Biochemistry & Pharmacology: Open Access

Adak, Biochem Pharmacol (Los Angel) 2014, 3:6
DOI: 10.4172/2167-0501.1000e171

Editorial Open Access

Spirulina and its Nutritional Importance: A Possible Approach for Development of Functional Food

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Food is a basic nutritional requirement, but as a result of substandard diet, approximately 925 million people are suffering from under nutrition in different regions of the world. Consequently a larger population in the underdeveloped world fall prey to the protein deficiency. On the other hand, busy lifestyles fragmented eating habits, change in consumer perception towards physical appearance, dietary choices and more importantly demanding an ideal wholesome food that address many diet and health related issues. Thus there is a need for developing a value added nutritional food supplement of natural origin.

To a great extent of scientific evidence has shown that there is a well-built positive relationship between consumed foods and human health, and that there is a beneficial correlation between the function of various food components to the treatment and prevention of specific illnesses. This will leads to the more focused interest of consumer on a diet with the capability to promote good health and to extend a healthy life span, which strongly prop up the newer exercise for development of functional foods. According to an international definition, Functional foods should be "a food similar in appearance to a conventional food (beverage, food matrix), consumed as part of the usual diet which contains biologically active components with demonstrated physiological benefits and offers the potential of reducing the risk of chronic disease beyond basic nutritional functions" [1]. Consumers today are more health conscious and more interested in health related products than ever before. This behaviour has led to the production of natural products such as the commercial production of microalgae. Of all the blue-green algaes, *Spirulina* has received the greatest interest [2]. In an effort to support the eradication of malnutrition by a food fortification approach through *Spirulina*, several international initiatives have been undertaken. This editorial focused on nutritional importance of *Spirulina*, to exploit it significantly in functional food preparation intended for human health.

Among the cyanobacteria, *Spirulina* (*Arthrospira*) termed as 'magic agent' due to its utility as food, feed, cosmetics and anticancer agent. However, interest aroused by other microorganisms has faded due to problems of digestibility or of their acid content. *Spirulina* seems to be best solutions for the simple production of high quality food supplement. It contains about 70% of dry weight as protein (compared with 22% in beef), and is considered as one of the richest protein sources in the plant kingdom [3]. Free fatty acids account from 70% to 80% of the total lipids. The carbohydrate content is 15–20% of dry weight, composed of glucose and glycogen. It also contains all the vitamins, with cyanocobalamin the most abundant (2 mg kg^{-1} of dried cells, 2 to 6 times richer than raw beef liver), 70% of B_1 (thiamine), 50% of vitamin B_2 (riboflavin), 12% of B_3 (niacin) and also a good source of tocopherol (vitamin E).

This work has largely focused on the genus *Spirulina,* which is cultivated in large open-air ponds in several countries. The use of cyanobacteria as a nonconventional source of food and protein seems promising. *Spirulina* supplementation was also successfully used in a trial to treat children suffering from chronic vitamin A deficiencies. The 1 g of *Spirulina* per day reduced the incidence of visual symptoms on these children from 80% to 10% the native population of Republic of Chad (Africa). It was used a sun dried hardened mat of collected from freshwater bodies to make sauces popularly called as "Dihé" Today. *Spirulina* is produced in more than 22 countries and is consumed in over 77 (IISMAN.org). The health benefits associated with consumption of *Spirulina* include: enhancement of the immune system, antioxidant activity, anticancer effects, antiviral effects for example hepatitis C and HIV treatment, control of hyperlipidemia and cholesterol, effects against hepatotoxicity, obesity, allergies, arthritis, immunomodulation, inflammation and diabetes [2]. *Spirulina* also helps against heavy metal intoxications [4], protects against radiation and malnutrition [5], and depression [6]. Therefore, *Spirulina* deserves further research. It was also stated that one factor inhibiting people from using *Spirulina* is a lack of awareness of the associated health benefits [7]. For examples iron in *Spirulina* is 60% better absorbed than ferrous sulphate and other complements. Consequently, it could represent an adequate source of iron in anemic pregnant women. Cereal-based functional products could be prepared by using cereals as substrates for probiotics and imparting functionality [8]. One way of creating a functional food is by inclusion of ingredients such as probiotics (mono-or mixed culture of live microorganisms which benefits man or animals by improving the properties of the indigenous microflora) and prebiotics (non-digestible food ingredients that stimulate the growth or activity of bacteria in the digestive system, which are beneficial to the health of the body) to levels that enable the consumer to derive optimal health benefits [9]. In today's world the development and utilization of different cereal based functional food is a challenging task. Invention of newer technologies for processing of cereals to improve their nutritional value vis-à-vis their acceptability by the end users will be the focus area in the near future [10]. A combination of probiotics and prebiotics have also been employed to enhance the health benefits of infant formulae; referred as synbiotics. Most of the commercial products containing probotics and prebiotics available today are dairy-based [11]. In this respect, it has been found that *Spirulina* biomass increase the rate of *in vitro* development of several strains of microorganisms present in fermented dairy products (*Lactococcus*, *Lactobacillus, Streptococcus,*

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Received: September 29, 2014; **Accepted:** September 06, 2014; **Published** September 08, 2014

Citation: Mishra P, Singh VP, Prasad SM (2014) *Spirulina* and its Nutritional Importance: A Possible Approach for Development of Functional Food. Biochem Pharmacol 3: e171. doi:10.4172/2167-0501.1000e171

Bifidobacterium) and in parallel, it expresses beneficial effect on their survival. Moreover, it has been demonstrated that *Lactobacillus* population in the human gastrointestinal tract is increased by *Spirulina* consumption [12]. Knowing their physicochemical characteristics is fundamental for the selection of the most suitable microalgae [13] to specific food technology applications and consequently successful novel food development.

Finally, apart from increasing the production (supply) and consumption (demand) in today's fast moving world of modernization, industrialization and urbanization, we need to adequately process the underutilized cereal in combination with probiotic and prebiotic; to create a variety of value added nutritious products. However, there are no published studies about the functional food development using underutilized crops like pearl millet, finger millet forming the base with the addition of *Spirulina* and fermented with probiotic curd culture. Subsequently the main aim of this editorial was set a forth to appraise the nutritional properties of *Spirulina* grown in favourable environmental and economic aspects, and largely unharnessed potentials make it a promising future resource.

Acknowledgements

Authors are thankful to The Head, Department of Botany, University of Allahabad, Allahabad for providing necessary lab facilities. Authors are also thankful to University Grants Commission, New Delhi for financial support.

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