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Research Article

Anti-Inflammatory and Analgesic Activity of *Musa balbisiana* Peels *In Vivo*

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Abstract

Musa balbisiana Peels (MBP) contains high levels of flavonoids, alkaloids, tannins, saponins, and triterpenoids. Flavonoids function to slow down the inflammatory process by inhibiting the arachidonic acid, forming prostaglandins, and releasing histamine. This study aimed to examine the anti-inflammatory and analgesic effects of MBP decoction. This study used the Winter method for anti-inflammatory assay by induction of carrageenan on the soles of rat's feet and Sigmund's method for analgesic assay with intraperitoneal induction of acetic acid in mice. Group I as a negative control, group II as a positive control with diclofenac sodium, group III as a low dose (200 mg/kg BW of MBP), group IV as a medium dose (400 mg/kg BW of MBP), and group V as a high dose (800 mg/kg BW of MBP decoction). The percentage of inhibition in the anti-inflammatory test in rats for groups II, III, IV, and V was 34.43%, 17.68%, 25.53%, and 25.4%, and the percentage of effectiveness for the anti-inflammatory test, respectively, was 51.35%, 74.15%, and 74.01%. The results of the percentage inhibition of the analgesic test in mice for groups II, III, IV, and V were 55.25%, 38.52%, 44.53%, and 49.31%, and the percentage of effectiveness for the analgesic test, respectively, followed by 69.71%, 80.59%, and 89.24%. Based on the results, it can be concluded that the decoction of the MBP has an anti-inflammatory and analgesic effect.

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INTRODUCTION

Inflammation is a complex biological response of vascular tissue to noxious stimuli such as pathogens, damaged body cells, or irritants[1]. Inflammation is triggered by releasing chemical mediators from damaged tissues and cell migration[2]. Pain, redness, swelling, and tissue and organ dysfunction are signs of inflammation[3]. This is a protective response made by the body against tissue damage caused by various stimuli[4]. In such cases, their defense reactions may cause progressive tissue injury, and anti-inflammatory or immunosuppressive drugs may be required to modulate the inflammatory process[5].

Pain is the most common symptom when inflammation occurs and can reduce the quality of life. Pain is an unpleasant sensory and emotional feeling associated with tissue damage[6]. Pain is often described as either noxious (noxious, protopathic) or harmless (non-noxious, epicritic), for example, light touch, warmth, or light pressure. Most people feel disturbed, uncomfortable, and tormented by the pain[7]. Many people cannot stand it and try to relieve pain by using painkillers or analgesics. Many different types of therapy have been developed to reduce pain caused by inflammation. In controlling inflammation and pain, drugs that can inhibit the disease are needed, so anti-inflammatory and analgesic drugs are needed, better known as anti-inflammatory and analgesic drugs (NSAIDs)[8]. The principal mechanism of action of NSAIDs, as analgesics, is the blockade of prostaglandin synthesis through cyclooxygenase inhibition (COX-1 and COX-2

enzymes) so that the production of PGI2 (prostacyclin) by COX-1 as a gastroprotective is also inhibited[9]. So if the therapy for pain and anti-inflammatory is carried out for a long time and requires high doses of drugs, that can be affected by side effects on the stomach[10].

Many herbal plants have been developed and have therapeutic effects for inflammation and pain, such as modern allopathic drugs with a single active substance with a single target pathway of action. Herbal medicines consist of various active molecules that work synergistically with various action targets[11]. The utilization of natural resources in the form of plants has long been used to cure diseases[12]. One of the plants used in medicine is *Musa balbisiana* (one type of banana). *Musa balbisiana* developing research, especially in terms of pharmacology and phytochemicals, is based on indications of medicinal plants that some people with empirically proven efficacy have used[13].

Musa balbisiana peels (MBP; **Figure 1**) have not been used optimally as traditional medicine, even though the fruit is widely used and consumed in the community. The use of this peel can undoubtedly reduce the organic waste of the MBP. The MBP contains high flavonoid content. Based on the results of the phytochemical screening conducted, it was known that the MBP contained flavonoids, alkaloids, tannins, saponins, and triterpenoids[14]. The GC-MS analysis showed that the major component of *M. balbisiana* extract was difluroisocyanotophosphine[15]. By inhibiting the arachidonic acid metabolic pathway, the formation of prostaglandins, and the release of histamine, flavonoids function as an anti-inflammatory or slow down the inflammatory process[16]. Flavonoids are anti-inflammatory agents because flavonoids in the body act to inhibit lipoxygenase enzymes, the role in leukotriene biosynthesis[17].

Figure 1. *Musa balbisiana* fruit

In addition to inhibiting the metabolism of arachidonic acid by reducing prostaglandins production, flavonoids also inhibit the secretion of lysosomal enzymes, which are inflammatory mediators. Inhibition of these inflammatory mediators can inhibit the proliferation of the inflammatory process[18]. Saponins are thought to interact with many membrane lipids. Membrane lipids such as phospholipids are precursors of prostaglandins and other inflammatory mediators. Saponins are thought to inhibit the increase in vascular permeability so that edema as a sign of inflammation does not occur[19]. Tannins have antioxidant activity, and antioxidants act as an anti-inflammatory in various ways, including inhibiting the production of O_2 oxidants by neutrophils, monocytes, and macrophages[20]. Based on these things, the authors are interested in further researching the anti-inflammatory effect that will be tested using the Winter method and the analgesic effect that will be tested using the Sigmund method of MBP decoction. The community has widely used this decoction method to manufacture traditional medicine because the extraction process is easy to do and does not require special tools. The anti-inflammatory and analgesic research carried out using MBP decoction aims to prove that the MBP has anti-inflammatory and analgesic effects.

MATERIALS AND METHODS

Materials

Musa Balbisiana peels fruit used in this study was obtained from Trirahayu Village, Negeri Katon District, Pesawaran Regency, Lampung Province, Indonesia. The experiment used Sprague Dawley (SD) male white rats aged 2-3 months with a bodyweight of 150-200 g as an anti-inflammatory test, and the Deutsche Denken Yoken strain male white mice aged 2-3 months old and weighed 25-30 g as an analgesic test, developed at the Non-Ruminant and Animal Hope Laboratory, Faculty of Animal Husbandry, IPB University. Other materials include diclofenac sodium, 0.5% CMC sodium, 1% carrageenan, 3% acetic acid, aquadest, feeding tube, stopwatch, and plethysmometer.

Methods

Plant determination

Plant samples identified as *M. balbisiana* were determined at Herbarium Bogoriense, Botany, Indonesian Institute of Sciences, Research Center for Biology, Cibinong Science Center, Bogor, Indonesia, with number 353/IPH.1.01/If.07/II/2020.

MBP decoction preparations

As much as 10 g of MBP powder was added with 200 mL of water, then it was heated until the volume was half of the initial volume with occasional stirring and then filtered through a filter heat sufficiently to obtain the desired volume of 100 mL.

Anti-inflammatory test

This research was carried out after obtaining ethical approval number 101/II/2021/KEPK from the Health Research Ethics Committee Universitas Pembangunan Nasional Veteran Jakarta. All actions were taken by minimizing pain and suffering in experimental animals[21]. An anti-inflammatory test was carried out using the Winter method to form edema on the paw of rats[22]. Before the experiment was carried out on rats, rats fasted for ± 18 hours while still being given water. The rats were weighed on the day of testing; 25 rats were taken at random and divided into five groups, respectively, with five rats each. Group I was a control (-) and given aquadest + 0.2 mL 1% carrageenan; Group II was the control (+) and was given 8.02 mg/200 g BW diclofenac sodium + 0.2 mL 1% carrageenan; while Groups III, IV, and V were the dose group that was given orally MBP decoction of 200; 400; and 800 mg/kg BW, respectively, and given 0.2 mL 1% carrageenan on the soles of the feet rat. Before being treated, measure the initial volume of the rat's paws by dipping the rat's paws into the plethysmometer. In the treatment of each anti-inflammatory test group, the rats were given the preparation of the test substance orally according to the dose of each treatment group. Thirty minutes later, the rat's paws were induced with 0.2 mL 1% carrageenan intraplantar continued to measure the volume of rat paw edema every hour for five hours. The calculations for area under the curve (AUC), percentage of anti-inflammatory (% antiinflammatory), and percentage of anti-inflammatory effectiveness (% effectiveness) occurring in the test group were presented in **Equations 1** to **3.**

$$\text{AUC} = \frac{(\text{Vn}-1+\text{Vn})(\text{tn}-\text{tn}-1)}{2} \qquad \dots [1]$$

$$\%\ \text{antiinflammatory} = 1 - \left(\frac{\text{the average value of AUC}}{\text{the average of AUC control}}\right)\text{x}100\% \qquad \dots [2]$$

$$\%\ \text{effectiveness} = 1 - \left(\frac{\text{t\% anti}-\text{inflammatory test}}{anti-inflammatory\ of\ diclofenac\ sodium}\right)x100\% \qquad \dots [3]$$

Vn : Volume of rat paw at hour/minute n
Vn-1 : Volume of rat paw at hour/minute (n-1)
tn : Hour n or minute n
tn-1 : Hour (n-1) or minute (n-1)

Analgesic test

The analgesic test was performed using the Sigmund method[23]. Before the experiment was conducted on mice, the mice fasted for ± 18 hours while still being given water. On the test day, the weight of the mice was weighed, and 25 mice were

taken at random and divided into five groups, with five mice each. Group I was a control (-) and was given aquadest + 0.2 mL/20 g BW 3% acetic acid; Group II was a control (+) and was given 81.16 mg/20 g BW diclofenac sodium + 0.2 mL/20 g BW 3% acetic acid; while Groups III, IV, and V were the dose group that was given orally MBP decoction of 200; 400; and 800 mg/kg BW, respectively, and given 0.2 mL/20 g BW 3% acetic acid. In the treatment of each analgesic test group, mice were given the test substance orally by the treatment dose of each group. Thirty minutes later, the mice were induced with 0.2 mL/20 g/BW 3% acetic acid intraperitoneally. Then the mice were placed in the cage; after the administration of acetic acid, the mice would give a writhing response which was indicated by moving a pair of front legs that were pulled forward and a pair of hind legs that were pulled back and rubbing their stomach against the bottom of the cage. The mice were observed, then the number of stretches shown by the mice was recorded every five minutes for an hour. The calculations for AUC were given in **Equation 4**, while % antiinflammatory and % effectiveness was calculated using **Equations 2** and **3**.

$$\mathrm{AUC} = ((\sum n - 1 + \sum n)(tn - tn - 1))/2 \quad \ldots [4]$$

∑n : Number of mice writhing in hours/minute n
∑n-1 : Number of mice writhing in hours/minute (n-1)
tn : Hour n or minute n
tn-1 : Hour (n-1) or minute (n-1)

Data analysis

The AUC values of data between each treatment group were analyzed using the SPSS® Statistical Analysis version 20. If the data on AUC values in all treatments had a normal and homogeneous distribution, the analysis would continue using one-way ANOVA (Analysis of Variance). If the results of the ANOVA test show that there is a statistically significant difference in each treatment, then the analysis will continue using the LSD (Least Significant Difference) test with a significance level of 5% (0.05) to determine whether there is a difference between each treatment. However, if the AUC value data has no requirements of a normal distribution and no homogeneity, the test continued with the Kruskal-Wallis method[24].

RESULTS AND DISCUSSION

Anti-inflammatory test

The data on the average volume of rat paw edema showed that the administration of the test substance reduced the volume of rat paw edema in the third hour after being induced by carrageenan. This shows that the ability of the test substance preparation can inhibit the increase in the volume of edema. The data is displayed in graphical form, as shown in **Figure 2**. Assessment of the effectiveness of anti-inflammatory drugs and looking at the increase and decrease in the volume of edema on the rat's paw can also be seen from the calculation of AUC. The greater the AUC value, the less effective an anti-inflammatory drug is. The results of the average AUC value in all treatment groups, the negative control AUC value was higher than all other test preparation groups. This indicates that carrageenan can induce the formation of edema on the soles of the rats' feet.

The AUC value of the test preparation and the positive control group was lower than the AUC value of the negative control group, indicating that the whole group of the test substance for the MBP decoction and the positive control had an anti-inflammatory effect. Based on the three decoction doses, it was found that the stew with a dose of 800 mg/kg BW was better at inhibiting the formation of edema in the soles of the rats' feet, as indicated by the lowest average AUC value compared to the other two groups (**Table I**). Based on the statistical test, it was found that there was a significant difference between the negative and the positive groups, and the three doses showed a decrease in edema volume compared to the negative group ($p<\alpha = 0.05$). There was a significant difference between the positive group and the dose group of MBP 200; 400; and 800 mg/kg BW, which indicated that the volume of edema in the positive group was smaller than that of the three-dose groups. There was no significant difference between the three-dose groups ($p<\alpha = 0.05$).

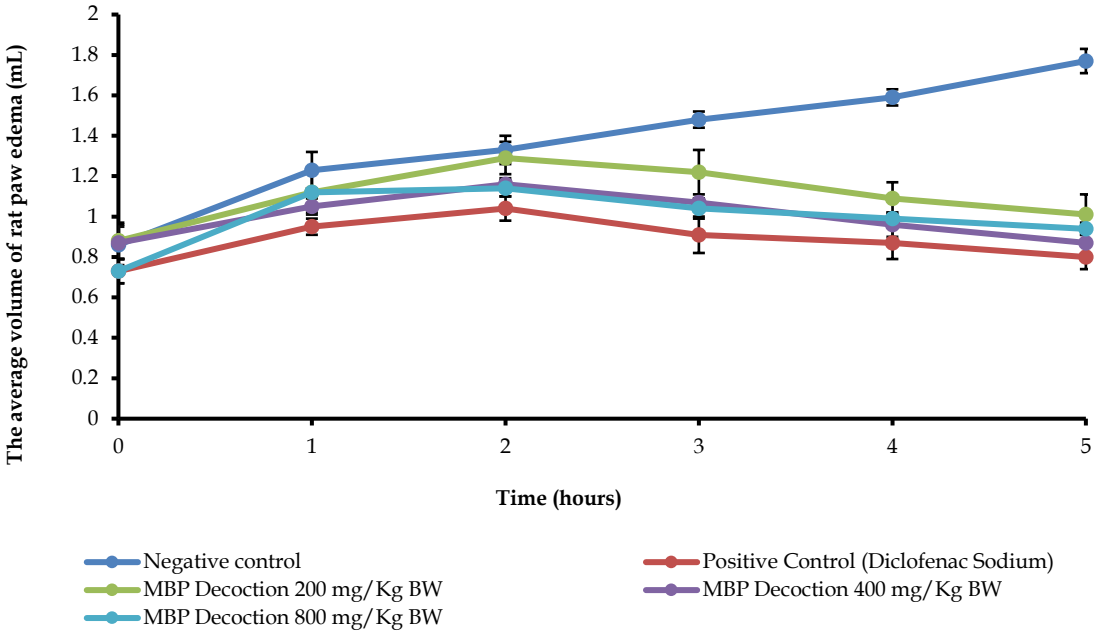

Figure 2. Correlation between time and the average volume of rat paw edema

Table I. The AUC values in the anti-inflammatory test

Groups	Value of AUC on rats (mL.hours)					Average ± SD
	1	2	3	4	5	
Negative control	6.74	7.31	6.98	7.06	6.31	6.88 ± 0.38
Positive control	4.62	4.09	4.50	4.53	4.83	4.51 ± 0.27
MBP 200 mg/Kg BW	5.44	6.00	6.25	4.75	5.86	5.66 ± 0.59
MBP 400 mg/Kg BW	5.30	5.17	4.93	4.86	5.36	5.12 ± 0.22
MBP 800 mg/Kg BW	5.02	5.18	4.93	5.03	5.40	5.13 ± 0.17

Analgesic test

Data on the average number of writhing in mice showed a decrease in the number of writhing in the 20th minute after being induced with acetic acid. This indicates the ability of the test substance to inhibit the increase in the number of writhing in mice. The data is displayed in graphical form, as shown in **Figure 3**. Assessment of the effectiveness of analgesic drugs and looking at the increase and decrease in the number of stretches in mice can also be seen from the AUC value. The smaller the AUC value, the greater the effectiveness of an analgesic drug. The results of the average AUC value can be seen that all doses have an analgesic effect because the negative control AUC value is higher than the positive control AUC value and other doses, but the 800 mg/kg BW has the lowest AUC value compared to the group other doses, as shown in **Table II**. There was a significant difference between the negative and positive groups and the three doses of MBP, which showed a decrease in the number of stretches in the positive and the three doses compared to the negative groups. There was a significant difference between the positive and three MBP dose groups, which showed that the number of stretches of the positive group was smaller than the three MBP dose groups. There was a significant difference between the MBP group at a dose of 200 mg/kg BW compared to the MBP group at a dose of 400 and 800 mg/kg BW, which showed the number of stretching of the MBP group at a dose of 200 mg/kg BW was more than that in the MBP group at a dose of 400 and 800 mg/kg BW. Moreover, there was a significant difference between the MBP group at a dose of 400 and 800 mg/kg BW, which showed that the MBP group at a dose of 400 mg/kg BW was more stretched than the 800 mg/kg BW group ($p<\alpha = 0.05$).

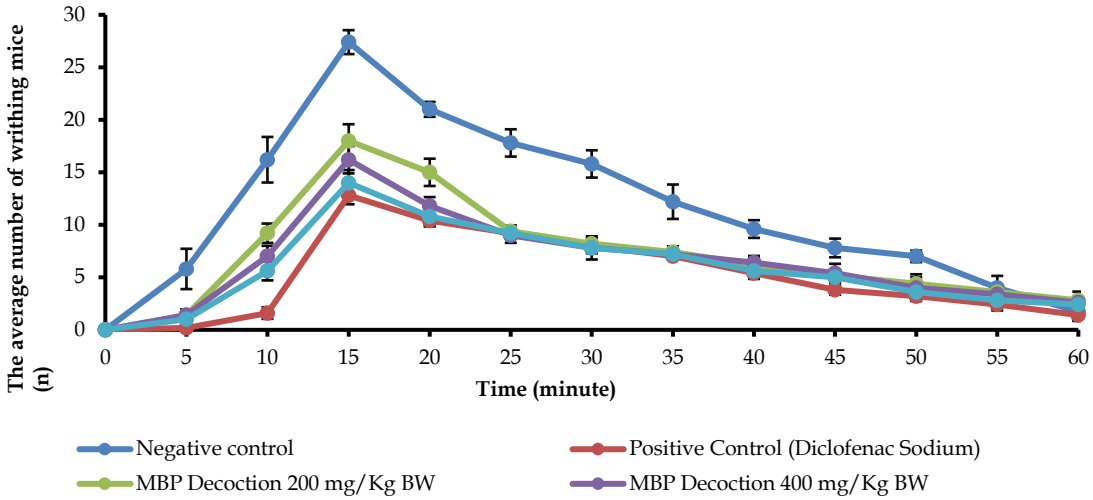

Figure 3. Correlation between time and the average number of writhing

Table II. The AUC values in the analgesic test

Groups	Value of AUC on mice (n)					Average ± SD
	1	2	3	4	5	
Negative control	732.5	735	657.5	710	722.5	711.5 ± 31.75
Positive control	330	322.5	332.5	312.5	320	323.5 ± 8.02
MBP 200 mg/Kg BW	430	450	432.5	475	435	444.5 ± 18,74
MBP 400 mg/Kg BW	392.5	395	390	420	407.5	401.0 ± 12.57
MBP 800 mg/Kg BW	372.5	355	372.5	372.5	360	366.5 ± 8.40

Percentage of inhibition of edema and writhing

The percentage of inhibition can be calculated from the average AUC data for the test and negative control groups, as shown in **Table III**. The positive control had better inhibition of edema and inhibition of the number of stretches than the test preparation group. It can also be seen that a decoction dose of 800 mg/kg BW (analgesic test) had the most significant inhibition of the amount of writhing compared to other decoction doses and a dose of 400 mg/kg BW (anti-inflammatory test).

Table III. % inhibition of edema and writhing of mice

Groups	% inhibition	
	% anti-inflammatory	% analgesic
Diclofenac sodium	34.43	55.25
MBP 200 mg/Kg BW	17.68	38.52
MBP 400 mg/Kg BW	25.53	44.53
MBP 800 mg/Kg BW	25.48	49.31

Percentage of anti-inflammatory and analgesic effectiveness

The percentage of effectiveness was calculated by comparing the average AUC of the test group with the average AUC of the positive control (diclofenac sodium), as shown in **Table IV**. The analgesic test preparation group at a dose of 800 mg/kg BW had better effectiveness as an analgesic compared to other doses, and the anti-inflammatory test preparation group at a dose of 400 mg/kg BW had a better anti-inflammatory effect than the analgesic test preparation group at a dose of 400 mg/kg BW with other doses.

Table IV. % anti-inflammatory and analgesic effectiveness

Groups	% effectiveness	
	% anti-inflammatory	% analgesic
MBP 200 mg/kg BW	51.35	69.71
MBP 400 mg/kg BW	74.15	80.59
MBP 800 mg/kg BW	74.01	89.24

The anti-inflammatory and analgesic research carried out using MBP decoction aims to prove that the MBP has anti-inflammatory and analgesic effects. In the MBP, some compounds are efficacious as anti-inflammatory and analgesic. The compounds contained in the peels of the *M. balbisiana* are flavonoids which are thought to have anti-inflammatory and analgesic activity[25]. The method used for the preparation of preparations is adjusted to the efficacious compounds, so it is hoped that these compounds are present in the preparations made. The decoction was chosen in this study because the stew is a method that is easy to apply, and the solvent is easy to obtain[26]. In the decoction, water is used as a solvent with high polarity. This high polarity will cause flavonoids to be attracted more during the extraction process[27]. The community has widely used this decoction method to manufacture traditional medicines because the extraction process is easy to do and does not require special tools. This method was chosen because flavonoid compounds are readily soluble in water; this property is influenced by the presence of OH groups in their structure which causes flavonoids to have polar properties and can dissolve in polar solvents. In addition, the infusion method, which is almost similar to decoct, succeeded in extracting total flavonoids as measured by UV-Visible spectrophotometry[28].

The doses of MBP decoction used for anti-inflammatory tests were 200, 400, and 800 mg/kg BW. In this study, the moderate and low doses of 400 and 200 mg/kg BW were based on the dose of ethanolic extract of the plant, one of which was the same species as the *M. balbisiana*, specifically *Musa acuminata*, which had been carried out by previous studies, in which these doses have been shown to provide anti-inflammatory and analgesic effects[29]. In this study, different test animals were used; the anti-inflammatory test was used by rats because the paws of rats were more prominent, so it was easier to measure and observe, while the analgesic test was used by mice because the mice were more sensitive to pain than rats and the reaction of mice to pain was easier to observe than mice[30]. Rats show more complex reactions than mice due to higher brain function. These reactions are, for example, sniffing, licking the soles of the feet, straightening the feet, or other unknown reactions[31].

In testing the anti-inflammatory effect using the Winter method, the parameter used is the decrease in the volume of edema in the soles of the mice (mL) compared to time (hours). This method was chosen because it is a commonly used anti-inflammatory test method, easy to perform, and can be measured quantitatively. Edema formation was carried out using carrageenan as a chemical induction of inflammation. Carrageenan was used because it did not cause injury or tissue damage to the rat's paws[32]. Carrageenan is more sensitive to anti-inflammatory drugs than other anti-irritants. In the phases of edema formation, there is the release of mediators that initiate the inflammatory process. The presence of edema formation phases also makes it easier to see the work of the anti-inflammatory substances that were tested more precisely, especially those that have a mechanism by inhibiting prostaglandin biosynthesis and COX formation. Edema that develops can last for six hours and gradually decrease over a day[33].

The instrument used in the anti-inflammatory test to measure the volume of edema in the soles of the rat's feet was a plethysmometer connected to a burette. The liquid used is mercury because mercury does not wet the rat's feet, and measurements are based on Archimedes' law; if an object is placed in a liquid, it will exert an upward force or pressure equal to the volume being pushed or moved. In the burette, methylene blue liquid was used to make it easier to read at the time of measurement, and the measurements were taken three times which were then averaged. When measuring the other rat's paw, the right paw does not kick the tool and interfere with the view when inserting the foot into the mercury[34].

Anti-inflammatory test studies were conducted on negative and positive controls and MBP decoction of 200, 400, and 800 mg/kg BW. Before testing from the 1st to the 5th hour (measurement of the volume of the rat's feet after carrageenan induction), a test was conducted at the 0th hour (before carrageenan induction). This was done to determine and ensure that the rat's feet were not swollen and in normal condition. This test was only carried out for five hours because the peak of edema that formed could not be observed. After all, the edema only lasted for six hours before slowly healing[35].

In the anti-inflammatory test, it was found that the average volume of edema in the negative control did not decrease the volume of edema in the rats' feet. In the negative control, the treatment given to rats only gave aquadest so that there was no inhibition of edema formation. Based on the average volume of edema in the positive control and MBP decoction, there was a decrease in edema on the soles of the rats. This happened because the positive control and MBP decoction had inhibitory activity on edema formation[36].

Anti-inflammatory activity can also be seen from statistical testing of negative control with the positive control, and MBP decoction for each dose showed a significant difference. The decrease in edema volume in the positive control and the three doses of MBP decoction occurred in the 3rd or 2nd hour after carrageenan induction. This shows that diclofenac sodium and MBP decoction inhibit edema formation because carrageenan induction can cause the release of inflammatory mediators (prostaglandins) three hours after carrageenan induction. This is also by the mechanism of action of diclofenac sodium as an anti-inflammatory which works by inhibiting COX and prostaglandin synthesis[37].

The statistical results of the positive control with MBP decoction of 200, 400, and 800 mg/kg BW showed a significant difference, and this indicates that diclofenac sodium as a positive control has better anti-inflammatory activity than the three doses of MBP decoction. However, there was no significant difference in the three doses of MBP decoction. This means that increasing doses of MBP decoction did not affect the inhibitory activity of edema or anti-inflammatory activity. When viewed from the AUC value of the average volume of the soles of the rat's paw, a dose of 800 mg/kg BW gave a better anti-inflammatory effect than a dose of 200 and 400 mg/kg BW.

The method used for the analgesic test used in this study is the Sigmund method; this method uses chemical stimulation with glacial acetic acid. 3% glacial acetic acid, 0.2 mL/20 g BW, can induce mild pain in mice, as indicated by writhing. The choice of this method is because this method is a simple method, easy to do, and commonly used. This method is also more specific for drugs that are thought to have prostaglandin inhibitory activity. The pain caused by glacial acetic acid only lasts for an hour and then gradually subsides[23,38]. The parameter measured in this method is the number of stretches of mice compared to time (minutes). No different from the anti-inflammatory test in this test, the test animals were fasted ± 18 hours before being given treatment; this was done so that the stomach organ was empty and there was no food left so that the test preparation that was absorbed by the body optimally was not disturbed by the existing food. Symptoms seen in mice when they feel pain after administration of acetic acid are characterized by contraction of the abdominal wall so that the legs are pulled back, stretch, and the abdomen touches the base of the space it occupies; this symptom is called writhing. This method's administration of the preparation was carried out 30 minutes before induction of glacial acetic acid and then observed for 60 minutes every five minutes. This aims to see that the test preparation work provides a protective effect against the pain caused by the inducer[39].

In the analgesic test, it was found that the average number of writhing of mice in the negative control was more than the average number of stretches of the positive control and preparations of MBP decoction at doses of 200, 400, and 800 mg/kg BW. This happened because the negative control was only given aquadest so that there was no inhibition of prostaglandin synthesis. On the other hand, the average number of stretches decreased in the positive control and preparations of MBP decoction. This shows that diclofenac sodium and the three doses of MBP decoction have analgesic activity. In the statistical test, it can also be seen that there is a significant difference between the negative control and the positive control and the three doses of MBP decoction. It can also be stated that the activity inhibits the synthesis of prostaglandins. This happens because acetic acid induces pain by stimulating the release of free arachidonic acid from the phospholipid tissue resulting in the formation of COX and prostaglandins so that drugs that can reduce the number of mice writhing due to the induction of glacial acetic acid can inhibit prostaglandin synthesis[40]. In the statistical test, positive control with three doses of MBP decoction has a significant difference, and this indicates that the positive control has better analgesic activity than the three doses of MBP decoction. Then the increase in the dose of MBP decoction at a dose of 200, 400, and 800 mg/kg BW showed that there was a significant difference between the three doses, so it can be said that the increase in the dose gave an increase in the analgesic effect.

In this study, the decoction of MBP at a dose of 200, 400, and 800 mg/kg BW has been shown to have % anti-inflammatory activity with 17.685; 25.53%; and 25.48%, and % effectiveness with 51.35%; 74.15%; and 74.01%, respectively. Furthermore, MBP decoction with a dose of 200, 400, and 800 mg/kg BW has an analgesic effect, with the % inhibition of writhing in mice at 38.52%, 44.53%, and 49.31%, and % effectiveness respectively 69.71%, 80.59%, and 89.24%. This finding is similar to the study conducted by Yuei *et al*.[29] investigating banana peels' anti-inflammatory and analgesic activity, especially the potency of the popular Cavendish variety consumed. In their study, two different doses, 200 mg/kg and 400 mg/kg bark ethanol

extract, were administered to rats by oral administration. The hot plate test showed a good analgesic reaction for an extract dose of 400 mg/kg rats treated at 60 minutes, comparable to a positive control of diclofenac sodium. The anti-inflammatory test showed good inflammatory action at six hours, comparable to positive control. The greatest inhibition of inflammation was seen at six hours which was 63% in rats receiving an extract dose of 400 mg/kg. These findings suggest that Cavendish bark exhibits analgesic and anti-inflammatory activity. After the two tests were carried out in this research, it could be seen that the MBP decoction had anti-inflammatory and analgesic activity. The anti-inflammatory and analgesic activity of MBP decoction involves the presence of compounds in the MBP which are attracted when decoction, one of which is a flavonoid[41]. By inhibiting the arachidonic acid metabolic pathway, the formation of prostaglandins, and the release of histamine, flavonoids function as an anti-inflammatory or slow down the inflammatory process[42].

CONCLUSION

The decoction of the MBP at a dose of 200, 400, and 800 mg/kg BW could have an inhibitory effect on edema on the soles of the rat's feet induced by 1% carrageenan solution and exerted an inhibitory effect on the amount of writhing in mice induced by acetic acid.

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AUTHORS' CONTRIBUTION

Ni Made Dwi Sandhiutami: conceptualization, data curation, formal analysis, funding acquisition, methodology, project administration, resources, supervision, validation, and writing -review & editing. **Sondang Khairani**: data curation, formal analysis, methodology, supervision, validation. **Rika Sari Dewi**: formal analysis, methodology, supervision, validation. **Zainur Rahman Hakim**: supervision, validation, editing and writing -review & editing. **Anita Rahmi Pradani**: investigation, visualization, and writing - original draft.

DATA AVAILABILITY

None.

CONFLICT OF INTEREST

The authors declare there is no conflict of interest..

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