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REVIEW ON ANTIULCEROGENIC ACTIVITY OF *MUSA SAPIENTUM* ON EXPERIMENTAL PEPTIC ULCERS IN RATS

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ABSTRACT

Musa sapientum which is commonly called Banana is an herbaceous plant of the family Musaceae. It is extensively cultivated throughout India.By literature survey different parts of *Musa sapientum* and also the aqueous and methanolic extract of *Musa sapientum* have been studied for antiestrogenic, hypolipidemic, antihypertensive, wound healing, antacid, hypoglycemic, diuretic and antiulcerogenic activities. The pill and stem extract of banana was found to have antiulcerogenic activity. But there is no evidence in literature for antiulcerogenic activity of *Musa sapientum*(unripe).Hence the present investigation was undertaken to study antiulcerogenic activity of ethanolic extract of unripe *Musa sapientum*(EEMS) on experimental peptic ulcers in rats.

KEYWORDS: *Musa sapientum*, EEMS, antiulcerogenic, diuretic, hypoglycemic.

INTRODUCTION

The stomach is a remarkable organ. The stomach, intestines and digestive glands secrete gastric juice that can digest the various foods, but it seldom digest itself (Davenport,1972). A number of autacoids mediate the resistance of the stomach lining to injury. Peptic ulcers are a common disorder of GIT (Mayty P et al., 2003). They occur mainly in the stomach and the proximal duodenum. They can also occur in the esophagus, jejenum and gastro anastomotic site. A peptic ulcers results from an imbalance between some endogenous aggressive factors include hydrochloric acid, pepsin, refluxed bile, leukotrienes, reactive oxygen species(ROS) and cytoprotective factors include mucus-bicarbonate barrier, surface active phospholipids,

prostaglandins, mucosal blood flow, cell renewal and migration,Non-enzymatic and enzymatic antioxidants and some growth factors.

Oxygen derived free radical reactions have been implicated in the pathogenesis of many human diseases like neurodegenerative disorder, ischemic heart disease, inflammation, diabetes and also peptic ulcer (Bafna and Balaraman, 2005). Reactive oxygen species (ROS) may cause gastric damage by altering physical, chemical, psychological factors which results gastric ulceration in human and experimental animals. Increase in ROS and/or a decrease in antioxidant levels causes oxidative stress, which plays an important role in the pathogenesis of gastric ulcer (Tian *et al.,* 2007). The metabolism of arachidonic acid, platelets, macrophages and smooth muscle cells generates the ROS, this may contribute to gastric mucosal damage. Oxygen free radicals are detrimental to the integrity of biological tissue and mediate their injury. The mechanism of damage involves lipid peroxidation, which destroys cell membranes and also release the intracellular components such as lysosomal enzymes which are responsible for further tissue damage. The radicals also promote degradation of the epithelial basement membrane components and complete alteration in the cell metabolism leads to mucosal damage (Demir *et al.,* 2003).

Nonsteroidal anti-inflammatory drugs (NSAIDs) are widely prescribed anti-inflammatory drugs to relieve mild and moderate pain and fever. NSAIDs have analgesic and antipyretic effects and when used in higher doses, anti-inflammatory effects can be a source of metabolic stress. These drugs may uncouple oxidative phosphorylation and inhibit cyclooxygenase (COX) activity, and have been shown to induce a small bowel enteropathy with increased epithelial permeability in rats (Somasundaram *et al.,* 1997).

The main indications for NSAID use are osteoarthritis and rheumatoid arthritis. However, NSAIDs are generally prescribed for the symptomatic relief of many medical conditions including ankylosing spondylitis, headaches and migraine, postoperative pain and renal colic (Higuchi *et al.,* 2009). The widespread use of these drugs is associated with some complications and side-effects which have become increasingly prevalent. The major concern with this group of drugs is the frequency and severity of their gastrointestinal side effects.

More than 50% of patients taking NSAIDs have some mucosal damage in their small bowel (Higuchi *et al.,*2009). Chronic administration of NSAIDs is associated with gastroduodenal mucosal erosion, ulceration, hemorrhage and perforation (Suleyman *et al.,*2010). Mild

dyspepsia, peptic ulcer and severe complications such as bleeding and perforations have been reported in 1-4% of patients taking NSAIDs (Helsper *et al.*, 2009).

Currently, researchers are in the search for new drugs of plant origin with effective activity to fight several diseases that today present a limited treatment, including gastrointestinal ailments. In the case of gastric ulcers, several plant extracts described in the specific cultural context are being investigated in search for sources of effective biomolecules in reducing the damage to gastric mucosa.

Nearly 240 medicinal plants and 21 plants based compounds were identified as antiulcer worldwide so far .To save the natural population of medicinal plant, harvesting and usage of renewable parts like leaf, fruit is to be adapted. Plant extracts are some of the most attractive sources of new drugs and have been shown to produce promising results for the treatment of gastric ulcer.

Musa sapientum is used for the treatment of many disorders in traditional system of medicine. Its leaves can be used in the treatment of cough and bronchitis. Roots are used to arrest hemoptysis, as anthelmintic (Khare, 2007). The fruit of *Musa sapientum*is traditionally used in diarrhoea (unripe), dysentery, intestinal lesions in ulcerative colitis, diabetes (unripe), uremia, nephritis, gout, hypertension, cardiac disease (Khare, 2007). It contains antioxidizer and counteracts the noxious effects of the free radicals. It is used as antidote for snake bite, asthma, burns, diabetes, fever, gangrene, gout, head ache, hemorrhage, inflammation, insomnia, intestinal parasites, sores, syphilis, tuberculosis, ulcers and warts. It is also used in diarrhoea, stomachaches, lack of appetite, maintaining bones healthy, gastric ulcer, strengthening the immune system, reducing the risk of hypertension. Flowers are used in dysentery and menorrhagia (Ghani, 2003). Stem juice of fruited plant is used for treating diarrhoea, dysentery, cholera, otalgia, hemoptysis and blood disorders, venereal diseases (Ghani, 2003). The plant is also used in inflammation, pain and snake bite (Coe and Anderson, 1999).

Microparticles are attractive drug delivery systems because their large contact surface with biological membranes allows rapid absorption of the active ingredient. Furthermore, for oral administration they present a great resistance to gastrointestinal fluid flux and can be captured by peyer's patches.

Microencapsulation is the process of enclosing a substance inside a membrane to form a microcapsule. It provides a simple and cost-effective way to enclose bioactive materials within a semi-permeable polymeric membrane. Both synthetic/semi synthetic polymers and natural polymers have been extensively utilized and investigated as the preparation materials of microcapsules (Freemantle, 2005). Although the synthetic polymers display chemical stability, their unsatisfactory biocompatibility still limits their potential clinical applications (Coviello *et al*., 2007). Because the natural polymers always show low/non toxicity, low immunogenicity and thereafter good biocompatibility, they have been the preferred polymers used in microencapsulation systems. Among the natural polymers, alginate has become one of the most common materials used to form microcapsules (Gaserod *et al*., 1998). It was used in this study to encapsulate extract of *Musa sapientum* intended for management of peptic ulcer disease.

The need for developing gastro-retentive dosage formulations has led to efforts to develop novel drug delivery devices to prolong the release of bioactive drugs in order to increase the gastric residence time of the dosage form. Since most of the gastric drugs are easily degraded in gastric acid, resulting in a lower pharmaceutical function.To improve the therapeutic benefit of these drugs various strategies that are currently available for the development of formulations include the formation of floating tablets, mucoadhesive tablets, mucoadhesive beads, etc., in order to retain these in the gastrointestinal tract (GIT) for an extended time to offer increased effectiveness.

REVIEW OF LITERATURE

Peptic ulcers are erosions in the lining epithelium of the stomach (gastric ulcers) or the duodenum (duodenal ulcers). Ulcers are caused by *Helicobacter pylori* (H. *pylori*) bacteria, which are now recognized as the primary cause for most ulcers. The second most common cause of ulcers is long-term use of non steroidal anti-inflammatory drugs such as aspirin.

The present review of literature reveals the effect of oral administration of *Musa sapientum* and other medicinal plants on gastric acid secretion and healing of acute gastric ulcer induced by NSAIDs and other inducers in rats.

Mohammad Zafar Imam *et al.*, (2011) investigated *in vitro* antioxidant activity of edible fruit of *Musa sapientum L. ssp. sylvestris* (Family: Musaceae). It is used by the traditional healers in the treatment of diarrhoea and dysentery. In his study, the methanolic extracts of peel

(MSPE), pulp (MSPU) and seed (MSSE) of the fruit were investigated for *in vitro* antioxidant activity using DPPH (1,1-diphenyl-2-picrylhydrazyl) radical scavenging capacity, reducing power, CUPRAC (Cupric Reducing Antioxidant Capacity) and total antioxidant capacity. The phenolic content of the extracts were also determined. The plant extracts showed a direct concentration dependent increase in scavenging DPPH radical. MSSE showed better scavenging activity than MSPE and MSPU with an IC_{50} value of 54.92 µg/ml, while the standard antioxidant, ascorbic acid, showed an IC_{50} value of 13.75 µg/ml. The Fe^{3+}/ferricyanide to ferrous and cupric ion reduction capacity of MSSE were better than the reference agent ascorbic acid. All three extracts showed good activity in total antioxidant assay. MSSE was also found to contain 244.38 mg/g of phenols. The results of his study indicated that MSSE has strong *in vitro* antioxidant activity.

Antioxidant activity basically refers to the action of a molecule that is capable of slowing or preventing the oxidation of other molecules. Antioxidants that scavenge free radicals play an important role for medical reasons. There is currently great attention placed on the search for alternative antioxidants from natural sources. In a study by Sumathy *et al.*, (2011), the antioxidant activity of *Musa Acuminata* flower extract was investigated using the DPPH radical scavenging assay. The percentage of scavenging effect is basically determined by the colour change of DPPH solution from purple to yellow or colourless. DPPH radical scavenging can be expressed in terms of IC_{50}, the concentration required to achieve 50% scavenging of DPPH radical under experiment condition. BHT(standard) had the highest scavenging activity compared to *Musa acuminata* flower extract. The IC_{50} value exhibited by banana flower was 7.63mg/ml slightly higher than BHT which was 6.12mg/ml. *Musa Acuminata* flower is an equally good antioxidant as the BHT standard used. In previous article it has been reported that banana plant can protect itself from oxidative stress by producing large amounts of antioxidant, thus it is considered as a good source of natural antioxidant.

Klotoe *et al.*,(2012) reported on the hemostatic properties of *Musa sapientum.* Its mechanism of action have been identified through hematologic tests such as Clotting Time, Prothrombin Time, Activated Partial Thromboplastin Time and Milk Precipitation Test; biochemical test (total proteins); macroscopic and microscopic tests performed on different blood products before and after addition of sap. The results obtained showed that *Musa sapientum* reduced significantly clotting Time. However, it has no effect on the individual factors of coagulation.

Its mechanism of action results from its ability to form a protein network which is a basis for cellular aggregation stopping bleeding. Moreover, Milk Precipitation Test showed astringent properties of *Musa sapientum* and therefore its vasoconstrictors properties. Phytochemical analyses revealed the presence of alkaloids, tannins, coumarins, reducing compounds, anthocyanins and leucoanthocyanes. *Musa sapientum* is great on treatment of bleeding and could help to elaborate new drugs.

Raquel Cassia Santosa *et al*., 2012, in their pharmacological study of *Byrsonima intermedia* (MBI), reported that the methanolic extract was evaluated in experimental models of gastric ulcers induced by multiple damaging agents (ethanol, HCL, NSAIDS). Gastric mucosal injury frequently occurs when noxious factors, such as NSAID, increased acid secretion, the presence of the bacteria *Helicobacter pylori*, ingestion of alcohol or mucosal ischemia overwhelm the mucosal defence factors. Among the three different doses of MBI examined in their study, the gastro protective effect was found to be greatest at the dose of 500 mg/kg in all experimental models.

Xueting Mei *et al.*, 2012, reported that alcohol consumption could induce gastric ulcers and zinc deficiency. Zinc complexes were reported to act as anti-ulcer, anti-inflammatory and antioxidant activity. Zn(II)–curcumin complex and its solid dispersions (SDs) were synthesized and evaluated for gastroprotective activity and mechanism against ethanol-induced ulcer. The Swiss murine fibroblast cell line (3T3) was used as an alternative *in vitro* model to evaluate the effects of Zn(II)–curcumin on cell proliferation. Zn(II)–curcumin were administered orally for seven consecutive days prior to induction of ulcers using ethanol. The gross and microscopic lesions were reduced, immunological and biochemical parameters were also decreased.

Mohamed Morsy *et al*., 2012, reported that Nebivolol, a β_1-adrenoceptor antagonist, exhibits vasodilatory and anti-oxidative properties that rendering it attractive candidate for protecting against gastric ulcer. The protective effect of nebivolol was evaluated against cold restraint stress (CRS)-induced gastric ulcer in rats. Rats were restrained, and maintained at 4°C for 3 h. Nebivolol (5 mg/kg, p.o.) was suspended in 0.5% aqueous solution of carboxymethyl cellulose and was administered 30 min before CRS. Nebivolol exhibited gastro protective effects as evidenced by significant decreases in ulcer index as well as free and total acid output, and pepsin activity in gastric juice in addition to gastric mucosal malondialdehyde concentration, with concomitant increases in gastric juice pH and mucin concentration along

with gastric mucosal reduced glutathione and nitric oxide (NO) concentrations compared with CRS rats. The protective effects of nebivolol were confirmed by gastric histopathological examination. Pretreatment with N_{ω}-nitro-L-arginine, a NO synthase inhibitor, partly altered the protection afforded by nebivolol. Nebivolol protected rats' gastric mucosa against CRS-induced gastric ulceration possibly through anti-oxidant activity, enhancement of gastric mucosal barrier and reduction in acid secretory parameters.

Yi Liu *et al*.,2012, reported that alcohol consumption could produce acute hemorrhagic gastric erosions, and excessive ingestion resulting in gastritis characterized by mucosal oedema, sub-epithelial haemorrhages, cellular exfoliation, and inflammatory cell infiltration, which is essentially an acute inflammatory reaction. However, prophylactic treatment with l-citrulline attenuated ethanol-induced gastric injury in a dose-dependent manner, with significant reduction of the gastric ulcer index when administered at oral doses between 300 and 900 mg/kg, particularly at the dose of 900 mg/kg. Despite the widely accepted notion that alcohol abuse leads to detrimental consequences in the gastrointestinal tract, the mechanisms underlying the ethanol-induced gastric mucosal injury still remain obscure. There is growing evidence that ethanol-induced gastric mucosal injury was closely related to the increased ROS level and the major source of ROS is from the activated neutrophils. On the other hand, organisms have enzymatic and non-enzymatic defenses, including GSH, SOD and GSH-px against the ROS-induced lipid peroxidation. Treatment with l-citrulline resulted in significant increases in the activities of SOD and GSH-px and the levels of GSH, as well as a decrease in MDA formation, reflecting its antioxidant potential. The mechanisms which underlie l-citrulline-mediated waning of oxidative stress in ethanol-induced gastric ulcer could be attributed to the direct antioxidant and free radical scavenging activity of l-citrulline or indirectly due to augmentation of intracellular GSH and SOD in the rat gastric tissues, all of which can scavenge superoxide, hydrogen peroxide, hydroxyl and lipid peroxyl radicals, and attenuate damages to the tissue. NO and ROS exert multiple modulating effects on inflammation and play key roles in the regulation of immune responses. Large amounts of NO, generated primarily by iNOS could be toxic and pro-inflammatory. In conclusion the effect of l-citrulline could be attributed to its reduction of oxidative damage, and its inhibitory effects on neutrophil infiltration as well as its anti-inflammatory effects in rat stomach tissues. Ethanol had been one of the contributing factors in the development of gastric ulcers according to Yanchao Wang *et al.*, 2012. Ethanol administration could induce certain pathological effects, such as infection of the gastric mucosa, gastritis, and gastric ulcer.

Ethanol-alone intake produced gastric mucosal damage, severe hemorrhage, inflammatory cells and lesion ulcers, but oral administration of sea cucumber fucoidan (SC-FUC) effectively protected stomach tissues against from mucosal damage and necrosis as well as apoptosis of gastric lesion ulcers. The protective effect of sea cucumber fucoidan was examined by employing a rat model of ethanol-induced gastric ulcer and treated with (SC-FUC) extracted from *Acaudina molpadioides* and explored the related mechanisms. Oral administration with 100 mg/kg body weight SC-FUC for 5 days can significantly prevent the formation of gastric ulcer. Moreover, SC-FUC pretreatment could alleviate ethanol-induced histological damage, reverse changes in tissue oxidation and antioxidase activities.

Fikret Vehbi Izzettin *et al.*,2012, determined the optimum protective therapy against the long term NSAID therapy-induced ulcers by comparing the gastro-protective effects of various antiulcer drugs (ranitidine, omeprazole, bismuth and misoprostol) alone or in combination with each other in different doses on indomethacin-induced gastric ulcers in rats. In their experimental study the protective effect of misoprostol (100 µg/kg/day and 10 µg/kg/day i.g.), omeprazole (5 mg/kg/day and 1.5 mg/kg/day i.p.), ranitidine (40 mg/kg/day and 10 mg/kg/day i.p.), bismuth (70 mg/kg/day and 15 mg/kg/day i.g.), combinations of misoprostol (10 µg/kg/day i.g.) plus omeprazole (1.5 mg/kg/day i.p.) and misoprostol (10 µg/kg/day i.g.) plus ranitidine (10 mg/kg/day i.p.) were investigated on indomethacin (50 mg/kg/day s.c.) induced gastric ulcers. Half an hour before indomethacin administration, each group received the above treatment regimens for 5 days. After 5- day treatment, the rats were sacrificed and histopathological and hematological examinations were performed. The following regimens were found to be effective in the prevention of indomethacin induced gastric lesions: 100 µg/kg misoprostol, 10 µg/kg misoprostol, 5 mg/kg omeprazole, combination of 10 µg/kg misoprostol plus 1.5 mg/kg omeprazole and 10 µg/kg misoprostol plus 10 mg/kg ranitidine. The prevention rates achieved by these treatments were 71.4%, 50%, 47.6%, 52.4% and 50%, respectively. As a result of this study, misoprostol and omeprazol were found to be effective in protection against NSAID induced gastric problems; while, ranitidine and bismuth were not. The combinations of these agents were not found to have additive or synergistic effects.

Kaname Ohyama *et al*., 2012, reported that Nonsteroidal anti-inflammatory drugs (NSAIDs) are valuable agents; however, their use had been limited by their association with mucosal damage in the upper gastrointestinal tract. NSAIDs inhibit cyclooxygenase and consequently block the synthesis of prostaglandins, which have cytoprotective effects in gastric mucosa; these effects on prostaglandins had been thought to be major cause of NSAID-induced

ulceration. However, studies indicate that additional NSAID-related mechanisms were involved in formation of gastric lesions. Toxico proteomic approach to understand cellular processes that are affected by NSAIDs in mouse stomach tissue during ulcer formation was used.

Daniella Lima *et al* .,2012, NSAIDs (i.e., indomethacin or acetylsalicylic acid) are known to induce gastric damage due to nonspecific inhibition of cyclooxygenase-1 (COX-1) and COX-2, and this dual inhibition may lead to gastrointestinal ulceration and bleeding. They evaluated essential oils from *Piper aleyreanum*(EOPa) treatment to protect the gastric mucosa. Notably, EOPa exerted gastroprotective activity and had prevented the formation of acute hemorrhagic erosion caused by oral ethanol administration. Gastric mucus is one of the main defensive secretions by epithelial cells and served as a physical barrier over the mucosa Neeru Vasudeva *et al*., 2012, had investigated the antiulcer activity of ethanol extract of *Aerva persica* by pylorus ligation. The extract was administered at the dose of 200 mg/kg orally, p.o. for 15 consecutive days. The ulcer index of the ethanol extract was found to be significantly reduced compared with control animals. The effect was also assessed by determining the free acidity, pepsin activity, total carbohydrate (TC), and protein content (PK) in control, standard, and test group animals. The *invivo* antioxidant activity was evaluated by determining the reduced glutathione level (GSH) and malondialdehyde (MDA) level in the tissue homogenates. The results revealed the significant reduction in the level of malondialdehyde and the increase in the level of reduced glutathione in the rats that received the ethanolic extract. Furthermore, histopathological studies had shown that pretreatment with the ethanolic extract of *Aerva persica* reduced pylorus ligation-induced hemorrhagic necrosis in rats. Qualitative phytochemical analysis of the alcoholic extracts of the root showed the presence of carbohydrates, flavonoids, saponins, alkaloids, and tannins .The antiulcerogenic properties may be due to flavonoids. Tannins, saponins, and flavonoids are known to affect the integrity of mucous membranes. Tannins, with their protein precipitating and vasoconstrictive effects, prevent the development of ulcers. Flavonoids are free radical scavengers that are known to play an important role in ulcerative and erosive lesions of the gastrointestinal tract.

Weiyang Chen *et al.*, 2012, in their review expressed that *Aloe ferox* has long been used to treat inflammation associated with injuries, as well as ailments such as conjunctivitis and sinusitis. They also disclosed that methanolic extracts of aloe species for anti-inflammatory

activity using the cyclooxygenase-1assay, and *Aloe ferox* exhibited inhibition. Aloeresin I (1 mmol/cm2) isolated from Cape aloe reduced the in vivo oedematous response (39%) induced by croton oil in the mouse ear with the same potency as aloesin, and to a higher extent than aloeresin H and indomethacin (0.3 mmol/cm2). In high doses (400 mg/kg), *Aloe ferox* exhibited anti-inflammatory and analgesic activities. Rat-paw oedema induced by carrageenan and formaldehyde was inhibited by 78.2% and 89.3%, respectively. The analgesic activity was 57.1 and 67.3% in phase 1 and 2 of the formalin test and 88.2% in acetic acid test.

Rodriguez-Gonzalez *et al*.,2012, reported on optimizing the functional properties (FPs) of pasteurized extracts of Aloe barbadensis Miller, which are rich in bioactive polymer acemannan and cell wall polysaccharides, using response surface methodology. Box - Behnken design was applied to evaluate the effects of three independent variables: age of plant (X1 = 3-5 years), pasteurization temperature (X2 = 65- 85°C), and pasteurization time (X3 = 15- 35 min) on swelling (Sw), water retention capacity (WRC), and fat adsorption capacity (FAC). Analysis of variance showed that the contribution of quadratic models was significant for the responses which were used for predicting all the responses. From response surface plots, age of plant, time and temperature exhibited independent and interactive effects on Sw, WRC and FAC properties. The optimal conditions to obtain alcohol insoluble residues (AIRs) from pasteurized samples with the highest values for the FPs were examined. A close agreement between experimental and predictive values was found.

Ejoba Raphael, 2012, reported that Chloroform and water extractions of *Aloe vera* and *Azadirachta indica* leaves were carried out so as to quantify the phytochemical yields in such samples, and to identify their main constituents of active compounds. The percentage yields obtained through the soxhlet (chloroform) extraction for the *Aloe vera* and *Azadirachta indica* leaves were 8.6% and 14.3%, while the percentage yields for the aqueous extracts of the leaves were 5.4% and 6.2%, respectively.

Non-Steroidal Anti-inflammatory Drugs(NSAIDs) like indomethacin and aspirin are known to induce numerous punctiform and filiform gastric ulcers during the course of anti-inflammatory theraphy and hence indomethacin induced ulcer model was used in the present study.Although the mechanisms underlying the ulcerogenicity of indomethacin are not completely understood,inhibition of prostagladin synthesis may be an important(Vane,1971).This view is supported by the fact that prostaglandins normally have a

protective function in the stomach by maintaining gastric microcirculation(Ferreira *et al.*, 1974) and cause gastric secretion of bicarbonate and mucus (Menguy and Desbaillets, 1967). Consumption of alcohol produce severe hemorrhagic lesions in the gastric mucosa and hence ethanol induced ulcer model was included in the present study.Ethanol-induced lesion formation may be multifactor. The factors involved in the formation of ulcer using ethanol have been described (Lange *et al.*, 1985).Further Koo *et al.*, (1986) have suggested that the gastric wall mucus depletion induced by ethanol is one of the pathogenic mechanisms responsible for gastric lesion.The numbers of lesions present on the gastric mucosa are indicative of the severity of ulcer disease (West, 1982).The diameter of the lesion are used for the determination of ulcer index,a measure of ulcer in the gastric mucosa.

The observed decrease in the ulcer index in *Aloe vera* gel extract pretreated groups of rats may be due to its antisecretory or cytoprotective properties or both.Though, the mechanism of ulcer formation by indomethacin and ethanol is quite different,the efficacy of the drug was found to be the same in controlling the gastric ulceration.

Although there is considerable controversy about the role of mucus in the prevention of gastric mucosal injury, the gastric mucus coat is considered to be important both in preventing damage to the gastric epithelium as well as in facilitating its repair(Wallace and Whittle, 1986).The incidence of ethanol -induced ulcers,which is predominant in the glandular part of the stomach,has been reported to stimulate the formation of leukotriene C4(LTC4) resulting in the damage of rat gastric mucosa (Cho *et al.*, 1985).

Administration of *Aloe vera* gel enhanced the mucosal resistance and thus resulted in decrease in ulcer index and ulcerated surface.The antisecretory drug ranitidine,also markedly inhibited the indomethacin-induced gastric lesions.These results suggest that the antiulcer activity of the *Aloe vera* gel extract against indomethacin-induced ulcer might also be related to its antisecretory effect.

Ranitidine did not overcome the mucus depletion induced by ethanol,since it acts via blocking of H2-receptors. On contrary,*Aloe vera* gel extract administration resulted in decreased ulcer index.The mucus depletion by ethanol was overcome by *Aloe vera* extract which underlines its cytoprotective nature.

Carbohydrates have been isolated from *Musa sapientum* (Anhwange, 2008). Catecholamines such as norepinephrine, serotonin, dopamine (Vettorazz, 1974), tryptophan, indole

compounds (Shanmugavelu and Rangaswami, 1962), pectin have been found in the pulp. Several flavonoids and related compounds (Leucocyanidin, Quercetin and its 3-Ogalactoside, 3-O-glucoside, and 3-O-rhamnosyl glucoside) were isolated from the unripe pulp of plantain (Lewis and Shaw, 2001). Serotonin, nor-epinephrine, tryptophan, indole compounds, tannin, starch, iron, crystallisable and non-crystallisable sugars, vitamin C, B-vitamins, albuminoids, fats, mineral salts have been found in the fruit pulp of *Musa sapientum*(Ghani, 2003). Acyl steryl glycosides such as sitoindoside-I, sitoindoside-II, sitoindoside-III, sitoindoside-IV and steryl glycosides such as sitosterol gentiobioside, sitosterol *myo*-inosityl- β-D-glucoside have been isolated from fruits of *Musa sapientum* (Ghoshal, 1985).

REFERENCES

1. Anhwange BA. Chemical Composition of *Musa sapientum* (Banana) Peels.J.FoodTech, 2008; 6(6): 263-6.
2. Bafna PA, Balaraman R.Anti-ulcer and anti-oxidant activity of Pepticare, a herbomineral formulation.Phytomedicine, 2005; 12: 264-70.
3. Cho CH, Ogle OW, Dai S. Astudy on the etiology of reserpine ulceration and the antiulcer action of solcoseryl in rat stomach. J. Pharm. Pharmacol, 1985; 37: 823-25.
4. Coe F, Anderson GJ. Ethnobotany of the Sumu (Ulwa) of southeastern Nicaragua and comparisons with Miskitu plant lore. Econ. Bot., 1999; 53: 363-83.
5. Coviello T, Matricardi P, Marianecci C, Alhaique F. Polysaccharide hydrogels for modified release formulations. Journal of Controlled Release, 2007; 119: 5–24.
6. Daniella KS, Lima Lamdir J, Ballico Fernanda Rocha Lapa Hilda P, Goncalves Lauro Merade Souza Marcello Lacomini,Maria Fernanda de Paula Werner,Cristiane Hatsuko Baggio,Isabela Tiemy Pereira,Luisa Mota da Silva,Valdir, A, Facundo and Adair Roberto Soares Santos. Evaluation of the antinociceptive anti-inflammatory and gastric antiulcer activities of the essential oil from Piper aleyreanum C.DC in rodents. Journal of Ethnopharmacology, 2012; 142(1): 274-82.
7. Davenport HW. Why the stomach does not digest itself. Sci. Am., 1972; 226: 87–93.
8. Demir S, Yilmaz M, Koseoglu M, Akalin N, Aslan D, Aydin A. Role of free radicals in peptic ulcer and gastritis. Turk. J. Gastroenterol., 2003; 14: 39-43.
9. Ejoba Raphael. Phytochemical constituents of some leaves extract of Aloe vera and Azadirachta indica plant species. Global Advanced Research Journal of Environmental Science and Toxicology, 2012; 1(2): 14-17.

10. Ferreira SH, Moncada S, Vane JR. Proceedings:Potentiation by prostaglandins of the nociceptive activity of bradykinin in dog knee joint. Brazilian J. Pharmacol., 1974; 50: 461.
11. Fikret Vehbi Izzettin, Mesut Sarcar, Betul Okuyan, Sule Apikoglu-Rabus, Ugur Cevikbas. Comparison of the protective effects of various antiulcer agents alone or in combination on indomethacin-induced gastric ulcers in rats. Experimental and Toxicologic Pathology, 2012; 64(4): 339-43.
12. Freemantle M. Polymers exploited for drug delivery. Chemical & Engineering News, 2005; 83: 45–47.
13. Gaserod O, Jolliffe IG, Hampson FC, Dettmar PW, Skjåk-Bræk G. The enhancement of the bioadhesive properties of calcium alginate gel beads by coating with chitosan. International Journal of Pharmaceutics, 1998; 175: 237–46.
14. Ghani A. Medicinal Plants of Bangladesh: Chemical Constituents and Uses 2nd Ed. The Asiatic Society of Bangladesh, 2003; 315.
15. Ghoshal S. Steryl Glycosides and Acyl Steryl Glycosides from *Musa paradisiaca*. Phytochem., 1985; 24(8): 1807-10.
16. Helsper CW, Smeets HM, Numans ME, Knol MJ, Hoes AW. and de Wit NJ. Trends and determinations of adequate gastroprotection in patients chronically using NSAIDs. Pharmacoepidemiol Drug Saf., 2009; 18: 800-6.
17. Higuchi K, Umegaki E, Watanabe T, Yoda Y, Morita E, Murano M, Tokioka S, Arakawa T. Present status and strategy of NSAID-induced small bowel injury. Gastroenterol., 2009; 44: 879-88.
18. Kaname Ohyama, Akina Shiokawa, Kosei Ito, Ritsuko Masuyama, Tomoko Ichibangase, Naoya Kishikawa, Kazuhiro Imai, Naotaka Kuroda. Toxicoproteomic analysis of a mouse model of nonsteroidal antiinflammatory drug -induced gastric ulcers. Biochemical and Biophysical Research Communications, 2012; 420(1): 210-15.
19. Khare CP. Indian Medicinal Plants, Springer Science+BusinessMedia, New York USA, 2007(Ed); 426.
20. Klotoe JR, Dougnon TV, Sacramento TJ, Dandjesso C, Edorh AP, Kondokpon H, Fanon VBA, Fah L, Ategbo JM, Loko F, Dramane K. Hemostatic potential of the sap of *Musa sapientum L.(Musaceae*). Journal of Applied Pharmaceutical Science, 2012; 02(06): 65-69.
21. Koo MW, Ogle OW, Cho CH. Effects of verapamil, carbenoxolone and N-acetylcysteine on gastric wall mucus and ulceration in stressed rats. Pharmacology, 1986; 32: 326-44.

22. Lange K, Peskar BA, Peskar BM. Stimulation of rat mucosal leukotrienes formation by ethanol.Naunyn Schmiedebergs. Archives fur Parmakologie, 1985; 3305.
23. Lewis DA, Shaw GP. A natural flavonoid and synthetic analogues protect the gastric mucosa from aspirin-induced erosions. J. Nutr. Biochem., 2001; 12: 95-100.
24. Mayty P. Studies focused merely on a single oxygen species through the induction of cytochrome. Smoking and pathogenesis of gastroduodenal ulcer- recent machanistic update, 2003; 97: 450.
25. Menguy R, Desbamets L. Role of inhibition of gastric mucous secretion in the phenomenon of gastric mucosal injury by indomethacin. Am. J. Digest Dis., 1967; 12: 862-66.
26. Mei X, Xu D, Xu S, Zheng Y, Xu S. Novel role of Zn II Curcumin in enhancing cell proliferation and adjusting proinflammatory cytokines -mediated oxidative damage of ethanol-induced acute gastric ulcers.Chem. Biol. Interact., 2012; 197(1): 31-39.
27. Mohamed A.Morsy,Gehan H.Heeba,Soha A.Abdelwahab,Remon R.Rofaeil. Protective effects of Nebivolol against cold resistant stress-induced gastric ulcer in rats:Role of NO,HO-1 and COX-1,2.Nitric Oxide, 2012; 27(2): 117-22.
28. Mohammed Zafar Imam ,Saleha Aktar,Md.Ehsanul Hoque Mazumder, Md.Sohel Rana. Antioxidant activities of different parts of *Musa sapientum L.Spp.Sylvestris* fruit. Journal of Applied Pharmaceutical Science, 2011; 01(10): 68-72.
29. Neeru Vasudeva, Payal Sethi, Surendra Kr. Sharma, Suresh Kumar, Sunil Sharma. Antiulcer Potential of the Ethanolic Extract of *Aerva persica* Merrill Root in Rats. Journal of Acupuncture and Meridian Studies, 2012; 5(2): 80-86.
30. Raquel Cassia Santos, Helio Kushima, Clenilson Martins Rodrigues, Miriam Sannomiya, Lucia Regina Machado Rocha, Tais Maria Bauab, Jorge Tamashrio, Wagner Vilegas, Clelia Akiko Hiruma-Lima. Brysonima intermedia A.Juss.:Gastric and duodenal anti-ulcer,antimicrobial and antidiarrheal effects in experimental rodent models. Journal of Ethnopharmacology, 2012; 140: 203-12.
31. Rodriguez-Gonzalez VM, Femenia A, Minjares-Fuentes R, Gonzalez-Laredo RF. Functional properities of pasteurized samples of *Aloe barbadensis* Miller:Optimization using response surface methodology. LWT-Food Science and Technology, 2012; 47(2): 225-32.
32. Shanmugavelu KG, Rangaswami G. Tryptophan and Indole Compounds in Banana Ovaries. Nature, 1962; 194: 775–76.

33. Somasundaram S, Rafi S, Hayllar J, Sigthorsson G, Jacob M, Price AB, Macpherson A, Mahmod T, Scott D, Wrigglesworth JM, Bjarnason I. Mitochondrial damage: a possible mechanism of the "topical" phase of NSAID induced injury to the rat intestine. Gut, 1997; 41: 344-53.
34. Suleyman H, Albayrak A, Bilici M, Cadirci E, Halici Z. Different mechanisms in formation and prevention of indomethacin-induced gastric ulcers. Inflammation, 2010; 33(4): 224-34.
35. Sumathy V, Jothy Lachumy S, Zuraini Zakarai, Sasidharan S. Invitro Bioactivity and Phytochemical Screening of *Musa Acuminata* Flower. Pharmacologyonline, 2011; 2: 118-27.
36. Tian Y, Jiang B, An L, Bao Y. Neuroprotective effect of catalpol against MPP^+-induced oxidative stress in mesencephalic neurons. Eur. J. Pharmacol, 2007; 568: 142-48.
37. Vane JR. Inhibition of prostaglandin synthesis as a mechanism of action for aspirin like drugs. Natl. New Biol., 1971; 231: 232-35.
38. Vettorazz G. 5-Hydroxytryptamine Content of Bananas and Banana Products. Food Cosmet. Toxicol., 1974; 12: 107-13.
39. Wallace JL, Whittle BJ. Role of mucus in the repair gastric epithelial damage in the rat .Inhibition of epithelial recovery by mucolytic agents. Gasteoenterology, 1986; 91: 603-11.
40. Weiyang Chen, Ben-Erick Van Wy K, Ilze Vermaak, Alvarom Viljoen. Cape aloes-Areview of the phytochemistry,pharmacology and commrcialisation of *Aloe ferox.* Phytochemistry Letters, 2012; 5(1): 1-12.
41. West GB. Testing for drugs inhibiting the formation of gastric ulcers. J. Pharmacol. Meth., 1982; 8:33-7.
42. Yanchao Wang, Wei Su, Cuiyu Zhang Changhu Xue, Yaoguang Chang, Xiaolin Wu, Qingjuan Tang, Jingfeng Wang. Protective effect of sea cucumber*(Acaudina molpadioides)* fucoidon against ethanol-induced gastric damage. Food Chemistry, 2012; 133(4): 1414-19.
43. Yi Liu, Xia Tian, Lingshan Gou, Xiaobin Fu, Sai Li, Nuo Lan, Xiaoxing Yin. Protective effect of L-citrulline against ethanol-induced gastric ulcer in rats. Environmental Toxicology and Pharmacology, 2012; 34(2): 280-87.