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Short Communication

The Effect of Ethyl Acetate Extract of Sungkai Leaves (*Peronema canescens* Jack.) On Uric Acid Levels in Hyperuricemia Male Albino Mice (*Mus musculus L.*)

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ABSTRACT

Hyperuricemia is a condition in which the level of uric acid in the blood increases. Uric acid is the end product of purine metabolism. Flavonoid compounds in *Peronema canescens* (Sungkai) leaves are considered to reduce uric acid levels. This study aims to determine the effect of varying the duration of administration and dose of the ethyl acetate extract of Sungkai leaves on the reduction of uric acid levels in hyperuricemic male albino mice induced by chicken liver juice (0.5 mL/20 g BW per oral) and potassium oxonate. The test animals, comprising as many as 54 mice, were divided into six groups: a negative control group that received only standard feed, a positive control induced with hyperuricemia and a standard control, allopurinol 13 mg/kg BW p.o once daily, and treatment groups I, II, and III were given *Peronema canescens* (Sungkai) leaf extract at doses of 125 mg/kg BW, 250 mg/kg BW, and 500 mg/kg BW with a duration of administration of 5, 10, and 15 days, respectively, following induction of hyperuricemia. Uric acid levels were measured post-administration of the extracts using an enzymatic method with a photometer at a wavelength of 546 nm from blood serum samples taken via the neck veins of mice. Data were analyzed using Analysis of Variance (ANOVA) and followed up with Duncan's test at a 95% confidence interval. The results showed a dose-dependent reduction in uric acid levels (p<0.05) compared to the negative control, with the optimal decrease among the three doses occurring at 500 mg/kg BW. The reduction in uric acid levels was concentration-dependent. This study showed that ethyl acetate extract from Sungkai leaves reduced uric acid levels in hyperuricemic male albino mice.

Keywords: *Peronema canescens* Jack., Sungkai leaf, extract, ethyl acetate, gout, hyperuricemia

Introduction

Indonesia is facing several health challenges in addressing infectious and non-communicable diseases. Two of the non-communicable diseases that are relatively high in Indonesia today are gout and diabetes mellitus. Hyperuricemia can cause gouty arthritis, a type of arthritis that interferes with daily activities and decreases work productivity (Natasha and Fitri, 2020).[1] According to World Health Organization (WHO) data, Indonesia has patients with joint disorders that reach 81% of the population. Gout is often also referred to as gouty arthritis and most often occurs in the elderly community. [1] According to the WHO, uric acid is part of purine metabolism. However, if the metabolism does not occur normally, uric acid crystals will accumulate in the joints, which can cause relatively intense pain. Uric acid is already in the body, but it is not considered a risk in normal amounts. Under normal circumstances, uric acid levels in men increase after puberty. However, in women, uric acid levels do not increase until menopause, due to the hormone estrogen, which increases the kidneys' excretion of uric acid.[2] Hyperuricemia occurs when uric acid levels in the blood exceed 6 mg/dL for women and 7 mg/dL for men. Hyperuricemia can lead to gout if left untreated. Gout is an inflammatory disease caused by the accumulation of monosodium urate crystals in the joints.[3]

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In general, increased uric acid levels in the blood are caused by the purine bases, specifically adenine and guanine. The adenine base is converted to hypoxanthine, and the guanine base is converted to xanthine. Then, hypoxanthine is converted to xanthine by the enzyme xanthine oxidase, which is later converted to uric acid.[4] One of the synthetic drugs commonly used to treat gout is allopurinol. Allopurinol is a nucleic acid derivative that can inhibit uric acid synthesis. It is a specific inhibitor of the xanthine oxidase enzyme, which belongs to the purine analog class of compounds. Purines are metabolized by xanthine oxidase to oxypurinol (alloxantin).[5] However, long-term use of allopurinol can cause serious adverse effects, such as skin redness and leukopenia. It can sometimes cause gastrointestinal toxicity and increase acute gout attacks at the start of therapy[5], allergic reactions, and symptoms of toxicity in various organs and body systems, as well as disorders of the skin, stomach, intestines, and blood disorders, which can also affect the kidneys.[6]

People who are increasingly aware of the adverse effects of using synthetic drugs are looking for alternative medications that are relatively safer, with essential ingredients derived from nature (mainly plants), with lower adverse effects. Indonesia is rich in natural resources, with every region boasting numerous endemic plants known to help prevent and treat diseases. One of the community's natural ingredients that has recently been used in traditional medicine is the Sungkai leaf (*Peronema canescens* Jack, family Lamiaceae). Currently, there is limited exploration of the content of bioactive compounds in *Peronema canescens* (PC) leaves. Traditionally, people are still restricted to using PC leaves to treat malaria and fever.[4]

The PC leaf plant is a typical Indonesian plant commonly found in South Sumatra and Kalimantan.[7] *Peronema canescens*, widely known as Sungkai, contains active ingredients that include flavonoids, alkaloids, steroids, phenolics, tannins, and saponins, which function as antibacterial agents. In addition, groups of polysaccharides, terpenoids,

alkaloids, and polyphenols have immunostimulating activity.[4]
Flavonoid compounds are thought to reduce fatty acid levels by inhibiting the activity of the xanthine oxidase (XO) enzyme, which is involved in the formation of uric acid from purine bases.[4] Flavonoids are extracted by ethyl acetate due to their semi-polar characteristics, which aid the extraction of semi-polar compounds.[6] *Peronema canescens* has been reported to possess immunomodulatory, antioxidant, antibacterial, and anticancer effects.[8] Other bioactive compounds identified in the extracts of this plant include *β*-Sitosterol, phytol, *β*-amyrin, and peronemins (A2, A3, B1, B2, B3, and C1), which may have informed its ethnomedicinal usage. Based on this plethora of pharmacological uses and ethnomedicinal reports, this current study aims to evaluate the effect of the plant's ethyl acetate extract on uric acid levels in hyperuricemic male albino experimental mice at different doses and duration of administration.

Materials and Methods

Plant collection
Peronema canescens Jack leaves were obtained from the UPTD of the Slaughterhouse, Aia Pacah, Koto Tangah District, Padang City, West Sumatra, with a GPS of -0.8654234, 100.3869164, and then identified by a taxonomist (NAME) at the Andalas University Herbarium (ANDA) and assigned a voucher number: 259/K-ID/ANDA/V/2022.

Chemicals and equipment
These include Aquadest (Indonesia Trading Co., Indonesia), and other reagents: n-hexane, ethyl acetate, sodium carboxymethyl cellulose (Na-CMC), chicken liver, potassium oxonate (Sigma Aldrich), Allopurinol 100 mg (Alofar®), uric acid analysis reagent (Glory®, Indonesia).
Other materials include test tube (Iwaki), Erlenmeyer (Pyrex®), rotary evaporator (Buchi), centrifuge (Centurion), tube (Onemed), micropipette (Eppendorf), gel activator tube (Golden Vac), Spectrophotometer (Riele), analytical balance (Ohaus®), grinder, and a blender.

Extraction of plant material
Fresh leaf samples were washed under running water and air-dried for seven days. The dried Sungkai leaves were finely chopped and then defatted using n-hexane. The sample (500 mg) was macerated with n-hexane (5 L) solvent for 24 hours with occasional stirring, then filtered with filter paper, and the pulp was dried. The pulp was macerated again using n-hexane (5 L) for 24 hours, then filtered, and the process was repeated until the colour of the macerate became clear, using 5 L of solvent. The dregs from the n-hexane maceration were dried and then macerated using ethyl acetate 5 L for 3-5 days. The filtrate was collected and concentrated by evaporation using a rotary evaporator until a thick extract was formed.

Test Animals
Test animals, 54 male albino mice, aged 2-3 months and weighing between 20 and 30 g, purchased from the animal house of the Faculty of Pharmacy, Andalas University, which had never been treated with drugs, were used for this study. Before the experiment, the mice were acclimated in the animal house at the Faculty of Pharmacy, Andalas University, for seven days and were provided with adequate food and water. Male mice were divided into six groups, namely a positive control group, a negative control group, a standard group (Allopurinol), and 3 test groups, each of which was given extract at a dose of 125 mg/kg BW, 250 mg/kg BW, and 500 mg/kg BW. Each group consisted of 3 mice with three repetitions. The three test groups and the standard group were administered the extract suspension or allopurinol orally once daily for 15 days. The animals in the treatment groups were given 13 mg/kg BW orally. Group I (Negative Control) received only standard rodent food and water for 15 days. Group II (Positive Control) was administered chicken liver juice (0.5 mL/20 g BW), potassium oxonate (250 mg/kg BW), and 0.5 mL of 0.5% Na-CMC solution. Group III (Standard Control) was induced per oral with chicken liver juice (0.5 mL/20g BW), potassium oxonate 250 mg/kg BW, and allopurinol suspension 13 mg/kg BW. Group IV (Treatment Group I) was induced with chicken liver juice (0.5 mL/20 g BW), potassium oxonate 250 mg/kg BW, and 125 mg/kg BW suspension of Sungkai leaf extract once daily. Group V (Treatment Group II) was induced with chicken liver juice (0.5 mL/20g BW), potassium oxonate (250 mg/kg BW), and a 250 mg/kg BW suspension of Sungkai leaf extract administered orally once daily. Group VI (Treatment Group III) was induced with chicken liver juice (0.5 mL/20 g BW), potassium oxonate (250 mg/kg BW), and a suspension of Sungkai leaf extract (500 mg/kg BW/kg BW), administered orally once daily.

Determination of Dosage
Approximately 0.5% Na-CMC was prepared by sprinkling 50 mg of Na-CMC over 1 mL of hot water in a hot mortar, and it was allowed to stand until it swelled for about 5 minutes. Then it was ground until homogeneous, and Aquadest was added until the volume reached 10 mL. Allopurinol was administered at 13 mg/kg body weight (bw) to the treatment groups, adjusted from the minimum daily dose of 100 mg/day used in humans.[9] The test animals were administered 13 mg/kg BW of the extract, while allopurinol was used as a standard control for comparison purposes. A total of 1 allopurinol tablet was weighed and finely ground. An amount of the powder equivalent to 13 mg of the active substance allopurinol was then weighed and suspended in 0.5% sodium carboxymethylcellulose (Na-CMC), and the mixture was brought up to 10 mL. The suspension was stirred until homogeneous. The doses of ethyl acetate extract from *Peronema canescens* Jack leaves used for this study were 125, 250, and 500 mg/kg BW. The extract obtained was suspended in 0.5% Na-CMC by mixing to achieve the desired concentration for treatment.

Induction of Hyperuricemia
Mice were induced with hyperuricemia using chicken liver juice (0.5 mL/20 g BW) orally and potassium oxonate at a dose of 250 mg/kg BW intraperitoneally, using a method previously described.[10] Potassium oxonate was weighed in amounts of up to 0.25 g and then suspended in a 0.5% NaCMC solution. The solution was then made up to a volume of 10 mL. While preparing chicken liver juice, 5 g of fresh chicken liver was used, which was blended into juice with 15 mL of distilled water at a ratio of 1:3 by weight of chicken liver to distilled water.

Treatment of Animals to the Test
Hyperuricemia was induced in all test animal groups by administering chicken liver juice (3 mL/g) orally and potassium oxonate (250 mg/kg BW) intraperitoneally. Chicken liver juice was administered on days 1-14, and potassium oxonate was administered on days 5, 10, and 15, with a 1-hour interval between the administration of chicken liver juice and potassium oxonate. From day 5 to day 15, each group received its respective treatment. The negative control group was given 0.5% Na-CMC suspension, and the positive control group was given allopurinol 13 mg/kg BW suspension. Groups IV, V, and VI were given the suspension of Sungkai leaf extract with different doses, namely 125 mg/kg BW, 250 mg/kg BW, and 500 mg/kg BW, with a range of 1 hour after potassium oxonate administration. Then, 1 hour after the last treatment on day 15, 5 mL of blood was withdrawn via the external jugular vein and accommodated in a gel activator tube to measure uric acid levels in experimental animals.[9]

Determination of Uric Acid Levels
Uric acid levels in albino male mice were examined on days 5, 10, and 15 after 1 hour of administration of Sungkai leaf extract suspension. Uric acid levels were analyzed using a photometer. Blood was collected using a gel-activated tube, then centrifuged at 4000 rpm for 20 minutes to separate the blood serum from the red blood cells. The serum obtained was separated using a micropipette and then stored in a microtube.[11] The serum was pipetted into a test tube using a micropipette, up to 25 mL. Then the serum was reacted with 1000 mL of the uric acid kit reagent. Reactions of the samples were performed by incubation for 10 minutes at room temperature (20-25 °C). After incubation, uric acid levels were read. The readings on the instrument require a solution of samples, standards, and blanks whose absorbance is read using a photometer at a wavelength of 546 nm.[12]

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Statistical Analysis

The data were expressed as mean ± SEM and statistically analyzed using Analysis of Variance (ANOVA) to assess differences in the average uric acid levels of the existing treatment groups and the length of observation in experimental animals. Differences between treatments were subjected to Duncan's multiple range test. SPSS statistical software was used to determine the effect of *Peronema canescens* leaf extract on days 5, 10, and 15. A 95% confidence level and significance were assessed at $p < 0.05$.

Results and Discussion

Plant extracts, including *Amomum villosum* Lour., *Artocarpus altilis*, and *Ilex cornuta*[12,13,14], have been reported to lower hyperuricemia through the inhibition of xanthine oxidase enzyme, reduction in uric acid secretion, and reduction of inflammation.[13,14] Before the experiment, the test animals were acclimated for seven days to ensure uniformity in diet and conditions among the test animals.[15] During acclimatization, mice were provided with standard food and water daily. The acclimatized mice did not experience drastic body weight loss (maximum 10%), were not disabled, and showed visually typical signs. Allopurinol, used as a first-line treatment for hyperuricemia, functions as a specific inhibitor of the xanthine oxidase enzyme, which is responsible for converting hypoxanthine to uric acid.[12] Groups IV, V, and VI mice were treated with an ethyl acetate extract of the plant at three different dosage variations (125, 250, and 500mg/kg BW). The extract was given after the mice were induced using chicken liver juice and potassium oxonate. The ethyl acetate extract of Sungkai leaves was insoluble in water; therefore, a suspension of the extract was prepared using 0.5% Na-CMC as a suspending agent immediately before administration. Na-CMC was chosen as a suspending agent because it can dissolve the ethyl acetate extract of Sungkai, making the test preparation homogeneous, inert, and unaffected by the active compounds present in the extract. Na-CMC has no pharmacological effect on uric acid levels in test animals.[13] Potassium oxonate was given intraperitoneally to hasten its absorption via the abdomen (abdominal cavity). This is due to the numerous blood vessels in the abdominal cavity, allowing the compound to enter the bloodstream directly and lead to a rapid response in the animal's body. Potassium oxonate was used as an agent to induce hyperuricemia because it works competitively to inhibit the uricase enzyme, which converts xanthine to allantoin, and is excreted through the urine. Hence, inhibiting the uricase enzyme, as shown by potassium oxonate, uric acid levels in the blood will increase.[16]. Additionally, chicken liver was also used as an inducer of hyperuricemia because it contains high levels of purines, a precursor to the formation of uric acid. Uric acid was analyzed using the enzymatic colorimetric method, where the working principle involves the oxidation of uric acid in a reaction catalyzed by the uricase enzyme. Hydrogen peroxide will be formed, which will react with N-ethyl-N-(2-hydroxy-3-sulfoprofile)-m-toluidine (TOOS) and 4-amino-antipyrine (4-AAP) in the presence of peroxidase (POD) and form quinoneimine red.[17]

The blood serum obtained (25 mL) was added to 100 mL of the uric acid reagent, shaken homogeneously, and incubated for 10 minutes. Thereafter, the uric acid levels were read using a spectrophotometer at a wavelength of 546 nm. The results of the study on the effect of administering ethyl acetate extract of Peronema canescens showed that uric acid levels in the serum of male albino mice ranged from 2.0 to 3.7 mg/dL (Table 1). These levels were outside the normal range of uric acid levels in mice, which is between 0.5 and 1.4 mg/dL. Statistical analysis using two-way ANOVA showed that dose variation significantly affected serum uric acid levels, with $p<0.005$. Similarly, the time variations also significantly affected uric acid levels in the blood, with a p-value of <0.005. The average results of uric acid levels on the 5th, 10th, and 15th day in each group are presented in Table 1. It was observed from the table that the positive control group (hyperuricemic group) experienced an increase in uric acid levels, with uric acid levels ranging between 2.0 and 3.7 mg/dL. These values were outside the normal range, with the normal limit being 0.5-1.4 mg/dL in mice.[12] A comparison of the positive control group with the negative control group, which had normal uric acid levels, reveals significantly different results ($p < 0.05$). This indicates that the administration of chicken liver juice and potassium oxonate is successful in increasing uric acid levels in male albino mice. Analysis of variance test (ANOVA test), showed significant values ($p<0.05$), indicating that treatment with the ethyl acetate extract of *Peronema canescens* leaves had a significant effect ($p<0.05$) on uric acid levels and time duration of dosing of the test animals also showed significant effect ($p<0.05$) on uric acid levels reduction in hyperuricemic male albino mice.

Table 1: Average uric acid levels in male albino mice

Group	Mean Uric Acid Levels (mg/dL) ± SE			Average (mg/dL) ± SE
	5 days	10 days	15 days	
Negative Control	1.300 ± 0.210	1.333 ± 0.210	1.333 ± 0.210	1.322 ± 0.121[a]
Positive Control	3.467 ± 0.210	2.400 ± 0.210	2.167 ± 0.210	2.678 ± 0.121[d]
Standard(All opurinol)	1.467 ± 0.210	0.900 ± 0.210	0.700 ± 0.210	1.022 ± 0121[a]
Ethyl acetate extract, 125 mg	3.067 ± 0.210	2.267 ± 0.210	1.067 ± 0.210	2.133 ± 0.121[c]
Ethyl acetate extract 250 mg/kg BW	2.733 ± 0.210	1.300 ± 0.210	1.133 ± 0.210	1.722 ± 0.121[b]
Ethyl acetate extract 500 mg/kg BW	1.900 ± 0.210	1.367 ± 0.210	0.800 ± 0.210	1.356 ± 0.121[a]

Note: [a, b, c, and d] in the same column indicate no significant difference

The value of uric acid levels in the test animals decreased significantly ($p < 0.05$) after administering PC ethyl acetate extract for 15 days compared to the positive control group. The results of data analysis comparing variations in doses of ethyl acetate extract of PC leaves showed a significant difference between each dose ($p < 0.05$), with a reduction in uric acid levels as the doses increased. According to the results of Duncan's follow-up test, the 500 mg/kg BW dose proved to be the most effective in lowering uric acid levels compared to the 250 and 125 mg/kg BW doses. This finding aligns with a previous study regarding the anti-hyperuricemic activity of Sungkai ethanol extract, which reported that a dose of 500 mg/kg BW of ethanol extract provided the most effective uric acid reduction, which was concentration dependent. That is, the higher the dose of ethanol extract given to animals, the better the effect on the reduction of uric acid levels. It is thus presumed that more active compounds are present at such higher doses.[18]

When viewed from the results of the average duration of administration of the ethyl acetate extract in each dose group, all the mice experienced a decrease in uric acid levels after receiving the extract for 15 days, with $p<0.05$. This indicates that uric acid levels in mice decreased with the duration of administration of various doses of ethyl acetate extract from Sungkai leaves. The longer the administration time of the ethyl acetate extract, the more the uric acid levels in mice decreased. This result is supported by previous research on the effectiveness of white dragon fruit ethanol extract in reducing uric acid levels in mice, which found that the best reduction in uric acid levels was observed following 15 days of treatment with the extract. The effect was almost as good as that of the positive control, given allopurinol.[19]

For the standard group, mice were given allopurinol at a dose of 13 mg/kg BW, obtained based on the oral dose in humans and converted to a mouse dose. From the results, the average uric acid level of male albino mice obtained indicates that the standard group lowered serum uric acid levels the most compared to other treatments, with an average level of 0.700 ± 0.210 mg/dL. This is in accordance with research conducted by Amir (2018), which states that from the 15th day of uric acid levels in each group, it can be seen that the administration of allopurinol reduced serum uric acid levels the most, with a percentage decrease in uric acid levels of 98.72%.[18] During the research, the average level of uric acid in the treatment given allopurinol was lower

than the average level of ethyl acetate extract of Sungkai leaf, which was 1.022 ± 0.121 mg/dL. This means that the effectiveness of allopurinol is superior to that of the ethyl acetate extract of *Peronema canescens* leaves in reducing uric acid levels.

The findings of this study showed that from the three doses of ethyl acetate extract of Sungkai leaves used, the dose that produced the lowest average level of uric acid was the 500 mg/kg BW dose with an average level of 1.36 ± 0.121 mg/dL followed by the 250 mg/kg BW dose with an average of 1.72 ± 0.121 mg/dL and the 125 mg/kg BW dose with an average of 2.13 ± 0.121 mg/dL. Considering the duration of treatment, the lowest uric acid levels, with an average level of 1.20 ± 0.086 mg/dL, were observed after 15 days of treatment, followed by an average level of 1.59 ± 0.086 mg/dL after ten days and an average uric acid level of 2.32 ± 0.086 mg/dL after 5 days of treatment.

The ethyl acetate extract of *Peronema canescens* leaves reduces uric acid levels, possibly due to the phytochemicals present in the extract, one of which is flavonoids. Flavonoids have a similar mechanism of action to allopurinol in lowering uric acid levels. Flavonoids are antioxidant compounds that can work to inhibit the xanthine oxidase enzyme so that uric acid production is reduced.[19] Based on these results, it can be concluded that the ethyl acetate extract of *Peronema canescens* Jack leaves reduced uric acid levels in hyperuricemic male albino mice. Our findings are in agreement with a previous study regarding the antihyperuricemic activity of the ethanolic extract of *Peronema canescens.*[18,20] The plant's activity is attributed to the presence of flavonoids and alkaloidal compounds that inhibit xanthine oxidase, thereby inhibiting the synthesis of uric acid in the body.

Conclusion

The results of the study concluded that the administration of various doses of ethyl acetate extract from *Peronema canescens* leaves resulted in a significant reduction in uric acid levels in hyperuricemic male albino mice, and its effect is comparable to that of allopurinol. Further research should validate these results in larger models, identify active compounds and mechanisms, and assess safety, pharmacokinetics, and long-term efficacy, paving the way for standardized formulations and potential clinical trials as a natural alternative to allopurinol.

Conflict of Interest

The author`s declare no conflict of interest.

Authors' Declaration

The authors hereby declare that the work presented in this article is original and that any liability for claims relating to the content of this article will be borne by them.

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References

1. Pribadi T, Rahma A, Yulendasari R. Giving Acupressure to Reduce Pain And Uric Acid Levels In Gout Clients In Poncowarno, Kalirejo District, Central Lampung. J. Creat Comm Serv. 2021;4(3):515–519.
2. Kussoy VFM, Kundre R, Wowiling F. Eating Habits of High Purine Foods with Uric Acid Levels in Public Health Centers. J. Nurs. 2019;7(2):1–7.
3. Fitriani U, Ardiyanto D, Mana TA. Evaluation of the Safety and Benefits of Herbal Herbs for Hyperuricemia. Health Research Bull. 2017;45(4):227–232.
4. Dillasamola D, Aldi Y, Wahyuni FS, Rauza SR, Dachriyanus SU, Harrizul R. Study of Sungkai (*Peronema canescens*, Jack) Leaf Extract Activity as an Immunostimulator With *In vivo* and *In vitro* Methods. Pharmacog. J. 2021;13(6):1397-1407.
5. Permatasari DAI, Kurniasri N, Mahardika MP. Qualitative and Quantitative Analysis of Dexamethasone in Rheumatic Pain Herbal Medicine Using Thin-Layer Chromatography (TLC)—Densitometry. J. Fundam. Appl. Pharm. Sci. 2021; 2, 10–22.
6. Sinata N, Utami R, Aisyah S. Activity of the Ethyl Acetate Fraction *Artocarpus altilis* (Parkinson Ex FA Zorn) Fosberg on Blood Uric Acid Levels in Hyperuricemic Male White Mice. Putih. 2019;2(2):122-6.
7. Dillasamola D, Wahyuni FS, Rita RS, Dachriyanus, Alen Y, Umar S, Aldi Y. Immunostimulating Study of Active Agent Fraction from Sungkai (*Peronema canescens* Jack.) Leaf from SARS-COV-2 Virus Antigen Exposure to NK and CD8+T Cells. Pharmacogn J. Phcogj.com 2022;14(4): 344-351
8. Ahkam AH, Susilawati Y, Sumiwi SA. *Peronema canescens* as a source of immunomodulatory agents: A new opportunity and perspective. Biology. 2024;13(9):744-752.
9. Iliopoulos G. Understanding and treating gout: A narrative review. Achaiki Iatriki. 2020;87.
10. Fadhila R, Nainggolan H. Antihyperuricemia of Lemongrass Extract (*Cymbopogon citratus*) on Male Mice with Potassium Oxonate and Chicken Liver Juice Induced. Appl. Res. Sci. Tech. 2024;4(2):90-101.
11. Rizki KP, Muslichah S, Ningsih IY. Effect of Combination of Ethanol Extract of Sidaguri Leaf (*Sida rhombifolia* L.) and Red Ginger Rhizome (*Zingiber officinale* Rosc.) on Hyperuricemic Male Mice. Health Lib e-J. 2018;6(2):205.
12. Cendrianti F, Muslichah S, Ulfa EU. Antihyperuricemic Activity Test of Extracts of n-Hexane, Ethyl Acetate, and Ethanol 70% of Tempuyung Leaves (*Sonchus arvensis* L.) in Hyperuricemic Male Mice. Health Lib e-J. 2013;2(2):3–7.
13. Dong L, Zhang S, Chen L, Lu J, Zhao F, Long T, Wen J, Huang J, Mao Y, Qi Z, Zhang J. In vivo anti-hyperuricemia and anti-gouty arthritis effects of the ethanol extract from *Amomum villosum* Lour. Biomed. Pharmacother. 2023;161:114532.
14. Sutyarso S, Kanedi M, Rokiban A, Wahyuni A. Anti-hyperuricemic effects of water-soluble fraction of leaf extract of sukun (*Artocarpus altilis*) on mice fed purine-rich foods. Biomed. Pharmacol. J. 2020;13(2):915-919.
15. Mao Y, Xu H, Xia P. *Ilex cornuta* leaves extracts ameliorate hyperuricemia by modulating uric acid transporters. J. Ethnopharmacol. 2025;336:118618.
16. Aldi Y, Amdani A, Bakhtiar A. Activity of Scopoletin Compounds from Noni Fruit (*Morinda citrifolia* Linn.) Against Macrophage Response of Male White Mice. J. Pharm. Health. 2016;6(1):25–35.
17. Wahyuni AS, Ariyanti R, Wahyuningtyas N, Wahyuni AS. Effect of Infusion of Salam Leaves (*Eugenia polyantha* Wight) on Reduction of Blood Uric Acid Levels in Male White Mice Induced with Potassium Oxonate Salam. Pharmacog. J. 2007;8(2):56–63.
18. Nasrul E, Sofitri. Hyperuricemia in Pre-Diabetes. And Heal. J. 2012;1(2):86–91.
19. Latief M, Tarigan IL, Sari PM, Aurora FE. Antihyperuricemic Activity of Sungkai Leaf (*Peronema canescens* Jack) Ethanol Extract in Male White Mice. Pharmacon: J Farm Ind. 2021;18(1):23–37.
20. Amir M, Irem Adriana Purukan J. Effectiveness Test of Ethanol Extract of White Dragon Fruit (*Hylocereus undatus*) on Reducing Blood Uric Acid Levels in Mice (*Mus musculus*). Ind J. Pharm. Sci. 2018;16(2):166–171.