Nutritional and Physicochemical Evaluation of Pasta Enriched with *Spirulina platensis*

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Abstract:

The Organoleptic Evaluation of the developed 5% *Spirulina* incorporated pasta showed the maximum mean score compared to control due intensification of colour and odour. The nutrient content of *Spirulina* based pasta was analyzed and it contains 9.18% of moisture, 0.399% of ash, 134 Kcal of Calorific Value, 6.10% of protein, 1.07 gms of fat, 29.20% of carbohydrates 4.21mgs of iron, 297.98mg of calcium and 120.92mgs of phosphorous. *Spirulina* based pasta prepared by incorporating *Spirulina* and Semolina wheat flour had significant difference in its nutritional composition when compared with the control. The developed *Spirulina* based pasta were subjected to microbial analysis for fungi and bacteria for three month and found to be safe.

Key words: *Spirulina,* Organoleptic Evaluation, Nutritional Composition, Therapeutic Agent.

Introduction:

Consumers demand food products made of low-fat, sugar-free, low-salt, supplemented with vitamins, minerals and free from synthetic additives. Rapid industrialization, urbanization, increasing participation of women in working force and consumer interest in health food has increased the demand of instant or convenience foods. During the past few decades, there has been a proliferation of instant and ready to cook convenience food, which requires a very little preparation by consumers. The challenges directed towards the food industry will be to fulfil the needs of the challenging world market and to meet new consumer product needs. Today consumers are demanding on ever broadening selection of snacks food. At present low nutrient content snack foods are available. It minimizes energy, time and cost.

At the age where feeding the world becomes a real challenge, malnutrition is a major public health problem in many parts of the world. Severe PEM, often associated with infection contributes to high child mortality in underprivileged communities. Further, early malnutrition can have lasting effects on growth and functional status. Protein Energy Malnutrition is a range of pathological conditions arising from coincident lack of protein and calories in varying proportions, occurring most frequently in infants and young children and usually associated with infections and deficiency of micro-nutrients. In India the problems of Protein Energy Malnutrition, anaemia, vitamin A deficiency are more prevalent among children and adolescents. Keeping this in mind the value added product using *Spirulina* was developed.

Spirulina as Nutrient Supplement

Spirulina is a spiral shaped blue green algae with length of 0.2 to 0.3 µm. There are more than 39 species but for its composition stability and balance of nutrients, *Spirulina platensis* is the species most used in developing countries (Ciferri, 1983; Mosulishvili *et al.*, 2002).

Spirulina has the highest protein of any natural food (65%); far more than animal and fish flesh (15-25%), soyabeans (35%), dried milk (35%), peanuts (25%), eggs (12%), grains (8-14%) or whole milk (3%), so *Spirulina* is an alternative source against malnutrition. UN General Assembly accepted and encouraged '*Spirulina* production and potential benefits of *Spirulina*' based on FAO and WHO revised resolution (Wang and Zhao, 2005).

Spirulina is a nutrient dense food. It is particularly rich in proteins and also contains carotenoids, vitamins, minerals and essential fatty acids. It contains 55-70 % protein, 15-25 % carbohydrates, 6-7 % moisture, 8-13 % minerals, 3-7 % fat and 8-10 % fiber (Khan, 2005). For centuries, native people have harvested *Spirulina maxima* from Chad Lake in Africa and Texcoco Lake in Mexico for use as a source of food, a fact which means that *Spirulina* deserves special attention both as a source of single cell protein (SCP) and because of its nutraceutical properties. (Vonshak, 1997; Anupama, 2000)

Developed *Spirulina* based food product was used as protein–rich health food for a long time and optimized the environmental growth factors for maximizing the biomass concentration and productivity of *Arthrospira* under the photoautotrophic cultivation in a microalgal culture tube. The potential health benefits of *Arthrospira* associated with antioxidant, immune modulation, anti–virus and anti–cancer effect, which are mainly due to three bioactive constituents such as phycocyanin (a biliprotein pigment), the sulfated polysaccharide *Spirulana* and polyunsaturated fatty acid (Dejsungkranont *et al.*, 2012).

Spirulina as Therapeutic Agent

Apart from being a health food, *Spirulina* has invaluable medical applications. Dietary supplementation of this organism showed protective effect towards food allergy. *Spirulina* has two types of water-soluble polysaccharides called "calcium spirulan" and "Immunila." These showed inhibitory effects against some viruses like HIV and they activate the immune system during cancer chemotherapy. *Spirulina* extracts prevent the formation of tumors and exhibit hypocholesterolemic and anti-diabetic properties. Supplementation of *Spirulina* in patients with oral cancer prevented further damage in these patients. Dietary *Spirulina* can act as an effective chemo-preventive agent against many carcinogens and mutagens (Desai *et al.*, 2004).

Several therapeutic properties of the *Spirulina* sp. have been reported. They produce an accelerated scarring of wounds; the phycocyanin can stimulate the immunological system and the gammalinolenic acid stimulates the prostaglandin synthesis, which are involved in regulation of the blood pressure. It is also beneficial in the treatment of specific eczemas and eases the pre-menstrual syndrome; helps in the

production of good cholesterol (HDL) and in the removal of bad cholesterol (LDL) excess from the bloodstream. It also helps in reducing the coronary and obesity diseases as it contains considerable quantities of phenylalanine that reduces the hunger. High contents of intact A vitamin reduce the risks of cancer (Henrickson 1989; Richmond 1988). An antioxidant and antimutagenic effect of the chlorophyll and some of its derivates such as chlorophyllin have also been reported (Azizan and Blevins 1995, Higashi and Okai 1998; Kumar *et al.* 1999; Ong *et al*. 1986; Tutour *et al.* 1998).

Materials and Methods

Procurement of *Spirulina*: *Spirulina* powder was purchased from ‘’A K Biotech Foods Company’’ Tamil Nadu.

Product development: The Pasta was processed on this formulation with special wheat flour. *Spiruina* based Pasta were developed in Aaho Food Industry, Jabalpur M.P.

Table: 1 Composition of *Spirulina* pasta

S.No.	Ingredients	Quantity (%)
1.	Semolina wheat flour	72
2.	Vegetable oil	4.5
3.	Salt	0.5
4.	Water	18
5.	*Spirulina* powder	5

Organoleptic Evaluation- The develop value added pasta was standardised using composite scoring evaluation with the help of experts. Sensory evaluation included selection of semi trained panel using Control and Developed *Spirulina* pasta were subjected to 5 point hedonic test by a panel of 10 judges.

Nutritional Evaluation- Prepared pasta was analyzed Moisture, Ash, Protein, Fat, Carbohydrate,, Energy, Iron, Calcium and Phosphorous(AOAC,1995).

Microbial examination: The cultural examination of the pasta samples for bacteriological analysis was done according to the standard method (ICMSF, 195). The isolation and identification of bacteria were performed as per as recommended by Cowan (1985) and Rahman (1997b).

Result and Discussion:

Table: 2 Organoleptic acceptability of *Spirulina* pasta

Proportion of *Spirulina* powder	**Mean score of Sensory Evaluation**					
	Appearance	Colour	Texture	Odour	Taste	Over all acceptability
Control 0%	3.5	4.1	4.0	3.9	4.2	3.9
5% ***Spirulina***	3.8	4.1	4.0	4.1	3.6	4.2

Table: 3 Nutritional analysis of control and *Spirulina* pasta

S. No.	**Test Parameters**	**Control**	***Spirulina* based pasta**	**Requirement as per**
1.	Protein%	5.60	6.10	0.1 to 60 %
2.	Carbohydrate%	28.10	29.20	0.1 to 70 %
3.	Moisture%	7.16	9.18	0.5 to 50 %
4.	Ash%	0.795	0.399	0.001 to 10 %
5.	Calorific Value	133 kcal / 100 g	134 k cal / 100 g	1 k cal / 100 g to 1000 k cal / 100 g
6.	Acidity %	9.10	9.30	1 to 10 %
7.	Iron mg/100 gm	1.97	4.21	10.60±0.04
8.	Calcium mg/100 gm	223.15	297.98	322.40±0.08
9.	Phosphorous mg/100 gm	59.34	120.92	165.00±0.05

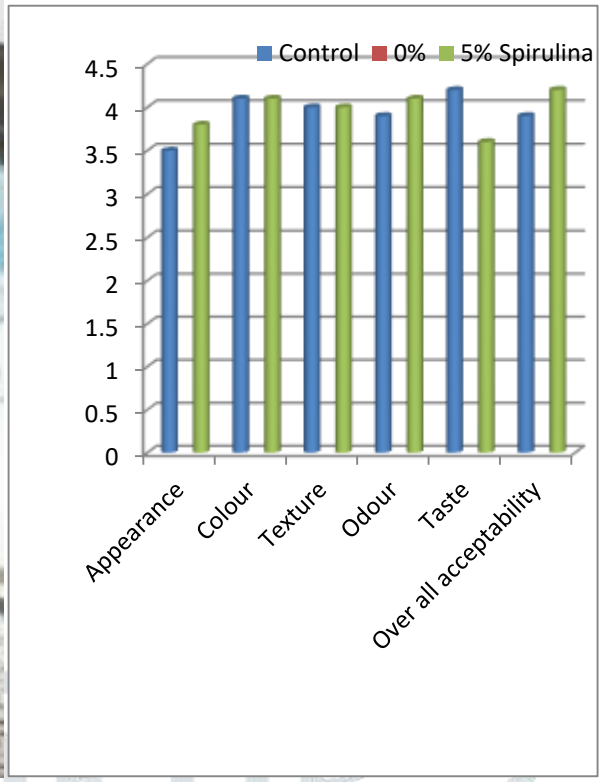
Pasta Production Unit

Drying

Spirulina Pasta

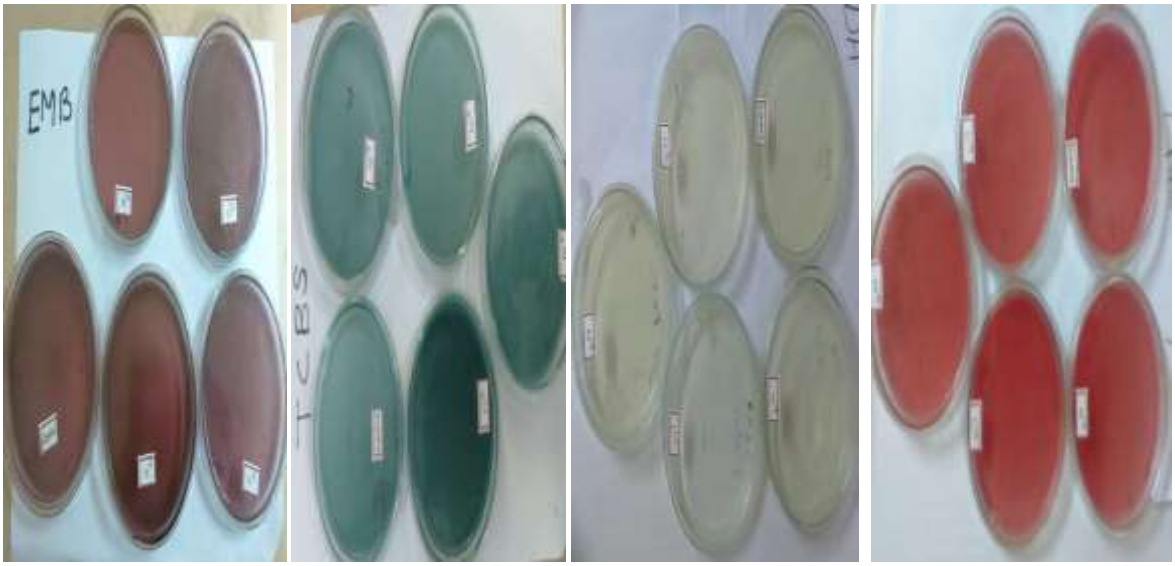
Control Pasta

Cooked Pasta



Organoleptic acceptability of *Spirulina* pasta

Different Media used for microbiological Examination



EMB Agar Plates TCBS Agar Plates PDA Agar Plates MacConkey Agar Plates

Organoleptic Evaluation: Table 2 reveals that control pasta and *Spirulina* based pasta samples were subjected to organoleptic evaluation by the experts and the results were noted. *Spirulina* fortified pasta were falling into the liked, disliked or neither like nor dislike. Study reveals that the study of food products from a total of 10 human experts, who has judge the pasta.

Nutritional Analysis: Nutritional analysis was judged under normal condition. Table 3 show that the data of nutritional contents of fortified *Spirulina* pasta was much higher than control samples.

Shelf life study: Under the present study shelf life of *Spirulina* pasta was judged on the basis of their organoleptic evaluation, during months, under normal condition.

Storage studies

The storage studies for the control and 5% *Spirulina* incorporated Pasta samples were carried out for a period of one month. They were analyzed microbially. The total bacterial and fungal counts were enumerated using plated count. EMB, TCBS, MacConkey, XLD and PDA media were used for the determination of Bacteria and fungi count. No contamination was found for the period of one month and the product is found to be microbially safe till the observed period.

Conclusion

The present work reveals that *Spirulina* fortified pasta prepared from *Spirulina* at 5% level were accepted on organoleptic parameters and the most acceptable products was found in satisfactory range during storage period. The results show that developed *Spirulina* fortified pasta was nutritious and their nutritional value is much greater than control samples. Thus this valuable product possess great extrusion potential with higher acceptability on organoleptic parameters thus better quality of *Spirulina* fortified pasta brings considerable advantages among the consumer.

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