https://doi.org/10.52763/PJSIR.BIOL.SCI.69.1.2026.22.29

Pak. j. sci. ind. res. Ser. B: biol. sci. 2026 **69B**(1) 22-29

Characterization of Guar Cultivar, Extraction of Guar Gum and Their Application in Bakery Products as a Fat Replacer

Muhammad Awais[a], Shabbir Ahmad[a]*, Sadaf Yaqoob[b], Muhammad Sibt-e-Abbas[a], Nida Firdous[a], Mamoona Amir[b], Naveed-Ul-Haq[c] and Nazish Javaid[b]

[a]Department of Food Science and Technology, MNS-University of Agriculture, Multan, Pakistan
[b]Department of Animal Food Producs Technology, Faculty of Food Science and Nutrition, Bahauddin Zakariya University, Multan, Pakistan
[c]National Institute of Food Science and Technology, University of Agriculture, Faisalabad, Pakistan

(received November 14, 2023; revised August 1, 2024; accepted August 5, 2024)

Abstract. The examination had been carried out to find out how guar gum affects the nutritional and qualitative characteristics of bakery goods, particularly cookies and cakes. At first guar beans were analyzed for their different physiochemical characteristics and guar gum was produced from guar beans. Then, using various concentrations, guar gum was introduced as a fat substitute in cookies and cakes. After thorough examination of these items, assessing a variety of quality factors, nutritional characteristics and sensory qualities. The prepared products will be assessed in terms of quality factors, nutritional characteristics and sensory attributes. According to the research, the mean values of the components of cookies' moisture, fat, ash, protein and fibre ranged from 2.98% to 3.35%, 9.36% to 15.05%, 1.41% to 2.17%, 6.64% to 7.34% and 1.41% to 2.17%, respectively. Similar results were found for cakes, where the mean values for moisture, fat, ash, protein and fibre, respectively, ranged from 19.06% to 23.03%, 6.70% to 7.34%, 12.6% to 15.17%, 1.55% to 2.35% and 1.49% to 2.22%. Physical factors including cookie thickness, spread factor and hardness as well as sensory traits were significantly altered. Additionally, the presence of guar gum had a significant impact on the physiochemical characteristics (volume and colour) and sensory qualities of cakes. The results of this physiochemical and sensory analysis conclusively showed that guar gum addition significantly increase the positive impact on the quality characteristics and customer acceptance of a variety of bakery items.

Keywords: guar gum, cookies and cakes, sensory characteristics, fat replacement

Introduction

Guar (*Cyamopsis tetragonoloba*), a drought-tolerant leguminous crop, has garnered significant attention due to its multifaceted applications in various industries. Among its primary components, guar gum, a galactomannan polysaccharide derived from the endosperm of guar seeds, is particularly notable for its exceptional thickening, emulsifying and stabilizing properties. These unique attributes have facilitated its widespread utilization in food, pharmaceuticals and cosmetics (Shakir *et al*., 2020; Mudgil *et al*., 2014). Pakistan is prodcuing about 15% of total production of guar world-widely (Sher *et al*., 2022). Guar seed comprise essential components including carbohydrates (50.2-59.9%), protein (22.9-30.6%), ash (3.0-3.5%) and fat (2.9-3.4%) (Kuravadi *et al*., 2013).

*Author for correspondence:
E-mail: shabbir.ahmad@mnsuam.edu.pk;
ft.shabbir@gmail.com

The guar gum powder is obtained from the endosperm of the guar seed by different processes like roasting, abrasion, splitting, sifting and refining (Mudgil *et al*., 2014). Guar gum is enriched source of polysaccharied (73-86%) in galactomannan form along with protein (3-6%), fibre (1-4%) and fat (0.5-1%). Recently, role of guar gum as a fat substitute in food was studied to lower down the total caloric content of food (Lal *et al*., 2021). In the food industry, guar gum used as gelling, thickening and binding agent as well as used for stabilization, emulsification, preservation, water retention, enhancement of water-soluble fibre content and as fat replacer etc. Guar gum provides good texture, thickening, mouth feel, water binding and emulsifying characteristics to food in which it added. The growing demand for food products that are healthier and more sustainable, where the decrease of fat content is a significant aspect, creates the need to use different fat replacers in food products (Saha and Samanta, 2019). By lowering the fat level in a variety of goods, while

retaining the appropriate sensory qualities and functionality, fat replacers play a significant role in the food industry. As a fat alternative, guar gum, a natural polysaccharide derived from guar beans, has received a lot of interest. When employed as a fat replacement in food compositions, guar gum, a natural polysaccharide produced from the guar bean, offers several technical benefits. Long chains of galactomannan units make up guar gum, which is very soluble in water. Because of its lengthy galactomannan chains' high-water solubility and extraordinary ability to bind water, it helps keep food products' moisture levels stable. For low-fat or fat-free foods to have the desired texture and sensory qualities, this characteristic is essential. Impact full inclusion of guar gum as a fat replacer in rice cookies was studied by Samakradhamrongthai *et al*. (2022). According to another study guar gum is an ideal fat replacer in cookies (70%) in combination with polydextrose (Colla *et al*., 2018). This research aims to provide useful insights to the food industry, potentially resulting in the production of healthier and more enticing bakery products by describing the guar cultivar, extracting its gum and analyzing its usefulness as a fat replacer in bakery items. Therefore, current study is designed to characterize the chemical and physical properties of guar beans and evaluate the potential of guar gum as fat substitute in bakery products.

Material and Methods

Procurement of raw material. Guar pods were harvested manually from the fields of MNS-University of Agriculture Multan. Chemicals were purchased from Sigma-Aldrich and Duksan pure chemicals and other raw material was purchased from the local market.

Drying and compositional analysis of guar. After harvesting guar pods were sun dried to remove the moisture and then dried pods were crushed for analysis. Proximate composition such as ash, moisture, fat, protein and fibre content of guar powder were determined by methods prescribed in AACC (2000).

Preparation of guar gum. Pods were harvested after maturation and ripen seeds were removed from the pods. The seeds were than ground in a mill at 1500-1800 rpm. For high quality gum, the crude crack with optimum moisture was heated at 105 °C. After that the material was passed from 20 mm mesh screen to separate from guar meal then separated endosperm was washed to remove any adhering dust. Endosperms then fed to hammer mill to flash ground. Hot air at passed through the mill. The air removed the all particles and then guar finely grounded and passed through sifters to separate product into mesh size of 40-250 mm (Mudgil *et al*., 2014). After that guar gum powdered was stored for further products development.

Product preparation. Cookies were made according to the method described by AACC (2000) ground flour 250 g, 125 g sugar, 100 g fat, eggs 45 g, baking powder 1.5 g, salt 1.2 g, 10-15 mL water were blended thoroughly in a dough mixer to get uniform mixture. Flour was mixed with salt, sugar, baking powder and added in fat: sugar creamy texture to make dough. The cookies were baked at 175-180 °C for 20 min in a baking oven, cooled and stored for further analysis. Guar gum was added in cake and cookies in ratio of 0(%), 15(%), 30(%) and 45(%) in T_0, T_1, T_2 and T_3, respectively. Quantity of the fat has been decided based on the flour and fat was partial substituted with guar gum.

Similarly, cake was prepared according to the method described by AACC (2000), sugar, fat and gum was mixed first. Afterwards this mixture was mixed with water and flour. The proportion of guar gum used in cake was mentioned in the following Table 1. After that cake was stored for further study.

Physiochemical analysis of cookies and cakes. Proximate analysis of products (cookies and cake) such as fat, protein, ash, moisture and carbohydrates were determined by methods described by AACC, 2000. Colour analysis of products were determined by using "ColourTec" colourimeter, as per the procedure described by Gul *et al*. (2018). Readings of "l", "a" and "b" were noted by placing each sample under the colour sensor of colourimeter.

Sensory evaluation of cookies and cakes. Products were subjected for sensory evaluation, using 20 trained and untrained panelists from MNS-university of Agriculture Multan. Cookies and cakes were evaluated

Table 1. Treatment plan for the partial substitution of fat with guar gum

Treatment	Fat%	Guar gum%
T_0	100	0
T_1	85	15
T_2	70	30
T_3	55	45

for texture, taste, colour, flavor, after taste and overall acceptability. The rating were on 1-9 point hedonic scale, ranging from 9 (extremely like) to 1 (dislike extremely) as per described by Lawless and Heymann, (2010).

Determination of thickness, diameter, spread factor and textural hardness of cookies. Diameter and thickness were measured by the methods that were described by Ahmad *et al*. (2017). According to methods six cookies were arranged edge to edge and diameter was evaluated in "mm" by using a scale. Cookies were revolved at angle of 90° for replica readings. This act was done three times and average diameter was recorded in "mm". The height was evaluated in "mm" by the aid of vernier caliper. The spread factor was evaluated by taking ratio of diameter and thickness of cookies.

Textural hardness of cookies was measured by the methods described by Piga *et al*. (2005) using texture analyzer. To determine the hardness, the cookie sample was placed on a flat surface and probe put over the center of the cookie. The probe pierced the cookie, which will then be crushed to a certain distance. The texture analyzer captured force-time data during the compression. The test was repeated on numerous cookies to determine their average hardness.

Determination of volume of the cake. Volume of cake was determined by method described by Zambrano *et al*. (2004) using a digital caliber.

Statistical analysis. For the statistical evaluation, all analysis were evaluated in triplicate to form the best reliability of resultant data. Statistical significance was prescribed by using (ANOVA) and data were represented as mean ± standard deviation. Standard significant difference was set as $P<0.05$ and non-significant difference ($P>0.05$) (Montgomery, 2017).

Results and Discussion

Compositional analysis of guar beans. The mean value of moisture, ash, fat, protein and fibre is given in Table 2. According to the results guar gum has 4.16% to 11.96% moisture, 4.33 to 5.86% ash, 3.93% to 4.59%. fat, 31.23% to 34.07% protein and 4.72% to 5.16% fibre. Current finding having similarity to results described by Kuravadi *et al*. (2013) and Ahmed *et al*. (2006).

Table 2. Characterization of the guar cultivars

Treatments	Moisture%	Fat%	Ash%	Protein%	Fibre%	NFE%
R_1V_1	9.52±0.03	4.25±0.02	5.15±0.16	32.33±0.02	4.87±0.07	42.67±1.53
R_1V_2	9.75±0.03	4.14±0.02	5.86±0.11	33.01±0.02	5.13±0.25	42.14±0.03
R_1V_3	9.77±0.01	4.22±0.28	5.02±0.76	31.43±0.03	4.72±0.03	44.83±0.03
R_1V_4	9.53±0.02	4.21±0.01	4.38±0.10	32.33±0.03	5.00±0.10	44.53±0.02
R_1V_5	4.16±0.02	3.93±0.48	4.97±0.55	33.50±0.04	5.03±0.17	47.91±0.01
R_2V_1	11.02±0.02	4.19±0.08	4.73±0.40	31.58±0.10	4.76±0.07	43.85±0.02
R_2V_2	11.96±0.03	4.25±0.02	4.33±0.17	33.38±0.03	5.12±0.05	41.24±0.02
R_2V_3	7.80±0.10	4.07±0.05	5.17±0.12	32.060.06	4.79±0.02	45.40±0.10
R_2V_4	8.13±0.06	4.23±0.03	5.47±0.10	31.23±0.03	4.83±0.05	45.39±0.02
R_2V_5	7.60±0.10	4.30±0.02	5.22±0.15	34.07±0.06	4.87±0.10	44.15±0.01
R_3V_1	10.36±0.03	4.59±0.03	5.72±0.27	32.46±0.05	5.05±0.07	42.12±0.02
R_3V_2	9.98±0.01	4.33±0.01	5.28±0.15	33.36±0.05	4.82±0.10	42.43±0.01
R_3V_3	8.41±0.01	4.07±0.03	5.13±0.10	33.68±0.03	4.76±0.01	43.94±0.01
R_3V_4	8.39±0.02	4.05±0.02	5.05±0.05	34.70±0.03	5.16±0.09	45.72±0.01
R_3V_5	10.67±0.02	4.32±0.02	5.09±0.07	31.49±0.03	4.94±0.03	43.82±0.02
R_4V_1	9.36±0.02	4.31±0.02	5.00±0.01	34.07±0.05	5.16±0.07	42.45±0.02
R_4V_2	9.88±0.02	4.51±0.02	5.05±0.08	32.11±0.05	5.09±0.06	41.24±0.01
R_4V_3	11.90±0.21	4.42±0.01	5.56±0.19	31.40±0.06	4.96±0.03	42.45±0.01
R_4V_4	8.39±0.02	4.30±0.02	5.19±1.57	33.20±0.05	4.91±0.07	44.33±0.02
R_4V_5	10.17±0.02	4.19±0.02	5.34±0.56	31.28±0.03	5.07±0.14	43.68±0.02

NFE = nitrogen free extract; R = replication; V_1 = BR-2017; V_2 = BR-99; V_3 = BR-90; V_4 = S-5823; V_5 = BR-6072.

According to another study guar beans contains 24.55-26.78% protein, 2.70-3.06 % fat, 8.44-9.81% fibre and 3.59-5.29% ash Tahmouzi *et al*. (2023). Findings of this study are also in line with current findings. Variations in results are due to differences in varieties of guar and different environmental (mositure, humidity and temperature) conditions.

Compositional analysis of cookies. The mean values of moisture, fat, ash, protein and fibre content obtained from the analysis are shown in Table 3. This describes the water content in the cookies in terms of moisture. The numbers are roughly 2.98% in T_0 and 3.35% in T3, respectively. These results were identical to the Chugh *et al*. (2013) who find the moisture content in cookies ranged from 2.1%-3.2%. Content of fat fluc-tuates between 15.05% in T_0 and 9.36% in T_3. Notably, lipid content reduces as the quantity of guar gum rises. The amount of ash in the cookies reveals their mineral composition. Values vary depending on the treatment, from 1.41% in T_0 to 2.17% in T_3. The amount of protein in the cookies is indicated from 6.64% in T_0 to 7.34% in T_3, the values are distributed. There is a general tendency toward less fat and more protein, along with an increase in guar gum. Like the ash content, fibre content varies from 1.41% in T_0 to 2.17% in T_3. These results are closer to the results of Zambrano *et al*. (2004) who stated that fat, ash, protein and fibre content ranged from 8.6-12.3%, 1.4-1.5%, 6.6-6.8% and 1.4-2.4% respectively. Results showed that higher ash and fibre content is typically the result of increasing the amount of guar gum in the cookies. As demonstrated from T_1 through T_3, lowering the fat amount of the cookies tends to raise their protein content. Although there is a modest variation in moisture content between treatments, there is no distinct pattern.

Diameter, thickness, spread ratio and hardness of cookies. Mean values of diameter, thickness, spread ratio and hardness are given in the Table 3. Highest value of diameter was found in T_1 65.82 (85% fat and 15% guar gum) and lowest value of diameter was found in T_3 63.43 (55% fat and 45% guar gum). These results are identical to the results of Pereira *et al*. (2013) who analyzed 44.66-49.70 mm diameter of cookies. Variation in resutls may be due use of gum powder in cookies formulation.

According to result of analysis thickness value of T_0 is 8.82 mm, T_1 is 8.88 mm, T_2 is 9.44 mm and T_3 is 9.91 mm, respectively. According to another study thickenss of cookies measured 9.86-13.33 mm (Pereira *et al*., 2013). Result of this study are in line with the current findings.

Maximum value of spread ratio was found at T_1 7.58 (85% fat and 15% guar gum) and minimum value of spread ratio was found at T_3 6.39 (55% fat and 45% guar gum). These results are identical to the results of Pereira *et al*. (2013) who measured 3.44-5.05 spread ratio in cookies. Resutls of current study are not in line

Table 3. Compositional, physical and colour profile of the cookies prepared by partial substitution of fat with guar gum

Treatment	T_0	T_1	T_2	T_3
Moisture%	2.98±0.19	3.19±0.14	3.07±0.18	3.35±0.20
Fat %	15.05±0.04^{a}	14.86±0.90^{a}	12.86±0.50^{b}	9.36±0.35^{c}
Ash %	1.41±0.01^{a}	2.08±0.01^{a}	2.16±0.11^{a}	2.17±0.01^{b}
Protein %	6.64±0.08^{a}	6.85±0.05^{b}	7.05±0.09^{bc}	7.34±0.15^{c}
Fibre %	1.41±0.01^{a}	2.08±0.01^{a}	2.16±0.11^{a}	2.17±0.01^{b}
Diameter (mm)	64.56±1.39	65.82±0.33	64.10±0.26	63.43±0.53
Thickness (mm)	8.82±0.01^{a}	8.88±0.06^{ab}	9.44±0.47^{b}	9.91±0.05^{b}
Spread factor	7.31±0.15^{a}	7.58±0.36^{ab}	6.79±0.35^{b}	6.39±0.09^{b}
Hardness (N)	28.73±0.66^{a}	33.18±0.58^{b}	41.07±1.00^{c}	51.11±1.13^{d}
L*	68.1±1.35	66.05±3.37	65.27±3.97	65.61±1.27
a*	5.54±0.44	4.50±0.61	4.10±0.93	4.14±0.73
b*	23.62±0.87	25.65±1.31	22.83±4.20	23.20±1.92

Values without letters or sharing same letters in a row against a parameter are non-significant ($P>0.05$) from each other, while values sharing different letters in a row against a parameter are significantly ($P<0.05$) different from each other; T_0 = control; T_1 = 85% fat and 15% guar gum; T_2 = 70% fat and 30% guar gum; T_3 = 55% fat and 45% guar gum.

with this study. Varitation inresutls may be due to variations in baking conditions, recpie optimization and different environmental conditions.

Mean values of physical characteristics of hardness were found between T_0 28.73 N, T_1 33.18 N, T_2 41.07 N, T_3 51.11 N, respectively. The mixture T3, which has a hardness value of 51.11 N and contains 55% fat and 45% guar gum, has the highest hardness rating. The mixture T0, which contains 100% fat and 0% guar gum, had the lowest hardness value, with a hardness value of 28.73 N. These results are identical to the results of Chugh *et al*. (2013) measured 25.07-84.02 N hardness in cookies.

Colour analysis of cookies. Parameter l* represents the darkness and whiteness in the samples, parameter a* represents the redness in the sample and parameter b* represents the yellowness in the sample. All these parameters are not present in the sample so that there was no significant difference (P>0.05) in the samples.

The results of parameter l* were in the range of 61.33 to 69.75. In parameter a* results were in range of 3.11 to 6.05. In parameter b* results were in range of 19.26 to 27.46. These results were similar to the results of Tahmouzi *et al*. (2023) who found that results for l* were 62.38-69.31, for a* 4.36-5.85 and for b* 21.47-25.12.

Physiochemical characteristics of cake. Mean values of moisture are shown in Table 4. Mean values of moisture were found in T_0 23.03±0.81, T_1 19.06±0.04, T_2 19.86±0.20, T_3 19.41±0.55. Maximum value of moisture was found in T_0 23.03% (100% fat and 0% guar gum) and minimum value of moisture was found in T_3 19.41% (55% fat and 45% guar gum). Analysis of variance shown highly significant difference (P<0.01) was obtained in the results of moisture of cake. Highly significant results were obtained due to the addition of guar gum which can retain moisture. These results are identical to the results of Bhise and Kaur (2013) who reported that moisture content in cake were ranged from 16%-21%. Results shown highly significant difference (P<0.01) was obtained in the results of protein. Variations occur due to the addition of guar gum which is a good source of protein so that protein of cookies was increased. Results of analysis ranged between 6.70±0.014-7.34±0.15. The maximum value of protein was found at T_3 7.34 (55% fat and 45% guar gum) and minimum value of protein was found at T_0 6.70 (100% fat and 0% guar gum). These results are identical to the results of Gularte *et al*. (2012) whose results were ranged from 5.4-6.4% for protein content. Analysis of variance shown highly significant difference (P<0.01) was obtained in the results of fat (Table 4). According to results mean values of fat in treatment T_0 15.17±0.10, T_1 14.55±0.08, T_2 12.6±0.2 and T_3 9.53±0.15 respectively. Maximum value of fat was found at T_3 9.53 (55% fat and 45% guar gum) and minimum value of fat was found at T_0 15.17 (100% fat and 0% guar gum). These results are identical to the results of Gomez *et al*. (2007) who found 12.8-13.6% fat in cakes. Mean values of ash were found between 1.55±0.33 to 2.35±0.28. Results indicate non-significant difference (P<0.01) results of fat of cake. The maximum value of ash was found at T_3 2.22 (55% fat and 45% guar gum) and minimum value of treatment mean of physical characteristics of ash was found at T_0 1.55 (100% fat and 0% guar gum).

Table 4. Compositional and colour profile of the cakes prepared by partial substitution of fat with guar gum

Treatment	T_0	T_1	T_2	T_3
Moisture%	23.03±0.81^{a}	19.06±0.04^{b}	19.86±0.20^{b}	19.41±0.55^{b}
Fat %	6.70±0.04^{a}	6.88±0.05^{b}	7.05±0.09^{bc}	7.34±0.15^{c}
Ash %	15.17±0.10^{a}	14.55±0.08^{b}	12.6±0.2^{c}	9.53±0.15^{d}
Protein %	1.55±0.33^{a}	2.18±0.01^{a}	2.35±0.28^{a}	2.22±0.02^{b}
Fibre %	1.49±0.04^{a}	2.12±0.02^{ab}	2.15±0.03^{bc}	2.22±0.03^{c}
Volume (cc)	457±2^{a}	464±3^{ab}	466.33±3.78^{bc}	472±2^{c}
l*	68.14±0.62^{a}	66.53±1.16^{ab}	65.63±0.63^{b}	64.91±0.17^{b}
a*	2.07±0.61^{a}	1.10±0.01^{ab}	0.58±0.44^{b}	0.26±0.17^{b}
b*	17.88±0.40^{a}	14.55±0.08^{b}	12.06±0.20^{c}	12.35±0.05^{c}

Values sharing same letters in a row against a parameter are non-significant (P>0.05) from each other, while values sharing different letters in a row against a parameter are significantly (P<0.05) different from each other; T_0 = control; T_1 = 85% fat and 15% guar gum; T_2 = 70% fat and 30% guar gum; T_3 = 55% fat and 45% guar gum; cc = cubic centimeter.

These results are identical to the results of Gularte *et al*. (2012) who found the ash contents were ranged from 1.4-1.7%. Mean values o of fibre was found between 1.49±0.04 in T_0, 2.12±0.02 in T_1, 2.15±0.03 in T_2, 2.22±0.03 in T_3, respectively. Maximum value of fibre was found in T_3 was 2.22% (55% fat and 45% guar gum) and minimum value of fibre was found in T_0 1.49% (100% fat and 0% guar gum). These results are in line with the results of Gularte *et al*. (2012) who found that fibre 1.4-1.7% in cake samples.

Volume of cake. Analysis of variance shown highly significant difference ($P<0.01$) in volume. Highly significant results were obtained due to the addition of guar gum (Table 4). Mean values of physical characteristics of volume treatment were found T_0 457±2, 464 ±3(T_1), 466.33±3.78(T_2) and 472±2(T_3) respectively. The maximum value of volume was found in T_3 was 472 (55% fat and 45% guar gum) and minimum value of volume was found in T_0 457 (100% fat and 0% guar gum). These results are identical to the results of Gomez *et al*. (2007) who reported the volume of cake ranged from 470-480. Guar gum is soluble gum which is used as stabilizer, emulsifier and thickener in various food products. The emulsifying action of the guar gum ensure the even distribution of the fat throughout the batter and dough of the baked products. Evenly distributed fat contributes to a finer crumb structure and enhances gas retention, both of which lead to increased volume (Mudgil *et al*., 2014).

Colour of cake. All these parameters l*, a* and b* for colour was highly significant difference ($P<0.01$) in the samples. L is for darkness to lightness, with values between 0 and 100, an is for greenness to redness, with values between -128 and +127 and b is for blueness to yellowness with values between -128 and +127 as well. Mean values of colour of cake is given below in the Table 4. The results of parameter l* were in the range of 64.76 to 68.65, parameter a* results were in range of 0.12 to 2.65 and parameter b* results were in range of 12.31 to 18.28. These results are close to the results of Tahmouzi *et al*. (2023) whose find the l* value 65.71-68.48, a* value 0.18-1.51 and b* value 12.66-18.83. Partial substitution of fat resulted in loss of shiny golden appearance on baking that contributes to variations in colour profile of products (Manzocco *et al*., 2000).

Sensory evaluation of cookies and cakes. Cookies samples were prepared by the utilization of guar gum examined for sensory characteristics like texture, flavour, taste, colour, after taste and overall acceptability. Results of sensory analysis of cookies were highly significant ($P<0.01$) to colour, taste, flavour, after taste, texture and overall acceptability (Table 5). The results were colour 4.2-8.13, texture -2.93-7.93, flavour 3.13-7.66, taste 3.73-8.26, after taste 2.93-7.8 and overall acceptability 3.53-8.18. According to another study colour, texture, taste, flavour, after taste and over all acceptability, the sensory scores ranged from 3.00 to 4.83, 3.25 to 4.25, 2.88 to 4.25, 3.01-4.91 and 2.36-4.25, respectively (Chugh *et al*., 2013). Variations in results due to change in quality and source of ingredients and sensory order effect.

Cake prepared by guar gum examined for sensory attributes like texture, flavour, taste, colour, after taste and overall acceptability. Results of sensory analysis of cake were highly significant ($P<0.01$) to colour, taste,

Table 5. Sensorial characteristics of cookies and cakes prepared by partial substitution of fat with guar gum

Treatments	Colour	Taste	Flavour	Texture	After taste	Overall acceptability
Cookies						
T_0	8.13±0.81^a	8.26±0.59^a	7.66±1.11^a	7.93±0.88^a	7.8±0.94^a	8.18±0.82^a
T_1	7.13±0.63^b	6.93±0.59^b	7.06±0.96^a	6.86±1.24^a	6.8±0.86^b	7.18±0.76^b
T_2	6.26±0.70^c	5.4±0.50^c	5.53±1.35^b	5.2±1.52^b	5.66±1.23^c	5.84±0.94^c
T_3	4.2±0.86^d	3.73±0.88^d	3.13±0.91^c	2.93±1.09^c	2.93±0.96^d	3.53±0.63^d
Cakes						
T_0	8.13±0.63^a	8.6±0.50^a	8.06±0.59^a	8.13±0.63^a	7.6±0.91^a	8.10±0.71^a
T_1	7±0.65^b	6.8±0.41^b	7.06±0.88^b	6.86±1.12^b	6.66±0.81^a	7.05±0.78^b
T_2	6.26±0.7^c	5.4±0.50^c	5.53±1.35^c	5.2±1.52^c	5.66±1.23^b	5.84±0.94^c
T_3	4.2±0.86^d	3.733±0.88^d	3.13±0.91^d	2.93±1.09^d	2.93±0.96^c	3.53±0.63^d

T_0 = control; T_1 = 85% fat and 15% guar gum; T_2 = 70% fat and 30% guar gum; T_3 = 55% fat and 45% guar gum.

flavour, after taste, texture and overall acceptability (Table 5). The results were in the range of 8.13-4.2, 8.13-2.93, 8.06-3.13, 8.6-3.73, 7.6-2.93 and 8.10-3.53 for colour, texture, flavour, taste, after taste and overall acceptability respectively.

Conclusion

The addition of guar gum in different concentrations as fat replacer in cakes and cookies improve the texture and sensory characteristics of the products. Incorporation of guar gum in many bakery products increase the utilization of guar gum in food and provide the natural resource of fat that would be good for health as compared to synthetic fat. The study concluded that guar gum can replaced 15% fat in cakes and cookies to get good quality product in terms of texture, volume and sensory acceptance.

Acknowledgment

Authors are thankful to the MNS-University of Agriculture, Multan for their support in conducting the research.

Conflict of Interest. The authors declare that they have no conflict of interest.

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