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The effect of whey protein on malondialdehyde, aerobic capacity, and leg muscle explosive power in basketball athletes

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ABSTRACT

Background: *High-physical activity, including aerobic capacity and leg muscle explosive power, can cause stress oxidative and decrease the performance of athletes. Whey protein contains essential amino acids that were beneficial to decreased malondialdehyde (MDA) levels.*
Objective: *To analyze the effect of whey protein on MDA level, aerobic capacity, and leg muscle explosive power in basketball athletes.*
Materials and Methods: *Randomized controlled trial using pre- and post-test design was conducted on 12 male athletes aged 16-18 years at PPLOP Central Java Basketball Club. The treatment group received 30 grams of whey protein, and the control group received 30 grams of chocolate powder as a placebo for 28 days. MDA levels were measured through Elisa methods. Aerobic capacity was measured by 20 meters sprint. Leg muscle explosive power was measured by vertical jump. Data were analyzed by an independent t-test.*
Results: *The mean MDA levels before intervention in the whey protein group were 182.36 (±59.05), and the mean after the intervention was 171.83 (±5.46). The mean before the aerobic intervention capacity was 36.95 (±5.84), and the mean after the intervention was 49.75 (±3.53). The mean leg muscle explosive was 83.50 (±21.58), and the mean after the intervention was 87.33 (±16.68). There were no effect of whey protein on MDA levels (p>0,05), aerobic capacity (p>0,05) and leg muscle explosive power (p>0,05).*
Conclusion: *Whey protein for 28 days had no effect on MDA levels, aerobic capacity, and leg muscle explosive power*

Keywords: *whey protein; MDA levels; aerobic capacity; and leg muscle explosive power*

BACKGROUND

Basketball is a high-intensity intermittent sport. This sport involves various types of physical activity, namely aerobic and anaerobic.[1] In basketball, practice is needed, especially in improving physical condition because the physical condition is one of the factors that significantly determines the athletes' performance.[2] The components of physical conditions that have an essential role in basketball sports activities, both as a supporting element in a particular movement or the main element in the effort to achieve perfect movement techniques, are power explosiveness and aerobic capacity. Aerobic capacity is related to high-intensity workouts [3], whereas explosive power is the maximum force used in the shortest possible time. The power of leg muscles is required for lay-up and jump short techniques. [4]

The physiological impact of high-intensity physical exercise on basketball athletes can increase the production of reactive oxygen species (ROS), which can cause imbalance and tissue damage [5]. The part of the cell that is prone to damage is cell membrane lipids. This process of membrane breakdown is called lipid peroxidation. One of the products of lipid peroxidation is malondialdehyde (MDA). MDA is an aldehyde derivative that can act as a secondary toxic messenger and trigger oxidative injury. Therefore, the level of MDA in the body can be used as an indicator of oxidative stress.[6] Oxidative stress damages cells and tissues, which are a significant factor in muscle fatigue and underperformance of athletes, leading to decreased glutathione concentrations. Maintaining glutathione status is proven to minimize oxidative stress and improve athletes' performance,[7] giving whey protein.

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Whey protein contains long-chain amino acids (BCAAs), including leucine, valine, and isoleucine which can play an antioxidant mechanism.8 Research on a high-protein diet containing BCAAs can reduce oxidative stress caused by high-intensity exercise in rats.[9]Amino acids in milk protein contain cysteine and taurine, reducing glutathione concentration during exercise. This mechanism is known through increased glutathione concentration caused by increased plasma antioxidant capacity, namely an increased aerobic metabolism without causing damage due to accumulated ROS.[10] In addition, whey protein can reduce muscle fatigue. The reduction in muscle fatigue during resistance training is the result of an increase in muscle buffer capacity during endurance sports. [11]

Previous studies of whey protein on improved performance in athletes show performance in the treatment group with a value of P = 0.001. In contrast, there was no improvement in performance in the placebo group.[12] Other studies have shown that administration at a dose of 30 grams in 300 ml can affect the total serum protein alanine aminotransferase (ALT), aspartate aminotransferase (AST), lactate dehydrogenase (LDH), and creatine kinase (CK) .[13]

This study analyzes whey protein on malondialdehyde levels, aerobic capacity, and leg muscle explosive power in basketball athletes at PPLOP Central Java.

MATERIALS AND METHODS

This was an experimental study with a randomized controlled trial design with pretest-posttest groups. This research was approved by the ethics commission No. 541/EC/KEPK/FK UNDIP/XII/2019. This research was conducted at *Pusat Pendidkan dan Latihan Olaharaga Pelajar* (PPLOP) Central Java. Subjects in this study were 12 basketball athletes divided into two groups, namely the treatment group, which was given 30 grams of whey protein. The control group was given 30 grams of cocoa powder for 28 days. This study's variables were MDA measurement, aerobic capacity, and leg muscle explosive power. Data collection was carried out two times. Namely, pre and post-intervention were carried out in the control group and placebo with each (n = 6 subjects in the whey group and n = 6 subjects in the placebo group). The data obtained were analyzed statistically using the SPSS version 21 program; data with normal distribution was stated by mean (±SD) while data with abnormal distribution was stated by median (min-max). Statistical differences were analyzed using independent t-test and paired t-test (data with normal distribution), and Wilcoxon, Mann Whitney (data with abnormal distribution). Intake data were obtained from the average 24-hour recall carried out two times in the control and placebo groups. MDA levels, aerobic capacity, and leg muscle explosive power were measured two times. The samples used to measure MDA levels were blood serum, aerobic capacity using multistage fitness, and leg muscle explosive power measured by jumping upright on a scaled board. MDA levels in blood serum were analyzed using the Thiobarbituric Acid Reactive Substances (TBARS) test method spectrophotometrically at a wavelength of 454 with maximum absorbance. Aerobic capacity and explosive power write the numbers according to at PPLOP standard. The research subjects are the athlete basketball men aged 16-18 years in PPLOP Java Central. The requirement to follow the practice of physical five times a week with a duration of 1.5 hours per workout, not taking supplements of antioxidants such as vitamin C, vitamin E during the intervention, did not exist, willing to follow the study through informed consent from the beginning of the study until the end.

RESULTS

Subject Characteristics

A total of 12 athletes from PPLOP Central Java were the subjects in this study. Subject characteristics data consisted of age, weight, height, BMI, Z-score (BMI / U), and physical activity. There was no significant difference in the data on subject characteristics (p> 0.05).

Tabel 1. Subject Characteristics in Both Groups

Data Characteristics	Whey Protein		Control		*p*
	Mean±SD	Minimum-Maximum	Mean ±SD	Minimum-Maximum	
Age (years)	17,33±1,366	16,00-19,00	16,33±0,516	16,00-17,00	0,240[b]
Weight (kg)	72,32±5,51	62,60-77,90	73,30±8,63	63,30-85,70	0,819[a]
Height (cm)	183,33±3,67	179,00-190,0	183.33±3.67	179,00-190,0	0,100[a]
BMI for age (kg/m^2)	21,28±1,53	19,50-23,40	22,85±1,54	21,20-25,00	0,107[a]
Z-Score (BMI/Age)	0,14±0,63	-0,50-0,92	0,32±0,72	-0,46-1,23	0,655[a]

Physical Activity (unit)	1,83±0,63	1,80-1,86	1,80±0,023	1,78-1,83	0,134[a]

[a:] Independent *t-test,* [b:] *Mann-Whitney*

The level of adequacy is obtained from the amount of intake in one day compared to individual needs and is calculated in percent. Table 2 shows no significant difference in energy intake, protein, fat, and carbohydrates (P> 0.05).

Table2. Adequacy Level of Nutrient Intake in Both Groups

Adequacy Level of Nutrient Intake	*Whey* Protein n=6		Control n=6		*p*
	Mean±SD	Minimum-Maximum	Mean±SD	Minimum-Maximum	
Energy (%)	68,33±5,58	60,70-75,30	67,31±7,95	58,53-77,42	0,802
Protein (%)	76,45±13,23	54,29-89,28	78,89±11,12	64,27-77,42	0,820
Fat (%)	79,68±13,35	64,58-95,30	73,86±7,65	63,64-82,90	0,376
Carbohydrate (%)	70,66±10,96	57,10-80,97	64,76±7,45	54,11-76,01	0,301

independent *t-test*

Malondialdehyde Levels, Aerobic Capacity, Leg Muscle Explosive in Both Groups

Tabel 3. MDA Levels, Limb Muscle Explosive Power, and Aerobic Capacity Before and After Intervention

Variable	Kelompok	n	Before Rerata±SD	After Rerata±SD	△	*P*
MDA levels (ng/ml)	*Whey* protein	6	182,36±59,05	171,83±53,46	10,55±6,56	0,011[a]
	Kontrol	6	195,17±48,75	190,46±48,26	-4,69±3,22	0,016[a]
	p		0,691[c]	0,540[c]	0,078[c]	
Aerobic Kapasity (ml/kg/min)	Whey Protein	6	36,95±5,84	49,75±3,53	12,80±5,97	0,003[a]
	Control	6	36,43±4,61	48,57±2,44	12,13±4,39	0,001[a]
	p		0,868[c]	0,515[c]	0,830[c]	
Leg Muscle Explosive (cm)	*Whey* protein	6	83,50±21,58	87,33±16,68	4,33±6,37	0,157[a]
	Control	6	64,33±8,91	73,00±9,57	8,67±11,69	0,140[b]
	p		0,065[d]	0,132[d]	0,444[c]	

[a:] Paired *t-test,* [b:] *Wilcoxon,* [c:] Independent *t-test, d Mann-Whitney*

Malondialdehyde levels, aerobic capacity, and leg muscle explosive power baseline by statistical Independent t-test and Mann-Whitney in the *whey* protein group and the control group are presented in Table 4.3. The test used was the independent t-test having the same conditions (p =>0.05) and after the intervention was not significant (p >0.05).

DISCUSSION

Research has not shown a significant effect before and after the intervention. There was no possible effect due to the short study time (28 days). In line with studies conducted on experimental animals, whey protein was not affected for four weeks to improve athletes' performance (p = <0.05).[14-15] In addition, high physical activity causes inflammation in athletes to be a factor. Sub-maximal exercise can increase neutrophils, reduce lymphocytes. 84 Previous studies have stated that high physical activity can cause inflammation with increased neutrophils, a secondary source of free radical production that can reduce an athlete's performance.[16]

On the other hand, this study has not been proven to increase the explosive power of leg muscles in either the whey protein group or the control group. Optimal explosive power is obtained progressively through training. There was no increase in the explosive power of the leg muscles because, during the study, there was no additional special training. Subjects only received appropriate

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training from the PPLOP institution. We recommend that the subject be given additional training to increase the explosive power of the leg muscles, namely by adding a training method with training circuits and plyometric exercises, in line with the research that the training method with training circuits can increase the explosive power of the leg muscles in athletes ($p = <0.05$)[17,] as well as athletes with high motor skills given the plyometric training method resulted in a high increase in explosive power ($p = <0.05$) [18]

Physicological factors, including stress factors and levels of anxiety in athletes, are caused by training and high demands. Therefore, the level of anxiety in athletes plays an essential role in determining achievement. In addition, the level of anxiety tends to be higher in competitive sports than in relatively non-competitive sports. In competitive sports, athletes are expected to win with high demands.[19] The research results in line with athletes measuring the level of anxiety associated with performance in athletes mention anxiety.

The study results show no effect on leg muscle explosive power performance because most athletes have the low aerobic capacity (36.0) and low explosive category athletes (60, cm). The researcher uses category standards used in institutions. PPLOP Central Java. It affects athletes' performance because the athlete's training period at PPLOP is different. Some are old and have just joined PPLOP. In line with the research, the performance of the training period of fewer than six months is still low because it is not used to the training being undertaken.[20]

The difference in value (Δ) for the decrease in MDA levels increased aerobic capacity in the whey protein group. Decreased malondialdehyde levels can also be triggered by the higher content of BCAAs, such as leucine, valine, isoleucine compared to other protein products.65 Whey protein is easily digested so that it has the characteristics of increasing the ability to stimulate muscle protein synthesis and repair skeletal tissue.[21] This study is also in line with research testing the antioxidant whey protein in cell culture using the C2C12 myoblasts technique. It has been shown that whey protein increases antioxidant capacity against oxidative stress and whey protein stimulates increased GSH, CAT / SOD enzyme activation, and inhibition of lipid peroxidation. The intervention of whey protein before and after for 60 days can reduce oxidative stress and increase endurance in athletes.[22]

CONCLUSION

There was an effect before and after 30 grams of whey protein for 28 days on decreasing malondialdehyde levels and increasing aerobic capacity.

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