myalgia (muscle ache). In Cuban medicine, Allspice along with other herbal mixtures is used to relieve indigestion. ^[19] Not only used in the areas where Allspice originated from, its use has been incorporated in the Indian traditional medicine, the Ayurveda. Allspice use in Ayurveda, which has been developed over the last two millennia, has likely originated from European colonization and subsequent use of it in Portuguese and the English populace in India. Its use includes use to relieve respiratory congestion and assorted odontalgia (toothache). In Europe, anecdotal uses of Allspice extract for dyspepsia and as purgative exist. Allspice essential oil, when added to massage oils and baths, is known to promote circulation so as to relieve pain from muscle cramps and strains. Also, it is used for headache, to combat stress and depression and to overcome fatigue because of its comforting scent. The reason why Allspice is used for treating indigestion might be due to the abundance of the common polyphenol Eugenol in Allspice, which is known to stimulate digestive enzymes. Furthermore, it has been shown that Eugenol has analgesic effect in neuralgia; it is often used as anesthetic by dentists. Eugenol could potentially contribute to the anti-inflammatory function associated with Allspice in traditional medicine. ^[20]

Disease preventive role of Allspice

Allspice contains various nutrients (eugenol, tannin, quercetin, Vitamin C and Vitamin A) that make it an effective antioxidant, which helps to decrease the concentration of free radicals within body, thus reduces the risk of developing diseases as well as age related problems. Application of allspice essential oil on some area is associated with providing a warming effect and also helps to increase blood circulation in that respective area, which ultimately helps to provide quick relief from swelling or pain. It is also used for strengthening the skeletal system. Its magnesium, calcium and phosphorus contents are accountable for improving bone mass. It has been seen that its consumption is very effective for decreasing spinal bone weakening especially among post-menopausal women. Its iron content plays significant role in synthesizing hemoglobin and RBC hence reduces the prevalence of anemia. It is also utilized as an imperative therapeutic substance for boosting up the energy level of body as it helps in cellular respiration. It helps to prevent general weakness as its Vitamin B2 content is associated with inhibiting fatigue. ^[21] It helps to prevent ageing as well thus it extensively used for promoting skin health. Its Vitamin C and copper contents are responsible for promoting collagen synthesis, which help to improve skin elasticity. It is very effective for enhancing skin glow as well and also reduces wrinkles as well as age spots. It helps to improve cardiac health and functionality thus significantly reduces the susceptibility of cardiovascular diseases. Its potassium content acts as an imperative vasodilator that helps to relax the blood vessels and thus promotes blood flow, which ultimately decreases the strain on heart as well as on arteries. It also exerts potent hypotensive effect. It helps to decrease the risk of developing atherosclerosis and coronary artery disease. Consumption of allspice is also very beneficial for lessening the prevalence of heart attacks and strokes. Allspice has potent antioxidant activity, which is responsible for protecting nerve cells from oxidative damages thus reduces the risk of developing neurodegenerative disorders. It contains numerous nutrients, which are essentially required by the body for promoting brain functions. It has been seen that its B vitamin content especially Vitamin B6 helps in the optimum growth and development of nervous system. It has been seen that consumption of allspice significantly reduces the prevalence of memory loss and cognitive decline. Its eugenol content is considered as the main component responsible for preventing various dental disorders. It helps to improve gum health. Its antimicrobial activity is accountable for improving oral hygiene by inhibiting microbial infestation thus reduces the risk of developing dental infectious diseases. Gargling with allspice added water significantly decreases bad mouth odour. ^[22] It is very beneficial for decreasing glucose load in blood as it has a low glycemic index thus it is considered as an effective therapeutic substance for diabetic patients. It is mainly associated with preventing the prevalence of type 2 diabetes mellitus. It helps to increase insulin sensitivity, which enhances the activity of

this hormone that ultimately helps to stabilize blood sugar level. The widespread and diverse uses of Allspice, the leaves and barks of *Pimenta* have stimulated several studies in the last two decades on systematic investigations of the potential evidence-based medical use of *Pimenta*. Although, most uses of Allspice as folk medicine are inherited from ancestors among different cultures, more scientific studies have been carried out for a systematic assessment of its active components from leaves, bark and berries of *Pimenta* and to delineate potential medicinal values of chemicals enriched or isolated from *P. dioica*.^[23]

Culinary uses

Within the food industry, dried mature allspice berries are used as a flavorant in pastries, juices and classic liqueurs such as Chartreuse and Benedictine. Consequently, essential oils derived from the plant are used mainly in the food industry for meat processing and as a commercial food flavouring. Dried allspice berry can be added to mulled wine. Allspice can also be sprinkled on curries for enhancing the flavor. It can be added to soups or stews before consumption. It can also be used as spice for preparing apple pie or pumpkin pie or ginger bread. It can be used for marinating purposes. It can also be used for preparing sauces and pickles. Jamaican jerk chicken is a famous dish, which requires allspice as an important ingredient. Consumption of herbal tea made up of allspice is very effective for reducing the prevalence of flatulence and stomach ache. Allspice blends well with ginger, lavender and other spices, making it diversified when it comes to the choices for aromatherapy. In Caribbean, there is a long history of using Allspice berries for folk healing. Jamaicans also drink hot tea with Allspice for colds, dysmenorrhea (menstrual cramps) and dyspepsia (upset stomach). It provides consistency to the flavor of soups and stews; also it perks up grains, from rice to couscous, millet to barley. Also It can be found in fairly sweet dishes just like pumpkin pie, fruit pies, puddings, cakes as well as ice cream. In the indigenous South America, people utilized allspice to taste their chocolate. In short, something that may possibly taste good along with cinnamon, cloves as well as nutmeg, possibly tastes excellent together with allspice too. The one difference in flavor in between allspice along with a combination of these other spices is always that allspice could be a moderate bit more peppery. Allspice is frequently included with sauces and marinades, and is also a typical component in several mulling as well as pickling spice blends. Allspice goes well in several tasty dishes made out of meats just like beef, lamb and wild game. Dating back to Mayan times, it was utilized to cure as well as protect meats. Today, those same qualities turn it into a common and also suggested, accessory for jerky-like chicken, pork and beef. Unsurprisingly, smoked as well as canned meats also regularly include allspice, just like Indian curry recipes. In terms of vegetables, allspice works the best for cabbage, Brussels sprouts along with other members of the cabbage family; along with beets, squash as well as other root vegetables; along with nightshades just like tomatoes, spinach, peppers, mushrooms and eggplant. Allspice is famous for being the primary component of the Caribbean “jerk” seasoning, a marinade combination, which is often used to flavor meats as well as poultry, particularly pork as well as chicken. The meat is marinated within the spicy seasoning and after that cooked over a wide open fire, just where allspice branches can be used for the firewood.

Discussion and Conclusion

Jamaica is also the world’s largest producer of allspice and Jamaican allspice is renowned for being of exceptional quality because it contains a higher level of essential oils, which give it more flavor than Allspice grown in other Caribbean islands or in Central America. Spices have been basically having importance in the culinary craft of seasoning nourishments since vestige. Aside from enhancing and flavoring, they are also utilized in indigenous meds, aromatherapy, pharmaceuticals, Nutraceuticals, additives, drinks, characteristic hues, scents, dental arrangements, beautifying agents and botanicals as a pesticide and subsequently, assume a critical job in the economy of the creating nation. These properties are because of an assorted cluster of synthetics incorporated by these flavors. Even though we believe of it like a cooking component, allspice is additionally considered to have got therapeutic qualities. Allspice is about 4% oil. A substance within the oil, known as eugenol, has germ killing as well as pain reducing features. Research claims that allspice might also combat particular bacteria, viruses as well as fungi and also enhance digestion of food. Allspice consists of considerable amount of manganese which is extremely essential for healthy growth of human bones. Osteoporosis and arthritis are few of the possible problems related with manganese deficiency. Manganese that we consume is stored in bones, liver and kidney and any insufficiency of manganese may directly affect these organs as well as their actions. Allspice is an essential ingredient that adds to bone density and bone repair. Some research recommended manganese supplementation to improve BMD (Bone Mineral Density). One of the most important features of allspice is its capability to lower inflammation and relieve pain in parts of the body. The active ingredients within the spice have chemical compounds which eliminate inflammation, making it perfect spice to give you some relief from arthritis, gout, muscle aches, or even hemorrhoids. Apart from that allspice has certain analgesic components which allow for pain reduction in the case of injury or surgical recovery. Allspice has calming, rubefacient effects which make it perfect for comforting the stomach and also facilitating healthy digestion. Eugenol found in allspice help to eliminate digestive problems like constipation, diarrhea, nausea and vomiting, while also encouraging regularity, which can help to reduce bloating and excess flatulence. The anti-inflammatory feature of allspice also eases cramps, which can ease the entire process of digestion. Allspice consists of certain antibacterial and antifungal effects, mainly in terms of stomach bacteria. In addition to assisting the gastrointestinal system function efficiently, it also protects from outside attack through a natural immune response. Additionally, when allspice is included to certain foods, it neutralizes the bacteria at that level,

before it enters the body and start damaging them. Allspice consists of copper which is a potent antioxidant that defends cells from free radical damage. It helps to reduce the appearance of wrinkles, age spots, and even macular-degeneration. [24] The antimicrobial, antibacterial, and antiseptic features of allspice help to enhance dental health though gargling with this spice wouldn't be mostly pleasing, it has been related to healthier dental and gum health by protecting against bacterial pathogens. Fiber rich foods help to reduce constipation by adding bulk to the stool. Bulky feces can move through the gut faster, resulting in an increased stool weight and enhanced regularity. The increase in fecal bulk also "dilutes" the effect of toxic substances within the colon. Stool consistency, stool weight and frequency of excretion are signs of colonic function. Increased bulking and decreased transit time are considered as the most widely known beneficial effects of dietary fibers in general. Fiber rich food is better to reduce constipation. Allspice contains significant amount of copper and iron that is ideal for enhancing circulation, since these are important components of red blood cells. Additionally, the rubefacient aspect of the spice is a stimulant, and warms the body. Combined with increased blood flow, it may result in extra energy and the proper oxygenation of extremities within the body. Iron also functions in the formation of certain enzymes which are crucial for general metabolism. Potassium found in allspice has an optimistic effect on heart health, since it is a vasodilator and releases much of the tension on the cardiovascular system. This causes an increase in blood flow through the relaxed blood vessels and decreases the strain on the arteries and heart, thus reducing the chances of developing atherosclerosis, and consequently, strokes and heart attacks. Allspice has a very low Glycemic index, which makes it beneficial and safe for those who are suffering from Type II diabetes. It rationalizes the blood sugar level if frequently consumed in the form of tea before the meals. People who suffer from Type II diabetes, the function of sugar absorption and conversion to energy is partially reduced. It is because consuming food with low Glycemic index tends to control blood glucose levels post meal. It contains desirable amount of carbohydrate. It also contains adequate amount of dietary fibre. It contains less amount of protein as well. It contains both saturated and unsaturated fatty acids but totally free from cholesterol. It provides sufficient amount of calories on its oxidation as it contains pleasing amount of carbohydrates and fats. It contains several vitamins, which include Vitamin A, vitamin C, Vitamin B3, Vitamin B6 and Vitamin B9. It contains numerous important trace elements such as calcium, phosphorus, sodium, potassium, iron, selenium, zinc and magnesium. [25] It also contains various biologically active components among which the most imperative substance is eugenol, which is responsible for exerting strong antioxidant activities.

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