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EFFECTS OF CALORIC HIGHPROTEIN DRINK ON BODY COMPOSITION, METABOLIC AND HORMONAL PARAMETERS OF FOOTBALL PLAYERS

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ABSTRACT: *This study aimed to study the effect of caloric high-protein drink on body composition, metabolic and hormonal parameters during a 12-week for athletic young men. Forty randomized athletic young men (aged 16to22 years) were divided into two groups, one groups consumed usual diet as control and the other group consumed tested caloric high protein diet (HP group). Both groups participated in a 12-week exercise program. Body composition and xercise-related hormones at baseline and 12 weeks were measured. Resting blood samples were analyzed at weeks 0 (PRE), 6 (MID) and 12 (POST) for total testosterone, cortisol and growth hormone. No difference was seen in energy intake between PR and PL (3034 ± 209 kcal and 3130 ± 266 kcal, respectively), but a significant difference in daily protein intake was seen between PR (2.00 g·kg body mass[BM]-1·d-1) and PL (1.24 g·kgBM-1·d-1). Cortisol concentrations were significantly lower at MID for PL and this difference was significantly differed than PR. No significant changes were noted in resting growth hormone1 concentrations in either group. Although protein supplementation appeared to augment lower body strength development,*

Key words: *Dietary recall , Body mass , testosterone, cortisol .*

INTRODUCTION

Approximately half of American collegiate athletes are reported to be using nutritional supplements, with protein supplementation being one of the most commonly used (Schenk and Costley, 2002). Although some studies have demonstrated that protein supplementation in previously untrained adults performing resistance exercise does not provide any benefit an regards to increases in lean tissue accruement or strength (Candow *et al.,* 2006a; 2006b), evidence does support a greater protein need for strength and power athletes an compared to endurance athletes and the sedentary population (Lemon *et al*., 1992 and Tarnopolsky *et al.,* 1992). Considering that heavy resistance exercise results in disruption or damage to the active muscle fibers, a greater protein intake may assist in the repair and remodeling process of these fibers (Tipton *et al.,* 2004). A decrease in muscle damage, attenuation of force decrements, and an enhanced recovery from resistance exercise has been demonstrated in subjects using protein supplements (Ratamess *et al.*, 2003 and .Kraemer *et al*., 2006) . The combination of resistance training with a greater amino acid pool may result in a positive nitrogen balance and an increase in protein synthesis (Tarnopolsky *et al*., 1992 and Roy *et al.,* 1997). This may have an important implications for improvements in both muscle size and strength.

Protein intake has also been suggested to have an important role in regulating the anabolic hormones that are involved with muscle remodeling (Chandler *et al*., 1994 and Kraemer *et al.,* 1998). When a protein supplement was provided to previously untrained men during 12 weeks of resistance training, post-exercise cortisol concentrations were reduced suggesting an attenuation in the rise of post-exercise muscle degradation (Bird *et al*., 2006). In addition, dietary protein content has also been suggested to influence resting testosterone concentrations (Volek *et a*l., 1997), and the hormonal response to an acute resistance exercise session (Kraemer *et al.,* 1998). However, there have only been a few studies that have examined the effect of prolonged protein supplementation (e.g. length of a typical off-season resistance training program) on changes in resting hormonal concentrations in experienced resistance trained competitive strength/power athletes.

For strength-trained individuals to maintain a positive nitrogen balance it is suggested that they need to consume a protein intake of 1.6 to 1.8 g·kg-1·day-1 (Tarnopolsky *et al*. , 1992 and American Dietetic Association *et al.*, 2000). For many athletes, the ability to achieve adequate protein intake is compromised due to inadequate nutrition attributed to low caloric intake, poor food choices, and irregular meals (Cole *et al*., 2005). To insure sufficient protein intake many athletes rely on protein supplementation (Schenk and Costley, 2002). However, the evidence supporting the efficacy of protein supplementation to the normal dietary intake of strength/power athletes is limited. Thus, the purpose of this study was to examine the effect of protein supplementation on body composition and resting endocrine concentrations during a 12-week resistance training program in competitive strength/power athletes.

MATERIALS AND METHODS

Subjects

Twenty-one male strength and power athletes volunteered for this study. Following an explanation of all procedures, risks and benefits each subject gave his informed consent to participate in this study. The Institutional Review Board of the College approved the research protocol. Subjects were not permitted to use any additional nutritional supplementation and did not consume anabolic steroids or any other anabolic agents known to increase performance for the previous year. Screening for anabolic steroid use and additional supplementation was accomplished via a health questionnaire filled out during subject recruitment.

Subjects were randomly assigned to either a protein supplement group (PR; n =11: 20.3 ± 1.6y; 1.82 ± 0.06 m; 93.9 ± 7.9 kg) or a placebo group (PL; n =10: 21.0 ± 1.2y; 1.83 ± 0.05 m; 97.7 ± 10.2 kg). All subjects were athletes from the College's Football team with at least 2 years of resistance training experience. The study followed a double-blind format.

Blood measurements

Subjects were required to arrive at the Laboratory in the early morning following an overnight fast for blood draws. All blood draws occurred at the same time of day for each testing session. Each blood sample was obtained from an antecubital arm vein using a 20-gauge disposable needle equipped with a Vacutainer® tube holder (Becton Dickinson, Franklin Lakes, NJ) with the subject in a seated position. Blood samples were collected into a Vacutainer® tube containing SST® Gel and Clot Activator. Serum was allowed to clot at room temperature and subsequently centrifuged at 1,500 x g for 15 minutes. The resulting serum was placed into separate 1.8-ml microcentrifuge tubes and frozen at -20°C for later analyses.

Biochemical and hormonal analyses

Serum total testosterone, growth hormone, IGF-I, and cortisol concentrations were determined using enzyme immunoassays (EIA) and enzyme-linked immunosorbent assays (ELISA) (Diagnostic Systems Laboratories, Webster, TX). Determinations of serum immunoreactivity values were made using a SpectraMax340 Spectrophotometer (Molecular Devices, Sunnyvale, CA). To eliminate inter-assay variance, all samples for a particular assay were thawed once and analyzed in the same assay run. All samples were run in duplicate with a mean intra-assay variance of < 10%. The molar ratio of total testosterone to cortisol (T/C ratio) was determined for each testing session to provide a measure of anabolic/catabolic status of the body.

Body composition

Body composition was determined using whole body-dual energy x-ray absorptiometry (DEXA) scans (Prodigy ; Lunar Corporation, Madison, WI). Total body estimates of percent fat, bone mineral density and bodily content of bone, fat and non-bone lean tissue was determined using company's recommended procedures and supplied algorithms. All measures were performed by the same technician. Quality assurance was assessed by daily calibrations and was performed prior to all scans using a calibration block provided by the manufacturer(Hoffmam, 2006)

Dietary recall

Three- day dietary records were completed every week of the study. Subjects were instructed to record as accurately as possible everything they consumed during the day including supplement (or placebo) and between meal and late evening snacks. Food Works Dietary Analysis software (Home Economics Faculty Menufia, University) was used to analyze dietary recalls.

Supplement schedule

The supplement and placebo was in powder form and provided in individual packets. The contents of each packet were mixed with 473 ml of water. Subjects consumed one drink every morning, and a second daily drink following their exercise session. The supplement was comprised of 260 kcal, 42 g of protein, 18 g of carbohydrates and 3 g of fat. Thus, on exercise days subjects in the supplement group would consume 84 g of protein from the supplement source. The protein content of the supplement consisted of a proprietary blend of milk protein concentrate, whey protein concentrate, L-glutamine, and dried egg white. The carbohydrates content of the supplement consisted of maltodextrin. The placebo (maltodextrin) was comprised of 260 kcal, 2 g of protein, 63 g of carbohydrates and 2 g of fat.

Statistical analysis

Statistical evaluation of the data was accomplished by a 2 (group) x 3 (time) or 2 x 2 repeated measures analysis of variance. In the event of a significant F- ratio, LSD post-hoc tests were used for pairwise comparisons.. A alpha level of $p \leq 0.05$ was used to determine statistical significance. All data are reported as mean ± SD.

RESULT

Average daily dietary intake is shown in Table (2). No significant difference in daily caloric intake was observed between PR and PL. However, significant differences existed between the groups in protein and intake. No significant changes in body mass, lean body mass or percent body fat were observed from PRE to POST training in either PR or PL, and no between group differences were noted as well (Table 2). Interestingly, Δ lean body mass was increased by 1.4 kg in PR, but only 0.1 kg in PL. Although these differences did not reach statistical significance ($p = 0.08$, ES = 0.78), a trend towards a greater lean tissue accruement in PR was evident.

Table 1: Average daily dietary intake.

Group	Kcal	Carbohydrate(g)	Protein (g)	Totel Protein (g.kg-1)	Fat (g)	%carbohydrat	%protein	%fat
PL	3109±30	415±31	178±11	1.14±0.05	91±10	55.5±0.2	15.4±0.3	29.1±1.22
PR	3012±22	310±31	138±10	2.00±2.1	102±21.2	45.6±2.1	24.5±3.51	29.9±2.76

* $p \leq 0.05$, significant difference between groups

Table 2: Body mass (kg) , lean body mass kg and body fat % results.

	Group	PRE	MID	POST
Body mass (Kg)	PL	98±2.3	98±10.3	98.3±6.9
	PR	93.7±8.3	94±9.7	94.6±7.1
Lean Body Mass (Kg)	PL	75.6±4.3	76.5±4.1	75.7±3.4
	PR	73.1±4.1	74.1±3.8	74.3±2.6
Body Fat (%)	PL	20.9±3.2	20.3±3.5	21.7±6.7
	PR	20.7±3.4	19.6±3.7	19.9±6.5

Resting total testosterone concentrations are shown in Figure 1. No significant change from PRE was observed in either group, and no between groups differences were noted. Changes in resting cortisol concentrations appear in Figure 2. Cortisol concentrations remained steady during all three measuring time points for PR. However, a significant decrease from PRE was observed at MID for PL. In addition, cortisol concentrations at MID for PL were significantly lower than PR. No other between group differences was observed. The T/C ratio is shown in Figure 3. No significant change from PRE occurred in either PR or PL, nor were any between group differences observed at any time point.

Resting growth hormone concentrations during the 12-week study are shown in Figure 4 . No significant changes from PRE in either PR or PL were seen in the resting concentrations of these hormones. In addition, no significant differences in the resting concentrations of these hormones were observed between the groups at any time point measured.

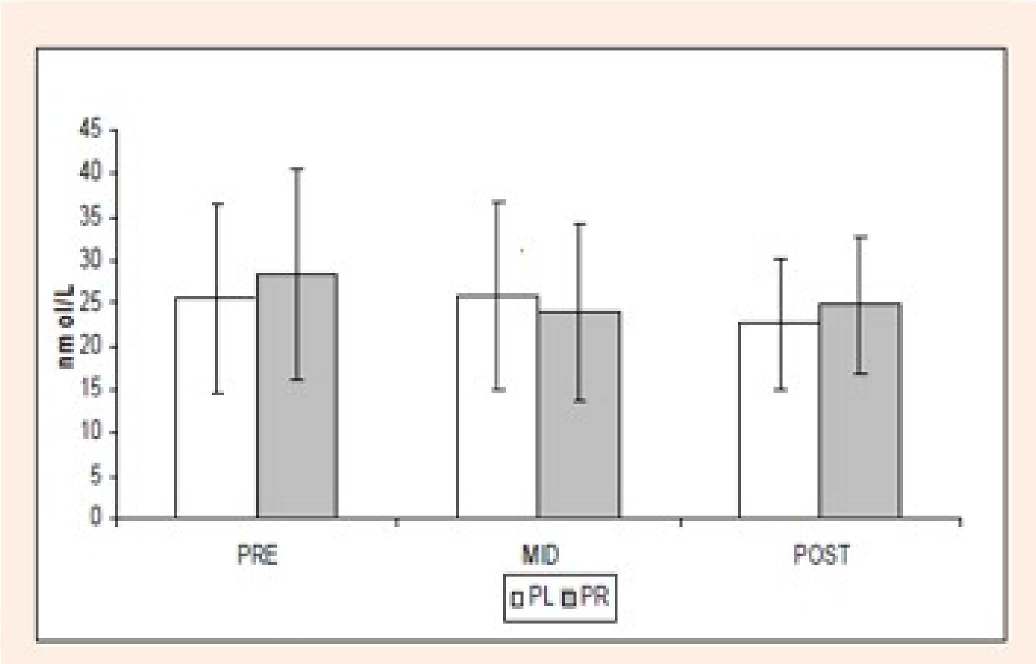

Fig . (1) : Resting testosterone concentrations of PL and PR groups (mean ± SD).

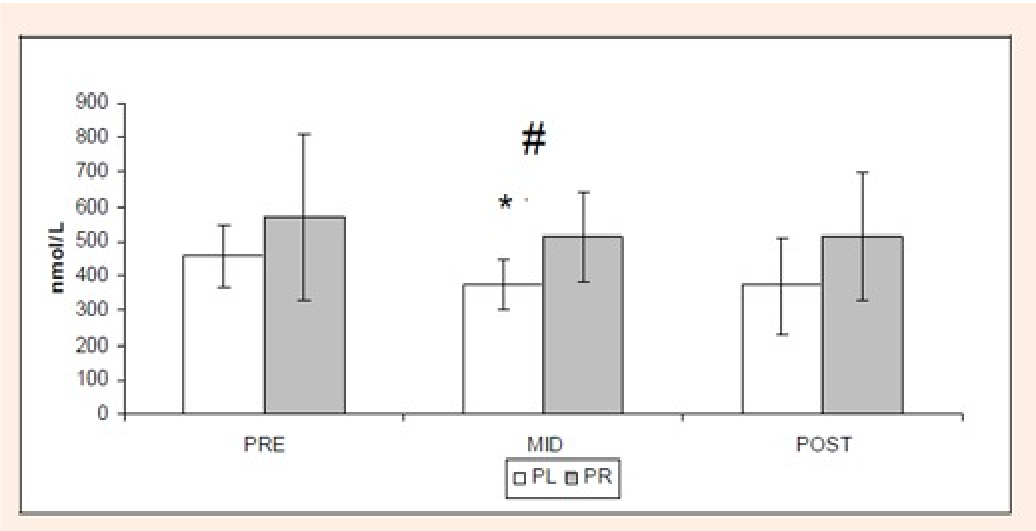

Fig . (2) : Resting cortisol concentrations of PL and PR groups (mean ± SD).
* Significant PRE to MID difference in PL; # = Significant difference between PL vs. PR.

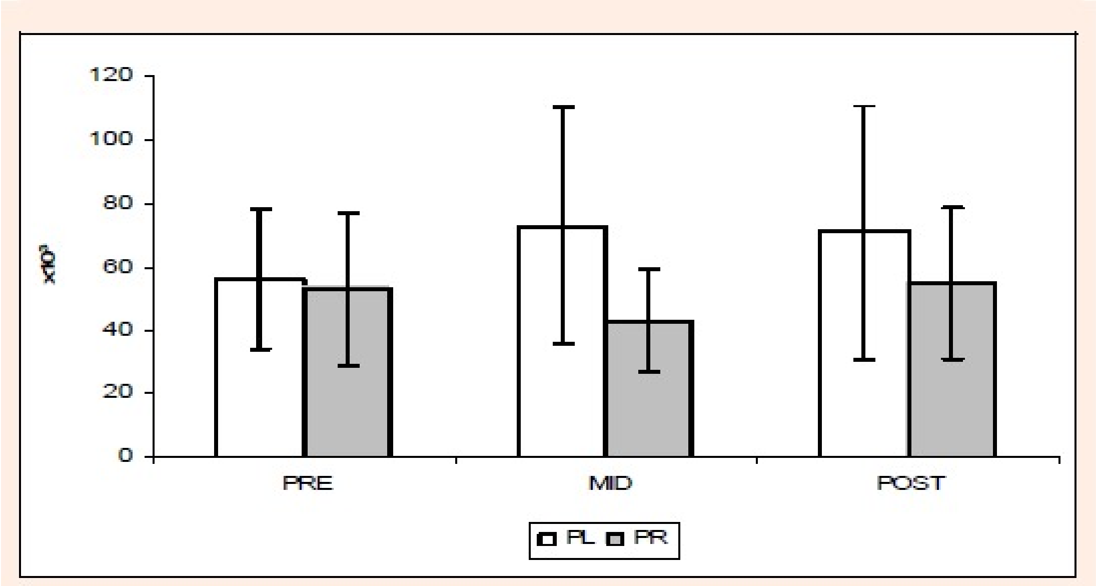

Fig (3) : The T/ C vatio of PL and PR groups .

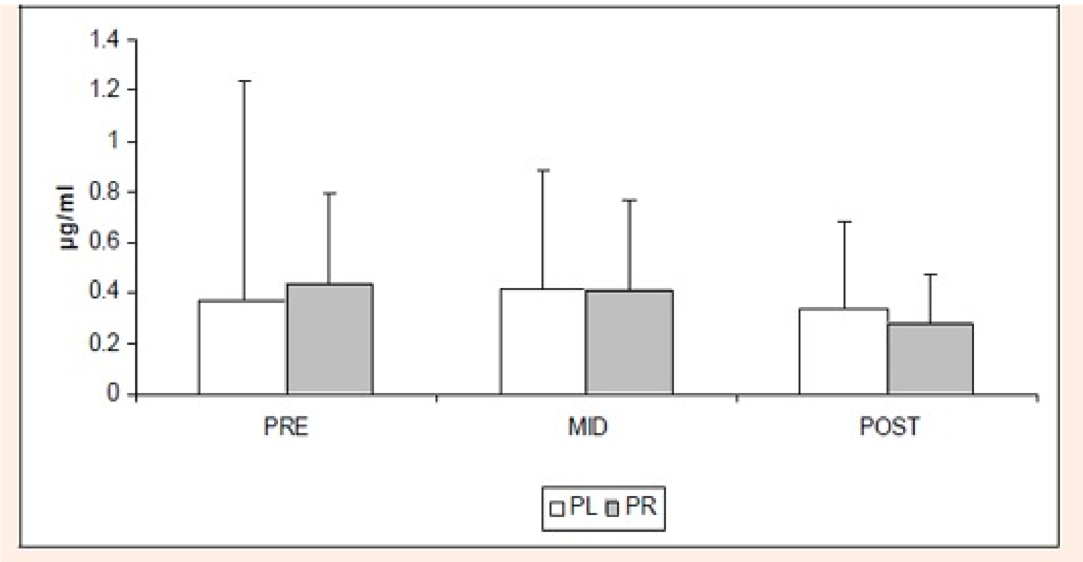

Fig (4): Resting Growth Hormone concentrations of PL and PR (mean ± SD).

DISCUSSION

The results of this study indicate that protein supplementation in collegiate strength/power athletes may augment lower body strength development an compared to a placebo. Changes in resting hormonal concentrations did not appear to support previous research that protein supplementation may augment anabolic hormonal responses. The energy intakes reported in this study are in agreement with previous investigationswhiel suggest that athletes do not consume adequate quantities of macronutrients including meeting desired protein intakes (Hinton *et al.,* 2004 and Cole *et al*., 2005). However, when subjects are provided a protein supplement they do appear to meet or exceed the recommended protein intake for strength/power athletes.

Despite a greater protein intake by PR no significant differences in body mass, lean body mass or fat mass were seen between the groups. Although higher protein intakes were associated with an increase in lean body mass, it is possible that the relatively low caloric intake by the subjects negatively impacted the ability to make significant gains in lean tissue accruement. Without consuming a sufficient caloric intake the ability of subjects to significantly increase body mass or lean body mass may be compromised.

An additional purpose of this study was to examine whether resting hormonal concentrations can be influenced by protein supplementation. A significantly lower cortisol concentration was seen at MID for PL compared to PR. These results contrast slightly with those found in other studies that demonstrated that resting cortisol concentrations tend to remain the same or decrease in subjects supplementing with protein (Kraemer *et al*., 1998 and Bird *et al*., 2006). The results seen in this study may reflect the higher (6%) training volume in the squat exercise experienced by PR. This is supported by previous studies demonstrating elevations in training volume, despite higher daily protein intake, can result in significant elevations in resting cortisol concentrations (Volek *et al*., 1997). It is possible that the higher training volume may have impacted the results seen in this study as well.

Previous research has shown that high protein diets are associated with low resting levels of testosterone (Anderson *et al*., 1987), while others have reported a negative relationship between the protein-to-carbohydrate ratio and resting testosterone concentrations (Volek *et al.,* 1997). In this study, 24% of the total energy consumed by PR was from protein, and only 15% of the total energy consumed by PL was from protein. Although the protein-to-carbohydrate ratio was lower than that reported by Anderson etal., (1987) (44% of total energy from protein in high protein group versus 10% of total energy in low protein group), this difference likely contributed to the results observed in this study. A negative correlation (-0.64, $p \leq 0.05$) was observed between testosterone concentrations at MID and the protein content of the diet. This trend continued, but the correlation between testosterone concentrations at POST and protein content did not reach significance ($r = -0.37$, $p = 0.10$). This is similar to previous results reported by Volek etal ., (1997). The data of this study appear to support the importance of macronutrient composition on resting testosterone homeostasis.

No significant changes from PRE were seen in either resting growth hormone or IGF-I concentrations. Resting growth hormone concentrations appear to be responsive to amino acid supplementation (Bratusch-Marrain and Waldäusi, 1979), however others have reported no effect of protein supplementation on resting growth hormone or IGF- I concentrations (Kraemer *et al.,* 2006). It does appear that changes in IGF-I concentrations are dependent upon energy intake, with caloric restriction being associated with decreases in IGF-I concentrations, while increases in caloric intake tends to elevate IGF-I (Forbes *et al.,* 1989 and Thissen *et al.,* 1994).

Conclusion

In conclusion, the results of this investigation confirm previous studies that have demonstrated that collegiate strength/power athletes may not meet daily recommended energy or protein needs. When athletes are provided a protein supplement they do appear to meet the recommended daily protein intake for strength/power athletes. Protein supplementation did appear to augment lower body strength development in experienced strength/ power athletes. Further examination appears warranted on protein supplementation in athletes that are consuming a diet meeting recommended energy intakes for strength/ power athletes.

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تاثير المشروب العالى الطاقة والبروتين على مكونات الجسم ؛ والتمثيل الغذائي والمقاييس الهرمونية للاعبي كرة القدم

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الملخص العربى

هذه الدراسة تختبر تأثير المشروب العالى الطاقة والبروتين على تركيب الجسم والتمثيل الغذائى والمقاييس الهرمونية لشباب الرياضيين خلال ١٢ أسبوع.

أربعون شاب رياضى (يتراوح اعمارهم من ١٦الى ٢٢ سنة) تم اختيارهم عشوائيا وتقسيمهم الى مجموعتين (المجموعة الأولى تستهلك الوجبة المعتادة كمجموعة ضابطة) والأخرى (تستهلك الوجبة المحتوية على الشراب العالى الطاقة والبروتين).

كلا المجموعتان شاركت خلال ١٢ أسبوع فى برنامج رياضى تم قياس تركيب الجسم والدلالات الهرمونية التى لها علاقة بالتمرينات الرياضية لكلا المجموعتين . تم تحليل عينات الدم فى الأسبوع قبل أجراء التجربة والأسبوع السادس وبعد الأسبوع الثانى عشر لقياس التيستيرون الكلى والكرتيزول .

وقد لوحظ أنه لايوجد فروق معنويه فى مأخوذ الطاقة بين المجموعتين (٣٠٣٤±٢٠٩) كيلو كالورى من (٣١٣٠± ٢٦٦) كيلو كالورى لكل من المجموعة المعطاة لها مشروب الطاقة والمجموعة الضابطة على التوالى . ولكن وجد فرق معنوى فى المأخوذ من البروتين بين المجموعتين على التوالى (٢جم/كجم كتلة الجسم،١.٢٤جم/كجم كتلة الجسم).

تركيز الكورتيزول كان معنويا أقل فى الأسبوع السادس للمجموعة الضابطة وهذا الأختلاف كان معنويا مختلف عند مقارنته بالمجموعة المختبرة. لايوجد أختلافات معنوية فى تركيز هرمون النمو فى كلا المجموعتان بالرغم من أن الأمداد بالبروتين أظهرت تطوير فى قوة عضلات الجسم وتركيبه.

الكلمات الارشادية : الماخوذ الغذائى – كتلة الجسم – التسترون – كورتيزون .