Diet Saboteurs?
Medications and Weight Loss

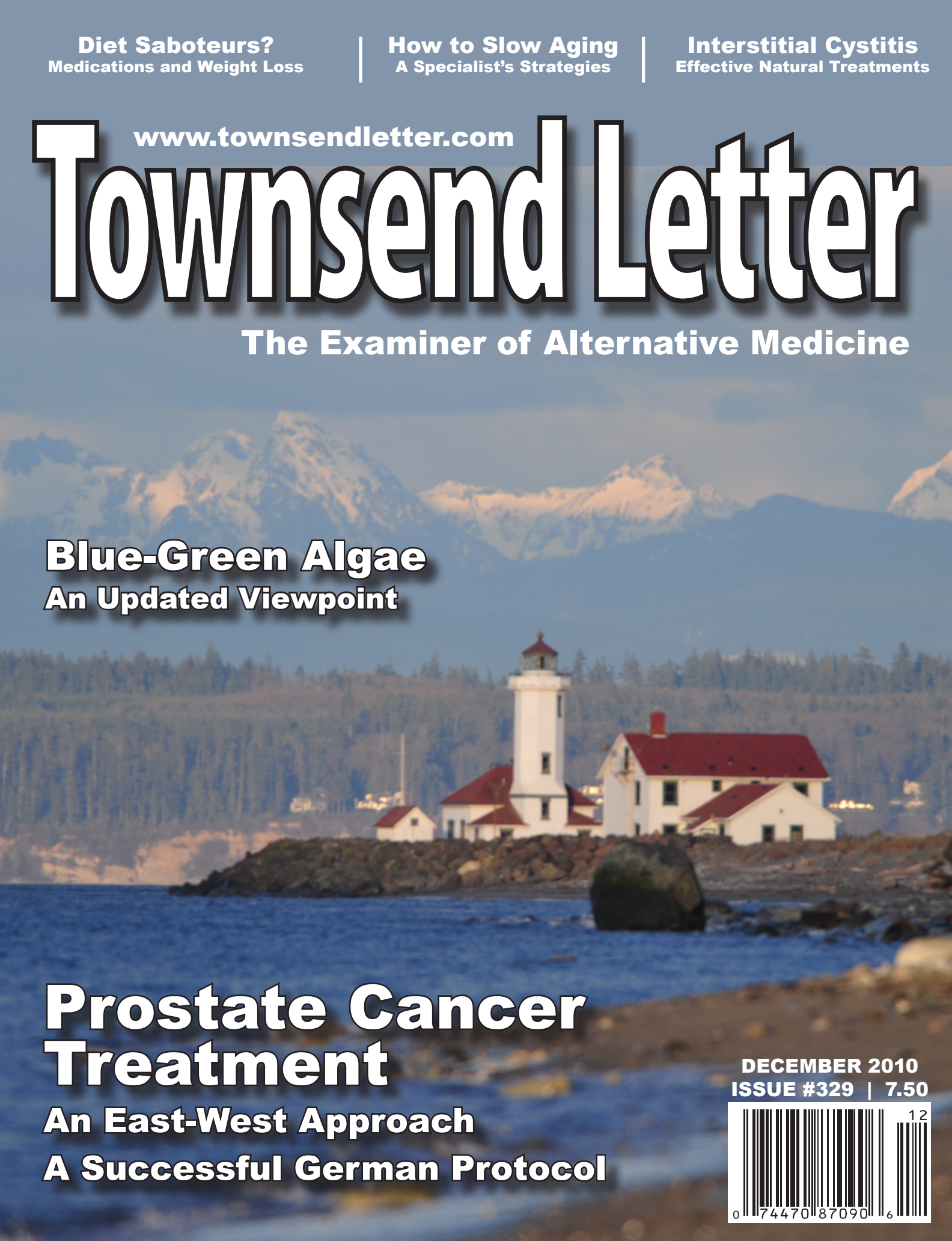
How to Slow Aging
A Specialist's Strategies

Interstitial Cystitis
Effective Natural Treatments

www.townsendletter.com

Townsend Letter

The Examiner of Alternative Medicine



Blue-Green Algae
An Updated Viewpoint

Prostate Cancer Treatment
An East-West Approach
A Successful German Protocol

DECEMBER 2010
ISSUE #329 | 7.50

'Why Blue-Green Algae Makes Me Tired': Perspective, 15 Years Later

by Christian Drapeau

In 1996, John McPartland wrote an article that was published in *Townsend Letter* ("Why Blue-Green Algae Makes Me Tired"), expressing his exasperation at being approached by distributors from what was then called Cell Tech, a multilevel marketing company selling the blue-green algae *Aphanizomenon flos-aquae* (AFA). Although his exasperation was understandable, given the aggressive business practice of some distributors at times, the information in his article was extremely misleading: a very negative report about AFA, attributing to this blue-green algae a slew of problems and suggesting that consumers were taking significant risks by simply consuming this species of algae as a dietary supplement – which was completely untrue. I then wrote a response correcting the various assertions made by McPartland, which was also published in *Townsend Letter* in 1997.

There would really be no point in raising this issue, nearly 15 years later, were it not for the fact that McPartland's article continues to resurface prominently on the Web, unaccompanied by my response. Having both articles linked together would allow the readers to peruse both arguments and decide for themselves, but this is not the case; only McPartland's is made available. Yet given that so much has been done in terms of research on AFA since the writing of these articles, the best way to serve readers is to look back at these writings from the perspective of an updated viewpoint. But before doing so, it remains important to revisit McPartland's original contentions, as they maintain a deceptive sense of validity when published in the absence of my original response.

McPartland listed several references reporting the neurotoxicity of AFA strains collected in various parts of the world, leading the reader to believe that AFA from Klamath Lake was producing a series of neurotoxins such as neosaxitoxin and anatoxin.[1–5] He also claimed that AFA was producing microcystin with an LD 50 of 50μg/kg.[6] He further suggested that AFA could be a vector for *Legionella pneumophila*, the cause of Legionnaires' disease, and *Vibrio cholerae,* which causes cholera, even though the quoted literature pertained to other species of blue-green algae growing in entirely other parts of the world.[7,8]

So the concern is not the existence or even the presence of toxins in food but rather their concentration.

Aside from its overall tone, the intent of this original letter can be easily appreciated when information of this nature is thus presented. While microcystins are indeed potent toxins when consumed in significant levels, the LD 50 reported is that of intravenous injection of the toxins, which cannot in any way be compared to oral intake. Just think; the LD 50 for intravenous table salt is less than a tablespoon. Or imagine injecting a tablespoon of peanut butter in your vein! Intravenous and oral intakes are two completely different things when talking about exposure to a substance. And it's not that proper information was lacking; studies already published at the time had reported a no observable adverse effect level (NOAEL) – that is, not a toxic but a safe level – ranging between 40 and 280 μg/kg.[9,10] Gary Flamm, PhD, former director of toxicology at the Food and Drug Administration, published an opinion in which he established, based on a review of the study by Fawell et al., a NOEAL of 100 μg/kg.[9,11] Later studies established a NOAEL of 333 to 500 μg/kg.[12] As for the oral LD 50 for microcystins, already published at the time of these writings, it is in fact 8000 to 12,000 μg/kg.[13,14] It is also important to mention that the potential presence of microcystin does not come from AFA, but rather from co-occurring *Microcystis spp.* at times present in Klamath Lake.[15]

Based on all this information, a safe level has been established by Oregon Department of Agriculture as 1 μg/g.[16] This value can be put in perspective when considering that Flamm recommended a safe limit of 5 μg/g, and that the actual safe limit, prior to the application of safety factors, is nearly 20,000 μg/day.[12] Many foods contain a wide variety of very potent toxins such as aflatoxins, a mycotoxin present in corn, peanuts, and other crops that is such a potent liver carcinogen that it is regulated at 20 μg/kg, 50 times lower than the limit established for microcystins.[17] Cabbage and related vegetables contain glucosinolates, which have

goitrogenic activity.[18] Sweet potatoes or legumes may produce hepatotoxins as well as compounds able to produce neuropathy and mental confusion.[19] Solanine may be found in potatoes, especially when improperly stored, which may result in headaches, incoherence, hallucination, and dizziness.[20,21] Many sources of wild-harvested fish contain significant levels of mercury, and shellfish may contain potent toxins responsible for several deaths every year.[22] So the concern is not the existence or even the presence of toxins in food but rather their concentration. When a compound is found below levels that have been established as safe, then a food is considered safe. The original letter presented the data pertaining to microcystin in a manner that intimated that AFA sold in the marketplace was potentially toxic, which was entirely inaccurate. AFA present in the marketplace is thoroughly tested and meets all standards of safety. The safety of AFA has been established in several studies and by more than 30 years of consumption.

Regarding the neurotoxicity of AFA, the concern was certainly legitimate at the time due to observation of strains of AFA elsewhere in the world that had proven able to produce neurotoxins. For that reason, a stringent quality-control program had already been developed whereby every single lot of AFA was tested for the possible presence of neurotoxins. As mentioned by McPartland and later reported, neurotoxicity was never observed in Klamath Lake.[15,23]

One aspect that caught the attention of several scientists regarding the toxic strains of AFA was that they were described as atypical non-colony-forming AFA.[24] In other words, the toxic strains originally identified and classified as AFA were not typical of AFA, which is a colony-forming filamentous cyanophyta, so the original identification could have been inaccurate. Indeed, the boundary between AFA and some *Anabaena* species can be unclear, and proper identification of the algal species can at times be problematic. *Anabaena spp*. is known to produce various kinds of neurotoxins. Subsequent developments in genetics have provided the tools to determine whether the toxic and nontoxic strains of AFA belonged to the same species. It was finally shown that all the toxic strains of AFA were genetically dissimilar to the nontoxic strains such as the Klamath Lake AFA, and most likely belonged to the *Anabaena* genera.[25]

As for the suggestion that AFA could be a carrier of cholera and Legionnaires' disease, I believe that the absence of any such case after more than 30 years of continued presence in the marketplace should suffice to refute this claim; otherwise we would have to cast the same presumption of health risk on *Spirulina spp*. and *Nostoc Spp*., two other species of blue-green algae widely used and well known for their safety. ➤

➤

But the focus of McPartland's 1996 letter entirely put the emphasis on presumed or potential health risk, ignoring the significant health benefits, which were in fact derided. At the time, little research had been done to document AFA's health benefits, so little could be said from a scientific standpoint. However, since 1996, a significant research effort has focused on AFA and produced compelling data pertaining to its health-promoting effects. First, AFA was shown in a double-blind crossover study to trigger the migration of natural killer (NK) cells from the blood to tissues, within one hour of consumption.[26] AFA was also shown to stimulate NK cell activity.[27] NK cells are a type of cytotoxic lymphocyte that constitutes a major component of the innate immune system. They play an important role in eliminating cancerous cells as well as cells infected by viruses. AFA was also shown to contain polysaccharides having immune-enhancing properties.[28,29]

Over the years, one of the most commonly reported benefits of consuming AFA has been mood elevation, as well as a feeling of mental energy and clarity, both suggestive of the presence of a neuroactive amino acid or a biogenic amine. In spite of extensive testing demonstrating the contrary, McPartland had stated that this effect was likely due to the presence of anatoxin in AFA, which he claimed acted like cocaine.[15] But further investigation later revealed that AFA is a significant source of the biogenic amine phenylethylamine (PEA).[30] PEA has been coined the "molecule of love" and is well known to alleviate depression and elevate mood, and it plays an important role in affective behavior as well as the pathogenesis of learning disabilities and attention deficit/hyperactivity disorder.[31–34]

Phycocyanin is the blue pigment present in all cyanophyta. In the living algal cell, phycocyanin serves as a protein storage unit and an antioxidant, protecting the cell from certain wavelengths. Phycocyanin has been shown to have strong antioxidant and anti-inflammatory properties. In various animal models of inflammation, phycocyanin was shown to reduce or prevent inflammation.[35,36] Phycocyanin has been shown to prevent certain forms of colitis.[37] The mechanism of action was identified as the ability to block the production of the inflammatory eicosanoids LTB_4 and PGE_2.[38,39] Phycocyanin has also been shown to be one of the strongest natural COX-2 (cyclooxygenase) inhibitors.[40]

More recently, AFA was shown to contain an L-selectin blocker that acts as a mild stem cell mobilizer. Consumption of a proprietary extract of AFA that concentrates the L-selectin blocker was shown to lead to an average increase of 25% to 30% in the number of circulating stem cells within one hour of consumption.[41] The ability of bone marrow stem cells to differentiate into a wide variety of specialized somatic cells such as cardiomyocytes, hepatocytes, pancreatic ß-cells, skin cells and skin appendages, and even neurons has been well documented.[42–47] In essence, bone marrow stem cells constitute the natural repair system of the body.[48] It is not surprising, therefore, that a higher number of circulating stem cells has been linked to greater health outcomes.[48–58] When tested in an animal model, this proprietary extract of AFA was shown to enhance tissue repair after cardiotoxin-induced injury to the tibialis muscle.[59]

Although some of the concerns raised nearly 15 years ago were legitimate, in spite of a lack of evidence of negative effects, the past decade has clearly established the safety of AFA and has put into evidence significant health-promoting properties.

Notes

1. Gorham PR. Toxic algae. In: Jackson DF, ed. *Algae and Man*. NY: Plenum Press; 1964:307–336.
2. Alam M, Euler KL. Chemical studies on toxins from the blue-green alga Aphanizomenon flos-aquae. In: WW Carichael, ed. *The Water Environment: Algal Toxins and Health*. New York: Plenum Press; 1981:405–414.
3. Gentile JH. (1971) Blue green and green algal toxins, pp. 27–67 in vol. 7 of Microbial Toxins, Kadis S, Ciegler A, Ajl SJ, Eds., Academic Press, NY.
4. Carmichael WA, Biggs DA, Peterson MA. (1979) Pharmacology of anatoxin-a, produced by the freshwater cyanophyte Anabaena flos-aquae. Toxicon 17:229–236.
5. Phinney HK, Peek CA. Klamath Lake, an instance of natural enrichment. In: *Transcript of 1960 Seminar on Algae and Metropolitan Wastes*. Robert A. Taft Sanitary Engineering Center, Cincinnati, OH; 1961.
6. Hunter PR. Cyanobacteria and human health. *J Med Microb*. 1992;36:301–302.
7. Tison DL, Pope DH, Cherry WB, Fliermans CB. Growth of Legionella pneumophila in association with blue-green algae (cyanobacteria). *Appl Environ Microbiol*. 1980;39:456–459.
8. Islam MS, Miah MA, Hasan MK, Sack RB, Albert MJ. Detection of non-culturable Vibrio cholerae O1 associated with a cyanobacterium from an aquatic environment in Bangladesh. *Trans R Soc Trop Med Hyg*. 1994;88:298–299.
9. Fawell JK. Toxins from blue-green algae: toxicological assessment of microcystin-LR and a method for its determination in water. WRC Foundation for Water Research; 1994.
10. Falconer IR, Burch MD, Steffensen DA, Choice M, Coverdale OR. Toxicity of blue-green alga (cyanobacterium) *Microcystis aeruginosa* in drinking water to growing pigs, as an animal model for human injury and risk assessment. *Environ Toxicol Water Qual*. 1994;9:131–139.
11. Oregon Department of Agriculture, December 1997.
12. Schaeffer DJ, Malpas PB, Barton LL. Risk assessment of microcystin in dietary Aphanizomenon flos-aquae. *Ecotoxicol Environ Saf*. 1999;44(1):73–80.
13. Falconer IR, Smith, JV, Jackson ARB, Jones A, Runnegar, MTC. Oral toxicity of a bloom of the cyanobacterium *Microcystis aeruginosa* administered to mice over periods up to 1 year. *J Toxicol Environ Health*. 1988;24:291–305.
14. Yoshida T, Makita Y, Nagata S, et al. Acute oral toxicity of microcystin-LR, a cyanobacterial hepatotoxin, in mice. *Nat Toxins*. 1997;5(3):91–95.
15. Carmichael WW, Drapeau C, Anderson DM. Harvesting and quality control of *Aphanizomenon flos-aquae* from Klamath Lake for human dietary use. *J Appl Phycol*. 2000;12:585–595.
16. Oregon Department of Agriculture. Statutory Reference 603-25-190.
17. Stoloff L, Van Egmond HP, Park DL. Rationales for the establishment of limits and regulations for mycotoxins. *Food Addit Contam*. 1991;8(2):213–221.
18. Fahey JW, Zalcmann AT, Talalay P. The chemical diversity and distribution of glucosinolates and isothiocyanates among plants. *Phytochemistry*. 2001;56(1):5–51.
19. Wilson BJ, Yang DT, Boyd MR. Toxicity of mould-damaged sweet potatoes (Ipomoea batatas). *Nature* 1970;227(5257):521–522.
20. Barceloux DG. Potatoes, tomatoes, and solanine toxicity (Solanum tuberosum L., Solanum lycopersicum L.). *Dis Mon*. 2009;55(6):391–402.
21. Beier RC. Natural pesticides and bioactive components in foods. *Rev Environ Contam Toxicol*. 1990;113:47–137.
22. Kumar KP, Kumar SP, Nair GA. Risk assessment of the amnesic shellfish poison, domoic acid, on animals and humans. *J Environ Biol*. 2009;30(3):319–325.

23. Stemtech. Frequently Asked Questions [website]. http://www.stemtechbiz.com/FAQ_sub.aspx#review_neurotoxicity.
24. Sawyer PJ, Gentile JH, Sasner JJ. Demonstration of a toxin from *Aphanizomenon flos-aquae* (L.) Ralfs. *Can J Microbiol*. 1968;14(11):1199–1204
25. Li, R, Carmichael, WW, Liu, Y, and Watanabe, MM. Taxonomic re-evaluation of Aphanizomenon flos-aquae NH-5 based on morphological and 16 rRNA gene sequences. *Hydrobiologica*. 2000;438:99–105.
26. Jensen GS, Ginsberg DI, Huerta P, Citton M, Drapeau C. Consumption of Aphanizomenon fl os-aquae has rapid effects on the circulation and function of immune cells in humans. *JANA*. 2000;2(3):50–58.
27. Hart AN, Zaske LA, Patterson KM, Drapeau C, Jensen GS. Natural killer cell activation and modulation of chemokine receptor profile in vitro by an extract from the cyanophyta Aphanizomenon flos-aquae. *J Med Food*. 2007;10(3):435–441.
28. Pugh N, Ross SA, ElSohly HN, ElSohly MA, Pasco DS. Isolation of three high molecular weight polysaccharide preparations with potent immunostimulatory activity from Spirulina platensis, aphanizomenon flos-aquae and Chlorella pyrenoidosa. *Planta Med*. 2001;67(8):737–742.
29. Pugh N, Pasco DS. Characterization of human monocyte activation by a water soluble preparation of Aphanizomenon flos-aquae. *Phytomedicine*. 2001;8(6):445–453.
30. Drapeau C. Antidepressant properties of the blue-green alga *Aphanizomenon flos-aquae*. Annual meeting of the American Holistic Medicine Association. Toronto; May 2002.
31. Sabelli H, Fink P, Fawcett J, Tom C. Sustained antidepressant effect of PEA replacement. *J Neuropsychiatry Clin Neurosci*. 1996;8(2):168–171.
32. Sabelli HC, Fawcett J, Gusovsky F, Javaid J, Edwards J, Jeffriess H. Urinary phenyl acetate: a diagnostic test for depression? *Science*. 1983;220(4602):1187–1188.
33. Sabelli HC, Mosnaim AD. Phenylethylamine hypothesis of affective behavior. *Am J Psychiat*. 1974;131:695–699.
34. Baker GB, Bornstein RA, Rouget AC, Ashton SE, van Muyden JC, Coutts RT. Phenylethylaminergic mechanisms in attention-deficit disorder. *Biol Psychiatry*. 1991;29(1):15–22.
35. Romay C, Armesto J, Remirez D, González R, Ledon N, García I. Antioxidant and anti-inflammatory properties of C-phycocyanin from blue-green algae. *Inflamm Res*. 1998;47(1):36–41.
36. Romay C, Ledón N, González R. Further studies on anti-inflammatory activity of phycocyanin in some animal models of inflammation. *Inflamm Res*. 1998;47(8):334–338.
37. González R, Rodríguez S, Romay C, et al. Anti-inflammatory activity of phycocyanin extract in acetic acid-induced colitis in rats. *Pharmacol Res*. 1999;39(1):55–59.
38. Romay C, Ledón N, González R. Phycocyanin extract reduces leukotriene B4 levels in arachidonic acid-induced mouse-ear inflammation test. *J Pharm Pharmacol*. 1999;51(5):641–642.
39. Romay C, Ledón N, González R. Effects of phycocyanin extract on prostaglandin E2 levels in mouse ear inflammation test. *Arzneimittelforschung*. 2000;50(12):1106–1109.
40. Reddy CM, Bhat VB, Kiranmai G, Reddy MN, Reddanna P, Madyastha KM. Selective inhibition of cyclooxygenase-2 by C-phycocyanin, a biliprotein from Spirulina platensis. *Biochem Biophys Res Commun*. 2000;277(3):599–603.
41. Jensen GS, Hart AN, Zaske LA, et al. Mobilization of human CD34+ CD133+ and CD34+ CD133(-) stem cells in vivo by consumption of an extract from Aphanizomenon flos-aquae--related to modulation of CXCR4 expression by an L-selectin ligand? *Cardiovasc Revasc Med*. 2007;8(3):189–202.
42. Deb A, Wang S, Skelding KA, et al. Bone marrow-derived cardiomyocytes are present in adult human heart: A study of gender-mismatched bone marrow transplantation patients. *Circulation*. 2003;107(9):1247–1249.
43. Körbling M, Katz RL, Khanna A, et al. Hepatocytes and epithelial cells of donor origin in recipients of peripheral-blood stem cells. *N Engl. J Med*. 2002;346(10):738–746.
44. Ianus A, Holz GG, Theise ND, Hussain MA. In vivo derivation of glucose-competent pancreatic endocrine cells from bone marrow without evidence of cell fusion. *J Clin Invest*. 2003;111:843–850.
45. Hasegawa Y, Ogihara T, Yamada T, et al. Bone marrow (BM) transplantation promotes beta-cell regeneration after acute injury through BM cell mobilization. *Endocrinology* 2007;148(5):2006–2015.
46. Cantürk NZ, Vural B, Esen N, et al. Effects of granulocyte-macrophage colony-stimulating factor on incisional wound healing in an experimental diabetic rat model. *Endocr Res*. 1999;25(1):105–116.
47. Mezey E, Key S, Vogelsang G, Szalayova I, Lange GD, Crain B. Transplanted bone marrow generates new neurons in human brains. *Proc Natl Acad Sci USA*. 2003;100, 1364–1369.
48. Drapeau C. *Cracking the Stem Cell Code*. Sutton Hart Press; 2010:254.
48. Werner N, Kosiol S, Schiegl T, et al. Circulating endothelial progenitor cells and cardiovascular outcomes. *N Engl J Med*. 2005;353(10):999–1007.
49. Vasa M, Fichtlscherer S, Aicher A, et al. Number and migratory activity of circulating endothelial progenitor cells inversely correlate with risk factors for coronary artery disease. *Circ Res*. 2001;89(1):E1–7.
50. Marchesi C, Belicchi M, Meregalli M, et al. Correlation of circulating CD133+ progenitor subclasses with a mild phenotype in Duchenne muscular dystrophy patients. *PLoS ONE*. 2008;3(5):e2218.
51. Diller GP, van Eijl S, Okonko DO, et al. Circulating endothelial progenitor cells in patients with Eisenmenger syndrome and idiopathic pulmonary arterial hypertension. *Circulation*. 2008;117(23):3020–3030.
52. Junhui Z, Xingxiang W, Guosheng F, Yunpeng S, Furong Z, Junzhu C. Reduced number and activity of circulating endothelial progenitor cells in patients with idiopathic pulmonary arterial hypertension. *Respir Med*. 2008;102(7):1073–1079.
53. Herbrig K, Haensel S, Oelschlaegel U, Pistrosch F, Foerster S, Passauer J. Endothelial dysfunction in patients with rheumatoid arthritis is associated with a reduced number and impaired function of endothelial progenitor cells. *Ann Rheum Dis*. 2006;65(2):157–163.
54. Grisar J, Aletaha D, Steiner CW, et al. Depletion of endothelial progenitor cells in the peripheral blood of patients with rheumatoid arthritis. *Circulation*. 2005;111(2):204–211.
55. Zhu J, Wang X, Chen J, Sun J, Zhang F. Reduced number and activity of circulating endothelial progenitor cells from patients with hyperhomocysteinemia. *Arch Med Res*. 2006;37(4):484–489.
56. Westerweel PE, Luijten RK, Hoefer IE, Koomans HA, Derksen RH, Verhaar MC. Hematopoietic and endothelial progenitor cells are deficient in quiescent systemic lupus erythematosus. *Ann Rheum Dis*. 2007;66(7):865–870.
57. Moonen JR, de Leeuw K, van Seijen XJ, et al. Reduced number and impaired function of circulating progenitor cells in patients with systemic lupus erythematosus. *Arthritis Res Ther*. 2007;9(4):R84.
58. Choi JH, Kim KL, Huh W, et al. Decreased number and impaired angiogenic function of endothelial progenitor cells in patients with chronic renal failure. *Arterioscler Thromb Vasc Biol*. 2004;24(7):1246–1252.
59. Drapeau C, Antarr D, Ma H, et al. Mobilization of bone marrow stem cells with StemEnhance® improves muscle regeneration in cardiotoxin-induced muscle injury. *Cell Cycle*. 2010;May;9(9):1819–1823.

Christian Drapeau
1011 Calle Amanecer
San Clemente, California 92673
cdrapeau@stemtechmail.com

Christian Drapeau is an author, research scientist and neuro-physiologist with over 13 years of research experience in the fields of natural foods and nutrition. While pursuing scientific research in collaboration with various universities and research centers on the health benefits of certain botanical raw materials, he has lectured on nutrition to thousands of people since 1994, presenting profound health information and insights with clarity and humor.

Mr. Drapeau has been the director of research and development at Cell Tech International and then Desert Lake Technologies, before cofounding Stemtech HealthSciences and becoming its chief science officer. Based on his own research as well as the review of research done by numerous other scientific teams, Mr. Drapeau and his collaborators proposed in 2001 a breakthrough theory on adult stem cell physiology. He is the coinventor of the revolutionary product StemEnhance.

Mr. Drapeau received a bachelor's degree in neurophysiology from McGill University, Montreal, in 1987 and a master's degree from the Department of Neurology and Neurosurgery from the Montreal Neurological Institute, McGill University, Montreal, in 1991.

◆