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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 people 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 the same number of patients was given placebo treatment. In post-fed groups patients were subjected to clinical examination for any changes after every 30 days for six months. Nutritional status of patients was assessed using mid arm circumference (MAC) value.

Results The relationship between improvement respondents following spirulina intake with respect to age, sex, nutrition and social condition of patients exposed to arsenic contaminated water was revealed. About 62% females showed improvement in comparison to 58.3% males. Spirulina intake caused more improvement in patients of age group 15-35 years (66.66%) than patients of 35 to 55 years (50%). Improvement occurred in 71.42% in middle class, while in poor class this was 69.29%. Malnourished arsenicosis patients showed equal improvement as well-nourished patients. The overall response revealed that 60% patients showed considerable improvement with spirulina treatment and the result was statistically significant (X^2=8.64 at p<0.01). In most cases the improvement occurred gradually and required about 6 months to become visible. The patients who followed doctors' advice and avoided drinking arsenic contaminated water and used surface water recovered early.

Conclusion The study evidenced that arsenic-induced toxicity could be prevented by treatment with spirulina. The intake proved to offer health benefits for arsenicosis. It is advocated that spirulina should be made available and blended into fruit or milk drinks or added to recipes for arsenicosis patients to boost nutrition and provide health and energy.

Key words
Spirulina, arsenicosis management.

Introduction

The notion '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 the economic impacts affecting agriculture and other related industries, water management, public health and overall national economy.[1-4] Both national and expatriate researchers

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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]

The present study was therefore undertaken to assess the viability of spirulina in the diet program, supportive treatment and nutritional improvement. The chief objective was 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 manifestations of chronic arsenicosis as per standard instruction and recommendation. Considering the endemicity of disease in the region, only clinical criteria were used for diagnosis.

Inclusion criteria

1. Patients who had given verbal consent 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 on 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 with 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 were on 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 was fed to other 20 arsenicosis patients.

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

Statistical analysis

All clinical data were computed using Microsoft Excel program for frequency distribution and calculating ratios. Chi-square test with Yates's correction was used for comparing the two groups and determining correlation between observations.

Result

Table 1 shows response of patients to spirulina and placebo with respect to sex, age, nutritional status and socioeconomic class. The sex-wise distribution of respondents to the treatment with spirulina demonstrated that 62.5% females showed improvement in contrast to 58.33% males. 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. Response to spirulina in middle class patients was 71.42%, while in poor class this was 69.29%. Malnourished patients responded to treatment equally well as well-nourished patients i.e. 60% each.

The overall improvement and response revealed that 60% showed considerable improvement with spirulina treatment (X^2=8.64, 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**. 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 peak. Thus spirulina gave significant health benefits (**Figures 1-4**). It was interesting to notice that the patients who avoided drinking arsenic contaminated water and used surface water were the ones to recover early.

Discussion

Extensive pollution of the major drinking water source i.e. underground tube well water, with high levels of arsenic has recently been recognized as an important public health hazard.[11] Millions of people have been exposed to the risk and the incidence of morbidity and mortality associated with arsenicosis calamity is increasing day by day.[1,12,13] Bangladesh researchers are seeking to find out new modalities of treatment.[14] The present study evaluates and validates the therapeutic efficacy and health benefit of ß-carotene containing spirulina in the treatment of chronic arsenicosis victims.

Spirulina is a microscopic spiral-shaped, blue- green vegetable algae that has been

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

Treatment groups	*Response to spirulina and placebo with respect to sex, age, nutritional stats and class*							
	Sex		*Age (years)*		*Nutritional status*		*Cass*	
	Male	*Female*	*25-35*	*36-55*	*Well-nourished*	*Malnourished*	*Poor*	*Middle*
Spirulina	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 Improvement in two groups with follow-up.

Treatment groups	*Degree of improvement at follow up visits*											
	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

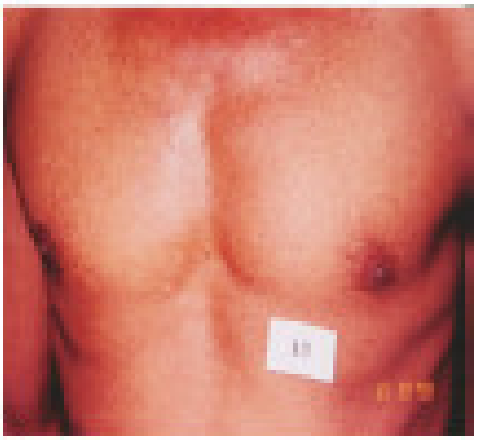

Figure 1 Pretreatment view of chest showing rain drop hyperpigmentation.

Figure 2 Posttreatment view.

Figure 3 Pretreatment hyperkeratotic lesions on soles.

Figure 4 Posttreatment view.

used as a significant food source for centuries. It is the nature's richest whole-food source of phytocyanin, an immune stimulant.[15,16,17] 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[18] experimenting on arsenicosis earlier found that high protein diet could play a 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 to be beneficial in promoting cell growth and repairing the damage of liver and kidney tissue.[19]

The present study revealed that the younger patients (15-35 years) improved more than the older arsenicosis patients (36-55 years). It could be due to better compliance in younger patients than in older ones. Another explanation is that in younger patients the spirulina could enhance biotransformation of inorganic arsenic to less toxic organic arsenic, by rapid elimination of arsenic from the body and preventing tissue deposition or by augmenting body's antioxidative defensive system.[11,20,21]

Malnourished patients showed marked improvement of their physical weakness and felt better after treatment. Different studies[9,19,22,23] demonstrated similar improvement in reducing skin manifestations of arsenicosis. Recently, leading dermatologists of the country advocated the beneficial effect of spirulina.[24,25,26]

Although most of the arsenic affected victims are males of low income group, females were found to be more aware about arsenic contamination of water.[27,28] This awareness led to avoiding the source of arsenic-contaminated tube well water. These women after receiving treatment with spirulina used surface water for washing, cooking and other domestic works.

The *in vitro* study by Chowdhury *et al.*[29] 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[22] in a hospital-based clinical trial with spirulina demonstrated improvement in skin manifestations.[9] The present study also advocates that spirulina should be made available and blended into fruit or milk drinks or added to recipes to boost their 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 ß-carotene.[25]

Conclusion

It is concluded that the use of spirulina could reverse the changes of arsenicosis 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. It is hoped that the present arsenicosis crisis would be minimized in the near future.

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