

Health Condition	Type of Study	Description of the Study and Outcome	Reference
Allergies	Randomized, double-blind placebo-controlled trial Non randomized before and after study Pre and Post In-Vitro Study A randomized double blind Placebo controlled study from Turkey	Individuals with allergic rhinitis were fed daily, either with placebo or Spirulina for 12 weeks Peripheral blood mononuclear cells were isolated before and after the Spirulina feeding and levels of cytokines (interleukin-4 (IL-4), interferon- $\gamma$ (IFN- $\gamma$ ) and interleukin-2), which are important in regulating immunoglobulin (Ig)E-mediated allergy, were measured. The study showed that high dose of Spirulina significantly reduced IL-4 levels by 32%, demonstrating the protective effects of this microalga toward allergic rhinitis. Ishii et al. studied the influence of Spirulina on IgA levels in human saliva and demonstrated that it enhances IgA production, suggesting a pivotal role of microalga in mucosal immunity. A Japanese team identified the molecular mechanism of the human immune capacity of Spirulina by analysing blood cells of volunteers with pre- and post-oral administration of hot water extract of Spirulina platensis. IFN- $\gamma$ production and Natural Killer (NK) cell damage were increased after administration of the microalga extracts to male volunteers [13]. Evaluated the effectiveness and tolerability of Spirulina for treating patients with allergic rhinitis, Spirulina consumption significantly improved the symptoms and physical findings compared with placebo ( $P < .001$ ), including nasal discharge, sneezing, nasal congestion and itching [14].	Mao TK, van de Water J, Gershwin ME. Effects of a Spirulina-based dietary supplement on cytokine production from allergic rhinitis patients. <i>Journal of Medicinal Food</i> . 2005;8(1):27–33 Ishii K, Katoh T, Okuwaki Y, Hayashi O. Influence of dietary Spirulina platensis on IgA level in human saliva. <i>Journal of Kagawa Nutrition University</i> . 1999;30:27–33. Hirahashi T, Matsumoto M, Hazeki K, Saeki Y, Ui M, Seya T. Activation of the human innate immune system by Spirulina: augmentation of interferon production and NK cytotoxicity by oral administration of hot water extract of Spirulina platensis. <i>International Immunopharmacology</i> . 2002; 2(4):423–434. Cingi C, Conk-Dalay M, Cakli H, Bal C. The effects of spirulina on allergic rhinitis. <i>European Archives of Oto-Rhino-Laryngology</i> . In press.
Viral Properties	In Vitro Study In Vitro Study	The active component of the water extract of <i>S. platensis</i> is a sulfated polysaccharide, calcium spirulan (Ca-Sp). According to Hayashi et al, Ca-Sp inhibits the in vitro replication of several enveloped viruses including Herpes simplex type I, human cytomegalovirus, measles and mumps virus, influenza A virus and human immunodeficiency virus-1 virus (HIV-1). An aqueous extract of <i>S. platensis</i> inhibited HIV-1 replication in human T-cells, peripheral blood mononuclear cells and Langerhan cells.	Hayashi K, Hayashi T, Maedaa M, Kojima I. Calcium spirulan, an inhibitor of envelope virus replication, from a blue-green alga <i>Spirulina platensis</i> . <i>Journal of Natural Products</i> . 1996;59:83–7. Ayeahunie S, Belay A, Baba TW, Ruprecht RM. Inhibition of HIV-1 replication by an aqueous extract of <i>Spirulina platensis</i> ( <i>Arthrospira platensis</i> ) <i>Journal of Acquired Immune Deficiency Syndromes and Human Retrovirology</i> . 1998;18(1):7–12.
Hyperlipidemia and Anti-Diabetic Effects and Obesity Effects	Non-randomized Pre-Post Study Non-randomized Pre-Post Study Non-randomized Pre-Post Study Double Blind Cross-over Study	Nakaya et al. in the first human study, gave 4.2 g day <sup>-1</sup> of Spirulina to 15 male volunteers and, although there was no significant increase in high-density lipoprotein (HDL) levels, they observed a significant reduction of low-density lipoprotein (LDL) cholesterol after 8 weeks of treatment. The atherogenic effect also declined significantly in the above group. Ramamoorthy administered Spirulina supplements in ischemic heart disease patients and found a significant reduction in blood cholesterol, triglycerides and LDL cholesterol and an increase in HDL cholesterol. Mani et al. in a clinical study, found a significant reduction in LDL : HDL ratio and glyated proteins in 15 diabetic patients who were given Spirulina. 2.8 g of Spirulina thrice a day over a period of 4 weeks showed a small but statistically significant reduction of body weight in obese outpatients.	Nakaya N, Homa Y, Goto Y. Cholesterol lowering effect of Spirulina. <i>Atherosclerosis</i> . 1988;37:1329–1337. Ramamoorthy A, Premakumari S. Effect of supplementation of Spirulina on hypercholesterolemic patients. <i>Journal of Food Science and Technology</i> .1996;33(2):124–128. Mani UV, Desai S, Iyer U. Studies on the long-term effect of Spirulina supplementation on serum lipid profile and glyated proteins in NIDDM patients. <i>Journal of Nutraceuticals, Functional and Medical Foods</i> . 2000; 2(3):25–32. Becker EW, Jakob B, Luft D, and et al. Clinical and biochemical evaluations of the alga spirulina with regard to its application in the treatment of obesity. A double-blind cross-over study. <i>Nutr Report Internat</i> 1986;33:565-574.
Anti-Cancer Effects	Un-blinded, non-randomized trial	This study looked specifically at the effects of Spirulina on oral carcinogenesis, in particular leukoplakia. The study conducted on a cohort of 77 patients reported that 45% of their study cohort showed complete regression of leukoplakia after taking Spirulina supplements for 1 year.	Mathew B, Sankaranarayanan R, Nair PP, et al. Evaluation of chemoprevention of oral cancer with Spirulina fusiformis. <i>Nutrition and Cancer</i> . 1995;24(2):197–202.
Chronic Arsenic Poisoning	A placebo-controlled, double-blind study	To evaluate the effectiveness of spirulina extract plus zinc in the treatment of chronic arsenic poisoning. Forty-one patients with chronic arsenic poisoning were randomly treated by either placebo (17 patients) or spirulina extract (250 mg) plus zinc (2 mg) (24 patients) twice daily for 16 weeks. Results showed that spirulina extract plus zinc twice daily for 16 weeks may be useful for the treatment of chronic arsenic poisoning with melanosis and keratosis.	Misbahuddin M, Islam AZ, Khandker S, Al-Mahmud I, Islam N, Anjumanara Efficacy of spirulina extract plus zinc in patients of chronic arsenic poisoning: a randomized placebo-controlled study. <i>Clinical Toxicology</i> . 2006;44(2):135–141.
Malnutrition	Randomized Study Randomized Single Blinded Study Randomized Single Blinded Study	A total of 228 children (6–11 years) were recruited and randomly divided into three groups supplemented with 4 g, 2 g or 0 g spirulina 5 d/ week for 10 weeks, respectively. After the 10-week intervention, serum $\beta$ -carotene concentrations of children with 2 or 4 g spirulina supplement increased by 0.160 and 0.389 $\mu$ mmol/l, respectively. Total-body vitamin A stores increased significantly, with a median increase of 0.160 mmol in children taking 2 g spirulina and of 0.279 mmol in children taking 4 g spirulina. Spirulina is a good dietary source of $\beta$ -carotene, which may effectively increase the total-body vitamin A stores of Chinese school-age children. 52 patients were randomized and in - this-preliminary study, results showed that both spirulina and soja improved - on nutritional status of malnourished HIV-infected patients but in terms of quality of nutritional improvement, subjects on spirulina were better off than subjects on soyabeans. Secondly, nutritional rehabilitation improves on immune status with a consequent drop in viral load. 550 undernourished children were recruited into 3 arms. Anthropometrics and haematological parameters allowed us to appreciate both the nutritional and biological evolution of these children. The rehabilitation with Spiruline plus Misola (this association gave an energy intake of 767 $\pm$ 5 kcal/day with a protein assumption of 33.3 $\pm$ 1.2 g a day), both greater than Misola or Spiruline alone, seems to correct weight loss more quickly.	Spirulina can increase total-body vitamin A stores of Chinese school-age children as determined by a paired isotope dilution technique Lei Li, Xianfeng Zhao, Jie Wang, Tawanda Muzhingi, Paolo M. Suter, Guangwen Tang and Shi-an Yin <i>Journal of Nutritional Science</i> (2012), vol. 1, e19, page 1 of7 Potential of Spirulina Platensis as a nutritional supplement in Malnourished HIV-Infected Adults in sub-saharan Africa: A Randomised, single-Blind study M. Azabji-Kenfack, S. edie Dikosso, e.g. Loni, e.A. Onana, e. Sobngwi, e. gbaguidi3, A.L. Ngougni Kana, g. Nguéfac-Tsague, D. Von der Weid, O. Njoya and J. Ngogang. · Nutrition rehabilitation of undernourished children utilizing Spiruline and Misola Jacques Simpore, · Fatoumata Kabore, · Frederic Zongo, · Deleli Dansou, · Augustin Bere, · Salvatore Pignatelli, · Daniela M Biondi, · Giuseppe Ruberto and · Salvatore Musumeci <i>Nutrition Journal</i> 2006;3 DOI: 10.1186/1475-2891-5-3

<p>Malnutrition</p>	<p>Field Level Trials Ongoing Field Level Study In 1991, a large non-randomized study of 10,000 children, (5000 cohort and 5000 controls) was conducted in more than 200 villages in Tamilnadu, India by the [[Murugappa Group]], funded by the [[Government of India]]. Children less than 5 years were supplemented with 1 gram of Spirulina for 12-18 months. A dramatic eighty percent reduction in clinical signs of Vitamin A deficiency as manifested by reduction in Bitot's spots, and xerosis was seen. A statistically significant increase in beta-carotene and retinol levels were also seen. Due to untimely demise of the Principal Investigator, [[C V Seshadri]], the results were not published, but the complete report is available as a Monograph. In 2013, [[JSW Group]], in India, launched a large community based "Mission Against Malnutrition", in the [[Bellary]] district of [[Karnataka]]. Over 3 years, more than 30,000 malnourished children, &lt; 6 years, have received granulated 1-2 grams of Spirulina over 6 months A dramatic 45% reduction in acute malnutrition has been documented, as manifested by reversal in weight for age z-scores. This impact was sustained for 6 months post-supplementation These results were validated, in a non-randomised study, of 1000 children, where a 46% and 67% reduction in malnutrition was evidenced among children who received 1 and 2 grams of Spirulina respectively, as compared to little change in the control groups A significant cognitive improvement has been noted among children who received Spirulina. This mission is ongoing and is the largest such mission against malnutrition to be conducted in India or worldwide.<a href="http://www.amm-mcrc.org/Publications/CVS_Monographs/Large_Scale_Nutritional_Supplementation.pdf">http://www.amm-mcrc.org/Publications/CVS_Monographs/Large_Scale_Nutritional_Supplementation.pdf</a> &lt;/ref&gt; · <a href="http://www.thehindu.com/news/cities/bangalore/foundation-spirulina-enhances-micronutrients/article8789940.ece">http://www.thehindu.com/news/cities/bangalore/foundation-spirulina-enhances-micronutrients/article8789940.ece</a> <a href="http://timesofindia.indiatimes.com/city/bengaluru/He-grows-spirulina-in-Bengalurus-backyard-to-fight-malnutrition/articleshow/52709433.cms">http://timesofindia.indiatimes.com/city/bengaluru/He-grows-spirulina-in-Bengalurus-backyard-to-fight-malnutrition/articleshow/52709433.cms</a> <a href="http://www.deccanherald.com/content/540587/malnourished-children-state-get-spirulina.html">http://www.deccanherald.com/content/540587/malnourished-children-state-get-spirulina.html</a> <a href="http://www.thehindu.com/news/national/karnataka/drop-in-malnutrition-cases-among-women-children-in-sandur-taluk/article7075818.ece">http://www.thehindu.com/news/national/karnataka/drop-in-malnutrition-cases-among-women-children-in-sandur-taluk/article7075818.ece</a> <a href="http://timesofindia.indiatimes.com/city/bengaluru/Corporates-help-govt-fight-malnutrition-using-spirulina/articleshow/52472904.cms">http://timesofindia.indiatimes.com/city/bengaluru/Corporates-help-govt-fight-malnutrition-using-spirulina/articleshow/52472904.cms</a>. Rajachar V, Gupta MK, Sengupta A. An Intervention Study for "Mission Against Malnutrition" in Bellary District, Karnataka. IPHA 2016: Towards Healthy Lifestyle. Organized by Himalayan Institute of Medical Sciences, Dehradun, Uttarakhand 4th to 6th March 2016.</p>	
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