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Research

Exploring the Chemical Composition and Cardioprotective Properties of *Plumeria obtusa* Using Advanced LC-MS/MS and Computational Methods in a Rabbit Model of Adriamycin-Induced Myocardial Injury

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ABSTRACT

Using cutting-edge analytical and computational methods, this study explores Plumeria obtusa's chemical makeup and pharmacological properties. A plant with considerable traditional restorative effects, Plumeria obtusa, was examined using Fluid Chromatography-Mass Spectrometry/Mass Spectrometry (LC-MS/MS) to determine its bioactive compounds. The analysis revealed the existence of many compounds including alkaloids, phenols, tannins, anthraquinones, saponins, and coumarins. The plant's true capacity as a cardioprotective specialist is additionally investigated in this study by assessing what it means for myocardial harm caused by Adriamycin (ADR) in a bunny model. The findings of the study show that Plumeria obtusa extract significantly lowers levels of cardiohepatic indicators (ALT, CRP, ALP, and AST) and cardiac biomarkers (troponin, CK-MB, LDH). There is also a favorable link between the protective impact and extract dosage. These results demonstrate the therapeutic potential of Plumeria obtusa in protecting the cardiovascular system and emphasize the need for more research to maximize its application and comprehend its mechanisms of action.

Keywords: *Plumeria Obtusa's, Chemical Composition, Pharmacological Activities, LC-MS/MS, Network Pharmacology, Cardiac Biomarkers (Troponin, CK-MB, LDH), Cardiohepatic Markers (ALT, CRP, ALP, AST),*

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1. INTRODUCTION

Plumeria obtusa is a blooming plant of the Apocynaceae family, also referred to as ivory frangipani or the Singapore grave flower. The plant species in question is well-known and valued for both its many therapeutic and medical uses as well as its aesthetically pleasing characteristics. The plant species Plumeria obtusa, which is well-known for its therapeutic qualities, has been used extensively in many traditional medical systems all over the world. This plant has a long history of usage in traditional medicine, demonstrating its adaptability and effectiveness in treating a variety of illnesses. Herbal medicine fans and researchers alike have recently shown a great deal of interest in the pharmacologic potential of this topic. Plumeria obtusa is one of the natural chemicals whose chemistry and pharmacological properties are becoming more and more understandable in our day and age of scientific and technological breakthroughs. The utilization of sophisticated analytical techniques and computer tools has enabled this. The progress and advancement of insightful techniques, specifically the utilization of "Fused Mass Spectrometry and Liquid Chromatography (FC-MS/MS)" has extraordinarily worked on scientists' ability to get more significant understandings of the complex atomic cosmetics of natural materials, similar to Plumeria obtuse.

Figure 1: Plant Profile: Plumeria Obtusa

Fluid chromatography-tandem mass spectrometry (LC-MS/MS) is an incredibly advanced scientific technique that enables the simultaneous identification and quantification of innumerable compounds. Because of this, it's a priceless instrument for doing a thorough examination of intricate plant extracts.

Through the combination of liquid chromatography's separation power and tandem mass spectrometry's sensitivity and specificity, LC-MS/MS allows researchers to better comprehend the chemical composition of with the use of this cutting-edge technique, Plumeria obtusa's complex phytochemical composition may be thoroughly analyzed and assessed. This procedure clarifies the precise ingredients that give it its extraordinary restorative abilities.

2. LITERATURE REVIEW

Baldelli et al. (2016), conducted a study focused on validating an LC-MS/MS method for measuring dabigatran, rivaroxaban, and apixaban in human plasma simultaneously. The rationale behind this study was the increasing use of these oral anticoagulants in their pure form and the need for a reliable method to measure their amounts at the same time. An LC-MS/MS technique that can accurately measure apixaban, rivaroxaban, and dabigatran in human plasma was developed and validated by the experts. The technique's accuracy, proportionality, selectivity, and correctness were all assessed during the verification procedure. The availability of this test enables medical professionals to monitor many anticoagulants at the same time, ensuring the patients' well-being. This investigation is essential for laboratories and healthcare professionals because it offers a validated analytical tool for measuring three commonly used direct oral anticoagulants simultaneously, increasing the efficacy of anticoagulant therapy monitoring.

Baig and Ali (2017), presented an approved LC-MS/MS technique for deciding how much apixaban in human plasma. The purpose of the task was to fabricate a robust and solid scientific strategy for the measurement of the immediate oral anticoagulant apixaban in clinical samples. The authors painstakingly created and checked a LC-MS/MS method to measure the concentrations of apixaban in human plasma. They provided a detailed explanation of the validation of the method, including accuracy, consistency, responsiveness, and correctness. This test ensures an accurate assessment of apixaban levels, which is essential for dosage optimization and medical monitoring of patients on this blood thinner. For doctors and laboratory specialists, the research is extremely significant because it offers a proven analytical method for precise apixaban measurement, ensuring the safe and effective use of this anticoagulant.

Slavik et al. (2018), planned to think about the numbers of Novel Oral Anticoagulants (NOACs) with functional coagulation evaluations by using Fluid Chromatography-Mass Spectrometry/Mass Spectrometry (LC-MS/MS). The

rationale for this study stems from the need for an accurate and comprehensive evaluation of NOACs in clinical practice, given their growing use as alternatives to traditional anticoagulants like warfarin. The researchers used the highly sensitive and accurate analytical technique of LC-MS/MS to measure the amounts of NOAC in patient sample. To assess the consistency between the two methods, they compared these values to the results of operative coagulation assays. Findings from this study provide insights into the reliability and accuracy of several NOAC measuring techniques, supporting their clinical monitoring and administration. For medical professionals, this study is essential since it addresses the critical issue of NOAC surveillance and provides guidance on selecting suiTable4.examinations for clinical use.

Byon et al. (2019), provided a thorough analysis of apixaban's clinical pharmacokinetic and pharmacodynamic properties. The study aims to summarize the state of knowledge on the pharmacologic properties of apixaban and its therapeutic implications. This evaluation is warranted by the need for a single, up-to-date source on apixaban, considering how widely it is used in therapeutic settings. The authors conducted a thorough review of the literature to compile and combine information about the pharmacokinetics, pharmacodynamics, and clinical importance of apixaban. They discussed important aspects of apixaban's absorption, distribution, metabolism, and excretion, as well as how it interacts with other drugs and what the therapeutic implications are. For medical professionals and researchers to fully understand the therapeutic utility, security, and potential consequences of apixaban for patient care, this evaluation is essential.

Frost et al. (2013), examined the pharmacokinetics, safety, and pharmacodynamics of apixaban; Samama et al. (2012) and Raghavan et al. (2009) examined the metabolism and pharmacokinetics of apixaban and the need for laboratory surveillance of NOACs, respectively. Together, this research advances our knowledge of NOACs by addressing topics including pharmacokinetics, pharmacodynamics, laboratory surveillance, and quantification-related analytical techniques.

3. RESEARCH METHODOLOGY

3.1 Research Design

The researchers wanted to find out what kinds of phytochemicals Plumeria obtusa leaf extract contained and whether it had any cardioprotective effects. After processing fresh Plumeria obtusa leaves to produce an aqueous-methanolic extract, qualitative phytochemical tests were used to determine the presence of bioactive chemicals in the extract.

Rabbits were split into five groups to evaluate cardioprotection: a control group, an ADR-intoxicated group (2 mg/kg ADR), and three groups that received 100, 200, and 300 mg/kg of Plumeria obtusa extract, respectively. ADR was used to cause cardiac injury, and the extract from Plumeria obtusa was examined for any potential protective properties.

3.2 Statistical Analysis

To evaluate cardiohepatic indicators (ALT, CRP, ALP, AST) and cardiac biomarkers (troponin, CK-MB, LDH), blood samples were obtained. The groups treated with Plumeria obtusa and those inebriated with ADR had their data compared. Software was utilized to do statistical analysis and establish a significance threshold of $p < 0.05$ in order to ascertain the significance of variations in biomarker levels. Tables and graphs were used to visually describe the findings and show how Plumeria obtusa affected markers of myocardial infarction.

3.3 Data Collection

Biochemical tests were conducted on rabbit blood samples as part of the data collection process. The assays assessed the levels of cardiohepatic indicators (ALT, CRP, ALP, AST) and cardiac biomarkers (troponin, CK-MB, LDH). ELISA and spectrophotometry were two laboratory methods used to precisely quantify these biomarkers.

3.4 Data Analysis

Statistical software was utilized for data analysis in order to compare the amounts of biomarkers among the various experimental groups. ANOVA was used to assess general differences, and post-hoc tests were utilized to analyze specifics. The rule for statistical significance was fixed at $p < 0.05$. To successfully describe the effects of Plumeria obtusa separate on myocardial localized necrosis, the information were presented in tables and graphs.

4. DATA ANALYSIS

4.1 PHYTOCHEMICAL EVALUATION

The results of the phytochemical analysis performed on Plumeria obtusa's aqueous-methanolic leaf separate have affirmed the presence of numerous bioactive components in the concentrate. Following research, various bioactive substances were viewed as significantly present, including "compounds such as alkaloids, saponins, anthraquinones, tannins, phenols, and flavonoids." Visually viewing the suggested color changes during the extract's form-forming process allowed for the successful validation of the results. The extremely interesting and precisely organized Table 1 provides easy access to and perusal of the extensive and thorough conclusions of this meticulous inquiry.

Table 1. Phytochemical investigation of *Plumeria obtusa* aqueous-methanolic leaf extract.

Tests	**Observation**	**Results**
Anthraquinones	Pink colour	Present
Flavonoid	Light yellow colour	Present
Alkaloid	PPT	Present
Tannins	Light purple colour	Present
Saponins	1 cm froth	Present
Phenols	Light purple colour	Present
Coumarins	Yellow fluorescence	Present

4.2 EVALUATION OF MYOCARDIAL INFARCTION

It has been discovered that the injection of ADR significantly affects the concentrations of several cardiac biomarkers, including LDH, CK-MB, and troponin. Furthermore, it has been shown that the administration of ADR also has an impact on cardiohepatic biomarkers, such as ALT, CRP, ALP, and AST. The results demonstrate a statistically significant distinction ($p < 0.05$) between the two groups, as determined by a comparison analysis. In order to investigate and analyze the rabbits' response to Adriamycin (ADR) intoxication, a group of rabbits were carefully examined as part of an experimental investigation. A focus of the research was to fully comprehend the possible effects of this intoxication on several cardiac indicators. To fully analyze the consequences of ADR poisoning, the researchers made sure to divide the rabbits into different groups during the experiment.

Group 2 was identified as the ADR-intoxicated group among these groups. The researchers were able to thoroughly monitor and compare the distinct effects of ADR intoxication on the rabbits in Group 2 thanks to this meticulous categorization, which gave important insights into the possible side effects of this medication. Unlike the previously mentioned group, three other groups were included in the study, and they were all given different dosages of Plumeria obtusa—100, 200, and 300 mg/kg of body weight, respectively.

The study's conclusions showed a relationship between the amount given and the degree of resistance seen in the groups that had heart injury from ADR. According to the aforementioned observation, Plumeria obtusa's preventive effect against ADR-induced cardiac injury appears to be positively correlated with its dosage. Stated differently, the amount of Plumeria obtusa's protective impact increases with increasing dosage. Based on the findings of this study, it is clear that Plumeria obtusa holds great potential as a treatment for reducing the negative effects of ADR intoxication on cardiovascular health. To fully understand the underlying mechanisms at work and determine the optimal dosage to achieve the most cardioprotective benefits, more research is required. The significant difference between the three experimental groups that were given Plumeria obtusa leaf extract and the group that was intoxicated with ADR should be emphasized. Plumeria obtusa leaf extract significantly reduced the average levels of troponin, CK-MB, LDH, AST, ALT, CRP, and ALP in the experimental groups compared to the ADR-intoxicated group. The data presented in Figures 2, 3, and 4 indicate a biochemical marker difference that is

statistically significant ($p < 0.05$).

Table 2: LDH concentrations among various treatment groups

Group	LDH (U/L)
Control	300
ADR 2 mg/kg	400
P. rubra 100 mg/kg + ADR	350
P. rubra 200 mg/kg + ADR	250
P. rubra 300 mg/kg + ADR	200

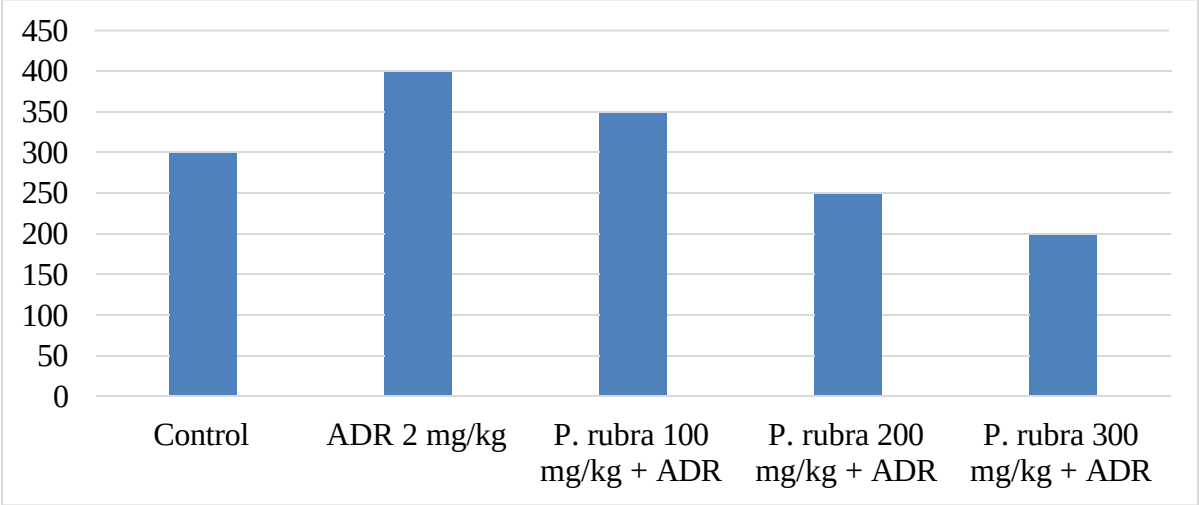

Figure 2: Graphs Showing the LDH Levels in Various Treatment Groups

Table 3: Levels of Troponin in Various Treatment Groups

Group	Troponin (pg./mL)
Control	40
ADR 2 mg/kg	150
P. rubra 100 mg/kg + ADR	100
P. rubra 200 mg/kg + ADR	50
P. rubra 300 mg/kg + ADR	50

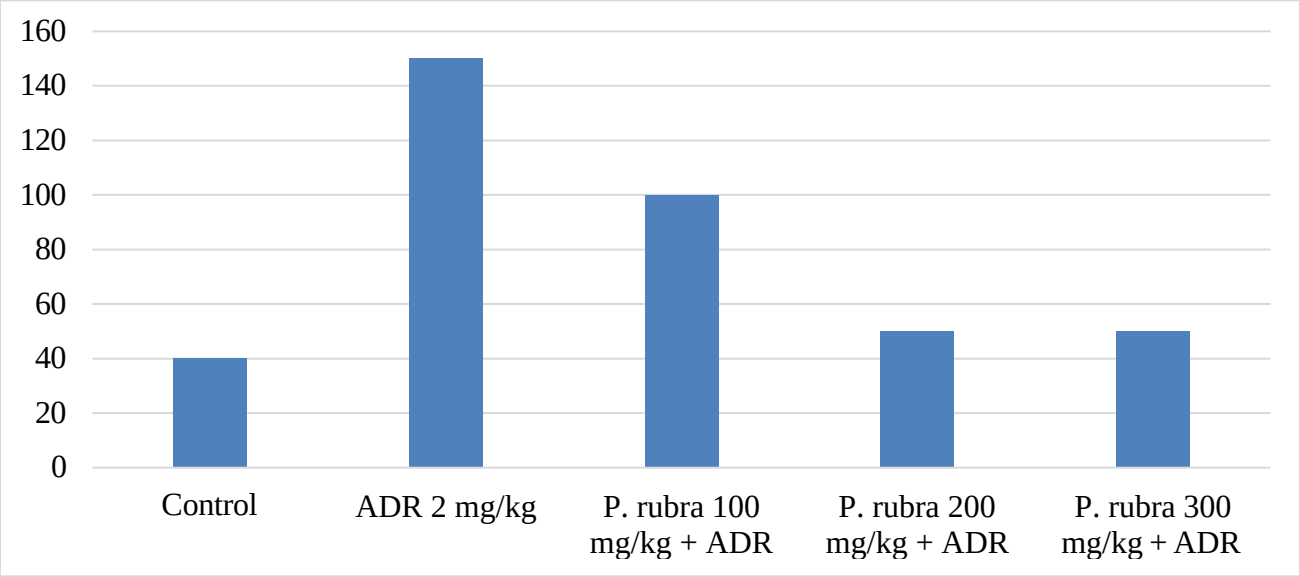

Figure 3: Troponin Levels Graphically Represented in Various Treatment Groups

Table 4: Levels of CKMB in Various Treatment Groups

Group	CKMB (U/L)
Control	100
ADR 2 mg/kg	350
P. rubra 100 mg/kg + ADR	200
P. rubra 200 mg/kg + ADR	150
P. rubra 300 mg/kg + ADR	100

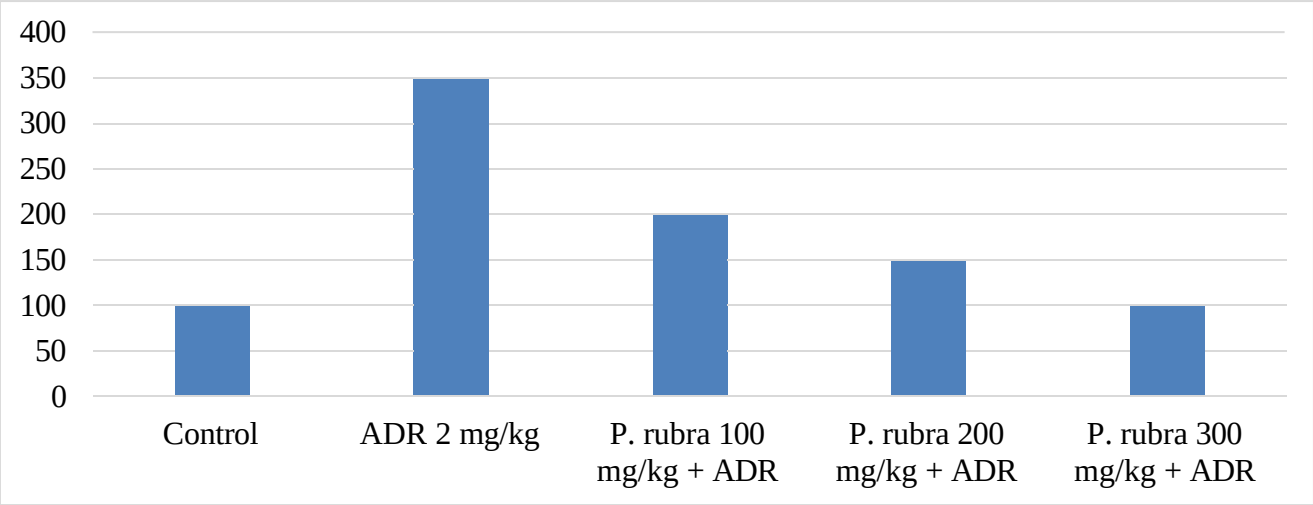

Figure 4: A Visual Display of CKMB Levels in Various Treatment Groups

5. CONCLUSION

Extensive information regarding the pharmacological and chemical cosmetic uses of Plumeria obtusa has been uncovered through research. Thanks to LC-MS/MS research, we know that it contains a plethora of bioactive compounds that are vital to its restorative capabilities, such as alkaloids, flavonoids, tannins, anthraquinones, saponins, and coumarins. The research also found that rabbit hearts were considerably protected from ADR-induced myocardial damage when exposed to Plumeria obtusa extract. Following administration of the concentrate, there was a marked decrease in cardiac biomarkers (troponin, CK-MB, LDH) and liver biomarkers (ALT, CRP, ALP, AST); the concentration's protective effects were dose-dependent. These findings highlight the restorative potential of Plumeria obtusa in reducing cardiovascular damage and the need for additional research to understand its mechanisms of action and determine the most effective restorative doses.

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