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Antioxidants And Astaxanthin In Sports Nutrition

(Spor Beslenmesinde Astaksantin ve Antioksidanlar)

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Abstract

The body has a certain natural defense mechanism which emerges against free radicals resulting from various metabolic mechanisms. The compounds that make up this defense mechanism are called "antioxidants". Astaxanthin is a powerful antioxidant found especially in shellfishes (shrimp, crab, lobster, roe etc.) and salmon in high quantity. Sports activities can be improved by balanced nutrition, but it also can be affected negatively by irregular eating habits. It is of vital importance that athletes keep balanced diet in order to get the most efficient result from their tough workouts. The studies about the nutrition of athletes emphasize the importance of antioxidants for the metabolisms of athletes.

Keywords: Astaxanthin, sports nutrition, antioxidants, sports performance.

Özet

Çeşitli metabolik mekanizmalar sonucu ortaya çıkan serbest radikallere karşı vücutta doğal bir savunma mekanizması vardır. Bu savunma mekanizmasını oluşturan bileşiklere "antioksidanlar" denir. Astaksantin özellikle kabuklu deniz ürünlerinde (karides, yengeç, ıstakoz, balık yumurtaları v. b) ve somon balığında bol miktarda bulunan çok güçlü bir antioksidandır. Sportif performans, dengeli bir beslenme sayesinde gelişebileceği gibi dengesiz bir beslenme ile olumsuz olarak etkilenebilir. Sporcuların yapmış olduğu zorlu antrenmanlardan üst düzeyde etkinlik sağlayabilmek için doğru beslenmeleri büyük önem taşımaktadır. Sporcu beslenmesinde yapılan araştırmalar, antioksidanların sporcu metabolizması açısından önemini vurgulamaktadır.

Anahtar Kelimeler: Astaksantin, sporcu beslenmesi, antioksidanlar, sportif performans.

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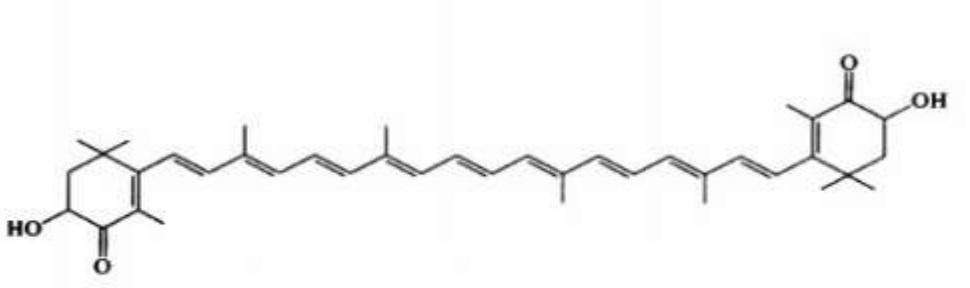
Introduction

Astaxanthin is a carotenoid belonging to a larger class of phytochemicals known as terpenes that can be found in microalgae, yeast, salmon, trout, krill, shrimp, crayfish, crustaceans, and the feathers of some birds (Fassett R.G, Coombes J.S, 2009; Guerin M, Huntley M.E, Olaizola M, 2003; Higuera-Ciapara I, Felix-Valenzuela L, Goycoolea F.M, 2006; Hussein G, Sankawa U, Goto H, Matsumoto K, Watanabe H, 2006; Pashkow F.J, Watumull D.G, Campbell C.L, 2008). In 2008, Aoi W et al. determined that astaxanthin has recently received attention due to its ability to scavenge free radicals, decrease inflammation, improve indices of lipid metabolism and attenuate lipid accretion, and increase exercise time to exhaustion in mice.

The astaxanthin is the ketone family of carotenoids, especially sea creatures (shrimp, crab, lobster and fish eggs) is a red pigment that occurs naturally in the bark is reported to have an effective mechanism for the protection of the structure until the cell membrane (Gök V, Kayacıer A, Telli R, 2006; Torrissen O.J, Christiansen R; 1995; Torissen O.J, Hardy R.W, Shearer K, 1989).



1. Chemical structure of the astaxanthin (3)

A new dietary ingredient submitted to the FDA in 2011 allows for consumption of natural astaxanthin at 12 mg/day. Based on research of its strong antioxidant capacity, astaxanthin was originally marketed as "The World's Strongest Natural Antioxidant" (Capelli B, Cysewski G, 2012). Further research has also shown astaxanthin never becomes a pro-oxidant (Martin H, Jager C, Ruck C, Schmidt M, 1999).

Astaxanthin has become attention-grabbing thanks to new scientific studies. It protects LDL-Cholesterol, cell membrane, cells and tissues by sweeping motion against the harms of free radicals. Astaxanthing is a red pigment existing in many living organism. It doesn't break down because of heat like other caroteneoids. Although its color clears away temporarily, it resumes when it's cold. It exists in especially shellfish and salmon. (Shrimp, crab, lobster, fish eggs etc.) Astaxanthin plays a role in growing for these living creatures and shows some activities like vitamin. On the other hand, it plays role in antioxidant for humans.

Additional research has validated astaxanthin's ability to increase strength and endurance in human and animal populations. New in vitro studies demonstrate the ability of astaxanthin to combat oxidation, which is of particular interest to athletes who generate

excessive levels of free radicals and wish to lengthen workouts and improve recovery time. Furthermore, astaxanthin is emerging as a safe and natural alternative to over-the-counter and prescription anti-inflammatories to help with overuse injuries as well as joint, tendon, and muscle pain (Capelli B, Cysewski G, 2012).

Although sportive performance can be developed thanks to balanced nutrition, it can also be negatively affected because of an unbalanced nutrition (Fox K, 1986). Athletes spend much of their time by doing exercise in order to increase their performances, however they usually ignore the advantages of a good diet. Indeed many great efforts are made and balanced nutrition is very important in order not to waste efforts and to show a higher-up performances (Ersoy G,1998).

Oxygen and Free Radicals

There are many discovered and various substances which have antioxidant features. While we take certain parts of it from diet (especially plants), our bodies produce certain parts of it as a defense system against free radicals. Antioxidants, which are produced as a defense against free radicals, are some enzymes like catalase, glutathione peroxidase and SOD (superoxide dismutase).

There's a natural defense mechanism in body against free radicals which exist because of various mechanisms. The compounds which form this defense mechanism are named as "antioxidants" (Gökpınar Ş, 2006).

Oxygen has a vital importance for human life, however some reactive oxygen types produced during normal metabolism have the potential of forming serious damages for body. (Diplock,1998) Many factors like environmental pollution, radiation, contamined waters, pesticide and oxygen metabolism in living cells inevitably cause free radicals formation. (Kaur and Kapoor, 2001).

Free radicals can also cause many diseases like inflammation, immune system diseases, aging, neurological diseases, atherosclerosis, hypentension, ischemic damage, carcinogenesis, mutagenesis, infectious diseases, liver diseases, lung diseases, eye diseases and urological diseases. (Kaneko et al, 1980; Zima et al, 1995).

Antioxidants

Lycopene

Lycopene is a characteristic and natural component which exist in tomato most. 75 mg lycopene in 200 gram tomato paste, 20 – 50 mg lycopene in 200 ml of tomate puree, canned tomato or tomato water, 4.6 mg lycopene in 200 gram of raw tomate exist. When cooking tomato, cis-lycopene formation which has better absorption occurs and it's much better for health. Lycopene in tomato is the component having the highest capacity of antioxidant. Lycopene shows a hundred times better effect than vitamin E which is the leading antioxidant vitamin(Abdelkhalık A, 2015).

B-Carotene

β-carotene is the pro-substance of vitamin A and turns into vitamin A in intestines and livers. We can divide molecules having vitamin A activity into two groups: the first group is the ones which have vitamin A activity in animal tissue; retinol, hydroretinol, retinal and retinoic acide. The second one is carotene which exist in many plants and fruits and turns into retinol,shows vitamin A activity. (Ayaşan T, Karakozak E, 2010).

Polyphenols

Polyphenols, isoflavones and flavanoids are the micronutritions whose antioxidant activities are gilctl. Especially hops, green tea and grape types are rich in polyphenols (Dündar Y, 2001).

Flavonoids

Although flavanoids were started to be researched many years ago, recent studies have become crucial and it's found out that flavanoids have anti-inflammatory, antiviral, antiallergic, antitornbotic features besides from its antioxidant features. Flavanoids whose number is estimated as over 4000,are rich in tea,apple,onion,legume family, tomato and red wine (Kahraman A, Serteser M, Köken T, 2002).

Caroteneoids

Caroteneoid group is the natural pigments which occur as yellow, orange and red and they are common in fruits, vegetables and plants, birds, bugs, marine animals and moss.

Caroteneoids exist in organism, which can photosynthesize with chlorophyll, in common and they form a source for all caroteneoids stocked in animals. It's also known that in animal body some part of carotenoids turn into retinol, whereas the other part exist in egg yolk, milk and fat in organelles (Baysal T, Ersus S, 1999).

The Important Antioxidant Vitamins

Tocopherol (Vitamin E)

Alphatocopherol is very resistant to heat and acides. Other tocopherols are damaged during the heating, cooking and freezing processes of nutritions. They're antioxidants, they stop the chain reaction leading to much more production of free radicals, they protect cell contents and membrane from damage, they prevent low density lipoprotein (LDL) oxidation and reduce the risk of heart diseases. "The Women's Health Study (WHS)" determined the decrease of cardiovascular deaths despite the fact that they're not effective on cardiovascular disease incidence and there was no increase in hemorrhagic stroke. There's also decrease in the prostate cancer(probably also colorectale cancer) risk of smoker men, decrease in the angina and thrombotic stroke risk; the increase in subarachnoid bleeding and hemorrhagic stroke. Vitamin E has no effect on age-related cataract. Butternut, margarine, oils, chicken, egg, red meat, beans, cereal and vegetable-fruits are the natural sources. Deficiency and excess of it are very rare (Gül S, Kılıçarslan A, 2012).

Vıtamın C (Ascorbic Acid)

Vitamin C is a very important antioxidant which exist in extracellular fluids and is water-soluble. Because it can't be synthesized in human body, it should be taken externally. Citrus fruits, pepper, zucchini, strawberry, fibre green vegetables and cabbages are among the best ascorbic acid sources. It's known that the consumption of these nutritions which are rich in vitamin C reduces the heart attack risk (Koca N, Feryal K, 2005).

Result and Discussion

In the study, the authors reported that each exercise group was able to run longer on the treadmill before exhaustion; however, those mice treated with astaxanthin also increased fat utilization during exercise compared to mice on a normal diet. In essence, astaxanthin improved various mechanisms associated with transporting long chain fatty acids into the mitochondria. In our current study, however, we see no evidence for the preferential use of fat. mitochondria. In our current study, however, we see no evidence for the preferential use of fat (Tarnopolsky M.A, Atkinson S.A, Phillips S.M, MacDougall J.D, 1995).

Posttest analysis showed an overall dose dependent increase in exercise time to exhaustion in mice receiving 6 and 30 mg/kg of astaxanthin vs. control. This would equate to approximately 420 mg and 2.1 g of astaxanthin in humans, respectively, assuming the astaxanthin was given to a 70 kg "reference male". Thus, the dosage given to the mice was significantly, higher than what we administered in our study. The authors of this study also observed a significant reduction in lactic acid and higher concentration of non-esterified fatty acids and plasma glucose concentrations throughout exercise in the astaxanthin treated groups (Ikeuchi M, Koyama T, Takahashi J, Yazawa K, 2006).

Only two studies have examined the efficacy of astaxanthin for improving exercise performance in humans, while only one of those studies examined some type of endurance performance. In 2002, Keisuke et al. examined the effectiveness of astaxanthin on the buildup of lactic acid following 1 200 m of running before and after 4 weeks of supplementation and found that the 2 min post-running lactic acid concentration was significantly lower in the astaxanthin supplemented runners vs. control.

Studies show that swimming exercise for different times and antioxidant use is effective on both pressing and removing free radicals in exercising and it can be suggested that suitable amount and method can be executed by developing this with different mechanisms in order to increase athletes' performances

Another study show that vitamin C supplement doesn't result in the increase of endurance and strength performances. On the other hand, it's proved that vitamin C supplement reduces oxydative stress, thereby muscle damage and muscle pain. (Atabek H.Ç, Özdemir F, 2010)

In studies about vitamin C on athletes, mostly its effects on athletic performance and its interaction with maxVO2 are researched. Matmen were supplemented by vitamin C for 30 days and as a gram daily and it was determined that there was a statistically non-significant

increase in maxVO2. Although it is statistically non-significant, there are some indicators referring that vitamin C has an effect on this increase. Moreover, there is no increase in maxVO2 of matmen who implemented the same training schedule without vitamin C, in fact there's a decrease (Arslan C, Gönül B, Dinçer S, Kaplan B, Çevik C, 2004).

When examining student groups which do regular sports, it's found out that it can affect lipide profile and reduce cardiovascular risk factors. It's known that exercise increases oxydative stress and reduces serum iron levels. Although from a first impression it seems like a negative side of exercise, it's stated that this problem can be easily solved by adding antioxidant nutritions and iron as a supplement into diet (Gürsoy Ş, 2008).

When examining the effects of acute exercise on antioxidant system paramets of footballers, SOD level is found out to be high after acute exercise of trained footballers and aerobic exercise type. There's no significant change in CAT level. There's decrease in MDA activity, on the other hand there's no significant change in vitamin E level (Sarıtaş N, 2012).

It's stated that vitamin E implementation increases antioxidant activity during acute taekwondo exercise, thus prohibits free radical formation and it also leads to the press on lactate levels and retards fatigue. In this regard proper dose vitamin E implementation can be beneficial in terms of health and performance of athlete (Boyalı E, 2009).

When the relationship between antioxidants and growth factors are researched, it's found out that antioxidants behave like growth factors and in some cases they affect growth factors and provide proliferation, on the other hand in some pathalogical cases like tumor formation they stimulate growth factor inhibitors' secretion and remove the effects of growth factors (Aydemir B, Karadağ E, 2009).

Conclusion

Studies show that green tea has antioxidant, antiinflammatory, antimutagenic, anticancerogenic, antiangiogenic, apoptotic, antiobese, hypolipidemia (cholesterol lowering), antiarteriosclerotic, antidiabetic, antibacterial, antiviral and antiaging effects (Şahin H, Özdemir F, 2006).

Vitamin and mineral consumption should be proper in sports branchs as well as team sports and when the deficiency is detected, vitamin-mineral supplement should be implemented by a consultant (Özdemir G, 2010).

In another study,it's stated that trainings lead to the loss of Fe++ with sweating depending on trainings' density, thus vitamin C supplement can be taken over daily requirement and adding vitamin C to diet may minimize this risk and it has positive effects on glucose metabolism by reducing insulin sensitivity (Koçyiğit Y, 2011).

Reference

Abdelkhalık, A. (2015). Efectos de la salinidad del agua de riego sobre el crecimiento, el rendimiento de los frutos y la calidad del fruto de dos cultivares de tomate (Lycopersicon esculentum Mill.) cultivadas en sistema hidropónico(Doctoral dissertation).

Aoi, W., Naito, Y., Takanami, Y., Ishii, T., Kawai, Y., Akagiri, S., Kato, Y., Osawa, T., Yoshikawa, T. (2008). Astaxanthin improves muscle lipid metabolism in exercise via inhibitory eff ect of oxidative CPT I modifi cation. Biochem Biophys Res Commun, 366, 892 – 897.

Arslan, C., Gönül, B., Dinçer, S., Kaplan, B., Çevik, C. (2004). Güreşçilerde C Vitamini Yüklenmesinin Serum Demir Ve Total Demir Bağlama Kapasitesine Etkisi. Fırat Üniversitesi Sağlık Bilimleri Dergisi, 18(4), 215-221.

Atabek, H.Ç., Özdemir, F. (2010). C Vitamini İlavesinin Egzersiz Performansına ve Kas Hasarına Etkisi. BESBD, 5(2), 60- 69.

Ayaşan, T. ve Emel, K. (2010). Hayvan Beslemede B-Karoten Kullanılması Ve Etkileri. Kafkas Üniversitesi Veterinerlik Fakültesi Dergisi, 16, 697-705.

Aydemir, B. ve Ebru, K., S. (2009). Antioksidanlar ve Büyüme Faktörleri ile ilişkisi. Kocatepe Üniversitesi Veterinary Journal, 2, 2.

Baysal, T. ve Seda E. (1999). Karotenoidler ve İnsan Sağlığı. Gıda Dergisi, 24, 3.

Boyalı, E. (2009). E Vitamini Uygulamasının Akut Taekwondo Egzersizinde Lipit Peroksidasyonu Antioksidan Enzimler ve Laktat Düzeylerine Etkileri. Doktora Tezi, Besin Hijyeni ve Teknolojisi Anabilim Dalı. Konya.

Capelli, B., Cysewski, G. (2012). The World's Best Kept Health Secret: Natural Astaxanthin. [ISBN-13: 978-0-9792353-0-6].

Dündar, Y. (2001). Fitokimyasallar ve Sağlıklı Yaşam. Kocatepe Tıp Dergisi, 2, 131-138.

Ersoy, G. (1988). Sağlıklı Yaşam, Spor ve Beslenme. Ankara: Damla Matbaası, s: i 10-114.

Fassett, R.G., Coombes, J.S. (2009). Astaxanthin, oxidative stress, infl ammation and cardiovascular disease. Future Cardiol, 5, 333 – 342.

Fox, E. L., Bowers, R. W., & Foss, M. L. (1989). *The physiological basis of physical education and athletics*. William C Brown Pub.

Gökpınar, Ş. (2006). Algal antioksidanlar. Ege Üniversitesi Su Ürünleri Dergisi, 23, 85-89.

Gök, V., Kayacıer, A., Telli, R (2006). Hayvansal Ve Mikrobiyal Kaynaklı Antioksidanlar. Gıda Teknolojileri Dergisi, 2, 35-40.

Higuera-Ciapara, I., Felix-Valenzuela, L., Goycoolea, F. M. (2006). Astaxanthin; a review of its chemistry and applications. Crit Rev Food Sci Nutr, 46, 185 – 196.

Hussein, G., Sankawa, U., Goto, H., Matsumoto, K., Watanabe, H. (2006). Astaxanthin, a carotenoid with potential in human health and nutrition. J Nat Prod, 69, 443 – 449.

Ikeuchi, M., Koyama, T., Takahashi, J., Yazawa, K. (2006). Effects of astaxanthin supplementation on exercise-induced fatigue in mice. Biol Pharm Bull, 29, 2106 – 2110.

Kahraman, A., Serteser, M., Köken, T. (2002). Flavonoidler. Kocatepe Tıp Dergisi, 3, 01-08.

Kaur, C., Kapoor, H.C. (2001). Antioxidants in fruits and vegetables-the millennium's health. Int. J. Food Sci. Tech., 36, 703-725.

Keisuke, S., Hiroshi, Y., Kazuhiro, A., Natsue, K., Akito, A., Kesatoki, K., Masahiro, Y. (2002). Sports Performance Benefi ts from Taking Natural Astaxanthin Characterized by Visual Acuity and Muscle Fatigue Improvement in Humans. J Clin Therap Med, 18, 1085 – 1100.

Koca, N. ve Feryal, K. (2005). Gıdalardaki Doğal Antioksidan Bileşikler. Gıda Dergisi, 30, 4.

Koçyiğit, Y. (2011). Antrene sporcularda C vitamini yüklemesinin demir ve demir bağlama kapasitesi üzerine etkileri. *Journal of Clinical and Experimental Investigations, 2,* 2.

Martin, H., Jager, C., Ruck, C., Schmidt, M. (1999). Anti- and prooxidant properties of carotenoids. J Pract Chem, 341 (3), 302- 8.

Özdemir, G. (2010). Spor Dallarına Göre Beslenme. Sportmetre Beden Eğitimi ve Spor Bilimleri Dergisi, VIII (1), 1-6.

Pashkow, F. J., Watumull D. G., Campbell, C. L. (2008). Astaxanthin: a novel potential treatment for oxidative stress and infl ammation in cardiovascular disease. Am J Cardiol, 101, 58D – 68D.

Şahin, H., Özdemir, F. (2006). Yeşil çayın sağlık üzerine etkisi. Türkiye 9. Gıda Kongresi; 24-26 Mayıs 2006, Bolu, 219- 222.

Sarıtaş, N. (2012). Dayanıklılık Antrenmanı Yapan Atletlerde E Vitamini Kullanımının Oksidan ve Antioksidan Kapasitesi ve Kas Hasarı Üzerine Etkisi. Beden Eğitimi ve Spor Bilimleri Dergisi, 6, 3.

Şerife, G. Ö. Z. ve Alpaslan K. (2012). Vitaminlerin Yaşamımızdaki Yeri Nedir, Ne Olmalıdır?. İç Hastalıları Dergisi, 19, 139-143.

Tarnopolsky, M.A., Atkinson, S.A., Phillips, S.M., MacDougall, J.D. (1995). Carbohydrate loading and metabolism during exercise in men and women. J Appl. Physiol, 78, 1360 – 1368.

Torrissen, O.J., Christiansen, R. (1995). Requirements for carotenoids in fish diets. Journal of Applied Ichthyology, 11(3- 4), 225-230.

Torissen, O.J., Hardy, R.W., Shearer, K. (1989). Pigmentation of salmonids – carotenoid deposition and metabolism. CRC Cr Rev Aq Sci, 1, 209-25.