Beta Glucans

So there I was. I am at the ‘expo’ for the Live-Strong Austin Marathon, and I’m just looking for friends who are going out to the race with me on this new hilly course. I was standing in front of a booth when I was asked if I wanted to be a subject of the study on a new product that helps to prevent illness following extreme effort. Me get an upper respiratory infection after a race? I knew this was so true. I remembered doing the ‘Jester’ races which are a series of three races in one day up the meanest half mile hill in the city. I won overall for the women because no one else is crazy enough to do a 5K, and a running and biking time trail on this nasty hill in the middle of February on one day! We all got sick! (I still got my medal and T-shirt. Isn’t that what it’s all about?) In any case I know also that the science backs up the concept of illness following over doing it in sports so it wasn’t just me having this issue. I was interested. After all, I signed up to do this race, an ironman a half ironman, and then another full ironman all this year. I better listen to these folks about something that might help me maintain my exercise and life’s schedule.

We know that moderate exercise reduces the number of sick days. Walking briskly 35 to 45 minutes a day five days a week reduced by about half the number of symptomatic days from colds in one study. Overtraining, however increases the risk of upper respiratory infections (URTI). Epidemiological studies support this observation as does prospective randomized research. Some studies report that the majority of endurance athletes do not report URTI after competitive races. However, some studies do clearly demonstrate in particular increased episodes of upper respiratory infections (URTI). So if athletes can avoid overtraining or over reaching, the risk is not increased. However we do know that upper respiratory infections are more likely after an intense effort and intense training. What do the studies show?

![Figure 2. Infection risk and immune function are related to the exercise workload.](From Nieman et al, undated monograph)

What has been found is that natural killer (NK) cell activity indicates immune effects of exercise. These cells decrease in both number and function after an intense effort. Neutrophils are also critical in early control of invading infectious agents. Neutrophil function is suppressed in athletes after intense effort. Salivary IgA concentration is decreased by overtraining and over reaching. The secretory immune system is the first barrier to colonization by pathogens and is present in our mouths and our intestines where respiratory viruses first enter the body. With runners, illness is highest in those with the lowest IgA levels.

The cyclic change in immunity is noted after each bout of prolonged and intensive exercise in athletes.
During the first 72 hours after intense exercise, viruses and bacteria may overwhelm the suppressed immune system and gain a foothold. The most extreme immune suppression is suspected to occur during the 1 to 2 weeks following an intense effort. This is in part due to an increase in circulating adrenal catecholamines. The results of extreme exercise efforts is lower neutrophils (white cells important in attacking infection), increase in inflammatory response with decreased activity against inflammation, and a decrease in NK (natural killer) cell activity which is important for fighting viruses. Delayed hypersensitivity response is decreased as is plasma concentrations of pro- and anti-inflammatory cytokines. This means at the whole body level that inflammation is increased by extreme exercise coupled with the inability of the immune system to counter exercise-induced damage. Similarly, as IgA decreases, our ability to recognize infectious or foreign materials decreases.

**Figure 1** Nutrition and the stress hormone response. Various stressors, including inadequate nutrition, prior exercise with inadequate recovery, psychological anxiety and environmental extremes (e.g. heat, altitude), modify the hormonal response to exercise. Changes in plasma levels of stress hormones, including catecholamines, adrenocorticotropic hormone (ACTH) and cortisol, are probably mostly responsible for the observed changes in immune function following an acute bout of exercise.

(From Gleeson, et al 2000)

So for those of us who do ironman competitions and marathon and ultra running this all sounds like a bad deal! In truth, though, we are so much more fit than our sedentary compadres. Training and competing is fun. And gosh durn it, I won my age group for that silly race! (Next
time I’ll bring a Sherpa)! However, our daily life stresses plus those of an intense exercise program may put us at risk of infection. Some supplements help to prevent infection such as Vitamin C if taken for the weeks prior to and after a race. Glutamine may be helpful. Carbohydrates should also diminish changes in immunity especially when used during the race event. Literature also shows that it is important to avoid nutrient deficiencies. An inadequate intake of protein will impair host immunity. This is well documented in those with extreme protein energy malnutrition. For athletes, we can avoid this issue associated with extreme weight loss by avoiding extreme dieting during training. For those that do not eat meat, use of a post exercise drink or a carbohydrate drink with free form amino acids, is also a good idea. Deficiency in fatsoluble vitamins A and E and water-soluble vitamins (B6, B12, and C) will impair immune function. Several minerals are known to exert modulatory effects including zinc, iron, magnesium, manganese, selenium and copper. Deficiency is an issue but supplementation should be cautious as too much of a good thing is not a good idea. Routine use of a daily supplement with these vitamins should be all that is required for someone on a normal diet meaning lots of fruits and vegetables with some protein (animal or adequate vegetable with additional vitamin B12, essential amino acids and glutamine). Note that excess vitamins can worsen immune function and cause illness. A multi-vitamin such as that from First Endurance will supply all that is needed for an endurance athlete when taken as prescribed (MultiV ®). No matter what multivitamin you choose make sure that it is absorbable and contains these items. So what else is there?

The interest in β-glucans comes from studies looking at the ability of our cells to recognize foreign substances. The β-glucans are a heterogeneous group of glucose polymers that form the cell wall structure of fungi and plants and bacteria. They are not found in animals. Recognition of β-glucans by vertebrates appears to occur exclusively via cell surface receptors. This means that in many cases, the immune system’s initial response to β-glucans is very similar to that of a virus or bacteria; however, after this initial response, is where the effect for β-glucans and virus/bacteria differ.

![Figure 2](http://www.jhoonline.org/content/2/1/25)

**Figure 2**

*The uptake and subsequent actions of β-glucan on immune cells.* β-glucans are captured by the macrophages via the Dectin-1 receptor with or without TLR-2/6. The large β-glucan molecules are then internalized and fragmented into smaller sized β-glucan fragments within the macrophages. They are carried to the marrow and endothelial reticular system and subsequently released. These small β-glucan fragments are eventually taken up by the circulating granulocytes, monocytes or macrophages via the complement receptor (CR)-3. The immune response will then be turned on, one of the actions is the phagocytosis of the monoclonal antibody tagged tumor cells.

(from Chan at al, 2009)
The healing properties of mushrooms have been noted dating back to 3000 BC and a number of fungal components have been implicated in these properties in particular, β-glucans. This was noted in the early 1900s when the ability of yeast to inactivate serum complement was first described. This led to the development of zymosan, which was used to investigate the complement system. The complement system is important in activating the immune system to stimulate protective host responses. There is now much published research showing the benefit of β-glucans. β-glucans can directly activate leukocytes and stimulate phagocytic, cytotoxic and antimicrobial activities. In addition these carbohydrates stimulate the production of pro-inflammatory mediators, cytokines and chemokines. β-glucans also enhance the ability of macrophages (another type of white cell we use to defend against infection) to recognize and clear apoptotic cells (dead cells). These carbohydrates persist in mammalian systems as humans cannot degrade these carbohydrates and must metabolize them slowly.

Leukocyte receptors exist for β-glucans that improve the ability of leukocytes to combat infection. We also know that fungal β-glucans help patients receiving chemotherapy by improving recovery of their marrow.

So is this really going to help me? A recent study showed a significant improvement in incidence of respiratory tract infections and mood state in marathon athletes using β-glucans. In a placebo controlled double blind study URTI symptoms and mood were evaluated after 2 to 4 weeks of administration of yeast based β-glucans. The group that used β-glucans had improved overall health and mood and less URTI symptoms.

This is good news! There is no doubt that at some time in the near future I will be ‘over reaching’. No matter what I do, life stressors and training for ironman will have an effect. It does not matter that I eat well and get enough sleep. It is just going to happen. (does this sound familiar?)

Okay. So I did my race. I feel great! I did well and I was a part of this study in Austin. Since it was double blinded neither the investigator or I knows if I got the supplement or the placebo. However I will say that I did not get my usual cold following the race and my mood is better. This is in spite of job stress, family stress and training stress. Wow! So we shall see.

Regardless of my personal story, the science looks good. Just like with the vitamins, nothing will get you a win but it would be nice to feel good after putting in the effort. Staying well is what it is all about realistically. I for one, am impressed by the science and am looking forward to this product being used in a form that is geared towards the athlete. This product being tested at the moment is used currently in a multitude of food products that are on the market such as fruit drinks, oat barn and others. This will add one more thing to my armamentarium and will provide support during my crazy schedule of training and working.

Check in for an update and I’ll fill you in on the results of this study once I know about them, or at least whether I received the β-glucan. I will bet you that I did!

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