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A review on banana, its nutritional components and bioactive compounds

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Abstract

The banana plant is one of the oldest known medicinal plants and most widely grown fruit crop in the world that are used to cure a number of diseases or infections. This review begins with a short history of the banana plant along with its nutritional composition and bioactive compounds. As per the nutritional composition, it recommended as a rich source of vitamins, minerals, carbohydrates, essential for human health. The banana plant contains several bioactive compounds, such as phenolic compounds, phytosterols and carotenoids, which help reduce the risk of diseases. Therefore, this review paper provides brief information about the nutritional composition and bioactive components of the banana plant.

Keywords: Banana, nutritional composition, bioactive compounds, phytosterols and carotenoids

Introduction

The banana is an herbaceous plant that belongs to the Musaceae family and has the three genera *Musa*, *Musella*, and *Ensete* (Probojati *et al.*, 2021) [1]. The two primary edible banana-producing species are *Musa acuminata* and *M. balbisiana* (Campos *et al.*, 2017) [2]. The most accessible and affordable crop in the world is the banana, which is grown and consumed in more than a thousand different types with varying tastes, colours, and chemical composition. The plantain is referred to as the cooking cultivar, while the banana is often referred to as the dessert cultivar (Oyeyinka & Afolayan, 2020; Vu *et al.*, 2018) [3, 4]. The main reasons that banana plants are planted are for their fruit and, to a lesser extent, for their natural fibres and wine (Khoozani *et al.*, 2019) [5]. The banana plant and its different parts are illustrated in figure 1. They are additionally utilised for shading, and due to their vast surface area and waxy composition; tree leaves are perfect for packaging big amounts of food (Ahmadi *et al.*, 2019) [6].

The peels and leaves of banana trees, exhibit antioxidant properties and biological effects, such as anti-diabetic, anti-diarrheal, anti-tumor, anti-mutagenic, and anti-ulcerogenic qualities (Kora, 2019) [7]. Additionally, it has been demonstrated that bioactive compounds found in bananas prevent the growth of bacteria or fungi (Chiang *et al.*, 2020; Evbuomwan *et al.*, 2018; Ismail *et al.*, 2018) [8, 9, 10]. Due to this plant's diversity, it has a wide-ranging antibacterial activity (Norfaradhiah & Rapeah, 2017) [11]. Vitamins and phenolic compounds are among the significant phytonutrients found in abundance in banana fruit (Lim, Lim, & Tee, 2007; Wall, 2006) [12, 13]. Minerals including phosphorus, potassium, magnesium, sodium, calcium, iron, zinc, copper and manganese are also significantly enriched in it (Forster *et al.*, 2003) [14]. Bananas, like other significant fruits, contain a distinctive variety of bioactive substances. The phenolics, carotenoids, flavonoids, and biogenic amines in the raw and matured banana have drawn the most interest. Banana pulp has also been shown to contain a small amount of phytosterols. Bananas have a higher antioxidant capacity than several berries, herbs, and vegetables due to these bioactive components, and this capacity rises as the fruit ripens. Therefore, this review paper provides brief information about the nutritional composition and bioactive components of the banana plant.

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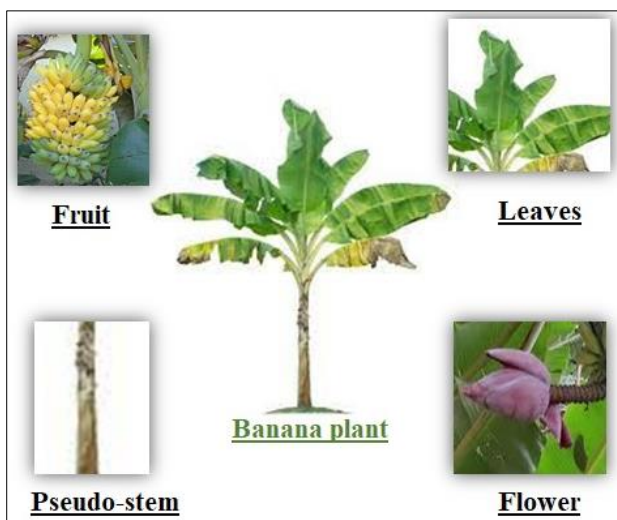


Fig 1: The banana plant and its parts

Nutritional composition

Banana contains a high nutritional value which leads to better adsorption of many nutrients with minimum fat absorption. They help to maintain plasma glucose levels and may even enhance endurance exercise performance (Netshiheni *et al.*, 2019) [15]. Bananas contain a lot of moisture. A normal-sized banana has 88 g of water in it (Ranjha *et al.*, 2022) [16]. Bananas that are ripe have a low Glycaemic index (GI) value since they only contain roughly 15 g of total sugar. The GI score is a measurement of how much food affects our blood sugar levels. A typical banana has about 26.95 g of carbs, or 12% of the daily recommended intake (Mateljan *et al.*, 2007) [17]. Bananas are abundant in dietary fibre in addition to vitamins and minerals. According to the US Department of Agriculture, a typical banana contains 4 g of dietary fibre (Ranjha *et al.*, 2022) [16]. Banana fruit contains phytochemicals, including sterols and unsaturated fatty acids. It is also considered a rich source of fiber, minerals and vitamins. An average-sized banana contains around 450-467mg of potassium. One banana might supply roughly 23 percent of the daily recommended potassium intake (Kumar *et al.*, 2012) [18]. Phosphorus serving provides 4 percent of the daily recommended intake (DRI) and don't include significant amount of calcium, though they do supply a considerable portion of the DRI (1% of the serving) (Mateljan, G. 2007) [17]. Dhar *et al.* (2012) [19] revealed that significant amounts of manganese are present in fresh bananas. For antioxidant enzymes, manganese serves as a cofactor i.e., manganese superoxide dismutase (MnSOD). The values given for vitamin C typically rely on old methods and techniques like calorimetry or titration and have other limitations. For adult males, the DRI (Dietary Reference Intake) for vitamin C is around 90 mg and 75 mg for women. A typical-sized "Cooking Banana," with a weight of 100 g, contains about 18.4 mg of vitamin C. vitamin B complex are class of water-soluble vitamins. These are essential to cell metabolism. Several of the Vitamin B complex are consistently found in bananas. A typical 100 g serving of *Musa × paradisiaca* (cooking banana) contains Vitamin B1 (Thiamine), vit. B2 (Thiamine), Vit. B3 (Niacin), and most importantly Vit. B6 (Pyridoxine). The nutritional composition of banana fruit provided in table 1.

Table 1: Nutritional composition of banana fruit (Baiyeri *et al.*, 2011; Ranjha *et al.*, 2020) [20, 16].

Proximate (%)	Banana fruit
Moisture	77.19
Fibre	16
Fats	0.75
Protein	3.50
Carbohydrates	22.12
Minerals (mg/100g)	
Iron	10.59
Potassium	18.50
Zinc	7.84
Vitamins (mg/100g)	
Vit. C	10.27
Vit. B1	0.04
Vit. B2	0.09
Vit. E	0.12
Vit. K	0.59

Bioactive compounds

Like other significant fruits, banana contain a distinctive variety of bioactive substances. In comprehensive review, Singh *et al.*, (2016) [21] have suggested that banana is wealthy in lots of bioactive compounds, which include carotenoids, flavonoids, phenolics, amines, vit. C, and vit. E having antioxidant activities to offer many human health benefits. Due to those bioactive compounds, bananas have a better antioxidant ability than some berries, herbs and vegetables and this ability will increase throughout fruit maturity. So, this section focuses on bioactive components in banana and these are illustrated in figure 2.

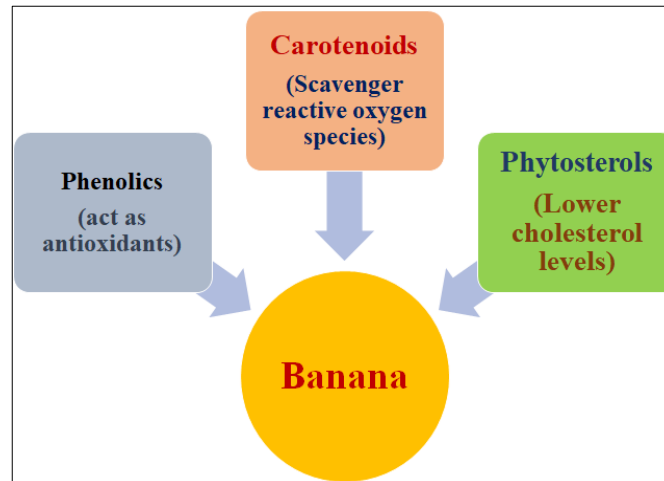


Fig 2: Bioactive substances in banana

Phenolic compounds

Phenolics found in banana are the chief bioactive substances having anti-oxidant effects and are helpful for offering health benefit. Due to presence of polyphenols, oxidative browning occurs when banana fruit cut (Netshiheni *et al.*, 2019) [15]. According to certain reports, bananas contain 7 mg of phenolic acids overall per 100 g of fresh weight (Singh *et al.*, 2016) [21]. Unripe bananas taste sour because of these chemicals. Several earlier studies have used the Folin-Ciocalteu colorimetric method to demonstrate the presence of phenolic compounds in bananas. (Sulaiman *et al.*, 2011) [22].

In the banana pulp, the range of Free phenolic compounds (solvent extractable) levels from 11.8 to 90.4 mg of GAE/100 g fresh weight (FW) (Singh *et al.*, 2016) [21]. Several distinct forms of phenolic compounds that cannot be extracted from cells can also be found in banana pulp (Arranz *et al.*, 2009) [23]. In the fruit pulp's soluble cell wall, they discovered condensed flavonoids and tannins (galocatechin, catechin and epicatechin) (Bennett *et al.*, 2010) [24]. They claimed that the cells' walls contained anthocyanidin delphinidin (Singh *et al.*, 2016) [21].

The important classes of flavonoids in banana are found to be flavanols, which contains kaempferol quercetin, cyanidins and myricetin. Many scientists have revealed the fitness advantages of flavonoids found in bananas. Flavonoids act as defensive scavengers against reactive oxygen species (ROS) and oxygen-derived free radicals liable for elderly and diverse diseases. Singh *et al.*, 2016 [21] said pulp of banana are great source of phenolics for health benefits.

Carotenoids

Carotenoids have distinct physiological properties that improve health, including their role as antioxidants and pro-vitamins, particularly in the scavenging of singlet oxygen. For their potential to lower the risk of diseases, particularly several cancers and eye issues, which are significant global health concerns, these have been the subject of extensive research. These are one of the most significant groups of plant pigments, which are categorized as oxygenated hydrocarbon derivatives (xanthophylls) and pure hydrocarbons (carotenes). These by-products of the isoprenoid biosynthetic pathway serve primarily as antioxidants and supplemental light-absorbing pigments in plants. Carotenoids are abundant in orange and yellow fruits, including bananas (Singh *et al.*, 2016) [21]. There were several different carotenoids found, including lutein, beta-carotene, neoxanthin, alpha-carotene, auroxanthin, violaxanthin, beta-cryptoxanthin, isolutein and alpha-cryptoxanthin. Beatrice *et al.*, 2015 [25] discovered that seven different banana cultivars had carotenoid contents that varied from 7760 to 10,633 lg/100 g FW. A thorough analysis of banana cultivars revealed that many genotypes have incredibly high and total carotenoid levels and provitamin. (Singh *et al.*, 2016) [21]. The difficulties of vitamin A insufficiency and chronic diseases are related to the shift in diet to imported processed foods and changes in lifestyle. Trans b-carotene, the most important provitamin A carotenoids, is found in the highest concentration (1412 lg/100 g) in banana cultivars with yellow and orange flesh, per investigations done in the Federated States of Micronesia. Consuming foods high in carotenoids boosts immunity and lowers the risk of developing diseases including cancer, diabetes, and cardiac problems. Banana genotypes rich in provitamin A carotenoids could be a valuable source of nutrition for populations lacking in vitamin A. Such genotypes can be produced and consumed in low-income nations with significant vitamin A deficiency-related health issues (Fungo *et al.*, 2013) [26]. Provitamin A carotenoids are quickly and easily absorbed by humans and transformed into vitamin A, hence reducing vitamin A deficiency.

Phytosterols

Due to their numerous health advantages, which include lowering blood cholesterol levels and reducing intestinal absorption of cholesterol, natural plant sterols, also known as

phytosterols, are added to functional meals (Marangoni & Poli, 2010) [27]. They also have anticancer effects and modulate the immune system. (Singh *et al.*, 2016) [21]. Numerous studies have shown that banana fruit has significant phytosterol content. Villaverde *et al.*, 2013 [28] found the phytosterols; cycloeucaleanol, cycloeucalenone, stigmaterol, cycloartenol, b-sitosterol and campesterol in banana cultivars. These compounds were found in unripe bananas with concentrations ranging from 2.8 to 12.4 g/kg DW in various varieties. Lowered blood cholesterol levels, reduced risk of cardiovascular disease, immune system modulation, and anticancer properties are just a few of the many health advantages of phytosterols (Marangoni *et al.*, 2010) [27]. A daily consumption of 1.6-2 g/day of phytosterols is known to lower plasma LDL cholesterol levels by 8–10% and cholesterol absorption from the gut by nearly 30% (Genser B *et al.*, 2012) [29].

Conclusion

Globally, due to high nutritive and medicinal value of banana fruit it consumed in both forms namely, raw and cooked. In the current review, it was observed that bananas contain a wide variety of highly valuable bioactive chemicals. The amount of helpful bioactive chemicals in bananas is sufficient to promote health. Due to their beneficial qualities, bananas have been utilised successfully in prevention of disease and promotion of health due to several studies that have demonstrated and verified the antioxidant activity of bioactive compounds. In breeding initiatives to produce bio-fortified cultivars, it is crucial to find, promote, and employ banana cultivars with high concentrations of these bioactive compounds. These cultivars might be wonderful resources for solving many health-related issues.

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