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EVALUATION OF ANTIDIABETIC POTENTIAL *MURRAYA KOENIGII* & *ABELMORACHUS ESCULENTUS* EXTRACT IN DIABETIC RAT

Mohammad Maaz[1]*,Preeti Kuniyal[2]

[1,2]HIMT College of Pharmacy,KnowledgePark, Greater Noida, UP

Corresponding Author Email:maazmohammad068@gmail.com

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Abstract:
Diabetes is a metabolic illness that has spread throughout the world in the 20 century. The effect of *lady finger and curry leaves* ethanolic extract on blood sugar levels was investigated in acute and prolonged study models in ethanol -induced diabetic rats.In the acute trial, the following medications were given orally: control, standard, combined extract of formulations, individual curry leaves and lady fingers administered to them. Blood sugar levels were measured before and after dose in the strategic response at 1, 7, and 14 hours, correspondingly.The 300 and 500 mg/kg concentrations of ethanolic extract were discovered after hyperglycemic testing. Significantly lower serum sugar concentrations was obtained.

Keywords: *Murraya koenigii*, *Abelmorachus esculentus, Diabetes, Blood sugar, Polyherbal*

1. Introduction

Diabetes Mellitus is a long-term metabolic disorder marked by chronically high blood sugar levels. To distinguish the illness from diabetes insipidus, which is also associated with excessive urination, British physician John Rolle introduced the term "mellitus" in the late 1700s. It's a rapidly increasing global problem with serious social, medical, and economic consequences [1-3].

In the lack of clear hyperglycemia, a good outcome should be validated by repeating any of the following methods on another day. Because the ease of implementation and the significant time investment of official glucose sensitivity testing, that requires 2 hours to perform and has no predictive benefit over the overnight test, it is preferred to assess a fasting blood glucose. Two overnight glucose levels above 126 mg/dl (7.0 mmol/l) are deemed definitive for diabetes mellitus, per the modern interpretation.

Diabetes insipidus is a rare condition that has signs similar to insulin resistance but does not cause sugar metabolism problems (insipidus meaning "without taste" in Latin) but does not include the same disease processes [4].

A diet rich in whole grain and fibre, as well as selecting beneficial fats like vegetable oils found in nuts, trans fats, or fish, have been shown to be helpful in preventing diabetes. Reducing sugary drinks & consuming less red meat as well as other saturated fat sources also can aid in diabetes prevention. Continuous smoking has also been linked to an

elevated risk of diabetic, therefore quitting can be a valuable preventive approach [5].
Herbs, or plants with medical properties, are the source of herbal remedies. There are various groupings within the plant kingdoms; however, botanical classification is not provided in this section. Conversely, there are four types of herbal plants: climbers, woody perennials, perennials and biennials, trees, and shrubs. This page onlydiscussesbloomingplants;fungus,fern,moss,andalgaearediscussedinpassing[6-8].
Medicinal herbalism, or the use of herbs, is the term for the practice of treating plants. Western modern medicine is not the same as medicinal Herbalism, but ultimately the two come together. For instance, using cascara or senna to relieve diarrhoea, sunburn and bruises with aloe Vera gel, and colds with friar's balsam or benzoin tincture [9].
Okra or lady finger in enriched in flavonoids, which are phenolic chemicals that are found naturally in a wide variety of foods, such as fruits, vegetables, and seeds. Flavonoids have been implicated as important potential chemopreventive agents due to mounting evidence of their preventative function against obesity and type 2 diabetes. We reviewed research on the impact of flavonoids and foods high in flavonoids on the modulation of the insulin-signaling pathway during type 2 diabetes and obesity, both *in vitro* and *in vivo*. It's interesting that not many studies involving humans have evaluated the modulatory impact of these phenolic chemicals at the molecular degree of insulin control [10-12]
Diabetes can be managed with a variety of medications and therapies, most of which have negative side effects and are costly (such as insulin and thiazolidinediones) for developing nations like India. impacts (such as low blood sugar). India has a long history of using traditional medicine in addition to having an enormous stock of natural resources.These systems have listed several spices that are frequently used in Indian food as having anti-diabetic qualities. Aim of the study if to investigate and develop a novel plant-based anti-diabetic drug that was tested in vitro and in vivo.

2. Methodology:

Sample collection and preparation: pharmacology department certified the leaves of plant name were gathered.The plant samples were collected from the local area and then allowed to washed with distilled water. The washed samples were kept for air dry to remove water traces.For 15 days, the sample were kept at room temperature. Then, using a motorized grinder, it was ground into dus.t This extract was obtained using Ethyl acetate, Ethanol, and Ethanol in order of rising polarity. In a soxhlet device, 300g of the crushed leaves was evenly put into a thimble & recovered with 1000ml Organic solvent [13].
Assay for the inhibition of alpha-amylase: 1000 µl of test materials with comparison medicine (100-1000 g.ml-1) liquids are combined with 0.5 ml buffer solution (pH 6.9 and 0.2mM) and -amylase (0.50 mg/L) solution in 0.5 ml dilution method (pH 6.9 and 0.2mM) solutions and stored at 25.00°C for 20 seconds. Each tube was then given 500.00 l of 1% starch solutions in phosphate buffer (pH 6.9 and 0.2mM). The resulting mixture was then maintained at 25°C for 10 minutes.
The reaction was terminated with 1 mL of DNS colour solution. The tubes was chilled to normal body temperature after five min in a water bath. The absorbance was measured at 540 nm after diluting the solution mixture using 5 mL D.W. Standards reflected 100 percent enzymatic activities and was performed out in the same way as extracts but with a different vehicle [13]

TLC slides preparation & activation: Mixture is composed of a mix of immobile & liquid phases. TLC plates are commonly prepared by pouring, dipping, sprinkling, or spraying. In the dropping technique, slurry is prepared and poured onto the glass. The slurry was spread out evenly across the glass plate. Dishes are cleaned in the oven. During the dipping procedure, two plates are dipped in slurry, separated, and then dried. The massive amount of slurry required is a disadvantage. TLC spreader is utilised in this approach. The glass plates are layered on top of each other on the base plate.

Slurry was pumped into the TLC spreader's reservoir. The spreader's thickness can be modified by turning a knob. For analytical applications, a thickness of 0.25 mm is commonly utilised. The plates was spreader rolled on them and then air dried. Plates are activated by exposing them to temperatures ranging from 100 to 120 degrees Celsius for one hour. For later usage, activated plates can be stored in a thermostatically controlled oven.

For excellent spotting the quantity of the solid material should be kept to a minimum. 2-Employing measuring cylinder, spot 4ug of a 1% mixture of reference or specimen. Spots ought to be 3 cm above the plate's bottom and must not be submerged in the solvent system. On a 1⁄4 plate, at least four locations can be found.

Industrial sheets with silica gel pre-applied are accessible. Choose a solvents by experimenting with different solvent on the sample. Dissolve a tiny amount of EtOH extract of unknown leaves in various flasks containing various polar solvent. Place the TLC plates in the chambers with the spotted flat side to decrease the pencil line around the solvents [14]. Allow this plates to dry after removing it from the potential depends.

Screening of Phytoconstituents: Preliminary phytochemical screening of ethanolic leaves extract of curry leaves &lady finger. The ethanolic leaves extract of was used for testing preliminary phytochemical screening in order to detect major chemical groups [15].

Pharmacological study: Healthy adult wistar rats strain between age 3week 1 month and weight approx. 200 gram Diabetes induce rat -Alloxan and Drug *murrya koenijii, Abelmoschus esculen*tus.

Experimental design: There was two groups formed from the animals. There was six animals each group. The dosage schedule and group size details are as follows[16].

Group	***Details of Group***	***Animal***	***Treatment and Dosing schedule***	***Duration of Treatment***
1	*Normal control group*	*6*	*Vehicle treated(0.1% normal saline)*	*14 days*
2	*Disease control*	*6*	*Alloxan 130mg/kg I.P*	*14 days*
3	*Treatment control (1^{st} dose level)*	*6*	*Curry leaves 200,400 mg/kg*	*14 days*
4	*Treatment control (2^{nd} Dose level)*	*6*	*Lady finger 200,400 mg/kg*	*14 days*
5	*Only drug treated 2^{nd} dose level*	*6*	*Curry leaves And lady finger dose*	*14 days*
6	*Standard drug*	*6*	*Metformin dose depend the animal weight*	*14 days*

Estimation of biochemical parameters

Collection of blood samples: Regular charting 14 days tail vein.Overnight blood specimens was taken, and blood sugar levels was measured after 1, 7, and 14 days of fasting.

Blood glucose level: The quantity of sugar in the blood specimen received from the mice is measured by the blood glucose level test. The testing is frequently done to look for high blood glucose concentrations which can indicate diabetic or insulin resistance [17].

Statistical analysis: Statistics research was performed by utilizing PRISM 5.0. All the data of Biochemical variables and body mass was represented as SEM. The values was examined for statistically relevance utilizing (ANOVA), comparing was performed by employing Dunnett's t test. P values less than 0.05 was deemed significant P values ≤0.01 was deemed very substantial, P ≤0.001 was deemed extremely substantial, and was not substantial [18].

3.Results and Discussions:

Sample collection:

The samples were collected from the tree located in the Noida. Initially, the collected samples were washed with distilled water and then crushed into powder. The fine powdered samples were dipped into polar and nonpolar solvents. Further, the samples were filtered and the extracts were collected into marked tubes after evaporating the solvents; as explained in figure.

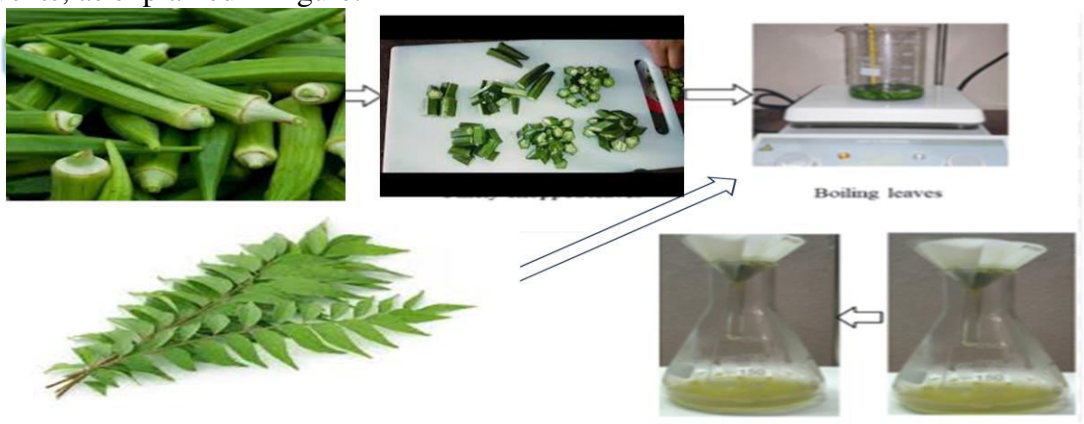


Figure 1: Extraction of bioactive compounds from *lady finger and curry leaves.*

Phytochemical screeing:

The extracted compounds were analysed for the presence and absence of phytochemicals and found that the terpenoids are present in all of the extracts, while flavonoids are absent in 70% ethanolic extract. The results were illustrated in table

Table 1:PhytochemicalTestResultsfor

Secondary metabolite	Lady finger			Curry leaves		
	Ethanol	Chloroform	Acetic acid	Ethanol	Chloroform	Acetic acid
Terpenoids	+	+	+	+	+	-
Flavonoids	+	+		+	+	-
Phlobatanins	+		+	+	-	+
Tanins	+	+	+	+	+	-
Courmarin	+		+	+	-	+
Leucoanthocyanin	-	-		-		-

Steroids	-	-	-	+	-	
Fatty acids	+	+	+	-	+	+

Table 2:Standard λmaxrange

S.No	Standardλmaxrange (innm)	λmaxobtained(innm) Lady finger	λmaxobtained(innnm) curry leaves
1.	Tannins(300 nm–365 nm)	300	299
2.	Saponins(230 nm-355 nm)	244	254
3.	Steroids(310 nm – 340 nm)	310	254
4.	Terpenoids (330 nm – 385 nm) &(255 nm – 340 nm)	314	351

Animal study for diabetes:

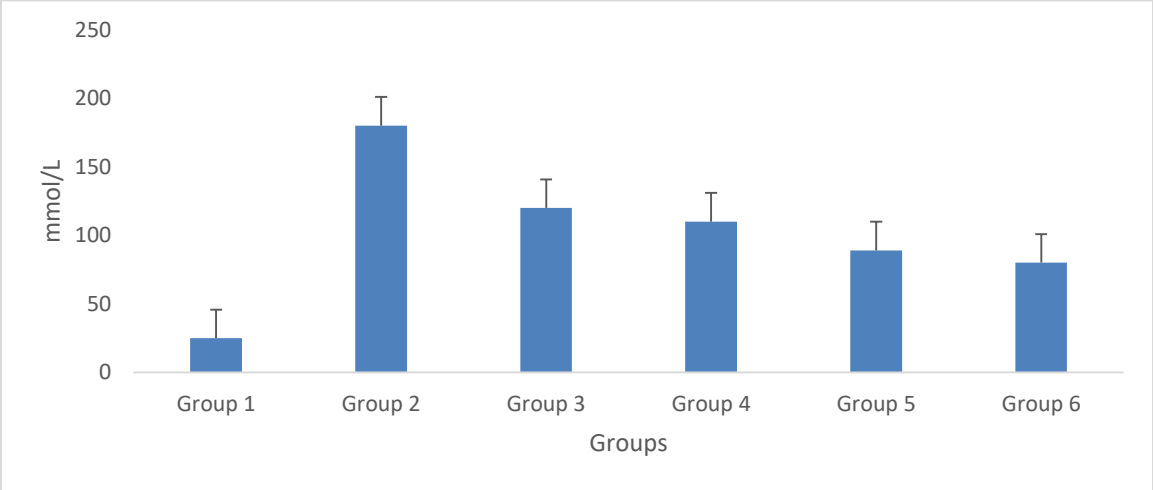


Table 3:Showingdifferentialcountsofleucocytesfoundindifferentgroups

DifferentGroups	Erythrocytes (NR: 7.0-10.1x10^6 Cells/cmm)	WBC (NR:-3.8-12.7x10^3 Cells/cmm)	Hemoglobin(NR: 14-18 gm/dl)	Platelets (NR:766–1677 x10^3Cells/cmm)
I	10.0	12.5	14.2	940.5
II	9.8	11.9	13.4	935.6
III	5.5	3.4	8.0	800.4
IV	9.3	11.0	13.0	856.5
V	9.8	11.6	14.0	840.0
VI	10.0	12.5	14.2	940.5

Groups	Neutrophil(NR:50-81%)	Lymphocyte (NR:14-44%)	Basophile(NR:0-1%)	Monocytes (NR:2-6%)	Eosinophil(NR:1-2%)
I	65.5±3	26.4±2	1.2±1	5.4±2	1.5±0.5
II	70.7±4.0	34.8±3	1.4±1	5.5±2	1.6±0.6
III	40.6±2.0	40.9±4	4.0±2	10.20±3	4.03±0.5
IV	58.4±3.0	32.9±3	1.30±0.3	5.4±0.5	2.15±0.2

V	63.5±3.0	27.8±2	1.5±1	5.6±2	2.12±0.2
VI	65.5±3	26.4±2	1.2±1	5.4±2	1.5±0.5

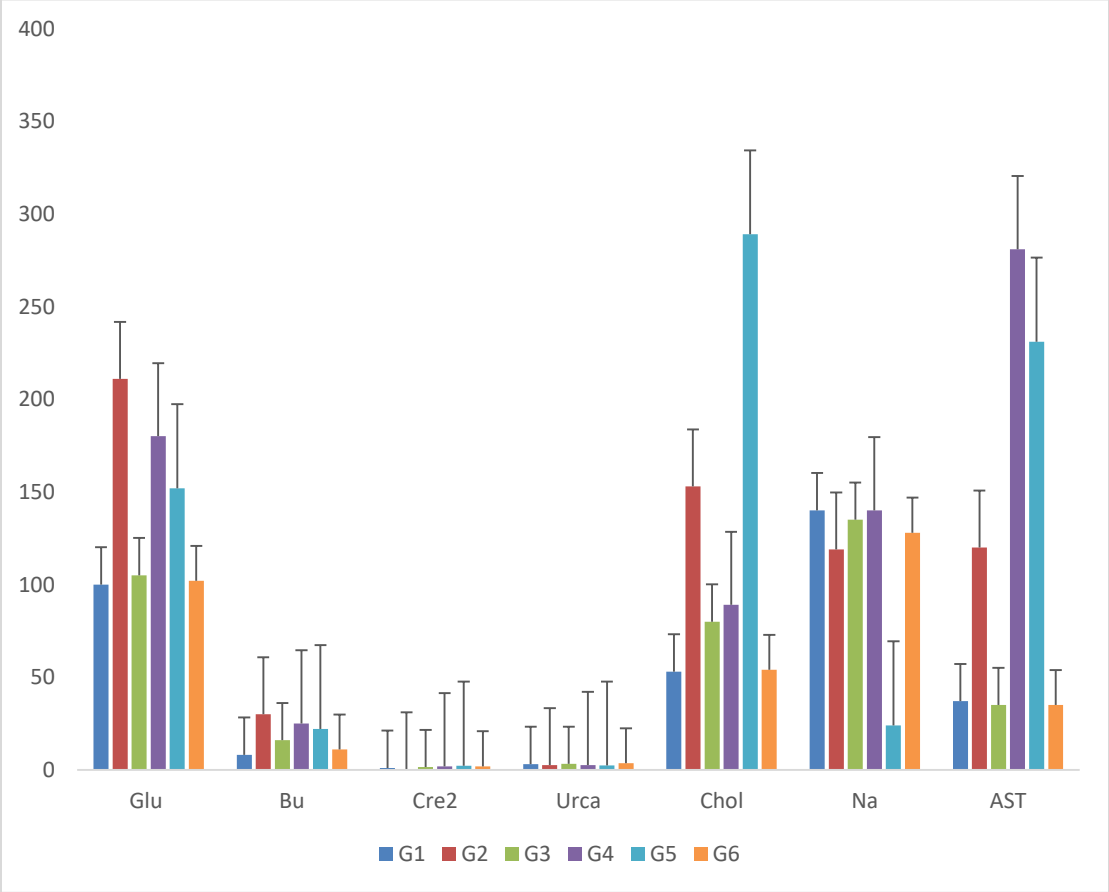
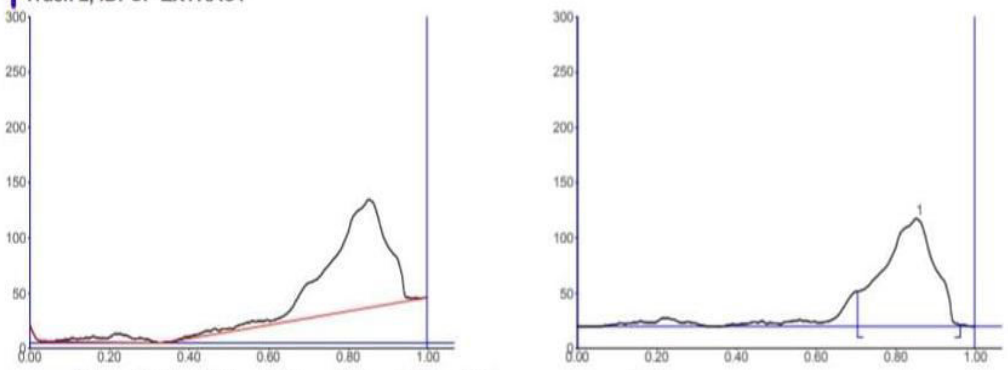


Figure 2: Serum routine test

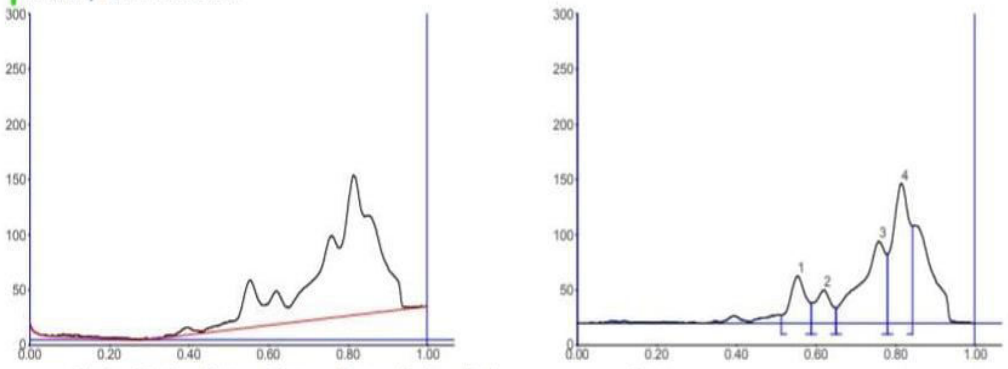
winCATS Planar Chromatography Manager

Track 2, ID: CP EXTRACT



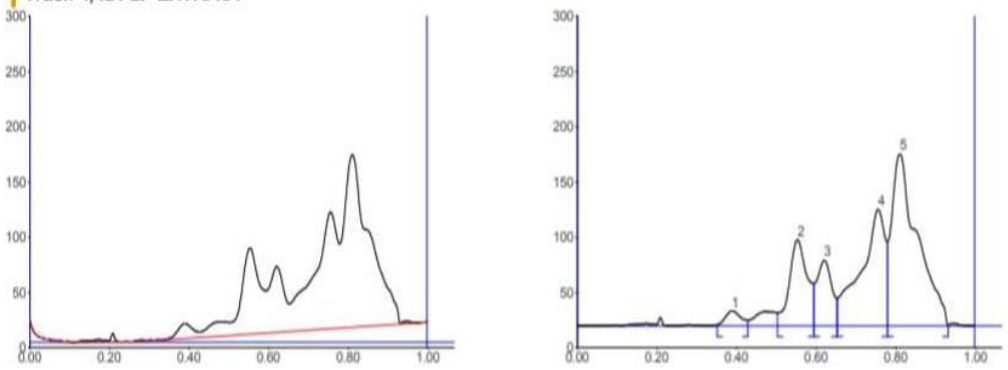
Peak	Start Rf	Start Height	Max Rf	Max Height	Max %	End Rf	End Height	Area	Area %	Assigned substance
1	0.71	31.9	0.85	97.9	100.00	0.96	1.6	10841.6	100.00	unknown *

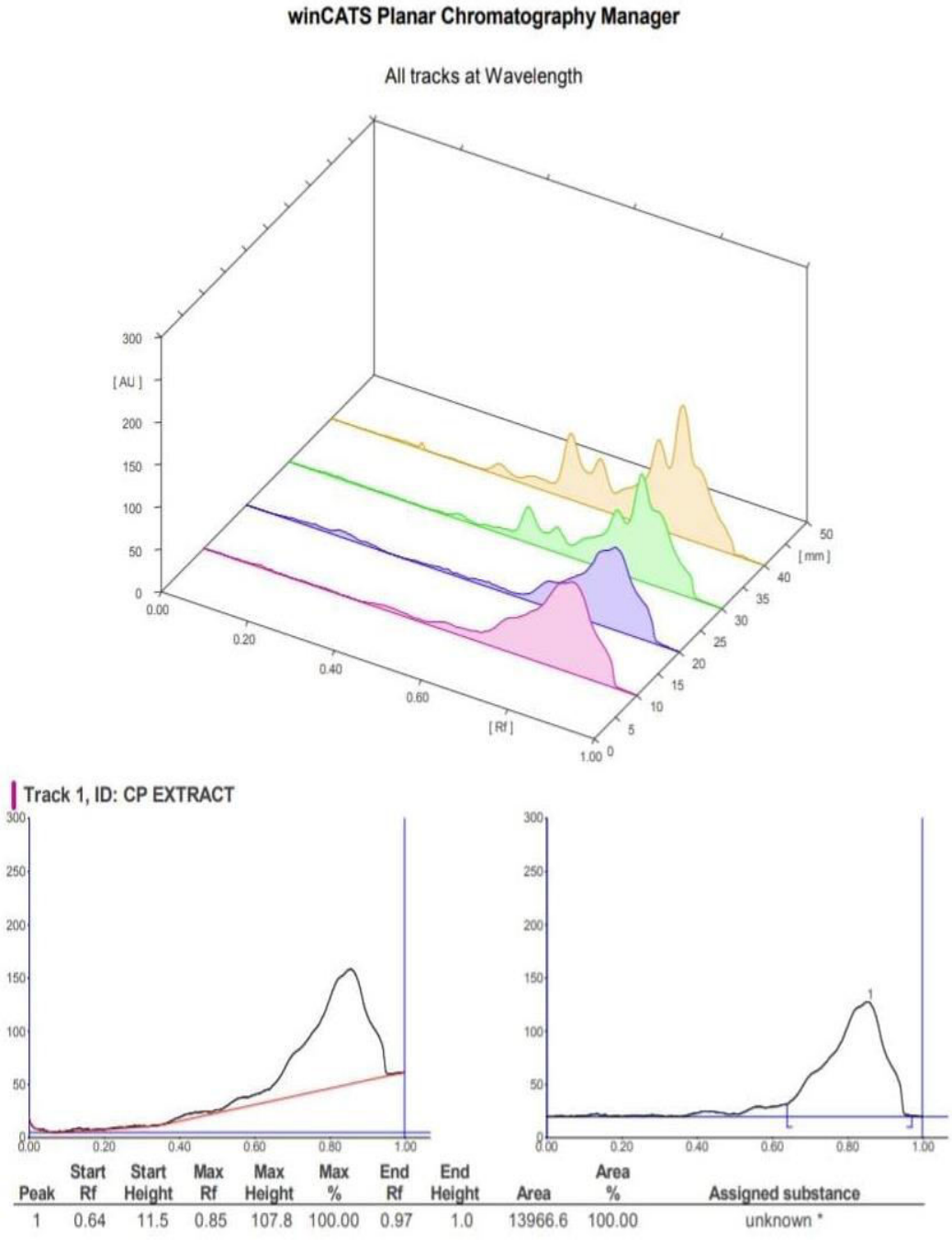
Track 3, ID: LF EXTRACT



Peak	Start Rf	Start Height	Max Rf	Max Height	Max %	End Rf	End Height	Area	Area %	Assigned substance
1	0.51	7.5	0.55	42.9	15.66	0.59	18.6	1443.8	12.80	unknown *
2	0.59	18.6	0.62	30.2	11.04	0.65	14.1	1040.1	9.22	unknown *
3	0.65	14.2	0.76	74.2	27.08	0.78	62.4	4087.8	36.25	unknown *
4	0.78	62.6	0.82	126.6	46.23	0.84	88.3	4706.1	41.73	unknown *

Track 4, ID: LF EXTRACT





Peak	Start Rf	Start Height	Max Rf	Max Height	Max %	End Rf	End Height	Area	Area %	Assigned substance
1	0.64	11.5	0.85	107.8	100.00	0.97	1.0	13966.6	100.00	unknown *

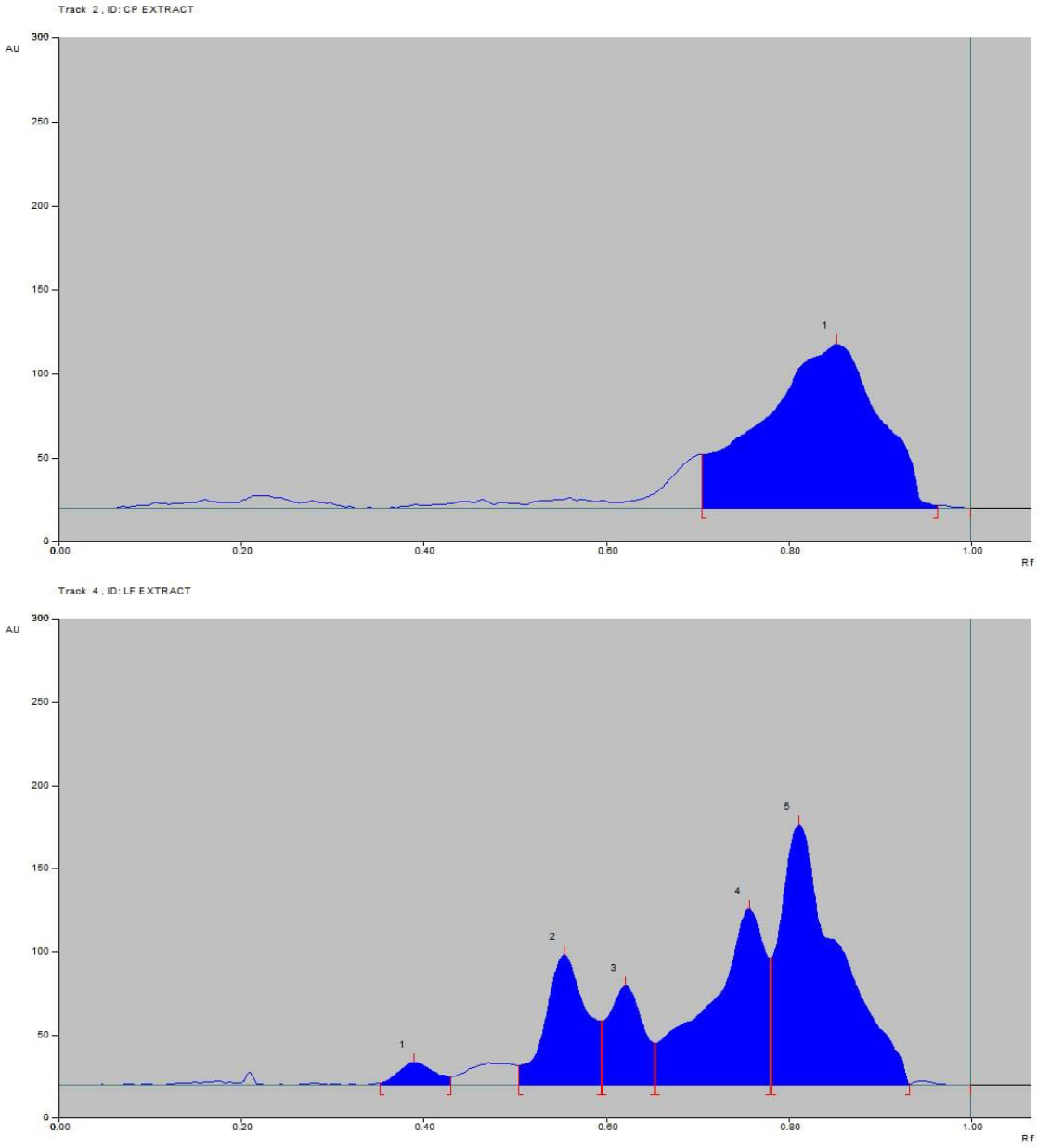


Figure 3: HPTLC analysis of the compounds

Peak	Rf	Area
1	0.35	466
2	0.50	3055
3	0.60	1959.6
4	0.65	5578.8
5	0.78	8823.3

Histopathology studies:

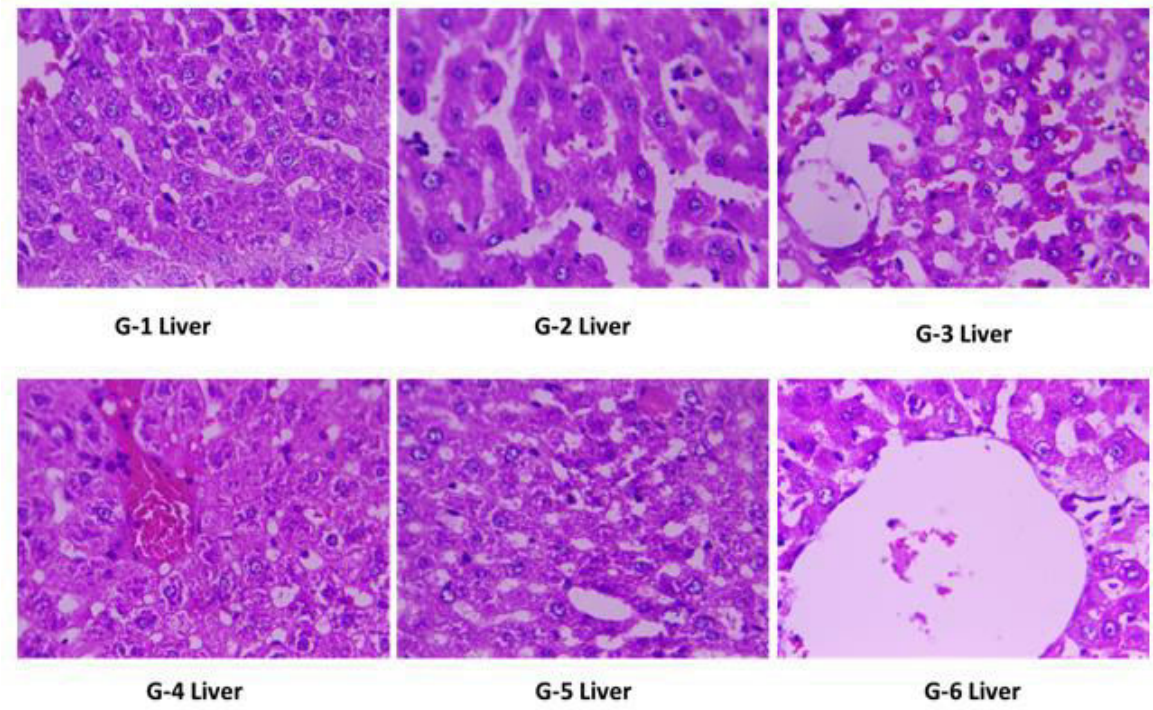


Figure 4: Histopathological studies on liver

The histopathological examination of the liver across different experimental groups reveals distinct variations attributable to the specific treatments administered. In the G1 (Control) group, the liver tissue is expected to display normal histological architecture, characterized by well-preserved hepatocytes, clear central veins, and minimal signs of inflammation or necrosis, indicative of a healthy liver. In contrast, the G2 (Standard) group, which might be subjected to a known standard treatment, should exhibit liver histology close to normal, potentially with slight improvements or minor deviations depending on the nature of the standard treatment used.

In the G3 (Curry leaves + Lady finger) group, the combined treatment of curry leaves and lady finger is anticipated to demonstrate protective or restorative effects on the liver. Histologically, this group should show reduced signs of liver damage, with a significant decrease in inflammatory cell infiltration, necrosis, and fatty degeneration, indicating the hepatoprotective synergy of the combined extracts. The G4 (Curry leaves) group is expected to show similar hepatoprotective effects, potentially manifesting as improved liver architecture, reduced inflammation, and lesser necrosis, reflective of the beneficial properties of curry leaves alone.

For the G5 (Lady finger extract) group, the liver histopathology should reveal beneficial effects of the lady finger extract, with improved hepatocyte integrity, reduced signs of oxidative stress, and lesser inflammation, highlighting its protective role against liver damage. Lastly, the G6 (Alloxan) group, which serves as a model for induced liver damage, is anticipated to display significant pathological changes. These changes might include extensive hepatocyte necrosis, pronounced inflammatory infiltration, and possible fatty changes, indicative of alloxan-induced hepatotoxicity and oxidative stress.

Overall, these expected histopathological findings reflect the varying impacts of different treatments on liver health, providing insights into their potential therapeutic or toxicological effects.

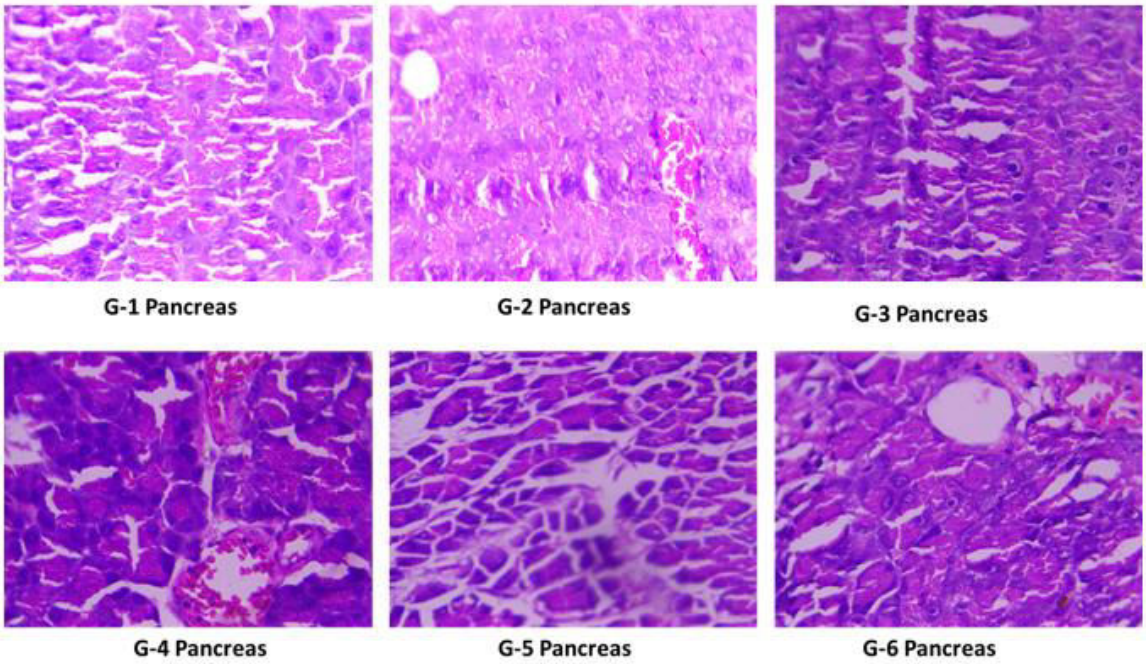


Figure 5: Histopathologial studies on Pancreas

The histopathological examination of the pancreas across different experimental groups reveals distinct variations attributable to the specific treatments administered. In the G1 (Control) group, the pancreatic tissue is expected to display normal histological architecture, characterized by well-preserved acinar cells and intact islets of Langerhans, with minimal signs of inflammation or necrosis, indicative of a healthy pancreas. In contrast, the G2 (Standard) group, which might be subjected to a known standard treatment, should exhibit pancreatic histology close to normal, potentially with slight improvements or minor deviations depending on the nature of the standard treatment used.

In the G3 (Curry leaves + Lady finger) group, the combined treatment of curry leaves and lady finger is anticipated to demonstrate protective or restorative effects on the pancreas. Histologically, this group should show reduced signs of pancreatic damage, with a significant decrease in inflammatory cell infiltration, necrosis, and degeneration, indicating the protective synergy of the combined extracts. The G4 (Curry leaves) group is expected to show similar protective effects, potentially manifesting as improved pancreatic architecture, reduced inflammation, and lesser necrosis, reflective of the beneficial properties of curry leaves alone.

For the G5 (Lady finger extract) group, the pancreatic histopathology should reveal beneficial effects of the lady finger extract, with improved acinar cell integrity, reduced signs of oxidative stress, and lesser inflammation, highlighting its protective role against pancreatic damage. Lastly, the G6 (Alloxan) group, which serves as a model for induced pancreatic damage, is anticipated to display significant pathological changes. These changes might include extensive necrosis of the acinar cells, pronounced inflammatory

infiltration, and possible degeneration, indicative of alloxan-induced pancreatic toxicity and oxidative stress.

Overall, these expected histopathological findings reflect the varying impacts of different treatments on pancreatic health, providing insights into their potential therapeutic or toxicological effects.

Conclusion

- **Curry Leaves and Lady Finger Combination (Group III)**: The combination treatment significantly disrupts blood parameters and induces a strong inflammatory response in the pancreas, suggesting potential adverse effects on health.
- **Curry Leaves (Group IV) and Lady Finger (Group V) Extracts**: Both individual treatments show mild protective effects on pancreatic tissue with slight impacts on blood health. These treatments may be beneficial in moderate doses but require careful monitoring of blood parameters, especially hemoglobin and platelet levels.
- **Control (Group I), Standard Treatment (Group II), and Alloxan (Group VI)**: These groups maintain relatively normal blood and tissue health, indicating stability and minimal adverse effects from the treatments.

References

1. Mandal S, Vishvakarma P. Nanoemulgel: A Smarter Topical Lipidic Emulsion-based Nanocarrier. Indian J of Pharmaceutical Education and Research. 2023;57(3s):s481-s498.
2. Mandal S, Jaiswal DV, Shiva K. A review on marketed Carica papaya leaf extract (CPLE) supplements for the treatment of dengue fever with thrombocytopenia and its drawback. International Journal of Pharmaceutical Research. 2020 Jul;12(3).
3. Bhandari S, Chauhan B, Gupta N, et al. Translational Implications of Neuronal Dopamine D3 Receptors for Preclinical Research and Cns Disorders. *African J Biol Sci (South Africa)*. 2024;6(8):128-140. doi:10.33472/AFJBS.6.8.2024.128-140
4. Tripathi A, Gupta N, Chauhan B, et al. Investigation of the structural and functional properties of starch-g-poly (acrylic acid) hydrogels reinforced with cellulose nanofibers for cu2+ ion adsorption. *African J Biol Sci (South Africa)*. 2024;6(8): 144-153, doi:10.33472/AFJBS.6.8.2024.141-153
5. Sharma R, Kar NR, Ahmad M, et al. Exploring the molecular dynamics of ethyl alcohol: Development of a comprehensive model for understanding its behavior in various environments. Community Pract. 2024;21(05):1812-1826. doi:10.5281/zenodo.11399708
6. Mandal S, Kar NR, Jain AV, Yadav P. Natural Products As Sources of Drug Discovery: Exploration, Optimisation, and Translation Into Clinical Practice. African J Biol Sci (South Africa). 2024;6(9):2486-2504. doi:10.33472/AFJBS.6.9.2024.2486-2504
7. Kumar S, Mandal S, Priya N, et al. Modeling the synthesis and kinetics of Ferrous Sulfate production: Towards Sustainable Manufacturing Processes. African J Biol Sci (South Africa). 2024;6(9):2444-2458. doi:10.33472/AFJBS.6.9.2024.
8. Revadigar RV, Keshamma E, Ahmad M, et al. Antioxidant Potential of Pyrazolines Synthesized Via Green Chemistry Methods. African J Biol Sci (South Africa). 2024;6(10):112-125. doi:10.33472/AFJBS.6.10.2024.112-125
9. Sahoo S, Gupta S, Chakraborty S, et al. Designing, Synthesizing, and Assessing the Biological Activity of Innovative Thiazolidinedione Derivatives With Dual

Functionality. African J Biol Sci (South Africa). 2024;6(10):97-111. doi:10.33472/AFJBS.6.10.2024.97-111
10. Mandal S, Bhumika K, Kumar M, Hak J, Vishvakarma P, Sharma UK. A Novel Approach on Micro Sponges Drug Delivery System: Method of Preparations, Application, and its Future Prospective. Indian J of Pharmaceutical Education and Research. 2024;58(1):45-63.
11. Mishra, N., Alagusundaram, M., Sinha, A., Jain, A. V., Kenia, H., Mandal, S., & Sharma, M. (2024). Analytical Method, Development and Validation for Evaluating Repaglinide Efficacy in Type Ii Diabetes Mellitus Management: a Pharmaceutical Perspective. Community Practitioner, 21(2), 29–37. https://doi.org/10.5281/zenodo.10642768
12. Singh, M., Aparna, T. N., Vasanthi, S., Mandal, S., Nemade, L. S., Bali, S., & Kar, N. R. (2024). Enhancement and Evaluation of Soursop (Annona Muricata L.) Leaf Extract in Nanoemulgel: a Comprehensive Study Investigating Its Optimized Formulation and Anti-Acne Potential Against Propionibacterium Acnes, Staphylococcus Aureus, and Staphylococcus Epidermidis Bacteria. Community Practitioner, 21(1), 102–115. https://doi.org/10.5281/zenodo.10570746
13. Khalilullah, H., Balan, P., Jain, A. V., & Mandal, S. (n.d.). Eupatorium Rebaudianum Bertoni (Stevia): Investigating Its Anti-Inflammatory Potential Via Cyclooxygenase and Lipooxygenase Enzyme Inhibition - A Comprehensive Molecular Docking And ADMET. Community Practitioner, 21(03), 118–128. https://doi.org/10.5281/zenodo.10811642
14. Mandal, S. Vishvakarma, P. Pande M.S., Gentamicin Sulphate Based Ophthalmic Nanoemulgel: Formulation and Evaluation, Unravelling A Paradigm Shift in Novel Pharmaceutical Delivery Systems. Community Practitioner, 21(03), 173-211. https://doi.org/10.5281/zenodo.10811540
15. Mishra, N., Alagusundaram, M., Sinha, A., Jain, A. V., Kenia, H., Mandal, S., & Sharma, M. (2024). Analytical Method, Development and Validation for Evaluating Repaglinide Efficacy in Type Ii Diabetes Mellitus Management: A Pharmaceutical Perspective. Community Practitioner, 21(2), 29–37. https://doi.org/10.5281/zenodo.10642768
16. Singh, M., Aparna, T. N., Vasanthi, S., Mandal, S., Nemade, L. S., Bali, S., & Kar, N. R. (2024). Enhancement and Evaluation of Soursop (Annona Muricata L.) Leaf Extract in Nanoemulgel: a Comprehensive Study Investigating Its Optimized Formulation and Anti-Acne Potential Against Propionibacterium Acnes, Staphylococcus Aureus, and Staphylococcus Epidermidis Bacteria. Community Practitioner, 21(1), 102–115. https://doi.org/10.5281/zenodo.10570746
17. Gupta, N., Negi, P., Joshi, N., Gadipelli, P., Bhumika, K., Aijaz, M., Singhal, P. K., Shami, M., Gupta, A., & Mandal, S. (2024). Assessment of Immunomodulatory Activity in Swiss Albino Rats Utilizing a Poly-Herbal Formulation: A Comprehensive Study on Immunological Response Modulation. Community Practitioner, 21(3), 553–571. https://doi.org/10.5281/zenodo.10963801
18. Mandal S, Vishvakarma P, Bhumika K. Developments in Emerging Topical Drug Delivery Systems for Ocular Disorders. Curr Drug Res Rev. 2023 Dec 29. doi: 10.2174/0125899775266634231213044704. Epub ahead of print. PMID: 38158868.

19. Abdul Rasheed. A. R, K. Sowmiya, S. N., & Suraj Mandal, Surya Pratap Singh, Habibullah Khallullah, N. P. and D. K. E. (2024). In Silico Docking Analysis of Phytochemical Constituents from Traditional Medicinal Plants: Unveiling Potential Anxiolytic Activity Against Gaba, Community Practitioner, 21(04), 1322–1337. https://doi.org/10.5281/zenodo.11076471
20. Pal N, Mandal S, Shiva K, Kumar B. Pharmacognostical, Phytochemical and Pharmacological Evaluation of Mallotus philippensis. Journal of Drug Delivery and Therapeutics. 2022 Sep 20;12(5):175-81.
21. Singh A, Mandal S. Ajwain (Trachyspermum ammi Linn): A review on Tremendous Herbal Plant with Various Pharmacological Activity. International Journal of Recent Advances in Multidisciplinary Topics. 2021 Jun 9;2(6):36-8.
22. Mandal S, Jaiswal V, Sagar MK, Kumar S. Formulation and evaluation of carica papaya nanoemulsion for treatment of dengue and thrombocytopenia. Plant Arch. 2021;21:1345-54.
23. Mandal S, Shiva K, Kumar KP, Goel S, Patel RK, Sharma S, Chaudhary R, Bhati A, Pal N, Dixit AK. Ocular drug delivery system (ODDS): Exploration the challenges and approaches to improve ODDS. Journal of Pharmaceutical and Biological Sciences. 2021 Jul 1;9(2):88-94.
24. Shiva K, Mandal S, Kumar S. Formulation and evaluation of topical antifungal gel of fluconazole using aloe vera gel. Int J Sci Res Develop. 2021;1:187-93.
25. Ali S, Farooqui NA, Ahmad S, Salman M, Mandal S. Catharanthus roseus (sadabahar): a brief study on medicinal plant having different pharmacological activities. Plant Archives. 2021;21(2):556-9.
26. Mandal S, Vishvakarma P, Verma M, Alam MS, Agrawal A, Mishra A. Solanum Nigrum Linn: An Analysis Of The Medicinal Properties Of The Plant. Journal of Pharmaceutical Negative Results. 2023 Jan 1:1595-600.
27. Vishvakarma P, Mandal S, Pandey J, Bhatt AK, Banerjee VB, Gupta JK. An Analysis Of The Most Recent Trends In Flavoring Herbal Medicines In Today's Market. Journal of Pharmaceutical Negative Results. 2022 Dec 31:9189-98.
28. Mandal S, Vishvakarma P, Mandal S. Future Aspects And Applications Of Nanoemulgel Formulation For Topical Lipophilic Drug Delivery. European Journal of Molecular & Clinical Medicine.;10(01):2023.
29. Chawla A, Mandal S, Vishvakarma P, Nile NP, Lokhande VN, Kakad VK, Chawla A. Ultra-Performance Liquid Chromatography (Uplc).
30. Mandal S, Raju D, Namdeo P, Patel A, Bhatt AK, Gupta JK, Haneef M, Vishvakarma P, Sharma UK. Development, characterization, and evaluation of rosa alba l extract-loaded phytosomes.
31. Mandal S, Goel S, Saxena M, Gupta P, Kumari J, Kumar P, Kumar M, Kumar R, Shiva K. Screening of catharanthus roseus stem extract for anti-ulcer potential in wistar rat.
32. Shiva K, Kaushik A, Irshad M, Sharma G, Mandal S. Evaluation and preparation: herbal gel containing thuja occidentalis and curcuma longa extracts.
33. Vishvakarma P, Kumari R, Vanmathi SM, Korni RD, Bhattacharya V, Jesudasan RE, Mandal S. Oral Delivery of Peptide and Protein Therapeutics: Challenges And Strategies. Journal of Experimental Zoology India. 2023 Jul 1;26(2).

34. Mandal, S., Tyagi, P., Jain, A. V., & Yadav, P. (n.d.). Advanced Formulation and Comprehensive Pharmacological Evaluation of a Novel Topical Drug Delivery System for the Management and Therapeutic Intervention of Tinea Cruris (Jock Itch). Journal of Nursing, 71(03). https://doi.org/10.5281/zenodo.10811676