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Hidden treasures: Exploring the bioactive compounds and medicinal properties of under-exploited fruits

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Abstract
Secondary metabolites from plants that have an impact on both people and animals are called bioactive substances. Because the bioactive components of plant extracts have antibacterial characteristics, they have been employed as antimicrobial agents since ancient times. Natural food products include a wide range of bioactive ingredients, particularly in vegetables, fruits, herbs, spices, oils, and whole grains. These include phenolic compounds, carotenoids, minerals, fatty acids, vitamins, peptides, and amino acids. It is also used in many other plant sciences, modern pharmacology, nanoscience, agrochemicals, cosmetics, the food industry, and geomedicine. Underutilized fruits offer a significant reservoir of bioactive compounds with potential health benefits, but they are often overlooked in regular agricultural operations. This thorough examination sheds light on the nutritional and medicinal significance of the many different bioactive compounds found in neglected fruits. These fruits have strong antibacterial and anti-inflammatory, They have anticancer and antioxidant capabilities due to their high concentrations of bioactive substances including phenolic compounds, flavonoids, carotenoids, vitamins, and dietary fibers. This article explores the phytochemical composition and bioactivity of many neglected fruits from various geographic locations, with a focus on their possible uses in functional foods, nutraceuticals, and medications. In addition, elements including genetic diversity, climate, and postharvest management practices that affect the bioactive content of underutilized fruits are discussed. In addition, elements including genetic diversity, climate, and postharvest management practices that affect the bioactive content of underutilized fruits are discussed. Knowing the bioactive ingredients in underutilized fruits highlights the need to preserve and use these fruits to advance human health and well-being in addition to illuminating their nutritional value.

Keywords: Bioactive compounds, antimicrobial agents, antibacterial properties, nano bioscience, phytochemicals

Introduction
Underutilized fruit crops are those that have value but are not widely grown, are scarce in the market, or are not cultivated commercially. These crops are grown, exchanged, and consumed in the local community. They are typically quite robust and can adapt to the local climate. According to the literature review, minor edible fruits have an important function in food and medicine. Many birds and animals, as well as people, consume these small fruits. These tiny fruits are a part of our indigenous fruit heritage. Individuals who carry these tiny fruits from the areas into the city occasionally sell them in temporary stores. Documentation of minor edible fruits in various places will aid in the creation of a comprehensive database of these underutilized fruits in local communities. There must be broad awareness campaigns so that the urban population is aware of the nutritious value of these little fruits. The term "bioactive" is composed of the terms "bio" and "active." The term "bio" is derived from "bios," which means "life" in Greek. The prefix "active" derives from the Latin word "activist," which means to be lively, energetic, or to include action. A bioactive chemical affects a living object, tissue, or cell, which is often demonstrated in laboratory research utilizing in vitro or in vivo methods. Although nutrients from meals are required for survival, the importance of bioactive chemicals has not been demonstrated because the body can survive without them or because the nutrients' functions obscure their effects. This action depicts every phenomenon that results in a type of life, a functioning system, or a process. Bioactive compounds are gaining popularity in a wide range of sectors, including geomedicine, plant science, current pharmacology, agrochemicals, cosmetics, the food

industry, nanoscience, and so on.

This developing area of research shows enormous promise, as seen by an increase in the number of research initiatives targeted at diversifying bioactive chemical sources and improving their production or salvage techniques. Plants produce typical bioactive compounds. Bioactive chemicals are not limited to plants. These substances are also found in certain animals and living things, such as bacteria, mushrooms, and microorganisms. According to Schrezenmeir *et al.*, (2000) [61], the concept of bioactivity frequently has two drawbacks. Positive and negative health outcomes have previously been investigated; the other requires the bioactive component to have quantifiable biological effects at physiologically relevant levels.

Given the broad range of physiological systems that this bioactivity may affect, achieving this endeavor will be difficult and require the simultaneous participation of multiple specializations and fields.

Bioactive chemicals are often unregulated and may be marketed as dietary supplements as there is insufficient proof of their safety or effectiveness. These are some bioactive compounds that are taken from under exploited fruits. Bioactive compounds, referred to as secondary plant metabolites, exert effects on both humans and animals, historically utilized for their antimicrobial properties in plant extracts. Phenolic compounds, carotenoids, minerals, fatty acids, vitamins, peptides, amino acids, and enzymes constitute a diverse array of bioactive compounds widely distributed in natural food sources, especially vegetables, fruits, herbs, spices, oils, and whole grains. These bioactive substances find uses in different industries, such as nanobioscience, agrochemicals, cosmetics, the food industry, geomedicine, plant science, and modern pharmacology. Despite their availability, underused fruits are frequently disregarded in standard agricultural operations, despite the fact that they contain a reservoir of bioactive compounds that may provide health advantages. This thorough investigation digs into the multitude of bioactive compounds present in underused fruits, shedding light on their nutritional and medicinal relevance (Kaur *et al*., 2023) [24]. Underutilized fruits boast high concentrations of bioactive substances like phenolic compounds, flavonoids, carotenoids, vitamins, minerals, and dietary fibers, contributing to their antioxidant, anti-inflammatory, anticancer, and antibacterial properties. Further research is necessary to fully explore the bioactive composition of various underutilized fruits and their associated health benefits. Exploring bioactive compounds in underutilized fruits opens up exciting possibilities for the development of functional foods, nutraceuticals, and pharmaceuticals.

Antioxidants play a crucial role in combating free radicals, contributing to cellular damage, and chronic diseases like cancer and heart disease (Niki, 2003) [37]. Bioactive compounds possess anti-inflammatory properties, aiding in the regulation of the body's inflammatory response and potentially alleviating conditions like arthritis and inflammatory bowel disease (Calder *et al.,* 2017) [10]. Research indicates that bioactive compounds may offer promising leads in the fight against cancer, with certain compounds inhibiting cancer cell growth and promoting apoptosis in cancer cells (Aggarwal, *et al*., 2003) [1]. Examples of underutilized fruits with promising bioactive profiles include jambul (*Syzygium cumini*), sea buckthorn (*Hippophae rhamnoides*), and prickly pear (*Opuntia spp*.). Incorporating underutilized fruits into functional foods can provide essential nutrients and additional health benefits. Nutraceutical supplements derived from bioactive extracts of underutilized fruits offer targeted health benefits. Further research may lead to the discovery of novel bioactive molecules with therapeutic potential for various diseases (Liu, 2004) [29].

2. Bioactive compounds in Almond

Almonds (*Prunus dulcis*) are the most extensively produced tree nuts in the world and belong to the Rosaceae family (Subhashinee *et al.*, 2008) [50]. Consuming fruits and nuts has been linked to a lower risk of chronic diseases. These foods contain a variety of phenolic acids, flavonoids, and antioxidants that are linked to sugars or other polyols via O-glycosidic or ester bonds (Milbury *et al*., 2006) [33]. According to various research findings, the Prunus genus has remarkable biological qualities, such as antioxidant, sedative, anti-inflammatory, and anti-hyperlipidemic actions. Our bodies naturally produce reactive oxygen species (ROS), such as superoxide anion (O_2), hydrogen peroxide (H_2O_2), and hydroxyl radical (HO), during metabolism. However, if these anions are widespread, they may be breaking down biological components such as proteins, lipids, enzymes, DNA, and RNA, causing tissue or cell damage associated with disease deuteriation (Amarowicz *et al*., 2004) [5].

According to the US Department of Agriculture (USDA) overall, lipids make up the bulk of unsaturated fatty acids (oleic around 70% and linoleic about 20%) and approximately 50.0% of the weight of almond kernels (49.9 g of total lipids/100 g). Lipids, minerals, proteins, and dietary fiber are some of these nutrients. According to the USDA database, the protein content of kernels varies between 16 and 22%, with each variety having a protein content of 21.2 g per 100 g. consisting of its three primary components, xyloglucans, cellulose, and pectin. Almonds are rich in water-soluble vitamins, particularly those of type B (which includes B_1, B_2, B_3, B_5, B_6, B_7, and B_9), and low in lipid-soluble vitamins (E) type, which is a major homolog of α-tocopherol and minor ones of β-tocopherol, γ-tocopherol, and α-tocotrienol. The heaviest component is the green hull, which makes up an average of 52% of the total fresh weight after accounting for the physio-chemical characteristics of various solid wastes from the processing of almonds. The shell and kernel (including skin) make up approximately 33% and 15% of the total fresh weight, respectively.

2.1 Phenolic compounds: Plant shikimic acid and pentose phosphate undergo phenylpropanoid metabolization, which yields phenolic compounds as secondary metabolites. All things considered, these compounds aid in shielding fruits, vegetables, and plants from oxidative damage. Common ingredients in plant-based meals and drinks, and phenolic compounds enhance the overall organoleptic properties of these items (Shahidi, *et al*. 2015) [49].

2.2 Flavonoids: A naturally occurring substance having a variety of phenolic structures, flavonoids can be found in tea, wine, fruits, vegetables, grains, bark, roots, and stems (Pietta 2000) [42p]. These natural goods are well recognized for their ability to improve health. Variations in their chemical structures lead to the classification of flavonoids into six distinct groups. First, flavones; second, flavanols;

third, flavanone; fifth, isoflavone; and sixth, anthocyanidin. Most flavonoids in plants are found as glycosides or carbohydrate groups; the remaining fraction is found in free form. Traditional medicine has long used flavonoids, and their strong antioxidant properties are primarily responsible for their medicinal benefits (Zhang *et al.*,2016) [60].

2.3 Flavones: The structural foundation of 2-phenylchromen-4-one (2-phenyl-1-benzopyran-4-one) is the basis for the family of flavonoids known as flavones (derived from the Latin flavus, meaning "yellow"). This can be seen in the opening image of the article. Flavones are found in food a lot, mostly in spices and various orange or yellow fruits and veggies. Examples of common flavones are apigenin (4',5,7trihydroxyflavone), luteolin (3',4',5,7-tetrahydroxyflavone), tangeritin (4',5,6,7,8 pentamethoxyflavone), chrysin (5,7-dihydroxyflavone), and 6-hydroxyflavone (Wang *et al.,* 2016).

2.4 Flavanol's: Belongs to the 3-hydroxyflavone backbone family of flavonoids, commonly known as 3-hydroxy-2-phenylchromen-4-one (IUPAC). The locations of the phenolic -OH groups account for their diversity. They should not be confused with flavins (with a "i"), which are formed from the yellow B vitamin riboflavin, or with flavanols (with a "a"), which comprise catechin (Rishi *et al*.,2016). Flavanols are found in a wide array of fruits and vegetables. Westerners consume an estimated 20 to 50 mg of flavanols per day. The type of diet a person follows determines how much they consume.

2.5 Flavanone: The class of flavonoids known as flavanones includes a range of fragrant, colorless ketones that are produced from flavone and are frequently found in plants as glycosides. These flavonoids belong to a class that has a similar chemical makeup. Typically, you may find them in citrus fruits like oranges, lemons, grapefruits, and tangerines. Hesperidin, naringenin, and eriocitrin are examples of common flavanones.

2.6 Isoflavone: Are modified forms of isoflavone, a naturally occurring family of isoflavonoids, some of which have effects on animals similar to those of phytoestrogen. Almost all beans in the family Fabaceae (Leguminosae) produce isoflavones (Setchell *et al*.,1994) [47]. Isoflavones are produced by a section of the general phenylpropanoid pathway, which in higher plants produces flavonoid compounds. Soybeans are the most common source of isoflavones in the human diet; the two primary isoflavones present in soybeans are genistein and daidzein. Phenylalanine is the first amino acid in the phenylpropanoid pathway. Naringenin, an intermediary in the route, is subsequently transformed into the isoflavone genistein by two enzymes specific to legumes: isoflavone synthase and dehydratase. Three enzymes particular to legumes, namely chalcone reductase, type II chalcone isomerase, and isoflavone synthase, function in a stepwise manner to transform chalcone, an intermediary naringenin, into the isoflavone daidzein. Plants use isoflavones and their derivatives as phytoalexin compounds to defend against pathogenic fungi and other microbes that cause disease. Moreover, soybeans use isoflavones to promote the soil bacterium Rhizobium's development of nitrogen-fixing root nodules.

2.7 Alkaloids: Any of a range of organic bases that naturally include nitrogen. Alkaloids affect human and animal physiology in a variety of important ways. Among the most well-known alkaloids are nicotine, ephedrine, quinine, strychnine, and morphine. Alkaloids are mostly found in plants, and they are especially prevalent in several groups of flowering plants (Robert *et al*.,1998) [45]. Alkaloids are thought to be found in up to 25% of higher plants, with thousands of distinct kinds known to exist.

2.8 Anthocyanidin: Anthocyanin aglycones are frequently found in plant pigments. They are based on the flavylium cation, which is an oxonium ion with hydrogen atoms substituted by different groups. Depending on the pH, they typically change from red to purple, blue, and bluish green (Khoo *et al.,* 2017) [26]. Anthocyanidins are important components of the flavonoid and polymethine coloring groups. The replacement of a phenyl group at position converts the flavylium cation into a chromenylium cation. Bicyclic pyrylium is sometimes known as benzopyrylium or chromenylium. The molecule's positive charge is mobile.

2.9 Terpenoids: Terpenoids, also known as isoprenoids, are a diverse group of naturally occurring chemical substances made of isoprene, 5-carbon molecules, and terpenes, which are polymers of isoprene (Qin *et al*., 2012) [42]. Although the majority of terpenoids are used for chemical interactions and protection in both abiotic and biotic environments, terpenoid metabolites play a vital role in a variety of growth and development processes.

2.10 Polyphenols: The naturally occurring substances known as polyphenols are mostly present in fruits, vegetables, cereals, and beverages. Plant-based diets contain compounds called polyphenols (Ahamed *et al*., 2017) [32]. They may be beneficial to your health and are rich in antioxidants. It is believed that polyphenols improve or help digestive issues, problems controlling weight, diabetes, neurodegenerative diseases, and cardiovascular disease.

2.11 Medicinal uses: The consumption of fruits and nuts has been linked to a lower risk of chronic diseases. Fruits and nuts are well-known sources of phenolic acids, flavonoids, and antioxidants. These compounds are typically conjugated with sugars or other polyols via O-glycosidic linkages or ester bonds. Prunus has intriguing biological qualities, including antioxidant, sedative, anti-inflammatory, and anti-hyperlipidemic effects.

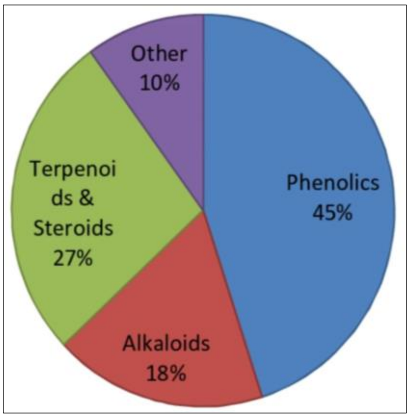

Fig 1: Pie diagram showing the percentage of bioactive compounds.

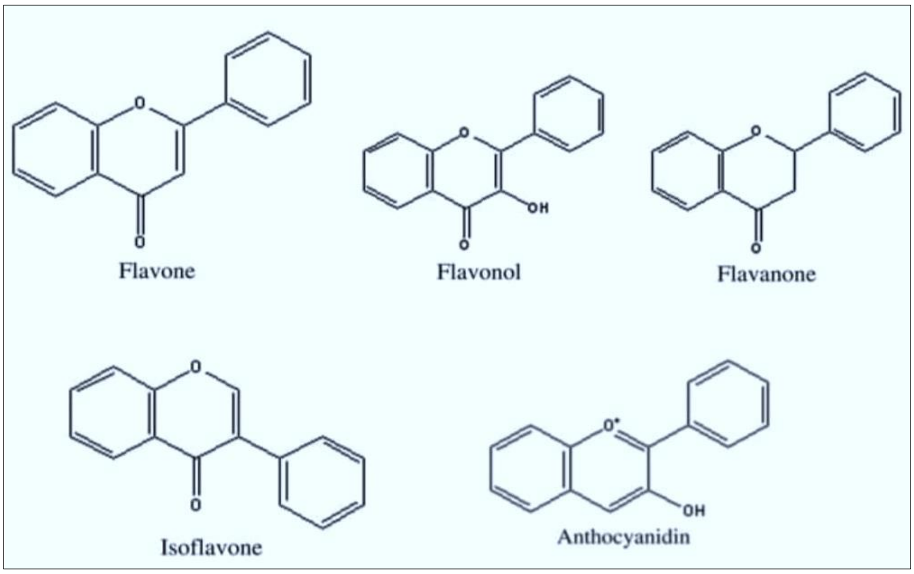

Fig 2: Representation of Chemical formula structures in Almonds

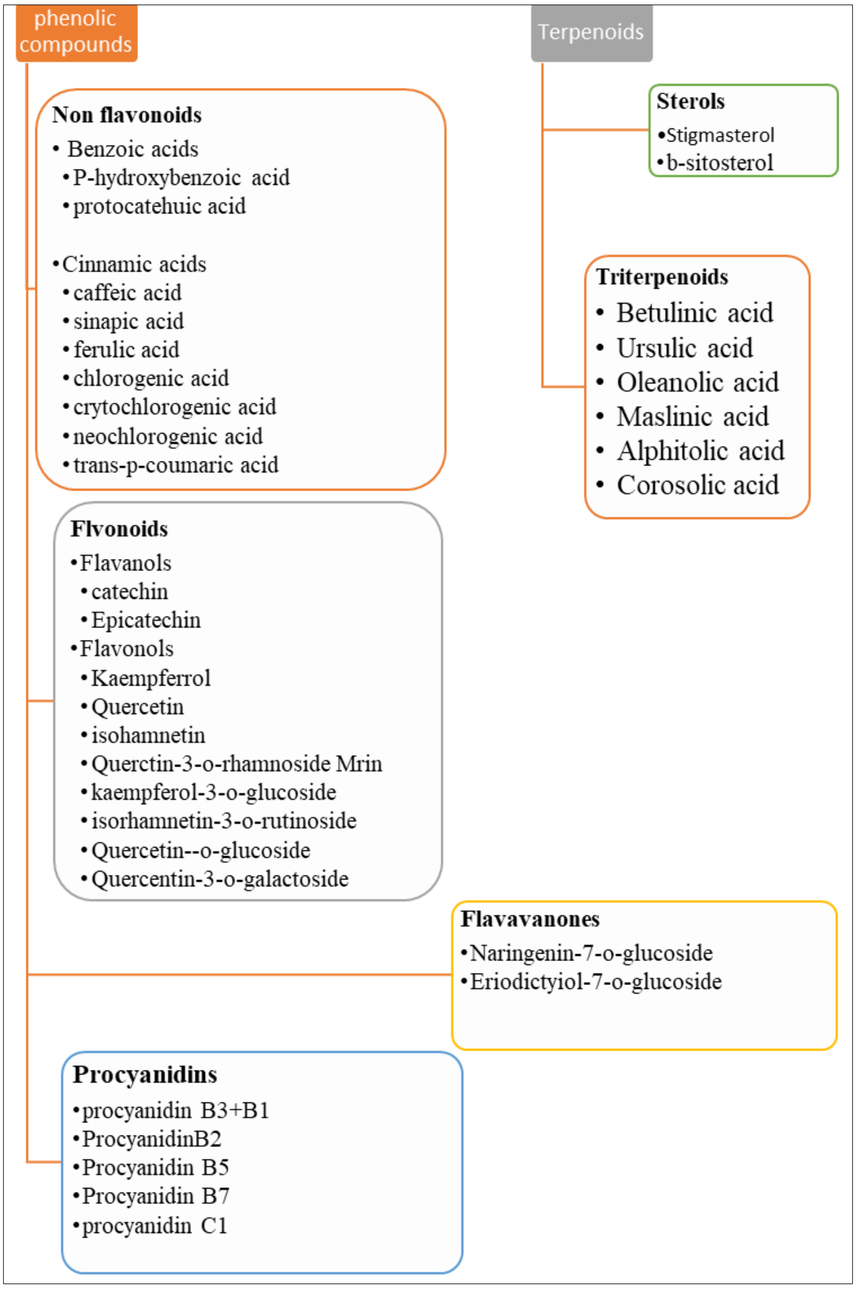

Fig 3: Representation of Bioactive compounds in Almonds.

3. Bioactive compounds in Bael

Bael (*Aegle marmelos* Correa L.) is a tropical fruit from Southeast Asia that belongs to the Rutaceae family. Bael grows throughout Southeast Asia, including Burma, Thailand, Sri Lanka, Pakistan, Bangladesh, and India. The pulp of the Bael fruit contains numerous bioactive and beneficial components, including flavonoids, terpenoids, coumarins, alkaloids, carotenoids, and other antioxidants. Furthermore, it contains considerable amounts of calcium, phosphorus, thiamine, riboflavin, niacin, vitamin C, and vitamin A.

3.1 Carotenoids: These are naturally occurring pigments found in bacteria, algae, and fungi, as well as plant parts such as leaves and fruits. With over 750 compounds discovered to date, they are one of the most diverse categories of natural products. Carotenoids come in two types: 1) carotenes; and 2) oxygenated xanthophylls (Rao *et al.*, 2014) [43]. Straight carotenes include phytoene and lycopene, while oxygenated carotenes like carotene and xanthophylls have hydroxyl, epoxy, or keto groups. Examples of carotenes containing cyclized hydrocarbon rings include zeaxanthin, violaxanthin, and lutein. Carotenoids are widely used in the pharmaceutical and cosmetic sectors as nutraceuticals, food colorants, and food supplements. The two major types of carotenoids are oxygenated xanthophylls and carotenes.

3.2 Alkaloids: Alkaloids comprise a diverse range of chemicals that are unrelated both structurally and biogenically. Quick purification was achieved for a number of additional pharmacologically significant alkaloids, such as caffeine, quinine, and strychnine. Because to advances in chemistry, substances can now be produced by (Roberts *et al.*,1998) [45]. Though alkaloid compounds are mostly found in plants, it is now known that other sources of alkaloids include bacteria, fungus, insects, and animals. The most prevalent building blocks for alkaloids are amino acids. Early in the history of alkaloids, pharmacologically significant alkaloids were discovered. Drugs include coffee, quinine, strychnine, and morphine.

3.3 Coumarins: The term "coumarin" is derived from the tonka bean, which was discovered in 1820. Coumarin belongs to the benzopyrone chemical family, which includes molecules with a benzene ring linked to a pyrone ring (Falco *et al.,* 2013) [18]. The benzopyrones are classified into two types: coumarins and flavonoids. It is broadly classified into three subgroups.

3.3.1 Simple coumarins: Simple coumarins are the hydroxylated, alkoxylated, and alkylated derivatives of the parent compound, coumarin Certain coumarins are not produced for medical use; rather, they are employed as scents, industrial additives, odor boosters in cosmetics, and odor neutralizers in paints, rubber, and plastics(Marchev *et al*., 2012).

3.3.2 Furanocoumarins: Furanocoumarins, or furocoumarins, are a class of organic chemical compounds composed of many different kinds of plants. The majority of plant species shown to contain furanocoumarins belong to only a few plant families. The plant families Rtaceae and Apiaceae include the vast majority of furanocoumarin-containing species. Furanocoumarins are found in only a few widely spread plant species in the Moraceae and Fabaceae groups (Wu *et al*., 2011) [57].

3.3.3 Pyrone-substituted coumarins: Similar to this, depending on the location of the pyran rings, there are two types of pyranocoumarins, such as xanthyletin and seselin (Yang *et al*., 2013) [58]. Warfarin and dicoumarol are examples of pyrone-substituted coumarins, which are derived from pyranocoumarins. The pyrone ring in these molecules has been replaced and altered.

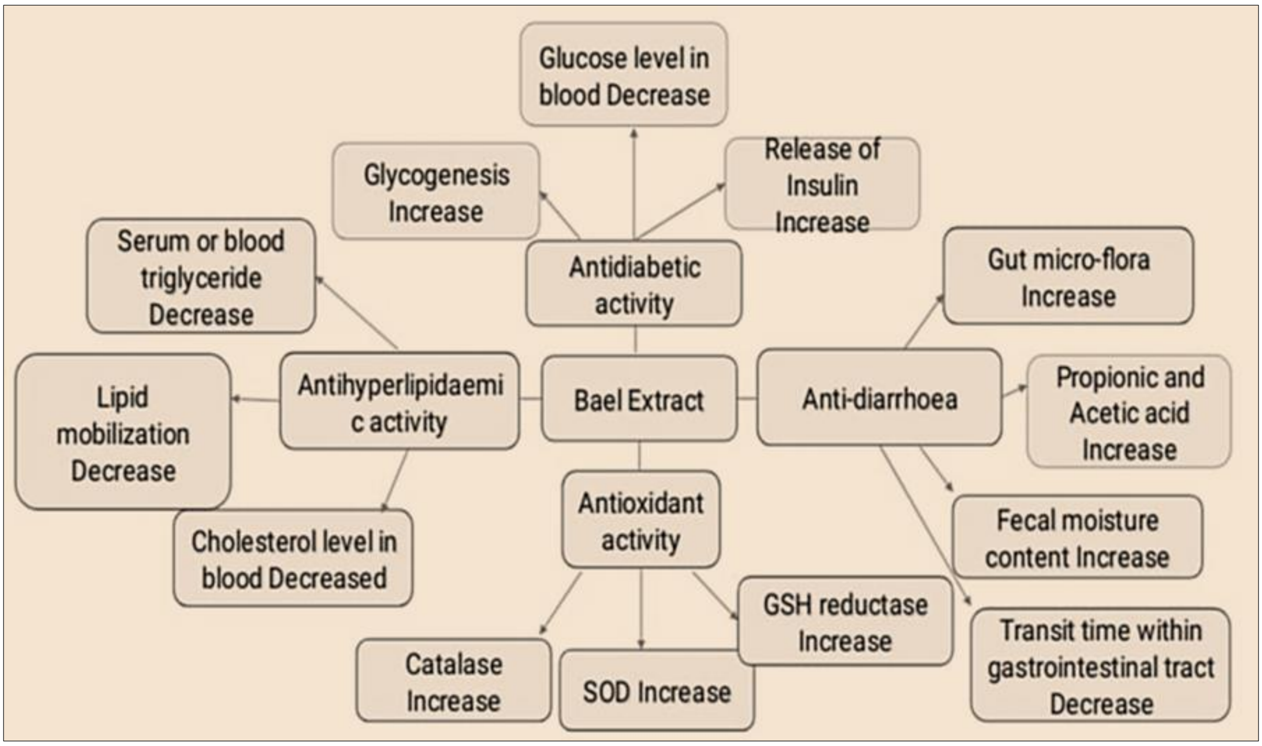

Fig 4: Representation of Bael extracts

4. Bioactive compounds in Apricots

Apricot (*Prunus armeniaca* L.,) is a tree that thrives in temperate regions. It is mostly found in Central Asia and is one of the most extensively planted Prunus species worldwide (Yuan *et al*., 2007) [59]. It provides a pleasant balance of carbohydrates, natural acids, and aroma. Beneficial phytochemicals that contribute to the color, texture, and nutritional profile of apricot fruit include vitamins, carotenoids, and phenolic compounds (phenolic acids, flavonoids, and lignins). The characteristics of apricots can ward off oxidative stresses, immune-stimulating agents, and chronic disorders (Madrau *et al*., 2009; Leccese *et al.,* 2011) [31, 28]. Chlorogenic and neo-chlorogenic acids, catechin, epicatechin, and rutin (or quercetin-3-rutinoside) are the most notable phenolic compounds found in apricot fruits (Dragovic-Uzelac *et al.*,2007) [16].

4.1 Medicinal uses: Phenolics are also called anticarcinogenic, antimicrobial, antiallergic, antimutagenic, and anti-inflammatory, also aiding the prevention of cardiovascular disease. Furthermore, phenolics reduce oxidation of LDL-lipoprotein, platelet aggregation, and red blood cell destruction. Phenols and carotenoids have antioxidant qualities that can help with chronic disorders (2-4). Antioxidants neutralize free radical reactive oxygen species produced endogenously during aerobic metabolism.

5. Bioactive compounds in Cherry

Sweet cherry (*Prunus avium* L.) is one of the most well-known tropical fruits. In addition to being an excellent source of several minerals and phytochemicals, sweet cherries also help maintain a balanced diet (Usenik *et al.*, 2010) [52-53] and comprise a range of phenolic chemicals, including anthocyanins, procyanidins, flavonols, and hydroxycinnamate. Later it was properlized by (Liu *et al.*, 2011) [30]; Cherry fruits included the cyanidin 3-O-glucoside and 3-O-rutinoside, whereas far lower amounts of peonidin-3-O-rutinoside and pelargonidin-3-O-rutinoside (Gonçalves *et al*., 2007; Kelebek & Selli, 2011) [20, 25]. Additionally, phenolic acids such as hydroxycinnamic acid derivatives (p-coumaroylquinic acid, chlorogenic acid, and neochlorogenic acid) are abundant in sweet cherries. These ingredients are important because they may co-pigment with anthocyanins to affect the color of cherry fruits (Mozetic *et al.*, 2002) [34]. 3-caffeoylquinic, 5-caffeoylquinic, and p-coumaric acids are the three main phenolic acids.

5.2 Medicinal uses: Consumption of sweet or sour cherries has been shown to lower the risk of cancer arthritis, inflammatory pain, and neurological illnesses (Kim *et al.*, 2005) [27].

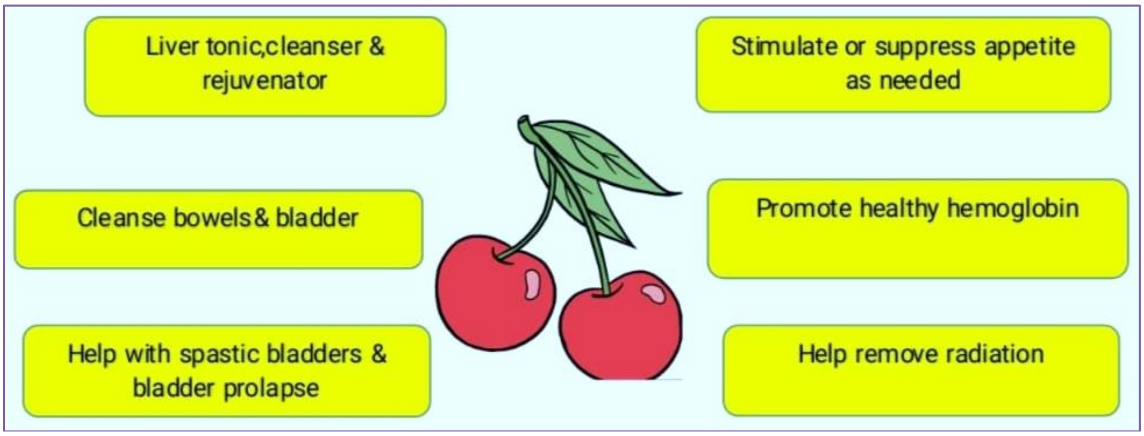

Fig 5: Medicinal uses of cherry

6. Bioactive compounds in Custard apple:

Custard apple (*Annona squamosa* L.) belongs to the Annonaceae family and grows in both subtropical and tropical climes. Flavonoids, phenolic chemicals, acetogenins, and cyclopeptides are all alkaloids. These are examples of bioactive chemicals or molecules that are responsible for a variety of biological processes. The seeds also contain tannins, vitamins C and E, and a higher quantity of amino acids. According to phytochemical investigations, the primary components of A. *squamosa* seeds include cyclopeptides and annonaceous acetogenins. Custard apple contains aporphine, norcodeine, romaine, cozy eating, glaucine, online, and norisocorydine in different parts of the plant.

6.1 Medicinal uses: Annona squamosa is a multifunctional plant with a variety of traditional and medicinal uses that promote a healthy lifestyle (Aiyeloja and Bello, 2006) [3]. Several plant species have been found to contain anti-oxidants, antimicrobials, antidiarrhea, anti-inflammatory, anti-parasitic, anti-convulsant, anti-malarial, anti-trypanosomal, anti-snake venom, anti-nociceptive, and a variety of other biological properties with pharmaceutical applications (Noumi and Safiatou, 2015) [38]. Annona leaves are used to treat yellow fever, tuberculosis, and smallpox. Annona stem bark can heal snakebites and hernias (Dambatta and Aliyu, 2012) [13]. Several plant components are used as antidotes to cure toxic bites and diabetes (Ogoli *et al.*, 2011) [39]. The custard apple plant has been recognized as having nutraceutical and industrial pharmaceutical potential, specifically anti-tumor activity.

6.2 Anti-Inflammatory: Inflammation is the body's defense mechanism, controlled by pro- and anti-inflammatory mediators. Several reasons can cause inflammation in the human body, including allergen contact, physical damage, thermal or chemical stimulation, and bacterial infection. In contrast, inflammatory disorders such chronic asthma, rheumatoid arthritis, inflammatory bowel disease, and multiple sclerosis can be caused by a combination of internal and environmental factors that influence anti-inflammatory mediators.

6.3 Antidiabetic Activity: In one study, an ethanolic and methanolic seed extract of *A. squamosa* was given to alloxan-induced diabetic rats (150 mg/kg BW) to observe how it affected blood glucose levels. The ethanolic (dose: 200 mg/kg) and methanolic (dose: 200 mg/kg) seed extracts of custard apple showed significant dose-dependent antihyperglycemic activity (43.96% and 45.99%, respectively). However, the ethanolic extract has a lower hyperglycemic effect than standard medication. Saponins, flavonoids, acetogenins, phenolic compounds, and alkaloids are all effective anti-diabetes agents.

6.4 Anticancer Activity: Chen *et al.*, (2005) studied the *in vivo* and *in vitro* anticancer efficacy of acetogenins produced from custard apple seed oil against human carcinoma cell lines. A. Sativa seed oil squamosa (47.98 mg/g) contains two major acetogenins, 12 and 15-cis-squamostatin-A. The high-performance HPLC technique is used to detect and quantify bulletin (256.18 mg/g). The study's findings show that seed oil has significant anticancer effects against A-549, Hela, MCF-7, and HepG2, particularly against Hep G2 (IC50: 0.36 mg/mL) and MCF-7 (IC50: 0.25 mg/mL) cells *in vitro*, implying that Custard apple seeds can be used as a potent ingredient in the development of anticancer drugs.

6.5 Hepatoprotective Activity: The liver is a vital organ in vertebrates and is prone to a variety of problems worldwide, including chronic hepatotoxicity caused by alcohol, pharmaceutical medicines (paracetamol, chemotherapy treatments), and toxic chemicals, which can lead to liver fibrosis and cirrhosis. An ethanolic extract of custard apple seeds was utilized in a trial to treat liver damage induced by alcohol.

6.6 Phytosterols: Phytosterols are phytosterols that, like cholesterol, act as structural components of plant cellular membranes. Plant sterols and stanols are included. Over 250 sterols and other related chemicals have been discovered. Free phytosterols derived from oils are water-insoluble, oil-insoluble, and alcohol-soluble**.**

6.7 Tetrapenoids: Terpenoids also called isoprenoids are a type of naturally occurring organic molecule generated from the 5-carbon substance isoprene, its derivatives called terpenes, diterpenes, and so on. Terpenoids, while frequently used interchangeably with "terpenes," have extra functional groups, most of which contain oxygen. Terpenoids are composed of around 80,000 chemicals when coupled with hydrocarbon terpenes. They are the most numerous classes of plant secondary metabolites, accounting for over 60% of all known natural compounds. Many terpenoids exhibit significant pharmacological bioactivity and thus appealing to medicinal chemists.

6.8 Phenylpropanoids: Plants manufacture phenylpropanoids, a broad class of chemical substances from amino acid phenylalanine and tyrosine. The name is derived from coumaric acid's six-carbon aromatic phenyl group and three-carbon propene tail, which is the primary intermediate in phenylpropanoid production.

Natural products derived from 4-coumaroyl-CoA include signals (precursors to lignin and lignocellulose), flavonoids, isoflavonoids, coumarins, aurones, stilbenes, catechin and phenylpropanoids. Cinnamic acid is used to make the coumaroyl component**.**

7. Bioactive compounds in Jackfruit

Jackfruit is a popular member of the fig, mulberry, and breadfruit families. The jackfruit is native to the Western Ghats of Southern India and Malaysia. Which is widely planted in tropical areas for its large, nutrient-dense fruit. Jackfruit contains a variety of phytochemicals in varying amounts, including carotenoids, flavonoids, volatile acids, sterols, and tannins.

Tetracyclic triterpenoids 9,19-cyclolanost-3-one-24,25-diol and 9,1-cyclolanost-3-one-24,2Sdiol, as well as cycloartenol and cycloartenol, have been identified. A. heterophyllus has been found to contain flavonoids such as Artoheteroids A-D, morin, artocarmin A, Albani A, euchrenone A, Morato-carpanone, and steppogenin.

7.1 Volatile acids: The word "volatile acidity" refers to the steam distillable acids contained in wine, which include acetic acid, as well as lactic, formic, butyric, and propionic acids. Although they can today be quantified by enzymatic, gas chromatographic, or HPLC techniques, these acids are most commonly measured using Cash Still.

7.2 Carotenoids: Carotenoids also known as tetraterpenoids are made by plants, algae, as well as some bacteria and fungi. All of these species can manufacture carotenoids from lipids and other essential organic metabolic building blocks. Additionally, endosymbiotic bacteria in whiteflies make it. Carotenoids are substances that are stored in the fatty tissues of animals and are only consumed by carnivorous animals. Carotenoids are better absorbed in the human diet when they are eaten with fat.

7.3 Medicinal purposes: Antioxidant qualities in jackfruit are crucial for curing the following human disorders and enhancing health.

7.4 Cardiovascular health: Dyslipidemia is one of the main risk factors for the emergence of coronary heart disease. The elevated levels of low-density lipoprotein cholesterol (LDLC) and decreased high-density lipoprotein cholesterol are the key characteristics (HDL-C) (Esmaillzadeh and Azadbakht., 2008) [17].

7.5 Improving digestion: The jackfruit's high fiber content (3.6 g/100 g) helps to promote smooth bowel motions and avoid constipation by eliminating carcinogenic substances from the large intestine (colon) and also protects the colon mucous membrane.

7.6 Improving skin health: The natural aging process that results in skin damage, worsens the skin is exposed to the sun for an extended period (photoaging). According to Widmer and colleagues, prolonged exposure to UV radiation is linked to substantial negative consequences to human skin including oxidative stress, early aging of the skin, sunburn, immunological suppression, and skin cancer.

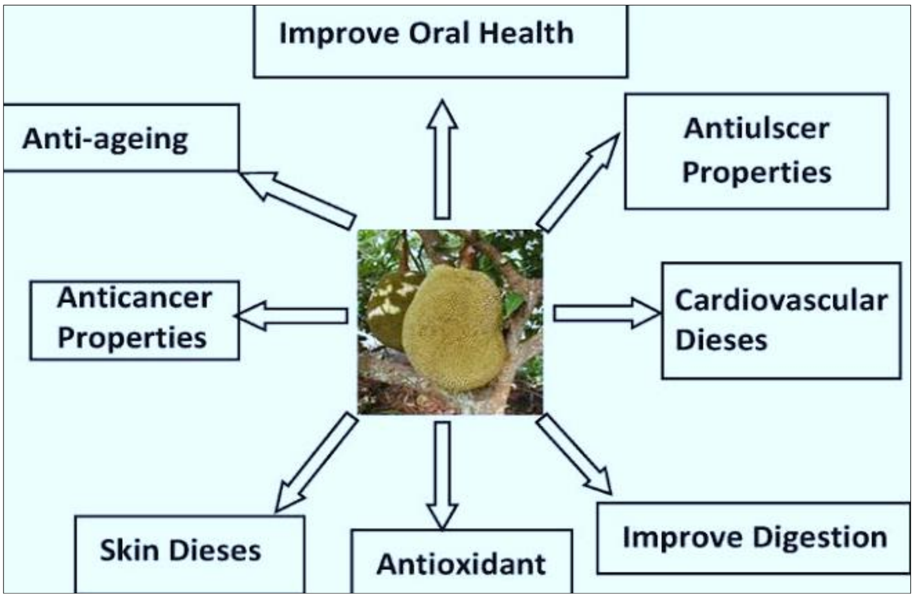

Fig 6: Medicinal properties of Jackfruit

7.7 Strengthening the bone: Magnesium content in jackfruit is high (young fruit has 27 mg/100 g and seeds have 54 mg/100g. It is vitamin rich for calcium absorption and works in conjunction with calcium to help build bones and fend off bone-related diseases like osteoporosis.

7.8 Improving stomach ulcer: It is one kind of peptic ulcer. A gastric ulcer is another name for stomach ulcer. A duodenal ulcer is the kind of peptic ulcer that occurs most frequently. Stomach ulcer is typically brought by infection with the Helicobacter pylori bacteria. The ulcer can heal with an acid-suppressing drug course of 4 to 8 weeks. In addition, the Helicobacter pylori infection is often treated with a 1-week course of two antibiotics and an acid-suppressing medication. This typically stops the ulcer from returning.

8. Bioactive compounds in Avocado

Avocado (*Persea Americana*), often known as avocado pear or alligator pear, has several bioactive components. It belongs to the Lauraceae family of flowering plants and is native to Mexico and Central America. Avocado fruit is a berry containing a single large seed, according to botany. The most prevalent ingredients among the three avocado species include bioactive chemicals such as vitamin E, carotenoids, and sterols, as well as fatty acids, fiber, potassium, vitamin B, 3p-coumaroyl-D-glucose, abscisic acid, pentadecylfuran, avocado furan, and oleic acid. Which are believed to be independent of the type of food ingested. Furthermore, avocados have been used extensively in the culinary, nutraceutical, pharmaceutical, and cosmetic industries.

8.1 Abscisic acid: ABA is a hormone produced by plants. ABA plays an important role in a wide range of developmental processes in plants, including bud and seed dormancy, organ size regulation, and stomatal closure. Environmental problems include drought, soil salinity, cold tolerance, freezing tolerance, heat stress, and heavy metal ion tolerance, all of which are critical for plants.

8.2 Oleic acid: Various animal and vegetable fats and oils occur naturally, including fatty acids and oleic acids. Despite the potential of yellow commercial samples, the oil is odorless and colorless. Oleic acid, with a lipid number of 18:1 cis-9, is a monounsaturated omega-9 fatty acid, according to chemical classifications. The chemical equation $CH_3(CH_2)7CH{=}CH(CH_2)7COOH$. The name derives from the Latin word "oleum," which signifies oil. In nature, it is the most common fatty acid. Oleates are the names of oleic acid salts and esters.

8.3 Proanthocyanidins: Condensed tannins, or "condensed tannins," are the second most prevalent natural phenolic component after lignins (Gu *et al*., 2003) [21]. Procyanidins are a category of oligomeric molecules generated solely from pro-anthocyanidins catechin and epicatechin. Procyanidins are categorized into two types: A and B. Type A procyanidins are linked by a C_4-C_8 or C_4-C_6 bond, which may coexist with another C_2-O-C_7 or the less common C_2-O-C_5 connection (Appeldoorn *et al.*, 2009) [7].

8.4 Medicinal uses: It has been demonstrated that certain bioactive substances improve vascular function. Xanthophylls prevent blood vessel degeneration by reducing the amount of oxidized low-density lipoproteins. Lutein and zeaxanthin also help to protect cartilage, prevent cataracts, and slow the progression of age-related macular degeneration. It has been proven that carotenoids in general protect the skin against UV-induced oxidative stress and inflammation. Avocado phytosterols have been shown in research to lessen the risk of coronary heart disease. To enhance heart health, the American Heart Association suggests consuming 2-3 g of sterols and stanols each day. Aside from decreasing cholesterol, -sitosterol has been shown to boost the immune system, relieve symptoms of benign prostatic hyperplasia, and prevent the production of cancer-causing chemicals.

9. Bioactive compounds in Jamun:

Jamun (*Syzygium cumini*) is also known as Eugenia cumini or *Syzygium* Jamun. It is known by a variety of common names, including Indian blackberry, Jambu, Mahaphala, Java plum, Malabar plum, jambolana, mesegerak, Jamelonguier, Jamblang, jambolana, and Kavika. The secondary metabolites, which are unprocessed byproducts of the Jamun plant, are the most important bioactive compounds. Initially, plant extracts were utilized to cure a wide range of diseases and disorders. Fruit contains essential oils such as lauric acid, phytochemicals, lipids, and phenols have active therapeutic properties.

9.1 Terpenes: According to Cho *et al*., (2017) [62], terpenes are organic compounds found in Jamun that are made up of multiple iso prunes units and have several benefits such as neuroprotective, antitumorigenic, anti-inflammatory, antimicrobial, antifungal, antiviral, antihyperglycemic, and antiparasitic properties. Furthermore, they retain pleasant scents and are employed as flavoring in the food and pharmaceutical industries.

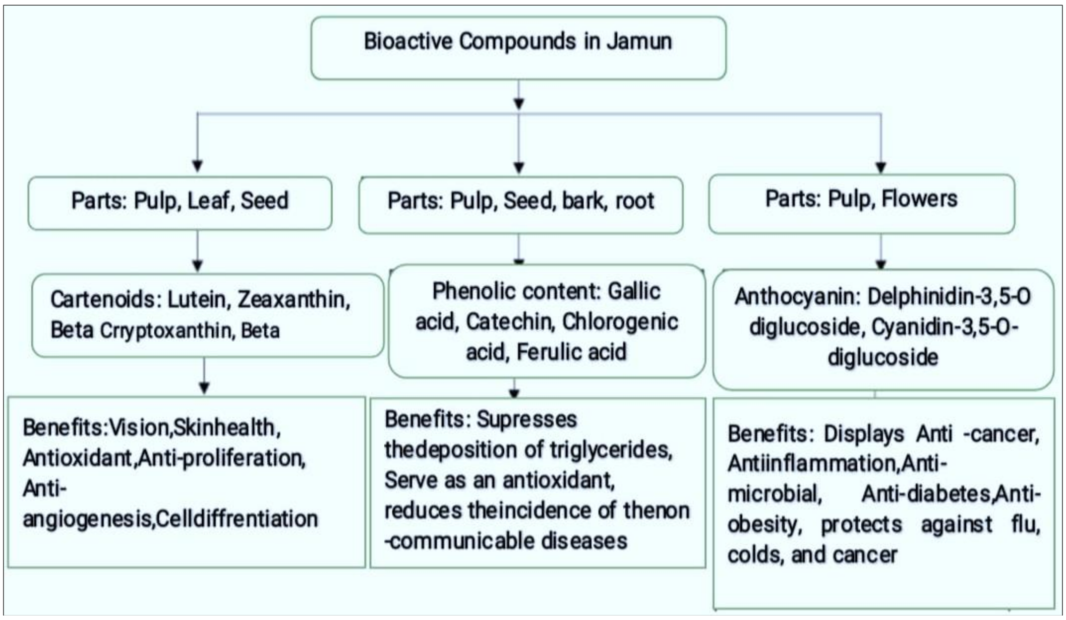

Fig 7: Representation of bioactive compounds in jamun

9.2 Medicinal uses: Ayurvedic medicine traditionally uses all plant components, including Jamun fruits, leaves, seeds, and bark. The bark contains tannins and carbohydrates, which explains why it has long been used as an astringent to cure disorders such as diarrhea (Namasivayam *et al.*,2008) [35]. The glycoside content of Jamun fruit seeds is expected to maintain their anti-diabetic properties. Jamun fruit seeds and pulp have various benefits for diabetics, including managing blood sugar levels and reducing diseases like neuropathy and cataracts.

10. Conclusion

Finally, our findings show that underused fruits have tremendous potential as sources of bioactive chemicals. We detected a variety of bioactive chemicals in these fruits, including polyphenols, flavonoids, vitamins, and antioxidants. These chemicals exhibit a variety of biological actions, including antioxidant, anti-inflammatory, antibacterial, and anticancer properties, indicating potential health benefits. Our findings highlight the necessity of expanding fruit consumption beyond popular kinds in order to benefit from the complete spectrum of bioactive chemicals found in nature. Incorporating underutilized fruits into your diet can boost nutritional diversity while also delivering certain health benefits. Furthermore, the bioactive compounds contained in these fruits have the potential for use in functional meals, nutraceuticals, and medications, creating chances for product development. A wealth of health-promoting potential has been hidden inside the world of underused fruits. These buried riches contain a wide range of bioactive compounds, which are natural molecules that have the potential to improve our health. From the colorful anthocyanins that give berries their rich colors to the strong antioxidants found in phenolic compounds, these fruits have a wide range of bioactive chemicals waiting to be discovered.

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