DEPARTMENT OF SCIENCE LABORATORY TECHNOLOGY
FACULTY OF LIFE SCIENCES
UNIVERSITY OF BENIN

ANTI-INFLAMMATORY EFFECTS OF PINEAPPLE AND COCONUT JUICE USING ACUTE AND CHRONIC INFLAMMATORY MODELS IN THE PAW OF ALBINO RATS

BY

Divine Efemena AKPONINE

LSC2OO2967

(PHARMACOLOGY AND PHYSIOLOGY TECHNIQUES)

NOVEMBER , 2025

CERTIFICATION

This is to certify that the research work titled "**NUTRITIONAL AND MEDICINAL BENEFITS OF PINEAPPLE AND COCONUT FRUIT JUICE**" was presented and submitted by **Divine Efemena AKPONINE** with matriculation number, **LSC2002967** of the Department of Science Laboratory Technology, Faculty of Life Sciences, University of Benin, Benin City.

_____ _____

DR. (MRS) O.E OBARO-ONEZEYI Date

(Seminar Supervisor)

_____ _____

MR. O. HARUNA Date

(Seminar Coordinator).

_____ _____

PROF. E.O. OSHOMOH Date

(Head of Department, SLT)

DEDICATION

I dedicate this work to GOD ALMIGHTY, Who has empowered me and provided for me through this work and has been my source of inspiration and strength, and my parents Mr and Mrs Akponine who taught me that hardwork and perseverance takes you over the line.

ACKNOWLEDGMENTS

My unwavering gratitude goes to God Almighty and I am also grateful to my seminar supervisor,Dr. (Mrs) O.E Obaro-Onezeyi and her Husband, Dr. P.O. Obaro for their guidance throughout the process of this research.

To my Parents, Mr and Mrs Akponine, my siblings, Daniella, Dominion and Duchess, I am very grateful for your prayers and support to seeing me through this process. I would also like to express my gratitude to my dear friends for their unwavering support throughout the duration of this research.

Finally, my sincere thanks goes to my lecturers for their support and care.

TABLE OF CONTENTS

ABSTRACT

Inflammation is a vital biological defense mechanism against harmful stimuli, yet excessive or chronic inflammation contributes to many diseases. This study investigated the anti-inflammatory effects of pineapple (*Ananas comosus*) and coconut (*Cocus nucifera*) juice, focusing on their potential synergistic activity. Fresh fruit juices were extracted, combined in varying concentrations, and administered orally to albino rats using standard experimental models of inflammation; including carrageenan- egg albumen- and formaldehyde- induced paw edema. The effects of the juice were compared with a standard non-steroidal anti-inflammatory drug (Ibuprofen, 10 mg/kg). Acute toxicity studies revealed no mortality or observable toxic effects at doses up to 5 ml/kg, indicating safety of juice. Results showed that treatment with pineapple and coconut juice produced significant dose-dependent reductions in paw edema across all models, comparable to the standard drug. The observed anti-inflammatory activity may be attributed to bioactive compounds such as bromelain in pineapple and lauric acid and polyphenols in coconut, which possess antioxidant and cytokine- modulating properties. These findings support the traditional use of these fruits in managing inflammation and suggest that their combined juice could serve as a natural, safe and effective alternative to synthetic anti-inflammatory agents. Further studies on molecular mechanisms and clinical applicability are recommended.

CHAPTER ONE

1.0 INTRODUCTION

1.1 INFLAMMATION AND ANTI-INFLAMMATORY DRUGS

Inflammation is a fundamental biological response to harmful stimuli, such as pathogens, damaged cells, or toxic irritants. It is designed to restore tissue homeostasis by eliminating the cause of injury, clearing necrotic cells, and initiating repair processes (Kato, 2020).

The process is tightly regulated, involving immune cells, blood vessels, and chemical mediators, and can be broadly classified as acute or chronic. Acute inflammation is rapid and short-lived, characterized by redness, heat, swelling, and pain. Chronic inflammation, by contrast, is prolonged, leading to simultaneous tissue damage and repair, often associated with chronic diseases such as diabetes, cancer, and autoimmune disorders (Gaikwad et al., 2025).

1.2 MECHANISMS OF INFLAMMATION

The inflammatory response begins with recognition of harmful stimuli through pattern recognition receptors (PRRs) that detect pathogen-associated molecular patterns (PAMPs) or damage-associated molecular patterns (DAMPs). This recognition triggers intracellular pathways such as NF-κB, MAPK, and JAK-STAT, which lead to cytokine and chemokine release (Muzamil et al., 2021). These mediators such as tumor necrosis factor-α (TNF-α), interleukin-1 (IL-1) , and interleukin-6 (IL-6) orchestrates the recruitment of neutrophils, macrophages, and other immune cells to the site of injury or infection (Muzamil et al., 2021).

Oxidative stress also plays a central role. The imbalance between reactive oxygen species (ROS) and antioxidants amplifies tissue injury and perpetuates inflammation. This mechanism has been increasingly linked to chronic inflammatory diseases (Vargas-Campos et al., 2024).

1.3 CAUSES OF INFLAMMATION

The causes of inflammation can be broadly divided into exogenous triggers(external) and endogenous triggers (internal).

1.3.1 Exogenous Causes

- **Pathogens**: Bacterial, viral, fungal, and parasitic infections are major causes. For instance, Helicobacter pylori infection induces gastric inflammation, while hepatitis viruses cause liver inflammation that can progress to cancer (Gaikwad et al., 2025).
- **Physical and chemical injury**: Trauma, burns, radiation, and exposure to toxic chemicals or pollutants initiate acute inflammatory responses (Kato, 2020).
- **Environmental exposures:** Pollutants, smoking, and allergens provoke chronic, low-grade inflammation, particularly in the lungs and cardiovascular system (Stewart, 2016).

1.3.2 Endogenous Causes

- **Tissue damage and necrosis:** Dying or stressed cells release intracellular contents that act as DAMPs, activating PRRs and driving inflammation (Muzamil et al., 2021).
- **Metabolic dysregulation:** Obesity and poor diet contribute to adipose tissue inflammation, driven by macrophage infiltration and cytokine release, leading to systemic metabolic disorders such as insulin resistance and type 2 diabetes (Gaikwad et al., 2025).
- **Autoimmunity**: Aberrant immune responses against self-antigens drive persistent inflammation, as seen in rheumatoid arthritis, psoriasis, and lupus (Stewart, 2016).
- **Oxidative stress and aging:** Continuous oxidative damage, combined with impaired resolution of inflammation, contributes to chronic conditions such as atherosclerosis, neurodegenerative diseases, and “inflammaging” (Vargas-Campos et al., 2024).

1.4 SIGNS AND SYMPTOMS OF INFLAMMATION

The signs and symptoms of inflammation include redness, heat, swelling, pain and loss of function. (Neville *et al.,* 2004)

1.5 TREATMENTS OF INFLAMMATION

1. Nonsteroidal Anti-inflammatory Drugs (NSAIDs)

NSAIDS inhibits cyclooxygenase (COX-1 and COX-2) enzymes, reducing prostaglandins responsible for pain, fever, and vasodilation.

Examples are Ibuprofen, Naproxen, Diclofenac, Celecoxib (COX-2 selective).

- **Clinical Use:** Acute musculoskeletal injuries, osteoarthritis, rheumatoid arthritis, fever.
- **Limitations:** Long-term use can cause gastrointestinal bleeding, kidney injury, and increased cardiovascular risk. (Derry *et al*., 2015)

2. Corticosteroids

Synthetic glucocorticoids suppress transcription of pro-inflammatory genes (IL-1, IL-6, TNF-α) and promote anti-inflammatory proteins.

Examples are Prednisone, Dexamethasone, Hydrocortisone.

- **Clinical Use:** Autoimmune diseases (RA, lupus), asthma, allergic reactions, septic shock.
- **Limitations:** Long-term use leads to immunosuppression, osteoporosis, diabetes, weight gain, and adrenal suppression. (Simon *et al*., 2018)

3. Disease-Modifying Anti-rheumatic Drugs (DMARDs) & Biologics:

DMARDS suppress immune overactivation by targeting cytokines or signaling pathways.

- **Types:**

a) **Traditional DMARDs:** Methotrexate, Sulfasalazine, Hydroxychloroquine.
b) **Biologics:** Target TNF-α (Etanercept, Adalimumab), IL-6 (Tocilizumab), or B-cells (Rituximab).
c) **Targeted synthetic DMARDs (tsDMARDs):** Janus kinase (JAK) inhibitors such as Tofacitinib.

- **Clinical Use:** Rheumatoid arthritis, psoriatic arthritis, Crohn's disease, ulcerative colitis.

- **Limitations:** Increased risk of infections (TB, hepatitis), high cost, monitoring required.(Fraenkel *et al., 2021)*

4. Lifestyle Modifications

- **Diet:** Anti-inflammatory diets rich in omega-3 fatty acids, fruits, and vegetables reduce chronic inflammation.

- **Exercise:** Improves joint function, reduces systemic inflammation, and prevents disability.

- **Weight Management:** Reduces mechanical stress and inflammatory markers in obese individuals.

1.6 AIM OF STUDY

To investigate the anti-inflammatory effects of pineapple and coconut extract using standard behavioral models in male and female Swiss albino mice.

1.7 OBJECTIVE OF STUDY

I. To evaluate the synergistic anti-inflammatory effect of pineapple and coconut extract.

II. To determine the optimal dosage of the pineapple and coconut extract that produces significant anti-inflammatory effect.

III. To investigate the time course of anti-inflammatory effect following treatment with the mixture.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 *Ananas comosus*

Pineapple (*Ananas comosus*) is a tropical fruit crop in the family Bromeliaceae, highly valued for its nutritional, medicinal, and industrial importance. Native to South America (Brazil–Paraguay region), pineapple spread globally during the colonial period and is now cultivated widely in tropical and subtropical regions. Today, major producers include Costa Rica, the Philippines, Thailand, Indonesia, and India, with Costa Rica as the world's largest exporter.

The pharmacological significance of pineapple is primarily attributed to bromelain, a mixture of proteolytic enzymes extracted from the fruit and stem. In addition, pineapple contains vitamins (notably vitamin C), minerals (e.g., manganese**,** potassium), and phytochemicals that exert antioxidant and anti-inflammatory effects. (Bartholomew *et al*., 2018)

2.1.1 Description of Pineapple Plant

Pineapple is a perennial plant with short and stout stem. It's leaves are long, lanceolate, stiff, often spiny and arranged in a rosette. The flowers of a pineapple are purple or reddish borne on a central spike; individual flowers develop into berries. A multiple fruit is formed by the fusion of many berries around a central axis, it is covered with a tough, scaly rind and crowned by spiny leaves.

2.2 Botanical Classification of Pineapple

Kingdom: Plantae

Phylum: Angiosperm

Class: Monocots (monocotyledoneae)

Order: Poales

Family: *Bromeliaceae*

Genus: *Ananas*

Species: *Ananas comosus*

(de Souza *et al.,* 2011)

2.3 Chemical Composition of Pineapples

Pineapple (*Ananas comosus*) is a tropical fruit rich in carbohydrates, mainly sucrose, glucose, and fructose, with citric acid as the dominant organic acid. It contains significant amounts of vitamin C (5.08–33.57 mg/100 g FW) and bioactive compounds such as phenolics (31.48–77.55 mg GAE/100 g FW) and flavonoids (6.16–34.50 mg rutin eq/100 g FW), contributing to its strong antioxidant properties. Minerals like potassium, calcium, magnesium, iron, and manganese are abundant, supporting its nutritional value. The fruit also contains bromelain, a proteolytic enzyme concentrated in the stem but also present in the pulp and peel, with notable therapeutic and industrial applications. Variationsp in chemical composition are genotype-dependent, reflecting environmental and genetic influences. (Haung *et al*., 2021)

- **Bromelain**

Pineapple juice is a rich source of **bromelain**, a group of proteolytic enzymes primarily found in the fruit and stem of *Ananas comosus*. **Bromelain** is known for its anti-inflammatory, anti-edematous, and mild analgesic properties. It helps break down proteins in the digestive tract, potentially aiding digestion, reducing bloating, and alleviating symptoms of sinusitis and arthritis. Studies have also explored its role in modulating immune responses and wound healing (Maurer, 2001)

- **Vitamins**

Pineapple juice provides a variety of vitamins, especially:

Vitamin C (ascorbic acid): a potent antioxidant that supports immune function, collagen synthesis, and iron absorption. (Figueroa and Thorne, 2018)

Vitamin A (in the form of beta-carotene): important for vision, skin health, and immune defense.These antioxidants help neutralize free radicals and reduce oxidative stress, contributing to overall cellular health.(Matsuoka, 2000)

- **Manganese**

Pineapple juice is particularly rich in **manganese**, a trace mineral vital for:

* Bone development and maintenance

* Energy metabolism

* Antioxidant enzyme function (e.g., superoxide dismutase)

Just 1 cup of pineapple juice can provide over **70% of the Recommended Daily Intake (RDI) for manganese. (Maret and Harris, 2012)

- **B-Vitamins (Thiamin and Vitamin B6)**

Thiamin (Vitamin B1): essential for carbohydrate metabolism and nerve function. It plays a key role in energy production by helping convert glucose into ATP.

Vitamin B6 (Pyridoxine): involved in protein metabolism, neurotransmitter synthesis (like serotonin and dopamine), and red blood cell production.

- **Potassium**

Pineapple juice contains moderate levels of potassium, an essential electrolyte involved in

* Nerve signal transmission

* Muscle contraction (including heart muscle)

* Blood pressure regulation

Although not as high as in bananas or oranges, the potassium content in pineapple juice still supports cardiovascular and muscular health.(Viera and Smit, 2015)

- **Iron**

While pineapple juice contains small amounts of iron, its high vitamin C content enhances non-heme iron absorption from other plant-based sources when consumed together. This makes pineapple juice a good addition to iron-rich meals, especially for those on vegetarian or vegan diets. (Zimmermann and Hurrell, 2007)

2.4 MEDICINAL BENEFITS OF PINEAPPLE

1. Anti-inflammatory Properties:

Pineapple contains a proteolytic enzyme called **bromelain**, which has been widely studied for its anti-inflammatory and analgesic properties. Bromelain inhibits the production of pro-inflammatory cytokines such as interleukin-1 and tumor necrosis factor-alpha. It also reduces levels of prostaglandin E2, which is associated with pain and inflammation.

Clinical Use: Bromelain is used in treating **osteoarthritis**, sports injuries, and post-operative swelling. (Pavan *et al*., 2012)

2. Digestive Aid

Bromelain also acts as a digestive enzyme, helping break down dietary proteins into amino acids. It is particularly useful for people with exocrine pancreatic insufficiency or those suffering from functional dyspepsia. Additionally, pineapple's fiber content supports healthy bowel movements.

Mechanism: Bromelain enhances protein digestion and may ease symptoms such as bloating, gas, and constipation. (Maurer. 2001)

3. **Immune System Support**:

Pineapple is rich in **vitamin C**, an essential antioxidant that contributes to immune defense by supporting various cellular functions. It stimulates the production and function of white blood cells and protects them against oxidative stress.

Additional Role: Vitamin C also enhances the skin's barrier function and promotes collagen production.(National Institute of Health (NIH), 2021)

4. Antioxidant and Anti-Cancer Potential**

Pineapple is rich in **phenolic compounds**, **flavonoids**, and **ascorbic acid**, all of which act as antioxidants. These compounds neutralize **free radicals**, thereby reducing oxidative stress, a major contributor to chronic diseases and aging. Some in vitro studies suggest bromelain may inhibit tumor cell growth by promoting apoptosis and modulating immune responses.

5. Wound Healing and Tissue Repair:

Bromelain enhances **tissue repair** by promoting debridement (removal of dead tissue), reducing bruising and swelling, and accelerating wound healing. It has been applied topically or orally for managing surgical wounds and burns.

Clinical Studies: Use of bromelain post-surgery has shown to reduce healing time and improve comfort.(Taussig and Batkin, 2008)

Plate 2.1: A Pineapple Fruit

Plate 2.2: A Pineapple Fruit

2.5 *Cocos nucifera* (Coconut)

Coconut (*Cocos nucifera* L.) is a tropical palm of the family Arecaceae, often called the “tree of life” due to its wide nutritional, medicinal, and industrial applications. Its fruit consists of a fibrous husk, hard shell, edible kernel, and liquid endosperm, each with economic significance. Coconut oil, derived from dried kernel (copra), is rich in medium-chain fatty acids, particularly lauric acid, which contributes to its antimicrobial and health-promoting properties (Mandal and DebMandal, 2011). Beyond nutrition, coconut products are widely applied in cosmetics, pharmaceuticals, and food industries. Toxicological evaluations further confirm the safety of *Cocos nucifera* oil and related derivatives, highlighting its versatile role in human use (Burnett et al., 2011). Thus, coconut remains a vital crop for both health promotion and global economies.

2.6 Botanical Classification of Coconut

Kingdom: Plantae

Division / Phylum: Magnoliophyta (Angiosperms – flowering plants)

Class: Liliopsida (Monocotyledons)

Order: Arecales

Family: Arecaceae (Palm family)

Genus: *Cocos*

Species: *Cocos nucifera* L.

(Mandal and DebMandal, 2011)

2.7 Chemical Composition of Coconut

Coconut is rich in medium-chain fatty acids, with lauric acid being the predominant component of coconut oil, contributing to its antimicrobial and metabolic benefits. The kernel contains proteins, carbohydrates, dietary fiber, and essential minerals such as potassium, calcium, magnesium, and iron, while also serving as a source of vitamins like vitamin C and several B-complex vitamins. Coconut water is particularly valued for its high electrolyte content, including potassium, sodium, and magnesium, making it a natural rehydration drink. Phenolic compounds and flavonoids present in different parts of the fruit contribute to antioxidant activity, while the testa and husk contain additional phytochemicals with medicinal potential. Overall, its composition underlies the nutritional, pharmacological, and industrial importance of the crop.

- **Calories**

Value: \~354 kcal

Explanation: Coconut is energy-dense due to its high fat content.(USDA FoodData Central (2020)

- **Protein**

Value: \~3.3 g

Explanation: Coconut contains a modest amount of protein, which supports tissue repair and enzyme production.(USDA FoodData Central (2020)

- **Fat**

Value: \~33.5 g

Explanation: High in saturated fats, especially lauric acid, which may have antimicrobial properties.(Dayrit, F. M. (2015)

- **Carbohydrates**

Value: \~15.2 g

Explanation: Mostly composed of dietary fiber and natural sugars, aiding digestion and energy supply. (USDA FoodData Central (2020)

- **Vitamin C**

Value: \~3.3 mg

Explanation: Provides some antioxidant support, though not a major source.(NIH Office of Dietary Supplements (2021

- **Calcium**

Value:\~14 mg

Explanation:Present in small amounts, supports bone health. (USDA FoodData Central (2020)

- **Iron**

Value: \~2.4 mg

Explanation: Aids in oxygen transport and preventing anemia. (USDA FoodData Central (2020)

- **Magnesium**

Value: \~32 mg

Explanation: Important for muscle function and energy production. (NIH Office of Dietary Supplements (2021)

2.7 MEDICINAL BENEFITS OF COCONUT MILK

1. **Medicinal Benefits of Coconut**

Coconut oil contains **lauric acid**, a medium-chain fatty acid (MCFA) that has been shown to exhibit **antiviral, antibacterial, and antifunga**l properties. When lauric acid is digested, it forms **monolaurin** which can destroy lipid-coated viruses (e.g., HIV, herpes, influenza) and bacteria such as ***Staphylococcus aureus*** and ***Helicobacter pylori***.

Mechanism: Monolaurin dissolves the lipid membranes of pathogens, disrupting their activity.(Dayrit, 2015)

2. Heart Health Support:

Although coconut oil is high in saturated fat, studies show that **medium-chain triglycerides (MCTs)** found in coconut may increase HDL ("good") cholesterol while not significantly affecting LDL ("bad") cholesterol in some individuals.

Note: The impact varies between individuals, and excessive consumption should be avoided.(Nevin and Raiamohan, 2004)

3. **Antioxidant Properties**:

Coconut water, milk, and oil contain **phenolic compounds** that function as antioxidants. These compounds help combat **oxidative stress**, which is linked to aging and chronic diseases such as cancer and neurodegeneration.

Components: Catechins, ferulic acid, and caffeic acid contribute to its antioxidant activity.(Marina *et al.,* 2009)

4. Anti-inflammatory Activity

Coconut milk and oil has been found to reduce inflammation by inhibiting pro-inflammatory enzymes such as cyclooxygenase (COX). It can be used both topically and orally for inflammatory conditions such as arthritis, skin disorders, and muscle aches.

Application: Used in traditional medicine for soothing burns, wounds, and eczema.(Intahphuak *et al*., 2010)

5. Skin and Wound Healing:

Coconut milk has been shown to promote wound healing and enhance skin barrier function. It boosts **collagen cross-linking**, provides **moisture**, and offers antimicrobial protection, making it useful in treating minor wounds, burns, and dermatitis.(Srivastava and Kumar, 2015)

6. Hydration and Electrolyte Balance:

Coconut water is a natural source of **potassium**, **magnesium, sodium,** and other electrolytes. It is often used for **rehydration** in cases of diarrhea, dehydration, and heat stroke, especially in tropical medicine.

Clinical Use: Considered a natural alternative to oral rehydration therapy (ORT).(Campbell-Falck, 2000)

Plate 2.3 : A Coconut Tree

Plate 2.4: A Coconut Fruit.

CHAPTER THREE

3.0 MATERIALS AND METHODS

3.1 Collection and Extraction of Plant Materials

The Pined apple and coconut fruits were purchased from of Oba market in Benin City, Edo State, Nigeria. They were cleaned and juiced with a food processor (Obaro et al., 2024).

The extracted juice sample was stored in an air tight container. The juice was freshly prepared and refugirated every morning throughout the experiment

3.2 Experimental Animals

Albino mice weighing 25 to 30 g and rats weighing 200 to 250 g were purchased from the Animal House of the Department of Anatomy, School of Basic Medicine, ,and University of Benin.

3.3. Acute Toxicity Study

The acute toxicity studies were performed in compliance with the guidelines set forth by the Organization for Economic Co-operation and Development (OECD, 2018).

Three (3) male mice and 3 female mice each were administered 5 ml of pineapple and coconut milk juice respectively and observed for 72 hours for possible signs of toxicity, mortality or morbidity.

Solvents/chemicals

Egg albumi, carrageenan and Chloroform (supplied by Fharmatrends Nigeria Ltd), Sodium Chloride all of analytical standards.

Drugs

Ibuprofen, were of pure samples and pharmaceutical standards.

Equipment

Centrifuge (HV-8M), Electric blender (Sc-1589), Electric oven (COV- 8320-C), Microscope (labron-307), Refrigerator (TR-131L), Water bath (WB-4MS).

Apparatus

Beakers (50ml, 100ml, 200ml, 1000ml), cages, cotton wool, crucible, cheese cloth, cover slip, distilled water, feed plates, glass slides, hand gloves, masking tape, methylated spirit, measuring cylinder (1000ml), oral gastric tube, pelletized feed, rat restrainer.

3.3 Systemic Acute Inflammation of the Rat Paw

By injecting phlogistic agents (such as fresh egg albumen or a 1% solution of carrageenan in normal saline) into the sub-plantar area of the paw, it is possible to cause an acute inflammatory response in rat paw records. The rat paw develops edema, which is seen as an intense pink swelling, as a result of the acute inflammatory response. The size of the paw is measured in terms of the volume at various intervals, using a Vernier calliper. Other methods of measurement paw size include volume displacement from a measuring cylinder containing water, measurement of linear circumference of the paw for using a tape and measurement of paw thickness with a micrometre screw gauge or calliper.

In some instance, the animal is sacrificed and the inflamed paw amputated and weighed. However, the latter should be relegated to extremely necessary experimental needs. Anti-inflammatory substance abolished or reduces the extent of the swelling or edema when compared to the negative control. Adult rats of either sex are used in this experiment. The animals are randomly allotted into groups based on the dose levels of the test substance and appropriate controls (NSAIDs such as Ibuprofen for positive control; the vehicle or suspending agents served as negative control). At time t = 0, the animal's right hind paw is measured for size. The test substance is administered. One hour after oral administration of test substance, the rat's right hind paw's sub-planter region receives an injection of phlogistic agent measured at 0.1 milliliter. At various times (0.5, 1, 2, 3, 4 and 5h) after carrageenan injection, the paw size is measured again. Edema is measured as a rise in size of the paw size at 0 hours and at various intervals following injection of a phlogistic agent. For each group, the relation (where paw volume is used) is used to calculate the inhibition level (%) of edema.

Inhibition (%) = [1-(Vt/Vc)] 100

Where, Vt = average paw volume of the treated group,

Vc = average paw volume of the control group.

3.4 Edema – Induced by Formaldeyhde in Rats

Formaldehyde edema has been shown to be mediated by histamine, 5-HT, substance P, and bradykinin and prostaglandins which are involved in the acute phase of inflammatory response. Sustenance of the edema beyond the initial 24h may invoke induction of other humoral and cell- mediated responses such as lymphocyte accumulation and proliferation, indicative of chronic inflammation. Due to the ability of formaldehyde to cause necrosis of the tissues of the paw, it is also thought that necrosis amplifies the later stages of the formaldehyde edema through activation of kinin, coagulation, complement and fibrinolytic systems and the mediator release from passenger leukocytes that are dying or dead. The arthritic foot appears swollen and painful initially but wanes within 1-3 days to prolong and further sustaining the arthritics; the paw is re-inflamed on day 3 with formaldehyde injection. The experiment typically lasts for 10 days.

The experiment uses adult rats of either sex. The animals are divided into five (5) groups at random, negative control (Distilled Water), extract treated and Ibuprofen (positive control) groups. On day 1 of the experiment, we use a Vernier calliper to measure the animal's right hind paw or volume (by displacement) and the test substance was administered (orally). One hour after oral administration of test substance, Edema is induced through injection administered sub-plantar at 0.1 ml of 2 % v/v formaldehyde solution. After 4 hours, the paw's volume or size is once more measured. On day 2, the animal is treated once and the size (or volume) of the arthritics foot measure. On day 3, after treatment and measurement of the arthritic foot size (or volume), edema is re induced by formaldehyde injection. From day 4- 7, the animal is treated daily and the size (or volume) of the arthritic foot measured. Changes in the size or volume of the arthritics foot is used as a measure of edema. The overall result of the anti-edema treatment is quantified by the area under the curve (AUC) of the time-course of the arthritic event, which represents the global response of edematous to arthritis from formaldehyde. The inhibition level in percentage of edema is determined using the relation, and the AUC is determined using the trapezoidal rule:

Inhibiton (%) = [1 – (AUCt / AUCc)] 100

Where, AUCt = AUC of the treated group

AUCc = AUC of the control group.

3.7. Administration of extract

Extract was freshly prepared every morning and administered orally to rats by carefully inserting an orogastric tube into the oral cavity of the rats. The animals were grouped into three categories groups; carrageenan induced for paw edema (a), egg albumen induced for paw edema (b) and formaldehyde induced for paw edema (c), consisting of 5 animals each.

Group I (Negative control) – Distilled Water (2 ml/kg)

Group II- Positive control (10 mg/kg Ibuprofen)

Group III, IV and V (1, 1.5 and 3 ml of the pineapple and coconut juice after acute toxicity study).Throughout the period of administration, food and water were given to the rats.

3.8. Statistical analysis

Every value is presented as Mean ± Standard Error of Mean (SEM). Using the UK's Graph Pad Prism 8.2 software, one-way ANOVA was used to analyse the data. $P \leq 0.01$ was used to define significance for differences.

RESULT

4.1 Acute Toxicity Study

Acute toxicity study revealed that there was no sign of toxicity, mortality or morbidity after administration of 5 ml/kg per body weight of the extracted juice and observed for 72 hours

4.2 Carrageenan induced for paw edema

Rat treated with the three doses of extract exhibited significant decreases in paw size, which when compared to the negative control, were significant (Figure 4.1).

4.3 Egg albumen induced for paw edema

Rat treated with the three doses of extract exhibited significant decreases in paw size, which when compared to the negative control, were significant (Figure 2).

4.4 Formaldehyde induced for paw edema

Rat treated with the three doses of the extract exhibited significant decreases in paw size, which when compared to the negative control, were significant (Figure 3).

Table 4.1: Acute effect of single dose of 5 ml of Pineapple and coconut juice administered to albino mice after 72 hours of administration.

Group(s)	Dose (mg/kg)	Cognition	Agility	Signs of Toxicity such as: Grooming, nausea, writhing, salivation, and diarrhoea	% Mortality after 72 hours of administration
Control	2 ml/kg	Normal	Normal	None	0
PACNTJ	5 ml/kg	Normal	Normal	None	0

PACNJ = Pineapple and coconut juice **of *O. gratissimum* and *I. gabonensis***

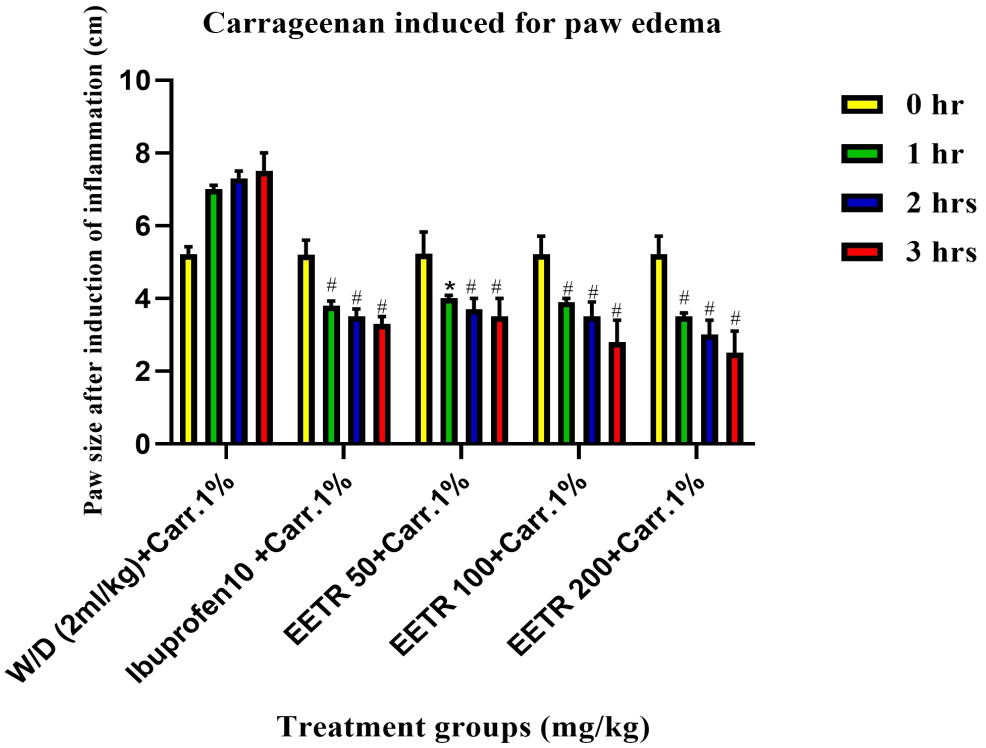

Figure 4.1: Effects of **pineapple and coconut juice** PACNJ 1.5, 2.5 and 5 ml/kg and Ibuprofen (10 mg/kg) on carrageenan induced for paw edema. Results are Expressed as mean ± S.E.M (n=5). * =P≤0.01 # =P≤0.001 as compared to control (Distilled Water (DW)) group.

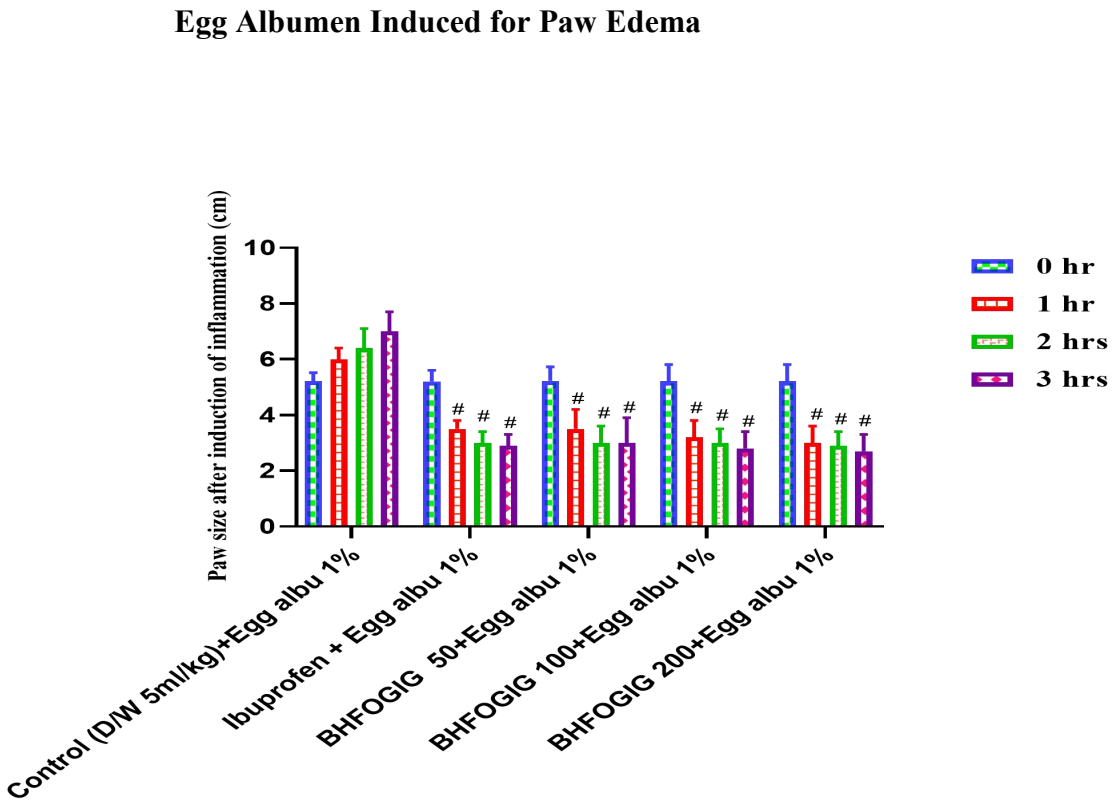

Figure 4.2: Effects of of **pineapple and coconut juice** PACNJ 1.5,2.5 and 5 Ibuprofen (10 mg/kg) on egg albumen induced for paw edema. Results are Expressed as mean ± S.E.M (n=5). * =*P≤0.01*, # =*P≤0.001* as compared to control group.

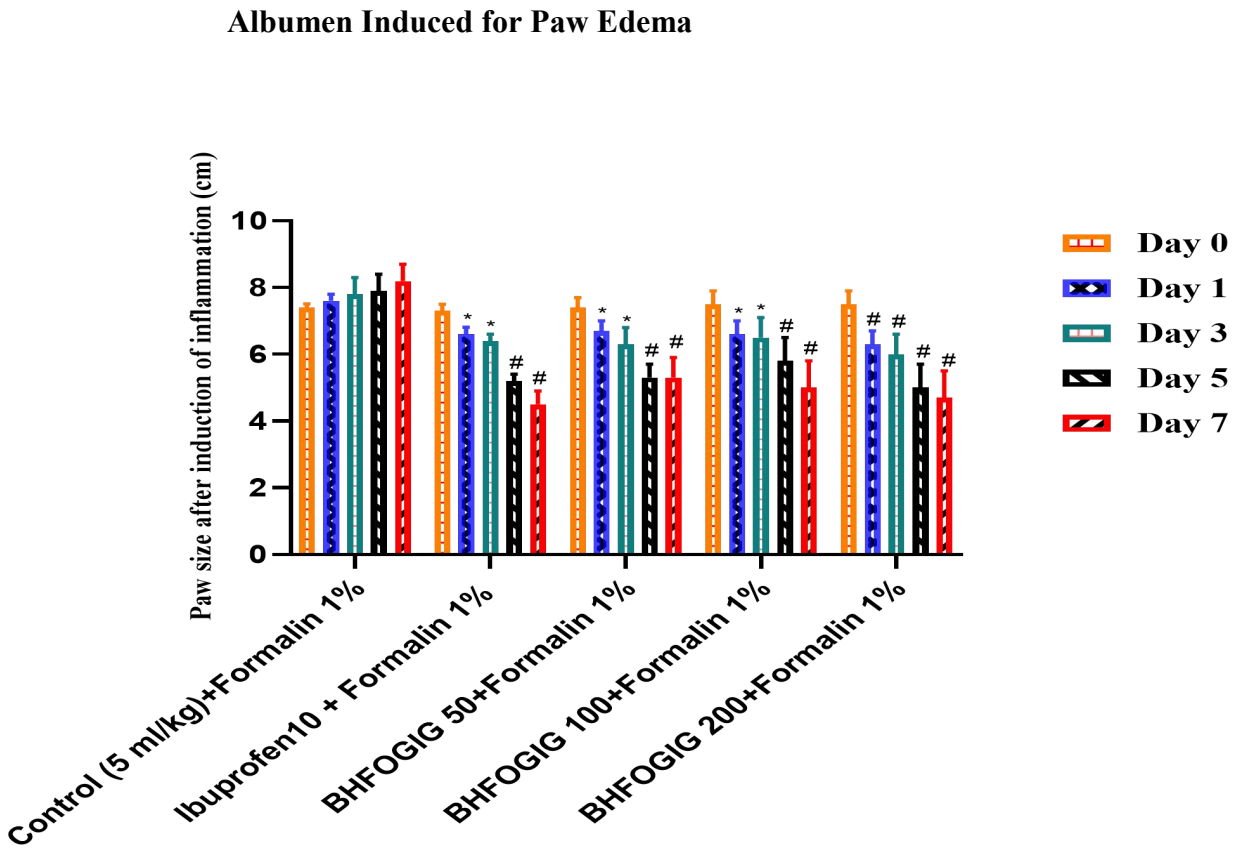

Figure 4.3: Effects of **pineapple and coconut juice** PACNJ 1.5, 2.5 and 3 ml/kg and Ibuprofen (10 mg/kg) on formaldehyde induced for paw edema. Results are Expressed as mean ± S.E.M (n=5). * =*P≤0.05*, # =*P≤0.01* as compared to control group.

CHAPTER FIVE

5.0. DISCUSSION AND CONCLUSION

5.1 DISCUSSION

Inflammation is a fundamental biological response to harmful stimuli, such as pathogens, damaged cells, or toxic irritants. It is designed to restore tissue homeostasis by eliminating the cause of injury, clearing necrotic cells, and initiating repair processes (Kato, 2020).

The process is tightly regulated, involving immune cells, blood vessels, and chemical mediators, and can be broadly classified as acute or chronic. Acute inflammation is rapid and short-lived, characterized by redness, heat, swelling, and pain. Chronic inflammation, by contrast, is prolonged, leading to simultaneous tissue damage and repair, often associated with chronic diseases such as diabetes, cancer, and autoimmune disorders (Gaikwad et al., 2025).

5.1.2 CARRAGEENAN INDUCED FOR PAW EDEMA

From the figure 4.1, the control group showed the lowest anti-inflammatory properties. There was a dose dependent relationship in the plant sample groups as the anti-inflammatory properties increased with higher doses of the extract. The standard drug ibuprofen showed a higher mobility time compared to the control group that received no treatment. The group administered the extract was significantly diff from the control group.

5.1.3 EGG ALBUMEN INDUCED FOR PAW EDEMA

From the figure 2, the control group which received no treatment showed the lowest anti- inflammatory properties. The standard anti- inflammatory drug showed higher anti-inflammatory properties compared to the control group. There was a dose-dependent relationship between the groups administered with the plant extracts. From the figure, it can be shown that the extract has anti-inflammatory activity.

5.1.4 FORMALDEHYDE INDUCED FOR PAW EDEMA

From the figure 4.3,, the control group showed the lowest anti-inflammatory properties. There was a dose dependent relationship in the plant sample groups as the anti-inflammatory properties increased with higher doses of the extract. The standard drug ibuprofen showed a higher mobility time compared to the control group that received no treatment. The group administered the extract was significantly diff from the control group.

CONCLUSION

In summary, the study demonstrated that both pineapple and coconut possess notable anti-inflammatory properties when tested on animal models such as rats. Extracts from these plants significantly reduced inflammation, supporting their traditional use in managing inflammatory conditions. The observed effects may be attributed to the presence of bioactive compounds such as bromelain in pineapple and lauric acid and polyphenols in coconut. These findings suggest that pineapple and coconut could serve as potential natural sources for developing safe and effective anti-inflammatory agents. Further studies on dosage, mechanisms, and clinical applications are recommended.

Gaikwad, V. V., Gitaje, S. R., Joshi, S. D., Kharmate, S. V., Phalle, D. R., More, M. P., Mali, M. A., & Shingade, P. P. (2025). Mechanisms of Inflammation Associated With Chronic Diseases: A Brief Review. *Journal of Advances in Medicine and Medical Research*, 37(3), 48–56.

Kato, H. (2020). Inflammatory Disease (1) What Is Inflammation? *Journal of Tokyo Women's Medical University*, 90(1), 1–13.

Muzamil, A., Tahir, H. M., Ali, S., Liaqat, I., Ali, A., & Summer, M. (2021). Inflammatory process and role of cytokines in inflammation: An overview. *Punjab University Journal of Zoology*, 36(2), 237–252.
Vargas-Campos, L.-E., et al. (2024). Inflammation from the basics to the clinical: Advances and challenges in oxidative stress. *Medical Research Archives*, 12(1).

Stewart, J. (2016). Inflammation: maladies, models, mechanisms and molecules. *British Journal of Pharmacology*.

Derry S, Wiffen PJ, Moore RA. *Topical NSAIDs for acute musculoskeletal pain in adults.* **Cochrane Database Syst Rev.** 2015;(6)\:CD007402.

Fraenkel L, Joan M, Bryant R,E William St Clair, Thurayya Arayasi, Kristine C, Kevin D,
2021 American College of Rheumatology Guideline for the Treatment of Rheumatoid Arthritis.* **Arthritis Care Res.** 2021;73(7):924–939.

Bartholomew, D. P., Paull, R. E., & Rohrbach, K. G. (2003). *The Pineapple: Botany, Production, and Uses.* Wallingford: CABI Publishing. ISBN 9780851995038.

de Souza E H, Souza F. V.D, de Carvalho Costa M. A. P, Davi Silva Costa Jr , Almeida dos Santos-Serejo J, Amorim E. P, Carlos Alberto da Silva Ledo 2011