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Seema

Ph.D., Research Scholar,
Department of Foods and
Nutrition, CCS Haryana
Agricultural University, Hisar,
Haryana, India

Jood S

Professor, Department of Foods
and Nutrition, CCS Haryana
Agricultural University, Hisar,
Haryana, India

Development and organoleptic acceptability of nutrient rich food products with *Spirulina*-wheat-bangal gram composite flour

Seema and Jood S

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Abstract

The main aim of study was development of nutrient rich food products (*matthi*) from wheat-bengal gram flour supplemented with different level of *Spirulina* powder (2, 4, 6 and 8%). Accepted levels were further evaluated for nutrient composition. The results of the study revealed that overall acceptability scores in terms of colour, appearance, texture, aroma and taste of prepared *matthi* by using four types of composite flour were rated as 'liked moderately' to 'neither liked nor disliked' by the panelists. Food products were found acceptable up to 6 per cent level of supplementation of *Spirulina* powder. Control *matthi* contained 2.25 per cent moisture, 11.21 per cent crude protein, 32.50 per cent crude fat, 1.72 per cent crude fibre and 2.73 per cent ash, while these contents found to be significantly ($p=0.05$) increased in *matthi* made from Type-I (2%), Type-II (4%) and Type-III (6%) composite flours. Total dietary fibre content of wheat flour *matthi* was 8.56 g/100g. On increasing the levels of *Spirulina* powder (2, 4 and 6%), total dietary fibre content was also increased significantly in of supplemented products.

Keywords: *Spirulina*, organoleptic evaluation, supplemented products

Introduction

In India, the problems of protein energy malnutrition, anemia and vitamin A deficiency are more prevalent among children and adolescents (Vijayarani *et al.* 2012; Fatima and Srivastava 2016)^[26, 51]. About 79 per cent of children between the age of 1-5 years and women 15-49 years of age are anemic in India. It is estimated that nutritional anemia contributes to about 24 per cent of maternal deaths every year and is one of the important causes of low birth weight which adversely affects the work output in adults and learning ability in children (ICMR 2010; Singh *et al.* 2018)^[8, 24]. Generally foods that are in trend today lacking in dietary fibre and micronutrients. Nutritional enrichment of food products can be helpful to use as carrier of nutrients due to their simple manufacturing process, better shelf life, high acceptability and consumption (Fadaei *et al.* 2013; Hafsa *et al.* 2014)^[4]. To overcome these problems, the need of nutrient rich foods came into existence.

One of such food which constitutes the most remarkable concentration of nutrients is '*Spirulina*'. Its first appeared on the earth more than 3.5 million year ago (Vijayarani *et al.* 2012; Udayasree *et al.* 2013; Kumoro *et al.* 2016; Shinde *et al.* 2018)^[26, 25, 10, 23]. The discovery of *Spirulina* marked an important breakthrough in tackling the problem of micronutrients deficiencies (Dewan 2014; Johnson *et al.* 2016; Patil *et al.* 2018; Ovando *et al.* 2018)^[3, 9, 16, 14]. *Spirulina* has a unique blend of nutrients that no single plant source can provide. It provides (65-70% dry basis) protein content of which 90-95 percent is digestible and high digestibility due to muco-polysaccharide cell wall (Dewan 2014; Yigit *et al.* 2016; Saharan and Jood 2018)^[3, 27, 19]. This cheaply accessible functional food can sustainably combat malnutrition that eclipses the third world countries (Patel and Goyal 2013; Hosseini *et al.* 2013; Mohan *et al.* 2014)^[15, 7, 12]. For value addition, nutrient rich ingredients like *Spirulina* and chickpea flour can be used along with wheat flour for enhancing the nutritional quality of wheat based bakery and traditional recipes Therefore, nutritional enrichment of these food products can be advantageous to use as carrier of nutrients (Saharan and Jood 2018)^[19].

Corresponding Author:**Seema**

Ph.D., Research Scholar,
Department of Foods and
Nutrition, CCS Haryana
Agricultural University, Hisar,
Haryana, India

Keeping this fact in view, the present study has been planned with objectives to development of value added food products (*Matthi*) and nutritional evaluation.

Materials and Methods

The present study was carried out in the Department of Foods and Nutrition, I.C. College of Home Science, Choudhary charan singh Haryana agricultural university, Hisar, Haryana during the year 2017-2019.

Procurement and preparation of samples

Wheat and bengal gram flour were procured in a single lot from local market. *Spirulina* powder (food grade) was also procured from market. All the samples were stored in LDPE packages for further use.

Standardization and formulation of composite flour

Different proportions of wheat flour, bengal gram flour and *Spirulina* powder were used for formulation of composite flour. As a control, wheat flour (100%) was used for *matthi*. In the ratios of 50:50:0 (control), 49:49:2 (Type-I), 48:48:4 (Type-II), 47:47:6 (Type-III) and 46:46:8 (Type-IV) four types of composite flours were prepared by using wheat flour, bengal gram flour and *Spirulina* powder.

Development of value added food products

Food products were prepared by adding *Spirulina platensis* powder in wheat flour, bengal gram flour at different levels. For *matthi* wheat flour, bengal gram flour and *Spirulina* powder were mixed and kneaded the dough after adding salt, *ajwain* and ghee in the mixture. Dough was rolled into sheets and deep fried till golden brown at low flame. Ingredients with different levels are given in Table 1.

Table 1: Ingredient with different level of *Spirulina* supplementation

Supplementation level (%)	Ghee (g)	Ajwain (g)	Salt	Oil	Lukewarm Water
Control (100% WF)	10.0	2.0	To taste	For frying	For kneading Dough
WF:BF:SP					
49:49:2 (Type-I)	10.0	2.0			
48:48:4 (Type-II)	10.0	2.0			
47:47:6 (Type-III)	10.0	2.0			
46:46:8 (Type-IV)	40.0	2.0			

WF: Wheat flour BGF: Bengal gram flour SP: *Spirulina* powder

Organoleptic acceptability of developed value added food products:

All the developed value added food products were organoleptically evaluated for their colour, texture, appearance, taste and overall acceptability by using 9-point Hedonic scale. On the basis of sensory acceptability, acceptable value added food products were further evaluated for their proximate composition and total dietary fiber content.

Proximate composition

The proximate composition of food products were determined by using the standard methods of analysis AOAC, (2000) [2]. Crude protein was determined by standard method of (AOAC 2000) [2] using KEL PLUS Automatic Nitrogen Estimation System. The micro Kjeldahl method was employed to determine the total nitrogen and the crude protein (N x 5.95). Crude fat extraction was done by petroleum ether using the Automatic SOCS Plus Solvent Extraction System. The ash and crude fibre contents were determined based on methods outlined in AOAC, (2000) [2].

Dietary fibre

Total, soluble and insoluble dietary fibre constituents were determined by the enzymatic method given by Furda (1981) [6]. Less than 1mm particle size food was defatted on a Socs-Plus apparatus as a sample. Water-soluble material was extracted by dispersing prepared sample in 200 ml of 0.005 N HCl. Starch and protein hydrolysis was completed by using alpha-amylase and bacterial protease, respectively. Insoluble dietary fibre (IDF) was isolated by filtering through a coarse-tared Gooch crucible and filtrate was further acidified by using concentrated HCL to precipitate soluble dietary fibre. This suspension was further filtered to get soluble dietary fiber (SDF). Sum of insoluble dietary fibre and soluble dietary fibre gave the amount of total dietary fiber.

Statistical Analysis

The data obtained were analyzed statistically using standard methods of analysis (Sheoran and Pannu 1999) [21]

Results and Discussion

Organoleptic characteristics of developed value added food products

Mean scores of organoleptic characteristics (colour, appearance, aroma, texture, taste and overall acceptability) of developed value added food products *matthi* are presented in the Table 2. Overall acceptability scores of *matthi* made from wheat flour and four types of composite flour i.e. Type-I, Type-II, Type-III and Type-IV were 7.90, 7.30, 7.06, 6.52 and 5.54, respectively. It was observed that *matthi* made from Type-IV composite flour scored lowest overall acceptability scores. Acceptability of *matthi* was found to be decreased with increasing the level of incorporation of *Spirulina* powder in wheat-bengal gram flour blend. Similar results were also reported by the workers in *Spirulina* supplemented bread, biscuits and snacks (Navacchi *et al.* 2012; Minh 2014; Saharan 2017; Shinde *et al.* 2018) [13, 11, 23]. Shinde *et al.* (2018) [23] reported that *Spirulina* supplementation affected slightly sensory characteristics of supplemented products might be due to its green colour and appearance. Food products having 6 % *Spirulina* exhibited sensory acceptance.

Table 2: Mean scores of organoleptic characteristics of value added *matthi*

Types of <i>Matthi</i>	Colour	Appearance	Aroma	Texture	Taste	Overall Acceptability
Control (WF 100%)	8.00±0.41	8.00±0.22	7.80±0.38	7.80±0.19	7.90±0.20	7.90±0.34
Type-I	7.40±0.51	7.40±0.21	7.50±0.43	7.30±0.27	6.90±0.31	7.30±0.39
Type-II	7.10±0.28	7.10±0.27	7.10±0.19	7.30±0.13	6.70±0.11	7.06±0.21
Type-III	6.50±0.77	6.60±0.39	6.80±0.23	6.90±0.14	5.80±0.15	6.52±0.41
Type-IV	5.90±0.71	5.20±0.40	6.10±0.21	5.30±0.13	5.20±0.17	5.54±0.31
CD (p=0.05)	0.32	0.20	0.17	0.08	0.09	0.24

Values are mean± SE of ten panelists

Type-I: WF: BGF: SP (49:49:2) Type-II: WF: BGF: SP (48:48:4)

Type-III: WF: BGF: SP (47:47:6) Type-IV: WF: BGF: SP (46:46:8)

WF: Wheat flour BGF: Bengal gram flour SP: *Spirulina* powder

Proximate composition

The results for proximate composition of *matthi* are given in Table 3. Control *matthi* contained 2.25 per cent moisture, 11.21 per cent crude protein, 32.50 per cent crude fat, 1.72 per cent crude fibre and 2.73 per cent ash, while these contents found to be significantly ($p=0.05$) increased in *matthi* made from Type-I, Type-II and Type-III composite flours. These

values ranged from 2.82 to 3.46, 17.73 to 20.99, 33.80 to 35.92, 2.98 to 3.97 and 2.84 to 3.43 per cent, respectively. Similar results were reported in *Spirulina* supplemented biscuits, cookies and snacks by other workers (Sharma and Dunkwal 2012; Vijjarani *et al* 2012; Ponciano 2015; Saharan 2017; Shinde *et al.* 2018) [20, 26, 17, 23]

Table 3: Proximate composition of value added *matthi* (% , on dry matter basis)

Types of Matar	Moisture*	Crude protein	Crude fat	Crude fiber	Ash
Control (WF 100%)	2.90±0.29	11.42±0.54	28.50±1.14	1.69±0.13	2.64±0.06
Type-I	3.19±0.17	17.62±0.32	29.45±0.99	2.92±0.18	2.69±0.12
Type-II	3.98±0.17	18.55±0.77	32.59±0.57	3.42±0.39	2.88±0.07
Type-III	4.22±0.18	20.59±0.45	34.84±0.87	3.95±0.17	3.31±0.13
CD ($p=0.05$)	0.15	0.31	0.53	0.12	0.06

*On wet fresh basis Values are mean± SE of three independent determinations.

Type-I: WF: BGF: SP (49:49:2) Type-II: WF: BGF: SP (48:48:4)

Type-III: WF: BGF: SP (47:47:6)

WF: Wheat flour BGF: Bengal gram flour SP: *Spirulina* powder

Total dietary fibre

The data given in Table 4 showed the total dietary fibre content of *matthi*. Total dietary fibre content of control *matthi* noted 8.56 g/100g and it was found in the range of 9.68 to 11.98 g/100g in all three types of snacks supplemented with *Spirulina*. Soluble and insoluble dietary fibre content of control *matthi* was noted 1.93 g/100g and 6.63 g/100g. Among the three types of *matthi*, Type-III *matthi* had maximum soluble content i.e. 3.01 g/100g followed by 2.99 g/100g in Type-II and 2.16 g/100g in Type-I *matthi*. However, significant ($p=0.05$) variations were observed among all types of *matthi*. The values for insoluble dietary fiber ranged from 8.52 to 9.97, respectively for Type-I, Type-II and Type-III *matthi*. Other workers also reported similar results in *Spirulina* supplemented products (Abd EL-Baky *et al.* 2015; Saharan 2017). It might be due to higher amount of dietary fiber in *Spirulina* powder.

It may be concluded from this research that *Spirulina* at 6% level can be successfully used in the development of food products (*matthi*) without affecting the sensory qualities of products. Addition of *Spirulina* has improved the nutrient profile of *matthi* specially the protein and fiber contents. Consumption of such enriched food products using *Spirulina* can benefit in a long run by improving the nutritional status of the general as well as malnourished population.

Table 4: Dietary fiber content of value added *matar* (g/100g, on dry matter basis)

Types of Matar	Total	Soluble	Insoluble
Control (WF 100%)	8.13±0.02	1.97±0.21	6.16±0.19
Type-I	9.76±0.36	2.99±0.21	6.77±0.41
Type-II	10.80±0.08	3.00±0.25	7.80±0.28
Type-III	11.90±0.41	3.36±0.34	8.24±0.45
CD($p=0.05$)	0.27	0.36	0.28

Values are mean ± SE of three independent determinations.

Type-I: WF: BGF: SP (49:49:2) Type-II: WF: BGF: SP (48:48:4)

Type-III: WF: BGF: SP (47:47:6)

WF: Wheat flour BGF: Bengal gram flour SP: *Spirulina* powder

References

1. Abd El Baky HH, El-Baroty GS, Ibrahim EA. Functional characters evaluation of biscuits sublimated with pure phycocyanin isolated from *Spirulina* and *Spirulina* biomass. Nutrition Hospitalaria 2015;32(1):231-241.
2. AOAC. Official methods of Analysis, Association of Official Analytical Chemist. Washington, D.C 2000.

3. Dewan. Impact of *Spirulina* as a nutritional supplement on the dietary intake and health status of adolescent girls of Shimla. Journal of Research: The Bede Athenaeum 2014;5(1):26-34.
4. Fadaei V, Mohamadi A, Darani K. Influence of *Spirulina platensis* powder on the starter culture viability in probiotic yoghurt containing spinach during cold storage. European Journal of Experimental Biology 2013;3:389-393.
5. Fatima A, Srivastava S. Development of protein rich products using *Spirulina*. International Journal of advancement in engineering technology, management and applied science 2016;3:198-201.
6. Furda I. Simultaneous analysis of soluble and insoluble dietary fibre. In: The Analysis of Fibre in Food. New York: Marcel Dekker 1981, 163-172.
7. Hosseini SM, Shahbazizadeh S, Khosravi-Darani K, Mozafari MR. Nutritional and medical applications of *Spirulina* microalgae. Mini Reviews in Medicinal Chemistry 2013;9:1-5.
8. Indian Council of Medical Research (ICMR). Nutrient requirements and recommended dietary allowances for Indians. A report of the expert group of the Indian council of medical research. National Institute of Nutrition, Hyderabad, India 2010, 1-2.
9. Johnson M, Hassinger L, Davis J, Devor ST, Di Silvestro RA. A randomized, double blind, placebo controlled study of *Spirulina* supplementation on indices of mental and physical fatigue in men. International Journal of Food Sciences and Nutrition 2016;67(2):203-6.
10. Kumoro AC, Johnny D, Alfilovita D. Incorporation of microalgae and seaweed in instant fried wheat noodles manufacturing: nutritional and culinary properties study. International Food Research Journal 2016;23(2):715-722.
11. Minh NP. Effect of *Saccharomyces cerevisiae*, *Spirulina* and preservative supplementation to sweet bread quality in bakery. International Journal of Multidisciplinary Research Development 2014;1(4):36-44.
12. Mohan A, Misra N, Srivastav D, Umapathy D, Kumar S. *Spirulina*- The nature's wonder: A review. Scholar Journal of Applied Medical Sciences 2014;2(4):1334-1339.
13. Navacchi MFP, Carvalho JCM, Takeuchi KP, Danesi EDG. Development of cassava cake enriched with its

- own bran and *Spirulina platensis*. Acta Scientiarum Technology 2012;34:465-472.
14. Ovando CA, Carvalho JCD, Pereira GVDM, Jacques P, Soccol VT, Soccol CR. Functional properties and health benefits of bioactive peptides derived from Spirulina: A review, Food Reviews International 2018;34(1):34-51.
 15. Patel S, Goyal A. Current and prospective insights on food and pharmaceutical applications of Spirulina. Current Trend in Biotechnology and Pharmaceutical 2013;7(2):696-707.
 16. Patil J, Matte A, Mallard C, Sandberg M. *Spirulina* diet to lactating mothers protects the antioxidant system and reduces inflammation in post-natal brain after systemic inflammation. Nutritional Neuroscience 2018;21(1):59-69.
 17. Ponciano GY. Production and utilization of microalgae. International Journal of Current Research in Bioscience and Plant Biology 2015;2(5):92-100.
 18. Saharan V. Value addition of food products using *Spirulina plantensis*: acceptability and nutrient composition. Ph.D Thesis, Department of Foods and Nutrition, CCS Haryana Agricultural University, Hisar, India 2017.
 19. Saharan V, Jood S. Dietary fibres, in vitro protein, total lysine, vitamin and antioxidant activity of noodles enriched with *Spirulina platensis* powder. Annals of Biology 2018;34(1):107-110.
 20. Sharma V, Dunkwal V. Development of *Spirulina* based biscuits: A potential method of value addition. Journal of Ethnobiology and Ethnomedicine 2012;6(1):31-34.
 21. Sheoran OP, Pannu RS. Statistical Package for agricultural workers. O.P. Stat College of Agriculture, Kaul, CCS Haryana Agricultural University, Hisar. India 1999.
 22. Sheoran OP, Pannu RS. Statistical Package for agricultural workers. O.P. Stat College of Agriculture, Kaul, CCS Haryana Agricultural University, Hisar. India 1999.
 23. Shinde Supriya, Lavale A, Shivaji, Nagare Kiran. *Spirulina* as an Additive for Better Nutrition. International Journal of Current Microbiology and Applied Sciences 2018;7:143-147.
 24. Singh S, Yadav A, Sony A. Nutritional evaluation and sensory characteristics of products developed from waste leaves of cauliflower. International Journal of Current Microbiology and Applied Sciences 2018;7:4782-4790.
 25. Udayasree V, Manjula K, Sowjanya M. Effect of *Spirulina* as a nutritional supplement in malnourished children. International Journal of Scientific Research 2013;2:2277-8179.
 26. Vijayarani D, Ponnalaghu S, Rajathivya J. Development of value added extruded product using *Spirulina*. International Journal of Health Science and Research 2012;2(4):42-47.
 27. Yigit F, Gurel-Gurevin E, Isbilen-Basok B, Esener OBB, Bilal T, Keser O *et al*. Protective effect of *Spirulina platensis* against cell damage and apoptosis in hepatic tissue caused by high fat diet, Biotechnic and Histochemistry 2016;91(3):182-94.