

# Early Prediction of Cardiac Diseases Using Artificial Intelligence, Mattibanana Extract, Molecular Docking, and Novel Drug Formulation

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## Abstract:

Cardiovascular diseases (CVDs), including myocardial infarction and angina pectoris, are major causes of global mortality and morbidity. Delayed diagnosis, unhealthy lifestyle, stress, diabetes, hypertension, and hyperlipidemia significantly increase cardiac risk. Early prediction and effective treatment are essential for reducing complications and improving patient survival. This article proposes an integrated approach combining Artificial Intelligence (AI), phytopharmaceutical research, molecular docking, and novel drug formulation using Mattibanana plant extract as a natural cardioprotective agent.

The AI-based predictive system analyzes clinical and physiological parameters such as ECG signals, blood pressure, cholesterol levels, glucose levels, heart rate variability, age, family history, obesity, smoking habits, and stress biomarkers. Machine learning and deep learning techniques including Random Forest, Support Vector Machine (SVM), Artificial Neural Networks (ANN), and Convolutional Neural Networks (CNN) are used to identify hidden patterns and predict the risk of myocardial infarction and angina at an early stage. The system aims to provide rapid, accurate, and low-cost cardiac risk assessment.

Simultaneously, phytochemical constituents present in Mattibanana extract are screened for cardioprotective activity. Molecular docking studies are performed against cardiovascular targets such as angiotensin-converting enzyme (ACE), HMG-CoA reductase, and inflammatory proteins to evaluate binding affinity and therapeutic potential. Selected compounds are further analyzed using ADMET prediction to determine drug-likeness and safety profiles. Lead compounds with favorable properties are proposed for development into novel formulations such as tablets, nanoparticles, or nanoemulsions. This multidisciplinary approach provides a promising strategy for preventive cardiology and plant-based drug discovery.

## Introduction

Cardiovascular diseases are among the leading causes of death worldwide and continue to place a major burden on healthcare systems. Myocardial infarction and angina pectoris are common forms of cardiovascular disorders caused mainly by reduced blood flow to the heart muscles. Lifestyle modifications, stress, obesity, smoking, hypertension, diabetes mellitus, and elevated cholesterol levels contribute significantly to the development of cardiac diseases. Despite advancements in diagnostic techniques and therapeutic approaches, many patients remain undiagnosed until severe cardiac complications occur.

The emergence of Artificial Intelligence has transformed the healthcare sector by enabling rapid disease prediction, data analysis, and decision-making support. AI systems can analyze large volumes of clinical and physiological data to identify patterns associated with disease progression. In cardiology, machine learning and deep learning algorithms are increasingly used for early detection of myocardial infarction, arrhythmia, heart failure, and angina.

Along with AI-based prediction systems, natural products and medicinal plants have gained attention as safer alternatives for the treatment of cardiovascular diseases. Medicinal plants contain bioactive compounds that possess antioxidant, anti-inflammatory, antihyperlipidemic, anticoagulant, and cardioprotective properties. Mattibanana plant extract is believed to contain phytochemicals capable of protecting cardiac tissues and improving cardiovascular function.

The integration of AI technology with phytopharmaceutical research and computational drug discovery can create innovative healthcare solutions. Molecular docking and in silico studies allow researchers to identify potential drug candidates by evaluating interactions between phytochemicals and cardiovascular targets. The present article discusses the role of AI in early cardiac disease prediction, the cardioprotective potential of Mattibanana extract, molecular docking strategies, and the development of novel formulations for effective cardiovascular therapy.

### **Cardiovascular Diseases and Their Global Impact**

Cardiovascular diseases are disorders affecting the heart and blood vessels. Common forms include coronary artery disease, myocardial infarction, angina pectoris, hypertension, heart failure, and arrhythmias. Myocardial infarction occurs when blood flow to the heart muscle is blocked, resulting in tissue damage or death. Angina pectoris is characterized by chest pain caused by insufficient oxygen supply to the heart.

#### **Several risk factors contribute to cardiovascular diseases:**

- A. Hypertension
- B. Diabetes mellitus
- C. Obesity
- D. Smoking and alcohol consumption
- E. High cholesterol levels
- F. Physical inactivity
- G. Stress and anxiety
- H. Genetic predisposition
- I. Poor dietary habits

According to global health reports, millions of deaths each year are associated with cardiovascular diseases. Early diagnosis and preventive healthcare strategies are essential to reduce mortality rates and improve quality of life.

### **Artificial Intelligence in Cardiac Disease Prediction**

Artificial Intelligence refers to the simulation of human intelligence using computer systems capable of learning, analyzing, and making decisions. AI technologies have revolutionized medical diagnostics by improving speed, accuracy, and efficiency.

#### **Machine Learning in Cardiology**

Machine learning algorithms analyze patient data to identify hidden patterns and predict disease occurrence. Commonly used machine learning algorithms include:

#### **Random Forest**

Random Forest is an ensemble learning method that uses multiple decision trees to improve prediction accuracy. It is widely used for cardiovascular risk assessment because of its ability to handle complex datasets.

### **Support Vector Machine (SVM)**

SVM is a supervised machine learning algorithm that classifies data into different categories. It is effective for detecting cardiac abnormalities and predicting myocardial infarction risk.

### **Artificial Neural Networks (ANN)**

ANNs are computational models inspired by the human brain. They are capable of learning complex relationships between patient parameters and disease outcomes.

### **Convolutional Neural Networks (CNN)**

CNNs are deep learning models particularly useful for image analysis and ECG interpretation. They help identify abnormalities in electrocardiogram signals associated with cardiac disorders.

### **Parameters Used in AI-Based Prediction**

The AI predictive model uses several clinical and physiological parameters:

- A. Electrocardiogram (ECG) signals
- B. Blood pressure
- C. Cholesterol levels
- D. Blood glucose levels
- E. Heart rate variability
- F. Oxygen saturation
- G. Body mass index (BMI)
- H. Age and gender
- I. Smoking history
- J. Family history of heart disease
- K. Physical activity level
- L. Stress biomarkers

The collected data are processed using machine learning algorithms to classify patients into low-risk, moderate-risk, or high-risk groups.

### **Advantages of AI-Based Cardiac Prediction**

AI-based systems offer multiple advantages in cardiovascular healthcare:

- A. Early identification of high-risk individuals
- B. Improved diagnostic accuracy
- C. Reduced healthcare costs
- D. Rapid and real-time analysis
- E. Support for clinicians in decision making
- F. Better management of rural healthcare systems
- G. Reduction in hospitalization and mortality

AI models can continuously improve through data learning and can be integrated with wearable sensors and mobile health technologies for continuous cardiac monitoring.

### **Mattibanana Plant Extract as a Cardioprotective Agent**

Medicinal plants have long been used in traditional healthcare systems for treating various diseases. Plant-derived compounds are considered safer and more economical than synthetic drugs. Mattibanana extract is proposed as a potential source of bioactive compounds for cardiovascular protection.

### **Phytochemical Constituents**

The extract may contain several important phytochemicals such as:

- A. Flavonoids
- B. Alkaloids
- C. Tannins
- D. Phenolic compounds
- E. Glycosides
- F. Saponins
- G. Terpenoids

These compounds possess antioxidant and anti-inflammatory activities that may help protect cardiac tissues from oxidative stress and inflammation.

#### **Role of Antioxidants in Cardiac Protection**

Oxidative stress is one of the major causes of cardiac tissue damage during myocardial infarction. Free radicals damage blood vessels and heart tissues, leading to inflammation and reduced cardiac function.

Antioxidants present in medicinal plants neutralize free radicals and prevent oxidative damage. Flavonoids and phenolic compounds are especially known for their cardioprotective effects.

#### **Anti-Inflammatory Activity**

Inflammation contributes significantly to the progression of cardiovascular diseases. Bioactive compounds present in Mattibanana extract may inhibit inflammatory mediators and reduce cardiac tissue injury.

The anti-inflammatory action may help:

- A. Reduce vascular inflammation
- B. Improve blood circulation
- C. Prevent plaque formation
- D. Decrease cardiac stress
- E. Protect myocardial tissues

#### **Molecular Docking in Drug Discovery**

Molecular docking is a computational technique used to predict interactions between drug molecules and biological targets. It helps identify compounds with strong binding affinity toward disease-related proteins.

Docking studies reduce the time and cost involved in traditional drug discovery by enabling rapid screening of multiple compounds.

#### **Cardiovascular Targets Used in Docking Studies**

##### **Angiotensin-Converting Enzyme (ACE)**

ACE plays a major role in blood pressure regulation. Inhibition of ACE helps reduce hypertension and cardiac workload.

##### **HMG-CoA Reductase**

This enzyme is involved in cholesterol synthesis. Inhibiting HMG-CoA reductase can lower cholesterol levels and reduce the risk of atherosclerosis.

##### **Beta-Adrenergic Receptors**

Beta receptors influence heart rate and cardiac contractility. Modulating these receptors helps control angina and hypertension.

### **Thrombin and Platelet Aggregation Proteins**

These proteins are associated with blood clot formation. Inhibition may help prevent thrombosis and myocardial infarction.

### **Steps Involved in Molecular Docking**

1. Identification of target proteins
2. Isolation of phytochemical compounds
3. Preparation of ligand structures
4. Preparation of protein structures
5. Docking simulation using software
6. Analysis of binding affinity
7. Evaluation of hydrogen bonding and molecular interactions
8. Selection of lead compounds

Common molecular docking software includes:

1. AutoDock
2. AutoDock Vina
3. PyRx
4. Discovery Studio
5. Schrödinger Suite

### **ADMET Prediction**

ADMET stands for Absorption, Distribution, Metabolism, Excretion, and Toxicity. ADMET studies are important for evaluating the safety and drug-likeness properties of compounds.

### **Importance of ADMET Studies**

1. Predict oral bioavailability
2. Determine metabolic stability
3. Evaluate toxicity risks
4. Assess blood-brain barrier penetration
5. Improve drug safety profile

Compounds showing favorable ADMET properties are considered promising drug candidates.

### **Novel Drug Formulation Strategies**

After identifying potent lead compounds through docking studies, suitable formulations can be developed to improve therapeutic effectiveness.

### **Herbal Tablets and Capsules**

Traditional formulations such as tablets and capsules provide convenient administration and dosage accuracy.

### **Nanoparticle-Based Drug Delivery**

Nanoparticles improve drug solubility, stability, and targeted delivery. Nanoformulations can increase bioavailability and reduce side effects.

### **Nanoemulsions**

Nanoemulsions are fine oil-in-water dispersions that improve absorption of poorly soluble phytochemicals.

### **Targeted Drug Delivery Systems**

Targeted systems deliver drugs directly to affected tissues, reducing systemic toxicity and improving therapeutic efficacy.

### **Integration of AI and Drug Discovery**

The combination of AI-based prediction with molecular docking and phytopharmaceutical research creates a powerful healthcare platform. AI can identify high-risk individuals, while computational drug discovery helps identify effective therapeutic agents.

This integrated approach offers:

1. Personalized treatment strategies
2. Rapid identification of lead compounds
3. Reduced research costs
4. Improved healthcare accessibility
5. Better disease management

AI models can also assist in analyzing docking data and predicting the biological activity of compounds.

### **Applications in Rural Healthcare**

Many rural regions lack advanced healthcare facilities and specialist cardiologists. AI-based diagnostic tools can provide rapid screening and risk assessment using portable devices and mobile applications.

The proposed system can help:

1. Detect disease at an early stage
2. Reduce emergency complications
3. Improve accessibility to cardiac care
4. Support telemedicine services
5. Lower healthcare expenses

### **Future Perspectives**

Future research can focus on:

1. Large-scale clinical validation
2. Integration with wearable biosensors
3. Development of AI-powered mobile health applications
4. Advanced nanoformulations
5. Personalized medicine approaches
6. Clinical trials of plant-derived cardioprotective formulations

The integration of genomics, proteomics, and metabolomics with AI may further improve disease prediction and therapeutic development.

### **Challenges and Limitations**

Despite its advantages, several challenges exist:

1. Requirement of large clinical datasets
2. Data privacy and ethical concerns
3. Standardization of herbal extracts
4. Limited clinical validation of plant compounds
5. Computational complexity
6. Regulatory approval challenges

Proper validation and multidisciplinary collaboration are necessary for successful implementation.

## Conclusion

Cardiovascular diseases remain a major global health concern, requiring innovative strategies for early diagnosis and effective treatment. Artificial Intelligence has emerged as a valuable tool for predicting myocardial infarction and angina through rapid analysis of clinical and physiological parameters. The incorporation of medicinal plant research, especially *Mattibanaa* extract, provides opportunities for discovering safer and more effective cardioprotective agents.

Molecular docking and ADMET prediction play important roles in identifying lead compounds with strong therapeutic potential. The development of novel formulations such as nanoparticles and nanoemulsions can further improve drug delivery and treatment outcomes.

The integration of AI, phytopharmaceutical research, molecular docking, and novel drug formulation represents a promising multidisciplinary approach for preventive cardiology and personalized medicine. This strategy may significantly reduce cardiovascular complications, improve patient survival, and contribute to the development of advanced plant-based therapeutics for future healthcare systems.

## Keywords:

Cardiovascular Diseases (CVDs) , Myocardial Infarction , Angina Pectoris , Artificial Intelligence in Healthcare, Machine Learning, Deep Learning, Random Forest Algorithm , Support Vector Machine (SVM), Artificial Neural Networks (ANN) , Convolutional Neural Networks (CNN) , Electrocardiogram (ECG) Analysis , Cardiac Risk Prediction

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