

RESEARCH PAPER

Development and Evaluation of Spirulina Incorporated Little Millet Cookies

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Abstract

Spirulina (*Spirulina platensis*), the blue green algae is a rich source of proteins and has several therapeutic properties. The present study focused on incorporating spirulina powder with little millet (*Panicum miliare*) flour in the preparation of cookies. Physico-chemical properties, textural profiles and sensory qualities of spirulina incorporated little millet special cookies were prepared and analysed. Cookies were prepared by incorporating spirulina powder (5-10%). Results of sensory evaluation showed that 8% spirulina powder with 75% little millet flour was highly acceptable, with a score for overall acceptability being 8.6. Carbohydrate, protein, fat, fibre, calcium and iron content of the standardized cookies were found to be 65.00; 12.31; 20.18; 5.41g; 27.50 and 6.92mg/100g, respectively. The shelf-life of the product was better in plastic containers (600G) than propylene bags (200G) for a storage period up to 30 d.

Keywords: Spirulina powder, little millet, cookies, nutrient, sensory qualities, physico-chemical properties

Spirulina is a low-fat, low-calorie, cholesterol-free source of easily digestible vegetable protein containing all the essential amino acid (Srilakshmi, 2001). Spirulina (*Spirulina platensis*) is a cyanobacteria, commonly referred as blue-green algae. In few countries, a small section of the population regularly use algae harvested from lakes (Becker, 1986). It is an excellent source of essential amino acid, quality protein, vitamins, minerals and fatty acids (Khan, 2005) besides some therapeutic properties such as hypocholesterolemic, immunological, antiviral and antiglutagenic effects (Mark, 2007). Commercial preparations of spirulina are used in the treatment of several metabolic disorders, heart ailments, obesity and diabetics. Spirulina can be consumed in the form of either dry powder, tablets, or flakes. It is also rich

in potassium and sodium; moderate in magnesium, phosphorus, iron and calcium along with traces of zinc, copper, manganese and selenium (Khader 2001).

Little millets is one of the oldest food grain known to mankind and possibly the first cereal grain used for domestic purpose. Millets possess immense health benefits natural antioxidants and gaining prime importance as a good source of protein, dietary fibre, energy and minerals which are involved in several metabolic functions of human body (Moure *et al.*, 2001). Hence, the current investigation on the development of Spirulina fortified cookies keeping in mind to address the nutritional unbalance, was made to enhance the nutritional value of cookies especially for children and elderly people. The results are reported here.

MATERIALS AND METHODS

Raw Materials

Spirulina powder, wheat flour, icing sugar, baking powder, fat, corn flour and vanillin powder having standard quality were procured from local market at Coimbatore. The little millet flour and spirulina powder used were cleaned by sieving through a 60 mesh sieve and mixed at various proportions (5-10%).

Preparation of cookies: The supporting ingredients added to the mixture were wheat flour, fat, icing sugar, baking powder, corn flour and vanillin powder as shown in Table 1. All the ingredients were mixed and made in the form of dough which was further rolled into uniform sheet of desired size before baking. About 4cm diameter round shaped dough with 6cm thickness were cut using cookies cutter and baked in an oven at 180°C for 15 min. The baked cookies were cooled for 2-3h and packed in thermally sealed polypropylene bags (200G) or in plastic container (600G). The cookies were stored for one month at room temperature 28°C and relative humidity of 65-85% for storage studies.

Analysis: The cookies were analyzed for the nutritional quality, texture profiles, organoleptic parameters for 10d internal over a period of 30d as per the methods described earlier (Watts, 1989).

The textural parameter of cookies *viz.*, force, distance and time were determined using the texture analyzer (TA-XT2, Stable Micro Systems. Model: Texture Export Version 1.22, Surrey, UK) following the method prescribed (Bourne *et al.*, 1966). Physical properties including diameter, thickness, spread ratio were calculated as per the methods described by the AACC (1969). Spirulina and little millet were taken in powder form and their nutritional values were also estimated using the methods suggested by AOAC (2005).

Sensory evaluation: The Spirulina incorporated cookies were evaluated for their sensory attributes by a panel of 25 trained members using 9 point hedonic scale (Watts *et al.*, 1989). The mean of sensory scores

for attributes *viz.* colour and appearance, flavour, texture, taste, and overall acceptability were recorded.

RESULTS AND DISCUSSION

Preliminary evaluation of cookies

The physico-chemical properties, sensory characteristics and storage quality of the developed products were evaluated. Based on the scores of sensory evaluation, the T₄ (8% of Spirulina powder mixed with little millet powder) combination was found to be more acceptable than the other combinations.

Table 1: Formulation of Spirulina incorporated little millet cookies

Ingredients (g)	Control	Incorporation levels					
	T ₀	5	6	7	8	9	10
		T ₁	T ₂	T ₃	T ₄	T ₅	T ₆
Little millet flour	75	75	75	75	75	75	75
Spirulina powder	—	5	6	7	8	9	10
Wheat flour	25	20	19	18	17	16	15
Icing sugar	30	30	30	30	30	30	30
Baking powder	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Fat	50	52	54	56	58	60	62
Corn flour	1	1	1	1	1	1	1
Vanillin powder	0.5	0.5	0.5	0.5	0.5	0.5	0.5

T₀: Little millet flour; T₁: Little millet flour + 5% Spirulina; T₂: Little millet flour + 6% Spirulina; T₃: Little millet flour + 7% Spirulina; T₄: Little millet flour + 8% Spirulina; T₅: Little millet flour + 9% Spirulina.

Physical properties of cookies

The physical properties of Spirulina powder incorporated cookies were compared with that of little millet flour cookies and the results are presented in Table 2. It was observed that before baking, the weight of cookies 200g (T₄) was found to increased marginally over the control 182g (T₀). The height of

the little millet based cookies before and after baking was 0.5, 0.6 and 0.6, 0.7cm respectively.

The final weight of cookies was 190g and 220g for T_0 and T_4 respectively. The effect of incorporation of spirulina with little millet flour incorporated of spirulina for making cookies, increased the hardness of the final product, while the stickiness was found to be decreased.

Table 2: Physical properties of cookies

Characteristics	Little millet flour cookies	Spirulina powder incorporated
	(T_0)	(T_4)
Dough weight (g)	182	200
Height before baking (cm)	0.5	0.6
Height after baking (cm)	0.6	0.7
Breadth (cm)	3.6	3.8
Spreadability (cm)	0.2	0.4
Final output (g)	190	220
No. of cookies	19	22
Hardness/Compression (Kg f)	0.95 ± 0.03	0.98 ± 0.04
Stickiness (g)	25.47 ± 0.87	24.01 ± 0.87

Nutrient composition of the cookies and effect of storage

The results of the nutrient analysis of spirulina incorporated little millet cookies are presented in Table 3. Each 100g sample of dried spirulina powder

contained protein 57.47, fat 7.53, carbohydrate 23.90, vitamin 10.10g, fibre 3.60g, minerals 2.80g, energy 290 Kcal, calcium 117mg, and iron 25.50mg and the nutrient content of little millet flour contain protein 7.70g, fat 4.70g, carbohydrate 67.00g, fibre 12.20g, energy 34.10 Kcal, calcium 17.00mg, and iron 9.30mg respectively. The moisture content was found to be increased from 8.45 to 8.49g for T_4 in P_2 during the storage period of 30d. Carbohydrate, protein, fat and fibre content of the standardized cookies were found to be 65.00; 12.31; 20.18; 5.41/100g, respectively. The observations further indicated a marginal increase in calcium 27.50 and iron content 6.92mg/100g than the control cookies.

Sensory Evaluation

The sensory evaluation scores of control and spirulina incorporated little millet cookies were evaluated on 0th and 30th d of storage and the mean scores of sensory attributes for the cookies were found to be high with an average acceptability rate of 8:75%. The mean score for colour and appearance, taste, flavour and texture was 8.7, 8.6, 8.7, and 8.6 respectively in (P_2) Plastic container for T_4 sample were found to be more acceptable at the end of the storage period. The crispiness of the cookies decreased, while the taste and lightness gradually increased during the storage period (Table 4). The overall acceptability were found to be 8.6 than the control cookies.

Table 3: Nutrient changes in little millet based cookies

Nutrients (g/100g)	Little millet flour				Little millet flour + Spirulina powder			
	Polypropylene		Plastic container		Polypropylene		Plastic container	
	0 th d	30 th d	0 th d	30 th d	0 th d	30 th d	0 th d	30 th d
Moisture	8.24	8.36	8.24	8.31	8.45	8.55	8.45	8.49
Carbohydrate	66.85	66.82	66.85	66.84	65.74	64.35	65.74	65.00
Protein	6.25	6.22	6.25	6.24	12.36	12.23	12.36	12.31
Fat	21.87	21.83	21.87	21.86	20.24	20.15	20.24	20.18
Crude fibre	2.65	2.61	2.65	2.64	5.62	5.37	5.62	5.41
Ash	0.90	0.87	0.90	0.89	0.89	0.84	0.89	0.85
* Calcium	15.73	15.69	15.73	15.72	27.56	27.41	27.56	27.50
* Iron	4.03	4.00	4.03	4.02	6.98	6.71	6.98	6.92

* (mg / 100g); d = days

Table 4: Sensory evaluation of the cookies

Parameter	Little millet flour				Little millet flour + Spirulina powder			
	Polypropylene		Plastic container		Polypropylene		Plastic container	
	0 th d	30 th d	0 th d	30 th d	0 th d	30 th d	0 th d	30 th d
Colour and appearance	8.5	8.3	8.5	8.4	8.8	8.5	8.8	8.7
Taste	8.6	8.4	8.6	8.5	8.7	8.5	8.7	8.6
Flavour	8.6	8.3	8.6	8.5	8.8	8.4	8.8	8.7
Texture	8.6	8.2	8.6	8.4	8.7	8.5	8.7	8.6
Overall acceptability	8.4	8.1	8.4	8.2	8.6	8.4	8.6	8.6

CONCLUSION

The results of the study showed that mixing 8g of spirulina powder with 75g of little millet flour for the preparation of cookies made the product superior both in nutritional value and physico-chemical properties with more acceptable sensory qualities.

REFERENCES

AACC. 1969. Methods of analysis. 7th Edition. American Association of Cereal Chemists. st Paul. Minnesota. USA.
 AOAC. 1995. Association of Official Analytical Chemists: Official Method of Analysis. 16th Edition. Arlington, V.A: AOAC.
 Khader, V. 2001. *Textbook of Food Science and Technology*, New Delhi. Directorate of Information and Publication of Agriculture, Indian Council of Agriculture.

Khan, Z., Bhadouria, P. and Bisan, P.S. 2005. Current pharmaceutical biotechnology. *Nutritional and Therapeutic Potential of Spirulina*, 6: 373 – 379.
 Mark, F. and Mc Carty. 2007. Clinical potential of Spirulinas: A source of phycocyanoblin. *Journal of Medicinal Food*, 10(4): 566 – 570.
 Moure, A., Cruz, J., Franco, D., Domoanguez, J., Sineir, J., Domoanguez, H., Nuana, M. and Parajoa, J. 2001. Natural antioxidants from residual sources. *Journal of Food Chemistry* 72: 145-171.
 Srilakshmi, B. 2001. *Food Science*. 2nd Edition. Delhi: New Age International Limited Publishers.
 Watts, B.M., Jlimaki, G.L. and Elias, L.G. 1989. *Basic sensory methods for food evaluation*. International Development Research Centre (IDRC). Ottawa, Canada, pp. 1-16.