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A comparative study on nutritional profile of spirulina cookies

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Abstract
In this study, spirulina which is one of the blue-green algae rich in protein 61.57% and contains a high proportion of essential amino acids (38.81% of the protein) and a source of naturally rich in vitamins especially vitamin B complex such as vitamin B12 (193 mg / 10 g) and folic acid (9.66 mg / 100 g), which helps the growth and nutrition of the child brain, also rich in calcium and iron it containing (1043.62 and
338.76 mg / 100 g, respectively) to protect against osteoporosis and blood diseases as well as a high percentage of natural fibers. The objective was "A Comparative study on nutritional profile of spirulina cookies". The spirulina used in the production of cookies by some addition percentages 0,5,10 and 15%. Data of sensory evaluation results showed that the adding spirulina by ratio zero had lower score for most properties compared to other tasted. The chemical analysis was done, the obtained data showed that the add spirulina a large role in increasing protein ratio and energy where the results were (9.09 - 554%) and (14.73 - 672%) for the samples the control sample and 5% spirulina.It was safety study microbiology samples prepared by adding cookies spirulina and all samples were microbiologically safe.

Keywords: nutritional value; chemical composition; amino acids, fatty acids, vitamins, minerals; microbiological examination

Introduction
Today, the consumers prefer low calorie, low fat, and low-cholesterol ready-to-eat foods, namely healthy and are aware of the relationship between diets and disease development. Given the efforts made to reduce the incidence of diseases such as malnutrition, cancer, cardiovascular, coronary heart disease and to improve the health status, development of foods rich recipes to play a major role in securing the health of consumers. Among baked products, cookies are especially popular being perceived as delicious products with special organoleptic properties. (Simpore, J: Zongo, F,)
Cookies are widely consumed confectionary products, appreciated for their organoleptic properties, versatility, convenience, texture, and appearance. Application of natural ingredients with functional properties beyond traditional nutrients is an attractive way to design newproducts (Masilli, L. Torzilla, G, Giovannelti, L,). Microalgal biomass is a valuable source of fine chemicals such as carotenoid pigments, vitamins, proteins, fatty acids and other biologically active compounds, presenting potential health benefits.
In this study, spirulina which is one of the blue-green algae rich in protein 61.57% and contains a high proportion of essential amino acids (38.81% of the protein) and a source of naturally rich in vitamins especially vitamin B complex such as vitamin B12 (193 µg/ 10 g) and folic acid

Table 1: Composition quantities

Composition Quantity(per 100g dry wt)	
Moisture	3.5 g
Protein	63.5 g
Fat (Lipids)	9.5 g
Fibre	3.00 g
Ash	6.70 g
N-free extract	15 g
Vitamins	
Provitamin A	213.00 mg
Thiamin (V.B1)	1.92 mg
Riboflavin (V.B2)	3.44 mg
Vitamin B6	0.49 mg
Vitamin B12	0.12 mg
Vitamin E	10.40 mg

Niacin	11.30 mg
Minerals	
Phosphorus	916.00 mg
Iron	53.60 mg
Calcium	168 mg
Potassium	1.83 g

(9.66 mg / 100 g), which helps the growth and nutrition of the child brain, also rich in calcium and iron it containing (1043.62 and 338.76 mg / 100 g, respectively) to protect against osteoporosis and blood diseases as well as a high percentage of natural fibers. So, the spirulina is useful and necessary for the growth of infants and very suitable for children, especially in the growth phase, the elderly and the visually appetite. It also, helps a lot in cases of general weakness, anemia and chronic constipation (Kadams Prabhasankar*)* Spirulina contain an selenium element (0.0488 mg/100 g) and many of the phytopigments such as chlorophyll and phycocyanin (1.472% and 14.18%), and those seen as a powerful antioxidant. It ensures the whole food and alkaline balance of the body (Guarda A. RosellC, Benedito, Galotto M).In some countries, snacks such as biscuits, cakes, cookies, which are consumed widely by children, have been fortified with iron and other nutrients and are used in the feeding program affairs of schools. According to the findings of this study, fortification of cookies with Spirulina microalgae is a highly effective method for increasing the nutrients in diet of children, due to its simplicity, low cost and feasibility. So it can be a suitable carrier for high fortification. Moreover, due to its availability, the cost of production becomes lower. (LiagS, Lixu, ChenZ)

Methodology

The experiment was conducted in the research laboratory of the Department of Food Science and Technology, BBAU, Lucknow & in the analysis laboratory of RFARC (Regional Food Analysis & Research Centre) situated in Lucknow. This chapter was divided into four phases of experimental work for completing the research in a planned way.

Sample preparation- Four samples are taken for experimental in this study,for fortification of cookies.

Table 2: Sample Preparation

Treatment	Sample Ingredients	Ratio Ingredients
A	Flour with spirulina powder	95 **%+5%**
B	Flour with spirulina powder	90%+10%
C	Flour with spirulina powder	85**%**+15**%**
D	Flour without spirulina powder	100%

Spirulina powder

Spirulina powder used in this study was purchased from Tamil Nadu

Cookies Preparation

Traditional Iranian cookies (as control) were prepared using the following formulation (% w/w): 50g flour, 12.5g sugar, 13.75g shortening oil, 4.4 g egg, and 0.375 g baking powder. Fortification was conducted by replacement of wheat flour by S. platensis biomass powder at 0.5%, 1% and 1.5% concentration levels (w/w). The cookies were baked in an oven at 180°C for 15 min. After cooling, cookies were kept inside sealed Cellophane packages (with low permeability to air, oils, greases, bacteria and water) at room temperature for 3 months.

Organoleptic Evaluation

Organoleptic evaluation of cookies was done by 5 trained panelists, after baking. Panelists were used clean white plastic dishes to serve 40 gram of labeled samples randomly on the palates, in individual booths at room temperature. Cookies were evaluated in terms of different attributes such as flavor, odor, color, texture uniformity, non-mouth texture and mouth texture according to 9 point hedonic test* (9; like extremely and 1; dislike extremely). Finally, total acceptability was calculated according to equation.

Nutritional and Physiochemical Analysis

The next phase involved nutritional value and physiochemical analysis of the functional cookies involving different parameters-

Nutritional Parameters-

- Determination of moisture.
- Determination of fat.
- Determination of protein.
- Determination of total mineral.
- Determination of carbohydrate
- Determination of energy.

Statistical Analysis

The 9-point hedonic scale data was analyzed using average score and standard deviation, in which the product with the highest average score and least standard deviation showed highest acceptability. The data was analyzed using chi-square test. The test was performed to show the significant difference in the values of different nutrient contents of control and experimental developed product.

Table 3: Nutrative Values of Spirulina and Refined Wheat

Composition Quantity (per 100 g dry wt.)		
Spirulina		
Moisture	3.5 g	Protein 11 g
Protein	63.5 g	Iron 2.7 g
Fat (Lipids)	9.5 g	Total Energy 348 g
Fibre	3.00 g	Carbohydrate 73.90 g
Ash	6.70 g	Fat 0.90 g
N-free extract	15 g	Minerals 0.60 g

***Source*:** NIN, Hyderabad 2011

Result and Discussion

Nutritional Composition of Spirulina & Refined Wheat

Spirulin are photosynthetic prokaryotic or eukaryotic microorganisms which produce carbohydrates, proteins, and lipids through photosynthesis process. Microalgae are grown as a good source of polyunsaturated fatty acids, pigments, antioxidants and therapeutically bioactive compounds.

Table 4: Nutrient Contents In Control And Experimental Product

S. No.	Parameters	Control	Experimental
1.	Moisture	3.20%	2.39%
2.	Fat	34.31%	57.88%
3.	Protein	9.09%	14.73%
4.	Carbohydrate	2.31%	23.07%
5.	Energy	554 Kcal	672 Kcal
6.	Total Minerals	1.09%	1.93%

The above table shows the higher value of energy, protein, carbohydrate, fat, moisture and total mineral in experimental sample compare to control.

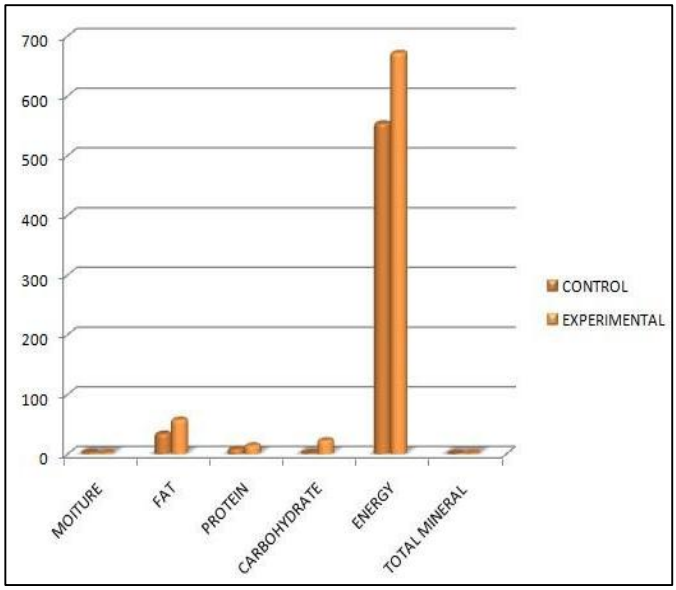

Fig 1: Fat, Protein Carbohydrate, Moisture Energy and Total minerals in control and Experimental product

Summary and Conclusion

Sweet cookies,nutritious food, can be fortified with addition of a natural microalgal biomass of Spirulina (rich in iron, protein and PUFAs, particularly GLA). Regardless of lower overall acceptability of Spirulina cookies compared to control, increment of antioxidant effects beside to anti-staling properties revealed a new niche food market.

The future trend is incorporation of Spirulina cookies study on storability of the cookie, ant- staling, ant-oxidation, and antimicrobial effects of Spirulina platensis microalgae. Also the examination of the influence of traditional cookies containing microalgae on probiotics strains is of special priority. Sensory studies on masking effects of different types and concentrations flavors on the taint of microalgae-enriched cookie can be considered.

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