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Original Article

Spirulina as food supplement is effective in arsenicosis

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Abstract

Background Spirulina, a blue green vegetable algae, has been used as a significant food source by millions of all ages. It seems to be an ideal therapeutic supplement to strengthen immune system and fight problems associated with disease complex.

Objectives To determine the benefit of spirulina in diet of patients with arsenicosis.

Patients and method A total number of 40 patients affected with arsenicosis were selected and clinical examination prior to feeding trials was done. They were placed under two groups. In one group spirulina powder was fed to 20 arsenicosis patients and in another group comprising the same number of patients was under placebo treatment. In post-fed groups patients were subjected to clinical examined for noticing any changes in improvement after every 30 days for six months. Nutritional status of patients was assessed using MAC (mid arm circumference) value.

Results The interrelatedness between improvement respondents following spirulina intake in respect of age, sex, nutrition and social condition of patients exposed to arsenic contaminated water has been revealed. The sex-wise respondents demonstrated that about 62% females showed improvement in comparison to 58.3% males. The spirulina intake caused more improvements in patients of age group 15-35 years (66.66%) than patients of 35 to 55 years (50%). The impact of spirulina improvement represents a different phenomenon on the vulnerability of social taboos. It occurred 71.42% in middle class, while in poor class this was 69.29%. The greatly vulnerable poverty related malnourished arsenicosis patients responded to improvement equally as attained by well nourished patients. The overall response revealed that 60% patients showed considerable improvement with spirulina treatment and the result is found statistically highly significant (x^2 =8.64 at P< 0.01). In most respondents the improvement gradually occurred and required about 6months to have good improvement. The patients who followed doctors' advice and avoided drinking arsenic contaminated and used surface water recovered early. It is clearly evidenced that spirulina could play consistent role in the treatment of arsenicosis patients.

Conclusion The study evidenced that arsenic which induces cellular toxicity could be prevented by treatment with known supportive treatment with spirulina. The intake has proved to offer health benefits for problems of arsenicosis. It is advocated that spirulina should be made available and blended into fruit or milk drinks or added to recipes to arsenicosis patients to boost nutritional value and provide health and energy.

Key words
Spirulina, arsenicosis management

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Introduction

The vibration 'arsenic engulfing Bangladesh' has been recently highlighted in the report of United Nations University in Tokyo and the Dhaka based Earth Identity Project consistently targeted to recognize economic impacts affecting agriculture and other related industries, water management, public health and overall national economy.[1-4] Both national and expatriate researchers expressed predictions regarding toxicity in humans. Bangladesh may emerge as the most vulnerable country in the world.5,6 According to the World Health Organization some 70 million are at risk of consuming arsenic contaminated water.7 Since drinking arsenic contaminated water causes chronic toxicity, there is therefore a crying need for development of supportive treatment service. Drugs used for chelating arsenic and use of antioxidants and salicylic acid for arresting the progression of symptoms have shown some success. Recently *Spirulina*, a blue-green algae developed by Bangladesh and French scientists has been found to have very good effects on people suffering from arsenicosis. Leading dermatologists have unanimously recommended spirulina to treat arsenic patients.[8,9,10,11]

The present study has therefore been undertaken to assess the viability of Spirulina in the diet program, supportive treatment and nutritional improvement. The chief objective is to confirm whether arsenic patients given spirulina show significant improvement and exhibit potential health benefits.

Patients and methods

Type of study The type of study undertaken was based upon randomized sampling and observational double-blind trial

Duration of study Six months

Study population A total number of 40 patients with suspected arsenicosis were selected. They were placed under two groups – each group comprising the same number of patients.

Patients' selection Patients who attended the arsenic clinic, Department of Dermatology and Venereology of Bangabandhu Sheikh Mujib Medical University, with typical clinical manifestation of chronic arsenicosis as per standard instruction and recommendation.

Inclusion criteria

1. Patients who had given verbal consents and were willing to comply with this study process.
2. Arsenicosis patients of both sex groups between 15 to 55 years.
3. Patients who did not receive any treatment (either systemic or topical) prior to one month of the study.
4. Patients having history of consumption of arsenic contaminated water.
5. Patients who had hyperpigmentation or leukomelanosis in the trunk and extremities, keratosis in palms and soles and other typical signs and symptoms of chronic arsenicosis

Exclusion criteria

1. Patients who refused to be included in the study.

2. Patients having age below 15 years and above 55 years of age.
3. Pregnant women and lactating mothers.
4. Arsenicosis with complications and malignancy.
5. Patients who are to take regularly antibiotics or steroids for other major systemic illnesses.

Spirulina/placebo administration Spirulina samples fed to 20 arsenicosis patients were given in the form of 10gm powder, dissolved in water and given daily in divided doses. Placebo likewise of spirulina was fed to other 20 arsenicosis patients.

Response to treatment Clinical examination of arsenic affected patients prior to feeding trials was recorded. In post-fed group of both placebo and spirulina treated patients were clinical examined for any improvement that occurred after every 30 days till six months. Nutritional status of patients was assessed using mid arm circumference (MAC) value.

Statistical analysis

Statistical analysis was done in which clinical scores were evaluated. Frequency distribution, Chi-square test, Yates's correction and other software like Microsoft Excel, MS chart were employed for determining significant correlation between observations.

Result

Table 1 showed the impact of responses of patients to spirulina among female personnel. The sex-wise distribution of respondents to the treatment of arsenicosis with spirulina demonstrated that slightly more than 62% females showed improvement, while in males the respondents were 58.33%. It was also evident that the spirulina intake caused more improvement in patients of age group 15 to 35 years (66.66%) than patients of age group 35 to 55 years (50%). It was interesting to note that the impact of arsenicosis and vulnerability to social taboos represent a different phenomenon. The spirulina that occurred in middle class people was 71.42%, while in poor class this was 69.29%. The great vulnerable poverty related to malnourished 60% arsenicosis patients responded to treatments equally as responded by well nourished patients.

The overall improvement and response revealed that 60% showed considerable improvement with spirulina treatment. A strong association between the spirulina intake and improvement status among patients with arsenicosis was noticed i.e. spirulina intake certainly caused improvement. (X^2 = 8.64 at p<0.01). The response of arsenicosis patients to both treatments (spirulina and placebo), although, was very slow, but the spirulina intake promoted earlier improvement. The data are presented in **Table 2** and shown in graph 1. In a few patients this was first noticed after one month but in most respondents the improvement gradually occurred and took about 6 months to have considerably good improvement. Thus spirulina gave significant health benefits (**Figures 1-4**). It was further interesting to notice that the patients who avoided drinking arsenic contaminated water and used surface water were the ones to recover early.

Table 1 Percentage distribution of patients responded to spirulina and placebo treatments.

Nature of treatment	*Frequency distribution percentage of respondents of different sex, age, nutritional stats and class*							
	Sex		*Age (years)*		*Nutritional status*		*Cass*	
	Male	*Female*	*25-35*	*36-55*	*Well-nourished*	*Malnourished*	*Poor*	*Middle*
Spiruina	58.33	62.50	66.66	50.00	60.00	60.00	69.29	71.42
Placebo	21.48	-	18.18	11.11	50.00	11.11	14.28	16.66

Table 2 Frequency distribution of arsenicosis respondents of spirulina and placebo intake showing different degrees of improvement.

Nature of treatment	*Percentages among respondents showing degrees of improvement after*									
	30 days	*60 days*		*90 days*		*120 days*		*150 days*		*180 days*	
Spirulina	-	+	10%	+	5%	+++	30%	+++	60%	+++	90%
		-	90%	++	15%	++	10%	++	15%	++	10%
				-	80%	-	60%	-	25%	-	0%
Placebo	-	-		+	10%	+	10%	+	30%	+	10%
				-	90%	++	10%	++	20%	++	50%
						-	90%	-	50%	-	40%

Degrees of improvement: +++, good; ++, moderate; +, slight noticeable; -, none

Figure 1 Pretreatment view of chest.

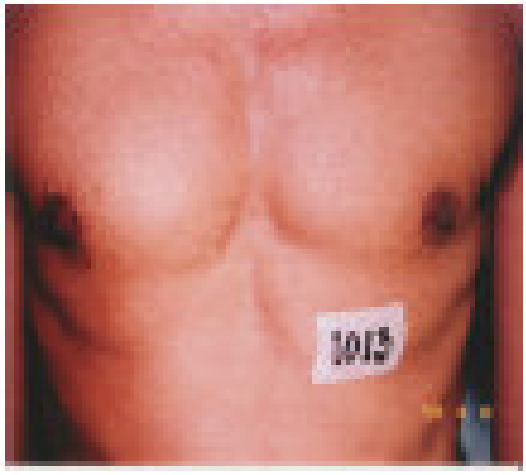

Figure 2 Posttreatment view.

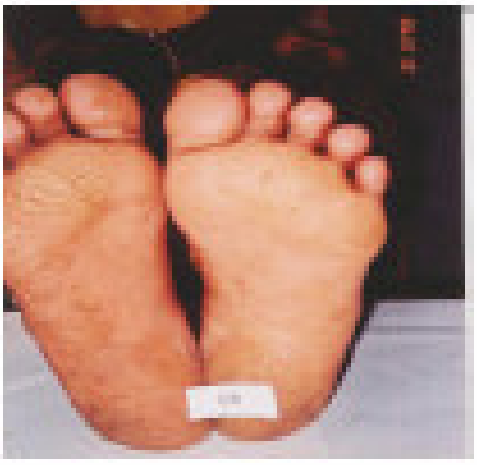

Figure 3 Pretreatment view of soles.

Figure 4 Posttreatment view.

Discussion

Extensive pollution of the major drinking water source underground tube well water with high levels of arsenic has recently been recognized as an important public health hazard.[12] As a result millions of people have been exposed to the risk of biomedical, environmental and socio-economic impact in the society, and the incidence of morbidity and mortality associated with arsenicosis calamity is increasing day by day.[1,13,14] Bangladesh researchers are seeking to find out new modalities of treatment.[15] The present study evaluates and validates the therapeutic efficacy and health benefit of the ß-carotene containing spirulina in the treatment of chronic arsenicosis victims.

Spirulina is a microscopic spiral-shaped, blue-green vegetable alga that has been used as a significant food source for centuries. It is the nature's richest whole-food source of phytocyanin, an immune stimulant.[16,17,18] Spirulina green powder can be blended into fruit and milk drinks or added to recipes to boost nutritional value. The study evidenced that irrespective of age, sex, nutritional status and socio-economic category the spirulina caused about 60 to 70% improvement among individuals with chronic arsenicosis. Guha Mazumder[19] experimenting on arsenicosis earlier found that the high protein diet could play role in the alleviation of symptoms of arsenic poisoning, because it enhanced the excretion of arsenic in urine by increasing methylation in the body. Many researchers demonstrated spirulina beneficial in promoting cell growth and repairing the damage of liver and kidney tissue.[20] It is revealed from the present study that arsenicosis patients belonging to older age group, 36-55 years improved a little more than the younger patients of the group 15-35 years in the spirulina intake population. The explanation is due to fact that older people were more careful and responsible to take medicine and followed the health care instruction appropriately than the younger. It may be speculated that in the older age group the spirulina intake could have enhanced more biotransformation of inorganic arsenic to less toxic organic arsenic, by rapid elimination of arsenic from the body and preventing tissue deposition and by increasing the ability of body's antioxidative defensive system.[12,21,22]

The therapeutic efficacy of spirulina in the treatment of arsenicosis suggested that malnourished patients showed marked improvement of their physical weakness and felt better after treatment. Different studies[9,20,23,24] demonstrated similar improvement in reducing skin manifestations of arsenicosis patients who received spirulina. Recently the leading dermatologists of the country advocated for the beneficial effect of spirulina.[25,26,27]

Although most of the arsenic affected victims are males of low income group, females are found to have more social awareness about arsenic contamination of water.[28,29] This awareness among females amounts to more motivation for avoiding the source of arsenic contaminated tube well water. The women after receiving treatment with spirulina used surface water for washing, cooking and other domestic works.

The *in vitro* study by Chowdhury *et al.*[30] has clearly shown that spirulina could act as a chelating agent when arsenic containing

urine is passed through a column chromatography containing spirulina. Momtaj and Hussein[23] in a hospital-based clinical trial with spirulina demonstrated improvement in skin manifestations.[9] Since spirulina intake has proved to offer health benefits for problems of arsenicosis, the present study also advocates that spirulina should be made available and blended into fruit or milk drinks or added to recipes to boost nutritional value In India spirulina known as "Spiru-Om" is well accepted by the children. It may be given in extruded noodles, sweetened with sugar to preserve the beta-carotene.[26]

Conclusion

It may therefore be concluded that the use of spirulina could reverse the conditions and restore the patients to normal life. However, long-term extensive studies are imperative to establish confidently the viability of spirulina for the treatment of arsenicosis. The mechanism of action of spirulina in the treatment and management of chronic arsenicosis if could be known in greater magnitude and could be driven at for setting up its potential benefit, then the present arsenicosis crisis in the form of calamity would be minimized in the near future.

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