



**INTERNATIONAL JOURNAL OF
PHARMACEUTICAL SCIENCES**
[ISSN: 0975-4725; CODEN(USA): IJPS00]
Journal Homepage: <https://www.ijpsjournal.com>



Research Article

Evaluation of the anti-inflammatory and HRBC membrane stabilization potential of *Kopsia fruticosa* (Roxb.) A. DC

Saif Y. Khan*, Rajendra D. Shinde

Department of Botany, St. Xavier's College (Empowered Autonomous Institute), 5, Mahapalika Marg, Fort, Mumbai 400001

ARTICLE INFO

Published: 28 Mar. 2025

Keywords:

Kopsia fruticosa, Anti Inflammatory, Protein Inhibition, Antiproteinase, Membrane stabilization

DOI:

10.5281/zenodo.15098915

ABSTRACT

Inflammation is a complex biological response to harmful stimuli, playing a crucial role in various diseases, including rheumatoid arthritis and autoimmune disorders. Natural plant-derived compounds have been explored for their potential to mitigate inflammation with minimal side effects. *Kopsia fruticosa*, a medicinal plant from the Apocynaceae family, has been traditionally used for treating inflammation-related ailments. This study evaluates the *in vitro* anti-inflammatory activity of ethanolic and aqueous extracts of *K. fruticosa* leaves and stems using protein denaturation inhibition, antiproteinase activity, and heat-induced hemolysis assays. The ethanolic extract of *K. fruticosa* leaves demonstrated the highest inhibition of protein denaturation ($IC_{50} = 100.37 \pm 2.91 \mu\text{g/ml}$) and proteinase activity ($IC_{50} = 407.88 \pm 9.34 \mu\text{g/ml}$). Similarly, the ethanolic extracts exhibited superior membrane stabilization properties against heat-induced hemolysis. These results suggest that *K. fruticosa* possesses mild anti-inflammatory properties, likely due to the presence of bioactive compounds such as flavonoids, tannins, and sterols. Further studies are needed to isolate and characterize these compounds for potential therapeutic applications in managing inflammatory disorders.

INTRODUCTION

Plants are able to create a wide range of chemical compounds that are used for vital biological processes as well as defense against predators like insects, fungi, and herbivorous mammals. It is estimated that less than 10% of the total number of plant compounds have been isolated so far; at least 12,000 have. The processes by which the chemical

constituents of plants mediate their effects on the human body are the same as those that are already well known to apply to the chemical constituents of conventional drugs. Herbal medicines have positive pharmacological effects, but they also have the same potential for negative side effects as traditional pharmaceuticals (Tapsell et.al., 2006; Lai et.al 2004). Heat, redness, pain, swelling, and

*Corresponding Author: Saif Y. Khan

Address: Department of Botany, St. Xavier's College (Empowered Autonomous Institute), 5, Mahapalika Marg, Fort, Mumbai 400001.

Email ✉: saif.khan@xaviers.edu

Relevant conflicts of interest/financial disclosures: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.



abnormal physiological processes characterize inflammation, which is the body's reaction to injury, infection, or destruction. The release of chemical mediators from damaged tissue and migrating cells causes it to occur (Herbal et.al., 1997). Increased vascular permeability, increased protein denaturation, and membrane alteration are just a few of the complicated processes that contribute to inflammation, which is frequently accompanied by pain. When an external stressor or substance, such as a potent acid or base, a concentrated inorganic salt, an organic solvent, or heat is applied, protein denaturation occurs, where the protein loses its tertiary and secondary structures. Denatured proteins generally no longer serve their intended biological purpose. An established cause of inflammation is protein denaturation (Leelaprakash et.al.,2010 ; Ingle et.al.,2011). There are two types of inflammation: acute and chronic. Leukocyte emigration, capillary infiltration, and increased vascular permeability are all indicators of acute inflammation. Activation, proliferation, and fibrosis of fibroblasts as well as the infiltration of mononuclear immune cells, macrophages, monocytes, and neutrophils are all symptoms of chronic inflammation. Rheumatoid arthritis (RA) is a chronic, incapacitating autoimmune disorder, and inflammation is a common clinical condition (Nadkarni,2000). It is thought that medicinal plants are a significant source of novel chemicals with potential therapeutic benefits. Therefore, it is advisable to view research into plants that have allegedly been used in folklore as anti-inflammatory agents as a fruitful and logical research strategy in the search for new anti-inflammatory drugs. Inflammation has the potential to be harmful, leading to hypersensitivity reactions that can be fatal and ongoing organ damage (Robbins et.al., 2008). The complex sequence of enzyme activation, mediator release, fluid leakage, cell displacement, tissue disruption, and repair that is necessary for the inflammatory response to tissue injury is usually triggered in the

majority of pathological conditions (Vane and Botting, 1995). Anti-inflammatory drugs that are steroidal and non-steroidal (SAIDs and NASIDs) are currently the most commonly used medications for acute inflammatory disorders. These medications may cause blood clots, which can cause heart attacks and strokes. Therefore, the creation of new anti-inflammatory medications with minimal side effects derived from natural sources is urgently needed. Flavonoids, alkaloids, terpenoids, phenols, tannins, glycosides, saponins, and steroids are some of the plant secondary metabolites that can be used to make powerful anti-inflammatory drugs (Mary et al., 2017; Fawole et al., 2009). *Kopsia fruticosa*, commonly known as the Malay coffee plant or coffee bush that belongs to family Apocynaceae, is a medicinal plant native to Southeast Asia, particularly found in countries like Malaysia, Indonesia, Thailand, and the Philippines. Traditionally, different parts of *Kopsia fruticosa*, such as leaves, stems, and roots, have been used by local communities to treat various ailments, including inflammation-related conditions. These traditional uses have prompted researchers to investigate the anti-inflammatory potential of *Kopsia fruticosa* in recent scientific studies. The aim of this research paper is to evaluate the in vitro anti-inflammatory activity of *Kopsia fruticosa* extracts using established cellular models. By subjecting the plant extracts to a battery of in vitro assays, we seek to explore the potential of *Kopsia fruticosa* as a natural source of anti-inflammatory compounds. The findings of this research may have significant implications in the field of natural product-based drug discovery for inflammatory conditions. If *Kopsia fruticosa* demonstrates potent anti-inflammatory activity in vitro, it could pave the way for further investigations to isolate and identify the bioactive compounds responsible for its anti-inflammatory effects. Such discoveries may contribute to the development of novel therapeutic agents for managing inflammatory disorders.





Figure 1 : Flowering twig of *Kopsia fruticosa*
(Picture taken by author Saif Khan, University of Mumbai, Kalina Campus)

1. MATERIALS AND METHODS

1.1 Collection of Plant material

The various *Kopsia fruticosa* parts were collected in March 2022 from the Alkesh Dinesh Modi Institute for Financial Studies campus, which is located in University of Mumbai, Kalina Campus, Santacruz East, Mumbai District, Maharashtra, India (19.068887⁰ Latitude to 72.858609⁰ Longitude). Plant sample was authenticated in Blatter Herbarium (BLAT). *Kopsia fruticosa* stem and leaf were air dried for three weeks at room temperature. Later, the dried components were finely ground into powder.

1.2 Extraction

40 gm of the plant's powdered stem and leaves were successively extracted in 200 ml of ethanol and water separately. Plant stem and leaf were extracted using a orbital shaker, samples kept in it for 48 hours at 31⁰C, until the powder mixed thoroughly with solvent. The volume was decreased to 50 ml by removing the solvent using a rotary evaporator unit to create a concentrated

extract. Using Whatman No. 1 filter paper, extracts were purified. The concentrated extract was kept in a pre-weighed screw-capped bottle and chilled to 40⁰C. Extracts were labelled as KFLAE (*Kopsia fruticosa* leaf aqueous extract), KFLEE (*Kopsia fruticosa* leaf ethanolic extract), KFSAE (*Kopsia fruticosa* stem aqueous extract) and KFSEE (*Kopsia fruticosa* stem ethanolic extract).

1.3 Assessment of in vitro anti inflammatory activity

1.3.1 Inhibition of protein albumin denaturation

The biological properties of protein molecules are lost during protein denaturation. Diabetes, cancer, and inflammatory diseases like rheumatoid arthritis have all been linked to protein denaturation. As a result, the ability of a substance to stop protein denaturation may also help to stop inflammatory disorders (Sangeetha and Vidhya, 2016). The reaction mixture (5ml) is made up of 2.8ml of phosphate buffered saline (pH: 6.4), 2ml of plant extracts with varying concentrations, and 0.2ml of fresh hen's egg albumin. Control was a

comparable volume of double-distilled water. The mixtures were then heated for 5 minutes at 70 °C after 15 minutes of incubation at 37.2 deg C in an incubator. Their absorbance at 660 nm was measured after cooling, using a vehicle as a reference. Diclofenac was used as a reference drug and handled similarly for the purpose of determining absorbance, with a final concentration of 1 mg/ml (Sakat et.al., 2010). Following is the calculation for the percentage inhibition of protein denaturation:

$$\text{Percentage inhibition} = \frac{\text{Absorption of control} - \text{Absorption of sample}}{\text{Absorption of control}} \times 100$$

1.1.1 Antiproteinase assay

Lysosomal membrane lysis, which releases the enzyme components that cause a variety of disorders, may take place during inflammation. Non-steroidal anti-inflammatory drugs (NSAIDs) work by stabilizing the lysosomal membranes or by preventing the release of lysosomal enzymes, respectively. When red blood cells are exposed to harmful substances, hemolysis and the oxidation of hemoglobin may result in the lysis of the red blood cell membranes. The inhibition of hypotonicity and heat-induced lysis of red blood cell membrane will be used as a gauge of the mechanism of anti-inflammatory activity because human red blood cell membranes are similar to lysosomal membrane (Jayasuriya et.al.,2017). In the following , extract's anti-tryptic activity was tested in accordance with the methodology described by (Anantha et.al.,1956). The reaction mixture (2.0 ml) contained 25 mM Tris-C1 buffer, pH 7.5, varying extract volumes, and 0.06 ml (0.6 ug) of trypsin. The mixture was incubated at 37°C for 5 minutes. Then 1 ml of 0.8% (w/v) casein was added. 20 more minutes were spent incubating the mixture, and then 2 ml of 2 M perchloric acid was added to stop the reaction. The cloudy suspension was clarified by centrifugation, and the absorbance of the supernatant was measured at 280 nm while a buffer served as a blank. The calculation of the

percentage inhibition of proteinase activity was done as previously mentioned. The results of the linear regression were graphically represented as the IC₅₀ values.

1.1.2 Heat induced haemolysis

Healthy human volunteer (author Saif Khan) in this case donated blood for assay, while any consumption of NSAIDs prior 2 weeks of the experiment are considered to be the prime exclusion criteria. Blood was removed from the body by certified professor from Department of Life Science and Biochemistry of St. Xavier's College (Mumbai), Na-Oxalate was used to prevent clotting. All the blood samples were stored at 4 °C for 24 h before use. Centrifugation for 5 mins at 2500 rpm was used for supernatant removal. Sterile saline solution (0.9% w/v NaCl) was used for washing and centrifugation was done at 2500 rpm for 5 min. The process of clearing supernatant was done in three repeated times and the packed cell volume was measured. Further in the assay, the reaction mixture (2 ml), consisted 10% RBC suspension and various test samples totaling 1 ml each. In the control test tube, saline was used in place of the test samples. Diclofenac sodium was a commonly prescribed medication. All centrifuge tubes containing reaction mixture underwent a 30-minute incubation in a water bath at 56 deg C. The tubes were cooled under running water after the incubation period. Centrifuging the reaction mixture at 2500 rpm for 5 minutes allowed the supernatants' absorbance to be measured at 560 nm. (Patel and Desai,2016 ; Ukuwani and Hasan,2015). The calculation of the percentage inhibition of proteinase activity was done as previously mentioned. The results of the linear regression were graphically represented as the IC₅₀ values.

1.1.1 Statistical analysis

WPS Excel 2014 was used to express all of the results (in triplicate) as mean standard deviation



(SD). Analysis of variance (ANOVA) was used in the statistical analysis of the group comparison. It was decided that 1% was the cut off for significant differences between groups. PSPP served as the statistical programme.

2. RESULTS

2.1 Inhibition of protein albumin denaturation

Loss of biological properties in protein molecules is known as denaturation. In diseases like rheumatoid arthritis, diabetes, cancer, etc., inflammation is brought on by the denaturation of proteins. Therefore, avoiding protein denaturation may also aid in avoiding inflammatory diseases. The current study demonstrated the aqueous and ethanolic extract of *K. fruticosa* stem and leaf in vitro anti-inflammatory activity by preventing protein denaturation. As seen in Fig. 2. , At 400µg/ml, the ethanolic stem extract of *K. fruticosa* showed the maximum inhibition of $71.0 \pm 1.45\%$. At a concentration of 25µg/ml, ethanolic stem extract showed the lowest inhibition of $7.89 \pm 0.88\%$. The lowest inhibition was seen in the aqueous extract of the leaf and stem within the range of 0.78% to 7.89%. IC₅₀ of leaf extracts of ethanol was found to be $100.37 \pm 2.91\mu\text{g/ml}$, as far as other extracts are concerned values were going beyond the concentration limit that was used in experiment.

2.2 Antiproteinase assay

Neutrophils are found in lysosomes and are recognised to be a rich source of serine proteinase. Leukocyte proteinase has been shown to be a major contributor to tissue damage during inflammatory reactions, and proteinase inhibitors have been shown to offer a notable degree of protection (Das and Chatterjee, 1995). In Fig. 3., As compared to standard maximum inhibition was seen in ethanolic extracts of *K. fruticosa* leaf at $46.15 \pm 0.03\%$. Ethanolic extracts of stem and aqueous extracts of both stem and leaf showed least inhibitory effect. IC₅₀ of leaf extracts of ethanol was found to be $407.88 \pm 9.34 \mu\text{g/ml}$ which was slightly greater than our extracts concentration limits.

2.3 Heat induced haemolysis

The extract was effective in inhibiting the heat induced haemolysis at different concentrations as seen in Fig. 4., The results showed that ethanolic extracts of *K. fruticosa* at concentrations of 400 µg/ml showed highest inhibition at $40.00 \pm 1.95\%$ i.e it protects erythrocyte membrane against lysis induced by heat. Whereas ethanolic and aqueous extracts of stem and leaf showed least inhibition. IC₅₀ values cannot be determined the values were going beyond our concentration limits. This indicates that higher concentrations of plant extracts would have been taken into consideration to have an effective result.

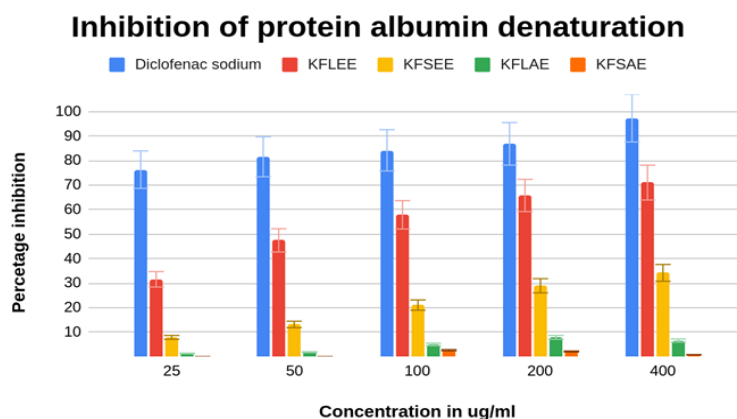


Figure 2 : In vitro anti inflammatory activity of plant extracts against protein denaturation



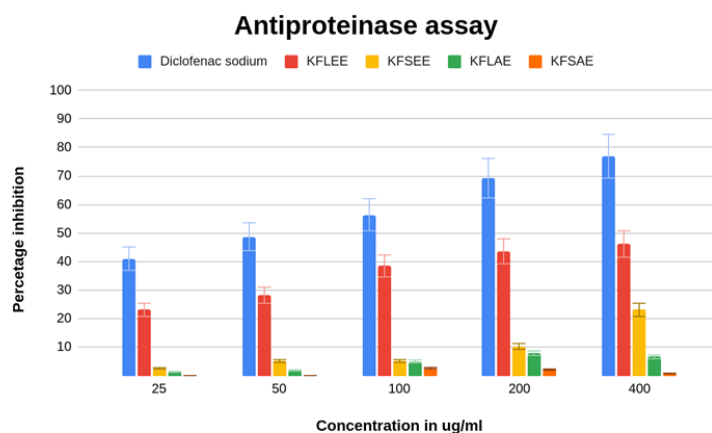


Figure 3 : In vitro anti inflammatory activity of plant extracts against proteinase inhibition

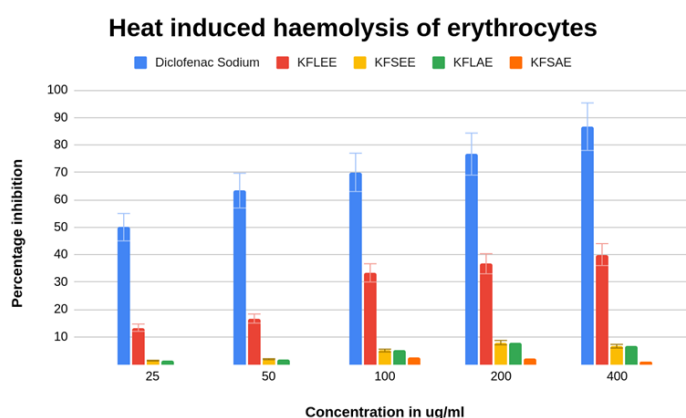


Figure 4 : In vitro anti inflammatory activity of plant extracts against heat induced haemolysis

1. DISCUSSIONS

Utilising plant extracts to treat a variety of diseases is known as herbal medicine. Depending on the local flora, medicinal plants come in a wide variety of regional varieties. While many modern drugs are now produced synthetically, many others are derived from plant materials. Many modern drugs were first extracted from plant sources (Chatterjee 1997). Numerous phytoconstituents, including triterpenoids, fatty acids, steroids, flavonoids, tannins, saponins, vitamins, proteins, sugars, vanillin, and ursolic acid, were found in *K. fruticosa* after phytochemical studies were conducted on the plant. These phytochemicals have a number of positive health effects, including anti-inflammatory, anti-cancer, anti-diabetic, anti-microbial, and antioxidant properties (Savitharamma et.al.,2011). The complex

biological process of vascular tissue responding to noxious stimuli, pathogens, and irritants results in inflammation, which is characterised by redness, warmth, swelling, and pain. Inflammation is a common symptom of infectious diseases like leprosy, tuberculosis, syphilis, asthma, inflammatory bowel syndrome, nephritis, vasculitis, celiac diseases, auto-immune diseases, and others. Prolonged inflammation causes rheumatoid arthritis, atherosclerosis, hay fever, ischemic heart diseases, and other conditions. Since the erythrocyte membrane and the liposomal membrane are similar, the stabilisation of the erythrocyte membrane suggests that the extract may also inhibit the degradation. By preventing the release of liposomal components from activated neutrophils, the liposomal membrane can be stabilised, thereby limiting the inflammatory response (Sherwood and Toliever, 2004 ; Libby

2008 ; Chou 1997). Protein denaturation is a well-known contributor to inflammation. Salicylic acid, phenylbutazone, and other anti-inflammatory medications have demonstrated dose-dependent ability to prevent thermally induced protein denaturation. A wide range of chemical and physical agents, such as acids, alkalies, alcohol, acetone, salts of heavy metals and dyes, as well as heat, light, and pressure, can cause proteins to change from a soluble to an insoluble state. This process is referred to as denaturation. Chick and Martin view heat denaturation as a protein-water reaction that almost certainly involves a hydrolysis (Mizushima and Kobayashi, 1968 ; Mann , 1906 ; Robertson , 1918 ; Chick and Martin, 1910). According to some research, the production of auto-antigens in some rheumatic diseases causes denaturation of proteins, which is one of the causes of rheumatoid arthritis. It might lead to the denaturation of proteins in vitro. The alteration of electrostatic force, hydrogen, hydrophobic, and disulfide bonds is a component of the denaturation mechanism. Numerous anti-inflammatory medications have demonstrated dose-dependent inhibition of thermally induced protein denaturation (Grant et.al , 1970). Aqueous and ethanolic extracts of *K. fruticosa* (leaf and stem) were tested for in vitro anti-inflammatory activity against HRBC membrane, protein denaturation against egg albumin, and proteinase enzyme. With increasing concentration, the aqueous and ethanolic extract of various *K. fruticosa* parts significantly increased their anti-inflammatory activity. This anti-inflammatory activity may be attributed to the presence of active phytocompound principles like flavonoids, triterpenoids, and related polyphenols. *K. fruticosa* can therefore be used as an anti-inflammatory medication. The investigation is motivated by the requirement for powerful natural anti-inflammatory agents with fewer side effects to replace chemical therapeutics.

2. CONCLUSION

The findings of the current study suggest that *K. fruticosa* leaf ethanolic extracts have mild anti-inflammatory properties. Strong concentrations of polyphenolic compounds like alkaloids, tannins, flavonoids, sterols, and phenols may be the cause of these activities. The extract fractions prevented proteinase activity, heat-induced denaturation, and stabilised RBC membrane. Each bioactive compound may need to be purified, and the purified form may exhibit increased activity. According to the study, *K. fruticosa* could be used to create a potent anti-inflammatory drug that could be used to treat a variety of diseases.

3. ACKNOWLEDGEMENTS

For their consistent assistance and support in completing the work to their satisfaction, the authors are grateful to Mr. Alok Gude, Head, Department of Botany and other staff members of the Department of Botany, Blatter Herbarium, and management of St. Xavier's College Autonomous, Mumbai. Authors are also thankful to Prof. (Dr.) Priya Sundarajan for helping with the HRBC assay and also providing necessary facilities in CAIUS and CIF laboratory of the college

REFERENCES

1. Anantha, T. S., Natarajais, S., & Cama, H. R. "Some biochemical aspects of inflammation." Biochemical Journal, 96 (1956): 281–288.
2. Chatterjee, A. The Treatise of Indian Medicinal Plants. National Institute of Science and Communication CSIR, New Delhi, 4 (1997): 212–217.
3. Chick, H., & Martin, C. J. "On the heat coagulation of protein." Journal of Physiology, 4 (1910): 404–430. Chou, C. T. "The anti-inflammatory effect of *Tripterygium wilfordii* Hook F on adjuvant-induced paw edema in rats and inflammatory mediator's release." Phytotherapy Research, 11(2) (1997): 152–154.



- [https://doi.org/10.1002/\(SICI\)1099-1573\(199703\)11:2<152::AID-PTR45>3.0.CO;2-L](https://doi.org/10.1002/(SICI)1099-1573(199703)11:2<152::AID-PTR45>3.0.CO;2-L)
4. Das, S. N., & Chatterjee, S. "Long-term toxicity study of ART-400." *Indian Indigenous Medicine*, 16(2) (1995): 117–123.
5. Fawole, O. A., Ndhlala, A. R., Amoo, S. O., Finnie, J. F., & Van Staden, J. "Anti-inflammatory and phytochemical properties of twelve medicinal plants used for treating gastrointestinal ailments in South Africa." *Journal of Ethnopharmacology*, 123(2) (2009): 237–243. <https://doi.org/10.1016/j.jep.2009.03.012>
6. Grant, N. H., Alburn, H. E., & Kryzanski, C. "Stabilization of serum albumin by anti-inflammatory drugs." *Biochemical Pharmacology*, 19(3) (1970): 715–722. [https://doi.org/10.1016/0006-2952\(70\)90234-0](https://doi.org/10.1016/0006-2952(70)90234-0)
7. Ingle, P. V., & Patel, D. M. "C-reactive protein in various disease conditions – An overview." *Asian Journal of Pharmaceutical and Clinical Research*, 4(1) (2011): 9–13.
8. Lai, P. K., & Roy, J. "Antimicrobial and chemopreventive properties of herbs and spices." *Current Medicinal Chemistry*, 11(11) (2004): 1451–1460. <https://doi.org/10.2174/0929867043365107>
9. Leela Prakash, G., & Mohan Dass, S. "In vitro anti-inflammatory activity of methanol extract of *Enicostemma axillare*." *International Journal of Drug Development and Research*, 3 (2010): 189–196.
10. Libby, P. "Role of inflammation in atherosclerosis associated with rheumatoid arthritis." *American Journal of Medicine*, 121(10) (2008): S21–S31. <https://doi.org/10.1016/j.amjmed.2008.06.014>
11. Mann, G. *Chemistry of the Proteids*. Archives of the Roentgen Ray, London and New York, 10(12) (1906): 346–347. <https://doi.org/10.1259/arr.1906.0192>
12. Mary, S. J., Chithra, B., & Sivajiganesan, S. "In vitro anti-inflammatory activity of the flowers of *Nerium oleander* (White)." *International Journal of Research - GRANTHAALAYAH*, 5(6) (2017): 123–128. <https://doi.org/10.29121/granthaalayah.v5.i6.2017.2005>
13. Mizushima, Y., & Kobayashi, M. "Interaction of anti-inflammatory drugs with serum proteins, especially with some biologically active proteins." *Journal de Pharmacologie*, 20 (1968): 169–173.
14. Nadkarni, A. K. *Indian Materia Medica*. Popular Press Bldg, 2000.
15. Patel, D., & Desai, S. "Phytochemical screening, in vitro antimicrobial and anti-inflammatory activity of methanolic extract of *Aster lanceolatus* Willd. leaves." *International Journal of Medicine Research*, 1(1) (2016): 26–30.
16. Robertson, T. B. *The Physical Chemistry of the Proteins*. New York and London, 1918.
17. Robbins, Cotron, Vinay, K., Abdul, K. A., & Nelson, F. *Pathologic Basis of Disease*. 7th ed., Elsevier Publication, 2008: 47–53.
18. Sakat, S., Juvekar, A. R., & Gambhire, M. N. "In vitro antioxidant and anti-inflammatory activity of methanol extract of *Oxalis corniculata* Linn." *International Journal of Pharmacy and Pharmaceutical Sciences*, 2(1) (2010): 146–155.
20. Sarveswaran, R., Jayasuriya, W. J. A. B., & Suresh, T. S. "In vitro assays to investigate the anti-inflammatory activity of herbal extracts: A review."
21. Savithramma, N. M., & Linga Rao, S. D. "Screening of medicinal plants for secondary metabolites." *Middle East Journal of Scientific Research*, 8 (2011): 579–584.
22. Sangeetha, G., & Vidhya, R. "In vitro anti-inflammatory activity of different parts of *Pedaliu murex* (L.)." *International Journal of Herbal Medicine*, 4(3) (2016): 31–36



23. Sherwood, E. R., & Toliver-Kinsky, T. "Mechanisms of the inflammatory response." *Best Practice and Research: Clinical Anaesthesiology*, 18(3) (2004): 385–405. <https://doi.org/10.1016/j.bpa.2003.12.002>
24. Tapsell, L. C., Hemphill, I., Cobiac, L., Patch, C. S., Sullivan, D. R., Fenech, M., Roodenrys, S., Keogh, J. B.,
25. Clifton, P. M., Williams, P. G., Fazio, V. A., & Inge, K. E. "Health benefits of herbs and spices: The past, the present, the future." *Medical Journal of Australia*, 185(S4) (2006): S1–S24. <https://doi.org/10.5694/j.1326-5377.2006.tb00548.x>
26. A. N., & Hassan, I. B. "In vitro anti-inflammatory activity of hydromethanolic seed, fruit and leaves extracts of *Capsium chinense* (Red Pepper)." *European Journal of Biomedical and Pharmaceutical Sciences*, 2(2) (2015): 57–65.
27. Vane, J. R., & Botting, R. M. "New insights into the mode of action of anti-inflammatory drugs." *Inflammation Research*, 44(1) (1995): 1–10. <https://doi.org/10.1007/BF01630479>

HOW TO CITE: Saif Y. Khan*, Rajendra D. Shinde, Evaluation of the anti-inflammatory and HRBC membrane stabilization potential of *Kopsia fruticosa* (Roxb.) A. DC, *Int. J. of Pharm. Sci.*, 2025, Vol 3, Issue 3, 2739-2747. <https://doi.org/10.5281/zenodo.15098915>

