1. INTRODUCTION

Thrombosis, formation or presence of a blood clot in a blood vessel is one of the vital reasons of blood circulation problem. Thrombi or emboli can lodge in a blood vessel and block the flow of blood in that location depriving tissues of normal blood flow and oxygen (Sayeed *et al*., 2014). Blood clot in the vessels is the fundamental pathophysiological process that underlies the acute coronary disorders such as pulmonary emboli, deep vein thrombosis, strokes and heart attacks; which are the main causes of morbidity and mortality in developed countries (Dewan and Das, 2013). Cardiovascular disease caused by blood clot (thrombus) formation is one among the most severe diseases (Kamal *et al*., 2015).

Focal (stroke) and Global (cardiac arrest) cerebral ischemia represent diseases that are common in the human population. Stroke and cardiac arrest, which are major causes of death and disability, affect millions of individuals around the world and are responsible for the leading health care costs of all diseases. After cerebral ischemia/ reperfusion, the reactive oxygen species production is dramatically increased and overwhelms endogenous antioxidant systems, leading to oxidative stress (Jaiswal and Tailing, 2014). Strokes are primarily classified into ischemic or haemorrhagic subtypes. Several genetic and environmental risk factors for stroke have been identified. As the thrombotic and thrombolytic systems are closely related to the pathogenesis of cardiovascular diseases, many studies on bacteria-induced platelet activation have been performed (Nakano *et al*., 2011).

Other than surgical interventions to remove or by pass the blockage, or the generation of collateral vessels to provide a new blood supply, the only treatment available is the administration of thrombolytic agents to dissolve the blood clot (Emran *et al*., 2015). Thrombolytic therapy is the use of drugs to break up or dissolve blood clots, which are the main cause of both heart attacks and stroke. Thrombolytic medications are approved for the immediate treatment of stroke and heart attack (Bahar *et al*., 2013).

Thrombolytic drugs rapidly lyse thrombi by catalyzing the formation of plasmin from plasminogen. These drugs create a generalized lytic state when administered intravenously (Dar and Tabassum, 2012). Thrombolytic agents can be categorized in several ways. Classification schemes can be devised on the basis of the source of the agent,

the propensity for enhanced enzymatic activity on a fibrin or cell surface or the mechanism of action (enzymatic vs. non-enzymatic) or different generation wise (Rao *et al*., 2010).

Thrombolytic agents such as tissue plasminogen activator, urokinase, streptokinase (SK), etc. are used to dissolve the already formed clots in the blood vessels. However, these drugs have certain limitations which cause serious and sometimes fatal consequences including hemorrhage, severe anaphylactic reaction, lack of specificity, etc. Moreover, as a result of immunogenicity multiple treatments with SK in a given patient are restricted. Due to the shortcomings of the available thrombolytic drugs, attempts are underway to develop improved recombinant variants of these drugs (Shivasharanappa and Londonkar, 2014). Tissue-type plasminogen activator (t-PA) is an endogenous enzyme that induces lysis of intravascular thrombi by the activation of plasminogen to plasmin, which degrades the fibrin components of blood clots (Baumer *et al*., 2013).

Agents from plant source are expected to be less antigenic and cheaper. Considerable efforts have been directed towards the discovery and development of natural products from various plant and animal sources which have antiplatelet, anticoagulant, antithrombotic and thrombolytic activities (Al-Mamun *et al.,* 2012).

Medicinal plants have been known for rich source of therapeutic agents for the prevention of diseases and ailments. Nature has great source with an enormous wealth of medicinal plants, therefore India has often been referred to as the Medicinal Garden of the world. A medicinal herb as potential source of therapeutic aids has attained a significant role in health system all over the world for both humans and animals not only in the diseased condition but also as potential material for maintaining proper health (Balakrishnan and Sharma, 2013). Plants have been known to relieve various diseases in Ayurveda. Therefore, the researchers today are emphasizing on evaluation and characterization of various plants and plant constituents against a number of diseases based on their traditional claims of the plants given in Ayurveda (Tiwari *et al*., 2011).

Plant constitutes an important source of active natural products which differ widely in terms of structures, biological properties and mechanisms of action. Phytochemicals are natural bioactive compounds found in plants that work with nutrients and fibers to act as defence system against disease or more accurately, to protect against diseases (Amari *et al*., 2014).

Since ancient times, about 80% of individuals use traditional medicine, which has chemical compounds derived from medicinal plants. These compounds are classified into primary and secondary metabolites. Phytochemical screening is the technique to identify these compounds present in the plant extract derived from any part of the plants like bark, leaves, flowers, seeds etc (Khandelwal *et al*., 2014). Herbal medicines are assumed to be of great importance in the primary healthcare of individuals and communities in many developing countries (Yusuf *et al.,* 2013). Medicinal plants play an important role in antioxidant properties. The undesirable effect of the modern medicine has already diverted the attention of the people towards herbal medicines. To increase the acceptability and awareness among the people, there is an urgent need to develop trust and faith towards the safer indigeneous system by establishing its validity in treatment of various diseases (Alok *et al*., 2014).

Antioxidants are micronutrients that have gained importance in recent years due to their ability to neutralize free radicals or their actions. There is also a considerable amount of evidence revealing an association between individuals who have a diet rich in fresh fruits and vegetables and the decreased risk of cardiovascular diseases and certain forms of cancer (Nandy *et al*., 2012). To prevent oxidation of oils and fats, the use of antioxidants is mandatory because compounds produced from the oxidation of oil such as hydroperoxide, hydroxyl radical and a single oxygen capacity can damage biological molecules. This causes cellular damage and the development of physiological abnormalities such as premature aging, neurological and heart disease (Delfanian *et al*., 2014).

Plants are potential sources of natural antioxidants. Synthetic antioxidants may have adverse biological effects on human body therefore; much attention has been put toward natural antioxidants (Bhowmick *et al*., 2015). Naturally occurring antioxidants in leaf vegetables and seeds, such as ascorbic acid, Vitamin E and phenolic compounds possess the ability to reduce the oxidative damage associated with many diseases. So many researchers have focused on natural antioxidants and in plant kingdom numerous crude extracts and pure natural compounds were previously reported to have antioxidant properties (Shantharam *et al*., 2015).

The application of computational methods to study the formation of intermolecular complexes has been the subject of intensive research during the last decade. It is widely accepted that drug activity is obtained through the molecular binding of one molecule (the

ligand) to the pocket of another, usually larger, molecule (the receptor), which is commonly a protein (Teodora *et al*., 2000).

Molecular docking is the most commonly used technique in the modern drug discovery process where computational approaches involving docking algorithms are used to dock small molecules into macromolecular target structures. A key objective of the commonly used molecular docking programs is to predict the correct placement of small molecules or ligands within the binding pocket of an enzyme or protein and the biological implications of this process. This knowledge is subsequently applied to identify novel ligands through virtual screening of compound libraries (Udatha *et al.,* 2012).

Moringa has long been recognized in traditional medicine worldwide as having value both as a preventive and treatment agent of several health conditions, including the treatment of inflammation, infectious diseases, cardiovascular, gastrointestinal, haematological and hepatorenal disorders. Several scientific articles has been published describing the antioxidant properties of Moringa, which can translate to its use as an anti-ageing herb (Ndhlala *et al*., 2014)

Therefore, the present study has been formulated with the following objectives:

1. Determination of the thrombolytic potential of *Moringa pterygosperma* Gaertn. *in vitro*.
2. Quantitative Detection of the phytoconstituents in the leaves and flowers of *Moringa pterygosperma* Gaertn. and screening the major phytoconstituents using HPTLC.
3. Assessment of the antioxidant status in the leaves and flowers of the selected plant source.
4. Analysis of a possible correlation between the percent thrombolysis and the cholesterol level among healthy volunteers.
5. To study the molecular interaction of active components in *Moringa pterygosperma* Gaertn. with target protein *in silico*.