IJMPR 2022, 6(4), 58-65

International Journal of Modern Pharmaceutical Research
www.ijmpronline.com

ISSN: 2319-5878
IJMPR
Research Article
SJIF Impact Factor: 5.273

PHARMACOLOGICAL SCREENING OF ANTI-ULCER POTENTIAL OF HYDROALCOHOLIC LEAVES EXTRACT (HLE) OF *MORUS ALBA* IN ALBINO RATS

***[1]Sanjay Kumar and [2]Shalini Singh**

[1]Research Scholar, Institute of Pharmaceutical Sciences and Research, Unnao (UP) IN.
[2]Assistant Professor, Institute of Pharmaceutical Sciences and Research, Unnao (UP) IN.

Received on: 25/02/2022
Revised on: 15/03/2022
Accepted on: 05/04/2022

***Corresponding Author**
Sanjay Kumar
Research Scholar, Institute of Pharmaceutical Sciences and Research, Unnao (UP) IN.

ABSTRACT

Peptic ulcer is acid-induced injury of intestinal system that is generally situated in stomach or upper segment of duodenum. It has been characterized by bared mucosa with imperfection stretching out into sub-mucosa. Few previous literatures indicates that anti-ulcer effect of Morus alba has been evaluated using extractions obtained using alcohol solvent. So, this research focuses on pharmacological screening of anti-ulcer potential of hydroalcoholic leaves extract of M. alba in albino rats. The extraction of the same was done by maceration process using hydroalcoholic solution (1:1) for better and optimum release of chemical constituents. Pylorus-ligation, cold restraints and forced swimming models were used to determine the anti-ulcerogenic activity. Various parameters were evaluated such as pH determination, volume of gastric content, free acidity, total acidity and various microscopical studies. In the models, M. alba leaf extract (hydroalcoholic) showed a significant anti-ulcer effect when compared to control group and for standard group (Ranitidine 20mg/kg). The effect as anti-ulcerogenic was seen in the dose dependent manner. In conclusion, hydroalcoholic leaves extract (HLE) of Morus alba is effective as anti-ulcer at both the doses. But effect was optimum in the dose of 400mg/kg than 200mg/kg. It suggests, to identify and isolate the responsible moiety for this anti-ulcer activity and to convert into suitable dosage form.

KEYWORDS: Hydroalcoholic, HLE, anti-ulcer, Morus alba, forced swimming induced-ulcer, pylorus-ligation.

INTRODUCTION

Peptic ulcer is acid-induced injury of intestinal system that is generally situated in stomach or upper segment of duodenum. It has been characterized by bared mucosa with imperfection stretching out into sub-mucosa (Zhang et al. 2014). Gastric ulcer is 4 times as prevalent as intestinal ulcer. In fact, men are more prone than women to suffer from duodenal ulcer. Individual susceptibility is crucial in the early phases of mucosal injury because only a small percentage of patients infected with H. pylori or by using NSAIDs develop peptic ulcers. Peptic ulcers are linked to functional poly-morphisms in various cytokine genes (Datta & Roychoudhury, 2015). Some common and alarming symptoms of PUD includes as epigastric pain, bloating, Abdominal load, nausea & emesis, weight loss/gain, hematemesis, melena, frequent, requent weight loss, dysphagia- progressive, over g.i.t. blood loss, Iron deficient anemia and cancer in ancestors.

The stomach and upper duodenum are the most often affected areas. Affected areas include the lower oesophagus, distal duodenum, and jejunum. In patients with a stomach ulcer, epigastric pain usually occurs 15-30 min after meal; however, discomfort in patients with a duodenal ulcer usually arrives 2-3 hours after a meal (Malik et al. 2021). NSAID users, on the other hand, have a four-fold greater risk of peptic ulcer complications, whereas aspirin users have twice the risk. The use of anticoagulants, corticosteroids, and SSRIs with NSAIDs or aspirin increases the risk of upper gastrointestinal hemorrhage (Kuna et al. 2019).

These are come common and rare factors behind the development of ulcer-

- Infection through H. Pylori
- NSAIDs induced ulcer
- Other medications
- Zollinger-Ellison illness
- Stomach Cancer
- Cancer of lungs
- Lymphomas
- Acute ailments
- Burns
- Head injuries
- Viral infections
- Circulatory insufficiency
- Radiation cure

- Crohn's disease
- Chemotherapy

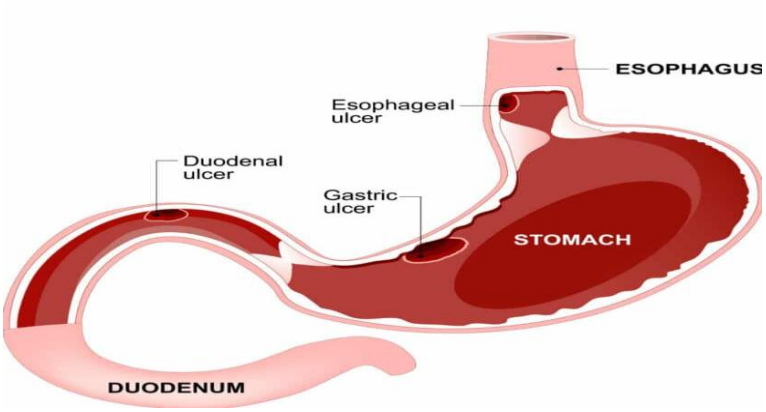

Fig. Depiction of ulcer.

Plant profile

For the everlasting well-being, life span and cure, to eliminate torment and uneasiness, scent, flavor and food humankind from one side of the planet to the other subject to the plant realm to address their all needs (Devi et al. 2013).

a.

b.

c.

d.

Fig. a. leaves b. fruits c. stem, d. roots of M. alba

Taxonomy

Division	:	Magnoliophyta
Super-division	:	Spermatophyta
Class	:	Magnoliopsida
Sub-class	:	Hamamelididae
Order	:	Urticales
Family	:	Moraceae
Genus	:	Morus
Species	:	*Morus alba*

Chemical Constituents

M. alba is natural product has a high return in one fruiting season in numerous nations, particularly in Asia. Besides, the concentrates and dynamic parts of mulberry natural product have shown various organic exercises, including cancer prevention agent, neuroprotective, antiatherosclerosis, immune-modulative (Yuan & Zhao, 2017).

Traditional uses

M. alba plant have long been utilized for a variety of biological purposes, including laxatives, odentalic emetic, & toxin-adsorbents, in addition to nourishment and flavor.

These are traditional uses (Banda et al. 2013) mentioned as below-

- Antitussive
- Anti-asthmatic
- Anti-inflammatory,
- Anti-diabetic,
- Anti-stress, and
- Antiviral activity.
- Hypoglycemic
- Anti-hypertensive
- Diuretic and
- Anti-mutagenic tonics.

On the basis of above literature survey, I found that anti-ulcer effect of *Morus alba* has been evaluated using extractions obtained using alcohol solvent.

This research focuses on pharmacological screening of anti-ulcer potential of hydroalcoholic leaves extract of *M. alba* in albino rats. The extraction of the same was done by maceration process using hydroalcoholic solution (1:1) for better and optimum release of chemical constituents.

MATERIALS AND METHODS

Experimental requirements

Morus alba hydroalcoholic leaves extract (HLE), Ranitidine (API), Water bath, distilled water, albino rats (either sex), rotatory evaporator, weighing machine, ethanol.

Collection, Identification & Authentication of plant

Leaves of *M. alba* will be obtained from the Unnao reason. It will be identified and authenticated by a botanist. The leaves are washed making dust-free and dried at room temperature or shade. The dried leaves are rendered into coarse powders and then finally into fine ones. The powder is weighed and soaked into hydroalcoholic solution- Ethanol + distilled water (1:1) for fifteen days with gradual stirrings. A rotating evaporator is used to dry the brownish, semisolid extract obtained under partial vacuum. The yield of the leaf extract is calculated as a percentage (Khan et al. 2020).

$$\text{percent yield} = \frac{\text{actual yield}}{\text{theoretical yield}} \times 100\%$$

Preparation of animals

Animal House, Institute of Pharmaceutical Sciences and Research (IPSR), Unnao will provide albino rats of either sex weighing 150–200 g. The animals are kept in good health, with room temperatures of 25°C and a 12-hour light/dark cycle. The relative humidity is kept at 44–56 percent, and the rats are provided a regular rodent diet and free access to water. The animals will continue to fast but have free access to water until 1 hour before the ulcers are induced (Bhajoni et al. 2016).

Experimental protocols

All the rats are divided into 4 groups (n=6) as followings-

Group 1: Rats are administered only distilled water once a day for 15 days.

Group 2: Rats are administered Ranitidine (20mg/kg) orally, for 15 days.

Group 3: Rats are administered HLE of M. alba (200mg/kg) orally, for 15 days.

Group 4: Rats are administered HLE M. alba (400mg/kg) orally up to 15 days.

Parameters

1. Pylorus ligation

Prior to pylorus ligation, all rats are kept in separate cages and starved for 24hr (water ad libitum). Coprophagy is avoided by keeping an eye on the animals. A mid-abdominal incision originating from xiphoid process is done under light ether anaesthesia (1cm). The pyloric ligation is performed using sterilized cotton thread while taking care not to disrupt the blood flow. The abdomen incision is completely washed with salt solution, dried, and wrapped with betadine-soaked cotton. The animals are slaughtered by cervical dislocation after 19hrs of pyloric ligation. By pinching the lower length of the oesophagus, the pyloric segment of the stomach is dissected out. The ulcer index is measured in the glandular part of the stomach (UI). The ulcer area is calculated by adding the width and length of each lesion, as well as the total area of every incision (mm2) (Abdulla et al. 2009).

The PI is calculated by the below mentioned formula-

$$(PI) = [(UAcontrol - UAtreated) \div UAcontrol] \times 100.$$

The gastric content is taken into tubes and after centrifugation it is used to test for different parameters-

- pH
- Volume of gastric content
- It is (content of gastric- lavage) titrated against 0.01N NaOH to determine free & total acidity (Dinda, 2012).

2. Cold Restraints stress

The test and control groups are fasted for 12hr just after the last dosing of the control/drug treatment. The rats are then kept in steel cage that is filled with water and maintained the temperature 3-5°C for 3hrs. After, they are sacrificed by cervical-dislocation. The dissected stomach is determined for ulcer levels in terms of UI & PI (Chatterjee et el. 1992; Bhajoni et al. 2016).

3. Forced swimming- induced ulcer

The rats are kept in a propylene tank (37×37×30cm) full of water reaching a height of 25cm to induce swimming stress. For period of 2 weeks, the extract is taken once a day. The rats are permitted to swim until they are completely exhausted on the 15th day, and end point is when the animal begins to drown. The mean swimming

time and mean ulcer index (UI) is then calculated in each animal (Dinda, 2012).

B. Evaluation parameters

1. Microscopical examination

All the groups of rodents are evaluated for deep haemorrhagic lesions of mucosal layer, submucosal oedema and leucocytes infiltration (Chandra et al. 2015).

2. pH detection

Gastric content is taken out and kept in contaminated free petri-dish. After, the pH is easily measured by using digital pH meter. It confirms about the acidity level in the rodent.

3. Gastric Volume determination

In this test, gastric content of stomach of rat is taken out and filled into measuring cylinder to confirm the actual volume of gastric fluid. It confirms about the level of acidity developed in the rat and effect of the drug.

4. Free & total acidity

In this procedure, firstly gastric content is taken out separately. It is (content of gastric- lavage) titrated against 0.01N NaOH to determine free & total acidity. It confirms the level of acidity and beneficial effect of drug given.

RESULTS AND DISCUSSION

1. Pylorus-ligation

In this method, ulcer index and percentage inhibition effect of HLE of Morus alba was determined for all the groups (1-4). Group 1 was treated with distilled water (20mg/kg), Group 2 administered Ranitidine (20mg/kg) while Group 3 administered HLE of Morus alba (200mg/kg) and Group 4 treated with HLE of Morus alba (400mg/kg).

Group 1 exhibited UI score of 1.82±0.06 but PI was observed Nil. Whereas, group 2 (Ranitidine 20mg/kg) demonstrated UI as 0.29±0.05 and PI as 94.07 that is highly significant as it serves at standard drug. So, UI was achieved minimum after ranitidine administration and PI was noted maximum in terms of ulceration inhibition. Group 3 (n=6) given HLE of Morus alba (200mg/kg) that reduced the ulcer index by up to 0.55±0.04 and PI was observed in ascending manner as 69.21.

Whereas, group 4 which was treated with HLE of Morus alba (400mg/kg) was demonstrated the ulcer index as 0.49±0.06 and percentage inhibition was recorded as 83.02 which is near to standard drug treatment.

So, in this model the result indicates that HLE of Morus alba in higher dose is much effective which is comparable to standard anti-secretory drug- ranitidine.

The following table confers the UI and PI effect of HLE of Morus alba in pylorus ligation- induced ulcer model.

Table Ulcer Index (UI) & Percentage Inhibition (PI) effect of HLE of Morus alba in pylorus ligation- induced ulcer model.

Group	Treatment	UI	PI
1	Distilled water (20mg/kg)	1.82±0.06	Nil
2	Ranitidine (20mg/kg)	0.29±0.05	94.07
3	HLE of Morus alba (200mg/kg)	0.55±0.04	69.21
4	HLE of Morus alba (400mg/kg)	0.49±0.06	83.02

Mean +S.E.M. n=6

2. Cold restraint stress

In this model, ulcer index and percentage inhibition effect of HLE of Morus alba was determined for all the groups (1-4). Group 1 was treated with distilled water (20mg/kg), Group 2 administered Ranitidine (20mg/kg) while Group 3 administered HLE of Morus alba (200mg/kg) and Group 4 treated with HLE of Morus alba (400mg/kg).

The UI and PI response of HLE of Morus alba was observed as 1.92±0.06 and Nil respectively, in group 1. Ranitidine (20mg/kg) treated group served as standard and exhibited UI as 0.43±0.04 and PI as 92.03. Group 3 fed with HLE of Morus alba (200mg/kg) was observed for its anti-ulcerogenic potential as 0.59±0.04 in terms of UI and 70.01 as percentage inhibition. In high dose, group 4 treated with HLE of Morus alba (400mg/kg) demonstrated Ulcer index as 0.51±0.02 and PI as 81.06.

So, mean to say that higher dose showed better anti-ulcerogenic effect in this model too when to the standard group.

The following table depicts the UI and PI effects of HLE of Morus alba in referred model.

Table Ulcer Index (UI) & Percentage Inhibition (PI) impact of HLE of M. alba in cold restraint stress model.

Group	Treatment	UI	PI
1	Distilled water (20mg/kg)	1.92±0.06	Nil
2	Ranitidine (20mg/kg)	0.43±0.04	92.03
3	HLE of Morus alba (200mg/kg)	0.59±0.04	70.01
4	HLE of Morus alba (400mg/kg)	0.51±0.02	81.06

Mean +S.E.M. n=6

3. Forced swimming- induced ulcer

In forced swimming- induced ulcer test, ulcer index and percentage inhibition effect of HLE of Morus alba was determined for all the groups (1-4). Group 1 was treated with distilled water (20mg/kg), Group 2 administered Ranitidine (20mg/kg) while Group 3 administered HLE of Morus alba (200mg/kg) and Group 4 treated with HLE of Morus alba (400mg/kg).

Group 1 fed with distilled water (20mg/kg) demonstrated UI as 1.92±0.06 and PI Nil as no effect on ulcerogenic potential was observed. Group 1 was administered Ranitidine in the dose of 20mg/kg, and shown UI as 0.43±0.04 and Percentage inhibition as 92.03. It reduced ulcer index due to high efficiency in ulcer prophylaxis. Group 3 which was given HLE of Morus alba (200mg/kg) demonstrated Ulcer index (UI) and Percentage inhibition as 0.59±0.04 and 70.01 respectively. Maximum anti-ulcerogenic response was seen in the treatment of group 4 (HLE of M. alba in the dose of 400mg/kg) as it exhibited UI as 0.51±0.02 and PI as 81.06.

The following table depicts the UI and PI of HLE of Morus alba in forced swimming- induced ulcer model-

Table Ulcer Index (UI) & Percentage Inhibition (PI) effect of HLE of Morus alba in forced swimming- induced ulcer model.

Group	Treatment	UI	PI
1	Distilled water (20mg/kg)	1.92±0.06	Nil
2	Ranitidine (20mg/kg)	0.43±0.04	92.03
3	HLE of Morus alba (200mg/kg)	0.59±0.04	70.01
4	HLE of Morus alba (400mg/kg)	0.51±0.02	81.06

Mean +S.E.M. n=6

4. pH detection

The pH detection of HLE of Morus alba was determined for all the groups (1-4). Group 1 was treated with distilled water (20mg/kg), Group 2 treated with Ranitidine (20mg/kg), Group 3 treated with HLE of Morus alba (200mg/kg) and Group 4 treated with HLE of Morus alba (400mg/kg).

Group 1 was administered distilled water (20mg/kg) and pH was observed as 2.13±0.12 after 15 days of continuous exposure of dosing frequency once per day. Group 2 given Ranitidine in the dose of 20mg/kg showed optimum and increased pH in the range of 4.23±0.13. Group 3 administered HLE of Morus alba for 15 days of continuous exposure, the pH was recorded as 2.98±0.14 whereas Group 4 given HLE of Morus alba once a day for 15 days and showed pH as 3.65±0.02. Therefore, the maximum pH increasing effect was seen in higher dose when compared to standard drug- Ranitidine (20mg/kg).

The following table depicts the response of HLE of M. alba on pH-

Table response of HLE of M. alba on pH.

Group	Treatment	pH range
1	Distilled water (20mg/kg)	2.13±0.12
2	Ranitidine (20mg/kg)	4.23±0.13
3	HLE of Morus alba (200mg/kg)	2.98±0.14
4	HLE of Morus alba (400mg/kg)	3.65±0.02

Mean +S.E.M. n=6

5. Volume of gastric content

The effect of volume of HLE of Morus alba on gastric content was determined for all the groups (1-4). Group 1 was treated with distilled water (20mg/kg) and served as control, Group 2 treated with Ranitidine (20mg/kg) considered as reference group, Group 3 treated with HLE of Morus alba (200mg/kg) taken as Test 1 and Group 4 treated with HLE of Morus alba (400mg/kg) observed as Test 2.

After 15 days of continuous treatment, volume of gastric content for group 1 was obtained as 12.11±0.76 ml. Group 2 administered with Ranitidine in the dose of 20mg/kg recorded for volume of gastric content as 5.66±0.62 ml. The volume of gastric content (ml) for

Group 3 treated with HLE of Morus alba was observed as 8.68±0.19 ml whereas group 4 exhibited and decreased level of secreted volume of gastric content as 7.19±0.44 ml which is much significant and comparable to standard group.

The following table demonstrates the decreased volume of gastric content (ml).

Table Effect of HLE of Morus alba on volume of gastric content (ml).

Group	Treatment	Volume of gastric content (ml)
1	Distilled water (20mg/kg)	12.11±0.76
2	Ranitidine (20mg/kg)	5.66±0.62
3	HLE of Morus alba (200mg/kg)	8.68±0.19
4	HLE of Morus alba (400mg/kg)	7.19±0.44

Mean +S.E.M. n=6

6. Free acidity

The effect of HLE of Morus alba on free acidity was determined for all the groups (1-4). Group 1 was treated with distilled water (20mg/kg) and served as control, Group 2 treated with Ranitidine (20mg/kg) considered as reference group, Group 3 treated with HLE of Morus alba (200mg/kg) taken as Test 1 and Group 4 treated with HLE of Morus alba (400mg/kg) observed as Test 2.

Group 1 administered with distilled water in the dose of 20mg/kg showed free acidity with value of 39.12±1.47 which is in-effective completely. Group 2 treated with ranitidine in the dose of 20mg/kg, all the animals exhibited mean value of free acidity as 24.21±2.34. Animals treated with test drug- HLE of Morus alba (200mg/kg) produced free acidity in the range of 31.32±1.31 whereas group 4 treated with same in the dose of 400mg/kg showed 27.11±1.22 free acidity which is near to standard drug- ranitidine.

The following table depicts the response of HLE of M. alba on free acidity-

Table Response of HLE of M. alba on free acidity (mEq/l).

Group	Treatment	Free acidity (mEq/l)
1	Distilled water (20mg/kg)	39.12±1.47
2	Ranitidine (20mg/kg)	24.21±2.34
3	HLE of Morus alba (200mg/kg)	31.32±1.31
4	HLE of Morus alba (400mg/kg)	27.11±1.22

Mean +S.E.M. n=6.

7. Total acidity

The effect of HLE of Morus alba on total acidity was determined for all the groups (1-4). Group 1 was treated with distilled water (20mg/kg) and served as control, Group 2 treated with Ranitidine (20mg/kg) considered as reference group, Group 3 treated with HLE of Morus alba (200mg/kg) taken as Test 1 and Group 4 treated with HLE of Morus alba (400mg/kg) observed as Test 2.

Total acidity was noted as 75.32±1.87 (mEg/l) in group 1 which was treated with distilled water (20mgkg). Group 2 treated with Ranitidine in the dose of 20mg/kg exhibited total acidity as 52.61±2.14. Whereas, group 3 showed total acidity as 69.42±1.51 that was administered HLE of Morus alba in the dose of 200mg/kg for persistently 15 days. At last, group 4 given HLE of Morus alba (400mg/kg) was evaluated for total acidity as observed as 57.71±1.42.

The following table shows the response of HLE of M. alba on total acidity-

Table Response of HLE of M. alba on total acidity (mEq/l).

Group	Treatment	Total acidity (mEq/l)
1	Distilled water (20mg/kg)	75.32±1.87
2	Ranitidine (20mg/kg)	52.61±2.14
3	HLE of Morus alba (200mg/kg)	69.42±1.51
4	HLE of Morus alba (400mg/kg)	57.71±1.42

Mean +S.E.M. n=6

In all the protocols, M. alba showed a significant anti-ulcerogenic activity when compared to reference drug-Ranitidine. The response was observed as dose dependent.

CONCLUSION

M. alba L. products are high in nutrients and bioactive chemicals, and they contain a wide range of pharmacological qualities that may aid in the prevention

and treatment of chronic disorders. M. alba L. has higher levels of phenolic compounds, riboflavin, niacin, total phenols, and alkaloids than other mulberry varieties. It is useful to extract unripe fruits with water to increase the immunological activity of M. alba. In M. alba, polysaccharides and pyrrol alkaloids are known to activate macrophages. Unknown components are thought to work in combination on immunological strengthening in the crude extract extracted with water. As a result, more research into undiscovered chemicals in M. alba (fruits) and their physiological consequences is required. It's also critical to develop phytochemicals for clinical trials (Chang et al. 1966).

It has been approved for having anti-ulcer potential in preclinical studied. Clinical trials are needed to confirm its actual property.

CONFLICT OF INTEREST

None

SOURCE OF FUNDING

Nil

REFERENCES

1. Abdulla Mahmood Ameen, Hapipah Mohd Ali, Khaled Abdul-Aziz Ahmed, Suzita Mohd Noor, Salmah Ismail. Evaluation of the anti-ulcer activities of Morus alba extracts in experimentally-induced gastric ulcer in rats. Biomedical Research, 2009; 20(1): 35-39.
2. Banda D, S. Neha, K. Dinesh, J. Kamal. Morus alba Linn: a phytopharmacological review. Int J Pharm Pharm Sci, 2013; 5(2): 14-18.
3. Bhajoni et al. Evaluation of the Antiulcer Activity of the Leaves of Azadirachta indica: An Experimental Study. Integrative Medicine International, 2016; 3: 10–16.
4. Chandra P, Kamal Kishore, Ashok K G. Effect of Ethanol Extract from Morus Alba Leaves Supplementation on Gastric Tissue Glutathione Level in Indomethacin Induced Ulcers in Rats. IJPSR, 2015; 6(12): 5308-14.
5. Chang, B.-Y.; Koo, B.-S.; Kim, S.-Y. Pharmacological Activities for Morus alba L., Focusing on the Immunostimulatory Property from the Fruit Aqueous Extract. Foods, 2021; 10: 1966.
6. Chatterjee T K, Chakraborty A, Pathak M, Sengupta G C. Effects of plant extract Centella asiatica (Linn.) on cold restraint stress ulcer in rats. Indian Journal of Experimental Biology, 1992; 30(10): 889-891.
7. Datta De D., Roychoudhury S. To be or not to be: The host genetic factor and beyond in Helicobacter pylori mediated gastro-duodenal diseases. World J. Gastroenterol, 2015; 21: 2883–2895.
8. Devi B, Neha S, Dinesh K, Kamal Jeet. Morus Alba Linn: A Phytopharmacological Review. IJPPS, 2013; 5(2): 14-18.
9. Dinda S C. Anti-ulcer activity of aqueous and ethanolic leaf extract of neem (Azadirachta indica) in albino rats. Journal of Pharmacy Research, 2012; 5(3): 1571-1573.
10. Huang JQ, Sridhar S, Hunt RH. Role of Helicobacter pylori infection and non-steroidal anti-inflammatory drugs in peptic-ulcer disease: a meta-analysis. Lancet, 2002 Jan 05; 359(9300): 14-22.
11. Jamshid M, Prakash RN, The histopathologic effects of Morus alba leaf extract on the pancreas of diabetic rats, Turk J Biol., 2012; 36: 211-216.
12. Khan Mohammad Asif, S B Tiwari, H Gupta, Huma Noor. Evaluation of anxiolytic and antidepressant potential of hydro-alcoholic leaves extract of Azadirachta indica in albino rats. Pharmacology Online, 2020; 3: 207-213.
13. Kuna L, Jelena J, Robert S, Nikola R L, L Vcev, M Smolic. Peptic Ulcer Disease: A Brief Review of Conventional Therapy and Herbal Treatment Options. J Clin. Med, 2019; 8(2): 179.
14. Malik Talia F., Karthik Gnanapandithan; Kevin Singh. Peptic Ulcer Disease, Treasure Island (FL): StatPearls Publishing, 2021.
15. Yuan Q, Zhao L. The Mulberry (Morus alba L.) Fruit—A Review of Characteristic Components and Health Benefits. J. Agric. Food Chem., 2017; 65(48): 10383–10394.
16. Zeng Q, H. Chen, C. Zhang, M. Han, T. Li, X. Qi, et al. Definition of eight mulberry species in the genus Morus by internal transcribed spacer-based phylogeny PLoS One, 2015; 10(8): e0135411.
17. Zhang B.B., Li Y., Liu X.Q., Wang P.J., Yang B., Bian D.L. Association between vac A genotypes and the risk of duodenal ulcer: A meta-analysis. Mol. Biol. Rep, 2014; 41: 7241–7254.