Effect of Soybean Milk in Conjunction with Aerobic Exercise on VO2 Max and Body Composition of College Students

Fei Su

A Thesis Submitted in Partial Fulfillment of Requirements for
degree of Master of Science in Exercise and Sport Science
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for Master of Science (Exercise and Sport Science)

October 2024

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TITLE Effect of Soybean Milk in Conjunction with Aerobic Exercise on VO2 Max and Body Composition of College Students

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ABSTRACT

This study explores the effects of soybean milk combined with aerobic exercise on VO2 max and body composition in male college students aged 18-21, majoring in fitness instruction and management. Thirty participants were selected, and their VO2 max and body composition were measured using the Harvard Step Test and Body Composition Test. Based on their Harvard Step Test scores, participants were paired from best to worst and randomly assigned to three groups of 10: Group 1 (soy milk + aerobic exercise) consumed 500 ml of soy milk mixed with 4 g of stevia 30 minutes before exercise, Group 2 (placebo + aerobic exercise) consumed 500 ml of water mixed with 4 g of stevia 30 minutes before exercise, and Group 3 performed aerobic exercise without supplementation. The experiment lasted 8 weeks, with three sessions per week. Data were collected before and after the experiment, and statistical analysis was conducted using paired-samples t-tests and one-way ANOVA, with pairwise comparisons made when statistically significant differences ($P < 0.05$) were observed. The results showed that the soy milk + aerobic exercise group had significant improvements in skeletal muscle, muscle content, and protein levels after 8 weeks. The placebo group exhibited significant weight reduction, while the aerobic exercise group experienced significant decreases in weight, BMI, and body fat percentage. Additionally, one-way ANOVA with Bonferroni testing revealed significant differences between the groups, with the soy milk + aerobic exercise group showing the most pronounced increases in skeletal muscle mass, muscle content, and protein levels.

Keyword : Soybean Milk, Cardiorespiratory Endurance, Body Composition, Aerobic Exercise

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TABLE OF CONTENTS

Page

LIST OF TABLES

Page

LIST OF FIGURES

Page

CHAPTER 1
INTRODUCTION

1. Background

At present, more and more relevant studies are showing that national health is related to the rise and fall of the country, and it can also judge the strength of the comprehensive national strength from the national physical health level. At present, countries all over the world attach great importance to the physical health of college students. Stanford University conducted a survey on the physical fitness and physical activity of college students in 2019, analyzing data from 700000 students from over 111 countries. The study found that the health status of college students has decreased. This has attracted widespread attention and discussion internationally. As of 2020, the national failure rate of college students' physical health has reached 30%. In 2021, a survey data on the physical health of 1.15 million school students showed that the obesity rate among students nationwide is constantly increasing. Lu Yanhong and Xiong Ping (2021) analyzed the physical fitness test results of a university in Hunan Province over the past three years and found that the overall physical condition of college students is still not optimistic, with strength, speed, and cardiopulmonary function at relatively low levels. Que Yongwei and Xiao Yaling (2022) conducted a survey and analysis on the changes in physical health of students at Guangzhou Navigation University from 2018 to 2020 and found that the phenomenon of low weight among female students and overweight and obesity among male students was more prominent at Guangzhou Navigation University.

At present, most countries are gradually starting to promote and publicize their own sports activities, invest in mass sports, fitness programs for all, etc., in order to strengthen the national physique. The State Council issued the "Healthy China 2030 Plan Outline" in 2016, with the core focus on people's health and the national strategy of "health for all". The State Council recently issued the National Fitness Plan (2021-2025), which makes plans to promote a higher level of development of national fitness in the future and better meet the people's fitness and health needs. It can be

seen that the improvement of national physical quality is important for national development.

At present, the study of national physical health by many scholars has shifted from the initial physical exercise to the study of nutritional status. Sports fatigue is very easy to occur in sports and fitness activities. At the 1982 International Conference on Exercise Biochemistry, sports fatigue was defined as "the physiological process of the body cannot sustain its function at a specific level or cannot maintain the predetermined exercise intensity". However, sports fatigue is a very common labor-saving phenomenon in sports. If fatigue cannot be recovered in time, resulting in fatigue accumulation, excessive fatigue will occur, which will turn sports fatigue into a pathological state and cause harm to the body. At present, research on the elimination of sports fatigue is mainly focused on nutrition to promote recovery.

Ivy John(2009)from the Department of Exercise and Health Education in the United States has demonstrated that after extensive exercise, scientific nutrition supplementation can maintain a rapid metabolic state, which is more conducive to the recovery of muscle glycogen reserves, the synthesis of skeletal muscle proteins, and the repair of microstructural damage to skeletal muscles during exercise, making muscles more powerful and allowing for rapid remodeling of skeletal structures. Muscle glycogen is the main energy source of moderate intensity exercise; In low intensity exercise, sugar is the primer of fatty acid oxidation for energy supply and plays a key role in maintaining blood glucose level; When any exercise starts, strengthens or attacks, it needs to be provided with energy by sugar metabolism (shui Xiaoping, 2022). When the muscle glycogen content is decreased or exhausted, exercise fatigue will occur. During aerobic exercise, the utilization of muscle glycogen is related to the duration of exercise intensity (Tao Jia, 2021).

According to the research conclusions of the above scholars, it can be seen that the scholars' research on adverse reactions after exercise is relatively valid from the perspective of nutrition. However, there are many factors affecting physical health, including nutritional status, acquired factors, environmental factors, social conditions,

different sports and so on. Among these indicators, the biggest factor that can affect the physical difference is the intake of nutrition. For example, the increase in the proportion of energy supplied by fatty acids decreases the exercise ability. In a long time (45-200 minutes) of high-intensity exercise, muscle glycogen reserves before exercise determine the time to reach exercise exhaustion, which directly affects the exercise ability of endurance training and competition. From the perspective of body sugar, the main role of blood sugar in exercise is the main energy supply substance of the central nervous system, which is used to maintain the normal function of the central nervous system. During long-term aerobic exercise, the exercise muscles continuously absorb blood sugar, which can maintain or improve exercise endurance (Franchise, 2009). As mature red blood cells have no granules, they can only carry out anaerobic metabolism, and the main energy material is sugar. Therefore, once the blood sugar level drops, the energy metabolism of red blood cells will be affected, and the ability to transport oxygen will be reduced, which will affect the aerobic metabolism of cells (Toma, K. 2009).

Yang Zeyi, a Chinese sports nutritionist, put forward that "the health of life lies in sports and nutrition". It can be seen that reasonable nutrition intake and sports are complementary, and also the key factor to improve physical fitness. Cao Jianmin (2014) mentioned in the meeting of "Scientific Fitness Nutrition Supplement" that the nutrition supplement in the national fitness needs to be reflected in the selection of nutrition characteristics of different sports properties, and there should be certain principles of nutrition supplement before, during and after sports. Zhang Yi (2019) mentioned in the study that in fitness exercise, the energy consumption of the body needs to balance the growth of the body by supplementing corresponding nutrients. In the article, there is a great correlation between the intake of nutrients and the training of athletes, the consumption of body nutrients and the absorption of nutrients by the body. Therefore, studying the standards and principles of fitness exercise and nutrition intake is the means of formulating scientific nutrition intake plans.

Whether from muscle glycogen or from blood sugar and other aspects of the study, it has been proved that the supplement of nutrition has a very obvious effect on

exercise. The research of You Lirong (2017) confirmed that soybean peptide sports tonic has a very obvious effect on promoting muscle growth. Subsequently, the regulatory effect of soybean polypeptide nutrition on exercise fatigue was also confirmed (Li Ke et al., 2021). Janice A Townsend (2019) believes that the product that can replace fluoride in milk is soybean milk, and soybean milk is richer in protein than milk. Therefore, it is feasible to study the influence of soybean milk on physical function after exercise. Leonardo Raposo Rocha Gomes (2021) mentioned in his research that, High intensity exercises can damage active muscles due to mechanical and oxidative stress. Dietary supplements can mitigate muscle damage, especially vegetable products with high content of antioxidant compounds, such as soybean. Soybean is a non-animal protein substitute, which contains all essential amino acids, and the GI index is also very ideal. Soy could also be an option for creatine supplementation, which supports the galactic energy system (Govindasamy Balasekaran, 2021).

Zhong Shixin (2022), in the press conference of "Soybean milk Nutrition Health and Consumption Consensus" sponsored by the China Food Industry Association, confirmed that Soybean milk has a certain role in promoting the physical health and nutrition intake of Chinese people, and encouraged government leaders, scientific research institutions, universities, social enterprises, etc. to popularize the knowledge of Soybean milk nutrition and health. This certifies the positive effects of soybean milk on human health. Zhang Juan et al. (2022) showed that protein, fat, dietary fiber, ash, total amino acid, total essential amino acid, amino acid score, fatty acid type, three fatty acids (SFA, MUFA, PUFA, especially α- The contents of linolenic acid), riboflavin, vitamin E, calcium, phosphorus, potassium, magnesium, zinc, sodium and soybean isoflavones were significantly higher than those of whole bean steamed bread and wheat flour steamed bread. Maximal oxygen consumption refers to the highest value of oxygen that can be consumed or used by histiocyte when engaged in the most intense exercise. It is the best indicator to evaluate cardiopulmonary endurance. Cardiopulmonary endurance, as a core component of physical health, is one of the important indicators reflecting physical health. Research has shown a high correlation between cardiopulmonary endurance and cardiac

metabolism, psychology, and certain physiological health indicators. Mohammad Hassan Sohouli (2021) mentioned in his study that isoflavones and other beneficial ingredients contained in soybean milk have good effects on cardiovascular health. The potential effects of soybean milk consumption on cardiometabolic risk factors in adults were comprehensively evaluated and a meta-analysis of relevant studies published up to June 2020 was conducted. Quantitative meta-analysis of 18 eligible randomized controlled trials (665 participants, age range 18 – 65 years) showed that soybean milk intake significantly reduced systolic and diastolic blood pressure, total blood pressure and low-density lipoprotein cholesterol, waist circumference, C-reactive protein and tumor negative factor-alpha.

It has been established that carbohydrate (CHO) loading before aerobic activities is a successful diet manipulation method to enhance prolonged exercise training and/or performance Govindasamy Balasekaran, 2021).

However, due to the rich nutrients in soybean milk, the research on the components that really affect the body function of college after aerobic exercise and whether the effects are obvious is still in the preliminary stage, and the results cannot be proved to be able to supplement the theory in this aspect. Therefore, this paper takes soybean milk as the research index to study the influence of soybean milk on heart rate, Maximal oxygen consumption, fat reduction and muscle gain, body weight, skeletal muscle, waist hip ratio, body protein content, etc. after aerobic exercise. This paper discusses whether soybean milk can have an obvious effect on human function after aerobic exercise through experiments.

Soybean milk is rich in plant protein, linoleic acid, linolenic acid, oligosaccharides, soybean lecithin and other components, which are of great benefit to human health. Soy protein in soybean milk is high-quality plant protein, which can provide 9 kinds of amino acids necessary for human body (Zhong Shixin, 2022). Soybean protein can also improve fat burning rate, decompose and excrete excess cholesterol, reduce cholesterol level in the body, thereby softening blood vessels, stabilizing blood pressure, and preventing obesity. The saponin contained in soybean milk has a strong antioxidant effect, which can promote fat metabolism and prevent

fat accumulation. At the same time, soybean milk is rich in calcium, phosphorus, iron and other minerals and various vitamins, which are essential ingredients for the human body.

As a traditional Chinese drink, soybean milk has a history of nearly 2000 years and has rich nutritional value. The composition is scientific and reasonable, and the matching of protein, carbohydrate and fat is scientific. Therefore, soybean milk is selected as the variable index in this experiment. The soybean milk selected for the experiment was prepared according to the unified standard. The soybeans used for the preparation of soybean milk are organic soybeans, non-genetically modified, pesticide free and chemical fertilizer free. Each 100ml contains 31 kcal of calories, 3g of protein, 1.6g of fat, 1.2g of carbohydrate, and trace elements such as magnesium, potassium, phosphorus, sodium, which have high nutritional value.

Tian Wei (2022) pointed out in the research on the integration of nutritional health and physical training that soybeans are rich in protein and organic acids, which has a significant effect on enhancing physical training. Qian Huawei (2017) carried out an experimental study on the use of sports nutrition system in college students' bodybuilding. The study believed that improving the intake level of protein would significantly improve the effect of bodybuilding. Govindasamy Balasekaran et al. (2021) found in their study on the effects of soybean milk intake on anaerobic performance and physiological indexes that the intervention of soybean milk with RAST significantly reduced fatigue index. Leonardo Raposo Rocha Gomes et al. (2021) found in the study that fermented soybean beverage can improve the exercise performance of Wistar rat skeletal muscle and reduce oxidative stress during anaerobic exercise. There are few studies on the effects of soy product intake on athletic performance and physiological indices. There is no research on the effect of soybean milk combined with aerobic exercise on the maximum oxygen uptake and body composition of college students. Therefore, this paper conducts research on the impact of soybean milk combined with aerobic exercise on the maximum oxygen uptake and body composition of college students, and conducts experiments with soybean milk as a variable to explore the actual use effect of soybean milk on college

students, and whether the protein content in soybean milk can play a muscle enhancing role on college students. It is convenient for people to drink soybean milk reasonably in sports in the future to provide some practical reference.

In the study of Nahid Bijeh (2022), participants drank 240 ml of soybean milk every day. The results showed that 240 ml of soybean milk+resistance training had synergistic effects on skeletal muscle regulatory markers, body composition and exercise performance of elderly men. Govindasamy Balasekaran (2021) studied 10 men (aged 23.2±1.23 years) who drank 500ml of soymilk +4g stevia daily. Since the volunteers in this study are college students, and there is little difference in age between them and Govindasamy Balasekaran's subjects, this experiment chooses 500ml soybean milk+4g stevia every time. Stevia is a sugar substitute used by diabetics. Stevia is added to improve the palatability of soybean milk. It has zero sugar, zero calories and zero fat, and will not have any impact on VO_2 max and body composition. This experiment is a double-blind study, and the volunteers have no knowledge of liquid composition.

2. Research objective

1. Comparison of VO_2 max and body composition before and after the experiment between aerobic exercise+soybean milk group (500ml soybean milk+4g stevia), aerobic exercise+placebo group (500ml water+4g stevia) and aerobic exercise group.

2. Compare the difference of VO_2 max and body composition between aerobic exercise+soybean milk group (500ml soybean milk+4g stevia), aerobic exercise+placebo group (500ml water+4g stevia) and aerobic exercise group.

3. Use paired sample T-test to compare the data before and after the experiment. Compare the differences between the three groups using one-way analysis of variance. Pair comparisons were made when a statistically significant difference was found at 0.05.

3. Research Questions

1. Under the condition of maintaining daily eating habits and routine training, can the intake of soybean milk 30 minutes before aerobic exercise have an impact on the VO_2 max and body composition of college students?

2. Can soybean milk combined with aerobic exercise help college students reduce fat and weight?

3. Can the protein content in soybean milk produce the effect of muscle enhancement?

4. Can soybean milk combined with aerobic exercise affect the cardiopulmonary endurance of college students?

4. Significant of study

There have been relatively few studies on soybean milk intake before exercise, and few studies on the effects of soy product intake on athletic performance and physiological markers. There is no research on the effect of soybean milk combined with aerobic exercise on the maximal oxygen consumption and body composition of college students. By studying the effect of soybean milk combined with aerobic exercise on the maximal oxygen consumption and body composition of college students, this paper aims to understand whether soybean milk can promote exercise and provide a reference for the intake of sports drinks.

5. Research Hypothesis

1. Taking soybean milk+ Aerobic exercise for 8 consecutive weeks can improve the cardiopulmonary endurance of college students.

2. Taking soybean milk+ Aerobic exercise for 8 consecutive weeks can reduce fat and increase muscle for college students.

3. Taking soybean milk+ Aerobic exercise for 8 consecutive weeks will have an impact on college students' weight, skeletal muscle, waist hip ratio and protein.

6. Scope of study

Population and sample

1. The volunteers were 51 male Fitness guidance and management major college students aged 18-21, who attended the Sichuan Vocational College of health and rehabilitation.

2. The sample group for this study is male college students majoring in fitness guidance and management, aged between 18 and 21 years old.51 volunteers passed the screening, and 30 volunteers were retained to participate in the experiment. The researchers administered the Harvard Step Test and body composition tests to 30 volunteers. Based on the Harvard Step Test scores in descending order, the best performers and the worst performers were then paired in order, and the pairs were randomly divided into 3 groups of 10 people each. The first group is AE+soybean milk group, the second group is AE+placebo group, and the third group is AE group.

Scope of research content

This study is an experimental study aimed at studying the effects of soybean milk combined with aerobic exercise on the VO_2 max and body composition of college students.

Variables used in the study

1. Independent variables

1.1 aerobic exercise+ soybean milk group (500ml soybean milk+4g stevia)

1.2 aerobic exercise+placebo group (500ml water+4g stevia)

1.3 aerobic exercise group

2. Dependent variables

2.1 Body composition (Includes weight, muscle, skeletal muscle, waist hip ratio, body fat percentage, protein, BMI, WHR)

2.2 VO_2 max, heart rate

3. Control variables

Includes age and sex

7. Basic Agreement

1. The tools used are tools that have been tested for effectiveness. The test subjects are 18-21-year-old Fitness guidance and management major college students from Sichuan Vocational College of health and rehabilitation.

2. The researchers compared the samples during the experiment:

2.1 Consumption of bean products

2.2 Eating in the same cafeteria during the experiment

2.3 Get enough sleep for 6-8 hours

3. Define the properties of the following samples

3.1 The sample is male, aged between 18-21 years.

3.2 The sample is the Sichuan Vocational College of Health and Rehabilitation Fitness guidance and management major in college students.

4. The sample received an Aerobic training program.

5. The participants in the research project volunteered and agreed to participate in the research.

6. Heart rate test adopts Haval step test, which is a physical performance test. It is a reliable, universally used physical fitness test to assess cardiovascular function.

And calculate the maximum oxygen uptake based on the heart rate during the recovery period to evaluate cardiopulmonary endurance.

7. Body weight, muscle, BMI, body fat percentage, skeletal muscle, waist to hip ratio, and protein were tested using the Tsinghua Tongfang human body composition tester.

8. Fitness guidance and management, major college students can drink soybean milk without any side effects or allergic reactions.

9. During this process, the researchers collected data manually and used the same instrument each time.

10. Three groups of subjects were in the same environment during the 8-week experiment.

8. Definitions of Terms

1. Soybean milk is made by grinding, filtering and boiling soybeans after soaking in water. Nutrition is very rich and easy to digest and absorb. The soybean milk used in the experiment was produced by Chengdu Juxin Huihai Catering Management Co., Ltd.

2. The maximal oxygen consumption refers to the amount of oxygen that the body can absorb during the maximum intensity of exercise in the human body, with all organs and systems functioning at their maximum. It is an important indicator reflecting the aerobic exercise ability of the human body.

3. Aerobic exercise program, 3 times a week for 8 consecutive weeks, Monday, Wednesday and Friday. After warming up, do 10 minutes of aerobic resistance exercise first. Then run on the treadmill and continue to run for 30 minutes after reaching your maximum heart rate, with a gradual progression from 65%-80% of your maximum heart rate.

4. Aerobic exercise refers to the exercise carried out by the human body under the condition of sufficient oxygen supply. In this process, the oxygen inhaled by the human body and the body's demand have reached a balance. Aerobic exercise is mainly a form of exercise that provides the energy required for exercise through aerobic metabolism. There is a linear relationship between exercise load and oxygen consumption. The training plan of this study added a small amount of aerobic resistance training.

5. Heart rates is a term used to describe the cardiac cycle, which refers to the number of beats per minute of the heart. It can be understood as the frequency of heart beating.

6. Body weight is the weight of the body measured in known weight units. Weight gain is directly related to muscle development and bone growth. When bones grow, bone density increases and weight increases. When the muscle grows, the coarse muscle fiber of the muscle increases and the weight increases.

7. Muscle is composed of muscle cells, which are slender and fibrous, so muscle components are also called muscle fiber components.

8. BMI is the body mass index, which is an international measure of human weight and health. Objective parameter values of weight and height were used to determine body mass in the range of BMI.

9. Body fat percentage refers to the percentage of fat content expressed as a percentage of its total body weight.

10. Skeletal muscle is the muscle that grows on the skeleton. Compared with muscle, the same point is fibrous, while the difference is that there are many stripes. The growth direction lies below the cell membrane.

11. Waist to hip ratio is a relative concept, that is, the ratio of waist circumference to hip circumference. The minimum waist circumference and the most prominent part of the hips are used for measurement.

12. Protein is one of the important components of all tissues and cells in the human body, and all parts of the body have proteins. It accounts for 18% of the total body mass. And the amount of protein content is directly related to life phenomena.

13. Cardiopulmonary endurance refers to a person's ability to sustain physical activity. This study used the Harvard Step Test to calculate the maximum oxygen uptake based on the recovery heart rate, in order to evaluate cardiopulmonary endurance.

CHAPTER 2
LITERATURE REVIEW

The purpose of this study is to explore the effects of soybean milk combined with aerobic exercise on the heart rate, maximal oxygen consumption, weight, muscle, BMI, Body fat percentage, skeletal muscle, waist hip ratio and protein of college students before and after the experiment. This experiment referred to the following literature materials.

1. Soybean milk
    - 1.1 General knowledge about soybean milk
    - 1.2 The importance of soybean milk
    - 1.3 Nutrients in soybean milk
    - 1.4 Absorption of nutrients in soybean milk
    - 1.5 Efficacy and function of soybean milk
2. Aerobic exercise
    - 2.1 Meaning of aerobic exercise
    - 2.2 Energy source of aerobic performance during exercise
    - 2.3 Factors of aerobic exercise
    - 2.4 Aerobic performance test
3. Maximal oxygen consumption, VO2 max
    - 3.1 Meaning of maximal oxygen consumption
    - 3.2 Effect of maximal oxygen consumption
    - 3.3 Measuring Maximal Oxygen Consumption
    - 3.4 Heart rate
4. Body composition

4.1 Body Mass Index (BMI)

4.2 Waist hip ratio (WHR)

4.3 Body Fat（PBF）

4.4 weight

4.5 skeletal muscle

4.6 muscle

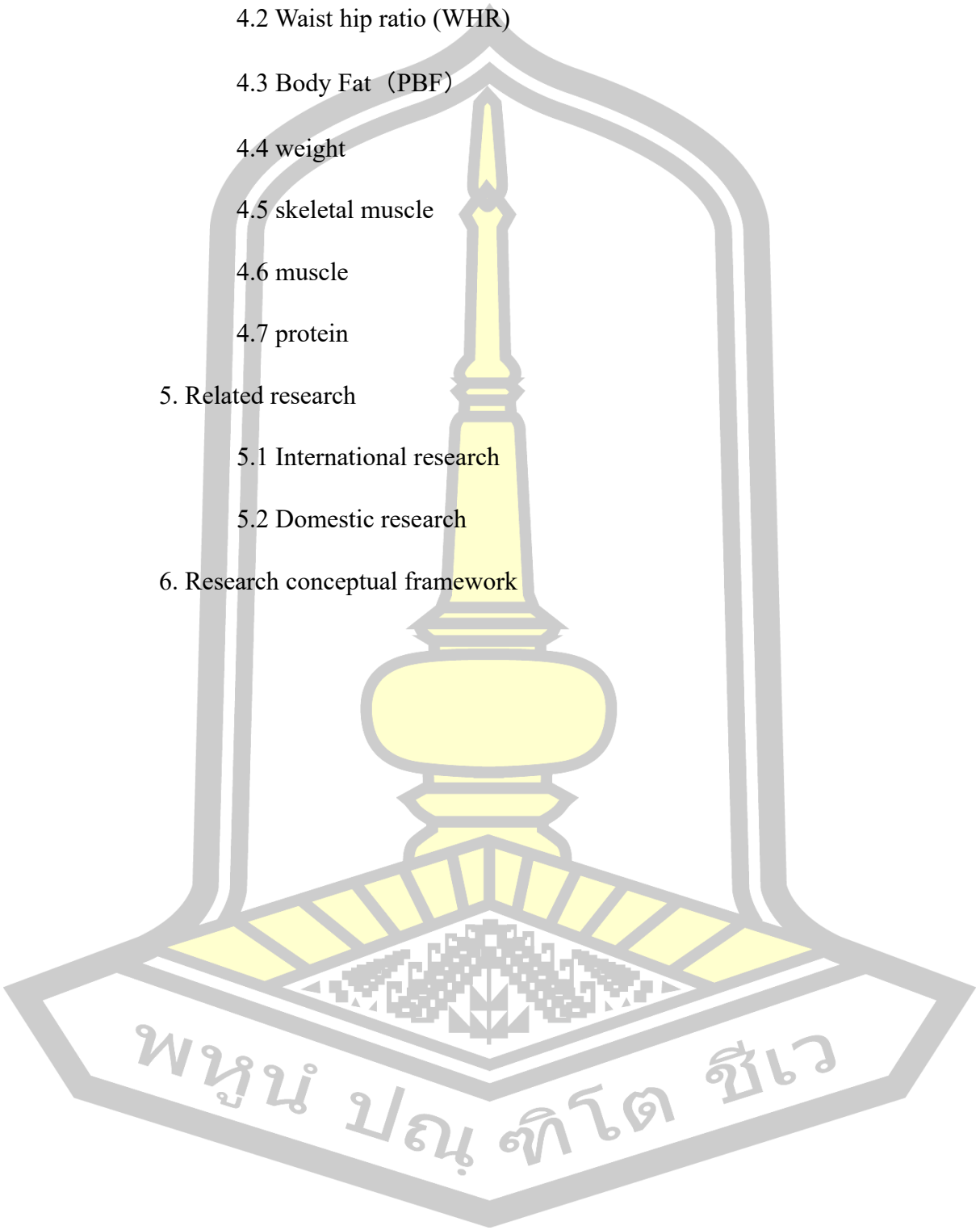
4.7 protein

5. Related research

5.1 International research

5.2 Domestic research

6. Research conceptual framework



1. Soybean milk

1. General knowledge about soybean milk

Soybean milk is a nutritious food made from crop soybeans. It is rich in protein and fat, known as "plant meat". soybean milk contains a variety of amino acids needed by the human body. Soybean milk is a kind of milky white to light yellow emulsion product extracted from soybean after grinding.

2. The importance of soybean milk

Long term drinking of soybean milk can ingest a large amount of high-quality protein, soybean lecithin, vitamins and minerals, especially for growing children. Histidine required by children contains 2.3% in soybean. Soybean plays an important role in the food composition of Chinese people, and it is one of the excellent nutritional foods for infants.

3. Nutrients in soybean milk

The main nutritional components in soybean milk are soybean protein, linoleic acid, linolenic acid and oligosaccharides. In the extracted soybean milk, the soybean fat is mainly composed of saturated fatty acids and unsaturated fatty acids, of which the unsaturated fatty acids account for 87.7% and contain no cholesterol. (Table 1)

Table 1 Nutrients in soybean milk

Nutrients in soybean milk	Every 100ml	NRV%
quantity of heat	31 kcal	2%
protein	1.6g	5%
fat	1.6g	3%
carbohydrate	1.2g	
sugar	0.6g	
purine	29.0mg	
Saturated fats (acids)	0.8g	4%
Unsaturated fat acid	0.7g	
Mono unsaturated fat acid	0.1g	
Polyunsaturated fatty acid	0.4g	
vitamin E	1.1mg	8%
Vitamin B12 (Cobalamin)	0.2mcg	8%

Nicotinic acid (nicotinamide/nicotinic acid)	0.1mg	1%
choline	6.4mg	1%
sodium	3.7mg	
potassium	117.0mg	6%
calcium	5.0mg	1%
phosphorus	42.0mg	6%
magnesium	15.0mg	5%
chlorine	3.0mg	
cutter	0.4mg	3%
zinc	0.3mg	2%
copper	0.2mg	11%
manganese	0.2mg	5%

4. Absorption of nutrients in soybean milk

More than 50% of linoleic acid in soybean milk can also decompose cholesterol, prevent vascular sclerosis, and have great nutritional value. Soybeans also contain lecithin, cephalin and inositol phospholipid, which are essential substances for human brain and liver. Soybeans also contain calcium, phosphorus, iron and other inorganic salts and various vitamins, which are also essential for the human body.

5. Efficacy and function of soybean milk

Drinking soybean milk for a long time has a very obvious effect on human growth and development. The plant protein in soybean milk can provide nine kinds of amino acids that the human body cannot synthesize by itself and must absorb from the diet. Soybean protein can also improve the fat burning rate, promote the excretion of excess cholesterol, keep the cholesterol content in the blood at a low level, thus softening blood vessels, stabilizing blood pressure, and preventing obesity. Saponin: It has strong antioxidant effect, can inhibit the formation of color spots, can also promote fat metabolism, and prevent fat accumulation. Linoleic acid and linolenic acid: linoleic acid in soybean milk can reduce the content of cholesterol and neutral fat in the blood, while linolenic acid can improve learning ability, resist allergies, and make the blood cleaner. Oligosaccharide: it can directly reach the intestine, promote the reproduction of lactic acid bacteria and other bacteria in the intestine, improve

intestinal metabolism, prevent constipation, and help prevent food poisoning and colorectal cancer. Soybean lecithin: lecithin is very important for the normal activity of cells. It can promote metabolism, prevent cell aging, keep the body young, and prevent color spots and dullness.

2. Aerobic training

1. Meaning of aerobic exercise

Aerobic exercise was first put forward in Kenneth H. Cooper's book Aerobics in 1968. Its specific meaning is that aerobic exercise refers to physical exercise carried out by the human body when oxygen is fully supplied. After years of development, people have a more accurate definition of aerobic exercise. The measurement standard of aerobic exercise is heart rate.

2. Energy source of aerobic performance during exercise

During Aerobic exercise, the heart rate is kept at 150 times/minute, and the blood can supply sufficient oxygen to the myocardium. As such, it is characterized by low intensity, rhythm, and long duration. It is required to exercise for at least 30 minutes each time, 3-5 times a week.

3. Factors of aerobic exercise

Oxygen can fully burn (i.e. oxidize) sugar in the body, consume fat in the body, enhance and improve heart and lung functions, prevent osteoporosis, and regulate psychological and mental state. It is the main exercise mode of fitness.

4. Aerobic performance test

The Harvard Step test, with a certain frequency, up and down a certain height of the steps, for a certain amount of time. Calculate maximal oxygen consumption based on the heart rate during the recovery period after the test, which is the most commonly used and effective method for evaluating aerobic capacity.

3. Maximal oxygen consumption

1. The meaning of maximal oxygen consumption

Maximal oxygen consumption (VO2 max) refers to the maximum intensity of exercise in the human body, with the highest organ and system functions, and the amount of oxygen that the body can absorb. As one of the important criteria for selecting endurance athletes, it is an important indicator reflecting the aerobic exercise ability of the human body, and high-level maximal oxygen consumption is the foundation of high-level aerobic exercise ability.

2. The impact of maximal oxygen consumption

Maximal oxygen consumption is the best indicator for evaluating an individual's cardiopulmonary endurance. Hemmasen's research results indicate that age and gender are one of the factors affecting maximal oxygen consumption. Men generally reach their maximal oxygen consumption peak at the age of 18-20, while women generally reach their peak at the age of 14-16. Afterwards, it decreased by 2% per year for men and 2.5% per year for women. There is a significant difference in the maximal oxygen consumption between males and females, with the absolute value of females being 10% lower than that of males. The average relative difference in maximal oxygen consumption between men and women is about 10.4ml/kg/min. So the volunteers in this study chose males. Crisolas' research found that the heritability of the maximal oxygen consumption was 93.4%, which proved that the maximal oxygen consumption was greatly affected by genetic factors. The difference in physical fitness and the level of training also has a significant impact on maximal oxygen consumption. Sports practice has proven that the size of maximal oxygen consumption is closely related to the performance of endurance events. Environmental factors are also one of the factors that affect maximal oxygen consumption. High temperature environments can significantly increase heart rate, leading to a decrease in aerobic capacity and maximal oxygen consumption. Elevations can also affect maximal oxygen consumption. Body fat percentage is also a factor that affects maximal oxygen consumption. Excessive fat can affect the level of maximal oxygen consumption.

3. Measurement of maximal oxygen consumption

This study used an indirect testing method to test the maximal oxygen consumption. According to the Harvard step test, the maximal oxygen consumption was calculated based on the recovery period heart rate.

Harvard Step Test Method (tested according to the American Association of Athletic Medicine (ACSM) method): For a duration of 3 minutes, step up and down at a standard distance (41.275cm), close to the height of a grandstand, 24 steps per minute (men), 22 steps per minute (women).

Metronome settings:

Step on a step with every beat of rhythm（“up,up,down,down”）

96 times/min (male)

88 times/min (female)

Immediately after the test, perform a pulse test, record a 15 second pulse, multiply by 4, and obtain a one minute heart rate.

Calculate maximal oxygen consumption through recovery period heart rate:

Male: VO2max(ml/kg/min)=111.33-(0.42×HR)

Female: VO2max(ml/kg/min)=65.81-(0.1847×HR)

Table 2 VO2 max performance comparison

age	Very poor	range	medium	good	Very good	excellent	Athlete level
female（ml/kg/min）							
20-29	＜28	29-34	35-43	44-48	49-53	54-59	＞60
30-39	＜27	28-33	34-41	42-47	48-52	53-58	＞59
40-49	＜25	26-31	32-40	41-45	46-50	51-56	＞57
50-65	＜21	22-28	29-36	37-41	42-45	46-49	＞50
male（ml/kg/min）							
20-29	＜38	39-43	44-51	52-56	57-62	63-69	＞70
30-39	＜34	35-39	40-47	48-51	52-57	58-64	＞65
40-49	＜30	31-35	36-43	44-47	48-53	54-60	＞61
50-59	＜25	26-31	32-39	40-43	44-48	49-44	＞56
60-69	＜21	22-26	27-35	36-39	40-44	45-49	＞50

4. Heart rate

4.1 Definition of heart rate

The heart rate refers to the number of beats of the heart per minute, subject to the first sound. It can be understood as the frequency of the heart beating, the number of times the heart beats at a certain time, or it can mean the speed of the heart beating.

4.2 Elements related to heart rate

In clinical medicine, it is pointed out that the heart rate will be accelerated under the condition of strenuous exercise and tension.

4.3 Factors affecting heart rate

There are many factors that affect heart rate, including the slowing of heart rate due to aging. Women have a faster heart rate than men. The heart rate increases during exercise and slows down during sleep. The heart rate increases when you are excited. The heart rate will also change under the action of drugs. Other situations, such as athletes' heart rate will be slower than normal people.

4.4 Heart rate test after exercise

This study used the Harvard Step Test to measure the post exercise heart rate of volunteers and evaluate their cardiorespiratory endurance. Resting heart rate is measured using a finger pressure oximeter.

The testing method is shown in 3.

4. Body composition

1. body mass index（BMI）

Body mass index (BMI) is a commonly used international standard to measure the degree of obesity and health of the human body.

BMI= weight（kg）÷（height（m））^{2}

Table 3 BMI Index Comparison

	lightweight	normal	overweight	Obesity
BMI	＜18.5	18.5-23.9	24-27.9	≥28

This study used a Tsinghua Tongfang body composition analyzer to measure BMI.

2. Waist hip ratio (WHR)

Waist hip ratio is the ratio of waist to hip circumference, an important indicator for determining central obesity, and an important indicator for evaluating body shape symmetry. The normal range is 0.85-0.95 for males and 0.7-0.8 for females, with pear shaped obesity below the standard and apple shaped obesity above the standard.

Researchers from Tehran Medical University in Iran proposed that the changes of waist circumference and hip circumference are related to the central obesity index on the risk of death. The research results indicate that the death risk coefficient of central obesity is higher, which is related to the overall fat content. Among them, excessive fat in waist circumference and hip circumference is a factor affecting the risk of death.

According to the research results of European Heart Journal, human body is generally divided into pear shaped body, hourglass shaped body and apple shaped body. The results showed that pear shaped and hourglass shaped women had a 91% lower risk of cardiovascular disease than apple shaped women.

Kinematic studies have shown that the waist hip ratio cannot be improved by dieting. In order to reduce the waist hip ratio, in addition to the whole body fat reduction aerobic training, it is also necessary to reduce the waist circumference and hip strength training.

Waist hip ratio test:

(1) Waist circumference: the horizontal circumference through the center of the umbilicus, or the circumference of the midpoint line between the lowest point of the rib and the upper edge of the iliac crest, measured with a tape at the end of exhalation and before the beginning of inspiration.

(2) Hip circumference: the horizontal circumference of the most prominent part of the hip, measured with a tape measure.

Waist to hip ratio (WHR)=waist circumference/hip circumference.

This study used a tape measure to measure the waist to hip ratio.

3. Body fat

Body fat percentage (PBF) refers to the percentage of fat content expressed as a percentage of total body weight. Body fat percentage is also used to describe the physical conditions of athletes. Visceral fat is mainly present in the abdominal cavity and is an important indicator of the risk of chronic diseases. People with excessive visceral fat often exhibit abdominal fat accumulation. The normal range of visceral fat is 6kg-10kg.

PBF= Fat weight/weight×100%

Male：10%-20%　Normal body shape

Female：18%-28%　Normal body shape

This study used a Tsinghua Tongfang human body composition analyzer to measure the percentage of body fat.

4. Weight

Weight is the body weight obtained by weighing naked or wearing clothes of known weight. In 2005, China Fashion Health magazine published five elements related to weight, including chromium, vitamin B6, vitamin B12, iron and zinc.

Chromium: It helps to control the blood sugar level, which in turn affects the response to feeling full and hungry.

Vitamin B6: Can be converted to absorb protein and fat, such as lack, failure to decompose the absorption of food will accumulate in the body, producing toxins.

Vitamin B12: It is stored in the liver after absorption. People with gastrointestinal digestive disorders need to supplement it most.

Iron: The study found that obese children are more likely to suffer from iron deficiency than normal weight children, which may be due to excessive fat deposition in the body, affecting the function of absorbing and using iron.

Zinc: maintain the normal taste and appetite of the human body and promote growth and development. Zinc deficiency will lead to digestive disorders, atrophy of muscle tissue, and greatly slow down metabolism. If it is replenished in time, the muscle quality will be improved quickly, and the metabolism will become vigorous, thus speeding up the burning of calories.

In addition to the factors under external influence, the relevant elements that can affect body weight are bones and muscles.

This study used the Tsinghua Tongfang Body Composition Analyzer to measure body weight.

5. Skeletal muscle

Skeletal muscle is a kind of muscle in the sports system, belonging to the striated muscle of the human body, attached to bone. When the ions in human body fluid remain sufficient and stable, it is one of the main factors affecting muscle contraction. For example, patients suffering from calcium deficiency will feel the symptoms of muscle or limb weakness, which is due to the disorder of ions in body fluid, resulting in a slight obstacle to muscle contraction. Other factors, such as normal and stable muscle cells, normal human hormone levels, and normal endocrine, are the main factors affecting skeletal muscle contraction.

This study used a Tsinghua Tongfang human body composition analyzer to measure skeletal muscle content.

6. Muscle

The human body has approximately 639 muscles, mainly composed of muscle tissue. Muscle cells are fibrous, so they are commonly referred to as muscle fibers. The human body is composed of approximately 6 billion muscle fibers, with the longest reaching 60 centimeters and the shortest only about 1 millimeter. In general, the normal range of male muscle content is between 35% -45% of body weight, while the normal range of female muscle content is between 25% -27%.

This study used the Tsinghua Tongfang Body Composition Analyzer to detect the muscle content in the subjects' bodies.

7. Protein

Protein is an important component of all cells and tissues in the human body. All important parts of the body need protein to participate. The amount of protein a substance consists of is called protein content. Generally speaking, protein accounts for about 18% of the total body weight. The higher the protein content, the higher the basal metabolism, and the lower the risk of obesity.

This study used a Tsinghua Tongfang body composition analyzer to detect the protein content in the subjects' bodies.

5. Related research

1. International research

In 2009, the American Sports Medical Association, the American Dietetic Association and the Canadian Association of Nutritionists jointly proposed that the proportion of fatty acids, monounsaturated fatty acids and polyunsaturated fatty acids should be 1:1:1 for the nutrition intake of fitness athletes, so as to supplement the nutrition needed for the mobilization of athletes.

C. Brooks Mobley (2017) studied the effects of whey, soy or leucine supplementation and 12-week resistance training on the strength, body composition, histological properties of skeletal muscle and adipose tissue of college-age men. 75 trained men (19-23 years old) participated in this double-blind experiment. The results of the study show that, among the untrained college-age men, neither L-leucine (LEU) nor protein supplementation (standardized as LEU) can provide additional benefits in increasing the overall skeletal muscle mass or overall strength. However, whey protein supplementation significantly increased the number of skeletal muscle satellite cells through resistance training, which may promote more favorable training adaptation in a longer time.

Marina Fabre (2017) investigated the effect of post-exercise protein intake on muscle mass and strength during resistance training, in which 31 healthy men (19-35 years) who had received resistance training participated ina nine-week double-blind trial. The results showed that compared with Fast protein (20), Fast protein (100) and Fast protein (50) beverages had higher bioavailability of leucine ($p<0.05$). However, the lean body weight ($p<0.01$), dynamic muscle strength ($p<0.01$) and isometric muscle strength ($p<0.05$) induced by resistance training increased similarly in all experimental groups. In conclusion, compared with Fast protein (20) group, the

increase of plasma amino acids after ingestion of Fast protein (100) and Fast protein (50) did not lead to higher long-term muscle adaptation.

Mark Messina1 (2018) conducted a meta-analysis to compare the effects of soybean protein supplementation and animal protein supplementation on the intensity and lean body weight (LBM) of resistance exercise training (RET). Nine studies involving 266 participants were identified. Five studies compared whey protein with soy protein, and four compared soy protein with other proteins (beef, milk or dairy protein). Meta-analysis showed that adding whey protein or soybean protein to RET could significantly increase the intensity, but there was no difference between groups (bench press Chi2=0.02, p=0.90; square Chi2=0.22, p=0.64). Whey or soybean alone (n=5) had no significant effect on LBM changes, and there was no difference between groups (Chi2=0.00, p=0.96). The strength and LBM of "other proteins" increased significantly (n=9), but there was no difference between groups (bench Chi2=0.02, p=0.88; square Chi2=0.78, p=0.38 and LBM Chi2=0.06, p=0.80). The results of meta-analysis showed that the soy protein supplement had similar strength and LBM gain on RET as whey protein.

Alexandra Ntemiri (2019) mentioned in the research that prebiotics can improve the biological imbalance of aging. The research results show that milk and soybean milk have anti-aging biological regulation effects, and both foods have significant effects on health-related groups, such as ruminal coccus and lactic acid bacteria.

Janice A Townsend (2019) studied other products that can replace the fluorine content in milk. The study involved 33 different brands and a total of 9 drinks. The results showed that the fluorine content of whole milk (0.03 ± 0.00 ppm) was significantly lower than that of Malk pure cashew milk and soybean milk, but the fluorine content of rice milk and pecan milk was lower than that of milk. The results of this study show that soybean milk is a kind of food that can replace milk to supplement the fluorine content and has a certain help effect on human nutrition intake.

Faeghe Ghasemi (2020) studied The Effect of Drinking Skim Milk, Soybean milk and Water on Rehydration and Exercise Performance in Young Trained Females, Eight training women (age 21.37 ± 0.71 years, BMI 22.06 ± 1.42 Kg) participated in the experiment. The results showed that compared with water test, the total amount of urine in milk and Soybean milk test were significantly reduced ($P<0.05$). In addition, the net liquid balance of the two experiments was significantly positive compared with the water experiment ($P<0.05$), and the exhaustion time was also longer than the water experiment ($P<0.05$). However, there was no significant difference in these variables between the two experiments of milk and Soybean milk ($P>0.05$). Therefore, drinking milk and soybean milk can better replenish water and maintain body fluid balance after exercise, which is related to improving exercise performance.

Heidi M (2020) studied the effect of protein from plants and animals on supporting muscle and strength development in resistance training. 61 untrained young men (n19) and women (n=42) (18-35 years old) participated in the 12-week study, and 48 people completed the experiment (17 men and 31 women). Multi-level model analysis showed that total weight, lean weight, peak torque of leg extensor and flexor increased. The thickness of lateral femoral muscle increased but did not reach statistical significance. There was no significant difference between the groups. The results showed that lean mass and strength gains were comparable in untrained participants when strength training and supplementing with leucine-matched soy or whey.

A Kazemi Mehr (2021) studied The Effect of Eight Weeks of Resistance Training and Soybean milk Consumption on Lipid Profile, Body Composition and Some Factors of Physical Fitness of Elderly Women in Yasuj, 48 Iranian elderly women (aged 65 ± 2.2 years) participated in the experiment. The results show that, It seems that resistance training and consumption of soybean milk as a non-pharmacological method can be an effective factor in preventing and promoting the health of elderly women by improving lipid profile, body composition and physical fitness.

Savvas Kritikos (2021) studied the effects of whey and soybean protein on the field activity, performance, muscle injury and redox reaction of football players after speed endurance training. Ten well-trained male football players participated in this study. The research results show that increasing the daily protein intake to 1.5 g/kg by taking whey or soybean protein supplements can alleviate the decline of sports performance during continuous speed endurance training without affecting the exercise-induced muscle injury and redox status markers. Considering that whey protein and soybean protein are equally effective, the author believes that soybean protein may be an effective and cost-effective substitute for dairy protein, which can be used to recover from football specific high-intensity training (such as speed endurance training).

Deby Tri Mario (2022) studied the ability to use high-protein foods (such as soybean milk, protein and tofu) as substitutes for muscle hypertrophy in weight training. 26 Indonesian male fitness members (18-25 years old) participated in the experiment. The results show that high-protein food can be used as a substitute for muscle hypertrophy in weight training. It should be noted that if you do not participate in well-planned weight training, eating protein-rich foods and supplements will not lead to muscle hypertrophy. The results of the study are expected to help weight training performers, such as fitness coaches, members and athletes, obtain alternative means of muscle hypertrophy programs.

Nahid Bijeh (2022) studied the Effects of Soybean milk in Conjunction with Resistance Training on Physical Performance and Skeletal Muscle Regulatory Markers in Older Men, sixty healthy elderly men (aged 65.63 ± 3.16 years) participated in this 12-week double-blind study. The results showed that soybean milk and resistance training had synergistic effects on skeletal muscle regulation markers, body composition and sports performance.

2. Domestic research

Huang Sen (2012) studied the effect of soybean phospholipids on the serum CK of rowers after strength training, and 20 male rowers participated in this study. The

results showed that the supplementation of soybean phospholipids could repair the damage of skeletal muscle caused by high strength training, reduce the overflow of CK in skeletal muscle cells, and reduce the level of serum CK.

Wang Xiru (2014) studied the effect of high-fat diet on rat heart and the protective effect of aerobic exercise and its combined supplementation of soybean isoflavones on the myocardium of high-fat mountain rats. The study sample is 48 8-week-old healthy rats, weighing 180-220g. The results showed that 6-week high-fat diet could increase the body weight and Lee's index of rats, increase the levels of TNF-a and IL-6 in plasma to different degrees, and induce inflammatory reaction in vivo. It leads to the up-regulation of the expression of myocardial Apelin-mRNA and myocardial NF-kB-mRNA, the increase of the content of ICAM-1 in myocardial vascular endothelium, the occurrence of myocardial inflammatory reaction and the damage of vascular endothelium in rats. Aerobic exercise or supplementation of soybean isoflavones can reduce body weight, alleviate inflammation and reduce myocarditis, thus protecting myocardium. The protective effect of aerobic exercise combined with soybean isoflavone supplementation on myocardium is more effective than that of aerobic exercise alone or soybean isoflavone supplementation.

Liu Na (2016) studied the effect of soybean oligopeptides on improving the sports ability of cross-country skiers. 21 men cross-country skiers from Jilin ski team participated in this four-week experiment. The research results show that soybean oligopeptides can increase the lean weight of cross-country skiers, reduce the production of lactic acid during exercise, promote the elimination of blood lactic acid after exercise, reduce the activity of CK, and have a certain protective effect on skeletal muscle cell membrane, thus effectively promoting the improvement of cross-country skiers' physical function.

Liu Huiyan (2016) studied the effect of soybean phosphatidylserine on the exercise ability of mice and the protective effect of myocardial tissue. The sample was 48 KM mice, and the experiment lasted for 4 weeks. The results showed that soybean phosphatidylserine could significantly improve the exercise ability of mice, prevent myocardial oxidative damage after vigorous exercise, and promote fatigue recovery.

You Lirong (2017) studied the research and development of soybean peptide exercise supplement and the analysis of its effect on promoting muscle growth. Soybean protein was deeply processed to prepare soybean peptide, and a solid beverage exercise supplement was developed using soybean peptide as raw material combined with complex juice. 20 bodybuilders and 20 fitness enthusiasts participated in the six-month muscle strengthening experiment. After sensory evaluation, nutritional analysis and solubility test, the sports supplement is easy to be accepted by the market due to its features of rich sensory experience, complete amino acid composition, high vitamin content and easy dissolution. The results of the study showed that both bodybuilders and fitness enthusiasts, although there are obvious differences in exercise level and exercise ability, but after taking this exercise supplement can effectively improve the muscle content and can reduce the body fat content of the users, to achieve effective BMI improvement results.

Wang Feng (2019) studied the effect of different doses of soybean protein on the anti-fatigue and exercise ability of rats. The sample was 40 male adult SD rats (6 weeks old) without specific pathogen (SPF), and the experiment lasted for 4 weeks. The results show that soybean protein can effectively improve the anti-fatigue ability of rats, improve the energy metabolism mode, improve the anti-oxidation ability, and reduce the sports injury, thus improving the sports ability of rats. Soybean protein supplement is expected to become a functional drink that can improve athletes' anti-fatigue ability and sports ability and has high development value.

Xie Yonglei (2019) studied the effects of soybean peptides on hemodynamics and myocardial autophagy in rats after exhaustive exercise. The study samples were 50 healthy male SD rats. The study found that soybean peptide 500mg/kg can significantly reduce the LVEDP and increase the hemodynamic parameters of LV dp/dt max, LVdp/dt min, LVSP and MABP in rats after exhaustive exercise; At the same time, soybean peptide 500 mg/kg can significantly improve the pathological changes of myocardial tissue in rats after exhaustive exercise, reduce myocardial structural damage and reduce the infiltration of inflammatory cells. The results show that soybean peptides can improve cardiac function, hemodynamics and pathological

damage in rats after exhaustive exercise, and its mechanism may be related to inhibition of autophagy.

Bai Haijun (2021) studied the preparation of selenium-rich soybean oligopeptide and its anti-fatigue function, and the experimental samples were 60 SPF Kunming male healthy mice. In the experiment, selenium-rich soybean was used as raw material to prepare soybean protein, and selenium-rich soybean oligopeptides were prepared by ultrafiltration extraction assisted with neutral protease and flavor protease enzymatic hydrolysis, and the selenium content was identified by ICP-MS. Finally, the anti-fatigue activity of selenium-rich soybean oligopeptides was comprehensively evaluated by mice exercise fatigue test. The results showed that selenium-rich soybean oligopeptides had a positive effect on anti-exercise fatigue in mice, and the anti-fatigue effect was significant at the dose of 100 mg/ (kgbw • d).

Bai Haijun (2021) studied the effect of taurine - hydrolyzed soybean protein complex system on exercise-induced fatigue rats. The study samples were 50 male healthy rats of SPF grade SD at the age of 8 weeks. The results showed that the exercise time of rats was significantly shortened after exercise fatigue modeling ($P < 0.05$). After feeding the taurin-hydrolyzed soybean protein complex system, which was initially screened in vitro antioxidant experiment, compared with the model group, the activity of serum superoxide dismutase, glutathione peroxidase and catalase in rats increased, and the concentration of malondialdehyde decreased, among which the antioxidant effect of the complex system with a mass concentration ratio of 1 ： 10 was the most significant in vivo. It has the best effect on prolonging endurance exercise time and reducing serum LA and BUN concentration in rats, indicating that the anti-fatigue effect is the best. By establishing the scatter diagram of the relationship between SOD activity and exercise time of rats, it was concluded that the antioxidant capacity of taurine - hydrolyzed soy protein complex system was positively correlated with the anti-fatigue effect ($R2 = 0.8205$).

Tan Qiushi et al. (2022) studied the effect of soybean peptide supplementation and exercise time on the serum free amino acid level of rats. The research results show that the continuous and regular supplementation of P-CHO, which is made up of

enzymolysis soybean peptide, during swimming endurance exercise in rats, can basically maintain or enhance the stability of various blood free amino acids in rats after 1.5 hours of exercise when the amount of peptide supplementation is less than 0.27 g/kg • bw/h, When exercising for 1.5-3.0 hours, a higher dose of peptide supplement (0.27-0.53 g/kg • bw/h) is needed to reach a higher level of free amino acids (especially branched chain amino acids) in the blood, At the same time, reduce tryptophan/branched-chain amino acid to meet the material and energy metabolism requirements during exercise, and may be beneficial to alleviate the fatigue of the exercise center and reduce the damage of skeletal muscle. The significant changes of single serum free amino acids were different with the increase of peptide supplementation during different exercise duration.

Xu Zujie (2022) studied the effects of soybean peptides on myocardial oxidative stress injury and Keap1-Nrf2 signal pathway in mice after one-time exhaustive exercise. The study samples were 30 male C57BL/6 mice. The results showed that the supplementation of soybean peptides could significantly improve the exercise ability of mice, improve the myocardial oxidative stress injury induced by one-time exhaustive exercise, and improve the antioxidant capacity. The mechanism may be related to the activation of Keap1-Nrf2 signal pathway.

According to the report of the "2020 Soybean milk White Paper on Nutrition and Health", in addition to rich plant protein, there are also vitamins, minerals, dietary fiber, oligosaccharides and other influential ingredients in Soybean milk, which are very beneficial to people who have been exercising for a long time. In addition, Soybean milk contains soybean isoflavones, soybean phospholipids, soybean saponins, soybean polysaccharides and other plant active ingredients unique to soybeans, which are not available in milk. From the research results of the above scholars, it has been proved that the ingredients contained in soybeans have a certain positive impact on human strength. Among them, soybean phospholipid has the function of repairing skeletal muscle, soybean isoflavone has the function of myocardial protection, soybean oligopeptide has the function of promoting body function, soybean peptide has the function of improving BMI, and soybean protein

has the function of improving energy metabolism. It can be seen that the nutrients in soybean will neutralize the function, heart rate, muscle, fat, etc. of human body after exercise. Especially in athletes, it is very important to enhance the ability of muscle contraction and tension. Muscles will consume muscle protein to supplement energy in the process of contraction or relaxation, and the mechanism of soybean milk is to improve the exercise ability of muscles through the decomposition of nutrients. Therefore, it is a scientific and reasonable way to keep healthy and improve sports ability to properly supplement soybean milk drinks during sports. In addition, when drinking soybean milk, you can choose the time period according to the needs of exercise. After exercise, it is the time for the body to consume a large amount of nutrients. At this time, drinking soybean milk can help the protein to absorb quickly and quickly supplement the nutrients needed by the body. If you drink soybean milk before exercising, the higher plant protein contained in soybean milk will help to supplement the body's needs, stimulate the growth of muscles, and also help to reduce fat. From the perspective of human absorption, soybean protein content is high and of good quality, but its protein digestion rate is only 60% to 65%. If it is made into tofu and various bean products, the digestion rate can be increased to 92%~96%. Some studies have shown that if you drink 200 ml of soybean milk every day, you can get 8.8 grams of protein with high digestibility. The research conclusions of the above scholars have laid a lot of theoretical foundation for the research of this paper. The literature content provides scientific basis for the fact that drinking soybean milk during exercise can increase muscle energy and burn body fat. The results of literature research show that the nutrients in soybean can enhance muscle quality and strength and avoid fat increase. It is also emphasized that in addition to supplementing the necessary protein, it is also necessary to supplement the intake of amino acids, glutamine, carbohydrates and other components, so that the exercisers can maintain a sense of fullness and be more powerful during exercise. The content of these nutrients in soybean milk is relatively rich, which further proves from the literature that soybean milk has a great role in helping the human body after exercise.

6. Research conceptual framework

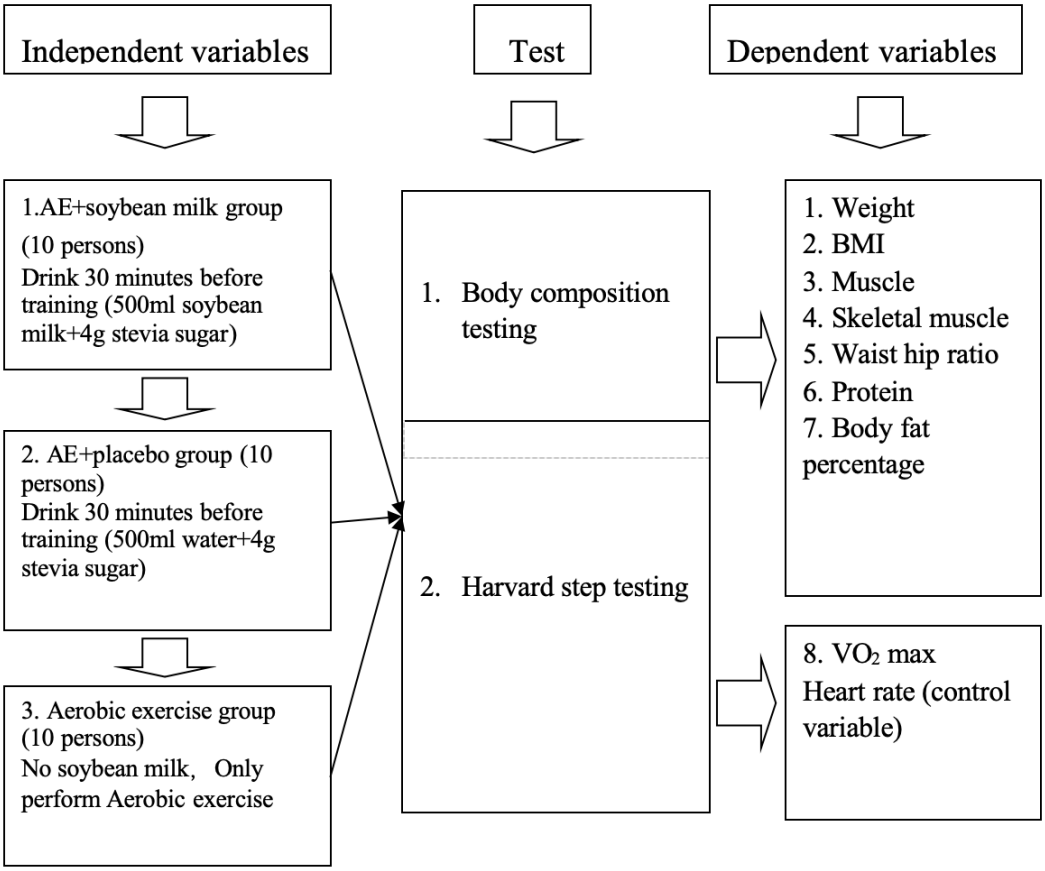


Figure 1 Research conceptual framework

CHAPTER 3
RESEARCH METHODS

This is an experimental study to study the effect of soybean milk combined with aerobic exercise on the maximal oxygen consumption and body composition of college students.

1. Research participants
    - 1.1 Population
    - 1.2 Target Group
    - 1.3 Sample selection criteria
2. Research tools and equipment
    - 2.1 Material and equipment
    - 2.2 Experimental testing tools
    - 2.3 Tools for collecting data
    - 2.4 questionnaire
    - 2.5 Steps to create a research tool
3. Research methods and data collection
    - 3.1 research process
    - 3.2 Data collection process
    - 3.3 Preparation method of soybean milk
4. Experimental site
5. Data analysis
6. Research statistics
    - 6.1 Formula for calculating variables
    - 6.2 Basic Statistics

6.3 Statistical data used in hypothesis testing

1. Research participants

. Population

The subjects of the study were male college students aged 18-21 years old with Fitness guidance and management major who studied at Sichuan Vocational College of Health and Rehabilitation. There are 51 male students in two classes specializing in fitness guidance and management.

Main field of study (at university)	Male population (person)
Fitness Instruction and Management 1, Class of 2023	26
Fitness Instruction and Management 2, Class of 2023	25
amount to	51

2. Target Group

The sample size was calculated according to Yamane's (1967) formula with an allowable error of 5%.

According to the formula： $n = \frac{N}{1+Ne^2}$

wherein：n represents the required sample size

N represents the total population

e represents significance level error

$$n = \frac{51}{1+51(0.05)^2}$$

Sample size n=45.232816, rounded to 45 people.

In this study, the pre-experimental sample was 15 people, and the final research sample was determined to be 30 people.

The researchers administered the Harvard Step Test and body composition tests to 30 volunteers. Based on the Harvard Step Test scores in descending order, the best performers and the worst performers were then paired in order, and the pairs were randomly divided into 3 groups of 10 people each. The first group is AE+soybean milk group, the second group is AE+placebo group, and the third group is AE group. The experimental grouping was based on the study of Govindasamy Balasekaran (2021).

3. Sample selection criteria:

3.1 Inclusion criteria

3.1.1 A male college student studying fitness guidance and management at Sichuan Vocational College of Health and Rehabilitation, aged 18-21.

3.1.2 Volunteers confirm their physical health through a doctor's health assessment and PAR-Q questionnaire.

3.1.3 No medical history, no significant injuries in the past three months.

3.1.4 Not allergic to bean products.

3.1.5 Fully understand the research objectives and all testing procedures.

3.1.6 Volunteers have not been injured in the past three months.

3.2 Exclusion criteria

3.2.1 Suffering from heart disease, hypertension and other diseases.

3.2.2 Pain interferes with exercise.

3.2.3 Unable to participate in the 8-week experiment.

3.2.4 For other reasons, do not want to continue to participate in the experimental test.

Experimental mode

This study is an experimental study, with testing conducted 8 weeks after training.

Table 4 Experimental mode

Experimental grouping	**30 minutes before exercise**	**Training plan**	**Exercise intensity/duration**	**dependent variable**	**test method**
1.AE+soybean milk group	500ml soybean milk+4gstevia sugar	Three runs and resistance exercises per week for 8 weeks.	1. Aerobic resistance training: 10 minutes 2. running Run 70% MHR/30 minutes	Weight, BMI, Muscle, skeletal muscle, Waist hip ratio, Protein, Body fat percentage, VO_2 max, Heart rate	1. Harvard Step Test. 2. Human body composition analyzer.
2.AE+placebo group	500ml water+4gstevia sugar				
3. Aerobic exercise group	×				

2. Research tools and equipment

1. Material and equipment

1.1 treadmill

1.2 metronome

1.3 step (41.275cm)

1.4 timer

1.5 Finger pressure pulse oximeter

1.6 Height and weight tester

1.7 soft ruler

2. Experimental testing tools

2.1 Harvard Step Test

2.2 Tsinghua Tongfang Human Body Composition Analyzer

2.3 Training Plan (Details can be found in the appendix)

Three times a week for 8 consecutive weeks. After warming up, do 10 minutes of aerobic resistance exercise first. Then run on the treadmill and continue to run for 30 minutes after reaching your maximum heart rate, with a gradual progression from 65%-80% of your maximum heart rate. (The training intensity was based on Sukanya Raroeng's research in 2013.)

3. Tools for collecting data (Details can be found in the appendix)

3.1 Harvard Step Test Record Form

3.2 Analysis Table of Human Body Composition

3.3 Training Plan completion record form

4. Questionnaire (Details can be found in the appendix)

4.1 General questionnaire on soybean milk research

4.2 Health assessment record form

4.3 Physical Activity Readiness Questionnaire (PAR-Q)

4.4 Questionnaire on feelings and symptoms after taking 500ml soybean milk

5. Steps to create a research tool

5.1 Researchers have investigated the physical health status of college students in recent years and found that the obesity rate among students nationwide is constantly increasing. Then, according to the research literature, theoretical research was carried out on the test method from the aspects of maximum oxygen uptake and body composition, including the promotion of soybean milk on people's health and exercise. Through domestic and overseas related research to study soybean milk.

5.2 Prepare tools for experimental data collection. The treadmill and Training Plan completion record form, Harvard step test tools and test record form, body composition analyzer and Body Composition Record Form.

5.3 Submit the training plan for this study to the paper management committee for review and make modifications according to the committee's decision.

5.4 Submit the training plan to 3 experts for review. The experts will check the rationality and effectiveness of the training plan, evaluate whether it is suitable, and give a score: (Item Objective Consensus: IOC)

Rated+1, considered appropriate

Rated 0, not considered appropriate

Rated as -1, not suitable

5.5 Revise the training plan based on expert opinions to ensure that the IOC score is qualified.

5.6 A preliminary experiment was conducted on 15 male college students aged 18 to 21 majoring in fitness guidance and management. Collect data and modify training plans.

3. Research methods and data collection

1. Research process

1.1 On Google, CNKI and ScienceDirect, relevant data and literature were consulted and collected with the keywords of "soybean milk, intake, athletes, training, Cardiopulmonary endurance, nutrition, body composition, skeletal muscle, protein, and influence" to provide theoretical basis for research.

1.2 Determine testing methods and tools based on research variables.

1.3 Create a record table for recording test data and training completion.

1.4 Invite 3 experts to inspect the quality of research tools:

Yan Hong, Associate Professor at Chengdu Sport University（Research direction: National Fitness and Social Sports, Aerobics Teaching and Training Theory and Methods）

Lei Ping，Associate Professor, School of Physical Education, Sichuan Normal University（Research direction: Sports Humanities and Sociology, Physical Education Teaching and Training）

Yang Shiyong，Professor at Chengdu Sport University

Professor at Jinjiang College, Sichuan University

Mahasarakham University doctoral supervisor

UdonThani Rajabhat University doctoral supervisor

（Research direction: Physical training, sports research methods, competitive weightlifting, etc）

1.5 Expert advice:

1.5.1 The maximum heart rate during running should reach 75-80% in the final stage.

1.5.2 Increase the intensity of aerobic resistance training.

1.5.3 Do does not use the same set of warm-up exercises and relaxation stretching exercises for the three training stages.

1.6 The training plan has been modified based on the advice of experts.

1.7 Prior to the experiment, an experimental study was conducted on 15 nonexperimental participants, and the training plan and experimental tools were revised based on the experimental results. Based on the preliminary experimental results and expert opinions, the intensity of aerobic resistance training and running training has been increased. In order to accurately measure the heart rate during the recovery period, the heart rate test was changed from a finger pressure oximeter to a 15 second pulse x 4.

1.8 The main problem of research ethics is that drinking soybean milk will not cause any harm to the experimental samples. Analyze the use of facilities and equipment related to training and testing, and provide research related documents, including Training Plan completion record form, Harvard step test record form, Human Body Composition Record Form, and determine testing tools.

2. Data collection process

2.1 The target of recruitment is 51 18-21 years old male college students with Fitness guidance and management major who are studying in Sichuan Vocational College of health and rehabilitation. After selection according to the corresponding standards, 30 people were retained. Participants agreed in writing to participate in the study.

2.2 Explain the experiment method to the volunteers, including distributing the introduction of the experiment process.

2.2.1 Volunteers should avoid strenuous exercise after 5pm on the day of the experiment, and should not consume alcohol, coffee, milk and soybean milk within 24 hours before the experiment. Then they should conduct body composition test and Harvard step test. And record the test results of volunteers before the experiment.

2.2.2 Volunteers train three days a week, Monday, Wednesday and Friday, at 7 p.m. Three groups were trained at the same time.

2.2.3 Data were collected again after the eighth week of training.

2.2.4 Summarize the research results and follow-up research suggestions.

4. Data collection flowchart

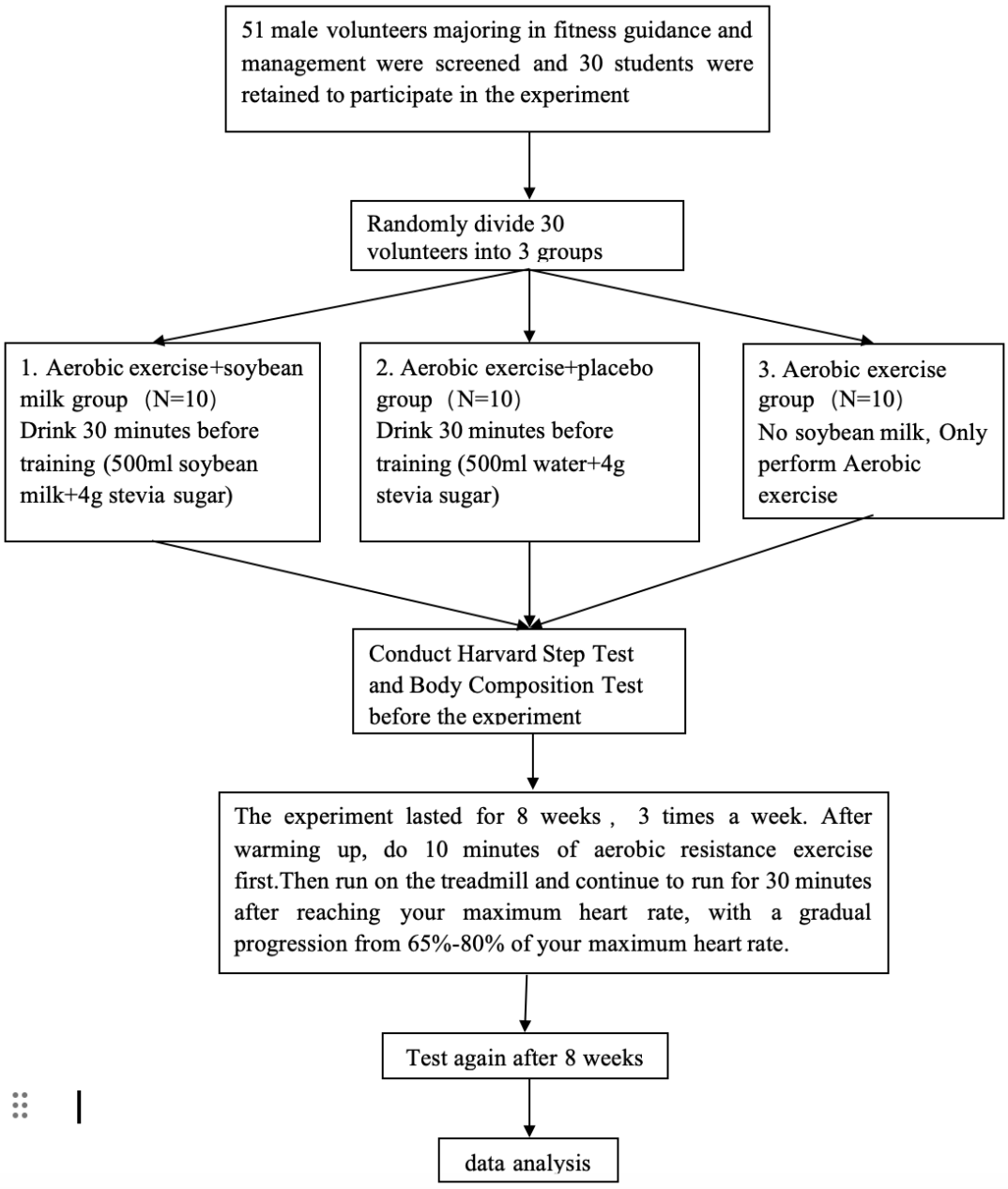


Figure 2 Data Collection Flowchart

3. Preparation method of soybean milk

Soybeans are purchased from the flagship store of Gaia Farm and have been tested by national institutions, with organic product certification and non-GMO certification.The soybean milk used in the experiment was produced by Chengdu Juxin Catering Management Co., Ltd. according to the following standards:

About 2 kg of good quality, cleaned soybeans (Glycine max) were soaked in previously well boiled water (bean-to-water ratio of 1:10) for 12 h, and half the bicarbonate of soda was added (to alleviate the problems associated with flatulence due to oligosaccharides). Next beans were washed and boiled in water for 10 min. After draining the water, the same procedure was repeated. This sustained hot water treatment helped to eliminate beany off flavors due to lipoxygenase and eliminate the anti-nutritional factors (Afroz et al., 2017). Next, use a wall breaker and drinking water to polish and boil, and then use a clean filter screen to filter the bean dregs. This filtrate is the soybean milk we use in our experiment. Fresh soybean milk was prepared for each experiment.

5. Experimental site

Sichuan Vocational College of Health and Rehabilitation gym

6. Data analysis

1. Tsinghua Tongfang Body Composition Analyzer BCA-1D produced by Tongfang Health Technology (Beijing) Co., Ltd. is used for measurement. The medical device adopts the direct segmental multi frequency bioelectrical impedance (DSM -BIA) test method. The weight, BMI, muscle content, skeletal muscle and protein of the volunteers were measured. The waist to hip ratio is measured and calculated using a tape measure.

2. Detect the recovery heart rate of the subjects after the Harvard Step Test. By recording the pulse for 15 seconds multiplied by 4, the 1-minute heart rate is obtained, and the VO_2 max is calculated based on the recovery period heart rate. Use the finger

pressure pulse oximeter produced by Zhejiang Jiantuo Medical Equipment Technology Co., Ltd. to measure the heart rate 3 minutes after the completion of the Harvard step test.

3. Calculate the mean value and standard deviation of Weight, BMI, Muscle, skeletal muscle, Waist hip ratio, Protein, Body fat percentage, VO2 max and Heart rate before and after the experiment.

4. Use paired sample T-test to compare the data before and after the experiment

5. One-way ANOVA was used to compare the differences between AE+soybean milk group, AE+placebo group and AE group. When a statistically significant difference of 0.05 is found, paired comparisons are conducted.

6 The experimental data were statistically analyzed using Excel and SPSS 22.

7. Research statistics

1 Formula for calculating variables

The formula for calculating VO_2 max based on the results of the Harvard Step Test (American Association of Sports Medicine, ACSM):

Male: VO_2 max (ml/kg/min) =111.33-(0.42*HR)

2 Basic Statistics

Percentage formula:

$$P=\frac{f\times 100}{N}$$

P represents the percentage, N represents the total number of data, and f represents the number of data to calculate the percentage.

Average formula:

X=（A1+A2+A3+....）÷N

X represents the average value, A represents each data, and N represents the total number of data.

Standard deviation (SD) formula:

$$S = \frac{\sqrt{(A-X)^2}}{N-1}$$

S represents the standard deviation, A represents each data, and X represents the mean.

3. Statistical data used in hypothesis testing

3.1 Obtain the recovery heart rate through the Harvard step test and calculate the maximum oxygen uptake using a formula.

3.2 Test body weight, BMI, body fat percentage, muscle content, skeletal muscle content, waist to hip ratio, and protein content through Tsinghua Tongfang Human Body Composition Analyzer.

3.3 The mean and standard deviation of AE+soybean milk group, AE+placebo group and AE group were calculated from the data before and after the experiment.

3.4 Compare the data before and after the experiment using paired sample T-test.

3.5 One-way ANOVA was used to compare the differences between AE+soybean milk group, AE+placebo group and AE group. When a statistically significant difference of 0.05 is found, paired comparisons are conducted.

CHAPTER 4
DATA ANALYSIS RESULTS

In this study, the researchers used soybean milk as a sports supplement and conducted eight weeks of aerobic training for male college students majoring in fitness guidance and management at Sichuan Vocational College of Health and Rehabilitation. Body composition testing was conducted using a human body composition analyzer, and recovery heart rate was measured using the Harvard step test. VO2 max was calculated based on the recovery heart rate. The researchers collected data before and 8 weeks after the experiment and conducted statistical analysis on the data before and after the experiment, as well as the data between the three experimental groups.

1. Symbols used in data analysis

2. The steps of data analysis results

3. Data analysis results

1. Symbols used to represent the results of data analysis

$\overline{X}$ Representing the average value

S.D. Representing standard deviation

P Representative significance value

n Representative sample size

t Represents the magnitude of the difference between two samples. The larger the t-value, the greater the difference; the smaller the t-value, the smaller the difference

df Representing degrees of freedom

F Represents the difference in sample variance. The larger the f-value, the greater the variance difference, and the smaller the f-value, the smaller the variance difference

MS Representing Mean Square

SS Representing Sum of Squares

2. The steps of data analysis results

1. Calculate the average and standard deviation of the age, height, and weight of three groups of volunteers. And verify whether the experimental data follows a normal distribution.

2. Compare the data before and after the experiment using paired sample t-test to determine if there is a significant difference.

3. Compare the data between the three groups after 8 weeks using One-way ANOVA Bonferroni test. If significance, perform multiple comparisons.

3. Data analysis results

1. Calculate the average and standard deviation of the age, height, and weight of three groups of volunteers (See Table 5 for details). And verify whether the experimental data follows a normal distribution (See Table 6 for details).

Table 5 The average and standard deviation of age, height, and weight of three groups of volunteers.

variable	Research group	$\bar{x}$	S.D.
Age (years)	group 1（n=10）	19.70	0.82
	group 2（n=9）	19.77	0.83
	group 3（n=10）	19.60	0.84
Height (cm)	group 1（n=10）	176.06	2.71
	group 2（n=9）	174.38	2.87
	group 3（n=10）	173.43	2.73
Weight (kg)	group 1（n=10）	72.61	6.05
	group 2（n=9）	72.22	5.41
	group 3（n=10）	70.42	4.69

Table 5 shows the mean and standard deviation of age, height, and weight for three groups of volunteers. The first group is soybean milk+aerobic exercise, the second group is placebo+aerobic exercise, and the third group is aerobic exercise. The height and weight of the three groups of volunteers are normally distributed.

Table 6 Show normality test of all dependent variables. (n=29)

variable	$\bar{x}$	S.D.	p
weight(kg)	71.73	5.31	0.200
BMI（kg/m^2）	23.35	1.54	0.200
WHR (cm)	0.79	0.05	0.200
BFP(%)	16.75	2.82	0.142
Skeletal muscle(kg)	35.47	2.41	0.200
muscle(kg)	55.44	3.77	0.200
protein(kg)	12.19	0.82	0.200
HR(time/ minute)	77.24	4.28	0.077
VO_2 max(ml/kg/min)	54.90	5.99	0.132

HR represents resting heart rate

According to the results in Table 6, $p>0.05$ indicates that all experimental data follows a normal distribution. Paired sample t-test can be performed.

2. Compare the data before and after the experiment using paired sample t-test to determine if there is a significant difference (See Table 7-10 for details).

Table 7 Comparison of the average value and standard deviation of the soybean milk+aerobic exercise group before and after the experiment 8 weeks (n=10)

Variable	Before the experiment		8 Weeks after		t	p
	$\bar{x}$	S.D.	$\bar{x}$	S.D.		
weight(kg)	72.61	6.05	73.17	5.81	-0.886	0.398
BMI（kg/m^2）	23.40	1.44	23.53	1.77	-0.756	0.469
WHR (cm)	0.78	0.05	0.79	0.04	-1.035	0.328
BFP(%)	16.71	2.76	16.00	3.15	1.563	0.152
Skeletal muscle(kg)	35.96	3.06	38.10	2.66	-6.953	0.000*
muscle(kg)	56.20	4.79	59.50	4.13	-6.925	0.000*
protein(kg)	12.35	1.05	13.16	0.91	-7.806	0.000*
VO_2 max(ml/kg/min)	54.46	7.12	53.20	4.05	0.728	0.485

*p<0.05 indicates significant differences in the data.

Table 7 shows the average and standard deviation of body composition and VO_2 max in the soybean milk+aerobic exercise group. The results obtained through paired sample t-test showed that after drinking soybean milk+aerobic exercise, the skeletal muscle, muscle content, and protein of the soybean milk+aerobic exercise group were significantly improved after 8 weeks.

Table 8 Comparison of mean and standard deviation of placebo+aerobic exercise group before and after 8 weeks of the experiment (n=9)

variable	Before the experiment		8 Weeks after		t	p
	$\bar{x}$	S.D.	$\bar{x}$	S.D.		
weight(kg)	72.22	5.41	70.98	5.29	3.607	0.007*
BMI（kg/m^2）	23.52	1.58	23.37	1.59	1.263	0.242
WHR (cm)	0.81	0.05	0.81	0.03	-0.354	0.733
BFP(%)	16.73	2.67	16.94	2.49	-0.696	0.506
Skeletal muscle(kg)	35.70	2.34	35.39	2.26	1.404	0.198
muscle(kg)	55.80	3.66	55.42	3.60	1.010	0.342
protein(kg)	12.26	0.80	12.17	0.77	1.037	0.330
VO_2 max(ml/kg/min)	55.42	6.30	54.55	5.64	0.322	0.755

*p<0.05 indicates significant differences in the data.

Table 8 shows the mean and standard deviation of body composition and VO_2 max in the placebo+aerobic exercise group. The results obtained through paired sample t-test showed that after drinking placebo+aerobic exercise, the placebo+aerobic exercise group had a significant decrease in weight after 8 weeks.

Table 9 Comparison of mean and standard deviation of aerobic exercise group before and after 8 weeks of experiment (n=10)

variable	Before the experiment		8 Weeks after		t	p
	$\bar{x}$	S.D.	$\bar{x}$	S.D.		
weight(kg)	70.42	4.69	67.82	3.36	2.917	0.017*
BMI（kg/m^2）	23.16	1.73	22.69	1.43	3.136	0.012*
WHR (cm)	0.80	0.05	0.77	0.04	1.647	0.134
BFP(%)	16.82	3.27	15.58	3.04	3.240	0.010*
Skeletal muscle(kg)	34.78	1.74	34.58	1.76	0.933	0.375
muscle(kg)	54.36	2.73	54.04	2.76	0.936	0.374
protein(kg)	11.98	0.58	11.90	0.60	1.037	0.327
VO2 max(ml/kg/min)	55.88	5.00	58.07	3.88	-1.500	0.168

*p<0.05 indicates significant differences in the data.

Table 9 shows the mean and standard deviation of body composition and VO_2 max in the aerobic exercise group. According to the paired sample t-test results, after 8 weeks of aerobic training, the weight, BMI, and BFP of the aerobic exercise group significantly decreased.

Table 10 Comparison of mean and standard deviation of heart rate after Harvard step test.

	Week 1 $\bar{x}$ ± S.D.	8 Weeks after $\bar{x}$ ± S.D.	t	p
AE+soybean milk				
HR(time/ minute)				
Immediately after exercise	135.40±16.97	138.40±9.65	-0.728	0.485
3 minutes after exercise	108.60±12.96	106.00±8.32	1.353	0.209
AE+placebo				
HR(time/ minute)				
Immediately after exercise	133.11±15.00	135.11±13.38	-0.313	0.762
3 minutes after exercise	108.55±11.51	105.22±7.31	0.732	0.485
Aerobic exercise				
HR(time/ minute)				
Immediately after exercise	134.40±11.91	126.80±9.24	1.500	0.168
3 minutes after exercise	105.30±7.88	99.10±4.81	2.160	0.059

Table 10 shows the mean and standard deviation of immediate heart rate and 3-minute heart rate after the Harvard Step Test.The results of paired sample t-test showed $p>0.05$, which is not significant.

3 Compare the data between the three groups after 8 weeks using one-way ANOVA Bonferroni test (See Table 11 for details). If significance, perform multiple comparisons (See Table 12 for details).

Table 11 Shows a comparison after 8 weeks of the three experimental groups.

variable		SS	df	MS	F	p
weight (kg)	Between Groups	144.627	2	72.313	2.979	0.068
	Within Groups	631.126	26	24.274		
	Total	775.752	28			
BMI (kg/m^2)	Between Groups	3.973	2	1.987	0.771	0.473
	Within Groups	67.006	26	2.577		
	Total	70.979	28			
WHR (cm)	Between Groups	0.008	2	0.004	1.967	0.160
	Within Groups	0.054	26	0.002		
	Total	0.062	28			
BFP (%)	Between Groups	9.154	2	4.577	0.534	0.593
	Within Groups	223.018	26	8.578		
	Total	232.172	28			
Skeletal muscle (kg)	Between Groups	67.512	2	33.756	6.597	0.005*
	Within Groups	133.040	26	5.117		
	Total	200.552	28			
muscle (kg)	Between Groups	160.333	2	80.166	6.382	0.006*
	Within Groups	326.580	26	12.561		
	Total	486.912	28			
protein(kg)	Between Groups	8.708	2	4.354	7.220	0.003*
	Within Groups	15.680	26	0.603		
	Total	24.388	28			
HR 1(time/ minute)	Between Groups	711.939	2	355.969	3.044	0.065
	Within Groups	3.40.889	26	166.957		
	Total	3752.828	28			
HR 2(time/ minute)	Between Groups	282.372	2	141.186	2.912	0.072
	Within Groups	1260.456	26	48.479		
	Total	1542.828	28			
VO_2 max (ml/kg/min)	Between Groups	125.984	2	62.992	3.041	0.065
	Within Groups	538.494	26	20.711		
	Total	664.478	28			

*p<0.05 indicates significant differences in the data.HR 1=instantaneous heart rate after Harvard Step Test; HR 2=Heart rate 3 minutes after Harvard Step Test.

According to the results in Table 11, there are significant differences in skeletal muscle, muscle, and protein among the three groups. So, we chose skeletal muscle, muscle, and protein for multiple comparisons.

Table 12 Shows a pairwise comparison of the differences of Skeletal muscle, muscle, and protein in three experimental groups

variable	group	$\bar{x}$	AE+soybean milk		AE+placebo		Aerobic exercise	
Skeletal muscle(kg)	AE+soybean milk	38.10			(-2.70)	0.04	(-3.52)	0.00
	AE+placebo	35.39	(2.70)	0.04			(-0.81)	1.00
	Aerobic exercise	34.58	(3.52)	0.00	(0.81)	1.00		
muscle(kg)	AE+soybean milk	59.50			(-4.07)	0.05	(-5.46)	0.00
	AE+placebo	55.42	(4.07)	0.05			(-1.38)	1.00
	Aerobic exercise	54.04	(5.46)	0.00	(1.38)	1.00		
protein(kg)	AE+soybean milk	13.16			(-0.98)	0.03	(-1.26)	0.00
	AE+placebo	12.17	(0.98)	0.03			(-0.27)	1.00
	Aerobic exercise	11.90	(1.26)	0.00	(0.27)	1.00		

The mean difference is significant at the 0.05 level.

Table 12 made multiple comparisons among the three experimental groups according to the Bonferroni test. The results showed that there were significant differences in skeletal muscle, muscle content and protein content between the soybean milk+aerobic exercise group and the placebo+aerobic exercise group, There are also significant differences in skeletal muscle, muscle content and protein content between the soybean milk+aerobic exercise group and the aerobic training group, However, there was no significant difference in experimental results between the placebo+aerobic exercise group and the aerobic training group. This result shows that soybean milk+aerobic exercise can significantly improve the skeletal muscle content, muscle content and protein content of college students.

CHAPTER 5
CONCLUSION DISCUSSION AND SUGGESTIONS

This study studied the effect of soybean milk combined with aerobic training on body composition and VO_2 max of college students, and reached the following conclusions:

1. Research objective

2. Conclusion

3. Discussion

4. Suggestions

1. Research objective

1. Comparison of VO_2 max and body composition before and after the experiment between aerobic exercise+soybean milk group (500ml soybean milk+4g stevia), aerobic exercise+placebo group (500ml water+4g stevia) and aerobic exercise group.

2 Compare the difference of VO_2 max and body composition between aerobic exercise+soybean milk group (500ml soybean milk+4g stevia), aerobic exercise+placebo group (500ml water+4g stevia) and aerobic exercise group.

2. Conclusion

1. According to the results of paired sample T test, the skeletal muscle, muscle content and protein of the soybean milk+aerobic exercise group were significantly improved after 8 weeks. The weight of the placebo+aerobic exercise group significantly decreased after 8 weeks. The weight, BMI, and BFP of the aerobic exercise group significantly decreased after 8 weeks.

2. According to the results of the one-way ANOVA Bonferroni test, skeletal muscle, muscle and protein were significant between the three experimental groups.

After Multiple Comparisons, the results showed that 8 weeks of soy milk + aerobic exercise significantly increased skeletal muscle content, muscle content and protein content.

3. Discussion

The purpose of this study was to examine the effects of soy milk combined with aerobic exercise on VO_2 max and body composition in college students. The results of the study showed that sustained intake of soymilk for 8 weeks combined with aerobic exercise significantly increased skeletal muscle mass, muscle mass and protein content. Continuous intake of placebo and aerobic exercise for 8 weeks can significantly reduce body weight. Continuous aerobic exercise for 8 weeks can significantly reduce weight, BMI, and BFP. The results of this study show the different effects of different interventions on body composition.

1. Differences in body composition and VO_2 max before and after the experiment were compared among the 3 experimental groups.

1.1 The study found that continuous 8 weeks of soybean milk intake combined with aerobic exercise can significantly improve the skeletal muscle content, muscle content and protein content. This is consistent with the hypothesis of this study that soybean milk+aerobic exercise can play a role in reducing fat and increasing muscle for college students. The average value of BFP in the soybean milk+aerobic exercise group before the experiment was 16.71, and the average value after 8 weeks was 16.00. Although the result was not significant, it showed a downward trend.

The results of the study by Liu Na (2016) showed that soybean oligopeptides have a protective effect on skeletal muscle cell membranes. The research results of Tan Qiushi (2022) demonstrate that soy peptides can alleviate skeletal muscle injury. Fabio L. Orsati (2017) believes that resistance training and high-quality protein intake can improve muscle mass and strength. His research results show that soy protein combined with 16 weeks of resistance training can significantly improve muscle strength. You Lirong (2017) conducted a 6-month

muscle building experiment on 20 bodybuilders and 20 fitness enthusiasts, and her findings proved that soy peptides prepared by processing using soy protein can be effective in increasing muscle content as a sports supplement. The research results of Deby Tri Mario (2022) show that soybean milk, protein and tofu can all increase muscle content. The research results of Nahid Bijeh (2022) show that resistance training+soybean milk can significantly increase muscle mass. Muscle mass refers to the proportion and quality of human muscle content, and the evaluation criteria mainly include muscle mass index and skeletal muscle content. These research results are consistent with the conclusions of this study. According to the research conclusion of Melissa M. Markofski (2018), when adequate protein intake is taken, amino acid supplementation plus aerobic training can improve muscle mass. Soybean milk is rich in plant protein and amino acids. In this study, the muscle content of the soybean milk+aerobic training group has significantly increased, which may be closely related to the rich nutrients in soybean milk and the comprehensive effect of aerobic exercise. Soybean milk combined with aerobic training may have a significant synergistic effect on improving the level of amino acids in the body and promoting muscle synthesis.

1.2 The study found that sustained 8-week intake of placebo + cardio training resulted in significant weight loss. Continuous aerobic training for 8 weeks can significantly reduce weight, BMI, and BFP.

The placebo component of this study was 500ml water+4g stevia. Based on the comparison of results between these two groups, we can conclude that supplementing water 30 minutes before exercise is not conducive to Lose fat. In the study of Nahid Bijeh (2022), BMI and BFP of his three intervention groups, resistance training+placebo group, soybean milk group and resistance training+soybean milk group, were significantly reduced. Whereas only the aerobic training group in the present study had a significant reduction in BMI and BFP, the soy milk combined with aerobic training group had a reduction in BFP, but the results were not significant. This may be related to the duration of the experiment and the training method. Nahid Bijeh's (2022) experiment lasted for 12 weeks, while the experiment in

this study lasted for 8 weeks. Although the training plan in this study includes aerobic resistance training, running training is still the main exercise method. Dorota The research results of Kostrzewa Nowak (2015) demonstrate that aerobic training can significantly reduce body weight, BMI, and BFP.A study by Hamid Arazi (2012) showed that 8 weeks of aerobic training had a significant effect on both body weight and BMI. This is consistent with the experimental results of this study.

1.3 VO_2 max is the best indicator for evaluating cardiorespiratory endurance, and research has shown that there is a high correlation between cardiorespiratory endurance and cardiac metabolism, psychology, and certain physiological health indicators.

Wang Zuiru's (2014) study showed that aerobic exercise combined with soy isoflavones supplementation was more effective in protecting the myocardium than either aerobic exercise or soy isoflavones supplementation alone. Wang Feng (2019) showed that soy protein can improve fatigue resistance, improve energy metabolism patterns, improve antioxidant capacity, reduce sports injuries, and thus improve athletic performance. A study by Yonglei Xie (2019) demonstrated that soy peptides have an ameliorative effect on cardiac function, hemodynamics, and pathological damage. In the study of Nahid Bijeh (2022), 12-week resistance training+soybean milk significantly increased VO_2 max. The research results of Fateme Ghorbani (2014) indicate that 6-week aerobic training can greatly improve cardiovascular strength and BMI.A study by Hamid Arazi (2012) showed that 8 weeks of aerobic training had a significant effect on VO_2 Max. This study assumes that soybean milk+aerobic training can improve college students' cardiopulmonary endurance, However, the results of this study indicate that the VO_2 max of all three experimental groups was not significantly affected, which may be related to environmental factors, The Harvard Step Test 8 weeks later was completed on May 27th, and volunteers reported that the hot weather affected their physical condition. The high temperature environment significantly increased heart rate, causing a decrease in aerobic capacity and VO_2 max.

2. Compare the differences between three experimental groups

According to the results of this study, soy milk combined with aerobic exercise helps to increase skeletal muscle content, muscle content and protein content. This is consistent with the research findings of Fábio L. Orsati (2017), Yulirong (2017), Nahid Bijeh (2022), and Melissa M. Markofski (2018). When performing aerobic exercise alone, it showed effective control overweight, BMI, and body fat percentage, indicating that aerobic exercise has a significant effect in reducing body fat and improving body composition. This is consistent with the findings of Kostrzewa Nowak (2015) and Hamid Arazi (2012). This may be due to the metabolic effect and energy expenditure of aerobic exercise, further validating the important role of aerobic exercise in weight management. In contrast, the placebo + aerobic exercise's only showed significance in weight loss, which may indicate that pre-exercise hydration is not appropriate. These findings provide an important basis for developing personalized health intervention strategies. For example, for those who mainly focus on muscle growth and protein supplementation, the combination of soybean milk and aerobic exercise may be an effective choice. For individuals aiming to lose weight and control body fat, simple aerobic training may be more suitable.

4. Suggestions

1. Suggestions for applying research

1.1 The experimental period should be extended to 12 to 16 weeks, because the average value of BFP in the soybean milk+aerobic exercise group and the average value of WHR in the aerobic training group showed a downward trend, but not significant.

1.2 The Harvard step test should pay attention to avoiding the influence of weather (temperature) and environment to avoid affecting the heart rate and VO_2 max of volunteers.

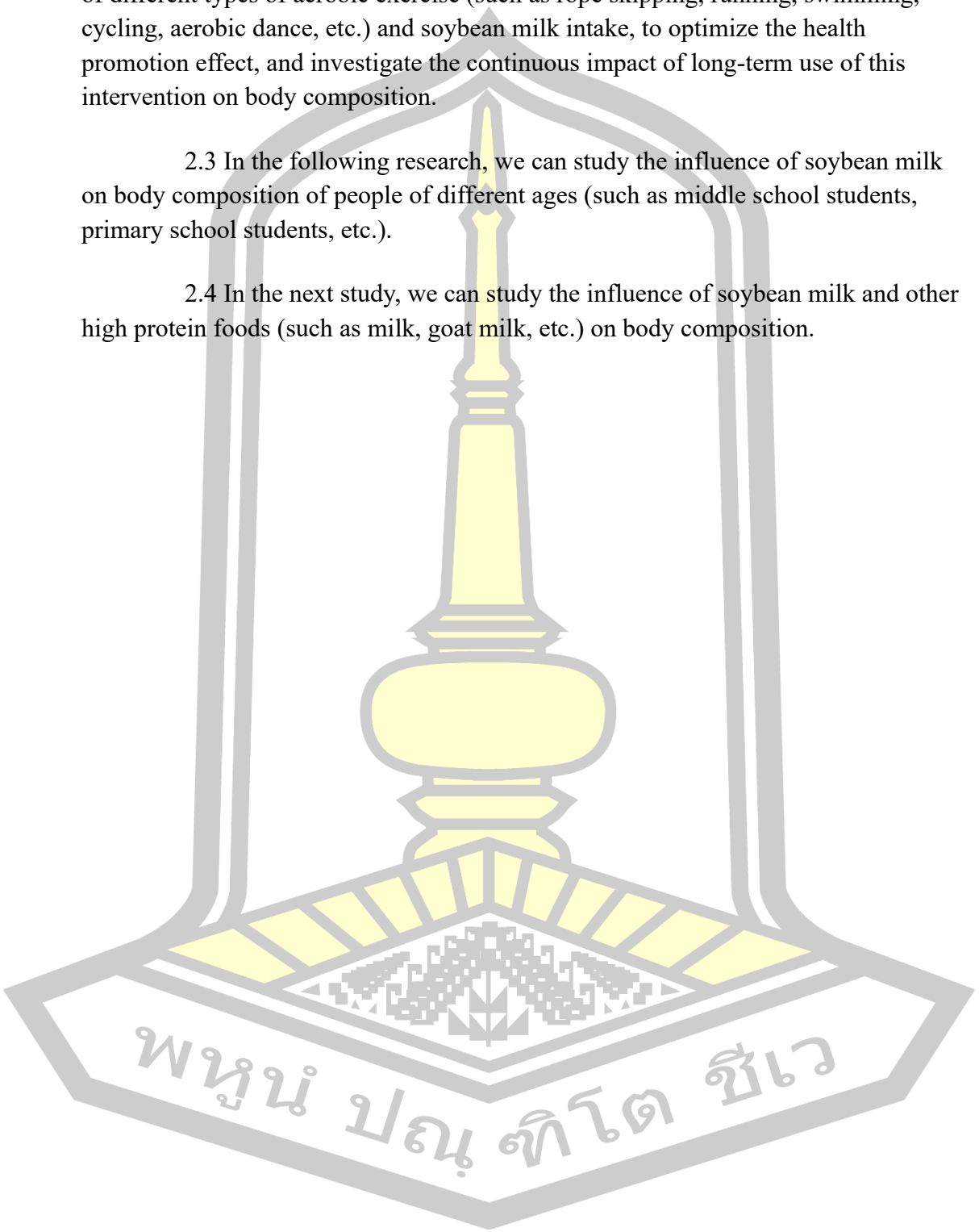
2. Suggestions for future research

2.1 In the following research, the differences in body composition between pre-exercise and post exercise supplementation can be studied.

2.2 In the following research, we can further explore the best combination of different types of aerobic exercise (such as rope skipping, running, swimming, cycling, aerobic dance, etc.) and soybean milk intake, to optimize the health promotion effect, and investigate the continuous impact of long-term use of this intervention on body composition.

2.3 In the following research, we can study the influence of soybean milk on body composition of people of different ages (such as middle school students, primary school students, etc.).

2.4 In the next study, we can study the influence of soybean milk and other high protein foods (such as milk, goat milk, etc.) on body composition.



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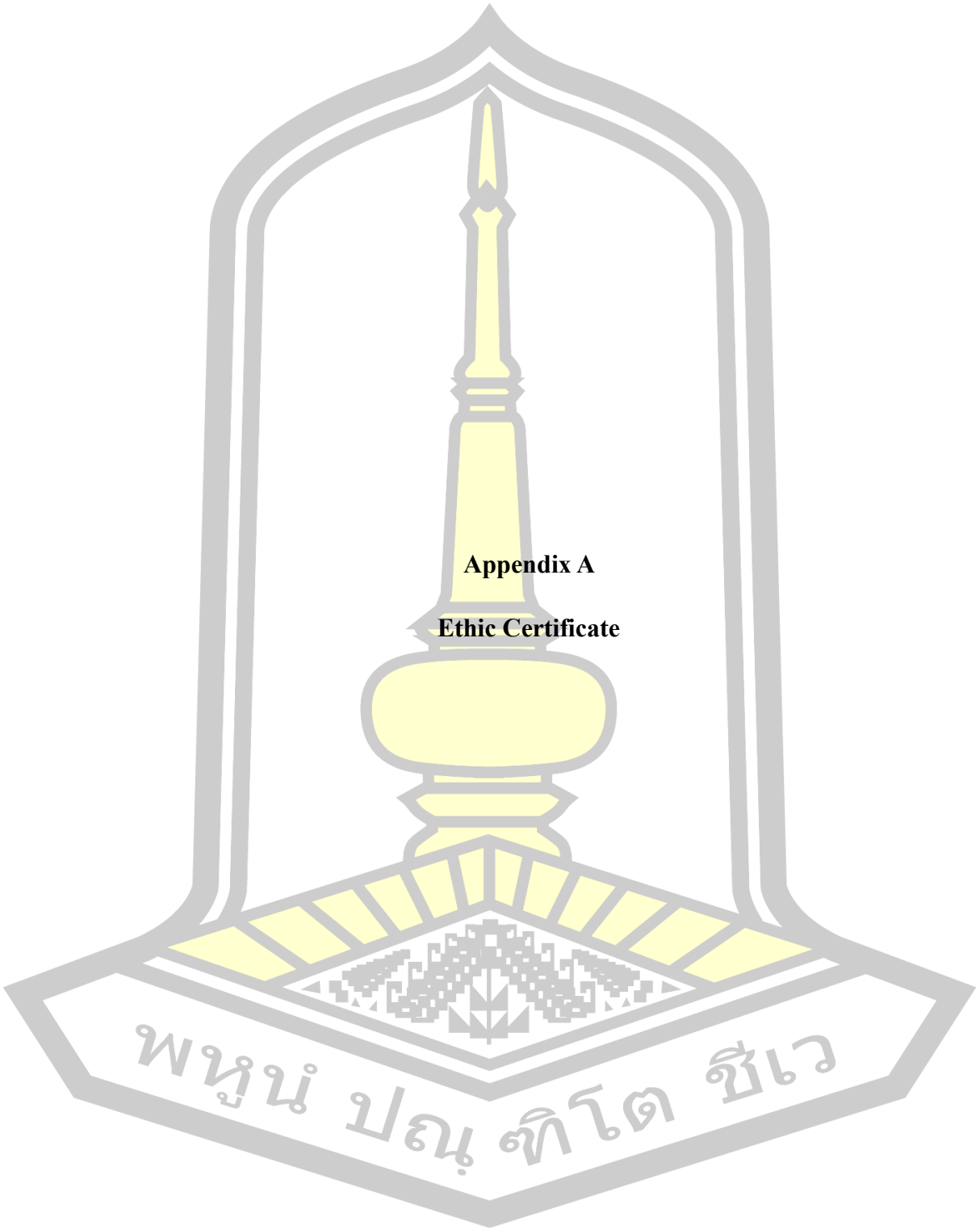
APPENDIX



Appendix A

Ethic Certificate

MAHASARAKHAM UNIVERSITY ETHICS COMMITTEE FOR RESEARCH INVOLVING HUMAN SUBJECTS

Certificate of Approval

Approval number: 545-535/2023

Title : Effect of soybean milk in conjunction with aerobic exercise on VO2 max and body composition of college students.

Principal Investigator : Su Fei
Responsible Department : Faculty of Education
Research site : Zigong City, Sichuan Province, China

Review Method : Expedited Review

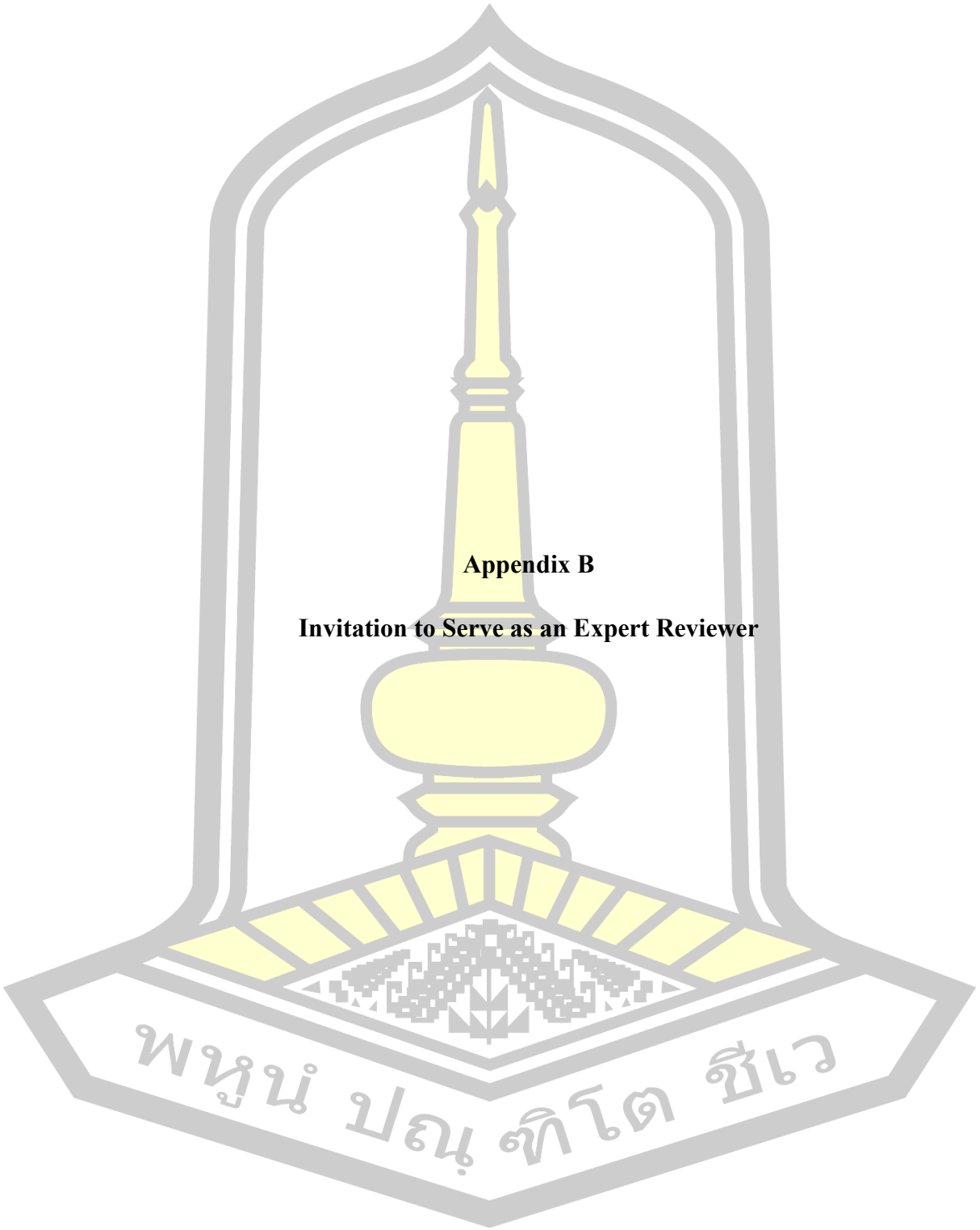
Date of Manufacture : 25 December 2023 **expire :** 24 December 2024

This research application has been reviewed and approved by the Ethics Committee for Research Involving Human Subjects, Mahasarakham University, Thailand. Approval is dependent on local ethical approval having been received. Any subsequent changes to the consent form must be re-submitted to the Committee.

Ratree S.

(Asst. Prof. Ratree Sawangjit)
Chairman

Approval is granted subject to the following conditions: (see back of this Certificate)



Appendix B

Invitation to Serve as an Expert Reviewer

FACULTY OF EDUCATION
MAHASARAKHAM UNIVERSITY

79/2 Muang, Maha Sarakham,
44000, THAILAND
Tel/fax +66 43 713 174
Email: cia.edu@msu.ac.th

Center for International Affairs

MHESRI No. 0605.5 (2) / CL968 **Date:** March 15, 2024

To: **Professor Yan Hong**
Chengdu Sport University
Professor Lei Ping
College of Physical Education, Sichuan Normal University
Professor Yang Shiyong
Chengdu Sport University

Subject: Expert Invitation

Our student, **Ms. Fei Su, student ID 63010556008,** majoring in the **M.sc. Exercise and SportScience Program** is currently undertaking a research project titled **"Effect of soybean milk in conjunction with aerobic exercise on VO2 max and body composition of college students"** under the guidance of Asst. Prof. Napatsawan Thanaponganan.

To ensure the successful execution and the highest quality of this research project, we are seeking your valuable expertise and experience. Therefore, I am sending a formal invitation to you to serve as the expert reviewer for the research instrument designed for this thesis project.

Your participation in this academic endeavor is highly valued and appreciated. Should you require any further information or have questions regarding this invitation, please do not hesitate to contact us by email.

Yours sincerely,

(Assoc. Prof. Chowwalit Chookhampaeng)
Dean, Faculty of Education,
Mahasarakham University

FACULTY OF EDUCATION
MAHASARAKHAM UNIVERSITY

79/2 Muang, Maha Sarakham,
44000, THAILAND
Tel/fax +66 43 713 174
Email: cia.edu@msu.ac.th

MHESRI No. 0605.5 (2) / CL957 **Date:** March 15, 2024

Data Collection Permission Request

To: Whom It May Concern
Sichuan Vocational College of Health and Rehabilitation

Subject: Data Collection Permission Request

Our student, **Ms. Fei Su**, **student ID 63010556008** majoring in the **M.Sc.Exercise and Sport Science Program** is currently undertaking a research project titled " Effect of soybean milk in conjunction with aerobic exercise on VO2 max and body composition of college students " under the guidance of Asst. Prof. Napatsawan Thanaponganan.

To ensure the success and quality of this project, we are seeking your permission to allow our students to process data collection within your institution.

The details of the data collection are as follows:

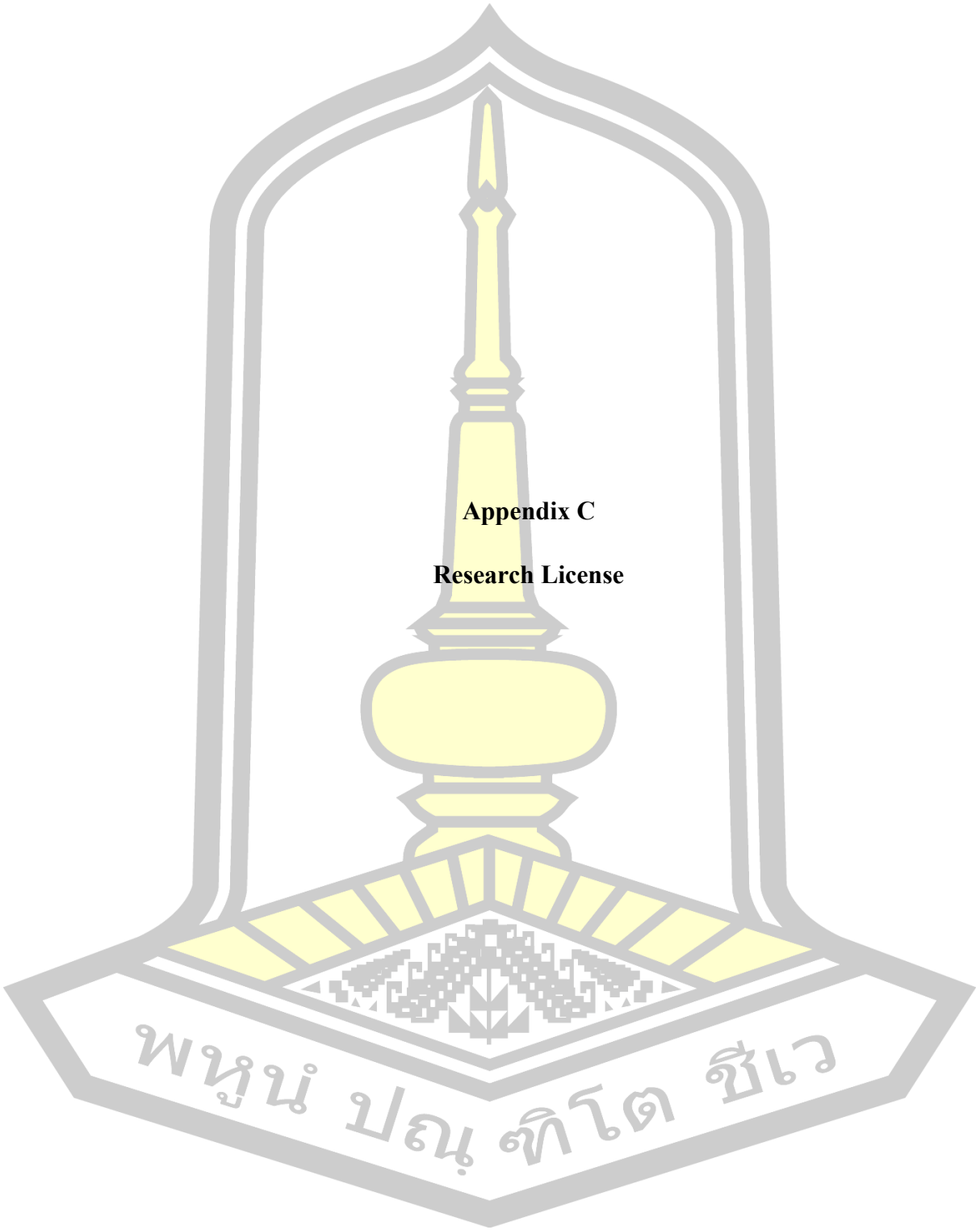
Thesis title: Effect of soybean milk in conjunction with aerobic exercise on VO2 max and body composition of college students
Period of data collection: April 1st to May 24st, 2024
Thesis advisor: Asst. Prof. Napatsawan Thanaponganan

We believe that your institution provides a valuable environment and resources that are essential for the successful execution of this research. The data collection process will be carried out diligently and with the utmost respect for your institution's policies and procedures. We acknowledge that the student has made the necessary preparations, including obtaining the Thesis title approval from our institution.

Should you require any further information or clarification regarding this permission, please feel free to contact us by email.

Yours sincerely,

Assoc. Prof. Chowwalit Chookhampaeng
Dean, Faculty of Education,
Mahasarakham University



Appendix C

Research License

Research License

As a signatory at the end of this article, I agree to participate in this study.

Project name:Effect of soybean milk in conjunction with aerobic exercise on VO_2 max and body composition of college students.

The name of the researcher : Su Fei

Supervisor : Asst. Prof.Dr.Napatsawan Thanaponganan

Study site:Sichuan Vocational College of Health and Rehabilitation

Telephone:+8618990015988 email : 17966674@qq.com

Read the explanation / listen to the explanation from Miss. Fei Su about volunteering in the research project on "Effect of soybean milk in conjunction with aerobic exercise on VO2 max and body composition of college students", the explanatory text consists of Full details about the purpose of the research, details of the research.I agree with the value of the study, I am aware of the benefits to be gained and the risks that may arise from participating in the study.Include guidelines for possible problems. Explanations and answers to any questions from the head of the research project were also received.

As well as the testimony from the researcher that will keep my information confidential. In addition, not anonymously or private information individually to the public. The results of the research will be presented in the form of an overview that is a summary of the research results for academic purposes only.

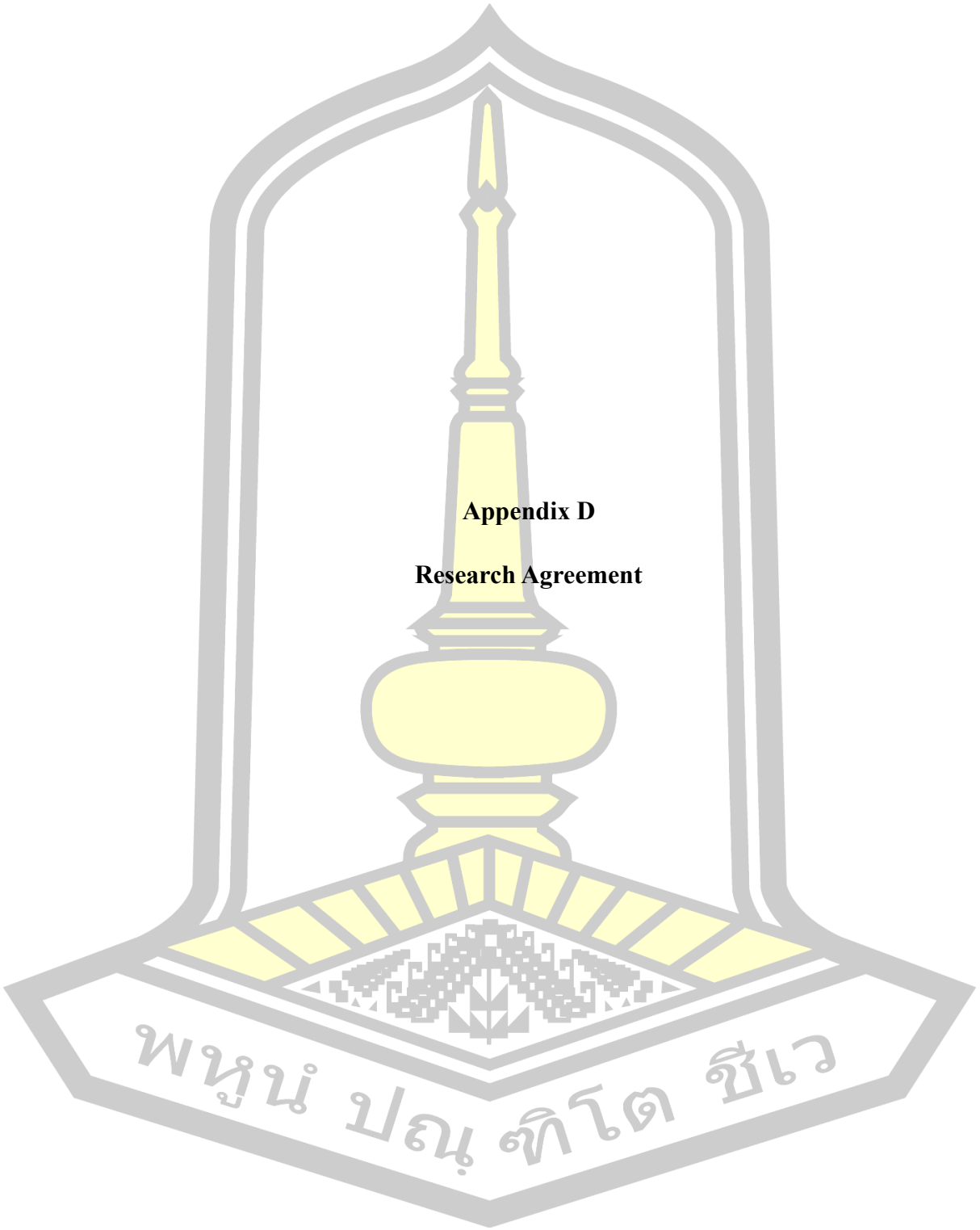
I know that there are some risks in this study. I may be injured in training, or I may feel unwell due to drinking soybean milk.I know that during the training process, there is guidance from researchers and full participation from doctors. If unexpected injuries or physical discomfort occur, doctors can provide timely treatment.

As a volunteer, I agree to participate in this 8-week experiment.I agree to train three times a week for 60 minutes each time. Drink 500ml soybean milk or placebo before training.I agree to use the Tsinghua Tongfang Human Body Composition

Analyzer to measure my weight, BMI, body mass percentage, muscle, skeletal muscle, waist to hip ratio, and protein. And agree to participate in the Harvard Step Test.

"In participating as a volunteer of this research project I join voluntarily." And I can withdraw from this study at any time. If I wish which will not have any effect and will not lose any rights in study or work that I will receive in the future.

.....	.....
( )	( )
Signatory study participant	Sign the principal investigator.
.....	.....
( )	( )
Witness	guardian



Appendix D

Research Agreement

Research Agreement

In order to effectively conduct human body composition and Harvard step testing, volunteers are required to comply with the following regulations:

1. Volunteers are not allowed to eat soy products before and during the experiment. One week before the experiment, volunteers are required to rest for at least 8 hours per day. During the experiment, ensure sufficient sleep for 6-8 hours per day.

2. Volunteers should eat in the same cafeteria during the experiment, and their dietary structure should not change as much as possible.

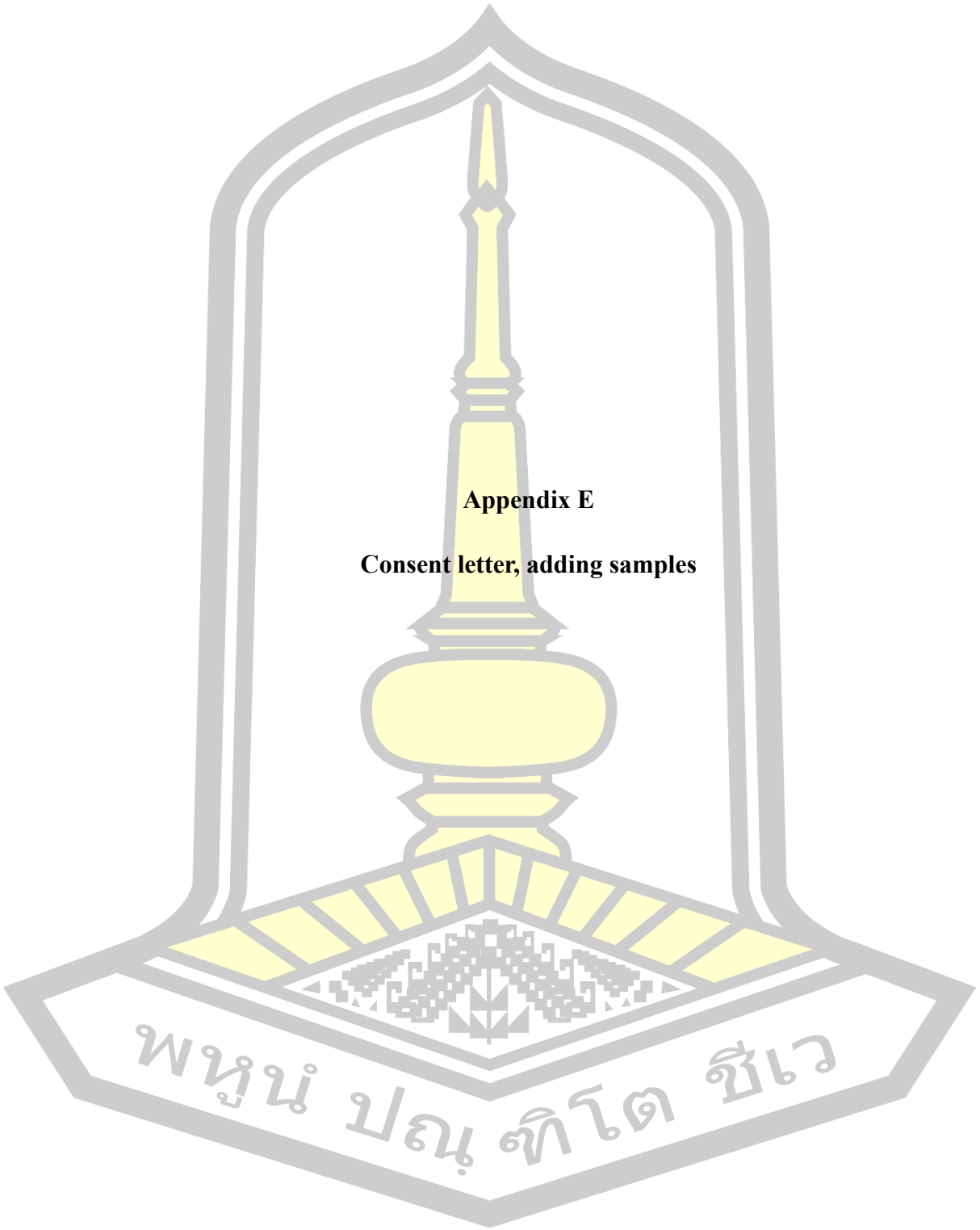
3. Volunteers should not engage in physical activity outside of class and training during the experiment, and should not engage in vigorous exercise before training.

4. Do not drink alcohol or caffeinated beverages within 24 hours before training.

5. Test dates require no drugs or stimulants, such as tea, coffee, or smoking。

6. Volunteers should wear clothing suitable for sports. During the testing process, if the athlete feels uncomfortable or if there is one thing that can be expected to have a negative impact on the test results, the testing should be stopped and the testing personnel notified.

7. Make every effort to complete the test.



Appendix E

Consent letter, adding samples

Consent Letter, Adding Samples

Clarification: Explain the participants of the study to the volunteers.

Project name:Effect of soybean milk in conjunction with aerobic exercise on VO_2 max and body composition of college students.

We invite you to participate in a study targeting male college students aged 18 to 20.

30 eligible volunteers were randomly divided into three groups: aerobic training+soybean milk group (500ml soybean milk+4g stevia), aerobic training+placebo group (500ml water+4g stevia) and aerobic training group .10 people in each group.

The AT+soybean milk group was supplemented with 500ml soybean milk 30 minutes before training, and the AT+placebo group was supplemented with 500ml placebo, while the AT group did not, for 8 consecutive weeks.

Within 24 hours before the experiment, participants are required to avoid alcohol, carbonated beverages, caffeine, and soy products. And ensure 6-8 hours of sufficient sleep every day.

All participants can participate in normal activities such as diet, exercise, etc., but be careful not to eat soy products, coffee, weight loss, etc.

The samples report at 6pm on each training day and avoid vigorous exercise within 5 hours before the training.

Conduct a body composition test and a Harvard step test before the experiment.

1. Train every Monday, Wednesday, and Friday for a total of 8 weeks. Each training session lasts for 1 hour, starting with a 15 minute warm-up exercise and then running on the treadmill. The treadmill can monitor real-time heart rate and maintain a 30 minute running workout after reaching 70% of the maximum heart rate. After the training, the speed on the treadmill gradually becomes slow walking, and after 5 minutes of slow walking, perform 10 minutes of stretching training. All three groups

participated in the same training at the same time, ensuring equal weekly exercise time and amount of exercise.

2. After 8 weeks, the body composition test and Harvard step test will be conducted again. Compare the data before and after the experiment for analysis.

3. After drinking soybean milk for 1 hour to 1 day, the sample received a questionnaire on symptoms. Whether you feel uncomfortable after drinking soybean milk, such as stomach discomfort, nausea, vomiting, dry lips, tight chest, abdominal dyspnea, shortness of breath, etc.

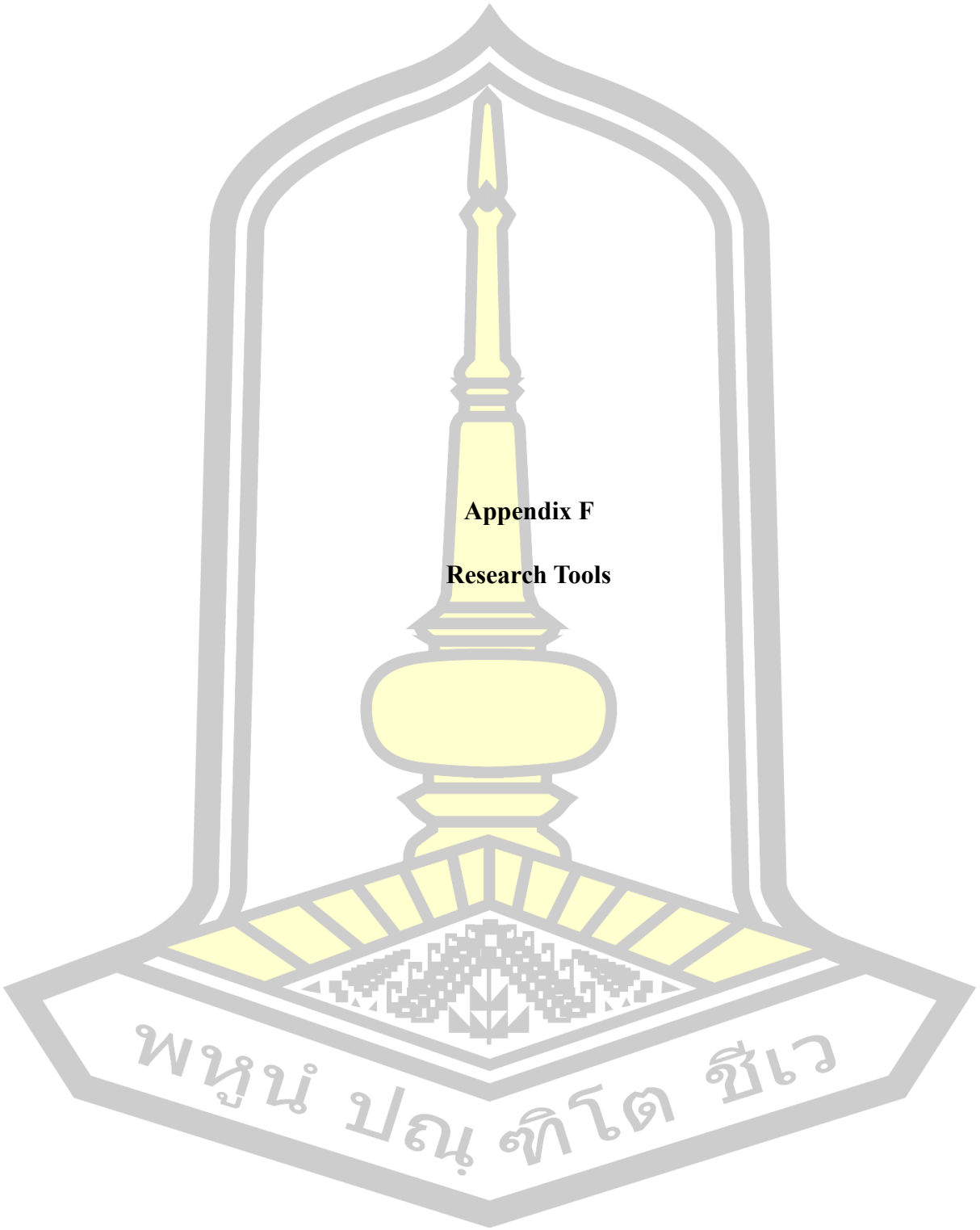
Accepting or refusing to participate in the study will not affect the sample. All information is confidential and for research purposes only. The research results are provided in the overview. Samples can submit a request to leave the study before the end of the study, without any reason or explanation.

If you have any questions, please contact Su Fei. Thank you.

Telephone: +86 18990015988

Thank you for your cooperation.

Signature: Su Fei



Appendix F

Research Tools

Research tools

1. General questionnaire
2. Health assessment record form
3. Physical Activity Readiness Questionnaire（PAR-Q）
4. Interview on feelings and symptoms after taking 500ml soybean milk
5. Transcript of Human Body Composition Test
6. Harvard Step Test Transcript
7. Training Plan

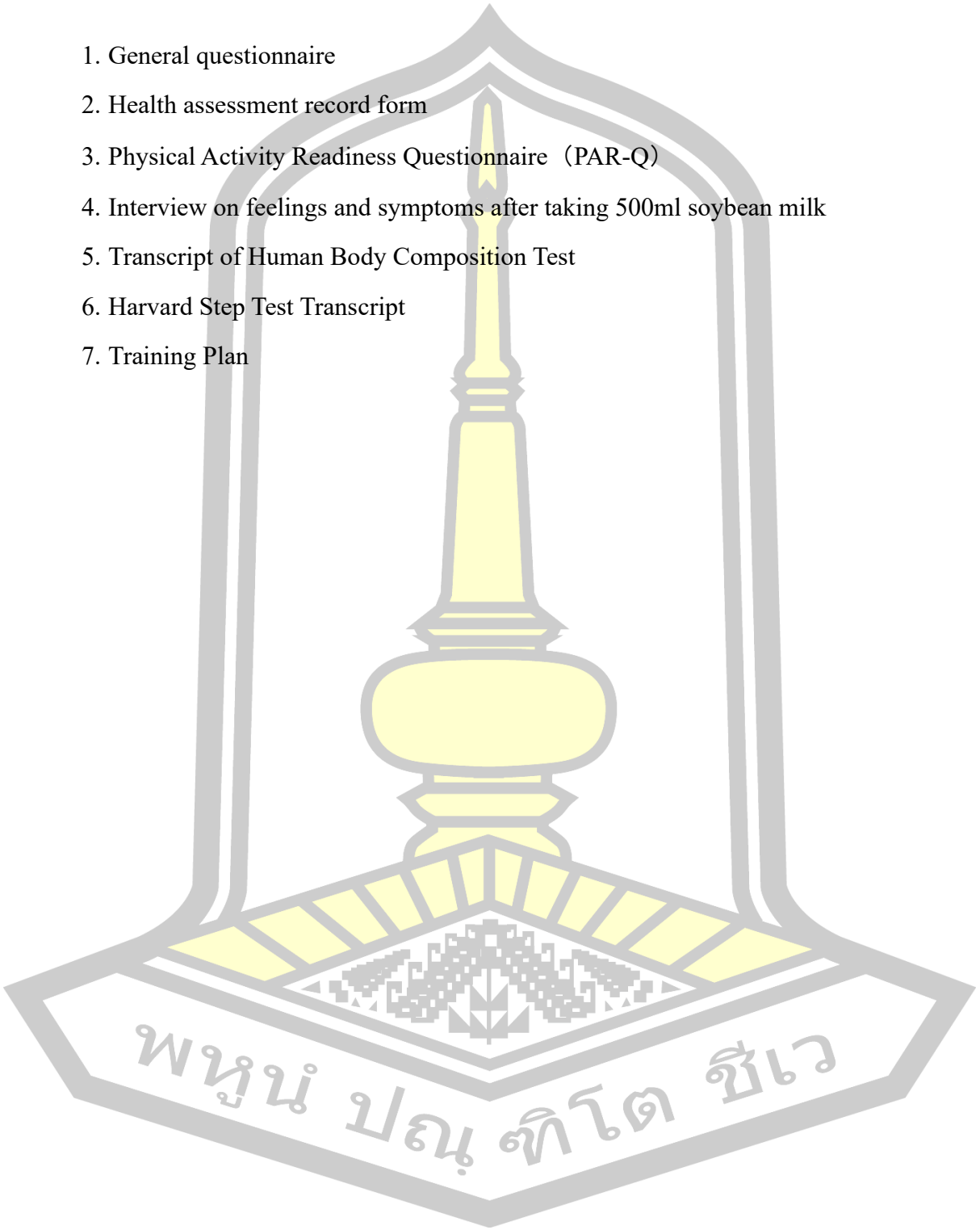


Table 1 : General questionnaire on soybean milk research

Hello, may I bother you for 4 minutes? I am conducting a study related to Soybean Milk and hope to select suitable volunteers through this survey questionnaire.The purpose of this study is to explore the effect of soybean milk combined with aerobic exercise on VO2 max and body composition of college students.If you are willing to participate in the experiment, please fill in the following questions.

Student ID : Age :

1. What is your height and weight?

height.....cm weight.....KG

2. Have you ever drunk Soybean Milk?

☐ YES ☐ NO

3. Do you have a habit of drinking soy milk?

☐ YES ☐ NO

4. Do you have a history of allergies to soy products?

☐ YES ☐ NO

5. Do you know some of the nutritional components of Soybean Milk?

☐ YES For example : ..... ☐ NO

6. Do you know some of the benefits of drinking soy milk?

☐ YES For example : ..... ☐ NO

7. Are you physically fit and willing to do aerobic training 3 times a week?

☐ YES ☐ NO

8. Food you often eat (multiple choices)？

☐ 8.1 Chicken cutlet rice, braised pork rice, covered rice, etc

☐ 8.2 Sweets: beverages, soda, pastries, etc

☐ 8.3 coffee

☐ 8.4 Cured products: salted eggs, sausages, bacon, etc

☐ 8.5 Prefer bland food

☐ 8.6 Love spicy food

☐ 8.7 Fried food, snacks

9. What supplements have you taken in the past month（multiple choices）?

☐ 9.1 Herbal name.....

☐ 9.2 Beauty and skincare products

☐ 9.3 Weight loss product

☐ 9.4 Muscle nutritional supplements

☐ 9.5 Ordinary health products

☐ 9.6 Brain tonics

☐ 9.7 Not taking any supplements or nutritional supplements

10. In the past month, the type of regular exercise other than professional training (single choice).

☐ 10.1 Walking/Running ☐ 10.5 Swimming

☐ 10.2 calisthenics ☐ 10.6 volleyball

☐ 10.3 football ☐ 10.7 badminton

☐ 10.4 basketball ☐ 10.8 tennis

☐ 10.9 Not exercising except for professional courses

11.What is the amount of sleep and rest time in the past month?

☐ 11.1 Less than 4 hours/day ☐ 6-8 hours/day

☐ 11.2 2 hours/day ☐ Over 8 hours/day

12.Are you willing to participate in this study?

☐ YES ☐ NO

The research object of this experiment is male college students who are not allowed to drink or smoke during their school years. Therefore, this survey questionnaire did not involve a survey on alcohol consumption and smoking.

Table 2 :

（signature）.....Study participant

weight.....kg

height.....cm

Health assessment record form

1. Family history.....

2. Your medical history.....

3. Drug History

3.1 Conventional medication.....

3.2 Drug allergy history.....

4. This table displays health information from samples diagnosed by doctors.

list	Inspection result
1. Heart rate (frequency/minute)	
2. Cardiovascular examination -Measure blood pressure -Listen to his heartbeat and pulse	
3. Musculoskeletal system screening ☐ Balanced, shoulder level ☐ neck movement ☐ Shoulder joint movement ☐ Movement of the elbow ☐ Movement of wrist and finger joints ☐ Knee joint anterior symmetry ☐ spine ☐ Leg muscle strength ☐ Balance of spinal curve	
Physical examination report	☐ normal ☐ abnormal ☐ Can participate in research ☐ Unable to participate in research
Examining doctor's signature：.....	

Table 3：**Physical Activity Readiness Questionnaire（PAR-Q）**

（A Questionnaire for People Aged 15 to 69）

If you are between the ages of 15 and 69, PAR-Q will tell you if you should consult a doctor before starting exercise.

Please read the questions carefully and answer each one honestly: check YES or NO.

YES NO

☐ ☐ 1. Has your doctor ever said that you have a heart condition *and* that you should only do physical activity recommended by a doctor?

☐ ☐ 2. Do you feel pain in your chest when you do physical activity?

☐ ☐ 3. In the past month, have you had chest pain when you were not doing physical activity?

☐ ☐ 4. Do you lose your balance because of dizziness, or do you ever lose consciousness?

☐ ☐ 5. Do you have a bone or joint problem (for example, back, knee or hip) that could be made worse by a change in your physical activity?

☐ ☐ 6. Is your doctor currently prescribing drugs (for example, water pills) for your blood pressure or heart condition?

☐ ☐ 7. Do you know of any other reason why you should not do physical activity?

Source of information:(ACSM. 2006)

Before any voluntary exercise, I have read and understood the above questions and filled out this self-assessment form.

（signature）.....Study participant （signature）.....researcher

(.....) (.....)

Table 4: Questionnaire on feelings and symptoms after taking 500ml soybean milk

NO	YES	
☐	☐	1. Do you feel Nausea or vomiting after drinking 500ml of soybean milk?
☐	☐	2. Do you feel Dizziness and headache after drinking 500ml of soybean milk?
☐	☐	3. Do you feel dyspnea after drinking 500ml soybean milk?
☐	☐	4. Do you feel tight chested after drinking 500ml soybean milk?
☐	☐	5. Do you feel stomachache after drinking 500ml soybean milk?
☐	☐	6. Do you have diarrea after drinking 500ml soybean milk?
☐	☐	7. Do you feel Dry lips and Tongue after drinking 500ml of soybean milk?
☐	☐	8. After drinking 500ml soybean milk, do you think soybean milk is Boring Food?
☐	☐	9. After drinking 500ml of soybean milk, do you feel rapid heartbeat?
☐	☐	10. After drinking 500ml of soybean milk, do you feel uneasy?
☐	☐	11. After drinking 500ml of soybean milk, do you have sleepless?
☐	☐	12. After drinking 500ml of soybean milk, do you have any constipation?
☐	☐	13. Do you have any other symptoms after drinking 500ml soybean milk?

If so, please.....

（signature）.....Study participant

(.....)

Table 5 : Transcript of Human Body Composition Test

Student ID	age	height	weight	BMI	WHR	BPF	Skeletal muscle	Muscle content	protein
A01									
A02									
A03									
A04									
A05									
A06									
A07									
A08									
A09									
A10									
B01									
B02									
B03									
B04									
B05									
B06									
B07									
B08									
B09									
B10									
C01									
C02									
C03									
C04									
C05									
C06									
C07									
C08									
C09									
C10									

This study used the Tsinghua Tongfang Body Composition Analyzer to measure body composition.

Comparison and Analysis Record of Body Composition

Aerobic training+soybean milk group

Student ID		A01	A02	A03	A04	A05	A06	A07	A08	A09	A10
BMI	Before testing										
	After 8 weeks										
WHR	Before testing										
	After 8 weeks										
BPF	Before testing										
	After 8 weeks										
weight	Before testing										
	After 8 weeks										
Skeletal muscle	Before testing										
	After 8 weeks										
Muscle content	Before testing										
	After 8 weeks										
protein	Before testing										
	After 8 weeks										

Aerobic training placebo group

Student ID		B01	B02	B03	B04	B05	B06	B07	B08	B09	B10
BMI	Before testing										
	After 8 weeks										
WHR	Before testing										
	After 8 weeks										
BPF	Before testing										
	After 8 weeks										
weight	Before testing										
	After 8 weeks										
Skeletal muscle	Before testing										
	After 8 weeks										
Muscle content	Before testing										
	After 8 weeks										
protein	Before testing										
	After 8 weeks										

Aerobic training group

Student ID		C01	C02	C03	C04	C05	C06	C07	C08	C09	C10
BMI	Before testing										
	After 8 weeks										
WHR	Before testing										
	After 8 weeks										
BPF	Before testing										
	After 8 weeks										
weight	Before testing										
	After 8 weeks										
Skeletal muscle	Before testing										
	After 8 weeks										
Muscle content	Before testing										
	After 8 weeks										
protein	Before testing										
	After 8 weeks										

Table 6 : Transcript of the Harvard Step test

AE+soybean milk group

Student ID	Heart rate/minute		VO_2 max	
	Before testing	After 8 weeks	Before testing	After 8 weeks
A01				
A02				
A03				
A04				
A05				
A06				
A07				
A08				
A09				
A10				

AE+placebo group

Student ID	Heart rate/minute		VO_2 max	
	Before testing	After 8 weeks	Before testing	After 8 weeks
B01				
B02				
B03				
B04				
B05				
B06				
B07				
B08				
B09				
B10				

AE group

Student ID	Heart rate/minute		VO_2 max	
	Before testing	After 8 weeks	Before testing	After 8 weeks
C01				
C02				
C03				
C04				
C05				
C06				
C07				
C08				
C09				
C10				

Table 7：Training Plan

The AT+soybean milk group was supplemented with 500ml soybean milk 30 minutes before training, and the AT+placebo group was supplemented with 500ml placebo, while the AT group was not supplemented.

Week 1-3

date	Exercise plan	Max HR (%)	Time (minutes)
Monday	1. Warm up 2. Aerobic resistance training 2.1 Sit ups：2 Set (1set/15) 2.2 Deep squat：2 Set (1set/10) 2.3 push-up：2 Set (1set/5) 3. Training on a treadmill RPE=4-6 4. Relaxation exercise **5.8** Walk slowly on the treadmill RPE=1-2 4.2 Relax stretching	60-65%	10 10 30 5 5
Wednesday	1. Warm up 2. Aerobic resistance training 2.1 Sit ups：2 Set (1set/15) 2.2 Deep squat：2 Set (1set/10) 2.3 push-up：2 Set (1set/5) 3. Training on a treadmill RPE=4-6 4. Relaxation exercise 4.1 Walk slowly on the treadmill RPE=1-2 4.2 Relax stretching	60-65%	10 10 30 5 5
Friday	1. Warm up 2. Aerobic resistance training 2.1 Sit ups：2 Set (1set/15) 2.2 Deep squat：2 Set (1set/10) 2.3 push-up：2 Set (1set/5) 3. Training on a treadmill RPE=4-6 4. Relaxation exercise 4.1 Walk slowly on the treadmill RPE=1-2 4.2 Relax stretching	60-65%	10 10 30 5 5

Week 4−6

date	Exercise plan	Max HR (%)	Time (minutes)
Monday	1. Warm up 2. Aerobic resistance training 2.1 Sit ups：2 Set (1set/30) 2.2 Deep squat：2 Set (1set/15) 2.3 push-up：2 Set (1set/10) 3. Training on a treadmill RPE=6-7 4. Relaxation exercise 4.1 Walk slowly on the treadmill RPE=1-2 4.2 Relax stretching	70-75%	10 10 30 5 5
Wednesday	1. Warm up 2. Aerobic resistance training 2.1 Sit ups：2 Set (1set/30) 2.2 Deep squat：2 Set (1set/15) 2.3 push-up：2 Set (1set/10) 3. Training on a treadmill RPE=6-7 4. Relaxation exercise 4.1 Walk slowly on the treadmill RPE=1-2 4.2 Relax stretching	70-75%	10 10 30 5 5
Friday	1. Warm up 2. Aerobic resistance training 2.1 Sit ups：2 Set (1set/30) 2.2 Deep squat：2 Set (1set/15) 2.3 push-up：2 Set (1set/10) 3. Training on a treadmill RPE=6-7 4. Relaxation exercise 4.1 Walk slowly on the treadmill RPE=1-2 4.2 Relax stretching	70-75%	10 10 30 5 5

Week 7-8

date	Exercise plan	Max HR (%)	Time (minutes)
Monday	1. Warm up 2. Aerobic resistance training 2.1 Sit ups：4 Set (1set/40) 2.2 Deep squat：2 Set (1set/20) 2.3 push-up：2 Set (1set/15) 3. Training on a treadmill RPE=7-8 4. Relaxation exercise 4.1 Walk slowly on the treadmill RPE=1-2 4.2 Relax stretching	75-80%	10 10 30 5 5
Wednesday	1. Warm up 2. Aerobic resistance training 2.1 Sit ups：4 Set (1set/40) 2.2 Deep squat：2 Set (1set/20) 2.3 push-up：2 Set (1set/15) 3. Training on a treadmill RPE=7-8 4. Relaxation exercise 4.1 Walk slowly on the treadmill RPE=1-2 4.2 Relax stretching	75-80%	10 10 30 5 5
Friday	1. Warm up 2. Aerobic resistance training 2.1 Sit ups：4 Set (1set/40) 2.2 Deep squat：2 Set (1set/20) 2.3 push-up：2 Set (1set/15) 3. Training on a treadmill RPE=7-8 4. Relaxation exercise 4.1 Walk slowly on the treadmill RPE=1-2 4.2 Relax stretching	75-80%	10 10 30 5 5

Note:

1. Maintain a maximum heart rate of 75-80% during training.
2. The training time is 1 hour in total.

Warm-up exercise

1-3 weeks

1. Head movement（1 minute）

The extension of neck muscles,The first two 8-beat heads move forward (head down), backward (head up), left (to the left), and right (to the right), while the last two 8-beat heads rotate from left to right or from right to left, respectively. Then repeat once.

Action requirements: the range from small to large, to achieve full activity.

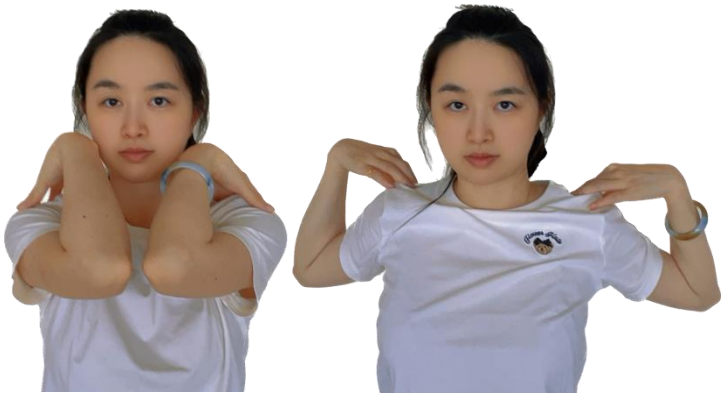
2. Chest expansion exercise（2 minutes）

Open the left foot to the left, shoulder width apart, bend and lift the elbows with both hands parallel to the ground.1-2 clap your elbows backward, palm down, 3-4 clap your arms straight and open back, palm up, 5-6 clap your arms up, palm forward, 6-8 clap your arms down, palm back. Repeat for 8 groups.

Action requirements: straighten your arms, pay attention to the direction of the palm, coordinate your movements, and apply appropriate force.

3. Shoulder movement（2 minutes）

Open the left foot to the left, shoulder width apart.Place your hands on your shoulders, rotate your elbows forward 16 times, and then rotate them back 16 times.



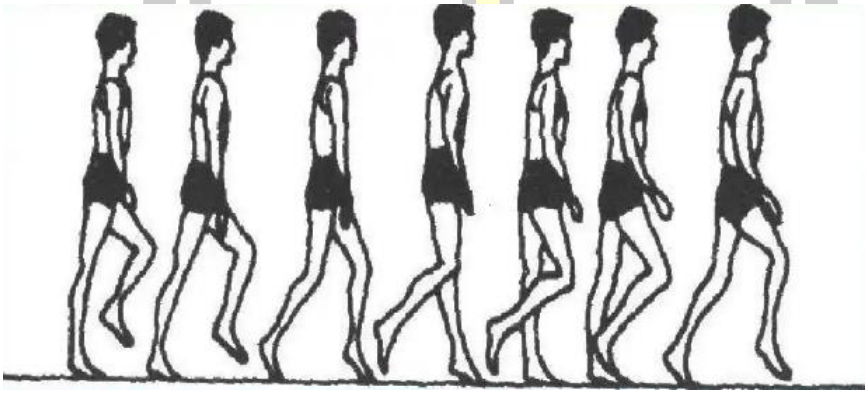
4. Lumbar and abdominal movements（1 minute）

Open the left foot to the left, slightly wider than the shoulder, straighten both legs, raise both hands flat on the side, palm down, maintain the same upper body posture, and keep the upper body parallel to the ground.Touch the left foot with the right hand, touch the right foot with the left hand, alternating left and right. Four × 8 beats.16 times in total.

Action requirements: The left and right rotation range should be large, with both legs straight and fully extended.

5. Trot（4 minutes）

Lean forward slightly, lift the thighs at an angle of approximately 35-45 degrees to the horizontal, relax the knee joints, and then press down on the thighs to extend the inertia of the lower leg forward. Soon, the soles of the feet will actively land on the ground, and the toes will complete the final “ground scraping” action.Run 6 times in a 10 meter length and rest intermittently.



4-6 weeks

1. Wrist and ankle movements（1 minute）

Cross your fingers naturally and place them in front of your chest. Place your left foot on the ground with the tip of your foot. Relax your ankle and wrist naturally and circle in a clockwise or counterclockwise direction. Then switch to the right foot and do the same.

Action requirements: The joints should be relaxed and the amplitude should be large.

2. Arm side extension（1 minute）

Feet shoulder width apart, lean forward, place your hands in front of you, open your right arm upwards, and then switch to the opposite side. A total of 16 times.

3. Lunge press leg（1 minute）

Left foot in front, thigh parallel to the ground; Extend your hind legs straight, keep your upper body perpendicular to the ground, hold your hands on your knees, and press down on your body.And then switch to the opposite side.

4. Side press leg（1 minute）

Bend your right leg and squat fully, landing your entire foot on the ground. Extend your left leg straight to the left and buckle your toes inward. Alternating left and right leg pressure.

5. Crotch high five（1 minute）

On the basis of natural standing, raise your arms horizontally, raise your legs and slap them in the crotch, alternating your left and right legs repeatedly. 16 times per group, do 2 groups.

6. Run with high legs（5 minutes）

While keeping the upper body straight, lift the legs alternately to the level, the faster the frequency, the better the effect.Run 5 times in a 10 meter length and rest intermittently.

7-8 weeks

1. Shoulder movement（2 minutes）

Draw a circle back with both shoulders, 16 times, and then draw a circle forward 16 times.

2. Step Back, Hands Up, Twist（2 minutes）

Pull back your left foot and squat down, turn your body to the right, lift your hands up, palms facing each other, then return to your original position and switch to the opposite side. A total of 16 times.

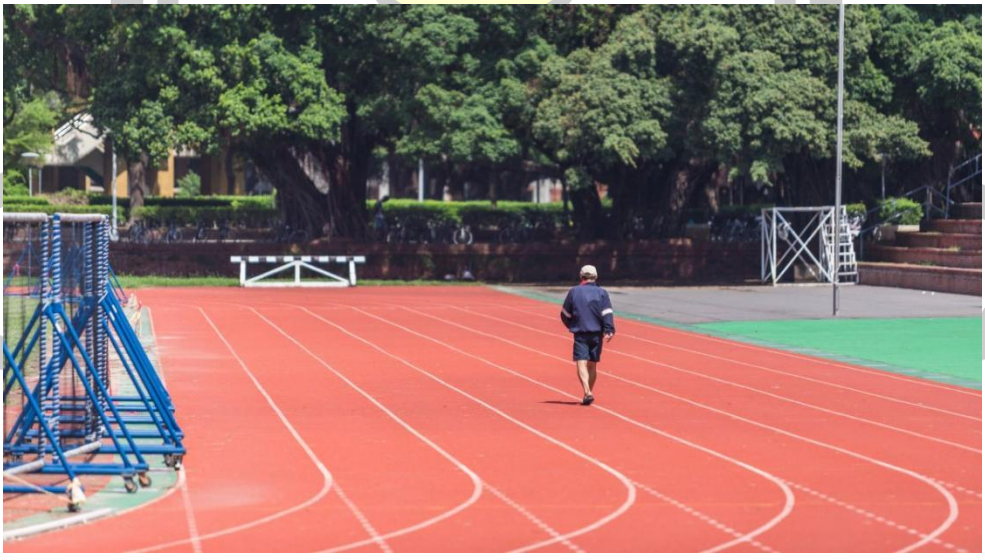
3. Abdominal Jump（1 minutes）

Open your left foot to the left, shoulder width apart, bend your knees slightly, and naturally place your hands on both sides of your body. When you hear the “1” command, jump up with force, and open your arms and legs as straight as possible. Repeat 5 times. Do 4 sets.

4. Jumping jack（2 minutes）

Stand with feet together and hands on both sides of the body.When jumping, spread your feet outward and clap your hands high above the ead. 8 times per group, do 4 groups with intermittent rest.

5. Jogging 400 meters（3 minutes）



Relaxation exercise

1. Gradually slow down on the treadmill and become a slow walking state. Relax your muscles and maintain for 5 minutes.

2. Relax and stretch

Stretching after running can promote the excretion of lactic acid, improve muscle soreness, promote muscle repair, and also enhance muscle elasticity, avoiding the occurrence of thick legs.

1-3 weeks

Action 1: Sit and stretch your hips for 30 seconds, then switch to the opposite side. Repeat it. （2 minutes）

Action 2: Lie on your back and stretch your hips for 30 seconds, then switch to the opposite side.Repeat it. （2 minutes）

Take a 1 minute break between the 2 movements.

4-6 weeks

Action 1: Stand and stretch the front thigh for 30 seconds, then switch to the opposite side.Repeat it. （2 minutes）

Action 2: Kneeling position, stretch the front of the thigh for 30 seconds, then switch to the opposite side.Repeat it. （2 minutes）

Take a 1 minute break between the 2 movements.

7-8 weeks

Action 1: Stretch the calves for 30 seconds, then switch to the opposite side.Repeat it. (2 minutes)

Action 2: Bend over and stretch your calves for 30 seconds, then switch to the opposite side.Repeat it. (2 minutes)

Take a 1 minute break between the 2 movements.

Training Record Form (Complete tick)

AE+soybean milk group

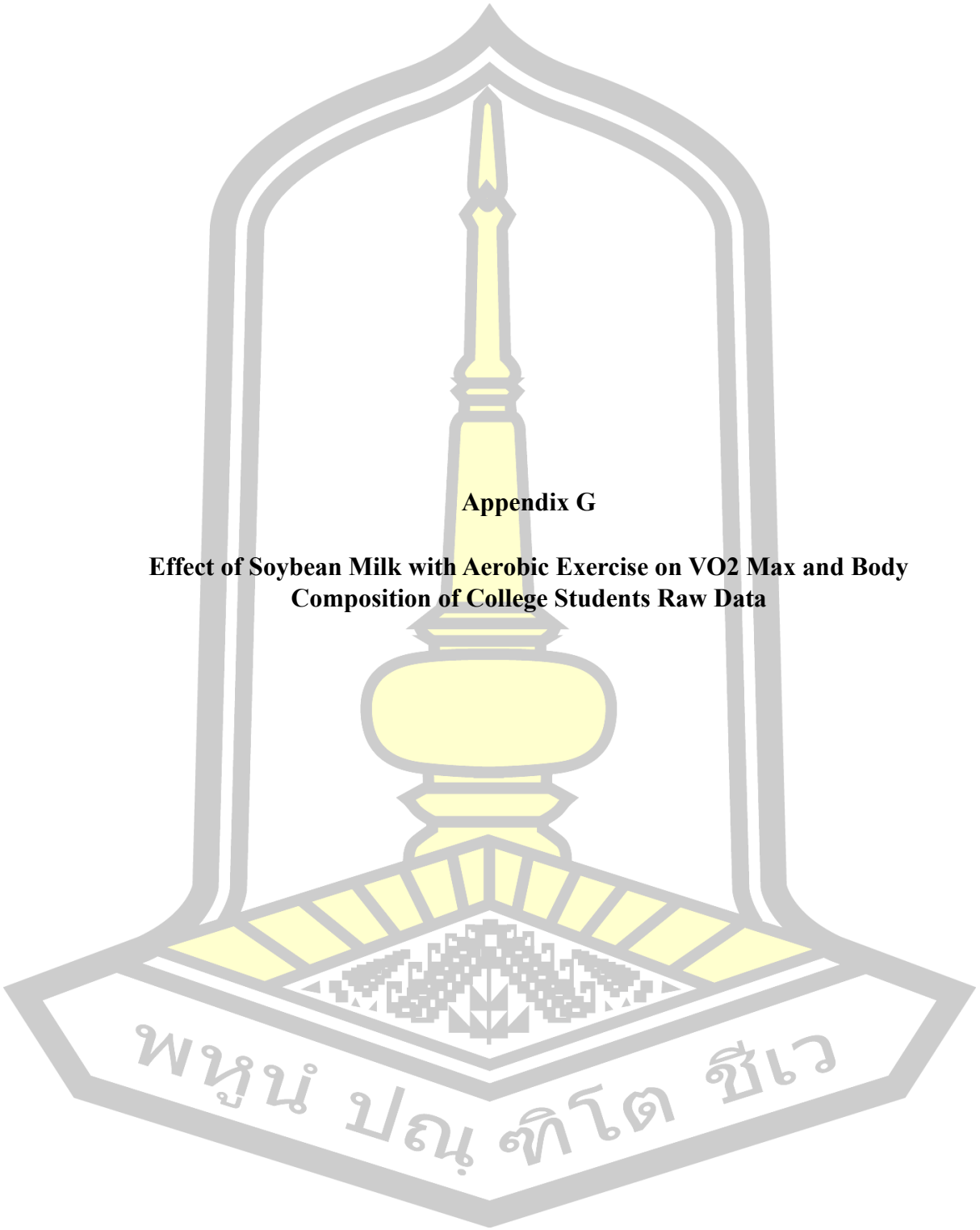
Student ID		A01	A02	A03	A04	A05	A06	A07	A08	A09	A10
week 1	Monday										
	Wednesday										
	Friday										
Week 2	Monday										
	Wednesday										
	Friday										
week 3	Monday										
	Wednesday										
	Friday										
Week 4	Monday										
	Wednesday										
	Friday										
week 5	Monday										
	Wednesday										
	Friday										
Week 6	Monday										
	Wednesday										
	Friday										
Week 7	Monday										
	Wednesday										
	Friday										
Week 8	Monday										
	Wednesday										
	Friday										

AE+placebo group

Student ID		B01	B02	B03	B04	B05	B06	B07	B08	B09	B10
week 1	Monday										
	Wednesday										
	Friday										
week 2	Monday										
	Wednesday										
	Friday										
week 3	Monday										
	Wednesday										
	Friday										
week 4	Monday										
	Wednesday										
	Friday										
week 5	Monday										
	Wednesday										
	Friday										
week 6	Monday										
	Wednesday										
	Friday										
week 7	Monday										
	Wednesday										
	Friday										
week 8	Monday										
	Wednesday										
	Friday										

AE group

Student ID		C01	C02	C03	C04	C05	C06	C07	C08	C09	C10
week 1	Monday										
	Wednesday										
	Friday										
Week 2	Monday										
	Wednesday										
	Friday										
week 3	Monday										
	Wednesday										
	Friday										
Week 4	Monday										
	Wednesday										
	Friday										
week 5	Monday										
	Wednesday										
	Friday										
Week 6	Monday										
	Wednesday										
	Friday										
Week 7	Monday										
	Wednesday										
	Friday										
Week 8	Monday										
	Wednesday										
	Friday										



Appendix G

Effect of Soybean Milk with Aerobic Exercise on VO2 Max and Body Composition of College Students Raw Data

Table 13 - 16 Raw data from the soy milk + cardio training group（n=10）

Table 13 Raw Data for Weight, BMI, and WHR Pre- and 8 Weeks After the Experiment

ID	weight（kg）		BMI		WHR	
	Before the experiment	8 weeks after	Before the experiment	8 weeks after	Before the experiment	8 weeks after
A01	76.6	75.6	23.8	23.6	0.76	0.81
A02	65.4	68.0	22.5	23.5	0.81	0.86
A03	74.8	74.9	24.3	24.5	0.80	0.78
A04	62.1	65.8	21.5	20.9	0.74	0.81
A05	73.2	70.9	22.9	22.4	0.83	0.78
A06	73.8	74.3	23.8	24.4	0.75	0.74
A07	79.5	81.4	25.8	26.6	0.86	0.83
A08	65.9	64.9	21.1	21.0	0.69	0.73
A09	79.2	81.6	24.8	25.1	0.83	0.85
A10	75.6	74.3	23.5	23.3	0.73	0.74
$\bar{x}$	71.73	73.17	23.40	23.53	0.78	0.79
S.D.	5.31	5.81	1.44	177	0.05	0.04

Table 14 Raw Data for BFP, Skeletal Muscle, and Muscle Before and After 8 Weeks of Experimentation

ID	BFP		Skeletal muscle		Muscle	
	Before the experiment	8 weeks after	Before the experiment	8 weeks after	Before the experiment	8 weeks after
A01	17.2	15.9	37.82	39.42	59.1	61.6
A02	19.0	20.2	31.48	33.79	49.2	52.8
A03	13.3	13.2	38.65	40.25	60.4	62.9
A04	17.5	14.3	30.27	34.75	47.3	54.3
A05	19.0	16.5	35.32	37.05	55.2	57.9
A06	16.1	16.6	36.60	38.46	57.2	60.1
A07	18.4	17.7	38.72	41.47	60.5	64.8
A08	12.2	12.0	34.43	35.52	53.8	55.5
A09	20.5	21.3	37.50	40.06	58.6	62.2
A10	13.9	12.3	38.84	40.25	60.7	62.9
$\bar{x}$	16.71	16.00	35.96	38.10	56.20	59.50
S.D.	2.76	3.15	3.06	2.66	4.79	4.13

Table 15 Raw data for protein, HR, and VO_2 max before and after 8 weeks of experimentation

ID	Protein		Resting heart rate	VO_2 max	
	Before the experiment	8 weeks after	Before the experiment	Before the experiment	8 weeks after
A01	13.0	13.6	68	65.97	57.57
A02	10.8	11.7	86	42.45	49.17
A03	13.3	13.9	75	60.93	54.21
A04	10.4	12.0	84	45.81	47.49
A05	12.1	12.8	76	59.25	59.25
A06	12.6	13.3	82	49.17	52.53
A07	13.3	14.4	77	57.57	47.49
A08	11.8	12.3	78	53.37	55.89
A09	12.9	13.7	76	55.89	54.21
A10	13.3	13.9	78	54.21	54.21
$\bar{x}$	12.35	13.16	78.00	54.46	53.20
S.D.	1.05	0.91	5.09	7.12	4.05

Table 16 Heart rate after Harvard step test

ID	HR 1		HR 2	
	Before the experiment	8 weeks after	Before the experiment	8 weeks after
A01	108	128	87	90
A02	164	148	128	114
A03	120	136	98	100
A04	156	152	126	118
A05	124	124	99	98
A06	148	140	118	112
A07	128	152	103	110
A08	138	132	114	108
A09	132	136	105	104
A10	136	136	108	106
$\bar{x}$	135.40	138.40	108.60	106.00
S.D.	16.97	9.65	12.96	8.32

HR 1=instantaneous heart rate after Harvard Step Test;HR 2=Heart rate 3 minutes after Harvard Step Test.

Table 17 – 20 Raw data for placebo + aerobic training group (n=9)

Table 17 Raw data for weight, BMI, and WHR before and 8 weeks after the experiment

ID	weight （kg）		BMI		WHR	
	Before the experiment	8 weeks after	Before the experiment	8 weeks after	Before the experiment	8 weeks after
B01	72.5	71.3	23.0	23.3	0.73	0.75
B02	73.5	72.4	24.1	24.0	0.89	0.85
B03	77.7	74.4	24.3	23.4	0.79	0.78
B04	74.4	74.1	23.5	23.5	0.81	0.82
B05	76.7	74.4	25.5	25.2	0.83	0.88
B07	66.3	65.6	23.0	22.8	0.80	0.80
B08	65.1	64.1	21.2	21.1	0.87	0.84
B09	78.7	78.8	25.7	25.9	0.83	0.83
B10	65.1	63.8	21.4	21.2	0.76	0.79
$\bar{x}$	72.22	70.98	23.52	23.37	0.81	0.81
S.D.	5.41	5.29	1.58	1.59	0.05	0.03

Table 18 Raw Data for BFP, Skeletal Muscle, and Muscle Before and After 8 Weeks of Experimentation

ID	BFP		Skeletal muscle		Muscle	
	Before the experiment	8 weeks after	Before the experiment	8 weeks after	Before the experiment	8 weeks after
B01	15.6	16.2	36.48	36.35	57.0	57.8
B02	20.5	19.6	34.68	34.88	54.2	54.5
B03	14.5	14.5	39.61	38.20	61.9	59.7
B04	15.5	16.9	37.44	36.92	58.5	57.7
B05	20.0	20.7	36.16	35.39	56.5	55.3
B07	14.5	13.5	33.72	33.98	52.7	53.1
B08	16.2	16.2	32.38	32.19	50.6	50.3
B09	20.0	19.6	37.56	38.27	58.7	59.8
B10	13.8	15.3	33.34	32.38	52.1	50.6
$\bar{x}$	16.73	16.94	35.70	35.39	55.80	55.42
S.D.	2.67	2.49	2.34	2.26	3.66	3.60

Table 19 Raw data for protein, HR, and VO_2 max before and after 8 weeks of experimentation

ID	Protein		Resting heart rate	VO_2 max	
	Before the experiment	8 weeks after	Before the experiment	Before the experiment	8 weeks after
B01	12.5	12.5	70	65.97	62.61
B02	11.9	12.0	85	44.13	55.89
B03	13.6	13.1	74	60.93	50.58
B04	12.9	12.7	80	49.17	55.89
B05	12.4	12.2	76	57.57	49.17
B07	11.6	11.7	78	56.73	59.25
B08	11.1	11.1	77	54.21	57.57
B09	12.9	13.2	74	55.89	44.13
B10	11.5	11.1	75	54.21	55.89
$\bar{x}$	12.26	12.17	76.55	55.42	54.55
S.D.	0.80	0.77	4.24	6.30	5.64

Table 20 Heart rate after Harvard step test

ID	HR 1		HR 2	
	Before the experiment	8 weeks after	Before the experiment	8 weeks after
A01	108	116	92	96
A02	160	132	124	106
A03	120	144	99	110
A04	148	132	128	102
A05	128	148	103	110
A06	130	124	104	99
A07	136	128	113	100
A08	132	160	106	120
A09	136	132	108	104
A10	133.11	135.11	92	96
$\bar{x}$	15.00	13.38	108.55	105.22
S.D.	108	116	11.51	7.31

HR 1=instantaneous heart rate after Harvard Step Test;HR 2=Heart rate 3 minutes after Harvard Step Test.

Table 21 - 24 Raw data for aerobic training group (n=10)

Table 21 Raw Data for Weight, BMI, and WHR Pre- and 8 Weeks After the Experiment

ID	weight（kg）		BMI		WHR	
	Before the experiment	8 weeks after	Before the experiment	8 weeks after	Before the experiment	8 weeks after
C01	69.7	65.5	23.9	22.9	0.71	0.70
C02	70.3	68.6	23.1	22.7	0.85	0.70
C03	67.7	66.4	23.1	22.9	0.78	0.84
C04	79.5	69.5	26.2	25.1	0.84	0.82
C05	72.7	69.8	24.5	23.7	0.88	0.80
C06	71.8	70.1	23.4	22.8	0.87	0.79
C07	64.5	63.3	20.4	20.8	0.74	0.76
C08	71.1	70.9	21.9	22.0	0.80	0.82
C09	73.8	72.1	24.2	23.8	0.79	0.77
C10	63.1	62.0	20.9	20.2	0.80	0.74
$\bar{x}$	70.42	67.82	23.16	22.69	0.80	0.77
S.D.	4.69	3.36	1.73	1.43	0.05	0.04

Table 22 Raw Data for BFP, Skeletal Muscle, and Muscle Before and After 8 Weeks of Experimentation

ID	BFP		Skeletal muscle		Muscle	
	Before the experiment	8 weeks after	Before the experiment	8 weeks after	Before the experiment	8 weeks after
C01	15.3	13.5	35.07	33.92	54.8	53.0
C02	18.7	18.1	33.98	33.66	53.1	52.6
C03	14.9	13.8	34.24	34.56	53.5	54.0
C04	23.8	20.4	36.09	36.03	56.4	56.3
C05	14.8	14.8	36.86	35.64	57.6	55.7
C06	19.8	18.5	34.24	34.24	53.5	53.5
C07	15.4	16.1	32.44	31.80	50.7	49.7
C08	12.6	10.9	37.05	37.88	57.9	59.2
C09	18.1	17.5	35.96	35.52	56.2	55.5
C10	14.8	12.2	31.93	32.57	49.9	50.9
$\bar{x}$	16.82	15.58	34.78	34.58	54.36	54.04
S.D.	3.27	3.04	1.74	1.76	2.73	2.76

Table 23 Raw data for protein, HR, and VO_2 max before and after 8 weeks of experimentation

ID	Protein		Resting heart rate	VO_2 max	
	Before the experiment	8 weeks after	Before the experiment	Before the experiment	8 weeks after
C01	12.1	11.7	72	62.61	55.89
C02	11.7	11.6	82	45.81	59.25
C03	11.8	11.9	74	60.93	59.25
C04	12.4	12.4	83	49.17	57.57
C05	12.7	12.3	76	57.57	59.25
C06	11.8	11.8	81	52.53	57.57
C07	11.2	10.9	76	55.89	49.17
C08	12.7	13.0	78	54.21	60.93
C09	12.4	12.2	75	55.05	57.57
C10	11.0	11.2	74	55.05	64.29
$\bar{x}$	11.98	11.90	77.10	55.88	58.07
S.D.	0.58	0.60	3.75	5.00	3.88

Table 24 Heart rate after Harvard step test

ID	HR 1		HR 2	
	Before the experiment	8 weeks after	Before the experiment	8 weeks after
A01	116	132	96	100
A02	156	124	120	98
A03	120	124	97	98
A04	148	128	116	99
A05	128	124	102	100
A06	140	128	110	98
A07	132	148	104	110
A08	136	120	106	100
A09	134	128	102	98
A10	134	112	100	90
$\bar{x}$	134.40	126.80	105.30	99.10
S.D.	11.91	9.24	7.88	4.81

HR 1=instantaneous heart rate after Harvard Step Test;HR 2=Heart rate 3 minutes after Harvard Step Test.

Appendix H

Photographs of the experimental process

Figure 3-4 Photos of the Experimental Process

Figure 3 Photos of the Experimental Process

Figure 4 Photos of the Experimental Process

BIOGRAPHY

NAME	Ms. Fei Su
DATE OF BIRTH	March 07, 1986
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