

Additional Areas of Research

Eur J Appl Physiol. 2006 Sep;98(2):220-6. Epub 2006 Aug 30.

Preventive effects of *Spirulina platensis* on skeletal muscle damage under exercise-induced oxidative stress.

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The effects of spirulina supplementation on preventing skeletal muscle damage on untrained human beings were examined. Sixteen students volunteered to take *Spirulina platensis* in addition to their normal diet for 3-weeks. Blood samples were taken after finishing the Bruce incremental treadmill exercise before and after treatment. The results showed that plasma concentrations of malondialdehyde (MDA) were significantly decreased after supplementation with spirulina ($P < 0.05$). The activity of blood superoxide dismutase (SOD) was significantly raised after supplementation with spirulina or soy protein ($P < 0.05$). Both of the blood glutathione peroxidases (GPx) and lactate dehydrogenase (LDH) levels were significantly different between spirulina and soy protein supplementation by an ANCOVA analysis ($P < 0.05$). In addition, the lactate (LA) concentration was higher and the time to exhaustion (TE) was significantly extended in the spirulina trail ($P < 0.05$). These results suggest that ingestion of *S. platensis* showed preventive effect of the skeletal muscle damage and that probably led to postponement of the time of exhaustion during the all-out exercise.

Publication Types:

- Randomized Controlled Trial
- Research Support, Non-U.S. Gov't

PMID: 16944194 [PubMed - indexed for MEDLINE]

Additional Areas of Research: Energy/Endurance/Muscle Damage

Effect of supplementation of blue green alga (Spirulina) on outcome of pregnancy in rats.

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To study the supplementary effect of Spirulina, pregnant rats were fed 5 different kinds of diets (casein, Spirulina, wheat gluten, Spirulina + wheat gluten, Spirulina-without additional vitamins and minerals), each providing 22% protein during the period of pregnancy. The outcome of pregnancy was assessed from litter and dams' weight and litter size. Maternal weight gain was found to be maximum with Spirulina + wheat gluten and least with the wheat gluten diet. Rats receiving Spirulina containing diets produced significantly ($p < 0.05$) higher litter size than those receiving casein and wheat gluten. In spite of having higher litter size, Spirulina containing diet groups produced pups with birth weights comparable to those of casein. Spirulina appears to be a good dietary supplement during pregnancy.

PMID: 8464842 [PubMed - indexed for MEDLINE]

Antiadhesive property of microalgal polysaccharide extract on the binding of *Helicobacter pylori* to gastric mucin.

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The emergence of antibiotic-resistant *Helicobacter pylori* is of concern in the treatment of *H. pylori*-associated gastroduodenal diseases. As the organism was reported to bind gastric mucin, we used porcine gastric mucin as substrate to assess the antiadhesive property of polysaccharides derived from *Spirulina* (PS), a commercially available microalga, against the binding of *H. pylori* to gastric mucin. Results show that polysaccharides prevented *H. pylori* from binding to gastric mucin optimally at pH 2.0, without affecting the viability of either bacteria or gastric epithelial cells, thus favouring its antiadhesive action in a gastric environment. Using ligand overlay analysis, polysaccharide was demonstrated to bind *H. pylori* alkyl hydroperoxide reductase (AhpC) and urease, which have shown here to possess mucin-binding activity. An in vivo study demonstrated that bacteria load was reduced by >90% in BALB/c mice treated with either *Spirulina* or polysaccharides. It is thus suggested that polysaccharides may function as a potential antiadhesive agent against *H. pylori* colonization of gastric mucin.

Publication Types:

- Research Support, Non-U.S. Gov't

Additional Areas of Research: *H. Pylori* (Gastric Ulcers)

Arch Latinoam Nutr. 1978 Jun;28(2):196-207.

[Nutritive value of the spirulina algae (*Spirulina maxima*)]

[Article in Spanish]

[Tejada de Hernández I, Shimada AS.](#)

Nine experiments were conducted, five of them in vivo to determine the limiting amino acids and digestibility of spirulina algae for the rat, and four in vitro to determine the digestibility of the product in pepsin and ruminal liquid. None of the amino acids studied (lysine, methionine, histidine) added alone or in combination to 10% protein (either crude or true) diets provided exclusively by spirulina, seems to be limiting although the results could be masked by the low palatability and acceptability of the product by the rats. The apparent digestibility of the algae was 67.4%. For the in vitro tests, the algae were subjected to several physical or chemical treatments, and the digestibility of the resulting product determined by four different techniques. In no case did the tested treatments have any effect on its digestibility.

Publication Types:

- English Abstract

PMID: 753178 [PubMed - indexed for MEDLINE]

Additional Areas of Research: Protein Absorption

Effect of ambroxol, spirulina and vitamin-E in naphthalene induced cataract in female rats.

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Anticataract activity of Ambroxol, Spirulina and Vitamin E was examined using the naphthalene cataract model. Adult female albino rats of Wistar strain weighing between 180 and 220 grams were taken and divided into eight groups. Group I received light liquid paraffin 5 ml/kg/ day p.o. for 6 weeks. Group II received naphthalene solution 0.5 gm/kg/ day p.o. for first three days and 1 gm/kg/day p.o. thereafter for six weeks. Group III received Ambroxol suspension in 0.5% carboxy methyl cellulose (CMC) at the dose of 100 mg/kg/day p.o. alongwith naphthalene. Group IV received Spirulina in distilled water at the dose of 1500 mg/kg/ day p.o. alongwith naphthalene. Group V received Vitamin E emulsion at the dose of 50 mg/kg/day p.o. alongwith naphthalene. Group VI received Ambroxol alone at the dose of 100 mg/kg/day p.o. Group VII received Spirulina alone at the dose of 1500 mg/kg/day p.o. Group VIII received vitamin E alone at the dose of 50 mg/kg/day p.o. Lens glutathione, soluble protein and water content profiles revealed the preventive role of Ambroxol, Spirulina and Vitamin E in naphthalene-induced cataract in female rats.

Publication Types:

- Comparative Study

PMID: 15881859 [PubMed - indexed for MEDLINE]

Additional Areas of Research: Eye (Cataract)

Vopr Pitan. 2004;73(2):28-31.

[Essential trace elements distribution in food micro algae *Spirulina platensis* biomass fractions]

[Article in Russian]

[Zaretskaia ES](#), [Gmoshinskii IV](#), [Mazo VK](#), [Zorin SN](#), [Aleshko-Ozhevskii IuP](#).

Distribution of some trace elements elements (zinc, selenium, iron, manganese, chromium) was characterized in enriched biomass of food micro algae *Spirulina platensis* by means of water-methanol fractionation. The majority of said trace elements was shown to be incorporated in intercellular hydrophylic fraction, e.g. could be connected to cellular proteins. This result enable the conclusion, that *Spirulina* is a suitable matrix for biotechnological incorporation of new food trace elements preparations.

Publication Types:

- English Abstract

PMID: 15154369 [PubMed - indexed for MEDLINE]

Additional Areas of Research: Trace Minerals

New food sources of essential trace elements produced by biotechnology facilities.

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Population satiety with trace elements (TE) is a problem that is widely discussed in nutrition science. For optimal nutrition, the form of TE eaten in food is very important. Organic forms of TE in nutrition are appropriate as human metabolism has adapted to these kinds of nutrients during species evolution. This is now considered a reason for the beneficial use of biotechnologically produced TE sources in human food. Advanced matrixes for TE incorporation are unicellular organisms such as yeast, lactobacilli and Spirulina. Addition of inorganic salts at certain concentrations into cultivation media enables the mineral ions to incorporate into the microbial biomass. As a consequence, the biomass becomes enriched with organic forms of incorporated TE, which are presented by their complexes with amino acids, proteins and probably lipids and polysaccharides. In addition, a new direction of research has made good advances, in which technology has been developed for production of organic forms of TE through complex formation between transition metals (zinc, copper, manganese, chromium, iron) with amino acids and peptides formed during enzymatic hydrolysis of food protein. This brief review discusses the results demonstrating the advances in the biotechnological production of new TE sources, to obtain food components destined for wide prophylaxis of TE deficiency or for dietary treatment of the adverse consequences of these deficiencies.

Publication Types:

- Review

PMID: 17546707 [PubMed - indexed for MEDLINE]

Additional Areas of Research: Trace Minerals

Nutrition rehabilitation of undernourished children utilizing Spiruline and Misola.

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BACKGROUND: Malnutrition constitutes a public health problem throughout the world and particularly in developing countries. **AIMS :** The objective of the study is to assess the impact of an elementary integrator composed of Spiruline (*Spirulina platensis*) and Misola (millet, soja, peanut) produced at the Centre Medical St Camille (CMSC) of Ouagadougou, Burkina Faso, on the nutritional status of undernourished children. **MATERIALS AND METHODS:** 550 undernourished children of less than 5 years old were enrolled in this study, 455 showed severe marasma, 57 marasma of medium severity and 38 kwashiorkor plus marasma. We divided the children randomly into four groups: 170 were given Misola (731 +/- 7 kcal/day), 170 were given Spiruline plus traditional meals (748 +/- 6 kcal/day), 170 were given Spiruline plus Misola (767 +/- 5 kcal/day). Forty children received only traditional meals (722 +/- 8 kcal/day) and functioned as the control group. The duration of this study was eight weeks. **RESULTS AND DISCUSSION:** 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 +/- 5 kcal/day with a protein assumption of 33.3 +/- 1.2 g a day), both greater than Misola or Spiruline alone, seems to correct weight loss more quickly. **CONCLUSION:** Our results indicate that Misola, Spiruline plus traditional meals or Spiruline plus Misola are all a good food supplement for undernourished children, but the rehabilitation by Spiruline plus Misola seems synergically favour the nutrition rehabilitation better than the simple addition of protein and energy intake.

Publication Types:

- Randomized Controlled Trial
- Research Support, Non-U.S. Gov't

PMID: 16430775 [PubMed - indexed for MEDLINE]

Additional Areas of Research: Malnutrition

[The effect of spiruline during nutritional rehabilitation: systematic review]

[Article in French]

[Halidou Doudou M](#), [Degbey H](#), [Daouda H](#), [Leveque A](#), [Donnen P](#), [Hennart P](#), [Dramaix-Wilmet M](#).

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BACKGROUND: To evaluate the impact of spiruline on nutritional rehabilitation. **DATA SOURCES:** Systematic search in medical and scientific databases (Medline, Cochrane, Embase) and other specific databases (PhD theses, reports...). **METHODS:** We selected studies in which spiruline was used as supplementation in malnourished patients, irrespective of the form and dose of spiruline and in controlled trials or not. Two persons made the selection separately. Nutritional status was estimated by anthropometric and biological measures. **RESULTS:** Thirty-one references were identified and seven studies were retained for this review; three randomized controlled and four non-controlled trials. Spiruline had a positive impact on weight in all studies. In non-controlled trials, the other parameters: arm circumference, height, albumin, prealbumin, protein and hemoglobin improved after spiruline supplementation. For these studies, methodology was the main drawback. None of the studies retained for analysis were double-blinded clinical trials and all involved small samples. Four of them did not have a control group for comparison. **CONCLUSION:** The impact of spiruline was positive for most of the considered variables. However, the studies taken into account in this review are of poor-methodological quality. A randomized, a large-sized double-blind controlled clinical trial with a longer follow-up should be conducted to improve current knowledge on the potential impact of spiruline on nutritional rehabilitation.

Publication Types:

- Comparative Study
- English Abstract
- Review

PMID: 19010626 [PubMed - indexed for MEDLINE]

Additional Areas of Research: Malnutrition

The effect of hydrolyzed Spirulina by malted barley on forced swimming test in ICR mice.

[Kim NH](#), [Jeong HJ](#), [Lee JY](#), [Go H](#), [Ko SG](#), [Hong SH](#), [Kim HM](#), [Um JY](#).

Department of Pharmacology, Institute of Oriental Medicine, Kyung Hee University, Seoul, Republic of Korea.

Spirulina is a true puree of a filamentous, spiral-shaped blue alga and exerts the useful properties as a source of many biochemicals. This study investigated the antidepressant-like effect of hydrolyzed Spirulina by malted barley on the forced swimming test in mice. After the forced swimming test, we examined the levels of several blood biochemical parameters in mice. The effect of the hydrolyzed Spirulina by malted barley-treated group for 2 weeks on the immobility time was significantly reduced in comparison with the control group ($p < .05$). Plasma level of blood urea nitrogen and lactate dehydrogenase was significantly decreased in the hydrolyzed Spirulina by malted barley-treated group compared with the control group ($p < .05$). It had no effect on the variation of creatine kinase, glucose, total protein, and albumin levels. Therefore, these results suggest that hydrolyzed Spirulina by malted barley might be a candidate among antidepressant agents.

Publication Types:

- Research Support, Non-U.S. Gov't

PMID: 18853331 [PubMed - indexed for MEDLINE]

Additional Areas of Research: Anti-Depressant

Spirulina enhanced the skeletal muscle protein in growing rats.

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BACKGROUND/AIM OF THE STUDY: This study evaluates the effects of the blue green alga spirulina as the sole dietary source of protein on muscle protein in weaning rats. **METHODS:** Young (30 days) Wistar rats were fed, during 60 days, with 17% protein spirulina (S) and compared to rats fed 17% protein casein (C). We evaluated the muscle total protein and DNA contents and the in vitro protein synthesis and degradation rates as well the myosin protein expression. **RESULTS:** The groups presented similar body weight (C = 427.3 +/- 8.6; S = 434.6 +/- 7.7 g) and length (C = 25.4 +/- 0.2; S = 25.6 +/- 0.2 cm). Soleus muscle total protein (C = 2.9 +/- 0.1; S = 2.7 +/- 0.1 mg/100 mg) and DNA (C = 0.084 +/- 0.005; S = 0.074 +/- 0.005 mg/100 mg) contents were also similar in both groups. Protein degradation (C = 427.5 +/- 40.6; S = 476.7 +/- 50.5 pmol/mg(-1) h(-1)) did not differ between the groups but protein synthesis (C = 17.5 +/- 1.0; S = 25.2 +/- 1.9 pmol/mg(-1) h(-1)) and myosin content (western blot analyses) were higher (P < 0.05, t test) in spirulina group. **CONCLUSIONS:** Although the spirulina proved adequate protein quality to maintain body growth, the muscle protein synthesis rates were increased by the ingestion of the experimental diet in young rats.

Publication Types:

- Research Support, Non-U.S. Gov't

PMID: 18807105 [PubMed - indexed for MEDLINE]

Additional Areas of Research: Muscle Protein Synthesis

Inflammopharmacology. 2009 Apr 24. [Epub ahead of print]

Evaluation of protective efficacy of *Spirulina platensis* against collagen-induced arthritis in rats.

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AIM: To assess the protective efficacy of *Spirulina platensis* against collagen-induced arthritis (CIA) in female Wistar rats based on the changes in paws thickness, serum albumin, cholesterol, lipid peroxidation, alkaline phosphatase and acid phosphatase activities and histology of paw joints. **METHODS:** Arthritis was induced by intradermal injection of Collagen and Freund's adjuvant incomplete suspension at several sites on the back with a dose of 2 mg kg⁻¹ of body weight and boosted with 0.1 ml intradermally at the base of the tail. CIA rats were orally treated with 200 and 400 mg kg⁻¹ per oral of *S. platensis* from 0 to 45th day. **RESULTS:** *S. platensis* at 400 mg kg⁻¹ per oral significantly elevates serum albumin and decreases the serum cholesterol, alkaline phosphatase and acid phosphatase activities, lipid peroxidation, paw thickness as well as normalize the joint histopathology of CIA rats. **CONCLUSIONS:** *S. platensis* (400 mg kg⁻¹) significantly normalizes changes observed in arthritic rats to near normal conditions, indicates that *S. platensis* has promising protective efficacy against CIA rats.

PMID: 19390977 [PubMed - as supplied by publisher]

Additional Areas of Research: Arthritis

Guang Pu Xue Yu Guang Pu Fen Xi. 2001 Dec;21(6):868-70.

[Determination of micro-elements in natural spirulina using FAAS]

[Article in Chinese]

[Duan M, Ma WX, Li L, Sun XT.](#)

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The analytic results show that the spirulina powder have a plenty of microelements(K, Na, Ca, Mg, Fe, Zn). Compared with that of rice, wheat flour, maize and soybean, the content of K, Na, Ca, Mg, Fe and Zn of it is respectively as from 4 to 10 times, from 10 to 80 times, from 25 to 70 times, from 3 to 15 times, from 4 to 36 times and from 4 to 24 times as theirs. The content of microelements of it compared with vegetable is much higher. The spirulina has a certain inhibition from cancer, high blood pressure, sugar diabetes and hasten body to absorb Se and Mo, and is of benefit to cardiac muscle. The experimental result indicated that spirulina was good health care food with value of nourish and medicinal.

Publication Types:

- English Abstract

PMID: 12958919 [PubMed - indexed for MEDLINE]

Additional Areas of Research: General Health

Spirulina in health care management.

[Kulshreshtha A](#), [Zacharia AJ](#), [Jarouliya U](#), [Bhadauriya P](#), [Prasad GB](#), [Bisen PS](#).

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Spirulina is a photosynthetic, filamentous, spiral-shaped and multicellular edible microbe. It is the nature's richest and most complete source of nutrition. Spirulina has a unique blend of nutrients that no single source can offer. The alga contains a wide spectrum of prophylactic and therapeutic nutrients that include B-complex vitamins, minerals, proteins, gamma-linolenic acid and the super anti-oxidants such as beta-carotene, vitamin E, trace elements and a number of unexplored bioactive compounds. Because of its apparent ability to stimulate whole human physiology, Spirulina exhibits therapeutic functions such as antioxidant, anti-bacterial, antiviral, anticancer, anti-inflammatory, anti-allergic and anti-diabetic and plethora of beneficial functions. Spirulina consumption appears to promote the growth of intestinal micro flora as well. The review discusses the potential of Spirulina in health care management.

Publication Types:

- Research Support, Non-U.S. Gov't
- Review

PMID: 18855693 [PubMed - indexed for MEDLINE]

Additional Areas of Research: General Health