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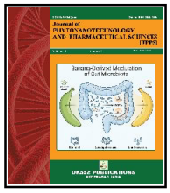

Review Article : Open Access

Role of banana in maintaining human health with special emphasis on gut health

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Abstract

Banana (*Musa acuminata* Colla) is a globally consumed fruit known for its high nutritional value and significant therapeutic potential, especially in maintaining gut health. This review comprehensively analyses the role of banana in digestive physiology, control of gut microbiota and management of common gastrointestinal disorders. Bananas are rich in dietary fiber, resistant starch, pectin, flavonoids, phenolic compounds, vitamins, and bioactive amines, which work together to support intestinal motility, enhance mucosal integrity, and promote the growth of beneficial microorganisms such as *Lactobacillus* and *Bifidobacterium*. Fermentation of prebiotics derived from bananas produces short-chain fatty acids, particularly butyrate, which contributes to anti-inflammatory effects and improved gut barrier function. The article further discusses the importance of bananas in various conditions, such as irritable bowel syndrome, inflammatory bowel disease, constipation, diarrhoea, gastroesophageal reflux disease, and peptic ulcers. Additionally, the antioxidant, antidiabetic, antimicrobial and anticancer activities of banana phytoconstituents have been highlighted. Traditional medical systems such as Ayurveda, Unani, and Siddha emphasise the cooling, nourishing, and digestive properties of bananas, supporting their therapeutic versatility. Overall, bananas emerge as a functional food with significant potential for promoting gut health and preventing diseases, reinforcing their importance in modern nutrition and integrative healthcare strategies.

1. Introduction

Before discussing this topic in detail, it is important to clarify the concept of the gut. The gut, also known as the digestive tract, is a complex system of organs involved in the digestion of food and the absorption of nutrients. It includes the esophagus, stomach, small and large intestines (Figure 1). The gut also contains trillions of microorganisms, collectively called the gut microbiota. This diverse population of bacteria and viruses plays a vital role in maintaining and regulating overall gut health.

Gut health refers to the proper functioning of the digestive system, including its immune, neuroendocrine, barrier, motor, and digestive activities. Recent research has shown that the gut microbiome plays a key role in regulating all of these functions, emphasising its importance in maintaining overall health and its involvement in the development of various diseases (Cani *et al*., 2017; Blacher *et al*., 2017). Many factors contribute to overall gut health. Diet plays a major role, as certain foods, such as yoghurt, help improve and maintain a healthy gut. In contrast, stress, insufficient sleep, and an unhealthy lifestyle can negatively affect gut function. Additionally, the use of antibiotics and other medications can disrupt the normal gut microbiota, leading to poor gut health. Recent studies suggest that environmental factors, particularly diet, strongly influence the gut microbiome, with dietary fiber serving as an important energy source for gut microorganisms (Smits *et al*., 2017; Frame *et al*., 2020; Pham *et al*., 2021). The term "gut health" has increasingly gained attention in both medical research and the food industry. It refers to the overall functional condition of the digestive system, including efficient digestion and absorption of nutrients, absence of gastrointestinal disorders, balanced and stable intestinal microbiota, proper immune function and maintenance of general health. Animal studies and limited human research suggest that the gut is teeming with beneficial bacteria that aid digestion through their enzymatic activity. The gut also plays a key role in regulating epithelial integrity and immune functions, which are essential for both intestinal health and overall health. In addition, the gut communicates with the brain *via* the vagus nerve and hormonal signals, providing information about energy intake and other physiological conditions that can affect mood and general health (Bischoff, 2011). Inadequate fruit intake is a major cause of increased mortality and is associated with a higher risk of chronic disorders and reduced quality of health. Regular consumption of fruits reduces the risk of many conditions, including diabetes, heart disease, digestive diseases and some types of cancer (WHO, 2018).

However, fresh green bananas are not usually eaten because they have a tough texture and an astringent taste, caused by the presence of soluble phenolic compounds, especially tannins (Sarawong *et al*., 2014; Falcomer *et al*., 2019). In Ayurveda and traditional Indian medicine systems, almost every part of the banana plant has been used to treat various health disorders. This widely consumed food is obtained from herbaceous plants belonging to the genus Musa. Being easily digestible and rich in nutrients, bananas are suitable for people of all age groups, and hence it is recognized as one of the most important food crops globally. Banana is a highly nutritious food

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(Table 1) that supports a balanced diet for people of all age groups around the world and also contributes to livelihoods through its cultivation, processing and trade. It is consumed in various forms and provides significant nutritional and medicinal benefits (Jyothirmayi and Rao, 2015).

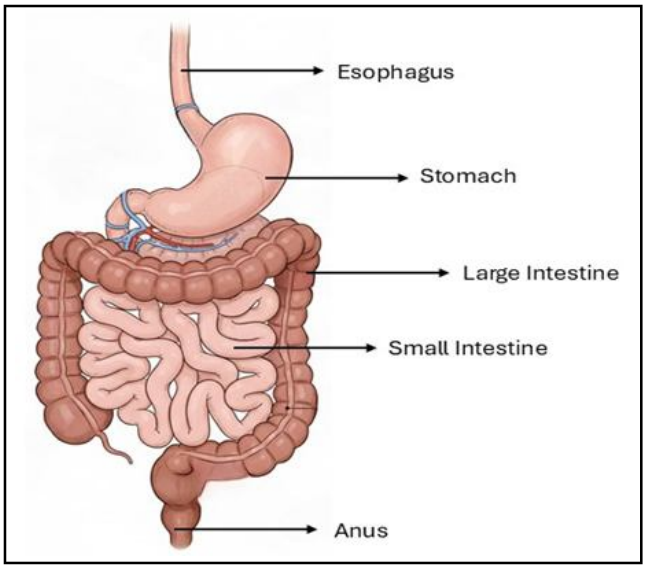


Figure 1: Anatomy of the human gut showing the esophagus, stomach, small intestine, and large intestine.

Table 1: Nutritional profile of banana

Nutrient	Amount
Energy	~89 kcal
Carbohydrates	22.8 g
Dietary fiber	2.6 g
Sugars	12.2 g
Protein	1.1 g
Fat	0.3 g
Potassium	358 mg
Magnesium	27 mg
Calcium	5 mg
Phosphorus	22 mg
Iron	0.26 mg
Vitamin C	8.7 mg
Vitamin B6	0.4 mg
Folate	20 µg
Water	~74 g

Bananas are rich in dietary fiber, resistant starch, and bioactive compounds, which play an important role in maintaining intestinal health (Table 2). Unripe bananas are particularly high in resistant starch, which acts as a prebiotic and promotes the growth of beneficial gut microbiota such as *Lactobacillus* and *Bifidobacterium*. These microorganisms ferment resistant starch to produce short-chain fatty acids, particularly butyrate, which supports intestinal barrier integrity and reduces inflammation. Ripe bananas (Figure 2) contain soluble fibers like pectin that help regulate bowel movements, improve stool consistency, and relieve constipation. Bananas also have mild antacid properties and help protect the gastric mucosa, making them beneficial in conditions like gastritis and peptic ulcers. Additionally, the potassium content in bananas helps maintain electrolyte balance and intestinal motility, improving overall digestive health (Anyasi *et al*., 2013).

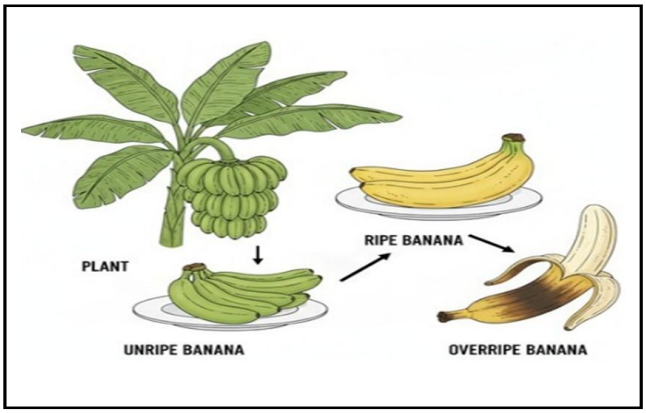


Figure 2: Stages of banana ripeness.

Bananas are a rich source of dietary fiber and have gained immense popularity in recent years due to their remarkable health benefits (Sujithra and Manikkandan, 2019). Dietary fiber is mainly composed of cellulose, hemicellulose, pectin and lignin, which are non-starch polysaccharides and resist digestion and absorption in the human digestive tract. Banana stem is an excellent source of fiber and is considered helpful in removing toxins from the body and reducing weight (Ho *et al*., 2015).

1.1 Gut health issues and their symptoms

(a) Irritable bowel syndrome (IBS)

Irritable bowel syndrome (IBS) is a functional gastrointestinal disorder marked by changes in bowel movement habits accompanied by abdominal pain or discomfort with no identifiable structural or biochemical abnormality. Various factors have been suggested as contributing to the pathogenesis of IBS, including abnormal gastrointestinal motility (constipation or diarrhoea), increased internal sensitivity, post-infection changes, imbalance of the brain-gut axis, and change in the intestinal microflora, bacterial overgrowth, food intolerance, decreased carbohydrate absorption and low-grade intestinal inflammation (Saha, 2014).

In the United States, IBS affects approximately 7-16% of the population. A global meta-analysis reported an overall combined prevalence of approximately 11%, with considerable variation observed across different geographical regions (Nathani *et al*., 2025).

The soluble fiber in bananas, such as pectin, helps regulate bowel movements and relieve both constipation and diarrhea, thereby helping to control irritable bowel syndrome. It also contains resistant starch and natural prebiotics that promote healthy gut bacteria. Fructooligosaccharides present in bananas improve the gut barrier function. Additionally, potassium maintains electrolyte balance, and antioxidants help soothe intestinal irritation, reducing symptoms like bloating and irregular bowel movements (Figure 3).

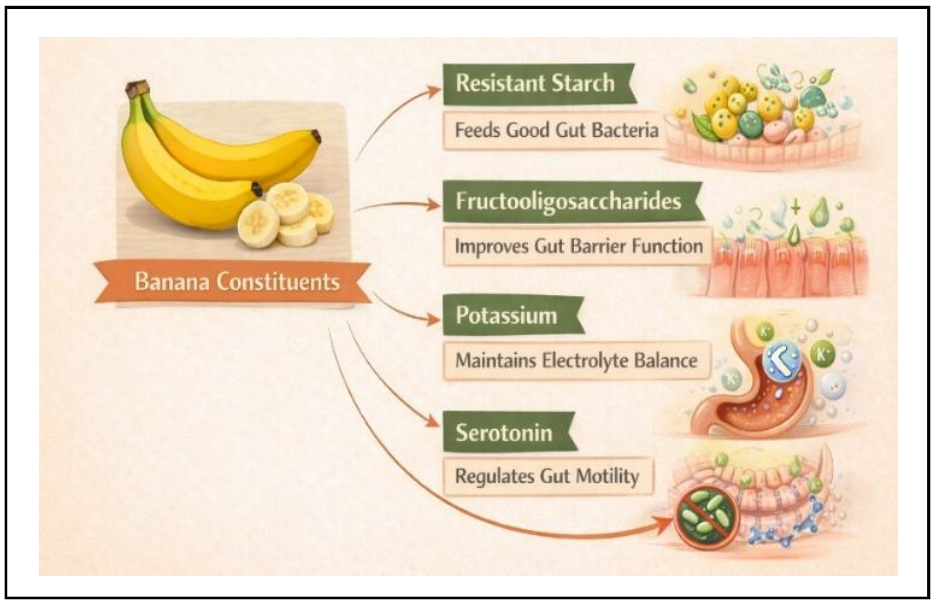


Figure 3: Banana constituents help in treating IBS.

(b) Inflammatory bowel disease (IBD)

Inflammatory bowel disease (IBD) primarily includes ulcerative colitis and Crohn's disease. The pathological features of these two conditions are fundamentally different; Crohn's disease usually causes transmural inflammation affecting the entire thickness of the intestinal wall, whereas ulcerative colitis is usually confined to the mucosal layer. Furthermore, Crohn's disease can affect any part of the digestive tract, from the mouth to the anus, while ulcerative colitis is primarily confined to the colon. Genetic susceptibility also differs between these two disorders. Consequently, despite being classified under inflammatory bowel disease, ulcerative colitis and Crohn's disease exhibit distinct clinical manifestations, therapeutic responses, and prognostic outcomes (Nasseri-Moghaddam, 2012). In North America, the incidence rates of inflammatory bowel disease vary between 2.2 and 19.2 cases per 100,000 person-years for ulcerative colitis and between 3.1 and 20.2 cases per 100,000 person-years for Crohn's disease. Crohn's disease is slightly more prevalent in women than in men, while ulcerative colitis affects both sexes equally. Inflammatory bowel disease is more common in developed countries and is often associated with areas with colder climates (McDowell *et al*., 2023).

The symptoms of IBD include chronic diarrhoea (may also be bloody in ulcerative colitis), abdominal pain and cramps, rectal bleeding, frequent and intense bowel movements, weight loss**,** loss of appetite and fatigue and weakness. Banana helps in managing IBD as it contains soluble fiber which smooths the digestion process and improves bowel function. The resistant starch and prebiotics promote healthy gut bacteria, while the flavonoid reduces the inflammation and leucocyanidin heals the intestinal lining (Figure 4).

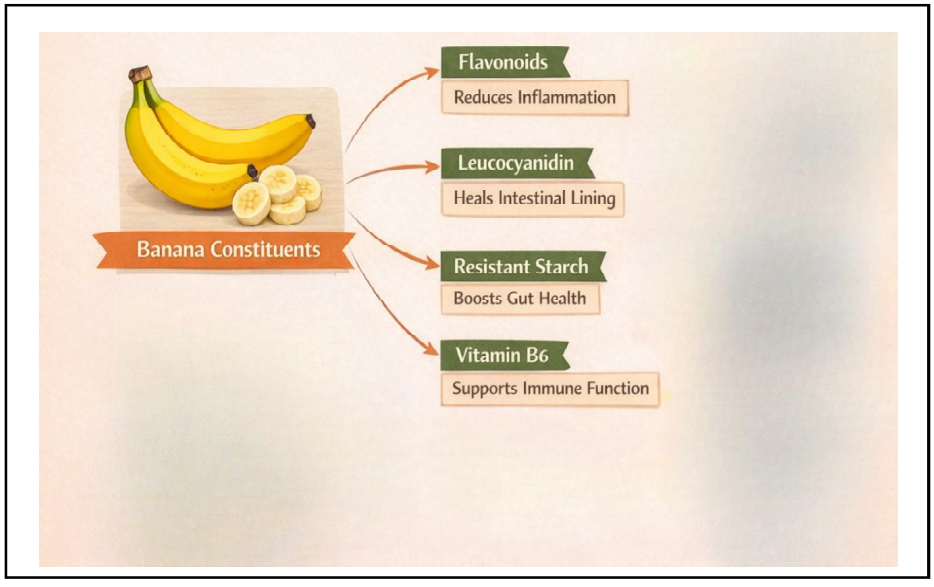


Figure 4: Banana constituents help in treating IBD.

(c) Gastroesophageal reflux disease (GERD)

Gastroesophageal reflux disease (GERD) is one of the most common digestive disorders globally, with an estimated prevalence of 18.1-27.8% in North America. About half the adult population experiences symptoms related to acid reflux at some point in their lives. According to the definition of Montreal, GERD is characterised by painful symptoms or complications resulting from the reflux of stomach contents into the esophagus (Clarrett and Hachem, 2018). In GERD, stomach contents flow back into the esophagus and, in some cases into the oral cavity, larynx, or lungs, causing esophagitis and inflammation of the affected mucous tissues. It is one of the most frequently encountered conditions in gastroenterology and primary care practice. Several risk factors contribute to the development of GERD, including hiatal hernia, age over 50 years, obesity (BMI >30), tobacco smoking, alcohol consumption, dietary habits involving fatty, spicy or acidic foods and low levels of physical activity (Azer and Goosenberg, 2025). The symptoms of GERD include heartburn, chest pain**,** difficulty swallowing (dysphagia), a feeling of something stuck in the throat (globus sensation), persistent cough, hoarseness, sore throat and nausea.

(d) Constipation

Constipation is a widespread gastrointestinal disorder that affects individuals of all age groups, from infants to the elderly, regardless of their gender, race, or socioeconomic status. It involves irregular and often difficult bowel movements and is more than a simple symptom. Constipation can significantly impact the quality of life and, if not managed properly, can result in several health complications. Chronic constipation is very common, affecting approximately 15% of the population in the United States. In 2006, approximately 5.7 million people consulted healthcare providers due to constipation, of which constipation was identified as the primary diagnosis in approximately 2.7 million cases (Diaz *et al*., 2023). The symptoms of constipation such as irregular bowel movements**,** hard or lumpy stools**,** feeling of an incomplete bowel movement, bloating or discomfort, abdominal pain or cramps and excessive gas. Bananas are helpful in relieving constipation because the fiber they contain helps thicken stools and promote regular bowel movements. They also support healthy digestion, making bowel movements easier (Figure 5).

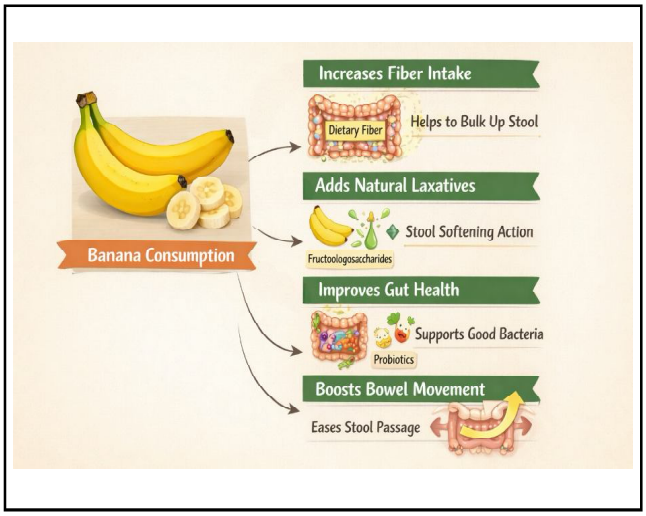


Figure 5: Banana helps in treating constipation.

(e) Diarrhoea

Diarrhoea is a condition of increased water content in the stool, resulting from a disruption of the normal intestinal processes that absorb water, ions, and nutrients in the small and large intestines. Acute diarrhoea involves three or more loose or watery bowel movements per day that can last up to 14 days, while diarrhoea that lasts longer than 14 days is considered chronic or persistent diarrhoea. Infection is the most common cause of acute diarrhoea, while non-infectious factors are often responsible for long-term cases. Chronic diarrhoea can commonly be caused by conditions such as inflammatory bowel disease, including Crohn's disease and ulcerative colitis. In Europe, the incidence of these diseases has increased over time. Ulcerative colitis increased from 6.0 cases per 100,000 person-years in 1962 to 9.8 per 100,000 person-years in 2010, while during the same period, the incidence of Crohn's disease increased from 1.0 to 6.3 per 100,000 person-years (Nemeth and Pfleghaar, 2022).

The symptoms of diarrhoea include frequent watery stools**,** abdominal cramps or pain, bloating and gas, nausea or vomiting, fatigue and weakness. Banana helps in treating diarrhoea by absorbing excess water in the intestines, thickening the stool and replenishing lost potassium. It also provides slowly digested energy and nourishes the good bacteria present in the gut, which helps in faster recovery (Figure 6).

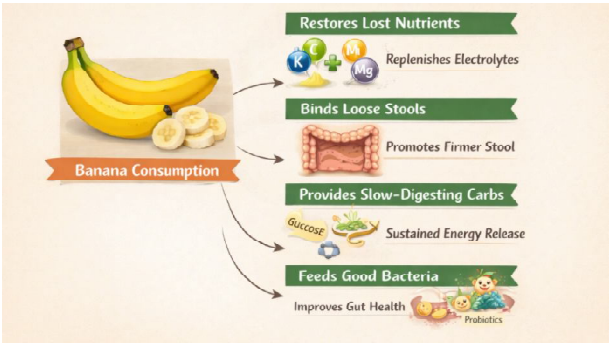


Figure 6: Banana helps in treating diarrhoea.

(f) Peptic ulcer

Peptic ulcer disease (PUD) refers to the breakdown of the mucosal lining of the gastrointestinal tract caused by the corrosive effects of gastric acid and pepsin. The lesion penetrates the mucosa and spreads to the muscular layer of the stomach or duodenum wall. PUD most commonly affects the stomach and proximal portion of the duodenum, although ulcers can also develop in the lower esophagus, distal portion of the duodenum, or jejunum. Patients suffering from gastric ulcers typically experience epigastric pain within 15-30 minutes of eating, while pain associated with duodenal ulcers typically appears 2-3 h after a meal. According to current clinical guidelines, testing for *Helicobacter pylori* is recommended in all individuals with peptic ulcer disease. Peptic ulcer disease (PUD) is primarily caused by *H. pylori* infection and the use of nonsteroidal anti-inflammatory drugs (Malik *et al*., 2023) (Figure 7). The symptoms of peptic ulcer include pain or burning in the upper abdomen, nausea and vomiting, feeling of bloating or heaviness in the stomach, loss of appetite, weight loss and heartburn.

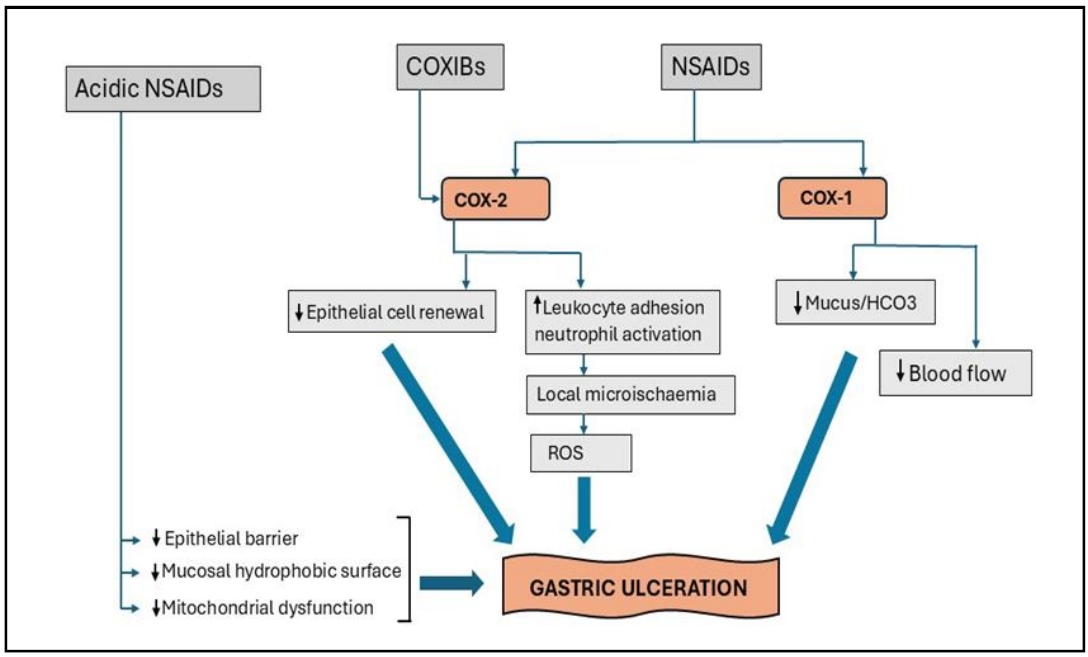


Figure 7: Pathophysiology of gastric ulceration caused by NSAIDs.

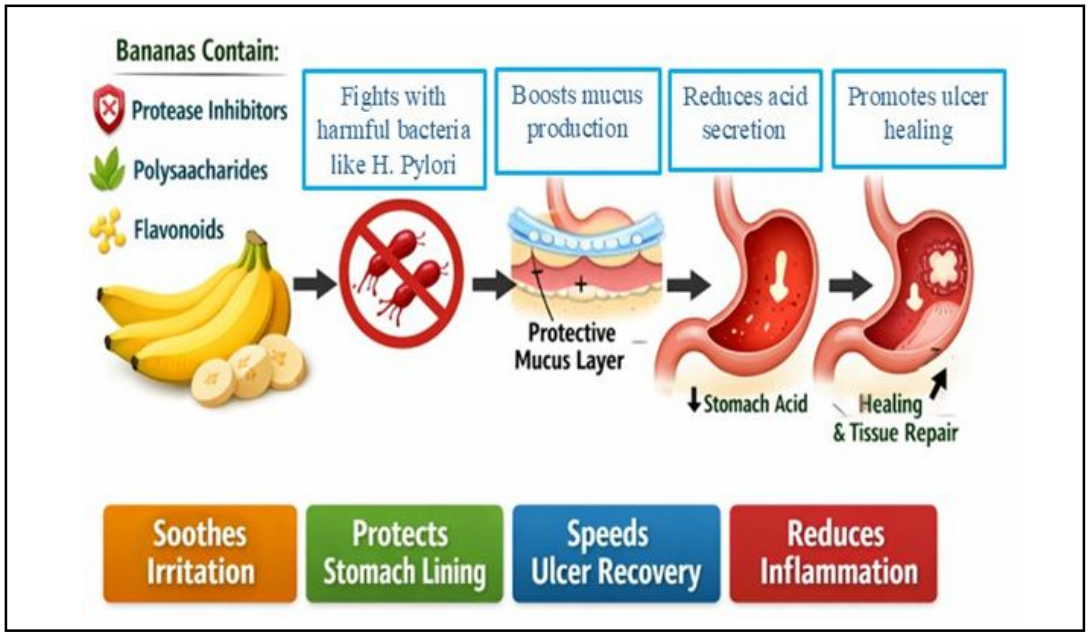


Figure 8: Banana helps in treating peptic ulcer.

Bananas helps in treating peptic ulcers by fighting harmful bacteria like *H. pylori*, increasing mucus production to protect the stomach lining, and reducing excess acid secretion. Its antioxidants and natural compounds soothe irritation and support faster healing of ulcers, which reduces pain and discomfort (Figure 8).

1.2 Microbiota and its importance

The human gut contains trillions of microorganisms that are essential for health. Microorganisms in the gut aid in fiber digestion, vitamin synthesis, immune system regulation, and protection against pathogenic microorganisms, thereby supporting overall digestive function.

1.3 Some common factors that destroy beneficial bacteria in the gut are:

- **Excessive use of antibiotics:** Overuse of antibiotics not only kills harmful bacteria but also destroys beneficial microorganisms present in the intestine.
- **Low fiber intake:** An inadequate amount of fiber in the diet hinders bowel movement and creates favourable conditions for the growth of harmful bacteria.

Table 2: Banana constituents and their role in gut health

S. No.	Chemical constituent	Presence in banana	Role in gut health
1.	Resistant starch	High in unripe bananas	Acts as a prebiotic, promotes the growth of beneficial gut microbiota and increases butyrate production.
2.	Pectin	High in ripe bananas	Improves stool consistency, regulates bowel movements, and relieves constipation.
3.	Insoluble fiber	Moderate	Enhances intestinal motility and prevents constipation.
4.	Tannins	Mainly in unripe bananas	Provides astringent effect; useful in diarrhoea and gut infections.
5.	Flavonoids	Present	Anti-inflammatory; helps maintain gut mucosal integrity.
6.	Short-chain fatty acids	Formed *via* fermentation	Strengthen gut barrier and reduce intestinal inflammation.
7.	Prebiotic Compounds	Present	Support beneficial bacteria such as *Lactobacillus* and *Bifidobacterium.*
8.	Leucocyanidin	High in unripe bananas	Exhibits strong anti-ulcer activity by enhancing gastric mucus secretion.

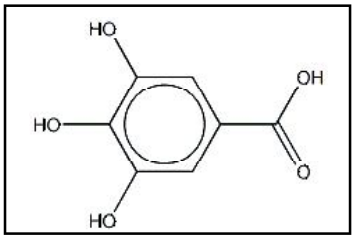
- **Unhealthy lifestyle:** Limited or no physical activity slows down digestion and other metabolic processes, leading to a decrease in the number of beneficial bacteria in the gut and an increase in the number of harmful microbes.
- **Stress:** High levels of stress disrupt the normal functioning of the intestines and contribute to various intestinal health problems.
- **Excessive sugar intake:** Diets rich in added sugar, such as processed foods and sweetened beverages, disrupt the balance of the gut microbiota and promote the growth of harmful bacteria.

2. Phytoconstituents present in banana

2.1 Phenolic compounds

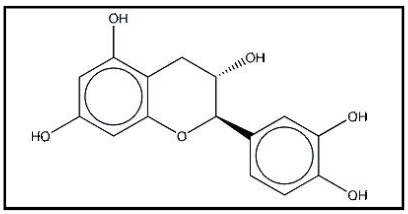
a. Gallic acid

- **IUPAC Name:** 3,4,5-Trihydroxybenzoic acid
- **Chemical formula:** $C_7H_6O_5$
- **Structure:**



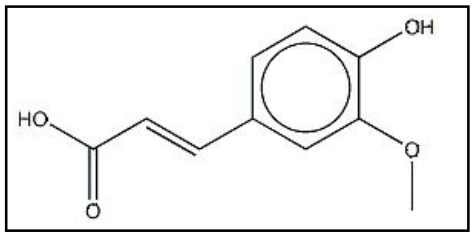
b. Catechin

- **IUPAC Name:** (2*R*,3*S*)-2-(3,4-Dihydroxyphenyl)-3,4-dihydro-2*H*-chromene-3,5,7-triol
- **Chemical formula:** $C_{15}H_{14}O_6$
- **Structure:**



c. Ferulic acid

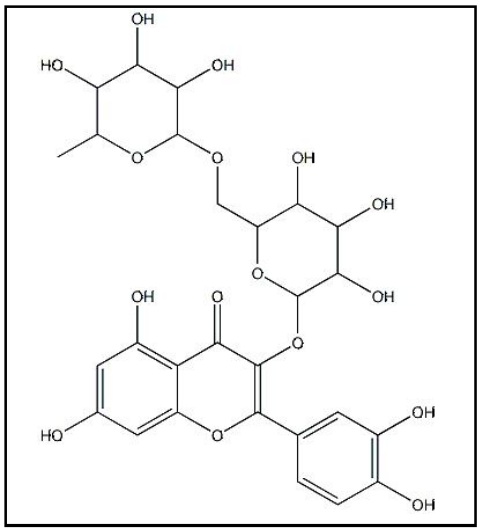
- **IUPAC Name:** (2*E*)-3-(4-hydroxy-3-methoxyphenyl) prop-2-enoic acid
- **Chemical formula:** $C_{10}H_{10}O_4$
- **Structure**



2.2 Flavonoids

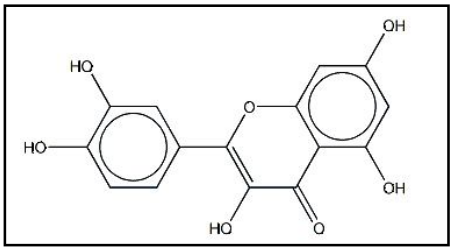
a. Rutin

- **IUPAC Name:** 32 ,42 ,5,7-Tetrahydroxy-3-[α-L-rhamnopyranosyl-(1-6)-β-D-glucopyranosyloxy] flavone
- **Chemical formula:** $C_{27}H_{30}O_{16}$
- **Structure**



b. Quercetin

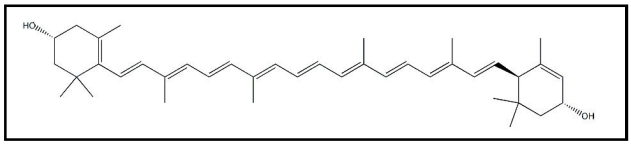
- **IUPAC Name:** 3,32 ,42 ,5,7-Pentahydroxyflavone
- **Chemical formula:** $C_{15}H_{10}O_7$
- **Structure**



2.3 Carotenoids

a. Lutein

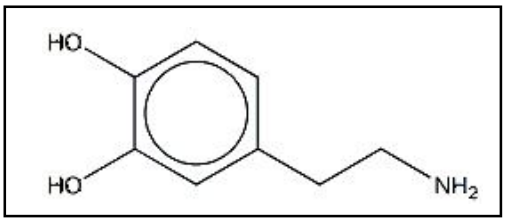
- **IUPAC Name:** (3*R*,6*R*,32 *R*)-β, ∑-Carotene-3,32 -diol
- **Chemical formula:** $C_{40}H_{56}O_2$
- **Structure**



2.4 Biogenic amines

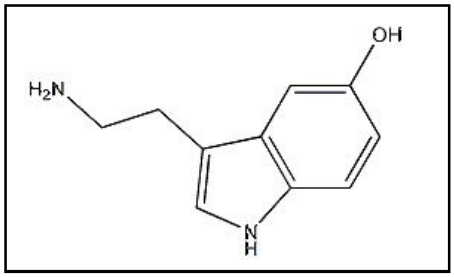
a. Dopamine

- **IUPAC Name:** 4-(2-Aminoethyl) benzene-1,2-diol
- **Chemical formula:** $C_8H_{11}NO_2$
- **Structure**



b. Serotonin

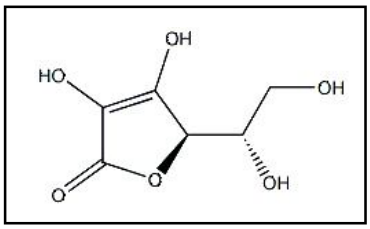
- **IUPAC Name:** 3-(2-Aminoethyl)-1*H*-indol-5-o
- **Chemical formula:** $C_{10}H_{12}NO_2$
- **Structure**



2.5 Vitamins

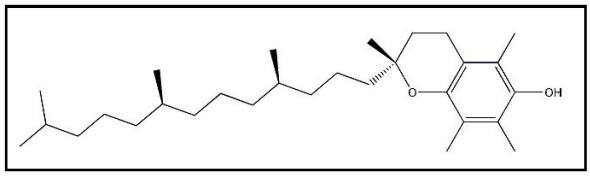
a. Vitamin C (Ascorbic acid)

- **IUPAC Name:** l-*threo*-Hex-2-enono-1,4-lactone
- **Chemical formula:** $C_6H_8O_6$
- **Structure**



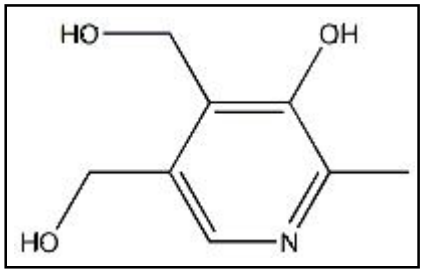
b. Vitamin E (Tocopherol)

- **IUPAC Name:** (2*R*)-2,5,7,8-Tetramethyl-2-[(4*R*,8*R*)-4,8,12-trimethyltridecyl]-3,4-dihydro-2H-1-benzopyran-6-ol
- **Chemical formula:** $C_{29}H_{50}O_2$
- **Structure**



c. Vitamin B6 (Pyridoxine)

- **IUPAC Name:** 4,5-bis(hydroxymethyl)-2-methylpyridin-3-ol
- **Chemical formula:** $C_8H_{11}NO_3$
- **Structure**



3. Health benefits and therapeutic potential of banana

- **Antioxidant activity:** Research has shown that antioxidants in the diet play an important role in reducing the risk of diseases like diabetes, cancer and cardiovascular disorders (Ohtani, 2020). The extract obtained from banana flowers can be used as a rich source of antioxidants in food applications. These extracts contribute to preventing oxidative reactions, protecting the integrity of DNA and preventing cardiovascular problems (Ramu *et al*., 2017; Das and Dhua, 2021; Revadigar *et al*., 2017).
- **Antidiabetic activity:** Inhibition of enzymes responsible for carbohydrate breakdown is commonly used in drug research as a marker of antidiabetic potential. Banana inflorescence contains

isolated components that exhibit varying levels of α-amylase and α-glucosidase inhibition.

- **Anticancer activity:** Research shows that extracts derived from banana inflorescences exhibit potential anticancer activity against various human cancer cell lines. Among them, two colorectal cancer cell lines, HT29 and HCT116, showed particular sensitivity to the ethanol extract of the inflorescence compared to other cancer cells (Revadigar *et al*., 2017; Arun *et al*., 2018; Nadumane and Timsina, 2014).

  Notably, these extracts displayed low toxicity towards human umbilical vein endothelial cells, indicating a high degree of selectivity of the active compounds. The exact molecular mechanisms underlying the toxic effects of banana inflorescence are still unclear. Preliminary evidence points to apoptosis as a possible mode of cell death (Nadumane and Timsina, 2014). In experiments with HT29 cells, ethanol extracts induced morphological changes characteristic of apoptotic cell death, such as loss of cell-to-cell adhesion, membrane blebbing, and cell shrinkage.

- **Antimicrobial activity:** Several studies have investigated the phytochemical components and antimicrobial properties of banana peels, with the aim of using this waste material in the management of microbial infections. These studies highlight banana peel as a potential alternative to synthetic drugs, as its phytochemicals are generally considered safe and free of toxic side effects and environmental risks. The study results of Lino *et al*. (2011) showed that the tannins in banana peel extract exhibit antimicrobial effects through their astringent properties and ability to precipitate proteins, which can interfere with the peptidoglycan of bacteria. As a result, aqueous extracts of banana peels exhibit inhibitory activity against gram-positive bacteria (Hikal *et al*., 2022). It has been proven by many studies that banana peel has antimicrobial properties. Ighodaro (2012) observed that banana peel extract showed inhibitory activity against *Staphylococcus aureus, Escherichia coli* and *Proteus mirabilis*.

- **Other biological activity:** In addition to the biological activities discussed earlier, other health benefits of banana inflorescence have also been reported, like managing enlargement of the prostate gland and improving urinary disorders (Su and Lin, 2018). Banana panicle extract also has antibacterial properties, showing activity against both Gram-positive and Gram-negative bacteria (such as *Bacillus cereus, Bacillus subtilis*, and *Staphylococcus aureus*) and gram-negative bacteria (including *Escherichia coli, Salmonella typhimurium,* and *Pseudomonas aeruginosa*), as well as some pathogenic fungi, such as *Cryptococcus albidus* and *Candida albicans* (Ramu *et al*., 2017; Jawla *et al*., 2012; Tin *et al*., 2015).

4. Taxonomical classification of banana

Kingdom: Plantae

Phylum: Angiosperms

Class: Liliopsida

Order: Zingiberales

Genus: *Musa*

Species: *acuminata*

5. Uses of banana in different medicine systems

5.1 Ayurveda medicine system

In the science of Ayurveda, foods are evaluated according to their taste (rasa), potency (virya), post-digestive results (vipaka) and their effect on the three doshas, vata, pitta and kapha. Banana is characterised by sweet taste (madhura rasa), cooling potency (sheeta virya), and sweet effect after digestion (madhura vipaka). Due to these properties, bananas help pacify Vata and Pitta doshas, while they can aggravate Kapha dosha. These Ayurvedic properties are responsible for the various medicinal benefits associated with banana consumption.

a. Ayurvedic classification

- **Rasa (Taste):** The taste of ripe bananas is predominantly sweet (madhura ras), while the taste of unripe bananas is astringent (kashaya ras). These tastes affect the balance of the doshas. Sweetness nourishes the tissues and calms vata, while the astringent property of raw banana helps reduce excess secretions and is beneficial in conditions like diarrhoea.

- **Virya (Potency):** Banana has a cooling effect (sheet virya), which helps in calming the pitta dosha by reducing heat, inflammation and acidity. However, in people who have a weak digestive fire or a predominance of kapha, this coolness can cause slow digestion or constipation.

- **Vipaka (Postdigestive effect):** Banana has a sweet post-digestive effect (madhura vipaka), which allows it to have nutritional and tissue-building effects even after digestion. This property helps in building ojas, which is essential for maintaining immunity and overall vitality.

b. Dosha effects: The effect of banana on doshas varies according to its level of ripeness.

- **Effects of ripe banana:** Ripe bananas help balance vata and pitta doshas, but can aggravate kapha due to their heavy and moist nature. These are most beneficial for individuals with a predominance of vata or pitta, especially when consumed with digestive spices or ghee.

- **Effects of unripe banana:** Unripe bananas have more astringency and lightness, making them effective in balancing kapha and pitta. These help reduce excess secretions, solidify loose stools and are useful in conditions like diarrhoea and dysentery. However, their dry nature can aggravate Vata dosha if not combined with warming or moisturising substances.

5.2 Unani medicine system

In Unani medicine, banana is known as mauj, and it is valued for its nutritional and medicinal properties and is commonly used as a dietary supplement to maintain health. According to Unani principles, banana has a cooling and moist nature (barid ratab), which makes it especially useful in conditions related to excessive heat and dryness in the body. Due to this nature, bananas are considered beneficial in calming safra (yellow bile) and reducing gastric irritation and acidity. Banana is described as a nutritious and energising food (muqawwi-e-badan) that helps improve body weight, energy levels and general vitality. It is often recommended for those experiencing weakness, debility, or recovering from illness. This fruit is also known for its

mild laxative properties, which, when consumed in moderation, can help regulate bowel movements and relieve constipation.

Bananas are an inexpensive food item that is a rich source of energy due to their high starch content. This fruit has two main parts (Figure 9): the pulp, which is the edible part, and the peel, which is usually considered an agricultural by-product (Kritsi *et al*., 2023).

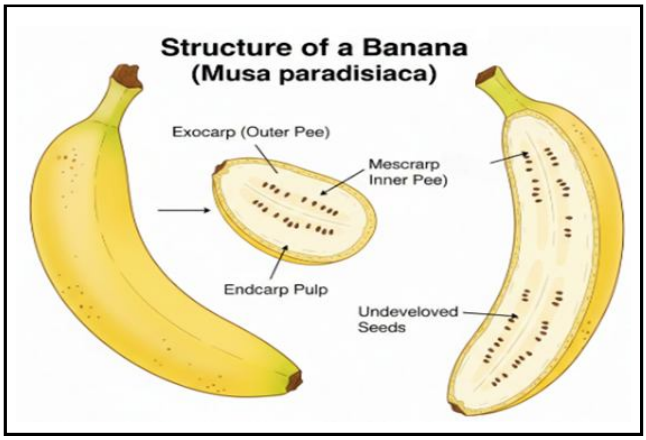


Figure 9: Structure of a banana.

In digestive disorders, bananas have traditionally been used to soothe the stomach lining and aid digestion. Its soft texture and soothing nature make it useful in managing conditions like gastritis and intestinal irritation. However, due to its moist and heavy nature, excessive consumption can cause phlegmatic imbalance, leading to slow digestion or flatulence, especially in individuals with weak digestive power. Therefore, Unani physicians often recommend consuming bananas with a fixative (musleh) such as honey or warm spices to improve digestion.

5.3 Siddha medicine system

In the Siddha system, banana (vazhai/vazhaipazham) is valued for its nourishing and cooling properties, which help balance the three doshas vata, pitta and kapha. Its cooling effect is especially beneficial in reducing bile-related problems such as acidity, inflammation and heat-related disorders.

Bananas are considered to be energising and easily digestible, making them suitable for children, the elderly, and those recovering from illness. Ripe bananas aid digestion and regular bowel movements, while unripe bananas and banana stems are used for their astringent effects in diarrhoea, dysentery, and bleeding disorders. Banana flowers are also used in treating metabolic and urinary diseases. However, excessive consumption of ripe bananas can aggravate constipation, leading to heaviness or indigestion, so it is often recommended to consume them with warming or as part of a balanced diet. There are many products available in the market that include banana as a nutritional ingredient (Table 3).

Table 3: Marketed formulation containing banana

S.No.	Chemical composition	Brand name	Company name
1.	Dehydrated nendran banana powder	Traditional baby vita	Best India Food Processing (P) Ltd.
2.	Banana fruit extract, gelatin capsule shell, Plant cellulose	Bloofah banana capsule	Bloofah
3.	Raw banana powder	Raw banana powder	Nutribud Foods Pvt. Ltd.
4.	Red banana powder	Red banana malt	HK foods
5.	Banana	Banana powder capsule	Era foods

6. Conclusion

Bananas are a valuable functional food that promotes gut health by improving digestion, microbial balance, bowel motility, and mucosal protection. They are rich in fiber, resistant starch, vitamins, minerals, and bioactive compounds, which help in managing gastrointestinal diseases and provide antioxidant, antimicrobial, and metabolic benefits. Traditional medical systems further reinforce their therapeutic importance, highlighting bananas as a safe, affordable, and effective dietary remedy for promoting overall health.

Availability of data and material

All data are provided within the manuscript.

Authorship contribution statement

Md. Hasheem Khan: Contributed to conceptualization, methodology design, data curation, and writing the original draft of the manuscript. **Aamir Imam**: Contributed to software handling. **Ijlal Husain**: Contributed to data collection. **Khushi Mishra**: Contributed to supervision and visualization of data presentation. **Badruddeen**: Contributed to conceptualization and critical review of the manuscript. **Mohammad Irfan Khan**: Contributed to project administration, validation, and final manuscript approval. **Juber Akhtar**: Contributed to resources, formal analysis, and manuscript proofreading. **Mahboobus Salam and Mohammad Ahmad:** Contributed to the literature review, data organization, and editing of the final draft.

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