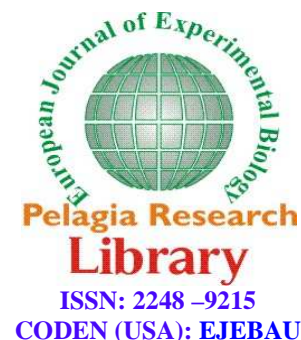




## Pelagia Research Library

European Journal of Experimental Biology, 2013, 3(1):10-15



### Comparison of whey protein and carbohydrate consumption on hormonal response after resistance exercise

Yaser Kazemzadeh<sup>1</sup>, Ardeshir Zafari<sup>2</sup>, Ali Bananaeifar<sup>3</sup>, Rashid Heydari Moghadam<sup>4</sup>,  
Nadia Abasrashid<sup>1</sup>, Rafee Shafabakhsh<sup>1</sup>

<sup>1</sup>Faculty of Physical Education and Sport Sciences, Islamshahr branch, Islamic Azad University, Tehran, Iran

<sup>2</sup>Department of Physical Education and Sport Sciences, Zanjan Branch, Islamic Azad University, Zanjan, Iran

<sup>3</sup>Department of Physical Education and Sport Sciences, South Tehran Branch, Islamic Azad University, Tehran, Iran

<sup>4</sup>Department of Ergonomic, School of Health, Hamedan University of Medical Sciences, Hamedan, Iran

---

#### ABSTRACT

Nutrition is a critical factor that influences on hormonal responses induced resistance exercise. The purpose of this study is comparison of impact of carbohydrate or protein consumption during exercise on hormonal responses following resistance exercise. Subjects of this study included that 20 untrained young men (age:22.3±3 y, bodymass: 74±5 kg) that divided randomly in two group and consumed carbohydrate (~750 ml 6% CHO beverage) or whey protein (0.2 g/kg) between a bout of resistance exercise with 75% 1 repetition maximum intensity. Blood samples were obtained pre and post exercise for determination of Cortisol, insulin, Growth Hormone (GH), Total Testosterone (TT) and insulin like Growth Factor -1 (IGF-1) concentrations. Results indicates that while cortisol significantly greater increased in PRO than CHO (17.23±4.59 vs 0.71±20.67 µg/dl, respectively, p<0.05), Insulin more increased in CHO compared PRO significantly (8.12 ±3.01 vs 4.69± 2.08, respectively, p<0.05). No significant difference was seen in GH, TT and IGF-1 for both groups. We conclude that ingestion of carbohydrate in during resistance exercise may inhibit catabolic hormone (cortisol) and increased anabolic hormone (insulin) and creating a hormonal milieu for anabolism when compared with whey protein. However in about other anabolic markers need greater investigations.

**Keywords:** Cortisol, Insulin, Growth Hormone, Total Testosterone, Insulin like Growth Factor -1

---

#### INTRODUCTION

An acute bout of resistance exercise performed in conjunction with carbohydrate ingestion during the exercise bout (Tarpennig 2001, Bird 2005), 10 min before and after exercise (Tayfault 2004), and 60 min after exercise (Roy 1997 and Borshim 2004) results in significantly increased in blood glucose and insulin levels. Insulin is entirely

anabolic hormone and therefore, Increases insulin concentrations after an acute bout of resistance exercise, thereby enhancing muscle protein balance (Roy 1997). This is most likely due to the inhibitory effect of insulin on muscle protein breakdown (Rasmussen 2003). In the other hand, without consumption of protein, concentration of plasma amino acids do not increase and net protein balance in body remained negative. In the absence of an increase in amino acid concentration, an increase in insulin has only a modest effect on muscle protein synthesis (Biolo 1995). Therefore, supplying exogenous amino acids after the exercise bout should allow expression of the stimulatory effect of insulin. Researcher showed that rates of protein synthesis and net protein balance are higher when amino acid availability is increased after an acute bout of resistance exercise than when subjects are fasted (Tipton 2001). As a result, amino acid supply to the muscle intracellular compartment through enhanced amino acid transport into muscle is suggested to be an important regulatory factor in determining the rate of muscle protein synthesis (Phillips 1999).

Cortisol is another hormone that has catabolic effects in body. Research has shown that different resistance exercise protocols result in an acute increase in cortisol (Tarpenning 2001, Kraemer 1998, Bird 1994). However, researcher suggest that excessive cortisol levels exhibited after a single bout of resistance exercise may elicit physiologic responses detrimental to the positive adaptations attributed to resistance training (Conley 1996). Carbohydrate ingestion during the exercise bout is suggested (Tarpenning 2001) to increase the exogenous glucose load, resulting in inhibition of the glucose-regulatory response of cortisol. Such an environment may provide greater potential for protein accretion and skeletal muscle growth, thus counteracting the stimulatory effect of cortisol on skeletal protein degradation. Other anabolic hormone such as growth hormone (GH), testosterone and insulin-like growth factor-I regulates protein synthesis and support net protein balance in muscles but there are no sufficient information about effect of nutritive intervention on their responses (Kimball 1988, Griggs 1989).

The current study examined the influence of consumption of whey protein and liquid carbohydrate on acute hormonal responses to a single bout of resistance exercise in untrained young men. Specifically, the objective of this study was to determine which one of nutritive interventions could be created better effect on the acute hormonal milieu during and after a bout resistance exercise.

## MATERIALS AND METHODS

*Subject:* The subjects of this study were 20 young volunteered men with no regular exercise or resistance training prior to the start of the study. The subjects, physical characteristics are listed in table 1. Subjects completed a health history questionnaire and par-Q before the start of the study and gave written consent after being informed of the risk associated with the study. Subject with contraindications to exercise as outlined by the American college of sport medicine and/ or who had consumed any nutritional supplements anabolic steroids 6 months prior to the study were excluded from participation. All experimentations were approved by the Ethics in Research Committee of the Azad University (Iran). Subjects were randomly assigned to one of two groups: CHO group ( $n = 10$ ), protein group ( $n = 10$ ). Subjects refrained from physical exercise for at least 48 h before participating in the study. The mean age, height, weight, and body fat percentage were  $22.3 \pm 3$  yr,  $177 \pm 4$  cm,  $74 \pm 5$  kg, and  $17.3 \pm 4$ , respectively.

*Anthropometrics and body composition testing:* During the initial laboratory session (day 1), descriptive data including height, weight, and body composition were obtained during the initial session (session for resistance training equipment familiarization), five days prior to the experiment day. Height was measured to the nearest 0.1 cm by using a stadiometer (seca, Italy) and weight was measured to the nearest 0.1 kg by using an electronic precision balance scale (Seca, Italy). Body composition was determined using a Body Space BF-350E bioelectrical impedance analyzer (BodySpace Corporation, Arlington Heights, South Korea). Subjects were required to refrain from all strenuous activity, alcohol use, caffeine, and sexual activity and were notified to maintain normal nocturnal sleep habits (i.e., approximately 8 h/night) throughout the experimental timeline.

*Muscular strength testing:* Muscular strength was assessed Four days before the exercise day by using selected resistance exercises including leg press, leg curl, leg extension, calf raise, lat pull down, bench press, barbell bicep curl, and supine triceps extension by 1-RM test. The process of 1-RM test is the same as that executed by Bird et al. (Bird 2005), including Warm-up consisting of one set of 5–10 repetitions at 40–60% of perceived maximum. Then Subjects rested for 1 min, performing light stretching. This was followed by 3–5 repetitions performed at 60–80% of perceived maximum. Thereafter, 3–4 subsequent attempts were made to determine the 1-RM, with the weight increased progressively until the subject failed at the given load. Three minutes of rest was allocated between the

lifts. By definition, 1-RM is the maximum amount of weight that could be lifted one time through a full range of motion, using good form at a tempo of 2:0:2 (2 s eccentric; 2 s concentric).

*Blood sampling:* Blood sampling were obtained prior to exercise and immediately post-exercise period for analysis of glucose (GLU), insulin (INS), cortisol (CORT), Growth Hormone (GH), total testosterone (TT) and INS like Growth Factor -I (IGF-I). After a 4-h fast, subjects sat quietly for a further 15-min period prior to blood collection to minimize hormonal fluctuations related to anticipatory responses Venous blood samples were obtained from the antecubital vein into 10 ml collection tubes. Blood samples were allowed to stand at room temperature for 20 min and then centrifuged for 10 min at 3000 rpm. The serum was then removed and frozen at  $-20\text{ }^{\circ}\text{C}$  for later analysis. Glucose was determined by an enzymatic spectrophotometric method (Dimension Xpand, Biomer Inc., Germany). INS, CORT, GH, total testosterone and IGF-1 concentrations were determined in duplicate and the average concentrations reported using commercially available ELISA kits (Diagnostics Systems Laboratories, Biomer Inc., Germany).

*Resistance training protocol:* Resistance exercise was employed, with intensity at approximately 75% of each individual 1-RM (i.e., 8–10 repetitions per set), with subjects performing each set to failure. The resistance exercise protocol used for this investigation was that previously used by Bird *et al.* (Bird *et al.*, 2005), which has been shown to influence hormonal concentrations. The session of exercise protocol were supervised by the principal investigators and/or trained university students. The resistance exercise protocol consisted of a complete body workout, with a combination of machine equipment and free weight exercises, including 4 exercises for lower body and 4 exercises for upper body in order: leg press, leg curl, and leg extension, and calf raise, lat pull down, bench press, barbell bicep curl, and supine triceps extension. The subject's should complete three sets of 8–10 repetitions at approximately 75% of their 1-RM. 1 minute of rest between each set and 2 minute between each exercise was allowed for recovery. These times of rest between sets and exercise induced influence plasma hormonal concentrations. The resistance exercise session lasted approximately 60 min (by a 6 min warm-up and 6 min warm-down period). The session of exercise were performed between 16:00 and 18:00 h to minimize the influence of diurnal variations on hormone release.

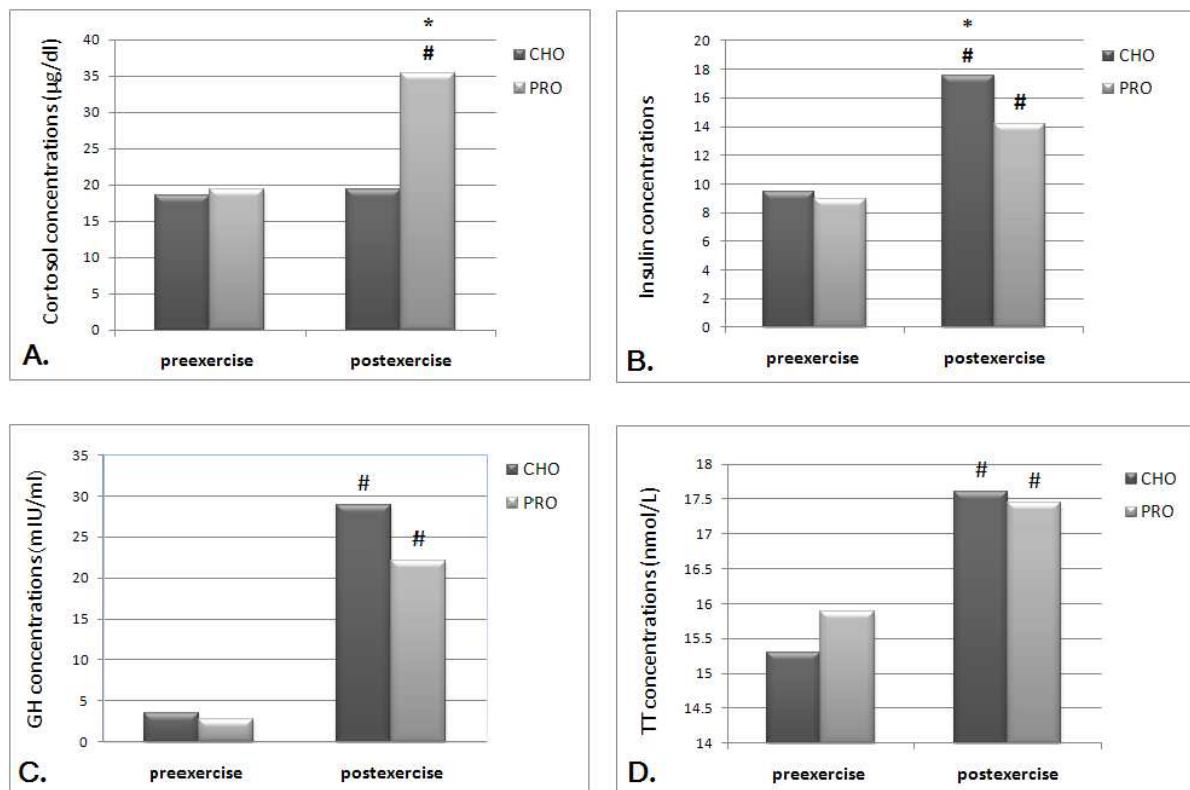
*Nutritive intervention:* subjects consumed either CHO (solution of 6% glucose, Quaker Oats, Inc., Chicago, IL, USA), or whey protein (0.2 g/kg of whey protein, Interactive Nutrition International Inc, Canada) dissolved in water at a fluid volume of 10 ml kg body mass<sup>-1</sup> (an average of 750 ml of solution). The Total beverages ingested between each exercise were divided by 9 servings depending on body size. The whey protein composition observed in table 1 which have been shown to enhance muscle anabolism following resistance exercise (Chromiak 2004, Kerksick 2006, Tang 2007).

| <b>Table 1. whey protein composition</b> |            |
|--|------------|
| Macronutrients                           | Percentage |
| Fat                                      | 3%         |
| Carbohydrate                             | 3.7%       |
| Protein                                  | 90%        |
| Alanine                                  | 3.5%       |
| Arginine                                 | 2.7%       |
| Aspartic acid                            | 8.1%       |
| Cysteine                                 | 1.3%       |
| Glutamic acid                            | 12.5%      |
| Glycine                                  | 1.5%       |
| Histidine                                | 1.4%       |
| Isoleusine                               | 4.1%       |
| Leusine                                  | 9.1%       |
| Lysine                                   | 7.0%       |
| Methionine                               | 1.6%       |
| Phenylalanine                            | 2.6%       |
| Proline                                  | 3.7%       |
| Serine                                   | 4.1%       |
| Thronine                                 | 4.1%       |
| Tryptophan                               | 2.1%       |
| Tyrosine                                 | 2.8%       |
| Valine                                   | 3.7%       |

*Statistical analysis:* Data was analyzed utilizing standard descriptive statistics, paired *t* tests to compare within group differences between pre- and post exercise, and two-way ANOVA (2 group  $\times$  2 time) with repeated measures to compare differences between the groups in hormonal responses. The source of significant differences was located using Tukey's HSD post hoc procedure. Regression analysis determined associations between selected variables. Analysis was performed using the Statistical Package for Social Sciences (SPSS v11.5). Significance was accepted when  $P < 0.05$ . Values are expressed as mean ( $\pm$ SD).

## RESULTS

*Glucose and Hormonal concentrations:* Glucose and hormonal concentrations in pre and post exercise are presented in figure 1. No significant differences were observed between groups in pre exercise concentrations of GLU. There were no significant Group  $\times$  Test interaction for glucose concentrations ( $p = 0.43$ ); However, significant main effects for group ( $p = 0.0005$ ) and for Test were observed ( $p = 0.019$ ). The data indicate that GLU concentrations in CHO group significantly increase after exercise than PRO group.



**Figure 1.** A representation of the means ( $\pm$ SD) for A. Cortisol concentrations at pre and post exercise B. Insulin concentrations at pre and post exercise C. GH concentrations at pre and post exercise D. TT concentrations at pre and post exercise. \* Significantly different ( $P < 0.05$ ) from PRO; # significantly different ( $P < 0.05$ ) from pre exercise.

Pre exercise INS concentrations were similarly in two groups but, were higher for CHO and PRO group after exercise. There were no significant Group  $\times$  Test interaction for INS concentrations ( $p = 0.13$ ); However, significant main effects for group ( $p = 0.0005$ ) and for Test were observed ( $p = 0.26$ ). The data indicate that INS responses in CHO and PRO groups significantly increase after exercise but in CHO group was greater than PRO. CORT significantly increases after exercise for but in CHO no changes were observed. There were no significant Group  $\times$  Test interaction for CORT concentrations ( $p = 0.41$ ); However, significant main effects for group ( $p = 0.0005$ ) and Test ( $p = 0.02$ ) were located. The data indicate that CORT concentrations in PRO group significantly increase after exercise. While no significant increases were observed in CHO group after exercise.

GH increased post exercise in two groups exercise. There were no significant Group  $\times$  Test interaction for GH concentrations ( $p=0.28$ ). In addition, no significant main effects for group or Test were located ( $p=0.095$  and  $p=0.17$ , respectively). The data indicate that although GH responses in CHO group decrease after exercise, but not significantly.

There were no significant Group  $\times$  Test interaction ( $p=0.55$ ) and main effect for group and Test for testosterone concentrations ( $p=0.27$  and  $p=0.33$ , respectively). These data indicate that although testosterone concentrations increase in two groups significantly after exercise but no significant differences were observed between the groups. There were no significant Group  $\times$  Test interaction, Group and Test for IGF-1 concentrations ( $p=0.19$ ,  $p=0.23$  and  $p=0.21$  respectively);

## DISCUSSION

The results of this study indicate that consumption of CHO or PRO during a bout of resistance exercise affects the post exercise hormonal milieu. The hormonal milieu displayed by the treatment groups affects the results of a bout of resistance exercise.

The experimental protocol and time of intake supplementations more closely resemble the study by Bird *et al.* who demonstrated that the ingestion of a 6g essential amino acid combined with ~675 ml of carbohydrate 6% during exercise induced greater stimulate INS after exercise (Bird 2005). Findings of this study are in agreement with recent reports and indicating that the effect of ingestion of intact protein during exercise is similar to crystallizing essential amino acids (Bird 2006). Furthermore, consumption of a liquid CHO or PRO beverage resulted in a substantial increase in the acute INS response to resistance exercise. These findings are in agreement with the recent reports that indicate addition of EAA or protein with CHO enhances the acute INS response (Bird 2005; Koopman 2005; Williams 2001). In the current study although CHO ingestion induced increased post exercise INS concentrations, probably these were not associated with an increase in muscle fractional synthetic rate (Roy 1997), because the previous investigations showed that the increase rate of amino acid uptake by muscles is necessary for hypertrophic response of skeletal muscle (Tipton 2001), although plasma amino acid concentration and rate of uptake of them by muscles were not determined in the current investigation.

In current investigation consumption of carbohydrate in CHO attenuated elevation of CORT concentration induced resistance exercise, in contrast to PRO group that CORT concentrations significantly increased after exercise. Kraemer suggests that an accumulated reduction in CORT concentrations results in reduced total tissue exposure to CORT, thereby influencing the subsequent phase of recovery by modulating anabolic and catabolic processes (Kraemer 1998). Recent investigations demonstrate that protein degradation 48-h post-exercise significantly correlates with CORT area under the curve concentrations and changes in muscle fiber cross-sectional area were significantly correlated with the changes in CORT response (Bird 2005). Therefore, chronic reductions in the exercise-induced CORT response associated with CHO and PRO ingestion can positively impact the skeletal muscle hypertrophic adaptation to resistance training via reductions in hormone-mediated protein degradation (Borsheim 2004; Tarpinning 2001; Thyfault 2004).

Post-exercise growth hormone concentrations in the current study, were significantly greater than those of pre-exercise in two groups. These findings indicate that ingestion of carbohydrate or/and protein during exercise dose not influence the responses of GH to resistance exercise. This response happens despite the dramatic increase in the levels of glucose after exercise in CHO. This is in disagreement with previous reports indicating that high levels of glucose inhibit the exercise-induced increase in growth hormone (Goldberg, 1969). Addition of glucose levels, several circulating substrates and hormones can affect the growth hormone-secretory pulses, including lactate and  $H^+$ , branched chain amino acids (BCAA), fatty acids, catecholamines. For example, lactate and  $H^+$  have been shown to play a role in exercise induced stimulation of growth hormone (Kraemer 1998). Although levels of these substrates in current study, were not monitored, it is likely that GH response affects with other regulators such as lactate or BCAA concentrations.

## REFERENCES

- [1] Biolo G., R.Y.D. Fleming and R.R. Wolfe, (1995), *J Clin Invest* 95 pp. 811–819.

- [2] Borsheim E., M.G. Cree, K.D. Tipton, T.A. Elliott, A. Aarland and R.R. Wolfe, (2004), *J Appl Physiol* 96 pp. 674–678.
- [3] Bird S.P. and K.M. Tarpenning, (2004), *Chronobiol Int* 21 pp. 127–142.
- [4] Bird SP, Tarpenning KM, Marino FE (2005) Liquid carbohydrate/essential amino acid ingestion during an acute bout of resistance exercise suppresses myofibrillar protein degradation. *Metabolism* (in press) DOI:10.1016/j.metabol.2005.11.011.
- [5] Bird, S.P., Tarpenning, K.M., & Marino, F.E. (2006) *Nutrition* (Burbank, Los Angeles County, Calif.), 22, 367–375.
- [6] Borsheim E, Cree MG, Tipton KD, Elliott TA, Aarland A, Wolfe RR. 2004 *J Appl Physiol* 96: 674–678,.
- [7] Chromiak J.A., Smedley B., Carpenter W., Brown R., Koh Y.S. and Lamberth J.G. et al., *Nutrition* 20 (2004), pp. 420–427.
- [8] Chandler, R. M., H. K. Byrne, J. G. Patterson, and J. L. Ivy. , 1994 *J. Appl. Physiol.* 76: 839–845.
- [9] Conley M.S. and M.H. Stone, (1996), *Sports Med* 21 pp. 7–17.
- [10] Goldberg A., (1979) *Diabetes* 31 (suppl 1), pp. 18–24.
- [11] Griggs R.C., W. Kingston, R.F. Jozefowicz, B.E. Herr, G. Forbes and D. Halliday, (1989), *J Appl Physiol* 66 pp. 498–503.
- [12] Kerksick C.M., Rasmussen C.J., Lancaster S.L., Magu B., Smith P. and Melton C. et al., *J Strength Cond Res* 20 (2006), pp. 643–653.
- [13] Kimball S.R. and L.S. Jefferson, (1988), *Diabetes Metab Rev* 4 pp. 773–787.
- [14] Koopman R, Wagenmakers AJ, Manders RJ, Zorenc AH, Senden JM, Gorselink M, Keizer HA, van Loon LJ (2005) *Am J Physiol Endocrinol Metab* 288:E645–E653
- [15] Kraemer W.J., R.S. Staron, F.C. Hagerman, R.S. Hikida, A.C. Fry and S.E. Gordon *et al.*, (1998), *Eur J Appl Physiol* 78 pp. 69–76.
- [16] Kraemer WJ, Volek JS, Bush JA, Putukian M, Sebastianelli WJ (1998b) *J Appl Physiol* 85:1544–1555 Rasmussen B.B. and S.M. Phillips, (2003), *Exerc Sport Sci Rev* 31 pp. 127–131.
- [17] Phillips S.M., K.D. Tipton, A.A. Ferrando and R.R. Wolfe, (1999), *Am J Physiol Endocrinol Metab* 276 pp. E118–E124.
- [18] Roy B.D., M.A. Tarnopolsky, J.D. MacDougall, J. Fowles and K.E. Yarasheski, (1997), *J Appl Physiol* 82 pp. 1882–1888.
- [19] Tarpenning K.M., R.A. Wiswell, S.A. Hawkins and T.J. Marcell, (2001), *J Sci Med Sports* 4 pp. 431–446.
- [20] Tang J. E, monolakos J J, kulbida G W, Lysecky P J, Moore D R and Philips S M. Minimal whey protein with carbohydrate stimulates muscle protein synthesis following resistance exercise in trained young men. NRC research press web site, November 2007.
- [21] Thyfault J.P., M.J. Carper, S.R. Richmond, M.W. Hulver and J.A. Potteiger, (2004), *J Strength Cond Res* 18 pp. 174–179.
- [22] Williams A.G, van den Oord M, Sharma A, Jones DA (2001) *Br J Sports Med* 35:109–113.