The Effects of Carbohydrates and Fats on Protein

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What is the effect of Carbohydrates and Fats on 24 hour nitrogen balance?

As has been discussed, energy has a tremendous nitrogen sparing effect (Millward, 2004). However, a related topic concerns the differential effects of fats and carbohydrates on nitrogen balance. In this context McCarger (1989) investigated the effect of a high carbohydrate and high fat diet on nitrogen retention, substrate utilization, and serum hormone concentrations in six healthy male subjects. The diets were administered at maintenance and at 75 % of maintenance calories. Results indicated that the high fat diet produced slightly greater nitrogen retention in the 75 % restricted diet than the high carbohydrate diet, while no differences existed between diets at maintenance. This led Millward (2004) to suggest that *"for now energy intakes can be considered independently from the composition of that energy as determinants of NB, thus simplifying the issue.*"

Carbohydrates and Fats in Resistance training exercise

While carbohydrates and fats may spare nitrogen in a similar manner, it is important to recognize that carbohydrates are critical for high intensity exercise. As an illustration Jacobs, Kaiser, and Tesch (1981) investigated the effect of depleting muscle fibers of glycogen on strength levels. It was found that glycogen depletion in both fiber types in the vastus lateralis was associated with impaired maximal muscular strength produced during a single dynamic contraction, as well as with reduced muscle fatigue patterns. Further it has been well established that a decrease in intensity, that would be associated with decreased glycogen stores would cause a significant loss of adaptation (Wilson and Wilson, 2005; Hickson et al.1981, 1982, and 1985; Sheply et al.,1992). These results suggest that a decrease in carbohydrates may indirectly decrease muscle tissue, or impair further adaptations.

Interaction between carbohydrates and protein / amino acid intake

Koopman and colleagues (2004) investigated the effects of carbohydrate (0.3 g per kg-per hour) (CHO), carbohydrate and protein (0.2 g per kg-h) (CHO-PRO) and carbohydrates, protein and leucine (0.1 g per kg-h) (CHO-PROL) on net protein balance, and amino acid oxidation rates. Results indicated that net balance was negative in the CHO condition, and positive in the CHO-PRO and CHO-PROL conditions, with the latter attaining the highest values. These results paralleled plasma insulin concentrations, with insulin being highest in the CHO-PROL condition, intermediate in the CHO-PRO condition, and lowest in the CHO condition. The net balance was improved through increased protein synthesis and decreased protein breakdown in the CHO-PROL condition relative to the other two conditions. Further protein oxidation was lowest in the CHO-PROL condition. The rationale is that leucine intake enhances insulin secretion (Koopman, 2004), and independently increases protein synthesis (Crozier, 2005; Garlick, 2005). It is generally thought that insulin enhances protein balance through hindering protein degradation (Biolo, 1999; Wolfe, 2002), which was supported by this study.

However, the role of insulin in stimulating protein synthesis is in debate (Koopman, 2004). In vitro studies have supported insulin's role in regulating protein synthesis, while a number of in vivo studies show either no stimulation of protein synthesis or various discrepancies (Hiller et al., 1998; Boirie, 2001). As an illustration Biolo et al. (1999) found that insulin infusion increased protein synthesis at rest, but not after resistance training exercise. The authors concluded that it was the decreased amino acid availability which depressed the stimulatory effect of insulin. This was supported by Biolo et al. (1995) when they found that maintained amino acid levels in the presence of hyperinsulemia increased protein synthesis. Further Hiller and colleagues (1998) suggested that discrepancies seen between in vitro studies and in vivo studies centered around plasma concentrations of insulin increase. To test this question Hiller et al. (1998) raised plasma insulin levels to concentrations similar to studies conducted in vitro, while maintaining amino acid concentrations. It was found that hyperinsulemia increased protein synthesis greatly. Therefore mechanisms which enhance the insulinogenic response to food, may enhance protein accretion. The efficacy of combining carbohydrates and protein on insulin secretion was demonstrated by Ivy et al. (2002) who found that the combined effects of protein and a high glycemic carbohydrate were greater on stimulating insulin secretion then their independent effects (also for a review on insulin's role in protein accretion see Knowlden, 2003)

Summary

In summary it appears that both carbohydrates and proteins have similar nitrogen sparing effects. In this context it is may be advisable to increase fats when carbohydrates are lowered. However because carbohydrates are critical to athletic performance the athlete should be conscious of decreased intensity and performance with decreased carbohydrate intakes. Finally there appears to be an interaction effect between protein and carbohydrates in stimulating insulin secretion. This latter effect may be beneficial when manipulated for protein accretion.