

LOW MUSCLE GLYCOGEN IMPAIRS ANABOLIC GENES

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In recent years, high-protein low-carb diet plans, such as Atkins, have been popular in the United States; people who have tried them have had tremendous success in shedding pounds of bodyfat. There is little debate that if you want to get shredded, low carb diets are the way to go. Low carb diets increases genes that accelerate fat burning, but does carbs have any effect on maintaining muscle?

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Many natural bodybuilders have reported that it is difficult to maintain mass while adhering to a low carb diet. Most pro-bodybuilders in their offseason increase carbs when they are trying to put on mass. A recent study in the Journal of Applied Physiology has revealed what many bodybuilders had intuition about: a low carb results in impaired genes for muscle hypertrophy. The study follows a 2005 study in which researchers from the Human Performance Lab in Indiana reported that a low carb diet blunts the expression of the muscle protein Akt. "Akt" or protein kinase B (PKB) is an important molecule in cellular signaling. Akt is also able to induce protein synthesis pathways, and is therefore a key signaling protein in the cellular pathways that lead to skeletal muscle hypertrophy, and general tissue growth. Akt is regulated in response to a wide variety of growth factors, including insulin, and, more recently, has been associated with rapid activation in response to exercise in human skeletal muscle. In the study, highly trained athletes performed a bout of cycling with either in a glycogen depleted state while the 2nd time the completed exercise with high glycogen stores. Akt expression was similar in both groups before and immediately after exercise. After 10 min of recovery in the high carbohydrate trial, Akt phosphorylation increased 1.5-fold. During the low glycogen trial after exercise, Akt remained unchanged.

The new study took the 2005 study further by examining the effects of low glycogen on muscle growth factors IGF-1, Myogenin (expressed during the development, maintenance, and repair of skeletal muscle.) and MyoD (marker of muscle growth. MyoD is expressed in activated satellite cells.)

Well resistance Trained Men have Blunted Anabolic Signaling Genes on Low Glycogen Diets

What separated this study from other studies is that they used highly trained athletes with a resistance training background. This study did not use rats or muscle petri dishes but well trained men. They had trained for almost 8 years consistently and had an exceptional leg press strength. Many studies use recreational college athletes which does not exactly replicate a bodybuilder busting his ass in the gym day in and day out. The researchers had the subjects deplete muscle glycogen, the subjects were then fed a low carbohydrate diet after exercise. The next day the subjects returned to the weight room and completed 1 legged leg press (8 sets of 5 repetitions ~80% of a 1 RM) with one leg that was glycogen depleted while the other leg was not. Muscle biopsies were taken before exercise, immediately after, and 3 hours after recovery.

When they examined the muscle biopsies the researchers found that low pre-exercise muscle glycogen concentrations reduced the gene expression of key muscle hypertrophy genes. Some of the more disturbing findings was that resting levels of genes involved in muscle hypertrophy (Myogenin and IGF-1) was lower in the glycogen depleted muscle². The study concluded that commencing resistance exercise with low muscle glycogen does not enhance the activity of genes implicated in promoting hypertrophy/muscle mass. Low carb diets are great for losing fat but the study raises awareness that low carb diets may not be conducive for muscle mass.

Please read the National Strength and Conditioning Association's article titled, "Is Muscle Glycogen an Important Concern for Athletes for Athletes who want to Stimulate Muscle Hypertrophy"

<http://www.nscs-lift.org/perform/articles/PTJ060601.pdf>

There is no doubt that low carb diets are great for fat loss, but the key question that remains to be answered is how many carbs do you need to hold on to muscle? There are no essential carbs but the study clearly brings awareness that training in a low glycogen state can impair key signaling anabolic genes.

- Creer A, Gallagher P, Slivka D, Jemiolo B, Fink W, Trappe S. Influence of muscle glycogen availability on ERK1/2 and Akt signaling after resistance exercise in human skeletal muscle. *J Appl Physiol.* 2005 Sep;99(3):950-6.

- Churchley EG, Coffey VG, Pedersen DJ, Shield A, Carey KA, Cameron-Smith D, Hawley JA. Influence of preexercise muscle glycogen content on transcriptional activity of metabolic and myogenic genes in well-trained humans. *J Appl Physiol.* 2007 Apr;102(4):1604-11.