

EFIKASI FLAVONOID PADA MULBERI MERAH TERHADAP PENURUNAN RADIKAL BEBAS DAN ALVEOLAR MAKROFAG AKIBAT PAPARAN ASAP ROKOK PADA TIKUS WISTAR

The Efficacy of Flavonoid in Red Mulberry on Reducing Free Radicals and Alveolar Macrophages Due to Cigarette Smoke Exposure in Wistar Rats

Rivan Virlando Suryadinata^{1*}, Dita Sukmaya Prawitasari¹, Indira Pradita Rochim¹

¹Faculty of Medicine, Universitas Surabaya, Surabaya

Jalan Raya Rungkut, Kali Rungkut, Surabaya, Jawa Timur, Indonesia

*e-mail: rivan.virlando.s@staff.ubaya.ac.id

Submitted: November 20th, 2020, revised: March 6th, 2021, approved: June 8th, 2021

ABSTRACT

Background. Free radicals in cigarette smoke will hurt health when they enter to the respiratory tract. An excessive increase of free radicals in the body will cause oxidative stress. Free radicals are generated physiologically by the body's metabolism and can neutralize antioxidants in the body. An imbalance number of free radicals will result in cell damage and death. It has characterized by an increase in malondialdehyde levels in the blood and alveolar macrophages in the lung tissue. Giving red mulberry (*Morus rubra*) as an intake of antioxidants from outside the body can prevent adverse effects of cigarette smoke. **Objective.** This study analyses flavonoids' impact on red mulberry in reducing free radicals due to exposure to cigarette smoke by lowering levels of malondialdehyde and alveolar macrophages. **Method.** This research is experimental with a post-test control group design using male Wistar rats (*Rattus norvegicus*) as experimental animals. Treatment of experimental animals through red mulberry per oral and exposure to cigarette smoke had conducted for 30 days. The parameters used were levels of malondialdehyde and alveolar macrophages in the lung tissue. **Results.** The research showed an increase in free radicals in the group exposed to cigarette smoke. Increasing intake of red mulberry can further reduce malondialdehyde levels and the number of alveolar macrophages ($p < 0.05$). **Conclusions.** The antioxidants in red mulberry can reduce malondialdehyde levels in the blood and the number of alveolar macrophages in lung tissue due to exposure to cigarette smoke.

Keywords: alveolar macrophage, cigarette, flavonoids, malondialdehyde, red mulberry

ABSTRAK

Latar Belakang. Radikal bebas yang banyak terkandung dalam asap rokok akan memberikan dampak negatif bagi kesehatan apabila masuk ke dalam saluran napas. Peningkatan radikal bebas dalam tubuh yang berlebihan akan menyebabkan terjadinya stres oksidatif. Secara fisiologis, radikal bebas dihasilkan dari metabolisme tubuh dan dapat dinetralkan oleh antioksidan dalam tubuh. Ketidakseimbangan jumlah radikal bebas akan mengakibatkan kerusakan dan kematian sel yang ditandai dengan peningkatan kadar malondialdehid dalam darah dan alveolar makrofag di jaringan paru. Pemberian flavonoid pada buah mulberi merah (*Morus rubra*) sebagai asupan antioksidan dari luar tubuh dapat mencegah dampak negatif dari paparan asap rokok. **Tujuan.** Penelitian ini bertujuan untuk menganalisis efek flavonoid pada mulberi merah dalam menurunkan radikal bebas akibat paparan asap rokok melalui penurunan kadar malondialdehid dan alveolar makrofag. **Metode.** Penelitian ini adalah eksperimental dengan *post-test control group design* menggunakan tikus wistar jantan (*Rattus norvegicus*) sebagai hewan coba. Perlakuan pada hewan coba melalui pemberian mulberi merah dan paparan asap rokok dilakukan selama 30 hari. Parameter yang digunakan adalah kadar malondialdehid dan alveolar makrofag di jaringan paru. **Hasil.** Penelitian ini memperlihatkan adanya peningkatan radikal bebas pada kelompok yang

diberikan paparan asap rokok. Peningkatan pemberian asupan mulberi merah dapat menurunkan kadar malondialdehid dan jumlah alveolar makrofag ($p < 0,05$). **Kesimpulan.** Antioksidan yang terkandung pada mulberi merah dapat menurunkan kadar malondialdehid dalam darah dan jumlah alveolar makrofag di jaringan paru akibat paparan asap rokok.

Kata kunci: alveolar makrofag, rokok, flavonoid, malondialdehid, mulberi merah

INTRODUCTION

Cigarettes have become a significant problem around the world. It has estimated that cigarettes account for six million deaths due to smoking each year. Although there has been a decrease in smokers' prevalence globally, the number of people who smoke has increased.¹ Therefore, many countries continue to reduce the number of smokers even though they have not achieved satisfactory results. The increase in the number of active smokers will not only increase the number of diseases caused by smoking, but it will directly improve the health costs.^{2,3} The increasing number of active smokers is more common in developing countries than in developed countries.⁴ The adult age group in developed countries such as the US has shown a decline in numbers.⁵ The opposite happens in developing countries where the number of active smokers is increasing, such as India, Saudi Arabia, and Indonesia.^{6,7,8}

Cigarette smoke that enters the respiratory tract continuously will cause an increase in airways diseases such as Chronic Obstructive Pulmonary Disease (COPD), asthma, chronic bronchitis, lung infections, and lung cancer.⁹ Various harmful substances in cigarette smoke will trigger free radicals, which disrupt the body's physiological processes. Free radicals can come from both inside and outside the body. Normally, free radicals are usually formed by metabolic waste and neutralized by enzymatic antioxidants, such as superoxide dismutase (SOD), glutathione peroxidase (GSH-Px), and catalase (CAT).¹⁰ The increase in free radicals from the body due to exposure to cigarette

smoke entering the respiratory tract will result in an excessive number of free radicals.¹¹

It will cause an imbalance between the number of free radicals and antioxidants in the body, resulting in oxidative stress and triggering lipid peroxidation reactions. This reaction will result in cell damage and death.¹² Prevention can do by taking antioxidants from outside the body to help neutralize free radicals. Antioxidants given orally are not enzymatic antioxidants because enzymatic antioxidants result from metabolism. Thus, they cannot obtain from the outside.¹³ It can identify the increase in cell damage caused by free radicals increasing malondialdehyde levels in the blood. The malondialdehyde parameter is one of the end products of lipid peroxidation. It not includes as free radicals.¹⁴ In addition, an increase in free radicals can also cause cell death and lung tissue damage. It will stimulate macrophages' alveolar movement as one of the primary defences in body tissues to carry out the phagocytosis process.¹⁵

Various antioxidants that can be consuming as non-enzymatic antioxidants are flavonoids, vitamin C, vitamin E, and carotenoids.¹⁶ Flavonoid-type antioxidants often reduce free radicals because they have a broad spectrum of health-enhancing effects as antioxidants, anti-inflammatory, and anti-carcinogenic.¹⁷ Red mulberry fruit (*Morus rubra*) is high in flavonoids and often consumed by people. This study aims to determine the effect of giving red mulberry in reducing free radicals due to the exposure to cigarette smoke through levels of malondialdehyde and alveolar macrophages as parameters.

METHODS

This study is an experimental study (Randomized Controlled Trial) with a post-test control group design. Male Wistar rats (*Rattus norvegicus*) used as research samples for 30 days. This study divides the experimental animal group into a negative control group, a positive control group, and three treatment groups. Each treatment group contains six experimental animals (Federer's Formula).¹⁸ This research has been approved by Komite Etik Penelitian Kesehatan Universitas Surabaya (No: 136/KE/VI/2020).

The male Wistar rat (*Rattus norvegicus*) weighs ± 200 g in normal conditions has never been the object of research. Meanwhile, the exclusion criteria were the experimental animals who were sick or died during the study. The maintenance and care of experimental animals during the study was regarding on the 3R principle (replacement, reduction, and refinement).¹⁸

Red mulberry fruit (*Morus rubra*) obtained from Mojokerto will be sorted and cleaned to get the fruit in good condition. Next, the juice-making process conducted using a blender and a filter to separate the pulp's juice. Red mulberry intake to experimental animals to adjust the flavonoid dose in red mulberry to the daily nutritional adequacy rate. The flavonoids of the red mulberry obtained will be measured (± 38 mg/g). Then, the flavonoids will convert from adults' daily needs (± 190 mg/kg) to the daily intake dose of Wistar rats 200 g (± 240 mg/tail) by using table Laurence and Bacharach. The red mulberry was given to experimental animals by oral sonde. The amount of red mulberry to be given to the treatment group was 3.25 g, 6.5 g, and 13 g.

Experimental animals were exposed to cigarette smoke using a smoking chamber (CO levels ± 50 PPM). The measurement of malondialdehyde levels ($\mu\text{g/ml}$) had carried out using spectrometry, while the alveolar macrophage measurement had conducted by

making histology. The lung tissue obtained will be processed histo-technique and carried out with hematoxylin-eosin (HE) staining. All tissue specimens had fixed with 10 percent formalin solution and a histological incision. Hematoxyline and eosin (HE) staining performed after transverse incisions of six microns had made with a rotary microtome.³ The mean number of alveolar macrophages calculated as many as five fields of view on each preparation.

This research was conducted for 30 days by dividing the rats into five groups. The first group was the negative control group, where the experimental animal did not receive any treatment; they only received daily intake (30 g/day). The second group was the positive control group, where the experimental animals' received daily information and exposure to tobacco smoke of 2 rods per day. In contrast, the three treatment groups were the groups that received exposure to tobacco smoke of 2 rods per day, daily intake, and different amounts of mulberry fruit (3.25 g, 6.5 g, and 13 g).

The research results obtained ratio data in the form of malondialdehyde and alveolar macrophage levels in each group. Data analysis was performed using the ANOVA test and continued with the least significance difference (LSD) test using SPSS version 22 to see any differences between groups.

RESULTS

The observations results of the mean of malondialdehyde levels in each experimental animal group are the negative control group (I); positive control group (II); treatment groups (III, IV, V) with exposure to cigarette smoke and with an oral dose of *Morus rubra* fruit 3 g, 6 g, and 12 g. Based on table 1, the mean of each treatment group, i.e., group I of 1.99 ± 0.40 , group II of 3.13 ± 0.61 , group III of 2.40 ± 0.44 , group IV of 2.28 ± 0.31 and group V of 2.15 ± 0.27 .

Table 1. The Mean Value of Malondialdehyde Levels Post Treatment (µg/ml)

Groups		Mean±SD
I	Negative control group, only food intake	1.99±0.49
II	Positive control group, food intake and exposure to cigarette smoke	3.13±0.61
III	The treatment group was exposed to cigarette smoke and intake of red mulberry (3 g)	2.40±0.44
IV	The treatment group was exposed to cigarette smoke and intake of red mulberry (6 g)	2.28±0.31
V	The treatment group was exposed to cigarette smoke and intake of red mulberry (12 g)	2.15±0.27

The observations results of the mean number of alveolar macrophages (Figure 1) in each experimental animal group are the negative control group (I); positive control

group (II); treatment groups (III, IV, V) with exposure to cigarette smoke and with an oral dose of *Morus rubra* fruit 3 g, 6 g, and 12 g.

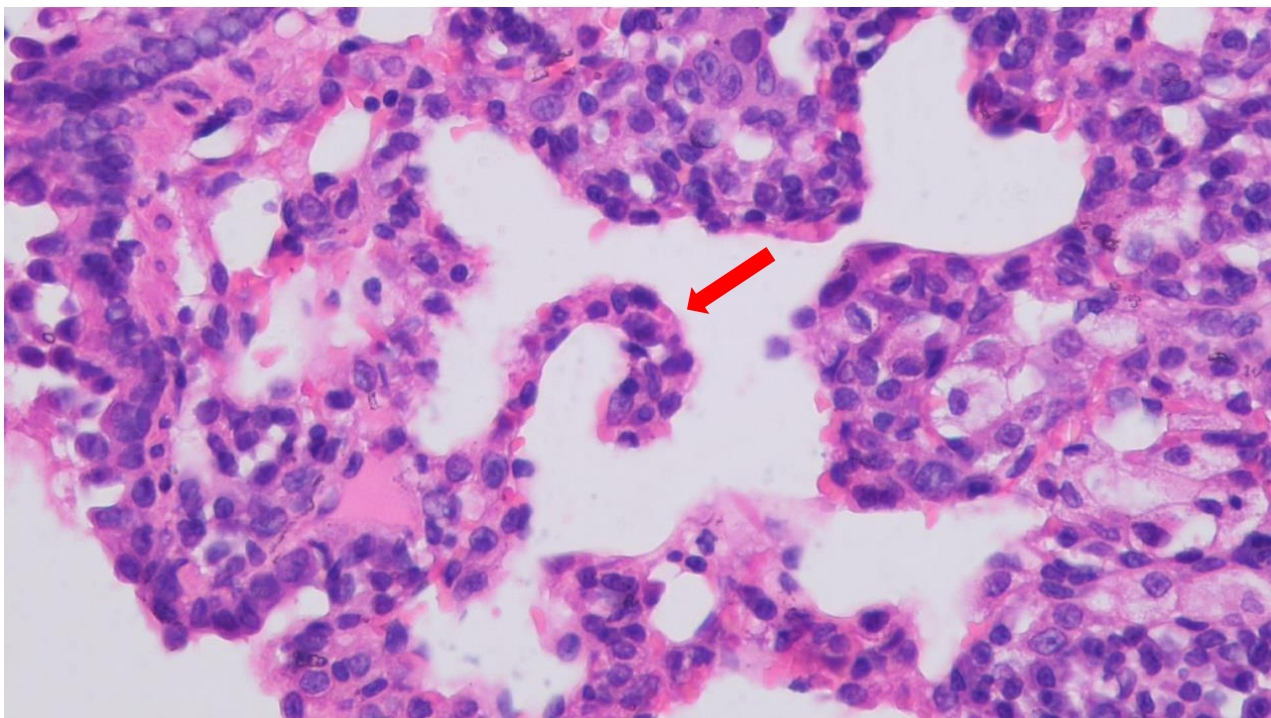


Figure 1. The Histology of Alveolar Macrophages in the Positive Control Group (Red Arrow)

Table 2 shows that the mean of each treatment group, i.e., group I is 5.36±0.52, group

II is 32.08±2.09, group III is 22.52±1.50, group IV is 17.58±1.10 and group V is 10.88±1.43.

Table 2. The Mean Number of Alveolar Macrophages Post Treatment

Groups		Mean±SD
I	Negative control group, only food intake	5.36±0.52
II	Positive control group, food intake and exposure to cigarette smoke	32.08±2.09
III	The treatment group was exposed to cigarette smoke and intake of red mulberry (3 g)	22.52±1.50
IV	The treatment group was exposed to cigarette smoke and intake of red mulberry (6 g)	17.58±1.10
V	The treatment group was exposed to cigarette smoke and intake of red mulberry (12 g)	10.88±1.43

Table 3 shows the normality and homogeneity test results of malondialdehyde levels. It offers a *p*-value more significant than 0.05. So, the data obtained has normality

(*p*>0.05) and is homogeneous (*p*=0.717). ANOVA test will conduct to determine the differences between groups, and the *p*-value has obtained 0.006.

Table 3. ANOVA Test Results on Research Variable

Groups	Malondialdehyde Levels	Alveolar Macrophages
I		
II		
III	0.006	0.000
IV		
V		

Based on table 3, the results of the normality and homogeneity test for alveolar macrophage show a *p*-value more significant than 0.05, so that the data obtained has

normality (*p*>0.05) and is homogeneous (*p*=0.085). ANOVA test has determined the differences between groups, and the *p*-value has obtained 0.000 (*p*<0.05).

Table 4. Least Significance Difference Test Results on Malondialdehyde Levels

Groups	I	II	III	IV	V
I	-	-	-	-	-
II	0.001	-	-	-	-
III	0.163	0.016	-	-	-
IV	0.316	0.006	0.679	-	-
V	0.574	0.002	0.390	0.652	-

The least significance difference (LSD) test used to compare between malondialdehyde groups (table 4). Group 2 showed a significant difference with each group ($p < 0.05$). It showed

that the group exposed to cigarette smoke could increase free radicals. Meanwhile, the other groups did not show any differences between each group ($p > 0.05$).

Table 5. Least Significance Difference Test Results on Alveolar Macrophages

Groups	I	II	III	IV	V
I	-	-	-	-	-
II	0.000	-	-	-	-
III	0.000	0.000	-	-	-
IV	0.000	0.000	0.000	-	-
V	0.000	0.000	0.000	0.000	-

The least significance difference (LSD) test compared alveolar macrophage groups (table 5). Each group showed significant differences between the other groups ($p < 0.05$).

DISCUSSION

Malondialdehyde levels and the number of alveolar macrophages in the lung tissue showed an increase in the positive control group compared to the negative control group. The malondialdehyde levels decreased gradually in the treatment group given red mulberry compared to the positive control group. The higher the amount of red mulberry, the lower the malondialdehyde levels and the number of alveolar macrophages. However, the decrease in malondialdehyde levels could not be the same as the negative control group. It showed that exposure to cigarette smoke that entered the body through the respiratory tract would increase free radicals in the blood.

Cigarette smoke contains various kinds of free radicals with a concentration of more than 10^6 molecules for each inhale. The types of free radicals in cigarettes are reactive oxygen species (ROS) and reactive nitrogen species (RNS).¹⁹ All kinds of extremists, when entering the airway, will increase the immune response in the lung

tissue. The free radicals entering the body will be considered foreign objects by the body to clean through the lung tissue's non-specific immune system, namely alveolar macrophages. Alveolar macrophages will carry out the phagocytosis process to reduce the free radicals that enter the lung tissue. It indicates that the increase in free radicals will directly follow an increasing number of alveolar macrophages in the lung tissue.²⁰

Free radicals are standard products produced by cells through metabolic processes and are neutralized physiologically by enzymatic antioxidants in the body. The most reactive type of radical is the superoxide radical. The radicals can be neutralized by enzymatic antioxidants, i.e., superoxide dismutase (SOD), to be converted into hydrogen peroxidase (H_2O_2), which will then be neutralized again by enzymatic antioxidants, namely glutathione peroxidase (GSH-Px) and catalase (CAT) into water (H_2O) and oxygen (O_2).²¹ Health problems will occur if there is a continuous increase in free radicals so that the antioxidants in the body are unable to neutralize all free radicals. It will result in oxidative stress, which triggers lipid peroxidase causing cell damage and death. The process of lipid peroxidase in cells will produce malondialdehyde. Thus, the decrease

or increase has dramatically influenced by free radicals in the body.²²

Prevention can provide an intake of antioxidants from outside of the body to neutralize excess free radicals.²³ The flavonoid antioxidant found in red mulberry is the type of antioxidant that can protect the body from reactive oxygen species. Flavonoids will react directly with superoxide radicals and other types of extremists. The high reactivity of the hydroxyl group from the flavonoid antioxidants causes the free radicals that have bounded to become more stable and unreactive.¹⁷

This study has shown a decrease in malondialdehyde levels and alveolar macrophages due to the administration of red mulberry. Exposure to cigarette smoke shows an increase in free radicals and the number of alveolar macrophages that can trigger an inflammatory response and cell damage. The flavonoids containing in red mulberry fruit can provide effective prevention against exposure to cigarette smoke. The malondialdehyde level with flavonoid 13 g has the same effectiveness as the negative control group. Meanwhile, the alveolar macrophages show differences in each treatment group.

CONCLUSION

Red mulberry, which contains flavonoid antioxidants, can reduce free radicals from exposure to cigarette smoke that enters the airways by reducing malondialdehyde levels in the blood and the number of alveolar macrophages in lung tissue.

ACKNOWLEDGEMENTS

The authors thank all who helped this research.

REFERENCES

1. Hoffman SJ, Mammone J, Rogers Van Katwyk S, Sritharan L, Tran M, Al-Khateeb S,

- et al. Cigarette Consumption Estimates for 71 Countries from 1970 To 2015: Systematic Collection of Comparable Data to Facilitate Quasi-Experimental Evaluations of National and Global Tobacco Control Interventions. *BMJ*. 2019;365:l2231.
2. Hall W, Doran C. How Much Can the USA Reduce Health Care Costs by Reducing Smoking?. *PLOS Med*. 2016;13(5):e1002021.
3. Suryadinata RV, Wirjatmadi B, Adriani M. Pengaruh Perubahan Hiperplasia Sel Goblet Selama 28 Hari Paparan Asap Rokok dengan Pemberian Antioksidan Superoxide Dismutase. *Indones J Public Heal*. 2016;11(1):60-8.
4. Gana GJ, Idris SH, Sabitu K, Oche MO, Abubakar AA, Nguku PM. Prevalence and Perception of Cigarette Smoking Among Out of School Adolescents in Birnin Kebbi, North-Western Nigeria. *Pan Afr Med J*. 2018;30.
5. Drope J, Liber AC, Cahn Z, Stoklosa M, Kennedy R, Douglas CE, et al. Who's Still Smoking? Disparities in Adult Cigarette Smoking Prevalence in the United States. *CA Cancer J Clin*. 2018;68(2):106-15.
6. Singh A, Ladusingh L. Prevalence and Determinants of Tobacco Use in India: Evidence from Recent Global Adult Tobacco Survey Data. Gorlova OY, editor. *PLoS One*. 2014;9(12):e114073.
7. Algabbani AM, Almubark R, Althumiri N, Alqahtani A, BinDhim N. The Prevalence of Cigarette Smoking in Saudi Arabia in 2018. *Food Drug Regul Sci J*. 2018;1(1):1-13.
8. Rasyid M, Ahsan A. Revenue and Cost Analysis for Unhealthy Commodity (Tobacco Products): Comparative Study among Indonesia and some ASEAN Countries. *Unnes J Public Heal*. 2020;9(1):1-10.
9. KC R, Shukla SD, Gautam SS, Hansbro PM, O'Toole RF. The Role of Environmental

- Exposure to Non-Cigarette Smoke in Lung Disease. *Clin Transl Med*. 2018;7(1):39.
10. Suryadinata RV, Wirjatmadi B. The Role of Selenium Micronutrients as Antioxidants in Exposure to E-Cigarette Smoke. *Asian J Pharm Clin Res*. 2019;12(8):265-8.
 11. Suryadinata RV, Wirjatmadi B, Adriani M, Sumarmi S. The Effects of Exposure Duration to Electronic Cigarette Smoke on Differences in Superoxide Dismutase and Malondialdehyde in Blood of Wistar Rats. *Int J Curr Pharm Res*. 2019;11(3):13-6.
 12. Nimse SB, Pal D. Free Radicals, Natural Antioxidants, and Their Reaction Mechanisms. *RSC Adv*. 2015;5(35):27986-8006.
 13. Suryadinata RV, Wirjatmadi B, Adriani M. Efektivitas Penurunan Malondialdehyde dengan Kombinasi Suplemen Antioksidan Superoxide Dismutase Melon dan Gliadin Akibat Paparan Rokok. *Glob Med Health Commun*. 2017;5(2):79-83.
 14. Marrocco I, Altieri F, Peluso I. Measurement and Clinical Significance of Biomarkers of Oxidative Stress in Humans. *Oxid Med Cell Longev*. 2017;1-32.
 15. Suryadinata RV. Effect of Free Radicals on Inflammatory Process in Chronic Obstructive Pulmonary Disease (COPD). *Amerta Nutr*. 2018;2(4):317-24.
 16. Carvalho JCT, Fernandes CP, Daleprane JB, Alves MS, Stien D, Dhammika Nanayakkara NP. Role of Natural Antioxidants from Functional Foods in Neurodegenerative and Metabolic Disorders. *Oxid Med Cell Longev*. 2018;2018:1–2.
 17. Panche AN, Diwan AD, Chandra SR. Flavonoids: an Overview. *J Nutr Sci*. 2016;5:e47.
 18. Suryadinata RV, Wirjatmadi B. Selenium Linked to Increased Antioxidant Levels and Decreased Free Radicals in Lung Tissue of Wistar Rats Exposed to E-Cigarette Smoke. *Journal of Global Pharma Technology*. 2020;12(9):32-9.
 19. Phaniendra A, Jestadi DB, Periyasamy L. Free Radical: Properties, Source, Target and Their Implication Various Diseases. *Indian J Clin Biochem*. 2015;30(1):11-26.
 20. Tan HY, Wang N, Li S, Hong M, Wang X, Feng Y. The Reactive Oxygen Species in Macrophage Polarization: Reflecting Its Dual Role in Progression and Treatment of Human Diseases. *Oxid Med Cell Longev*. 2016;2016: 2795090.
 21. Domej W, Oetti K, Renner W. Oxidative Stress and Free Radicals in COPD – Implications and Relevance for Treatment. *Int J Chron Obstruct Pulmon Dis*. 2014;9:1207-24.
 22. Liguori I, Russo G, Curcio F, Bulli G, Aran L, Della D, et al. Oxidative Stress, Aging and Disease. *Clin Interv Aging*. 2018;13:757-72.
 23. Birben E, Sahiner UM, Sackesen C, Erzurum S, Kalayci O. Oxidative Stress and Antioxidant Defence. *World Allergy Organ J*. 2012;5(1):9-19.

ISSN. 2086-5198

MEDIA GIZI MIKRO INDONESIA

INDONESIAN JOURNAL OF MICRONUTRIENT

Vol. 12, No. 2, Juni 2021

**BALAI PENELITIAN DAN PENGEMBANGAN KESEHATAN MAGELANG
KEMENTERIAN KESEHATAN REPUBLIK INDONESIA**

Kapling Jayan Borobudur Magelang Jawa Tengah

Telp. 0293 789435, Fax. 0293 788460

MGMI	Vol. 12	No. 2	Hal. 85-164	Magelang Juni 2021	ISSN. 2086-5198
-------------	--------------------	------------------	------------------------	-------------------------------	----------------------------

Terakreditasi (SINTA 2) Nomor : 30/E/KPT/2019

MEDIA GIZI MIKRO INDONESIA**INDONESIAN JOURNAL OF MICRONUTRIENT**

Vol. 12, No. 2, Juni 2021

Terbit dua kali setahun pada bulan Juni dan Desember, dalam satu volume ada dua nomor, berisi tulisan yang diangkat dari hasil penelitian di bidang gizi mikro. Artikel telaah atau review artikel, dimuat atas undangan.

- Editor in Chief** : Mohamad Samsudin, SKM, M.Kes
- Editor** : Dr. dr. Suryati Kumorowulan, M.Biotech (Balai Litbangkes Magelang - Bioteknologi)
 Dr. Donny Kristanto M., SKM, M.Kes. (Balai Litbangkes Magelang - Epidemiologi dan Biostatistik)
 Dr. Gurendro Putro, SKM, M.Kes. (Puslitbang HMK Jakarta - Kebijakan Kesehatan)
 Dr. Leny Latifah, MPH, Psi (Balai Litbangkes Magelang - Psikologi Perkembangan)
 Harry Freitag Luglio Muhammad, S.Gz., M.Sc.RD (FK-KMK UGM Yogyakarta - Gizi)
 Dr. Agus Wijarnaka, S.SiT, M.Kes., Ph.D. (Poltekkes Yogyakarta - Teknologi Pangan)
 Setyaningrum Rahmawaty, M.Kes., Ph.D. (Fakultas Ilmu Kesehatan UMS Solo - Gizi Klinik)
 Diah Yunitawati, S.Psi, MPH (Balai Litbangkes Magelang - Psikologi)
 Marizka Khairunnisa, S.Ant, M.A. (Balai Litbangkes Magelang – Antropologi)
 Cati Martiyana, S.Sos., MPH (Balai Litbangkes Magelang – Promosi Kesehatan)
 Adriyan Pramono, S.Gz., M.Si. (FK UNDIP Semarang-Gizi dan Metabolisme)
- Editor Bahasa** : Jusmianty Garing, S.S., M.A. (Balai Bahasa Sulawesi Selatan)
 Tony Heryadi, M.Hum. (Balai Bahasa Jawa Barat)
- Mitra Bestari** : Prof. Dr. Ir. Y. Marsono, MS (FTP UGM Yogyakarta - Teknologi Pangan)
 Prof. Dr. Ir. Ali Khomsan, MS (FEMA IPB Bogor - Gizi Masyarakat)
 Prof. Dr. Ir. Dodik Briawan, MCN (FEMA IPB Bogor - Gizi Masyarakat)
 Prof. Dra. Yayi Suryo P., M.Si., Ph.D (FK-KMK UGM Yogyakarta - Promosi Kesehatan)
 Prof. dr. Veny Hadju, M.Sc., Ph.D (FKM Universitas Hasanuddin Makassar - Gizi)
 Prof. dr. Nur Indrawaty Lipoeto, M.Sc., Ph.D, Sp.GK (FK Universitas Andalas Padang - Gizi Klinik)
 Prof. Dr. Astuti Lamid, MCN (Persagi - Gizi Mikro)
 Prof. Dr. Sri Sumarmi, SKM, M.Si. (FKM Universitas Airlangga Surabaya - Gizi)
 Prof. Dian Handayani, SKM, M.Kes, Ph.D (FK Universitas Brawijaya Malang - Gizi)
 dr. Yudha Patria, Sp.A(K), Ph.D (RSUP dr. Sardjito Yogyakarta - Endokrinologi Anak)
 Dr. Toto Sudargo, SKM, M.Kes. (FK-KMK UGM Yogyakarta - Gizi Masyarakat)
 Dr. Dra. Retna Siwi Padmawati, M.A. (FK-KMK UGM Yogyakarta - Antropologi)
 Dr. dr. Tjokorda Gde Dalem Pelayun, Sp.PD, KEMD (FK UNDIP Semarang - Endokrinologi)
 Dr. Ir. Basuki Budiman, M.Sc, PH (Persagi - Gizi Mikro)
 Dr. Susetyowati, DCN, M.Kes. (FK-KMK UGM Yogyakarta - Gizi Masyarakat)
 Dr. Siti Helmyati, DCN, M.Kes. (FK-KMK UGM Yogyakarta - Gizi Kesehatan)
 Dr. drg. Titik Respati, M.Sc.PH (FK Unisba Bandung - Epidemiologi dan Biostatistik)
 Dr. Nelis Imanningsih, STP, M.Sc. (Puslitbang BTDK Jakarta - Teknologi Pangan)
 Dr. Ir. Anies Irawati, M.Kes. (Persagi - Gizi Tumbuh Kembang Anak)
 dr. Harli Amir Mahmudji, Sp.PD-KEMD (RSJ Prof. Dr. Soerojo Magelang - Endokrinologi)
 Gemala Anjani, M.Si., Ph.D (FK UNDIP Semarang - Teknologi Pangan)
 Dr. Kun Aristiati Susiloretni, SKM, M.Kes. (Poltekkes Semarang - Gizi)
 Dra. Rachmalina Soerachman, M.Sc.PH (Puslitbang Upaya Kesehatan Masyarakat Jakarta - Antropologi/Perilaku Kesehatan)
 Dra. Ani Margawati, M.Kes., Ph.D (FK UNDIP Semarang - Antropologi Gizi)
- Section Editor** : Cati Martiyana, S.Sos., MPH (Koordinator)
 Diah Yunitawati, S.Psi., MPH
 Marizka Khairunnisa, S.Ant., MA
 Slamet Riyanto, S.Gz.
 Rina Purwandari, S.Si.
 Candra Puspitasari, STP
 Anggita Mirzautika, Apt, M.Farm.
 Nafisah Nur'aini
- Sekretariat** : Edi Susanto, SH (Sekretaris)
 Nur Asiyatul Janah, S.Kep.
 Arifin Habsara Kridarta, S.Kom. (IT)
- Alamat** : Balai Penelitian dan Pengembangan Kesehatan Magelang (Balai Litbangkes Magelang)
 d.a. Kapling Jayan, Borobudur, Magelang, Jawa Tengah, 56553
 Telp. (0293) 789435, Fax. (0293) 788460
- Izin Mengutip** : Bebas dengan menyebutkan sumber
- Jumlah Eksemplar** : -

Media Gizi Mikro Indonesia (MGMI) merupakan jurnal ilmiah yang diterbitkan oleh Balai Penelitian dan Pengembangan Kesehatan Magelang (Balai Litbangkes Magelang) secara berkala dua kali setahun. Tulisan yang dimuat berupa naskah/artikel hasil penelitian dan pengembangan, hasil analisis ilmiah data sekunder, rangkuman tentang topik terkini di bidang gizi mikro meliputi vitamin dan mineral. Artikel diulas dari berbagai disiplin ilmu: kesehatan, kedokteran, lingkungan dan sosial. Redaksi menerima naskah/artikel, baik dari peneliti di Balai Litbangkes Magelang maupun dari luar Balai Litbangkes Magelang. Jurnal ini bisa diakses secara online melalui: <http://ejournal2.litbang.kemkes.go.id/index.php/mgmi>

MEDIA GIZI MIKRO INDONESIA

INDONESIAN JOURNAL OF MICRONUTRIENT

Vol. 12, No. 2, Juni 2021

DAFTAR ISI (CONTENT)

1. **Efikasi Flavonoid pada Mulberi Merah terhadap Penurunan Radikal Bebas dan Alveolar Makrofag Akibat Paparan Asap Rokok pada Tikus Wistar**
The Efficacy of Flavonoid in Red Mulberry on Reducing Free Radicals and Alveolar Macrophages Due to Cigarette Smoke Exposure in Wistar Rats
Rivan Virlando Suryadinata, Dita Sukmaya Prawitasari, Indira Pradita Rochim 85-92
2. **Efektivitas Suplementasi Zat Besi dan Vitamin C untuk Memperbaiki Status Anemia Santri**
Efficacy of Iron and Vitamin C Supplementation for Improving Anemia Status among Boarding School Students
Kartika Pibriyanti, Susi Nurohmi, Dianti Desita Sari 93-106
3. **Pengaruh Asupan Zat Gizi dan Jamu Pelancar Air Susu Ibu (ASI) terhadap Kadar Zat Besi (Fe) Asi Ibu Menyusui**
The Effect of Maternal Nutritional Intake in Breastfeeding and Galactogogum Jamu on Breastmilk Iron (Fe) Level
Enggar Wijayanti, Zuraida Zulkarnain 107-118
4. **Profil Zat Gizi Mikro (Zat Besi, Zink, Vitamin A) dan Kadar Hemoglobin pada Ibu Hamil**
Micronutrient Profile (Iron, Zinc, Vitamin A) and Hemoglobin Level in Pregnant Women
Ade Nugraheni, Mutiara Prihatini, Aya Yuriestia Arifin, Fifi Retiaty, Fitriah Ernawati 119-130
5. **Analisis Klaster: Karakteristik, Kandungan Zat Gizi, dan Senyawa Aktif Extra Virgin Olive Oil di Supermarket**
Cluster Analysis: Characteristic, Nutrient Content, and Active Compound of Extra Virgin Olive Oil in Supermarket
Retno Mardhiati, Sri Anna Marliyati, Drajat Martiano, Siti Madanijah, I Wayan T Wibawan 131-142
6. **Hubungan antara Tingkat Kecukupan Lemak Tidak Jenuh Tunggal, Mineral, dan Status Gizi dengan Kejadian Hipertensi pada Lansia di Posbindu PTM Puskesmas Tajur Kota Tangerang**
Relationship between the Level of Monounsaturated Fat, Mineral, and Nutritional Status with the Incidence of Hypertension in Posbindu PTM Puskesmas Tajur Tangerang City
Kristina Rosalia Pakpahan, Nadiyah, Harna, Mertien Sa'pang, Yulia Wahyuni 143-152
7. **Analisis Sensoris dan Umur Simpan Makanan Selingan Prediabetes Berbasis Tuna (*Thunnus Sp.*) dan Labu Siam (*Sechium Edule*)**
*Sensory Analysis and Shelf-Life of A Diabetic Snack Made from Tuna (*Thunnus sp.*) and Chayote (*Sechium edule*)*
Toto Sudargo, Atika Anif Prameswari, Bianda Aulia, Tira Aristasari, Khusnul Alfionita, Rahadyana Muslichah, Alim Isnansetyo, Indun Dewi Puspita, Siti Ari Budhiyanti, Sheila Rosmala Putri ... 153-164

BALAI PENELITIAN DAN PENGEMBANGAN KESEHATAN MAGELANG
KEMENTERIAN KESEHATAN REPUBLIK INDONESIA

Kapling Jayan Borobudur Magelang Jawa Tengah
Telp. 0293 789435, Fax. 0293 788460

KATA PENGANTAR

Puji syukur kami panjatkan kepada Allah SWT atas limpahan rahmat-Nya, penerbitan jurnal Media Gizi Mikro Indonesia (MGMI) edisi Juni 2021 dapat terselesaikan. Jurnal MGMI TERAKREDITASI LIPI terhitung mulai tanggal 16 April 2013 dengan nomor: 512/Akred/P2MI-LIPI/04/2013 dan akreditasi ulang yang terakhir oleh Kemenristekdikti pada tanggal 12 November 2019 dengan peringkat **SINTA 2**. Harapan kami, hal tersebut dapat memotivasi para penulis untuk berbagi informasi yang bermanfaat bagi perkembangan ilmu khususnya di bidang gizi mikro. Jurnal MGMI khusus menyajikan artikel yang membahas permasalahan gizi mikro meliputi vitamin dan mineral dari berbagai sudut pandang ilmu kesehatan, kedokteran, lingkungan, dan sosial.

Jurnal MGMI telah tersebar luas dan dibaca oleh kalangan akademisi meliputi dosen dan mahasiswa dari Fakultas Kesehatan Masyarakat, Kedokteran, Keperawatan, Gizi, dan Poltekkes, kalangan birokrasi yaitu pelaksana program Dinas Kesehatan Kabupaten/ Kota dan kalangan profesi yaitu para peneliti lembaga penelitian di bidang kesehatan. Redaksi menerima naskah atau artikel ilmiah, baik dari dalam maupun dari luar institusi Balai Litbangkes Magelang yang belum pernah dimuat atau sedang tidak diajukan ke jurnal ilmiah lain.

Jurnal MGMI terbitan volume 12, nomor 2, Juni 2021 menampilkan tujuh artikel. Artikel pertama menganalisis efikasi flavonoid pada mulberi merah; artikel kedua membahas efektivitas suplementasi zat besi dan vitamin C terkait anemia, artikel ketiga membahas asupan makanan ibu menyusui dengan kandungan zat besi dalam ASI; artikel keempat menganalisis zat gizi mikro dan kadar hemoglobin pada ibu hamil. Artikel kelima menganalisis karakteristik serta kandungan vitamin dan senyawa pada *extra virgin olive oil*. Artikel keenam membahas hubungan lemak tidak jenuh tunggal, mineral, dan status gizi dengan kejadian hipertensi lansia; dan artikel terakhir menganalisis formulasi rasa dan umur simpan makanan selingan prediabetes.

Semoga jurnal MGMI dapat memberikan manfaat bagi para pembaca. Kami menerima kritik dan saran dalam rangka perbaikan dan peningkatan kualitas jurnal MGMI.

Redaksi Pelaksana

MGMI Juni 2021

by Rivan Virlando Suryadinata

Submission date: 01-Aug-2021 04:37PM (UTC+0700)

Submission ID: 1546044554

File name: MGMI_Rivan.pdf (538.33K)

Word count: 3625

Character count: 19214

EFIKASI FLAVONOID PADA MULBERI MERAH TERHADAP PENURUNAN RADIKAL BEBAS DAN ALVEOLAR MAKROFAG AKIBAT PAPARAN ASAP ROKOK PADA TIKUS WISTAR

The Efficacy of Flavonoid in Red Mulberry on Reducing Free Radicals and Alveolar Macrophages Due to Cigarette Smoke Exposure in Wistar Rats

Rivan Virlando Suryadinata^{1*}, Dita Sukmaya Prawitasari¹, Indira Pradita Rochim¹

¹Faculty of Medicine, Universitas Surabaya, Surabaya

Jalan Raya Rungkut, Kali Rungkut, Surabaya, Jawa Timur, Indonesia

*e-mail: rivan.virlando.s@staff.ubaya.ac.id

Submitted: November 20th, 2020, revised: March 6th, 2021, approved: June 8th, 2021

ABSTRACT

Background. Free radicals in cigarette smoke will hurt health when they enter to the respiratory tract. An excessive increase of free radicals in the body will cause oxidative stress. Free radicals are generated physiologically by the body's metabolism and can neutralize antioxidants in the body. An imbalance number of free radicals will result in cell damage and death. It has characterized by an increase in malondialdehyde levels in the blood and alveolar macrophages in the lung tissue. Giving red mulberry (*Morus rubra*) as an intake of antioxidants from outside the body can prevent adverse effects of cigarette smoke. **Objective.** This study analyses flavonoids' impact on red mulberry in reducing free radicals due to exposure to cigarette smoke by lowering levels of malondialdehyde and alveolar macrophages. **Method.** This research is experimental with a post-test control group design using male Wistar rats (*Rattus norvegicus*) as experimental animals. Treatment of experimental animals through red mulberry per oral and exposure to cigarette smoke had conducted for 30 days. The parameters used were levels of malondialdehyde and alveolar macrophages in the lung tissue. **Results.** The research showed an increase in free radicals in the group exposed to cigarette smoke. Increasing intake of red mulberry can further reduce malondialdehyde levels and the number of alveolar macrophages ($p < 0.05$). **Conclusions.** The antioxidants in red mulberry can reduce malondialdehyde levels in the blood and the number of alveolar macrophages in lung tissue due to exposure to cigarette smoke.

Keywords: alveolar macrophage, cigarette, flavonoids, malondialdehyde, red mulberry

ABSTRAK

Latar Belakang. Radikal bebas yang banyak terkandung dalam asap rokok akan memberikan dampak negatif bagi kesehatan apabila masuk ke dalam saluran napas. Peningkatan radikal bebas dalam tubuh yang berlebihan akan menyebabkan terjadinya stres oksidatif. Secara fisiologis, radikal bebas dihasilkan dari metabolisme tubuh dan dapat dinetralkan oleh antioksidan dalam tubuh. Ketidakseimbangan jumlah radikal bebas akan mengakibatkan kerusakan dan kematian sel yang ditandai dengan peningkatan kadar malondialdehid dalam darah dan alveolar makrofag di jaringan paru. Pemberian flavonoid pada buah mulberi merah (*Morus rubra*) sebagai asupan antioksidan dari luar tubuh dapat mencegah dampak negatif dari paparan asap rokok. **Tujuan.** Penelitian ini bertujuan untuk menganalisis efek flavonoid pada mulberi merah dalam menurunkan radikal bebas akibat paparan asap rokok melalui penurunan kadar malondialdehid dan alveolar makrofag. **Metode.** Penelitian ini adalah eksperimental dengan post-test control group design menggunakan tikus wistar jantan (*Rattus norvegicus*) sebagai hewan coba. Perlakuan pada hewan coba melalui pemberian mulberi merah dan paparan asap rokok dilakukan selama 30 hari. Parameter yang digunakan adalah kadar malondialdehid dan alveolar makrofag di jaringan paru. **Hasil.** Penelitian ini memperlihatkan adanya peningkatan radikal bebas pada kelompok yang

diberikan paparan asap rokok. Peningkatan pemberian asupan mulberi merah dapat menurunkan kadar malondialdehid dan jumlah alveolar makrofag ($p < 0,05$). **Kesimpulan.** Antioksidan yang terkandung pada mulberi merah dapat menurunkan kadar malondialdehid dalam darah dan jumlah alveolar makrofag di jaringan paru akibat paparan asap rokok.

Kata kunci: alveolar makrofag, rokok, flavonoid, malondialdehid, mulberi merah

INTRODUCTION

Cigarettes have become a significant problem around the world. It has estimated that cigarettes account for six million deaths due to smoking each year. Although there has been a decrease in smokers' prevalence globally, the number of people who smoke has increased.¹ Therefore, many countries continue to reduce the number of smokers even though they have not achieved satisfactory results. The increase in the number of active smokers will not only increase the number of diseases caused by smoking, but it will directly improve the health costs.^{2,3} The increasing number of active smokers is more common in developing countries than in developed countries.⁴ The adult age group in developed countries such as the US has shown a decline in numbers.⁵ The opposite happens in developing countries where the number of active smokers is increasing, such as India, Saudi Arabia, and Indonesia.^{6,7,8}

Cigarette smoke that enters the respiratory tract continuously will cause an increase in airways diseases such as Chronic Obstructive Pulmonary Disease (COPD), asthma, chronic bronchitis, lung infections, and lung cancer.⁹ Various harmful substances in cigarette smoke will trigger free radicals, which disrupt the body's physiological processes. Free radicals can come from both inside and outside the body. Normally, free radicals are usually formed by metabolic waste¹³ and neutralized by enzymatic antioxidants, such as superoxide dismutase (SOD), glutathione peroxidase (GSH-Px), and catalase (CAT).¹⁰ The increase in free radicals from the body due to exposure to cigarette

smoke entering the respiratory tract will result in an excessive number of free radicals.¹¹

It will cause an imbalance between the number of free radicals and antioxidants in the body, resulting in oxidative stress and triggering lipid peroxidation reactions. This reaction will result in cell damage and death.¹² Prevention can do by taking antioxidants from outside the body to help neutralize free radicals. Antioxidants given orally are not enzymatic antioxidants because enzymatic antioxidants result from metabolism. Thus, they cannot obtain from the outside.¹³ It can identify the increase in cell damage caused by free radicals increasing malondialdehyde levels in the blood. The malondialdehyde parameter is one of the end products of lipid peroxidation. It not includes as free radicals.¹⁴ In addition, an increase in free radicals can also cause cell death and lung tissue damage. It will stimulate macrophages' alveolar movement as one of the primary defences in body tissues to carry out the phagocytosis process.¹⁵

Various antioxidants that can be consuming as non-enzymatic antioxidants are flavonoids, vitamin C, vitamin E, and carotenoids.¹⁶ Flavonoid-type antioxidants often reduce free radicals because they have a broad spectrum of health-enhancing effects as antioxidants, anti-inflammatory, and anti-carcinogenic.¹⁷ Red mulberry fruit (*Morus rubra*) is high in flavonoids and often consumed by people. This study aims to determine the effect of giving red mulberry in reducing free radicals due to the exposure to cigarette smoke through levels of malondialdehyde and alveolar macrophages as parameters.

METHODS

This study is an experimental study (Randomized Controlled Trial) with a post-test control group design. Male Wistar rats (*Rattus norvegicus*) used as research samples for 30 days. This study divides the experimental animal group into a negative control group, a positive control group, and three treatment groups. Each treatment group contains six experimental animals (Federer's Formula).¹⁸ This research has been approved by Komite Etik Penelitian Kesehatan Universitas Surabaya (No: 136/KE/VI/2020).

The male Wistar rat (*Rattus norvegicus*) weighs ± 200 g in normal conditions has never been the object of research. Meanwhile, the exclusion criteria were the experimental animals who were sick or died during the study. The maintenance and care of experimental animals during the study was regarding on the 3R principle (replacement, reduction, and refinement).¹⁸

Red mulberry fruit (*Morus rubra*) obtained from Mojokerto will be sorted and cleaned to get the fruit in good condition. Next, the juice-making process conducted using a blender and a filter to separate the pulp's juice. Red mulberry intake to experimental animals to adjust the flavonoid dose in red mulberry to the daily nutritional adequacy rate. The flavonoids of the red mulberry obtained will be measured (± 38 mg/g). Then, the flavonoids will convert from adults' daily needs (± 190 mg/kg) to the daily intake dose of Wistar rats 200 g (± 240 mg/tail) by using table Laurence and Bacharach. The red mulberry was given to experimental animals by oral sonde. The amount of red mulberry to be given to the treatment group was 3.25 g, 6.5 g, and 13 g.

Experimental animals were exposed to cigarette smoke using a smoking chamber (CO levels ± 50 PPM). The measurement of malondialdehyde levels ($\mu\text{g/ml}$) had carried out using spectrometry, while the alveolar macrophage measurement had conducted by

making histology. The lung tissue obtained will be processed histo-technique and carried out with hematoxylin-eosin (HE) staining. All tissue specimens had fixed with 10 percent formalin solution and a histological incision. Hematoxyline and eosin (HE) staining performed after transverse incisions of six microns had made with a rotary microtome.³ The mean number of alveolar macrophages calculated as many as five fields of view on each preparation.

This research was conducted for 30 days by dividing the rats into five groups. The first group was the negative control group, where the experimental animal did not receive any treatment; they only received daily intake (30 g/day). The second group was the positive control group, where the experimental animals' received daily information and exposure to tobacco smoke of 2 rods per day. In contrast, the three treatment groups were the groups that received exposure to tobacco smoke of 2 rods per day, daily intake, and different amounts of mulberry fruit (3.25 g, 6.5 g, and 13 g).

The research results obtained ratio data in the form of malondialdehyde and alveolar macrophage levels in each group.¹ Data analysis was performed using the ANOVA test and continued with the least significance difference (LSD) test using SPSS version 22 to see any differences between groups.

RESULTS

The observations results of the mean of malondialdehyde levels⁶ in each experimental animal group are the negative control group (I); positive control group (II); treatment groups (III, IV, V) with exposure to cigarette smoke and with an oral dose of *Morus rubra* fruit 3 g, 6 g, and 12 g. Based on table 1, the mean of each treatment group, i.e., group I of 1.99 ± 0.40 , group II of 3.13 ± 0.61 , group III of 2.40 ± 0.44 , group IV of 2.28 ± 0.31 and group V of 2.15 ± 0.27 .

Table 1. The Mean Value of Malondialdehyde Levels Post Treatment ($\mu\text{g/ml}$)

	Groups	Mean \pm SD
I	Negative control group, only food intake	1.99 \pm 0.49
II	Positive control group, food intake and exposure to cigarette smoke	3.13 \pm 0.61
III	The treatment group was exposed to cigarette smoke and intake of red mulberry (3 g)	2.40 \pm 0.44
IV	The treatment group was exposed to cigarette smoke and intake of red mulberry (6 g)	2.28 \pm 0.31
V	The treatment group was exposed to cigarette smoke and intake of red mulberry (12 g)	2.15 \pm 0.27

The observations results of the mean number of alveolar macrophages (Figure 1) each experimental animal group are the negative control group (I); positive control

group (II); treatment groups (III, IV, V) with exposure to cigarette smoke and with an oral dose of *Morus rubra* fruit 3 g, 6 g, and 12 g.

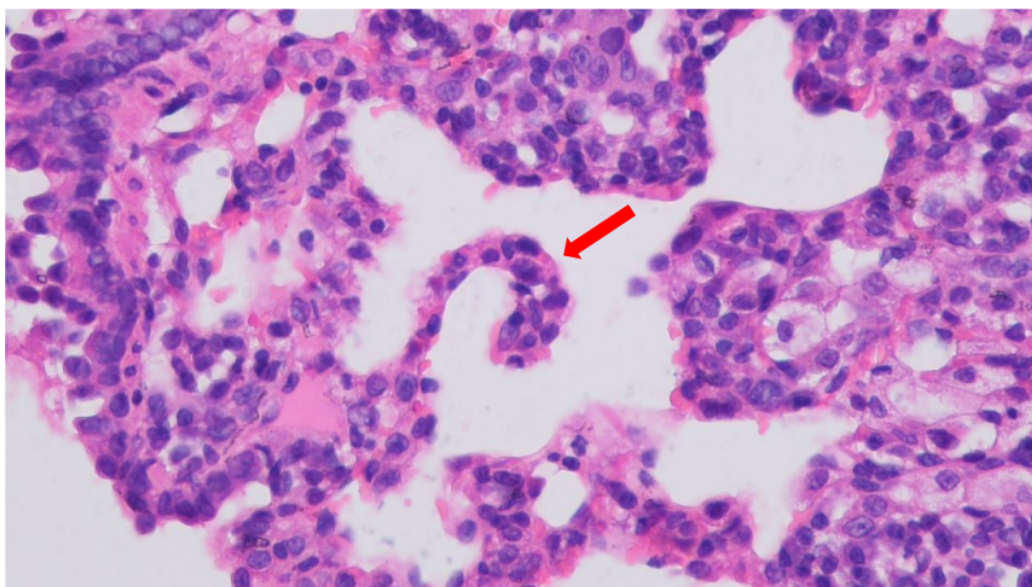


Figure 1. The Histology of Alveolar Macrophages in the Positive Control Group (Red Arrow)

Table 2 shows that the mean of each treatment group, i.e., group I is 5.36 \pm 0.52, group

II is 32.08 \pm 2.09, group III is 22.52 \pm 1.50, group IV is 17.58 \pm 1.10 and group V is 10.88 \pm 1.43.

Table 2. The Mean Number of Alveolar Macrophages Post Treatment

	Groups	Mean±SD
I	Negative control group, only food intake	5.36±0.52
II	Positive control group, food intake and exposure to cigarette smoke	32.08±2.09
III	The treatment group was exposed to cigarette smoke and intake of red mulberry (3 g)	22.52±1.50
IV	The treatment group was exposed to cigarette smoke and intake of red mulberry (6 g)	17.58±1.10
V	The treatment group was exposed to cigarette smoke and intake of red mulberry (12 g)	10.88±1.43

Table 3 shows the normality and homogeneity test results of malondialdehyde levels. It offers a p -value more significant than 0.05. So, the data obtained has normality ($p>0.05$) and is homogeneous ($p=0.717$). ANOVA test will conduct to determine the differences between groups, and the p -value has obtained 0.006.

Table 3. ANOVA Test Results on Research Variable

Groups	Malondialdehyde Levels	Alveolar Macrophages
I		
II		
III	0.006	0.000
IV		
V		

Based on table 3, the results of the normality and homogeneity test for alveolar macrophage show a p -value more significant than 0.05, so that the data obtained has normality ($p>0.05$) and is homogeneous ($p=0.085$). ANOVA test has determined the differences between groups, and the p -value has obtained 0.000 ($p<0.05$).

Table 4. Least Significance Difference Test Results on Malondialdehyde Levels

Groups	I	II	III	IV	V
I	-	-	-	-	-
II	0.001	-	-	-	-
III	0.163	0.016	-	-	-
IV	0.316	0.006	0.679	-	-
V	0.574	0.002	0.390	0.652	-

The least significance difference (LSD) test used to compare between malondialdehyde groups (table 4). Group 2 showed a significant difference with each group ($p < 0.05$). It showed

that the group exposed to cigarette smoke could increase free radicals. Meanwhile, the other groups did not show any differences between each group ($p > 0.05$).

Table 5. Least Significance Difference Test Results on Alveolar Macrophages

Groups	I	II	III	IV	V
I	-	-	-	-	-
II	0.000	-	-	-	-
III	0.000	0.000	-	-	-
IV	0.000	0.000	0.000	-	-
V	0.000	0.000	0.000	0.000	-

The least significance difference (LSD) test compared alveolar macrophage groups (table 5). Each group showed significant differences between the other groups ($p < 0.05$).

DISCUSSION

Malondialdehyde levels and the number of alveolar macrophages in the lung tissue showed an increase in the positive control group compared to the negative control group. The malondialdehyde levels decreased gradually in the treatment group given red mulberry compared to the positive control group. The higher the amount of red mulberry, the lower the malondialdehyde levels and the number of alveolar macrophages. However, the decrease in malondialdehyde levels could not be the same as the negative control group. It showed that exposure to cigarette smoke that entered the body through the respiratory tract would increase free radicals in the blood.

Cigarette smoke contains various kinds of free radicals with a concentration of more than 10^6 molecules for each inhale. The types of free radicals in cigarettes are reactive oxygen species (ROS) and reactive nitrogen species (RNS).¹⁹ All kinds of extremists, when entering the airway, will increase the immune response in the lung

tissue. The free radicals entering the body will be considered foreign objects by the body to clean through the lung tissue's non-specific immune system, namely alveolar macrophages. Alveolar macrophages will carry out the phagocytosis process to reduce the free radicals that enter the lung tissue. It indicates that the increase in free radicals will directly follow an increasing number of alveolar macrophages in the lung tissue.²⁰

Free radicals are standard products produced by cells through metabolic processes and are neutralized physiologically by enzymatic antioxidants in the body. The most reactive type of radical is the superoxide radical. The radicals can be neutralized by enzymatic antioxidants, i.e., superoxide dismutase (SOD), to be converted into hydrogen peroxidase (H_2O_2), which will then be neutralized again by enzymatic antioxidants, namely glutathione peroxidase (GSH-Px) and catalase (CAT) into water (H_2O) and oxygen (O_2).²¹ Health problems will occur if there is a continuous increase in free radicals so that the antioxidants in the body are unable to neutralize all free radicals. It will result in oxidative stress, which triggers lipid peroxidase causing cell damage and death. The process of lipid peroxidase in cells will produce malondialdehyde. Thus, the decrease

or increase has dramatically influenced by free radicals in the body.²²

Prevention can provide an intake of antioxidants from outside of the body to neutralize excess free radicals.²³ The flavonoid antioxidant found in red mulberry is the type of antioxidant that can protect the body from reactive oxygen species. Flavonoids will react directly with superoxide radicals and other types of extremists. The high reactivity of the hydroxyl group from the flavonoid antioxidants causes the free radicals that have bounded to become more stable and unreactive.¹⁷

This study has shown a decrease in malondialdehyde levels and alveolar macrophages due to the administration of red mulberry. Exposure to cigarette smoke shows an increase in free radicals and the number of alveolar macrophages that can trigger an inflammatory response and cell damage. The flavonoids containing in red mulberry fruit can provide effective prevention against exposure to cigarette smoke. The malondialdehyde level with flavonoid 13 g has the same effectiveness as the negative control group. Meanwhile, the alveolar macrophages show differences in each treatment group.

CONCLUSION

Red mulberry, which contains flavonoid antioxidants, can reduce free radicals from exposure to cigarette smoke that enters the airways by reducing malondialdehyde levels in the blood and the number of alveolar macrophages in lung tissue.

ACKNOWLEDGEMENTS

The authors thank all who helped this research.

REFERENCES

1. Hoffman SJ, Mammone J, Rogers Van Katwyk S, Sritharan L, Tran M, Al-Khateeb S,

4. et al. Cigarette Consumption Estimates for 71 Countries from 1970 To 2015: Systematic Collection of Comparable Data to Facilitate Quasi-Experimental Evaluations of National and Global Tobacco Control Interventions. *BMJ*. 2019;365:l2231.
2. Hall W, Doran C. How Much Can the USA Reduce Health Care Costs by Reducing Smoking?. *PLOS Med*. 2016;13(5):e1002021.
3. Suryadinata RV, Wirjatmadi B, Adriani M. Pengaruh Perubahan Hiperplasia Sel Goblet Selama 28 Hari Paparan Asap Rokok dengan Pemberian Antioksidan Superoxide Dismutase. *Indones J Public Heal*. 2016;11(1):60-8.
4. Gana GJ, Idris SH, Sabitu K, Oche MO, Abubakar AA, Nguku PM. Prevalence and Perception of Cigarette Smoking Among Out of School Adolescents in Birnin Kebbi, North-Western Nigeria. *Pan Afr Med J*. 2018;30.
5. Drope J, Liber AC, Cahn Z, Stoklosa M, Kennedy R, Douglas CE, et al. Who's Still Smoking? Disparities in Adult Cigarette Smoking Prevalence in the United States. *CA Cancer J Clin*. 2018;68(2):106-15.
6. Singh A, Ladusingh L. Prevalence and Determinants of Tobacco Use in India: Evidence from Recent Global Adult Tobacco Survey Data. Gorlova OY, editor. *PLoS One*. 2014;9(12):e114073.
7. Algabbani AM, Almubark R, Althumiri N, Alqahtani A, BinDhim N. The Prevalence of Cigarette Smoking in Saudi Arabia in 2018. *Food Drug Regul Sci J*. 2018;1(1):1-13.
8. Rasyid M, Ahsan A. Revenue and Cost Analysis for Unhealthy Commodity (Tobacco Products): Comparative Study among Indonesia and some ASEAN Countries. *Unnes J Public Heal*. 2020;9(1):1-10.
9. KC R, Shukla SD, Gautam SS, Hansbro PM, O'Toole RF. The Role of Environmental

- Exposure to Non-Cigarette Smoke in Lung Disease. *Clin Transl Med*. 2018;7(1):39.
10. Suryadinata RV, Wirjatmadi B. The Role of Selenium Micronutrients as Antioxidants in Exposure to E-Cigarette Smoke. *Asian J Pharm Clin Res*. 2019;12(8):265-8.
 11. Suryadinata RV, Wirjatmadi B, Adriani M, Sumarmi S. The Effects of Exposure Duration to Electronic Cigarette Smoke on Differences in Superoxide Dismutase and Malondialdehyde in Blood of Wistar Rats. *Int J Curr Pharm Res*. 2019;11(3):13-6.
 12. Nimse SB, Pal D. Free Radicals, Natural Antioxidants, and Their Reaction Mechanisms. *RSC Adv*. 2015;5(35):27986-8006.
 13. Suryadinata RV, Wirjatmadi B, Adriani M. Efektivitas Penurunan Malondialdehyde dengan Kombinasi Suplemen Antioksidan Superoxide Dismutase Melon dan Gliadin Akibat Paparan Rokok. *Glob Med Health Commun*. 2017;5(2):79-83.
 14. Marrocco I, Altieri F, Peluso I. Measurement and Clinical Significance of Biomarkers of Oxidative Stress in Humans. *Oxid Med Cell Longev*. 2017;1-32.
 15. Suryadinata RV. Effect of Free Radicals on Inflammatory Process in Chronic Obstructive Pulmonary Disease (COPD). *Amerta Nutr*. 2018;2(4):317-24.
 16. Carvalho JCT, Fernandes CP, Daleprane JB, Alves MS, Stien D, Dhammika Nanayakkara NP. Role of Natural Antioxidants from Functional Foods in Neurodegenerative and Metabolic Disorders. *Oxid Med Cell Longev*. 2018;2018:1-2.
 17. Panche AN, Diwan AD, Chandra SR. Flavonoids: an Overview. *J Nutr Sci*. 2016;5:e47.
 18. Suryadinata RV, Wirjatmadi B. Selenium Linked to Increased Antioxidant Levels and Decreased Free Radicals in Lung Tissue of Wistar Rats Exposed to E-Cigarette Smoke. *Journal of Global Pharma Technology*. 2020;12(9):32-9.
 19. Phaniendra A, Jestadi DB, Periyasamy L. Free Radical: Properties, Source, Target and Their Implication Various Diseases. *Indian J Clin Biochem*. 2015;30(1):11-26.
 20. Tan HY, Wang N, Li S, Hong M, Wang X, Feng Y. The Reactive Oxygen Species in Macrophage Polarization: Reflecting Its Dual Role in Progression and Treatment of Human Diseases. *Oxid Med Cell Longev*. 2016;2016: 2795090.
 21. Domej W, Oetti K, Renner W. Oxidative Stress and Free Radicals in COPD – Implications and Relevance for Treatment. *Int J Chron Obstruct Pulmon Dis*. 2014;9:1207-24.
 22. Liguori I, Russo G, Curcio F, Bulli G, Aran L, Della D, et al. Oxidative Stress, Aging and Disease. *Clin Interv Aging*. 2018;13:757-72.
 23. Birben E, Sahiner UM, Sackesen C, Erzurum S, Kalayci O. Oxidative Stress and Antioxidant Defence. *World Allergy Organ J*. 2012;5(1):9-19.

MGMI Juni 2021

ORIGINALITY REPORT

13%

SIMILARITY INDEX

11%

INTERNET SOURCES

7%

PUBLICATIONS

4%

STUDENT PAPERS

PRIMARY SOURCES

1	isainsmedis.id Internet Source	1%
2	bmcmmededuc.biomedcentral.com Internet Source	1%
3	Samuel H. T. Chen, Ying-Hsiung Lee, Fu-Chan Wei, Jehn-Yih Huang, Hung-Chi Chen. "In Vivo Evaluation of Leucocyte Dynamics in Cremaster Muscle in Rats After Exposure to Cigarette Smoke", Scandinavian Journal of Plastic and Reconstructive Surgery and Hand Surgery, 2009 Publication	1%
4	www.bmj.com Internet Source	1%
5	e-journal.unair.ac.id Internet Source	1%
6	www.hindawi.com Internet Source	1%
7	innovareacademics.in Internet Source	1%

8	worldwidescience.org Internet Source	1 %
9	connects.catalyst.harvard.edu Internet Source	1 %
10	garuda.ristekbrin.go.id Internet Source	1 %
11	"Role of Oxidative Stress in Pathophysiology of Diseases", Springer Science and Business Media LLC, 2020 Publication	<1 %
12	pt.slideshare.net Internet Source	<1 %
13	www.jpma.org.pk Internet Source	<1 %
14	patents.google.com Internet Source	<1 %
15	avidityfitness.net Internet Source	<1 %
16	biomedpharmajournal.org Internet Source	<1 %
17	Etha Rambung. "ELECTRIC CIGARETTES'S EFFECT TO THE MDA LEVELS IN BLOOD OF WISTAR RAT", Human Care Journal, 2020 Publication	<1 %

pubs.rsc.org

18 Internet Source <1 %

19 www.researchsquare.com Internet Source <1 %

20 Zhiyu Fang, Yutao Chen, Ge Wang, Tao Feng, Meng Shen, Bin Xiao, Jingyi Gu, Weimin Wang, Jia Li, Yongjun Zhang. " Evaluation of the antioxidant effects of acid hydrolysates from polysaccharides using a model ", Food & Function, 2019
Publication <1 %

21 iai.id Internet Source <1 %

22 repository.ubaya.ac.id Internet Source <1 %

Exclude quotes On

Exclude matches < 5 words

Exclude bibliography On

MGMI Juni 2021

GRADEMARK REPORT

FINAL GRADE

/10

GENERAL COMMENTS

Instructor

PAGE 1

PAGE 2

PAGE 3

PAGE 4

PAGE 5

PAGE 6

PAGE 7

PAGE 8

DAFTAR INDEKS MEDIA GIZI MIKRO INDONESIA
Vol. 12, No.1, Desember 2020-Vol. 12, No.2, Juni 2021

Indeks Pengarang:

Alfionita K 12(1):1, 12(2):153
Anggriawan F 12(1):75
Arifin AY 12(2):119
Aristasari T 12(1):1, 12(2):153
Aulia B 12(1):1, 12(2):153, 163
Budhiyanti SA 12(2):153
Budiyanti SA 1, 163
Ernawati F 12(1):25, 38, 84, 12(2):116, 119, 127
Fahmida U 12(1):53
Fuada N 12(1):63
Gifari N 12(1):39
Harna 12(2):143
Hidayat T 12(1):27
Isnansetyo A 12(1):1, 12(2):153, 163
Juwantoro D 12(1):15
Kusumawardani HD 12(1):15, 25
Madaniyah S 12(1):24, 12(2):104, 131
Mardhiati R 12(2):131
Marliyati SA 12(2):131
Martiano D 12(2):131
Muslichah R 12(2):153
Musoddaq MA 12(1):27
Nadiyah 12(1):39, 12(2):143
Nugraheni A 12(2):119
Nurohmi S 12(2):93
Nuzrina R 12(1):39
Pakpahan KR 12(2):143
Pibriyanti K 12(2):93
Prameswari AA 12(1):1, 12(2):153, 163
Prawitasari DS 12(2):85
Prihatini M 12(2):119
Puspita ID 12(1):1, 12(2):153, 163
Putri SR 12(1):1, 12(2):153
Retiaty F 12(2):119
Rochim IP 12(2):85
Sa'pang M 12(2):143
Salimar 12(1):63, 12(2):128
Samsudin M 12(1):15, 25, 36
Sanjiwani PA 12(1):53
Sari DD 12(2):93
Sari M 12(1):39
Setyawati B 12(1):63
Shinta D 12(1):53

Sitoayu L 12(1):39, 12(2):150
Sudargo T 12(1):47, 48, 51, 12(2):153, 163
Sukandar PB 12(1):27
Suryadinata RV 12(2):85, 91, 92
Susanti N 12(1):75, 12(2):105, 151
Susbiantonny A 12(1):27
Wahyuni Y 12(2):143
Wibawan IWT 12(2):131
Wijayanti E 12(2):107
Zulkarnain Z 12(2):107

Indeks Subjek:

Adiposa 12(2):101
AIN-93M 12(1):15, 17, 18, 19, 23
AKG 12(1):42, 47, 60
Alcohol swab 12(2):96
Aldosteron 12(2):149
Alveolar makrofag 12(2):85, 86
Ammonium persulfate digestion 12(1):27, 29
Anemia 12(1):40, 41, 49, 63, 64, 65, 66, 68, 69, 70, 71, 72, 73, 75, 76, 77, 78, 81, 83
Antioksidan 12(1):24, 12(2):85, 133, 139
Antropometri 12(1):42, 46, 55, 57, 12(2):96, 101, 145
Asam amino 12(1):8, 40, 44, 47, 71, 12(2):102
Asam askorbat 12(2):95, 102
Asam folat 12(2):95, 96, 100, 102, 103, 121, 125
Asam lemak 12(2):132, 133, 134, 135, 138, 139, 146, 148, 155, 161, 162
Asam ribonukleat 12(1):55
ASI eksklusif 12(2):108, 165
ASI matang 12(2):108, 165
ASI matur 12(2):113, 165
ASI transisi 12(2):108, 113, 165
Aterosklerosis 12(1):16
Atrium 12(2):149
Bioaktif 12(2):108, 133
Blood lancet 12(2):96
Chiari malformation 12(1):55
Copper 12(1):12, 117, 12(2):165
Dekantansi 12(2):132
Demielinasi 12(2):103
Deoxyribonucleic acid 12(1):55
Diabetes mellitus 12(1):1, 16
Diastolik 12(2):96, 97, 98, 99, 101, 144, 146, 148

Diet 12(2):95, 102, 103, 107, 114, 115, 145, 153
 Dislipidemia 12(1):3,18,16 12(2):104, 166
 Docosahexaenoic acid (DHA) 12(1):2, 12(2):155
 Eicosapentaenoic acid (EPA) 12(1):2, 12(2):155
 Ekstraseluler 12(2):149
 Elektron 12(2):102, 120
 ELISA 12(1):18, 27, 29, 12(2):121, 166
 Energy expenditure 12(1):23
 Ensefalopati 12(1):65
 Enzim 12(1):2, 23, 55, 12(2):102, 110, 120
 Epilepsi 12(2):109
 Eritrosit 12(1):64, 12(2):102
 Escherichia coli 12(1):2, 7, 11, 64, 71, 73, 74
 Extra virgin olive oil EVOO 12(2):131, 132, 133, 134, 135, 136, 137, 138, 139, 140, 166
 Fe 12(2):93, 94, 95, 96, 97, 98, 99, 100, 101, 102, 103, 105, 107, 108, 109, 110, 111, 112, 113, 114, 115, 116, 121, 131, 133, 139, 155, 166
 Fe²⁺ 12(2):102, 166
 Fe³⁺ 12(2):102, 166
 Ferritin 12(2):95, 102
 Fetal alcohol spectrum disorders FASD 12(1):65, 71
 Fitat 12(2):102, 149
 Flavin-iron enzyme 12(2):102
 Flavonoid 12(2):85, 86, 87, 91, 131, 132, 133, 134, 136, 137, 139, 140, 155
 Food recall 12(1):39, 40, 41, 54
 Fortifikasi 12(1):28, 33, 34
 Fosfor 12(1):2, 12(2):149
 GAKI 12(1):28, 29, 33, 51
 Gondok 12(1):36, 37
 Hb 12(1):64, 65, 84, 12(2):93, 94, 95, 96, 97, 98, 99, 108, 109, 110, 111, 112, 113, 114, 115, 119, 121, 124, 125, 129, 166
 HDL 12(1):8, 23, 12(2):138, 166
 Hematology Analyzer 12(1):65, 12(2):109, 166
 Hepcidin 12(1):65, 70
 High performance liquid chromatography HPLC 12(2):121, 134, 166
 Hiperkalsemia 12(2):148
 Hiperkolesterolemia 12(1):15, 16, 17, 18, 21, 22, 24
 Hipertensi 12(1):16
 Hipertirotropinemia 12(1):23
 Hipokalemia 12(2):149
 Hipotensi 12(2):96, 97
 Hipotiroid 12(1):16, 17, 23
 Homeostatis 12(2):115
 Hormon paratiroid 12(2):149
 Hormon tiroid 12(1):15, 16, 17, 23, 12(2):144
 HPT 12(1):16, 23
 Imunomodulator 12(2):131, 133
 Indeks Massa Tubuh 12(1):42, 50, 51, 12(2):97, 109, 151, 152, 166
 Inflamasi 12(2):126
 Inhibitor 12(2):145
 Intraseluler 12(2):149
 Iodium 12(1):3, 5, 6, 9, 10, 23, 24, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36
 In vivo 12(1):17
 Kalium 12(1):2, 30, 12(2):144, 145, 146, 147, 148, 149, 150
 Kalsium 12(1):2, 12(2):96, 100, 144, 145, 146, 147, 148, 149, 150
 Kardiovaskular 12(2):144
 Karotenoid 12(2):132, 133, 134, 136, 137, 139, 140
 KIO₃ 12(1):30, 31, 34
 Kofaktor 12(1):23, 12(2):95
 Kolagen 12(2):95
 Kolesterol 12(1):7, 8, 15, 16, 17, 18, 19, 21, 22, 23, 24, 12(2):138, 144
 Kolostrum 12(2):108, 113
 Konstipasi 12(1):82
 Kreatinin 12(2):110
 Kurang energi kronis 12(2):101
 Laktasi 12(2):113, 114
 Laktoferin 12(2):114, 115
 Lansia 12(1):24, 25, 12(2):143, 144, 145, 146, 147, 149, 150
 Lemak abdominal 12(2):101
 Lipid 12(1):12, 24, 25, 26, 12(2):140, 163, 164, 166
 Lipolisis 12(1):23
 Lisosom 12(2):95
 Low density lipoprotein 12(1):16, 12(2):144
 Magnesium 12(2):143, 144, 145, 146, 147, 148, 149, 150
 Makronutrien 12(1):4, 12(2):107, 108, 132, 144
 Malondialdehyde 12(2):85, 86, 87, 89, 90, 91, 154, 157, 162
 Menopause 12(2):144, 145
 Metabolisme 12(1):2, 15, 16, 17, 23, 41, 12(2):85, 95, 102, 120, 138, 155
 Microangiopathic Hemolytic Anemia (MAHA) 12(1):64
 Microtoise 12(1):39, 40, 42, 55, 12(2):146

Mielin 12(1):54, 12(2):103
 Mikronutrien 12(2):107, 108, 132, 144
 Mineral 12(1):4, 8, 9, 23, 53, 60, 12(2):100, 102, 103, 108, 120, 121, 133, 137, 143, 144, 145, 146, 147, 150
 Mioglobin 12(2):102, 120
 Monitoring 12(2):129, 166
 Monounsaturated Fatty Acid (MUFA) 12(2):138
 Multipara 12(1):71
 Natrium 12(1):2, 12(2):144, 149, 156
 Neuropsikologi 12(1):60
 Nonanemia 12(2):96, 99, 103
 Nonheme 12(1):71, 12(2):95, 102, 115
 Nulipara 12(1):79
 Nutrisurvey 12(1):42, 55
 Obesitas 12(1):16, 22, 23, 12(2):96, 100, 101, 109, 111, 149
 Obesitas Sentral 12(2):101
 Oksalat 12(2):149
 Oksigenisasi 12(2):144
 Overweight 12(1):50, 62, 12(2):100, 101, 143, 144, 145, 146, 147, 148
 Paritas 12(1):70, 78, 79, 113
 Perceptual Reasoning (Pri) 12(1): 55
 Peripheral Resistance 12(1):55, 12(2):150
 Polyunsaturated Fatty Acids (Pufa) 12(2):138
 Posbindu 12(2):143, 144, 145, 150, 151, 167
 Predisposisi 12(1):82
 Preeklampsia 12(2):124
 Prehipertensi 12(2):96, 101
 Preklinis 12(2):149
 Prenatal Alcohol Exposure (PAE) 12(1):65
 Primipara 12(2):79
 Protein 12(1):1, 2, 3, 4, 5, 6, 7, 8, 9, 11, 22, 23, 47, 48, 55, 60, 12(2):95, 96, 100, 102, 103, 107, 108, 111, 113, 115, 116, 126, 127, 144, 155, 157
 PTM 12(2):143, 144, 145, 150, 167
 Radikal Bebas 12(2):85, 167
 Reaksi Maillard 12(2):157, 161
 Renin-Angiotensin 12(2):144, 149
 Reseptor 12(1):23, 12(2):115, 123
 Retikulo Endothelial 12(2):120
 Saintifikasi Jamu 12(2):107, 109
 Saponin 12(1):2, 12(2):155
 Saturation 12(2):103
 Scurvy 12(2):95
 Seluler 12(1):78, 82, 12(2):95
 Semi Quantitative-Food Frequency Questionnaire (SQ-FFQ) 12(2):148
 SGOT 12(2):110, 167
 SGPT 12(2):110, 167
 Simpatetik 12(2):149
 Simplisia 12(2):110
 Sprague Dawley 12(1):15, 17, 18, 25
 Sistolik 12(2):96, 97, 98, 99, 101, 144, 145, 146, 148
 sTfR 12(2):119, 120, 123, 125, 126, 129, 167
 Stimulus 12(2):144
 Streptozocotin-Nicotinamide 12(2):156
 Stres Oksidatif 12(2):85
 Strip Hemoglobin 12(2):96
 Sukrosa 12(1):19
 Suplementasi 12(1):55, 12(2):93, 94, 95, 96, 102, 103, 121, 126
 Tablet Tambah Darah (TTD) 12(2):94
 Tanin 12(2):102
 Thermogravimetri 12(1):4
 Thiobarbituric Acid 12(2):153, 154
 Thyroid Stimulating Hormone (TSH) 12(1):27, 29
 Tiroid 12(1):15, 16, 17, 23, 24, 27, 35, 12(2):126, 144, 166
 Transferin 12(2):95, 102, 103, 115, 126
 Transporter 12(2):102
 Triterpen 12(1):2
 Trombositopenia 12(1):65
 Underweight 12(2):100, 101
 Universal Salt Iodization (USI) 12(1):28
 Uptake 12(2):95
 Ureum 12(2):110
 Urinary Iodine Concentration (UIC) 12(1):27, 28
 Variasi Diurnal 12(2):115
 Vasodilator 12(2):145
 Verbal Comprehension (VCI) 12(1):55
 Ventrikel 12(2):149
 Volume Sekuncup 12(2):149
 Working Memory (WMI) 55
 WUS 12(1):27, 28, 29, 30, 31, 32, 33, 34, 35, 12(2):117, 167
 Zink 12(1):3, 23, 53, 54, 55, 56, 57, 58, 59, 60, 61, 12(2):100, 116, 120, 123, 125, 167
 Z-Score 12(1):39, 40, 42, 44, 46, 48, 12(2):96

MEDIA GIZI MIKRO INDONESIA

INDONESIAN JOURNAL OF MICRONUTRIENT

Vol. 12, No. 1, Desember 2020

ISSN. 2086-5198

ABSTRAK

DDC: 612346

ANALISIS ZAT GIZI MAKRO, GIZI MIKRO, DAN ORGANOLEPTIK MAKANAN TABUR BERBASIS TUNA DAN LABU SIAM UNTUK TERAPI DIET PREDIABETES

Toto Sudargo, Atika Anif Prameswari, Bianda Aulia, Tira Aristasari, Alim Isnansetyo, Indun Dewi Puspita, Siti Ari Budiyaniti, Sheila Rosmala Putri, Khusnul Alfionita
MGMI Vol. 12, No. 1, Desember 2020: 1-14

ABSTRAK

Latar Belakang. Pengaturan diet bagi pasien prediabetes merupakan salah satu pencegahan kejadian penyakit diabetes melitus secara dini. Labu siam dan ikan tuna merupakan bahan pangan lokal yang mengandung banyak senyawa di mana mampu menanggulangi masalah diabetes sehingga dapat dimanfaatkan sebagai makanan tabur fungsional. Pengembangan makanan berbasis tuna dan labu siam perlu diperhatikan karena dapat merubah kandungan zat gizi makro maupun mikro dan sifat organoleptiknya. Penelitian ini bertujuan untuk menganalisis zat gizi mikro, makro, dan organoleptik makanan tabur berbasis Tuna dan labu siam untuk terapi diet prediabetes. **Metode.** Penelitian eksperimental dengan rancangan acak lengkap (RAL) menggunakan 3 formula makanan tabur Chaguro yaitu, F1 (ikan tuna 60% dan labu siam 40%), F2 (ikan tuna 50% dan labu siam 50%), dan F3 (ikan tuna 40% dan labu siam 60%). Penelitian ini juga menganalisis kandungan kadar air dan uji mikroba. Analisis statistik dilakukan dengan uji *Kruskall Wallis* dan uji *Post-Hoc Mann Whitney* untuk melihat perbedaan tingkat kesukaan dari tiap formula makanan tabur. **Hasil.** Hasil uji kadar air pada ikan tuna didapatkan pengeringan ikan tuna selama 10 jam dengan suhu 55°C dan 65°C menghasilkan kadar air yang memenuhi syarat <7 persen yaitu 5,85±0,15% dan 5,96±0,00%, berturut-turut. Pada uji kandungan gizi, kadar abu, kadar protein, kadar lemak, kadar serat kasar, dan Zn dalam 100 g formula Chaguro F1 masih dalam batas aman untuk dikonsumsi. Berdasarkan uji organoleptik, parameter kenampakan, aroma, tekstur, dan rasa ikan paling kuat adalah Formula F1. Hasil angka lempeng total (ALT) untuk makanan tabur Chaguro yaitu sebesar $5,5 \times 10^3$ CFU/gr. Uji mikroba *Salmonella* sp. dan *Escherichia coli* pada makanan tabur Chaguro dinyatakan negatif. **Kesimpulan.** Formula F1 (ikan tuna 60% dan labu siam 40%) merupakan formula yang paling kuat dan memiliki sifat dominan ikan dibandingkan dengan formula lain dan sudah memenuhi syarat SNI Abon 01-3707-1995 dari segi kandungan gizi, kecuali kadar air dan ALT.

Kata kunci: labu siam, pangan fungsional, organoleptik, prediabetes, Tuna

DDC: 611.4563

BERAT BADAN DAN FUNGSI TIROID TIKUS HIPERKOLESTEROLEMIA

Hastin Dyah Kusumawardani, Deni Juwantoro, Mohamad Samsudin
MGMI Vol. 12, No. 1, Desember 2020: 15-26

ABSTRAK

Latar Belakang. Asupan makanan tinggi lemak dan tinggi kalori berdampak pada peningkatan kadar kolesterol dalam darah. Hormon tiroid mengatur berbagai proses metabolisme dalam tubuh diantaranya sintesis, mobilisasi, dan degradasi lipid. Hormon tiroid berhubungan erat dengan indeks massa tubuh dengan mekanisme pengaturan laju metabolisme dan pengendalian keseimbangan energi. **Tujuan.** Penelitian ini bertujuan mengetahui perbedaan fungsi tiroid dan berat badan pada tikus hiperkolesterolemia. **Metode.** Penelitian dilakukan di Laboratorium Pusat Studi Pangan dan Gizi UGM. Sampel penelitian adalah 30 ekor tikus Sprague Dawley. Tikus dibagi menjadi 5 kelompok perlakuan yaitu (1) STD adalah kelompok tikus sehat diberi pakan diet standar AIN-93M, (2) HK-KN adalah kelompok tikus hiperkolesterol diberi diet pakan standar AIN-93M, (3) HK-DB adalah kelompok tikus hiperkolesterol diberi diet tepung daging buah pisang uter, (4) HK-BU adalah kelompok tikus hiperkolesterol diberi diet tepung buah utuh pisang uter, dan (5)

HK-KB adalah kelompok tikus hiperkolesterol diberikan diet tepung kulit buah pisang uter. Penimbangan sisa pakan dilakukan setiap hari dan penimbangan berat badan tikus setiap minggu. Analisis data menggunakan uji statistik one-way ANOVA dan regresi linier.

Hasil. Tidak ditemukan perbedaan asupan pakan pada kelompok tikus STD, HK-KN, HK-DB dan HK-BU. Perbedaan asupan pakan berbeda signifikan pada kelompok HK-KB. Tidak ditemukan perbedaan berat badan pada kelompok STD, HK-DB, dan HK-BU. Perbedaan berat badan ditemukan pada kelompok HK-KN dan HK-KB. Tidak ditemukan perbedaan kadar TSH pada semua kelompok tikus perlakuan. **Kesimpulan.** Peningkatan berat badan terjadi pada kelompok tikus STD, HK-KN, HK-DB, dan HK-BU, sedangkan pada kelompok HK-KB mengalami penurunan berat badan. Tidak ditemukan perubahan fungsi tiroid pada semua kelompok tikus perlakuan.

Kata kunci: berat badan, hiperkolesterolemia, fungsi tiroid

DDC: 664459826

HUBUNGAN KANDUNGAN IODIUM GARAM RUMAH TANGGA DENGAN STATUS IODIUM WANITA USIA SUBUR DI KABUPATEN WONOGIRI

Taufiq Hidayat, Muhamad Arif Musoddaq, Alfien Susbiantonny, Prihatin Broto Sukandar
MGMI Vol. 12, No. 1, Desember 2020: 27-38

ABSTRAK

Latar Belakang. Status iodium merupakan penentu utama gangguan tiroid pada wanita. Wanita usia subur (WUS) merupakan kelompok populasi berisiko tinggi. Gangguan fungsi tiroid pada WUS akan meningkatkan risiko kehamilan dan berdampak negatif terhadap perkembangan anak. **Tujuan.** Penelitian ini untuk mengetahui hubungan kandungan iodium garam rumah tangga dan status iodium WUS di Kabupaten Wonogiri. **Metode.** Studi potong lintang dilakukan di Kabupaten Wonogiri. Total 170 responden wanita berusia 15-49 tahun, dilakukan pengukuran terhadap kandungan iodium garam rumah tangga, konsentrasi iodium urine (KIU), dan kadar *thyroid stimulating hormone* (TSH) serum. Analisis kandungan iodium garam rumah tangga dilakukan dengan metode titrasi iodometrik, KIU dengan metode *ammonium persulfate digestion*, dan kadar TSH serum dengan metode *enzyme-linked immunosorbent assay* (ELISA). **Hasil.** Analisis 170 sampel menunjukkan cakupan garam beriodium rumah tangga yang memadai yaitu 53,5 persen. Median KIU WUS 178,5 µg/L, dengan proporsi nilai KIU < 100 µg/L dan < 50 µg/L masing-masing 17,7 persen dan 7,1 persen. Kandungan iodium garam rumah tangga berhubungan bermakna dengan KIU WUS ($p < 0,05$) dan tidak berhubungan bermakna dengan kadar TSH serum WUS ($p > 0,05$). **Kesimpulan.** Cakupan garam beriodium tingkat rumah tangga di Kabupaten Wonogiri di bawah sasaran *universal salt iodization* (USI) (cakupan ≥ 90 persen). Nilai KIU < 100 µg/L dan < 50 µg/L masing-masing kurang dari 50 persen dan 20 persen, menunjukkan asupan iodium memadai. Kandungan iodium garam rumah tangga berpengaruh terhadap tingkat asupan iodium.

Kata kunci: iodium, status iodium, iodium urine

DDC: 616.3959822

ANALISIS ASUPAN ENERGI, ZAT GIZI MAKRO, VITAMIN C, ZAT BESI, SENG, DAN IMT/U BERDASARKAN TINGKATAN KOGNITIF SISWA KELAS 5 DI SD NEGERI DURI KEPA 13 PAGI JAKARTA BARAT

Mariana Sari, Laras Sitoayu, Nazhif Gifari, Nadiyah, Rachmanida Nuzrina
MGMI Vol. 12, No. 1, Desember 2020: 39-52

ABSTRAK

Latar Belakang. Tingkatan kognitif adalah tingkatan pengetahuan anak dalam kemampuan berpikir, mengingat sampai memecahkan masalah, sedangkan intelegensi (kecerdasan) merupakan tindakan terarah yang membutuhkan keterampilan dan kemampuan nalar yang baik untuk memecahkan masalah. Perkembangan otak

<p>berkaitan dengan kemampuan kognitif seseorang yang memiliki peranan penting terhadap prestasi dan keberhasilan dalam pendidikan. Asupan gizi dan status gizi yang normal dibutuhkan dalam pertumbuhan dan perkembangan optimal anak. Hasil survei menyatakan bahwa 34,3 persen anak usia sekolah di Indonesia memiliki kognitif rata-rata. Faktor yang memengaruhi perkembangan kognitif yaitu keturunan, kematangan biologis, pengalaman fisik, lingkungan, dan ekuilibrisasi. Tujuan. Tujuan penelitian untuk mengetahui perbedaan asupan energi, zat gizi makro, vitamin C, zat besi, seng, dan IMT/U berdasarkan tingkatan kognitif. Metode. Sampel yang diambil berjumlah 60 orang dengan desain <i>cross-sectional</i>. Asupan makanan diukur menggunakan <i>food recall</i>, IMT/U menggunakan timbangan dan <i>microtoise</i>, perkembangan kognitif menggunakan kuesioner. Uji statistik menggunakan <i>t-test independent</i> dan <i>Mann Whitney</i>. Hasil. Siswa dengan kognitif konkret 43 persen dan kognitif formal 57 persen. Rata-rata asupan energi yaitu 1292 kkal; triptofan 0,3 g; linoleat 2,6 g; linolenat 0,13 g; karbohidrat 178 g; vitamin C 6,3 mg; zat besi (Fe) 4,8 mg; seng (Zn) 4,9 mg; dan IMT/U -0.1 z-score. Variabel yang signifikan adalah asupan energi ($p=0,0001$), triptofan ($p=0,032$), linoleat ($p=0,003$), linolenat ($p=0,044$), karbohidrat ($p=0,0001$), zat besi (Fe) ($p=0,032$), seng (Zn) ($p=0,009$), dan IMT/U ($p=0,038$). Asupan vitamin C tidak signifikan dengan nilai $p=403$. Kesimpulan. Asupan energi, zat gizi makro, zat besi, seng, dan IMT/U yang memadai berpengaruh terhadap perkembangan kognitif siswa kelas 5 di SD Negeri Duri Kepa 13 Pagi Jakarta Barat. Siswa dengan asupan zat gizi dalam jumlah cukup dan IMT/U normal memiliki tingkatan kognitif lebih tinggi dibandingkan siswa yang memiliki asupan zat gizi dan IMT/U kurang.</p> <p>Kata kunci: IMT/U, kognitif, asupan, zat gizi, anak usia sekolah</p>	<p>DDC: 616156 MEROKOK, KONSUMSI ALKOHOL, MAKANAN DAN MINUMAN TERCEMAR E. COLI KAITANNYA DENGAN ANEMIA PADA IBU HAMIL Noviati Fuada, Budi Setyawati, Salimar MGMI Vol. 12, No. 1, Desember 2020: 63-74</p> <p>ABSTRAK Latar Belakang. Prevalensi anemia pada ibu hamil secara global masih cukup tinggi. WHO melaporkan pada tahun 2011 prevalensi sebesar 38 persen. Sedangkan data nasional menyebutkan prevalensi anemia pada ibu hamil cenderung meningkat. Tujuan. Penelitian ini bertujuan untuk mengetahui hubungan anemia dengan konsumsi alkohol, kebiasaan merokok, kontaminasi <i>E. coli</i> pada makanan dan minuman yang dikonsumsi ibu hamil. Metode. Penelitian <i>cross-sectional</i>, dilakukan di dua kelurahan di Kota Bogor. Sampel berjumlah 134 ibu hamil dengan usia kehamilan 0-9 bulan yang berasal dari <i>database</i> riset Kohor Tumbuh Kembang Anak Tahun 2013. Sampel analisis berjumlah 96 ibu hamil yang memenuhi kriteria inklusi antara lain tinggal menetap di wilayah penelitian, bersedia diperiksa darah, dan mengizinkan makanan yang dikonsumsi untuk diperiksa di laboratorium. Data dianalisis dengan uji regresi logistik. Variabel dependen adalah status anemia pada ibu hamil. Variabel independen adalah status <i>E. coli</i> pada makanan dan minuman yang dikonsumsi ibu hamil, perilaku konsumsi alkohol, dan perilaku merokok. Hasil. Terdapat 37,5 persen ibu hamil yang merokok menderita anemia ($p=0,233$) dan konsumsi alkohol 75 persen menderita anemia ($p=0,024$). Ibu hamil yang mengonsumsi makanan dan minuman tercemar <i>E. coli</i> menderita anemia masing-masing sebesar 37,1 persen ($p=0,003$) dan 34,5 persen ($p=0,036$). Ibu hamil yang mengonsumsi alkohol mempunyai peluang terbesar menderita anemia. Variabel yang berinteraksi sebagai model penentu anemia adalah konsumsi alkohol dengan minuman yang tercemar <i>E. coli</i>. Kesimpulan. Anemia pada ibu hamil berhubungan dengan faktor perilaku konsumsi alkohol, makanan dan minuman yang tercemar <i>E. coli</i>.</p> <p>Kata kunci: alkohol, anemia, <i>E. coli</i>, ibu hamil</p>
<p>DDC: 371.859868 ASUPAN ZINK DAN TINGKAT KECERDASAN ANAK SEKOLAH DASAR DI KOTA KUPANG, NUSA TENGGARA TIMUR Putu Amrytha Sanjiwani, Dewi Shinta, Umi Fahmida MGMI Vol. 12, No. 1, Desember 2020: 53-62</p> <p>ABSTRAK Latar Belakang. Permasalahan gizi merupakan permasalahan serius yang dapat berdampak pada perkembangan kognitif dan motorik, serta prestasi akademik terutama pada usia sekolah. Kognitif merupakan interaksi antara faktor bawaan dan faktor lingkungan. Zink merupakan salah satu mineral mikro yang berkontribusi terhadap fungsi kecerdasan. Kekurangan zink akan berdampak pada perkembangan kecerdasan melalui perubahan perhatian, aktivitas, perilaku neuropsikologikal, dan perkembangan motorik. Tujuan. Penelitian ini dilakukan untuk menganalisis hubungan antara asupan zink dengan tingkat kecerdasan anak sekolah dasar di Kota Kupang. Metode. Penelitian ini merupakan penelitian kuantitatif dengan rancangan <i>cross-sectional</i>. Penelitian dilakukan pada anak di 12 sekolah dasar di 6 kecamatan se-Kota Kupang. Data tingkat kecerdasan anak dikumpulkan oleh 3 orang psikolog dengan menggunakan metode <i>Wechsler Intelligence Scale for Children: Second Edition</i> (WISC-II). Data asupan zink dalam penelitian ini dikumpulkan oleh enumerator dengan metode <i>food recall</i> 24 jam selama 3 hari yang meliputi hari sekolah dan hari libur. Tes distribusi normal dilakukan untuk variabel kontinu menggunakan <i>Kolmogorov-Smirnov test</i>. Uji korelasi untuk melihat hubungan antara asupan zink dengan tingkat kecerdasan menggunakan uji <i>Spearman</i>. Hasil. Proporsi kurus dalam penelitian ini adalah 23,9 persen dan asupan rata-rata zink adalah 3,79 mg/hari dan masih belum mencukupi kebutuhan yang dianjurkan. Hasil uji <i>Spearman Rho</i> ditemukan adanya korelasi positif yang signifikan antara asupan zink dengan tingkat kecerdasan anak ($r=0,17$; $p=0,006$). Pada hasil uji regresi linier ditemukan faktor yang paling berhubungan dengan skor kecerdasan adalah jenis kelamin ($p=0,016$), dan tidak terdapat hubungan antara asupan zink dengan kecerdasan anak. Penelitian ini menemukan anak perempuan memiliki tingkat kecerdasan 4 poin lebih tinggi dibandingkan anak laki-laki. Kesimpulan. Asupan zink dari makanan tidak berhubungan dengan tingkat kecerdasan anak, tetapi jenis kelamin merupakan faktor dominan tingkat kecerdasan anak.</p> <p>Kata kunci: tingkat kecerdasan, anak sekolah, WISC, asupan zink</p>	<p>DDC: 616.1559832 PENGARUH VIDEO EDUKASI TERHADAP KEPATUHAN KONSUMSI TABLET BESI IBU HAMIL ANEMIA DI PUSKESMAS KOTA PALANGKA RAYA Nila Susanti, Fery Anggriawan MGMI Vol. 12, No. 1, Desember 2020: 75-84</p> <p>ABSTRAK Latar Belakang. Video merupakan sarana penyuluhan kesehatan yang dikembangkan karena visualisasinya menggunakan dua indera yang akan memudahkan proses penyerapan pengetahuan. Penggunaan media video dalam edukasi tentang anemia kepada ibu hamil termasuk salah satu promosi kesehatan untuk meningkatkan kepatuhan. Tujuan. Penelitian ini bertujuan untuk mengetahui apakah terdapat pengaruh pemberian edukasi melalui video terhadap kepatuhan konsumsi tablet besi pada ibu hamil anemia. Metode. Penelitian ini adalah penelitian kuasi eksperimen dengan menggunakan kelompok kontrol dan kelompok eksperimen tanpa randomisasi. Penelitian ini dilakukan di beberapa Puskesmas Kota Palangka Raya yang memiliki prevalensi ibu hamil anemia tinggi, yaitu Puskesmas Panarung dan Puskesmas Bukit Hindu dengan masing-masing 15 sampel ibu hamil yang anemia. Penelitian dilaksanakan selama 30 hari pada bulan Maret hingga April 2019. Teknik pengambilan sampel melalui metode purposive sampling dengan instrumen pengambilan data berupa lembar check list. Analisis statistik menggunakan uji beda Non-Parametric Mann Whitney pada data yang distribusinya tidak normal dan uji beda Parametric Independent Sample T-Test pada data yang distribusinya normal. Hasil. Hasil penelitian menunjukkan ibu hamil yang patuh setelah intervensi sebanyak 26,7 persen pada kelompok kontrol dan 86,7 persen pada kelompok eksperimen. Nilai p-value pengaruh edukasi melalui video terhadap kepatuhan konsumsi tablet besi pada kelompok eksperimen adalah 0,002. Perbedaan kepatuhan konsumsi tablet besi bermakna pada kedua kelompok setelah pemberian edukasi melalui video dengan p-value=0,001. Sedangkan sebelum intervensi edukasi melalui video tidak ada perbedaan bermakna dengan p-value=0,063. Intervensi media leaflet juga tidak menunjukkan pengaruh yang bermakna ($p=0,531$). Perbedaan bermakna terlihat pada tingkat pendidikan (0,018), tetapi tidak terdapat pada usia dan pekerjaan ($p=1$ dan 0,067). Kesimpulan. Ada perbedaan kepatuhan konsumsi tablet besi yang bermakna setelah intervensi edukasi melalui video.</p> <p>Kata kunci: anemia, kepatuhan, tablet besi, ibu hamil, video</p>

MEDIA GIZI MIKRO INDONESIA
INDONESIAN JOURNAL OF MICRONUTRIENT

Vol. 12, No. 1, December 2020

ISSN. 2086-5198

ABSTRACT

DDC: 612346

MACRONUTRIENT, MICRONUTRIENT, AND ORGANOLEPTIC ANALYSIS OF POWDER FOOD MADE OF TUNA AND CHAYOTE FOR PREDIABETES DIET THERAPY

Toto Sudargo, Atika Anif Prameswari, Bianda Aulia, Tira Aristasari, Alim Isnansetyo, Indun Dewi Puspita, Siti Ari Budiyantri, Sheila Rosmala Putri, Khusnul Alfionita

MGMI Vol. 12, No. 1, December 2020: 1-14

ABSTRACT

Background. Diet management is one of the preventive measures for diabetes mellitus type 2. Chayote and Tuna are local resources that are easy to find and contain beneficial health nutrients. Raw food develops into powder will change its macronutrient and micronutrient content and its organoleptic properties. This study aimed to analyze the macro and micronutrients of Tuna and Chayote based food for prediabetes diet therapy. **Method.** This experimental study was conducted to compare 3 formulas of developed powder food called "Chaguro": F1 (60% Tuna, 40% Chayote), F2 (50% Tuna, 50% Chayote), and F3 (40% Tuna, 60% Chayote). We also assessed the moisture level of Tuna and Chayote dried using different temperatures and duration and conducted a microbiology test. Statistical analysis was performed using the Kruskal Wallis test followed by the post-hoc Mann-Whitney U test. **Results.** Drying Tuna for 10 hours at 55°C dan 65°C produced the lowest water content (5.85±0.15% and 5.96±0.00%, respectively) and met the standard requirement of <7 percent. According to the national standard of similar food (Tuna floss), ash, protein, fat, crude fiber, and zinc content in F1 met the described criteria. The organoleptic assessment showed that F1 had the strongest fish characteristics (appearance, aroma, texture, and flavor). The total plate count of Chaguro F1 was 5.5 x 10³ CFU/g, while Salmonella sp. and E. Coli tests were negative. **Conclusion.** F1 formula had dominant fish characteristics compared to other formulas and met the standard in terms of nutrient content, except for its moisture content.

Keywords: chayote, functional food, organoleptic, prediabetes, Tuna

DDC: 611.4563

BODY WEIGHT AND THYROID FUNCTION IN HYPERCHOLESTEROLEMIC RATS

Hastin Dyah Kusumawardani, Deni Juwantoro, Mohamad Samsudin

MGMI Vol. 12, No. 1, December 2020: 15-26

ABSTRACT

Background. Intake of high fat and calorie foods has an impact on increasing blood cholesterol levels. Thyroid hormones regulate various metabolic processes in the body, including synthesis, mobilization, and lipids degradation. In the normal function of thyroid gland, thyroid hormone works optimally to regulate metabolic rate and control energy balance. **Objective.** This study was to analyze body weight and thyroid function difference in hypercholesterolemia rats. **Method.** This research was conducted at UGM Central Laboratory for Food and Nutrition Studies. The research sample was 30 Sprague Dawley rats. Rats were divided into five treatments groups: (1) STD, a group of healthy rats given AIN-93M standard diet, (2) HK-KN, a group of hypercholesterolemic rats given AIN-93M standard diet, (3) HK-DB, a group of hypercholesterolemic rats given a diet with uter banana pulp, (4) HK-BU, a group of hypercholesterolemic rats given a diet of uter banana whole fruit flour, and (5) HK-KB, was a group of hypercholesterolemic rats given a diet of uter banana peel flour. Daily weighing of the leftover feed and weekly weighing of the rats were conducted. Data were

analyzed with one-way ANOVA and linear regression. **Results.** There was no difference feed intake in the STD, HK-KN, HK-DB and HK-BU groups. The difference feed intake was significantly in HK-KB group. There was no differences in body weight in STD, HK-DB, and HK-BU groups. Differences in body weight found in HK-KN and HK-KB groups. There was no difference in TSH levels in all of treatment rats groups. **Conclusion.** Increased body weight occurred but not significant in STD, HK-KN, HK-DB, and HK-BU groups, and in HK-KB group was decreased. There were no changes in thyroid function in all groups of treated rats.

Keywords: body weight, hypercholesterolemia, thyroid function

DDC: 664459826

THE RELATIONSHIP BETWEEN HOUSEHOLD SALT IODINE CONTENT AND IODINE STATUS IN WOMEN OF CHILDBEARING AGE AT WONOGIRI REGENCY

Taufiq Hidayat, Muhamad Arif Musoddaq, Alfien Susbiantonny, Prihatin Broto Sukandar

MGMI Vol. 12, No. 1, December 2020: 27-38

ABSTRACT

Background. Iodine status is a crucial determinant of thyroid disorders in women. Women of childbearing age are in high-risk population groups thyroid disorders may lead to obstetric complications and have a significant negative impact on childhood development. **Objective.** The purpose of this study was to know the relationship of household salt iodine content (SIC) and status iodine in women of childbearing age at Wonogiri Regency. **Method.** A community-based cross-sectional study was conducted at Wonogiri Regency. A total of 170 women aged 15-49 years were assessed for household SIC, urinary iodine concentration (UIC), and serum thyroid stimulating hormone (TSH) level. Household SIC was measured by iodometric titration method, UIC by ammonium persulfate digestion method, and serum TSH level by enzyme-linked immunosorbent assay (ELISA). **Results.** Analysis of 170 samples revealed that the median of UIC values was 178.5 µg/L, with the proportion of the samples < 100 µg/L and < 50 µg/L were 10.6 percent and 3.5 percent, respectively. The household coverage of adequately iodized salt was 53.5 percent. The household SIC significantly correlated with UIC (p<0.05) and no significantly correlated with serum TSH levels (p<0.05). **Conclusion.** The household coverage of adequately iodized salt at Wonogiri Regency is below the universal salt iodization (USI) goal (≥ 90 percent coverage). The UIC < 100 µg/L and < 50 µg/L were less than 50 percent and 20 percent respectively, indicating adequate iodine nutrition. Household SIC affected the level of iodine intake.

Keywords: iodine, iodine status, urinary iodine

DDC: 616.3959822

ANALYSIS OF ENERGY INTAKE, MACRO NUTRIENT, VITAMIN C, IRON, ZINC, AND BMI/A BASED ON COGNITIVE LEVELS IN GRADE 5 STUDENT AT SD DURI KEPA 13 PAGI WEST JAKARTA

Mariana Sari, Laras Sitoayu, Nazhif Gifari, Nadiyah, Rachmanida Nuzrina

MGMI Vol. 12, No. 1, December 2020: 39-52

ABSTRACT

Background. The cognitive level is the level of children's knowledge of the ability to think and remember to solve problems. Intelligence directed actions that require skills and functional reasoning abilities to solve problems. Brain development is related to the cognitive abilities of a person who has an essential role

<p>in achievement and success in education. Nutritional intake and normal nutritional status need optimal growth and development of children. The survey results indicate that 34.3 percent of school-age children in Indonesia have average cognitive status. Factors that affect cognitive ability are heredity, biological maturity, physical experience, and environment. Objective. The study's objective is to know the difference in energy intake, macronutrient, vitamin C, iron (Fe), zinc (Zn), and BMI/A to the cognitive level. Method. This is a cross-sectional study design with a sample of 60 students. Tools for data collection are food recall for food intake, BMI/A using scales and microtoise, cognitive development using standardized questionnaires. Statistical analysis test using independent t-test and Mann Whitney. Results. Students with concrete cognitive 43 percent and formal 57 percent. The average energy intake is 1292 kcal, tryptophan 0.3 g, linoleate 2.6 g, linoleate 0.13 g, carbohydrate 178 g, vitamin C 6.3 mg, iron 4.8 mg, zinc 4.9 mg, and BMI/A -0.1 z-score. Significant variables were energy intake ($p=0.0001$), tryptophan ($p=0.032$), linoleic ($p=0.003$), linolenic ($p=0.044$), carbohydrate ($p=0.0001$), iron $p=0.032$), zinc ($p=0.009$), and nutritional status ($p=0.038$). Vitamin C intake was not significant with $p=403$. Conclusion. Energy intake, macro nutrients, iron, zinc, and BMI/A which tolerates an affect the cognitive development of fifth grade students at SD Negeri Duri Kepa 13 Pagi Jakarta Barat. Students with sufficient nutritional intake and normal BMI/A have higher cognitive levels than students whose nutritional intake and BMI are less.</p> <p>Keywords: BMI/A, cognitive, intake, nutrients, school-age children</p>	<p>Noviati Fuada, Budi Setyawati, Salimar MGMI Vol. 12, No. 1, December 2020: 63-74</p> <p>ABSTRACT</p> <p>Background. The prevalence of anemia in pregnant women globally is still relatively high. WHO reported in 2011, the prevalence was 38 percent. Meanwhile, national data states that the prevalence of anemia in pregnant women tends to increase. Objective. This paper aims to determine the relationship between anemia and alcohol consumption, smoking habits, and E. coli contamination in pregnant women's food and beverages. Method. A cross-sectional design was conducted in two urban villages in the city of Bogor. The sample was 134 women from the Child Development 2013 Cohort with 0-9 months' gestational age. A sample of 96 pregnant women met the inclusion criteria, which were willing to be a respondent, staying in the study area, willing to have blood tests, and allowing the food to be examined in the laboratory obtained. Data analyzed by logistic regression. The dependent variable is the anemia status in pregnant women. The independent variables were E. coli on food and beverages consumed by pregnant women, alcohol consumption, and smoking behavior. Results. We found that 37.5 percent of pregnant women who smoke ($p=0.233$) and 75 percent of alcohol consumption ($p=0.024$) suffer from anemia. Pregnant women who consumed drinks and drinks tainted with E. coli suffered from anemia were 37.1 percent ($p=0.003$) and 34.5 percent ($p=0.036$). Pregnant women who consume alcohol have the highest chance of suffering from anemia. The interacting variable as a model to determine anemia was alcohol consumption with E. coli contaminated drinks. Conclusion. There is a significant relationship between anemia status in pregnant women who consumed alcohol, eating, and drinking contaminated with E. coli.</p> <p>Keywords: alcohol, anemia, E. coli, pregnant women</p>
<p>DDC: 371.859868</p> <p>CORRELATION BETWEEN ZINC INTAKE AND COGNITIVE SCORE AMONG SCHOOL AGE CHILDREN IN KUPANG, EAST NUSA TENGGARA</p> <p>Putu Amrytha Sanjiwani, Dewi Shinta, Umi Fahmida MGMI Vol. 12, No. 1, December 2020: 53-62</p> <p>ABSTRACT</p> <p>Background. Nutrition deficiencies are a severe problem and affect cognitive and motor development and academic performance, especially in school age children. Cognitive function is the dynamic interaction between nature and nurture factors. Zinc deficiency may affect cognitive development by altering attention, activity, neuropsychological behavior, and motor development. Objective. This research was conducted to analyze the correlation between zinc intake and cognitive score among elementary school children in Kupang. Method. The study was a cross-sectional study, with 251 students from 12 elementary schools in Kupang. Psychologists collected the cognitive score measurement using the Wechsler Intelligence Scale for Children: Second Edition (WISC-II). Measurement of zinc intake used 24-h recall for three days (non-consecutive days) include weekday and working day. The normal distribution test used the Kolmogorov-Smirnov test. Spearman correlation test analyzes the correlation between zinc intake and nutritional status with the cognitive score. Results. Proportion of wasting was 23.9 percent, and the average zinc intake of children was 3.79 mg/day, and it was below 56.5 percent from zinc requirement. Spearman correlation test showed significant positive correlation between zinc intake with cognitive score among elementary school children ($r=0.17$; $p=0.006$). Based on linear regression, this study found the strongest association was in sex ($p=0.016$), and zinc intake on borderline significant association with a cognitive score ($p=0.077$). This study found that girls have 4 points higher intelligence than boys. Conclusion. There was no significant association between zinc intake from food to cognitive score, but sex is the most significant cognitive score factor.</p> <p>Keywords: cognitive score, school children, WISC, zinc intake</p>	<p>DDC: 616.1559832</p> <p>THE EFFECT OF EDUCATION USING VIDEO ON THE CONSUMPTION OF IRON TABLETS AMONG ANEMIC PREGNANT WOMEN IN PALANGKA RAYA CITY</p> <p>Nila Susanti, Fery Anggriawan MGMI Vol. 12, No. 1, December 2020: 75-84</p> <p>ABSTRACT</p> <p>Background. Health education using video is now preferred because using two senses will better drive knowledge development. The use of video in education about anemic to pregnant women is one type of health promotion to improve iron tablet consumption adherence. Objective. This study aims to determine whether there is an effect of providing educational video on adherence to iron tablet consumption in anemic pregnant women. Method. This study is a quasi-experiment using control and an experimental group without randomization. This research was conducted in several Palangka Raya City Public Health Centers, with a high prevalence of anemic in pregnant women. Panarung Public Health Center and Bukit Hindu Public Health Center were the study area, each with 15 anemic pregnant women. The study was conducted for 30 days in March to April 2019. Respondents recruited using a purposive sampling method with checklist sheets as data collection tools. Statistical analysis used was the Non-parametric Mann Whitney difference test for the non-normal data and Parametric Independent Sample T-Test on normal data distribution. Results. After the intervention, pregnant women who obeyed were 26.7 percent in the control group and 86.7 percent in the experimental group. The p-value of educational video on iron tablet consumption compliance in the experimental group was 0.002. The difference in compliance with iron tablet consumption was significant in the two groups after educational videos with p-value=0.001. Whereas before the educational video intervention, there was no significant difference with p-value=0.063. Leaflet media intervention also did not show a significant effect ($p = 0.531$). Significant differences were seen on education (0.018), but not in age or occupation ($p=1$ and 0.067). Conclusion. There is a difference in compliance with iron tablets between groups.</p> <p>Keywords: anemic, compliance, iron tablets, pregnant women, video</p>
<p>DDC: 616156</p> <p>THE ASSOCIATION OF SMOKING, ALCOHOL CONSUMPTION, E. COLI CONTAMINATED FOOD AND BEVERAGES WITH ANEMIA IN PREGNANT WOMEN</p>	<p>Keywords: anemic, compliance, iron tablets, pregnant women, video</p>

MEDIA GIZI MIKRO INDONESIA

INDONESIAN JOURNAL OF MICRONUTRIENT

Vol. 12, No. 2, JUNI 2021

ISSN. 2086-5198

ABSTRAK

DDC: 362296

EFIKASI FLAVONOID PADA MULBERI MERAH TERHADAP PENURUNAN RADIKAL BEBAS DAN ALVEOLAR MAKROFAG AKIBAT PAPARAN ASAP ROKOK PADA TIKUS WISTAR

Rivan Virlando Suryadinata, Dita Sukmaya Prawitasari, Indira Pradita Rochim

MGM Vol. 12, No. 2, Juni 2021: 85-92

ABSTRAK

Latar Belakang. Radikal bebas yang banyak terkandung dalam asap rokok akan memberikan dampak negatif bagi kesehatan apabila masuk ke dalam saluran napas. Peningkatan radikal bebas dalam tubuh yang berlebihan akan menyebabkan terjadinya stres oksidatif. Secara fisiologis, radikal bebas dihasilkan dari metabolisme tubuh dan dapat dinetralkan oleh antioksidan dalam tubuh. Ketidakseimbangan jumlah radikal bebas akan mengakibatkan kerusakan dan kematian sel yang ditandai dengan peningkatan kadar malondialdehid dalam darah dan alveolar makrofag di jaringan paru. Pemberian flavonoid pada buah mulberi merah (*Morus rubra*) sebagai asupan antioksidan dari luar tubuh dapat mencegah dampak negatif dari paparan asap rokok. **Tujuan.** Penelitian ini bertujuan untuk menganalisis efek flavonoid pada mulberi merah dalam menurunkan radikal bebas akibat paparan asap rokok melalui penurunan kadar malondialdehid dan alveolar makrofag. **Metode.** Penelitian ini adalah eksperimental dengan *post-test control group design* menggunakan tikus wistar jantan (*Rattus norvegicus*) sebagai hewan coba. Perlakuan pada hewan coba melalui pemberian mulberi merah dan paparan asap rokok dilakukan selama 30 hari. Parameter yang digunakan adalah kadar malondialdehid dan alveolar makrofag di jaringan paru. **Hasil.** Penelitian ini memperlihatkan adanya peningkatan radikal bebas pada kelompok yang diberikan paparan asap rokok. Peningkatan pemberian asupan mulberi merah dapat menurunkan kadar malondialdehid dan jumlah alveolar makrofag ($p < 0,05$). **Kesimpulan.** Antioksidan yang terkandung pada mulberi merah dapat menurunkan kadar malondialdehid dalam darah dan jumlah alveolar makrofag di jaringan paru akibat paparan asap rokok.

Kata kunci: alveolar makrofag, rokok, flavonoid, malondialdehid, mulberi merah

pada kelompok Fe+Vit C, 55,6 persen dikategorikan memiliki status anemia sedang. Rata-rata kadar Hb sebelum intervensi pada kelompok Fe adalah 10,7 g/dL sedangkan pada kelompok Fe+Vit C adalah 11,1 g/dL. Kadar Hb mengalami peningkatan secara signifikan pada kelompok Fe dan Fe+Vit C menjadi 13,0 g/dL dan 12,4 g/dL setelah intervensi dilakukan. Namun demikian tidak terdapat perbedaan yang signifikan pada kadar Hb setelah intervensi antara kedua kelompok perlakuan. **Kesimpulan.** Suplementasi Fe maupun Fe+Vit C dapat memperbaiki status anemia pada santri meskipun kadar Hb pada kedua kelompok tidak berbeda nyata setelah intervensi.

Kata kunci: remaja, anemia, suplementasi besi, vitamin C

DDC: 612.66

PENGARUH ASUPAN ZAT GIZI DAN JAMU PELANCAR AIR SUSU IBU (ASI) TERHADAP KADAR ZAT BESI (Fe) ASI IBU MENYUSUI

Enggar Wijayanti, Zuraida Zulkarnain

MGM Vol. 12, No. 2, Juni 2021: 107-118

ABSTRAK

Latar Belakang. Air susu ibu (ASI) mengandung makronutrien dan mikronutrien yang sangat penting bagi bayi yang baru lahir. Salah satu mikronutrien penting yang terdapat dalam ASI adalah zat besi (Fe). Asupan makanan ibu selama menyusui dan pemberian jamu pelancar ASI diduga berpengaruh terhadap kadar Fe pada ASI yang dihasilkan. **Tujuan.** Penelitian ini bertujuan mengetahui pengaruh zat gizi (makronutrien dan mikronutrien) dari makanan yang dikonsumsi oleh ibu dan pemberian jamu pelancar ASI dengan kandungan Fe dalam ASI. **Metode.** Penelitian ini merupakan penelitian kohort intervensi dan merupakan bagian dari penelitian "Observasi Klinik Formula Jamu Pelancar Air Susu Ibu (ASI)" yang dilakukan selama bulan Maret sampai Desember 2018. Penelitian ini dilakukan di tempat praktik enam orang dokter Saintifikasi Jamu (SJ) di wilayah eks Karesidenan Surakarta. Subjek merupakan ibu menyusui berjumlah 34 orang berusia 17–40 tahun. Data kadar Fe dalam ASI dan konsumsi makanan ibu diambil pada hari sebelum perlakuan (hari ke-0) dan setelah 28 hari pemberian jamu pelancar ASI (hari ke-28). Data konsumsi makanan dikumpulkan melalui wawancara menggunakan formulir *food recall 2x24* yang diambil pada satu hari kerja (Senin–Jumat) dan satu hari di akhir pekan (Sabtu–Minggu). Data selanjutnya, dianalisis dengan program *Nutrisurvey 2007*. **Hasil.** Penelitian ini mendapatkan tingkat konsumsi energi, protein, lemak, karbohidrat, zat besi, dan seng kecuali vitamin C dari subjek lebih rendah dari Angka Kecukupan Gizi (AKG) untuk ibu menyusui. Hasil uji Wilcoxon menunjukkan tidak ada perbedaan kadar Fe ASI sebelum dan sesudah perlakuan. Hasil uji regresi linier menunjukkan tidak ada hubungan yang bermakna antara kadar Fe dalam ASI dengan asupan zat gizi ibu ($p > 0,05$). **Kesimpulan.** Asupan gizi ibu dan pemberian jamu pelancar ASI tidak berpengaruh terhadap kadar Fe dalam ASI.

Kata kunci: ibu menyusui, ASI, kadar zat besi, asupan gizi

DDC: 612.615

PROFIL ZAT GIZI MIKRO (ZAT BESI, ZINK, VITAMIN A) DAN KADAR HEMOGLOBIN PADA IBU HAMIL

Ade Nugraheni, Mutiara Prihatini, Aya Yuriestia Arifin, Fifi Retiaty, Fitrah Ernawati

MGM Vol. 12, No. 2, Juni 2021: 119-130

ABSTRAK

Latar Belakang. Anemia pada ibu hamil sampai saat ini masih menjadi masalah kesehatan masyarakat di Indonesia. Anemia pada ibu hamil dapat berdampak pada kesehatan ibu hamil dan anak yang akan dilahirkan. Di negara sedang berkembang seperti di Indonesia penyebab anemia sebagian disebabkan kurang asupan zat besi, dan zat gizi mikro lainnya seperti zink dan vitamin A. **Tujuan.** penelitian ini bertujuan untuk meneliti profil zat gizi mikroserum ibu hamil dan melihat hubungan antara kadar Hb dengan kadar sTfR,

zink, dan vitamin A pada ibu hamil. **Metode.** Desain penelitian ini adalah potong lintang yang merupakan bagian dari penelitian kohort biomedis tahun 2018 dengan subjek penelitian ibu hamil berusia 16–46 tahun sebanyak 114 sampel. Variabel yang diamati adalah kadar Hb, sTfR, zink, dan vitamin A. Data dianalisis menggunakan SPSS versi 18.0 dengan uji deskriptif dan uji korelasi pearson. **Hasil.** Hasil penelitian menunjukkan bahwa masih terdapat ibu hamil yang tergolong pada usia berisiko, yaitu pada kelompok usia 16–19 tahun sebanyak 5,3% dan kelompok usia 41–46 tahun sebanyak 3,5%. Proporsi anemia pada ibu hamil tertinggi dijumpai pada kelompok usia 20–30 tahun yaitu 67,9% dan kelompok usia 31–40 yaitu 33,0%. Secara umum ibu hamil mengalami anemia sebanyak 35,1% dan kekurangan zink sebanyak 86,8%. Kadar sTfR, zink, dan vitamin A berhubungan dengan kadar hemoglobin pada ibu hamil. Untuk mencegah anemia pada ibu hamil perlu perbaikan kadar besi, zink, dan vitamin A yang dapat dilakukan dengan meningkatkan asupan makanan sumber zat besi, zink, dan vitamin A khususnya pada ibu hamil usia 20–30 tahun.

Kata kunci: anemia, profil zat gizi mikro, ibu hamil, defisiensi zink

DDC: 615.3

ANALISIS KLASER: KARAKTERISTIK, KANDUNGAN ZAT GIZI, DAN SENYAWA AKTIF EXTRA VIRGIN OLIVE OIL DI SUPERMARKET

Retno Mardhiati, Sri Anna Marliyati, Drajat Martiano, Siti Madanijah, I Wayan T Wibawan

MGMI Vol. 12, No. 2, Juni 2021: 131-142

ABSTRAK

Latar Belakang. Kandungan zat gizi *extra virgin olive oil* (EVOO) memiliki banyak manfaat untuk kesehatan manusia. Beberapa manfaat antara lain sebagai imunomodulator, mencegah penyakit jantung dan vaskuler lainnya, mencegah penyakit alergi, memperbaiki fungsi liver, dan mencegah penyakit lainnya. Kandungan zat gizi tiap merek EVOO tidak sama, ditentukan oleh banyak faktor.

Tujuan. Penelitian ini bertujuan menganalisis klaster berdasarkan karakteristik kimiawi, kandungan zat gizi, dan senyawa aktif pada tujuh sampel produk EVOO dari supermarket. **Metode.** Desain deskriptif digunakan dalam penelitian ini. Pengumpulan tujuh sampel produk EVOO di supermarket wilayah Daerah Khusus Ibukota (DKI) Jakarta dilakukan pada bulan Maret 2019. Pemeriksaan sampel produk EVOO dilakukan di Laboratorium Balai Besar Industri Agro (BBIA) Kementerian Perindustrian dan Laboratorium Biofarmaka dan Lembaga Penelitian Pengabdian Masyarakat (LPPM) Institut Pertanian Bogor (IPB). Analisis yang digunakan adalah analisis klaster melalui pendekatan *hierarchical method*. **Hasil.** Berdasarkan karakteristik kimiawi, ditemukan bahwa sampel produk EVOO ke-6 memiliki karakteristik kimiawi paling berbeda. Sampel produk EVOO ke-4 memiliki kandungan asam lemak jenuh paling berbeda. Kandungan asam lemak tak jenuh pada sampel produk EVOO ke-1, 3, dan 4 mendekati kesamaan. Kandungan vitamin E pada sampel produk EVOO ke-2 dan kandungan zat besi pada sampel produk EVOO ke-6, berbeda dengan sampel produk EVOO lainnya. Kandungan total flavonoid pada sampel produk EVOO ke-2, 3, dan 4, memiliki kadar mendekati kesamaan. Kandungan total karotenoid pada sampel produk EVOO ke-2 dan ke-6 juga memiliki kadar mendekati kesamaan. **Kesimpulan.** Karakteristik kimiawi pada semua sampel produk EVOO yang ditemukan dalam penelitian memiliki nilai hampir sama. Sampel produk EVOO di supermarket memiliki perbedaan kandungan asam lemak tak jenuh, total flavonoid, dan total karotenoid.

Kata kunci: asam lemak, zat besi, flavonoid, minyak zaitun, vitamin E

DDC: 6161359824

HUBUNGAN ANTARA TINGKAT KECUKUPAN LEMAK TIDAK JENUH TUNGGAL, MINERAL, DAN STATUS GIZI DENGAN KEJADIAN HIPERTENSI PADA LANSIA DI POSBINDU PTM PUSKESMAS TAJUR KOTA TANGERANG

Kristina Rosalia Pakpahan, Nadiyah, Harna, Mertien Sa'pang, Yulia Wahyuni

MGMI Vol. 12, No. 2, Juni 2021: 143-152

ABSTRAK

Latar Belakang. Hipertensi dapat menyebabkan berbagai penyakit yang saling berhubungan. Semakin bertambahnya umur maka fungsi fisiologis tubuh juga semakin berkurang dan terjadi perubahan-perubahan terutama pada perubahan fisiologis karena dengan semakin bertambahnya umur, fungsi organ tubuh akan semakin menurun baik karena faktor alamiah maupun karena

penyakit. Hipertensi juga sering dikaitkan dengan status gizi karena seseorang yang memiliki berat badan lebih cenderung mengalami hipertensi daripada orang dengan berat badan normal. Salah satu gangguan kesehatan yang paling banyak dialami oleh lansia yaitu berkurangnya kekuatan jantung. Asupan makan sangat berperan penting dalam menunjang kesehatan dan kontrol tekanan darah.

Tujuan. Penelitian ini bertujuan untuk mengetahui hubungan tingkat kecukupan lemak tidak jenuh tunggal, kalsium, magnesium, kalium, dan status gizi dengan kejadian hipertensi pada lansia di Posbindu PTM Puskesmas Tajur Kota Tangerang. **Metode.** Rancangan penelitian menggunakan desain cross-sectional. Rancangan dipilih secara proportional stratified random berjumlah 108 responden. Analisis data menggunakan Chi Square. **Hasil.** Hasil penelitian menunjukkan bahwa tingkat kecukupan lemak tidak jenuh tunggal (96,3%), kalsium (81,5%), dan kalium (54,6%) tergolong kurang (<77% AKG) namun untuk tingkat kecukupan magnesium tergolong cukup (68,5%) dan sebagian besar responden dengan status gizi overweight (74%). Oleh karena itu, tidak terdapat hubungan antara tingkat kecukupan lemak tidak jenuh tunggal, kalsium, magnesium, kalium, dan status gizi dengan kejadian hipertensi ($p>0,05$). **Kesimpulan.** Tidak ada hubungan antara kecukupan konsumsi lemak tidak jenuh tunggal, kalsium, magnesium, kalium, dan status gizi dengan kejadian hipertensi pada lansia di Posbindu PTM Puskesmas Tajur Kota Tangerang. Akan tetapi kemungkinan disebabkan faktor resiko lain yang berhubungan dengan hipertensi yang tidak dianalisa dalam penelitian ini. Selain itu, perlu diperhatikan asupan untuk menunjang kesehatan lansia.

Kata kunci: hipertensi, mineral, lemak tidak jenuh tunggal, status gizi

DDC: 612346

ANALISIS SENSORIS DAN UMUR SIMPAN MAKANAN SELINGAN PREDIABETES BERBASIS TUNA (*Thunnus sp.*) DAN LABU SIAM (*Sechium edule*)

Toto Sudargo, Atika Anif Prameswari, Bianda Aulia, Tira Aristasari, Khusnul Alfionita, Rahadyana Muslichah, Alim Isnansetyo, Indun Dewi Puspita, Siti Ari Budhiyanti, Sheila Rosmala Putri

MGMI Vol. 12, No. 2, Juni 2021: 153-164

ABSTRAK

Latar Belakang. Uji sensoris dan uji umur simpan pada pengembangan produk pangan diperlukan agar produk yang dihasilkan dapat diterima dan aman bagi konsumen. Individu yang mengalami prediabetes memiliki kesempatan untuk mencegah atau menunda perkembangan terjadinya diabetes melitus (DM) jika dapat memperbaiki pola hidupnya. Makanan selingan adalah bagian penting dalam manajemen pola makan penyandang prediabetes sehingga jumlah dan jenis bahan makanannya perlu dipertimbangkan. **Tujuan.** Penelitian ini bertujuan untuk menganalisis dan merumuskan sifat organoleptik dan umur simpan suatu produk makanan selingan untuk penyandang prediabetes.

Metode. Penelitian ini menggunakan desain eksperimental dengan rancangan acak lengkap untuk menguji karakteristik sensoris empat formula rasa pada produk makanan selingan prediabetes. Uji pendugaan umur simpan dengan Accelerated Shelf-Life Testing (ASLT) Arrhenius melalui pendekatan nilai angka thiobarbituric acid (TBA) dilakukan pada produk yang belum diberi rasa. Produk disimpan pada suhu 4°C, 27°C, dan 45°C. Analisis statistik dilakukan dengan uji Kruskal Wallis dilanjutkan uji Post-Hoc Mann Whitney. **Hasil.** Tidak terdapat perbedaan yang signifikan antar formula pada parameter warna dan aroma sampel, tetapi terdapat perbedaan yang signifikan pada parameter rasa, tekstur, dan nilai keseluruhan ($p<0,05$). Hasil analisis uji pendugaan umur simpan menunjukkan bahwa persamaan regresi pada orde 1 dapat digunakan sebagai pendekatan untuk memprediksi umur simpan makanan selingan untuk prediabetes. **Kesimpulan.** Makanan selingan prediabetes yang paling disukai untuk parameter warna, aroma, rasa, dan penilaian keseluruhan adalah formula F3 (bumbu bubuk bawang dan garam), sedangkan formula F2 (bumbu bubuk bawang) adalah yang paling disukai untuk parameter tekstur. Prediksi umur simpan makanan selingan untuk prediabetes pada suhu ruang/normal 30°C adalah 80,97 hari atau sama dengan 2,69 bulan.

Kata kunci: labu siam, prediabetes, analisis sensoris, umur simpan, tuna

MEDIA GIZI MIKRO INDONESIA

INDONESIAN JOURNAL OF MICRONUTRIENT

Vol. 12, No. 2, JUNE 2021

ISSN. 2086-5198

ABSTRACT

DDC: 362296

THE EFFICACY OF FLAVONOID IN RED MULBERRY ON REDUCING FREE RADICALS AND ALVEOLAR MACROPHAGES DUE TO CIGARETTE SMOKE EXPOSURE IN WISTAR RATS

Rivan Virlando Suryadinata, Dita Sukmaya Prawitasari, Indira Pradita Rochim

MGMI Vol. 12, No. 2, June 2021: 85-92

ABSTRACT

Background. Free radicals in cigarette smoke will hurt health when they enter to the respiratory tract. An excessive increase of free radicals in the body will cause oxidative stress. Free radicals are generated physiologically by the body's metabolism and can neutralize antioxidants in the body. An imbalance number of free radicals will result in cell damage and death. It has characterized by an increase in malondialdehyde levels in the blood and alveolar macrophages in the lung tissue. Giving red mulberry (*Morus rubra*) as an intake of antioxidants from outside the body can prevent adverse effects of cigarette smoke. **Objective.** This study analyses flavonoids' impact on red mulberry in reducing free radicals due to exposure to cigarette smoke by lowering levels of malondialdehyde and alveolar macrophages. **Method.** This research is experimental with a post-test control group design using male Wistar rats (*Rattus norvegicus*) as experimental animals. Treatment of experimental animals through red mulberry per oral and exposure to cigarette smoke had conducted for 30 days. The parameters used were levels of malondialdehyde and alveolar macrophages in the lung tissue. **Results.** The research showed an increase in free radicals in the group exposed to cigarette smoke. Increasing intake of red mulberry can further reduce malondialdehyde levels and the number of alveolar macrophages ($p < 0.05$). **Conclusions.** The antioxidants in red mulberry can reduce malondialdehyde levels in the blood and the number of alveolar macrophages in lung tissue due to exposure to cigarette smoke.

Keywords: alveolar macrophage, cigarette, flavonoids, malondialdehyde, red mulberry

upper arm circumference (MUAC), and waist circumference. Prior to the intervention, the majority of subjects in the Fe group (58.6%) had mild anemia while 55.6 percent in the Fe+Vit C group had moderate anemia. Before intervention, hemoglobin levels in the Fe and Fe+Vit C groups were 10.7 g/dL and 11.1 g/dL, respectively. After the intervention, hemoglobin levels in Fe and Fe+Vit C groups increased significantly to 13.0 g/dL and 12.4 g/dL, respectively. However, there was no significant difference in hemoglobin levels between the two treatment groups after intervention. **Conclusion.** Iron supplementation with or without vitamin C improved the anemia status among subjects even though hemoglobin levels in the two groups were not significantly different after the intervention.

Keywords: adolescent, anemia, iron supplementation, vitamin C

DDC: 612.66

THE EFFECT OF MATERNAL NUTRITIONAL INTAKE IN BREASTFEEDING AND GALACTOGOGUM JAMU ON BREASTMILK IRON (FE) LEVEL

Enggar Wijayanti, Zuraida Zulkarnain

MGMI Vol. 12, No. 2, June 2021: 107-118

ABSTRACT

Background. Breast milk contains macronutrients and micronutrients that are critical for newborns. Iron (Fe) is a vital micronutrient found in breast milk. The mother's diet has a significant impact on her physiological response to breastfeeding. Maternal food intake during breastfeeding and galactogogum jamu administration has been believing related to Fe levels in breastmilk. **Objective.** This study aims to determine the effect of maternal nutrition intake and galactogogum jamu on iron (Fe) levels in breastmilk. **Method.** This research is a cohort intervention study, conducted as part of the research "Clinical Observation of the Formula of Jamu Pelancar ASI" from March to December 2018. This research had done at the offices of six herbal medicine doctors in eks Karesidenan Surakarta. The participants were 34 breastfeeding mothers ranging in age from 17 to 40 years. Data on Fe levels in breast milk and maternal food consumption had collected on the first day of treatment (day 0) and 28 days later (day 28). Food consumption data were gathered through interviews using a 2x24 hour food recall form administered on one weekday (Monday-Friday) and one weekend (Saturday-Sunday). The Nutrisurvey 2007 program had used to analyze additional data. **Results.** The results showed that the level of energy, protein, fat, carbohydrate, iron, and zinc consumption except for vitamin C from subjects was lower than the nutritional adequacy rate (RDA) for breastfeeding mothers. The Wilcoxon test revealed no significant difference in breastmilk iron levels before and after the intervention. There was no meaningful relationship between Fe levels in breast milk and maternal nutrient intake ($p > 0.05$) at the multiple linear regression test. **Conclusion.** Maternal nutritional intake and galactogogum jamu have no significant effect on breastmilk iron levels.

Keywords: breastfeeding mothers, breastmilk, iron levels, nutrition intake

DDC: 616.15

EFFICACY OF IRON AND VITAMIN C SUPPLEMENTATION FOR IMPROVING ANEMIA STATUS AMONG BOARDING SCHOOL STUDENTS

Susi Nurohmi, Kartika Pibiyanti, Dianti Desita Sari

MGMI Vol. 12, No. 2, June 2021: 93-106

ABSTRACT

Background. Anemia has become a widespread nutritional issue in Indonesia and even around the world. This issue needs to be overcome because it has an impact on the quality and productivity of human resources. One of the efforts to reduce the prevalence of anemia is to provide iron supplementation for adolescents. Some researches showed vitamins could increase iron effectiveness. **Objective.** This study aimed to analyze the efficacy of iron and vitamin C supplementation on anemia in boarding school students. **Method.** Subjects participating were 56 female adolescent students aged 16 to 18 years old with hemoglobin levels of < 12 g/dL. The research design was quasi-experimental with two treatment groups. One group received iron (Fe), while the other received iron and vitamin C (Fe+Vit C). The treatment consisted of weekly supplementation for 90 days. Statistical analysis was used to identify the differences between two treatment groups (Independent sample t-test and Mann Whitney) as well as treatment changes (Paired sample t-test and Wilcoxon).

Result. The results showed that more than half of the subjects had normal nutritional status as seen from BMI for Age, mid-

DDC: 612615

MICRONUTRIENT PROFILE (IRON, ZINC, VITAMIN A) AND HEMOGLOBIN LEVEL IN PREGNANT WOMEN

Ade Nugraheni, Mutiara Prihatini, Aya Yuriesta Arifin, Fifi Retiaty, Fitriah Ernawati

MGMI Vol. 12, No. 2, June 2021: 119-130

ABSTRACT

Background. Anemia in pregnant women is still a public health issue in Indonesia. Anemia in pregnant women can hurt the

<p>health of both the pregnant women and their unborn children. In developing countries such as Indonesia, the cause of anemia is partly due to lack of iron intake and other micronutrients such as zinc and vitamin A. Objective. The study aims to determine the micronutrient profile of pregnant women's serum and to assess the relationship between Hb levels and levels of sTfR, zinc, and vitamin A in pregnant women. Method. The study design was a cross-sectional part of the 2018 biomedical cohort study, which included 114 pregnant women ranging in age from 16 to 46 years old. The levels of Hb, sTfR, zinc, and vitamin A were all variables observed. SPSS version 18.0 was used to analyze the data, which included descriptive and Pearson correlation analysis. Results. The results showed that there were still pregnant women who were classified as at risk, namely in the age group 16–19 years as much as 5.3% and in the age group 41–46 years as much as 3.5%. The 20–30 year age group had the highest rate of anemia, at 67.9%, while the 31–40 year age group had 33.0%. In general, 35.1% of pregnant women were anemic, and 86.8% were zinc deficient. Conclusion. Level of sTfR, zinc, and vitamin A are associated with Hemoglobin levels in pregnant women. To prevent anemia in pregnant women iron, zinc, and vitamin A levels must be improved, which can be accomplished by increasing zinc and vitamin A intake, particularly in pregnant women aged 20–30 years. Keywords: anemia, micronutrients status, pregnant women, zinc deficiency</p>	<p>diseases. As you get older, the physiological function of the body also decrease and there are changes, especially in physiological changes, because with age, the function of organs will decrease both due to natural factors and due to disease. Hypertension is also often associated with nutritional status because someone who is overweight more likely to do hypertension than normal people. One of the most common health is problem of experienced by the elderly is reduced heart strength. The food intake is very important role to supporting healthy and blood pressure control. Objective. This study aim to determine the relationship between the adequacy level of monounsaturated fat, calcium, magnesium, potassium, and nutritional status with the incidence of hypertension in the elderly at Posbindu PTM Puskesmas Tajur Tangerang City. Method. The design of research used a cross-sectional design. The design was selected by proportional stratified random amounting to 108 respondents. Data analysis using Chi Square. Results. The findings showed that the adequacy level of monounsaturated fat (96.3%), calcium (81.5%), and potassium (54.6%) was classified as low (<77% RDA) but the adequacy level of magnesium was sufficient (68.5%) and most of them with overweight nutritional status (74%). There was not relationship between the adequacy of monounsaturated fat, calcium, magnesium, potassium, and nutritional status with the incidence of hypertension ($p>0.05$). Conclusion. There is no relationship between the adequacy of consumption of monounsaturated fat, calcium, magnesium, potassium, and nutritional status with the incidence of hypertension due to the hypertension at Posbindu PTM Puskesmas Tajur Tangerang City caused by many factors such as age, gender, education level, food intake, genetics, smoking habits, and stress. It is necessary to pay attention to intake supporting the health of the elderly people. Keywords: hypertension, mineral, monounsaturated fatty acid, nutritional status</p>
<p>DDC: 615.3 CLUSTER ANALYSIS: CHARACTERISTIC, NUTRIENT CONTENT, AND ACTIVE COMPOUND OF EXTRA VIRGIN OLIVE OIL IN SUPERMARKET Retno Mardhiati, Sri Anna Marliyati, Drajat Martiano, Siti Madanijah, I Wayan T Wibawan MGMI Vol. 12, No. 2, June 2021: 131-142 ABSTRACT Background. Nutrient contents of extra virgin olive oil (EVOO) possess abundant benefits for human's health. Some of them function as immunomodulator, preventing heart disease and other vascular diseases, preventing allergic diseases, improving liver's function, and avoiding other diseases. The EVOO's nutrient contents in different EVOO brands are not identical since they are determined by many factors. Objective. This study aimed to do cluster analysis, based on their chemical characteristic, nutrient content, and active compound of seven product samples of EVOO supplied in supermarket. Method. Descriptive design was used in this study. The collection of seven EVOO product samples from supermarkets in Great Jakarta area was done in March 2019. The EVOO product samples examination was performed in Bogor at The Center of Agro Based Industry Laboratory of Ministry of Industry and Biofarmaka, laboratory of Institute for Research and Community Service Bogor Agricultural University. Analysis used in this study was cluster analysis with hierarchical method approach. Result. Based on chemical characteristic, it was found that EVOO product sample 6th had the most different chemical characteristic. EVOO product sample 4th contained the most different unsaturated fatty acid content whereas unsaturated acid content of sample 1st, 3rd, and 7th were similar. The vitamin E content of EVOO product sample 2nd and the iron content of EVOO product sample 6th were different from other samples. Total flavonoid content of EVOO product sample 2nd, 3rd, and 4th were similar. Total carotenoid content of EVOO product sample 2nd and 6th were also comparable. Conclusion. The chemical characteristics of all EVOO product samples found in the study had almost the same value. The EVOO product samples from supermarket supplies possess differences on unsaturated fatty acid, total flavonoid, and carotenoid content. Keywords: fatty acid, Fe, flavonoid, olive oil, vitamin E</p>	<p>DDC: 612346 SENSORY ANALYSIS AND SHELF LIFE OF A DIABETIC SNACK MADE FROM TUNA (<i>Thunnus sp.</i>) AND CHAYOTE (<i>Sechium edule</i>) Toto Sudargo, Atika Anif Prameswari, Bianda Aulia, Tira Aristasari, Khusnul Alfionita, Rahadyana Muslichah, Alim Isnansetyo, Indun Dewi Puspita, Siti Ari Budhiyanti, Sheila Rosmala Putri MGMI Vol. 12, No. 2, June 2021: 153-164 ABSTRACT Background. Sensory analysis and shelf-life evaluation in the development of food products is essential to ensure product acceptance and safety for consumers. Individuals who have prediabetes have the opportunity to prevent or delay the development of DM if they can improve their lifestyles. Snacks are an essential part of diet management for people with prediabetes, so the amount and type of food ingredients need to consider. Objective. This study aimed to analyze and formulate organoleptic properties and shelf-life of a snack product for people with prediabetes. Method. This study used an experimental design with a completely randomized design to test the sensory characteristics of four seasoning formulas for a prediabetic snack product. The estimated shelf-life test with the Arrhenius Accelerated Shelf Life Testing (ASLT) with the thiobarbituric acid (TBA) numerical value approach had carried out on the unseasoned product. The product had stored at different temperatures: 4°C, 27°C, and 45°C. Statistical analysis was performed using the Kruskal Wallis test followed by a Mann Whitney test. Results. There were no significant differences between the formulas in the color and aroma parameters. There were, however, significant differences in the parameters of taste, texture, and overall values ($p<0.05$). The analysis results of the shelf-life prediction test showed that the regression equation in order of 1 was used as an approach to predict the shelf-life of the product. Conclusion. The F3 formula (onion powder and salt seasoning) was the majority of preferred prediabetic snacks for color, aroma, taste, and overall parameters. Then, the F2 formula (onion powder seasoning) was the most preferred texture parameter. The predicted shelf-life for this prediabetes snack product at room temperature/normal (30°C) was 80.97 days or 2.69 months. Keywords: chayote, prediabetes, sensory analysis, shelf-life, tuna</p>
<p>DDC: 6161359824 RELATIONSHIP BETWEEN THE LEVEL OF MONOUNSATURATED FAT, MINERAL, AND NUTRITIONAL STATUS WITH THE INCIDENCE OF HYPERTENSION IN POSBINDU PTM PUSKESMAS TAJUR TANGERANG CITY Kristina Rosalia Pakpahan, Nadiyah, Harna, Mertien Sa' pang, Yulia Wahyuni MGMI Vol. 12, No. 2, June 2021: 143-152 ABSTRACT Background. The hypertension can cause various related</p>	<p>diseases. As you get older, the physiological function of the body also decrease and there are changes, especially in physiological changes, because with age, the function of organs will decrease both due to natural factors and due to disease. Hypertension is also often associated with nutritional status because someone who is overweight more likely to do hypertension than normal people. One of the most common health is problem of experienced by the elderly is reduced heart strength. The food intake is very important role to supporting healthy and blood pressure control. Objective. This study aim to determine the relationship between the adequacy level of monounsaturated fat, calcium, magnesium, potassium, and nutritional status with the incidence of hypertension in the elderly at Posbindu PTM Puskesmas Tajur Tangerang City. Method. The design of research used a cross-sectional design. The design was selected by proportional stratified random amounting to 108 respondents. Data analysis using Chi Square. Results. The findings showed that the adequacy level of monounsaturated fat (96.3%), calcium (81.5%), and potassium (54.6%) was classified as low (<77% RDA) but the adequacy level of magnesium was sufficient (68.5%) and most of them with overweight nutritional status (74%). There was not relationship between the adequacy of monounsaturated fat, calcium, magnesium, potassium, and nutritional status with the incidence of hypertension ($p>0.05$). Conclusion. There is no relationship between the adequacy of consumption of monounsaturated fat, calcium, magnesium, potassium, and nutritional status with the incidence of hypertension due to the hypertension at Posbindu PTM Puskesmas Tajur Tangerang City caused by many factors such as age, gender, education level, food intake, genetics, smoking habits, and stress. It is necessary to pay attention to intake supporting the health of the elderly people. Keywords: hypertension, mineral, monounsaturated fatty acid, nutritional status</p>

UCAPAN TERIMA KASIH

Pengelola Jurnal Media Gizi Mikro Indonesia (MGMI), Balai Litbangkes Magelang mengucapkan terima kasih kepada:

1. Prof. dr. Veny Hadju, M.Sc., Ph.D (FKM Universitas Hasanudin Makassar)
2. Prof. Dr. Sri Sumarmi, SKM, M.Si. (FKM Universitas Airlangga Surabaya)
3. Prof. Dr. Ir. Ali Khomsan, MS (FEMA IPB Bogor)
4. Prof. dr. Nur Indrawaty Lipoeto, M.Sc, Ph.D, Sp.GK (FK Universitas Andalas Padang)
5. Prof. Dra. Yayi Suryo Prabandari, M.Si, Ph.D (FK-KMK UGM Yogyakarta)
6. Prof. Dr. Astuti Lamid, MCN (Persagi)
7. Dr. Siti Helmyati, DCN, M.Kes. (FK-KMK UGM Yogyakarta)
8. Dr. Susetyowati, DCN, M.Kes. (FK-KMK UGM Yogyakarta)
9. Dr. Ir. Anies Irawati, M.Kes. (Persagi)
10. Dr. Ir. Basuki Budiman, M.Sc, PH (Persagi)
11. Dr. Toto Sudargo, SKM, M.Kes. (FK-KMK UGM Yogyakarta)
12. Dr. Nelis Imanningsih, STP, M.Sc. (Puslitbang BTDK Jakarta)
13. Dr. Kun Aristiati Susiloretni, SKM, M.Kes. (Poltekkes Semarang)
14. Gemala Anjani, M.Si, Ph.D (FK UNDIP Semarang)

sebagai mitra bestari jurnal MGMI yang telah melakukan telaah artikel yang diterbitkan pada edisi Desember 2020, volume 12 nomor 1 dan edisi Juni 2021, volume 12 nomor 2.

Kami segenap pengelola jurnal MGMI juga mengucapkan bela sungkawa atas meninggalnya Dr. dr. Sandi Iljanto, MPH sebagai mitra bestari (2012–2019) dan Tony Heryadi, M.Hum. sebagai editor bahasa Indonesia (2021).

Kami mengucapkan terima kasih atas kontribusi dan dukungan Almarhum pada jurnal MGMI selama ini. Semoga seluruh pengabdian dan amal ibadahnya diterima oleh Tuhan Yang Maha Esa.

Redaksi Pelaksana

PEDOMAN PENULISAN NASKAH

- Naskah yang dimuat dalam jurnal Media Gizi Mikro Indonesia (MGMI) adalah naskah/artikel hasil penelitian, hasil analisis ilmiah data sekunder, analisis kebijakan, rangkuman tentang topik terkini di bidang Gizi Mikro mencakup vitamin dan mineral.
- Naskah yang dikirim ke redaksi belum pernah dimuat atau tidak sedang diajukan untuk dimuat di media lain.
- Kepastian pemuatan atau penolakan naskah akan diberitahukan secara tertulis. Dewan Redaksi berhak mengubah isi dari naskah yang dimuat tanpa seizin penulis, sepanjang tidak bertentangan dengan pokok tulisan. Naskah yang tidak dimuat akan dikembalikan kepada penulis.
- Naskah ditulis dalam bahasa Indonesia dengan abstrak bahasa Inggris dan bahasa Indonesia. Demikian pula jika naskah ditulis dalam bahasa Inggris abstrak ditulis dalam bahasa Inggris dan bahasa Indonesia.
- Abstrak harus singkat dan jelas (250-300 kata), diketik dengan huruf miring (*italic*), jarak 1 spasi, disertai 3-5 kata kunci (*keywords*). Komponen abstrak terdiri dari latar belakang (*background*), tujuan (*objective*), metode (*method*), hasil (*results*) dan kesimpulan (*conclusion*).
- Sistematika penulisan naskah untuk hasil penelitian mengikuti kaidah sebagai berikut:
 - **Judul:** diketik dengan huruf kapital tebal (bold), tidak lebih dari 14 kata tanpa menghitung kata depan dan kata penghubung, singkat dan jelas mencerminkan isi tulisan;
 - **Identitas:** nama lengkap para penulis dan instansi tempat bekerja diketik di bawah judul; dianjurkan mencantumkan alamat lengkap dan email untuk memudahkan komunikasi;
 - **Abstrak:** ditulis dalam bahasa Indonesia dan bahasa Inggris disertai kata kunci 3-5 kata;
 - **Pendahuluan:** meliputi latar belakang, rumusan masalah, hipotesis (optional) dan tujuan;
 - **Metode:** meliputi disain studi, waktu dan tempat, sampel/informan, variabel, cara pengumpulan data dan analisis;
 - **Hasil:** meliputi karakteristik sampel, data deskriptif, hasil-hasil penting;
 - **Pembahasan:** meliputi hasil secara ilmiah, ringkas, fokus terhadap interpretasi hasil yang diperoleh, keterbatasan penelitian (jika ada);
 - **Kesimpulan:** kesimpulan dalam bentuk narasi, bukan pointers;
 - **Saran** (opsional);
 - **Ucapan terima kasih;**
 - **Daftar Pustaka:** artikel berupa hasil penelitian paling sedikit memiliki 10 acuan primer, sedangkan artikel kajian/tinjauan (review) paling sedikit memiliki 25 pustaka acuan.
- Jika naskah bukan dari hasil penelitian, sistematika disesuaikan dengan alur yang runtut.
- Naskah/artikel dikirim dalam bentuk file elektronik melalui aplikasi OJS MGMI (<http://ejournal2.litbang.kemkes.go.id/index.php/mgmi/about/submissions>) dan via e-mail (mgzimikro@yahoo.com).
- Naskah ditulis dalam program microsoft word (ms word), batas tepi kiri 3.5 cm, batas tepi kanan, atas, dan bawah 3 cm, spasi 1.5 kecuali tabel, huruf arial font 11, tebal naskah 10-18 halaman kertas ukuran A4.
- Setiap tabel, gambar, grafik dan bagan diberi nomor urut. Judul tabel ditulis pada bagian atas, sedangkan judul gambar, grafik dan bagan ditulis pada bagian bawah.
- Lambang, singkatan atau akronim dalam naskah boleh digunakan hanya sesudah ada penjelasan atau kepanjangannya.
- Penulisan daftar pustaka/rujukan menganut sistem nomor (Vancouver). Rujukan disusun sesuai dengan nomor pemunculan dalam teks dan disarankan menggunakan program Mendeley. Berikut contoh penulisan rujukan:
 1. **Jurnal/terbitan berseri**

Nama majalah dengan singkatan index medicus, bila penulis lebih dari 6 orang maka yang ketujuh ditulis et al.

Szabolcs I, Podoba J, Feldkamp J, Dohan O, Farkas I, Sajgo M, et al. Comparative Screening for Thyroid Disorders in Old Age in Areas of Iodine Deficiency, Long Termiodine Prophylaxis and Abundant Iodine Intake. *Clin Endocrinol (Oxf)*. 1997;47:87-92.
 2. **Penulis buku**

Murti B. *Desain dan Ukuran Sampel untuk Penelitian Kuantitatif dan Kualitatif di Bidang Kesehatan*. Yogyakarta: Gadjah Mada University Press; 2009.
 3. **Penulis bab dalam buku**

Mosley WH, Chen LC. An Analytical Framework for The Study of Child Survival in Developing Countries. In: Mosley WH, Chen LC, editors. *Child Survival Strategies for Research*. Cambridge: Cambridge University Press; 1984. p. 25-45.
 4. **Prosiding pertemuan ilmiah**

Atmarita, Tilden R. Masalah Gizi Perkotaan di Indonesia: Sudah Perlu Mendapat Perhatian. Dalam: Sandjaja, Jahari AB, Sumarno I, Sofia G, Rochamah, Hartati B, Soekatri M, editors. *Prosiding Kongres Nasional Persagi dan Temu Ilmiah XII*; 8-10 Juli 2002; Jakarta; 2002. p. 556-66.
 5. **Laporan penelitian**

Kumorowulan S. Pengaruh Pemberian Povidone Iodine dan Iodium Tincture Secara Topical terhadap Kelenjar Tiroid. *Laporan Penelitian*. Magelang: Balai Penelitian dan Pengembangan Gangguan Akibat Kekurangan Iodium; 2006.
 6. **Terbitan pemerintah**

Badan Pusat Statistik. *Statistik Penduduk Usia Lanjut*. Jakarta: Badan Pusat Statistik; 2007.
 7. **Lembaga**

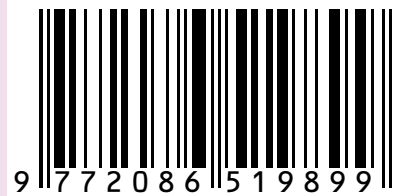
World Health Organization. *The World Health Report, Shaping The Future*. Geneva: World Health Organization; 2003.
 8. **Makalah dalam pertemuan ilmiah, kongres, simposium atau seminar yang belum diterbitkan**

Adisumarmo S. Biosafety in Indonesia and Its Possible Development: An Extended Thought on Biosafety Measures. *ISAAA Asia Biosafety Workshop*. Bogor: 22-24 April 1994.
 9. **Skripsi/tesis/disertasi**

Samsudin M. Hubungan Kadar Plumbum (Pb) dalam Daerah dengan Fungsi Tiroid (TSH-FT4) di Daerah Perkotaan. *Tesis*. Yogyakarta: Program Pasca Sarjana Epidemiologi Klinik Universitas Gadjah Mada, 2007.
 10. **Website**

Indra R, Patil S, Joshi R, Pai M, Kalantri PS. Accuracy of Physical Examination in The Diagnosis of Hypothyroidism: A Cross Sectional Double Blind Study. *J Postgrad Med*. 2004; 50:7-11. Diunduh dari: <http://www.ncbi.nlm.nih.gov/pubmed/15047991>, tanggal 23 April 2009.

ISSN. 2086-5198



9 772086 519899