Effect of Standardised Extract Pegagan Embun (Hydrocotyle sibthorpioides Lam). toward Natural Killer Cell and CD8 Cell Activities on While Male Exposed to H5N1 Virus Antigen

by Afriwardi Afriwardi

Submission date: 18-Mar-2022 10:27AM (UTC+0800)
Submission ID: 1786795146
File name: Effect_of_Standardised_Extract_Pegagan_Embun_Hydrocotyle.pdf (642.43K)
Word count: 4952
Character count: 26321

Scientific Foundation SPIROSKI, Skopje, Republic of Macedonia
Open Access Macedonian Journal of Medical Sciences. 2022 Mar 01; 10(A):334-339.
https://doi.org/10.3889/oamjms.2022.8667
eISSN: 1857-9655
Category: *A - Basic Sciences*
Section: *Pharmacology*

OPEN ACCESS

Effect of Standardised Extract Pegagan Embun (*Hydrocotyle sibthorpioides* Lam.) toward Natural Killer Cell and CD8 Cell Activities on White Male Mice Exposed to H5N1 Virus Antigen

Afriwardi Afriwardi[1], Fitratul Wahyuni[2], Elidahanum Husni[3], Aditya Alqamal Alianta[4], Yufri Aldi[2]*

[1]Department of Physiology, Faculty of Medicine, Universitas Andalas, Padang, West Sumatera, Indonesia; [2]Department of Pharmacology, Faculty of Pharmacy, Universitas Andalas, Padang, West Sumatera, Indonesia; [3]Department of Biology of Pharmacy, Faculty of Pharmacy, Universitas Andalas, Padang, West Sumatera, Indonesia; [4]Department of Socio-economics, Faculty of Animal Science, Universitas Andalas, Padang, West Sumatera, Indonesia

Edited by: Sinisa Stojanoski
Citation: Afriwardi A, Wahyuni F, Husni E, Alianta AA, Aldi Y. Effect of Standardised Extract Pegagan Embun (*Hydrocotyle sibthorpioides* Lam.) toward Natural Killer Cell and CD8 Cell Activities on White Male Mice Exposed to H5N1 Virus Antigen. Open-Access Maced J Med Sci. 2022 Mar 01; 10(A):334-339. https://doi.org/10.3889/oamjms.2022.8667
Keywords: Hydrocotyle sibthorpioides Lam.; Immunostimulan; Natural killer cell; CD8 cell
***Correspondence:** Yufri Aldi, Faculty of Pharmacy, Universitas Andalas, Padang, West Sumatera, Indonesia. E-mail: yufrialdi@phar.unand.ac.id
Received: 17-Jan-2022
Revised: 15-Feb-2022
Accepted: 25-Feb-2022
Copyright: © 2022 Afriwardi Afriwardi, Fitratul Wahyuni, Elidahanum Husni, Aditya Alqamal Alianta, Yufri Aldi
Funding: This research did not receive any financial support
Competing Interest: The authors have declared that no competing interest exists
Open Access: This is an open-access article distributed under the terms of the Creative Commons Attribution-NonCommercial 4.0 International License (CC BY-NC 4.0)

Abstract

AIM: Community in Indonesia used pegagan embun (*Hydrocotyle sibthorpioides* Lam.) to increase endurance. Based on that, the study aimed to determine the effects of pegagan embun extract on natural killer (NK) cells and CD8 cells activities in white male mice exposed to the H5N1 antigen.

MATERIALS AND METHODS: As many as thirty-five experimental white male mice were used, divided into seven groups, by varying the time of administration of the H5N1 antigen. Groups I and II, were given the test extract for 7 days and induced H5N1 antigen on days 1 and 7, then evaluated on day 8. Group III was given a test extract for 3 days, then induced antigen on the 4th day and continued with giving the test extract until day 7th. In Groups V and VII, only H5N1 antigen induction on day 1 and evaluated on day 8. Groups IV and VI were given the test extract for 7 and 4 days. The observations examine the activities of NK cells and CD8 cells. The data were analyzed with a one-way analysis of variation method with p = 0.05, then analyzed with Duncan Multiple Range Test.

RESULTS AND DISCUSSION: After calculating, the NK cell activity for groups 1 to 7, respectively: 2.12; 2.03; 2.07; 1.87; 1.98; 1.91; and 1.95 ng/mL while for CD8 cell activity 22.23; 24.61; 23.69; 21.10; 19,20; 19.87; and 18.13 ng/mL. The results showed that giving pegagan embun extract to white male mice exposed to the H5N1 antigen increase the activities of NK cells and CD8 cells.

CONCLUSION: It concluded that administration of standardized extract of pegagan embun (*H. sibthorpioides* Lam.) at a dose of 200 mg/kg BW increased NK cells activities and CD8 cells of white male mice exposed to H5N1 virus antigen.

Introduction

The immune-mediated disease is an enormous problem in developing countries such as Indonesia. Viruses, bacteria, fungi, protozoa, and parasites are some of the most common pathogenic microorganisms found in the environment, and they are the principal causes of illness in people [1].

The immune system is a defense system in the human body separated into the nonspecific immune system and specific immune system [2]. The nonspecific immune system is the immune system acquired from birth, while the specific immune system is the acquired immune system [3]. The nonspecific immune system fights disease in the same way against all types of disease. It works quickly if pathogenic microorganisms enter the body. In contrast, the specific immune system works precisely because the response to each microbe is different and must recognize the type of microbe to be treated. Therefore, this immune system works for a long time to cause a response [2].

In the body, nonspecific and specific immune systems work together to eliminate the infection. The immune response consists of various cells and soluble molecules secreted by these cells. The primary cells such as lymphocytes (B cells, T cells, and natural killer [NK] cells), phagocytes (neutrophils, eosinophils, monocytes, and macrophages), accessory cells (basophils, mast cells, and platelets) involved in immune reactions on the infection [4]. NK cells are part of lymphocyte cells where NK cells can kill target cells directly without prior sensitization and without depending on major histocompatibility complex (MHC). Apart from being independent of MHC, these cells also do not interact with target cells via the T cell receptor (TCR).

NK cells have an essential role in the natural defense against the growth of cancer cells and various infectious diseases, especially viral infections. 95% NK cells functioned as killer cells. The virus-infected target cells and other target cells coated with immunoglobulin G (IgG). IgG-coated virus-infected target cells and other target cells (IgG). As a result, NK cells are cytotoxic

cells that rely on antibodies. ADCC stands for antibody-dependent cell-mediated cytotoxicity [5]. In addition to this, NK cells also function as a co-stimulator that stimulates macrophages, T cells, and B cells, thus bridging the interaction between innate immunity and adaptive immunity [5]. NK cells provide the first line of defense until the specific immune system, such as CD8+ T cells, and antibodies, work properly [6]. CD8+ T cell is system immune, neoplasm growth that work when viruses infected. The formation of CD8+ T cells is the result of the presentation of viral antigen by MHC Class I molecules (MHC-I) present on all nucleated cells, including virus-infected cells. Activated CD8+ T cells will produce cytokines that kill viruses or cells infected with viruses so that these cells will die. The cytokines released by CD8 T cells are Porphyry and Granzyme as well as NK cells and produce interferons, where these compounds will inhibit the proliferation and differentiation of viruses and inhibit the attachment of the virus to its receptors in normal cells [5].

The components of the nonspecific immune system consist of phagocytic cells, called polymorphonuclear cells and macrophages and NK cells. One of the body's efforts to defend itself against the entry of antigens is a virus by destroying the virus concerned non-specifically by the process of phagocytosis, regardless of the differences between foreign substances. In this case, leukocytes, including phagocytes, play a critical role, especially macrophages. Viral particles must adhere to the phagocyte's surface for phagocytosis to occur. It moves towards the target antigen, and macrophages will move towards the antigen, which will release substances or mediators called chemotactic originating from the virus. Furthermore, the virus enters the cell by endocytosis and by the process of phagosome formation, then the cell is trapped in the phagosome sac as if it swallowed and then destroyed [7], [8], [9].

During the COVID-19 pandemic, the immune system's ability was tested to maintain individual health. The immune system is the primary defence mechanism that influences the presence or absence of infectious diseases, such as COVID-19. In COVID-19, the immune system plays a prominent role in the success or failure of the treatment process. The data supports that most COVID-19 patients who not helped are elderly and have comorbidities that aggravate their condition [10].

The body's defense mechanism is enhanced by certain compounds that are immunostimulants, which are defined as compounds that can increase the body's defense mechanisms, both specifically and non-specifically, both cellular and humoral defense mechanisms [7]. Therefore, there are chemical compounds that can increase the activity of the immune system, and these compounds obtained from plants [11], [12], [13].

China used pegagan embun or *Hydrocotyle sibthorpioides* Lam. to eliminate swelling (anti-swelling) [11], anti-inflammatory, laxative urine, antibiotics, fever reducers, neutralize toxins (detoxifications), and phlegm laxative (expectorant) [14], [15], [16] reported that the extract of *H. sibthorpioides* had a strong anticancer impact and influenced the immune function of mice.

Previous research related to the activity of the extract of pegagan embun (*H. sibthorpioides* Lam.) toward the hematopoietic male white mice with anemia at doses of 100 mg/kg BW, 50 mg/kg BW, and 10 mg/kg BW that increased erythrocyte count, reticulocyte count, hemoglobin level, and hematocrit value [17]. Another study tested the anti-inflammatory effect of the ethanolic extract of the pegagan embun (*H. sibthorpioides* Lam.). It used the granuloma method and the leukocyte cell count in white male mice. The study conducted pegagan embun extract gel preparation was 0.5%, 1%, and 2% topically. The result showed that the extracted reduced the exudate volume of male white mice. The variation concentration of extract significantly affected the exudate volume of carrageenan-induced mice [18]. Total and percentage of leukocytes from pegagan embun increasing the activity and phagocytic capacity of peritoneal macrophage cells of male white mice at a 200 mg/kg BW [19]. Pegagan embun is also immunostimulating [20]. Pegagan embun extract also has a hematopoietic effect on male white mice [21].

The big problem caused by the SAR-CoV-2 virus has led to the importance of conducting research related to natural immune enhancement. However, considering the difficulty of obtaining a license to use and obtain the Sar-Cov virus vaccine and the Sar-Cov antigen, the research was conducted to the closest vaccine from the H5N1 virus. Based on the explanation, this research aimed to examine the effect of pegagan embun extract (*H. sibthorpioides* Lam.) on NK cells, CD8 cells, and leukocyte cells in white male mice, increasing the body's defense system.

Materials and Methods

Methods

The experimental completely randomized design was conducted to extract pegagan embun, standardization of pegagan embun extract, dose determination, experimental animals' preparation, suspension's manufacture, administration of suspension, treatment of experimental animals, and data analysis.

Tools

The tools on this study: UV-vis spectrophotometer (Thermo Scientific Genesys 10S UV-visible), Evaporator (Buchi R-210 Rotavapor), UV-lamp (Camag), beaker glass (Pyrex), measuring

cup (Pyrex), measuring flask (Pyrex), volume pipette (Pyrex), digital scale (SF-400), Silica gel 60 F254 (Merck), desiccator, dark bottle, TLC vessel,), animal cage, oven (Memmert), centrifuge (Gemmy PLC-03), hemocytometer (Neubauer), spectrophotometer (BIO-RAD), slides (Slides), microplate, Elisa reader (BIO-RAD), incubator (Biosan).

Materials

The materials used pegagan embun, aquadest (Andeska), Na Charboxy Methyl Cellulosa, 70% ethanol (Andesca), 80% ethanol, ethyl alcohol P (Merck), Chloroform P (Merck), Methyl alcohol P (Merck), glacial acetic acid P (Merck), routine, silica gel 60 F254 (Sentana), KI (Merck), Feri Clorida (Merck), Hidragiry Clorida (Merck), Alumunium Clorida (Merck), Mouse NK cell kit and CD8 cells (Bioassay Technology Laboratory), H5N1 Vaccine no. batch VF09B30 (Caprivac® AI-K).

Collecting and identification of pegagan embun

Pegagan embun sample collected in Batu Gadang Village, Lubuk Kilangan District, Padang City, West Sumatra. The ANDA Herbarium, Department of Biology, Faculty of Mathematics and Natural Sciences (FMIPA) Universitas Andalas (UNAND) Padang, West Sumatra, Indonesia was identified this pegagan embun.

Extracting pegagan embun

A total of 1 kg of pegagan embun was dried and finely ground before being macerated in a 70% ethanol solvent. Fill the macerator with one part dry Simplicia powder and ten parts solvent. Soak for the 6 h, stirring occasionally, and then strain after 18 h. Repeat the filtering process twice more, using the same type and amount of material each time. Collect all of the macerates and evaporate using a rotary evaporator until thick extract obtained.

Extract standardisation

Pegagan embun extracts were characterized in both nonspecific and particular ways. Drying shrinkage, total ash content, and acid insoluble ash content were used for nonspecific characterization, whereas an organoleptic test, identity parameter, chemical content test, thin-layer chromatography, and total flavonoid content determination were used for specific characterization.

Dosage and induction

Dosage for induction used one variant optimal dose of pegagan embun extract as 200 mg/kg BW [21]. The induction used the H5N1 Cavrivac® AI-K vaccine with a dose of 50 µL administered intramuscularly.

Treatment of experimental animals

This study used healthy white male mice (*Mus musculur* BALB/c strain) with a bodyweight of 22-28 g. Totalling thirty-five white male mice divided randomly into each group consisting of five mice. Table 1 shows the treatment of this study.

Table 1: The group's treatment

Group	Extract induced (day)	Vaccinated (day)	Evaluation (day)
I	1^{st}–7^{th}	7^{th}	8^{th}
II	1^{st}–7^{th}	1^{st}	8^{th}
III	1^{st}–3^{rd}	4^{th}	8^{th}
	4^{th}–7^{th}	-	
IV	2–7 (Na CMC)	1^{st}	8^{th}
V	1^{st}–7^{th}	-	8^{th}
VI	2^{nd}–4^{th}	1^{st}	8^{th}
VII	1^{st}–4^{th}	-	5^{th}

The treatment is given once a day in the afternoon. Before being treated, the experimental animals were acclimatised for 7 days. The treatment process lasted for 7 days, and an evaluation was eight mornings [22]. The experimental animals were provided feed and water, then their body weight and motoric activities were monitored every day. The experimental animals were those whose body weight did not surpass 10% of the average experimental animal's body weight.

Blood serum collecting for NK cells and CD8 cells

Blood drawn utilizing the guillotine (neck artery). Then the blood was collected and centrifuged for 30 min at 3000 rpm. Then the serum was used to test the levels of NK cells and CD8 cells using the ELISA method. The protein markers from NK cells and CD8 can be detected in plasma cells using an ELISA kit [23].

Data analysis

The data were analyzed statistically with the One-way analysis of variation (ANOVA) method. Then, the result was analyzed with Duncan's Multiple Range Test with IBM SPSS type 24.

Ethics approval

The ethics approval on animal testing was obtained from the Ethics Committee of the Faculty of Medicine, Universitas Andalas. This research passed the ethical review with letter of ethics contract number: 174/UN.16.2/KEP-FK/2020.

Results

The chromatography of pegagan embun extract (*H. sibthorpioides* Lam.) showed in Figure 1:

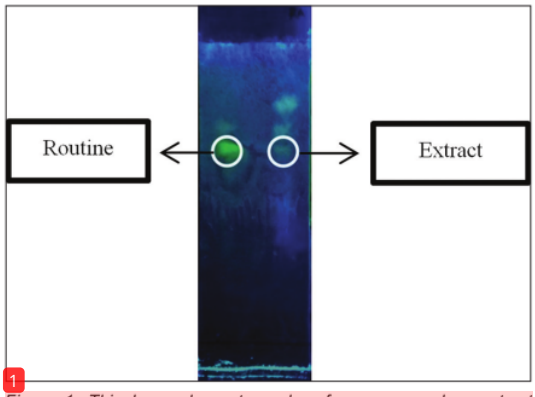

Figure 1: Thin layer chromatography of pegagan embun extract (Hydrocotyle sibthorpioides Lam.) viewed under a 366 nm UV lamp

The concentrations of NK cells and CD8 cells showed in (Figures 2 and 3).

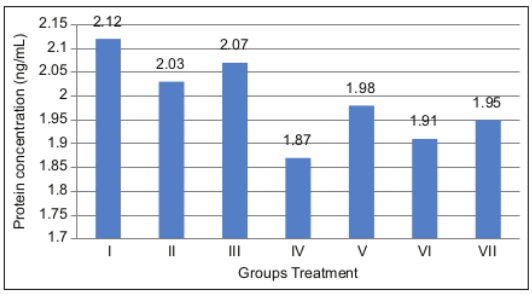

Figure 2: Graphic of NK cell protein concentration of white male mice after administration of standardized extract of pegagan embun (Hydrocotyle sibthorpioides Lam.) 200 mg/kg BW exposed to H5N1 virus antigen

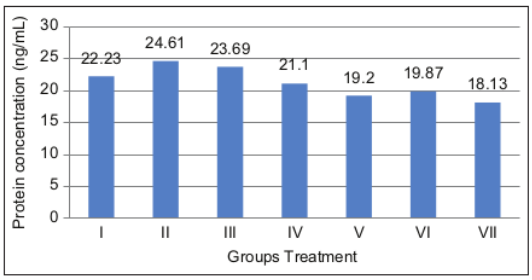

Figure 3: Graphic of CD8 cell protein concentration of white male mice after administration of standardized extract of pegagan embun (Hydrocotyle sibthorpioides Lam.) 200 mg/kg BW exposed to H5N1 virus antigen

The ANOVA test and DMRT on NK cells conducted, and the result showed in Tables 2 and 3:

Table 2: The result of ANOVA Test of NK Cells activities after administration of standardized extract of pegagan embun (*Hydrocotyle sibthorpioides* Lam.) 200 mg/kg BW exposed to H5N1 virus antigen

	Sum of square	Df	Mean Squares	F Ratio	Sig.
Between Group	0.22	6	0.03	2.72	0.033
Within Group	0.39	28	0.01		
Total	0.61	34			

Table 3: The result of DMRT of NK Cells activities after administration of standardized extract of pegagan embun (*Hydrocotyle sibthorpioides* Lam.) 200 mg/kg BW exposed to H5N1 virus antigen

Groups	n	Subset for alpha = 0.05		
		I	II	III
4	5	1.87		
6	5	1.91	1.91	
7	5	1.95	1.95	
5	5	1.98	1.98	1.98
2	5	2.03	2.03	2.03
3	5		2.07	2.07
1	5			2.12
Sig.		0.07	0.07	0.09

The ANOVA test and DMRT on NK Cells conducted, and the result showed in Tables 4 and 5:

Table 4: The result of ANOVA Test of CD8 activities after administration of standardized extract of pegagan embun (*Hydrocotyle sibthorpioides* Lam.) 200 mg/kg BW exposed to H5N1 virus antigen

	Sum of square	Df	Mean squares	F Ratio	Sig.
Between group	170.39	6	28.39	18.35	0.000
Within group	43.31	28	1.54		
Total	213.70	34			

Table 5: The result of DMRT of CD8 Cells activities after administration of standardised extract of pegagan embun (*Hydrocotyle sibthorpioides* Lam.) 200 mg/kg BW exposed to H5N1 virus antigen

Groups	n	Subset for alpha=0.05					
		I	II	III	IV	V	VI
7	5	18.13					
5	5	19.2	19.2				
6	5		19.86	19.86			
4	5			21.09	21.09		
1	5				22.23	22.23	
3	5					23.69	23.69
2	5						24.61
Sig.		0.18	0.40	0.13	0.16	0.07	0.25

Discussion

The extract chromatographed a very thin layer using n-butanol: acetic acid: water (4:1:5) as the eluent and silica gel plate F254 as the stationary phase, using rutin as the comparison and an Rf value of 0.55cm. Pegagan embun (*H. sibthorpioides* Lam) total flavonoid content by method two, as published in Supplement II of the Indonesian Herbal Pharmacopeia version I (Ministry of Health, 2011) 411 nm the maximum wavelength obtained. The calibration curve measured with concentrations of 140, 120, 100, 80, and 60 ppm to obtain a linear equation y= 0.0065x–0.1207 with R = 0.9992, then the absorbance of the extract measured at 411 nm, and the absorbance value of the extract entered into a linear equation to yield 1.18% average total flavonoid content.

Fresh pegagan embun collected, cleaned of contaminants, washed with running water, and air-dried to become dry Simplicia before being used to make pegagan embun extract. Simplicia dried, then mashed in a blender to get powdered Simplicia. A 70% ethanol solvent was used to macerate the samples [24]. As much 170.74 grams of extract recovered from 1037.05

grams of Simplicia powder, with an extract yield of 16.46%. The drying shrinkage of the extract was 3.95% after standardisation of pegagan embun extracts. This conclusion was consistent with the Indonesian Herbal Pharmacopeia, which states that the drying shrinkage of pegagan embun extract is less than 10%. The total ash content of pegagan embun extract (*H. sibthorpioides* Lam.) was determined to be 2.55%. It met the requirements of the Indonesian Herbal Pharmacopeia, which stated that the total ash content of pegagan embun extract should not exceed 16.6%. According to the Indonesian Herbal Pharmacopeia, the acid insoluble ash content produced is 0.07%. The extract of pegagan embun contains no more than 2.3% insoluble ash.

The organoleptic study designed to provide a basic introduction to the pegagan embun extract, which has a dark brown color and a bitter taste. The phytochemical test revealed that the pegagan embun extract contained flavonoids, phenolics, terpenoids, and saponins. The serum sample was used to examine NK cells and CD8 cells, obtained from centrifugation of mice blood taken from the neck of mice and then the concentration determined by the ELISA method. NK cells and CD8 cells function to kill cells that are infected and unwanted by the body [25]. The highest concentration of NK cells was found in Group 1, which was 2.12 ng/μL, and the lowest concentration in Group 4 in the treatment group induced by vaccine without extract, which was 1.87 ng/μL. After the one-way ANOVA statistical, there was a significant difference with a $p < 0.05$. It explained that the data from each treatment group indicated an increase in the concentration of NK cells compared to the group of mice induced by the vaccine. NK cells play an essential role in nonspecific immunity against intracellular pathogens that can recognize and kill abnormal cells and destroy cells that contain viruses or neoplasm cells. NK cells are activated by interferons which are generally produced and released by virus-infected cells. Interferons affect accelerating maturation and cytolytic effects of NK cells. It increased virus resistance in uninfected cells [21], while NK cells are a subset of lymphocytes with either a CD 16 or CD 56 surface (a receptor for FC). The surface characteristics of CD 16 and 56 have been used to ensure that these cells are NK cells that can differentiate between T cells and B cells. It also does not interact with the TCR [26].

NK cells components of innate immunity act as killers (cytotoxicity) by secreting lysosomes containing perforins and granzymes and producing cytokines IFN-γ, TNF-α, IL-5, IL-13 [27]. NK cells also function as co-stimulatory that can stimulate macrophages, T cells, and B cells, thus bridging the interaction between innate immunity and adaptive immunity [28]. The concentrations of NK cells and CD8 cells showed in (Figures 2 and 3).

The graphic showed the highest CD8 cell protein weight in Group II, 24.61 ng/mL. The group that received the extract treatment for 3 days then induced on the 4 days and continued with the extract until day eighth compared to Group 7 that could treat only induced by the vaccine on the 1st day and evaluated on day 4th which was 18.13 ng/mL, and this proved that there was an increase in the concentration of CD8 cells in the group that was given the extract and induced with the H5N1 vaccine compared to the group that only induced without given extract.

ANOVA result showed a significant difference ($p < 0.05$). CD8 cells express the CD8 co-receptor and destroy infected cells between dependent MHC-I specific antigens. CD8 cells can kill cells directly and through the induction of apoptosis [29]. CD8 cells contain abundant azurophilic granules capable of destroying various tumor cells, infected cells, and abnormal cells without prior sensitization [30]. The innate and adaptive immune systems carry out an effective viral response from the host through the production of various proinflammatory cytokines, activation of T cells, CD 4, and CD8 cells. T cells are essential for controlling viral replication, limiting virus spread, and clearing infected cells. However, tissue caused by viruses makes excessive production of proinflammatory cytokines, recruitment of proinflammatory macrophages and granulocytes. It is called a Cytokine Storm, leading to more severe tissue damage [31].

Conclusion

This study showed administration of standardized extract of pegagan embun (*H. sibthorpioides* Lam.) at a dose of 200 mg/kg BW increases NK cells activities and CD8 cells of white male white mice exposed to H5N1 virus antigen. The body's ability to kill viruses that enter has been enhanced due to the increase activity of NK cells and CD8 cells. Following investigations should undertake acute and subacute toxicity tests so that this standardized extract may be examined clinically.

Acknowledgment

The authors would like to thank the Rector Universitas Andalas through the Institute for Research and Service Society or "*Lembaga Penelitian dan Pengabdian Kepada Masyarakat*," which facilitated and funding the research in the scheme of "*Penelitian Dasar Unggulan Klaster Riset Publikasi Guru Besar Universitas Andalas*" (PDU KRP1GB UNAND), Batch I, the year 2021, with Contract Number. T/7/UN.16.17/PT.01.03/KO-PDU-KRP1GB/2021 signed on March 30th, 2021.

References

1. Marbun RA, Situmorang N, Wahyuni S. The effect of immunomodulator by extract ethanol of herba binary (*Artemisia vulgaris* L.) Toward the response of delayed-type hypersensitivity in rat males. J Penelitian Farm Herb. 2018;1(1):17-21.
2. Hasdianah, Dewi P, Peristiowati, Imam SS. Imunologi. Diagnosis dan Teknik Biologi Molekuler. Yogyakarta: Nuha Medika; 2014.
3. Radji M. Imunologi and Virologi. Jakarta Barat: PT ISFI Penerbitan; 2015.
4. Lestari YE. Analisis Model Matematika Pada Interaksi Sistem Imun Dengan Pertumbuhan sel Tumor (Doctoral Dissertation, Universitas Islam Negeri Maulana Malik Ibrahim); 2011.
5. Supatmo Y, Susanto H, Sugiharto S. The Effect of exercise on NK Cell as Immune Indicators. Med Keolahragaan Indones. 2015;5(2):30-6.
6. Meiliana N. The Effect of Ethanol Extract of Eleuthrine palmifolia L. Merr orally administration on BALB/c Mice or to mitigate of NK Cel and CD 8+ Decreasing. J Bios Pascasarjana. 2016;18(1):13-23.
7. Kresno S. Imunologi: Diagnosis dan Prosedur Laboratorium. 5th ed. Jakarta: FKUI Press; 2010.
8. Singh Y, Fuloria NK, Fuloria S, Subramaniyan V, Almalki WH, Gupta G, *et al*. Disruption of the biological activity of protease-activated receptors2/4 in adults rather than children in SARS CoV-2 virus-mediated mortality in COVID-19 infection. Drug Dev Res. 2021;82(8):1075-8. https://doi.org/10.1002/ddr.21874
   PMid:34469011
9. Singh Y, Fuloria NK, Fuloria S, Subramaniyan V, Meenakshi DU, Chakravarthi S, *et al*. N-terminal domain of SARS CoV-2 spike protein mutation associated reduction in effectivity of neutralizing antibody with vaccinated individuals. J Med Virol. 2021;93(10):5726-8. https://doi.org/10.1002/jmv.27181
   PMid:34232521
10. Kusnul Z. COVID-19 Infection and Immune-system: The role of herbal medicine based on efficacious natural products. J Ilmiah Pamenang. 2020;2(2):26-31.
11. Nugroho YA. The Effect of Piper betle L. fruits Plectranthus scutellariodes L. leafs honey, and yolk combination administrated on activities improvement of phagocytic capacity of macrophages. Med Litbang Kesehatan. 2012;22(1):1-5.
12. Subramaniyan V, Chakravarthi S, Seng WY, Kayarohanam S, Fuloria NK, Fuloria S. Impact of COVID-19 in public health: Prevalence and preventive approaches. Pak J Pharm Sci. 2020;33(4):1739-45.
    PMid:33583811
13. Subramaniyan V, Fuloria S, Darnal HK, Meenakshi DU, Sekar M, Nordin RB, *et al*. COVID-19-associated mucormycosis and treatments. Asian Pac J Trop Med 2021;14(9):401-9. https://doi.org/10.4103/1995-7645.326253
14. Huang Q, Zhang S, Huang R, Wei L, Chen Y, Lv S, *et al*. Isolation and identification of an anti-hepatitis B virus compound from *Hydrocotyle sibthorpioides* Lam. J Ethnopharmacol. 2013;150(2):568-75. https://doi.org/10.1016/j.jep.2013.09.009
    PMid:24051027
15. Yu F, Yu F, McGuire PM, Li R, Wang R. Effects of *Hydrocotyle sibthorpioides* extract on transplanted tumors and immune function in mice. Phytomedicine. 2007;14(2-3):166-71. https://doi.org/10.1016/j.phymed.2006.03.010
    PMid:16730434
16. Badrunasar A, Santoso H. In: Rachman E, Siarudin M, editors. Tumbuhan Liar Berkhasiat Obat. Jawa Barat: Forda Press; 2016.
17. Nazmi R. Anti-inflammatory Effect Test of Extract Ethanol Pegagan Embun (*Hydrocotyle sibthorpioides* Lam.) with Granuloma Pouch Method or Uji Efek Antiinflamasi Ekstrak Etanol Herba Pegagan Embun (*Hydrocotyle sibthorpioides* Lam.) dengan Metode Granuloma Pouch., (Bachelor Thesis, Universitas Andalas); 2020.
18. Afriwardi, Nazmi R, Dillasamola D, Badriyya E, Aldi Y. Anti-inflammatory activity of Pegagan Embun (*Hydrocotyle sibthorpioides* Lam.) plant extract on topical application. Pharmacogn J. 2021;13(2):411-7.
19. Afriwardi, Aldi Y, Dillasamola D, Larakhansa YA, Badriyya E. Immunostimulatory activities of pegagan embun (*Hydrocotyle sibthorpioides* Lam.) in white male mice. Pharmacogn J. 2021;13(2):368-75.
20. Afriwardi, Fitri A, Husni E, Badriyya E, Aldi Y. Immunostimulant Activity of Pegagan Embun Herbs Extract (*Hydrocotyle sibthorpioides* Lam.) with carbon clearance method towards male white mice. Pharmacogn J. 2021;13(6):1472-7.
21. Husni E, Dillasamola D, Badriyya E, Angelia R, Aldi Y. Ethanol extract activity of pegagan embun (*Hydrocotyle sibthorpioides* L.) against hematopoietic on anemic male white mice. Pharmacogn J. 2021;13(4):866-73. https://doi.org/10.5530/pj.2021.13.111
22. Jola C. Chapter four empirical research in an embodied practice: Can the study of partnering touch, touch on something new? Thinking Touch in Partnering and Contact Improvisation: Philosophy, Pedagogy, Practice. Newcastle upon Tyne, United Kingdom: Cambridge Scholars Publishing; 2020. p. 52.
23. Suckow MA, Stevens KA, Wilson RP, editors. The Laboratory Rabbit, Guinea Pig, Hamster, and other Rodents. Cambridge, Massachusetts: Academic Press; 2012.
24. Minstry of Health, Republic Indonesia or Depkes RI. Suplemen III Farmakope Herbal Indonesia. 1st ed. Jakarta. Kementrian Kesehatan RI; 2013.
25. Abbas AK, Lichtman AH, Pillai S. Imunologi Dasar Abbas: Fungsi dan Kelainan Sistem Imun. 6th ed. Amsterdam, Netherlands: Elsevier; 2020. p. 15-8.
26. Bruunsgaard H, Skinhøj P, Pedersen AN, Schroll M, Pedersen BK. Ageing, tumour necrosis factor-alpha (TNF-α) and atherosclerosis. Clin Exp Immunol. 2000;121(2):255-60. https://doi.org/10.1046/j.1365-2249.2000.01281.x
    PMid:10931139
27. Hutasuhut F.Low Immunity Response on Elders. Seri Kesehatan (Health Series). 2006;10(1):10.
28. Orange JS, Ballas ZK. Natural killer cells in human health and disease. Clin Immunol. 2006;118(1):1-10. https://doi.org/10.1016/j.clim.2005.10.011
    PMid:16337194
29. Baratawidjaja KG, Rengganis I. Imunologi Infeksi: Imunologi Dasar. 8th ed. Jakarta: Balai Penerbit FKUI; 2009. p. 399-449.
30. Kumar V, Cotran R, Robbins S. In: Prasetyo A, Pendit B, Priliono T, editors. Buku Ajar Patologi. Jakarta: EGC Penerbit Buku Kedokteran; 2007.
31. Lie G, Fan Y, Lai Y, Han T, Li Z, Zhou P. Coronavirus infections and immune responses. J Med Virol. 2020;92(4):424-32. https://doi.org/10.1002/jmv.25685
    PMid:31981224

Effect of Standardised Extract Pegagan Embun (Hydrocotyle sibthorpioides Lam). toward Natural Killer Cell and CD8 Cell Activities on While Male Exposed to H5N1 Virus Antigen

ORIGINALITY REPORT

19%	20%	0%	3%
SIMILARITY INDEX	INTERNET SOURCES	PUBLICATIONS	STUDENT PAPERS

PRIMARY SOURCES

1	ijisrt.com Internet Source	19%

Exclude quotes	On	Exclude matches	< 3%
Exclude bibliography	On		