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Nutritional Value of Cyanobacteria Arthrospira Indica

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ABSTRACT

Microalgae generally grow autotrophic ally and are ubiquitous in nature. They represent a major untapped resource of genetic potential for valuable bioactive agents and fine biochemical. This proven ability of microalgae to produce these compounds places these microorganisms in the biotechnological spotlight for applications and commercialization as in the pharmaceutical industry. The production of micro algal metabolites, which stimulate defense mechanisms in the human body, has spurred intense study of the application of micro algal biomass and products thereof in various food preparations, pharmacological and medical products. There is, therefore, a huge scope for further study of the identified algal compounds and their activities in the treatment and prevention of various diseases. Pharmaceutically valuable products from microalgae and its industrial commercialization today is still in its infancy and can be seen as a gateway to a multibillion dollar industry.

Key Words: Microalgae, Applications, Medicine

INTRODUCTION

The world population, which accounted eight billion in 2011, and is estimated to touch upto nine billion by 2050. With over increasing population, the need for resources is also increasing, which in turn increases our dependency on agricultural crops .In order to provide food that times, the annual production of cereals needs a jump of about 50% i.e. from2.1 billion tons/ year .to 3 billion tons /year However, even after over-utilization of agricultural crops for food, chemicals, and biofuels, the need of growing population has not been fulfilled. Taking into account the challenges, which are rising due to mismanagement in food and energy resources, a question arises: where we will land in the upcoming future? That is why the necessity of addressing these challenges has raised.

To achieve future food demands, cyanobacteria and otheralgae have presented themselves as the most promising candidates because they are endowed with thecomplex photosynthetic system, and can absorb a broad wavelength of the solar radiation for channelizing this energy into other chemicals. Another aspect which makes them more suitable is that they do not require arable lands for their growth. They can grow on residual nutrients with high productivity along with an enrichment in lipids (60–65% of dry weight), proteins, total fibers (33–50% higher than higher plants) and carbohydrates, which could cut out the high prices of food obtained from agriculture-based industries (3,4,5).

Cyanobacteria and algae are the immense sources of several metabolites such as alkaloids, carbohydrates, flavanoids, pigments, phenols, saponins, steroids, tannins, terpenes, and vitamins which can be utilized in biotechnology and industrial fields. Some metabolites such as cyanotoxins are reported to have toxic effects, but they can be exploited for their allelochemical nature and can be introduced in agricultural fields as pesticides i.e., algicides, fungicides, weedicides, and herbicides. Apart from the toxic metabolite production, they are also enriched with several pharmacologically active compounds that have antibacterial, anticancerous, antifunal, antiplasmodial, antiviral, and immunosuppressive activities, which have aggravated interest in cyanobacteria nutritional experiments clearly indicate the high nutritional value of microalgae in the diet of pigs, cows, sheep, chicken and other domestic animals, as well as many aquatic organisms (in aquaculture). In most studies to date, algae are not considered as an essential feed source due to the need of large amounts of biomass, but even when used in small amounts, algae have been credited with improving the immune system, lipid metabolism, gut function, stress resistance, as well as increasing of appetite, weight, number of eggs, reproductive performance or reducing cholesterol levels (5).

A large number of nutritional and toxicological evaluations demonstrated the suitability of algae biomass as a valuable feed supplement or a substitute for conventional protein sources (soybean meal, fish meal, etc.). Research results indicate the possibility of new farming methods in order to improve the quality of meat and eggs, and it may also be considered in order to lower the cholesterol level in blood and egg yolks. Large world's chicken and rabbit farms have excellent results using microalgae in the diet of these animals, so that their use in many animal farms is increasing worldwide. According to several companies have shifted their focus from algal biodiesel production to high value products such as ω-3 and protein rich biomass as animal feed.

Microalgae are a source of food and a dietary supplement in the commercial cultivation of aquatic organisms. Their importance in aquaculture is not surprising considering the fact that they are natural food for these organisms. Algal cells contain relatively large amount of protein (5,6) and small amount of structural constituents. Using some species of microalgae in the diet of fish try to lowers their price to 50%, and in order to obtain a higher nutritional value of microalgal biomass, it is often used a combination of two or more species . Genus Spirulina is widely used as a feed additive in the Japanese fish farming industry, with inclusionlevels0.5-2.5. Sturgeon fed with Spirulina-based feed even outperformed those receiving fish meal-based diets (10)Recently, attention has been drawnto the microalgae Isochrysis galbana and Diacronema vlkianum due to their ability to produce long chain PUFA, mainly EPA and also DHA that are accumulated as oil droplet.

In the present study Arthrospira indica a blue green prokaryotic alga had been used for nutritional studies.

MATERIALS AND METHODS

Pure cultures of alga Arthrospira indica in CFTRI medium were used for laboratory and improvised CFTRI medium had been used for mass cultivation . Cultures were shaken manually till the end of the experiment to enhance the growth of alga. Initially plastic tubs were used for mass cultivation of alga,and harvested on 15th day by filtering through muslin cloth and washed several times before drying. This dried algal mass was used for nutritional studies
White female albino rats were taken for feeding experiments. Rats were administered with 25mg alga /rat/day for a period of one month. Rats were taken into two groups one set of five rats as controlled and another of five as treated rats . All the rats were weighed on every fifth day.At the end of experiments animals were autopsied under ether anesthesia. The blood of animals was collected by cardiac puncture and separated in 2 forms i.e. Separated in two forms i.e. is coagulated and uncoagulated. After this vital organs i.e. heart, liver, kidney, lungs and reproductive organs i.e. ovary, uterus, were separated on ice bath and cleared from adherent tissues and their weight were recorded.

The uncoagulated blood was used for hemoglobin estimation whereas coagulated one was used for remaining biochemical analysis of blood, serum proteins, urea nitrogen, albumin, globulin ratio, Very Low Density Lipids (VLDL), Low Density Lipids (LDL), High Density Lipids (HDL), triglycerides, serum glutamic phyruvate transaminase (SGPT).

Table-1 : Increase In Body And Organ Weights (gms) Of Female Rats After Administration With A. indica 25 mg / Rat / Day For 30 Days

DAY	Body Weigth	Heart	Liver	Lungs	Kidney	Ovary	Uterus
CONTROL	3.3	0.502	3.88	0.387	0.588	0.074	0.14
TREATED	14	0.614	5.417	0.541	0.647	0.119	0.164

Table-2: Biochemical Studies Of Organelles After Administration Of 25 Mg Alga / Rat / Day

	% Protein				
	Heart	**Liver**	**Kidney**	**Ovary**	**Uterus**
CONTROL	12.16	13.95	19.12	7.8	11.9
TREATED	13.59	17.44	19.52	11.8	13.8
	% Cholesterol				
	Heart	**Liver**	**Kidney**	**Ovary**	**Uterus**
CONTROL	2.7	3.7	4.75	5.06	5.46
TREATED	2.35	2.85	2.88	6.87	4.2
	% Glycogen				
		Liver			
CONTROL		0.37			
TREATED		0.384			

The weight course which was taken at interval of 5 days has tabulated it had clearly showed that body weight of controlled set of rats was suppressed by weight of rats feed with additional diet of 25 mg of Arthrospira .(table-1) The average gain in body weight was 11.3 gms. In treated set against unfed controlled-set, where it was just 6.0 gms. The growth was comparatively slow in controlled set, against algae fed animals

The gain in body weight also went hand in hand with gain in individual organs. The average weight of heart, liver, lungs and kidneys in algae fed animals was 0.614, 5.417, 0.541, 0.647 gms. against 0.502, 0.388, 0.387, 0.647 gms in unfed rats (Table 1). Besides the increase in the weight of vital organs, a marked increase in the weight of reproductive organs i.e. ovary and uterus was also recorded. It weighed 0.119 and 0.163 gm in alga treated rat, against 0.074 and 0.140 gm in their unfed counterparts. All these organs gain weight. But in permissible limit.

The comparative blood-biochemistry of rats fed with Arthrospira, against their unfed controls rendered interesting results pertaining to proteins, albumin, globulin and their ratio, hemoglobin, urea, nitrogen, SGOT, SGPT, billirubins, cholesterol, triglycerides, VLDL, LDL, HDL, glucose and electrolytes. The total protein of the blood serum in treated rats was 8.7 g/dl against 8.2 g/dl in unfed controls. The average values of albumin and globulin were 3.3 and 5.4 g/dl, against 2.75 and 5.5 g/dl in controls.

Their ratio being 0.61 and 0.50 in treated and untreated animals. Similarly, the average hemoglobin content was 14.1 g/dl against 13.3 g/dl in controlled set . The average value of urea nitrogen was 26.8 and 27.1 mg/dl in treated and untreated rat's blood respectively. Glucose was 108 mg/dl in controls against 112 mg/dl in alga-fed rats. A marked reduction in SGOT and SGPT was noticed in Arthrospira fed animals. SGOT was 265 u/l and 320 u/l and SGPT was 52 u/l and 109 u/l respectively in experimental and controlled-set, D-Bilirubin were registered 0.05 mg/dl and T-bilirubin were registered 0.80 mg/dl in treated set against 0.565 mg/dl and 0.86 mg/dl in unfed animals. .

The cholesterol and triglycerides were registered to be low in alga fed rats, The average value of 72 mg/dl in controlled set got reduced to 66mg/dl in treated set . Similarly triglycerides were reported to be 47 mg/dl in unfed blood serum against 50 mg/dl in alga-fed animals. Likewise decreased value of VLDL and LDL i.e. 10.0 and 45 mg/dl in controlled set and 9.0 and 39.0 mg/dl in treated set respectively were observed. However, the HDL level was almost same i.e. 18 mg/dl in treated and 17 mg/dl in untreated sample.

As far as haemoglobin was concerned it was enhanced in algal treated ones. At 25 mg does, it was more by 0.8 g/dl whereas at 50 mg dose, it was more by 2.0 g/dl in female and 3.3 g/dl in males.

Blood serum biochemically revealed enhanced amounts of proteins and albumins. Whereas globulin was reduced. This in turn enhanced the albumin, globulin ratio. This has been a beneficial impact of alga in maintaining normal status of the tissues of the liver and other cells. The level of urea nitrogen also gets reduced in both the experiments. A significant decrease in the total bilirubin and D-bilirubin was noted in male as well as in female rats. The decrease in bilirubins is known to cause abnormalities in liver. Thus the Arthrospira indica can be incorporated to improve patients suffering from hepatitis or jaundice. Besides the level of cholesterol, triglycerides, VLDL, LDL, SGOT, SGPT also gets reduced in blood serum of treated rats against their unfed controls in the experiment.

Besides the blood and blood serum analysis, tissue biochemistry has also yielded intresting results. Protein content was 13.59, 17.44, 19.52, 11.8. 13.8% respectively in heart, liver, kidney, ovary and uterus in alga-fed animals against 12.16, 13.95, 19.12, 7.8, 11.9 % in unfed rats (Table 2). Cholesterol content of animals administered with alga yielded 2.35, 2.85, 3.88, 6.75, 5.87, 4.2 % respectively in heart, liver, kidney, adrenal, ovary and uterus of treated rats in contrast to 2.7, 3.7, 4.75, 7.2, 5.06, 5.46% in controlled rats (Table2).

Enhanced values of glycogen i.e. 0.37 mg/gm in liver of controlled animals 0.384 mg/gm in treated animals were estimated (Table 2).

CONCLUSIONS

Considering the fact that microalgae are poorly explored, their cultivation can be independent of external conditions, more efficient convert solar energy and in comparison with higher plants, they do not require fertile soil, produce a wide range of substances, can be used for different applications and some species reproduce very fast, so that these organisms present a really remarkable source of biomass and certain compounds (10). An advantage of particular importance is the possibility to regulate and define metabolism and the production of the target compound by manipulating the cultivation conditions. While amixture of different species or combinations with other food opens up many possibilities, their use in feed can also solve the issue of using certain plants which are, in the first place, used as a food. Also, they can lower the price of animal feeding

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