Comparative Effects of High Branched-Chain Amino Acid Drink, Cow milk, or Sports Drink on Performance in Male Football Players

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A Thesis Submitted in Partial Fulfillment of the Requirements
for the Degree of Master of Science Program in Food and Nutrition
Department of Nutrition and Dietetics
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การเปรียบเทียบผลของการดื่มเครื่องดื่มที่มีกรดอะมิโนโซ่กิ่งสูง นมวัว หรือเครื่องดื่มเกลือแร่สำหรับนักกีฬา ต่อสมรรถภาพการเล่นกีฬาในนักฟุตบอลชาย

นางสาวภัทรพร พันธุ์พิทย์แพทย์

วิทยานิพนธ์นี้เป็นส่วนหนึ่งของการศึกษาตามหลักสูตรปริญญาวิทยาศาสตรมหาบัณฑิต
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ภัทรพร พันธุ์พิทย์แพทย์ : การเปรียบเทียบผลของการดื่มเครื่องดื่มที่มีกรดอะมิโนโซ่กิ่งสูง นมวัว หรือเครื่องดื่มเกลือแร่สำหรับนักกีฬา ต่อสมรรถภาพการเล่นกีฬาในนักฟุตบอลชาย (Comparative Effects of High Branched-Chain Amino Acid Drink, Cow milk, or Sports Drink on Performance in Male Football Players) อ.ที่ปรึกษาวิทยานิพนธ์หลัก: รศ. ดร. ภญ จงจิตร อังคทะวานิช, 147 หน้า.

การศึกษานี้เป็นการเปรียบเทียบผลของการดื่มเครื่องดื่มที่มีกรดอะมิโนโซ่กิ่งสูง นมวัว หรือเครื่องดื่มเกลือแร่สำหรับนักกีฬา ต่อสมรรถภาพการเล่นกีฬาในนักฟุตบอลชายจำนวน 49 คน อายุ 16-18 ปี ของทีมโรงเรียนมัธยมในจังหวัดระยองจำนวน 4 ทีม ซึ่งการศึกษานี้เป็นการศึกษาแบบ single-blinded crossover trial โดยนักกีฬาจะถูกแบ่งออกเป็น 3 กลุ่ม ได้แก่ 1) เครื่องดื่มเกลือแร่สำหรับนักกีฬา (140 กิโลแคลอรี่ ; คาร์โบไฮเดรต 34.0 กรัม ; ไขมัน 0.001 กรัม) 2) นมวัว (170 กิโลแคลอรี่ ; คาร์โบไฮเดรต 9.0 กรัม ; โปรตีน 10.0 กรัม โดยมี กรดอะมิโนโซ่กิ่ง 1.5 กรัม; ไขมัน 10.0 กรัม) และ 3) เครื่องดื่มที่มีกรดอะมิโนโซ่กิ่งสูง (170 กิโลแคลอรี่ ; คาร์โบไฮเดรต 25.9 กรัม; โปรตีน 10.8 กรัม โดยมีกรดอะมิโนโซ่กิ่ง 4.5 กรัม; ไขมัน 2.8 กรัมt) ในปริมาตร 250 มล. โดยนักกีฬาผู้เข้าร่วมจะได้รับเครื่องดื่มหลังสิ้นสุดการซ้อมทุกวันเป็นเวลา 10 วันสำหรับแต่ละกลุ่ม โดยจะมีช่วงพัก 1 สัปดาห์ก่อนจะเปลี่ยนกลุ่ม ก่อนที่จะได้รับเครื่องดื่มแต่ละชนิดนักกีฬาทุกคนจะต้องได้รับการประเมินปริมาณไขมันในร่างกาย ความอ่อนตัว ความทนทานของกล้ามเนื้อ กำลังกล้ามเนื้อ ความเร็ว และการบาดเจ็บ ในระหว่างที่ได้รับเครื่องดื่มนักกีฬาผู้เข้าร่วมวิจัยจะได้รับแบบบันทึกการรับประทานอาหาร (3-day food record) อีกด้วย และจะประเมินอีกครั้งเมื่อครบระยะเวลาการศึกษาของแต่ละกลุ่มเครื่องดื่ม จากผลการศึกษาพบว่าปริมาณไขมันใต้ผิวหนังเพิ่มขึ้นในกลุ่มเครื่องดื่มที่มีกรดอะมิโนโซ่กิ่ง 0.36±1.38% เมื่อเทียบกับกลุ่มนมวัว 0.15±0.85% ในขณะที่กลุ่มเครื่องดื่มเกลือแร่สำหรับนักกีฬามีปริมาณไขมันใต้ผิวหนังลดลง 0.35±0.92% นอกจากนี้ยังพบว่ากลุ่มนมวัวและกลุ่มเครื่องดื่มที่มีกรดอะมิโนโซ่กิ่งสูงมีความมีความอ่อนตัวของกล้ามเนื้อเพิ่มขึ้น 0.88±2.00 ซม. และ 0.04±2.49 ซม. ตามลำดับ แต่ลดลงในกลุ่มเครื่องดื่มเกลือแร่สำหรับนักกีฬา 0.14±1.98 ซม. ในการทดสอบความทนทานของกล้ามเนื้อโดยการวิดพื้นพบว่าในกลุ่มเครื่องดื่มเกลือแร่สำหรับนักกีฬาและกลุ่มเครื่องดื่มที่มีกรดอะมิโนโซ่กิ่งสูงเพิ่มขึ้น 3.76±8.50 ครั้ง และ 0.33±9.10 ครั้ง ตามลำดับ แต่ลดลงในกลุ่มนมวัว 0.47±4.34 ครั้ง นอกจากนั้นเครื่องดื่มทั้งสามชนิดไม่มีผลต่อกำลังกล้ามเนื้อ ($p > 0.05$) การทดสอบความเร็วในนักกีฬาพบความแตกต่างอย่างมีนัยสำคัญทางสถิติที่ระยะ 5 ม. 10ม. และ 20 ม.ดังจะเห็นได้จากกลุ่มเครื่องดื่มเกลือแร่สำหรับนักกีฬามีความเร็วลดลงที่ระยะ 5 ม.0.13±0.26 วินาที ที่ระยะ 10 ม. 0.11±0.22 วินาที และที่ระยะ 20 ม. 0.15±0.23 วินาที เมื่อเทียบกับกลุ่มนมวัวที่ลดลงที่ระยะ 5 ม.0.02±0.11 วินาที ที่ระยะ 10 ม. 0.02±0.14 วินาที และที่ระยะ 20 ม.0.03±0.15วินาที ($p<0.05$) สำหรับการประเมินการบาดเจ็บพบว่าลดลงในกลุ่มนมวัวเมื่อเปรียบเทียบแบบก่อนและหลัง ($p < 0.05$) และไม่พบความแตกต่างในกลุ่มเครื่องดื่มที่กรดอะมิโนโซ่กิ่งสูงหรือกลุ่มเครื่องดื่มเกลือแร่สำหรับนักกีฬา บริเวณที่พบการบาดเจ็บคือ สะโพก เข่า และข้อเท้าด้านซ้าย กล่าวโดยสรุปเครื่องดื่มทั้งสามชนิดมีผลต่อสมรรถภาพการเล่นกีฬาในนักฟุตบอลที่แตกต่างกันทั้งในด้านที่เพิ่มสมรรถภาพและลดสมรรถภาพการเล่นกีฬา

ภาควิชา	โภชนาการและการกำหนดอาหาร	ลายมือชื่อนิสิต	....
สาขาวิชา	อาหารและโภชนาการ	ลายมือชื่อ อ.ที่ปรึกษาหลัก	....
ปีการศึกษา	2558		

5576856337 : MAJOR FOOD AND NUTRITION
KEYWORDS: BRANCHED-CHAIN AMINO ACID / COW MILK / SPORTS DRINK / FOOTBALL PLAYERS / PERFORMANCE

PATTARAPORN PANPITPATE: Comparative Effects of High Branched-Chain Amino Acid Drink, Cow milk, or Sports Drink on Performance in Male Football Players. ADVISOR: ASSOC. PROF. DR. JONGJIT ANGKATAVANICH, 147 pp.

This study investigated the comparative effects of high branched-chain amino acid drink, cow milk or sports drink on the performance of 49 male football players aged between 16 and 18 years old in 4 school teams in Rayong province of Thailand. This is a single-blinded crossover trial with 3 subgroups:1) sports drink (140 kcal; 34 g Carbohydrate(CHO); 0.001 g Fat), 2) Cow milk (170 kcal; 9.0 g CHO; 10.0 g Fat; 10 g Protein including 1.5 g Branched-chain amino acids(BCAA) and 3) Branched chain amino acid (BCAA) (168 kcal; 25.9 g CHO; 2.8 g Fat; 10.8 g Protein including 4.5 g BCAA), which were administered in 250 ml package. Each group received a supplement drink after the completion of their match training program every day, for 10 days per supplement with 1-week washout period. Before and after each period these tests were measured: body fat composition, flexibility, muscular endurance, muscle power, speed and injury, and a 3-day food record. The results showed that the BCAA group significantly increased in body fat at 0.36±1.38% compared to cow milk group at 0.15±0.85%, while there was a decrease of 0.35±0.92% in the sports drink group. Flexibility test showed the modest significant increase in milk group at 0.88±2.00cm and 0.04±2.49cm in BCAA group, but lowered in sports drink group by 0.14±1.98cm. For the endurance test by push-ups there were increases of 3.76±8.50 and 0.33±9.10 times in sports drink group and BCAA group respectively, while a decrease was seen in cow milk group of 0.47±4.34 times. Sprint time showed mild significant increase in sports drink group. It was higher between pre and post intervention at 5 m 0.13±0.26 sec, 10 m 0.11±0.22 sec and 20 m 0.15±0.23 sec compared to cow milk group at 0.02±0.11 sec, 0.02±0.14 sec and 0.03±0.15sec, respectively. No significant disparity was observed for muscle power. Evaluation of injuries revealed a significant decrease in cow milk group between pre and post intervention, meanwhile, no significant difference was observed in sports drink group or BCAA group. The hips, knees and ankles were common injury spots. Muscle pain was aggravated when performing sport ($p<0.05$). In conclusion, branched-chain amino acid drink, sports drink and cow milk had mixed effects on physical performance, either beneficial or undesirable, in male football players.

Department:	Nutrition and Dietetics	Student's Signature	....
Field of Study:	Food and Nutrition	Advisor's Signature	....
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To my family, I cannot find the best word to say to all of you for everything, lifting up my spirit. To my best mom and dad, who give me the chance to fulfill my study. To my husband, thanks again for the advice and assistance. This study would not be completed without you. To my daughter, my best gift. Thanks for coming into my life.

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CONTENTS

Page

Page

Page

Page

Page

Page

LIST OF TABLES

LIST OF FIGURES

ABBREVIATIONS

BCAA	=	Branched-chain amino acid
CHO	=	Carbohydrate

CHAPTER 1

INTRODUCTION

CHAPTER 1

Introduction

Background and rationale

Football is a team sport which is popular around the world and also in Thailand. In the past, it might have been just a sport to be played for unity and enjoyment. Currently, it has become a career which can bring a large income for players. Therefore, there are many people who are interested in football as an occupation. The great income must be exchanged for the physical fitness of players. If a player cannot maintain his health effectively, the path of his career will be shortened. It is a sport that requires several skills applied simultaneously in order to play well, such as speed, endurance and body strength. Also, it is a sport that requires two systems of energy, which are the aerobic and anaerobic systems. Therefore, athletes need to have good physical fitness to maintain their standard of sports performance. Moreover, football is a sport that can result in collisions between players. That is why it has the high risk of injury, as can be seen from the many matches which had injured athletes. The tolerance ability against collision in each match and injury area, such as the tendons, will affect the ease of treatment and determine the time needed to recover in the case of this kind of injury.

From the academic journal of FIFA Football, it was explained that they had collected injury reports of football players by comparing training hours and match hours. This is a study that compared incidences (frequency of injuries) and the environment in which injuries occurred in football players aged 14-16 years old, 16-18 years old, and in teams of adult football players in 2 European countries, namely the Czech Republic and Austria(1). The findings of this research indicated that:

- Injury statistics will vary according to ages of the players, skill levels of players, training hours and match hours.

- The fitness levels of the players who have lower skill levels are important. Although they have more training hours, there were also higher injury statistics.
- The more training hours, the less injury statistics found in the actual report.

Ekstrand J. *et al*. (2) studied the injury characteristics in professional football players and found that during the season when competitive matches were played, hamstring injuries were much more likely to occur, when compared to injuries such as quadriceps strains, ankle sprains or MCL knee sprains which were no more likely to occur during competition than during regular training.

The most important consideration is how to enable the athlete to return to a match or to playing football as quickly as possible. This is because if the athletes cannot play for their contracted team for a long period it may have a negative effect on the club and the players themselves. Therefore there are many people who would like to study about reducing injuries and sports performance rehabilitation by using nutrition or food consumption to be one of the important tools used in the treatment and sports performance enhancement of athletes.

Sports drink containing CHO and electrolytes have been found to delay fatigue in elite athletes, while manufacturers argue that sports drink enhance performance during intermittent, high intensity and/or prolonged exercise.

Milk contains protein which has been suggested as an effective drink for exercise.

Branched-chain amino acids are the one choice that athletes choose to drink to improve their performance and reduce injuries.

Therefore, a project comprising a comparative study about the effects of consuming high branched-chain amino acid drinks or cow milk or sports drink on performance in male football players will be helpful for finding the best nutritional drink to enhance sports performance and relieve pain. This will be especially useful for football players including clubs and the football fraternity of Thailand as well.

In conclusion, there is evidence suggesting that BCAAs, sports drink and cow milk have benefits to improve performance in athletes. Therefore, what are the nutritional products that affect the sports performance of football players and have the properties to reduce injuries and improve recovery times of athletes?

Specific Aims

The purpose of this study is to compare the efficacy of high branched-chain amino acid drinks, cow milk, or sports drink on football performance and the reduction of muscle injuries in male football players.

For this study, all participants performed five exercise tests before the test period and at the end of the period. All players in each team were separated into three groups and they received the nutritional drink for each group. The sit and reach test was used to assess the flexibility of the muscles. Push ups and sit ups were used to assess the endurance of the upper and torso muscle groups. The vertical jump was used to determine the effect on power, and the 20 m sprint was used to determine the effect on speed.

Hypothesis

The following hypotheses were tested during experiments with branched chain amino acid drinks can Improving physical performance by

1.1 Decrease Percentage of body fat composition

1.2 Increase Flexibility

1.3 Increase Muscular endurance

1.4 Increase Muscular power

1.5 Increase Speed and Reducing muscle injury in athletes when compare with milk and sports drink.

Scope of the research

The effects of nutritional drinks on football players from 4 teams in Rayong Province as follows:

1) Team of Pluakdaeng Pittayakom School

2) Team of Rayongwittayacom 3 School

3) Team of Taksin Secondary school and

4) Team of Bankhai Secondary school

Benefit

The results of this study provided the effects of three available drinks on the performance of football players. Therefore, the athletes will select the most suitable drink which can improve their physical performance.

Limitation

The limitation of this research study should be acknowledge:

1. Results are limited to this specific amount of 10 g protein and 4.54 g of branched chain amino acid to be consumed.
2. Before starting this trial, the researcher studied male football players aged 20-35 years old with 7 g of BCAA in 450 ml; 42 g CHO; 17.55 g protein (273 kcal), cow milk 450 ml; 16.2 g CHO; 18 g protein (306 kcal) and sports drink 450 ml; 61.2 g CHO (252 kcal), but the participants in the BCAA supplementation groups got diarrhea. Moreover, they had matches in another province that made it inconvenient to enroll for the test. Therefore, they did not accept the trial.

Hence the researcher adjusted the net volume of all nutritional drinks to 250 ml and the dosage of branched chain amino acid drink to 4.54 g (168 kcal) and revised the age of participants to male youth players (16-18) who practice at school. Therefore, they were certain to be able to participate in the testing.

3. The motivation from coaches and the players themselves may affect the physical performance test of the players.

4. Differences in dwelling and/or campus, and also the differences in food and nutrition may also affect the results.

CHAPTER 2

LITERATURE REVIEW

CHAPTER 2

Literature Review

1.The Energy System

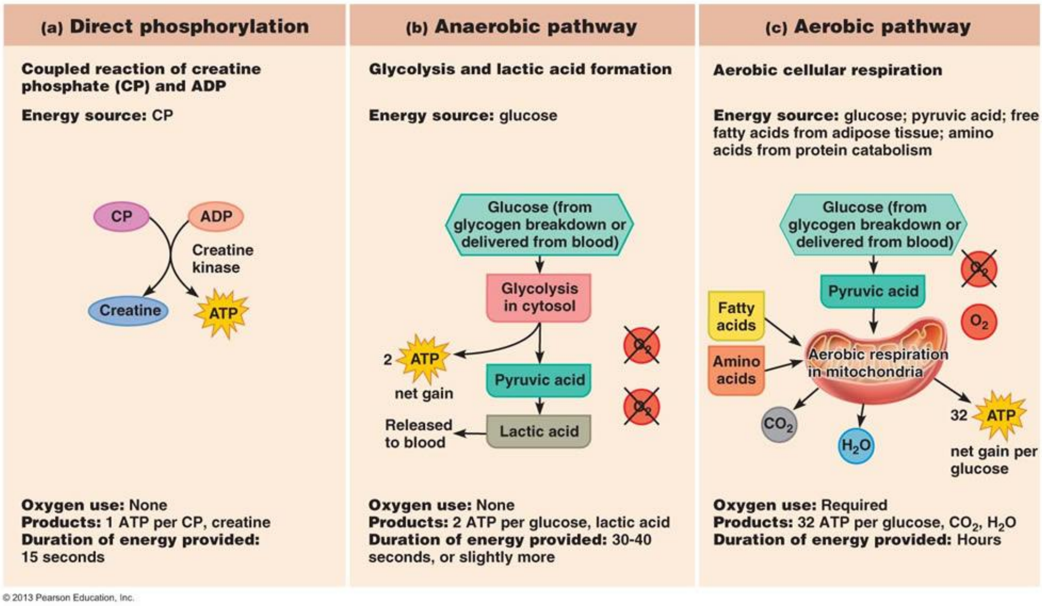

Figure 1.*The energy systems (3)*

There is little ATP stored within the muscles, but when it is used it can be quickly replaced via the process of phosphorylation by creatine phosphate, glycolysis and both anaerobic and aerobic respiration. If oxygen is present, muscles are able to work aerobically, but problems arise when the demands upon the muscles through exercise exceed the capacity of the muscle to generate sufficient ATP, and so the metabolism switches to anaerobic glycolysis.(3)

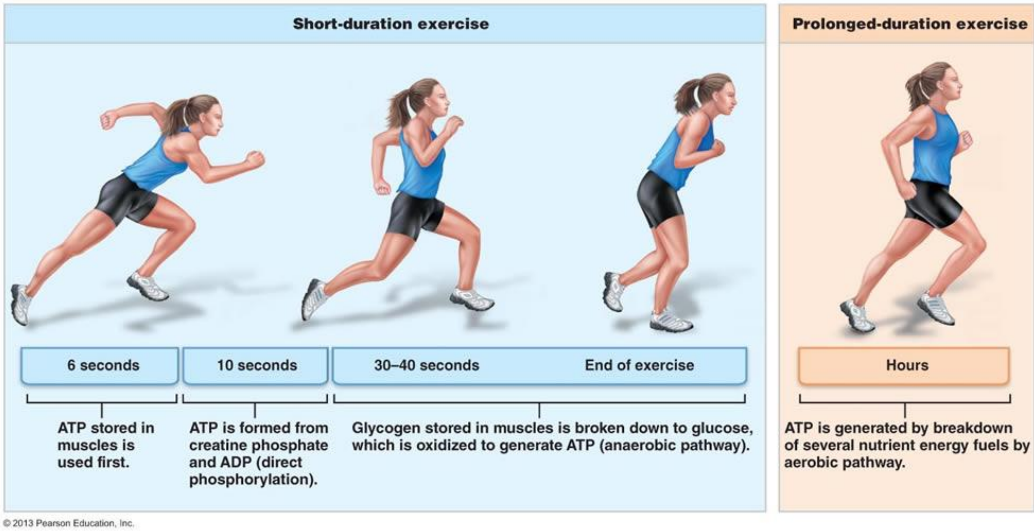

Figure 2. The relationship between duration of exercise and the energy system (3)

Muscle fatigue occurs when the muscles are no longer able to contract in the absence of adequate ATP levels, while oxygen debt denotes the surplus oxygen which would be needed to replace the stored oxygen, glycogen, ATP and creatine phosphate. Furthermore, lactic acid must be converted to pyruvic acid glucose when the muscles work hard during exercise (3).

1.1 The role of protein and amino acids in muscle composition and function

The most commonly found proteins in mammals are actin and myosin, and they can comprise up to 65% of total muscle protein. The primary amino acids they contain have a strong influence upon the make-up of the amino acids which are derived when muscle proteins are broken down during the course of protein synthesis. Of note is the high proportion of branched-chain amino acids (BCAAs) which include valine, leucine and isoleucine and comprise 20% of all amino acids obtained from proteins. All essential amino acids can be found within muscles, which can explain why muscles make such an excellent source of nutrition.(4)

Muscle protein metabolism relies heavily on the balance between amino acids in the free muscle pool and those found in proteins, with the implication being that amino acids, including BCAAs, may have a limiting effect on protein synthesis. This theory would extend to potentially include methionine and tyrosine (4).

1.2 Substrate Utilization

Substrates of various types and in varying quantities are expended in accordance with the nature of the exercise and the time it takes, as shown in Figure 3. Short intensive bursts of activity, such as a ten-second sprint, will use the energy at a rate of 50 kcal/min provided by the reserves of creatine phosphate and ATP. Once these reserves have been used, the body can manage a further two minutes of intense activity by breaking muscle glycogen down to G6P. The glycolysis process generates around 30 kcal/min of energy, and its limits do not depend on the availability of muscle glycogen but rather on the swift build up of lactic acid in the muscles as exercising endures.(5)

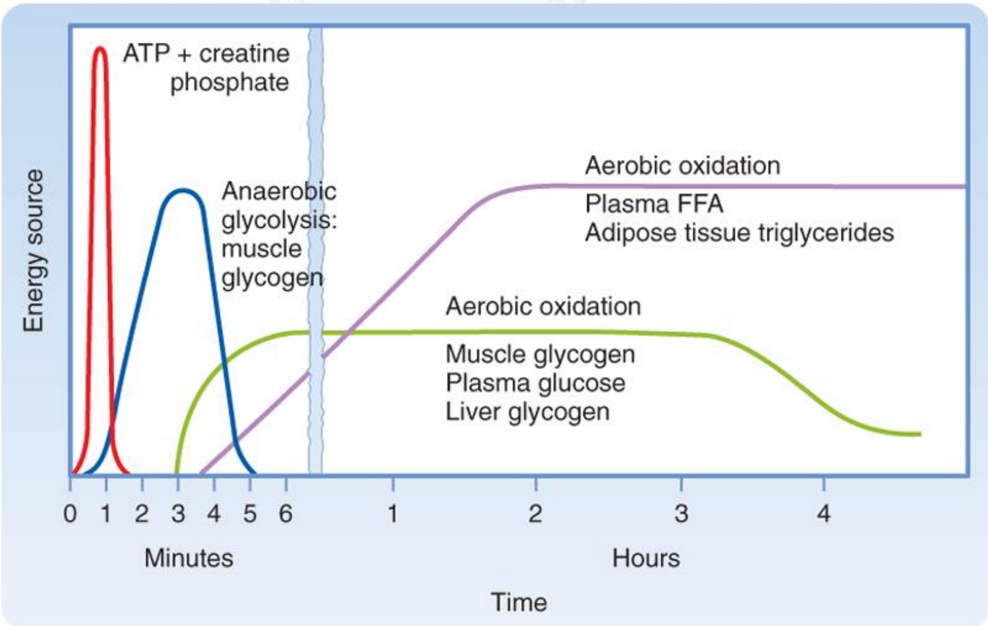

Figure 3. Substrate utilization (5)

Following an exhaustive anaerobic exercise period of several minutes, an oxygen debt of 10 to 12 L may be accrued, and must be settled before any further exercise can be performed. Around 6 to 8 L of oxygen would be needed oxidize the lactic acid to carbon dioxide, or alternatively to resynthesize it back to glucose to store in the liver. A further 2 L of oxygen would be necessary to restore the ATP and creatine phosphate reserves in the muscles, while another 2 L of oxygen would be sufficient to restore oxygen levels in the lungs and in other body fluids, including that which is found in the blood attached to myoglobin and haemoglobin.(5)

When the exercise is carried out at lower intensity but for a longer duration, substrates provide the energy required via aerobic oxidation, generating up to 12 kcal/min. As shown in Figures 38-23, substrates are added to muscle glycogen from circulation, before the uptake of glucose from plasma starts to increase sharply after a few minutes of exercise, rising to around 30 times its original level in the case of certain muscles. At rest, glucose uptake by the muscles is controlled by insulin, and this continues under exercise conditions, however, when the uptake must be increased, insulin no longer regulates the greater uptake. When exercise begins, both ATP and intracellular glucose levels drop, while in contrast AMP will rise, allowing it to stimulate the transportation of glucose to the muscles via the activation of AMP kinase. This will, of course, consume the reserves of extracellular glucose, so in order to keep the levels of plasma glucose normal, the production of hepatic glucose has to be around five times greater than at rest. This can be achieved initially via glycogenolysis, with endurance levels capable of being boosted in advance of exercise through a higher than normal intake of carbohydrates in the days leading up to the planned exercise, which builds up glycogen reserves in the liver and muscles. When exercise takes longer, however, energy through gluconeogenesis is more significant because the reserves of liver glycogen are gradually reduced. Amino acids are then released in greater quantities through muscle proteolysis, and are taken up by the liver at an increased rate. Gluconeogenic enzymes, such as PEPCK become more prominent as the transcription of their genes is triggered. All of these processes are governed by sympathetic neural activity and also by the influence of the changing balance of glucagon and insulin.(5)

Over time, the main energy substrate is created by the fatty acids which are released from TGs in adipose tissue; these can meet over 60% of all energy requirements during long exercise sessions. When the AMP levels are also heightened, the activated AMP kinase will phosphorylate and thus inhibit the performance of the enzyme acetyl-CoA carboxylase. As a consequence, malonyl CoA levels drop, since it is a product of acetyl CoA carboxylation. Malonyl CoA is able to limit CPT, which encourages fatty acids to enter the mitochondria, where oxidation takes place to generate the energy demanded to allow the muscles to continue working. With the exception of the higher circulating levels of lactate and pyruvate stemming from improved glycolysis, the remaining plasma substrates show pattern changes which closely match those which would be observed in times of fasting, although the period of time involved is appreciably shorter. In the recovery phases, when glycogen reserves in the muscles and liver have to be replenished, energy is required to accomplish this, as well as to convert unspent FFA back to TGs (5).

Differences in the duration or intensity of an exercise session will inform the differences in the significance of the role played by each of the substrates, although other influential factors include diet, the surrounding environment, and any previous training. For example, the oxidation of amino acids obtained from muscle protein has a minimal effect on the energy metabolism of an athlete, especially when the body can provide sufficient carbohydrate reserves as an alternative (6).

1.4 The Anaerobic System in Footballers

It is the aerobic metabolism which delivers the majority of a player's energy requirements during a football match, but it is the anaerobic metabolism which is responsible for the short bursts of intense activity which have the most significant bearing upon the match result. Players must jump, sprint, tackle and compete with each other for control of the ball, and all of these actions make demands upon the anaerobic system (7, 8).

Various research studies have examined the lactate profiles of both male and female footballers during matches, and most of this research has found that the lactate profile is lower in the second half of the game than in the first, suggesting that intensity would be reduced during the later stages of the match. The rate at which lactate can be cleared from the body is dependent upon its concentration levels, and also on the player's activity during the recovery phase and the player's aerobic capacity (8).

1.5 Protein Metabolism in Aerobic Conditions

The breakdown of protein is not the optimal energy source, but in aerobic conditions it does have the ability to resynthesize ATP. The process of protein metabolism can take place only within the mitochondria. It begins with the deamination of amino acids in the skeletal muscles and in the liver, before the products are changed into either pyruvate or acetyl-CoA which can directly join the citric acid cycle under aerobic conditions to form NADH and $FADH_2$, and also ATP through the electron transport chain. Various amino acids including serine, glycine, threonine and cysteine can be converted into pyruvate before becoming acetyl-CoA and joining the citric acid cycle; these amino acids are classified as glucogenic. Another classification is ketogenic amino acids which include leucine, isoleucine, tyrosine, lysine, phenylalanine and tryptophan;

these are directly converted to acetyl-CoA and subsequently join the citric acid cycle. Finally, there are amino acids such as arginine, and glutamine which can enter the citric acid cycle directly. During exercise, the glucogenic amino acids support gluconeogenesis. Ketogenic amino acids, on the other hand, will synthesize triacylglycerol rather than glucose (9).

1.6 Carbohydrate metabolism

Animals are able to store glycogen by converting glucose to this form via glycogenesis, then when energy is required from glucose, the glycogen can be broken down by glycogenolysis. The resulting glucose is then converted using the pentose phosphate pathway into ribose-5-phosphate, which can also be found in nucleotides, and NADPH which serves as a strong reducing agent. Energy is generated when glucose is converted into pyruvate by oxidization through glycolysis. When no oxygen is present, pyruvate becomes lactate, while in oxygen it will instead break down further to become acetyl-CoA. ATP can be obtained from acetyl-CoA through the electron transport system and the citric acid cycle, making it a valuable source of energy. It should be remembered that carbohydrate metabolism is closely related to the metabolism of other nutrients, so acetyl-CoA can also be produced when fatty acids or certain amino acids are degraded. Indeed, when too much acetyl-CoA occurs, the excess can be converted into fatty acids (10).

The principal carbohydrate substrate used in exercise is muscle glycogen. The rate at which it is utilized is dependent upon the intensity of the workload faced by the muscles. As the exercise period endures, the muscle glycogenolysis rate falls along with the declining glycogen levels and glycogen phosphorylase activity, while the availability of blood-borne substrates such as FFA increases. When glycogenolysis takes place during exercise, it is because of the activation of glycogen phosphorylase, which can occur in two different ways. One of these is more active while the other is less active. Phosphorylase b to a transformation will take place as a reaction to raised sarcoplasmic Ca^{2+} as the muscles contract and the hormones are stimulated by adrenaline, controlled by the b-adrenoceptor and also by the intracellular second messenger cAMP. Furthermore, allosteric modulators, including AMP, IMP, and the substrates Pi and glycogen can support glycogen phosphorylase activity and glycogenolysis in the muscles. Alternatively, when pyruvate dehydrogenase activity increases while exercise takes place, typically due to raised intramuscular Ca^{2+}, this can support greater carbohydrate oxidation. Together, these processes serve to match the oxidation action and the rate of muscle glycogenolysis so that it can respond effectively to the demand for ATP. (10)

Carbohydrates can also be obtained for glucose in the blood and in the muscles; the uptake will change as exercise is performed, in accordance with the duration and intensity of that physical activity. The contracting skeletal muscles receive greater quantities of glucose and insulin as blood flows are increased by exercise, although this in itself amounts to only around 30% of the measurable increase in muscular glucose uptake (20), so it can be concluded that other factors related to the muscle have a role to play. These factors include heightened sarcolemmal transport of glucose and also the triggering of glycolytic and oxidative enzymes which govern glucose metabolism (19). In particular, sarcolemmal glucose transport takes place via facilitated diffusion; the GLUT-4 isoform controls contraction and insulin-stimulated glucose transport, while the GLUT-4 transporter belongs to the group of facilitative glucose transporters which can be mainly expressed in skeletal and cardiac muscles and in adipose tissue. During exercise, the main mechanism behind the rise in sarcolemmal glucose transport is the translocation of GLUT-4 from its intracellular storage site to the plasma membrane. Observations of this process concerning skeletal muscles have been recorded in both rats and humans, but the precise nature of the cellular mechanisms which serve to boost sarcolemmal glucose transport when the muscles contract has yet to be fully understood, but it seems likely that rising sarcoplasmic Ca^{2+} may be a crucial factor. Furthermore, since exercise can assist the translocation of VAMP-2 (Vesicle-Associated Membrane Protein) to the sarcolemma, it can be inferred that at the molecular level, the mechanisms which translocate the GLUT-4 vesicles may closely resemble those which are involved in the trafficking of synaptic vesicles and membrane proteins.(10)

When athletes undergo endurance training, they begin to rely less upon blood glucose and on glycogen in the muscles and liver when they exercise, while lipid oxidation tends to rise for the same power output. The benefits of training are less significant, however, if the exercise is performed at the same level of intensity. When the diet is changed to raise the intake levels of carbohydrates, this is normally tied to a greater reliance on muscle glycogen, which will be governed to a certain extent by the glycogen availability prior to exercise. There is little impact on muscular glucose uptake while lipid oxidation is reduced. If the outside temperature is higher, then muscle glycogenolysis is typically increased along with liver glucose output and glycaemia (31), while carbohydrate oxidation is also enhanced. This would seem to be governed by muscle temperatures and by rising levels of plasma adrenaline (6).

2. Youth Players

In young players, the physical demands may differ from adults because the players are still growing and developing physically. For example, young players usually have lower VO2max levels (<60 mL /kg/min) than adults (8). In these circumstances the issue of nutrition is vital, since it must support growth as well as delivering energy for sporting purposes. Furthermore, it should be noted that players mature and develop at different rates so players of the same age may be at different stages of their physical development. For this reason, the rules used in youth football may differ slightly from the conditions in adult football; typical differences are the smaller pitches used, the smaller teams in terms of number of players, and also specific prohibitions of certain activities such as sliding tackles. These differences can make the game safer and more enjoyable for the young players (11).

3. Nutrition

Foods and nutrition are important for athletes for providing energy in addition to training. This can be clearly apparent from the actions of Football Confederations who are giving precedence to the issue of a handbook covering key information related to foods and nutrition for footballers in order to improve and enhance their performance (12) especially for athletes who need more protein than the average person in order to enhance and activate muscle recovery since the muscles become repeatedly strained as a result of exercise.

3.1 Protein recommendation

The Thai Recommended Daily Intake (RDI) for proteins in male adolescents aged between 13-18 years old is displayed in Table 1 (13).

Table 1 Thai RDA for youth males (13)

Age	Weight (kg)	Height (cm)	Energy (kcal/day)	Protein		Ca (mg/day)	Vit D (/day)
				g/day	g/kg BW		
13-15	49	163	2,100	58	1.2	1,000	5
16-18	57	169	2,300	63	1.1	1,000	5

Table 2 The nutrients recommendations of the American College of Sports Medicine (ACSM) and Academy of Dietetics and Nutrition (14)

Nutrient	Recommendation
Protein (15 – 20%)	• 1.2 – 1.4 g/kg BW/day for endurance athletes • 1.6 – 1.7 g/kg BW/day for strength athletes • RDA 0.8 - 1.0 g/kg BW/day
Carbohydrate (50-60%)	6-10 g/kg/bw/day
Fat (<30% of total kcal/day)	Less than 10% from saturated fat

Table 3 The protein recommendation from ISSN (International Olympic Committee and the International Society for Sports Nutrition) (15)

Daily or habitual protein requirements		
Physical activities level	g/kg BW / day	Comments
ISSN		
General Fitness	0.8 – 1.0 g/kg BW	Focus on protein quality. Amino acid content. Whole foods. Safe, convenient supplements where needed.
Older individuals	1.0 – 1.2 g/kg BW	
Moderate amount of intense training	1.0 / 1.5 g/kg BW	
High volume of intense training	1.5 – 2.0 g/kg BW	

3.2 Branched-Chain Amino Acids and physical performance

Branched Chain Amino Acids (BCAAs) are among the nine essential amino acids for humans and account for 35% of the essential amino acids in muscle proteins and 40% of the preformed amino acids required by mammals, and include valine, isoleucine and leucine (16). BCAAs are unique among amino acids in not being broken down by the liver. For other amino acids, the liver and gut are able to control the levels of dietary amino acids which are released into the bloodstream. In the case of BCAAs, however, the diet can influence the levels and concentrations of plasma in peripheral tissues such as adipose or skeletal muscles. Catabolism of BCAAs is greater in peripheral tissues as a result of higher cell concentrations, while the breakdown of BCAA is the skeletal muscles supports the creation of alanine and glutamine and also serve to maintain glucose homeostasis. BCAAs and glucose metabolism are closely linked as a part of the glucose-alanine cycle, through which BCAAs are continuously released from the liver and the splanchnic bed as shown in Figure 6. The uptake by the muscles leads to higher intracellular concentrations and triggers the transamination of BCAAs, in which amino nitrogen is transferred to alanine which produces pyruvate. Alanine can also be used by the liver in assisting the process of hepatic gluconeogenesis. While the overall importance of this glucose-alanine cycle is not yet wholly determined, over 40% of endogenous glucose production during exercise has been attributed to this activity (17).

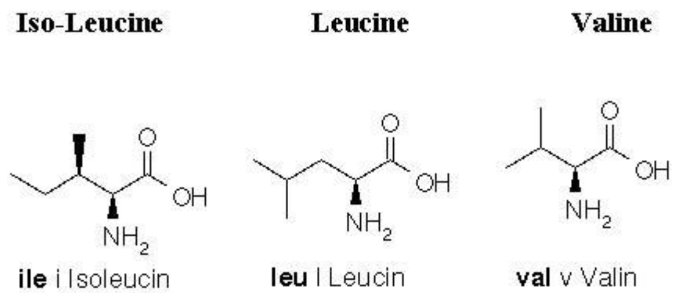

Figure 4. The structures of branched-chain amino acids (18)

As outlined previously, amino acid catabolism usually takes place in the liver, except in the case of BCAAs such as isoleucine, valine and leucine. This is because the liver cannot provide the particular enzyme which starts their catabolic pathways. Therefore, these BCAAs are catabolized primarily in muscle, adipose tissue, the brain and the kidneys (5). The result of BCAA catabolism is NADH and $FADH_2$ which in turn produce ATP.

Under conditions of aerobic exercise BCAAs are oxidized to generate aerobic energy within the mitochondria of skeletal muscles, while at the same time, the liver catabolizes the other six essential amino acids (19). Aerobic exercise can significantly boost the metabolism level of BCAAs (20), so whenever exercise is prolonged, it will lead necessarily to the depletion of BCAAs in the muscles because most of the available reserves will have been metabolized.

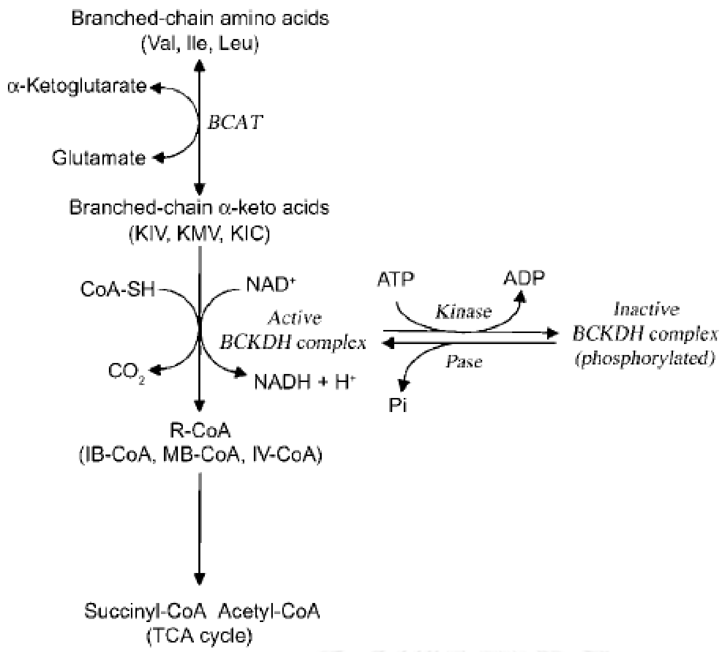

Figure 5. Metabolism of branched-chain amino acids (Shimomura et al., 2006)(20)

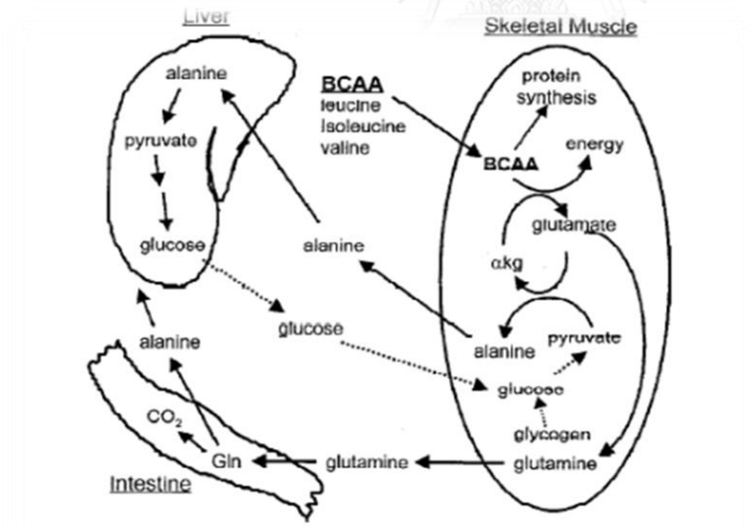

Figure 1. Picture represents movement of the BCAA from viseral tissues (liver and gut) through blood circulation to uptake by skeletal muscle. In muscle tissue, BCAA are used for protein synthesis, production of energy, and synthesis of alanine (Ala) and glutamine (Gln). Alanine and glutamine are released from muscle and return to the liver and gut as substrates for endogenous production of glucose. Abbreviations: BCAA branched-chain amino acids, α-kg alpha-ketoglutarate.

Figure 6. The movement of BCAA from visceral tissues through blood circulation to uptake by skeletal muscles (17)

The review of Gleeson (21) covering the relationship between physical activity and branched chain amino acids indicated that branched chain amino acids can also help to reduce fatigue after playing sports. In addition, eating branched chain amino acids before exercise can reduce injuries and physical symptoms after the exercise is completed.

3.2.1 Branched-chain amino acids and the Relationship with Resistance Exercise

In an investigation of amino acid supplementary effects upon hormonal profiles in resistance trained males by supplementing the group with high BCAA (6 g per day) for 3 weeks and allowing training in the 4th week, the results showed a lower level of serum creatine kinase and cortisol when compared with the placebo (lactose). This result therefore suggests that high levels of BCAA supplementation may produce a net anabolic hormonal profile while attenuating training induced increases in muscle tissue damage (22).

Furthermore, a study of resistance trained males for the longer duration of 8 weeks was carried out, in which the volunteer subjects were randomly allocated to either the BCAA group or the carbohydrate group. The outcome revealed that for trained athletes performing resistance training with BCAA supplementation on a hypocaloric diet were able to retain their lean mass with no loss of skeletal muscle functionality even though fat mass was simultaneously lost (23).

However, the study of Soran et al (24) investigated the effects of different doses of branched chain amino acids on muscle damage by using 14.8 g and 33.3 g of BCAA at 30 minutes before and after exercise. The results showed levels of serum CK and LDH which are indicators for the muscles of serum CK and LDH between the pre- and post-exercise measures from 24 hours to 48 hours, but there were no significant differences between the two groups. So, from this result it can be indicated that giving different doses of BCAA did not affect muscle injuries for footballers while exercising the lower parts of the body with resistance.

3.2.2 Branched-chain amino acids and the Relationship with Endurance Exercise

A study conducted by Greer et al. determined the effects of BCAAs on aerobic performance and rate of perceived exertion compared with carbohydrate beverages (CHO) and a non-caloric placebo (PLAC). All participants received equal supplements of 200 kcal of BCAA (24.3 g) and CHO before and at 60 minutes of exercise. From the study it was found there was no difference in the distance achieved by cyclists between BCAA and CHO, but the rate of perceived exertion was reduced at 75 and 90 minutes in the BCAA sample compared with PLAC. Hence, eating branched chain amino acids will increase the concentration of branched chain amino acids in the blood by reducing the intensity of the exercise but will not affect the sporting performance of consumers (25).

A study carried out by Reinaldo A. Bassit et al. examined triathletes and marathon runners and used 6 g of branched chain amino acids 30 days before competition and a week after competition for the triathletes, and 15 days before the test day for the runners. The triathletes received BCAA twice a day after training while the runners received a single dose (3 g of BCAA). After the test day, only the triathletes were administered 3 g of BCAA in the morning for one week. All participants had their blood collected 45 minutes before the event and 15 minutes after their race. The results showed that this approach can strengthen immunity by creating glutamine; the main amino acid that is important for the immune system (26).

Blomstrand et al. (27) investigated the effects of BCAA on physical performance and plasma concentration by having 7.5 g and 16 g of branched chain amino acids consumed by cross-country runners and marathon runners (five times for cross-country and four times for marathon), respectively. The indication would be that athletes who had eaten branched chain amino acids would show improvements in both physical fitness and brain effectiveness when compared with athletes who drank common drinks. Moreover, the results from this study showed no changes in the plasma concentration of tyrosine and phenylalanine during the marathon race, suggesting that BCAA may suppress the rate of protein degradation during exercise, which leads to improved performance in marathon runners.

These results are consistent with the preliminary studies of Shimomura (20) who found that eating 5 g of branched chain amino acids 15 minutes before exercise can reduce tissue injury and fatigue symptoms after exercise for several days in healthy adults who did not take regular exercise. Furthermore, the study of Wiśnik et al. (28) also investigated the effects of BCAAs on psychomotor performance by using 7 g of branched chain amino acids 1 hour before exercise. They found no significant difference in biochemical outcomes for BCAA and placebo, but in multiple choice reaction time the BCAA sample showed shorter times than the placebo group before and during exercise. Therefore, BCAA can reduce the duration before the response to a trigger. It will be effective when used in athletes requiring quick reactions to the external environment, such as football players or athletes in team sports.

In a study of the effects of branched chain amino acids on perceived exertion rate while exercising by using BCAA solution containing 7 g/L, all participants received 150-200 mL of solution immediately before exercise and at the 15 minute point during exercise. The total amount of BCAA supplied to subjects was 90 mg/kg bodyweight.

There were no significant differences in physical performance between BCAA and placebo, but the plasma concentration ratio of free tryptophan/BCAAs, which increased by 45% during exercise and by 150% 5 minutes after exercise in the placebo trial, remained unchanged or even decreased when BCAAs were ingested. Therefore, it could be explained that branched chain amino acids can maintain or decrease the ratio of free tryptophan / BCAAs which will increase after exercise and be a cause of fatigue (29).

7.5 g/L of the branched chain amino acids can improve the mental performance of female football players as well (30). In addition, in a study of the influence of BCAA supplements on urinary protein metabolite concentrations after swimming, the results found that swimmers who had eaten 12 g immediately before training in breast stroke and immediately after training in front crawl stroke for 14 days, had lower concentrations of urinary urea nitrogen, hydroxyproline (HP) and 3-methylhistidine (3MH). Therefore, BCAA could help to prevent protein breakdown in muscles (31).

A review of the literature concerning the effects of BCAA supplements on skeletal muscles when exercising shows that there are benefits to be obtained from supplementation in terms of reducing damage to muscles caused by exercise and in supporting the muscle-protein synthesis process. It can thus be concluded that BCAAs may have a positive role to play for sportspersons. While many of the studies carried out in humans have used small doses of .5 g of BCAA, it has not yet been established exactly what dosage levels might yield the best results (19). Investigation of leucine in healthy men by intravenous infusion of leucine has been compared with normal saline. The results indicated that leucine decreases the plasma concentrations of several amino acids and also whole body valine flux, oxidation, and phenylalnine flux. Hence, leucine inhibits protein degradation by decreasing the plasma concentrations of several amino acids, particularly valine and isoleucine. Taking branched chain amino acids to increase the balance of protein will obviously have a positive effect in people with protein deficiencies (32).

A study conducted by Coombes gave 12 g of the branched chain amino acids per day for 14 days, and found that the branched chain amino acids would support a level of serum which could indicate reduced tissue injury. (33)

In the study of Jackman (34), the researcher examined the role of BCAAs during recovery following eccentric exercise. All subjects received BCAA supplements which comprised 7.3 g of the branched chain amino acids on the test day (3.5 g of leucine, 2.1 g of isoleucine and 1.7 g of valine). The supplements were administered 30 minutes before exercise and 1.5 hours after exercise, between lunch and dinner. On the following 2 days, supplements were consumed between meals (4 times). The results showed that muscle function decreased after the eccentric exercise, but the degree of force loss was unaffected by BCAAs compared with the placebo. In the BCAA group there was a decrease in flex muscle soreness at 48 hours and 72 hours. From the explanation of the area under the curve, flexed muscle soreness was found to be lower in BCAAs than in the placebo group. Therefore, the researcher concluded that branched chain amino acids could reduce muscle injuries, but did not increase exercise performance by reducing the workload of the muscles.

Table 4 The studies of branched-chain amino acids and physical performance in order to dosage

Author	Subjects	Method	Measurement	Dosage	Result	Conclusion
Shimomura Y, J Nutr. 2006 Feb;136(2):529S-532S.	-young healthy female and male -16 females and 4 males -Divided subjects into 2 groups which separate by sex	-BCAA solution (150 mL) containing 5 g of BCAA mixture (Ile:Leu:Val 5 1:2.3:1.2) -Placebo solution 150 ml contain 5 g of dextrin -Consume 15 min before exe. The exercise test consisted of 7 sets of 20 squats/set (total 140 squats), with 3-min intervals between each set	-muscle soreness using visual analog scale -muscle fatigue using visual analog scale -plasma BCAA concentration	-BCAA solution 150 ml containing 5 g of a BCAA (Ile:Leu:Val =1: 2.3 :1.2) *preliminary study	1.Muscle soreness in female was highest on the 2nd and 3rd day in PLA. But the peak soreness occur only in 2nd and was sig.lower in BCAA gr. 2.Muscle soreness in male peak on 2nd and tended to be lower in BCAA gr.,but not sig. 3.Muscle fatigue in both sex tended to be lower in BCAA gr.	The results indicate that the ingestion of *5 g of BCAAs before exercise* can reduce DOMS and muscle fatigue for several days after exercise
Bassit RA, Nutrition. 2002 May;18(5):376-9.	-12 male triathletes Swam 1.5 km, cycled 40 cm and ran 10 km. -24 marathon runner (ran 30 km in 2 h)	-Separate into 2 groups 1.BCAA 2.PLA Triatlete ->consume 30 d before competition and 1 wk after Marathon -> consume supplement 15d before test. -Dose of BCAA 1.single dose for marathon (6 g of 60%L-Leu,20%L-Val,20%Ile) 2.triatlete received 2 dose /d ->3 g before race 30 min and 3 g in the morning (for 1 wk after)	-plassma glutamine Collect blood 45 min before and 15 min after race)	-6 g of BCAA (60%L-Leu,20%L-Val,20%L-Ile) 1 month+1wk intervention for triathlete 15 d intervention for marathon	-after exe. both gr. has shown to decrease plasma glutamine concentration, but in BCAA gr can improve and increase proliferative response in peripheral blood mononuclear cells	BCAA supplementation recovers the ability of peripheral blood mononuclear cells proliferate in response to mitogens after a long distance intense exercise, as well as plasma glutamine concentration.

E. BLOMSTRAND Acta Physiologica ScandinavicaVolume 159, Issue 1, pages 41–49, January 1997	-7 males endurance trained cyclist	Separate into 2 gr. 1.BCAA group -solution 150-200 mL contain 7 g/L of BCAA (40% Val, 35% Leu ,25% Iso) 2.placebo -flavor water The subjects were supplied with total of 90 mg/BW of BCAA Total dose =6.6 g of BCAA Consume -immediately before exe. -every 15 min during exe. Total time that give supplement 6 time	-blood sample 10 min before exe. , every 20 min durng exe. And 5 min after end of exe. -muscle biopsy 5 min before exe.and within 3-4 min of ending exe. -rating of perceived exertion and mental fatigue by Borg scale ->before exe and during exe every 10 min -color word test to measure cognitive performance ->within 10 min after finish exe.	-solution 150-200 mL contain 7 g/L of BCAA (40% Val, 35% Leu ,25% Iso) *Total dose =6.6 g of BCAA *1 day intervention	- No difference in the physical performance between the control and placebo group.	The plasma concentration ratio of fTRP/BCAAs increased 45% during exercise and by 150% after exercise in the placebo trial, still sameor even decreased when BCAAs were ingested.
WiŚnik P, Appl Physiol Nutr Metab. 2011 Dec;36(6):856-62. doi: 10.1139/h11-110. Epub 2011 Nov 3.	-10 male soccer players	-randomized double blind -separate into 2 groups 1.BCAA 2.placebo -give before exe. 1 hr.	-running test 45 mins -during the test , blood samples were taken for lactate, glucose, free fatty acid, and catecholamine determination	-7 g of BCAA/d -1 wk interventions	-placebo, MRT shortened during the 1st exercise bout then it increased during the resting break, meanwhile, the 2nd bout, MRT decreased. During recovery, MRT was more shortening. -BCAA, MRT was shorter than during placebo before and during exercise. No significant differences weas found between BCAA and placebo trials in biochemical indices *MRT = multiple-choice reaction time	BCAA supplementation might be recommended in sport activities that change in intensity and require quick responses to external signals (e.g., soccer and other team games).

E.BLOMSTRAND, *Acta* Physiol *Scand* 1991, 143, 225-226	-6 females soccer players	Double blinded cross over 1.experimental group 6% carbohydrate drink containing 7.5 g 1-l BCAA (40% valine, 35% leucine and 25% isoleucine) 2.placebo group 6% carbohydrate Solution*Consume during game but did not tell volume and when *1 wk washout	-mental performance use Stroop Colour and Word TestTest 2-2.5 h before the game and within 45 min after the end of game.-blood sample -Plasma amino acid -Plasma tryptophan	-7.5 g/L of BCAA	The performance of the subjects in all parts of the CWT was improved in the game when the experimental drink was taken. -CWT was sig. within gr. *not compare between gr.	BCAA during exercise can maintain the improved mental alertness caused by physical exercise.
E. Blomstrand Eur J Appl Physiol (1991) 63:83-88	-Male runner -25 subjects 30 km. cross country race -193 subjects marathon (42.2 km)	Each gr. of subjects separate into 2 gr. 1.BCAA - BCAA contained 50% valine,35% leucine and 15% isoleucine in a 5% carbohydrate solution (cross-country) -> 5timew -For marathon -> 4 time 50% valine, 30% leucine and 20% isoleucine in plain water (marathon) 2.The placebo drink consisted of a 5% carbohydrate solution (cross-country) or flavoured water (marathon).	- mental performance the Stroop Colour and Word Test (CWT) for cross country race -Physical performance measurements. For marathon -Plasma analysis Plasma glucose and free fatty acid	- 7.5 g of BCAA (cross-country) - 16 g of BCAA(marathon) *1 day intervention	In 30-km cross-country the mental performance was improved in BCAA gr. whereas the CWT scores were similar in placebo group. The running performance in the marathon was improved for the "slower" runners (3.05 h-3.30 h) when BCAA was taken during the race; however, there was no significant effect on the performance in the "faster" runners	Both mental and physical performance was improved by an intake of BCAA during exercise. In addition, the effects of exercise on the plasma concentration of the aromatic amino acids were altered when a BCAA supplement was given during the marathon.

Coombes JS J Sports Med Phys Fitness. 2000 Sep;40(3):240-6.	-16 males	-divided subjects into 2 group 1.supplement group 12 g/d of BCAA + normal diet 2.control group Only normal diet	1.serum creatine kinase (CK) 2.lactate dehydrogenase (LDH) Which the indicator for muscle damage	-12 g of BCAA/day Supplementation for 14 days	**-Dietary analyses indicated that all subjects consumed the recommended daily intake of BCAA (0.64 g/kg in their normal diets. -Baseline serum values for CK and LDH were not different between groups in the 7 d before the test. However there were significant increases between the pre-exercise and postexercise values for LDH and CK until 5 d -BCAA supplementation significantly reduced this change in LDH from 2hrs to 5 d posttest, and CK from 4 hrs to 5 d post-test.**	**Supplementary with BCAA decreased serum concentrations of the intramuscular enzymes CK and LDH following prolonged exercise, even when the recommended intake of BCAA was being consumed. This founding suggests that BCAA supplementation may reduce the muscle damage associated with endurance exercise**
Tang FC. J Am Coll Nutr. **2006 Jun;25(3):188-94.**	<u>19 healthy males</u> who enrolled to swimming course level 2 (familiar with breast stroke and crawl stroke ,<u>but not highly trained competitive athletes</u>) - 19-22 years old	-double blind ,counter balance study -separate 2 groups 1.BCAA 12 g of BCAAs/day; in capsules: leucine 54%, isoleucine 19%, valine 27% 2.placebo 12g of glucose/day ; in capsules -3 times/d (4g/meal) -during meal time supplement were given	urinary hydroxyproline (HP) methylhistidine(3MH) and creatinine -urine and blood samples Before(d0), during (d7) and after (d14) -3 day before competition the participants avoid to eat meat to eliminate 3-methylhistidine(3MH) and creatinine -on d15 collected urine and blood sample (urine3and blood3) -25 min after breast and stroke (blood and urine 4) -after crawl stroke (blood and urine 5) -d16	-12 g of BCAA/d -investigated for 15 days -1st dose before exe. (7.30 a.m.) -2nd dose after breast stroke immediately Rest 1 hr. -3rd dose after crawl stroke competition immediately	2 weeks of dietary supplementation <u>did not induce</u> any changes in the plasma glucose and total BCAA concentrations of both groups, did not change in the urinary urea nitrogen, HP, and 3MH concentrations in urine.	Swimming induced muscle proteolysis which was prevented by BCAA supplementation. The mechanism could be attributed to the availability of ammonia provided by the oxidation of supplemented BCAAs during exercise

Wesley David Dudgeon	17 resistance trained males (21-28 years old) -Randomized in to BCAA group (N=9) CHO group (N=8)		-body composition -muscular fitness -1RM bench press -1RM squat -rating metabolic rate -caloric restrict diet	14 g of BCAA -CHO total 28 g (7 g before and 14	-BCAA lost fat mass and maintain lean mass -CHO lost lean mass -1RM squat increase in both groups, but in BCAA was greater. -1RM bench press increased in BCAA, but decreased in CHO. -muscular endurance increase in CHO	BCAA can maintain lean mass with no loss of skeletal muscle
Soran et al	-30 male soccer players -double blind	Divided into 3 groups 1.200 mg/kg BW 2.450 mg/kg BW 3.dextrin 200 mg/kg BW (placebo) -30 mins before and after exe.	-CK -LDH 30 mins before exe. And 24,48 hr after	-200 mg/kg BW (14.8 g) of BCAA -450 mg/kg BW (33.3 g) of BCAA	Significant increases between pre and post for CK and LDH from 24 hr to 48 hr. No significant difference between 2 groups.	The different dose of BCAA did not effect on muscle injuries

Jackman SR, Med Sci Sports Exerc. 2010 May;42(5):962-70	- 24 non–weight-trained males	-single-blind experimental trial -Separated into 2 groups 1.supplementary group SUP was 3.5 g of leucine, 2.1 g of isoleucine, and 1.7 g of valine mixed in 300 mL of artificially sweetened and flavored water. 2.placebo group Contained 300 mL of artificially sweetened and flavored water supplements were consumed 30 min before exercise, 1.5 h after exercise, between lunch and dinner, and before bed	Eccentric exercise protocol -Muscle soreness, Plasma concentrations of CK and Mb -interleukin-6 (IL-6) - muscle function using electrical stimulation with a Tornvall chair -putative blood markers of muscle damage before and after (1, 8, 24, 48, and 72 h) exercise	3.5 g of leucine, 2.1 g of isoleucine, and 1.7 g of valine mixed in 300 mL (7.3 g of BCAA) 4 times/d -between meal -Total dosage 29.2 g of BCAA/day -Supplementation for 3 day	Muscle function decreased after the eccentric exercise ,but the degree of force loss was unaffected by BCAA ingestion. In SUP was decrease in flexed muscle soreness compared with PLA at 48 h and 72 h. Flexed muscle soreness, expressed as area under the curve, was lower in SUP than in PLA	BCAA supplementation may attenuate muscle soreness, but it does not ameliorate eccentric exercise-induced decrements in muscle function or increases in reputed blood markers of muscle damage, when consumed before exercise and for 3 d after an eccentric exercise bout.
Greer BK, J Strength Cond Res. 2011 Feb;25(2):539-44.	-9 healthy untrained ma *avoid eating for 4 hours before each exercise trial -maintain similar dietary patterns for the 3 days before each trial	-3 treatment phases for this study 1.BCAA 2.CHO 3.PLAC -> non caloric (only water+lemon flavor+artificial sweetener) *BCAA and CHO beverage is isocaloric = 200 kcal -5 min before and at 60 minutes of exercise	-blood sample Blood Glucose Branched-Chain Amino Acids Concentrations -Time Trial Performance -Rate of Perceived Exertion -Respiratory Exchange Ratio	-BCAA beverage (4.8 g isoleucine, 12.2 g leucine, and 7.30 g valine (100 kcal) -Total = 24.3 g/serving So the subjects received 48.6 g of BCAA /d	There was no difference between the BCAA and PLAC trials. RPE was reduced at the 75-minute and 90-minute mark during the BCAA trial as compared with the PLAC trial. There were no significant differences found for the trial vs. time interaction in regard to respiratory exchange ratio.	BCAA supplementation, although effective at increasing blood concentrations of BCAA, did not influence aerobic performance but did attenuate RPE as compared with a PLAC beverage.

Nair et al	2 groups -L-leucine -saline -infusion	2 groups -L-leucine -saline -infusion	-plasma concentration of insulin,growth hormone,glucagon -epinephrine and norepinephrine -amino acids concentration	- L-leucine 154 ± 1 μmol/kg/hr	L-leucine decreased plasma concentration of several amino acids and whole body valine flux, oxidation and phenylalanine flux	Leucine inhibit protein degradation by decrease plasma concentration of several amino acids

3.3 Milk and physical performance

Milk is a drink which contains protein, calcium and vitamin D, which strengthens bones and muscles (body composition). Milk's principal proteins are the casein and whey proteins which contain branched-chain amino acids, and in particular leucine, especially in skimmed milk. Whey and casein have differing bioavailability and absorption rates; notably whey protein will dissolve in water and so it be easily digested, hence the term 'fast protein'. When whey protein is consumed, amino acids become available to the body very quickly afterwards. In contrast, casein does not dissolve in water and instead delivers its amino acids much more slowly. However, these amino acids will be maintained within the body at higher levels for much longer. The differences in how these proteins work may explain the body's responses to milk when undertaking exercise (35).

One review of the impact of milk consumption and resistance training on body composition found resistance exercise and milk/dairy consumption can positively impact body composition in women by promoting favourable changes in all three body compartments: fat, lean (muscle) and bone (36). Therefore, there have been further studies about the effects of milk on physical performance. One of the studies was that of Saunders (37) who studied drinks containing a skimmed milk protein of 6.5 g in cyclists. It was found that cyclists who had consumed the drink containing skimmed milk protein could ride for longer periods and had lower rates of fatigue and muscle injuries compared with those who did not drink skimmed milk. Kim (38) studied the effects of low-fat chocolate milk with 8 grams of protein components after exercise in athletes. It was found that low-fat chocolate milk supports performance equivalent to sports drink. Meanwhile, the study of Gilson et al (39) found that drinking chocolate milk with 28 g of protein within 5 minutes after training for 4 days could decrease levels of serum creatine kinase which is an indicator of muscle injury. This result is consistent with the study of Cockburn (40) which indicated that drinking milk or beverages containing 34 g of protein can reduce muscle injury caused from exercise.

From the study of Jason (41) related to endurance training in males, it was found that both time to exhaustion and total work could be increased significantly by consuming chocolate milk and a drink to replace fluids, in comparison with drinks which replace carbohydrates. The implication is that chocolate milk supports recovery after exhaustion from exercise. In further studies of the effects of milk on endurance, it was revealed that milk consumption on the completion of exercise was also helpful (42).

Finally, research carried out by Lunn et al. (42) investigated how fat-free chocolate milk consumption can influence the kinetic and cellular markers of protein turnover, levels of muscle glycogen, and the recovery of the body from long periods of sustained exercise. It was revealed that milk provided greater benefits than drinks based purely on carbohydrates in terms of muscle protein fractional synthetic rate (FSR) and leucine kinetics.

Calcium plays an important role in maintaining muscle strength and density. One study of calcium in pre-exercise meals showed that a prolonged and high intensity bout of stationary cycling attenuates the exercise induced rise in markers of bone resorption (43).

Vitamin D is a fat soluble fibre which can be synthesized in the body by using energy from sunlight, and it is also found in a few foods. A review of evidence from 16 randomized controlled trials on the effects of treatment with vitamin D on muscle function, with the exception of studies of subjects above 50 years old revealed that in eleven studies the level of 25-hydroxyvitamin D (25OHD) was below 50 nmol/l and the level of the plasma 25OHD was increased significantly in all studies. In seven studies vitamin D was shown to have an effect on the muscle strength of the lower legs, body sway, and/or physical performance (44). A systematic review showed that 4 or 5 studies and 2 of 3 studies investigating the effects of vitamin D supplements on balance and gait respectively produced the conclusion that there was no significant influence. However, 4 of the studies did reveal a significant influence on muscle strength, although this effect was not confirmed in 3 similar studies of the same phenomenon. Furthermore, no statistically significant relationship could be confirmed between the use of vitamin D and the outcome of sit-to-stand tests in half of the studies reviewed. Therefore there is no consensus established on the benefits of vitamin D upon physical sporting performance (45). Another review of evidence that vitamin D affects physical and athletic performance indicated that it may improve athletic performance in athletes with a vitamin D deficiency. Athletes reach maximum performance levels when 25(OH)D levels reach the level usually attained via natural, full-body, summer sun exposure, which can be measured as around 50 ngImLj1. These levels would also offer some protection to the athlete from other medical problems, both chronic and acute (46).

Table 5 The Studies of milk and physical performance in order of dosage range

Author	Subjects	Method	Measurement	Dosage	Result	Conclusion
Saunders et al	15 male cyclists	2 groups -CHO -CHO+P Consume every 15 min of exe, 10 ml/kg BW immediately after exe -subjects rode cycle ergometer at 755 vo2max	-metabolic measure (VO2,CO2,ventilation),heart rate, RPE every 30 min -blood glucose, CPK, lactic acids at rest and every 30 min during exe.	-1.8 ml/kg BW 127 ml of fluid every 15 mins for 70 kg BW (26 g of CHO, 6.5 g of whey protein) / 355 ml of water	- time to fatigue 1st ride(75% vo2max), subjects rode29% longer in CHO+P than CHO 2nd ride(85%vo2max), subjects rode 40% longer in CHO+P than CHO alone -plasma CPK were lower in CHO+P than CHO.	CHO+P increase time to fatigue and lower rate of muscle damage
Kim J et al	-5 males -8 females Soccer players (11 females,15 males)	-Randomized crossover 2 groups -low fat chocolate milk -CHO-electrolyte (CE) -consume immediately after 1st practice and 2 hr later	-time to fatigue (20 m shuttle run)	-8 g of protein in milk (160 kcal, CHO 27g) -CE -> 50 kcal, CHO 14g	- No significant difference in run time were reported for the group. For the men only, there was a trend of increased time to fatigue with chocolate milk compared with the CE	Low fat chocolate milk promote recovery between training period during pre-season as same as CHO-electrolyte beverage

Haakonssen EC.et al	-32 trained female cyclists	-randomized counterbalanced crossover -2 groups 1.calcium rich meal 2.con	-blood sample pre-post, immediately, 40,100 and 190 mins -biomarker of bone resorption	1352 mg calcium	-PTH and CTX-I increased from pre to post-exercise in both conditions but was attenuated in CAL. -PTH was lower in CAL immediately post-exercise and lower at 40 min post-exercise.	Ca2+ can attenuate the exercise induced increase in marker of bone resorption
Howarth KR.et al	-6 active men	-randomized -separate 7 d -consume 15 min interval for the 1st 3 h of recovery	-muscle biopsy (vastus leteralis) -breath -questionnaire -blood	-1.2 g CHO/kg/h (L-CHO) -1.2 g CHO/kg/h + 0.4 g protein /kg/h (CHO-P) -1.6 g CHO/kg/h (H-CHO) -750 ml/h -> 3 h	-muscle FSR was higher in PRO-CHO compare with L- and H-CHO -Whole body and net protein balance(WBNB) positive only during PRO-CHO -glycogen synthesis was not different between trials	-Ingestion Pro+CHO during recovery from aerobic exe can increased muscle FSR and improved WBNB -1.2g CHO/kg/h did not enhance glycogen resynthesis

Lunn WR. et al.	-8 male runners (complete 6)	- 7 days washout -45 mins exercise bout and following 3 hr recovery -consume 2 drinks 1.milk 2.con	-cellular marker of protein turnover -muscle glycogen -performance	-fat free chocolate milk 16 g protein -296 kcal -480 ml	-Muscle protein fractional synthetic rate (FSR) and phosphorylation higher in milk. -Enzymatic activity assays indicated lower caspase-3 activity during recovery for MILK and higher 26S proteasome activity for CON -time to exhaustion was greater for MILK	Milk provide greater benefit than CHO beverage
Karp JR. et al	-9 trained cyclist males	-crossover into 4 groups -1 wk washout 1.chocolate milk 2.fluid replacement (FR) 3.CHO replacement (CR)	-time to exhaustion -total work perform -heart rate -rate of perceive exertion	-19.1 g protein in chocolate milk -18.5 g protein in CR -Volume 509.1 ml	Time to exhaustion and total work significant increase in chocolate milk and FR compare with CR.	Chocolate milk may benefit for recovery from exhaustion, glycogen depletion exercise

Cockburn et al	-24 healthy men in team sports	4 independent group -milk based CHO-P -milk -CHO -water (CON)	-creatine kinase (CK) Myoglobin (Mb) Immediately before exe,24 and 48 hr after	-34 g of protein	DOMS was not significantly different between groups. -Peak torque (dominant) was significantly higher 48 h after CHO-P compared with CHO and CON, and M compared with CHO. -Total work of the set (dominant) was significantly higher 48 h after CHO-P and M compared with CHO and CON. -CK was significantly lower 48 h after CHO-P and M compared with CHO. -Mb was significant lower 48 h after CHO-P compared with CHO.	milk and milk-based protein–CHO drinks consumed immediately after resistance-based eccentric muscle-damaging exercise lead to the attenuation of EIMD 48 h later.

3.4 Sport Drinks and physical performance

Sports drink are available in various brands, sizes and flavours. Some are designed specifically to replace electrolytes lost by sweating during physical exertion. Others replace carbohydrates that are used during exercise to refresh muscles and the brain (47). There are many studies which have proved that it can enhance sports performance of athletes compared with water, due to the fact that while exercising, blood sugar levels and accumulated glycogen will be reduced. Therefore, sports drink will boost blood sugar levels resulting in better sports performance of athletes (48). In addition, drinking sports drink with sugar can reduce the loss of muscle compared with water (49) as well as helping to increase health performance for those who drink while exercising continuously for a long period including short period sports, such as sprinting (50, 51). However, the study of Saunders (37) found that mixing protein into beverages can increase the effectiveness of reducing symptoms of fatigue or injury as well.

From studies of the effect of sports drink during exercise on endurance capacity, the results have shown that percentages of fluid retention, levels of serum sodium concentration, percentage changes in plasma volume at 5 hours of recovery, blood glucose concentrations at 0 minutes and 1hour and also endurance capacity were higher in sports drink compared to water or a placebo (52).

In addition, the examination of sports drink on post-exercise metabolism showed the effect of green tea-based sports drink on glucose, citrate and lactate levels in plasma and on acetone, 3-OH-butyrate, and lactate levels in urine when using multilevel PLS-DA models of plasma and urine. It was also found that levels of caffeine and hippuric acid increased in urine which indicated that they were absorbed by green tea extract components. Accordingly, the researcher concluded that NMR-based metabolomics allowed the complex effects of a green tea extract–based carbohydrate/hydroelectrolyte beverage on the energy metabolism of athletes during recovery by post-exercise rehydration to be evaluated (53).

A broad review of over one hundred smaller studies of the performance effects of sports drink was performed by Coombes et al. (54) who concluded that the type of test used to assess performance had a greater influence on the outcome than the drinks themselves. Factors such as the training state of the athletes or the environmental circumstances were more significant. The studies investigated were organized in various ways, designed to assess variables such as the timing of the drink intake, the control of pre-exercise glycogen levels, the rate of drinking and the contents of the drinks. Most studies revealed no significant influence whenever the CHO concentration was relatively low and the drink was consumed before exercise. However, just over half the studies showed that mild CHO solutions consumed during the exercise rather than in advance did improve performance levels.

Moreover, carbohydrate – electrolyte solutions (CES) were able to enhance endurance times in active females (55).

Kingsley et al. (56) investigated three different carbohydrate-hydration strategies to compare their effects upon on blood glucose concentration, hydration status and physical exercise performance during a football match simulation. Volunteers drank equal quantities of a 9.6% carbohydrate–caffeine–electrolyte (∼6 mg/kg BW caffeine) solution containing carbohydrate–electrolyte gels (H-CHO), a 5.6% carbohydrate–electrolyte solution with electrolyte gels (CHO), or an electrolyte solution containing electrolyte gels (PL). Evaluation was performed using blood samples which were first taken at rest, and the subsequently immediately before starting exercise, and then at 15 minute intervals during the simulated football match. The conclusion from this research was that sprint performance could be improved by mixing carbohydrates with caffeine, while blood glucose concentrations were raised both initially and at the 90 minute phase. However, there was a negative impact upon hydration status in comparison with the approach of using the 5.6% carbohydrate–electrolyte and electrolyte solutions.

Meanwhile investigations have also been carried out upon the effects of consuming a carbohydrate-electrolyte solution by using the 90-minute Loughborough Intermittent Shuttle Test. This test revealed a significant effect on time ($p=0.001$) and differences between 0–45 and 75–90 min ($p < 0.05$). However, footballing skill performance was lowered by 3% when the results were compared before and after exercise when using the carbohydrate-electrolyte solution. In the same test using a placebo, the decrease in skill was 14% ($p = 0.07$), while in the simulated football match, skill levels declined during the last half hour. When players received 52 g/ h carbohydrate as they exercised, their skill levels did not decline as much as when they received only a placebo of similar taste (57).

However, the response of blood glucose and blood lactate to the intake of carbohydrates during a football match must also be considered, so a study was undertaken involving ten male players who were given either a 6% CHO-electrolyte solution or a placebo electrolyte solution two hours before the game commenced, and also ten minutes before the start of each half, and at 15 minute intervals during the game. The study discovered that the blood glucose response to exercise was altered, with higher concentrations observed at the 30-45 minute stage in the carbohydrate group when compared to the placebo group. The second half of the game was different, however, with blood glucose concentrations showing no difference between groups, since reductions from peak values took place at half time. The concentrations of blood lactate were higher after 15 minutes of exercise than at rest and remained heightened for the duration of the exercise. However, supplements had no effect upon response time patterns. Therefore, it was concluded that the consumption of 6% CHO-electrolyte drinks had no positive effect on blood glucose concentrations for the second half of a football match (58).

Table 6 The Studies of sports drink and physical performance in order of dosage range

Author	Subjects	Method	Measurement	Dosage	Result	Conclusion
Clayton DJ.et al	-12 unrestrained males	-randomized double blind crossover -3 groups 1.low energy (PLA) 2.whey protein isolate (Pro) 3.sucrose drink (CHO) -consume 100 ml of water at 15 min and before to interval 1,3 and 5	-heart rate -RPE -vo2max At 15 ,30 mins during exe and at the end of each interval	-6% whey protein (529 kj) -> 30.3 g protein,0.6 g CHO -6% sucrose (529 kj) ->0.3 g protein,30.8 g CHO -volume 500 ml	Energy consumed at the ad-libitum lunch was lower after PRO than PLA, but not different between CHO and the other trials. Post -exercise drink, total energy intake was not different between trials.	Post-exercise liquid protein ingestion may enhance the adaptive response of skeletal muscle, this may be possible without affecting gross energy intake relative to consuming a low energy drink.
Russell M.et al 2012	-15 male football players	- randomized crossover 2 groups -6% CHO-electrolyte solution (CHO) -electrolyte solution (PL)	-blood sample (at rest, immediately before exercise, every 15 min during exercise and10 min into the half time) -Precision, success rate, ball speed and an overall index	-6% sucrose, 23 mmol /l sodium and 14 mmol/l chloride	CHO supplementation influenced shooting, where CHO attenuated the decline in shot speed and SPS index. -Supplementation did not affect passing or dribbling. -Blood glucose responses to exercise were influenced by supplementation, where concentrations were higher at 45 min and during half-time in CHO compared with PL. -Blood glucose concentrations reduced between half-time and 60 min in CHO.	CHO supplementation attenuated decrements in shooting performance during simulated soccer match-play

Russell M.et al 2014	-10 male academy soccer players	-crossover -2 groups 1.CHO-electrolyte 2.electrolyte (placebo) - 1 wk washout	-blood samples (every 15 min during match)	-6% sucrose ,23 mmol/l sodium, 14 mmol/l chloride	-Glucose concentrations were higher at 30 to 45 min in the CHO than in the placebo. -In 2nd half, blood glucose concentrations were similar between 2 trials. -Blood lactate concentrations were elevated above those at rest in the first 15 minutes of exercise remained elevated throughout exercise.	CHO-electrolyte beverage before and during soccer match play did not advantage on blood glucose concentrations throughout the second half of exercise

Sun HF.et al 2015	-8 healthy active females	-random crossover -2 group 1.CHO-electrolyte 2.Placebo Every 20 min during treadmill run (60 min)	-time to exhaustion -plasma glucose -heart rate, RPE, rate of perceived thirst scale(PTS), and score of the perceived abdominal discomfort scale (PAS) -blood lactate, osmolality	-19 mEq Na+ and 6% CHO	-The time to exhaustion was longer during the CES than PL. -The plasma glucose concentration in the CES was higher than PL. -No differences was found in the plasma lactate level, respiratory exchange ratio, heart rate, perceived rate of exertion, sensation of thirst, or abdominal discomfort between 2 trials.	CES improves the moderate intensity endurance capacity of active females during the follicular phases.
John O'Reilly et al 2013	-7 healthy male football players	-randomized crossover -1 wk washout -2 groups 1.CHO (C) 2.CHO-free (CF) -consume at least 500 ml of water 2 hr before training	-skill performance (Loughborough Soccer Passing Test) -hydration status -core tem (Tc)	-6.6% CHO -2ml of fluid/kg BW every 15 min	-Improvement was observed in movement time and overall LSPT performance postexercise in consuming CHO compared with CHO-F drinks. -No differences were observed in Tc or absolute and relative body mass loss between the trial groups -Urine output was greater in CHO	Consumption of CHO drink during a soccer-specific exercise session in hot and humid weather induce the improvement in overall soccer skill performance postexercise.

Kingsley M.et al 2014	-14 soccer players	-randomized crossover -7±2 d washout 3 groups - H-CHO -CHO -PL	-blood glucose rest, immediately before exe, every 15 min -sprint	-9.6 g CHO (H-CHO) -5.6 g CHO (CHO) -0.5 g CHO (PL)	-No supplementation were effective in preventing a drop in blood glucose at 60 min. Mean sprint speed was faster in H-CHO when compared with PL. -Supplementation increase in plasma osmolality in H-CHO ($p < 0.001$) without change in CHO or PL. -mean sodium concentrations were higher in H-CHO when compared with PL	**High carbohydrate with caffeine resulted in improved sprint performance and elevated blood glucose concentrations throughout the first half and at 90 min of exercise**
Goedecke JH.et al **2013**	-9 males university team sport (soccer 7, rugby 2)	-2 groups 1.CHO-P 2.CHO Every 15 min	-modified LIST performance -hydration effect (urine osmolarity, urine volume) -heart rate, gut fullness, RPE -blood glucose,	-8% CHO -6% CHO + 2% whey protein	-Distance covered and maximal speed decreased in the final 15 min of exercise, and whilst not significant, CHO-P improve the modest improvement in each variable, respectively. -Average running speed declined in the final 15 min of the CHO trial only, with protein providing a mild improvement. -No differences between trials were found in body mass or plasma volume change, urine volume, heart rate, gut fullness, RPE, blood glucose or serum insulin. Blood urea concentration increased in the CHO-P trial only.	CHO enhance multiple-sprint sport exercise performance above carbohydrate, potentially through altered central fatigue or increased protein oxidation.

Elfegoun TB.et al 2000	-8 male tennis players	-randomized crossover -3 conditions 1.rest condition (CON) 2.sports drink (SPD) 3.placebo (PLC) -2 wks washout	-physical performance test (strength, speed ,power and endurance)	-pre match 1.drink 2.placebo -match 1. drink 2. placebo -post match 1. drink 2. placebo	-no significant differences between the three conditions in lower limbs. -EMG data of upper limbs showed higher fatigue of the triceps brachii in the placebo compared to the rest condition, while the ingestion of sports drink attenuated this fatigue.	tennis players are adequately hydrated and ingest balanced meals between matches, then no large drop in physical performance is observed even during consecutive competitive matches.
Ali A.et al 2009	-17 male soccer players	-randomized crossover -1 wk washout -fluid intake 15 min (6 time)	-skill performance time -O2 uptake -blood sample -RPE	-fluid 800 ml/h -52 g CHO /h	combined skill test data showed a significant time effect with differences between 0–45 and 75–90 min. skill performance was decrease 3% from pre to post exercise in the CHO, but in the PL the decrease was 14%.	Soccer skill performance appears to decline during the last 15 min of exercise within the 90-min intermittent running test.

Fritzsche RG.et al 2009	-8 male endurance trained cyclists	-randomized double blind -exe 122 min at 62% max O2 uptake -separate 48-72 h	-maximal neuromuscular power (Pmax) -thermoregulation -cardiovascular function -metabolism	1.water with no CHO (W) 2.containing a few CHO (W+C) 3.204±14 g CHO in few water © 4.few water with no CHO (placebo) *W,W+C -> ingest 1/3 of total volume before exe. During exe remain drink equal 4 time (8,31,61,91 min)	-Pmax was related in all groups at 26 min of exe. -from 26 to 116 min Pmax was decrease in C and placebo, severally	ingestion of W attenuates the decline in Pmax. -ingestion of W+CHO attenuates the decline in maximal power more than does W alone, -ingestion of C alone does not attenuate the decline in Pmax compared with Pl.
Miccheli A. et al 2009	-44 male athletes	-randomized crossover -divided into 2 groups -2 evaluations at an interval for 1 wk -oligomineral water -hydroelectolyte drink	-blood sample at rest immediately after exe,120 min after the end of exe -urine sample at rest and 120 min after exe	-volume 750 ± 250 ml	Plasma and urine metabolic profiles showed an effect of the green tea–based sports drink on glucose, citrate, and lactate levels in plasma and on acetone, 3-OH-butyrate, and lactate levels in urine.	

3.5 Timing of nutrition intake

Duration of eating also affects the body. Milou Beelen et al. (59) compiled research on the effects of eating nutrients to support health restoration after exercise. He suggested that eating carbohydrates 1.2 g/kg/hr after performing exercise can increase glycogen synthesis in the muscles. There is another study supporting the idea that if you eat 0.8 g/kg/hr of carbohydrates with 0.2-0.4 g/kg/hr of protein after exercise, it will have an effect close to that of eating 1.2 g/kg/hr of carbohydrates but it will increase the rate of protein synthesis in muscle. This suggests that if you eat after exercise, it can be effective for the body. This is consistent with the research of Emma Cockburn et al. (60) who studied the duration of drinking milk effects in carbohydrates and proteins which affect injury rates caused by exercise. It was found that drinking milk immediately after exercise or within 24 hours could reduce muscle injuries after exercise compared with drinking before exercise.

It is not advisable to consume proteins immediately before exercise because of the long time taken for gastric emptying. However, consuming proteins after exercise can support recovery and help in sustaining a positive protein balance. Studies have shown that 20 g of intact protein along with 9 g of essential amino acids should be consumed following exercise for the most beneficial effect on muscle protein synthesis which will also give the body a positive protein balance (61).

3.6 Recovery Time

Under exercise conditions the body uses energy to drive muscle activity, thereby neglecting the anabolic processes. The main energy sources supporting exercise are carbohydrates, but energy can also be drawn from amino acids in muscle proteins through catabolic and gluconeogenic processes, especially if exercise is extended over a longer period. These processes are able to break down the amino acids for protein synthesis while exercise is taking place. Consequently, any period of exercise will give the body a negative nitrogen balance because the quantity of protein broken down exceeds the quantity synthesized. This state can be maintained for up to 48 hours after intensive exercise before the balance is restored (62).

Recovery time is defined as the time taken for damage to the muscles caused by activity to be repaired. This repair will also include the restoration of the enzymes in the muscle fibres which produce energy and the carbohydrate stored within muscle cells and the endocrine and immune systems. Recovery will require the muscles to increase their protein levels which will lead to greater strength and reserves of energy. It will also boost the enzyme levels available to enhance the lactate threshold.

4. Physical Performance in Football

Football is a team sport which is played by using a ball between 2 teams of 11 players on each side. This sport is widely accepted as the most popular sport in the world, and also in Thailand. It is a team sport that makes demands of both the anaerobic and aerobic systems. In the course of the 90 minutes a match lasts, professional footballers will cover up to 10 km while working at a level close to the anaerobic threshold, which equates to between 80 and 90% of the maximum heart rate. This may be an endurance test, but contained within the match will be short spells of intense action as players sprint, turn, tackle and man oeuvre their bodies to control the ball. There may also be physical contact with other players to take into account (8).

During the match, most of the general activity is governed by the aerobic metabolism while the intensive periods of high level action require the anaerobic system. The abilities demanded of a footballer therefore encompass muscular strength, muscular endurance, speed, flexibility, and of course footballing skills (63, 64). The element of muscle strength is related to the capacity of a muscle to resist an external force, such as a weight. Developing muscle strength through exercise can help to prevent injury and improve performance. Meanwhile, flexibility requires that joints are able to move to their fullest extent, which also depends on the length of the muscles involved. Flexibility will enable certain movements to be performed without tearing muscles or ligaments. Finally, muscle endurance refers to the capacity of a muscle group to perform an action repeatedly over time without significant loss of performance.

A football match demands that its players are able to alternate hard work with periods of relatively light work. Over 70% of a game can be spent performing gentle activities, albeit with a high heart rate which indicates the use of high energy levels. Studies of professional players have revealed that each might perform up to 250 short energy-intensive actions in a match, which places a significant workload upon the anaerobic energy systems. This energy demand can explain why fatigue is a constant challenge to players throughout a match (12). Nowadays there are more football matches played, and athletes are becoming injured during football matches more often. The areas that are most likely to be injured are the muscles in the back of the thigh and groin, along with ankles and knees. The risk factors of injury are age and pre-existing injuries to certain areas (65). When players get injured, they have to take time away from the game for treatment for long periods. This affects their chances of playing matches for the team in competition. Nutrition will be one of the key factors which can help to prevent injuries and can also help to speed recovery periods after injuries have occurred. It is also a factor in enhancing sporting performance when fully fit.

4.1 Physical Performance Tests

4.1.1 Percentage of body fat

The objective is to determine the muscle and fat distributions in the body, noting that high levels of fat are undesirable since obesity can cause the risk of disease to be increased. Furthermore, for sportsmen, surplus fat reduces performance levels since it hinders the production of muscular force, while also adding weight which must be moved. Body fat percentages can be determined through a number of approaches.

1. **Skinfold method**

Skinfold measurements can be used to obtain a body fat percentage by a wide variety of techniques, which depend to a certain extent on the type of person measured. Therefore the approach taken should be one which is commonly used for people of the type under assessment. The variety in methods can of course lead to differences in results, so comparisons and accuracy cannot be relied upon. It is thus important to understand which method was used when interpreting any kind of skinfold test.

1.1 Body density equations: Durnin and Womersley

Durnin and Womersley (66) developed a formulaic approach to estimating body fat percentages through skinfold test data. The formula they developed is useful in not being population specific because it was derived from data taken from heterogeneous sample groups of widely varying ages.

Four skinfold measurements must be taken (biceps, triceps, subscapular, suprailiac) in order to calculate the percentage of body fat. The log of their sum can then be substituted in one of the equations presented as follows

Table 7 *Equation to calculate percentage of body fat (67)*

Age (years)	Equations for males
< 17	D = 1.1533 – (0.0643 x L)
17 - 19	D = 1.1620 – (0.0630 x L)

*D = predicted density of the body (g/ml), L = log of the total of the 4 skinfolds (mm).

Then obtain % body fat using the Siri equation

% Body Fat = (495 / Body Density) - 450

However, the use of skinfold measurements does not guarantee an accurate estimation of body fat percentage, but a series of tests can be used to measure changes in the composition of the body's fat levels over time. Correct use of calipers is also critical since mistakes in calibration can lead to errors. As a result, the accuracy of skinfold measurements depends on the skill and experience of the person conducting the measurements. Accreditation can be obtained in this skill through ISAK. Nevertheless skinfold measurements remain are very common means of evaluating body composition due to their simplicity in comparison with hydrostatic weighing or other approaches. The cost of testing is very low, once the cost of calipers has been taken into account.(67)

Table 8 Body compositions in Thai male football players(68)

Group of athletes		Weight (kg)	Height (cm)	% body fat
Thailand national football team (N=71)	mean	67.3(57.3-77.3)	171.6 (162.4-180.8)	11.21(8.3-14.1)
Youth Thailand National football Team (N=32)	mean	63.3(57.8-68.7)	172.1(166.5-177.7)	11.9(9.5-14.3)

4.1.2 Vertical jump test

The vertical jump test requires the use of a portable force-plate to calculate the jumping capacity of the player and thus determine muscular power. The test uses the squat jump where the hands are held at the sides, and the free counter movement jump. Arnason *et al*. found that performance in the vertical jump test was a powerful indicator of performance in competitive football (8).

Table 9 *Data for the vertical jump in Thailand national football team players (68)(Sport Authority of Thailand)*

Group	Distance (cm)			
	Mean	S.D.	Minimum	Maximum
Youth Thailand National football team (N=49)	52	7.0	35	66
Youth Thailand National football team with age not more than 17 years old (N=32)	53	4.6	45	61

4.1.3 Flexibility (sit and reach test)

Flexibility is often measured using the sit and reach test, which provides information about the hamstrings and the lower back muscles. The test can indicate problems related to tightness which are found in lower back pain, lumbar lordosis, and forward pelvic tilt and lower back pain. Wells and Dillon developed this particular test which has become the most common test of general flexibility.

Test reliability can be compromised by the extent of warm up time permitted, and the insistence on following exactly the same procedural steps whenever the test is performed. Recorded norms for sit and reach are taken without warm ups, but performance will be improved if a warm up is allowed. Taking the test after some other endurance test will also raise test performance levels. Where a warm up is taken, the conditions must be noted so they can be repeated in subsequent tests otherwise comparisons become invalid.

The test is not difficult to perform, so is quick and convenient. A broad range of data exist in the literature to allow standard comparisons to be made.

One drawback is that individual body measurement differences can make comparisons between players difficult to interpret; different players are of different sizes.

Furthermore, the test is relevant only to the lower back muscles and hamstrings so cannot be used to reach conclusions about other areas of the body (69, 70).

Table 10 Normal standards for sit and reach (cm)(68)

Group	Poor	Fair	Average	Good	Excellent
Thailand National football team	≤ 2	3 - 7	8 - 18	19 - 23	≥ 24
Youth Thai athletes	≤ 2	2 - 6	7 - 17	18 - 22	≥ 23

4.1.4 Muscular endurance

1. Push ups

The reliability of a test refers to the extent to which the results can be obtained in a consistent manner to assess that which is intended to be assessed. The reliability will thus depend on the conditions under which the test is performed in terms of strict measuring protocols and procedures and the motivation of the athlete to perform to his best.

The validity of a test refers to the extent to which the measurement made is actually a measurement of what was intended, and also the extent to which the conclusions drawn from those measurements can be considered suitable and relevant. In this case, the test can provide a suitable indication of the effects that training has upon an athlete's physical performance and improvements (71).

2. Sit ups

This test provides data about the strength of the abdominal muscles and the endurance capability of these abdominals and hip-flexors, which play a vital role in supporting the back and ensuring core stability.

Table 11 the standards for muscular endurance (time)(68)

Program	Poor	Fair	Average	Good	Excellent
Push ups	< 10	11-20	21-39	40 - 49	> 50
Sit ups	< 20	21 -30	31 - 49	50 – 59	>60

4.1.5 Sprint 20 m

Different distances can be used for sprint tests according to the particular requirements of the sport for which the athlete is being tested.

However, various factors can affect the results, such as the conditions of the running surface, the weather, and the reliability of the timing from the start. Therefore these conditions should be replicated or at least recorded so they can be taken into consideration when analyzing the data. In particular, crosswinds are better than head or tailwinds when measuring sprint speeds.

Table 12 the data for sprint standards of 5, 10 and 20 meters from the Australian Institute of Sport (AIS)(68)

Group of football players		Speed (sec)		
		5 m	10 m	20 m
Youth AIS (N = 15)	mean	1.07(1.02–1.11)	1.78(1.70–1.86)	3.01(2.89–3.12)
Youth Australian National team Age 17 years old (N = 21)	mean	1.11(1.03–1.16)	1.85(1.74–1.91)	3.12(2.96–3.19)
Australian National Olympic team (N=31)		1.10 (1.00–1.18)	1.81(1.69–1.90)	3.04 (2.92 – 3.19)

5. Food records

The use of a food record requires the athlete to take detailed notes on all food and drink consumption during the study period. This may be a period of up to 7 days, and may be requested several times during the course of a season or year. By taking notes, the athlete need not try to remember everything and thus the record is an accurate means of validating other approaches which include dietary evaluation. It is normal, however, to use food records taken over periods of several days and repeated over several years in order to avoid the kind of variations which occur between days and between seasons. Such data can thus uncover information which might not be divulged so readily when food frequency questionnaires (FFQ) are used. Indeed, for validity and reliability, a three-day food record is typically an improvement over a food frequency questionnaire, but the use of the FFQ still offers advantages in terms of cost, administration, and its ability to collate large sets of data from large samples (72).

6. Evaluation of pain scores

6.1 Sport injuries

In players at all age groups, sports injuries are not unusual, and they can often affect players over a long period of time. In cases where the injury causes lasting pain, it is important to consult a specialist in sports injuries so that treatment can be administered to prevent the pain becoming chronic. Specialists should be able to construct rehabilitation plans for sports injuries which will help players to make a full recovery and return to competitive action.

6.2 Visual analogue scale

In a majority of studies (73%), soreness has been the principal indicator of injury, while in terms of eccentric contraction, measurement tools have typically aimed to find an objective method of measuring the degree of soreness – with 12% seeking to determine the force applied to a muscle group in order to reach the pain threshold, while 63% applied a subjective visual analogue or numerical scale to assess the level of soreness.(73) (74).

The visual analogue scale which is used to measure acute pain through the Intraclass Correlation Coefficients (ICC) would seem to be quite effective, since it has been shown to be possible to reproduce 90% of results to within 9 mm. Therefore it can be stated that the VAS offers a suitable means of measuring acute pain (73).

CHAPTER 3

METHOD

CHAPTER 3
METHOD

Objective

The objective of this research is to compare the efficacy of high branched-chain amino acids drink, cow milk or sports drink on football performance and reducing muscle injury. That is the clinical single-blinded crossover trial which was approved for ethical consideration by The Ethics Review Committee for Research Involving Human Research Subjects, Health Science Group, Chulalongkorn University.

Conceptual framework

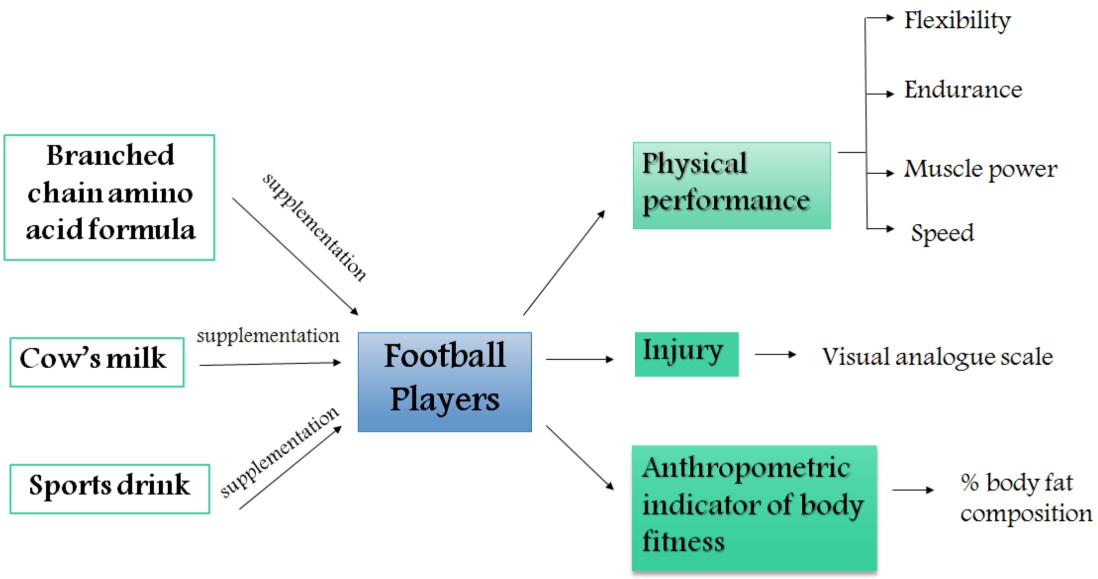

Figure 7 Conceptual framework

Participants Selection

The participants will be football players who co-operated in the research who can drink nutritional product with high branched-chain amino acid drink or cow milk or sports drink including recording their consuming during the research and can test physical performance for 6 times. The volunteers were selected from Rayong area competitive soccer program. There are considerably more youth males' competitive soccer teams in Rayong, subjects were limited to males. The subject selection process included a random selection of highly motivated players who were capable of completing the exercise tests. Before approaching the selected players, the experimental protocol was explained to the prospective subject's coach first to see if they would allow their athletes to participate.

Inclusion Criteria

a. Male Football Player

b. Aged between 16-18 years

c. Same level of competition

Exclusion Criteria

a. Athletes with injury cannot attend the training.

b. Used any supplementations

c. Lactose intolerance

d. Alcohol use

e. Missing from physical performance test

Football Team Selection

In this research, due to all four teams, Pluakdaeng Pittayakom School, Rayongwittayakom Paknam School, Taksin Secondary School and Bankhai Secondary School are young football teams with the same goal that committed to improve athletes to be the champion of young league cup. The principle of selection is similar training programs of the three teams which is expected to have a similar training period.

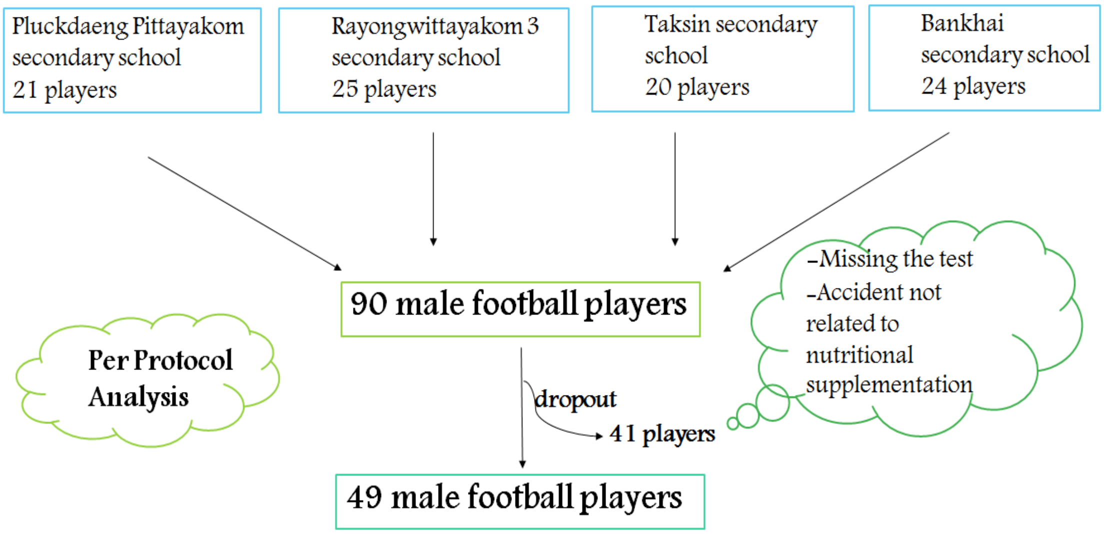

Figure 8 Participants selection

Methods of Experiment Group Division

The participated athletes will be randomly selected for group allocation.

Sample Size Calculation

The number of participants in this research referred from the research of Colin D. Wilborn et al.(75) which used difference of vertical jump level between whey protein group and casein protein group. The researcher brought values in the formulas as follows:

$$n = \frac{\sigma^2 (Z_{1-\alpha/2} + Z_{1-\beta})^2}{(\mu_1 - \mu_2)^2}$$

By prescribing $n =$ Sample Size

α is a value of type I error which is $Z_{\alpha/2}$ = 1.96

β is a value of type II error which $1-\beta = 90\%$; Z_{β} = 1.28

μ_1 = Vertical jump average 4.1 cm in whey protein group

μ_2 = Vertical jump average 3.5 cm in casein group

s^2 is the variance which represent by SD.^{2}

$$n = \frac{\sigma^2 (Z_{1-\alpha/2} + Z_{1-\beta})^2}{(\mu_1 - \mu_2)^2}$$

$$= \frac{1.25^2 (1.96 + 1.28)^2}{(4.1 - 3.5)^2} = 45.56 \approx 46$$

Due to this research has 10% dropout, so the total of participants in this research is 52 persons.

Materials

Nutritional foods given to the athletes consist of high branched-chain amino acids, low fat cow milk and sports drink.

3 days food record form

Questionnaire of sports injury

Stopwatch

Sit and reach box

Skinfold caliper

Weighing apparatus with a delicacy 0.1 kg

Height indicator with delicacy 0.1cm.

Nutritional products used in the research

This research intends to compare the effects of high branched-chain amino acid drink, cow milk and sports drink which is available in the market. Due to there were many researches that studied about the effect of nutritional product with high branched-chain amino acids and its performance on physical performance and injury. But all of those studies about comparison between nutritional product with high branched-chain amino acids and sports drink or milk and sports drink. There was no study which compared the effects high branched-chain amino acid drink, cow milk and sports drink on performance.

How to select types and quantities of the products in this research

1) It started by determining the quantity of high branched-chain amino acid drink which is expected to be effective on sports performance. There were some literature reviews, it could be found the effect of high branched-chain amino acids drink on sports performance for athletes was in the range of 5.0 -7.5 g. From the study of Shimomura Y., it could be found that consuming 5 g of branched-chain amino acids 15 minutes before exercise can delay onset muscle soreness after exercise for several days. The researcher used the amount of nutritional product with high branched-chain amino acids total 4.54 g which is close to such the research. There is only one brand of nutritional product with high branched-chain amino acids in Thailand, that is Aminoleban Oral. The 4.54 g of Aminoleban Oral requires 4 measuring spoon. It contains 10.8 g of protein and 168 kcal of energy.
2) The researcher will choose cow milk correctly to close the amount of protein and energy in Aminoleban Oral. It has 10 g of protein and 170 kcal of energy.
3) The sports drink were selected from the products for athletes (Sport drink) that available to buy in the market. The one bottle of sports drink (250 cc) gives energy 140 kcal which close to nutritional drink and cow milk.

Product information

Aminoleban Oral

Aminoleban Oral is nutritional product designed specifically for people suffering from chronic liver conditions. It provides supplementary nutrition and is characterized by its high concentration of branched-chain amino acids, which can be up to 45%.

INDICATIONS

The product is used to alleviate the symptoms associated with chronic liver impairment by providing nutritional support. Patients with hepatic encephalopathy will also benefit from its use.

Cow milk

For cow milk, the researcher chose Thai-Danish UHT milk, 250-ml package which is available in the market. It contains total fat 10 g (saturated fat 6 g), cholesterol 35 mg, sodium 100 mg, total carbohydrate 9g (dietary fiber 2 g, sugars 7 g), protein 10 g and small amounts of micronutrients. The calories break down from fat 54%, CHO 22%, and protein 24%.

Sports drink

Sponsor® orange flavor was used in this trial. Total calories are 140 kcal. It also contains total carbohydrate 34 g (sugar 32 g), sodium 110 mg and iron.

Table *13 Summary table of 3 types of nutrient supplements quantities used in the research*

Group / Component	Branched-chain amino acid drink	Cow milk	Sports drink
Energy (kcal)	168	170	140
Protein (g)	10.8	10	-
Branched-chain amino acids (g)	4.54	1.51	-
Carbohydrate(g)	25.92	9	34
Fat (g)	2.8	10	0.1

Measure	4 measuring spoon	1 box	1 bottle
Net volume (cc)	250	250	250

Research Design

The research design is a study of clinical nutritional in term of Single-Blind Crossover Trial by dividing into 3 study groups (21 persons for each group) who will receive one from three forms of interventions, that is, 1) High branched-chain amino acid drink 2) Cow milk 3) Sports drink for 10 days in each period and will rotate until receiving all interventions (Period 1-3) (Figure 9).

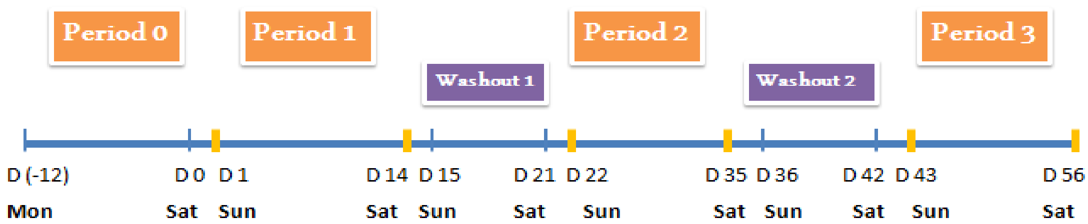

Figure 9. Overall image of study design

Period 0 was collected data only for 3 days food records are representatives which athletes have to eat before intervention period (Monday D (-12), Friday D (-8) in the 1st week and Wednesday D (-3) in the 2nd week)

Period 1 took two weeks. There will be physical performance test for athletes and questionnaire of muscle injury for 2 times (before and after)in Day 1 (Sunday) and Day 14 (Saturday) by letting athletes drink the first type of study products after finished training in the evening since Monday-Friday for both 2 weeks, except Saturday-Sunday that are matching days. There will be washout for one week before entering Period 2. In the washout phase, athletes will eat normally

Period 2 and Period 3 will take two weeks. The athletes will be changed their nutritional products until receiving all types of nutritional products. (Figure 10)

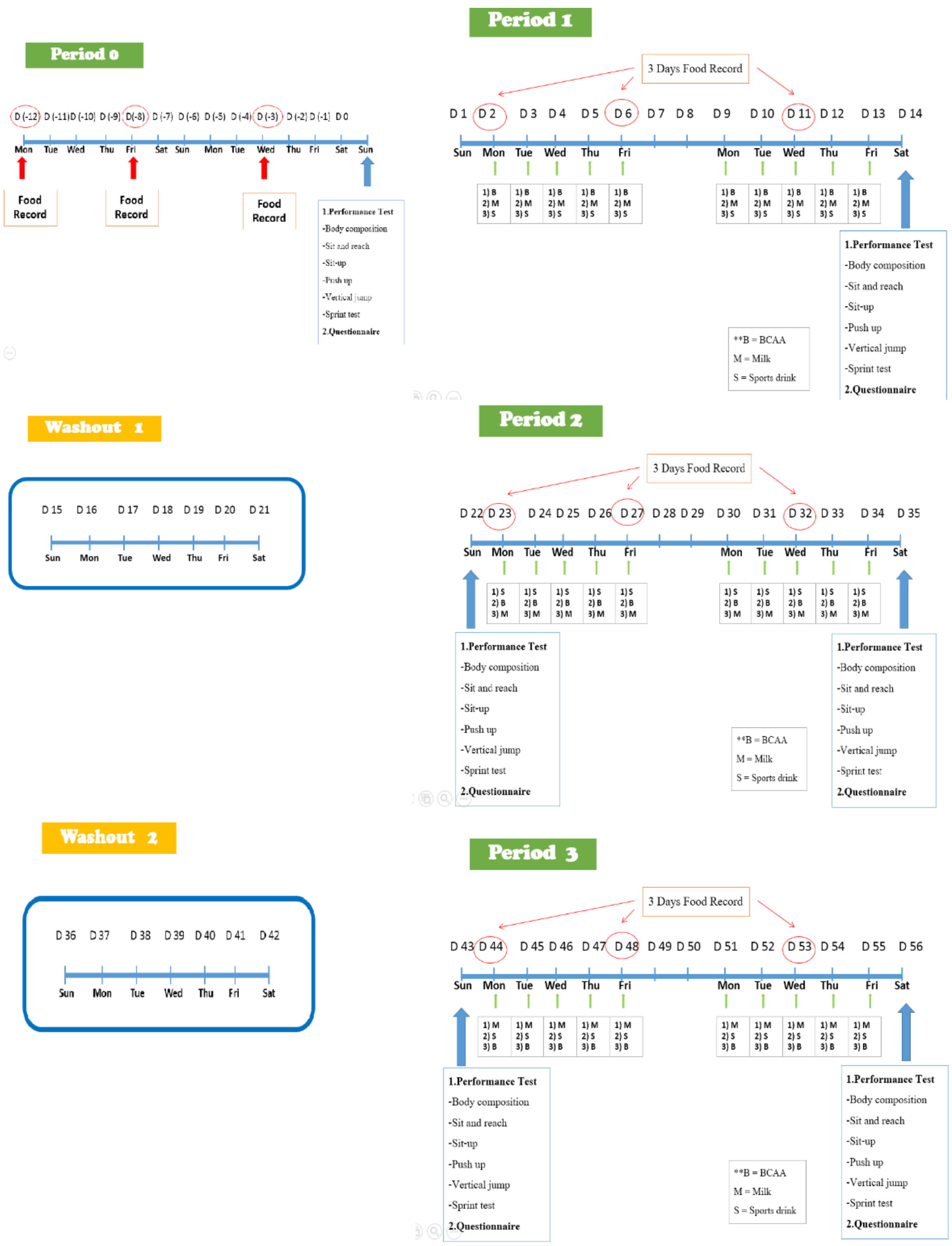

Figure 10. Showed studied in each period

The researcher expected this research to be a Single-Blind Crossover Trial that participants in the researchers will not know which type of nutritional products will be taken to athletes to reduce bias in the assessment. However, all participants will receive all 3 types of products by rotation at the end of the period.

Dietary instruction during the study

This research is comparison of effects from nutritional products consumption. The researcher inspect athletes to consume foods normally by no skipping any meal to receive complete nutrition. The principles are indicated as follow.

1. Energy: The researcher asked for cooperation from the athletes who participated in the research for eating foods with proper quantity of energy approximately everyday.

2. Protein: Foods high in protein are such as meat, milk, egg and nut. The researcher asked for cooperation from the athletes who participated in the research for eating protein foods approximately everyday.

Food record

The participants would receive 24-h food record form. They had to record during 2 weeks before entering research by recording in Monday and Friday of the first week and Wednesday of the second week. While research had been started, the participants would receive one of three nutritional products for drinking in Monday to Friday (Day2-6 and Day 9-13, Day 23-27and Day 30-34 and Day 44-48 and Day 51-55) and the food record for recording in Monday and Friday(Day 2and Day 6) and Wednesday (Day 11), Monday and Friday (Day 23 and Day 27) and Wednesday(Day 32) ,Monday and Friday(Day 44 and Day 48) and Wednesday(Day 53) of period 1,2 and 3, respectively. In each period, there would be one week washout for the participants to consume foods as normally.(Figure 11).

Study Period total 69 days

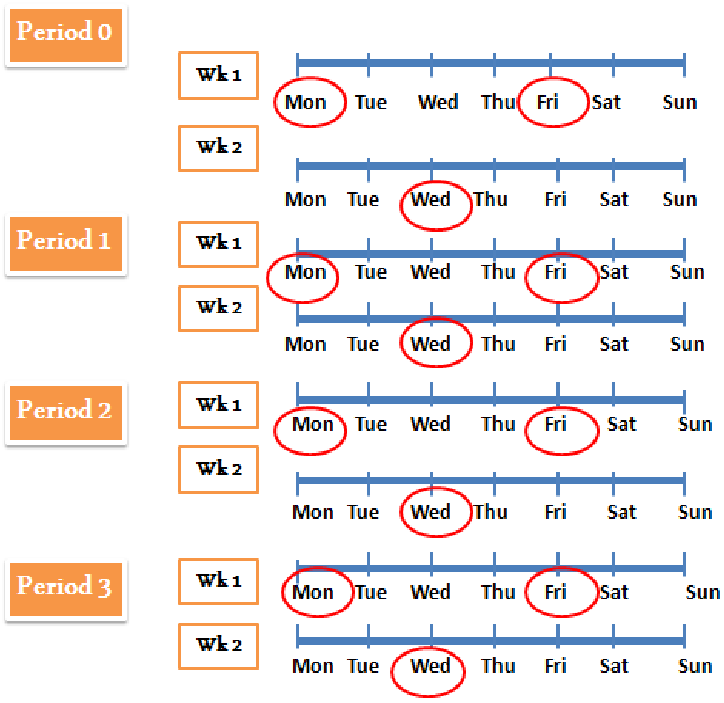

Figure 11 showed 3 days food record in each period

Activities on test day

Data Collection and 3 groups of activities:

Day 1,22, 43 and Day 14,35,56 (end of the 2nd week)

07.00 a.m. Body Composition Test, takes around 5 minutes.

07.45 a.m. Flexibility Test takes around 5 minutes.

08.00 a.m. Muscular EnduranceTest, takes around 10 minutes.

10.00 a.m. Vertical JumpTest ,takes around 5 minutes.

15.00 a.m. Sprint Test (5,10 and 20 meter) takes around 5 minutes.

15.30 a.m. Answering Pain Assessment Questionnaire takes around 5 minutes.

* The starting time will be adjust by coach and convenient time of each team.

Table 14 The team of researchers at least 2 persons who will assist on testing.

Name	Duties
1. Mr. Pongpat Intarat	Record weight, height
2. Mr. Chairat Sae-kow	Record weight, height and subcutaneous measurement Control and record Muscular EnduranceTest which consists of Push-ups and Sit – up. Control and record Sprint Test(5,10 and 20 meter) and Vertical Jump Test.

All of the team of researchers are physiotherapists whose knowledge, understandings and having experience in sports performance test.

Physical Performance Test

1. **Body Composition Measurement**

In this measurement, weight and height are recorded for each subject to indicate shape and body composition. A supporting measurement of body composition is fat tissue, so it is measured and recorded as well. Typically, this measurement is taken by employing callipers to gauge the thickness of subcutaneous fat (Skinfold callipers) in 4 positions (biceps, triceps, subscapular, suprailiac) to calculate the percentage of body fat.

Figure 12 measurement of biceps

Figure 13 measurement of triceps

Figure 14 measurement of triceps

Figure 15 measurement of suprailiac

2. **Flexibility**

Sit and Reach Test

This is a test of flexibility of hamstrings and the lower back muscle groups which is important for football players by kicking the ball.

Tool Sit and reach box

Methods In this test, athletes remove their shoes and place their feet into the indicator while seated on the floor. From this position, they stretch their arms ahead as far as possible, keeping hands and arms on both sides of the scale. The fingertips on both hands must remain evenly in the position for 2 seconds and the distance read in cm units. Each test is repeated 2 times with the best result recorded.

Figure 16. sit and reach test

3. Muscular Endurance Test

Muscular Endurance Test is a test of muscle function to resist weight in continuous period. The test method of upper body muscle groups is push-ups and for torso muscles group is sit – up.

Tool and Equipment Pad and stopwatch

Methods

3.1 Push-ups

Figure 17 Push up test

This test begins from the prone position, with the body outstretched and facing the ground. The feet and palms should be the only body parts touching the ground with the body in a straight and horizontal position. A repetition consists of lowering the body by bending the arms at the elbows until the chest nearly touches the ground and raising the body to the starting position. This motion is repeated continuously, as many times as possible within 1 minute.

3.2 Sit – up

The test begins with the subject lying on the back with knees slightly bent and both hands on either side of the head. From this position, subjects raise their upper bodies from the waist until they can touch both elbows to both knees. Each repetition is completed after the subjects lower their upper bodies back to the starting position. This motion is repeated continuously, as many times as possible in one minute.

Figure 18 sit up test

4. Muscle Power Test

Vertical JumpTest

Vertical Jump Test is a test of leg muscle power or explosive power that is necessary for kicking a ball, jumping and hitting by head, jumping to get a ball, running up and others.

<u>Tool</u> Yard strick or wall

<u>Methods</u>

In this test, athletes were asked to raise their dominant hands to their fullest height, with the height measured from the ground to the hands in cm. Subsequently, the athletes used their non-dominant (weak) hands to grasp their waists while raising their dominant hands over their heads. They were then asked to jump as high as possible while maintaining the position, using the hand over their heads to touch the highest possible place on the scale. Each subject was tested 3 times with the highest mark recorded for each. The difference between jumping distance to the height of the hand was calculated by measuring from a normal standing position.

Figure 19 Vertical jump test

5. Speed

Sprint Test (5,10 and 20 meter)

Sprint Test in the distance of 20 meters is a primary speed of athletes or anaerobic power.

<u>Tool</u> Smooth surface runway or football field, automatic timer that can record time at the distance 5 meters, 10 meters and 20 meters (If there is no automatic timer, it can be replaced with 3 stopwatches to record time at 5 meters, 10 meters and 20 meters.)

<u>Methods</u>

In the sprint tests, athletes stand leaning forward at the starting point. Upon receiving the signal to start, athletes run as fast as possible to the end of the distance designated for the particular test, with the start/finish time recorded for each test and distance of 5, 10 and 20 metres. Each test distance was conducted 3 times with the best time recorded.

Figure 20 Sprint 20 m. test

Statistical analysis

1. Displaying median with average and data distribution measurement with standard deviation (S.D.) in case of quantitative data, and difference of physical performance of each group.
2. Food record was analyzed by IMMUCAL-Nutrients version
3. Test of significance was performed by specifying statistical significance level at α = 0.05 by 4 methods of statistical analysis as follows.
   a) The analysis of difference between pre and post period in each group Independent T-test
   b) The analysis of difference among 3 groups in the same period with statistics One Way ANOVA
   c) The analysis of Post hoc test (Scheffe)
   d) Wilcoxon Signed Rank test was used for analyze the questionnaire injury

Ethical consideration

The researcher protects authority of the participants in the research by

1) Concealing names of athletes who participated in this research in all data collection points by using data records and codes with no display or name records.
2) Keeping names, codes and numbers of the research participants separately.
3) The researcher did not provided payment for athletes. But in the research project, the athletes will receive 3 types of nutritional foods.

CHAPTER 4

RESULT

Chapter 4
Result

This research is unique in examining the available information which compares the effects upon the body and sporting performance of milk, sports drink and drinks containing branched-chain amino acids when consumed by male footballers aged between 16 and 18 years. While various studies have investigated the effects of these interventions in isolation, no study has previously sought to directly compare all of the available supplements which can be used by sportsmen. The objective in this study was therefore to make the necessary comparisons without making any alterations to the regular lives of the study participants. The study focused in particular upon the skills and activity levels that are required during the course of a typical football match.

The study group was comprised of forty nine male football players aged between 16 -18. Individual performance was tested during each period and measured for body fat composition, flexibility, muscular endurance, muscle power and sprints.

Table 15 *Baseline characteristics of football players in each team*

Team / Variables	Pluakdeang N = 17 Mean (S.D.)	R.Y.W.3 N = 10 Mean (S.D.)	Bankhai N = 11 Mean (S.D.)	Taksin N = 11 Mean (S.D.)	Total N = 49 Mean (S.D.)
Ages	17.76 (0.437)	16.60 (0.516)	16.73 (0.467)	17.27 (0.467)	17.18 (0.67)
Height (cm)	166.353 (4.488)	168.80 (2.573)	167.00 (5.800)	165.27 (4.962)	166.8 (4.59)
Weight (kg)	56.92 (5.066)	50.89 (5.490)	57.61 (7.657)	54.94 (8.303)	55.40 (6.786)

%body fat	12.10 (1.973)	10.93 (2.831)	13.43 (4.119)	11.88 (4.524)	12.11 (3.327)
Flexibility (cm)	13.24 (6.190)	9.20 (4.517)	8.64 (5.938)	15.27 (3.636)	11.84 (5.821)
Push up (time)	34.65 (10.056)	21.90 (9.620)	35.82 (11.260)	26.55 (7.090)	30.49 (10.932)
Sit up (time)	54.53 (9.274)	47.30 (7.889)	42.18 (7.574)	43.45 (7.019)	47.80 (9.50)
Vertical jump (cm)	52.65 (5.303)	43.65 (4.859)	48.23 (6.322)	52.86 (3.592)	49.87 (6.187)
Sprint time (sec)					
At 5 m	1.25 (0.131)	1.48 (0.142)	1.65 (0.119)	1.56 (0.200)	1.46 (0.218)
At 10 m	1.99 (0.123)	2.23 (0.111)	2.37 (0.134)	2.32 (0.179)	2.20 (0.208)
At 20 m	3.29 (0.137)	3.65 (0.147)	3.78 (0.187)	3.78 (0.207)	3.58 (0.275)

Table 16 Baseline of 3 days food record before starting to supplementation (period0)

Team / Variables	Pluakdeang N = 17 Mean (S.D)	R.Y.W.3 N = 10 Mean (S.D)	Bankhai N = 11 Mean (S.D)	Taksin N = 11 Mean (S.D)	Total N = 49 Mean (S.D.)
Energy (Kcal)	1206.46 (331.77)	1304.77 (193.76)	1412.59 (166.59)	1368.11 (340.57)	1309.09 (284.01)
CHO (g)	149.19 (41.17)	159.77 (31.28)	184.02 (32.98)	155.93 (49.72)	160.68 (40.83)
Protein (g)	51.74 (15.76)	56.30 (15.52)	51.59 (6.97)	55.12 (13.18)	53.39 (13.36)
Fat (g)	44.66 (17.10)	49.10 (9.79)	52.53 (9.16)	58.57 (18.21)	50.39 (15.17)

Table 17 *Comparison the physical performance between pre and post in each supplement (Pair sample t-test)*

Variables / Supplements	Sports drink				Milk				BCAA			
	Pre Mean (S.D)	Post Mean (S.D)	Mean diff.	P value within	Pre Mean (S.D)	Post Mean (S.D)	Mean diff	P value within	Pre Mean (S.D)	Post Mean (S.D)	Mean diff	P value within
1. Body weight	55.40 (6.87)	55.76 (6.88)	-0.36	0.002*	56.110 (6.93)	56.106 (6.89)	0.004	0.964	56.40 (7.05)	56.72 (6.98)	-0.32	0.014*
2. Percentage of body fat composition	12.11 (3.36)	11.77 (3.48)	0.34	0.011*	11.73 (3.48)	11.89 (3.43)	-0.16	0.211	11.55 (3.58)	11.91 (3.51)	-0.36	0.023*
3. Flexibility	11.84 (5.82)	11.69 (5.94)	0.14	0.616	11.51 (6.28)	12.39 (6.36)	-0.88	0.003*	12.69 (6.74)	12.73 (6.69)	-0.04	0.909
4. Push up	30.49 (10.93)	34.24 (10.68)	-3.75	0.003*	32.96 (9.68)	32.49 (9.58)	0.47	0.452	33.41 (11.00)	33.73 (13.85)	-0.32	0.803
5. Sit up	47.80 (9.50)	50.63 (10.44)	-2.84	0.009*	49.57 (10.31)	51.18 (8.66)	-1.61	0.068	50.06 (9.94)	53.61 (11.05)	-3.55	0.000*
6. Vertical jump	49.87 (6.19)	48.68 (6.50)	1.19	0.010*	48.73 (6.27)	48.18 (6.81)	0.55	0.160	49.50 (6.67)	49.29 (7.23)	-0.24	0.648
7. Sprint time (sec)												
7.1 At 5 m	1.45 (0.22)	1.59 (0.24)	-0.13	0.001*	1.64 (0.12)	1.65 (0.14)	-0.01	0.233	1.67 (0.12)	1.71 (0.10)	-0.04	0.020*
7.2 At 10 m	2.20 (0.21)	2.31 (0.20)	-0.11	0.001*	2.38 (0.15)	2.40 (0.14)	-0.02	0.326	2.43 (0.15)	2.48 (0.13)	-0.05	0.016*
7.3 At 20 m	3.58 (0.28)	3.74 (0.26)	-0.15	0.000*	3.76 (0.17)	3.79 (0.20)	-0.03	0.149	3.84 (0.21)	3.90 (0.23)	-0.06	0.025*

*BCAA = Branched chain amino acid drinks ; P value = 0.05

Table 18 Comparison the difference of physical performance between all nutritional products (One way ANOVA)

supplements / Physical performance	Sports drink Mean diff (S.D)	Milk Mean diff (S.D)	BCAA Mean diff (S.D)	P value
Body weight	0.36 (0.76)	0.004 (0.63)	0.32 (0.87)	0.763
Percentage of body fat composition	-0.35 (0.92)	0.15 (0.85)	0.36 (1.38)	0.001*
Flexibility	-0.14 (1.98)	0.88 (2.00)	0.04 (2.49)	0.049*
Push up	3.76 (8.50)	-0.47 (4.34)	0.33 (9.10)	0.016*
Sit up	2.84 (7.25)	1.61 (60.6)	3.55 (5.90)	0.323
Vertical jump	-1.19 (3.12)	-0.55 (2.70)	0.23 (3.57)	0.084
Sprint				
Sprint time at 5 m	0.13 (0.26)	0.02 (0.11)	0.04 (0.12)	0.003*
Sprint time at 10 m	0.11 (0.22)	0.02 (0.14)	0.05 (0.15)	0.028*
Sprint time at 20 m	0.15 (0.23)	0.03 (0.15)	0.06 (0.18)	0.005*

*BCAA = Branched -chain amino acid drinks ; P value = 0.05

Table 19 The post hoc test of physical performance (Scheffe)

Variables	Groups	Mean	Mean diff			P value		
			Sports drink	Milk	BCAA	Sports drink	Milk	BCAA
% body fat	Sports drink	-0.35		-0.500	-0.709		0.038*	0.002*
	Milk	0.15			-0.208			0.562
	BCAA	0.36						
flexibility	Sports drink	-0.14		-1.020	-0.184		0.070	0.916
	Milk	0.88			0.837			0.165
	BCAA	0.04						
Push up	Sports drink	3.76		4.224	3.429		0.025*	0.087
	Milk	-0.47			-0.796			0.875
	BCAA	0.33						
Sprint time								
Sprint time at 5 m	Sports drink	0.13		0.116	0.092		0.006*	0.037*
	Milk	0.02			-0.024			0.801
	BCAA	0.04						
	Sports drink	0.11		0.092	0.060		0.031	0.223

Sprint time at 10 m	Milk	0.02		-0.032		0.652
	BCAA	0.05				
	Sports drink	0.15	0.121	0.093	0.038*	0.055
Sprint time at 20 m	Milk	0.03		-0.028		0.767
	BCAA	0.06				

*BCAA = Branched-chain amino acid drinks; P value = 0.05

1. **Percent of Body fat**

Percentage of body fat composition between pre and post period of each supplement showed significant increase in branched-chain amino acid drinks group (*p* = 0.023), but it was significant decrease in sports drink group. (*p*= 0.011) There were no significant difference in milk group, but the trend was increase (*p*= 0.211). (figure19)

For comparison the difference of body fat percentage in pre and post period of all nutritional products showed significant difference in all supplements (*p* = 0.001), with the branched-chain amino acid drinks group exhibiting the most difference from post period was more than pre period, followed by sports drink which pre period was more than post period and milk by post period more than pre period) (figure 20)

To compare between group found sport drinks was lower than milk (p = 0.038) and branched-chain amino acid drinks (p = 0.002).(figure 21)

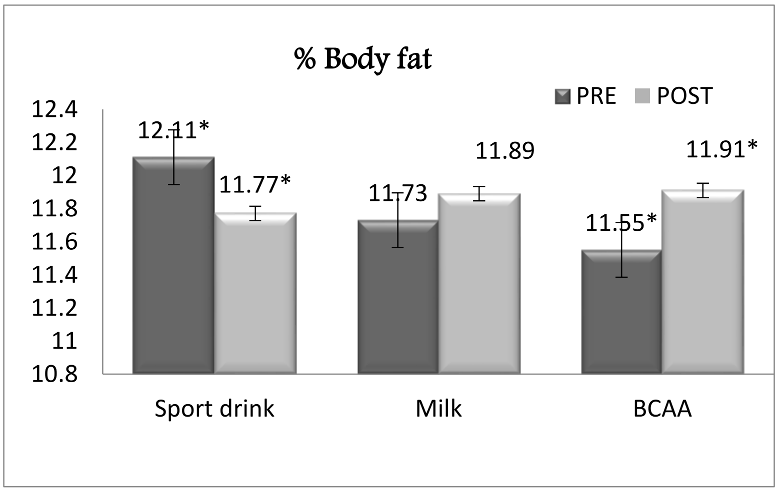

Figure 21 *Comparison Effects of nutritional drinks on %body fat composition in pre and post period. (p<0.05)*

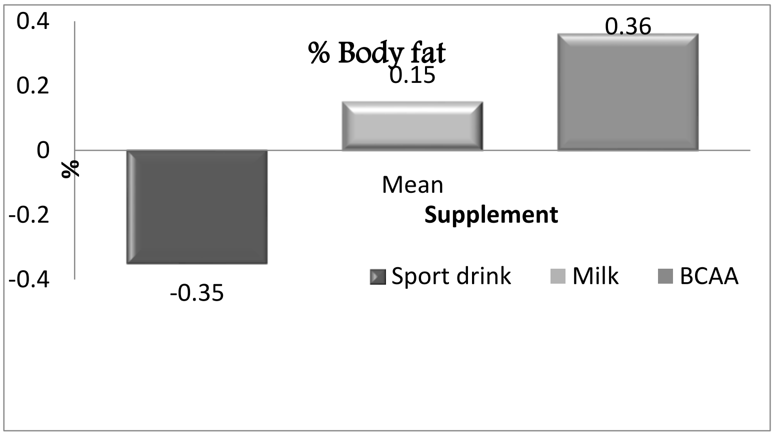

Figure 22 Comparison the different of %body fat composition between pre and post period among all nutritional drinks (p<0.05)

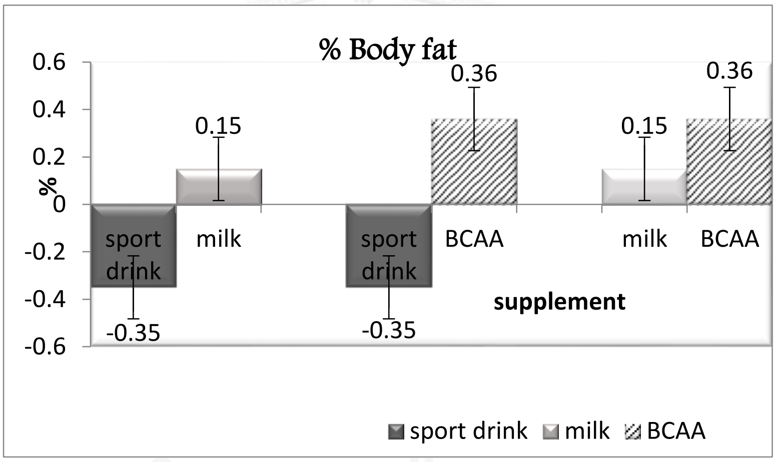

Figure 23 Comparison the different of %body fat composition between group in pre and post period

2. Flexibility

Flexibility was significant increase in milk (p = 0.003) and no significant different in BCAA and sports drink between pre and post period. (figure 22)

To compare the difference of flexibility in all supplements showed that a significant difference was present in each group (p = 0.049), with milk exhibiting the most difference by post is more than pre, followed by sports drink which pre is less than post and BCAA which post is more than pre. (figure 23)

No significant difference of flexibility was found when compare between pair of supplement by sports drink and milk (p = 0.070), sports drink and BCAA (p = 0.916) and milk and BCAA (p = 0.165). (figure 24)

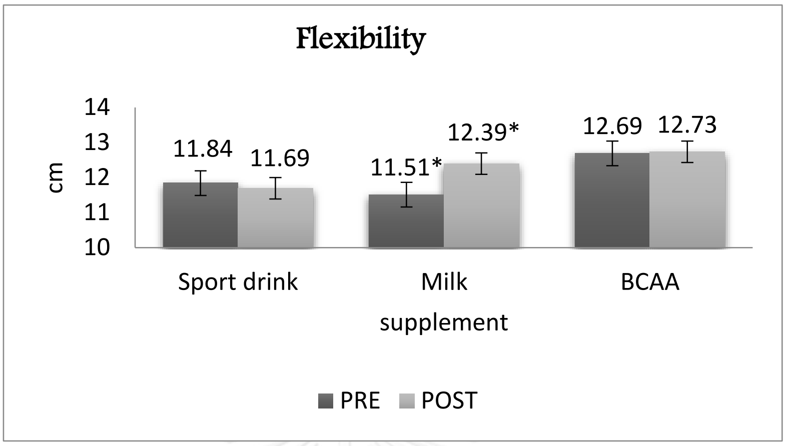

Figure 24 *Comparison effects of nutritional drinks on flexibility in pre and post period. ($p<0.05$)*

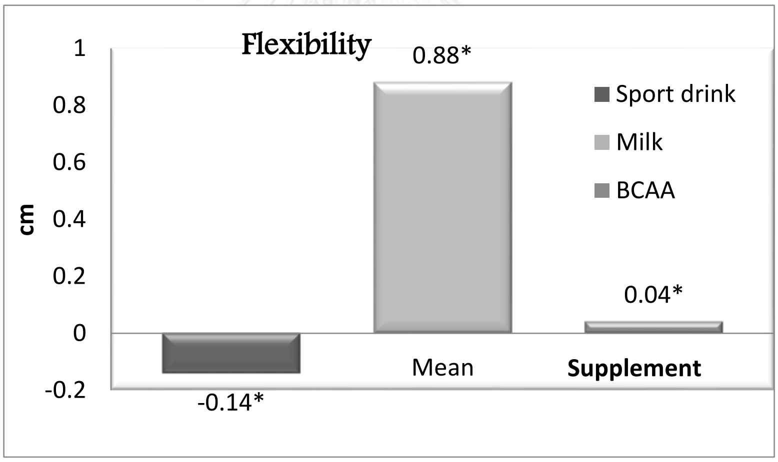

Figure 25 *Comparison the different of flexibility between pre and post period* among all nutritional drinks *($p<0.05$)*

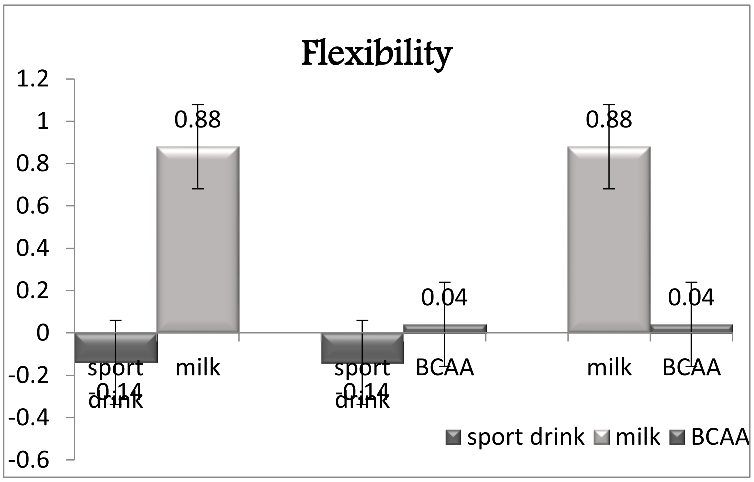

Figure 26 *Comparison the different of flexibility between group in pre and post period (p<0.05)*

3. Push up

Push up was significant increase in sport drinks (p= 0.003) and no significant different was found in milk and BCAA group (p = 0.452 and p = 0.803) in pre and post period. (figure 25)

For comparison the difference of push up of all nutritional drinks showed that all drinks had a significant affect (p = 0.016), with sports drink having the most difference which post period was higher than pre period, followed by milk which post period was decrease when compare with pre and BCAA, after supplementation which BCAA the push up time was high when compare with the beginning.(figure 26)

To compare the difference of push up between pair of supplement found sport drinks was higher than milk (p = 0.025). (figure 27)

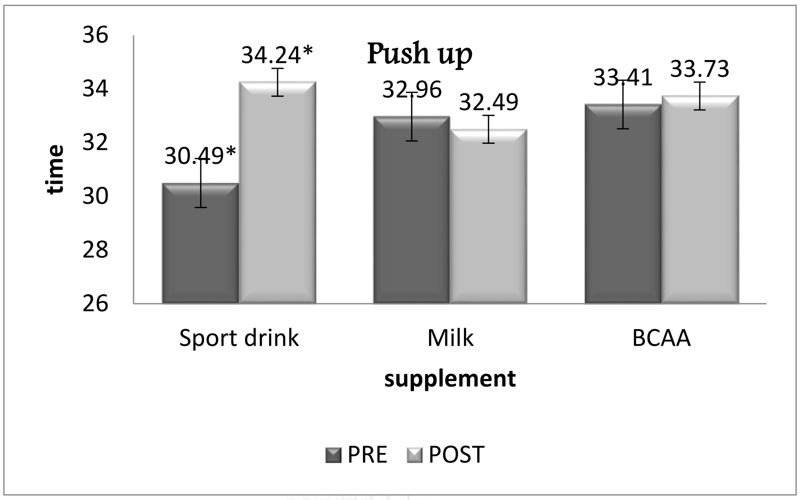

Figure 27 Comparison effects of nutritional drinks on push up in pre and post period. (p<0.05)

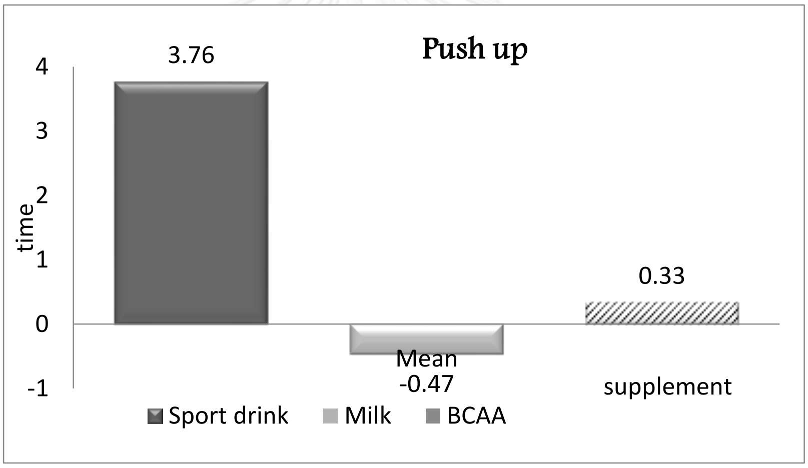

Figure 28 *Comparison the different of push up between pre and post period* among all nutritional drinks *(p<0.05)*

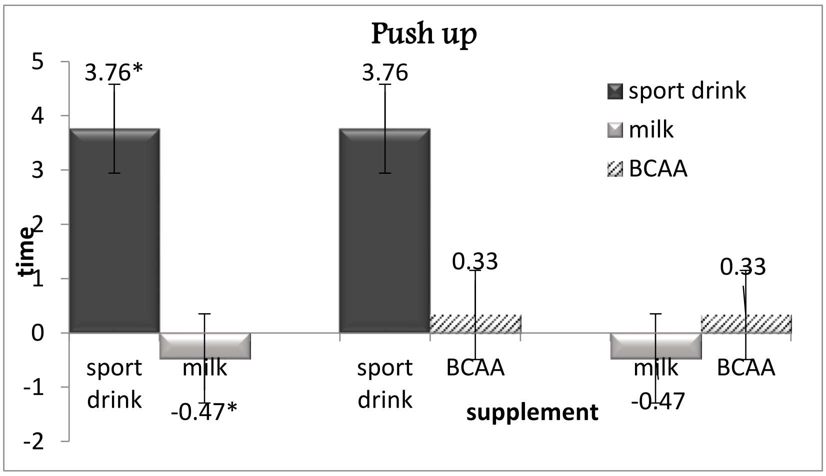

Figure 29 *Comparison the different of push up between group in pre and post period* (p<0.05)

4. Sit up

Sit up test was significant increase in sport drinks and BCAA (p=0.009 and p = 0.000), but no significant different in milk (p = 0.068) when compare between pre and post period. (figure 28)

For comparison of the difference of sit up test between all groups showed no significant different was presented. (p = 0.323) (figure 29)

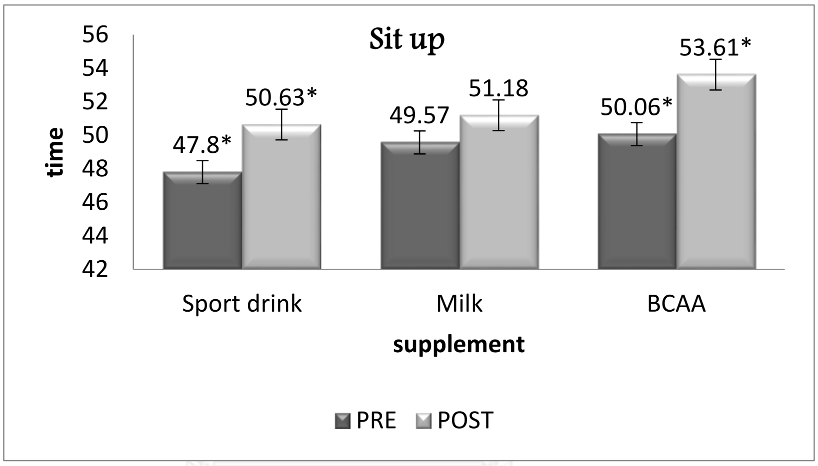

Figure 30 Comparison effects of sit up between pre and post period. (p<0.05)

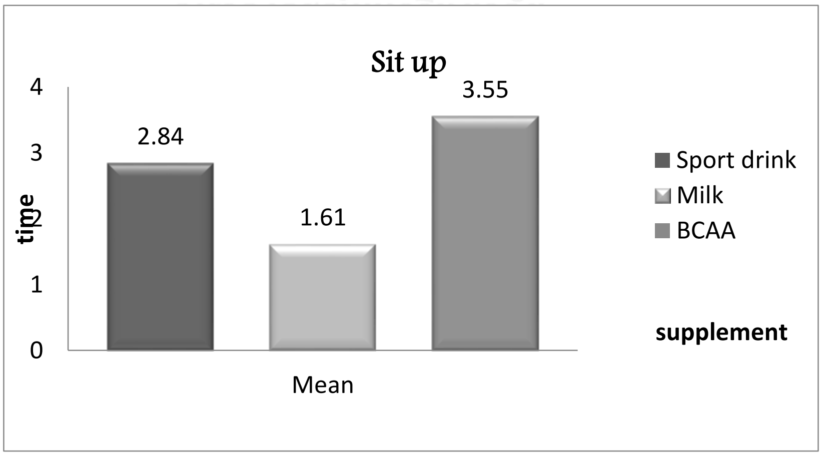

Figure 31 Comparison the different of push up between pre and post period *among all nutritional drinks* (p<0.05)

5. Vertical jump

Vertical jump was significant decrease in sports drink (p = 0.010) and no significant different was found in milk (p = 0.160) and BCAA (p = 0.648) in pre and post period. (figure 30)

The comparison of the difference of jump between all groups showed no significant different. (p = 0.084) (figure 31).

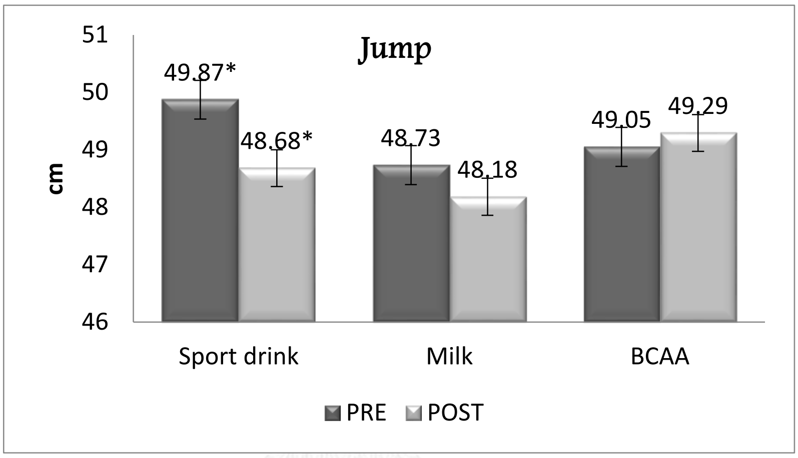

Figure 32 Comparison effects of vertical jump between pre and post period ($p<0.05$)

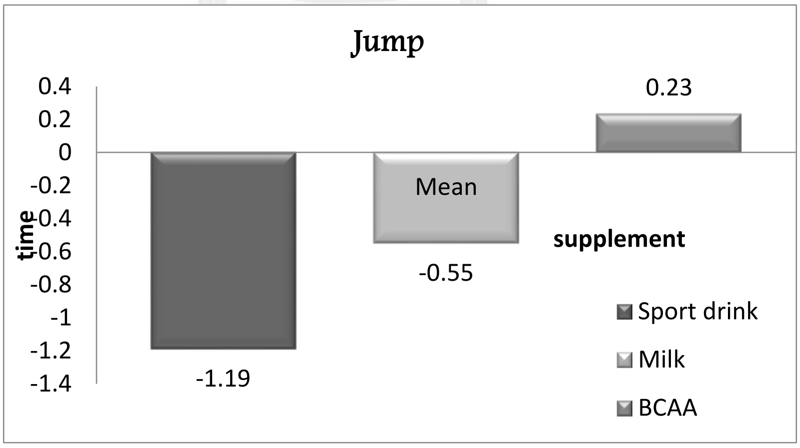

Figure 33 *Comparison the different of vertical jump between pre and post period* among all nutritional drinks *($p<0.05$)*

6. Sprint

Sprint 5 meters

Sprint time at 5 meters showed significant increase of time in sport drinks and BCAA (p = 0.001 and p = 0.020), but no significant different was observed in milk (p = 0.233) when compare in pre and post period. (figure 32)

For comparison the difference of time in all drinks showed the most significant different in sports drink followed by BCAA and milk which post is higher than pre. (p = 0.03) (figure 33)

The comparison between pair of drinks found sport drinks was higher than milk and BCAA.(figure 34)

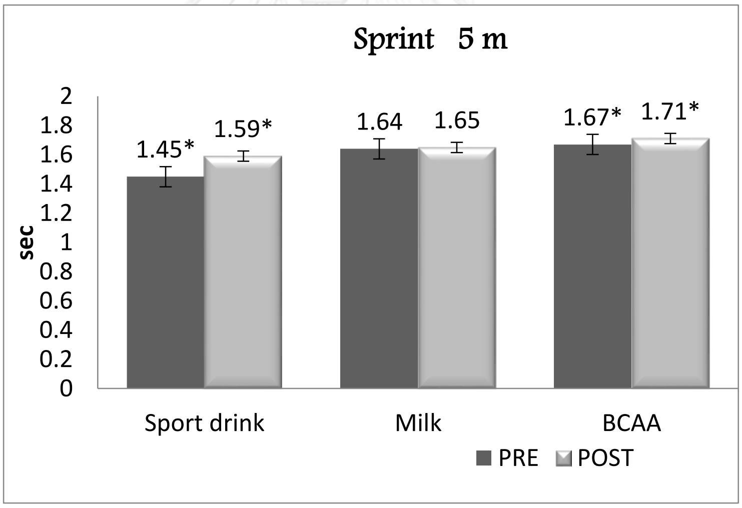

Figure 34 *Comparison effects of sprint time at 5 m between pre and post period. (p<0.05)*

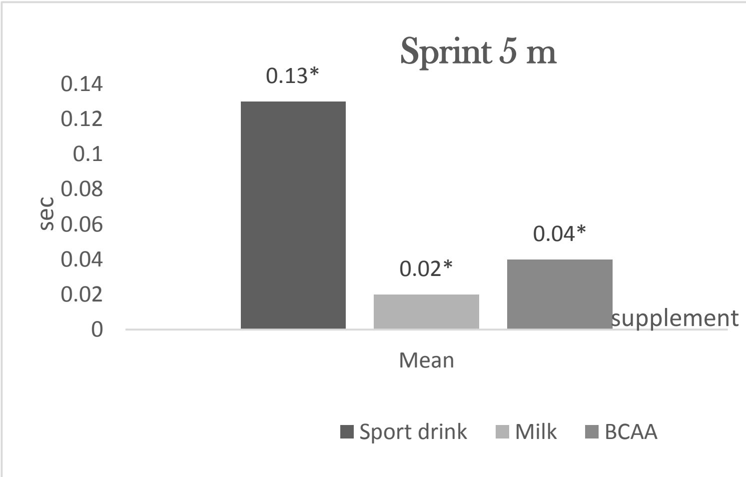

Figure 35 *Comparison the different of sprint time at 5 m between pre and post period* among all nutritional drinks *(p<0.05)*

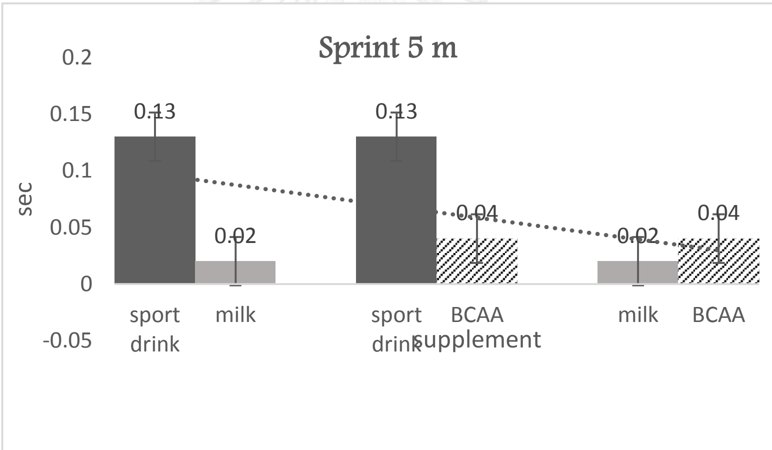

Figure 36 *Comparison the different of sprint time at 5 m between group in pre and post period (p<0.05)*

Sprint 10 meters

Sprint at 10 meters showed significant increase of time in sport drinks and BCAA (p =0.001 and p = 0.016), but showed no significant different in milk (p = 0.326) when compare in pre and post period. (figure 35)

The comparison of the difference of time in all supplement showed the most significant different in sport drinks followed by BCAA and milk which time was increase in post period. (p = 0.028) (figure 36)

To compare between pair of supplements found sprint time at 10 m of sport drinks was higher than milk (p = 0.031). Therefore, the speed in sports drink was decreased. (figure 37)

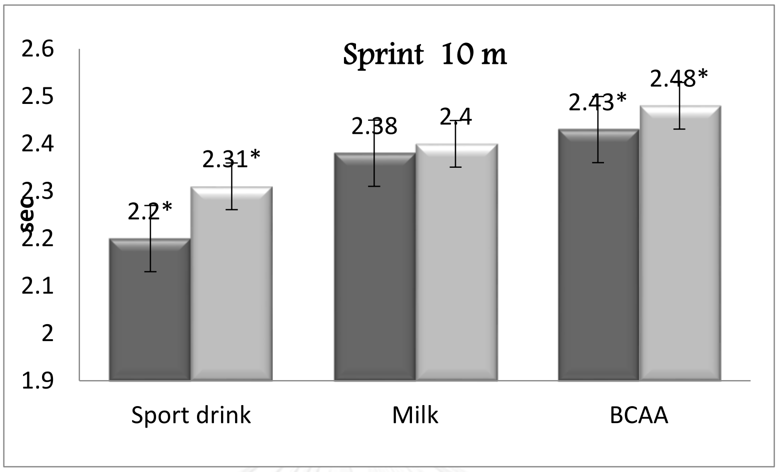

Figure 37 Comparison effects of sprint time at 10 m between pre and post period (p<0.05)

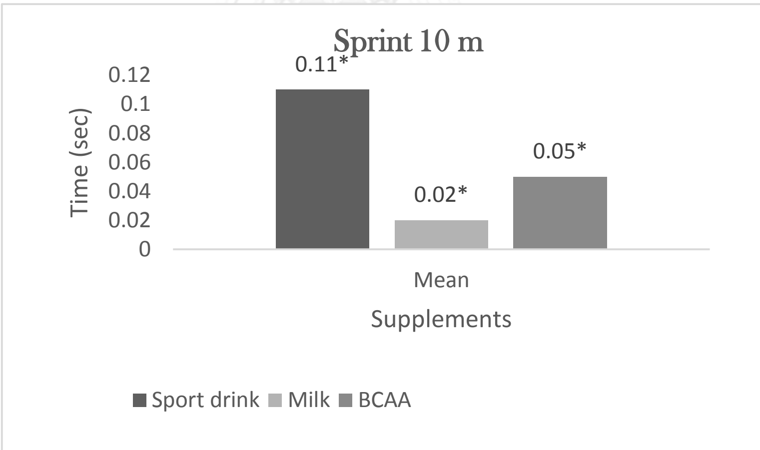

Figure 38 *Comparison the different of sprint time at 10 m between pre and post period* among all nutritional drinks *(p<0.05)*

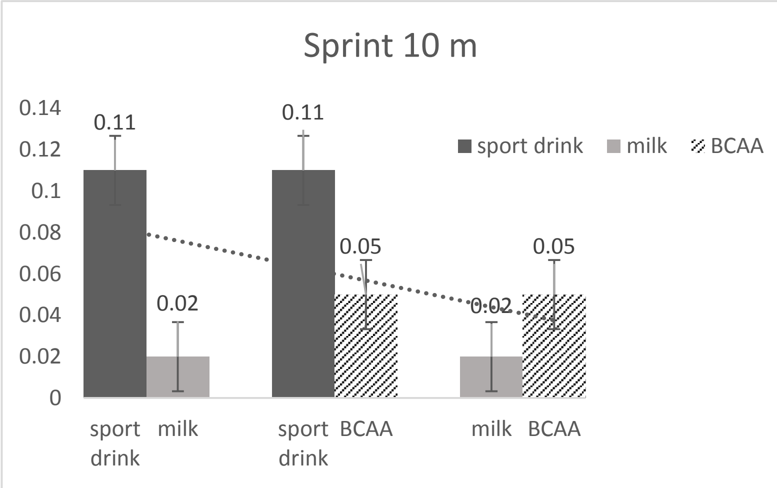

Figure 39 *Comparison the different of sprint time at 10 m between group in pre and post period (p<0.05)*

Sprint 20 meter

Sprint at 20 meters showed significant increase of time in sport drinks and BCAA (p = 0.000 and 0.025), but no significant different was found in milk (p= 0.149) when compare in pre and post period. (figure 38)

To compare the difference of time in all supplements showed the most significant different in sport drinks followed by BCAA and milk which post period was more than pre period. (p < 0.005) (figure 39)

The comparison between pair of group found sprint time at 20 m of sport drinks was higher than milk (p = 0.038). Hence, the speed of sports drink was decreased. (figure 40)

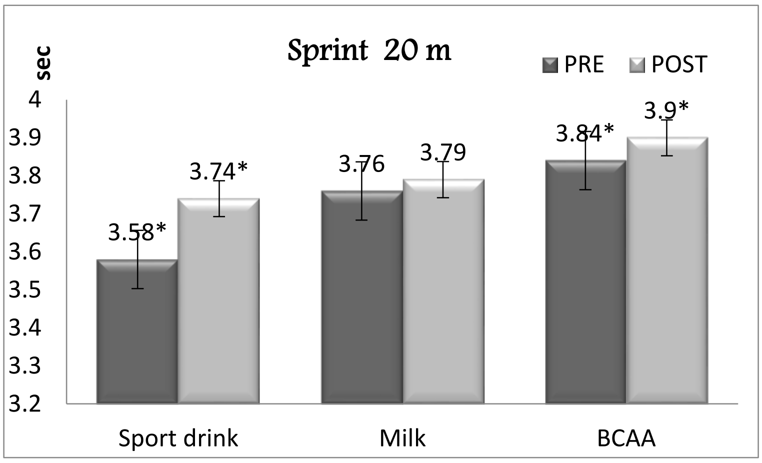

Figure 40 *Comparison effect of sprint time at 20 m between pre and post period. (p<0.05)*

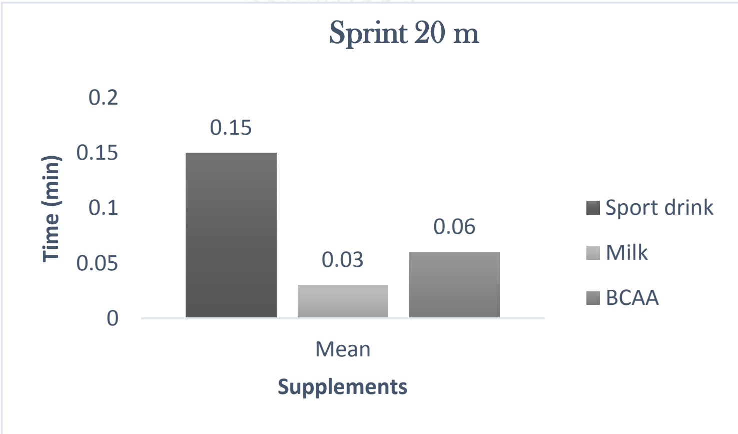

Figure 41 *Comparison the different of sprint time at 20 m between pre and post period* among all nutritional drinks *(p<0.05)*

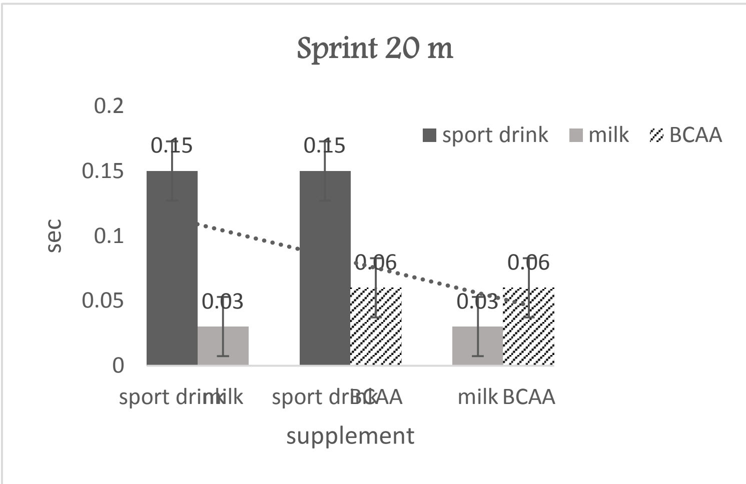

Figure 42 *Comparison the different of sprint time at 20 m between group in pre and post period (p<0.05)*

7. Evaluation of muscle injury via questionnaire

There is no significant different between pre and post period of all area for sport drinks, milk and BCAA, except Lt. hip / leg / knee /ankle which is significant different in milk at p=0.05. For performing sport found that significant different between pre and post period in milk at p<0.05 by post is less than pre and no significant different in sport drinks and BCAA. There is significant different between pre and post period of experienced when having symptom of milk at p<0.05 by post is less than pre and no significant different in sport drinks and BCAA.

Table 20 *Areas of body that have injury (Wilcoxon sign rank test ; P<0.05)*

Supplementation / Areas	Sports drink (P value)	Milk (P value)	BCAA (P value)
Head or face	0.317	0.317	1.000
Lt. shoulder / arm / wrist	0.317	0.102	0.317
Rt. Shoulder / arm / wrist	0.317	0.102	0.317
Chest / stomach	0.157	0.157	0.317
Lt. hip / knee / ankle	0.157	0.039*	0.157
Rt. Hip / knee /ankle	0.102	0.102	0.157

Table 21 *Activities that aggravated pain symptom (Wilcoxon signed rank test; P<0.05)*

Supplementation / Activities	Sports drink (P value)	Milk (P value)	BCAA (P value)
Supine	1.000	1.000	1.000
Side lying	0.317	0.317	1.000
Standing	0.317	0.102	0.317
Sitting	0.157	0.157	1.000
Walking on the flat surface	0.317	0.063	0.317
Ascending stair	0.317	0.063	0.157

Performing overhead work	**0.317**	**0.157**	**0.317**
Scratching your own back	0.317	0.102	0.317
Lifting the light object	0.317	0.102	0.317
Throwing object	0.317	0.157	0.157
Walking on uneven ground	0.317	0.063	0.157
Performing sport	1.000	0.039*	0.157

Table 22 Pain score

	Sports drink (N=49)		Milk (N=49)		BCAA (N=49)	
	Pre	Post	Pre	Post	Pre	Post
Mean (S.D.)	0.59 (1.499)	0.43 (1.155)	0.94 (1.819)	0.63 (1.334)	0.47 (1.043)	0.35 (0.879)
Max	5	5	7	5	4	4
Min	0	0	0	0	0	0
Mode	0	0	0	0	0	0

Table 23 Pain score (Wilcoxon signed rank test; P < 0.05)

Supplements	P value
Sports drink	0.102
Milk	0.016*
BCAA	0.063

There is a significant difference between pre and post period of pain score in group of milk at p = 0.016 by post is less than pre and no significant different were observed in sport drinks and BCAA.

Table 24. 3 Days Food record

Groups	Variables	Mean (S.D)	P value	Mean diff			P value		
				Sports drink	Milk	BCAA	Sports drink	Milk	BCAA
	Energy		0.000*						
No supplement		1309.09 (284.01)		-222.87	-263.09	-189.78	0.007*	0.001*	0.032*
Sports drink		1531.95 (335.88)			-40.22	33.08		0.939	0.965
Milk		1572.17 (282.08)				73.30			0.720
BCAA		1498.87 (346.78)							
	CHO		0.000*						
No supplement		160.68 (40.83)		-50.115	-28.515	-36.414	0.000*	0.023*	0.002*
Sports drink		210.80 (51.08)			21.600	13.701		0.135	0.521
Milk		189.20 (41.73)				-7.899			0.861
BCAA		197.09 (46.02)							
	Protein		0.000*						
No supplement		53.39 (13.36)		.068	-7.988	-9.188	1.000	0.020*	0.005*
Sports drink		53.33 (10.44)			-8.056	-9.256		0.019*	0.004*
Milk		61.38 (10.51)				-1.200			0.973
BCAA		62.58 (14.94)							
	Fat		0.000*						
No supplement		50.39 (15.17)		-2.390	-13.247	-1.497	0.892	0.000*	0.970
Sports drink		52.78 (14.91)			-10.856	0.893		0.006*	0.993
Milk		63.63 (13.37)				11.749			0.002*
BCAA		51.89 (16.59)							

8. **3-day Food Record**

From this table it can be seen that energy, carbohydrate, protein and fat intake between groups showed significant differences $p < 0.001$.

From this table it can also be seen that the comparison of the energy of food in each period shows a significant difference ($p < 0.05$). This means that for the sports drink, milk and BCAA period there was greater energy of food than before the subjects enrolled in the study.

For the comparison of CHO between each period ($p < 0.05$) the results showed that in the period of sports drink, milk and BCAA there was a greater CHO intake than before the subjects entered the starting period.

For protein intake during the period of milk the subjects had greater protein intake levels than in the period with no supplement and with sports drink. Moreover, in the BCAA period the athletes also had greater protein intake than in the period without supplements and with sports drink.

Lastly, in the comparison of fat intake, it was shown that in the milk period the subjects had more fat than in the periods with no supplement, sports drink, or BCAA.

The result related to the physical performance players were then compared between the pre and post intervention periods.

Table 25 The conclusion of physical performance in male football players between pre and post period

Variables \ Supplements	Sports drink	Milk	BCAA
% body fat composition	Significant Decrease(p =0.011*)	No significant difference(p =0.211)	Significant Increase (p=0.023*)
Flexibility (cm)	No significant difference (p=0.616)	Significant Increase(p=0.003*)	No significant difference(p=0.909)
Muscular endurance (time)			
- Push up	Significant Increase (p=0.003*)	No significant difference(p=0.452)	No significant difference(p=0.803)
- Sit up	Significant Increase (p=0.009*)	No significant difference(p=0.068)	Significant Increase (p=0.000*)
Vertical jump (cm)	Significant Decrease (p=0.010*)	No significant difference(p=0.160)	No significant difference(p=0.648)
Sprint time (sec)			
- At 5 m	Significant Increase(p=0.001*)	No significant difference(p=0.233)	Significant Increase (p=0.020*)
- At 10 m	Significant Increase(p=0.001*)	No significant difference(p=0.326)	Significant Increase (p=0.016*)
- At 20 m	Significant Increase(p=0.001*)	No significant difference(p=0.149)	Significant Increase (p=0.025*)

Table 26 The conclusion of physical performance in male football players among Sports drink, Cow milk and Branched-chain amino acid drink

Supplements / Variables	Sports drink and Milk	Sports drink and BCAA	Milk and BCAA
%Body fat	Significant difference (p = 0.038*)	Significant difference (p = 0.002*)	No significant difference (p = 0.562)
Flexibility	No significant difference(p =0.070)	No significant difference(p = 0.916)	No significant difference(p = 0.165)
Muscular endurance			
- Push up	Significant difference(p= 0.025*)	No significant difference(p= 0.087)	No significant difference (p=0.875)
- Sit up	No significant difference	No significant difference	No significant difference
Muscle power (Jump)	No significant difference	No significant difference	No significant difference
Sprint time			
Sprint time at 5 m	Significant difference (p=0.006*)	Significant difference (0.037*)	No significant difference(p=0.801)
Sprint time at 10 m	Significant difference (p=0.031)	No significant difference(p=0.223)	No significant difference(p=0.652)
Sprint time at 20 m	Significant difference (0.038*)	No significant difference(p=0.055)	No significant difference(p=0.767)

CHAPTER 5

DISCUSSION

CHAPTER 5
DISCUSSION

Findings

The principal result of the current study was to determine the effects on the physical performance of male footballers of sport drinks, milk, and branched-chain amino acid drinks. A comparison of the effects of the various supplements on the percentage of body fat revealed differences in each case: the BCAA group showed the greatest difference (Post > Pre), with sports drink in second place (Pre > Post) followed by milk (Post > Pre). Flexibility was boosted significantly by milk, but no discernible difference could be attributed to either sports drink or BCAAs. Push-ups were supported by sports drink, while milk and BCAAs did not provide a significant improvement. In comparison to all supplements there was a significant effect for all three approaches at the 5% significance level: sports drink showed the greatest effect (Post > Pre) with milk second (Pre > Post) followed by BCAAs (Post > Pre). However, neither sit-ups nor jumps showed and significant difference in any category, but sprint times were improved in all cases, with sports drink producing the greatest effect, followed by BCAAs and then milk.

From the questionnaire concerning injuries, a significant difference was revealed in the pre- and post-periods for milk at p = 0.039 such that (Pre > Post), but no difference was observed for sports drink or BCAAs in terms of sports performance.

Dietary assessment showed significant increases in energy, carbohydrate, protein and fat between the no supplementation period and supplementation with the three nutritional drinks (p=0.000), but when comparisons were made among the nutritional drinks, it was shown that milk had a significant increase in protein and fat compared with branched-chain amino acid drinks and sports drink (p=0.019, 0.004) and (p=0.006, 0.002).

Explanation

1. General Characteristics

In the study, the mean age of the young players participating was 17.1 ± 0.67 years, which involved a narrower range than the majority of similar studies. Other studies have typically examined participants aged between 20 and 25 years (26, 76-81). Therefore it can be expected that the performance levels and metabolism data might differ in this study when compared to adults in other studies. The body weight is no significant difference between all nutritional drink. These differences might lead to different outcomes and thus to different conclusion.

2. Physical Performance

2.1 Percentage of body fat

The modest increase was observed in BCAA supplements (pre 11.55±3.58%, post 11.91±3.51%), which significantly increased the percentage of body fat. Sports drink (pre 12.11±3.36%, post 11.77±3.48%) presented a significant decrease between the pre- and post-period evaluations. Milk (pre 11.73±3.48%, post 11.89±3.43%) produced no significant effects.

Other studies have achieved varied and contrary results. A previous study of BCAA supplementation in rats over 40 weeks found that body weight and fat were lower in the leucine group after the trial compared with the control group. However, results were elevated in the adult group (82). Additionally, the administration of leucine resulted in lower body fat. Using activated mTOR pathways in skeletal musculature, adipose tissue, and placental cells, leucine augments protein synthesis and supports energy metabolism while hampering the degradation of protein (83).

However, these results might simply be due to weight gain from sports drink or BCAA, while in athletes, the training program or effects of matches may be influential. This result may be related with confounding factors such as the social status of each participant that affects the selection of food consumption. Moreover, level of training program set by the coach may vary for tactical reasons, and these may account for some result differences.

2.2 Flexibility

A significant difference was present in each group, with milk exhibiting the modest difference (pre: 11.51±6.28cm; post: 12.39±6.36cm), followed by sports drink (pre: 11.84±5.82cm; post: 11.69±5.94cm) and BCAA (pre: 12.69±6.74cm; post: 12.73±6.69cm). Flexibility, related to the ability of joint movement and the structure around muscles to achieve a full range of motion, is the performance characteristic most affected by milk. Due to the joint stress associated with dynamic multi-joint movements used in football, good flexibility is essential. Easy injuries, as well as strength, endurance, agility and speed decreases can result from the lack of adequate joint movement. Milk has numerous nutrients, including vitamin D, calcium, whey protein and casein that may positively affect flexibility. Studies have been conducted on the attenuation of exercise-induced muscle damage (EIMD) as a result of the effects of acute milk and milk-based protein–CHO (CHO-P) supplementation (40). Those studies examined four independent groups of 6 healthy males each. Each group consumed water (CON), CHO sports drink, milk-based CHO-P, or milk (M), post EIMD. Immediately before, as well as 24 and 48 hours after EIMD, DOMS, isokinetic muscle performance, creatine kinase (CK), and myoglobin (Mb) were assessed. At no point in time was DOMS significantly different between groups. Compared with CHO and CON, and M compared with CHO, peak torque (dominant) was significantly higher 48 hours after CHO-P. After CHO-P and M compared with CHO and CON, total work of the set (dominant) was significantly higher ($p < 0.05$) after 48 hours. Compared with CHO, CK was significantly lower ($p < 0.05$) 48 hours after CHO-P and M. Compared with CHO, Mb was significantly lower ($p < 0.05$) 48 hours after CHO-P. Milk and milk-based protein–CHO supplementation resulted in the attenuation of isokinetic muscle performance decreases and increases in CK and Mb, 48 hours post-EIMD. Therefore, milk had a small benefit in reducing muscle injury which may lead to an effect on the flexibility of the muscles. From this study, errors from participants and motivation from coaches and participants may affect the result because when considering the data, it showed differences in mere millimeters.

2.3 Endurance

All supplements had a significant effect ($p <0.05$), with sports drink having the modest increase (push up; 3.76±8.50 times, sit up; 2.84±7.25 times), followed by BCAA (push sit up; 3.55±5.90 times), but milk showed significant difference between the pre- and post-intervention. In this study, all subjects consumed nutritional drinks immediately after training which conforms to the guidelines of Milou Beelen et al. (59) who suggested that athletes who eat carbohydrates after performing exercise can increase glycogen synthesis in the muscles. Hence, this may have an effect on endurance performance. Glycogen synthesis in the muscles takes place after exercise in two stages. Initially is would appear to occur without regard to circulating insulin levels and takes up to one hour. The glycogen synthesis rates in this stage are typically high, at 30–45 mmol · kg dw–1 · hr–1, but then fall quickly by up to 90% in the absence of CHO intake. Glycogen synthesis in the muscles in both stages is marked by heightened glycogen synthase activity and glucose transport rate.

A typical push-up test is a test of muscle function resistance and endurance to weight over an uninterrupted period. A significant difference in muscular endurance is shown for branched-chain amino acids during and after push-ups. In a central fatigue hypothesis, the role of BCAAs predicts that free fatty acids (FFAs) are mobilized from adipose tissue and transported via the blood to the muscles to serve as fuel. The circulating FFA concentration increases due to the increased rate of mobilization compared to the rate of uptake by the muscle. Both FFA and the free-tryptophan (fTRP) attach to albumin and compete for the same connection sites. The increasing FFA concentration causes the fTRP to be displaced from binding to albumin. As a result, the fTRP concentration and fTRP:BCAA ratio in the blood elevates. Because BCAAs and fTRP compete for carrier-mediated entry into the central nervous system by LNAA transporter, increases in this ratio result in increased fTRP transport across the blood–brain barrier. The alteration of fTRP to serotonin (5-HT) occurs and leads to a local increase of this neurotransmitter after being taken up. The role of serotonin in the onset of sleep and its status as a determinant of mood and aggression has been established in previous research. As such, the overall supposition was that the increase in serotoninergic activity results in eventual central fatigue. Such fatigue would compel athletes to stop exercising or at least moderate the strength of any exercise (21). Therefore, serotonin formation may be diminished by the ingestion of BCAAs, resulting in delayed fatigue and improved endurance during exercise.

In a preliminary crossover study (20) of young healthy male and female adults with sporadic exercise habits, study subjects were separated randomly into 2 groups. The participants ingested supplements 15 minutes prior to exercise. Subsequently, they were required to complete 7 sets of 20 squats per set with 3-minute intervals between each set. Squats were performed every 2 seconds in each set. This particular study concluded that the ingestion of a BCAA solution (150 mL) containing 5 g of a BCAA (Ile:Leu:Val 5 1:2.3:1.2) before exercise could delay or reduce the onset of muscle soreness (DOMS) and muscle fatigue, even several days after the completion of the exercise. In non-weight training males, the supplementation of BCAA was given over four meals: 30 minutes before exercise, 1.5 hours after exercise, between lunch and dinner, and before bed. The following 2 days, four supplements were consumed between meals. Muscle soreness, muscle function and muscle damage were measured by the trial. After eccentric exertion, the results showed a muscle function decrease. However, BCAA ingestion had no significant effect on the degree of force. Compared with PLA at 48 hours and 72 hours, flexed muscle soreness was perceived in BCAA. Compared with the placebo group, the area under the curve of flexed muscle soreness was lower for the BCAA group. Although it does not improve eccentric exercise, induce decreases in muscle function or increase the marker of muscle damage, BCAA supplements may effectively lessen muscle soreness (34).

2.4 Power (vertical jump)

In this research, no significant difference ($p > 0.05$) was revealed in the vertical jump for any of the supplements tested (Sports drink; -1.19±3.12 cm, Milk; -0.55±2.70 cm and BCAA; 0.23±3.57 cm). In terms of distance, the results showed a decline when the results before and after consumption of milk or sports drink were compared. BCAA, in contrast, produced a rising trend. Vertical jumps demand considerable explosive leg muscle power, and require greater amounts of energy to perform. (68) Errors in testing may occur in terms of the participants' motivation, for example pressure from coaches or themselves that leads to small differences in outcome between pre- and post-period. Furthermore, it is therefore expected that a greater lactate accumulation will be the result, and this lactate build up may have an influence on the distances the subjects are able to jump.

2.5 Sprinting

For the sprinting test, the best results in terms of times at 5 m, 10 m and 20 m came from the ingestion of sports drink, with milk and BCAA following behind. Body weight in sports drink and BCAA period were significant increase ($p<0.05$), therefore, weight did not affect to the speed test. However, it can be suggested that motivation and environment may also be confounding factor which can affect the results in this test.

These findings do not confirm the results from other studies. In one piece of research, the effects of a combination of BCAAs and arginine upon intermittent sprint performances in the context of handball were examined over a period of two consecutive days. The changes in sprint times in percentage terms were significantly better in the BCAA plus arginine trial (AA trail), while the mean assessments of perceived exertion during the tests were significantly reduced in the AA trial when compared with the placebo trial (77). Another study investigated the influence of BCAA supplements on the performance and also the immunological variables in cyclists during training. In the 4 km time trial, BCAA came close to achieving significance in presenting an increase of 11% between pre- and post-period evaluations.(84) This study also assessed the effects of both carbohydrate and carbohydrate-protein supplements on self-regulated repeated sprint performance simulated for team sports when the supplements were administered at 15 minute intervals. The maximum speed and the distance covered both showed declines in the final 15 minutes of the exercise period (by 6.1% and 4.2% respectively), while the carbohydrate-protein group showed small improvements in each of the variables measured, although these were not significant. In the carbohydrate group, the mean running speed fell in the final 15 minutes, while protein provided a small improvement (85). Meanwhile, in the study comparing the three carbohydrate-hydration strategies on blood glucose concentration, hydration status and exercise performance and hydration status using simulated football match conditions, it was found that sprinting speeds were faster in high carbohydrate with caffeine in comparison with electrolyte solution (56).

3. Injury Questionnaire

Musculoskeletal injury is a common accident in sports. The pain assessment that was used in this trial is developed from the example provided by a multidimensional assessment tool which was originally used in a large population-based study in Switzerland which focused on musculoskeletal health. The Pain Standard Evaluation Questionnaire (SEQ Pain) was designed in order to try to evaluate pain while taking into account its multidimensional nature through determining the intensity and exact location of the pain, the extent to which this pain occurred during activity, the different triggers and onset times for the pain, and the frequency with which pain relieving medication was administered (86).

In this trial, the results showed in performing sport found that the significant difference between the pre- and post-periods in milk ($p < 0.05$) was of the form (Post > Pre), while no significant difference arose in sport drinks and BCAA. This result is similar to the study of Cockburn which found that creatine kinase (CK) levels were notably decreased ($p < 0.05$) when measured 48 hours after the ingestion of CHO-protein and milk when compared with the outcome from CHO. Myoglobin (Mb) levels were found to be significantly lower ($p < 0.05$) when measured 48 hours after the ingestion of CHO-protein when compared with the outcome from CHO. In evaluation for post-exercise induced muscle damage (EIMD) at 48 hours, milk and milk-based protein–CHO supplements produced declines in isokinetic muscle performance and raised he levels of CK and Mb (40). Furthermore, research into the influence of milk on performance in team sports following EIMD revealed that after 48 hours milk could limit the increases in sprint time over 10 m, and seemed to have a positive influence on means sprint times at 15 m when measured in the Loughborough Intermittent Shuttle Test. Even after 72 hours, milk had the capacity to control increases in the 15 m sprint times and had positive effects on agility. No other variables could produce unambiguous results, however. In conclusion, milk can limit the decline in performance in sprinting and agility and can support the ability to carry out the repeated sprints which are a typical requirement in team sports such as football (87). Furthermore, serum CK levels were significantly reduced ($p < 0.05$) after 4 days of ITD with CM (316.9 ± 188.3 U·L-1) in comparison with CHO (431.6 ± 310.8 U·L-1) when considering the effects of chocolate milk ingestion on muscle recovery markers after football training (39).

4. **Food record**

From this study it was found that the energy intake in the supplementation period was significantly increased when compared with no supplementation (BCAA period: 1498.87±346.78kcal; 197.09±46.02 g CHO; Milk period: 1572.17±282.08kcal; 189.20±41.73 g CHO: Sports drink period: 1531.95±335.88kcal; 210.80±51.08 g CHO: No supplementation period: 1309.09±284.01; 160.68±40.83 g CHO; $p < 0.05$), but no significant differences were observed when comparing between the different supplement groups, as was also the case with carbohydrates. For protein intake, sports drink showed a significant decrease when compared with milk and BCAA (BCAA period: 62.58±14.94 g Protein; Milk period: 61.38±10.51 g Protein; Sports drink period: 53.33±10.44 g Protein; No supplementation period; 53.39±13.36 g Protein). Milk revealed a significant increase in fat when compared with no supplementation, sports drink and BCAA (BCAA period: 51.89±16.59 g Fat; Milk period: 63.63±13.37 g Fat; Sports drink period: 52.78±14.91 g Fat; No supplementation period: 50.39±15.17 g Fat). From the record it can be concluded that the subjects were lower in energy and protein intake when compared with the recommended levels for young Thai males and athletes(Recommendation for energy 2,100-2,300 kcal/day for male with age between 13-18 years old; Protein recommendation 1.2-1.7 g/kg BW/day or 58-63 g/day) (13, 88). Therefore, this may affect the physical performance and fitness of the players. In addition, differences in social status and environment may be a cause of low caloric intake.

Food consumption is important for everybody, but especially for athletes and adolescents. Therefore, coaches or accomplices must realize this and pay attention to the nutrition that their athletes receive, in addition to the normal focus only on tactics. Advising young players and providing them with knowledge may help them to improve their nutrition.

CHAPTER 6

CONCLUSION

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Conclusion

A dietary assessment of a 3-day food record revealed significant differences between no supplementation (period 0) and three nutritional drinks. Protein levels were higher in the branched-chain amino acid drink and cow milk groups compared to no supplementation and the sports drink group. However, no significant difference was observed between the branched-chain amino acid drink and milk groups. The intakes of cow milk group was significantly higher in fat compared with no supplementation, the sports drink, and the branched-chain amino acid drink group. Regarding total energy intakes, all study periods were lower than the recommended intake for young Thai males. Therefore, coaches and trainers should pay attention to the nutrition of their team members and not focusing solely on tactics. Advising young players through increased knowledge may help to improve their nutrition.

Sports drink group increased muscular endurance for sit up and push up tests between the pre- and post-periods, however, muscle power and percentage of body fat composition decreased in this group.

A modest increase in muscle flexibility was found in cow milk supplemented group. Other physical performance and anthropometric tests showed no significant difference between the pre- and post-periods.

The branched-chain amino acid drink supplementation led to an increase in the number of sit ups, an indicator of muscle endurance. The percentage of body fat composition in this group increased between the pre- and post-periods. There was no significant difference between pre- and post-periods for the push up test, jump, and flexibility.

Furthermore, speed modestly decreased in all the supplementation groups between the pre- and post-intervention periods.

Evaluation of injury using the visual analogue scale showed a significant decrease for milk group. The left hip, knee and ankle were areas of injury, and sporting activity aggravated the pain. No significant difference between pre- and post-periods was observed for the sports drink and branched-chain amino acid drink groups.

Therefore, the branched-chain amino acid drink, sports drink, and cow milk supplementation showed mixed effects, either beneficial or undesirable aspects of physical performance in male football players. Athletes should pay attention to their food and nutrition as low calorific intake compared with normal levels may also affect physical performance.

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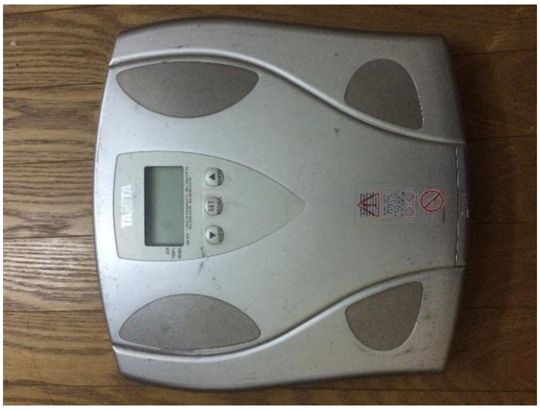
APPENDIX

Material

Study products

Skinfold caliper

Sit and reach box



Weighing apparatus

ข้อมูลสำหรับผู้มีส่วนร่วมในการวิจัย

ชื่อโครงการวิจัย การเปรียบเทียบผลของการรับประทานอาหารเสริมที่มีกรดอะมิโนโซ่กิ่งสูงหรือนมวัวหรือเครื่องดื่มเกลือแร่ต่อสมรรถภาพการเล่นกีฬาในนักฟุตบอลชาย

ชื่อผู้วิจัย …นางสาวภัทรพร พันธุ์พิทย์แพทย์.......

สถานที่ติดต่อผู้วิจัย.. (ที่ทำงาน) คณะสหเวชศาสตร์ จุฬาลงกรณ์มหาวิทยาลัย 154 ถนนพระราม 1 ปทุมวัน กรุงเทพ 10330

โทรศัพท์มือถือ ……084-663-5495……… E-mail : mayji_pat_nut@hotmail.com

(ที่บ้าน) 1/28 หมู่ 7 ถนนราชพฤกษ์ แขวงบางเชือกหนัง เขตตลิ่งชัน กรุงเทพมหานคร 10170

1. **สวัสดีท่านผู้เข้าร่วมในการวิจัย** ก่อนที่ท่านจะตัดสินใจเข้าร่วมในการวิจัย ขอให้ท่านทำความเข้าใจกับงานวิจัยนี้ โดยอ่านข้อมูลต่อไปนี้อย่างละเอียดรอบคอบ และสอบถามข้อมูลเพิ่มเติมหรือข้อมูลที่ไม่ชัดเจนได้ตลอดเวลา

2. **โครงการนี้เกี่ยวข้องกับการเปรียบเทียบผลของการรับประทานอาหารเสริมที่มีกรดอะมิโนโซ่กิ่งสูง,นมวัว และเครื่องดื่มเกลือแร่** โดยดื่มในช่วงเย็นหลังการฝึกซ้อมทุกวันเป็นเวลา 10 วัน (จันทร์ – ศุกร์) สำหรับอาหารแต่ละชนิด

3. **วัตถุประสงค์ของการวิจัย** เพื่อเปรียบเทียบผลของอาหารเสริมที่มีกรดอะมิโนโซ่กิ่งสูง ,นมวัว และเครื่องดื่มเกลือแร่ที่มีต่อสมรรถภาพการเล่นกีฬาของนักฟุตบอล

4. **รายละเอียดของนักกีฬาผู้มีส่วนร่วมในการวิจัย**

การวิจัยนี้เป็นการศึกษาทีมฟุตบอลที่อยู่ในจังหวัดระยอง 3 ทีม คือ ทีมโรงเรียนปลวกแดงพิทยาคม ,ทีมโรงเรียนนิคมวิทยา และทีมโรงเรียนมาบตาพุดพันพิทยาคาร ผู้วิจัยจึงขอรับสมัครนักกีฬาผู้ร่วมวิจัยจากแต่ละทีม จำนวนทีมละ 21 คน

นักกีฬาผู้สามารถเข้าร่วมการวิจัยมีคุณสมบัติดังนี้

1) นักกีฬาที่มีอายุตั้งแต่ 16 – 18 ปี
2) มีความยินดีเข้าร่วมโครงการ
3) สามารถบริโภคอาหารเสริมที่มีกรดอะมิโนจำเป็นสูง,นมวัวและเครื่องดื่มเกลือแร่ได้

หากมีสิ่งต่อไปนี้ *จะไม่ต้องร่วมโครงการ*

1) ผู้รักษาประตู(เนื่องจากการฝึกซ้อมของผู้รักษาประตูต่างจากผู้เล่นในตำแหน่งอื่น)
2) นักกีฬาที่มีอาการบาดเจ็บ ไม่สามารถเข้ารับการฝึกซ้อมได้

แต่ละทีมจะแบ่งย่อยออกเป็น 3 กลุ่ม กลุ่มละ 7 คน โดยแบ่งการศึกษาออกเป็น 4 ระยะ

ระยะเตรียมการ ในระยะนี้จะขอความร่วมมือท่านผู้ร่วมวิจัยบันทึกการรับประทานอาหารของท่าน 3 วัน ในระยะเวลา 2 สัปดาห์ คือวันจันทร์และศุกร์ในสัปดาห์ที่หนึ่ง และวันพุธในสัปดาห์ที่สอง โดยผู้วิจัยจะมีแบบฟอร์มบันทึกให้ท่าน ต่อจากนั้นในระหว่างที่ท่านฝึกซ้อม วันจันทร์-ศุกร์ ทั้ง 2 สัปดาห์ จะให้ท่านดื่มอาหารเสริมชนิดใดชนิดหนึ่งใน 3 รูปแบบ ครั้งละ 250 ซีซี (ประมาณนมกล่องขนาดปกติ 1 กล่อง) ในตอนเย็นหลังการฝึกซ้อม รวม 10 วัน โดยท่านจะได้รับจนครบทั้ง 3 ชนิดในระยะที่ 3

<u>ระยะที่ 1</u>

วันแรก (วันอาทิตย์)

07.00 น. วัดส่วนสูง ชั่งน้ำหนัก และวัดปริมาณไขมันใต้ผิวหนัง ใช้เวลาประมาณ 5 นาที

07.45 น. ทดสอบความอ่อนตัว (Flexibility test) ใช้เวลาประมาณ 5 นาที

08.00 น. ทดสอบความอดทนของกล้ามเนื้อ (Muscular Endurance) ใช้เวลาประมาณ 10 นาที

10.00 น.ทดสอบแรงกล้ามเนื้อ (Vertical Jump) ใช้เวลาประมาณ 5 นาที

15.00 น. ทดสอบวิ่งเร็ว (Sprint test: 5,10 and *20* meter) ใช้เวลาประมาณ 5 นาที

15.30 น. ตอบแบบสอบถามการบาดเจ็บ ใช้เวลาประมาณ 5 นาที

ในวันจันทร์-ศุกร์ ของสัปดาห์ที่ 1 และ 2 ท่านจะได้รับผลิตภัณฑ์อาหารอย่างใดอย่างหนึ่งใน 3 ผลิตภัณฑ์ โดยในวันจันทร์และวันศุกร์ ของสัปดาห์แรก และวันพุธของสัปดาห์ที่สอง จะขอให้ท่านบันทึกการรับประทานอาหารของท่าน ในวันเสาร์-อาทิตย์ เป็นวันที่มีการแข่งขัน ไม่ต้องบริโภคอาหารเสริม

ในวันเสาร์ของสัปดาห์ที่สอง ซึ่งเป็นวันสุดท้ายของระยะการศึกษาที่ 1 ผู้วิจัยจะขอให้ท่านทดสอบสมรรถภาพอีกครั้ง ซึ่งเป็นวิธีเดียวกันกับในวันแรกที่ท่านได้ถูกทดสอบไปแล้ว

ท่านจะมีเวลาพัก 1 สัปดาห์ ก่อนเข้าสู่ระยะที่ 2 ในระยะพักนี้ขอให้ท่านรับประทานอาหารตามปกติ

ระยะที่ 2 และ 3

เหมือนกับระยะที่ 1 เพียงเปลี่ยนอาหารเสริมเป็นชนิดที่ 2 และ 3 ตามลำดับ

คำแนะนำการปฏิบัติตัวในด้านการรับประทานอาหารในระหว่างการวิจัย

งานวิจัยครั้งนี้เป็นการเปรียบเทียบผลของอาหารเสริม ผู้วิจัยต้องการให้นักกีฬารับประทานอาหารตามปกติ โดยไม่งดมื้ออาหาร ได้รับสารอาหารที่ครบถ้วน โดยจะขอชี้แจงหลักการ ดังนี้

1. พลังงาน ผู้วิจัยขอความร่วมมือจากนักกีฬาผู้ร่วมวิจัยในการรับประทานอาหารที่ให้พลังงานตามปกติที่รับประทานใกล้เคียงกันทุกวัน

2. โปรตีน อาหารที่เป็นแหล่งของโปรตีน ได้แก่ เนื้อสัตว์ นม ไข่ และถั่ว ผู้วิจัยขอความร่วมมือนักกีฬาผู้ร่วมวิจัยในการรับประทานอาหารกลุ่มโปรตีนให้ได้ปริมาณใกล้เคียงกันทุกวัน

5. วิธีการศึกษา

การทดสอบความอ่อนตัว (Flexibility test) โดยวิธีทดสอบนั่งงอตัว (Sit and reach)

ให้นักกีฬายืดเหยียดกล้ามเนื้อ ถอดรองเท้าแล้วนั่งบนพื้น เหยียดขาตรงสอดเท้าเข้าชิดบริเวณยันเท้าของกล่องหรือม้าวัด จากนั้นเหยียดแขนตรงไปข้างหน้าให้มือและแขนวางทาบบนสเกลทั้งสองข้างแล้วก้มตัวไปข้างหน้าพร้อมกับขยับแขนมือไปข้างหน้าให้ไกลที่สุด ให้ปลายนิ้วทั้งสองข้างเสมอกัน และรักษาระยะทางไว้ประมาณ 2 วินาที อ่านระยะจากจุด “0” ถ้าปลายนิ้วมือเลยปลายเท้าขึ้นไปบันทึกเป็นบวก ถ้าปลายนิ้วมือไม่ถึงปลายเท้าบันทึกเป็นค่าลบ หน่วยวัดเป็นเซนติเมตร ทดสอบ 2 ครั้ง ใช้ครั้งที่ดีที่สุด

การทดสอบความอดทนของกล้ามเนื้อ (Muscular Endurance)

การดันพื้น (Push-ups)

ท่าเริ่มนอนคว่ำเหยียดขา ปลายเท้าชิดแตะพื้น เหยียดแขนตรง ฝ่ามือคว่ำแตะพื้น จากนั้นผ่อนแรงแขน ลดลำตัวลงหน้าอกเกือบชิดพื้น หรือใช้ศอกเป็นมุมฉาก แล้วยกตัวขึ้นใหม่เหมือนท่าเริ่มต้น ทำอย่างต่อเนื่อง ถูกต้อง รวดเร็ว มากที่สุดภายในเวลา 1 นาที

การลุก - นั่ง (Sit – up)

ท่าเริ่มนอนหงายกับพื้น ชันเข่าตั้งขึ้นเป็นมุมฉาก มือทั้งสองข้างอยู่ชิดข้างศีรษะ จากนั้นยกศีรษะและไหล่ขึ้น ให้ศอกทั้งสองข้างแตะเข่า แล้วผ่อนแรงให้ศีรษะลงพื้น แล้วยกขึ้นใหม่ ทำต่อเนื่องอย่างถูกต้องรวดเร็วมากที่สุดภายใน 1 นาที

การทดสอบแรงกล้ามเนื้อ (Muscle Power) ทดสอบยืนกระโดดสูง (Vertical Jump)

1.ให้นักกีฬายืนตรงยกมือข้างที่ถนัดขึ้นไปข้างบนให้สูงที่สุด แล้ววัดระยะความสูง หน่วยเป็นเซนติเมตร

2.ยืนกระโดดสองขา (Dynamic leg jump) ให้นักกีฬานำมือข้างที่ไม่ถนัดจับที่เอวส่วนมือข้างที่ถนัดยกขึ้นเหนือศีรษะ จากนั้นย่อเข่าแล้วกระโดดให้สูงที่สุด ใช้มือข้างที่ถนัดแตะสเกลหรือระยะทางของ Yardstrick ให้สูงที่สุด ทำการทดสอบ 3 ครั้ง ใช้ครั้งที่สูงที่สุด ข้อควรระวัง นักกีฬาต้องยืนกระโดด ห้ามวิ่งและมือที่จับเอวห้ามหลุดออกจากเอว

การทดสอบความเร็ว (Speed) ทดสอบวิ่งเร็ว (Sprint test: 5,10 and 20 meter)

1.ให้นักกีฬายืนท่าเท้านำเท้าตามเตรียมออกวิ่ง บริเวณจุดเริ่มต้น

2.ให้สัญญาณปล่อยตัวนักกีฬาต้องวิ่งเร็วที่สุด ในระยะ 20 เมตร บันทึกเวลาที่ระยะ 5 เมตร 10 เมตร และ 20 เมตร ทดสอบ 3 ครั้ง ใช้ครั้งที่เวลาดีที่สุด

สถานที่ดำเนินการทดสอบสมรรถภาพการเล่นกีฬาของผู้ร่วมวิจัย จะดำเนินการที่สนามฟุตบอลที่ท่านทำการฝึกซ้อม

รวมเวลาที่ขอให้ท่านเข้าร่วมการวิจัย 69 วัน โดยจะมีการทดสอบสมรรถภาพ 6 ครั้ง คือวันอาทิตย์ก่อนเริ่มต้นการวิจัยของแต่ละการทดลอง (สัปดาห์ที่ 1,4 และ 7) และวันเสาร์ของสัปดาห์ที่ 2, 5 และ 8โดยที่ในแต่ละครั้งจะใช้เวลาประมาณ 35นาที

ประโยชน์ของการวิจัยนี้ เพื่อให้ทราบถึงผลของผลิตภัณฑ์ที่มีต่อสมรรถภาพการเล่นกีฬาของนักกีฬา จะได้เลือกใช้ให้ถูกต้องเพื่อให้เกิดประโยชน์สูงสุดต่อนักกีฬาและสโมสรและวงการกีฬาต่อไป ทั้งนี้เพราะในปัจจุบันนอกเหนือจากการฝึกซ้อมแล้วอาหารเสริมก็เป็นทางเลือกหนึ่งที่นักกีฬาและผู้ฝึกสอนเลือกใช้ แต่ราคาของผลิตภัณฑ์อาหารเสริมนั้นจัดว่าสูง ซึ่งหากพบว่าผลิตภัณฑ์ใดช่วยส่งเสริมประสิทธิภาพที่ใกล้เคียงกันของนักกีฬาในราคาที่ต่ำกว่าและหาซื้อได้ง่ายในท้องตลาด ก็จะเป็นการประหยัดรายจ่ายและเพิ่มความสะดวกให้กับทางสโมสรได้

โดยในงานวิจัยนี้อาจมีความไม่สะดวกในกรณีที่นักกีฬาผู้ร่วมวิจัยต้องเป็นทีมเยือน ซึ่งการเดินทางอาจมีผลต่อการทดสอบสมรรถภาพการเล่นกีฬา อีกทั้งเนื่องจากนักกีฬาอาจไม่เคยรับประทานอาหารเสริมทุกวันจึงอาจเป็นการเพิ่มความไม่สะดวกให้แก่นักกีฬา รวมทั้งหากนักกีฬาแพ้นมวัวก็จะไม่สามารถเข้าร่วมงานวิจัยได้

งานวิจัยนี้จะไม่มีค่าเสียเวลาแก่ผู้ร่วมวิจัย ผู้วิจัยมอบผลิตภัณฑ์อาหารเสริมที่ใช้ในงานวิจัยให้แก่ผู้ร่วมวิจัย โดยผู้ร่วมวิจัยแต่ละท่านจะได้รับอาหารเสริมที่มีกรดอะมิโนโซ่กิ่งสูงจำนวน 2 กระป๋อง นมวัวจำนวน 20 กล่อง และเครื่องดื่มเกลือแร่จำนวน 20 ขวด

*การเข้าร่วมการวิจัยเป็นโดย**สมัครใจของท่าน*** และสามารถ**ปฏิเสธ**ที่จะเข้าร่วมหรือ**ถอนตัว**จากการวิจัยได้ทุกขณะ โดยไม่ต้องให้เหตุผลและไม่สูญเสียประโยชน์ที่พึงได้รับ

หากท่านมีข้อสงสัยให้สอบถามเพิ่มเติมได้โดยสามารถติดต่อผู้วิจัยได้ตลอดเวลา และหากผู้วิจัยมีข้อมูลเพิ่มเติมที่เป็นประโยชน์หรือโทษเกี่ยวกับการวิจัย ผู้วิจัยจะแจ้งให้ท่านทราบอย่างรวดเร็ว เพื่อให้ผู้มีส่วนร่วมในการวิจัยทบทวนว่ายังสมัครใจจะอยู่ในงานวิจัยต่อไปหรือไม่

ข้อมูลที่เกี่ยวข้องกับท่านจะถูกเก็บเป็น**ความลับ** หากมีการเสนอผลการวิจัยจะเสนอเป็นภาพรวม ข้อมูลใดที่สามารถระบุถึงตัวท่านได้จะไม่ปรากฏในรายงาน

หากท่านไม่ได้รับการปฏิบัติตามข้อมูลดังกล่าวสามารถร้องเรียนได้ที่ คณะกรรมการพิจารณาจริยธรรมการวิจัยในคนกลุ่มสหสถาบัน ชุดที่ 1 จุฬาลงกรณ์มหาวิทยาลัย ชั้น 4 อาคารสถาบัน 2 ซอยจุฬาลงกรณ์ 62 ถนนพญาไท เขตปทุมวัน กรุงเทพฯ 10330 โทรศัพท์ 0-2218-8147 โทรสาร 0-2218-8147 E-mail : eccu@chula.ac.th

ข้อมูลสำหรับผู้ฝึกสอน

ชื่อโครงการวิจัย การเปรียบเทียบผลของการรับประทานอาหารเสริมที่มีกรดอะมิโนโซ่กิ่งสูงหรือนมวัวหรือเครื่องดื่มเกลื่อแร่ต่อสมรรถภาพการเล่นกีฬาในนักฟุตบอลชาย

ชื่อผู้วิจัย …นางสาวภัทรพร พันธุ์พิทย์แพทย์.......

สถานที่ติดต่อผู้วิจัย.. (ที่ทำงาน) คณะสหเวชศาสตร์ จุฬาลงกรณ์มหาวิทยาลัย 154 ถนนพระราม 1 ปทุมวัน กรุงเทพ 10330

โทรศัพท์มือถือ ……084-663-5495……… E-mail : mayji_pat_nut@hotmail.com

(ที่บ้าน) 1/28 หมู่ 7 ถนนราชพฤกษ์ แขวงบางเชือกหนัง เขตตลิ่งชัน กรุงเทพมหานคร 10170

3. สวัสดีท่านผู้ฝึกสอน ขอให้ท่านทำความเข้าใจกับงานวิจัยนี้ โดยอ่านข้อมูลต่อไปนี้อย่างละเอียดครอบคอบ และสอบถามข้อมูลเพิ่มเติมหรือข้อมูลที่ไม่ชัดเจนได้ตลอดเวลา

4. โครงการนี้เกี่ยวข้องกับการเปรียบเทียบผลของการดื่มเครื่องดื่มที่มีกรดอะมิโนโซ่กิ่งสูง,นมวัว และเครื่องดื่มที่เกลือแร่โดยดื่มในช่วงเย็นหลังการฝึกซ้อมทุกวันเป็นเวลา 10 วัน(จันทร์-ศุกร์) สำหรับอาหารแต่ละชนิด

3. วัตถุประสงค์ของการวิจัย เพื่อเปรียบเทียบผลของอาหารเสริมที่มีกรดอะมิโนโซ่กิ่งสูง ,นมวัว และเครื่องดื่มเกลือแร่ ว่าจะมีผลต่อสมรรถภาพการเล่นกีฬาของนักฟุตบอลอย่างไร

4. รายละเอียดของนักกีฬาผู้มีส่วนร่วมในการวิจัย

การวิจัยนี้เป็นการศึกษาทีมฟุตบอลที่อยู่ในจังหวัดระยอง 3 ทีม คือ ทีมโรงเรียนปลวกแดงพิทยาคม ,ทีมโรงเรียนมัธยมตากสิน ,ทีมโรงเรียนระยองวิทยาคมปากน้ำ และทีมโรงเรียนมัธยมบ้านค่าย ผู้วิจัยจึงขอรับสมัครนักกีฬาผู้ร่วมวิจัยจากทีมของท่าน จำนวน 21 คน

โดยนักกีฬาผู้สามารถเข้าร่วมการวิจัยมีคุณสมบัติดังนี้

1) นักกีฬาที่มีอายุตั้งแต่ 16 – 18 ปี
2) มีความยินดีเข้าร่วมโครงการ
3) สามารถบริโภคอาหารเสริมที่มีกรดอะมิโนโซ่กิ่งสูง ,นมวัวและเครื่องดื่มเกลือแร่ได้

หากอยู่กรณีต่อไปนี้ *จะไม่ต้องร่วมโครงการ*

3) ผู้รักษาประตู (เนื่องจากการฝึกซ้อมของผู้รักษาประตูต่างจากผู้เล่นในตำแหน่งอื่น)

4) นักกีฬาที่มีอาการบาดเจ็บ ไม่สามารถเข้ารับการฝึกซ้อมได้

การวิจัยแบ่งออกเป็น 4 ระยะ โดยนักกีฬาแต่ละคนจะได้รับการขอให้ดำเนินการต่อไปนี้

ระยะเตรียมการ ในระยะนี้จะขอความร่วมมือนักกีฬาผู้ร่วมวิจัยบันทึกการรับประทานอาหารของตนเอง 3 วัน ในระยะเวลา 2 สัปดาห์ คือวันจันทร์และศุกร์ในสัปดาห์ที่หนึ่ง และวันพุธในสัปดาห์ที่สอง โดยผู้วิจัยจะมีแบบฟอร์มบันทึกให้

ต่อจากนั้นในระหว่างที่นักกีฬาของท่านมีการฝึกซ้อม วันจันทร์-ศุกร์ ทั้ง 2 สัปดาห์ จะให้นักกีฬาดื่มอาหารเสริมชนิดใดชนิดหนึ่งใน 3 รูปแบบ ครั้งละ 250 ซีซี (ประมาณนมขนาดปกติ 1 กล่อง)ในตอนเย็นหลังการฝึกซ้อม รวม 10 วัน โดยนักกีฬาจะได้รับจนครบทั้ง 3 ชนิดในระยะที่ 3

<u>ระยะที่ 1</u>

วันแรก (วันอาทิตย์)

07.00 น. วัดส่วนสูง ชั่งน้ำหนัก และวัดปริมาณไขมันใต้ผิวหนัง ใช้เวลาประมาณ 5 นาที

07.45 น. ทดสอบความอ่อนตัว (Flexibility test) ใช้เวลาประมาณ 5 นาที

08.00 น. ทดสอบความอดทนของกล้ามเนื้อ (Muscular Endurance) ใช้เวลาประมาณ 10 นาที

10.00 น.ทดสอบแรงกล้ามเนื้อ (Vertical Jump) ใช้เวลาประมาณ 5 นาที

15.00 น. ทดสอบวิ่งเร็ว (Sprint test: 5,10 and 20 meter) ใช้เวลาประมาณ 5 นาที

15.30 น. ตอบแบบสอบถามการบาดเจ็บ ใช้เวลาประมาณ 5 นาที

ในวันจันทร์-ศุกร์ ของสัปดาห์ที่ 1 และ 2 นักกีฬาจะได้รับผลิตภัณฑ์อาหารอย่างใดอย่างหนึ่งใน 3 ผลิตภัณฑ์ โดยในวันจันทร์และวันศุกร์ ของสัปดาห์แรก และวันพุธของสัปดาห์ที่สอง จะขอให้นักกีฬาบันทึกการรับประทานอาหารของท่าน ในวันเสาร์-อาทิตย์ เป็นวันที่มีการแข่งขัน ไม่ต้องบริโภคอาหารเสริม ในวันเสาร์ของสัปดาห์ที่สอง ซึ่งเป็นวันสุดท้ายของระยะการศึกษาที่ 1 ผู้วิจัยจะขอให้นักกีฬาทดสอบสมรรถภาพอีกครั้ง ซึ่งเป็นวิธีเดียวกันกับในวันแรกที่นักกีฬาได้ถูกทดสอบไปแล้ว

นักกีฬาจะมีเวลาพัก 1 สัปดาห์ ก่อนเข้าสู่ระยะที่ 2 ในระยะพักนี้ขอให้นักกีฬารับประทานอาหารตามปกติ

ระยะที่ 2 และ 3

เหมือนกับระยะที่ 1 เพียงเปลี่ยนอาหารเสริมเป็นชนิดที่ 2 และ 3 ตามลำดับ

5. วิธีการศึกษา

การทดสอบความอ่อนตัว (Flexibility test) โดยวิธีทดสอบนั่งงอตัว (Sit and reach)

ให้นักกีฬายืดเหยียดกล้ามเนื้อ ถอดรองเท้าแล้วนั่งบนพื้น เหยียดขาตรงสอดเท้าเข้าชิดบริเวณยันเท้าของกล่องหรือม้าวัด จากนั้นเหยียดแขนตรงไปข้างหน้าให้มือและแขนวางทาบบนสเกลทั้งสองข้าง แล้วก้มตัวไปข้างหน้าพร้อมกับขยับแขนมือไปข้างหน้าให้ไกลที่สุด ให้ปลายนิ้วทั้งสองข้างเสมอกัน และรักษาระยะทางไว้ประมาณ 2 วินาที อ่านระยะจากจุด “0” ถ้าปลายนิ้วมือเลยปลายเท้าขึ้นไปบันทึกเป็นบวก ถ้าปลายนิ้วมือไม่ถึงปลายเท้าบันทึกเป็นค่าลบ หน่วยวัดเป็นเซนติเมตร ทดสอบ 2 ครั้ง ใช้ครั้งที่ดีที่สุด

การทดสอบความอดทนของกล้ามเนื้อ (Muscular Endurance)

การดันพื้น (Push-ups)

ท่าเริ่มนอนคว่ำเหยียดขา ปลายเท้าชิดแตะพื้น เหยียดแขนตรง ฝ่ามือคว่ำแตะพื้น จากนั้นผ่อนแรงแขน ลดลำตัวลงหน้าอกเกือบชิดพื้น หรือใช้ศอกเป็นมุมฉาก แล้วยกตัวขึ้นใหม่เหมือนท่าเริ่มต้น ทำอย่างต่อเนื่อง ถูกต้อง รวดเร็ว มากที่สุดภายในเวลา 1 นาที

การลุก - นั่ง (Sit – up)

ท่าเริ่มนอนหงายกับพื้น ชันเข่าตั้งขึ้นเป็นมุมฉาก มือทั้งสองข้างอยู่ชิดข้างศีรษะ จากนั้นยกศีรษะและไหล่ขึ้น ให้ศอกทั้งสองข้างแตะเข่า แล้วผ่อนแรงให้ศีรษะลงพื้น แล้วยกขึ้นใหม่ ทำต่อเนื่องอย่างถูกต้องรวดเร็วมากที่สุดภายใน 1 นาที

การทดสอบแรงกล้ามเนื้อ (Muscle Power) โดยทดสอบยืนกระโดดสูง (Vertical Jump)

1.ให้นักกีฬายืนตรงยกมือข้างที่ถนัดขึ้นไปข้างบนให้สูงที่สุด แล้ววัดระยะความสูง หน่วยเป็นเซนติเมตร

2.ยืนกระโดดสองขา (Dynamic leg jump) ให้นักกีฬานำมือข้างที่ไม่ถนัดจับที่เอวส่วนมือข้างที่ถนัดยกขึ้นเหนือศรีษะ จากนั้นย่อเข่าแล้วกระโดดให้สูงที่สุด ใช้มือข้างที่ถนัดแตะสเกลหรือระยะทางของ Yardstrick ให้สูงที่สุด ทำการทดสอบ 3 ครั้ง ใช้ครั้งที่สูงที่สุด ข้อควรระวัง นักกีฬาต้องยืนกระโดด ห้ามวิ่งและมือที่จับเอวห้ามหลุดออกจากเอว

การทดสอบความเร็ว (Speed) ทดสอบวิ่งเร็ว (Sprint test: 5,10 and 20 meter)

1.ให้นักกีฬายืนท่าเท้านำเท้าตามเตรียมออกวิ่ง บริเวณจุดเริ่มต้น

2.ให้สัญญาณปล่อยตัวนักกีฬาต้องวิ่งเร็วที่สุด ในระยะ 20 เมตร บันทึกเวลาที่ระยะ 5 เมตร 10 เมตร และ 20 เมตร ทดสอบ 3 ครั้ง ใช้ครั้งที่เวลาดีที่สุด

สถานที่ดำเนินการทดสอบสมรรถภาพการเล่นกีฬาของผู้ร่วมวิจัย จะดำเนินการที่สนามฟุตบอลที่นักกีฬาผู้ร่วมวิจัยทำการฝึกซ้อม

รวมขอเวลานักกีฬาของท่านเข้าร่วมการวิจัย 69 วัน โดยจะมีการทดสอบสมรรถภาพ 6 ครั้ง คือวันอาทิตย์ก่อนเริ่มต้นการวิจัยของแต่ละการทดลอง (สัปดาห์ที่ 1, 4 และ 7) และวันเสาร์ของสัปดาห์ที่ 2, 5 และ 8 โดยที่ในแต่ละครั้งจะใช้เวลาประมาณ 35 นาที

ประโยชน์ของการวิจัยนี้ เพื่อให้ทราบถึงผลของผลิตภัณฑ์ที่มีต่อสมรรถภาพนักกีฬา จะได้เลือกใช้ให้ถูกต้องเพื่อให้เกิดประโยชน์สูงสุดต่อนักกีฬาและสโมสรและวงการกีฬาต่อไป ทั้งนี้เพราะในปัจจุบันนอกเหนือจากการฝึกซ้อมแล้วอาหารเสริมก็เป็นทางเลือกหนึ่งที่นักกีฬาและผู้ฝึกสอนเลือกใช้ แต่ราคาของผลิตภัณฑ์อาหารเสริมนั้นจัดว่าสูง ซึ่งหากพบว่าผลิตภัณฑ์ใดช่วยส่งเสริมประสิทธิภาพที่ใกล้เคียงกันของนักกีฬาในราคาที่ต่ำกว่าและหาซื้อได้ง่ายในท้องตลาด ก็จะเป็นการประหยัดรายจ่ายและเพิ่มความสะดวกให้กับทางสโมสรได้

งานวิจัยนี้จะไม่มีค่าตอบแทนแก่ผู้ร่วมวิจัย ผู้วิจัยจะขอมอบผลิตภัณฑ์อาหารเสริมที่ใช้ในงานวิจัยให้แก่ผู้เข้าร่วมงานวิจัย โดยนักกีฬาผู้ร่วมวิจัยแต่ละท่านจะได้รับอาหารเสริมที่มีกรดอะมิโนโซกิ่งสูงจำนวน 2 กระป๋อง นมวัวจำนวน 20 กล่อง และเครื่องดื่มที่มีน้ำตาลจำนวน 20 ขวด

โดยในงานวิจัยนี้อาจมีความไม่สะดวกในกรณีที่นักกีฬาผู้ร่วมวิจัยอาจไม่เคยรับประทานอาหารเสริมทุกวันจึงอาจเป็นการเพิ่มความไม่สะดวกให้แก่นักกีฬา รวมทั้งหากนักกีฬาแพ้นมวัวก็จะไม่สามารถเข้าร่วมงานวิจัยได้

*การเข้าร่วมการวิจัยเป็นโดย**สมัครใจของนักกีฬา*** และสามารถ**ปฏิเสธ**ที่จะเข้าร่วมหรือ**ถอนตัว**จากการวิจัยได้ทุกขณะ โดยไม่ต้องให้เหตุผลและไม่สูญเสียประโยชน์ที่พึงได้รับ

หากท่านมีข้อสงสัยให้สอบถามเพิ่มเติมได้โดยสามารถติดต่อผู้วิจัยได้ตลอดเวลา และหากผู้วิจัยมีข้อมูลเพิ่มเติมที่เป็นประโยชน์หรือโทษเกี่ยวกับการวิจัย ผู้วิจัยจะแจ้งให้ท่านทราบอย่างรวดเร็ว เพื่อให้ผู้มีส่วนร่วมในการวิจัยทบทวนว่ายังสมัครใจจะอยู่ในงานวิจัยต่อไปหรือไม่

ข้อมูลที่เกี่ยวข้องกับนักกีฬาจะถูกเก็บเป็น**ความลับ** หากมีการเสนอผลการวิจัยจะเสนอเป็นภาพรวม ข้อมูลใดที่สามารถระบุถึงตัวนักกีฬาได้จะไม่ปรากฏในรายงาน

หากท่านไม่ได้รับการปฏิบัติตามข้อมูลดังกล่าวสามารถร้องเรียนได้ที่ คณะกรรมการพิจารณาจริยธรรมการวิจัยในคนกลุ่มสหสถาบัน ชุดที่ 1 จุฬาลงกรณ์มหาวิทยาลัย ชั้น 4 อาคารสถาบัน 2 ซอยจุฬาลงกรณ์ 62 ถนนพญาไท เขตปทุมวัน กรุงเทพฯ 10330 โทรศัพท์ 0-2218-8147 โทรสาร 0-2218-8147 E-mail: eccu@chula.ac.th

หนังสือแสดงความยินยอมเข้าร่วมการวิจัย *ฉบับกลุ่มทดลอง*

ทำที่..

วันที่............เดือน.....................พ.ศ. ....

เลขที่ นักกีฬาผู้มีส่วนร่วมในการวิจัย......................

ข้าพเจ้า ซึ่งได้ลงนามท้ายหนังสือนี้ ขอแสดงความยินยอมเข้าร่วมโครงการวิจัย

ชื่อโครงการวิจัย การศึกษาผลของการรับประทานเสริมกรดอะมิโนโซ่กิ่งต่อสมรรถภาพในนักฟุตบอลชาย (The Effects of High Branched-Chain Amino Acids Oral Food Supplement on Performance in Male Football Players) เพื่อศึกษา

ชื่อผู้วิจัย นางสาวภัทรพร พันธุ์พิทย์แพทย์

ที่อยู่ที่ติดต่อ 154 ถนนพระรามที่ 1 เขตปทุมวัน กรุงเทพฯ 10330

โทรศัพท์ 0-22181099 ต่อ 103

โทรศัพท์เคลื่อนที่ 084-663-5495 อีเมล์: mayji_pat_nut@hotmail.com

ข้าพเจ้า ได้**รับทราบ**รายละเอียดเกี่ยวกับที่มาและวัตถุประสงค์ในการทำวิจัย รายละเอียดขั้นตอนต่างๆ ที่จะต้องปฏิบัติหรือได้รับการปฏิบัติ ความเสี่ยง/อันตราย และประโยชน์ซึ่งจะเกิดขึ้นจากการวิจัยเรื่องนี้ โดยได้อ่านรายละเอียดในเอกสารชี้แจงผู้เข้าร่วมการวิจัยโดยตลอด และ**ได้รับคำอธิบาย**จากผู้วิจัย จนเข้าใจเป็นอย่างดีแล้ว

ข้าพเจ้าจึงสมัครใจเข้าร่วมในโครงการวิจัยนี้ ตามที่ระบุไว้ในเอกสารชี้แจงผู้เข้าร่วมการวิจัย โดยอาตมายินยอมให้ดำเนินการดังนี้

1. *ชั่งน้ำหนัก วัดส่วนสูง วัดไขมันใต้ผิวหนัง จำนวน 6 ครั้งห่างกัน วัน*
2. *ตอบแบบสัมภาษณ์การฉันภัตตาหารในรอบ 24 ชั่วโมงที่ผ่านมา จำนวน 2 ครั้ง* ครั้งละ 20 นาที *ห่างกัน 56 วัน*
3. *เข้ารับการฝึกอบรม ปฏิบัติการสูตรสงฆ์ไทยไกลโรค 1 วัน จำนวน 1 ครั้ง*
4. *ตอบแบบสอบถามแบบสำรวจการรับรู้การเกิดปัญหาสุขภาพที่เกี่ยวข้องกับโภชนาการ จำนวน 2 ครั้ง ห่างกัน 56 วัน ครั้งละ 20 นาที*

5. *ตอบแบบสอบถามแบบแสดงความเห็นในการแก้ไขปัญหาเกี่ยวกับโภชนาการในสถานการณ์จำลอง จำนวน 2 ครั้ง ห่างกัน 56 วัน ครั้งละ 20 นาที*
6. *เข้ากลุ่มย่อย การให้คำปรึกษาแบบกลุ่มเพื่อประเมินผลการใช้สื่อสงฆ์ไทยไกลโรค จำนวน 4 ครั้ง ครั้งละ 1 ชั่วโมง (ทำในวันเดียวกับที่มาตรวจร่างกาย 2 ครั้งและจัดอีก 2 ครั้ง ที่ 14 และ 28 วัน หลังจากตรวจร่างกายครั้งแรก)*

ข้าพเจ้ามีสิทธิ**ถอนตัว**ออกจากการวิจัยเมื่อใดก็ได้ตามความประสงค์ **โดยไม่ต้องแจ้งเหตุผล** ซึ่งการถอนตัวออกจากการวิจัยนั้น จะไม่มีผลกระทบในทางใดๆ ต่อข้าพเจ้าทั้งสิ้น

ข้าพเจ้าได้รับคำรับรองว่า ผู้วิจัยจะปฏิบัติต่ออาตมาตามข้อมูลที่ระบุไว้ในเอกสารชี้แจงผู้เข้าร่วมการวิจัย และข้อมูลใดๆ ที่เกี่ยวข้องกับอาตมา ผู้วิจัยจะ**เก็บรักษาเป็นความลับ** โดยจะนำเสนอข้อมูลการวิจัยเป็นภาพรวมเท่านั้น ไม่มีข้อมูลใดในการรายงานที่จะนำไปสู่การระบุตัวข้าพเจ้า

หากข้าพเจ้าไม่ได้รับการปฏิบัติตรงตามที่ได้ระบุไว้ในเอกสารชี้แจงผู้เข้าร่วมการวิจัย ข้าพเจ้าสามารถร้องเรียนได้ที่คณะกรรมการพิจารณาจริยธรรมการวิจัยในคน กลุ่มสหสถาบัน ชุดที่ 1 จุฬาลงกรณ์มหาวิทยาลัย ชั้น 4 อาคารสถาบัน 2 ซอยจุฬาลงกรณ์ 62 ถนนพญาไท เขตปทุมวัน กรุงเทพฯ 10330 โทรศัพท์ 0-2218-8147 โทรสาร 0-2218-8147 **E-mail: eccu@chula.ac.th**

ข้าพเจ้าได้ลงลายมือชื่อไว้เป็นสำคัญต่อหน้าพยาน ทั้งนี้ข้าพเจ้าได้รับสำเนาเอกสารชี้แจงผู้เข้าร่วมการวิจัย และสำเนาหนังสือแสดงความยินยอมไว้แล้ว

ลงชื่อ..	ลงชื่อ..
(..)	(..)
ผู้วิจัยหลัก	นักกีฬาผู้มีส่วนร่วมในการวิจัย

ลงชื่อ..

(..)

พยาน

รูปแบบหนังสือแสดงความยินยอมเข้าร่วมการวิจัย

สำหรับผู้ปกครอง และผู้อยู่ในปกครอง

คำแนะนำ: โปรดปรับข้อความให้สอดคล้องกับโครงการวิจัยของท่าน

ทำที่...

วันที่ ....เดือน.....................พ.ศ. ....

เลขที่ ประชากรตัวอย่างหรือผู้มีส่วนร่วมในการวิจัย…......................

ข้าพเจ้า ซึ่งได้ลงนามท้ายหนังสือนี้เกี่ยวข้องเป็น (โปรดระบุเป็น พ่อ/แม่/ผู้ปกครอง/ผู้ดูแล ของ(ชื่อผู้มีส่วนร่วมในการวิจัย) ....) ขอแสดงความยินยอมให้ผู้ที่อยู่ในปกครอง/ในความดูแลของข้าพเจ้าเข้าร่วมโครงการวิจัย

ชื่อโครงการวิจัย ...การเปรียบเทียบผลของการรับประทานอาหารเสริมที่มีกรดอะมิโนโซ่กิ่งสูงหรือนมวัวหรือเครื่องดื่มเกลือแร่ต่อสมรรถภาพการเล่นกีฬาในนักฟุตบอลชาย…..

ชื่อผู้วิจัย ....นางสาวภัทรพร พันธุ์พิทย์แพทย์…………………………………………….

ที่อยู่ที่ติดต่อ .... คณะสหเวชศาสตร์ จุฬาลงกรณ์มหาวิทยาลัย.......................................

.................154 อาคารจุฬาพัฒน์ 1 ถนนพระราม 1 ปทุมวัน กรุงเทพ 10330………………………

โทรศัพท์ ....084-6635495...

ข้าพเจ้าและผู้ที่อยู่ในปกครอง/ในความดูแลของข้าพเจ้า **ได้รับทราบ**รายละเอียดเกี่ยวกับที่มาและวัตถุประสงค์ในการทำวิจัย รายละเอียดขั้นตอนต่างๆ ที่จะต้องปฏิบัติหรือได้รับการปฏิบัติ ความเสี่ยง/อันตราย และประโยชน์ซึ่งจะเกิดขึ้นจากการวิจัยเรื่องนี้ ข้าพเจ้าได้อ่านรายละเอียดในเอกสารข้อมูลสำหรับกลุ่มประชากรตัวอย่างหรือผู้มีส่วนร่วมในการวิจัยโดยตลอด และ**ได้รับคำอธิบาย**จากผู้วิจัย **จนเข้าใจเป็นอย่างดี**แล้ว

ข้าพเจ้าจึง**สมัครใจ**ให้ผู้ที่อยู่ในปกครอง/ในความดูแลของข้าพเจ้าเข้าร่วมในโครงการวิจัยนี้ ภายใต้เงื่อนไขที่ระบุไว้ในเอกสารข้อมูลสำหรับกลุ่มประชากรตัวอย่างหรือผู้มีส่วนร่วมในการวิจัย โดยข้าพเจ้ายินยอมให้ผู้ที่อยู่ในปกครอง/ในความดูแลของข้าพเจ้า เข้าร่วมในการวิจัย และผู้ที่อยู่ในปกครอง/ในความดูแลของข้าพเจ้าสมัครใจเข้าร่วมการวิจัยนี้ ภายใต้เงื่อนไขที่ระบุไว้ในเอกสาร

ข้อมูลสำหรับกลุ่มประชากรตัวอย่างหรือผู้มีส่วนร่วมในการวิจัย โดยก่อนเริ่มการวิจัยผู้ที่อยู่ในปกครอง/ในความดูแลของข้าพเจ้า ต้องบันทึกการรับประทานอาหารของตนเอง 3 วัน ในระยะเวลา 2 สัปดาห์ คือวันจันทร์และศุกร์ในสัปดาห์ที่หนึ่ง และวันพุธในสัปดาห์ที่สอง เมื่อเริ่มงานวิจัยข้าพเจ้าต้องรับประทานอาหารเสริมทั้ง 3 ชนิด ภายใน 30 นาทีหลังการฝึกซ้อม เป็นเวลา 10 วัน สำหรับแต่ละการทดลอง พร้อมทั้งบันทึกการรับประทานอาหารในรอบ 24 ชั่วโมงเป็นเวลา 3 วันเช่นเดียวกับก่อนเริ่มงานวิจัย และผู้ที่อยู่ในปกครอง/ในความดูแลของข้าพเจ้ารับทราบว่าจะได้รับการทดสอบสมรรถภาพการเล่นกีฬารวมทั้งสิ้น 6 ครั้ง ซึ่งประกอบด้วย

07.00 น. วัดส่วนสูง ชั่งน้ำหนัก และวัดปริมาณไขมันใต้ผิวหนัง ใช้เวลาประมาณ 5 นาที

07.45 น. ทดสอบความอ่อนตัว (Flexibility test) ใช้เวลาประมาณ 5 นาที

08.00 น. ทดสอบความอดทนของกล้ามเนื้อ (Muscular Endurance) ใช้เวลาประมาณ 10 นาที

10.00 น.ทดสอบแรงกล้ามเนื้อ (Vertical Jump) ใช้เวลาประมาณ 5 นาที

15.00 น. ทดสอบวิ่งเร็ว (Sprint test: 5,10 and 20 meter) ใช้เวลาประมาณ 5 นาที

15.30 น. ตอบแบบสอบถามการบาดเจ็บ ใช้เวลาประมาณ 5 นาที

รวมเวลาที่ขอให้ท่านเข้าร่วมการวิจัย 69 วัน โดยการทดสอบสมรรถภาพทั้ง 6 ครั้ง คือวันอาทิตย์ก่อนเริ่มต้นการวิจัยของแต่ละการทดลอง (สัปดาห์ที่ 1,4 และ 7) และวันเสาร์ของสัปดาห์ที่ 2, 5 และ 8โดยที่ในแต่ละครั้งจะใช้เวลาประมาณ 35นาที

ข้าพเจ้ามีสิทธิให้ผู้ที่อยู่ในปกครอง/ในความดูแลของข้าพเจ้าหรือเป็นความประสงค์ของผู้ที่อยู่ในปกครอง/ในความดูแล **ถอนตัว**ออกจากการวิจัยเมื่อใดก็ได้ **โดยไม่ต้องแจ้งเหตุผล** ซึ่งการถอนตัวออกจากการวิจัยนั้น จะไม่มีผลกระทบในทางใดๆ ต่อผู้ที่อยู่ในปกครอง/ในความดูแลของข้าพเจ้าและตัวข้าพเจ้าทั้งสิ้น

ข้าพเจ้าได้รับคำรับรองว่า ผู้วิจัยจะปฏิบัติต่อผู้ที่อยู่ในปกครอง/ในความดูแลของข้าพเจ้าตามข้อมูลที่ระบุไว้ในเอกสารชี้แจงผู้เข้าร่วมการวิจัย และข้อมูลใดๆที่เกี่ยวข้องกับผู้ที่อยู่ในปกครอง/ในความดูแลของข้าพเจ้า ผู้วิจัยจะ**เก็บรักษาเป็นความลับ** โดยจะนำเสนอข้อมูลจากการ

วิจัยเป็นภาพรวมเท่านั้น ไม่มีข้อมูลใดในการรายงานที่จะนำไปสู่การระบุตัวผู้ที่อยู่ในปกครอง/ในความดูแลของข้าพเจ้าและตัวข้าพเจ้า

หากผู้ที่อยู่ในปกครอง/ในความดูแลของข้าพเจ้า ไม่ได้รับการปฏิบัติตรงตามที่ได้ระบุไว้ในเอกสารชี้แจงผู้เข้าร่วมการวิจัย ข้าพเจ้าสามารถร้องเรียนได้ที่ คณะกรรมการพิจารณาจริยธรรมการวิจัยในคน กลุ่มสหสถาบัน ชุดที่ 1 จุฬาลงกรณ์มหาวิทยาลัย ชั้น 4 อาคารสถาบัน 2 ซอยจุฬาลงกรณ์ 62 ถนนพญาไท เขตปทุมวัน กรุงเทพฯ 10330 โทรศัพท์ 0-2218-8147, 0-2218-8141 โทรสาร 0-2218-8147 **E-mail: eccu@chula.ac.th**

ข้าพเจ้าและผู้ที่อยู่ในปกครองเข้าใจข้อความในข้อมูลสำหรับกลุ่มประชากรตัวอย่างหรือผู้มีส่วนร่วมในการวิจัยและหนังสือยินยอม โดยตลอดแล้ว ได้ลงลายมือชื่อไว้เป็นสำคัญต่อหน้าพยาน ทั้งนี้ข้าพเจ้าได้รับสำเนาเอกสารข้อมูลสำหรับกลุ่มประชากรตัวอย่างหรือผู้มีส่วนร่วมในการวิจัยและสำเนาหนังสือแสดงความยินยอมไว้แล้ว

ลงชื่อ...
(...)
ผู้วิจัยหลัก

ลงชื่อ...
(...)
ผู้มีส่วนร่วมในการวิจัย

ลงชื่อ...
(...)
พยาน

ลงชื่อ...
(...)
พ่อ/แม่/ผู้ปกครอง/ผู้ดูแล

หมายเหตุ *ในกรณีที่มีผู้มีส่วนร่วมในการวิจัยอายุระหว่าง 8-17 ปี ต้องลงนามให้ความยินยอมร่วมกับบิดา/มารดาหรือผู้ปกครอง*

รหัสทีม ☐☐ รหัสนักกีฬา ☐☐☐

วันเดือนปีที่บันทึกข้อมูล ☐☐/☐☐/☐☐

ระยะการศึกษา ☐ 1 ☐ 2 ☐ 3

การประเมินความเจ็บปวดจากอาการบาดเจ็บจากการเล่นกีฬา

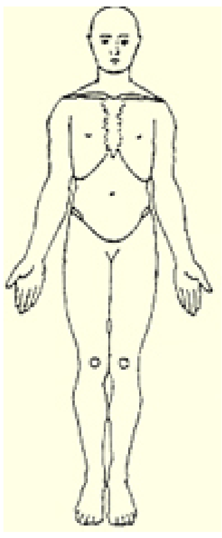
1.ท่านมีอาการบาดเจ็บเนื่องจากการเล่นกีฬามากน้อยเพียงใดในรอบ 2 สัปดาห์ที่ผ่านมา

ใส่คำตอบลงในช่องที่ตรงกับอาการบาดเจ็บของท่าน หากไม่มีอาการบาดเจ็บให้ท่านเลือกคำตอบ “ไม่มีอาการบาดเจ็บ”

	ไม่มีอาการบาดเจ็บ						ปวดทน
ศรีษะหรือใบหน้า	☐	☐	☐	☐	☐	☐	☐
ไหล่ แขน หรือมือ ข้างซ้าย	☐	☐	☐	☐	☐	☐	☐
ไหล่ แขน หรือมือ ข้างขวา	☐	☐	☐	☐	☐	☐	☐
หน้าอกหรือท้อง	☐	☐	☐	☐	☐	☐	☐
ก้น สะโพก ขา เข่า หรือข้อเท้าข้างซ้าย	☐	☐	☐	☐	☐	☐	☐
ก้น สะโพก ขา เข่า หรือข้อเท้าข้างขวา	☐	☐	☐	☐	☐	☐	☐

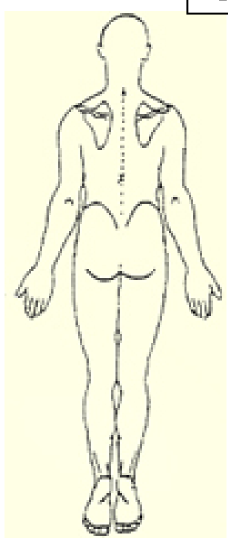
2.หากท่านมีอาการเจ็บ ขอให้ระบายบริเวณที่ได้รับบาดเจ็บของท่าน

ขวา



ซ้าย

ซ้าย



ขวา

3.ท่านรู้สึกเจ็บปวดมากน้อยเพียงใดหากท่านทำกิจกรรมต่อไปนี้

	ไม่มีอาการปวด						ปวดทนไม่ได้
นอนหงาย	☐	☐	☐	☐	☐	☐	☐
พลิกตัวตอนนอน	☐	☐	☐	☐	☐	☐	☐
ขณะยืน	☐	☐	☐	☐	☐	☐	☐
นั่ง	☐	☐	☐	☐	☐	☐	☐
เดินบนพื้นราบ	☐	☐	☐	☐	☐	☐	☐
ขึ้นบันได	☐	☐	☐	☐	☐	☐	☐
ทำงานที่ต้องยกแขนเหนือศีรษะ เช่น แขวนรูป	☐	☐	☐	☐	☐	☐	☐
เกาหลัง	☐	☐	☐	☐	☐	☐	☐
ยกของที่มีน้ำหนักเบา	☐	☐	☐	☐	☐	☐	☐
ขว้างวัตถุ เช่น ลูกบอล	☐	☐	☐	☐	☐	☐	☐
เดินบนพื้นที่ไม่เรียบสม่ำเสมอ เช่น สนามหญ้า	☐	☐	☐	☐	☐	☐	☐
เล่นกีฬา	☐	☐	☐	☐	☐	☐	☐

4.1 ความถี่ของอาการบาดเจ็บในรอบ 2 สัปดาห์

มีอาการตลอดเวลา	มีอาการทุกวัน แต่ไม่ตลอดเวลา	2-6 ครั้ง / 1 สัปดาห์	2-6 ครั้ง / 2 สัปดาห์	< 2 ครั้ง ในรอบ 2 สัปดาห์	ไม่มีอาการ
☐	☐	☐	☐	☐	☐

4.2 สิ่งที่กระตุ้นอาการบาดเจ็บของท่าน

	ใช่	ไม่ใช่
กิจกรรมที่ใช้แรงมาก	☐	☐
กิจกรรมที่ใช้แรงปานกลาง	☐	☐
กิจกรรมที่ใช้แรงน้อย	☐	☐

	☐	☐
อยู่เฉยๆ หรือขณะพัก	☐	☐
เหตุอื่นๆ	☐	☐
หาสาเหตุไม่ได้	☐	☐

4.3 ความถี่ของการใช้ยาหรือการรักษาอื่นๆในการบรรเทาอาการบาดเจ็บ

หลายครั้งในหนึ่งวัน	1 ครั้ง/วัน /สัปดาห์	2-6 ครั้ง /2สัปดาห์	1-4 ครั้ง 2 สัปดาห์	< 1 ในรอบ	ไม่ใช้ยา
☐	☐	☐	☐	☐	☐

หากท่านมีอาการปวด อาการปวดของท่านอยู่ในระดับใด

0 1 2 3 4 5 6 7 8 9 10

0	1	2	3	4	5	6	7	8	9	10
ไม่มีอาการปวด	ปวดน้อย ไม่มีความทุกข์ ทรมาน, ไม่รู้สึกกังวลใด ๆ ต่ออาการปวดในขณะนี้			ปวดปานกลาง รู้สึกทุกข์ ทรมานจากอาการปวดพอสมควร มีความกังวลไม่มากนัก ยังมีความรู้สึกว่าสามารถทนได้			ปวดมาก รู้สึกทุกข์ ทรมาน จากอาการปวดมาก ทำให้เกิดความกังวลมากและไม่สามารถนอนหลับพักผ่อนได้			ปวดรุนแรงจนทนไม่ไหว

5. หลังจากดื่มเครื่องดื่มที่ได้รับ อาการปวดกล้ามเนื้อของท่านเป็นอย่างไร

☐	☐	☐
มากขึ้น	น้อยลง	ไม่เปลี่ยนแปลง

ดัดแปลงจาก

A Pain Assessment Scale for population based-on studies : development and validation of the pain module of the Standard Evaluation Questionnaire. Pain 2008 May:136(1-2):62-74.

Measurement tools used in the study of eccentric contraction-induced injury. Sports Med. 1999 Jan;27(1)43-59

รหัสทีม □□ รหัสนักกีฬา □□□

เพิ่มเติมรายละเอียดด้านหลังได้

วัน □จันทร์ สัปดาห์แรก ระยะที่ .....(0/1/2/3) □ศุกร์ สัปดาห์แรก ระยะที่ .....(0/1/2/3) □พุธ สัปดาห์ที่สอง ระยะที่ .....(0/1/2/3)

อมูล □□/□□/□□

แบบบันทึกการรับประทานอาหารในรอบ 24 ชั่วโมงของวันที่บันทึก

มื้อ	เมนูที่รับประทาน	ข้าว (ทัพพี)	ก๋วยเตี๋ยว (ทัพพี)	ไข่ (ฟอง)	เนื้อสัตว์ (ช้อนโต๊ะ)	เต้าหู้/ถั่ว/ชีส	ขนม	ผลไม้ (คำ)(ผล)	เครื่องดื่ม (แก้ว)	นมวัว (ซีซี)/นมเปรี้ยว (ซีซี)/โยเกิร์ต (กระปุก)	ผลิตภัณฑ์เสริมอาหารชนิดเม็ด/ผง/น้ำ
1.มื้อเช้า ตั้งแต่ตื่นนอน	....										
2.กลางวัน	....										
3.เย็น จนถึงเข้านอน	....										

Certificate of Approval

AF 02-12

The Ethics Review Committee for Research Involving Human Research Subjects, Health Science Group, Chulalongkorn University
Institute Building 2, 4 Floor, Soi Chulalongkorn 62, Phyat hai Rd., Bangkok 10330, Thailand,
Tel: 0-2218-8147 Fax: 0-2218-8147 E-mail: eccu@chula.ac.th

COA No. 119/2013

Certificate of Approval

Study Title No.060.1/56 : **COMPARATIVE EFFECTS OF HIGH BRANCHED-CHAIN AMINO ACIDS ORAL FOOD SUPPLEMENT OR LOW FAT COW MILK OR SUGARY DRINK ON PERFORMANCE IN MALE FOOTBALL PLAYERS**

Principal Investigator : MISS PATTARAPORN PANPITPATE

Place of Proposed Study/Institution : Faculty of Allied Health Sciences, Chulalongkorn University

The Ethics Review Committee for Research Involving Human Research Subjects, Health Science Group, Chulalongkorn University, Thailand, has approved constituted in accordance with the International Conference on Harmonization – Good Clinical Practice (ICH-GCP) and/or Code of Conduct in Animal Use of NRCT version 2000.

Signature: Prida Tasanapradit
(Associate Professor Prida Tasanapradit, M.D.)
Chairman

Signature: Nuntaree Chaichanawongsaroj
(Assistant Professor Dr. Nuntaree Chaichanawongsaroj)
Secretary

Date of Approval : 17 July 2013   Approval Expire date : 16 July 2014

The approval documents including

1) Research proposal
2) Patient/Participant Information Sheet and Informed Consent Form
3) Researcher
4) Questionnaire

Protocol No. 060.1/56
Date of Approval 17 JUL 2013
Approval Expire Date 16 JUL 2014

The approved investigator must comply with the following conditions:

1. *The research/project activities must end on the approval expired date of the Ethics Review Committee for Research Involving Human Research Subjects, Health Science Group, Chulalongkorn University (ECCU). In case the research/project is unable to complete within that date, the project extension can be applied one month prior to the ECCU approval expired date.*
2. *Strictly conduct the research/project activities as written in the proposal.*
3. *Using only the documents that bearing the ECCU's seal of approval with the subjects/volunteers (including subject information sheet, consent form, invitation letter for project/research participation (if available).*
4. *Report to the ECCU for any serious adverse events within 5 working days.*
5. *Report to the ECCU for any change of the research/project activities prior to conduct the activities.*
6. *Final report (AF 03-12) and abstract is required for a one year (or less) research/project and report within 30 days after the completion of the research/project. For thesis, abstract is required and report within 30 days after the completion of the research/project.*
7. *Annual progress report is needed for a two- year (or more) research/project and submit the progress report before the expire date of certificate. After the completion of the research/project processes as No. 6.*

VITA

Miss Pattaraporn Panpitpate was born on June 6, 1988 in Trat Province, Thailand. She received her Bachelor of Science Program (Physical Therapy) form Chulalongkorn University in 2010. After graduation, she has been employed in the position of physical therapist at Bankhai Hospital, Rayong.

While she was a physiotherapist she always think that food and nutrition may help and support her patients parallel with her treatment.

Therefore, she continued the Master of Science Program (Food and Nutrition), Chulalongkorn University, 2011.