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## **Effectiveness of Ajwa Date (*Phoenix dactylifera*) on Blood Lactate Recovery in Rats (*Rattus norvegicus*) with Induced Physical Activity**

Fatmawaty Mallapiang <sup>a\*</sup>, Suryani As'ad <sup>b</sup>, Syamsiar S. Russeng <sup>c</sup>, Andi Armyn Nurdin <sup>d</sup>, Burhanuddin Bahar <sup>e</sup>

<sup>a</sup> Faculty of Medicine and Health Sciences Alauddin State Islamic University

<sup>b</sup> Faculty of Medicine, University of Hasanuddin

<sup>c</sup> School of Public Health, University of Hasanuddin

<sup>a</sup>fatmawatymallapiang@yahoo.co.id

### **Abstract**

This study was aimed to find out the effect of various Ajwa date (*Phoenix dactylifera*) dosages on blood lactate recovery in female Wistar rats (*Rattus norvegicus*) with induced physical activities, using 20 female Wistar rats divided randomly into four groups (n = 5). This study used pre-post test with control group design. Group I were fed with Ajwa date suspension at dosage of 0.058g/200g BW (dosage A), Group II at dosage of 0.116g/200g BW (dosage B), Group III at dosage of 0.232g/200g BW, and Group IV as control fed with NaCMC of 100 mL/BW (dosage D). The Ajwa date suspension administration was followed by induced physical activities that included swimming for 30 minutes. The blood lactate was measured before swimming, at minute 5 and minute 30 after swimming. One way Anova test indicated that there was a significant difference between the Ajwa date dosages (dosages A, B, C, and D) in affecting the blood lactate at minute 5 after the physical activity with  $p = 0.042$  ( $<0.05$ ), and at minute 30 after physical activity with  $p = 0.002$  ( $<0.05$ ). Whereas the post hoc LSD test indicated that the Group B (moderate dosage) was the effective dosage ( $3.34 \pm 0.36$ ,  $p = 0.002$ ) in the recovery of lactate level in rats with induced physical activity.

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\* Corresponding author.

Ajwa date provided effect on blood lactate recovery in female Wistar rats. The effective dosage of Ajwa date in accelerating the recovery was the dosage B (moderate dosage) equivalent to 7 Ajwa dates.

**Keywords:** Ajwa date; blood lactate; rats; physical activities.

## 1. Introduction

Economic activities always need manpower with high productivity [1]. To achieve this, a special attention needs to be given to the causes of the manpower exhaustion that includes work intensity and duration, working environment, circadian rhythm, physical problems, pain and health conditions, as well as monotonous working behavior [-4]. In the last 3 years, women have shown an increasing participation in employment [5]. This related to difficult economic situation in their family that requires the women to accompany their husbands for livelihood, while at the same time need to manage their home and family [6] predisposing them to exhaustion in working. Exhaustion or fatigues a natural process in human that affects the reduced productivity of manpower [6-10]. Fatigue is caused by the accumulation of blood lactate due to high physical activities in prolonged time [7]. Ajwa dates have been demonstrated to contain high nutrients, with energy of 282 kcal, carbohydrate of 75.03 gram/100 gram fruit, total glucose of 63.35 gram/100 g fruits, potassium of 696 mg, and magnesium of 54 mg [11].

There are no currently specific studies on dates or its content to reduce lactate level after physical exercises. A study showed that giving carbohydrate-electrolyte drinks to exercising athletes could accelerate the lactate release from blood [12]. High input of carbohydrate and potassium (electrolyte) provided great benefit in minimizing fatigue, thus accelerating the recovery time. Dates contain high carbohydrate and potassium making it a potential agent in minimizing the lactic acid accumulation in blood that results in tired feeling. This study was aimed to assess the effect of various Ajwa date dosages on blood lactate recovery in female white mice (*Rattusnorvegicus*) with induced physical activity.

## 2. Materials and Methods

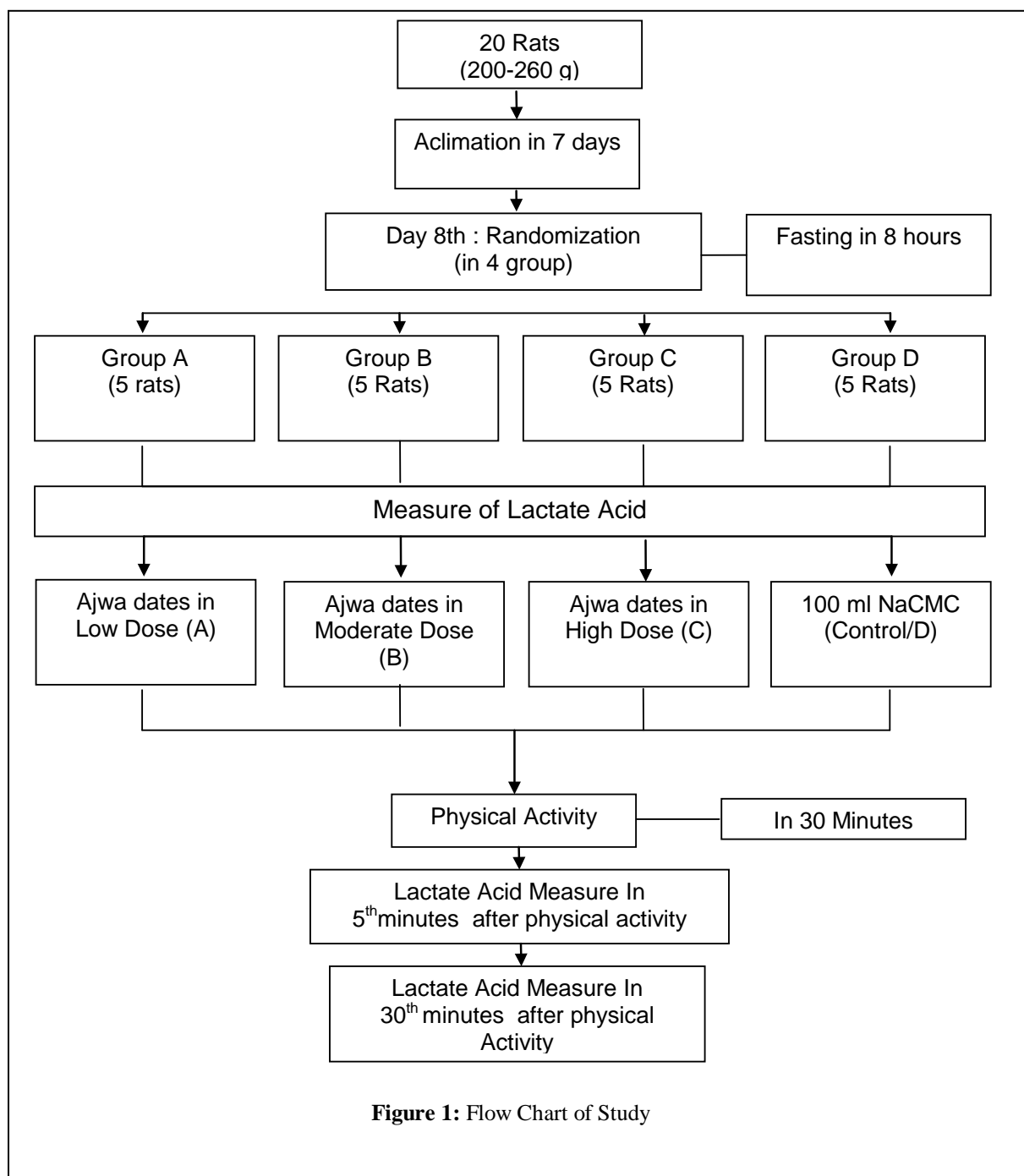
### 2.1 Study Design

This study was a true experimental study with randomized group pre-post test with control group design, conducted in Biopharmaceutical Laboratory from February 9<sup>th</sup> 2015 to March 31<sup>st</sup>2015 and had obtained ethical approval recommendation from Ethical Committee of Health Research at Medical Faculty of Hasanuddin University Makassar (No:0130/ H4.8.4.5.31/PP36-KOMETIK/2015).

The subjects of this study consisted of female white wistar rats (*Rattusnorvegicus*) with the following inclusion criteria: pure offspring, 2-3 months old, 200-260 g of body weight, no visible anatomical defects. Whereas the exclusion criteria were: suffering from disease during seven days of adaptation period, infected during the treatment was in progress, or died during treatment.

The assignment of study objects to each group was based on the minimum experimental animal number defined

[13], namely 5 animals. Therefore, the total number of the required experimental animals were 20 animals divided into four groups. All of the experimental animals were adapted for 7 days with the administration of standard feed AD2 and corns in controlled dosage and ad libitum water administration.



Ajwa dates in this study were administered to experimental animals in agar suspension form to facilitate its passage into animals body using oral sonde, and observed for its effect on blood lactate release after performing physical activity by swimming. Study was divided into 4 treatments with different Ajwa dates dosages (dosage A: 0.058 g/200 BW of rat, dosage B: 0.116 g/200 BW of rat, dosage C: 0.232 g/200 BW of rat), and control group (D) with NaCMC administration of 100 ml/BW. The Ajwa dates dosages administered to experimental

animals were the conversion results from human consumption dosage or 7 Ajwa dates [14].

Physical exercise was performed at day 8. The blood lactate level was measured at 30 minutes before Ajwa dates administration (pre). The experimental animals then performed physical activity by swimming for 30 minutes at a pool sized 50x40x50 cm with water depth of 30 cm [13]. The blood samples were collected from tail vein and then measured for its lactate level using *Accutrend Plus* with *lactate strips* and the results were available within 60 seconds. Blood lactate level was measured at 5 minutes and 30 minutes after swimming. Five minutes after physical exercise is the peak of lactate accumulation in the blood [10]. The recovery of lactate takes about 60 minutes, and 30 minutes are needed to reach half of initial condition [9] by only resting.

## 2.2 Statistical Analysis

The obtained data from measurements were analyzed using SPSS software. Statistic test in this study used one way Anova test to find out the blood lactate difference of each group (A, B, C, and D) at 5<sup>th</sup> minutes and 30<sup>th</sup> minutes after physical activity continued with post-hoc LSD test to assess the inter-group difference. Before the one way Anova test, a normality test with Kolmogrov-Smirnov was performed to ascertain the data distribution was normal, and data homogeneity test using *Lavene's test*.

## 3. Study Results

Blood lactate change rate in female wistar rats from pre condition to minute 5 and minute 30 after physical activity can be seen from Figure 1.

**Grafik 1:** Flow of Lactate Change in Blood Based of Dosage Variation Group

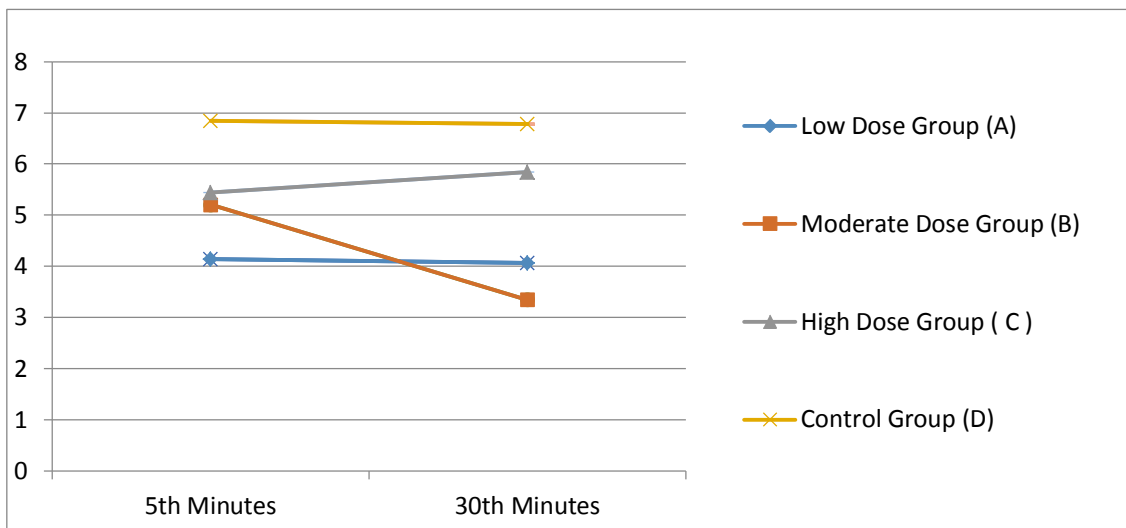


Table 1 shows the mean and standard deviation of blood lactate level at minute 5 and minute 30 by dosage (dosage A :0.058 g/200 BW of rats, dosage B: 0.116 g/200 BW of rats tikus, and dosage

**Table 1:** Mean  $\pm$  SD Lactate Acid In Blood Based of Ajwa Dates Dosage Variation. Source: Primary Data, 2015

| Lactate Acid             | Kelompok Dosis       |            |                      |            |                      |            |                      |            |  |  | p     |
|--------------------------|----------------------|------------|----------------------|------------|----------------------|------------|----------------------|------------|--|--|-------|
|                          | A<br>(Mean $\pm$ SD) |            | B<br>(Mean $\pm$ SD) |            | C<br>(Mean $\pm$ SD) |            | D<br>(Mean $\pm$ SD) |            |  |  |       |
| 5 <sup>th</sup> Minutes  | 4,14                 | $\pm$ 0,99 | 5,20                 | $\pm$ 1,59 | 5,44                 | $\pm$ 0,89 | 6,84                 | $\pm$ 1,70 |  |  | 0,042 |
| 30 <sup>th</sup> Minutes | 4,06                 | $\pm$ 0,58 | 3,34                 | $\pm$ 0,36 | 5,84                 | $\pm$ 1,28 | 6,78                 | $\pm$ 2,12 |  |  | 0,002 |

C: 0.232 g/200 BW of rats), and control group (D).Next, the discrimination test between groups with post-hoc LSD test can be seen from Table 2.

#### 4. Discussion

Lactate system is very important for high intensity activities in prolong time [15,16]. In performing physical activities, energy fulfilment is obtained through two paths, aerobic and anaerobic. Energy path used by our body depend on the intensity of physical activity. Aerobic path uses much oxygen to yield energy while doing activities. This aerobic path occurs for high intensity activity in 20-30 seconds only. Whereas, anaerobic path is an energy fulfilment path due to insufficient oxygen level. The high level of activity promote the muscle to contract anaerobically [7]. During the physical activity by anaerobic path, the increasing of lactate in blood or muscle will occur. After doing anaerobic activity for 2 minutes, production of lactate will be piled up and inhibit the glycolysis, so that it will affect the physical performance and cause fatigue [7].

Physical activities performed in this study are sub-maximal activities with high intensity for 30 minutes. These activities certainly use energy fulfilment anaerobically. This is marked by the increasing of lactate level in trial animal blood on 5<sup>th</sup> minutes after physical activities stopped. The recovery of lactate in blood is mainly affected by activity intensity that has been performed. Intensity will influence the mechanism of lactate path from muscle to blood stream, liver, heart, and skeletal muscle. When the long period of physical activity justly stopped, the lactate level will increase in muscle cells. The increasing of this lactate level would decrease pH of cells due to the high level of acid inside the cells that higher than outside the cells that inhibit glycolytic enzyme, disturb the metabolism process, and ATP production. Enzymes inside the cells are very sensitive with pH.

Muscle contraction anaerobically require ATP through anaerobic glycolysis or lactic acid system. Energy is a vital requirement to guarantee the performing of physical activity [7]. Carbohydrate give 80% energy contribution in performing high intensity activity for long time duration [15]. This explain the role of Ajwa dates (*Phoenix dactylifera*) in recovering fatigue among trial animal, due to the high level of carbohydrate in Ajwa dates as many as 74,97 g (58% of daily requirement). Carbohydrate will be broken down into glucose before processed to yield energy. In addition, Ajwa dates also rich with glucose based on USDA (63.35 g /100 g dry fruit), so that glucose supply from Ajwa dates is highly potential in recovering lactate level after performing physical activity.

**Tabel 1:** Mean  $\pm$  SD Kadar Laktat Darah Berdasarkan Variasi Dosis Kurma Ajwa

| Dosage Variation |                 | p      |
|------------------|-----------------|--------|
| Low Dose         | - Moderate Dose | 0.388  |
| Low Dose         | - High Dose     | 0,043* |
| Low Dose         | - Control       | 0.004* |
| Moderate Dose    | - Low Dose      | 0,388  |
| Moderate Dose    | - High Dose     | 0.007* |
| Moderate Dose    | - Control       | 0.001* |
| High Dose        | - Low Dose      | 0.043* |
| High Dose        | - Moderate Dose | 0.007* |
| High Dose        | - Control       | 0.263  |
| Control          | - Low Dose      | 0.004* |
| Control          | - Moderate Dose | 0.001* |
| Control          | - High Dose     | 0.263  |

Source: Primery Data, 2015

Figure 1 showed that on 5<sup>th</sup> minutes after physical activity, lactate level on trial animal blood was higher than pre physical activity. This finding confirm the study by [17, 18] that the peak accumulation of lactate acid occur on 5<sup>th</sup> minutes after physical activity. This condition resulting in the lower contraction of muscle and finally cause fatigue.

Physical activity is a conducting of respective and repetitive movement [19] that give a regular and systematic physical pressure [17, 20]. Fatigue as a result of lactate accumulation on muscle is undeniable thing. Lactate is not a harmful substance in the body, it's presence as a result of natural and normal process. However, the accumulation of lactate can be minimized in order the physical activity can be performed optimally in a longer period and supported with sufficient energy supply.

Main product formed from complex carbohydrate hydrolysis is glucose in blood. Furthermore, through glycogenesis, the glucose is stored in the liver (5-8%) and muscle (1-3%) as glycogen. Lactate and alanin as a result of partial metabolism of glucose in certain tissue is transported to liver and kidney to be synthesized again into glucose through gluconeogenesis mechanism. During activity session, when the muscle in hypoxia condition, the glycogen will be converted into glucose, and then glucose is converted into lactic acid. Through the blood stream, lactic acid enter the liver and converted again into glucose. This glucose enter the blood and then reach the muscle. Inside the muscle, glucose is converted again into glycogen [21].

Oneway anova test showed that there was a significant difference (effect) of various doses of Ajwa dates (Group A, B, C, and D) on lactid acid at fifth minutes (p value=0,042; p<0,05). This indicate that after performing *swimming test*, rats undergo high level of fatigue. The same thing is found in 30<sup>th</sup> minutes after performing physical activity that showed the significant difference (p = 0,001; p<0,05). Whereas, post hoc LSD test showed

that group B (moderate dosage) was the effective dosage ( $3.34 \pm 0.36$ ,  $p= 0.002$ ) in recovering lactic acid induced by physical activity (table 2).

Moderate dose in this study is based on Hadits of Rasulullah that is 7 dates. So, this study result among rats induced physical activity has proven that standard delivered by Rasulullah narrated by Bukhari and Muslim able to give good effect in recovering fatigue according the body requirement. Result of Group B was better than Group C (high dose) and Group A (low dose). This is indicate that something good that is given excessively is not automatically give a better result. This kind of situation has been explained on several part in Al-Qur'an such as in Surah Al-A'raf, verse 31 "in truth, Allah does not love the extravagant" The same thing is repeated again in A'raaf verse 55, Al An'am verse 141, Al Anfaal verse 58, Al Baqarah verse 190, Az-Zumar verse 53, dan Surah Al Maa-idah verse 87.

Carbohydrate give 80% energy contribution in performing high intensity activity for long time duration (Murray et al., 2008). This explain the role of Ajwa dates in recovering fatigue among rats, due to the high level of carbohydrate in Ajwa dates as many as 74,97 g (58% of daily requirement). Carbohydrate will be broken down into glucose before processed to yield energy. In addition, Ajwa dates also rich with glucose based on USDA (63.35 g /100 g dry fruit), so that glucose supply from Ajwa dates is highly potential in recovering lactate level after performing physical activity.

Glucose is necessary for continuity of energy supply for the muscle to maintain activity that is being performed, which is processed in Cori cycle (Junusul, 1989). Cori cycle is very important during high intensity activities due to it help the transportation of lactic acid to decrease fatigue. Activity that uses energy through anaerobic path will produce a number of lactic acid produced by the muscle then converted into piruvic acid during performance and are broken down into carbon dioxide and H<sub>2</sub>O in mitochondria. in the other word, lactic acid is carried out from blood into liver to be converted into glycogen through glycolysis. Glycogen in liver will be broken down into glucose and is transported to blood and return to the muscle for glycolysis process. The optimum glucose supply will maintain the transportation process of lactic acid in Cori cycle that able to make the conversion of lactic acid into energy on anaerobic path become efficient.

Effect of lactic acid reduction in blood has been investigated in many study previously, but most of them use fat, protein, carbohydrate [22], and electrolyte drink [23]. There are still small number of study that conduct trial using nutrient content of fruit, and even there still no study used dates, especially Ajwa dates.

In conducting this study, we faced some obstacles such as the limited reference of effective dose of dates, so that the dose is based on Hadits Rasulullah. Another obstacle was the lack of reference that discuss about the relevance and evidence of recovering effect of dates for fatigue, most of the researcher correlate it with care or therapy of disease. in addition, the physical exercise of trial animal was limited to 30 minutes.

It is suggested for further research about benefit of Ajwa dates on physical fatigue to include the physical fitness in the research.

## **5. Conclusion**

There is a significant difference on the peak of blood lactate accumulation (5<sup>th</sup> minutes after physical exercise) and also on recovering velocity of blood lactate level (30<sup>th</sup> minutes after physical exercise) among group with low dose, moderate dose, high dose, and control. So, the Ajwa dates can be used as an alternative food source for the workers to enhance their productivity through recovering of fatigue efficiently.

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