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THE EFFECT OF GOAT MILK CONSUMPTION ON BLOOD CALCIUM AND HEMOGLOBIN IN SOCCER PLAYERS

Yusni Yusni ^{*1} and Amiruddin Amiruddin ²

Department of Physiology ¹, Faculty of Medicine, Physical Education ², Health and Recreation, Universitas Syiah Kuala, 23111 Banda Aceh, Aceh, Indonesia.

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Correspondence to Author:

Dr. Yusni Yusni

Department of Physiology, Faculty of
Medicine, Universitas Syiah Kuala,
Jalan Teuku Tanoh Abee, Kopelma
Darussalam, Syiah Kuala, 23111
Banda Aceh, Aceh, Indonesia.

E-mail: yusni@unsyiah.ac.id

ABSTRACT: Calcium and iron are the main minerals needed to support performance and also to improve the physical components of soccer players. This study aims to analyze the effect of goat milk consumption on calcium and blood hemoglobin levels in junior soccer players. This study was an experimental study with a pretest-posttest design. Research subjects were 22 soccer players, male, aged 12-14 years. The treatment was 250 mg fresh goat milk, given 3 times a week (every Tuesdays, Thursdays, and Sundays), between 06.00 pm-06.30 pm) after playing football for 90-120 min and given for 21 days. Examination of blood calcium levels was conducted using O-cresolphthalein complexone. Examination of hemoglobin levels was performed using the method of calorimetry. Data were analyzed using homogeneity of variance ($p < 0.05$), a test of normality ($p < 0.05$) and paired t-test ($p < 0.05$). The results showed that the average calcium level increased about 1.72% from 9.43 mg/dL to 9.50 mg/dL; ($p = 0.05$) and the mean blood hemoglobin level increased about 9.2% from 14.25 g/dl to 14.55 g/dl ($p = 0.05$) after consuming goat's milk. We conclude that regular consumption of fresh goat milk can maintain the adequacy of calcium and also hemoglobin within the normal limits in soccer players. Although our study found that fresh goat's milk does not significantly increase calcium levels and blood hemoglobin in soccer players, we suppose that if taken at doses greater than 250 mg per day, more than 21 days may be better to increase the calcium and blood hemoglobin.

INTRODUCTION: The need for calcium and iron (Fe) increases in adolescents, and both of these minerals are needed higher in adolescent athletes compared to non-athletes ^{1, 2}. Iron deficiency anemia is a common problem in adolescents ¹. Adolescent athletes have the potential to suffer hypocalcemia and anemia if not offset by high nutrient intake Calcium and Fe ¹.

Milk is a good source of nutrients for female athletes ². Goat's milk is an important nutrient and as a source of calcium that is predicted to meet the needs of calcium for adolescent athletes ³⁻⁵. Calcium in goat milk is higher than in cow's milk goat's milk, therefore be beneficial to improve the performance of athletes ^{4,6}.

Calcium is a micromineral that is needed for muscle and bone during exercise, such as playing soccer ⁷. We have examined that the calcium level is positively related to muscle strength and physical performance in soccer players ⁸. Iron is a mineral that is needed to improve the performance of athletes ⁷.

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The need for calcium and iron in adolescent athletes is high⁹. Medium iron deficiency can reduce exercise performance in athletes^{7,9}. Iron is a mineral essential for erythropoiesis activity and muscle metabolism⁷. The human body needs iron on average 15-20 mg daily⁷. Iron is an important component in the formation of hemoglobin and myoglobin. Sufficiency in iron influence on physical activity^{7,9}. Hemoglobin (Hb) function is to carry oxygen to the cells, the metabolism of glucose, fat, and protein to produce energy (ATP). Myoglobin function is bound to oxygen and serves to receive, store and release oxygen into muscle cells. Therefore, decreasing iron levels in the body can cause a decrease in work productivity and also a decrease in the percentage of muscle strength in soccer players. It is the basic necessity of maintaining adequate calcium and hemoglobin in football players through the provision of additional intake of calcium and iron.

One nutrient that is thought to increase calcium levels and hemoglobin is fresh goat milk¹⁰. Some research indicates that goat milk is beneficial to increase the levels of calcium and prevent hypocalcemia¹⁰⁻¹². Goat's milk has been proven to be useful for preventing and also treating anemia in non-athletes,^{1,3,10,13} but whether consumption of fresh goat's milk can increase calcium levels and blood hemoglobin in soccer players still do not need to be studied. This study was a preliminary study and use to guide for the potential benefits of goat milk as an essential nutrient for athletes for the prevention and treatment of iron deficiency and hypocalcemia.

MATERIALS AND METHODS:

Study Design: This study was a quasi-experimental with a pretest-posttest without a control group design. The duration of the study was 6 months from June to November 2015. The research location was in the Department of

Physiology, Faculty of Medicine, Universitas Syiah Kuala, Banda Aceh, Aceh, Indonesia. Calcium and Hb examination were carried out in the Prodia Clinical laboratory in Banda Aceh, Aceh, Indonesia.

Subject Research: The research subjects were 22 soccer players from soccer clubs in Banda Aceh, Aceh, Indonesia, male, 12-14 years old, no calcium supplements, no consume cow's milk or other milk, non-smoking, did not drink alcohol, the subject is willing to be the subject by signing written informed consent (known and with the consent of the parent and coach). The examination of calcium levels is using the O-cresolphthalein complexon method. Normal blood calcium level is 8.6-10.3 mg/dl. Examination of blood hemoglobin levels using the cyanmethemoglobin method. Normal Hb levels in men are 13 g/dL.

Treatment and Laboratory Procedures: The treatment was fresh goat milk, given as 250 mg, 3 times a week, every Tuesday, Thursday and Sunday, the time of administration is in the afternoon (06.00-06.30 pm) after physical training, given for 21 days starting from October 11 until November 3, 2015. The fresh goat's milk given is pasteurized goat's milk and hygiene.

Ethical Approval: This study was approved by the ethics committee of medical research, Faculty of Medicine, Universitas Syiah Kuala, Banda Aceh with its ethical approval letter number 304/KE/FK/2015. Data analysis was analyzed using the homogeneity test of variance with Levene test ($p < 0.05$), normality test with Kolmogorof-Smirnov ($p < 0.05$) and paired t-test ($p < 0.05$).

RESULTS: The characteristics of the research subjects such as age, weight, height, body mass index (BMI) and blood pressure (systolic and diastolic) among subjects showed no significant difference ($p > 0.05$), as seen in **Table 1**.

TABLE 1: CHARACTERISTICS OF RESEARCH SUBJECTS

Variable	n	Mean	SD	p-value
Age (year)	22	13,13	1,45	0,08
Weight (kg)	22	53,47	9,78	0,98
Height (cm)	22	161,61	9,04	0,44
BMI (kg/m ²)	22	20,03	2,92	0,54
Systolic Blood pressure (mmHg)	22	121,36	6,65	0,09
Diastolic Blood Pressure (mmHg)	22	82,95	5,03	0,05

Note: $p > 0.05$ = the data showed no significant difference, BMI = Body Mass Index

The results of the variance homogeneity test using the Levene test of calcium levels and blood hemoglobin levels showed that the data variance was homogeneous ($p>0.05$), as seen in **Table 2**.

TABLE 2: HOMOGENEITY TEST OF CALCIUM AND Hb SERUM IN SOCCER PLAYERS

Variable	Levene statistic	p-value
Calcium (mg/dl)	2,10	0,11
Hb (gr/dl)	1,73	0,36

Note: $p>0.05$ = the data variance is homogeneous

The normality test showed that serum calcium levels and blood hemoglobin levels among subjects were normally distributed ($p>0.05$), as seen in **Table 3**.

TABLE 3: TEST OF NORMALITY OF CALCIUM AND CTx LEVELS IN SOCCER PLAYERS

Uji normalitas	Kolmogorof-Smirnov Z	p-value
Calcium (mg/dl)	1,05	0,21
Hb (gr/dl)	0,44	0,98

Note: $p>0.05$ = normal distribution

The results of paired t-test data ($p<0.05$) to analyze the effect of giving goat's milk on serum calcium levels, the hemoglobin of the blood of soccer athletes can be seen in **Table 4**.

TABLE 4: PAIRED T-TEST ANALYSIS OF THE EFFECT OF GOAT MILK CONSUMPTION ON CALCIUM LEVELS AND HEMOGLOBIN IN JUNIOR SOCCER ATHLETES

Variable	Data	n	Mean \pm SD	t	p-value
Calcium (mg/dL)	Pre-test	22	9.34 \pm 0.23	2.04	0.05
	Post-test	22	9.50 \pm 0.30		
Hb (g/dL)	Pre-test	22	14.24 \pm 0.98	2.61	0.05
	Post-test	22	15.55 \pm 1.14		

Note: * significance at the level of error of 5% ($p<0.05$)

The results showed that calcium levels increased slightly (1.71%) after giving fresh goat milk for 21 days, but the increase in levels was not significantly different ($p = 0.05$). The results of this study also showed that blood Hb levels slightly increased (9.2%) after administration of goat milk, but the increase was not statistically significant ($p=0.05$).

DISCUSSION: The results of this study indicate that consumption of fresh goat milk slightly increases serum calcium levels in junior soccer players. Goat milk is a source of minerals and has high mineral content such as calcium, potassium,

phosphorus, potassium, protein chloride, Magnesium (Mg), Iron (Fe), Zinc, Selenium, Copper, and vitamins ^{4, 13-15}. Calcium content of goat milk is about 134 mg per 100 grams and higher than cow's milk (100 mg per 100 grams) ¹³. Calcium is a major mineral needed for soccer players. Calcium is essential to build the structure and working of bones, muscles, and nerves work function and for blood coagulation ⁴. Phosphorus, not only acts as a mineral that builds bones, works nerves and muscles but also benefits energy production ⁴. Copper is useful for the metabolism of oxygen and iron ⁴. Goat's milk also can be beneficial nutrients to improve the performance of athletes because of the goat milk is rich in carnitine and contains about 40% medium-chain triacylglycerols (MCT) ^{1, 3, 4, 13}.

Both of them play a role in accelerating fat burning and also increasing energy production from fatty acids ¹. Goat milk also contains high medium-chain triglycerides (MCTs) which are useful for increasing nutrient absorption and energy production in the human body ⁴.

Goat milk contains vitamin a, vitamin D, thiamin, vitamin B2 (Riboflavin), niacin, and pantothenate ⁴. Vitamin D plays a role in increasing the absorption of calcium, phosphorus, and bone health ^{4, 16}. Riboflavin is needed by soccer players to improve their performance ¹⁶. Riboflavin is a role as an energy generator in the oxidation reaction process ^{12, 15, 16}. Riboflavin is also needed for the synthesis of coenzyme flavin adenine dinucleotide (FAD) and flavin mononucleotide (FMN). Both of these enzymes play a role in the process of energy production derived from glucose, glycerol, fatty acids, and amino acids ^{12, 15, 16}. Athletes with riboflavin deficiency result in the onset of fatigue, weakness and decreased performance ¹⁶.

A study in rats demonstrated that administration of goat milk in normal mice could increase hemoglobin levels ¹², as well as with the rat anemia ^{1, 11}. The consumption of goat milk can maintain the balance of calcium and hemoglobin in the human body ³. Goat milk plays a role in the recovery of iron deficiency anemia because it works to improve Fe bioavailability, Fe metabolism and also vitamin D biosynthesis ¹.

Limitations of the Study: The results of this study indicate that regular administration of fresh goat milk does not significantly increase serum calcium levels and blood hemoglobin levels in junior soccer players. This might be due to several factors, namely:

1. The duration of milking; need to be considered for the provision of fresh goat milk for a longer period of time,

2. The dose of fresh goat milk given is likely to be less and need to be considered for dosing twice the daily requirement (further research is needed).

Teenagers are age with a very high level of calcium needs; moreover, the calcium requirement in athletes is much higher compared to non-athletes. The study also did not use a control group as a comparison, so there was no comparison of the effects of giving goat's milk.

CONCLUSION: Based on the results of this study concluded that although regular consumption of fresh goat's milk does not increase significantly of serum calcium and blood hemoglobin, however, the consumption of fresh goat milk regularly can maintain adequate of calcium and Hb in junior football players. However, this research was a preliminary study that needs to be continued using a larger dose with a longer period of time given.

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