The Pharma Innovation Journal 2021; 10(8): 1418-1421

www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277- 7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2021; 10(8): 1418-1421

www.thepharmajournal.com
Received: 05-06-2021
Accepted: 13-07-2021

Bachate AH
Department of Food Engineering, College of Food Technology, VNMKV, Parbhani, Maharashtra, India

Kshirsagar RB
Department of Food Engineering, College of Food Technology, VNMKV, Parbhani, Maharashtra, India

Patil BM
Department of Food Engineering, College of Food Technology, VNMKV, Parbhani, Maharashtra, India

Bhargavanandha KS
Department of Food Engineering, College of Food Technology, VNMKV, Parbhani, Maharashtra, India

Corresponding Author:
Bachate AH
Department of Food Engineering, College of Food Technology, VNMKV, Parbhani, Maharashtra, India

Studies on the effect of addition of partially hydrolyzed guar gum (PHGG) on quality of frozen dessert (Kulfi)

Bachate AH, Kshirsagar RB, Patil BM and Bhargavanandha KS

Abstract
In the present investigation, the effect of partially hydrolyzed guar gum (PHGG) on quality attributes of frozen dessert (*kulfi*) was studied. Partially hydrolyzed guar gum obtained by enzymatic hydrolysis was added in frozen dessert (kulfi), it can be used as rich source of dietary fiber as it contains about 80-83% soluble dietary fiber. In the present study, frozen dessert (kulfi) prepared with incorporation of dietary fiber using partially hydrolyzed guar gum. Frozen dessert (kulfi) were prepared from milk, sugar, cream and partially hydrolyzed guar gum at the levels of (3 per cent, 5 per cent and 7 per cent) and compared with control sample containing 0.2% native guar gum. The quality characteristics like textural (firmness, cohesiveness, gumminess and adhesiveness), chemical (pH and acidity), proximate analysis (Carbohydrate, protein, fat, ash, moisture, Soluble dietary fiber) and microbial analysis of kulfi samples were analyzed. The PHGG incorporated kulfi showed decreased value in firmness, gumminess and adhesiveness, whereas increased in cohesiveness. Proximate composition showed slight variations with PHGG level. Coliform count was not detected in prepared kulfi.

Keywords: Partially hydrolyzed guar gum (PHGG), frozen dessert (kulfi), dietary fiber, textural properties

Introduction
Kulfi is a 500 year old famous frozen dessert and it possesses an advantaged position among the customary Indian dairy items. A famous frozen dessert kulfi is originated in India. Kulfi is otherwise called qulfi, kulfa, kulphy and so on (Pandit, 2004) [21]. The word kulfi gets its inception from the Hindustani word kulaf which means a "lock" or a "container" that must be opened. What's more, without a doubt the opening of the metal cone that encases the frozen enjoyment must be gotten into to deliver the sugary treat (Aneja, 1992) [4].

Kulfi is a native frozen milk item. The item is notable from all ages in our country and is extremely well known in the Northern side of India. Kulfi contains fat, TS, protein, SNF, lactose and ash roughly about 8.53 per cent, 34.18 per cent, 3.43 per cent, 11.02 per cent, 6.17 per cent and 0.84 per cent respectively. The business Icecream can be set up from formulation expressed by (Char and Lee, 1983) [10]. Generally it is produced and sold on small and scattered scale by halwai and street vendors by regular practices.

Mechanical strength of the blend and its resistance to melting identifies the body or consistency of kulfi. The resistance like heat shock resistance is depend on nature and concentration of the stabilizer/emulsifier utilized (Aneja, 1992) [4]. Under varied stabilisers, (Raju *et al.*, 1989) [22] discovered that as the concentration of milk was raised, the average values of melt-down property decreased, it means greater melting resistance. As compare to addition of starch, addition of sodium alginate shows more melt-down resistance. Due to stabilizing nature of sodium alginate, melting resistance may occur as studied by (Glicksman, 1969 and Broszkowsha *et al.*, 1968) [12, 8].

Somewhat hydrolyzed guar gum is comparative in design and function when contrasted with local guar gum as proven from different characterization procedures, for example, Fourier Transform Infrared Spectroscopy, Differential Scanning Calorimetry and X-beam Diffraction (Mudgil *et al.*, 2012b) [17]. As evidenced from rheology and viscometry there is only difference in two properties like viscosity and molecular weight. Partially hydrolyzed guar gum have no color, no taste, no odor and shows low viscosity in aqueous medium. Different studies on partially hydrolyzed guar gum regarding their physicochemical and structural properties have been reported (Mudgil *et al.*, 2012c) [18]. Based on the results from sub chronic feeding study and mutagenicity tests, enzymatically hydrolyzed guar gum is reported as safe for consumption. So, it may be utilized as a fiber fortification in different food product without

disturbing their tangible properties. Due to its high resistance to human stomach-related emission and interaction with various nutrients and metabolites, partially hydrolyzed guar gum as a soluble dietary fibre is beneficial in many illnesses such as diabetes, cardiovascular illness, and stomach-related difficulties (Yoon *et al*., 2008) [28].

Partially hydrolyzed guar gum (PHGG) is a water soluble dietary fibre that has a variety of physiological effects, including increasing defecating frequency and lowering the pH of faeces in both healthy men and constipated women, as well as lowering serum cholesterol, free fatty acid, and glucose levels in humans **(**Greenberg & Sellman, 1998; Heini *et al.*, 1998; Trinidad *et al.*, 2004; Minekus *et al.*, 2005; Stewart & Slavin, 2006; Yoon *et al.*, 2006) [13, 14, 25, 16, 24, 27].

Materials and Methods

The present investigation was carried out in Department of Food engineering with collaboration of Department of Food Chemistry and Nutrition in College of Food Technology, VNMKV, Parbhani during year 2020-21.

Materials

The raw material such as milk, cream, sugar etc. were purchased from local market of Parbhani. Guar gum required for research work was available in the department of Food Engineering and the department of Food chemistry and Nutrition.

Chemicals and glassware

The chemicals of analytical grade and glass wares required during investigation were used in the department of Food Engineering.

Processing and analytical equipment

Texture analyzer, laboratory pH meter, water bath were made available from the department of Food Engineering.

Methods

Proximate analysis

All samples were analyzed for moisture, crude protein, crude fat, total ash, mineral and total carbohydrate contents according to their respective standard methods as described in (AOAC, 2000) [5].

Determination of pH and acidity

5gm sample was taken and equal quantity of water mixed and pH of prepared sample was measured by laboratory pH meter and the acidity of frozen dessert kulfi was determined by process given by (Ranganna, 1986) [23].

Texture profile analysis of kulfi

Kulfi samples were analyzed for textural characteristics like firmness, adhesiveness, cohesiveness and gumminess. Texture analysis was carried out as per method of Akalin *et al.,* (2008) [2] with some modifications. TPA was conducted at room temperature using a Texture Analyser equipped with a P/36R stainless steel cylindrical probe. kulfi samples stored at -18 °C for 5 days were tempered to -10 °C for 24 h before analysis. The conditions for analysis were as follows: penetration distance = 15 mm, force = 5.0 g, probe speed during penetration = 3.3 mm s^{-1}, probe speed pre and post penetration = 3.0 mm s^{-1}. The values of firmness, cohesiveness, adhesiveness and gumminess were determined as per manufacturers software.

Results and Discussion

1. Proximate composition of kulfi

Kulfi prepared with various levels of PHGG analysed for nutritional composition in order to know the nutritional quality of product. Results related to various nutritional parameters of kulfi were evaluated and tabulated in Table 1.

Table 1: Proximate composition of kulfi

Sample code	Observations (%)					
	Moisture	Fat	Protein	Carbohydrate	Ash	SDF
S_0	61.91±0.95	12.7±0.14	8.19±0.02	16.05±1.2	2.8±0.14	-
S_1	61.30±0.86	11.20±0.12	8.03± 0.03	15.50±1.51	3.03±0.16	2.37±0.12
S_2	60.34±0.27	10.91±0.57	7.55±0.28	14.44±1.5	3.13±0.33	3.95±0.43
S_3	60.25±0.20	10.70±0.53	7.09±0.22	13.98±1.7	3.16±0.46	5.53±0.66
SE±	0.03265	0.04185	0.00408	0.05787	0.03689	0.00385
CD @5%	0.09577	0.12275	0.01197	0.16973	0.10821	0.01129

*Each value is average of three determinations

All samples of kulfi were analysed for proximate composition *viz*., moisture, fat, protein, carbohydrate, ash and soluble dietary fiber. Data from table 1 revealed that moisture content of kulfi in case of all samples were slightly decreased as level of PHGG increased. The control sample had highest moisture content as compared to other samples. At par results were observed in moisture content of kulfi. The mean value recorded for moisture content were (S_0) 61.91±0.95 per cent, (S_1) 61.30±0.86 per cent, (S_2) 60.34±0.27 per cent, (S_3) 60.25±0.20 per cent. The decrease in moisture content may be attributed due to addition of PHGG in kulfi.

Results demonstrated for fat content of kulfi showed that there was least variation among samples. As concentration of PHGG increased the fat content of samples were decreased slightly. For control sample (S_0) 12.7±0.14 per cent, it showed higher fat content among all samples. (S_1) 11.20±0.12 per cent, (S_2) 10.91±0.57 per cent, (S_3) 10.70±0.53 per cent respectively.

Protein content of samples were slightly decreases as the PHGG concentration increases. Control sample showed highest protein content *viz*., 8.19±0.02per cent, while S_3 showed lowest protein content *viz*., 7.09±0.22 per cent. S_1 and S_2 had 8.03± 0.03 and 7.55±0.28 per cent protein respectively.

It was observed that there was minimal variation in carbohydrate content of kulfi. The mean value for carbohydrate content were (control) 16.05±1.2 per cent, (S_1) 15.50±1.51 per cent, (S_2) 14.44±1.5 per cent and (S_3) 13.98±1.7 per cent respectively. Similarly, results found for ash content was 3.16±0.46, 3.13±0.33, 3.03±0.16 and 2.8±0.14 per cent for S_3, S_2, S_1 and S_0 respectively.

Soluble dietary fiber (SDF) increases as concentration of PHGG increases. S_1, S_2 and S_3 showed 2.37±0.12, 3.95±0.43

and 5.53±0.66 per cent respectively. These findings were supported by (Bhadakwad *et al.,* 2009; Kumar *et al.,* 2012; Ahsan *et al.,* 2015 and Mudgil *et al.,* 2016) [7, 15, 1, 19].

Effect of PHGG on pH and acidity of kulfi

To know the effects of guar gum and PHGG on chemical properties i.e. pH and acidity of kulfi the samples were tested and analyzed. Obtained results demonstrated in Table 2.

Table 2: Effect of addition PHGG on pH and acidity of kulfi

Sample	pH	Acidity (per cent)
S_0	6.15	0.18
S_1	6.19	0.144
S_2	6.20	0.126
S_3	6.23	0.108

From the results summarized in Table 2, it was observed that pH increased with successive treatments. This was attributed due to addition of partially hydrolyzed guar gum. The per cent acidity was slightly decreased with increased level of PHGG in kulfi. The control sample (S_0) showed highest value i.e. 0.18 per cent. pH of different treatment is in the range of 6.19 to 6.23. The results were found to be similar with results reported by (Nigam, 2015) [20].

Texture profile for prepared kulfi

Textural examination of prepared kulfi with varied concentrations of PHGG was performed using a texture analyser (TA- XT, Stable Micro System, UK) to measure firmness, cohesiveness, gumminess and adhesiveness.

Table 3: Effect of PHGG on textural properties of kulfi

Sample	Firmness (kg)	Cohesiveness	Gumminess (kg)	Adhesiveness (kg/s)
S_0	0.414	0.990	0.409	0.039
S_1	0.229	0.997	0.228	0.029
S_2	0.211	1.006	0.212	0.024
S_3	0.152	1.013	0.153	0.019
SE±	0.15558	0.57872	0.16247	0.01672
CD@5%	0.4572	0.47654	0.47654	0.04903

*Each value is average of three determinations

The addition of soluble fibre increased the textural properties of kulfi, according to the results obtained for textural criteria. Food firmness is defined as the highest force applied to the food sample during the initial compression to the required level.

Firmness is an important criterion that is used for assessment of textural evaluation of food products. From the above table 3, it was observed that as concentration of PHGG increases the firmness of sample decreases. The highest value for firmness was observed in control sample. The values obtained for the firmness of kulfi were ranged between 0.152 to 0.414 Kg. Highest firmness was recorded for sample S_0 (0.414 kg.) which was followed by S_1 (0.229 Kg), S_2 (0.211 Kg) and S_3 (0.152 Kg).

Beside firmness adhesiveness and gumminess of PHGG fortified kulfi also decreased. Control sample without addition of PHGG was the most adhesive sample (0.039 Kg).The lowest value for adhesiveness was observed for kulfi fortified with 7 per cent PHGG (0.019 kg). For gumminess also, as PHGG level increased gumminess of sample decreased. The value obtained for gumminess ranged between (0.153 kg) for S_3 to (0.409 kg) for control sample S_0. Hardness and cohesiveness values are usually multiplied to get the gumminess of a food sample.

Cohesiveness of samples raised with raising concentration of PHGG. Kulfi samples had cohesiveness ranging from 0.990 to 1.013 kg. The control kulfi (S_0) was the least cohesive, whereas the kulfi sample (S_3) with 7 per cent PHGG was the most cohesive. Partially hydrolyzed guar gum causes increased binding and a more compact structure in kulfi by strengthening the bonding between sugar and casein molecules, resulting in a cohesive structure (Barak & Mudgil, 2020) [6] reported similar results.

4. Microbial analysis of kulfi

According to (Cappuccino & Sherman's, 1996) [9] method, the accepted frozen dessert (kulfi) sample (S_2) was subjected to microbial studies for total plate count, yeast and mould count and coliform count of freshly prepared frozen dessert (kulfi) samples on nutrient agar, potato dextrose agar and VRB agar media, respectively Table 4 displays the recorded results.

Table 4: Microbial analysis of prepared kulfi

Times in weeks	Total Plate Count (cfu/ml) $\times 10^3$	Yeast and mold count (cfu/ml)$\times 10^3$	Coliform count MPN/ml
1	2.28	ND	ND
2	2.60	1.40	ND
3	2.90	1.10	ND

ND: Not Detected

Pasteurization, freezing and hardening are the major processes in the food safety process for inhibiting the growth of organisms and eliminating microbiological dangers (Anderson & Nielson, 1995) [3]. The ingredients in kulfi may contain germs, lowering the product's quality (El-Sharef *et al.*, 2005) [11].

The microbiological characteristics of selected kulfi samples were examined and confirmed in this investigation. Table 4 shows the findings of total plate counts of selected kulfi samples. The total plate count, yeast and mould count and coliform count of kulfi (S_2) was measured after 1, 2 and 3 weeks showed in above table 4, Total plate count after 1, 2 and 3 weeks was observed 2.28×10^3, 2.60×10^3 and 2.90×10^3(cfu/ml) respectively. Yeast and mould count was not detected within 1 week. After 2 and 3 weeks 1.40×10^3 and 1.10×10^3(cfu/ml). Coliform count was not detected. Kulfi made with varied quantities of partially hydrolyzed guar gum was determined to be acceptable in terms of microbiological quality and to be less contaminated. The findings were in close agreement with those reported by (Trivedi, 2014) [26].

Conclusion

The developed technology of frozen dessert (kulfi) by incorporation of partially hydrolyzed guar gum (PHGG) is a new avenue for dairy industries which can be explored

commercially as an innovative nutraceutical dessert (kulfi) specially for its high soluble dietary fiber and also be recommended as an alternative for milk digestive disorder and also for lactose intolerance consumers. As PHGG obtained from enzymatic hydrolysis contains about 80-83% soluble dietary fiber. Frozen dessert (kulfi) with utilization of partially hydrolysed guar gum found to be nutritious with health beneficial properties. The sample S_2 with 5 per cent partially hydrolyzed guar gum (PHGG) found to be good in textural properties like firmness, adhesiveness, cohesiveness and gumminess with incorporation of PHGG in frozen dessert kulfi enriched with the soluble dietary fiber and also retained its nutritional characteristics.

References

1. Ahsan S, Zahoor T, Hussain M, Khalid N, Khaliq A, Umar M. Preparation and quality characterization of soy milk based non-dairy ice cream. International Journal of Food and Allied Sciences 2015;1(1):25-31.
2. Akalin AS, Karagozlu C, Unal G. Rheological properties of reduced fat and low fat ice cream containing whey protein isolate and insulin. European Food Research Technology 2008;227:889-895.
3. Anderson TG, Nielsen H. Ice cream and aerated deserts: The technology of dairy products. Edited by R.Early Blackie Academic and Profession, London, England 1995.
4. Aneja RP. Traditional milk specialities: A survey, In: Dairy India. Devarsons Stylish Printing Press, New Delhi, 1992, 269.
5. AOAC. Official methods of analysis.17 th edition. Association of Official Analytical Chemist, Washington, DC 2000.
6. Barak S, Mudgil D. Effect of guar fiber on physicochemical, textural and sensory properties of sweetened strained yoghurt. Biointerface Research in Applied Chemistry 2020;10(3):5564-5568.
7. Bhadakawad AD, Adangale SB, Shinde DB, Mitkari KR, Khating LE. Preparation of golden kulfi from buffalo milk blended with safflower milk. Asian Journals of Dairy and Foods Research. 2009;28(1):35-38.
8. Broszkhowsha B, Klepacka M, Zesnauleszk GS. Kulfi a traditional frozen dessert: A review. In Dairy science Abstract. Journal of food science 1968;31(2):3656-3659.
9. Cappuccino JG, Sherman N. Microbiology: A Laboratory Manual. The Benjamin /cummings publication, Co. Inc. NY. 1996.
10. Char SK, Lee SG. Evaluation of sensory quality of commercial ice-cream. Journal of Food Science and Technology 1983;10(3):556-558.
11. EL-Sharef N, Ghenghesh KS, Abognah YS, Gnan SO, Rahouma A. Bacteriological quality of ice cream in tripoli, Libya. Food Control 2005;17:637-641.
12. Glickman M. Gum technology in food Industry. *Academic Press*, New York 1969, 590-592.
13. Greenberg NA, Sellman D. Partially hydrolyzed guar gum as a source of fiber. Cereal Food World. American Association of Cereal Chemists 1998;43:(9):703-707.
14. Heini AF, Castro CL, Schneider H, Kirk KA, Considine RV, Weinsier RL. Effect of hydrolyzed guar fiber on fasting and postprandial satiety and satiety hormones: A double-blind, place Bocontrolled trial during controlled weight loss. International Journal of Obesity. 1998;22(1):906-909.
15. Kumar A, Singh KP, Gupta MP, Singh B. Physico-chemical quality of kulfi. Indian Research Journal of Extension Education 2012;2(1):242-243.
16. Minekus M, Jelier M, Xiao JZ, Kondo S, Iwatsuki K, Kokubo S *et al*. Effect of partially hydrolyzed guar gum (PHGG) on the bioaccessibility of fat and cholesterol. Bioscience, Biotechnology and Biochemistry. 2005;69(5):932-938.
17. Mudgil D, Barak S, Khatkar BS. X-ray diffraction, IR spectroscopy and thermal characterization of partially hydrolyzed guar gum. International Journal of Biological Macromolecules. 2012b;50(4):1035-10395.
18. Mudgil D, Barak S, Khatkar BS. Effect of enzymatic depolymerization on physicochemical and rheological properties of guar gum. Carbohydrate Polymer. 2012c;90(1):224-228.
19. Mudgil D, Barak S, Khatkar BS. Development of functional yoghurt via soluble fiber fortification utilizing enzymatically hydrolyzed guar gum. *Food Bioscience*. 2016;1 4(1):28-33.
20. Nigam R. Development of technology for Chhana based Kulfi. M.Tech. Thesis, National Dairy Research Institute, Karnal, Haryana, India 2015.
21. Pandit P. Technology studies on the manufacture of kulfi using artificial sweeteners. (Master's Thesis). National Dairy Research Institute, Karnal, India 2004.
22. Raju AA, Ali MP, Reddy KK, Reddy CR, Rao MR. Studies on preparation and quality of kulfi. The Indian Journal of Dairy Science 1989;42(1):127-129.
23. Ranganna S. Proximate constituents. In: handbook of analysis and quality control for fruits and vegetable products. Tata Mc Graw Hill Publishing Co. Ltd. New Delhi 1986, 1-30.
24. Stewart ML, Slavin JL. Molecular weight of guar gum affects short-chain fatty acid profile in model intestinal fermentation. Molecular Nutrition Food Research. 2006;50(10):971-976.
25. Trinidad T, Perez E, Loyola A, Mallillin A, Encabo R, Yokawan T, *et al*. Glycemic index of sunfibre (*Cyamopsis tetragonolobus*) products in normal and diabetic subjects. International Journal of Food Science and Technology 2004;39(1):1093-1098.
26. Trivedi VB. *Use of basil (Tulsi) as flavouring ingredient in the manufacture of ice cream. (Master's Thesis).* Anand agricultural university, Anand, India 2014.
27. Yoon SJ, Chu DC, Juneja LR. Physiological functions of partially hydrolyzed guar gum. Journal of Clinical Biochemistry Nutrition 2006;39(1):134-144.
28. Yoon SJ, Chu DC, Juneja LR. Chemical and physical properties, safety and application of partially hydrolyzed guar gum as dietary fiber. Journal of Clinical Biochemistry and Nutrition 2008;42(1):1-7.