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Effect of Essential Oil of Basil Leaf (*Ocimum basilicum*) on Malondialdehyde (MDA) Levels in Wistar Rats with Excessive Physical Activity

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ABSTRACT

Introduction: Excessive physical activity causes the formation of ROS and RNS in the body, which can damage cellular lipids, DNA and proteins. This is responsible for the formation of oxidants that cause the aging process. Malondialdehyde (MDA) is produced from lipid peroxidation and is the end product of oxidative stress. This study aims to prove that administration of basil leaf essential oil can reduce levels of MDA in Wistar rats with excessive physical activity.
Methods: This research was an experimental post-test only control group design using male rats as the object of research. The sample was divided into 2 groups, the treatment group which was given basil essential oil 30 minutes before physical activity, and the control group which was given 1 ml of aquabidest every day 30 minutes before excessive activity. Each group was given physical activity in the form of swimming for 60 minutes. Then on the 21st day, MDA levels were examined using the ELISA method on blood. Data is recorded and analyzed.
Results: The average (MDA) level in the control group was 3.229 nmol/mL (95% CI 2.823 – 3.635) with a standard deviation of 0.816. The lowest MDA level in the control group was 2.456 nmol/mL and the highest was 5.217 nmol/mL. The average MDA level in the treatment group was 2.356 nmol/mL (95% CI 2.204 – 2.508) with a standard deviation of 0.285 nmol/mL. The lowest MDA level in the treatment group was 1.768 nmol/mL and the highest was 2.772 nmol/mL.
Conclusion: Administration of basil essential oil resulted in lower MDA levels than controls in Wistar rats subjected to excessive physical activity.

Keyword: Malondialdehyde. Basil essential oil, physical activity

INTRODUCTION

Physical activity triggers a series of physiological and biochemical reactions. Anaerobic metabolism is the foundation of any explosive muscle activity. Excessive physical activity causes the formation of ROS and RNS in the body, which can damage cellular lipids, DNA and proteins. Oxidative stress is the cause of various disorders such as aging, inflammation, cardiovascular disease, neurodegenerative disease, and cancer. It can be caused by an imbalance between the production of free radicals and the body's antioxidants. There is a strong dose-response relationship between physical exercise and oxidative stress. [1,2]
Aging is the result of various factors and causes malfunctions in molecular structure, cellular function, and organ function.[1] One current mechanical explanation for

aging is the "free radical theory of aging". This theory postulates that the fundamental cause of aging and related disorders is the breakdown of endogenous antioxidant defenses due to free radical damage of cellular macromolecules.[2] One of the causes of many diseases, especially degenerative diseases, is the accumulation of oxidative damage due to excess free radicals in the body. Reactive compounds that have one or more unpaired electrons are called free radicals.[3]

Free radicals can accumulate in the body after intense exercise, antioxidants supplementation or those antioxidants contained in food and drinks might help reducing stress. Antioxidants are safe for human consumption whether natural, which present in as vegetables, fruits, or synthetic ones.[4] Malondialdehyde is produced from the lipid peroxidation process and is one of the end products of oxidative stress biomarkers, including superoxide dismutase, catalase, and glutathione peroxidase. The level of MDA is influenced by the level of free radicals in the body. Free radicals trigger lipid peroxidase and the production of arachidonic acid, which initiates DNA-damaging agents such as MDA and 4-HNE.[5] MDA has a toxic effect that damages cell membranes due to oxidative stress when MDA has reached its highest level, consequently it must be reduced.[6]

Basil (*Ocimum basilicum L*) has a good reputation as a medicinal component where the essential oil in basil has effects as an antioxidant, antidiabetic, antimutagenic, antianxiety. Antimicrobial, analgesia.[7] Basil leaf essential oil contains the antioxidant components such as apigenin, quercetin, rutin, and p-hydroxybenzoic, caffeic, vanillic, and rosmarinic acids. Researchers have explained that the antioxidant properties of basil leaves can help people fight cancer, maintain heart health, and reduce the body's inflammatory reactions. Basil leaf essential oil has nephroprotective potential because it does not negatively affect the results of biochemical and histological tests on the kidneys and liver. [8,9]

This study aims to prove that administration of basil leaf essential oil can reduce levels of Malondialdehyde (MDA) in Wistar rats with excessive physical activity.

METHODS

This research is an experimental post-test only control group design study using male rats, aged 12-14 weeks, with body weight of 180-200 grams. The material used in this research is the essential oil of basil leaves. The sample was divided into 2 groups, the treatment group which was given basil essential oil 30 minutes before physical activity, and the control group which was given 1 ml of distilled water every day 30 minutes before excessive activity. Each group was given physical activity in the form of swimming for 60 minutes. Then on the 21st day, MDA levels were examined using the ELISA method on blood. MDA levels were analyzed by Mann – Whitney non-parametric test.

RESULTS

Examination of MDA levels was carried out after treatment on day 21. The results of the descriptive analysis of MDA levels in each group are shown in Table 1. The average malondialdehyde (MDA) level in the control group was 3.229 nmol/mL (95% CI 2.823 – 3.635) with a standard deviation of 0.816. The lowest MDA level in the control group was 2.456 nmol/mL and the highest was 5.217 nmol/mL. Furthermore, the average MDA level in the treatment group was 2.356 nmol/mL (95% CI 2.204 – 2.508) with a standard deviation of 0.285 nmol/mL. The lowest MDA level in the treatment group was 1.768 nmol/mL and the highest was 2.772 nmol/mL. The results of the Shapiro – Wilk test on the MDA level variable presented that the data in the control group were not normally distributed (P value <0.05) while the data in the treatment group were normally distributed.

Table 1. Descriptive analysis of MDA levels in the control and treatment groups

Variables	Groups	n	Mean	SD	Minimal – Maximal	95% CI	p-value
MDA levels (nmol/mL)	Control	18	3,229	0,816	2,456 – 5,217	2,823 – 3,635	0,001
	Treatment	16	2,356	0,285	1,768 – 2,772	2,204 – 2,508	

Figure 1 shows that the control group has higher MDA levels than the treatment group. The mean difference between the two groups was statistically significant ($p < 0.05$).

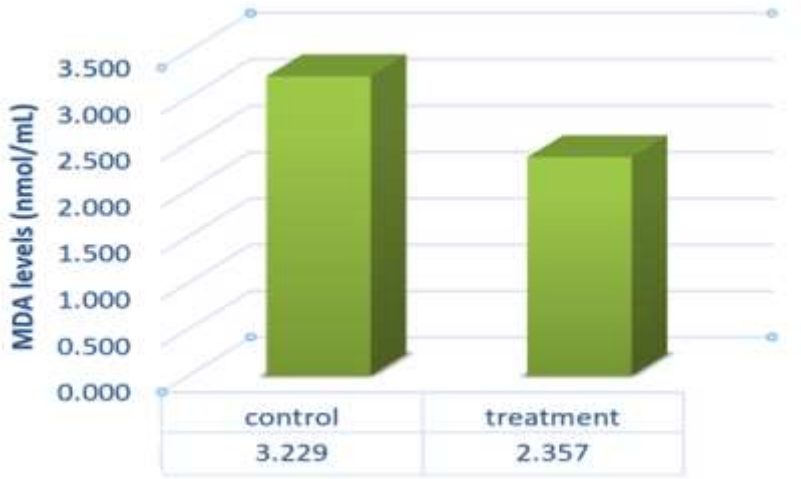

Figure 1. Comparison Graph of Average MDA Levels at Control and Treatment Group

DISCUSSION

When exercising, carbon dioxide production increases, the lactic acid accumulates and haemoglobin oxygen saturation becomes lower, hence it caused increasing oxygen demand. Excessive physical exercise increases oxygen consumption up to 100-200 times. This condition can trigger oxidative stress and if it continues it will eventually damage cells in the body.[10] Studies in laboratory animals show that acute aerobic exercise increases levels of oxidative stress in the blood and tissues such as skeletal muscle and the brain, heart, lung, liver, kidney and spleen. Excessive physical training that is carried out continuously can change the redox balance by accumulating excess oxidative stress resulting in damage to cells and tissues.[11]

When training is too hard, the ROS in the network increases. Superoxide ions, or free radicals, account for 2-5% of the oxygen required for metabolism. Lipid oxidation of muscle cell membranes will involve the emission of free radicals. Lipid peroxidation is a process that can lead to aging and cell dysfunction.[12] Malondialdehyde (MDA) is a by-product of the oxidative stress phase where reactive oxygen species (ROS) cause damage to cell membranes. Indicators of oxidative stress caused by free radicals include malondialdehyde (MDA), a metabolite produced as a by-product of lipid peroxidation by free radicals.

According to the literature, basil essential oil is optimal in preventing oxidative damage due to free radicals.[13] The high concentration of the bioactive components of basil essential oil, especially the flavonoids, makes it effective in reducing oxidative stress resulting from strenuous exercise. Directly, Flavonoids can neutralize free radicals as chain-breaking antioxidants and indirectly increase endogenous antioxidants.[14]

The ability to scavenge oxygen radicals and anti-inflammatory activity have been linked, making an antioxidant-rich diet important.[15] Due to its anti-inflammatory properties, its ability to reduce the formation of inflammatory cytokines from eicosanoids, and its ability to prevent the formation of prostaglandins, linolenic acid is one of these compounds. Stronger anti-

inflammatory activity correlates with a greater ability to entrap oxygen radicals. Basil leaves (*Ocimum basilicum L*) are a good example because they contain flavonoid chemicals. By scavenging free radicals and blocking oxidative stress and inflammation.[16,17]

CONCLUSION

Administration of basil essential oil resulted in lower MDA levels than controls in Wistar rats subjected to excessive physical activity.

Declaration by Authors

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