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The Effect of Basil Leaf Extract (Ocimum Bacilicum L) on Beta 2 Microglobulin Levels, Uric Acid and Kidney Histology in White Galuh Wistar Rats (Rattus Norvegicus Strain Wistar) Induced by Monosodium Glutamate (MSG)

Tiarany Erlinda[1], Chrismis Novalinda[2], Linda Chiuman[3], Subang Aini[4]
[1] Master of Biomedical Science Study Program, Prima Indonesia University, Medan
[2] PUI Phytodegenerative and Lifestyle Medicine, Prima Indonesia University, Medan
[3] PUI Phytodegenerative and Lifestyle Medicine, Prima Indonesia University, Medan
[4] Faculty of Medicine and Health Sciences, Adiwangsa Jambi University
*E-mail : e-mail id of Corresponding Author please mention here

ABSTRACT
In this research, the author aim to investigate the influence of basil leaf administration on Beta-2 microglobulin levels, uric acid concentration, and kidney histology in Wistar rats induced with MSG, as well as to determine the most effective dose of basil leaf extract for improving kidney function. Basil leaves (Ocimum basilicum) are known as one of the traditional medicinal plants commonly used for therapeutic purposes. A total of 25 male Wistar rats weighing 200–230 grams were used in this study. The animals were divided into five treatment groups. The first group served as the control and received neither MSG nor basil leaf extract. The second group was given only MSG without basil leaf extract. The third, fourth, and fifth groups were administered MSG followed by basil leaf extract at doses of 87.5 mg/kg BW, 175 mg/kg BW, and 350 mg/kg BW, respectively. At the end of the treatment period, blood samples were collected for the measurement of Beta-2 microglobulin and uric acid levels, while kidney tissues were taken for histological examination. The findings revealed that the administration of basil leaf extract led to significant differences in Beta-2 microglobulin, uric acid levels, and kidney histopathology compared to the MSG-only group. In conclusion, basil leaf extract was shown to lower B2M and uric acid levels and improve kidney tissue structure damaged by MSG exposure.

Keywords: *Ocimum basilicum, beta-2 microglobulin, uric acid, kidney histology, MSG.*

INTRODUCTION
The kidneys are responsible for the production of hormones such as erythropoietin, 1,2-dihydroxyvitamin D, and renin. They also excrete waste products and toxins such as urea, creatinine, and uric acid, and regulate extracellular fluid volume, serum osmolality, and electrolyte concentrations. The glomerulus, proximal tubule, distal tubule, and ductus form the nephron, which is the functional component of the kidney. In the treatment of patients with kidney disease or pathologies that impair kidney function, assessing kidney function is crucial. Kidney function tests can be used to detect kidney disease, monitor kidney response to treatment, and determine the severity of kidney disease (Gounden et al., 2022).
Based on data from the Ministry of Health of the Republic of Indonesia (2022), several reports worldwide indicate that the incidence of acute kidney failure (ARF) in the community ranges

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from 0.5 to 0.9%. 0.7 to 18% in hospitalized patients, and 20% in intensive care unit (ICU) patients, with reported mortality rates ranging from 25% to 80%. According to the National Library of Medicine from 2004 to 2012, the overall incidence of AKI was 23.2%, the incidence of AKI in adults was 21.6%, and in children it was 33.7%.

Archives of Academic Emergency Medicine 2013-2018, 770 AKI patients with an average age of (1 – 99) years were evaluated (59.1% male) cases of AKI cause 89% were prerenal Furthermore, in this study the author also used Beta microglobulin (B2M) which is a protein that is useful as a marker of kidney damage because of its ability to be excreted through the kidneys. Increased levels of B2M in the blood and urine, especially in patients with signs and symptoms of kidney disease, can indicate kidney problems. B2M can also help differentiate between problems in the glomerulus (the part of the kidney that filters blood) and the renal tubules (the part of the kidney that reabsorbs important substances). This can be strengthened by the reason that B2M is a marker of tubular damage, a marker of glomerular damage, a marker of kidney damage due to toxins, a marker of kidney function in kidney transplantation, and as a kidney excretory.

METHODS

A true experimental laboratory study with a completely randomized design using mice as research subjects. The research design used was a Randomized Post Test Only with Control Group Design. The experimental design used a factorial Completely Randomized Design (CRD) with five groups. In the treatment group there were a minimum of 5 male mice. The number of treatment groups was 5, so the total number of mice needed was 25 mice. Jambi City Health Office Laboratory. This research was conducted from March to August 2025.

Research Variables:

1. Independent variable: basil leaf extract
2. Dependent variables: Plasma β2 microglobulin examination, Plasma Uric Acid examination, and histopathological features of rat kidneys.
3. Control variables: Cage size and condition, sex, body weight, age, type of rat feed, and MSG dosage.

Tools: Rat drinking container, Rat scales (SF-400), 10 mL measuring cylinder, 250 mL beaker, Erlenmeyer flask, Stirrer, Rat gastric tube, 5 mL and 3 mL syringes (terumo), EDTA tube (vaculab), Centrifugator, Microtip, Micropipette, 15 mL centrifuge tube, Cuvette tube, Shimadzu 1700 spectrophotometer, Object glass and Storage rack

Ingredients: Basil leaf extract (Ocimum basilicum L.), MSG, Rat Elisa β2 microglobulin kit ABIN367427 reagent, BioMajesti JCA-BM6010 DiaSys uric acid reagent, Chemicals for kidney histology tissue preparation, and Standard drinking feed.

White rats (Rattus novergicus) Wistar strain, male, 2 months old, healthy, weighing 150-200 grams, and without anatomical defects, the following are the sample inclusion criteria if they do not meet these criteria will be excluded. The rats used consisted of 25 rats, divided into 5 groups of 5 rats each and determined the treatment for each group. The rats were obtained from the Jambi City Health Office Laboratory.

RESULTS

The study of the effect of basil leaf extract (Ocimum basillicum L.) on Beta 2 microglobulin levels, uric acid and kidney tissue histology of white rats (Rattus norvegicus strain Wistar) induced by Monosodium glutamate (MSG) in white rats of the Wistar strain was conducted in

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the laboratory of the Jambi City Regional Health Office for 14 days. The sample size consisted of 25 rats divided into five groups, namely the control group (K1), the MSG-induced group (K2), the MSG-induced group and given vitamin E orally at a dose of 1.2 mg/day (K3), the MSG-induced group and given basil leaf extract at a dose of 200 mg/kg BW (K4), and the MSG-induced group and given basil leaf extract at a dose of 300 mg/kg BW (K5).

MSG has a negative impact on the kidneys, as evidenced by increased B2M and uric acid levels, as well as the percentage of kidney damage. Research conducted by Putri et al. (2019) showed that administering MSG at a dose of 1.6 g/kgBW can cause an increase in blood urea and creatinine levels. In this study, administering MSG at a dose of 40 mg resulted in an increase in B2M and uric acid levels in the blood, accompanied by histopathological damage to the kidneys.

Table 1. Mean levels of B2M, Uric Acid and Kidney Histology, Normality Test, Homogeneity Test, and one way ANOVA after treatment:

Treatment Group	Mean ± SD (pg/dL)	P value		
		Shapiro-Wilk Test	Levene's Test	One-way ANOVA test
Normal (K1)	95.04 ± 2.46	0.194*		
Negative control (K2)	30.92 ± 2.05	0.953*		
Negative control (K3)	62.57 ± 1.98	0.785*	0.274**	0.000*
Treatment (K4)	53.68 ± 2.33	0.815*		
Treatment 2 (K5)	69.63 ± 0.75	0.902		

The normality test using the Shapiro-Wilk test showed that all data collected were normally distributed ($p>0.05$), with K1, K2, K3, K4, and K5 showing significant values. Data on B2M levels, uric acid, and kidney histology were homogeneous, as Levene's homogeneity test yielded a result of 0.274 ($p>0.05$). The results of the One Way ANOVA test showed a significant difference between at least two groups, with a p-value of 0.000 ($p<0.05$).

Table 2. LSD Post-Hoc Test Results

	Group	P value Post-Hoc LSD test
Normal (K1)	Negative control (K2)	0.000*
	Negative control (K3)	0.000*
	Treatment (K4)	0.000*
	Treatment 2 (K5)	0.000*
Negative control (K2)	Normal (K1)	0.000*
	Negative control (K3)	0.000*
	Treatment (K4)	0.000*
	Treatment 2 (K5)	0.000*
Negative control (K3)	Normal (K1)	0.000*
	Negative control (K2)	0.000*
	Treatment (K4)	0.000*

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	Treatment 2 (K5)	0.000*
Treatment (K4)	Normal (K1)	0.000*
	Negative control (K2)	0.000*
	Negative control (K3)	0.000*
	Treatment 2 (K5)	0.000*
Treatment 2 (K5)	Normal (K1)	0.000*
	Negative control (K2)	0.000*
	Negative control (K3)	0.000*
	Treatment (K4)	0.000*

Significant differences between groups are shown in Table 4.2 with the results of the Post-Hoc LSD test ($p<0.05$). Significant differences in values were seen between the normal group (K1), the negative control group (K2), and the positive control group (K3). The lowest levels were in group K2, compared to groups K1 and K3. In the positive control group (K3), there was a statistically significant difference between treatment groups 1 (K4) and 2 (K5). Specifically, the levels in K3 were greater than K4 and lower than K5. Both the first treatment group (K4) and the second treatment group (K5) showed a significant decrease in levels compared to the control group (K1). However, there was a striking difference in the levels between the negative control group (K2), treatment group 1 (K4), and treatment group 2 (K5), with K4 and K5 having greater values than K2. In addition, compared to group 1 (K4), the levels of B2M, uric acid and kidney histology were greater in group 2 (K5).

DISCUSSION

The results of this study indicate that the B2M level in the blood of mice in the control group was 7.32 µg/mL compared to the other treatment groups. In a study conducted (Eatman et al, 2016) the B2M level in mouse urine was found to be 4 µg/mL. In normal human individuals the B2M level is 2.6 mg/L 14 or there is a study (Cheung et al, 2016) which states the average upper level of human B2M serum is 1.4 µg/mL. The normal value of B2M in human urine is 230-300 µg/l) (Singh et al, 2017). This study found an increase in B2M levels in mice induced with MSG of 13.32 µg/mL. In non-diabetic mice induced with contrast media, an increase in B2M levels of 516 ng/mg were found in the kidneys.

A study by Contini et al. (2012) showed that serum β2 microglobulin and serum creatinine levels increased with the severity of kidney disease in 88 patients at Sheikh Zayed Hospital, Lahore. A study by Giordano et al. (2015) found that elevated urinary β2 microglobulin indicated renal proximal tubular injury in 46 patients undergoing kidney biopsy. Elevated B2M levels can occur in all patients with chronic kidney disease (CKD), with an average of 25.6 mg/L, indicating a 10-fold increase compared to normal individuals.

It is known that β2microglobulin (B2M) has a small size, so it can be easily filtered by the glomerulus. Approximately 99% of β2microglobulin is reabsorbed by the proximal tubule and catabolized. Measurement of serum β2microglobulin levels provides information on impaired tubular function. In a study conducted by (Ali et al, 2017) showed that intraperitoneal injection of ethanol extract of O. basilicum can significantly reduce morphine withdrawal syndrome and total morphine withdrawal scores divided into two doses, namely 20 mg / kgBW and 40 mg / kgBW in the morphine group. It appears that administration of total ethanol extract of O. Basilicum may suppress NMDA receptor activation and prevent signs of morphine withdrawal by its inhibitory effect on the immune system and pro-inflammatory cytokines.

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O. basilicum leaves are a rich source of flavonoids that have been shown to possess various biological properties related to antioxidant mechanisms. Tanaka et al., (2015) reported that the main components of O. basilicum are: linalool (29.68%), (Z) cinnamic acid methyl ester (21.49%), cyclohexene (4.41%), alpha-cadinol (3.99%), 2,4-diisopropenyl-1-methyl-vinylcyclohexane (2.27%), 3,5-pyridine-dicarboxylic acid, 2,6-dimethyl-diethyl ester (2.01%), beta-cubebene (1.97%), guaia1 (10), 11-diene (1.58%), cadinene (1.41%), (E) - cinnamic acid methyl ester (1.36%) and beta-guaiene (1.30%).

This study also found that ischemia in the renal tubules in the group given basil leaf extract was less than that given only MSG. This indicates that basil leaf extract can prevent kidney damage, this is in accordance with research (Sharma, 2015) which states that administration of basil leaf extract can improve kidney histological abnormalities in rats that have been induced with adriamycin (chemotherapy drug). Renal tubule damage due to MSG exposure is in the form of narrowing of the tubular lumen due to swelling of the renal tubules and in the tubular lumen found hyaline casts which are a collection of damaged protein residues and necrosis in the renal tubular epithelium (Mahidin, 2018).

CONCLUSION

Based on the research that has been done, the following conclusions can be drawn: Administration of basil leaf extract affects the levels of B2M and uric acid as well as kidney histology in white wistar rats induced by MSG. The average levels of B2M and uric acid as well as kidney histology in white wistar rats in the normal group (K1) were 95.04 pg/mL, the negative control group (K2) was 30.92 pg/mL, the positive control group (K3) was 62.57 pg/mL, treatment group 1 (K4) was 53.68 pg/mL, treatment group 2 (K5) was 69.63 pg/mL The dose of basil leaf extract of 300 mg/kgBW had higher levels of B2M and uric acid as well as kidney histology compared to the dose of basil leaf extract of 200 mg/kgBW in white wistar rats induced by MSG. The three statements above show that administering Ocimum basilicum can improve kidney function damage caused by administering MSG, as evidenced by a decrease in B2M levels, uric acid and the level of kidney damage.

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