Effect Of Dietary Protein and Fat Content on Muscle Protein Synthesis (MPS)

Xingzhi Chen *

American University, Washington, 20016, America

* Corresponding Author Email: xc4742a@student.american.edu

Abstract. This paper aims to explore how the ratio of protein and fat in the diet affects the efficiency of muscle synthesis, provide more scientific dietary guidance for amateur athletes and bodybuilders, and provide a concise and reasonable reference for ordinary people who pursue a healthy diet. This paper integrates various academic literatures published on the official platform in recent years and analyzes the effects of protein and fat on the body based on data and experimental results. It mainly aims at and refutes some wrong ideas in the public stereotype, such as the harm of excessive intake of protein, the harm of long-term low-fat or fat free diet, etc., in order to correct the misleading of outdated literature and false commercial propaganda on the public diet concept. Judging from the results, both protein and fat are indispensable parts of daily diet, and single nutrients should not be too much or too little. A normal adult's daily intake of fat should not be less than 20% of total calories, and protein intake should not exceed 1.6 grams per kilogram of individual weight. The results of this study highlighted the important role of various nutrients in the diet, as well as the harm of long-term low-fat or fat free diet, and provided guiding suggestions for balanced diet and daily diet.

Keywords: Muscle protein synthesis; protein; fat content.

1. Introduction

Nowadays, muscle protein synthesis (MPS) is a core topic in the field of fitness and sports science. MPs describes the metabolic process of skeletal muscle proteins involved by amino acids. Studies have shown that muscle growth and maintenance not only depend on regular training, but also are closely related to the type and proportion of nutrients ingested. Especially the ratio of protein and fat in diet is of great significance for promoting muscle synthesis, recovery and strength growth. Even for adults who are not involved in sports, or the elderly and children whose muscle content is significantly lower than the former, the proportion of nutrients in the diet also profoundly affects their health. At present, the research on the intake of the three basic nutrients in the nutrition community has tended to be improved, and the conclusions and assumptions of a large number of papers have been more carefully supplemented. However, due to the time lag between the popularization and application of academic information, much outdated information and misunderstandings are widely disseminated among the public. Therefore, how to correctly guide the public to eat a healthy diet is crucial.

The growth of overweight and obese people in developing countries has spawned a variety of dietary strategies to control weight. With the help of some commercial companies, moderate or high protein diet is becoming more and more popular and widely promoted for weight loss, fitness or muscle gain. In many similar dietary recommendations, protein intake is significantly higher than the recommended intake (higher than 1.2 g protein/kg body weight/day), while fat intake is too low or even not [1]. This just caters to the stereotype of the public about these two nutrients. For the general public, fat, especially animal fat, is usually defined as unhealthy, so people who lose weight tend to avoid fat intake as much as possible. For amateur fitness people, they tend to be too superstitious about the positive role of protein and eat a lot of high protein foods or even protein supplements. This paper summarizes the current cutting-edge information in the academic community, aiming to explore how the proportion of protein and fat in the diet affects the efficiency of muscle synthesis, and provide more scientific and concise dietary reference for ordinary people and amateur athletes.

2. Effect of Protein on Muscle Synthesis

2.1. Diet Protein

In human normal diet, protein intake is most closely related to muscle. Adequate protein intake is essential to activate the muscle synthesis process, especially after strength and endurance training. Proteins provide essential amino acids, which serve as basic units for the construction and repair of muscle fibers. Studies have shown that high-quality proteins, such as whey protein, can be rapidly digested and absorbed, thereby effectively promoting muscle synthesis. Therefore, in the amateur fitness crowd, reducing the proportion of carbohydrates in daily diet and increasing the intake of protein have become a recognized common sense. However, with the improvement of people's quality of life and the popularity of nutritional supplements in the market, protein intake has become too simple. When discussing the effect of protein intake on muscle synthesis, we usually emphasize its positive role, especially in the field of strength training and body building. However, the possible negative effects of excessive protein intake on muscle synthesis and overall health are also worthy of attention [2].

2.2. Protein Intake

First of all, it needs to be clear that protein intake should be compatible with individual weight, activity level and overall health status. Although protein is the key to muscle synthesis, protein exceeding the actual requirement in the body will not be converted into muscle but may cause a burden. The recommended dietary intake (RDA) of protein is 0.8 g protein per kilogram of body weight. For healthy adults, 15-30 grams of protein per meal is generally recommended. The positive effect of more than 80 grams of protein per meal on human body began to shrink sharply. Excessive protein intake may lead to an imbalance in nitrogen balance, which may increase the burden on the kidney, especially in individuals with potential kidney problems. A long-term high protein diet may aggravate the filtration load of the kidney, thereby increasing the risk of kidney disease [3].

2.3. Hazards Caused by Excessive Intake of Protein

A study from ISRN nutrition classified daily protein intake into three levels: 47 g / day (low protein diet), 95 g / day (medium protein diet), and 142 g / day (high protein diet). Eating a high protein diet for 6 consecutive weeks brings significant acid load to the kidneys and increases the risk of stone formation (decreased urinary citrate levels, decreased urinary saturation, and increased undissolved uric acid). [2]

Second, excessive protein intake may lead to dehydration. The metabolic process of protein generates nitrogen waste, which is mainly discharged in the form of urea. This process requires a lot of water, so a high protein diet may increase the body's demand for water. If the intake of water is insufficient to supplement the loss during metabolism, dehydration may occur.

In addition, excessive dependence on protein may also lead to insufficient intake of other nutrients. For example, excessive animal protein intake may lead to low intake of dietary fiber and fat, which are essential for maintaining intestinal health, cardiovascular health and overall nutritional balance.

From the perspective of muscle synthesis, excessive protein intake does not provide more benefits than moderate intake. A healthy adult's daily intake of protein should be 0.8 grams per kilogram of body weight. Bodybuilders and older people who lack muscle can consume more protein to promote muscle synthesis, but the overall intake should also be controlled within the range of 1.4-1.6 g / kg body weight. The promotion effect of excessive high protein diet on muscle synthesis will not increase for a long time but may bring the health risks mentioned above [4].

3. Effect of Fat on Muscle Synthesis

3.1. Diet Fat

When discussing the impact of dietary fat intake ratio on health and muscle synthesis efficiency, we often face the contradiction between the negative stereotype of fat intake and the actual positive value. First, fat is often regarded as the main cause of obesity and cardiovascular disease in traditional dietary concepts. This negative stereotype stems from past research on the association between dietary fat and health risk. Compared with proteins that are more closely related to muscle synthesis, people usually ignore or even deliberately avoid fat intake. However, studies have shown that although the direct role of fat in muscle synthesis is less significant than that of protein, it plays an important role in the overall energy supply and hormone balance. Fat is an important source of energy, especially in long-term or low-intensity exercise. For muscle synthesis, although fat is not a direct building block, it plays an important role in energy supply and cell membrane construction [5].

3.2. Types and Positive Effects of Fat

In modern life, people's fat intake from food can be roughly divided into animal fat and vegetable fat. Monounsaturated and polyunsaturated fatty acids in plant fats, such as omega-3 and omega-6 fatty acids, have a positive impact on endocrine and metabolic health. Omega-3 fatty acids have been proved to improve insulin sensitivity, promote the effective secretion and function of insulin, and thus have a positive impact on glucose metabolism. In addition, these unsaturated fatty acids also play an important role in regulating the inflammatory response by affecting the synthesis of inflammatory mediators such as prostaglandins and leukotrienes, and then affecting the overall metabolic state [6].

Animal fat is usually rich in saturated fatty acids, while vegetable fat is mainly monounsaturated and polyunsaturated fatty acids. Excessive intake of saturated fatty acids is associated with endocrine disorders, which may lead to an increase in insulin resistance, thereby affecting glucose metabolism and lipid metabolism. Long-term excessive intake of saturated fatty acids may affect hormone sensitivity and hormone receptor expression, leading to increased risk of metabolic diseases such as obesity and type 2 diabetes. This is also the main source of the negative impression of fat in public cognition: animal fat is saturated fat, which is harmful to the body. However, this is just a misunderstanding. The distribution of different fatty acids in nature depends more on the growth environment of the organism. Plants grown in tropical climate, such as coconut, are more likely to produce saturated fat, while plants grown in temperate climate, such as olive tree, are more likely to produce unsaturated fat. Similarly, salmon grown in cold waters are rich in omega-3 unsaturated fatty acids. According to the data, coconut oil (about 85%) is the highest and olive oil (about 15%) is the lowest among the common saturated fat containing foods, while lard, a widely criticized animal fat, ranks in the middle of the ranking with a saturated fatty acid content of about 40%. At the same time, animal fat is the source of essential fatty acids of arachidonic acid. These fatty acids are essential for maintaining the integrity and function of cell membranes. Cholesterol contained in it is also an important part of nerve tissue and brain health [6,7].

3.3. Hazards Caused by Low Fat Intake

In addition, from an endocrine perspective, fatty acids have a direct impact on hormone synthesis. For example, fatty acids are important precursors for the synthesis of steroidal hormones, including sex hormones such as testosterone and estrogen, as well as corticosteroids. Therefore, the type and number of fatty acids have a profound impact on hormone balance and function. Taking adult women as an example, the synthesis of estrogen and progesterone is seriously affected after long-term low-fat diet, which leads to irregular or excessive menstruation, premenstrual syndrome or anovulation. [8]

In conclusion, the proportion of fat intake in the diet has an important impact on health, muscle synthesis efficiency, and the balance of endocrine and metabolism. Abandoning the negative stereotype of fat and correctly understanding and applying the characteristics of different types of fat

can optimize muscle synthesis and overall metabolic efficiency while ensuring health. Therefore, when making a dietary plan, we should pay attention to the type and intake of fat to ensure the best health and physical effect. For normal adults, daily fat intake should account for about 20%-35% of total calories. For an adult who consumes 2000 calories a day, the daily intake of fat should be between 44g and 78g, and saturated fat should be less than 25g, but greater than 0 [9,10].

4. Conclusion

In conclusion, in the current research literature on the effect of dietary protein to fat intake ratio on muscle protein synthesis, this paper can draw some preliminary conclusions. The daily protein intake of normal adults should be about 0.8g per kilogram of body weight, which can be appropriately increased to less than twice the value for older people with significantly reduced muscle content or sports fitness crowd / pregnant women who need protein urgently. However, too much belief in the positive role of protein and blindly increasing the protein intake ratio will cause additional burden to the body and will not continue to produce positive benefits for muscle protein synthesis. On the contrary, fat is the opposite. Due to the cardiovascular and other diseases that may result from excessive use of saturated fat, people tend to think that the less fat in a healthy diet is the better. But for normal adults, the daily intake of calories from fat should be about 20-35%. Low fat intake is not only harmful to the body, but also hinders MPs to a great extent. Even saturated fat should be ingested appropriately to maintain physiological needs. For professional athletes and fitness people, professional dietitians are the objects they often deal with, so their diet is often divided into different stages and targeted. However, for amateur athletes and ordinary people, it is not rational to follow suit and pay attention to the advantages of protein or completely stop the intake of fat. It should be noted that the health of diet should be based on balance and diversification.

Although protein intake has been widely studied and confirmed to stimulate MPs, the molecular mechanism of MPS is still not fully understood by fat intake, which is also quite important. Due to the public's prejudice against fat, especially saturated fat, some people have a more extreme fat free diet, which tends to do more harm than good to the body. Future studies need to further explore how fat affects muscle synthesis through mTOR signaling pathway or other metabolic pathways. In addition, most of the existing studies focus on the impact of short-term protein and fat intake on MPS, and the research cycle usually does not exceed 6 months. Longer term studies are needed to observe how long-term dietary patterns affect muscle mass and function, and their relationship with MPS.

At the same time, the influence of genetic differences between populations on nutrient intake and muscle response is another research focus. For example, there may be significant differences in the response of different muscle fiber types and genders to protein and fat. In addition, the interaction between protein and fat is complex, and they affect each other in the process of digestion, absorption and metabolism, which makes it difficult to separate the independent effect of a single nutrient on MPS, while the study of the interaction between the two still has certain limitations. Although different dietary patterns (such as intermittent fasting, high protein diet, low-carbon water diet, ketogenic diet, etc.) have been proposed, it is not clear how they and the former comprehensively affect MPs, and further exploration is needed.

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