CHAPTER 1. INTRODUCTION

1.1 Background

Inflammation is a positive response of the body to the injured area due to tissue damage caused by physical trauma, destructive chemicals, or microbial agents (Harianto, *et al.,* 2021). Inflammation aims to reduce, destroy, and allocate damaging agents and damaged tissues (Agustina *et al.,* 2015). An excessive inflammatory response will result in acute tissue damage. In some cases, inflammation may resolve on its own. However, the healing takes quite a long time. To reduce the effects of inflammation, commercial drugs from the steroid and non-steroidal groups are usually used. However, both types of drugs have side effects that are bad for the body if used in the long term. Steroid drugs can reduce the body's immune response to infection, reduce glucocorticoid synthesis (steroid hormones that control the inflammatory response), cause hypertension, osteoporosis, (Sukmawati *et al.,* 2015) thin skin, dermatitis, purpura, and acne (Coondoo, *et al.,* 2014). Anti-inflammatory drugs from the non-steroidal group (AINS) can cause gastrointestinal disorders and interfere with platelet function (Sukmawati *et al.,* 2015).

The high side effects of using synthetic anti-inflammatory drugs make it necessary to look for other efforts sourced from organic materials that are still natural, such as plants (Nifinluri *et al.,* 2019). Until now, many extracts from plants have been studied to be developed as anti-inflammatory drugs, such as ethanol extracts of karamunting leaves (*Rhodomyrtus tomentosa* (Ramadhiani, *et al.,* 2019); Srikaya leaves (*Annona squamosa* L.) (Pramitaningastuti and Anggraeny, 2017);

banana leaves (*Musa paradisiaca* L.) (Sukmawati, *et al.,* 2015); *Citrus aurantium* L. (Kang *et al.*, 2011). However, the provision of such materials through extraction processes such as maceration or reflux requires expensive solvents. In addition, the process involves heating which can degrade important compounds in the extract. Finally, it is difficult to obtain high purity extracts, so extraction through fermentation processes is more appropriate and suitable for use. One of the extraction processes through fermentation is known as eco-enzyme (Mavani *et al.*, 2020).

Eco-enzyme is a liquid product from the processed organic waste of fresh vegetables and fruits that is fermented by adding brown sugar (Rochyani *et al.*, 2020). To be harvested, eco-enzyme fermentation usually takes at least 3 months (Penmatsa *et al.,* 2019). However, recent research, conducted by Rahayu *et al.*, 2020) found that the manufacture of eco-enzymes can be accelerated by adding baking yeast (Fermipan) to as much as 1% of the volume of water used. The addition of baking yeast containing *Saccharomyces cerevisiae* will accelerate the fermentation process in the process of manufacture eco-enzyme so that eco-enzyme can be harvested within 8-10 days with conditions that meet the standards of eco-enzyme for harvesting.

Eco-enzyme is useful for health (as a disinfectant, and cleaner), for households (as a substitute for bath soap, floor cleaner, and mouthwash), and for agriculture (as a liquid organic fertilizer, and vegetable pesticide) (Hasanah, 2021). The results of Jannatan's research (2022) show that eco-enzymes are effective as insect pest repellents. In addition to being produced for the environment and cleaning, recently eco-enzymes have begun to be used as an external medicine to -

replace synthetic ointments for itching, minor bruising, or redness from insect bites.

Several studies have reported the benefits of eco-enzymes as antibacterial (Ramadani *et al.*, 2022; Saramanda and Kaparapu, 2017; Mavani *et al.*, 2020), but there is no scientific information regarding their medical efficacy as anti-inflammatory. Bananas and oranges are popular fruits that are favored by many people and can be found throughout the year. Every day, the skin of these two types of fruit is found in various places. Based on research by Nurlatifah *et al.*, (2021), it is known that the eco-enzyme of banana peel and orange peel contains acetic acid, lactic acid, flavonoids, alkaloids, and saponins. These compounds have the potential to be used as anti-inflammatory drugs.

This study aims to determine the anti-inflammatory effects and potential activity of eco-enzymes from banana peel and eco-enzymes from citrus fruit peel as anti-inflammatory in carrageenan-induced mice and the effect of banana peel eco-enzymes and citrus fruit peel eco-enzymes as a substitute for anti-inflammatory synthetic ointments. In this study, only one type of fruit peel was used to make one type of eco-enzyme, as Nurlatifah *et al.*, (2021) did. The selection of one type of fruit peel in making this eco-enzyme aims to determine the exact organic compounds contained in each fruit peel that have the potential as an anti-inflammatory.

1.2 Problem Formulations

The problem formulations of this research are as follows:

1. Whether eco-enzymes from banana peels and orange peels are effective in

counteracting carrageenan-induced skin inflammation in white mice?

2. Could eco-enzymes from banana peel and orange peel affect the quantity of leukocytes involved in the inflammatory process in mice?
3. What are the bioactive compounds in the eco-enzyme from banana peel and orange peel that have the potential as an anti-inflammatory?

1.3 Research Objectives

The objectives of this study are:

1. To determine the effect of eco-enzyme from banana peel and orange peel in counteracting inflammation in the skin of carrageenan-induced white mice.
2. To determine the capability of eco-enzyme from banana peel and orange peel in regulating the quantity of leukocytes involved in the inflammatory mice.
3. To determine the active compounds in eco-enzyme from banana peel and orange peel that have the potential as an anti-inflammatory.

1.4 Research Benefits

This research results are expected to provide scientific evidence of the beneficial use of eco-enzymes from banana peel and orange peel effective as anti-inflammatory traditional medicine and information related to other ways of utilizing useless organic waste into new products that have many benefits.