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Phytochemical and Pharmacological study of musa sapientum

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Abstract:
The exploration of banana peels has garnered significant interest among researchers owing to their rich composition of bioactive chemicals. This review article specifically delves into the anti-ulcer activities exhibited by banana peels, underscoring their potential as natural antioxidants and as a viable option for pharmaceutical purposes in the treatment of various diseases. Bananas, classified under the genus Musa (Musaceae), are cultivated in tropical and subtropical regions and are widely recognized as an edible fruit.Peptic ulcer disease (PUD), encompassing both gastric and duodenal ulcers, stands out as one of the most prevalent gastrointestinal disorders. The existing challenges in treating peptic ulcers are attributed to the limited efficacy and severe side effects associated with currently available drugs. Recognizing this, the review emphasizes the effectiveness of Musa sapientum peel, a component of herbal medicine, in the treatment of peptic ulcers.Flavonoids, identified as the most abundant polyphenols in plants, emerge as key contributors to the observed gastroprotective effects against peptic ulcers, both in vivo and in vitro. These compounds demonstrate cytoprotective and rehabilitative effects by enhancing defense factors, such as mucus and prostaglandins, while concurrently safeguarding against potentially harmful factors through their antioxidative, anti-inflammatory, and antibacterial activities.In the context of the prevailing challenges associated with conventional drugs, the exploration of indigenous alternatives like Musa sapientum, characterized by fewer side effects, becomes the focal point of this review. The ultimate goal is to present a more effective and safer approach for the management of peptic ulcer disease. The study is poised to contribute to a comprehensive understanding of the chemical composition of banana (Musa sapientum) peel, shedding light on its potential applications in the realm of healthcare and herbal medicine.

Keywords: **Anti-ulcer, *Musa sapientum* ,Flavonoids, Banana peel.**

INTRODUCTION:

In tropical and subtropical locations, bananas (Musa spp., Musaceae family) are one of the principal fruit crops grown for their edible fruits. The average fruit weighs 125 grams, of which 25% is dry substance and 75% is water. When ripe, banana fruits come in a variety of sizes and hues, including red, purple, and yellow. A banana's peel, or outer shell, is its fruit.It is a byproduct of processing bananas and domestic use.[1,2] Banana peels are either thrown away after consumption or utilized as fertilizer or animal feed.[3] Banana peel exhibits a variety of properties and has long been utilized in traditional medicine. Peelings from bananas are used as a natural cure for wounds and ailments like depression. Through cultural diversity, banana byproducts have been utilized more widely to wrap food, clothing, and other items during festivities.[4] Although flavonoids are primarily responsible for these plants' therapeutic qualities, other organic and inorganic substances such coumarins, alkaloids, terpenoids, tannins, phenolic acids, and antioxidant micronutrients like copper, manganese, and zinc may also have an impact.[5]Antioxidants may be extracted from banana peels, which is a wonderful approach to minimize waste because bananas are mostly used as food seasonings or to make essential oils. Crushed leaves and bark of the plant have an energetic flavor that turns sharp.[6] Phenolic acids, phenylpropanoids, flavones, flavonols, anthocyanins, and tannins can all be found in different concentrations in plant materials.The goal of this research is to increase the production of extracts in the form of bioactive components from fruit and vegetable waste by refining the methods that use ultrasonic and microwave assistance.[7.8] Banana peels contain a wealth of phytochemical substances that have pharmacological properties including antibacterial, antifungal, antioxidant, antiulcer, and anticancer properties.[9]The goals of peptic ulcer treatment include pain relief, ulcer healing, and averting complications. The treatment options for peptic ulcers have changed significantly with the introduction of proton pump inhibitors (PPIs) like omeprazole, lansoprazole, pantoprazole, esomeprazole, and rabeprazole, as well as histamine (H2)-receptor antagonists like famotidine, cimetidine, and nizatidine for the management of peptic ulceration. 10The fundamental C6-C3-C6 backbone structure of all flavonoids allows for their classification into 13 subgroups based on various substituents (Figure 1). Among these, flavonols, flavones, isoflavones, flavanones, flavanols, and anthocyanidins are particularly well-studied.[11]Peptic ulcer is a sore that forms in the lining of the stomach or the duodenum. A peptic ulcer is caused by an imbalance between the function of the mucus-bicarbonate barrier, surface active phospholipids, prostaglandins (PGs), mucosal blood flow, cell renewal and migration, nonenzymatic and enzymatic antioxidants, and certain growth factors, and some endogenous aggressive factor(s) [hydrochloric

acid, pepsin, refluxed bile, leukotrienes, reactive oxygen species (ROS)].[12] Flavonoids have anti-ulcer properties that include suppressing the production of acids, raising gastric mucus and bicarbonate secretion, and inhibiting the activity and level of pepsin. Flavonoids Regulate Gastric Secretion Pathways to Exert Anti-Ulcer Effects.[13]Here, we comprehensively searched reports have been conducted and proved that banana peel possesses medicinal properties like other parts of the banana plant.

1. Banana peels: The outer layer or cover of a banana fruit is called a banana peel. It is a byproduct of processing bananas and domestic use.[14] It is used as animal food. However, there are some concerns regarding the impact of tannin in the husks on the animals that ingest them.[15]. In addition, banana peels are utilized as a component in food preparation, water filtration, the synthesis of numerous biochemical products, and the generation of inorganic waste. Peels from banana bananas are occasionally fed to fish, zebras, poultry, goats, primates, and other animals.[16] A graphical outline of the present review is presented in figure1.

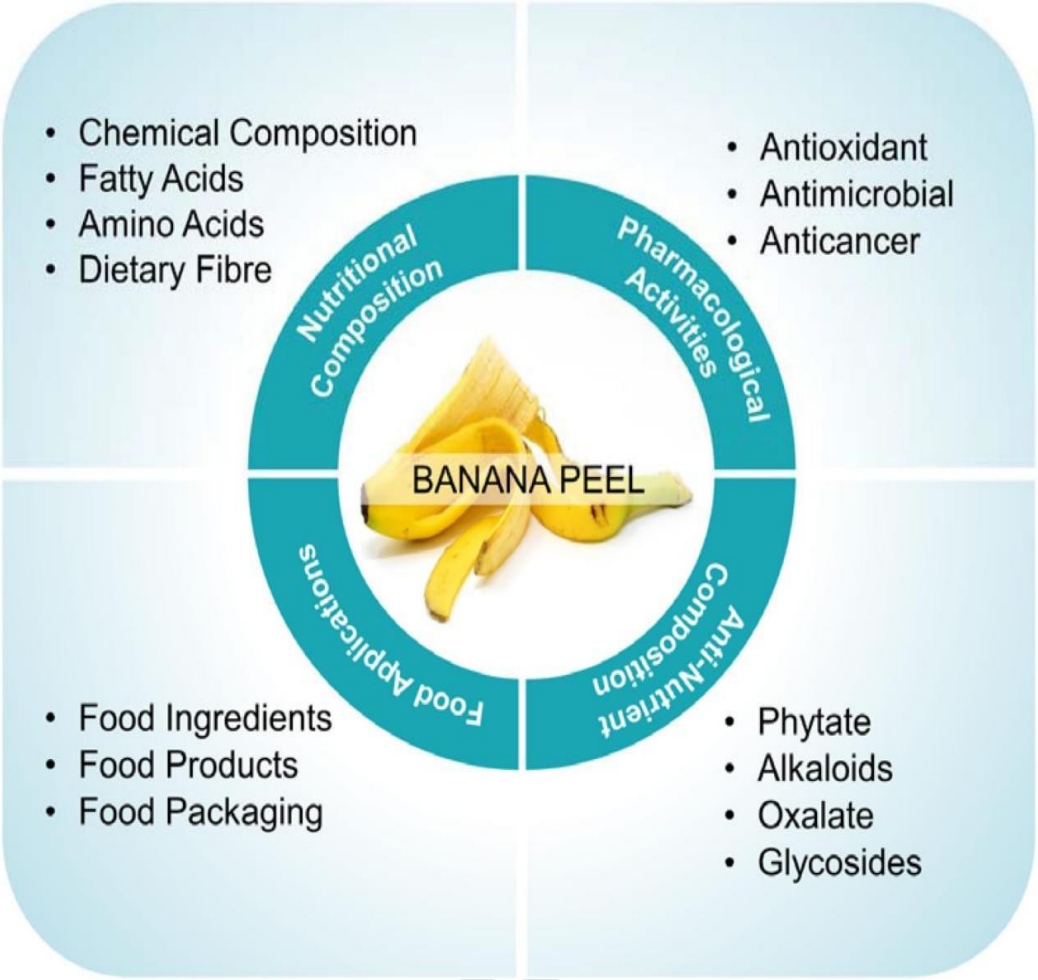

Figure1. Graphical outline of the present review

Chemical composition of banana peel

Banana peels (Musa sapientum) have been demonstrated to contain a variety of nutrients and minerals. They found crude proteins in the amount of 1.95 ± 0.14%, crude fat 5.93 ± 0.13%, and 11.82 ± 2.17% carbohydrate in the banana peel. Banana peels contained the following minerals: sodium, calcium, magnesium, iron, and phosphorus. Manganese, copper, zinc, and potassium were discovered in extremely low amounts of mg/100 g.[17]

Primary metabolites found in banana peels include 50% dietary fiber, 7% crude proteins, and 10% crude fat. 3% starch, essential amino acids (leucine, phenylalanine, threonine, and valine), and polyunsaturated fatty acids (linoleic acid, α-linoleic acid), micronutrients (calcium, iron, magnesium, potassium, zinc [18]. It also contains 10-20% pectin, 6-12% lignin, cellulose 7-9%, 6-9% hemicellulose. The peel of bananas is a rich source of several phytochemical substances. (Table 1)

Table1 Phytochemical compounds present in banana peel

Sr.no	Phytochemical compounds	Concentration
1	Phenolic compounds	0.9-3g/100g
2	Gallocatechin	160mg/100g
3	Anthocyanins	-
4	Carotenoids	300-400mg/100gm
5	Sterols and triterpens	-

The phenolic compounds amount found in the banana peel (*Musa acuminata* Colla AAA) range from 0.9 to 3.0 g/100 g dry weight.[19] On the other hand, carotenoids have been identified in the banana peel, such as *β*-carotene, *α*-carotene, and various xanthophylls, in the range of 300–400 *μ*g lutein equivalent/100 g [20].Also, Anal et al.attained flavonoid (196 mg/g quercetin equivalent) from the banana peel extract. In the study of Behiry et al. , they achieved and identified rutin with a high amount (973.08 mg/100 g dry extract, *Musa paradisiaca*).[21] Plantain banana peel flour contains a total phenol level of 7.71 mg GAE/g and includes ferulic acid (0.38%) and caffeic acid (0.06%), as phenolic compounds identified in banana peel extract.[22] Figure 2 shows the chemical compounds of banana peels.

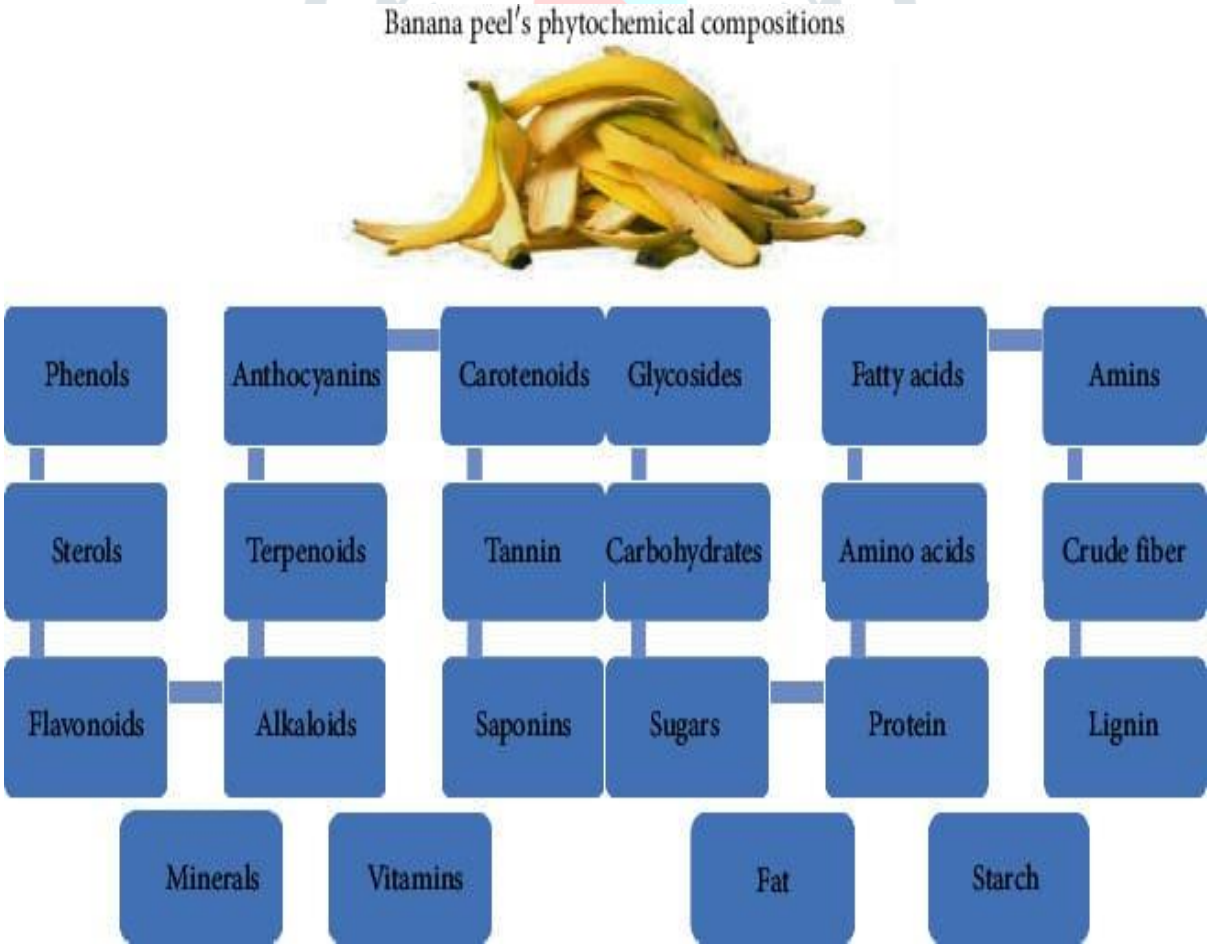

Figure 2: The chemical components of banana peel

Pharmacological activities of banana peel

Banana peels contain a wealth of phytochemical substances that have pharmacological properties including antibacterial, antifungal, antioxidant, antiulcer, and anticancer properties.

Anti-ulcer activity of banana peel

The category of upper gastrointestinal tract disorders known as Peptic Ulcer Disease (PUD) are characterized by mucosal erosion that is more than or equal to 0.5 cm and is brought on by the erosive action of pepsin and acid.a sore that appeared on the stomach, small intestine, or esophageal lining.Gastric and duodenal ulcers are the most prevalent types. .[23] Simply said, ulcers are lesions that pierce the mucosa of the gastrointestinal tract (G.I.T). Therefore, when aggressive factors like increased HCL and pepsin secretion, parietal cell mass, and gastrin generation outweigh defensive factors like PGs and enlarged mucous cells, the etiology of gastro-duodenal (peptic) ulcer develops.[24.]

- Factors invovled in the pathogenic and recurrence of PUD
- Overproduction of pepsin and acid
- Gastrointstinal infection by Helicobacter pylori , a gram-negative spiral bacterium
- Chronic usage of ulcer-causing medications, such as nonsteroidal anti-inflammatory drugs (NSAIDs) like indomethacin and aspirin, etc.
- Cigarette smoking
- Alcohol consumption
- Family history

A peptic ulcer is a lesion that develops in the duodenum or stomach lining. A peptic ulcer results from an imbalance in the functions of the mucus-bicarbonate barrier, prostaglandins (PGs), mucosal blood flow, enzymatic and nonenzymatic antioxidants, cell renewal and migration, some growth factors, and some endogenous aggressive factor(s) [pepsin, leukotrienes, reactive oxygen species (ROS), hydrochloric acid, refluxed bile, and leukotrienes].[25]The prospect of creating novel anti-ulcer medications by the isolation of various chemical compounds with anti-ulcer properties from medicinal plants is appealing, as these compounds have demonstrated encouraging outcomes in the management of gastric ulcers.[26,27]

The bioactive compounds (usually glycosides, alkaloids, lupeols, essential oils, etc.) that are extracted from crude extracts are either employed directly as medicinal agents or as building blocks to synthesize effective medications, or they function as models for pharmacologically active compounds during the drug-synthesis process.[28]

Fruits of the *musa sapientum* plant have been shown to prevent a number of illnesses. Green, unripe It has been observed that *Musa sapientum* protects rats' stomach mucosa from damage.[29] It has an effect on the healing of the ulcer.[30] Herbal medications are commonly given due to their efficiency, few side effects, and affordable price, even in cases when the biologically active components are unknown.[31] Flavonols are the most abundant class of phenolic compounds found in the peel of plantian cultivars.Table 2 depicts some of the major identified phenolic compounds in the banana peel.[32]

Table 2, Found phenolic chemicals in the peel of bananas.

Phenolic compounds	Banana peel	Quantity
Flavanols:		
kaempferol	Red banana	28.80 µg/ml
	Yellow banana	9.30 µg/ml
Isoquercitrin	Red banana	14.54 µg/ml
	Yellow banana	10.47 µg/ml
Rutin	M. paradisica	973.08 mg/100g
Myricetin	M.paradisica	11.52mg/100g
Hydorxycinnamic acids:		
Ferulic acid	M.paradisica	1.63mg/100g
Cinnamic acid	Karpooravalli(ABB)	1.93ng/g
Alpha-hydroxycinnamic acid	Karpooravalli(ABB)	40.66ng/g
Sinapic acid	Karpooravalli(ABB)	10.29ng/g
P-Coumaric acid	Karpooravalli(ABB)	8.05ng/g
Catecholamine:		
Dopamine	Grande Naine(AAA)	1.72mg/g
Dopamine	Gruesa(AAA)	1.17mg/g
L-Dopa	Grande Naine(AAA)	0.31mg/g
L-Dopa	Gruesa(AAA)	0.56mg/g

Extraction Of Flavonoid Content[33-34]

1) Prepration of powder:-

Using a hot air oven, the banana peels were chopped into small pieces and dried for 48 hours at 50 °C. Using a blender, the dry materials were ground into a powder and stored in a vacuum aluminum bag at 4 °C until needed.

2) Extracts yield from banana peels:-

Using microwave and ultrasonic extraction at 40, 50, and 60 °C, 100 ml of 95% (v/v) ethanol was used to extract the powdered samples (5 g). For the microwave (CRS Concave Reflex System, DAOVOO KOR-6327 Model) and ultrasonic (Cole-Palmer Instrument Company Limited, Germany), the extraction times were 10, 15, 20 min and 30, 60, 90 min, respectively. With

whatman no. 1 filter paper, the solutions—which contained extracts and solvents—were filtered. After that, the solvents were evaporated at 50 °C under 100 mbar using a rotary evaporator (BUCHI R-144V, Germany).

Following an exact weighing of the dried extract, the extract yield was computed and given as the proportion of crude extract to raw materials:

Extract yield (%) = (g of extract / g of dried samples)*100

3)Total phenolic contents of extracts from banana peels:-

As per Singleton et al. (1999), the Folin–Ciocalteu technique was employed to ascertain the total phenolic contents. [33]diluting an aliquot of the extract (100 µL) with 5 ml of distilled water, 250 µL of newly made Folin-Ciocalteu reagent was added. One milliliter of ten percent (w/v) sodium carbonate in ultrapure water was added and thoroughly mixed after five minutes of incubation at room temperature (21 °C). Following a 20-minute room temperature standing period, the mixes' absorbance at 760 nm was measured in comparison to the blank. As a standard, the phenolic content was reported in milligrams of gallic acid.

4)Flavonoid contents in the extracts from banana peels

With minor adjustments, the flavonoid content was assessed using the methodology outlined by Meda et al. (2005).[34] After diluting an aliquot of the extract solution (100 µL) with 5 ml of ultrapure water, 300 µL of 5% sodium nitrite was added. Following a 5-minute incubation period at room temperature, 300 µL of aluminum trichloride (10% w/v) that had been solubilized in ethanol was added. The mixture was allowed to sit at room temperature for six minutes. Subsequently, four milliliters of 0.1 M sodium hydroxide and four milliliters of ultrapure water were added. The absorbance at 415 nm was then measured using a UV-vis spectrophotometer against a blank sample, which was the combination solution devoid of sample extracts. To measure the flavonoid levels, quercetin was employed as a reference at varying doses (0–0.30 mg/ml).

Detection of Flavonoids:-

Magnesium ribbon and a few drops of concentrated HCL were added to 2ml of extracts in a test tube; pink or red colors indicate the presence of flavonoids.[35]

Anti-Ulcer Mechanisms of Flavonoids

A peptic ulcer is produced by an imbalance in gastrointestinal defensive factors, such as prostaglandins, mucus, and bicarbonate, and potentially damaging elements, such as pepsin, acid, and H. pylori infection. (Figure 3). Flavonoids have anti-ulcer properties such as reducing acid secretion, inhibiting pepsin level and activity, and enhancing stomach mucus and bicarbonate secretion. Furthermore, flavonoids strengthen mucosal cytoprotective, antioxidant, anti-inflammatory, and antibacterial defenses against peptic ulcers. Typically, one type of flavonoid can provide anti-ulcer functions through several mechanisms.[36]

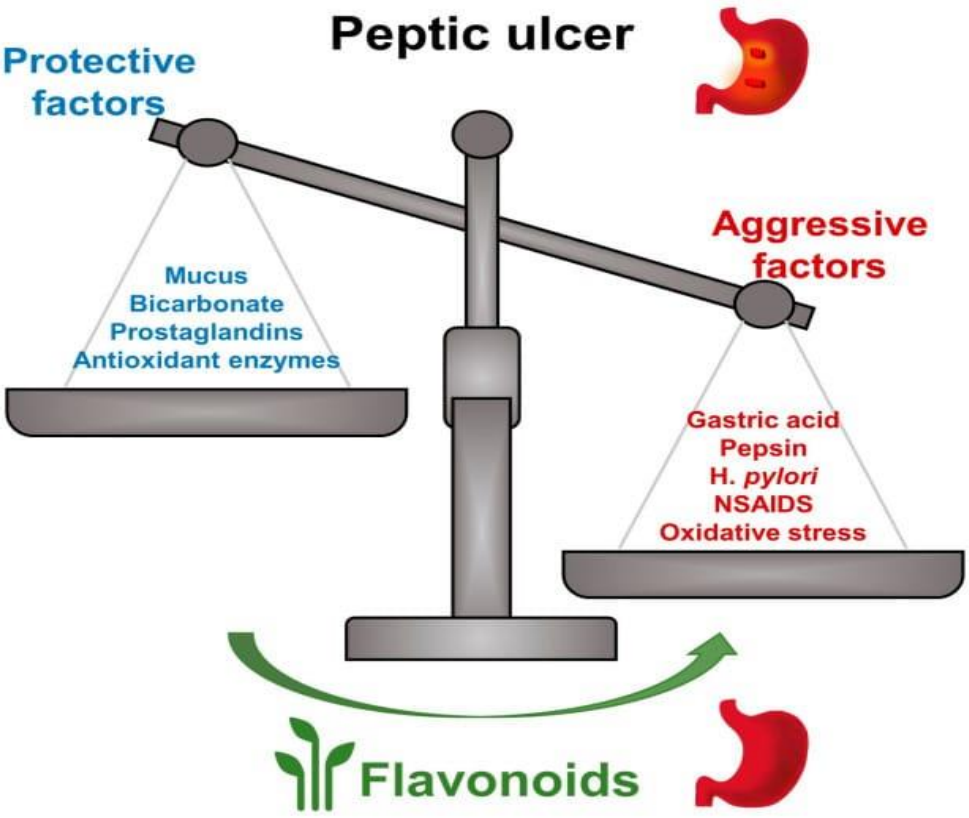

Figure 3. By bringing protective and aggressive elements into balance, flavonoids have anti-ulcer actions. By bolstering protective factors like mucus, bicarbonate, prostaglandins, antioxidant enzymes, etc. and opposing aggressive forces like stomach

acid, pepsin, H. pylori, non-steroidal anti-inflammatory medicines (NSAIDs), oxidative stress, etc., flavonoids exhibit anti-ulcer properties.

A)Flavonoids Exert Anti-Ulcer Effects by Regulating Gastric Secretion Pathways

The stomach typically secretes a variety of substances, such as gastric mucus, pepsin, and acid. Gastric mucus shields the epithelial cells from harm caused by gastric acid and pepsin, while stomach acid and pepsin aid in the digestion of food that has been consumed (Figure 4). Nonetheless, a high gastric acid concentration exacerbates peptic ulcer mucosal damage.[37]

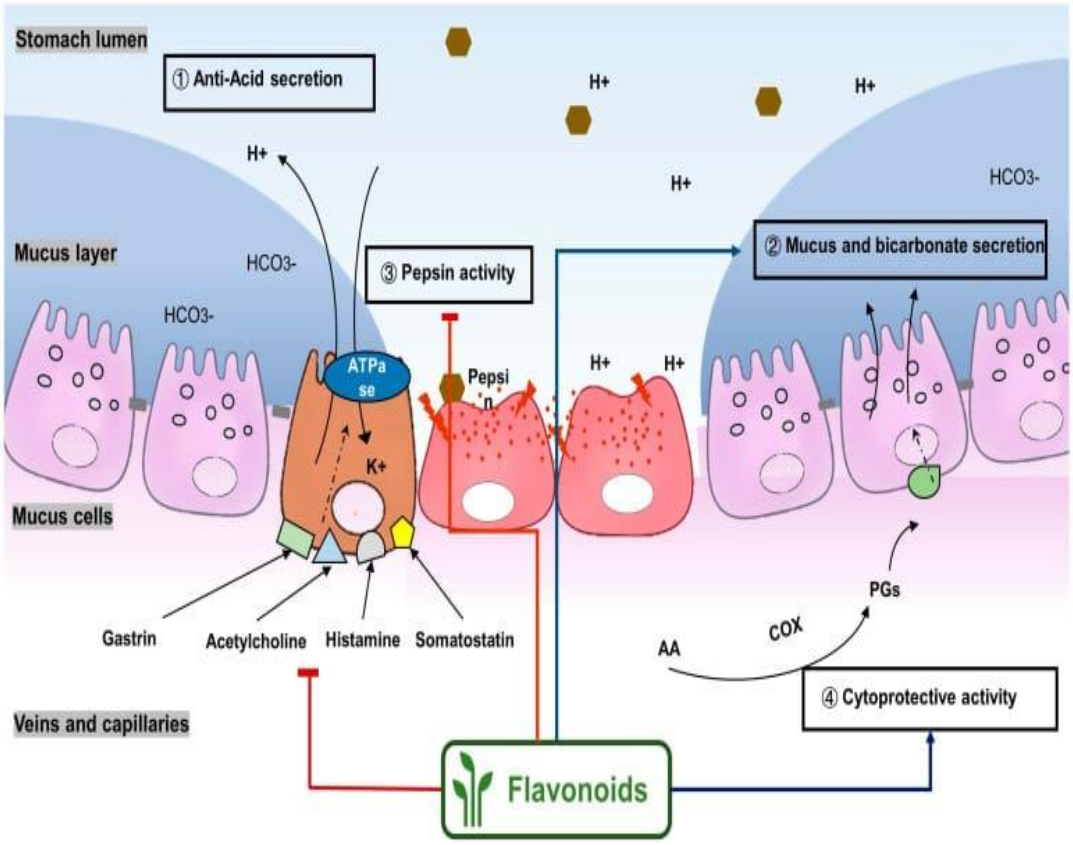

Figure 4. Flavonoids prevent ulcers via modulating stomach secretory routes and prostaglandin levels. Flavonoids (1) reduce acetylcholine, gastrin, histamine, and somatostatin levels while reducing H+K+-ATPase activities, hence limiting gastric acid secretion; (2) enhance mucus and bicarbonate secretion; (3) inhibit pepsin activity; and (4) have cytoprotective effect at the prostaglandin level.

As a result, inhibiting excessive stomach acid output is critical for treating peptic ulcers. Gastrointestinal hormones control the secretion of stomach acid. Acetylcholine, gastrin, and histamine are the primary hormones that cause parietal cells to release acid. Somatostatin also reduces acid secretion and imposes a tonic restriction on parietal, enterochromaffin-like, and gastrin cells by acting on sst2 receptors. [38] More significantly, a proton pump in the parietal cell membrane called H+K+ATPase catalyzes H+ transfer during the last stage of stomach acid secretion at the price of ATP hydrolysis.[39]

Conclusion

The review was focused on the, the phytochemical and pharmacological study of banana peel has revealed a rich source of bioactive compounds with potential health benefits. The presence of diverse phytochemicals such as polyphenols, flavonoids, alkaloids, and other secondary metabolites highlights the therapeutic potential of banana peels. These compounds exhibit various pharmacological activities, including antioxidant, anti-inflammatory, antimicrobial, anticancer, and anti-diabetic properties.

The utilization of banana peels in traditional medicine and the growing interest in natural remedies have spurred research into unlocking the full potential of this often overlooked waste product. The findings suggest that banana peels could be a valuable resource for developing novel therapeutic agents and functional foods. Additionally, the anti-inflammatory and antioxidant properties of banana peels may contribute to the prevention and management of chronic diseases.

However, it's important to note that further research is needed to fully understand the mechanisms of action, optimize extraction methods, and determine appropriate dosage forms for practical applications. Moreover, studies exploring the safety profile and potential side effects are crucial for the development of banana peel-derived products for human consumption.

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