HOW MUCH PROTEIN DO RESISTANCE TRAINING ATHLETES NEED?

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Athletes are constantly seeking any edge they can get. One of those is body composition, since performance can be potentially improved by increasing muscle mass and losing body fat. This is especially critical for athletes who compete in weight class sports where the highest lean body mass (LBM) to body fat ratio is preferential. Consumption of dietary protein by athletes is a common intervention done to maximize gains in muscle and strength, especially when resistance exercise is performed (24). The main belief for the increased consumption of dietary protein consumption is that it is needed to generate more muscle protein (21). Dietary protein amounts for athletes are typically more than the recommended daily allowance (RDA) of 60 g per day (21). But how much more protein does an athlete need? The purpose of this article is to analyze the current research on the optimal amount of dietary protein for resistance training athletes.

Regular resistance exercise can lead to increases in skeletal muscle mass via hypertrophy (23). One of the main influences for hypertrophy is a positive muscle protein balance (2). Positive muscle protein balance is achieved when the rate of new muscle protein synthesis (MPS) exceeds that of muscle protein breakdown (MPB) (2). Resistance training stimulates the process of MPS where new proteins are added to muscle tissue (4,6,22). This acute increase in MPS can last for up to 48 hr (7). Skeletal MPS is also stimulated by protein feeding (9,26). However, if only resistance training is done and no food is provided, the net protein response will be negative (22). When protein is consumed along with resistance training, there is an additive effect in MPS (17). Athletes seek to maximize a hypertrophic response to exercise with the general acceptance that this may translate into performance gains; thus, the employment of resistance training plus protein is a good option.

The two main mechanisms to maximize with dietary protein consumption for those already doing resistance exercise are essential amino acid (EAA) content and leucine content. Muscle protein is composed of 20 amino acids, of which, nine are considered essential in that the body cannot manufacture them on its own. Theses EAAs must be obtained from food (e.g., dietary protein). The branched-chain amino acids (BCAAs) are a subset of three of the nine EAAs comprised of leucine, isoleucine, and valine (29). Leucine by itself can activate the protein kinase B-mammalian target of rapamycin (mTOR) pathway responsible for the translation initiation phase of MPS (1,8,12,21). The effects of leucine have been shown *in vitro* (outside a living organism) and *in vivo* (in a living organism) in humans and mouse models (3,10,11,19,20). Based on current research, an optimal dose of leucine to be consumed per meal for a robust response in muscle MPS is estimated at 1 – 3 g, although an exact dosage is unknown (5,19,20). This is known as the "leucine threshold effect," which is similar to turning on a standard light switch—once the light is on, pushing up harder on the switch does not make the light any brighter (7,18). The second key needed to acutely maximize MPS is EAAs, since they serve as the raw building materials to assemble more contractile proteins in the muscle. Research done in animals and humans has demonstrated as little as 6 g of EAAs is effective at increasing MPS (13,25).

In an acute study, researchers compared the consumption of 80 g of protein over 12 hr to determine the anabolic effect (2). Protein was consumed in 10, 20, or 40 g feedings in a pulsed, intermediate, or bolus ingestion. They found that a repeated ingestion of 20 g of whey protein was best for increasing MPS.

To sum up, to acutely maximize MPS, approximately 1 – 3 g of leucine and approximately 6 g or less of EAAs is currently theorized to be optimal. Both of these can be achieved by a bolus dose of approximately 20 g of a high-quality protein, such as whey protein.

CHRONIC STUDIES

Acute research is a great start to whittle down the myriad options to test in the lab, but they must be followed up with chronic research. Many times, the acute response does not match the chronic response. The focus of the following short review will be on chronic studies and also a worst-case scenario—a hypocaloric diet. If a higher amount of protein can keep LBM during this worst-case metabolic scenario, then that serves as data for the minimal amount of daily dietary protein. If an athlete is in a hypercaloric muscle gain state (consuming fewer calories than the amount of calories burned), this amount of "worst case" protein should be more than enough.

Layman et al. performed a randomized study on 48 women, aged 40 – 56 years, over 16 weeks to investigate the effects of exercise and different amount of protein intake using a 2 x 2 block design (diet x exercise) (14). Subjects were divided into four groups: 1) low protein intake only, 2) low protein intake plus exercise, 3) high protein intake only, and 4) high protein intake plus exercise. For the exercise portion, subjects performed five days per week of walking and two days per week of resistance exercise. The high protein group received 1.5 g protein/kg body mass/day compared to the low protein group that received 0.8 g protein/kg body mass/day. Caloric intake was the same in both groups with more carbohydrates provided in the low protein group to make up the difference (dietary fat was the same for both groups). While all groups lost body weight ($p < 0.05$), three of the four groups lost LBM also. The high protein plus exercise group was the only group without any significant change in lean mass (-0.9%; $p = 0.39$). The low protein only group saw the largest decrease in lean mass (-5.4%; $p < 0.001$). This study demonstrated that a higher dietary protein intake (1.5 g protein/kg/day) with exercise (walking plus two days of resistance training) resulted in a loss of body fat without a loss in LBM.

Mettler et al. studied 20 subjects who had been exercising for over six months for 360 min per week over five exercise sessions that included two resistance training sessions (16). The average body fat level of the subjects was 16.5%. In a parallel design, they were divided into a low protein group (control) at 1.0 g protein/kg body mass/day and a high protein group set at 2.3 g protein/kg body mass/day. Calories were changed up over the course of the study, where the first week was used to assess the baseline intake and expenditure. For the second week, the subjects were placed at their baseline energy intake levels with weeks three and four being reduced to 60% of their baseline intake with dietary fat making up the caloric difference between the high and low protein groups. Body composition and performance tests were conducted at the end of each week. Before the study started, a familiarization trial for each of the performance tests was conducted to reduce the learning effect in the study. While there was no difference in fat loss between the dietary groups at the end of the study (both groups lost 2.0 and 2.1 kg respectively), the low protein group did see a significant loss of LBM. From this study, a protein intake of 2.3 g protein/kg body mass/day may be protective against a loss of LBM under hypocaloric conditions (16). This data matches the results from Layman et al. above to provide evidence that a higher protein intake may reduce the loss of LBM, despite a severe calorie deficit (14).

In another intervention study, this time in 19 college-aged male bodybuilders, Walberg et al. used three groups: 1) control group, 2) a low protein group at 0.8 g/kg/day (high carbohydrate), and 3) a high protein group set at 1.6 g/kg/day (28). Both of the protein groups were hypocaloric at 18 kcal/kg/day, similar to the study by Layman et al. (14). The researchers found that both groups lost similar amounts of body fat (approximately 2 kg), and this was very similar to the absolute fat loss in the study by Mettler et al. (16). In this present study, however, both groups lost lean body mass (28). The higher protein group lost less LBM at a 1.4 kg versus a 2.7 kg loss for the low protein group. This study demonstrated that while 1.6 g protein/kg/day decreased the loss of LBM, it did not entirely stop the loss of LBM during a very low caloric period. A major limitation of this study was the very short duration of only two weeks (28).

Lastly, Mero et al. investigated 15 women who participated in recreational resistance training (15). They were divided into two groups: 1) 1,110 kcal/day deficit and 2) 550 kcal/day deficit. Both groups were fed a high protein diet of 1.4 g/kg/day for four weeks. They found that both groups saw a significant reduction in weight of 2.0 kg in the 550 kcal/day deficient and 3.8 kg in the 1,110 kcal/day deficient group ($p < 0.001$). Neither group saw any loss of LBM, as the weight loss was from fat mass. A major limitation of this study was the use of an estimation for resting metabolic rate (RMR) to set caloric intakes; thus, the actual caloric deficit may have been different than reported.

PRACTICAL APPLICATION

These four studies, when taken as a whole, provide evidence that even in a severe case of very low caloric intake, such as 1.4 – 2.3 g protein/kg body mass/day, could halt or at least slow down the loss of LBM while still allowing for the loss of body fat. For example, if an athlete weighs 220 lb (100 kg), that equates to 140 – 230 g of dietary protein per day, which would be split out over a minimum of four meals per day (27). For the dose of 140 g, that calculates out to 35 g of protein per meal. At the higher end of 230 g per day, it splits out to 57.5 g per meal if the athlete eats four meals, or 46 g of protein per meal if the athlete eats five meals per day. In summary, this research sheds some light on how much protein strength and power athletes need on a daily basis to maximize their gains.

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