The Effect of Mangosteen (Garcinia mangostana L.) Peel to Creatine Kinase Serum in Male Rats (Rattus norvegicus) with Fatigue from Swimming

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Abstract— **Oxidative stress that occurs due to heavy physical exercise causes cells damage in the body, including muscle cells. Acute or chronic muscle cells damage can be marked by measuring the content of creatine kinase in the serum. Natural antioxidant consumption is a way to overcome the effect of oxidative stress. One of natural antioxidants is mangosteen (Garcinia mangostana L) peel with high content of antioxidants, xanthone and anthocyanin. The aim of this study is to understand the effect of mangosteen peels to creatine kinase serum in male rats (Rattus norvegicus) which have swimming fatigue. This is a true experimental study with post-test only control group design with 29 white rats as the experimental animals which were divided into 4 groups. The first group was given distilled water while the others groups were given mangosteen peels extract with dosage of 50, 100 and 200 mg/KgBW for 3 weeks. Physical activity, swimming, was done thrice in a week to all groups. Creatine kinase test was done at the last day of treatment where the rats had swum to fatigue. The average of creatine kinase serum shows a significant reduction. From the three dosage, 200 mg/KgBW of extract mangosteen peels is better to reduce creatine kinase serum content compared to the other two dosage in male rats. From this study, it can be concluded that mangosteen (Garcinia mangostana L) peels extract acts as antioxidant to lower creatine kinase serum in male rats (Rattus norvegicus) with swimming fatigue.**

Keywords—Mangosteen peels extract; creatine kinase; swimming fatigue.

I. INTRODUCTION

Physical training is a series of structured and rhythmic physical activities with a specific intensity in a certain amount of time that aims to increase physical fitness [1]. However, maximum physical activity can cause fatigue and even muscles injury. Exercise raises oxygen consumption as the metabolism increases in the body such as in muscles, the heart and brain [2]. The increase of oxygen consumption is able to badly affect the cells in the body including muscle cell.

Skeletal muscle produces reactive oxygen species (ROS) when contracted. The imbalance between ROS and antioxidant in the body due to physical activity lead to a condition known as oxidative stress [3]. The raise of oxidative stress can be dangerous to all macromolecules like lipid, protein and DNA [4]. This condition triggers damages in muscle cell.

There is a physiology indicator that is considered as an important parameter to observe the training volume and intensity like Plasma Creatine Kinase to prevent oxidative stress to occur. A number of studies about physical training and Creatine Kinase have been done. There is an insignificant increase of creatine kinase concentration in runners who did 6 kilometer run [5]. According to [6] endurance training induces the rise of creatine kinase level in the circulation.

Oxidative stress effect can be overcome by giving a good either natural [7] or synthesized antioxidant [3,8,9,]. Natural antioxidant studies is Anthocyanin from purple tubers and black rice [10,11], ginger [12], ginseng [13] and grape seed extract [14].

One of the plants in Indonesia that contains antioxidant is mangosteens (Garcinia mangostana L) in its skins. Several studies show that mangosteen rind containe Xanthone and Anthocyanin [15,16,17,18]. The research for mangosteen peel efficacy is still limited to health and not in sports. For health, mangosteen skin works as antihistamine [19], antiinflammation, pain killers and neuropsychiatry [20], anti-cancer [21] and anti-diabetic [22,23]. The background of study encourages the research to see the effect of mangosteen (Garcinia mangostana L) skin extract to creatine kinase serum level in male rats (Rattus norvegicus) that are let to swim to fatigue.

II. METHOD

This study is a pure experimental research with posttest-only control group design. The sample in this research was 29 of 2-month old white male rats (Rattus norvegicus) with body weight of 180 – 200 grams. The rats are acclimated for one week in the cage and they were given food and drink as much as they like. The light was controlled to be 12 hours lights (06.00 – 18.00) and 12 hours dark (18.00 – 06.00), while the room temperature and humidity were left at their natural state. The usage and handling of experimental animal have obtained ethical clearance from ethics committee in Mathematics and Natural Sciences Faculty of Universitas Sumatera Utara, Medan.

Samples were put into 4 groups, the first group as a control group was given distilled water and swimming activity. The second group received 50mg/kg weight of mangosteen rind extract and asked to swim. The third and fourth groups were given 100 mg/kg and 200mg/kg weight of mangosteenn skin respectively and swimming activity for both groups. Swimming was done three times a week for 30 minutes in Week I, 35 minutes in Week II and 40 minutes in Week III. At the end of treatment, the rats were let to swim to almost drawn or when fatigue was shown with full body except the nose in the water and the weakening of limbs movement.

Mangosteen rind extract (EKBM) was made by ethanol 96% maceration method. Extract was given every day, half an hour before the swim. Creatine Kinase examination was done at the last day of treatment after the rats swam to fatigue. The rats were executed and the blood was taken from the heart. Blood test was done with enzymatic kinetic method. Data obtained was tested with ANOVA test and followed by LSD Test. Differences were considered significant at $p<0,05$.

III. RESULTS

This research aims to observe the effect of mangosteen (Garcinia mangostana L) rind extract to creatine kinase serum level is male rats (Rattus norvegicus) that were asked to swim to fatigue. From the study, the difference of creatine kinase level is shown in Table 1 and Figure 1.

From Table 1, it can be seen that the average level of creatine kinase is the highest in control group. Next, the group that was given mangosteen peel extract had reduction in creatine kinase level. In *ANOVA* test, p value obtained was equal to 0.000 which means that there is a significant difference in the average level of creatine kinase in male rats that were asked to swim to fatigue after the administration of mangosteen rind extract in various dosage. *LSD* test show 200 mg/kg weight dosage was better in reducing creatine kinase serum level in male rats.

IV. DISCUSSION

The research shows that creatine kinase is the highest in control group that received aquadest and swimming. Similar result was shown in a study conducted by [24] in which creatine kinase serum increased in rats which had swum to fatigue. Creatine kinase is an indicator that marks muscle damage [25]. Endurance test is able to cause damages in muscle tissue. This condition is known as rhabdomyolysis [6,26]. The damages are indicated by the increase of several circulations in muscle protein like creatine kinase, lactate dehydrogenase and myoglobin [27].

Creatine kinase serum decreased in the groups of rats which were given mangosteen skin extract. Several studies used natural plants and showed the influence to creatine kinase. Reference [28] found that the administration of curcumin is effective in reducing creatine kinase-MB level. Lycium barbarum administration is able to reduce creatine kinase and CK-MB activities in rats that were asked to swim to fatigue [24]. Mangosteen rind extract has the potential as antioxidant [15] like xanthone and anthocyanin [18]. Antioxidant is a substance that is capable to ward off and muffle the negative impact of oxidants in the body by donating one of the electrons. As a result, oxidant activity can be hindered [29]. The antioxidant activity of mangosteen peel extract reduces stress oxidation hence the reduction of damages in mucle cell.

Based on this study, it can be concluded that mangosteen rind extract (Garcinia mangostana L.) as antioxidant is able to reduce creatine kinase serum level in male rats (Rattus norvegicus) which were let to swim to fatigue.

TABLE 1. Differences in Levels of Creatin Kinase in Male Rats

Parameter	**Treatment group**				***p* value**
	P1	**P2**	**P3**	**P4**	
Creatine Kinase (U/L)	1037,86 ±45,05	960,57 ±71,51	819,50 ±97,87	727 ±39,62	0,000*

Note: P1 (Control); P2 (EKBM 50 mg/KgBW); P3 (EKBM 100 mg/KgBW); P4 (EKBM 200 mg/KgBW); Average ± S.D ; * indicates the difference between groups ($p<0,05$).

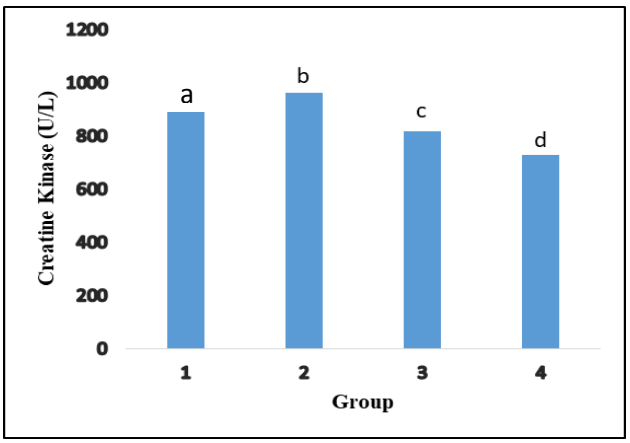

Fig. 1. LSD testing in group control, EKBM 50 mg/KgBW, EKBM 100 mg/KgBW and EKBM 200 mg/KgBW. ^{a,b,c,d}. ($p<0,05$).

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