



Original Research Article

Development of Value Added Extruded Product Using Spirulina

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ABSTRACT

The sensory analysis of the developed value added extruded product using spirulina showed that 5% spirulina incorporated product got the maximum mean score compared to 10% and 15% due intensification of colour and odour. The nutrient content of spirulina was analyzed and it contains 6.47gms of moisture, 0.17gms of ash, 347.96gms of energy, 62.4gms of protein, 1.07 gms of fat, 22.24gms of carbohydrates, 90.48mgs of iron, 825.1mg of calcium, 744.39mgs of phosphorous and 3495 µg of carotene. Extruded products prepared by incorporating spirulina and whey water had significant difference in its nutritional composition when compared with the control. The developed extruded products were subjected to microbial analysis for fungi and bacteria for one month and found to be safe.

Key words: Value added ,extruded product, spirulina, whey water, nutritional composition

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 fulfill 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. Extrusion has become a very important role in food processing operation. Today, the food extruder is used to produce

pasta, ready-to eat cereals, snacks, confectionery products, modified starches for soup, baby food and instant foods, beverage bases and texturized vegetable proteins. Extrusion cooking technology is a high temperature-short time processing for the development of new innovative products. It minimizes energy, time and cost.

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

Nutritive value of Spirulina

Spirulina is a blue-green algae. It is a simple, one-celled form of algae that thrives in warm, alkaline fresh-water bodies. The name "spirulina" is derived from the Latin word for "helix" or "spiral"; denoting the physical configuration of the organism when it forms swirling, microscopic strands. Spirulina is a super food, full of nutritional wonders, truly an amazing food. Spirulina is being developed as the "food of the future" because of its amazing ability to synthesize high-quality concentrated food more efficiently than any other algae.

Most notably, Spirulina is 65 to 71 percent complete protein, with all essential amino acids in perfect balance. It is rich in gamma linolenic acid, iron and vitamin A. Spirulina is one of the few plant sources of vitamin

B12, usually found only in animal tissues. A teaspoon of Spirulina contains twice the amount of this vitamin found in an equivalent serving of liver. According to the MedlinePlus website, spirulina contains as much as 70 percent protein, chlorophyll, B-complex vitamins, vitamin E, iron, more beta-carotene than carrots and the essential fatty acid known as GLA. Spirulina is one of the few plant sources of vitamin B12, usually found only in animal tissues. A teaspoon of Spirulina supplies 2 1/2 times the Recommended Daily Allowance of vitamin B12 and contains over twice the amount of this vitamin found in an equivalent serving of liver. Spirulina also provides high concentrations of many other nutrients - amino acids, chelated minerals, pigmentations, rhamnose sugars (complex natural plant sugars), trace elements, enzymes - that are in an easily assimilable form.

<http://www.naturalways.com/spirul1.htm>

Spirulina is used for boosting the immune system, lowering cholesterol, heart health, diabetes treatment, wound healing, improving digestive health and as an antidote to depression and anxiety. Ciferri (1983) reported that spirulina by its dry weight contain 60-70% protein. [1] Switzer (1980) analyzed and found spirulina powder contain 65% protein. [2] Spirulina is cultivated all around the world and is used as a human dietary supplement as well as whole food which is available in tablet, flake and powder form. Spirulina is marketed and consumed in Germany, Brazil, Philippines, India, Africa and other countries where public administration, sanitary organizations and associations have approved human consumption (Henrikson, 1994). [3]

Therapeutic value of spirulina

Scientists at the prestigious Harvard Medical School in Boston found that a water extract of spirulina prevent the replication of HIV-1 virus in human T-cell lines. The viral

production was reduced by approximately 50%. The researchers separated the extract into a polysaccharide fraction and a fraction depleted of polysaccharides and found antiviral activity in both. They concluded that the water extracts of spirulina contain antiretroviral activity that may be of potential clinical interest (Ayehunie et al., 1998).^[4]

Spirulina is a super food, full of nutritional wonders, truly an amazing food. It regulates blood sugar, blood pressure and cholesterol, a food that can alleviate pain from inflammation and deliver antioxidant activity to ward off life threatening diseases like cancer, Alzheimer's heart diseases and stroke, a food that improves immune system, alleviates allergies and has been proven to fight many different viruses, a food that help eyes and brain, helps in reducing weight, increases friendly flora in the intestine and improves digestion. Scientific research shows that spirulina may help in all these areas and more. It contains every essential amino acids, more beta carotene than any other whole food, it is the best whole food source of gamma linolenic acid, B-vitamins, minerals, trace elements, chlorophyll and enzymes (Kelly Moorhead et al., 1993).^[5] It regulates blood pressure, blood sugar and cholesterol. It improves immune system. It also has the antioxidant property and aids in weight loss. Used since ancient times for its nutritional benefits, spirulina continues to be used as an antiviral, antineoplastic, antioxidant, a lipid-lowering agent and as a weight loss aid. Spirulina has been used for centuries as a nutritional supplement and for numerous medical purposes, such as assisting weight loss and lowering lipids.

Spirulina contains pigments like zeaxanthin and phycocyanin. Some observational studies have also shown these xanthophylls may help reduce the risk of certain types of cancer, particularly those of

the breast and lung. Emerging studies suggest a potential contribution of lutein and zeaxanthin prevent heart disease and stroke (Ribaya-Mercado and Blumberg, 2004).^[6]

Phycocyanin, an amazing water soluble new pigment is only found in blue green algae like spirulina that gives it bluish tint. Scientists in Spain showed that an extract of spirulina containing phycocyanin is a potential free radical scavenger and inhibits microsomal lipid peroxidation(Iijima et al., 1982).^[7] A recent study showed that it is a powerful anti inflammatory agent (Reddy et al., 2000).^[8] It has also been shown to inhibit the allergic inflammatory response (Remierez et al.,2002).^[9] Spirulina helps prevent heart damage caused by chemotherapy using doxorubicin, without interfering with its anti-tumor activity (Khan, 2005).^[10] Spirulina reduces the severity of strokes and improves recovery of moments after a stroke (Wang et al., 2005)^[11] and prevents and treats hay fever (Chen , 2005).^[12]

Whey water is rich in protein. It enhances the immune function and antioxidant property. Hence the study is undertaken to prepare a value added pasta product incorporated with nutrient dense spirulina and whey water.

Objectives

- To develop value added extruded products with different proportions of spirulina, replacing water with whey water
- To assess the acceptable level of incorporation of spirulina powder in extruded products organoleptically
- To analyse and compare the nutritional composition of the control and the most acceptable developed extruded product

MATERIALS AND METHODS

- **Ingredients used** - Spirulina, whey water, refined wheat flour and corn flour were used. Spirulina powder was purchased from Spirulina Production Research and Training Centre- Antenna trust in Madurai.

- **Development of value added Extruded products** - Table 1 shows the incorporation of various percentages of ingredients used to develop the extruded products.

Table 1- Percentage of ingredients used to develop the extruded products

Group	Refined wheat flour (g)	Spirulina (g)	Corn flour (g)
Control	100	-	-
Experimental A	90	5	5
B	85	10	5
C	80	15	5

The materials such as refined wheat flour, corn flour, spirulina and whey water (30%) were mixed thoroughly in a single screw extruder. After extrusion the products were dried in a cabinet drier at 60°C for an hour and packed tightly in pouches.

- **Organoleptic Evaluation**-Developed value added pasta was standardized with the help of 6 panel members using 5 point hedonic scale
- **Nutritional Evaluation**-Prepared pasta was analysed –Moisture, Ash,Energy,Protein, Carbohydrate, Iron, Calcium and Carotene

RESULTS AND DISCUSSION

- Organoleptic Evaluation**- Table 2 reveals the mean score of organoleptic acceptability of value added extruded product

Table 2 - Organoleptic acceptability of value added extruded product

Proportion of Spirulina powder	Mean score of Sensory Evaluation					
	Appearance	Colour	Texture	Odour	Taste	Over all acceptability
5%	5	5	5	4.8	5	4.96
10%	4.5	4.7	4.6	4.8	4.8	4.68
15%	4.5	4.3	4.8	4.5	4.6	4.55

The developed extruded products were subjected to sensory analysis with different variations in spirulina powder of 5%, 10% and 15%. It was found that 5% spirulina incorporated extruded product got the maximum mean score of 4.9 in the sensory evaluation.

- ii. **Nutritional evaluation-** The nutrient content of spirulina powder was analyzed and the results were given below

Table 3- Nutrient content of spirulina powder

Nutrient	Amount
Moisture (g)	6.47
Ash (g)	0.17
Energy (kcal)	347.96
Protein (g)	62.4
Fat(g)	1.07
Carbohydrate (g)	22.24
Iron (mg)	90.48
Calcium (mg)	825.1
Phosphorous(mg)	744
Carotene (µg)	3495

Table 4 unfolds the data of nutritional contents of control and the most accepted extruded product incorporated with 5% level of spirulina

Table 4- Proximate composition of value added extruded product

Nutrients	Control	Developed
Moisture (%)	8.2	7.6
Energy (KCal)	107	124
Protein (g)	10.7	13.8
Carbohydrate(g)	74.7	71.2
Iron (mg)	0.2	5.06
Calcium(mg)	39.9	81.5
Carotene (µg)	26.3	176

The most accepted extruded product incorporated with 5% spirulina showed higher amount of nutrients compared to control group.

Storage studies

The storage studies for the control and 5%, 10%, 15% spirulina incorporated 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. Nutrient Bengal agar medium was used for the determination of 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

Value added extruded product can be made by incorporating spirulina powder upto the level of 5%. The macro and micro nutrient content of extruded product will be enriched by incorporation of spirulina powder. The product is found to be microbially safe till the observed period of a month. This developed extruded product will not only improve the nutritional status of the community but also solve a number of nutritional problems prevailing in the community.

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