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THE PROTEIN INTAKE OF TRAINED BODYBUILDERS IS CONCENTRATED IN LUNCH AND DINNER

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ABSTRACT

Regular protein intake throughout the day can contribute to maximising protein synthesis and improve recovery and muscle mass gain. The objective of this study was to evaluate the dietary intake and the distribution of protein, carbohydrate, lipid and energy intakes of trained bodybuilders. Twelve men with experience in resistance training participated in the study. Body composition was determined by octapolar bioimpedance. Food intake was assessed using five 24-hour food recall schedules. The subjects presented the following characteristics: Age = 25.2 ± 3.4 years; Height = 179.5 ± 4.6 cm; Weight = 84.9 ± 8.7 kg; Body Fat = 14.7 ± 5.6% and Fat Free Mass = 85.3 ± 5.6%. The average time of weight training practice was 5.9 ± 3.1 years, with a weekly frequency of 5.0 ± 0.6 workouts and each session lasting an average of 64.2 ± 17.8 minutes. The average caloric intake was 2201 ± 223 kcal which represented 26.2 ± 6.0 kcal/kg. Only 33.3% of the individuals had adequate energy intake. The participants had a mean daily consumption of 1.6 ± 0.5 g/kg/day for proteins, 2.9 ± 0.8 g/kg/day for carbohydrates and 0.9 ± 0.4 g/kg/day for fat. The percentage of adequacy was 58.3%, 50%, and 91.7% for carbohydrates, proteins, and fat, respectively. Protein consumption was irregular throughout the day, being concentrated at lunch (52.2 ± 17.8 g) and dinner (40.2 ± 20.5 g). We conclude that the individuals consumed a diet with low energy content and irregular distribution throughout the day, especially of protein. Thus, the results indicate that the dietary intake of the volunteers can be improved expressively.

Key words: Athletes. Body Composition. Protein Intake. Bodybuilding.

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RESUMO

Ingestão de proteínas de praticantes de musculação treinados é concentrada no almoço e jantar

A ingestão regular de proteínas ao longo do dia pode contribuir para maximizar a síntese proteica e melhorar a recuperação e ganho de massa muscular. O objetivo deste trabalho foi avaliar o consumo alimentar e a distribuição da ingestão de proteínas, carboidratos, lipídios e energia de praticantes de musculação treinados. Participaram do estudo 12 homens com experiência em treino resistido. A composição corporal foi determinada por bioimpedância octapolar. O consumo alimentar foi avaliado utilizando cinco recordatórios alimentares de 24 horas. Os indivíduos apresentaram as seguintes características: Idade = 25,2 ± 3,4 anos; Altura = 179,5 ± 4,6 cm; Peso = 84,9 ± 8,7 kg; Gordura Corporal = 14,7 ± 5,6% e Massa Livre de Gordura = 85,3 ± 5,6%. O tempo médio de prática de musculação foi 5,9 ± 3,1 anos, com frequência semanal de 5,0 ± 0,6 treinos e cada sessão durando em média 64,2 ± 17,8 minutos. O consumo calórico médio foi de 2201 ± 223 kcal o que representou 26,2 ± 6,0 kcal/kg. Apenas 33,3% dos indivíduos faziam consumo adequado de energia. Os participantes apresentaram consumo diário médio de 1,6 ± 0,5 g/kg/dia para proteínas; 2,9 ± 0,8 g/kg/dia de carboidratos e 0,9 ± 0,4 g/kg/dia de lipídios. O percentual de adequação foi de 58,3%, 50% e 91,7% para carboidratos, proteínas e lipídios, respectivamente. O consumo de proteínas foi irregular ao longo do dia sendo concentrado no almoço (52,2 ± 17,8 g) e jantar (40,2 ± 20,5 g). Conclui-se que os indivíduos consumiram dieta com baixo teor de energia e distribuição irregular ao longo do dia, especialmente de proteínas. Assim, os resultados indicam que o consumo alimentar dos voluntários pode ser melhorado expressivamente.

Palavras-chave: Atletas. Composição Corporal. Ingestão Proteica. Culturismo.

INTRODUCTION

Nutrition constitutes one of the pillars for achieving optimal physical performance and muscle mass development in athletes and sportspeople of various sports modalities.

To achieve optimal performance in resistance exercises it is necessary to adopt adequate nutrition about the quantity, quality, and timing of nutrient intake. In addition, it is essential that the individual performs good hydration and has a restful sleep.

Proper nutrition also contributes to health promotion, reducing the risk of chronic diseases and improving cognitive, emotional, and behavioural performance, providing general well-being (Macedo, Sousa, Fernandez, 2018; Pereira, Cabral, 2007).

Inserted within the physical activities and classified as strength training, weight training provides the improvement of general physical condition, sports performance and muscle mass growth, also called hypertrophy, is characterized by the increase in the volume of the muscle cross-section (Adam and collaborators, 2013; Oliveira, Rodrigues, 2007).

In recent decades there has been an increase in concern with body image. With this, there has been an increase in the number of people who attend weight training gyms, which are widely used to promote muscle mass gain, mainly aiming at the search for the "perfect body", currently characterized by increased muscle mass associated with low body fat percentage (Hevia, Painelli, 2017; Paes, 2016).

In this respect, the increase in muscle mass is associated with protein synthesis. To maximize muscle protein synthesis and accelerate hypertrophy one must combine a high-calorie diet with adequate protein intake.

According to the study by Jäger and collaborators (2017), daily protein intake should be between 1.4 to 2.0 g/kg per day.

Iraki and collaborators (2019), on the other hand, recommend a daily intake between 1.6 and 2.2 g/kg per day. Furthermore, it has been suggested that regular protein intake throughout the day can enhance muscle mass gain (Areta and collaborators, 2013; Mamerow and collaborators, 2014).

Thus, it has been proposed as an optimal pattern to maximize muscle protein synthesis to consume 4 to 5 meals daily with at least 20 grams of high-quality protein (Areta and collaborators, 2013; Gillen and collaborators, 2017; Mamerow and collaborators, 2014; Phillips, Van Loon, 2011).

However, studies have shown that most bodybuilders ingest amounts of protein within the recommended range, but there is little data on the distribution of protein intake throughout the day (Bernardes, Della Lucia, Faria, 2016, Gillen and collaborators, 2017; Lima, Lima, Braggion, 2015; Silva-Junior, Abreu, Silva, 2018).

Considering that the distribution of protein intake throughout the day can influence protein synthesis and muscle hypertrophy and due to the scarcity of studies showing the distribution of energy and nutrient intake, especially protein, throughout the day, the present study aimed to evaluate the distribution of energy and macronutrient intake of well-trained bodybuilders.

MATERIALS AND METHODS

The sample was selected by convenience and composed of 12 men (Age = 25.2 ± 3.4 years; Height = 179.5 ± 4.6 cm; Weight = 84.9 ± 8.7 kg, Body Fat = 14.7 ± 5.6%, Fat-Free Mass = 85.3 ± 5.6%).

The individuals were recruited through informative posters placed in gyms and by direct invitation from the researchers.

Before starting the research, the participants were informed about the procedures to be performed, risks, and benefits. All those who agreed to participate signed an informed consent form. The project was approved by the Ethics Committee on Human Research of the Universidade Federal de Lavras, the institution where the research was carried out, under opinion number 2.984.792.

Anthropometric and Body Composition Assessment

To determine the height of each participant, we used a wooden stadiometer fixed to the wall with a scale in millimetres with an accuracy of 0.1 cm (Sanny®).

The individual stood barefoot with heels together, feet forming a 45° angle, back straight so that the occiput, back, buttocks, and heels were touching the anthropometer, arms extended at the side of the body, and head facing forward in the Frankfurt plane (Gibson, Wagner, Heyward, 2019).

Body composition was determined using the InBody 230 octapolar electric

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bioimpedance device (Biospace®). To perform the bioimpedance test, volunteers were instructed to follow the procedures described by Bera (2014): Fasting for at least 4 hours before the test; No intense physical activity the 24 hours before the test; Urinating at least 30 minutes before the test; No consumption of alcoholic beverages in the 48 hours before the test; and No use of diuretics for 7 days before the test.

Food Consumption Evaluation

To determine the food intake, five 24-hour food records were collected from each volunteer, one for each week.

The data was filled out detailing the food eaten at each meal with its respective portions, preparation method, and brand of food when necessary.

Later, the records were analyzed in the online software DietBox®. In this program, the foods described in the food records were converted into energy and nutrients. From the results, the mean daily food intake of energy and macronutrients per meal was calculated.

The adequacy of energy intake was calculated considering the values recommended by Nóbrega and collaborators (2009), who recommend daily consumption of 30 to 50 kcal/kg/day.

To determine the adequacy of daily consumption of carbohydrates, proteins, and fat, the values proposed by Iraki and collaborators (2019) were adopted, which recommend daily consumption of 3 to 5 g/kg/day for carbohydrates, 1.6 to 2.2 g/kg/day for protein, and 0.5 to 1.5 g/kg/day for fat. The adequacy of protein intake per meal was calculated according to the values proposed by Campbell and collaborators (2007) which is 20 to 40 g/meal.

Data were analyzed using Statistical Package for the Social Sciences® (SPSS) software (version 21). Data are presented as mean and standard deviation or as percentages. One-way ANOVA was performed to compare the mean protein intake between meals.

RESULTS

The sample was constituted of bodybuilding practitioners (n=12), and 2 individuals were amateur bodybuilding athletes. The average time of bodybuilding practice was 5.9 ± 3.1 years (minimum = 3 years and maximum = 11 years), with a weekly frequency of 5 ± 0.6 workouts and each session lasting an average of 64.2 ± 17.8 minutes.

Table 1 shows the data on average daily energy and nutrient intake. The average energy and carbohydrate intake per kilogram of body weight were below the recommended minimum. Nevertheless, most of the daily energy intake was from carbohydrates. The average protein and fat intake per kilogram of body weight remained within the recommended range.

Table 1 - Average consumption of energy and nutrients by bodybuilding practitioners, Lavras-MG, Brazil.

Total Energy (kcal)	2201	223	
Energy (kcal/kg)	26.2	6.0	30-50 kcal/kg/day*
Total Carbohydrate (g)	239.2	36.4	
Carbohydrate (g/kg)	2.9	0.8	3-5 g/kg/day**
Carbohydrate (%)	44.1	8.8	-
Total Protein (g)	133.6	20.6	
Protein (g/kg)	1.6	0.5	1.6-2.2 g/kg/day**
Protein (%)	24.4	6.1	-
Total fat (g)	79.2	11.4	
Fat (g/kg)	0.9	0.4	0.5-1.5 g/kg/day**
Fat (%)	31.8	7.2	-

Legend: * Nóbrega and collaborators (2009); ** Iraki and collaborators (2019).

The distribution of energy and nutrients in the meals taken throughout the day was evaluated in the present study. However, the results presented refer to the four meals (breakfast, lunch, afternoon snack and dinner) that were taken by all volunteers (Table 2).

The daily consumption of energy, protein and fat was higher at lunch and dinner,

characterizing an irregular distribution throughout the day and concentrated in the main meals. The daily consumption of carbohydrates throughout the day was more regular, being higher at the snack and dinner.

Table 2 - Distribution of the average consumption of energy and nutrients in four meals of bodybuilding practitioners, Lavras-MG, Brazil.

Breakfast	429.5 ± 5.1	51.4 ± 16.3	17 ± 8.8	12.8 ± 7.7
Lunch	582.5 ± 6.9	44.6 ± 15.6	52.2 ± 17.8	20.5 ± 11.7
Afternoon snack	391.7 ± 4.7	55.3 ± 19.5	15.5 ± 11.2	13 ± 6.6
Dinner	641.3 ± 7.6	59.6 ± 16.2	40.2 ± 20.5	26.4 ± 23.2

Figure 1 shows the data on the adequacy of daily energy and macronutrient intake. Most participants had a hypoenergetic, normoglycemic and normolipidemic dietary intake pattern. Only 33.3% of the individuals had energy intake within the recommended range.

Although the average consumption of carbohydrates per kilogram of body weight was below the recommended range, most participants (58.3%) consumed this nutrient adequately. It was observed that 50% of the individuals consumed protein within the recommended range.

It is noteworthy that 41.7% of the participants had protein consumption below 1.6 g/kg/day and only one participant consumed more than 2.2 g/kg/day. The fat intake of the sample was adequate in 91.7% of the participants.

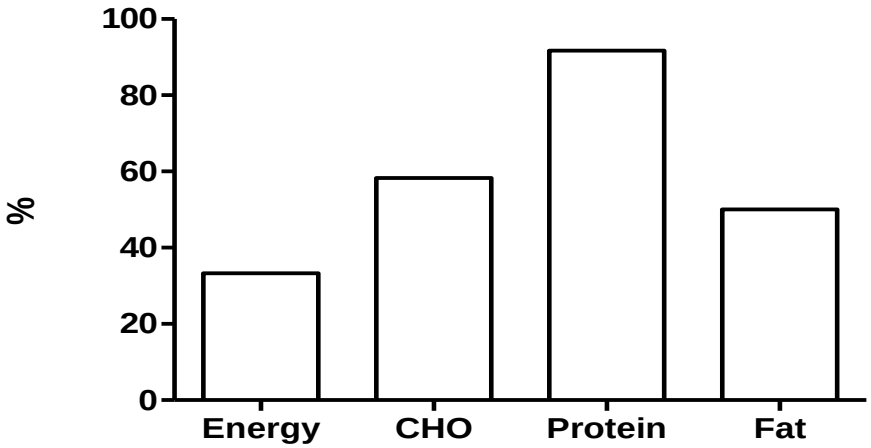

Figure 1 - Percentage of the adequacy of daily intake of energy and macronutrients of bodybuilding practitioners, Lavras-MG, Brazil.
Legend: CHO = Carbohydrate.

Figure 2 shows the data regarding the distribution of protein intake per meal. Protein consumption was irregular throughout the day and concentrated in large meals (lunch and dinner).

The consumption of 20 to 40 g of protein per meal was considered adequate.

Most participants ate less than 20 g of protein at breakfast (66.7%) or afternoon lunch (75%). All participants (83.3%) who had inadequa

te protein intake at lunch had more than the recommended maximum value (>40 g). At dinner, 41.7% ate more than 40 g and 16.7% less than 20 g.

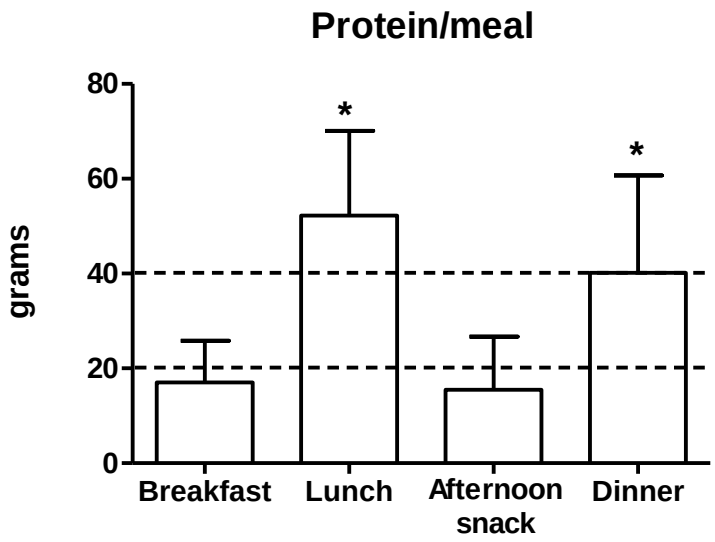

Figure 2 - Distribution of protein intake per meal of bodybuilding practitioners, Lavras-MG, Brazil. *lunch and dinner higher than breakfast and afternoon snack - p<0,0001.

DISCUSSION

The present study aimed to evaluate the distribution of energy and macronutrient intake of well-trained bodybuilders based on the collection of five 24-hour food recalls. In general, research on food intake uses one to three 24-hour dietary recalls or diaries.

Thus, it is considered that the use of a larger number of diaries allows for a more complete characterization of the distribution and consumption of energy and nutrients.

The present study's main result was the irregular protein intake distribution throughout the day.

The consumption of this nutrient was concentrated in the large meals, commonly eaten by the Brazilian population, lunch and dinner. This pattern was repeated for energy and fat intake. The intake of carbohydrates varied less between meals (Table 2).

The average protein intake per kilogram of body weight corresponded to the minimum value recommended by Iraki and collaborators (2019) (Table 1).

Half of the participants had adequate intake (1.6-2.2 g/kg/day) (Figure 1). In the literature, there is no consensus on the optimal recommendation for athletes in specific modalities.

For example, Morton and collaborators (2018) report that ingesting twice the Recommended Dietary Allowance (RDA), i.e. 1.6 g/kg/day would be sufficient to maximize hypertrophy induced by resistance training. However, some individuals may require ≈2.2 g/kg/day or more to achieve maximal protein synthesis (Bandegan and collaborators, 2017).

Five participants consumed less than 1.6 g/kg/day and were classified with inadequate intake.

Sommer and collaborators (2019) found a higher percentage of adequacy (97.7%) and Silva-Junior, Abreu, Silva (2018) observed a lower value (40%) than the value observed in the present study (50%). However, in both studies, the authors used different recommendations from the present research, which makes it impossible to directly compare the individuals who consumed protein in adequate amounts.

Resistance training, such as weight training, is capable of stimulating muscle protein synthesis that can remain elevated for a period of 24-48 hours (MacDougall and collaborators, 1995).

Studies have shown that regular protein distribution in meals taken throughout the day can maximize acute anabolic responses as well as chronic anabolic adaptations (Areta and collaborators, 2013; Mamerow and collaborators, 2014; Schoenfeld, Aragon, 2018).

In the present study, the distribution of protein intake in the meals that were taken by

all subjects throughout the day was assessed (Figure 2).

The consumption of 20 to 40 g/meal was considered adequate as proposed by Campbell and collaborators (2007).

Irregular protein consumption was observed throughout the day with the intake concentrated on large meals (lunch and dinner). At breakfast and supper, the average consumption was lower than the recommended minimum (20 g).

Gillen and colleagues (2017) also observed irregular protein intake in Dutch athletes who had a dietary intake pattern distributed over three daily meals (breakfast, lunch, and dinner).

The authors observed that protein intake was concentrated at dinner.

The highest protein intake was observed at lunch. Ten volunteers (83.3%) exceeded the maximum value recommended by Campbell and Collaborators (2007), which is 40 g of protein per meal.

For Ramos, Navarro (2012), excessive protein intake brings no additional benefit for lean mass gain, as well as no increase in performance because there is a limit to the accumulation of protein in tissues (Nóbrega and collaborators, 2009).

In the study by Witard and collaborators (2014), 48 young trained men were analyzed for post-exercise maximum protein synthesis rate (MPS) and concluded that 40 g of whey protein failed to increase MPS compared to consuming 20 g, instead causing a marked increase in the body's rate of amino acid catabolism indicators.

In the present study, the average energy intake was less than 30 kcal/kg body weight (Table 1) and was higher at lunch and dinner (Table 2).

Other researchers found similar results in bodybuilding practitioners (Sehnem, Soares, 2015; Oliveira, Faicari, 2017; Silva-Junior, Abreu, Silva, 2018).

The low percentage of individuals who presented adequate energy intake refers to a characteristic behaviour that has been reported in the sports field as Relative Energy Deficiency in Sport (RED-S), behaviour that leads athletes and sportspeople to consume less energy than they need. This chronic eating pattern can lead to hormonal, metabolic, and psychological dysfunction, impairing health and performance (Statuta, Asif, Drezner, 2017).

However, to correctly judge the adequacy of energy intake it is necessary to know the purpose of the training since individuals engaged in hypertrophy training benefit from a hyperenergetic diet. On the contrary, for individuals aiming at weight loss, a hypoenergetic diet, not too restrictive, will be the most appropriate.

Regarding carbohydrate intake, although the average in grams per kilogram of body weight was below the recommended range, more than half of the participants (58.3%) had adequate consumption (3-5 g/kg/day). However, all participants who presented inadequate carbohydrate intake consumed less than the minimum recommended (3 g/kg/day).

The values observed in the present study are lower than those found in other studies (Chappell, Simper, Barker, 2018; Silva-Junior, Abreu, Silva, 2018).

Carbohydrate is the main energy substrate used during intense weight training workouts. Thus, low carbohydrate intake can impair muscle glycogen replenishment and reduce the ability to perform work (Lima-Silva and collaborators, 2013).

However, it is common for bodybuilders to train each muscle group 1-2 times per week. With this, the intervals between workouts of the same muscle group will be long, about 2 to 3 days, and supposedly may be sufficient to ensure adequate replenishment of muscle and liver glycogen stores, even with consumption of about 3 g/kg/day.

In the present study, 91.7% of participants had an adequate intake of fat. The average intake of fat was 0.9 g ± 0.4 g/kg/day, a value lower than that found by Menon and Santos (2012) and similar to the values found by Silva-Junior, Abreu, Silva (2018) and Chappell, Simper, Barker (2018).

Although fat is not a relevant source of energy in weight training, low intake, especially in the long term, can impair testosterone synthesis and favour deficiency of fat-soluble vitamins (A, D, E and K) and essential fatty acids, such as omega-3 (Thomas, Erdman, Burke, 2016).

In the present study, no subjects ingested less than 0.5 g/kg/day or less than 20% fat of total daily energy intake.

As a result of these findings, it is observed that the dietary intake pattern of bodybuilders investigated in this study is still far from ideal dietary planning.

CONCLUSION

We conclude that protein, energy and fat intake distribution is irregular throughout the day and concentrated at lunch and dinner.

Half of the sample consumed a normoprotein diet and most consumed a hypoenergetic, normoglycemic, and normolipidic diet.

In addition, a relevant percentage presented low carbohydrate intake. Thus, the results indicate that the food intake of individuals can be significantly improved.

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