Formulation and quality evaluation of *Spirulina* incorporated ready to serve (RTS) functional food (Papad)

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Abstract:

Functional beverages have been gaining importance in recent times. It helps in prevention of diseases and promotion of health. It is the best opportune for delivering the essential vitamins, minerals, phytochemicals and antioxidants as it is convenient and most preferred by consumers. This study was carried out to develop and investigate the properties of the *Spirulina* incorporated papad Ready to serve (RTS) functional food. Five ratios of RTS functional food (Papad) were prepared from *Spirulina* Powder, Sabudana, Potato, Water and Salt. The food product hence prepared along with the control sample was subjected to sensory evaluation by panel members using nine-point hedonic scale. The two best variations chosen by the panellists were further selected for quality evaluation. Nutritional composition studies revealed that the food product was a good source of vitamin C and protein. The products were considered safe for consumption until thirty days from the date of preparation. Hence, the functional food product prepared can be considered an ideal replacement for the commercially available other food products.

KEY WORDS: RTS, FUNCTIONAL FOOD, SPIRULINA, NEW PRODUCT DEVELOPMENT,

INTRODUCTION

Proteins are the most abundant macromolecules in living cells of animal and plant tissues. For humans, dietary protein is essential for growth, development, reproduction, lactation, and health (Wu, 2010). Across Europe, about 61 % of the dietary protein is supplied by animal-derived foods (de Boer *et al.*, 2006), which are nutritious and meet dietary requirements due to adequate amounts and proper ratios of amino acids and micronutrients (FAO/WHO, 1991). The global demand for protein is continuously rising due to population growth, increasing incomes, and a consequently growing middle-class (Sabaté & Soret, 2014; Wu *et al.*, 2014). During this development, an increase in demands for more nutrient-dense foods, mainly of animal origin, can be observed. The underlying phenomenon is described by Bennett's law who described the positive correlation between increasing wealth and higher consumption of meat and dairy while consuming less protein from staples (Bennett, 1941). Global food systems have responded to growing demand through increased productivity based on intensification, fertilization, and genetic modification (Fedoroff, 2015). However, growing demands cannot be met by a simple increase in agricultural production without harming

the environment and depleting natural resources. Today's intensive agricultural systems already influence the environment through its increased emissions of greenhouse gases (GHG) like nitrous oxide (N2O) which is linked to the use of nitrogen fertilizers, methane (CH4) from enteric fermentation of ruminants as well as carbon dioxide (CO2) emissions from the combustion of fossil fuels (Guyomard *et al.,* 2012; Yusuf *et al.,* 2012). Securing food production under planetary constraints is consequently one of the urgent tasks to be solved in re-cent times. A transformation of the food sector, or more aptly a transition to sustainable1 production, is therefore highly needed to secure the provision of food while limiting the im- pact on the environment (Vinnari & Vinnari, 2014). The production of animal-source foods occurs at a high environmental cost and generates more GHG emissions than the production of plant-based foods (Di Paola *et al.,* 2017; Sabaté *et* 2 *al.,* 2015).

Spirulina is a photosynthetic, filamentous spiral-shaped, multicellular, and blue-green microalgae. The two most important species are *Spirulina maxima* and *Spirulina platensis.* This microorganisms' cell division occurs by binary fission. It belongs to Cyanophyceae class, the Oscillatoriaceae family; this cyanobacterium is characterized by spiral chains of the cells enclosed in a thin sheath. *Spirulina* has a very long history of being served as a source of food for the human being. *Spirulina* is a spiral filament generally found in freshwater. It contains 60%-70% protein in dry weight. The protein elements consist of 18 types of amino acids, several vitamins, such as vitamins A, B, E, and K, minerals, and fatty acids necessary to the body. It contains carotenoids, chlorophyll, and major phycocyanin pigments. *Spirulina* pigments are colorful chemical compounds that only reflect light at certain wavelengths. This makes them appear colorful as flowers, corals, and animal skins which contain pigments that give them their color. More important than their reflection of light is the ability of a pigment to absorb certain wavelengths. Because they interact with light to absorb only wavelengths, pigments are useful to plants and other autotrophic organisms, which make their food using photosynthesis. Olimentsare how the energy of sunlight is captured for photosynthesis. However, since each pigment reacts with only a narrow range of the spectrum, there is usually a need to produce several kinds of pigments for each colour, to capture more of the sun’s energy. *Spirulina* pigments have massive commercial value as natural colorants in nutraceutical, cosmetics, and pharmaceutical industries, besides their health benefits. An extensive range of pigments including phycobiliproteins is present in *Spirulina.* C-phycocyanin (C-PC), a phycobiliprotein, is one of the key pigments of *Spirulina,* microalgae used in many countries as a dietary supplement (Kudduse*t al.,*2013).

MATERIAL AND METHODS

Strain Collection :

Dry Powder of *Spirulina platensis* was purchased from Batra Herbals, Bhopal (M.P.)

Composition of *Spirulina* based Papad:

Sabudana, potato, *Spirulina* powder water, and salt essence were taken. In that *Spirulina* powder was incorporated for the preparation of Papad. The Papad was manufactured in the confectionary.

Composition of *Spirulina* Papad

S.No.	Ingredients	Quantity
1.	*Spirulina* Powder (gm)	100gm
2.	Sabudana (gm)	500gm
3.	Potato (gm)	500gm
4.	Water	1000ml
5.	Salt	10gm

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.

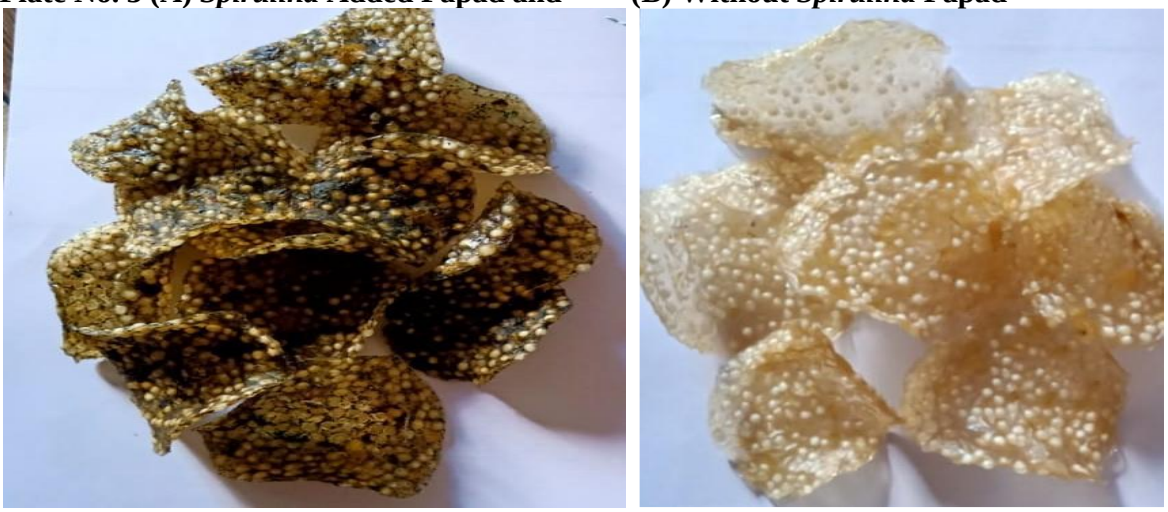
Nutritional Evaluation- Prepared pasta was analyzed Moisture, Ash, Protein, Fat, Carbohydrate,, Energy, Iron, Calcium and Phosphorous(AOAC,1995).

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).

Plate No. 1 *Spirulina* Powder

Plate No.2 (A) *Spirulina* Added (B) Without *Spirulina*

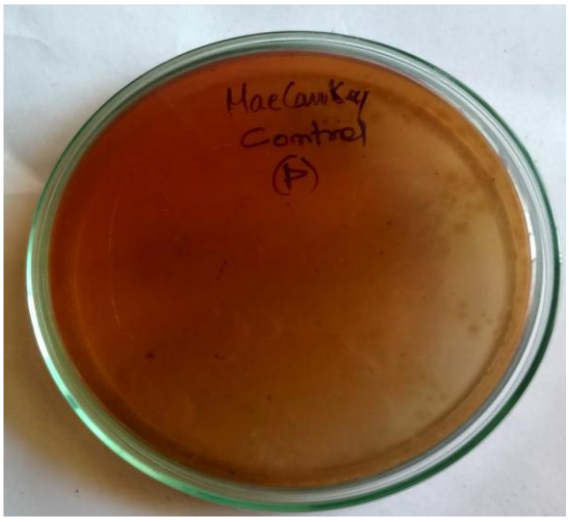
Plate No. 3 (A) *Spirulina* Added Papad and (B) Without *Spirulina* Papad



(A) (B)

Plate NO.4 (A) *Spirulina*Added Dry Papad and (B) Without *Spirulina* Dry Papad

Plate No. 5 Different Media Used for microbiological testing



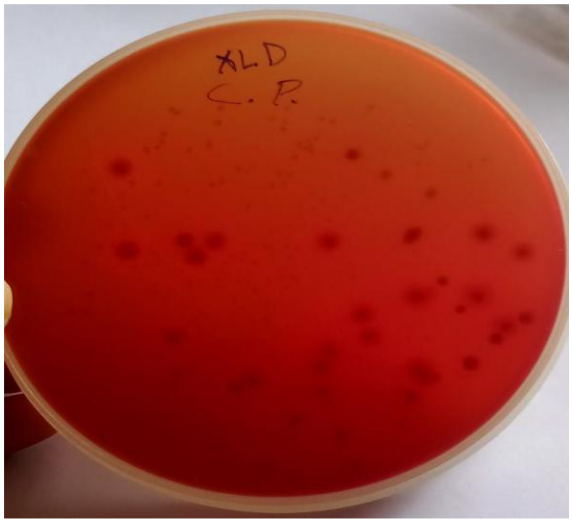


Plate No. 6 Colonies of *Salmonella sp.* Grown on MacConkey Agar plate

Plate No. 7 Colonies of *Staphylococcus sp.*grown on XLD agar plate

Plate No. 8 Colonies of *Vibrio parchaemolyticus* grown on TCBS Agar plate

RESULTS AND DISCUSSION

Nutritional Evaluation:-

The nutritional composition of the standard product "*Spirulina* Papad" (100gm) was concluded by using nutritive values of Indian foods by Gopalan *et.al*., (2004). Essential nutrients such as protein, energy, carbohydrates, fats, minerals, crude fibers, and iron were calculated and presented in table 1. Moisture is an important parameter because it significantly affects the shelf life and growth of the microbes.

In *Spirulina* products Papad the moisture content was found to be 8.46%. Ash is composed of inorganic matter generally present in Papad. It includes iron, copper, potassium, sodium, and zinc. Besides, providing needed minerals to the diet, ash increases yeast fermentation by providing minerals to yeast. In this study, the Papad sample have 4.48% Ash by mass, while crude fiber was 0.86% mass. The content is very important to check the quality of Papad. It is a key factor to determine the stability of different Papad. The protein content was calculated at 33.77%. The fat content found in the Papad sample was 0.33% and the carbohydrate content was 52.96% by mass. The energy content of the Papad sample was 349.89% kcal/100gram.

In the control product Papad the moisture content was found to be 9.28%. Ash in Papad was 3.12% and Fat, Fiber, Sugar, and Total Carbohydrate were 0.33%, 0.88%, 2.68%, and 86.33% in control Papad. The energy content of the Papad was 351.89 Kcal/100 gram.

Quality Analysis of developed Papad Samples

Types	Flavour	Taste	Colour	Texture	Overall Acceptability
C	8.9±1.0	9.3±1.1	8.5±1.1	8.2±1.5	**8.7±0.5**
S1	8.3±1.6	7.4±1.7	8.4±1.3	8.3±0.9	**8.1±0.5**
S2	7.7±1.7	8.1±1.0	8.6±1.0	7.8±1.7	**8.1±0.4**
Mean±SD	**8.1±0.6**	**8.1±0.9**	**8.4±0.3**	**8.1±0.2**	

Quality and stability of *Spirulina* Papad

Studies on the quality and stability and Shelf Life stability of *Spirulina* Papad in very valuable from the viewpoint of risk assessment. Total viable count or total plats count is used as an indicator of the bacterial population on a sample. It is widely used to gain opinions about the hygienic quality of microbiological load and shelf stability of foodstuffs.

The result of the microbiological test showed the presence of bacteria (Table:5) such as *Salmonella sp. Staphylocccoccus sp. Vibrio parahaemoly ticus, Escherichia coli,* and *Aspergillus sulfurous.* Result of shelf life studies showed that the total plate count in *Spirulina* Papad tested over 45 days for bacteria were less than 15. The *Spirulina* Papad had a 45 day shelf life.

Spirulina is a "Super food.'' It is the most nutritious, concentrated whole food known to humankind. It has a rich, vibrant history, and occupies an intriguing biological and ecological niche in the plant kingdom. *Spirulina* is truly a portion of amazing food, full of nutritional wonders. Imagine a food that can help regulate blood sugar, blood pressure, and cholesterol; a portion of food that can alleviate pain from inflammation and deliver antioxidant activity to ward off life-threatening diseases like cancer, Alzheimer's, heart disease, and stroke; a food that helps and protects the liver and kidneys and removes radiation from the body; a food that improves the immune system, alleviates allergies and has been proven to fight many different viruses; a food that helps your eyes and brain; a portion of food that can help you lose weight, increase friendly flora in the intestines and improve digestion**.**

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