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**Introduction**

Polyphenols are naturally found in plant-based food and have a wide spectrum of complicated structures. The basic monomer in polyphenols is the phenolic ring, which is divided into phenolic acids and phenolic alcohols. Polyphenols are divided into various types based on the strength of the phenolic ring, but the most common are phenolic acids, flavonoids, stiblins , phenolic alcohols, and lignans. Bioactive substances are phytochemicals that preserve human health from chronic degenerative diseases. Polyphenols are a type of physiologically active chemical found in plants. These substances are found in plants such as fruits, vegetables, cereals, and coffee and they are ingested by humans. Polyphenols are also used as a degenerative disease preventative. Polyphenol research has been hampered by the structural complexity of the compounds. Polyphenols are the most common antioxidants in our diet. These inhibit the oxidative change in low density lipoprotein, which is the primary mechanism in atherosclerosis endothelial lesions. Polyphenols have been implicated in the treatment of cardiovascular disease, osteoporosis, neurodegenerative illness, cancer, and diabetes mellitus, according to research

Many fruits and vegetables, such as kale, onions, and broccoli, contain phenolic acids as a major polyphenol. Pomegranate juice, tea extracts, and grape extracts have all been linked to less atherosclerotic lesions. Polyphenols' preventive effect in health and illness is well-known in food; they're consumed on a regular basis and are high in antioxidants and phytochemicals. Polyphenols also have a pro-oxidant feature, which works against the cell's metabolic process. It could also entail inhibit cell propagation and apoptosis. Many other effects of polyphenols have been discovered in studies, such as the decrease of enzymes like lipoxygenase and telomerase.(add something more in your word after reading this paraG.)

**Classification and chemistry of polyphenols**

The two types of phenolic acids are hydroxycinnamic and hydroxybenzoic acids. Hydroxybenzoic acids in the human diet are uncommon, which is why they aren't thought to play a function in human health. Cinnamic acid and benzoic acid derivatives have C1-C6 and C3-C6 backbones, respectively. Some phenolic acids are found in free form in vegetables and fruits, while phenolic acids in bound form are found in hull, bran, and seed. Bounded phenolic acids are liberated from bran, hull, and seed by acid, alkali, and enzyme hydrolysis. Despite blackberries, which contain 270 mg/kg of fresh weight, and some other red fruits, plant-based meals contain low levels of these acids. Flavonoids are made up of two benzene rings linked by three carbon chains from acids neighbouring pyran ring. Flavonoids are divided into six classes based on the oxidation state of the central carbon. These classes include flavanones, flavanols, flavonols, isofalvons, flavons, and anthocyanidins. In addition, more than 4000 flavonoids have been discovered in plants. A double bond was observed between C3 and C2 in flavonols, and a hydroxyl group was linked at C3. Flavonols make up the majority of flavonoids found in various foods. These chemicals are primarily found in onions, although they can also be found in broccoli and leeks. Flavonoids have a common backbone structure of C6-C3-C6, with two phenolic nature units (C6). Flavonoids are divided into four sub-classes based on their hydroxylation configuration: flavonoles, flavones, flavanones, and anthocyanadins. The C2 of the C ring is linked to the B ring in most flavonoids, but C3 and C4 linkages are also seen. Despite the fact that chalcones lack a C ring, they are classified as flavonoids, and they are found in apples and hops. Glycones are these fundamental structures, and glycosides are a type of lycoctonine isoflavones, ring C is connected to ring B from its C3 edge. Such chemicals are also common in legumes. Isoflavones have a better influence on health in areas where soybeans are the primary food source. Daidzein and genistein, as well as glycetein, are two primary isoflavones present in soy. These chemicals can also be found in red clovers. The most common isoflavone-aglycones are 7-O-glucosides and 6-O-malonyl-7-O-glucosides. Dalbergin is the most common neo-flavonoid found in plant-based meals because their formation is triggered by light . Fruit covers are high in flavonols because of the light exposure to the different edges of the fruits on the same plant, and even on the same piece of fruit the flavanol content varies. Flavanols can be found in both mono and poly compounds. These flavonoids unlike other flavonoids such as flavons and flavonons are not found in glycosylated form in the human diet. Catechins and epicatechins are the class's main representatives. Flavones are less common flavonoids with a double bond between the C3 and C2 carbon atoms. Flavones are prevalent in the peel or skin of fruits. The flavone content of mandarin essential oil is 6.5 g/L of flavones.

Flavonones have a carbon ring with a saturated three carbon ring and contain an oxygen molecule at C4. Flavanones are most commonly found in citrus fruits, although they can also be found in fragrant plants. Hesperidin is found in oranges, whereas eriodictyol is found in lemons. Citrus fluids contain 470–761 mg/L of hesperidin. Flavonones are found in the stiff parts of fruits and covers entire foods have five times the amount of flavonones as juices. The presence of –OH in between C4 and C7 is similar to estradiol. Isoflavones, the array of these chemicals is likely to estrogens. Because of their ability to connect to esterogen receptors, these substances are referred to as phytoestrogens.

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Soy and its derivatives, particularly glycitein and geinstein, are the principal sources of isoflavones, which can be found as aglycones or conjugated with glucose monomer. Soy milk contains up to 130 mg/L of fresh soy and up to 1530 mg/L of fresh soy. These, like soy milk, are temperature sensitive and transform to glycosides when exposed to heat. Because of anthocyanins, which are hydrophilic colourants, plants and fruits have a red or blue colour. Fruit covering is the primary source of anthocyanins, which are contained in the form of anthocyanidins and a moiety of sugar at C3 or at the 5, 7-position of the A-ring.

* **Types of polyphenols**

Polyphenols have been identified in over 8,000 different forms. They can be further divided into four categories.

Flavonoids around 60% of all polyphenols are found in these. Quercetin, kaempferol, catechins, and anthocyanins are examples of antioxidants found in foods such as apples, onions, dark chocolate, and red cabbage.

Phenolic acids are a type of phenolic acid. Around 30% of all polyphenols belong to this category. Stilbenes and lignans for example, are mostly found in fruits, vegetables, whole grains, and seeds.

Polyphenolic amides are a type of polyphenolic amide. Capsaicinoids in chilli peppers and avenanthramides in oats fall under this category.

Polyphenols from other sources. Resveratrol in red wine, ellagic acid in berries, curcumin in turmeric, and lignans in flax seeds, sesame seeds, and whole grains are all members of this category.

The amount and type of polyphenols found in foods are determined by several factors, including the food's origin, maturity, and how it was grown, transported, stored, and prepared.

(you repeat it)Several factors influence the amount and type of polyphenols contained in foods, including the food's origin, maturity, and how it was grown, transported, stored, and prepared.

* **Healthy benefits of polyphenols**

**May lower blood sugar levels**

Polyphenols may contribute to a lower risk of type 2 diabetes by lowering blood sugar levels.

This is partly due to the fact that polyphenols may inhibit starch from being broken down into simple sugars, minimising the risk of blood sugar increases after meals.

These substances may also aid in the secretion of insulin, a hormone necessary for transporting sugar from the bloodstream to your cells and maintaining blood sugar levels.

Polyphenol-rich diets have also been linked to lower fasting blood sugar levels, improved glucose tolerance, and improved insulin sensitivity, all of which are crucial factors in lowering your risk of type 2 diabetes.

In one study, persons who consumed the most polyphenol-rich foods had a 57 percent lower risk of acquiring type 2 diabetes over the course of 2–4 years than those who consumed the least.

Anthocyanins appear to have the most significant anti-diabetic impact among polyphenols, according to study. Berries, currants, and grapes are examples of red, purple, and blue foods that contain them.

**May lower your risk of heart diseases**

Polyphenols can help your heart health if you include them in your diet.

Experts believe this is due to polyphenols' antioxidant capabilities, which assist to lower chronic inflammation, which is a risk factor for heart disease.

Polyphenol supplements are linked to lower blood pressure and LDL (bad cholesterol levels), as well as increased HDL (good cholesterol levels), according to two recent studies.

Another study discovered that people with greater enterolactone levels, which are a marker of lignan intake, have a 45 percent lower chance of dying from heart disease. Flax seeds and whole grains are high in lignans, a type of polyphenol.

**May prevent blood clots**

Polyphenols may lower your chances of getting a blood clot.

Platelets circulating in your bloodstream begin to clump together, forming blood clots. Platelet aggregation is a beneficial technique for reducing excessive bleeding.

Excess platelet aggregation, on the other hand, can generate blood clots, which can lead to serious health problems like deep vein thrombosis, stroke, and pulmonary embolism.

Polyphenols may help minimise platelet aggregation, decreasing the formation of blood clots, according to test-tube and animal research**.**

**May protect against cancer**

Polyphenols may help you avoid forming a blood clot.

Blood clots form when platelets flowing in your bloodstream cluster together. Platelet aggregation is an effective way to stop excessive bleeding.

Excess platelet aggregation, on the other hand, can cause blood clots, which can result in major health issues such as deep vein thrombosis, stroke, and pulmonary embolism.

According to test-tube and animal research, polyphenols may help reduce platelet aggregation, reducing the formation of blood clots.

**May promote healthy digestion**

Polyphenols may aid digestion by encouraging the growth of healthy gut bacteria while inhibiting the growth of harmful bacteria.

Polyphenol-rich tea extracts, for example, have been shown to boost the growth of beneficial bifidobacterial.

Green tea polyphenols may also aid in the fight against harmful bacteria such as C. difficile, E. coli, and Salmonella, as well as alleviate symptoms of peptic ulcer disease (PUD) and inflammatory bowel disease.

Polyphenols may also help probiotics thrive and survive, according to new findings. These are probiotic bacteria that can be found in fermented foods and taken as a supplement. More investigation, however, is required.

**May promote brain function**

Polyphenol-rich foods may help you concentrate and remember things better.

In one study, drinking grape juice, which is naturally high in polyphenols, helped older persons with modest mental impairment improve their memory in as little as 12 weeks.

Others believe cocoa flavanols boost cerebral blood flow and have connected these polyphenols to better working memory and attention.

Ginkgo biloba, a polyphenol-rich plant extract, appears to improve memory, learning, and attention. It's also connected to better brain activity and short-term memory in dementia patients.