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Preparation and Quality Evaluation of Iron Binding Protein Augumented Dhokla Using Spirulina and Other Natural Ingredients

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Spirulina is a nature's present as extremely good meals to mankind. It is a photosynthetic filamentous microalga which has emerged as a amazing meals complement because of its wealthy micro- and macronutrient contents. The frame of Spirulina is smooth and with vulnerable mobileular wall that makes it effortlessly digestible. It is a precious supply of proteins, vitamins, minerals, β-carotene, fatty acids, etc. which makes it best as meals and fodder. NASA has said that the dietary cost of one thousand kg of fruits and veggies equals to at least one kg of Spirulina. In 1992 WHO has declared Spirulina as "Best meals for future" to redress malnutrition specifically in children. Apart from being a meals complement, Spirulina has won sizeable reputation and paramount significance because of the presence of sure pigments and secondary metabolites. It suggests pharmacognosic homes like immuno-protective, anticancer, antidiabetic, antiviral, anti-obesity, etc. it's far the maximum nutritionally concentrated compact entire meals recognized which owe a capacity to significantly lower the probabilities of growing cancer, coronary heart disease, or stroke or of contracting a lifethreatening virus along with HIV and save you eyes from cataract formation. In the present study, spirulina enriched food dhokla (SBDF) was developed. SBDF accept overall acceptability by panelist such as color and appearance, aroma/odour, flavor and

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taste, body and texture. SBDF showed good amount of protein (10.48%), and iron (30.48%) as compared to control. Afterward, the developed SDFB exhibited good amount of antioxidants content (38.62%) and moisture conent (14.56%), respectively. SBDF can be most attractive and nutritious food for every people due to rich source of protein and iron. This novel food can solve diseases/problems related with protein and iron deficiency.

Keywords: Spirulina; protein; iron; nutritionist dhokla; every population.

1. INTRODUCTION

Nutrient rich a super food of spirulina for super health. Can be defined is a super food that have heath enhancing benefits and disease preventing properties above and over their usual nutritional value. Spirulina is the common name for animal and human diet supplements created chief from that is Cynobacteria, Arthrospira maxima and arthrospireaplatensis. Antiviral and antiglutegenic effect, Spirulina has many therapeutic properties such as hypocholestrolemic or immunological.Spirulina this is excellent source of protein.

The word instant mix food where is some of the ingredients is premixed. Easy and fast to prepare, This is simple. Instant food available home made choice or provide an easy. (AS [1]. The food is used for preparation of various sweets and snack. This is helps to save significant resources such as time and energy [2].

Dhokla is a having its origin in Gujarati India. Dhokla is a vegetarian food item this is made a fermented batter from semolina and chickpea, rice [3]. Dhokla is used for breakfast, snack, occasionally. This is a side dish or as a snack is usually tasty and slightly sugary in taste. Soft in consistency so right even for old people or children, This is liked by the all age groups. Because Dhokla is a soft diet or easily digestible [4].

The present study was spirulina with iron rich Dhokla is very tasty and fluffy and good nutritious. Because spirulina microscopic and filamentous cyanobacterium that originates its name from spiral and helical nature of its filaments [5]. Spirulina refers to the dried biomass of Arthrospira platensis, An marine water and oxygenic photosynthetic bacterium create world wide in fresh [6]. It is alga represents an important diet in humans and has been used as a richest in protein and vitamins especially $B_{12,}$ Minerals specially Iron supplement in human without any significant. And this is abundant in other nutrient, like carotenoid, sulpholipids, glycolipid, phycocyaninetc [7]. Spirulina and their food based on easily digestible. The function of spirulina in growth immunity and inhence resistence to viral infections are well documented (H Chakdar et all 2012).

The currently study was spirulina with iron rich dhokla is good for all age groups. Because Iron or protein important for all age groups men and women [8]. It is prevent in bones disease, Anemia. Or maintain to body building and growth in specially energy [9]. So Iron rich with spirulina and protein presented dhokla it was very important for children, Adult, young, old age, men and women etc.

In the current study spirulina based food developed by using natural ingredients and after the development of product and further it has been checked sensory and proximal properties.

2. MATERIALS AND METHODS

2.1 Collection of Ingredientds

`Green Pea (*Camellia sinensis*), Carrot (*Daucus carota* subs. Sativa), Spinach (Spinacia Oleracea), Gram Flour (*Cicer arietinum*), Spirulina (*Arthrospira platensis*), Masturd seed (*Brassica nigra*) powder was purchased on the big bazar of the lukhnow,Utter Pradesh, India. Spirulina was procured from the Patanjali, Pvt, Ltd. Kanpur Utter Pradesh India. All the chemicals required for analysis of the sample were purchased from Merck, India.

2.2 Development of Food Dhokla

For the development of dhokla, All ingredients was washed with normal water (10 minutes to removal of dust particals [10]. After washed carrot is crushed by crusher (model:WCM India) for 30 minutes, Gram flour after cleaned by sieve (Shree Technogy) roasted in 20 minutes slow flam, Or spinach was chopped, Steam in 20

minute (30^0c), Green pea used micxure grinded (model Maharaja), Mustard seed after cleaned used [11].

Development of dhokla, the following the ratio was taken for 1kg, Gram flour (250 gm), Spinach (250 gm), Green Pea (300 gm), Carrot (250 gm), Mastard seed (50 gm), Mustard oil (100 gm), Kari leaves (50 gm), Green chilly (100 gm), Baking powder (5 gm).

Spirulina powder (10 gm) as recommended dose (Santos et al., 2016) and final mixed and water to make (1 Litter) it was pouring consistency as per All ingredient mixed in 30 minute accept spirulina was mixed properly 10 minutes clock wise and 10 minutes anti clock wise, keep the better aside for 20 minutes for fermenting [12]. And used in butter peper or light oil, and cooked in high tempreture in (80^0c) 20 minutes microwave (model: Whirlpool WMC30516A). It was 10 minute standing time then checked, Insert a knife, It was come out clean. And oil or black mustard seeds and sauté for 10 minutes, It was added curry leaves and Green chilly sauté for while in 10 minutes in (20^0c) for this run knife all around like this and place a plate over it and then flip it.this is was cut into the piece, ([13], It was tadka on the top of the dhokla pieces rectangular shape (8cm x 6 cm x 5 cm) to obtain Iron rich dhokla in nutrition weighing 70 gm each for control sample. All process was done in the Laboratory of Bakery and confectionary Lab, Department and Human development and Family studies from Baba saheb Bhimrao Ambedkar University Lukhnow Utter Pradesh India.

2.3 Sensory Evaluation

The developed dhokla was analyzed for five mainly sensory characteristics (appearance, taste, texture, and overall acceptability). Sensory evaluation was performed by a panel 10 trained panelists. Sensory evaluation was performed at e normal tempreture, 10 point Hedonic rating scale (all most panelist is like extreamly 2=4=8=10 like extreamly) was used for evaluating of the food bar like the appearance, body and texture, aroma, taste and overall acceptability of the food dhokla.

2.4 Estimation of the Protein of Dhokla Food

The developed food dhokla was examined for protein as per Lowry method (1951). Briefly, the sample was diluted with 1 mL distilled water and further added 0.9 mL of solution A [2 g L^{-1} potassium sodium tartrate ($KNaC_4H_4O_6{\cdot}4H_2O$) and 100 g L^{-1} sodium carbonate (Na_2CO_3) in 0.5 M NaOH) mixed at 50 °C for 10 min]. Afterward, the sample was cooled at room temperature and added 1 mL of solution B [0.2 g L^{-1} $KNaC_4H_4O_6{\cdot}4H_2O$ and 0.1 g L^{-1} copper sulphate pentahydrate ($CuSO_4{\cdot}5H_2O$) in 0.1 M NaOH) mixed properly for 10 min at normal room temperature]. In the last stage, before incubation 3 mL of solution C [Folin–Ciocalteu phenol reagent in H_2O (1:16 *v*/*v*)] was added and left for 10 min at 50 °C. For the standard curve preparation, bovine serum albumin (BSA) was used in the following ratio; 0.1, 0.5, 1, 2, 5, 10 gmL^{-1}) and absorbance of the sample was read at 650 nm by spectrophotometer.

2.5 Estimation of Iron in Food Dhokla

A volume of 1 mL of a neutral pH solution containing 0.1-100 µg of iron (II) in a 10-mL of the morin reagent solution was made in 10 ml test tube. Afterward, 1mL of 0.001 M sulfuric acid was added in the mixed sample and incubated for 1 min. 4 mL of ethanol was further added and maintained 10 mL volume with deionized water. The absorbance of the sample and blank was read at 415 nm by spectrophotometer. For control, ferric chloride (Himedia, Mumbai) was used.

2.6 Estimation of Antioxidant Activity

For the estimation of antioxidant activity in food dhokla, 1,1-disphenyl- 2-picrylhydrazyl (DPPH) as radical scavenging agent was used (Braca et al. 2001). Briefly, 1 gm of food bar sample was dissolved in 100 ml ethanol and allowed to remain still overnight. After overnight incubation, sample was centrifuged at 3000 rpm for 10 min and removed the pelleted or solid part of the sample. Further, 0.2 ml of sample was mixed with 1 ml of freshly prepared DPPH solution (80µg/ml ethanol) in a test tube covered with aluminium sheet. For control, 0.2 ml distilled water and 1 ml of DPPH solution was added into it. All samples were allowed to remain in the dark for 30 min and further were the absorbance of the samples and blank sample were measured by UV-Vis spectrophotometer at 517 nm.

2.7 Moisture Content

For the estimation of moisture content, food dhokla sample (20 gm) was heated in the hot air

oven with the lids of the moisture dishes off at the specified air temperature (100^{o}C) and 72 h. After heating, sample was cooled to room temperature. The initial weight and final weight was calculated using the given formula for estimation of moisture content-

M=Mw/Mw +MdX 100%

Where M: moisture content, Mw: mass of water removed from the food bar after drying, Md: mass of food bar after drying, and Mw + Md: initial mass of food sample before drying.

2.8 Statistical Analysis

Each treatment had three replications and all the experiments were performed in triplicates. Data were analysed using means and using standard deviation as per Gomez and Gomez (1984).

3. RESULT AND DISCUSSION

In the present study, there was two dhokla developed namely; 1, common food dhokla and 2, *Spirulina* enriched dhokla. After the development of dhokla food, the product was analysed for proximate. *Spirulina* enriched dhokla was observed 10.48 g protein in 100 g sample, while in common food dhokla, there was found 8.86 g protein/100 g dhokla sample. Approximately154.5% protein content was increased in *Spirulina* enriched dhokla sample as compared to control sample (common food dhokla) (Fig. 1). Increase of protein content in *Spirulina* enriched dhokla was observed due to addition of *Spirulina.* Proteins are important thing of each unmarried mobileular in human frame and this is why are essential to be blanketed in one's diet. Spirulina includes generally excessive quantity of protein among fifty five and 70% through dry weight . Spirulina includes vital amino acids especially leucine, valine, isoleucine, tryptophan, methionine, phenylalanine, theanine, and lysine . Aspartate and glutamate are the 2 nonessential amino acids found in Spirulina. Unlike different plant-derived proteins, Spirulina is a really perfect protein as it includes all of the vital amino acids. Its fame as a plant-primarily based totally supply of complete protein makes it an excellent nutritional complement desire for vegetarians. Spirulina cells do now no longer have cellulose partitions however incredibly fragile envelope of murein that is certainly considered one among its types in plant kingdom. This explains the very excessive digestibility of its proteins. The internet protein utilization (NPU) is calculated through understanding the proportion of nitrogen retained whilst supply of proteins beneath Neath studying the handiest proscribing dietary factor. The NPU cost of Spirulina is expected among fifty five and 92% greater in contrast to casein . While, the load received through the man or woman divided through the load of protein ingested is referred to as protein performance ratio (PER). The PER values for Spirulina become determined out to be double than casein (M, Mathur 2018).

The moisture content of the nutritional dhokla indicates the amount of liquid glucose present in the sample which works as a binding agent in the nutritionist dhokla. It was found to be better moisture content (12.42%) in the common food dhokla in comparison to *Spirulina* food dhokla 14.56 (Fig. 1). Means addition of *Spirulina* did not affect the moisture content of the nutritionist dhokla. In the presence of higher moisture content in the food, microbes such as bacteria, molds, and fungi can easily attack. In this way, the self-life of the food has been decreased when the moisture content will be high [14]. However, moisture of the food did not change the taste, colour and other nutritional of the food bar [15].

In the present study, **Iron content** in *Spirulina* food dhokla was observed 30.48 mg, while in the common food bar, iron was 18.86 mg. Means *Spirulina* food dhokla was found 551.72% higher iron content as comparison with common food dhokla. Iron is one of the important essential inorganic micronutrients that the body needs to carry out various functions and processes for healthy living system [16]. The property of rich source of iron i.e., *Spirulina* that makes economically important food [17]. Several diseases related with iron deficiency can be treating via *Spirulina* enrich food. Spirulina incorporates the pigment phycocyanin that is proven to stimulate the bone marrow to provide blood cells extra effectively. It additionally modulates the manufacturing of cytokines through human blood mononuclear cells and will increase flavonoids and sulfolipids Spirulina therefore complements purple blood cell's manufacturing and function. Its consumption has proven a consistent growth in common values of suggest corpuscular haemoglobin. Older ladies have been benefitted extra swiftly from Spirulina supplements Level of anaemia become additionally reduced in youngsters given Spirulina supplements for 12 weeks.

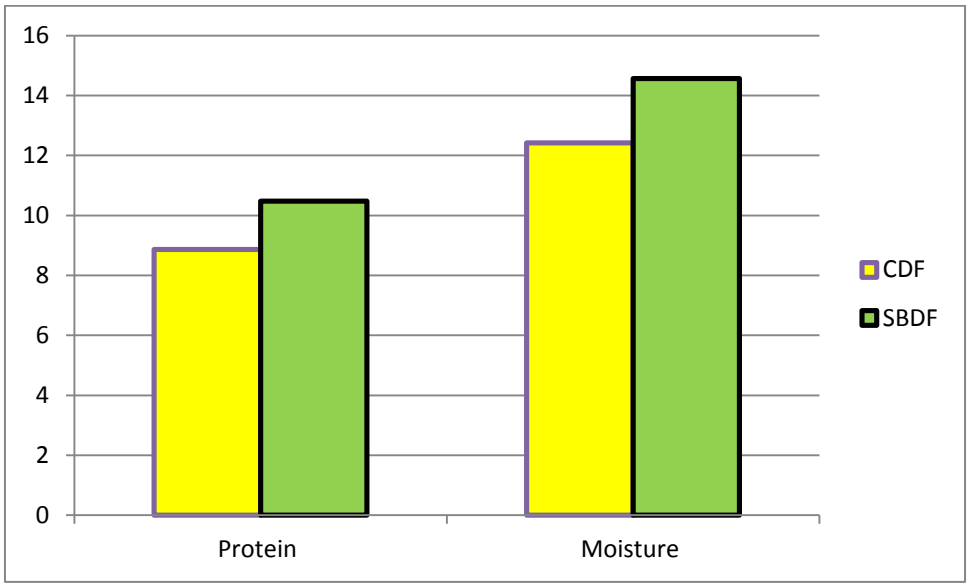

Fig. 1. Protein and moisture content estimation in developed Dhokla food

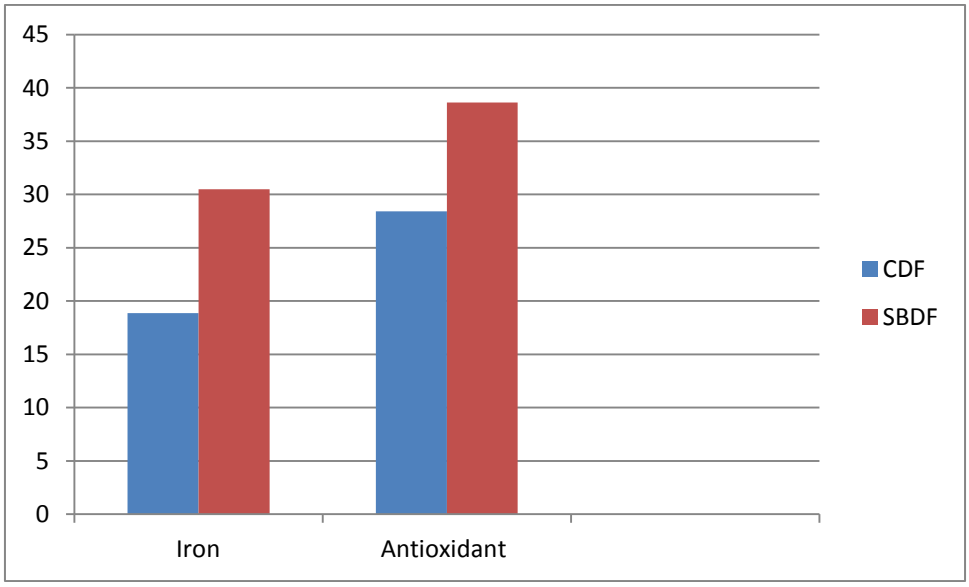

Fig. 2. Iron and antioxidant content estimation in developed Dhokla food

In the present study, the total **antioxidants content** in *Spirulina* rich dhokla was 38.62 %, while in the common food dhokla it was recorded 28.40%, respectively. The antioxidant property of *Spirulina* rich dhokla was 384.84% higher as compared with common food dhokla. Antioxidants are matters which neutralize the unstable free radicals present in the body produced by oxidative stress. The advantageous antioxidant assets. Spirulina are because of the presence of tocopherols, beta-carotene and phenolic acids. In the presence of those assets. Antioxidants are materials which neutralize the volatile unfastened radicals generated because of oxidative strain. This useful antioxidant belongings of Spirulina is because Bioactive Molecules of Spirulina: A Food Supplement 11 of the presence of tocopherols, phenolic acids, and beta-carotene. This causes prevention of oxidative strain and infection and their associative damages. Geriatric sufferers administered Spirulina for sixteen weeks confirmed a remarkable development in antioxidant potential, as measured through extended ranges of antioxidants in plasma of the individuals. (M.Mathur 2018)

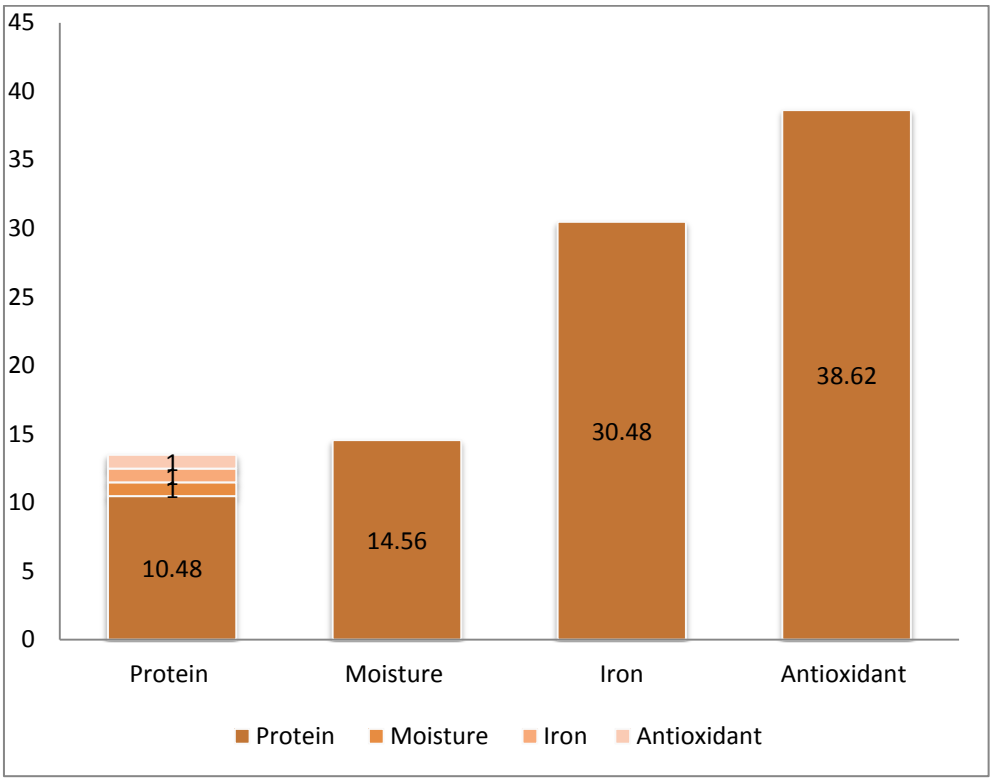

Fig. 3. SBDF

Table 1. Sensory evaluation parameters (10 Point Hedonic Scale) of developed Dhokla food

Developed Food Dhokla	Colour and appearance	Aroma/odour	Flavour and taste	Body and texture	Overall acceptability
CDF	7.24±0.12	8.20±0.61	8.26±0.48	8.81±0.21	8.62±0.24
SBDF	9.12±0.08	9.10±0.12	8.45±0.24	8.64±0.41	7.54±0.22

*Data are mean of three replicates ± standard error of means. Where, **CDF**: Common Dhokla food, **SBDF**: Spirulinabased Dhokla Food*

3.1 Sensory Evaluation

In this study, the colour of the *Spirulina* enriched dhokla was observed significantly different from control (common food dhokla) sample (Table 1). Sensory analysis was performed primarily to identify the nutrition dhokla with the highest acceptability and to contribute to one understands of human population product selection. In this study, higher content of protein in *Spirulina* enriched dhokla (10.48 g/100 g dhokla) was noticed and showed more the intense greenness of the dhokla, and the better the appeal as compared to control sample (Table 1). It was observed that the panellists could not find significant difference between the common and *Spirulina* enriched dhokla in the terms of odour and aroma. The common food dhokla (sample) was scored higher acceptability in terms of odour/aroma (9.10±0.12) than *Spirulina* enriched dhokla (Table 1).

Taste is one of the main important factors of food for acceptability of many population. In addition, taste is a more powerful element than health-promoting aspects for product selection. The better taste indicates that they likely it is for the product to gain the acceptability of Adult, children, Young and elderly population. In the present study, sensory scores of taste and flavour of *Spirulina* food dhokla was 8.45±0.24 which was similar as control's score 8.26±0.48 (Table 1). This score was reduced might be due to some bitter taste of *Spirulina* food dhokla. The acceptance of novel product like *Spiriluna* enriched dhokla also depends on the properties of taste or flavour.

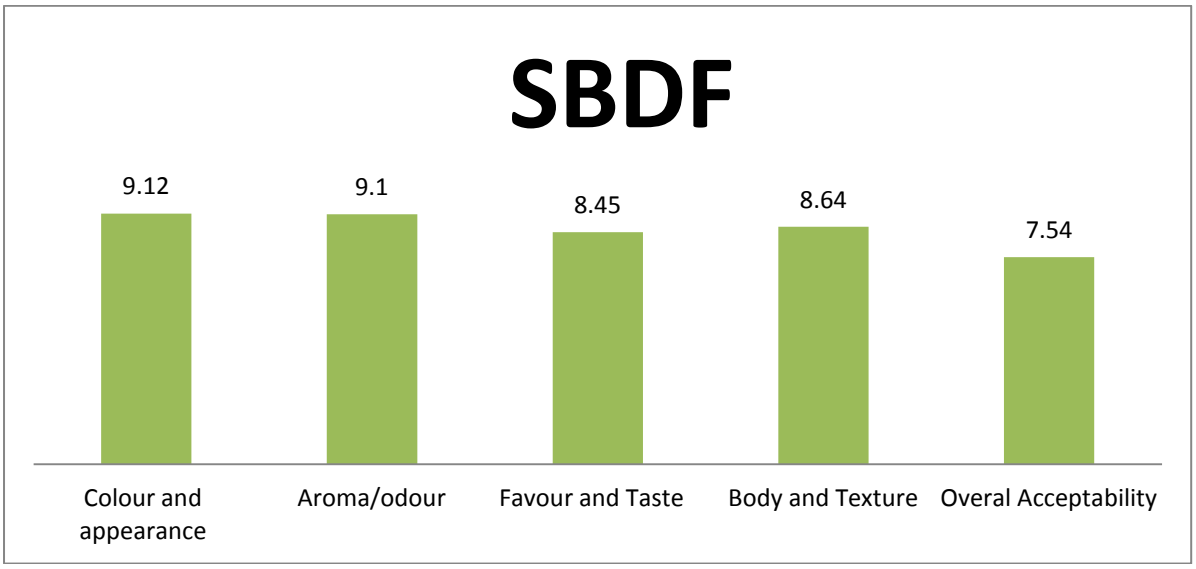

Fig. 4. Spirulina Dhokla food

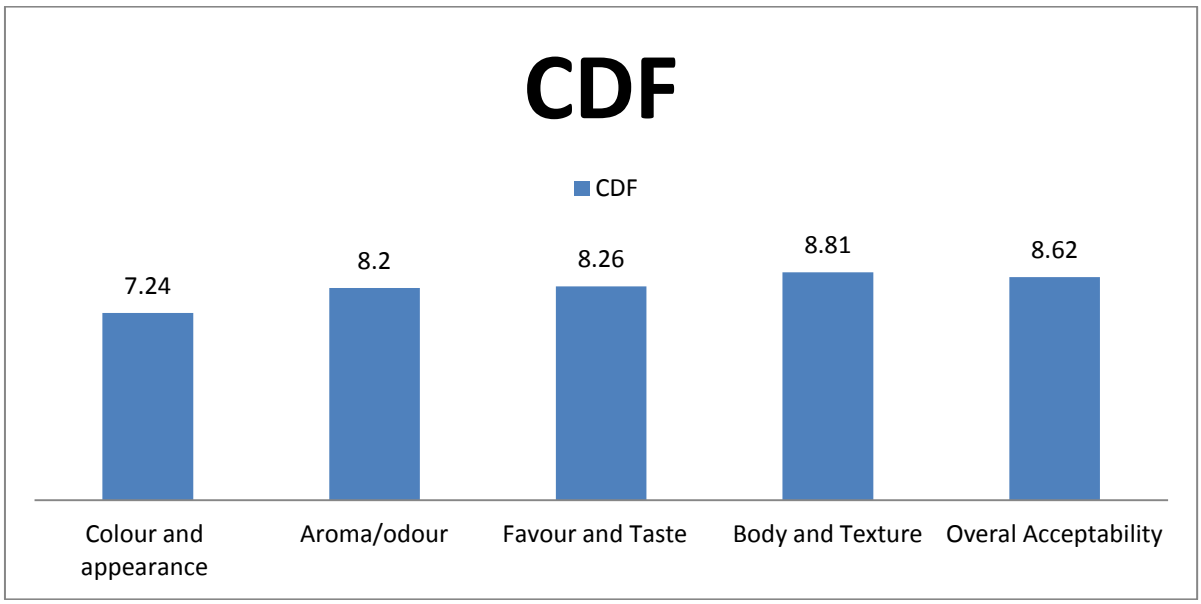

Fig. 5. Common Dhokla food

Spirulina enriched dhokla was most acceptable in terms of body and texture as compared with control sample by the panellists. It was scored 8.64±0.41 (*Spirulina* based dhokla) which was closest to the control's score (8.81±0.21) (Table 1).Body and texture of the food dhokla were mainly affected by basan used for making the dhokla. . The chewiness properties of the food dhokla also depend on the body and texture and vegetables added product has more hardness and fluffiness as compared to normal dhokla spirulina added product is very good (Anganadham et al. 2016).

4. CONCLUSION

Preventive healthcare says "allow your meals be your medicine." Spirulina absolutely comes in such class of meals supplement. As mentioned withinside the paper, it has a variety of bioactive molecules with extraordinarily excessive quantity of digestible protein, 9 crucial amino acids, excessive ranges of β-carotene, nutrition B12, iron and hint minerals, rare crucial fatty acid γ-linolenic acid (GLA), and pigments like C-phycocyanin (C-PC) and phycobilin which makes it extraordinarily desirable. In addition, it has no

obvious terrible cultural and spiritual troubles related to its consumption.

DISCLAIMER

The products used for this research are commonly and predominantly use products in our area of research and country. There is absolutely no conflict of interest between the authors and producers of the products because we do not intend to use these products as an avenue for any litigation but for the advancement of knowledge. Also, the research was not funded by the producing company rather it was funded by personal efforts of the authors.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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