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ANTI-INFLAMMATORY STUDY OF AQUEOUS EXTRACT OF AVERRHOA CARAMBOLA

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ABSTRACT

Inflammation is a natural response of the body to injury or harmful substances. However, excessive inflammation can lead to various health problems. Natural products obtained from plants and fruits are being studied for their possible anti-inflammatory properties. The present study aimed to evaluate the anti-inflammatory activity of the aqueous fruit extract of *Averrhoa carambola* (star fruit) using the bovine serum albumin (BSA) protein denaturation method. The extract was tested at concentrations of 50, 100, 150, and 200 µg/mL, and ibuprofen was used as the standard drug for comparison. The absorbance was measured using a spectrophotometer at 660 nm. The results showed that the extract inhibited protein denaturation by 55.17%, 68.96%, 75.86%, and 86.20% at the respective concentrations. The anti-inflammatory activity increased with an increase in the concentration of the extract. The results were comparable to those obtained with ibuprofen. This study suggests that the aqueous fruit extract of *Averrhoa carambola* has potential anti-inflammatory activity. However, further studies are required to confirm its effectiveness and safety.

KEYWORDS: *Averrhoa carambola*, Anti-inflammatory activity, Aqueous fruit extract, Protein denaturation, Bovine serum albumin (BSA), Ibuprofen, In vitro study.

INTRODUCTION

❖ ***Averrhoa carambola***



FIG NO 1: Fruit of Averrhoa carambola.

Averrhoa carambola L., commonly known as carambola or starfruit, is a perennial tree in the family Oxalidaceae. The fruit is of high commercial value and is specially and extensively distributed and cultivated in southern China, Southeast Asia, India, and northern South America.[1] A.carambola is fleshy, crunchy, juicy, slightly tart, acidic, and sweet in taste. It is star shaped and golden yellow in appearance. [2]

Star fruits are regarded as an abundant source of various nutrients such as minerals, proteins, and vitamins, and also rich in natural phytochemicals such as flavonoids, terpenes, saponins, alkaloids, proanthocyanidins, vitamin C, tartaric acid, oxalic acid, α-ketoglutaric acid, citric acid, vitamin B1 and B2, carotene, pectin, cellulose, gallic acid, epicatechin, fatty acids, volatile flavors, fibers, hemicellulose, polysaccharides, and sterols.[3]

Carambola has considerable nutritional importance. The fruit contains water, carbohydrates, dietary fibre, vitamins, minerals, and various phytochemicals. It is particularly recognized as a source of vitamin C and antioxidant compounds. The fruit also contains organic acids and phenolic compounds that contribute to its characteristic flavour and biological properties. The nutritional composition can vary according to cultivar, stage of maturity, growing conditions, and post-harvest handling.[4]

Apart from being consumed fresh, carambola has several culinary and commercial applications. The ripe fruit can be eaten directly, while both ripe and less-ripe fruits may be used in juices, beverages, salads, pickles, jams, jellies, preserves, sauces, and other food products. The attractive star-shaped slices are also commonly used as garnishes for food and beverages. The fruit's distinctive appearance has increased its popularity in both domestic and commercial markets.[5]

❖ **Anti-inflammatory activity**

Inflammation is a natural protective response of the body to injury, infection, irritation, or harmful stimuli. It helps the body eliminate the cause of injury and initiate tissue repair. However, excessive or prolonged inflammation may contribute to the development of several diseases, including rheumatoid arthritis and other inflammatory disorders. Anti-inflammatory agents are substances that reduce or control this inflammatory response. In pharmaceutical research, plant extracts are frequently investigated for their potential anti-inflammatory properties because they may contain bioactive constituents such as flavonoids, phenolic compounds, tannins, terpenoids, and other phytochemicals.

The protein denaturation method is a commonly used in vitro screening technique for evaluating the potential anti-inflammatory activity of plant extracts and other test substances. It is relatively simple, economical, and suitable for preliminary laboratory investigations. The method evaluates the ability of a test substance to inhibit heat-induced denaturation of proteins, commonly bovine serum albumin (BSA). The results help researchers compare the preliminary anti-denaturation activity of different concentrations of an extract with that of a standard anti-inflammatory drug.

Protein denaturation is the process in which a protein loses its natural three-dimensional structure due to external factors such as heat, extreme pH, or chemical agents. This structural alteration may change the protein's physical and biological properties. Inflammatory diseases can involve protein-related processes, but heat-induced denaturation of albumin in a laboratory is only a simplified experimental model and does not reproduce inflammation in the human body.

The protein denaturation assay is based on the principle that certain substances can prevent or reduce heat-induced protein denaturation. Bovine serum albumin is commonly used as the model protein because it is readily available and responds to changes in temperature and experimental conditions. When the protein solution is heated, denaturation and aggregation may cause changes in turbidity or absorbance. If a plant extract inhibits these changes, it may indicate anti-denaturation activity. The percentage inhibition is calculated by comparing the absorbance of the treated sample with that of the control. [6,7]

MATERIALS AND METHODS

Protein denaturation by bovine serum albumin

The reaction mixture (0.5 ml) consists of 0.45ml bovine serum albumin (5% aq. Solution) and 0.05ml of fruit extract of 50,100,150,200 (µg/ml) concentrations and pH was adjusted to

6.3 using 1N HCl. The sample incubated for 37ºC for 20 min and then heated at 57ºC for 30 min. Ibuprofen used as standard drug (50,100,150,200 µg/ml). after cooling the sample, 2.5ml phosphate buffer saline (pH 6.3) was added to each tube. Absorbance was measured spectrometrically at 660 nm. For control test, 0.05ml distilled water was used instead of extract while product control lacked bovine serum albumin. The percentage inhibition of protein denaturation was calculated by using the formula:

Percentage of inhibition = $[(A_0 – A_1) / A_0] \times 100$

Where,

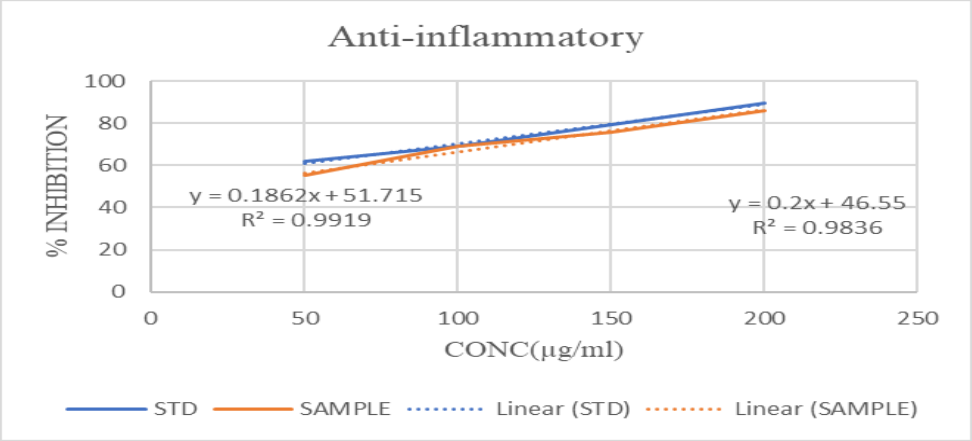
- A_0 = absorbance of the control
- A_1 = absorbance of the sample/ standard

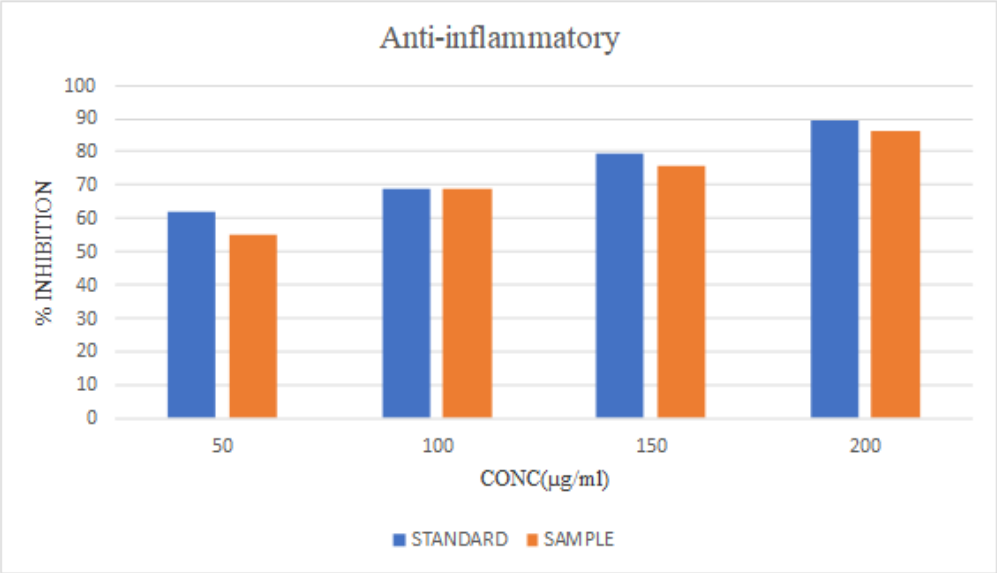
Calculation of IC_{50} (50% Inhibitory concentration)

The concentration (µg/ml) of the drug required to denature 50% protein was calculated from the graph. The IC_{50} was calculated for concentration of both the sample and standard.[8]

RESULT

SL.NO	Sample	Concentration(µg/ml)	Absorbance at 660nm	% inhibition
1.	Control		0.029	
2.	Standard (Ibuprofen)	50	0.011	62.06
		100	0.009	68.96
		150	0.006	79.31
		200	0.003	89.65
3.	Drug extract	50	0.013	55.17
		100	0.009	68.96
		150	0.007	75.86
		200	0.004	86.20





CONCLUSION

The present study evaluated the in vitro anti-inflammatory activity of the aqueous fruit extract of *Averrhoa carambola* using the bovine serum albumin protein denaturation method. The results demonstrated that the extract inhibited heat-induced protein denaturation in a concentration-dependent manner. The percentage inhibition increased from 55.17% at 50 µg/mL to 86.20% at 200 µg/mL, indicating an increase in anti-denaturation activity with increasing extract concentration. Ibuprofen, used as the standard drug, exhibited 62.06% to 89.65% inhibition over the same concentration range. Although the extract showed slightly lower activity than the standard at most concentrations, both exhibited similar inhibition at 100 µg/mL. These findings suggest that the aqueous fruit extract of *Averrhoa carambola* may contain bioactive constituents contributing to its potential anti-inflammatory properties. However, the protein denaturation assay provides only preliminary in vitro evidence and does not establish clinical anti-inflammatory efficacy. Further studies, including phytochemical characterization, toxicity assessment, and appropriate in vivo investigations, are necessary to confirm its activity, safety, and potential pharmaceutical applications.

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