

Health Benefits of Spirulina

ABSTRACTS – SCIENTIFIC STUDIES

COMPILED BY

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NUTRITIONAL BENEFITS OF SPIRULINA

Spirulina – the nutraceutical food has become widely available as a food ingredient in the last 30 years. Spirulina is the most nutritious, concentrated food known to man containing antioxidants, phytonutrients, essential fatty acids, probiotics, and nutraceuticals. Spirulina is the best whole food source of protein, betacarotene, Gamma Linolenic Acid, B-Vitamins, minerals, chlorophyll, sulpho-lipids, glyco-lipids, super oxide dismutase, phycocyanin, enzymes and provides many nutrients that are lacking in most people's diets. It is cultivated, processed and marketed worldwide for its rich nutritional profile. It is used extensively in the health foods, pharmaceutical and speciality feed sectors.

Spirulina has a blend of nutrients that no single plant source can provide. In contrast to most vegetable matter, Spirulina does not have a cell wall made of cellulose, thereby making it easily digestible. Moreover Spirulina has got no side effects and is non-toxic in nature.

A strong immune system is the basis for good health. Many health problems result from the inability of the immune system to stop a disease process in its initial stage. It is now well established that nutrient deficiency is associated with consistent changes in immune responses. Spirulina provide a nutritional role in modulating immune system function favorably and appears to have a balancing effect on important immune cells. The nutrients present in Spirulina boosts the immune system. Published studies from all over the world confirms that Spirulina and its extracts fed to mice, chickens, cats, fish and even humans, consistently improves immune system function. Spirulina up regulates the key cells and organs of the immune system, improving their ability to function in spite of stress from environmental toxins and infectious agents. Medical scientists have found that Spirulina, apart form stimulating the immune system, it actually enhances the body's ability to generate new blood cells.

Spirulina contains its own anti-oxidants like beta-carotene, superoxide dismutase, selenium and vitamin E. Antioxidants helps to protect the body against free radicals formed due to stress, exposure to toxic chemicals, drugs and poor diets. Free radicals can lead to degenerative disease like cancer, aging, age related macular degeneration etc., Studies have revealed that antioxidants in fruits and vegetables and Spirulina have a synergistic effect.

Today Spirulina is being used as a therapeutic agent because of its antioxidant, anticancer properties and its ability to strengthen the immune system. Spirulina is known to improve Malnourishment, and Vit. A status in children and in pregnant women respectively. Spirulina has properties known to lower blood sugar levels in diabetics, have beneficial effects on patients suffering from pancreatitis, hepatitis and cirrhosis; may helpful in glaucoma and cataracts, gastric ulcers, night blindness, liver and circulation disorders; and in controlling anaemia. It has high contents of essential poly unsaturated fatty acids and is effective in lowering cholesterol level in serum and liver, thus making it an effective ingredient in formulations for heart patients.

Spirulina is a good probiotic. Probiotics are good for health as they strengthen the immune system to prevent disease and cancer. Spirulina's probiotic effect helps in maintaining healthy micro flora thus helps in better digestion, absorption and protection from infection.

Scientific studies also have indicated that Spirulina has got anti-inflammatory, anti-allergic, anti-microbial and anti-stress properties and also helps in the treatments of asthma, arthritis etc. Recent studies have indicated that Spirulina has a property of reducing heavy metals and nephrotoxic substance from the body. Studies confirm that this property is due to its combination and amazing concentration of nutrients.

This paper contains the abstracts of the studies conducted with "Parry's Spirulina" on the Health benefits of Spirulina.

- TI:** **Bioavailability of Spirulina Carotenes in Preschool Children** (Dec, 1990)
- AU:** Vure Annapurna, Nisha Shah, Paddidri Bhaskaram, Mahtab Bamji S and Vinodini Reddy
- AD:** National Institute of Nutrition, Indian Council of Medical Research, Jamai Osmania P.O. Hyderabad
- AB:** Experiments were carried out to assess *Spirulina fusiformis*, a blue-green alga, as a source of vitamin A in preschool children. The absorption of total carotenes and β -carotene from a single dose of *Spirulina* containing 1200 μ g of β -carotene was examined in apparently healthy children aged 3-5 years. After stabilization on an almost carotene-free diet taken for 7 days, a bolus dose of *Spirulina* was fed along with the meal. Fecal excretion of total carotene and β -carotene for 4 days prior to the supplementation and 4 days after supplementation were examined. The effect of daily supplementation of either *Spirulina* or of vitamin A for one month on serum retinol levels was also examined. The mean absorption of total carotene was found to be 72.3% and that of β -carotene, 75.2%. Serum retinol showed a significant improvement in both the *Spirulina* and vitamin A-supplemented groups, the increase being slightly better in the vitamin A-supplemented group. On withdrawal of the supplements, serum retinol levels returned to pre-supplementation levels by 1 - 3 months in both groups. The bioavailability of carotenes from *Spirulina* is thus comparable to that from other sources such as carrots and green leafy vegetables, thus suggesting the potential use of this alga as a dietary source of pro-vitamin A.
- SO:** J.Clin. Biochem, Nutr., 10, 145- 151, 1991
- TI:** **A study of haemoglobin levels in humans fed on Spirulina supplement**
(June 1990)
- AU:** Seshadri C.V & Valliammai Subramanian
- AD:** Murugappa Chettiar Research Centre, Tharamani, Madras.
- AB:** The study was undertaken by the Research Centre on the effect of *Spirulina* administration on haemoglobin levels. *Spirulina* was administered to volunteers of Murugappa Chettiar Research Centre and New Ambadi Estates Pvt. Ltd., Chennai. The volunteers' average age was 35 years. The dosage given was 2gms of *Spirulina* / day. The volunteers were asked to mix the powder in a glass of buttermilk and consume it. During the study period, the volunteers were advised not to take coffee or tea before and after one hour of the *Spirulina* administration. The haemoglobin count. (gms/dl) and body weight were taken on the 0th and 36th day. There was an increase of average haemoglobin 1.33 gms/dl and body weight 1.25 Kg respectively.
- SO:** Monograph Series on the Engineering of Photosynthetic Systems. Vol. 30.

TI: **Effect of supplementation of Spirulina fusiformis on the levels of blood glucose and lipid profile of non-insulin dependent diabetics** (August 1991)

AU: Vinitha Raghunath

AD: Dept. of Home Science, Women's Christian College, Madras

AB: The study was designed to determine the effect of supplementing two grams of Spirulina daily to the diets of 16 newly detected, non-insulin dependent diabetics for a period of 40 days. The effect of supplementation was assessed by testing the level of plasma glucose at fasting and after a glucose load, serum total and HDL - cholesterol and serum triglycerides on the initial day and after 20 and 40 days of Spirulina supplementation. The data obtained from the interview schedule revealed that majority of the diabetics were in the age range of 45 and 50 years with polyuria being the most common symptom. All the diabetics consumed foods that were most conducive to their health. Supplementation of Spirulina for a period of 40 days was found to lower plasma glucose levels and serum total cholesterol level in the diabetics, however there was no change in the serum HDL - cholesterol and serum triglyceride levels after supplementation. Supplementation of Spirulina in the form of capsules to diabetics was found to be acceptable by all the subjects and was found to be beneficial for diabetic patients.

TI: **Beta-carotene Therapy for Tropical Pancreatitis** (October 1991)

AU: Shenoy K.T, Jayanthibai, Sarah V., Leena K.B.

AD: Department of Gastroenterology & Biochemistry, Medical College, Thiruvananthapuram .

AB: The study was conducted to assess the effect of beta-carotene in the relief of pain with tropical pancreatitis with the hypothesis that there is oxidant stress in the pathogenesis of tropical pancreatitis and of pancreatic pain. 28 patients with tropical pancreatitis, TP with large pseudo cyst, associated malignancy and end stage disease, were studied in an 8 weeks double blind cross over trial with betacarotene 4800 IU/day or placebo. The results of evaluation indicated that there was reduction in Lipid peroxides following active therapy. Analysis of visual analogue scale scores when compared to background pain showed beneficial effect. The study concluded that betacarotene offers a new approach for pain management in Tropical pancreatitis.

SO: Indian Journal of Gastroenterology, Vol.10 No.4 ; C.V. Seshadri and N. Jeeji Bai (Eds.), Spirulina ETTA Nat. Symp. MCRC, Madras. 1992

TI: **Porphyria Cutanea Tarda Responding to Spirulina** (October 1992)

AU: Pavithran K., Ramachandran Nair P.

AD: Dept. of Dermato-Venerology, Medical College Hospital, Kottayam

AB: A male patient of porphyria cutanea tarda responded to oral Spirulina - an alga rich in beta-carotene. The beta-carotene in the Spirulina quenches the singlet oxygen, which is responsible for the tissue damage in porphyria - associated photosensitivity. Treatment: The dosage of 3gms of Spirulina daily for 3 weeks resulted in complete remission of the skin lesions and associated photosensitivity. He was then maintained on Spirulina 1gm daily for 3 months. There was no recurrence of the lesions.

SO: Ind J of Dermatol, Venereol and Leprol 1992, 58

TI: **Efficacy of Spirulina fusiformis in a case of rheumatoid arthritis** (1992)

AU: Malathi Mohan

AD: Dept. of Home Science, Women's Christian College, Chennai

AB: Subject: Mrs. S.J; Age 44 years; Height 162.5 cm; Weight 51.5 Kg
Occupation: Secretarial assistant in a college
Health problem as diagnosed: Rheumatoid arthritis with swelling in the joints since 1988;
Treatment: Over 3 years; initial: Allopathy; Second: Siddha medicine; Third: Allopathy; Fourth: All external balms available in the market, including ayurvedic oils along with pain killers; Fifth: Aspirin treatment-over 500 tablets; Last: Spirulina fusiformis from Dec. 1990 to date.

Mrs. S.J. Came upon Spirulina when an elderly aunt, who was taking it, advised her to try it. As the Department of Home Science was then collaborating with the Murugapa Chettiar Research Centre and New Ambadi Estates Pvt. Ltd (Algal Division) over a project, Mrs. S.J. was given 2g packets of Spirulina powder to be taken once a day after breakfast. Within two days she noticed the pain had decreased and within 10 days, the swelling on her knee reduced. Since then Mrs. SJ has been taking Spirulina and is very happy with the results.

Changes: She has very little pain now, the swelling has disappeared. She is able to bend her knees and sit on the floor. Only squatting is a little troublesome. She is very thankful to Spirulina fusiformis.

SO: C.V. Seshadri and N. Jeeji Bai (Eds.), Spirulina ETTA Nat. Symp. MCRC, Madras. 1992

- TI:** **Large-scale nutritional supplementation with Spirulina Alga** (1991-1993)
- AU:** C.V.Seshadri, Jayam,
- AD:** MCRC, Madras 1991 –93.
- AB:** The Spirulina feeding among rural 5000 pre-school children with 1 gm / day has reduced the prevalence of Bitot’s spot and prevented the occurrence of severe form of Vitamin A deficiency. (Corneal xerosis). Giving 1 gm. per day has increased the serum retinol levels. The prevalence of B complex deficiency is reduced in pre-school children with this supplementation.
- SO:** Monograph Series on Engineering of Photosynthetic Systems, Vol. 36.
- TI:** **Effect of Spirulina supplementation on hypercholesterolemic patients** (April 1994)
- AU:** Amudha Ramamurthy
- AD:** Dept. of Home Science, Avinashilingam institute for women, Coimbatore
- AB:** The effect of Spirulina on hypercholesterolemic patients was carried out in Coimbatore city. Thirty ischaemic heart disease patients without any complications of the disease and with blood cholesterol levels above 250mg/dl were selected for the study and divided into three groups of 10 each for supplementation of Spirulina. Subjects in groups A and B received 2g and 4g Spirulina per day, respectively for three months. Group C served as control. The study has revealed that Spirulina plays a key role in weight reduction, lowering the blood cholesterol levels and improving the lipid profile of patients.
- SO:** J. Food Sci. Technol., 1996, Vol. 33, No.2, 124-128

TI: **Role of Beta-carotene in the management of Oral Submucous Fibrosis** (1994)

AU: IPE Varghese, Hari S

AD: Dept. of Oral Pathology, Govt. Dental College, Calicut.

AB: This preliminary study was conducted to find out the utility of nutritional supplements like betacarotene (Spirulina) in the management of Oral Submucous Fibrosis. A total of 50 patients from the out patient department of Dental College, Calicut participated in the comparative clinical study. The study group was divided in to two groups as Experimental and Control with 25 patients in each group. All the patients were graded clinically into mild (Grade I) moderate (Grade II) and severe (Grade III) cases.

All the patients belonging to the control group were put on 1. Submucosal injections of placentrex (1ml/week) 2. Multivitamins 3. Colossal Iodine 1 teaspoon tds. and 4. Hot water exercises. The patients belonging to the study group were also put on the same regimen but in addition, β -carotene (Multinal powder / liquid) in the form of a suspension was kept in the oral cavity for 5-10 minutes and swallowed 3 times a day. The study was carried out for a period of 3 months. The results showed that there is a significant percentage reduction in the severity of the disease as revealed by the pre-treatment and post-treatment grades after using β -carotene regimen.

SO: 27th Kerala State Dental Conference 1994.

- TI:** **Evaluation of Chemoprevention of Oral Cancer with Spirulina fusiformis** (1995)
- AU:** Mathew B, Sankaranarayanan R, Nair P.P, Varghese C, Thara S, Padmavathy B, Sreedevi N and Nair M.K.
- AD:** Regional Cancer Centre, Trivandrum.
- AB:** The blue green microalgae, used in daily diets of natives in Africa and America have been found to be a rich natural source of Proteins, Carotenoids and other micronutrients. Experimental studies in animal models have demonstrated an inhibitory effect of Spirulina algae on oral carcinogenesis. Studies among preschool children in India have demonstrated Spirulina fusiformis (SF) to be an effective source of dietary vitamin A. We evaluated the chemopreventive activity of SF (1 g/day for 12 months) in reversing oral leukoplakia in pan tobacco chewers in Kerala, India. Complete regression of lesions was observed in 20 of 44 (45%) evaluable subjects supplemented with SF, as opposed to 3 of 43 (7%) in the placebo arm ($p < 0.0001$). When stratified by type of leukoplakia, the response was more pronounced in homogeneous lesions: complete regression was seen in 16 of 28 (57%) subjects with homogenous leukoplakia, 2 of 8 with erythroplakia, 2 of 4 with verrucous leukoplakia and 0 of 4 with ulcerated and nodular lesions. Within one year of discontinuing supplements, 9 of 20 (45%) complete responders with SF developed recurrent lesions. Supplementation with SF did not result in increased serum concentration of retinol or Beta-carotene, nor was it associated with toxicity. This is the first human study evaluating the chemopreventive potential of SF. More studies in different settings and different populations are needed for further evaluation.
- SO:** Nutrition & Cancer Vol. 24, No. 2 1995 (197-202).

TI: Weight Gain, Serum Lipid Parameters and Histopathology of the Organs of Hyperlipidemia induced Male Albino Rats fed Spirulina fusiformis (April 1995)

AU: Nirupama Rachel Matthan

AD: Dept. of Home Science, Women's Christian College, Chennai

AB: The present study was designed to determine the weight gain, serum lipid parameters and histopathology of the organs of hyperlipidemia induced male albino rats fed spirulina fusiformis. The effect of supplementation was assessed by determining the serum total cholesterol, its fractions (HDL, LDL, VLDL) and serum triglyceride levels and in addition calculating the atherogenic index, the total weight gain, total food intake and Feed Efficiency Ratio. The study period consisted of a four-week observation period and an eight-week supplementation period. During the observation period, the rats were divided into two groups of 18 each - Group I fed the basal diet and Group II fed the hypercholesterolemia inducing diet (HID). In the supplementation period, the rats were further subdivided into four groups of six each. Group I and II were maintained on the basal and hypercholesterolemia inducing diets, while Spirulina was supplemented at a 10% level to the diets of the rats in Group III on the basal diet (Basal + S) and Group IV on the hypercholesterolemia inducing diet (HID+S). The study concluded that Spirulina could be considered as an effective hypolipidemic agent because it was found to reduce the serum total cholesterol, LDL, VLDL and triglyceride levels, all of which are potent risk factors for atherosclerosis.

TI: Effect of Spirulina supplementation on Vitamin A status during pregnancy (March 1995)

AU: Mridula Malandkar,

AD: Dept. of Post-Graduate Studies and Research in Home Science. S.N.D.T. University, Bombay

AB: The effect of Spirulina supplementation was studied in relation to maternal serum retinol. After assessing the nutritional status, 40 pregnant women (7 month of pregnancy) were randomly allocated either to the experimental (supplemented) group or to the control (un-supplemented) group. The treatment group received 1.4 gm/day of Spirulina, which is equivalent to 1344 mcg of beta-carotene till delivery. The results of the present study suggest that the supplementation with Spirulina is effective for better maternal Vitamin A status and better pregnancy outcome. Percentage increase in the serum retinol levels ranged from 44-46% of the initial value for all the categories.

TI: Effect of Spirulina in the Management of Erosive Oral Lichen Planus - A Preliminary Study (January 1998)

AU: IPE Varghese, Hari S, Joseph P.A and Jayashree. K

AD: Department of Oral Pathology. Government Dental College, Calicut, Kerala.

AB: 30 patients with erosive lichen planus were selected and put on a standard regimen of oral prophylaxis combined with elimination of all local irritants, multivitamins and in addition beta-carotene Spirulina in the form of a suspension was kept in the oral cavity for five to ten minutes and swallowed. This was done three times a day for a period of three months. The results indicated that 76.6% in the sample showed reduction of erythema without much change in the lesion.

SO: Indian Journal of Clinical Practice, Volume 8, No. 8, January 1998.

TI: Effect of Supplementation of Spirulina on Serum betacarotene levels of Pre-school Children (January 1999)

AU: Sindhu V

AD: Dept. of Home Science, Food Science & Nutrition, N.U.P.G. Centre, Nuzvid

AB: Supplementary value of the vitamin A (β -carotene) of spray dried Spirulina (Blue green alga) has been studied to assess its effect on serum β -carotene levels of 30 pre-school children. Majority of the subjects was having deficient levels of serum vitamin A. The test subjects were given a daily supplement of Spirulina (2g) containing about 1600mg of β -carotene for 30 days. The rise in serum β -carotene levels was observed after 30 days.

Irrespective of the initial serum vitamin A levels, all the subjects responded well to the supplementation trial and the final serum concentrations of all subjects reached a range close to normal individual levels given for pre-school children. No adverse effects were observed.

Spirulina, which is at present used as a highly nutritious food, has been proven through this experiment to have considerable potential to satisfy the Vitamin A needs in situations where dietary intake through other sources is inadequate.

TI: Effect of Spirulina as a Nutritional Supplement on Malnourished Children
(December 1999)

AU: Fathima Kauser and Salma Parveen

AD: Dept. of Human Development and Family Studies, Justice Basheer Ahmed Sayeed Women's College, Chennai

AB: The study was carried out on 20 malnourished children in the age group of six years and were divided into two groups, 10 as experimental and 10 as control. The children of experimental group were given nutritional supplement Spirulina (1 gram / day) for a period of three months and the control group was given placebo for the same period. Diet pattern was same for all the 20 subjects.

Results showed that there was an increase in the serum haemoglobin level and serum protein level in the experimental group after the supplementation with Spirulina. There was also a definite change in the academic performance and intelligence level of the children after the supplementation. There was no difference in the serum levels of the control group in the study period of three months. The intelligence test showed a difference in the control group, but it was not significant.

From the above study, it is concluded that the increase in serum levels and change in intelligence and academic performance in the experimental group as compared to control group is definitely due to the effect of Spirulina.

SO: The Ind. J. Nutr.Dietet., (2001), 38, 269-273

TI: Effect of Spirulina (an alga) on alcohol induced Hepatotoxicity – Lipid and lipid profile (April 2000)

Au: Leena Ukil, Santoshi Bandla, Kushik R, Sheela Sasikumar.

Ad: Dept of Biochemistry DG Vaishnav College, Chennai.

Ab: The Hepatoprotective effect of Spirulina has been exhibited by the assay of marker enzymes AsAT and A1AT in serum of albino rats that were fed with alcohol and Spirulina concurrently. A significant decrease in the serum activity of these enzymes was noted in this group of animals from that of pure ethanol fed animals. The assay of lipid peroxides ascertained the fact that hepatocellular damage was indeed due to oxidative stress. Spirulina being an excellent natural source of antioxidant enzymes and vitamins has been very successful in controlling this oxidative damage and hepatoprotective in nature.

TI: Effect of Spirulina supplementation on the Blood Haemoglobin, Lipid profile and lipid peroxidation of the elderly (April 2000)

AU: Mahalakshmi. B

AD: Dept. of Home Science, Queen Mary's College, Chennai

AB: The study was conducted to derive information on the effect of Spirulina supplementation on the blood haemoglobin, lipid profile and lipid peroxidation levels of the elderly. The experimental group were supplemented with Spirulina at 2gm / day for a period of 45 days. The blood parameters were assessed during pre-intervention and post intervention period and after 20 days of supplementation. The results indicated that there was a significant elevation of the blood haemoglobin level after Spirulina supplementation. The lipid profile of the elderly in the experimental group were improved when compared to the control with decrease in serum cholesterol, serum LDL and a marked increase in HDL levels. There was a significant decrease in the lipid peroxidation level in the experimental group. A short period of 20 days was not sufficient to derive information on the withdrawal effect of Spirulina.

TI: Hypocholesterolemic effect of Spirulina on obese women (April 2000)

AU: Mahalakshmi T

AD: Department of Nutrition and Dietetics, Vellalar College for Women, Erode

AB: The study was conducted with a specific objective to estimate the changes in weight, cholesterol and phospholipid levels of obese individuals after Spirulina supplementation. A total of 50 subjects were divided into two groups of 25 each as Experimental and control. The experimental group was supplemented with 2gm/day of Spirulina for a period of 3 months. The conclusions of the study implied that Spirulina administration was effective in treating obese individuals. There was a remarkable decrease in their mean body weights from 68.78 kg to 66.70 kg and there was a significant decrease in mean serum cholesterol levels from 274.02 mg / 100 ml to 224.08 mg / 100 ml.

TI: Effect of Supplementaion of Spirulina on Diabetic and Hyperlipidemic Patients (May 2000)

AU: Sangeethapriya C

AD: Dept. of Home Science, Avinashilingam Institute for Home Science and Higher Education for Women - Deemed University, Coimbatore

AB: The study was conducted to find out the effect of Spirulina supplementation on blood glucose and lipid levels of diabetic and hyperlipidemic patients. 30 diabetic patients with hyper cholesteremia having the random blood sugar level between 150 - 200 mg/dl and cholesterol level above 250 mg/dl were selected for the study and were divided into three groups of 10 each for supplementation of Spirulina. Subjects in group A and B received 4gm and 6gm of Spirulina / day. Group C served as control without any supplementation. The study has revealed that Spirulina plays a very impressive role in lowering the blood sugar and cholesterol levels and improving the lipid profile of individuals suffering from diabetes mellitus with hyperlipidemia. It could also be used as a safe remedy for weight reduction without any harmful side effects.

TI: Pharmacological Evaluation of Hepatoprotective activity of Spirulina in Hepatotoxicity induced by long term treatment of Antitubercular drugs (2000)

AU: Nimbkar S.R; Juvekar A.R;

AD: Pharmaceutical Divn, Dept. of chemical Tech; University of Mumbai (U.D.C.T)

AB: The present study is aimed to investigate whether marine source plants like Spirulina platensis (Cyanobacteria / blue green algae) can protect the liver in rodents from Antitubercular Drugs induced hepatotoxicity. To resemble clinical situation in this experimental work; albino rats were treated with Rifampiin:100 mg / kg; Isoniazid: 50 mg / kg; individually and in combination by oral route for 30 days and 90 days respectively. Spirulina platensis was given simultaneously. Regeneration ability of the hepatocytes was checked. Assessment of hepatic damage was done on the basis of serum biochemical levels of alanine, aspartate aminotransferase, alkaline phosphatase, cholesterol, L.D.H., reduced glutathione (GSH) and plasma levels of the RMP by suitable H.P.L.C observations of the histological changes.

The adverse changes induced by daily administration of anti-TB drugs; were found to be near normal and histological pattern was almost normal in Spirulina platesnis treated rats. These results suggest that Spirulina platensis algal extract has potential hepatotprotective activity.

SO: Phytomedicine, Supplement II (2000), 89

TI: Impact of Spirulina supplementation on anaemic adolescent girls (14-16) years
(May 2000)

AU: Uma K.R

AD: Avinashilingam Deemed University, Coimbatore.

AB: The study was conducted to assess the extent of prevalence of anemia among the adolescent girls and to observe the impact of Spirulina supplementation. 4 grams of Spirulina was supplemented to the experimental groups of 20 subjects for a period of 90 days. Conclusions drawn were that Spirulina improved the biochemical profile of anaemic subjects especially the haemoglobin and serum iron content.

TI: A Comparative Study of The Effect of Supplementation of Spirulina and Iron Tablets on Anaemic Adult Working Women Belonging to Lower Income Group (April 2001)

AU: Vilasini B

AD: Dept. of Home Science, Women's Christian College, Chennai

AB: The present study was designed to determine and compare the efficacy of Spirulina and iron tablets on the haemoglobin levels of anaemic adult women. Twenty-one subjects with blood haemoglobin levels below 13g/dl were selected for the study and were divided into three groups. Subjects in Group I were supplemented with Spirulina capsules at 2gms / day, subjects in Group II were supplemented with iron tablets and those in group III were treated as controls. The study was carried out for a period of 90 days.

The study concludes that both synthetic supplements like iron tablets and natural supplements like Spirulina were effective in increasing the blood haemoglobin levels of anaemic adult women and the effect produced by both the supplements was more or less alike. The results of the study also showed that both iron and Spirulina supplements were effective in the treatment of (marginal) iron deficiency anaemia without causing any side effects.

TI: Effect of Spirulina Supplementation on Vitamin A status During Pregnancy and Lactation (September 2001)

AU: Mridula A. Naik

AD: Dept. of Food Science and Nutrition, Dept. of Postgraduate Studies and Research in Home Science, S.N.D.T. Women's University, Mumbai

AB: A longitudinal study of 133 pregnant and lactating women residing in slum areas of Mumbai suburbs was undertaken to study the effect of supplementing their diets with Spirulina – a cyanobacterium on the vitamin A status. Only 94 of the recruited women exhibited continual participation through out the study. Serum retinol, β -carotene and breast milk retinol were estimated at various stages of pregnancy and lactation by High Performance Liquid Chromatography. The dietary survey revealed insufficient intake of vitamin A and other nutrients, which was reflected in subnormal biochemical profile. The overall baseline values for maternal serum retinol and β -carotene were $22.2 \pm 0.99 \mu\text{g/dl}$ and $67.3 \pm 4.50 \mu\text{g/dl}$ for pregnant women and $23.4 \pm 1.34 \mu\text{g/dl}$ and $73.0 \pm 5.36 \mu\text{g/dl}$ for lactating mothers respectively indicating marginal vitamin A deficiency. Spirulina supplements fulfilled around 100 and 65 percent of β -carotene requirement for Indian pregnant and lactating mothers respectively. Spirulina supplementation from third trimester of pregnancy till forty-five days post-partum (Group I-PL) determined to be the most propitious with 72 and 51 percent increase ($p < 0.01$) in serum retinol and β -carotene concentration respectively from its baseline values. This group also reported the highest retinol concentration in colostrum ($144.2 \pm 8.01 \mu\text{g/dl}$) compared to its unsupplemented counterpart ($98.2 \pm 6.59 \mu\text{g/dl}$). The increased breast milk retinol in women from Group I-PL was maintained at higher level ($68.0 \pm 4.02 \mu\text{g/dl}$) compared to other groups which received Spirulina supplementation either during pregnancy – Group I-P ($43.2 \pm 3.46 \mu\text{g/dl}$) or lactation – Group II ($51.1 \pm 1.99 \mu\text{g/dl}$). Lactating mothers belonging to the Group II that received spirulina supplements for 45 days post-partum showed 20 and 30 percent increase in serum retinol and β -carotene respectively. There was 58 and 46 percent increase in serum retinol and β -carotene concentration respectively in pregnant women belonging to Group I-P. The study also confirmed the bioavailability of β -carotene to the fetus as indicated by the increased ($p < 0.01$) cord blood levels of serum retinol and β -carotene ($27.3 \pm 1.34 \mu\text{g/dl}$ and $50.1 \pm 1.99 \mu\text{g/dl}$ resp.) in the supplemented group, which was not observed in the control group ($15.0 \pm 1.32 \mu\text{g/dl}$ and $36.6 \pm 3.61 \mu\text{g/dl}$ respectively). The study revealed no impact of Spirulina supplementation on fetoplacental function test as measured by maternal serum progesterone levels and serum total proteins. A statistically significant ($p < 0.05$) increase of around 25% in hemoglobin levels was found only in women belonging to the Group I-PL. The study confirms that low-physiological-daily dose of β -carotene from Spirulina is efficacious in improving maternal and neonatal vitamin A status during pregnancy and lactation. Spirulina seems to be the safe, biological food supplement with multi-nutrient admixture that can address the multiple-nutrient deficiencies highly prevalent in Indian women.

TI: Effect of Spirulina supplementation in the management of Bronchial Asthma (2001)

AU: Rhuta Labhe

AD: Dept. of Foods & Nutrition, M.S. University of Baroda, Baroda

AB: The present study was planned with the broad objective of studying the therapeutic role of Spirulina in the treatment of bronchial asthma. The specific objectives were to study the effect of Spirulina supplementation in asthma patients for a period of four months on their, Nutritional and protein status and Lung function.

Twenty-seven patients with mild to moderate degree of asthma were categorized into three groups. Group A: the control group kept only on medication for a period of four months. Group B: the experimental group kept on Spirulina and medication for a period of two months after which Spirulina supplementation was withdrawn for the next two months while medication was continued; Group C: the experimental group kept on only Spirulina supplementation for a period of four months. The patients belonging to Group B and C were provided the capsules at level of 1g/day.

The study has summarized the beneficial role of Spirulina as follows:

- Spirulina supplementation has helped to improve the lung function efficacy and the biochemical parameters i.e. total protein and its fractions in asthmatics. On withdrawal of the supplements a decrease in total proteins and its fractions was observed which suggests the beneficial role of Spirulina as a rich source of nutrients.
- Exclusive Spirulina supplementation to asthmatics (without medication) over a period of four months was found to be as beneficial in the treatment of asthma as when only medication was provided.
- Long term Spirulina supplementation for at least two to four months on daily basis is required for optimal improvement in pulmonary function to asthmatics.

TI: Effect of Supplementation of Spirulina on the Nutritional Status of Pregnant Women (2001)

AU: Mubheena Ghori

AD: Dept. of Nutrition Food Service Management & Dietetics, Islamiah Women's Arts & Science College, Vaniyambadi

AB: The present study was designed to determine the effect of supplementation of Spirulina on the Anthropometric measurements, serum total proteins, albumin / globulin ratio, serum iron and blood haemoglobin levels of pregnant women. The study group was divided into two Experimental and Control with 20 subjects in each group. The subjects in the experimental group were supplemented with Spirulina at 1gm/day for a period of 60 days. The results of the study have shown that there was a significant increase in the body mass index of the subjects after supplementation with Spirulina at 5% level. There was also a slight increase in the serum protein, serum iron level and blood haemoglobin levels. Since the supplementation period was for a very shorter time, there was overall improvement in the nutritional status of the subjects though not significant.

TI: Comparison of Natural Beta-carotene and combination of betacarotene, Vitamin-E,C and Minerals (Revox) in the management of Oral Submucous Fibrosis (2001)

AU: Dr. R. Triveni

AD: Dept. of Oral Medicine & Radiology, Govt. Dental College, Bangalore

AB: Oral submucous fibrosis is a premalignant and crippling of the oral mucosa, which is found predominantly in Indians. A total of 50 patients with submucous fibrosis have received two regimens of treatment. For one group local injections of hydrocortisone (25mg/ml), hyaluronidase (1500IU) alternative weeks with systemic administration of natural betacarotene (spirulina) twice daily was given, another group alsong with local injection combination of betacarotene with other antioxidants (Revox) was given. The patients were followed up for a period of three months, biopsy was done before and after the treatment.

Clinical and histopathological comparison of both the groups showed statistical significant improvement in mouth opening and reduction in burning sensation and thickness of collagen bundles, but early response was seen in group A patients (natural betacarotene). Irrespective of natural betacarotene or Revox, grade III patients responded well compare to grade IV patients.

TI: A Study on the “Anti-stress activity of Spirulina platensis” (Dec 2001)

AU: A.R.Juvekar, Nachankar R.S*, Naik A.D, Mehta V.B, Sathaye S.S.

AD: Pharmaceutical Divn, Dept. of chemical Tech; University of Mumbai (U.D.C.T)

AB: Spirulina platensis, popularly known as Blue Green Algae, the most nutritive food on earth, which is to promote physical health, improve defense mechanisms of the body and enhance longevity. These attributes are similar to the modern concept of adaptogenic agents, which are known to afford protection of human physiological system against diverse stressors. The present study was undertaken to investigate adaptogenic (anti-stress) activity of spirulina platensis.

Effect of spirulina was evaluated against cold stress induced changes in blood glucose levels, blood ascorbic acid levels, adrenal gland weight, adrenal gland ascorbic acid content and histopathology of adrenal glands. Study revealed that Spirulina at doses 100, 200 & 500 mg/kg, (oral) prevented adrenal gland hyperactivity, which was indicated by inhibition of weight variation in adrenal gland, recovery of fall in adrenal gland ascorbic acid content, reduction of rise in blood glucose and blood ascorbic acid levels and normalisation of morphology in histology of adrenal glands.

Spirulina at the doses 200 & 500 mg/kg (oral) is also found to be effective against chronic restraint stress induced increase in blood glucose levels and restraint stress induced immunosuppression.

TI: A Study on the synergistic Effect of Spirulina platensis and Betacarotene on subjects with Rheumatoid Arthritis (April 2002)

AU: Mathy Dharnesh P

AD: Dept. of Home Science, Women's Christian College, Chennai

AB: The study was designed to investigate the synergistic effect of supplementation of Spirulina platensis and beta-carotene in relieving the symptoms of rheumatoid arthritis. 6 subjects were selected and were supplemented with Spirulina at 2gms and Betacarotene at 20mg / day for a period of 30 days. After supplementation, 67% of the subjects expressed relief from pain at joints, 50% experienced reduction in swelling in joints and 67% of the subjects expressed relief from stiffness in joints experienced during the early hours of the day.

The study concludes that the synergistic effect of supplementation of Spirulina platensis and betacarotene resulted in a significant improvement in the subjects self assessment of their condition. But this was not reflected in any of the conventional measurements of the disease activity like erythrocyte sedimentation rate, C-reactive protein and rheumatoid factor, which could be due to the lower dosage of the supplement and a shorter period of study.

TI: Studies on the Antidiabetic Effect of Spirulina with reference to Glucose Metabolism in Albino Mice, Mus musculus (Swiss) (September 2002)

AU: K.F. Farzana¹, S. Ganga² and C.D. Lethi¹

AD: 1. Dept. of Zoology, Holy Cross College, Trichy.
2. Dept. of Zoology, Periyar EVR College, Trichy

AB: Spirulina is reported to have anti-diabetic property, which is attributed to its richness in antioxidants. This experiment was designed to study the same with reference to glucose metabolism in albino mice, *Mus musculus*, which was induced diabetes using Streptozotocin (STZ) and subsequently administered with spirulina. Diabetes was induced in mice using a single high dose of STZ and were force-fed on Spirulina for a period of 60 days. The parameters such as blood glucose and liver glycogen levels were estimated in control, diabetes induced (STZ administered) and experimental (STZ administered mice force fed with spirulina) mice. The results confirmed the anti-diabetic property of Spirulina.

TI: Impact of Spirulina food supplement on premalignant conditions in women

AU: Soffi Cheriyan

AD: Dept. of Home Science, College of Agriculture, Vellayani, Tamil Nadu

AB: The study entitled "Impact of Spirulina food supplement on premalignant conditions in women" was undertaken with an objective to formulate food supplements incorporating spirulina and to assess its impact on premalignant conditions of the oral cavity of selected subjects.

The study was undertaken among two fishermen communities viz., Puthukuruchy and Maryanad in Thiruvananthapuram district.

Clinical assistance from Regional Cancer Centre aided in conducting medical camp to screen 60 fisherwomen in the age group of 40-55 years with oral precancerous symptoms who were habituated with betel quid chewing. The 60 women were divided into experimental and control groups of 30 members each.

Personal profile of the respondents indicated that majority were above 50 years of age, illiterate and engaged in fish vending. Most of the families were of nuclear type and their monthly income ranged between Rs 1000 - 3000.

Dietary surveys revealed an absolutely ill balanced but uniform pattern comprising rice and fish. All the respondents were non-vegetarians and fish was the main non-vegetarian food in their diet. However consumption of vegetables, green leafy vegetables, pulses, egg, milk and milk products were less. The diet of

the women were deficient in all the nutrients except calcium when compared to RDA.

An enquiry on the personal habits revealed that all the women were tobacco chewers with 50% chewing for more than 30 years. Majority of them chewed 5-9 quids a day for duration of 5-10 minutes each time.

Clinical examination of the oral cavity of the respondents indicated that 85% suffered from leukoplakia and the remaining showed submucous fibrosis (SMF) as the precancerous condition.

Majority of the respondents suffered from homogenous type of leukoplakia with size less than 2cm and generalized type of SMF with an interlabial diameter (IDL) between 1-3 cm. Most of them complained an intolerance to spices and a few were prone to problem associated with taste perception and appetite.

Nutritional status revealed that all the women were below the normal height and weight standards. Body mass index of the women showed that 45% suffered from energy deficiency. Among 86.7%, the blood haemoglobin and among 40% the serum betacarotene levels were below the acceptable values.

For the feeding trial six spirulina based supplements incorporating one gram spray dried spirulina per portion were standardized in the laboratory. The six supplements were lemon-ginger squash, rava laddu, rice balls, bengal gram balls, coconut chutney powder and green gram chutney powder. Three highly preferred supplements (lemon-ginger squash, rava laddu and rice balls) were selected for the feeding trial of six months duration.

Assessment of the impact of spirulina supplementation on the precancerous condition of the oral cavity revealed that among the 86.7% suffering from leukoplakia, there was complete remission among 13.4% and regression was seen in 14%. Meanwhile in the control group the condition was found to aggravate. It was also noted that in the experimental group the number of subjects having ulcerated type (moderate) of leukoplakia had been reduced as they were shifted to the mild form (homogenous type). With regard to submucous fibrosis (SMF) among the 13.3% cases, there was regression in 10%. Almost all the subjects in the experimental group regained their tolerance to spices, which can be considered as a positive impact of feeding spirulina over a period of six months.

Changes in serum betacarotene levels of the respondents in the experimental group revealed that there was an average increase of 0.385 mcg/ml after six months of supplementation. At the same time a decrease was noted in the betacarotene level of the control women. There was an average increase of 1.17g/dl in the haemoglobin level of the experimental group as a result of spirulina supplementation.

Supplementary feeding with spirulina also indicated improvement in general appetite and taste perception among the experimental women.

Nutrition and health education imparted to the experimental women revealed an excellent gain in knowledge from the post-test scores.

Due to the education programme 23.3% respondents stopped the habit of chewing and 56.7% excluded tobacco while chewing. Their oral hygiene could also be improved.

Acceptable spirulina food supplements could be formulated and the present trial evidenced that these supplements imposed a positive role in reversing the precancerous symptoms of the oral cavity in fisher women.

TI: Antioxidant and hypolipidemic effects of Spirulina and natural carotenoids in broiler chicken.

AU: Reddy, B. S., Yuvaraj, N., Babitha, V., Ramnath, V., Philomina, P. T., Sabu, M. C.

AD: Department of Physiology, College of Veterinary and Animal Sciences, Mannuthy - 680 651, Thrissur, Kerala, India.

SO: Indian Veterinary Journal, 2004 (Vol. 81) (No. 4) 383-386

AB: A total of 40 one-day-old broiler chicks were studied. Supplementing Spirulina with and without natural carotenoids resulted in significantly ($P < 0.01$) higher activities of superoxide dismutase and catalase in the erythrocytes with a concomitant increase in reduced tripeptide glutathione content. Also, Spirulina and natural carotenoids supplementation resulted in decreased levels of total serum lipids and cholesterol.

TI: In Vitro Study On The Antiviral Properties Of Arthrospira Platensis (Spirulina Platensis) And Four Traditional Medicinal Plants For Human Herpes Virus Type - 2 (April 2006)

AU: R. Senthil Kumar

AD: Presidency College, Chennai

AB: Aim of the Study:

Herpes Simplex Virus (HSV)

- ❖ Causes life threatening diseases especially in immune compromised patients
- ❖ Persists in host for life time after primary infection
- ❖ Due to wide spread use of drug (acyclovir), organism gain resistance
- ❖ This indicates to search for new anti-viral agents to treat infections of HSV

- ❖ The present study aims to test the aqueous extract of Spirulina and four traditional medicinal plants (Lyophilized)

Discussion:

- ❖ complete inhibition of virus by lyophilized Pongamia extract at 31.25µg/ml conforms the results of earlier work on seitz filtered extract at 20µg/ml Elanchezhiyan et al (1993)
- ❖ Hayashi K, Hayashi T, Kojima I.(1996) had reported the anti HSV-1 activity in hot water infusion of spirulina platensis the result on anti HSV – 2 activity is a first report in aqueous extract of spirulina platensis at 31.25µg/ml
- ❖ The lyophilized extract of Azardirachta indica extract was tried against HSV – 2, its efficacy has been brought to light for the first time at a concentration of 7.81µg/ml.
- ❖ Present study reveal no reports on anti HSV – 2 activity against Terminale chebula and Coleus ambonicus.

Conclusion:

- ❖ lyophilized Pongamia seed extract was found to inhibit HSV – 2 and its efficacy was similar to MIC of Acyclovir (31.25µg/ml)
- ❖ aqueous extract of spirulina platensis was completely inhibitory at a 7.81µg/ml concentration is much lower than acyclovir inhibitory concentration
- ❖ lyophilized extract of Azardirachta indica was also found to inhibit HSV – 2 at 7.81 µg/ml, which is also lower than Acyclovir inhibitory concentration