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Evaluation of Tamarindus Indica Extract for Its Potential Anti-Inflammatory Activity

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Abstract

Chronic inflammation is a leading cause of various non-infectious diseases worldwide. Over the years, Tam-arindus indica has played a fundamental role in tradi-tional medicine as an anti-inflammatory agent. Widely recognized for its medicinal properties, T. indica was evaluated in this study for its potential anti-inflammatory activity using an in vitro model. The ex-tract was tested at varying concentrations (20–100 µg/mL) and compared to Diclofenac sodium as the standard drug. This research investigated the anti-inflammatory properties of various extracts derived from T. indica fruit shells. These effects may be attributed to its bioactive compounds, including alkaloids, flavonoids, tannins, phenols, saponins, and steroids. The findings suggest that Tamarindus indica extract holds promise as a natural alternative for managing inflammation. Further investigation is warranted to explore its mechanisms and validate its efficacy through additional in vitro and in vi-vo studies..

Keywords: Tamarindus indica, Anti-inflammatory, BSA and Diclofenac sodium.

1 Introduction

The global failure to monitor and treat infectious diseases linked to antibiotic-resistant microorganisms is well-documented. Moreover, heightened focus is essential from all robust organizations globally to develop effective solutions and secure financing for researchers to prevent the escalation of this problem. The management of microbial infections commenced with the discovery and advancement of antibiotics. Antimicrobial agents are essential for reducing the worldwide impact of infectious diseases [1]. Conversely, antibiotic resistance has become increasingly prevalent globally, frequently attributable to novel resistance mechanisms that facilitate the proliferation and dissemination of resistant bacterial strains [2]. The limited availability of antibiotics effective against resistant pathogenic bacteria has rendered the proliferation of multi-drug-resistant (MDR) strains a public health issue.

Virulence factors play critical roles in the rising mortality and morbidity rates associated with life-threatening diseases: facilitating microbial evasion of host defenses, accelerating evolutionary processes, and enhancing the pathogenicity of microbial cells. Treatment failures are being documented at an unparalleled pace, particularly for infections caused by multi-drug-resistant (MDR) and multi-virulence bacteria [3].

Treatment failures are increasing due to the transmissibility of genetic elements that confer both virulence and antibiotic resistance, coupled with a decline in the discovery and development of new antimicrobial agents. Consequently, emerging trends in antimicrobial strategy development focus on inhibiting microbial

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virulence factors instead of growth mechanisms.
The use of anti-virulence agents with other antimicrobial medications can prevent treatment failures. Numerous anti-virulence strategies have been documented, such as toxin neutralization, inhibition of biofilm formation, suppression of cell adhesion, downregulation of virulence gene expression, and interaction with virulence proteins and enzymes. Numerous novel chemical compounds have demonstrated anti-virulence properties; nevertheless, their potential adverse effects on various systems inside the human body pose significant therapeutic challenges that hinder their application. Consequently, we revert to utilizing natural chemicals derived from medicinal plants to combat the virulence factors of resistant diseases. Medicinal herbs offer numerous benefits, including their safety and their antibacterial properties. Numerous secondary metabolites have been identified in medicinal plants that can be utilized to treat various ailments [4]. Identifying the bioactive components in medicinal plants is crucial for selecting the most effective antibacterial agents. Various techniques can be employed to discover biologically active substances with high separation efficiency, including bio-autography assays and thin-layer chromatography (TLC) [5].

Plant phytochemicals, including flavonoids, phenolic compounds, alkaloids, and tannins, induce secondary metabolism and demonstrate antibacterial properties against human diseases and phytopathogens in plants [6]. The Tamarind tree is a significant multipurpose medical plant, originating in India, utilized for treating gastrointestinal disorders, including dysentery and diarrhea-related ailments; promoting wound healing; managing diabetes; addressing hepatic disorders; and combating certain helminthic and bacterial infections, attributed to its high concentrations of phenolic compounds, cardiac glycosides, crude proteins, and carbohydrates. Tamarin-dus indica L (T. indica) possesses notable therapeutic benefits, as evidenced by various phytochemical investigations. The T. Indica pulps serve several industrial applications, including the creation of flavoring agents and confections; concurrently, the seeds are utilized in food preparation to enhance texture and viscosity. In this context, salads, stews, and soups are prepared with the leaves and blossoms of T. Indica in various regions globally. The seeds of T. indica encompass numerous active biological components, including fatty acids (palmitic ac-id, eicosanoic acid), phenolic antioxidants, campesterol, and b-amyrin [7]. Conversely, leaf extracts of T. indica are recognized for their numerous components, including flavonoids (e.g., naringenin, epicatechin, catechin, and apigenin), polyphenols, β-carotene, and ascorbic acid. These phenolic compounds, with diverse chemical structures, may be utilized for medicinal purposes due to their potent biological activity. Historically employed for the treatment of gonorrhea and the care of chronic ulcers. This is utilized as an ornamental plant due to its appealing foliage and vibrant bloom colors. The leaf exhibits possible anti-cancer and antibacterial properties. The bloom is funnel-shaped and exhibits a violet or purple hue. Leaves comprise β-sitosterol, 1-tricontanol, flavonoids, lipids, and quercetin. Roots are utilized for the control of obesity, diabetes, TB, ulcers, and wound care. The seeds within the desiccated flower pots are black. Each flowering pod comprises three to five seeds. The goal of this current investigation was to assess the anti-inflammatory activity potentials of an ethanolic extraction of Tamarindus indica fruit shell analysis of in-vitro biological activities [8].

2 Experimental

2.1 Collection of samples

Fruit shells of Tamarindus indica were procured from Thiruvkanager village, Tirupattur, Tirupattur District, Tamil Nadu, India, based on cost-effectiveness, accessibility, and medicinal properties. Shells of Tamarindus in-dica were locally sourced, meticulously cleaned with tap water and distilled water to eliminate dust and extraneous elements, then cut into small fragments, air-dried, and ground into powder for subsequent application.

2.2 Extraction of plant material

From the fruit shell were washed with regular water to prepare the plant extract, followed by a rinse with distilled water. Following the air-drying process, the leaf samples were placed in the shade for 5–7 days and subsequently finely powdered using a mixer grinder. 5 grams of powdered shells were combined with 100 milliliters of sterilized water and heated to 60 °C for 30 minutes, followed by cooling. Following filtration with Whatman filter paper, the resulting clear extract was collected and stored at 4 °C for subsequent processing. Finally, it was denoted as TIFs [9].

Fig 1: Preparation and extraction of Tamarindus indica

2.3 Anti-inflammatory activity by Albumin Denaturation assay method

The albumin denaturation assay was conducted according to the methodology outlined by Mizushima and Kobayashi (1968). Diclofenac sodium served as the benchmark for this operation. The reaction mixture comprised sample concentrations between 100 and 500 μg/ml, in addition to a 1% aqueous solution of albumin fraction [10]. The absorbance of the combination was assessed at a wavelength of 660 nm (figure 2). The inhibition percent age (%) was calculated using Equation (1).

% inhibition = [(C (OD) – S (OD))/C (OD)] x 100

Fig: 2 Different concentrations of standard and TIFs for Anti-inflammatory activity

Inflammation and bodily pain are interconnected, resulting in numerous medications possessing both analgesic and anti-inflammatory properties.31, 32 T. indica is es-teemed in traditional medicine as a principal herb for al-levitating musculoskeletal pain and other inflammatory conditions.8, 13, 33, 34 Indeed, T. indica is recognized for its anti-inflammatory and analgesic properties, likely through the down-regulation of the nuclear factor-kappa B (NF-kB) and the p38 mitogen-activated protein kinase pathway.

3. Results and Discussions

The current study assessed anti-inflammatory activity by an albumin denaturation assay. The results were compared to the standard medication diclofenac sodium. The assay validated the anti-inflammatory properties of prepared fruit shell extract, demonstrating efficacy comparable to the standard medication, as illustrated in Fig. 3 and Table 1. The anti-inflammatory activity of TIFs increased with concentration, showing a dose-dependent effect. At the lowest concentration (20 μg/mL), TIFs demonstrated a significantly higher percentage inhibition of inflammation (65.91%) compared to Diclofenac sodium (34.09%) [11].

As the concentration increased, the anti-inflammatory activity of TIFs continued to rise, reaching its maximum at 100 μg/mL (79.55%). However, Diclofenac sodium outperformed TIFs at this concentration, exhibiting a higher percentage inhibition of 93.18%. The results sug-gest that TIFs possess notable anti-inflammatory activity, particularly at lower concentrations where it outper-forms Diclofenac sodium.

CONCENTRATION (μg)	**TIFs (Sample)(μg)**	**Diclofenac sodium (Drug)(μg)**
20	65.90	34.09
40	63.63	31.81
60	68.18	43.18
80	72.72	63.63
100	79.54	93.18

Table 1: Anti-inflammatory activity of TIFs

This could indicate that TIFs may be effective at lower dosages, potentially reducing side effects associated with higher doses of conventional drugs like Diclofenac sodium [12-13].

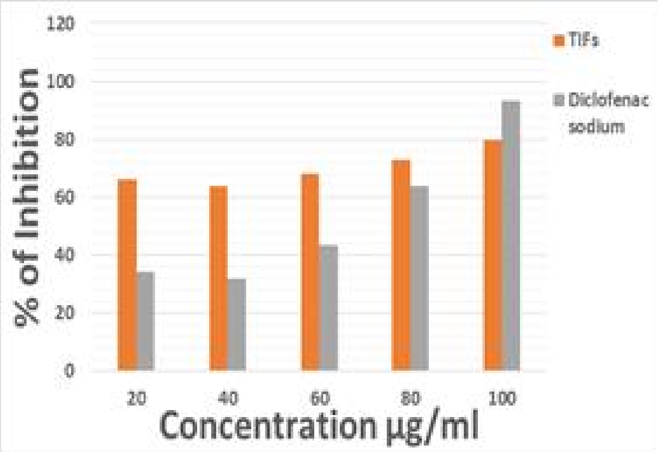

Fig 3: Graphical representation of Anti-inflammatory activity of TIFs

The Anti-inflammatory activity demonstrated that shell extracts were exhibited, with TIFs IC50 values of 80.5 µg for Diclofenac sodium and 60.6 µg for the aqueous extract, respectively. Recent research suggest that cerium oxide nanoparticles obtained from the fruit shell of Tam-arindus indica may serve as potential therapeutic and en-vironmental agents [14-15].

4. Conclusion

This study was focused on the production of methanol ex-tract of Tamarindus indica fruit shell, an emerging tech-nique research experiments in herbal science. To devel-op a cost effective and environmentally friendly method for shell extract from TIFs. They have possessed the po-tent antioxidant substances which may be responsible for its anti-inflammatory, and chemo protective mechanism as well as justify the basis of using this plant's extract as folkloric remedies. Further studies are still needed to un-equivocally determine the activity of these molecules and to evaluate their anti-inflammatory effects individually.

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Conflict of Interest: Nil

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