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SUITABILITY STUDIES OF VARIOUS FIBERS AND OTHER NOVEL INGREDIENTS FOR PREPARATION OF FUNCTIONAL *DODA BURFI (INDIAN MILK CAKE)*

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ABSTRACT

Doda burfi, also known as dhoda or simply doda is characterized by granular texture, caramelized flavour, and dark brown colour with pleasant aroma of added nuts. For preparation of functional doda burfi, five different fibers were screened. The aim of the study was to prepare a functionally healthy counter product of conventional burfi in output. Therefore natural non- conventional sweetener stevia was also tested for its suitability in burfi and to further increase the functionality, phytosterol (cholesterol lowering substance) was added to prepare functional doda burfi. In total, five different fibers namely wheat bran, oat fiber, microcrystalline cellulose, inulin and Diesol™ (hydrolyzed gum acacia) were evaluated in the product and the best two fibers were taken further for the preparation of functional doda burfi. Sensory studies revealed oat fiber and Diesol™ as best fibers in the product and consumer survey revealed the functional product acceptable and comparable to conventional product.

***Keywords:* Caramelized milk product, Sensory, Granular, Phytosterol, soluble Fiber, stevia.**

INTRODUCTION

In recent years of awaken awareness and constantly increasing health regimen among all the segments of population, there has been increasing demand for health benefitting foods. This urge has given way for the development of variety of functional foods in variety of foodstuffs. Successful types of functional products have been designed to reduce the high blood pressure, cholesterol, blood sugar, and osteoporosis, improvement of gut and intestinal health and immune enhancer and are available in market in one form or the other. Various functionally active ingredients fortified or enriched food products like products with fat/ calorie replacers (artificial sweeteners), vitamins and minerals, fiber/ prebiotics and probiotics, phytosterols, stanols, antioxidants, herbs, micronutrients and many more are becoming choice of modern consumer. Among these, fiber enriched or fortified foods and products prepared using artificial sweeteners carries an exceptional demand and importance in today's life. The interest in the development of functional foods is growing day by day due to growing consumer awareness regarding their health, physical status and at the same

time consumer wants to satisfy their needs without compromising with the food intake habits. The recent reported cases of ailments specially fear of diabetes and obesity have inclined modern consumer towards artificial sweeteners and non- calorie sweeteners. Consumption of non-calorie sweeteners is also increasing day by day and availability of artificially sweetened products on the shelves in market is a good example of the same in real life. Also, high-fiber diets have been linked with reduced high serum cholesterol level and various digestive disorders. Fiber not only increases bulk of the food and moves it through the colon more rapidly, but also helps in preventing constipation and possible colon and rectal cancer (Niness 1999; Thompson 2005). Epidemiological studies correlating the high consumption of dietary fiber and lower incidence of certain diseases such as cardiovascular and cancer of colon & rectum, boosted searches on dietary fiber. Several diseases such as diabetes, arthrosclerosis, breast cancer, diverticulitis, hemorrhoids, have been connected with a low fiber intake (Gutkoski et al. 2007) and high risk of obesity (Alfieri et al. 1995; Van Itallie 1978). Apart from this, fiber also improves the bulkiness of product and acts as a prebiotic for the growth of essential bacteria.

Dairy products are often considered good source of various minerals, protein with good amount of fat along with vitamins but lack dietary fiber as an essential component of human diet. However, there are certain traditional Indian composite dairy products available, which are known for their additional advantage of containing fiber, besides providing the inherent benefits of milk. *Doda burfi* is an example of such type of product which is a heat desiccated traditional sweetmeat of northern India popular in many states especially in Punjab, U.P. Haryana and Rajasthan (Singh and Kumar 2006). The product is made from germinated wheat flour (*angoori atta*), buffalo milk and sugar along with certain optional ingredients such as pure ghee/fat and various nuts used for garnishing. The product is characterized by pleasant caramelized flavor, dark brown color and sticky granular body. The product contains most of the nutrients in pre-digested form and serves as an excellent source of dietary fiber, usually absent in dairy products. But high calorific value owing to presence of high amount of sugar and fat with no perceived health benefits, are the main drawbacks associated with this and many other traditional Indian dairy products. A recent data depicts that the diabetic population of the country at present is 180 million and is expected to double by the year 2030 (WHO, 2006). Modern lifestyle and changes in diet pattern contributed a significant role in increasing these life threatening diseases. To lead a healthful and nutritionally sound life, functional foods presently have become the need as according to World Health Organization (WHO) report, nearly 1 billion adults are overweight, with 300 million estimated to be clinically obese (Montgomery 2004). Thus, in order to cater the health conscious category of consumers, low calorie, probiotic, micronutrient fortified dairy products have been introduced recently in Indian market and demand for such functional and healthy foods is growing day by day. Globally the market for functional dairy products is estimated to be $ 14 billion with countries like Japan and Europe taking the lead (Anon 2007). These new ranges of available functional ingredients with proven health benefits and their incorporation in food products is expected to revolutionize the food industry.

Though the conventional *doda burfi* contains good amount of fiber in it, but further fortification with various fibers and to assess the effect of various fibers with dietary fiber, the study was planned in such a manner so that the extent of fairly acceptable fiber addition can be made. Also, the preparation of dietetic *doda burfi* if possible, could revolutionize the traditional sector. Keeping in mind, the benefits associated with fiber and non conventional sweeteners, functional *doda burfi* was prepared using variety of refined fibers and natural sweetener-stevia, available commercially in the form of powder. Further, to add value of this product, cholesterol lowering component - phytostanol was added at last stage of product preparation.

MATERIAL AND METHODS

Raw materials and ingredients

Milk: Fresh raw buffalo whole milk was procured from the Experimental Dairy of the National Dairy Research Institute (Karnal), India.

Starter culture: The mixed *dahi* starter culture NCDC-167 was obtained from the National Collection of Dairy Cultures, NDRI, Karnal. The starter culture was maintained in autoclaved reconstituted skimmed milk by sub-culturing once in fortnight for attaining high activity.

Dietary fibers: In total five different fibers were tried for preparing functional *doda burfi*, and based upon the sensory results obtained best two fibers were carried further for final product preparation.

a) *Diesol™ (Hydrolyzed gum acacia)* Free sample of hydrolyzed gum acacia (Batch Number 75060) available with a brand name Diesol™, was supplied by M/s Drytech processes (I) Pvt. Ltd, India.

b) *Wheat bran* Wheat bran was procured from M/s S.A. Pharmachem, Chemicals Limited, Mumbai (MH), India.

c) *Oat fiber* Oat bran (300-33) (Batch Number CA8 259) was procured from M/s S.A. Pharmachem Chemicals Limited, Mumbai (MH), India.

d) *Microcrystalline cellulose (MCC)* Microcrystalline cellulose (MCC) pure grade 2037 (Batch Number 2037) was procured from M/s Vikaash chemicals, Chennai (TN), India.

e) *Inulin* Inulin (Batch Number RTDCW8 DCW8) with brand name *Beneo ST* was procured from M/s DPO Food Internationals Pvt. Limited, Mumbai (MH), India.

Saturated Phytosterol esters: Free sample of Phytosterol esters was supplied by M/s Raisio, Finland.

Maltodextrin: Maltodextrin powder (Batch Number 79/B3899) of DE 12- 15 was supplied by M/s Sukhjit Starch and Chemicals Limited, Phagwara (Pb), India.

Stevia: Naturally occurring sweetener *Stevia rebaudiana* (in powder form) was procured from M/s Harboveda (Batch number SW100655), Noida, India.

Other ingredients such as refined cane sugar, wheat, and nuts of good quality for garnishing of *doda burfi* were procured from the local market.

Packing and storage

Doda burfi was hot filled (temperature about 70°C) directly from kettle in the previously cleaned and greased trays. Disinfected packaging material (using chlorinated water 25 ppm and dried after treatment) (multilayer co- extruded film) was employed to pack the product and the samples were packed under hygienic conditions.

Proximate and sensory analysis

Physico-chemical attributes like moisture, protein, fat, acidity, pH, ash, total sugars and dietary fiber were analyzed in the final product according to the standard procedures prescribed either by BIS or AOAC. For sensory evaluation, male panelists (n=7) and female panelists (n=2) between the ages of 30 to 55 years participated in this study and provided informed consent. For better acceptance of the results at wider scale, 9-point hedonic scale was used for the sensory evaluation of the product. Five different attributes namely, colour and appearance, body and texture, sweetness, flavor and overall acceptability were observed for sensory evaluation by a panel of minimum of nine judges.

Instrumental colour analysis

The surface color of finished product (functional *doda burfi*) was also measured using a "Colorflex" colorimeter supplied by Hunterlab (Hunter Associates Laboratory, Reston, VA, USA) along with the supplied software (version 4.10). The results were expressed in terms of the CIE-Lab system.

Statistical Analysis

The results obtained in the present study were subjected to analysis of variance (ANOVA) involving three replicates of each attribute, using MS-Excel software (Version 2003) of Microsoft, USA and the significance was established at 95 percent confidence interval. All data are reported as means ± standard deviations (SD).

RESULTS AND DISCUSSION

Selection of fiber and optimization of acceptable value:

In the earlier phase of this study, several preliminary trials were conducted to choose appropriate fibers and optimize their maximum and minimum levels that could be incorporated in the preparation of functional *doda burfi*. The basic ingredients of *doda burfi* constitute as- germinated wheat flour (GWF), milk, and sugar wherein GWF is the source of dietary fiber to the product. To further fortify the product with dietary fiber, minimum values were decided keeping in mind so as to reach at a point where the product could be labeled as "fortified with dietary fibers". The maximum and minimum range for various fibers except Diesol™ (hydrolyzed gum acacia) were taken as 5% and 2.5 per cent, respectively to enrich and label the product "prepared with dietary fiber" whereas the minimum and maximum limits for Diesol™ , (decided on the basis of sensory acceptable values and considering the textural requirements of the product integrity) were came out as 0.5 and 0.75 per cent, respectively. Diesol™ was used at lower range comparative to other fibers owing to its high soluble fiber content and consequent more retention of moisture content in the final product. More amount of soluble fiber disintegrates the distinctive texture of *doda burfi*, hence the values were chosen in a manner to meet the specific texture requirements of the product, keeping in mind the originality of the product. To maintain the specific product bulkiness which otherwise is provided by the sugar in conventional product, bulking agent (maltodextrin of 12°B) is added at constant rate of 5 per cent along with diesol @ 0.75% as constants. To evaluate the performance of these fibers, fibers were added individually at above said rates and the samples were evaluated sensorily by trained panelists. Results of the sensory evaluation have been shown in the comparative form in Table 1. As the literature pertaining to *doda burfi* is scanty, wherever it is possible the results are compared with other sweetmeats or dairy based products. The overall acceptability results of MCC, wheat fiber and inulin revealed that product prepared using these fibers secured almost comparable sensory scores, whereas the maximum acceptable scores were fetched by oat fiber (2.5%) and Diesol™ (0.75%), when used at specific rates. It can be observed that sweetness scores decreased in all cases when fiber was added at higher rate. However, the reverse was found in case of Diesol™ wherein high sweetness scores were obtained at higher values of fiber used. This can be due to the comparative lesser percentage of the fiber used in the product preparation, which did not hinder with the perceivable intensity of sweetness in the product. Functional product always score comparative less scores compared to conventional one and similar observations with respect to decreased acceptability of the product were recorded by Hashim et al. (2009) when tested fibers (date fiber and wheat bran) were used beyond 4.5 and 1.5 per cent, respectively, in yoghurt.

Table I: Sensory scores of various fibers used for screening in the preparation of functional *doda burfi* (n=9)

Fiber / level	MCC (%)		Wheat fiber (%)		Inulin (%)		Oat fiber (%)		Diesol (%)	
	2.5	5.0	2.5	5.0	2.5	5.0	2.5	5.0	0.5	0.75
Colour	6.64±0.35	6.86± 0.27	5.62±0.06	6.0±0.11	6.5±0.04	6.25±0.15	6.7±0.03	6.4±0.14	5.8±0.05	6.5±0.21
Texture	5.71±0.68	5.62±0.19	5.75±0.08	6.25±0.06	5.87±0.18	5.37±0.25	6.7±0.21	5.7±0.11	6.0±0.02	6.7±0.02
Sweetness	5.79± 0.27	5.71±0.42	6.25± 0.27	5.87±0.04	7.0±0.24	6.75±0.06	6.8±0.11	6.3±0.23	6.9±0.14	7.1±0.08
Flavour	5.86± 0.53	5.98±0.04	4.87±0.05	5.62±0.07	5.875±0.07	5.75±0.34	6.4±0.10	5.6±0.09	6.7±0.21	6.9±0.42
OA	5.71^{B}± 0.45	5.70^{b}±0.11	5.12^{B}±0.42	5.62^{b}±0.21	5.75^{B}±0.31	5.5^{b}±0.21	6.58^{A}±0.24	5.7^{b}±0.04	6.5^{A}±0.34	6.9^{a}±0.05

CD ($p<0.05$) for upper percentages of fibers used (5.0 and 0.75) =0.711 ; CD ($p<0.05$) for lower percentages (2.5 and 0.5) of fibers used = 0.731

Values bearing a, b superscripts depicts significant differ values for upper percentages of fiber used ($p<0.05$) whereas A, B are statistically different for lower percentages of fiber used

Based on the results obtained (overall acceptability scores), it can be observed that product prepared with oat fiber and Diesol™ were adjudged best and the same were used further for the preparation of functional product. Also, Oat has been documented in several studies and is a well known component for its enhanced nutritional and functional properties

(Tiwari and Cummins 2012) due to the presence of soluble dietary fibers (β-glucan) and contains significant amount of phytochemicals that can exhibit anti-oxidant activity (Panfili et al. 2003; Tiwari and Cummins 2009). Considering the health benefits of β-glucans, research has focused on increasing the β-glucan content of commonly consumed food and food products (Brennan & Cleary 2005). Various studies using oat fiber as an active ingredient for improving the functional properties of the food have been carried out in products like bread (Flander et al. 2006), poori (Yadav and Ranjan 2011), chapatti (Yadav et al. 2010) and pasta (Kaur et al. 2011). However, studies pertaining to hydrolyzed gum acacia (Diesol) are yet to be reported. Comparative sensory results of screened fibers in functional product have been shown in Fig. 1. Apart from various functional properties, oat fibre has also been reported as a fat replacer in a study conducted by (Pinero et al. 2008) in low-fat beef patties. Thus, addition of oat fiber holds a promising option for preparation of *doda burfi* to reduce further addition of pure fat during product preparation.

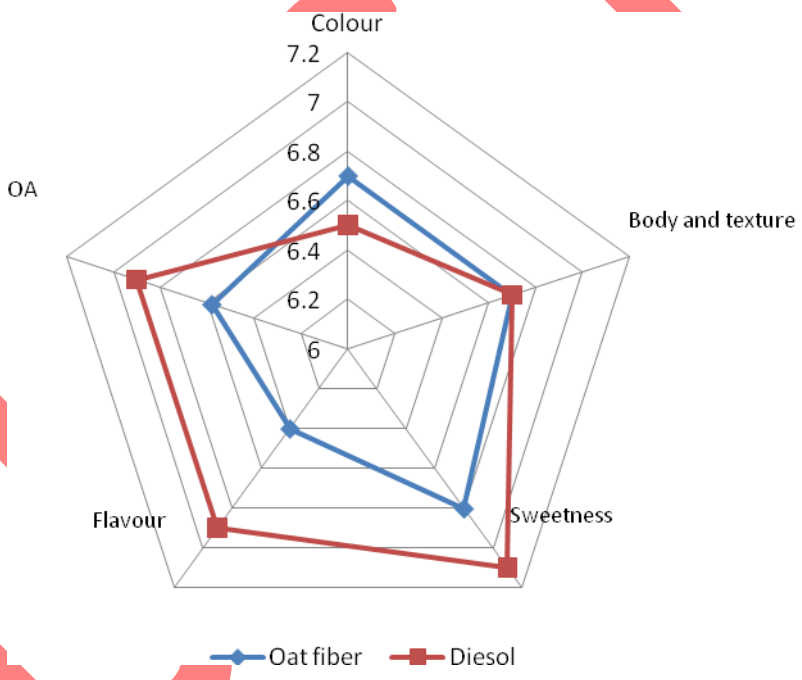

Fig. 1: Comparative sensory scores of chosen fiber- Oat and Diesol™

Selection of level of sweetener: Initially keeping in mind the demand for modern consumer and need of health conscious segment, whole amount of sugar was replaced with natural sweetener – stevia but it was found that the specific bulkiness of the product and the characteristic body and texture could not be obtained without incorporation of sugar. Hence to maintain the product characteristics, a part of sugar was replaced with sweetener and several levels of sugar and sweetener blends were tried. Similar results with disturbed product characteristics beyond 50 per cent replacement of sugar with stevia were observed in kulfi and replacement of sugar above 50% resulted in bitter taste, lack of brownish appearance and

icy texture (Giri et al. 2012). These results also conceded with the findings reported by Goel (2008) in *basundi*- a dairy based confection. Stevia has been successfully used in the preparation of various products such as cookies (Kulthe et al. 2011) and chocolates (Pandey and Singh 2011).

For partial replacement of sugar with stevia, four best combinations 25:75, 50:50, 75:25 and 100:0 (control) for sugar and stevia, respectively were tried. Sensory evaluation results obtained from different combinations have been presented in Table 2. It can be observed that highest sensory scores were secured by the control product whereas partial replacement of sugar with stevia by 50 per cent, fetched lowest sensory scoring. Though the product prepared with 25:75 stevia and sugar blend had second highest rating after control samples. However, keeping in mind the health benefits associated with natural sweetener and non-significant and tolerable loss in sensory scores product prepared with reverse ratios i.e. 75:25 (stevia:sugar) was chosen to prepare the ultimate functional product.

Table II: Sensory scoring of functional *doda burfi* prepared using a blend of table sugar and artificial sweetener in different ratios

Attributes	A	B	C	D
Colour	6.4±0.21	6.9±0.03	7.1±0.04	7.3±0.34
Texture	5.9±0.52	6.6±0.38	6.6±0.04	7.1±0.42
Sweetness	6.3±0.23	6.9±0.33	6.6±0.34	7.3±0.27
Flavour	5.6±0.09	6.8±0.26	6.4±0.08	7.1±0.03
Overall acceptability (OA)	5.7±0.21	6.8±0.24	6.6±0.05	7.1±0.09

Where,

A: 50% each
B: 25% Stevia and 75% sugar
C: 75% Stevia and 25 % sugar
D: control 100 % sugar

Keeping the target of progressive fortification of *doda burfi* without loss of sensory appeal, use of phytosterol (cholesterol lowering component) was taken up. The initial studies demonstrating the cholesterol lowering effect of phytosterols in humans were reported by Pollak (1953) in the early 1950's and till date research is continuing to study various aspects of phytosterols on human health.

Selection of level of phytostanol: Phytosterols/stanols are also known to have several bioactive properties with possible implications for human health (Normen et al. 2000). Studies showed daily intake of 2-3 g sterols and stanols lowers LDL level by 10% and likely lowers CHD by 12-20% in the first 5 years and by 20% over a life time (Weststrate and

Meijer 1998). Similarly, based on some previous studies, two different levels of phytostanol were tried with the final recipe of functional *doda burfi*. The levels worked upon were 3.0% and 4.5% and the results were compared with control sample with zero or no added phytostanol in it. To select the best optimal level of phytostanol, product was evaluated by a panel of semi trained judges using a 9-point hedonic scale for sensory attributes and the results have been presented in Fig. 2. On the basis of results obtained, 3.0% phytostanol was adjudged the best level to be used further in the studies for the development of functional *doda burfi*.

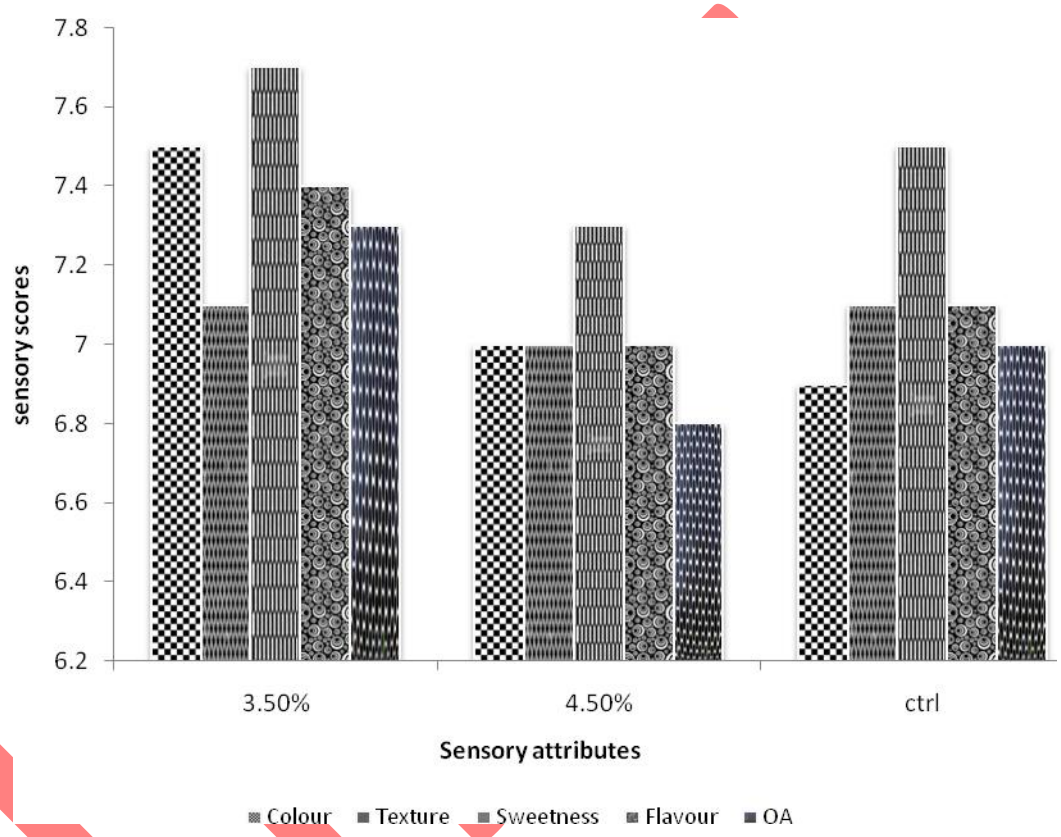

Fig. 2: Sensory evaluation results of functional product having varying percentage of phytostanol

Various dairy based products containing phytosterol or its esters; stanols have been prepared like cheese spreads (Wolfs et al. 2006), bars (Katan et al. 2003), margarines (Hallikainen and Uusitupa 1999), and many more but no indigenous or traditional sweetmeat with incorporated phytosterol has been reported so far. Phytostanol being, non-polar in nature apart from performing the action of lowering the cholesterol also provided shinier appearance to the product appeal and thus less amount of pure ghee was used during the final stages of the product preparation for glossy character in the product.

Development of functional doda burfi: Doda burfi was prepared using the recipe given by Singh and Jha (2006) with little modifications. Germinated wheat flour (GWF), sugar and milk along with a small quantity of NCDC culture 167 were used as basic ingredients in the

recipe of *doda burfi*. Near the end of process development, oat fiber and Diesol™ were added at the rate 2.5 and 0.75 per cent, respectively with replacement of sugar in the ratio 75 per cent along with maltodextrin as bulking agent. To this, at last stages of product preparation, phytostanol was added at 3% level and the product was evaluated by a panel of semi trained judges. Thus, characteristics of the developed product have been presented in Table 3. Different physico-chemical, sensory and instrumental colour characteristics of the developed product were analyzed and found comparable with the conventional product. Fiber analyzed in the final product revealed to provide more than half of daily requirement of dietary fiber per 25 g of product/day.

Table III Characteristics of the developed functional *doda burfi* (n=9)

Property	Attribute	Functional product
Sensory	Colour and appearance	7.66 ± 0.04
	Texture	7.58 ± 0.24
	Sweetness	7.00 ± 0.91
	Flavour	7.75 ± 0.04
	Overall acceptability	7.25 ± 0.05
Physico-chemical	Moisture, %	15.28 ± 1.23
	Fat, %	18.07 ± 1.54
	Protein, %	15.31 ± 0.98
	Total sugars, %	25.27 ± 0.49
	pH, %	5.61 ± 0.05
	Acidity, % LA	1.15 ±0.06
	Ash, %	2.43 ± 0.09
	Dietary fiber, (%)	
	TDF (Total Dietary fiber)	11.47 ± 1.47
Instrumental colour values	Lightness (L*)	33.40 ± 0.05
	Redness (a*)	14.90 ± 0.04
	Yellowness (b*)	23.17 ± 0.09

CONCLUSION

Doda burfi is a popular sweetmeat of northern India having high fat and sugar content. Fortification of product with fiber and effect of sugar replacer was studied to prepare

functional *doda burfi* with view to make it suitable for health conscious segment. Further to lower down the cholesterol, added phytosterol also acted as a fat replacer to some extent. Study revealed the best acceptability of oat fiber and Diesol™ out of tested five different fibers. Also replacement of sugar with stevia was found acceptable in ratio (25:75) compared to the whole replacement. Developed functional *doda burfi* was found to have similar product characteristics and overall acceptability when compared with the conventional product.

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