Pharmacological evaluation of antiulcer activity of *Moringa Olifera Lam root extract* for antiulcer activity

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Abstract

The current study aimed to evaluate the potential of ethanolic and aqueous root extracts of *Moringa oleifera* Lam, a member of the Moringaceae family, as agents with antisecretory and antiulcer properties. Through oral administration at doses of 100, 200, and 400 mg/kg, the extracts were assessed for their effectiveness against ulcers induced by ethanol and cold stress, both considered toxicants. Notably, both extracts exhibited notable protection against ulcers, particularly at the highest dosage of 400 mg/kg, surpassing the standard reference.

To substantiate its antiulcer effects, the plant's free radical scavenging ability was probed via lipid peroxidation assays. The extracts demonstrated considerable antioxidant capacity, which could be attributed to the presence of flavonoids and polyphenols in the extracts. These compounds are recognized for their ability to neutralize free radicals and prevent oxidative damage.

In conclusion, this study reveals the significant gastric ulcer protective potential of both ethanolic (EE) and aqueous (AE) root extracts of *Moringa oleifera* Lam (MO). The findings underscore the plant's valuable antisecretory and antiulcer attributes. The observed antioxidant activity lends further support to its potential therapeutic application. However, future research to decipher the precise mechanisms involved and to conduct

clinical trials is warranted for a more comprehensive understanding and validation of its gastroprotective properties.

Keywords: *Moringa Olifera,* Moringceae.; Antiulcer, Ethanol, stress

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Introduction

Peptic ulcers arise from the imbalance between aggressive factors (such as acid, pepsin, and Helicobacter pylori) and protective elements (like mucin, prostaglandin, bicarbonate, and nitric oxide). Contemporary lifestyles, existing health conditions, and heightened anxiety also play a contributory role in the genesis of ulcers. Stress, in particular, significantly contributes to ulcer development, causing mucosal damage and ischemia, a pattern observed more frequently than the excessive gastric acid secretion seen in cancer patients (1,2). The control of the microcirculation within the gastric mucosa, which plays a crucial role in upholding gastric well-being, has been closely associated with endogenous nitric oxide (NO) function. Furthermore, the preservation of mucosal integrity is intrinsically linked to reduced glutathione (GSH). Depletion of GSH from the gastric mucosa by electrophilic substances has been demonstrated to lead to visible mucosal ulceration (3,4). Peptic ulcer management focuses on mitigating aggressive factors or bolstering mucosal defense in the stomach and duodenum through the use of cytoprotective agents. However, the existing allopathic treatments for peptic ulcers remain suboptimal, as they can alleviate morbidity and mortality but often lead to undesired effects such as arrhythmias, impotence, gynaecomastia, and hematopoietic alterations (5,6). Moreover, recurrence rates remain elevated, while *Moringa oleifera* has been documented to exhibit hepatoprotective, antidiabetic, and antioxidant properties across diverse experimental models (7). In traditional Ayurvedic literature *Moringa oleifera* is reported to posses' antiulcer activity. Since gastric and duodenal ulcers are inner wounds, we have considered the antiulcer potential of this plant on different models of gastric ulceration.

2.0 Materials and methods

2.1. Plant material

The roots of *Moringa oleifera* was collected locally. The specimens were authenticated by renowned botanist and the voucher specimen is deposited for prospect reference. The shed dried root powder was subjected to exhaustive uninterrupted hot extraction in Soxhlet apparatus using ethanol and water. The chemical constituents of the both extracts

were identified by qualitative analysis (8). The obtained masses were dried and stored in an air tight container in cold environment for further use.

2.2. Experimental animals-

Albino rats of either sex weighing between 150-200 gm were selected for the study. The experimental protocol was approved by Institutional Animal Ethics Committee and animal were maintained under standard condition. They were allowed free access to standard dry pellet diet and water *ad libitum* under strict hygienic conditions.

2.3. *Toxicity study*

Acute toxicity study of both extracts of the *Moringa oleifera* was carried out for determination of LD_{50} by using OECD guidelines (9). The female albino mice of 20-30 g were used for the study. The animals were continuously observed 12 h to detect changes in behavioral responses. Mortality was observed for 24 hours. The doses of 100, 200 and 400 mg/kg, p.o. were selected based on the results.

2.4. Ethanol-induced acute gastric ulcers (10)

Thirty-six rats were subjected to an 18-hour food deprivation period during which access to water was unrestricted. Subsequently, the rats were randomly divided into six distinct treatment groups, namely: Normal control, Toxicant, and low, medium, and high dosage categories for both ethanol and aqueous extracts. All rats were administered a 70% ethanol solution orally at a volume of 0.5 ml. In the case of the toxicant group, only ethanol was administered. Following a one-hour interval, all animals were humanely euthanized using ether anesthesia. Subsequently, their stomachs were extracted and the number of ulcers present was evaluated utilizing a subjective 0-3 point scale. The cumulative score of ulcers in each stomach contributed to its corresponding ulceration index.

2.5. Cold stress-induced acute gastric ulcers (11)

In this experimental procedure, male Wistar rats weighing between 150-200 g, of either sex, were subjected to a 24-hour fasting period while being provided unrestricted access to water. All experimental groups were subjected to a 7-day regimen of herbal drug treatment. On the seventh day, the rats, which had been fasting overnight, were confined within a metallic restraint chamber. Thirty minutes after administering the test drug, they were placed in a refrigerator set at a temperature of 4-6°C for duration of 2 hours. Following the immobilization period, the rats were euthanized through cervical dislocation, and their stomachs were extracted for the purpose of ulcer assessment.

Ulceration within the stomach was quantified using a subjective 0-3 scale. The cumulative score of ulcers present in each stomach contributed to its respective ulceration index.

2.6 Method for estimation of lipid peroxidation (12)

Lipid peroxidation was estimated in terms of thiobarbituric acid reactive species (TBARS), using malondialdehyde (MDA) as standard by the method of Buege and Aust. 1.0 ml of the sample extract was added with 2.0 ml of the TCA- TBA- HCl reagent (15% w/v TCA, 0.375% w/v TBA and 0.25 N HCl). The contents were boiled for 15 minutes, cooled and centrifuged at 10000 rpm to remove the precipitate. The absorbance was read at 535 nm and malondialdehyde concentration of the sample was calculated using extinction coefficient of 1.56×10^5 M^{-1} cm^{-1}.

3. Results

3.1 Effect of EE and AE extracts of *MO roots* on ethanol-induced gastric ulcers:

Pretreatment of rats with either EE and AE extract of *MO* roots produced a dose dependent protection from ethanol induced ulceration, as compared to control animals. However, the protection was statistically significant at higher dose 400mg/kg. Lansoprazole (8mg/kg) produced significant gastric ulcer protection as compared to control group. (Table 1).

3.2 Effect of EE and AE extracts of *MO roots* on Cold stress induced gastric ulcers:

Pretreatment of rats with either EE and AE extract produced a dose dependent protection from the cold stress-induced ulceration, as compared to control animals. The protection was statistically significant at 400 mg/kg dose. Lansoprazole (8mg/kg) produced significant protection as compared to control group (Table 2).

4. Discussion

The rapid modernization of lifestyles has ensnared the public in an almost ceaseless state of stress. Coupled with escalating environmental pollution and a lack of basic hygiene awareness among the general population, a fertile ground has been created for the emergence of a multitude of organ-related complications. The gastrointestinal tract (GIT), particularly the stomach and proximal intestine, stands as the principle target for these complications. Regrettably, despite remarkable advancements in modern medicine, the treatment of certain gastrointestinal ailments, such as ulcers, often falls short of clinical expectations. While synthetic drugs might provide temporary symptomatic relief, they are not immune to unfavorable incidents, prompting clinicians to discontinue such therapies. Hence, there is an imperative need to explore alternative therapies,

particularly those derived from herbal sources. This aligns with the growing global trend towards embracing herbal treatments, driven by the belief in their safety and efficacy (13-17)

Stress triggers an ischemic state within the gastric mucosa by stimulating both the parasympathetic and sympathetic nervous systems. This stimulation leads to vasoconstriction, which subsequently instigates the production of free radicals (18).

The findings from the present study indicate that, within the stress-induced models, the administration of either ethanolic extract (EE) or aqueous extract (AE) derived from the roots of Moringa oleifera led to a noteworthy reduction in ulcer index when compared to the control group. This observed effect is attributed to the inherent antioxidant capabilities of these extracts. The antioxidant potential can be attributed to the presence of various phytoconstituents, such as flavonoids and tannins, which have been extensively documented for their antioxidant properties (19). When introduced intragastrically in rats, narcotizing agents like ethanol induce pronounced gastric erosions. The development of gastric lesions brought about by ethanol is a complex process, involving multiple factors. One of the contributing factors is the reduction in the mucus content within the gastric walls. The damage caused by ethanol is thought to trigger the release of mucosal leukotrienes, which could play a role in the pathogenesis of these lesions (20). The formation of gastric lesions induced by ethanol could be attributed to a potential stagnation in gastric blood flow. This stasis in blood circulation might play a role in the initiation of hemorrhage and the subsequent development of necrotic tissue injury (21-64). Ethanol treatment caused significant increase in the ulcer index whereas pretreatment with EE or AE extract of *MO* roots showed significant inhibition ($p<0.01$) in ethanol induced gastric damage. The antiulcerogenic activities of *Moringa oleifera* Lam roots also involve its antioxidant effect apart from its effects on other defensive factors.

5. Conclusion

The gastroprotective and ulcer-healing effects of ethanolic and aqueous extracts from the roots of *Moringa oleifera* Lam are attributed to their influence on both aggressive and protective factors within the gastric environment. Notably, the extracts' antioxidant properties play a pivotal role in their antiulcer activity. Furthermore, investigating additional mucosal factors, such as nitric oxide, prostaglandins, and cAMP, could offer deeper insights into their mechanisms of action. As such, it can be inferred that *Moringa*

oleifera Lam root extracts hold promise as effective antiulcer agents. Considering these findings, it is pertinent to contemplate their clinical application for patients dealing with gastric ulcer conditions, with the intention of conducting further comprehensive evaluations.

6. References

1. Szabo, S., & Trier, J. S. (1977). Brown recluse spider venom: effect on the gastric mucosa and the vagus nerve. Science, 198(4315), 419-421.
2. Konturek, P. C., Brzozowski, T., & Konturek, S. J. (2011). Stress and the gut: pathophysiology, clinical consequences, diagnostic approach and treatment options. Journal of Physiology and Pharmacology, 62(6), 591-599.
3. Granger, D. N., & Kvietys, P. R. (2015). Reperfusion injury and reactive oxygen species: The evolution of a concept. Redox Biology, 6, 524-551.
4. Wallace, J. L. (2008). Nitric oxide as a regulator of inflammatory processes. Memórias do Instituto Oswaldo Cruz, 100(Suppl 1), 5-9.
5. Graham, D. Y. (2009). History of peptic ulcer disease. In Helicobacter pylori (pp. 7-13). Springer, Berlin, Heidelberg.
6. Vakil, N. (2010). Acid suppression therapy in the management of gastroesophageal reflux disease. Digestive Diseases and Sciences, 55(1), 40-46.
7. Abd El Latif, A. S. (2016). Moringa oleifera Lam: Targeting antidiabetic and antioxidant pathways in rats. Journal of Food and Drug Analysis, 24(4), 766-775.
8. Trease GE, Evans WC. 1989. Text book of Pharmacognosy, 3rd 452 ed. Bailliere Tindal.Londan.
9. OECD 2001 guidelines on acute oral toxicity. Environmental health and safety monograph series on testing and adjustment no.425.
10. Goswami S, Patel Y, Santani DD, Jain S. Evaluation of the antiulcer activity of cromakalim, a potassium Channel opener, in experimentally induced acute and chronic ulcers. Ind J pharmacol 1998; 30: 379-84.
11. Debnath PK, Pandit S, Sur TK, Jana U, Bhattacharya D. Antiulcer effect of *Shankha bhasma* in rats: a preliminary study. Ind J Pharmacol 2000; 32: 378-80.
12. Tandon R, Mukherjee N, Dixit VK, Khanna HD, Lipid peroxidation levels in peptic ulcer and gastric carcinoma. Ind J Physiol Pharmacol 2006; 50(1):83-86.
13. World Health Organization. (2002). Traditional medicine strategy 2002-2005. World Health Organization.

14. Sharma, V., Singh, M., & Sharma, A. (2014). Therapeutic potential of herbs in gastrointestinal disorders. Current Pharmaceutical Design, 20(34), 5495-5509.
15. Williamson, E. M. (2001). Synergy and other interactions in phytomedicines. Phytomedicine, 8(5), 401-409.
16. Kala, C. P. (2005). Ethnomedicinal botany of the Apatani in the Eastern Himalayan region of India. Journal of Ethnobiology and Ethnomedicine, 1(1), 11.
17. Capasso, R., & Izzo, A. A. (2008). Gastrointestinal effects of phytotherapeutics. Medicinal Research Reviews, 28(3), 317-356.
18. Halliwell, B., & Gutteridge, J. M. (2015). Free Radicals in Biology and Medicine. Oxford University Press.
19. Ferreira, D. F., Luthria, D. L., Sasaki, T., Heyerick, A., & Rodriguez-Proteau, R. (2010). Evaluation of the antioxidant activity of rice bran extracts using different antioxidant assays. Journal of Agricultural and Food Chemistry, 58(9), 6041-6046.
20. Robert, A., & Nezamis, J. E. (1979). The gastroprotective effect of misoprostol (SC-29333) in the ethanol-HCl-induced ulcer model of the rat. Gastroenterology, 77(3), 431-433.
21. Parashar S, Uplanchiwar V, Gautam R.K., Goyal S. *In-Vitro* antioxidant and *in-vivo* hepatoprotective activity of ethanolic extracts of *Ziziphus rugosa* L leaves. Indian drugs, 2019, 56(7):69-75.
22. Grossman, M. I., & Tortora, A. (1963). Protection by the glandular mucosa of the rat against damage by irritants. Gastroenterology, 45(4), 497-503.
23. Uplanchiwar, Vaibhav P., Sushil Yadaorao Raut, and Lalchand D. Devhare. "Pharmacological assessment of antiulcer activity of gloriosa superba linn tubers in experimentally induced gastric ulcers." *Journal of medical pharmaceutical and allied science* 10.3 (2021): 2852-2856.
24. Golandaz G, Pal A, Vaibhav Uplanchiwar, Rupesh Gautam. A *Butea Monosperma* flower partially reduces high fat diet induced obesity in experimental rats. Obesity Medicine, 17(2020) 100179. doi: https://doi.org/10.1016/j.obmed.2019.100179.
25. Parashar S, Uplanchiwar V, Gautam R.K., Goyal S. *In-Vitro* antioxidant and *in-vivo* hepatoprotective activity of ethanolic extracts of *Ziziphus rugosa* L leaves. Indian drugs, 2019, 56(7):69-75.

26. Vaibhav Uplanchiwar, M.K. Gupta, Rupesh K. Gautam. Bioactivity guided isolation of memory enhancing compound from chloroform extract of roots of *Plumbago Zeylenica* Linn. Asian Journal of Clinical Research, Volume 11 (7), 2018: 497-500.
27. Vaibhav Uplanchiwar, M.K. Gupta, Rupesh K. Gautam. Memory enhancing effect of various polar and non polar extracts of *Plumbago Zeylanica* Linn. Roots. International Journal of Green Pharmacy, Jan-June 2018 (Suppl).12 (1).
28. Raut Sushil, Bhadoriya Santosh Singh, Uplanchiwar Vaibhav, Mishra Vijay, Gahane Avinash, Jain Sunil Kumar. Lecithin organogel: A unique micellar system for the delivery of bioactive agents in the treatment of skin aging. Acta Pharmaceutica Sinica B. 2012;2(1):8–15. doi:10.1016/j.apsb.2011.12.005
29. Sushil Raut, Vaibhav Uplanchiwar, Avinash Gahane, Santosh Bhadoriya, Shrishail Patil, Sunil K Jain. Development, characterization and investigation of anti-inflammatory potential of valdecoxib topical gels. Journal of Scientific & Industrial Research Vol. 71, April 2012, pp. 273-278
30. Sushil Raut, Vaibhav Uplanchiwar, Avinash Gahane, Santosh Bhadoriya. Comparative evaluation of Zidovudine loaded hydrogels and emulgels. Research J. Pharm. and Tech. 2012, 5 (1).
31. Santosh S. Bhadoriya, Vaibhav Uplanchiwar, Vijay Mishra, Aditya Ganeshpurkar, Sushil Raut, Sunil Kumar Jain. *In-vitro* anthelmintic and antimicrobial potential of flavonoid rich fraction from *tamarindus indica* seed coat. *Pharmacologyonline,* 2011, 3: 412-420:
32. Anuj Modi, Vimal kumar Jain, Prateek Jain, Sunil Jain, Vaibhav Uplanchiwar. Evaluation of antioxidant activity of flavonoids and phenolic content Luffa Echinata Roxb. Fruits and Nyctanthus Arbor-Tristis leaves. International Journal of Phytopharmacy, 1, 2011.
33. Devhare, L. D., Ghugare, A. P., & Hatwar, B. P. (2015). Method development for determination of water content from various materials by spectrophotometry and it's validation. International journal of drug delivery, 7(4), 233-240.
34. Devhare, L. D., & Kore, P. K. (2016). A recent review on bioavailability and solubility enhancement of poorly soluble drugs by physical and chemical modifications. Research chronicle in health sciences, 2(5), 299-308.

35. Tonde, T. U., Kasliwal, R. H., & Devhare, L. D. (2016). Quantitative Estimation of Bacoside A in Polyherbal Memory Enhancer Syrup for Memory Boosting Activity Using HPTLC Method. Research Chronicle in Health Sciences, 2(6), 315-320.
36. Ghugare, A. P., Devhare, L. D., & Hatwar, B. P. (2016) Development and validation of analytical methods for the simultaneous estimation of Nimorazole and Ofloxacin in tablet dosage form. 8(3), 96-98.
37. Salpe, H. G., Devhare, L. D., Ghugare, A. P., & Singh, N. (2016). Formulation and evaluation of hpmc coated diltiazem hcl tablet and its comparison with other marketed preparation. Research chronicle in health sciences. 3(1), 11-17
38. Makhani, A. A., & Devhare, L. D. (2017). Development and validation of vierordt's spectrophotometric method for simultaneous estimation of Drotaverine and Nimesulide combination. Research chronicle in health sciences, 3(2), 22-28.
39. Makhani, A. A., & Devhare, L. D. (2017). Development and Validation of Analytical Methods for Drotaverine and Nimesulide Combination. Research Chronicle in Health Sciences, 3(3), 40-44.
40. Katole, G., & Devhare, L. D. (2020). Recent insight into some emerging natural resources with remarkable hepato protective potentials. International journal of pharmaceutical science and research, 5(1), 41-47.
41. Uplanchiwar, V. P., Raut, S. Y., & Devhare, L. D. (2021). Pharmacological assessment of antiulcer activity of gloriosa superba linn tubers in experimentally induced gastric ulcers. Journal of medical pharmaceutical and allied science, 10(3), 2852-2856.
42. Devhare, L. D., & Gokhale, N. (2021). Acid neutralizing capacity and antimicrobial potential of selected solvent extract from various indigenous plants. Journal of Advanced Scientific Research, 12(04), 175-179.
43. Devhare, L. D., & Gokhale, N. (2022). Antioxidant and Antiulcer property of different solvent extracts of Cassia tora Linn. Research Journal of Pharmacy and Technology, 15(3), 1109-1113.
44. Devhare, L. D., & Gokhale, N. (2023). In silico anti-ulcerative activity evaluation of some bioactive compound from Cassia tora and Butea monosperma through moleculer docking approach. International journal of pharmaceutical sciences and research, 14(2), 1000-1008.

45. Devhare, L. D., & Gokhale, N. (2023). A brief review on: phytochemical and antiulcer properties of plants (fabaceae family) used by tribal people of gadchiroli maharashtra. International journal of pharmaceutical sciences and research, 14(4), 1572-1593.
46. Nikam N, R., Vaishnavi, A., & Devhare, L. D. (2023). Parenteral drug delivery approach: an overview. Journal of xidian university, 17(1), 386-400.
47. Shende, S. M., Bhandare, P., & Devhare, L. D. (2023). In-vitro: micropropagation of mint and investigate the antibacterial activity of mint extract. Eur. Chem. Bull, 12(5), 780-784.
48. Bodhankar, S. S., Devhare, L. D., Meshram, A. S., Moharkar, D. W., & Badwaik, C. B. (2023). Formulation and in vitro evaluation of dental gel containing ethanglic extract of Mimosa pudica. European Chemical Bulletin, 12(5), 1293-1299.
49. Devhare, L. D., Bodhankar, S. S., Warambhe, P., Uppalwar, S. V., Uchibagle, S., & Shende, S. M. (2023). Important role of food and nutritional security during Covid-19: A survey. European Chemical Bulletin. 12(5), 1363-1374.
50. Pathak, N. R., Devhare, L. D., Sawarkar, K. R., Dubey, M., Trivedi, V., Thakre, A. R., & Thakare, V. M. (2023). Aclinial reveiew on pharmacological evaluation of Thiazolidine and Isatin in the new millenium as magic moieties. European Chemical Bulletin. 12(5), 3410-3417.
51. Singh, S., Minj, K. H., Devhare, L. D., Uppalwar, S. V., Anand, S., Suman, A., & Devhare, D. L. (2023). An update on morphology, mechanism, lethality, and management of dhatura poisoning. European Chemical Bulletin. 12(5), 3418-3426.
52. Suruse, P. B., Jadhav, B. A., Barde, L. G., Devhare, L. D., Singh, S., Minj, K. H., & Suman, A. (2023). Exploring the potential of Aerva Lanata extract in a herbal ointment for fungal infection treatment. Journal of Survey in Fisheries Sciences. 10(1), 1922-1932.
53. Shende, S. M., Meshram, B., Karemore, H., & Devhare, L. D. (2023). Development And Characterization of Glycerogelatin Suppositories For Enhanced Efficacy. European Journal of Pharmaceutical and Medical Research. 10(6), 522-528.
54. Thakare, V. M., Umare, S. A., & Devhare, L. D. (2023). Separation and purification of carboxymethyl cellulose from Spinacia Oleracea for use in pharmaceutical dosage form. European Chemical Bulletin. 12(5), 4062-4080.

55. Suruse, P. B., Deshmukh, A. P., Barde, L. G., Devhare, L. D., Maurya, V. K., Deva, V., & Priya, N. S. (2023). Rimegepant embedded fast dissolving films: A novel approach for enhanced migraine relief. Journal of Survey in Fisheries Sciences, 10(1) 2071-2084.
56. Prasad, M., Suman, A., Srivastava, S., Khosla, G., Deshmukh, A., Devhare, L. D., & Meshram, S. S. Butea monosperma stem bark extract partially reverses high fat diet-induced obesity in rats. European Chemical Bulletin. 12(5), 4267 – 4273.
57. Shukla, M., Tiware, S. A., Desai, S. R., Kumbhar, S. T., Khan, M. S., Mavai, Y., & Devhare, L. D. (2023). Pharmacological Evaluation of Gloriosa Superba Linn Flower Extract For Antiulcer Activity. Journal of Survey in Fisheries Sciences. 10(2) 463-470.
58. Polireddy, P., Malviya, V., & Devhare, L. D. (2023). Assessment of Hepatoprotective Potential of Ecbolium Linneanum Extract on Experimental Animals. Journal of Coastal Life Medicine. 2(11) 884-890
59. Devhare, L. D., Hiradeve, S. M., & Bobade, T. (2017). Method Development & Validation For Determination of Water Content. LAP LAMBERT Academic Publishing.
60. Shukla, M., Tiware, S. A., Desai, S. R., Kumbhar, S. T., Khan, M. S., Mavai, Y., & Devhare, L. D. (2023). Pharmacological Evaluation of Gloriosa Superba Linn Flower Extract For Antiulcer Activity. Journal of Survey in Fisheries Sciences, 10(2) 463-470.
61. Polireddy, P., Malviya, V., Arora, S., Singh, M., Pooja Tanaji, G., Devhare, L. D., & Dharmamoorthy, G. (2023). Assessment of Hepatoprotective Potential of Ecbolium Linneanum Extract on Experimental Animals. Journal of Coastal Life Medicine, 11(2) 884-890.
62. Singh, M., Malik, A., Devhare, D. L., Ruikar, D. B., Krishnan, K., Kumar, D. V., & Devnani, D. (2023). Comparative Case Study on Tuberculosis Patients Between Rural And Urban Areas. Journal of Survey in Fisheries Sciences, 10(2) 622-632.
63. Devhare, L. D., Kumbhar, S. T., Chitrapu, P., Kundral, S., & Borkar, A. A. (2023). In-Silico Molecular Docking Study of Substituted Imidazo 1, 3, 4 Thiadiazole Derivatives: Synthesis, Characterization, and Investigation of their Anti-Cancer Activity. Journal of Coastal Life Medicine, 11(2) 1237-1245.

64. Thakre, S. M., Kumar, D. V., Ahuja, A., Hamid, N., Thakre, A. R., Khan, M. S., & Devhare, D. L. (2023). Exploring the Influence of an Antifungal Medication on Patients Receiving Oral Hypoglycemic Therapy: Investigating the Interplay Between Medications. Journal of Coastal Life Medicine, 11(2) 1255-1262.
65. Devhare, L. D., Katole, G. (2018) Diluent and granulation study on Metformin Hydrochoride. LAP LAMBERT Academic Publishing.
66. Krishna KVVS, Jain PK, Devhare LD, Sharma RK. A Study on Antidiabetic Potential of Dried Fruits Extract of Eucalyptus Globulus in Experimental Animals. Journal of Biomedical Engineering 2023, 40(3), 99-110
67. Tiwari R, Mishra J, Devhare LD, Tiwari G. PharmaAn Updated Review on Recent Developments and Appli-Cations of Fish Collagen. Pharma Times 2023, 55(6), 28-36

Table 1. Effect of EE extract of the Roots of *MO* against alcohol-induced gastric ulcer in rats

Group and dose	Ulcer positive animals	Ulcer index	%Ulcer protection
Control (2% w/v gum acacia)	6	7.427±0.04	-
Lansoprazole (8 mg/kg)	1	1.800±0.04**	76.67
Low dose EE (100mg/kg)	4	5.417±0.15**	22.45
Medium dose EE (200mg/kg)	3	4.227±0.02**	40.55
High dose EE (400mg/kg)	2	3.214±0.10**	61.01
Low dose AE (100mg/kg)	4	5.217±0.15**	23.88
Medium dose AE (200mg/kg)	3	4.227±0.06**	43.82
High dose AE (400mg/kg)	2	3.727±0.10**	63.02

Table 2. Effect of EE extract of the Roots of *MO* against cold stress induced gastric ulcers in rats.

Group and dose	Ulcer positive animals	Ulcer index	%Ulcer protection
Control (2% w/v gum acacia)	6	11.43±0.14	-
Lansoprazole (8 mg/kg)	1	1.447±0.03**	81.00
Low dose EE (100mg/kg)	5	8.396 ± 0.07**	21.00
Medium dose EE (200mg/kg)	4	6.10 ± 0.16**	38.00
High dose EE (400mg/kg)	3	5.223 ± 0.06**	56.17
Low dose AE (100mg/kg)	4	7.33 ± 0.15**	37.00
Medium dose AE (200mg/kg)	3	5.23± 0.07**	58.00
High dose AE (400mg/kg)	2	3.22 ± 0.07**	70.00

Table 3. Lipid Peroxidation Estimation in treated groups in ethanol induced ulcer model in rats

** P < 0.01 when compared with control

Sl. No.	Treatment	Malondialdehyde (MDA) (nm/g gastric tissue)
A.	Normal control	24.03 ± 0.32
B.	Control	44.44 ± 0.50
C.	Lansoprazole	27.34 ± 0.48**
D.	Low dose EE (100mg/kg)	36.38±0.91**
E.	Medium dose EE (200mg/kg)	33.59 ± 1.43**
F.	High dose EE (400mg/kg)	29.22±1.39**
G.	Low dose AE (100mg/kg)	38.04±1.69**
H.	Medium dose AE (200mg/kg)	31.04±0.75**
I.	High dose AE (400mg/kg)	29.17±1.07**

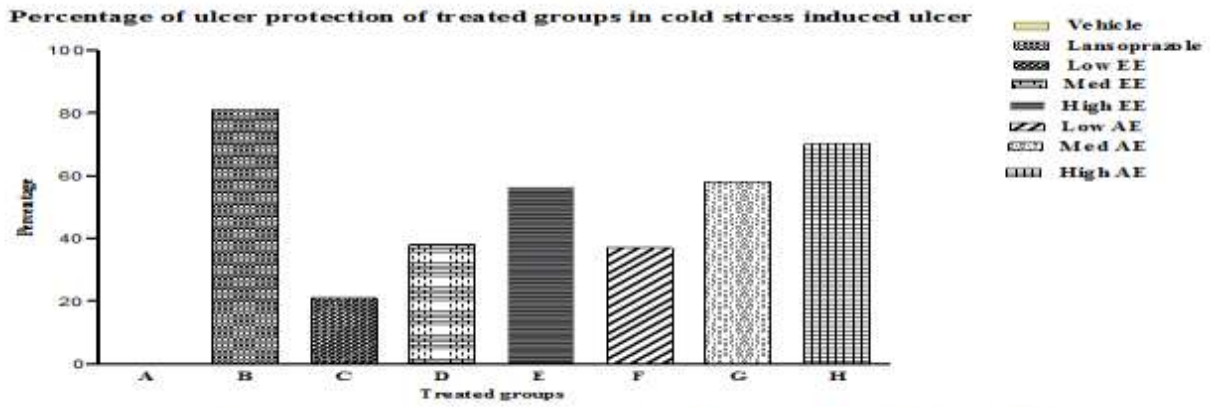

Fig 02: Percentage Ulcer protection in cold stress induced ulcer model

Percentage of ulcer protection of treated groups in cold stress induced ulcer
Vehicle
Lansoprazole
Low EE
Med EE
High EE
Low AE
Med AE
High AE
Percentage
100
80
60
40
20
0
A
B
C
D
E
F
G
H
Treated groups

Fig 02: Percentage Ulcer protection in cold stress induced ulcer model

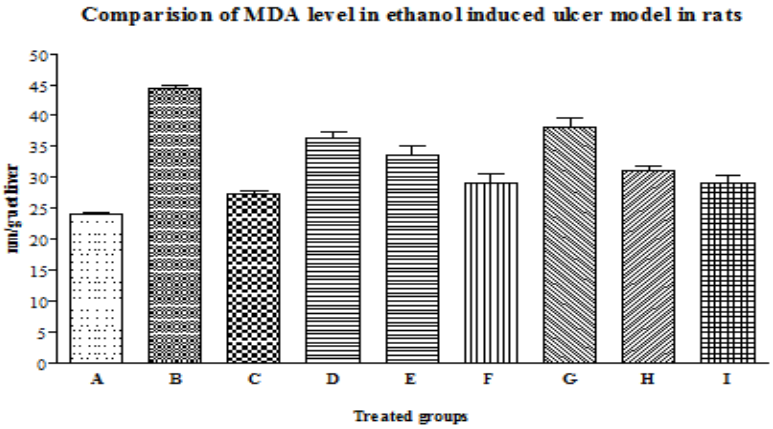

Fig 03: Comparison of MDA levels in ethanol induced ulcer model in rats.

Ethanol induced ulcer model

Normal Control

Control

Lansoprazole

Cold stress induced ulcer model

Normal Control

Control

Lansoprazole

High dose of EE

High dose of AE