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Anti-Inflammatory Effects of Miang Bean Leaves (*Mucuna pruriens*)

Fadilaturahmah, Firman Syukri, Yona Afriani, Putra Santoso*

Department of Biology, Faculty of Mathematics and Natural Sciences,
Andalas University, Padang, Indonesia 25163
*Corresponding author: putrasantoso@sci.unand.ac.id

Abstract

Inflammation is a serious health problem that needs treatment. The use of steroids and non-steroidal anti-inflammatory drugs (NSAIDs) can actually relieve inflammatory reactions well, but their long-term use can have many side effects and are uneconomical. Therefore, the use of natural ingredients that are effective and economical is needed. One of the plants that are considered anti-inflammatory is the leaves of miang beans (*Mucuna pruriens*). The purpose of compiling this narrative review is to analyze the phytochemical content of miang beans leaves and its mechanisms for inflammatory reactions. The narrative study of this preparation was carried out using the literature study method from August to September 2020. The phytochemical content of miang bean leaves are alkaloids, flavonoids, saponins, cyanogenic glycosides, and tannins. Phytochemicals that have a direct anti-inflammatory effect are alkaloids, flavonoids, saponins, and tannins. Alkaloids are antibacterial. If there are bacteria that cause inflammation, the alkaloids will damage the bacterial peptidoglycan cell walls, thus causing bacterial cell death and preventable inflammatory reactions. Flavonoids have anti-inflammatory effects by inhibiting macrophages from producing NO (nitric oxide) and inhibiting the cyclooxygenase pathway. Saponins affect the inflammatory reaction by inhibiting the lipoxygenase pathway and inhibiting the release of inflammatory mediators. Meanwhile, tannins affect the inflammatory reaction by inhibiting macrophages from producing ROS (Reactive Oxygen Species). Potential which is fatal because it can turn into cyanide acid. However, the content of these cyanogenic glycosides can be minimized by drying at low temperatures. So, mung bean leaves are effective as anti-inflammatory drugs because the alkaloids, flavonoids, saponins, and tannins they contain are anti-inflammatory.

Keywords: Anti-inflammatory, Flavonoids, Mucuna pruriens, Saponins, Tannins

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1 Introduction

Inflammation is the response of the immune system to dangerous stimuli such as pathogens, damaged cells, toxic compounds, or radiation [1]. Response inflammation is characterized by conditions such as rubor (redness), heat (heat), dolor (pain), tumors (swelling), and dysfunction [2]. Inflammation treatment includes two aspects, namely pain relief and stop the network breakdown process. Use of steroids and drugs non-steroidal anti-inflammatory drugs (NSAIDs) can relieve the inflammatory reaction well, but can give side effects if used for an extended period time long. Systemic use of steroids as anti-inflammatory drugs for a long time, it has a side effect in the form of decreased synthesis endogenous glucocorticoids, decrease the body's general response to infection, osteoporosis, moon face, and hypertension. Use of non-steroidal anti-inflammatory drugs (NSAIDs) also have side effects in the form of digestive tract disorders, interfere with platelet function and inhibit pregnancy induction [3].

The high risk of side effects due to the use of chemical-based drugs triggered the exploration of effective and natural medicinal ingredients safer. These natural-based medicines generally come from various kinds of herbs [4]. Various medicinal plants have been tested for effectiveness and its mechanism of action scientifically. The results also prove that medicinal plants do contain compounds that are clinically beneficial to health [5].

Plants are used as ethnomedicine by various tribes have a unique ingredient and presentation method that shows its height of local ethnic knowledge about medicinal plants [6]. One example is in Tanjung Modang, Tanah Datar, West Sumatra. Public utilizing miang bean leaves as an anti-inflammatory, even though the fruit skin is from miang beans are an allergen that can cause severe and acute inflammation. According to the people of Tanjung Modang, how to make anti-inflammatory drugs from miang bean leaves by crushing the miang nut leaves by hand, then put it on the affected area of the body. However, until now, there has been no scientific evidence about the effectiveness of leaves miang nuts as an anti-inflammatory. However, based on information regarding the use of miang bean leaves by the Tanjung Modang community then this plant can be developed as a medicine potential modern.

Based on study, miang nuts contain alkaloids, coumarin, flavonoids, methionine, tyrosine, and alkylamine which can increase antioxidants [7]. Other researchers found that peanut seeds contain several bioactive compounds such as glycosides, saponins, tannins, terpenoid, calcium, phosphorus, potassium, phytic acid, and L-DOPA [8]. Other than that, miang beans have a high protein content, so they are good as raw material for making tempeh [9]. Miang bean seeds also contain several some many acids good essential amino (histidine, threonine, isoleucine, cysteine, and methionine) [10].

Scientific information about the properties of bioactive substances in miang bean leaves especially as a medicine is still very limited. Therefore, the preparation of a narrative review on the anti-inflammatory effects of miang bean leaves is needed as an effort to explore potential natural medicinal materials based on local wisdom. The purpose of this review article is to analyze the phytochemical content in miang bean leaves and the mechanism of action of these phytochemicals as an anti-inflammatory.

2 Method

This article review is carried out by collecting secondary data from articles in national or international journals and books, then analyzing the data, and the results obtained are written in the form of a narrative review.

3 Plant of Miang Bean (Mucuna pruriens)

Classification of miang bean plants according to plantlist.org (2010), namely Kingdom: Plantae; Phylum: Tracheophyta; Class: Magnoliposides; Order: Fabales; Family: Fabaceae; Genus: Mucuna; Species: *Mucuna pruriens* (L.) DC. *Mucuna pruriens* or miang bean can grow to a height of 10-15 meters, creeping at the soil surface, vines, or twists on other plants. This plant is an annual shrub whose

main roots have many side roots [11]. Miang beans are oval, slightly flattened, light brown, pink-brown, purple, or black. Trifoliolatus leaves, ovoid with blunt or rounded edges, leaf surface the bottom is hairless. The flowers are white or purple. The pods hairy, measuring 10-15 cm long by 1.5-2 cm wide and each containing 5-6 seeds [9].

3.1 Inflammation Reaction Mechanism

Inflammation is a physiological response to infection and tissue injury initiate pathogen killing, tissue repair process and assist restore homeostasis to the infected or injured site. If the response Failure to regulate anti-inflammatory agents can result in chronic injury and help other diseases to develop [12]. The occurrence of inflammation is local reactions of tissues or cells to a stimulus. If there is an injury, there is a stimulus to release certain stimulating chemicals the occurrence of tissue changes as a manifestation of inflammation, namely histamine, serotonin, bradykinin, leukotriene, and prostaglandin [13].

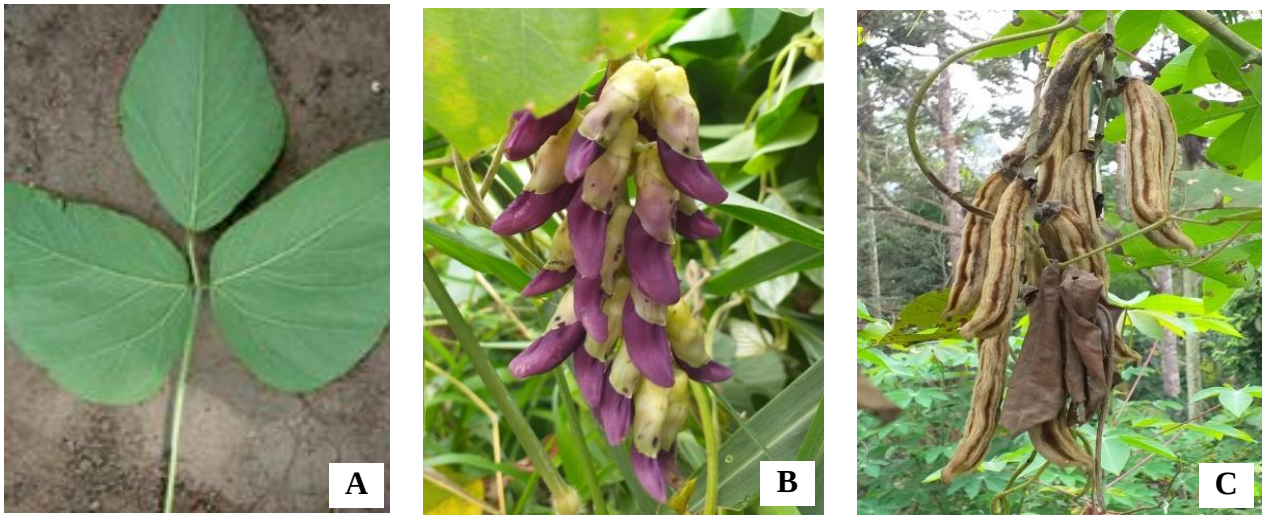

Figure 1. Plant of Miang Bean (A.Leaves B.Flower C.Rind)

The inflammatory reaction involves a complex interaction of many cells with different inflammation releasing a spectrum of chemical mediators and affect various target networks. Despite the clinical manifestations of response allergy varies depending on the tissue and antigen involved, however the reaction allergy consists of an early phase response involving accompanied mast cell degranulation with the release of histamine and other mediators including cytokines and phase response the end is characterized by the migration of inflammatory cells from the circulation. These inflammatory cells releasing additional chemical mediators in the lead to the final phase response in chronic inflammation, priming of nasal tissue, and tissue damage [14].

The inflammatory reaction involves the action of several enzymes. One of which is cyclooxygenase (COX) is present in the biosynthetic pathway of prostaglandins, thromboxane, and prostacyclin. According This enzyme was discovered in 1988 by Dr. Daniel Simmons, a researcher from Harvard University. Cyclooxygenase is divided into two, namely COX-1 and COX-2. COX-1 as a housekeeping gene in almost all normal tissues, while the COX-2 enzyme responsible for the inflammatory and painful mechanisms [15]. COX-2 forms PGE2 and PGI2 which can cause several biological processes, namely increased capillary permeability, pyretic, and hyperalgesia. Cyclooxygenase-2 (COX-2) or prostaglandin H synthase is the main enzyme in the prostaglandin system (PGE). COX-2 enzyme plays a role in the formation of prostaglandins followed by pathophysiological processes such as edema and hyperalgesia [16].

3.2 Phytochemical Contents of Miang Bean Leaves (Mucuna pruriens)

The phytochemical content of miang bean leaves is presented in table 1.

Table 1. Phytochemical content of miang bean leaves

Phytochemical	% composition
Alkaloids	9.60 ± 0.141
Flavonoids	4.90 ± 0.200
Saponins	24.60 ± 1.979
Cyanogenic glycosides	20.74 ± 0.452
Tannins	32.55 ± 0.778

Values are means ± standard deviation [17]

Based on the table 1, it can be seen that the phytochemical content contained in miang bean leaves. The phytochemical content consists of alkaloids, flavonoids, saponins, cyanogenic glycosides, and tannins. The largest percentage composition of miang bean leaves was tannins, namely 32.55% and the lowest was flavonoids, namely 4.9%. While the percentage of alkaloids is 9.65; saponins 24.6%; and 20.74% cyanogenic glycosides.

3.3 Anti-Inflammatory Activities of Miang Bean Leaves

The anti-inflammatory activity of miang bean leaves is presented in Figure 2.

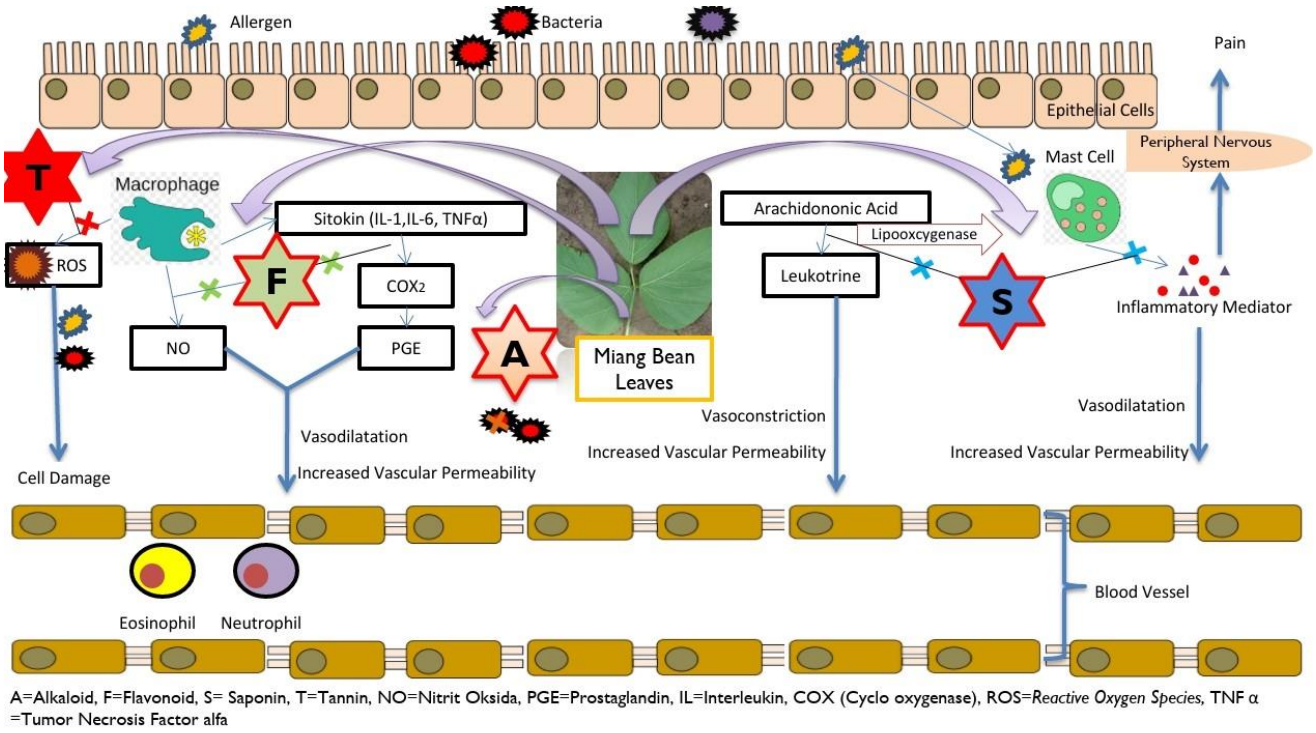

Figure 2.The working mechanism of the phytochemical content of miang bean leaves (alkaloids, flavonoids, saponins, and tannins) against inflammatory reactions

Based on figure 2 scheme (made by reviewing literature studies), it can be seen the mechanism of alkaloids, flavonoids, saponins, and tannins in influencing inflammatory reactions. Alkaloids are antibacterial and if there are bacteria that cause inflammation, the alkaloids will cause bacterial cell death, so that inflammation can be prevented. Flavonoids affect the inflammatory reaction by several mechanisms, namely by inhibiting macrophages in producing NO (Nitric Oxide) and inhibiting the cyclooxygenase pathway. This causes the formation of PGE (prostaglandin) so that vasodilation and increased vascular permeability do not occur. Thus, the symptoms of inflammation can be reduced. Saponins also affect inflammatory reactions by several mechanisms, namely inhibiting the

lipooxygenase pathway which results in no vasoconstriction and an increase in vascular permeability. In addition, saponin also inhibits the release of inflammatory mediators (histamine), so it does not affect the peripheral nervous system and inflammatory symptoms such as pain and itching do not occur. Whereas tannins affect the inflammatory reaction by inhibiting macrophages from producing ROS (Reactive Oxygen Species), if ROS is not formed then cell damage that occurs due to inflammation will not occur, thus reducing the symptoms of inflammation.

The above statement is supported by the opinion of Retno et al., alkaloids are the most secondary metabolite compounds that have nitrogen atoms, which are found in plant and animal tissues. Alkaloids in plants function as poisons that protect them from herbivorous insects, growth-regulating factors, and storage compounds capable of supplying nitrogen and other elements needed by plants [18]. Alkaloids have potential as an antibacterial by damaging the peptidoglycan constituent components in bacterial cells, so that the cell wall layer does not form and causes death in the bacterial cell [19].

The antibacterial properties of these alkaloids will affect the inflammatory mechanism. Inflammation caused by bacteria usually causes the infected cells to secrete pus. Therefore, alkaloids as antibacterials will inhibit cell damage that causes inflammation.

Other phytochemical contents of miang bean leaves are flavonoids. Flavonoids are polyphenolic compounds that are found in foods derived from plants and have been proven to be antimicrobial, antineoplastic, antihypertensive, antihepatotoxic, antioxidant, and anti-inflammatory. Flavonoids have an anti-inflammatory response via many routes and block molecules such as COX, INS, cytokines, and matrix metalloproteinases. Some flavonoids such as quercetin blocked the cyclooxygenase and lipooxygenase pathways when concentrations were relatively high, whereas at lower concentrations the lipooxygenase pathway was the main target of anti-inflammatory activity [20].

This is supported by the opinion of Nijvelt, flavonoids also have an anti-inflammatory response through many mechanisms, namely inhibiting cyclooxygenase (COX) and lipooxygenase activity, inhibiting leukocyte accumulation, inhibiting neutrophil degranulation, and inhibiting histamine [21]. Meanwhile, flavonoids inhibit the secretion of arachidonic acid, lysosomal enzymes, and endothelial so that proliferation and exudation from the inflammatory process are also inhibited. The inhibition of the release of arachidonic acid from inflammatory cells will cause a lack of arachidonic substrate for the cyclooxygenase and lipooxygenase pathways [22]. Besides inhibiting arachidonic acid metabolism, the secretion of lysosomal enzymes, endothelial cells, and neutrophil cells, flavonoids also inhibit capillary permeability [23]. Flavonoids inhibit nitric oxide production and inhibit iNOS expression. Nitric oxide synthase is a pro-inflammatory gene secreted during the inflammatory process (ultimate phase) induced by macrophages [24]. Nitrite oxide is a free radical in the form of a gas and is produced by phagocytes (monocytes, macrophages, neutrophils). Phagocytes are supplemented with inducible nitric oxide synthase (iNOS), activated by interferon-gamma (IFN-γ) or tumor necrosis factor (TNF) to produce NO. In the inflammatory process, Th1 cells activate macrophages to produce nitric oxide (NO) via iNOS. NO will cause increased blood vasodilation, increased blood circulation which causes inflammation. So that the flavonoid content in miang bean leaves can reduce inflammation symptoms by inhibiting NO production [25].

The phytochemical content of miang bean leaves is saponins. Saponins are a heterogeneous group of active glycosides that are naturally produced by plants, lower marine animals, and some bacteria. Saponins have been reported to have various biological activities such as hemolysis, antimicrobial, pesticide, insecticide, anthelmintic, analgesic, anti-inflammatory, sedative, and anti-tumor. Because they have various biological activities that cause saponins to become commercial compounds that are applied in the food, cosmetics, and pharmaceutical industries. All tested crude saponin extracts had significant anti-inflammatory activity. The mechanism of action of saponins in inflammatory reactions is mediated through inhibition of the release and synthesis of agents that cause inflammation. The inflammatory agents in question are histamine, bradykinin, serotonin, leukotriene,

and prostaglandins. If the release of these inflammatory mediators is inhibited, the reaction from inflammation will also be reduced [26]. Based on research conducted by Sur et al., that the saponins isolated from the leaves and root extracts of Camellia sinensis have been shown to inhibit era genetic-induced edema of rat feet [27]. Saponins will influence the inflammatory mechanism by inhibiting the formation of exudates and inhibiting the increase in vascular permeability [2].

Other phytochemical content of miang bean leaves, namely tannins. Tannin has potential as an antibacterial with its mechanism of destroying the membrane of bacterial cells. Astringent tannin compounds can induce the formation of complex compound bonds to enzymes or microbial substrates and the formation of a tannin complex bond against metal ions which can increase the toxicity of the tannin itself [28]. Meanwhile, tannin compounds have antioxidant activity, where this antioxidant acts as an anti-inflammatory by inhibiting the production of oxidants (O2) by neutrophils, monocytes, and macrophages. Inhibition of oxidant production (O2) will reduce the formation of H2O2, resulting in impaired production of hypochlorous acid and hydroxyl radicals, as well as directly inhibiting reactive oxidants such as hydroxyl radicals (OH) and hypochlorous acid [22]. This is supported by the statement of Luliana et al., that tannin compounds play a role by activating glucocorticoid receptors by increasing or decreasing the transcription process of genes involved in the inflammatory process [29]. According to Mahatriny et al., stated that free form tannin compounds and tannin-protein complexes have anti-inflammatory properties [30]. Apart from having anti-inflammatory activity, tannins are also known to have astringent, anti-diarrheal, diuretic, and antiseptic activity [31].

3.4 Perspective Future of Miang Bean Leaves

Miang bean plants are classified as plants that have not been widely used or cultivated. The use of miang beans that has been widely used is the seeds as a food substitute for soybeans because they contain good essential amino acids. However, the use of miang bean leaves has not been widely used. In fact, miang bean leaves are potential ingredients to be used as anti-inflammatory drugs. The use of miang bean leaves as an anti-inflammatory drug will reduce the use of steroid anti-inflammatory drugs or non-steroidal anti-inflammatory drugs (NSAIDs) which have many side effects and are not economical.

4 Conclusions

Miang bean leaves have the potential as an anti-inflammatory. Phytochemicals that have direct potential as anti-inflammatory properties are alkaloids, flavonoids, saponins, and tannins. Flavonoids have the potential to be anti-inflammatory by inhibiting macrophages from producing NO (nitric oxide) and inhibiting the cyclooxygenase pathway. Saponins influence the inflammatory reaction by inhibiting the release of inflammatory mediators and inhibiting the lipooxygenase pathway. The tannins affect the inflammatory reaction by inhibiting macrophages from producing ROS (Reactive Oxygen Species). Meanwhile, alkaloids have the potential to be antibacterial and cyanogenic glycosides are toxic because they can break down into cyanide acid. However, the content of these cyanogenic glycosides can be minimized by drying at low temperatures.

5 Acknowledgments

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6 Conflicts of Interest

The authors declare no conflict of interest.

7 References

[1] Medzhitov R. 2010. Inflammation: New Adventures of an Old Flame. *Cell.* 140(6):771–776.

[2] Fitriyani A, Winarti L, Muslichah S, Nuri. 2011. Anti-Inflammatory Test of Red Betel Leaf Methanol Extract (*Piper crocatum* ruiz & pav) on White Rats. Traditional Medicine Magazine Journal. 16 (1): 34-42.

[3] Sukmawati, Yuliet, Hardani R. 2015. Anti-Inflammatory Effectiveness Test of Ambon Banana Leaf Ethanol Extract (*Musa paradisiacal* L.) against Keragenan-Induced White Rats. GALENIKA Journal of Pharmacy. 1 (2): 126-132.
[4] Winter J.M, Tang Y. 2012. Synthetic Biological Approaches to Natural Product Biosynthesis. *Curr Opin Biotechnol.* 23(5):736–743.
[5] Kayne SB. 2010. *Traditional Medicine.* Pharmaceutical Press*.* London.
[6] Evizal R, Endah R, Ardian, Agung W, Deddy A. 2013. Diversity of Plants and Ethnomidycin Herbs in East Lampung. Semirata Proceedings of FMIPA University of Lampung. 10-12 May 2013. Lampung, Indonesia. pp. 279-286.
[7] Mulyani L, Kartadarma E, Fitrianingsih S.P. 2016. Benefits and Content of Kara Benguk Nuts as Herbal Medicine. Pharmacy Proceedings. August 2016. Islamic University Bandung, Indonesia. pp 351-357.
[8] Thyagaraju, Divya B.J, Suman B., Venkataswamy M. 2017. The Anti-Inflammtory Effect of Fabaceae aand Alliaceae Plants. *Indo American Journal of Pharmaceutical Research.* 4(11):3856-3862.
[9] Retnaningsih, Ch, Setiawan, A, Sumardi. 2011. Antiplatelet Potential of Koro Peanut (*Mucuna pruriens* L.) from Hexane Fraction compared with Aspirin in Hypercholesterolemic Rats. Scientific Content Series. 14 (1): 80.
[10] Lampariello L.R, Cortelazzo A, Guerranti R, Sticozzi C, Valacchi G. 2012. The Magic Velvet Bean of *Mucuna pruriens. Journal of Traditional and Complementary Medicine.* 2(4):331-339.
[11] Puri *and* Raman. 2010. *Natural Aphrodisiacs: Myth or Reality.* First Edition*,* Xilibris Corporation. United States of America.
[12] Calder P.C. 2009. Polyunsaturated Fatty Acid and Inflamantory Procces. *Biochemie.* 91(5):791.
[13] Lumbanraja, L.B. 2009. Phytochemical Screening and Anti-Inflammatory Effect Test of Ethanol Extract of Tempuyung (*Sonchus arvensis*) Leaves against Inflammation in Rats. Thesis. University of Northern Sumatra.
[14] Chen L, Huidan D, Hengmin C. 2018. Inflammatory Responses and Inflammation Associated Diseases in Organs. *Oncotarget.* 9(6):7204-7218.
[15] Multazar A, Nursiah S, Rambe A, Harahap. 2012. Expression of Cyclooxygenase-2 (COX-2) in Chronic Rhinosinusitis Patients. *Research Report*. University of Northern Sumatra.
[16] Stables MJ, Gilroy D.W. 2011. Old and New Generation Lipid Mediators in Acute Inflammation and Resolution. *Proress in Lipid Research.* 50(1):35-51.
[17] Ujowundu C.O, Kalu F.N, Emejulu A.A, Okafor O.E, Nkwonta C.G, Nwosunjoku E.C. 2010. Evaluation of the Chemical Composition of *Mucuna utilis* Leaves in Herbal Medicine in Southeastern Nigeria. *African Journal of Pharmacology.* 4(11):811-816.
[18] Retno N, Elly P, Sukarsono. 2016. Identification of Alkaloid Compounds from Caramunting Stems (*Rhodomyrtus tomentosa*). *Indonesian Journal of Biology Education.* 2 (3): 231-236.
[19] Simanjuntak. 2008. Identification of Chemical Compounds in the Fruit of the Mahkota Dewa (*Phaleria macrocarpa*), Tymelaceae. *Indonesian Journal of Pharmaceutical Sciences*. 6: 23-28.
[20] Mona S. Mohammed, Wadah J.A. Osman, Elrashied A.E. Garelnabi, Zuheir Osman, Bashier Osman, Hassan S. Khalid, Magdi A. Mohamed. 2014. Secondary Metabolites as Anti-Inflammatory Agents. *The Journal of Phytopharmacology.* 3(4):275-285.
[21] Nijveldt R.J, E Van Nood, D.E.C Van Hoorn, P.G Boelens, K. Van Norren, P.A.M Van Leeuwen. 2001. Flavonoid: a Review of Probable Mechanisms of Action and Potential Applications. *American Journal of Clinical and Nutrition.* 74:418-425.
[22] Gusti, Ayu. 2020. The Effectiveness of Kecombrang Flower Extract Gel (Etlingera elatior) as Anti-Inflammation Against Mice Induced by Keragenesis. *Medicament Scientific Journal.* 6 (1): 66-71.
[23] Kurniawati, 2005. Anti-Inflammatory Activity Test of Graptophyllum Griffin Methanol Extract on White Rats. *Dentistry Magazine Special Edition National Scientific Meeting IV,* 11-13 August 2005: 167-170.
[24] Cardenes H, Arango D, Nicholas C, Duarte S, Nuovo GJ, Gonzalez M, Guttridge, Grotewold, Doseff A. 2016. Dietary Apigenin Exert Immune-regulatory Activity In Vivo Reducing NF-kB Activity, Halting Leucocyte Infiltration and Restoring Normal Metabolic Function. *Int J Mol Sci.* 17:323.
[25] Pratiwi A, Ferlino S, Robiyanto R. 2018. Antiinflammatory Activity of Ethanolic Exstract from Karas Leaves (*Aquilaria malaccensis* Lamk.). *Pharmaceutical Sciences and Research.* 5(3):152-158
[26] Hassan H, Sule MI, Musa AM, Musa KY, Abubakar MS, Hassan AS. 2012. Antiinflammatory Activity of Crude Saponin Extract from Five Nigerian Medical Plants. *Afr J Tradit Complement Altern Med.* 9(2):250-255.
[27] Sur, P; Chaudhuri, T; Vedasiromoni, JR; Gomes, A and Ganguly, DK. 2001. Anti-inflammatory and antioxidant property of saponin of tea (*Camellia sinensis* (L) O. Kuntze) root extract. *Phytotherapy Research.* 15: 174-176.

[28] Akiyama H, Fuji K, Yamasaki O, Oono T, Iwatsuki K. 2001. Antibacterial Action of Several Tannins Against *Staphylococcus aureus*. *Jac.* 48:487-491.
[29] Luliana, S., R. Susanti, and E. Agustina. 2017. Anti-Inflammatory Activity Test of Ciplukan Herba Water Extract (*Physalis angulata* L.) against Male White Rats (*Rattus norvegicus* L.) Wistar Strain Induced by Carrageenan. *Traditional Medicine Journal.* 22 (3): 199-205.
[30] Mahatriny, N.N., Payani, N.P.S., Oka, I., Astuti, K.W. 2014. Phytochemical Screening of Papaya Leaf Ethanol Extract (*Carica papaya* L.) Obtained from Ubud, Gianyar Regency, Bali. *Scientific Papers.* Udayana University. Bali.
[31] Khanbabaee, K. dan Ree, T. V. 2001. Tannins: Classification and Definition. *Nat Prod Rep.* 18: 641-649.