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ORIGINAL ARTICLE

Investigation on Production of Low Fat Muffin Cake utilizing *Ocimum basilicum* Seed Powder, Guar gum and isolated soy protein

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ABSTRACT
Due to the increased consumption of high amounts of oil and oil products such as Muffin cakes, today, a suitable alternative seems to be essential. Therefore, the present study examines the possibility of producing low-fat Muffin cake (50% of oil removal) using soy protein (zero, 10 and 20%), guar gum (zero, 0.15 and 0.30%) and basil powder (zero, 1 and 2%). The results showed that any increase in the amount of soy protein, guar gum and basil powder will lead to increase in the quality of viscosity of the cake and also final product moisture and hence a decrease in water activity. Also the findings indicated that the sample containing 10% soybean and 2% basil powder had the highest specific volume and least amount of hardness compared to those of other samples (2 hours and one week after baking). Finally, tasting the samples, the panelists introduced the samples containing 10% soybean protein and basil powder as the best samples. Then, the best the sample was compared with control sample (no oil removal) and the results indicated that the texture hardness of each sample was equal within 2 hours after baking. But samples containing 10% soy protein and 2% basil powder had softer texture in one week after baking. In addition, there were an increase and a decrease in protein and fat contents in the sample containing 10% soybean protein and 2% basil powder. So, the positive results of this study support the possibility of producing low-fat Muffin cake enriched with protein of desirable quality and quantity.
Keywords: low-fat Muffin cake, soy protein, guar gum, basil seed

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INTRODUCTION

Bakery products are the most consumed foods in the world and among these products; cakes are the most popular products due to their deliciousness and special organoleptic characteristics [1]. Among different types of cakes, Muffin cake has a special position due to its deliciousness. Flour, sugar, oil and eggs are the four main ingredients used to make cakes and each plays an important role in the cake structure and nutritional quality [2, 3]. However, the tendency of people to consume diet food aimed at preventing weight gain and maintaining healthy standards of life and baking industry products as the main food of the society garnered many researchers' and producers' attention on introducing low calorie diet to the market. Great attention has been paid to the fat reduction in the food formulations, as it is the most important factor in calorie-producing calculations and its excessive consumption may lead to irreparable harm to the physical health [4]. On the other hand, due to the important role of fat in the primary formulation of the baking industry products, we should find a suitable alternative preserving the product features such as spongy and soft texture, flavor and color. Hence, different fat replacements were used in the bakery products. Abozeid and et al [2011] used microcrystalline, pectin, egg-white as fat replacers in the formulation of cakes and pastries. They found that the sample containing pectin, egg-whites had a structure similar to those of the control sample (without oil removal). Khalil [21] examined using carbohydrate-based fat replacement with Sodium stearoyllactylate emulsifier to remove some of the oil in cake formulations. Findings showed that samples with 25 and 50 percent of oil retained aroma and taste, softness and chew-ability properties have similar features to those of the control sample. Furthermore, softness and chew-ability of the product texture were greatly improved by addition of emulsifiers in combination with carbohydrate-based fat replacer. In their study, Dilek et al [17] found that the use of

poly dextrose as a fat replacer in the formulation of cake, not only reduced 22% of the final product calorie, but also it reduced the size of the air bubbles of the cake batter and distributed them homogenously in the texture of the product and the results suggested a harder texture, but with a crust similar to that of the control sample. Garcíaa et al [19] used lipase enzymes, emulsifiers and inulin as fat replacers in the formulation of cake. Their findings demystify that cake samples containing emulsifiers had less density and more viscoelastic properties. Also, the samples containing lipase had the most texture softness during storage time. Furthermore, the results showed that in the presence of inulin, the microstructure of the internal part of the cake had been improved. Moreover, Rafael et al [26] did a survey on the Chia flour (protein synthesis) as a fat replacer in cake formulations, and suggested that comparing to the control sample (without oil removal), by replacing 25% of the fat with Chia Flour, no change occurred in the color, taste, texture and overall acceptability of the produced samples. Size and porosity of the cake reduced and its texture hardness increased when we replaced more than 50 percent of the oil with this flour. Using tofu (cheese made from soy milk) in the formulation of low-fat cake, Power *et al* [25] stated that the texture hardness of the product considerably increased by replacing more than 50% of oil with tofu, and this led the panelists to reject the final product acceptability, particularly in terms of smell and taste. Laura *et al* [22] examined the effects of hydroxypropyl methylcellulose and inulin on biscuit. The results revealed that only 15% of oil replacement in the formulation made the panelists to accept the sample taste. Having focused on the conducted studies in the field of fat replacements and the society growing demand for producing and introducing diverse dietetic products, researchers aimed at reducing 50 percent of the oil used in the formulation of Muffin cake and reviewing its replacement with isolated soy protein (at three levels: zero, 10 and 20%), guar gum (zero, 0.15 or 0.30 percent) basil powder at three levels (zero, 1 or 2%) in a completely randomized design based on factorial physico-chemical, textural and sensory properties of the product.

MATERIALS AND MTHODS

Materials

Star Flour was purchased with extraction rate of 83 per cent from flour Golmakan (Mashhad, Iran).The flour needed for the experiment was prepared and kept at 4 °C.

Other ingredients used in experiments were as follow:

Sugar with the brand name of sweet sugar (Mashhad, Iran), invert syrup form Aryan Glucose Company (Tehran, Iran), liquid vegetable oil from Varamin Factory (Tehran, Iran), baking powder with the name of Shahsavan (Mashhad, Iran) which were purchased from a confectionery store.Tlavng (brand name) fresh eggs were prepared the day before producing the sample and were stored in the refrigerator (4 °C). Guar gum (brand MEYPROtm GUAR E412), lecithin emulsifier and vanilla (brand RHOVANILLA) from Rvdya Company (France), isolated soy protein from Soy Sun Company (Tehran, Iran) and basil seeds were purchased from the local market.

Methods

The physicochemical properties of wheat flour such as moisture, protein, ash, fat, wet gluten and Falling Number were measured based on AACC standard procedures (2000). To prepare the basil powder, basil seeds were washed with water. Then, they were placed on a cabinet drying- tray and were dried at 60-55 °C and air flow of 1.5 - 2 meter per second for 5 hours. Immediately, the dried grains were converted into powder using Moulinex electric rubbing mill (AR1066Q) with high speed (220 rpm). In order to control the size of the granules, they were passed through a 100 mesh sieve.

Cake batter preparation and cake production

Cake batter basic formula (control) contains 100% wheat flour, 25% sugar, 25% oil, 36% eggs, 12% invert syrup, 2% baking powder and 0.2% vanilla and appropriate amount of water (60- 50% depending on the treatment). 50% of the oil contained in the low fat cake formulation (12.5 percent) was replaced with isolated soy protein at three levels: zero, 10 and 20%, guar gum at three levels: zero, 0.15 and 0.30 and basil powder at three levels: zero 1 and 2% (on the basis of wheat flour weight). It should be noted that in order to maintain the fatty acids in basil seeds, 1% Lecithin emulsifier was added to all cake samples. Generally, to prepare a cake, oil, sugar and eggs were mixed using an electric mixer (Electra EK-230M, Japan) at a speed of 128 rpm for 6 minutes to produce a cream containing air bubbles. Then, water, invert syrup, guar gum and basil powder were added into the cream and we mixed them for 4 minutes. Next, isolated soy protein, baking powder and vanilla were added into the flour and the obtained mixture was added into the cream gradually. Then, using funnel pitchers, 55 grams of the produced cake batter was poured into paper cases placed in the cake special molds. Then, baking process was performed using Karl Welkerkg electric oven (Germany) at 170 ° C for 20 minutes. Following cooling process, each sample was packaged in polyethylene bags and stored at room temperature to evaluate its quantity and quality [5].

Physico-chemical tests on cake batter and Muffin cake

Cake batter viscosity

Bostwick viscosity meter (made in China) was used in order to measure cake batter viscosity [6].

Measurement of moisture, fat, protein, water activity and specific volume of the Muffin cake

The AACC standard (2000) numbers 16-44, 10-30 and 10-46 were used to measure moisture, fat and protein content of wheat flour, respectively. The water activity of each treatment was measured using a water activity meter (Model Lab Touch, made in England) within 2 hours after baking at 25 °C. An alternative method of volume displacement with rapeseed was used to measure the specific volume of the cake samples according to standard AACC (2000) No. 10-72.

Texture evaluation

Cake texture was evaluated based on Ronda and colleagues (2005) method using a texture meter at intervals of 2 hours and one week after baking. The maximum force required for a cylindrical probe to penetrate from the center of the cake with a flat end (2 cm diameter and 3.2 cm in height) at a speed of 30 millimeter (mm) per minute, was considered as the hardness index. It is worth noting that in order to achieve accurate internal texture hardness of the cake; the top part of it was removed with a knife. The trigger and the target points were 0.05 Newton and 30 mm, respectively. In fact, the hardness value was obtained in terms of force-deformation curve. In this case; the hardness was equal to the force-deformation curve maximum value, which was expressed based on the Newton (N).

Sensory Characteristics Testing

Sensory test was performed using Azizi proposed method [14]. Ten panelists were selected from among trained persons in accordance with the triangular test and Gacula and colleagues method [18]. Then, the cake sensory characteristics like form, upper surface characteristics, lower surface characteristics, porosity, texture hardness and softness, ability to chew, smell, taste were evaluated and their rank coefficients were equal to 4, 2, 1, 2, 2, 3 and 3, respectively. Evaluation index ranged from very bad (1) to very good (5). With this information, the overall acceptance (number of cake quality) was calculated using equation 1 (Sahari et al., 2013).

Equation 1 $$Q = \sum \frac{(P*G)}{\sum P}$$

Overall rating P=Rank coefficient G= characteristics coefficient

Statistical Design and Results Analysis

The results of the first phase of this research were examined using Mstat-c software, version 1.42 and also the factorial design with completely randomized three-factor arrangement. For this purpose, half of the oil in the Muffin cake formulation (12.5 percent) was replaced with the three factors i.e. isolated soy protein (at levels of zero, 10 and 20%), guar gum (at three levels: zero, 0.15 and 0.30%) and basil powder (at three levels: zero, 1 or 2 percent). In the second phase, using T test, nutritional and technological characteristics of the best Muffin cake sample of the first phase was compared with those of the control sample in which no oil replacement occurred (25% oil). Each cake sample was prepared in three replicates in the both phases and the corresponding tests were performed on them. Means were compared by Using Duncan's test at a significance level of 0.95 percent (p<%05).

RESULTS AND DISCUSSION

Qualitative characteristics of wheat flour

Flour characteristics are shown in table 1.

First phase: The effect of adding fat replacers on the production of low-fat Muffin cake

Physicochemical tests on the batter cake and Muffin cake

Viscosity

Table 2 shows the interaction of three factors of isolated soy protein, guar gum and basil powder on the viscosity of the produced samples, As you can see, with an increase of these three factors in the initial formulation of the product, the distance traveled by batter cake in a given time, was significantly decreased at P <0.05 which means that the viscosity of the cake batter was increased by the addition of these three compounds to the cake batter. Likewise, the results clearly showed that the control sample and the sample containing 20 percent of the isolated soy protein, 0.30% guar gum and 2% basil powder had the least and the highest viscosity levels, respectively.

Isolated soy protein seems to improve the viscosity of the cake batter of the bakery industry products by strengthening the gluten network. The results indicated that the viscosity of cake batter of the low fat cake increased by increasing the content of the guar gum and basil powder in the product formulation. In addition, Guarda et al [20] suggested that and gum and mucilage-containing compounds ability to quickly absorb water is the main reason for this event. However, examining different hydrocolloids effects, Pernell

et al [24] suggested that the effective factor increasing the quality of cake viscosity is the gel network formed by the compounds of the cake batter texture of the baking industry products.

Moisture

Table 2 shows the results of interaction of the isolated soy protein, guar gum and basil powder. According to the table, the control sample and the samples containing 20% isolated soy protein, 0.30% guar gum and 2% basil powder had the least and the most moisture contents, respectively. As indicated, the use of the isolated soy protein, guar gum and basil powder had significant role in increasing the moisture content of the low fat Muffin cakes. It should be noted that guar gum played more important role than isolated soy protein and basil powder in this regard. There is noted in the scientific sources that, in addition to the emulsifying, concentrating and foaming properties of the soybean and its derivatives, it is widely consumed due to the fact that it has high protein content and is able to increase water holding capacity accordingly [7]. Finally, it should be said as McCarthy et al [23] stated that these material that are hydrophilic in nature, are able to interact with water and reduce water distribution and stability during the baking process and this is a very effective factor that increases the final product moisture during and after the baking process. So as the present study findings clearly indicated, gums (such as guar gum) and mucilage-producing compounds (such as basil powder) due to having hydroxyl groups are hydrophilic in nature and are able to increase the final product moisture.

Water activity

After observing the results, It was clearly revealed that the presence of guar gum and basil powder in the low-fat Muffin cake formulation reduced the water activity of the produced samples. It is worth noting that guar gum played more important role than basil powder in decreasing the water activity of the produced samples. On the other hand, in order to perform Millard reaction, the most suitable water activity rate should be within 0.6 to 0.7 (8). Therefore, the brown color and flavor of the final product was improved by the addition of guar gum and basil powder into the low fat Muffin cake formulations and they made a positive effect on reducing the water activity in order to perform Millard reaction. Chinachoti [16] expressed two main factors influencing the water activity reduction and the reduced contact with water polar molecules, which are as follows: gel network formation and closure of water in this network. In this case, he also expressed that the produced food moisture and its water activity increased and decreased respectively.

Texture hardness within two hours and one week after baking

Results of the interaction of the isolated soy protein, guar gum and basil powder on the hardness of the cake texture within two hours and one week after baking in Table 3, clearly indicated that the sample containing 20% isolated soy protein,3% guar gum,2% basil powder and the sample containing 10% isolated soy protein, 2% basil powder had the most and the least texture hardness, respectively.

By looking at the texture hardness within one week after baking, it seems that 20% isolated soy protein and 3% guar gum contents weren't as effective as 10% isolated soy protein and 15% guar gum contents in decreasing texture hardness, although, independently they produced less hard texture than the control sample. It is most likely affected by the complete formation of the gluten network and texture hardening of the final product after baking. This means the lack of fat in the control formulation (the sample with 50% less oil than the basic formulations) was replaced with a portion of the isolated soy protein or guar gum and then the remaining protein and gum helped strengthening the gluten network. Consequently, it played an important role in thickening of the air bubbles of the cake batter and the texture compression. It was expected that the sample contains 20% protein, 0.30% guar gum and 2% basil powder, due to the highest strength of the gluten network, has the highest degree of texture hardness, even more than the control sample (sample where there is no fat replacer). On the other hand, besides using a suitable fat replacer in low-fat Muffin cake formulation, we should adopt appropriate measures to prevent the loss of moisture in bakery products because the fat contained in these types of food plays important role in retaining moisture and preventing it from going out during the baking time [9]. As it was observed, compared to the control sample, the compounds used in this study (isolated soy protein, guar gum and basil powder), as fat replacers, all retained the water absorption nature of the cake batter and the ability to increase moisture. Surely, it can be said that, in the present study, all the produced samples had a better texture than the control sample within one week after baking. In fact, the selected fat replacers in low fat Muffin cake played a positive and effective role in reducing the staling process. Finally, it should be noted that Bent et al [15] and Ashwini et al [13] made similar reports regarding the role of hydrocolloids as an emollient and anti-staling factors in cake.

Specific volume

According to Table 3, the sample containing 20% isolated soybean protein, 0.30% guar gum and 2% basil powder and the sample containing 10% soy protein and 2% basil powder had the lowest and highest specific volume, respectively. It should be noted that oil itself is one of the factors retaining incoming air

bubbles during the mixing process in cake formulations. Here it seems that not only proteins, gums and mucilage have the ability to be a suitable fat replacer, but also they have the ability to strengthen the cell walls and do not allow the walls to be torn. The important point is that if we use excessive amount of additives in the formulation, it may hamper the air bubbles expansion during baking process due to the excessive increase in the strength of the their wall and therefore, not only there is no increase in volume of the final product texture, but also the texture is hard and compressed. In this study, the high levels of isolated soy protein, guar gum and basil powder (especially in combination mode) caused the same problem in low-fat cake.

Sensory characteristics

Table 4 shows the interaction of isolated soy protein, guar gum and basil powder on the score given in sensory evaluation to the form and shape of the produced samples. The results showed that form of the sample containing 10% isolated soy protein and 2% basil powder were more superior to the other samples.

The panelists expressed that the unexpectedly darker color of the sample containing 20% isolated soybean, was the main reason for the low rating of its high surface characteristics.It should be noted, based on the panelists" decision, the sample containing 1% of basil powder was better than the sample containing 2% of it, in terms of upper surface characteristics. Because according to some sensory panelists, there can be seen tiny black particles on the surface of the sample containing 2% of basil powder that consequently, the desirability of the final product was reduced. On the other hand, the sample containing 1% basil powder was more superior to the control sample due to its smoother and brighter colored surface. Also, the samples containing guar gum had a more humongous surface with minimal shrinkages due to higher moisture retention and this was the main reason for their superiority over the control sample. In the evaluation of the low surface characteristics of the final product, low rating given to the control sample due to its low quality color that most likely was due to the lack of oil. Also in this sample shrinkages and cracks were observed which may be as a result of of its inability to maintain moisture during the baking process.

On the other hand, a darker color is seen in the samples containing high levels of isolated soy protein, which was unexpectable and considered as a burnt cake by the panelists. Also, there was a report on abnormal surface (sticky surface) that was apparently due to too much water absorption of the cake batter of the samples containing high level of protein, guar gum and basil powder used in the formulation of low-fat cake. The panelists stated that the two samples received the highest score during the porosity and hollowness evaluation (the sample containing 10% isolated soy protein and 2% basil powder and the sample containing 10% isolated soy protein and 0.15% guar gum) had tiny pores. Furthermore, these pores were distributed homogenously in the whole texture of the product and this was the main reason why these two samples received the highest score of hollowness and porosity. According to the results of the evaluation of the texture of the low-fat cake samples, the sample containing 10% isolated soy protein and 2% basil powder were given the highest score on their texture qualitative properties, because this sample had the lowest amount of texture hardness than other samples. It was predicted that the sample containing 20% isolated soy protein, 0.30% guar gum, 1% basil powder and the other sample containing 20% isolated soy protein, 0.30% guar gum and 2% basil powder receive the lowest scores regarding their textures softness and hardness. According to the sensory panelists, these two samples had a sticky texture and consequently were not approved in terms of qualitative standards and received very little acceptability. Moreover, the texture of the control sample was not satisfying and received very low acceptability in terms of qualitative characteristics which according to the reports, it was due to the dry and brittle nature of this sample. According to the results of table 4, the highest chew-ability score was given to the sample with 10% isolated soy protein and 2% basil powder. In this study, the sample containing 20% isolated soy protein, 0.30% guar gum and 2% basil powder was given low scores due to the undesirable hardness of its texture, a sticky feeling in mouth and spending more time to chew and swallow them.

As the results showed that the amount of the additives that were used to compensate for the lack of oil in the cake basic formulation, was so excessive that caused the formation of a firm gluten network that retained too much moisture in itself during the baking process, which led to the formation of an abnormal, sticky and pasty texture.It should also be noted that there was a shortage of fat and fat replacer in the formulation of the control sample.Based on the evaluators' viewpoint, it had dry and poor texture quality that made chewing difficult.According to Table 4, the highest smell, taste score was given to the sample containing 10% isolated soy protein and 0.15 percent guar gum. The panelists also, stated that the taste and smell of the sample containing 2% basil powder are not undesirable because of the presence of a slight smell and taste of basil in this sample; they gave lower scores to the sample containing 2% basil powder comparing the sample containing 1% of this additive.Also, using higher amount (more than 25%)

of guar gum produced more undesirable smell than the lower amount of it (10 and 11) that the result of this study confirmed it. Because the sample containing 0.15% guar gum received higher scores than the sample containing 0.30% of guar gum in terms of smell, taste and flavor. Also, it is more likely that reduction of sweet taste in the samples containing 20% isolated soy protein, which was reported by the panelists, is affected by the undesirable texture. Since samples containing 20% isolated soy protein had a hard, sticky and unswallow able texture comparing to the sample containing 10% of this additive, an impaired release of flavor producers happens. Therefore, if an appropriate amount of gums and mucilage compounds are used during the process of replacing oil, besides having a desirable texture, flavor producers will be preserved, too.

According to Table 4, the highest overall acceptability was given to the sample containing 10% isolated soy protein, 2% basil powder and the sample containing 10% isolated soy protein and 0.15 percent guar gum. Jointly. Thus, since these two samples had the highest score in many parameters, it was expected that compared with other produced samples, their overall acceptability scores be at the highest level and the panelists introduced these two samples, as the samples of low-fat cake with high acceptable characteristics from the perspective of the consumer.

Second phase: Comparison of the best first phase sample with the control sample

In the first phase of this study, isolated soybean protein, guar gum and basil powder were used to reduce 50% of the oil contained in the muffin cake formulation. Finally, based on the sensory evaluation, two samples containing 10% isolated soybean protein,2% basil powder and 10% isolated soybean protein,10% guar gum were selected as the best samples by the panelists. But between these two samples, the one containing 10% isolated soybean protein and 2% basil powder had softer texture and higher specific volume. Therefore, as texture is a fundamental parameter in the baking industry products, this low-fat cake sample was selected to be compared with the sample with no oil removal (control).

Texture hardness within two hours and one week after baking

As it can be seen in Table 5, there is no significant difference between the texture hardness of control sample and samples containing 10% isolated soy protein and 2%basil powder at $P < 0.05$. It indicates that 50% replacement of the oil in the basic formulation with 10% isolated soy protein and 2% basil powder has been properly done and it has no negative impact on the hardness of the product texture.

As Table5 shows,the sample containing 10% isolated soy protein and 2% basil powder had lower level of texture hardness than the control sample within one week after baking.As these two samples (control and the best sample of the first phase) had equal hardness within 2 hours after baking, it can be concluded that the staling process in the control sample was more than the sample containing 10% isolated soy protein and 2% basil powder. It's most likely related to the greater ability of isolated soybean protein and basil powder than oil ability in retaining moisture during storage time and reducing retro gradation phenomenon.

Fat

As the results of Table 5 show, the control sample had higher amount of oil than the sample containing 10% isolated soy protein and 2% basil powder. It seems that lack of oil in the sample containing 10% isolated soybean and 2% basil powder was due to a suitable fat replacer that not only had a positive effect on the qualitative and quantitative characteristics of the produced cake texture, but also produced a better product than the control sample in terms of texture quality.

Protein

As can be seen in Table 5, comparing to the control sample, the sample containing 10% isolated soy protein and 2% basil powder had significantly higher amount of protein at $P < 0.05$. It was expected that the protein content of the product be a lot higher in the sample used isolated soy protein as a fat replacer.

Table 1. Qualitative characteristics of wheat flour

Qualitative characteristics	value
Moisture (percent)	13.6
Protein (percent)	10.3
Ash (percent)	0.64
Fat (percent)	3.25
Wet gluten (percent)	26.7
Falling number (s)	402

Table 2. Interaction effect of adding isolated soybean protein, guar gum and basil powder at different levels on the viscosity of the cake batter, moisture and water activity levels of the low fat Muffin cake

isolated Soy Protein (percent)	guar gum (percent)	basil powder (percent)	Viscosity (cm)	Moisture (percent)	water activity
0	0	0	6.37 ± 0.06 a	11.53 ± 0.15 v	0.808 ± 0.001 a
		1	5.77 ± 0.06 c	12.33 ± 0.15 u	0.779 ± 0.001 ab
		2	5.27 ± 0.06 d	13.03 ± 0.15 t	0.742 ± 0.003 bcd
	0.15	0	4.90 ± 0.10 e	16.49 ± 0.06 n	0.758 ± 0.003 abc
		1	4.30 ± 0.00 g	16.57 ± 0.12 n	0.729 ± 0.002 be
		2	3.57 ± 0.06 j	18.77 ± 0.15 i	0.697 ± 0.002 cde
	0.30	0	4.27 ± 0.06 g	18.57 ± 0.15 i	0.719 ± 0.002 be
		1	3.63 ± 0.06 ij	18.43 ± 0.15 jk	0.691 ± 0.002 de
		2	3.20 ± 0.06 k	20.20 ± 0.20 f	0.669 ± 0.003 e
10	0	0	6.13 ± 0.06 b	13.63 ± 0.06 s	0.808 ± 0.001 a
		1	5.30 ± 0.10 d	14.57 ± 0.15 r	0.779 ± 0.001 ab
		2	4.03 ± 0.06 h	15.33 ± 0.21 p	0.743 ± 0.002 bcd
	0.15	0	4.57 ± 0.06 f	17.07 ± 0.15 m	0.757 ± 0.001 abc
		1	3.70 ± 0.00 i	17.37 ± 0.12 l	0.729 ± 0.000 be
		2	2.97 ± 0.06 l	18.33 ± 0.15 k	0.697 ± 0.003 cde
	0.30	0	3.70 ± 0.10 i	19.87 ± 0.15 g	0.718 ± 0.002 be
		1	3.20 ± 0.00 k	20.80 ± 0.20 e	0.691 ± 0.001 de
		2	2.47 ± 0.06 n	22.50 ± 0.10 b	0.669 ± 0.002 e
20	0	0	6.10 ± 0.00 b	14.83 ± 0.15 q	0.808 ± 0.002 a
		1	4.53 ± 0.06 f	15.33 ± 0.15 p	0.777 ± 0.003 ab
		2	4.00 ± 0.00 h	15.93 ± 0.21 o	0.741 ±0.002 bcd
	0.15	0	4.33 ± 0.06 g	17.07 ± 0.15 m	0.758 ± 0.002 abc
		1	3.23 ± 0.06 k	18.63 ± 0.15 ij	0.729 ± 0.001 be
		2	2.73 ± 0.06 m	19.23 ± 0.15 h	0.696 ± 0.002 cde
	0.30	0	3.60 ± 0.00 j	21.07 ± 0.15 d	0.717 ± 0.002 be
		1	2.77 ± 0.06 m	22.17 ± 0.15 c	0.689 ± 0.002 de
		2	2.20 ± 0.10 o	23.57 ± 0.12 a	0.669 ± 0.002 e

(Statistically, similar letters has no significant difference at P <0.05)

Table 3. Interaction of adding isolated soybean protein, guar gum and basil powder at different levels on the texture hardness of the low-fat Muffin cake within two hours and one week after baking

isolated soy protein (percent)	guar gum (percent)	basil powder (percent)	hardness(N)		specific volume (Ml / g)
			2 hours after baking	a week after baking	
0	0	0	10.87 ± 0.15 c	18.53 ± 0.15 a	1.67 ± 0.06 k
		1	10.33 ± 0.15 d	16.13 ± 0.21 c	2.03 ± 0.06 j
		2	9.20 ± 0.10 g	15.80 ± 0.10 d	2.30 ± 0.10 i
	0.15	0	9.50 ± 0.10 f	14.63 ± 0.15 f	2.30 ± 0.00 i
		1	8.73 ± 0.15 h	14.47 ± 0.21 f	2.67 ± 0.06 h
		2	7.70 ± 0.10 j	13.57 ± 0.15 h	3.23 ± 0.06 f
	0.30	0	7.63 ± 0.12 jk	12.60 ± 0.17 j	3.03 ± 0.12 g
		1	7.43 ± 0.06 k	12.10 ± 0.10 k	3.23 ± 0.06 f
		2	6.37 ± 0.12 m	11.27 ± 0.21 l	3.57 ± 0.06 e
10	0	0	6.97 ± 0.06 l	12.70 ± 0.20 j	4.10 ± 0.00 d
		1	5.07 ± 0.15 o	7.93 ± 0.15 o	4.60 ± 0.10 b
		2	4.45 ± 0.15 p	6.37 ± 0.15 q	5.00 ± 0.10 a
	0.15	0	5.03 ± 0.06 o	6.40 ± 0.17 q	4.67 ± 0.07 b
		1	5.63 ± 0.12 n	7.20 ± 0.10 p	4.27 ± 0.06 c
		2	6.40 ± 0.10 m	7.33 ± 0.15 p	4.07 ± 0.06 d

			0	6.30 ± 0.10 m	8.80 ± 0.10 n	4.03 ± 0.12 d
		0.30	1	7.17 ± 0.06 l	10.37 ± 0.15 m	3.60 ± 0.10 e
			2	8.13 ± 0.12 i	11.07 ± 0.15 l	2.93 ± 0.06 g
			0	8.27 ± 0.12 i	13.07 ± 0.15 i	2.93 ± 0.15 g
		0	1	9.60 ± 0.10 f	13.30 ± 0.20 hi	2.27 ± 0.06 i
			2	10.37 ± 0.15 d	13.93 ± 0.15 g	2.27 ± 0.06 i
			0	9.90 ± 0.10 e	14.03 ±0.21 g	2.03 ±0.06 j
	20	0.15	1	10.83 ± 0.15 c	15.50 ± 0.10 e	1.70 ± 0.00 k
			2	12.27 ± 0.21 b	15.60 ± 0.17 de	1.67 ± 0.10 k
			0	10.90 ± 0.10 c	15.87 ± 0.15 cd	1.30 ± 0.06 l
		0.30	1	12.37 ± 0.15 b	17.37 ± 0.15 b	1.33 ± 0.06 l
			2	13.67 ± 0.15 a	17.50 ± 0.25 b	1.13 ± 0.06 m

Statistically, similar letters has no significant difference at P <0.05

Table4. The interaction of adding isolated soybean protein, guar gum and basil powder at different levels on the sensory properties of low-fat Muffin cake

Isolated soy protein %	Guar %	Basil %	form	upper surface properties	lower surface properties	porosity and hollowness	Texture Hardness and texture softness	chew-ability	smell, taste and flavor	overall acceptability
0	0	0	1.47 ± 0.12 k	1.00 ± 0.00 p	2.07 ± 0.12 j	1.47 ± 0.00 lm	1.87 ± 0.12 i	2.07 ± 0.12 jk	2.00 ± 0.00 k	1.81 ± 0.05 m
		1	1.87 ± 0.12 j	2.87 ± 0.12 g	2.27 ± 0.12 i	1.80 ± 0.12 jk	2.13 ± 0.12 h	2.27 ± 0.12 ij	2.20 ± 0.00 j	2.06 ± 0.03 l
		2	2.27 ± 0.12 i	2.27 ± 0.12 i	2.67 ± 0.12 g	2.47 ± 0.12 no	2.60 ± 0.20 g	2.47 ± 0.12 hi	2.00 ± 0.00 k	2.39 ± 0.07 jk
	0.15	0	2.33 ± 0.12 i	1.80 ± 0.00 k	2.60 ± 0.20gh	2.07 ± 0.12 jk	2.67 ± 0.12 g	2.53 ± 0.12 h	2.20 ± 0.20 j	2.32 ± 0.03 k
		1	2.67 ± 0.12 h	2.13 ± 0.12 ij	2.93 ± 0.12 f	2.27 ± 0.12 ij	2.93 ± 0.12 f	2.93 ± 0.12 g	2.73 ± 0.12 i	2.77 ± 0.21 h
		2	3.07 ± 0.12 fg	1.67 ± 0.12 kl	3.13 ± 0.12 e	2.80 ± 0.20 g	3.40 ± 0.00 e	3.07 ± 0.12 g	1.67 ± 0.12 l	2.66 ± 0.05 i
	0.30	0	3.00 ± 0.00 g	2.67 ± 0.12 h	3.53 ± 0.12 d	2.80 ± 0.20 g	3.47 ± 0.12 de	3.40 ± 0.00 f	2.18 ± 0.00 j	3.09 ± 0.02 g
		1	3.07 ± 0.12 fg	2.53 ± 0.12 h	3.53 ± 0.12 d	2.87 ± 0.12 fg	3.47 ± 0.12 de	3.67 ± 0.12 f	3.40 ± 0.12 g	3.12 ± 0.08 g
		2	3.27 ± 0.12 f	2.53 ± 0.12 h	3.87 ± 0.12 c	3.07 ± 0.12 ef	3.80 ± 0.20 c	3.80 ± 0.20 e	3.07 ± 0.20 h	3.37 ± 0.09 f
10	0	0	3.53 ± 0.12 e	4.13 ± 0.12 b	4.20 ± 0.00 b	3.47 ± 0.12 d	4.20 ± 0.20 b	4.13 ± 0.12 d	3.00 ± 0.00 h	3.54 ± 0.03 e
		1	4.53 ±0.12 c	4.00 ± 0.00 bc	4.80 ± 0.00 a	4.27 ± 0.12 b	4.80 ± 0.00 a	4.47 ±0.12 c	4.73 ±0.00 b	4.46 ± 0.02 b
		2	5.00 ± 0.00 a	3.93 ± 0.12 c	4.73 ± 0.12 a	5.00 ± 0.00 a	4.93 ± 0.12 a	4.93 ± 0.12 a	4.53 ± 0.12 c	4.75 ± 0.04 a
	0.15	0	4.73 ±0.12 b	4.53 ± 0.12 a	4.80 ± 0.00 a	4.93 ± 0.12 a	4.87 ± 0.12 a	4.73 ± 0.12 ab	4.93 ±0.12 a	4.77 ± 0.04 a
		1	4.40 ± 0.20 c	3.53 ± 0.12 e	4.67 ± 0.12 a	4.00 ± 0.00 c	4.80 ± 0.00 a	4.67 ± 0.12 bc	4.73 ± 0.12 b	4.42 ± 0.06 b
		2	4.00 ± 0.00 d	3.00 ± 0.00 g	4.13 ± 0.12 b	3.53 ± 0.12 d	4.20 ± 0.20 b	4.20 ± 0.20 d	4.27 ± 0.12 d	3.93 ± 0.04 d
	0.30	0	3.93 ± 0.12 d	4.60 ± 0.00 a	4.20 ± 0.00 b	3.53 ± 0.12 d	4.20 ± 0.00 b	4.13 ± 0.12 d	4.20 ± 0.00 de	4.09 ± 0.04 c
		1	3.27 ± 0.12 f	3.73 ± 0.12 d	3.87 ± 0.12 c	3.13 ± 0.12 e	3.67 ± 0.12 cd	3.80 ± 0.00 e	4.07 ± 0.12 e	3.62 ± 0.02 e
		2	3.00 ± 0.20 g	3.27 ± 0.12 f	3.20 ± 0.00 e	2.53 ± 0.12 h	3.07 ± 0.12 f	3.07 ± 0.12 g	3.60 ± 0.20 f	3.11 ± 0.01 g
20	0	0	3.00 ± 0.00 g	2.00 ± 0.00 j	3.20 ± 0.00 e	2.47 ± 0.23 hi	3.07 ± 0.12 f	3.07 ± 0.12 g	2.00 ± 0.00 k	2.44 ± 0.07 j
		1	2.27 ± 0.12 i	1.60 ± 0.12 lm	2.47 ± 0.12 h	2.07 ± 0.12 jk	2.67 ± 0.12 g	2.53 ± 0.12 h	1.80 ± 0.00 l	2.12 ± 0.03 l
		2	1.80 ±	1.07 ± 0.12	2.20 ± 0.00	1.87 ± 0.12	2.13 ±	2.27 ±	1.73 ±	1.85 ± 0.06 m

		0.20 ^{j}	^{op}	^{ij}	^{kl}	0.12 ^{h}	0.12 ^{ij}	0.12 ^{l}	
0.15	0	2.27 ± 0.12 ^{i}	1.60 ± 0.00 ^{lm}	2.47 ± 0.12 ^{h}	2.07 ± 0.12 ^{jk}	2.60 ± 0.20 ^{g}	2.47 ± 0.12 ^{hi}	1.40 ± 0.00 ^{m}	2.09 ± 0.04 ^{l}
	1	1.40 ± 0.00 ^{k}	1.27 ±0.12 ^{n}	2.07 ± 0.12 ^{j}	1.60 ± 0.00 ^{m}	1.80 ± 0.00 ^{i}	2.07 ± 0.12 ^{jk}	1.13 ± 0.12 ^{n}	1.59 ± 0.07 ^{n}
	2	1.13 ± 0.12 ^{l}	1.07 ± 0.12 ^{op}	1.80 ± 0.00 ^{k}	1.27 ± 0.12 ^{op}	1.20 ± 0.20 ^{j}	1.87 ± 0.12 ^{k}	1.07 ± 0.12 ^{n}	1.30 ± 0.02 ^{o}
0.30	0	1.47 ± 0.12 ^{k}	1.67 ± 0.12 ^{kl}	2.07 ± 0.12 ^{j}	1.47 ± 0.12 ^{no}	1.87 ± 0.12 ^{i}	2.07 ± 0.12 ^{jk}	1.07 ± 0.12 ^{n}	1.60 ± 0.07 ^{n}
	1	1.13 ± 0.12 ^{l}	1.47 ± 0.12 ^{m}	1.80 ± 0.00 ^{k}	1.13 ± 0.12 ^{p}	1.13 ± 0.12 ^{j}	1.87 ± 0.12 ^{k}	1.00 ± 0.00 ^{n}	1.31 ± 0.03 ^{o}
	2	1.07 ± 0.12 ^{l}	1.20 ± 0.00 ^{no}	1.73 ± 0.12 ^{k}	1.07 ± 0.12 ^{p}	1.13 ± 0.12 ^{j}	1.40 ± 0.20 ^{l}	1.00 ± 0.00 ^{n}	1.14 ± 0.09 ^{p}

Statistically, similar letters has no significant difference at P <0.05

Table 5, Comparison of the nutritional and textural properties of the best sample of the first phase with the control sample.

sample	Texture(N)		Fat(percent)	Protein(percent)
	2 hours after baking	1 week after baking		
control	4.71 ± 0.12 ^{a}	9.44 ± 0.05 ^{a}	14.39 ± 0.22 ^{a}	8.6 ± 0.35 ^{b}
First phase best sample	4.45 ± 0.15 ^{a}	6.37 ± 0.15 ^{b}	9.9 ± 0.36 ^{b}	12.9 ± 0.69 ^{a}

Statistically, similar letters in each column have no significant difference at p <0.05

CONCLUSION

The results showed that with the increase of isolated soy protein, guar gum and basil powder contents, the cake batter viscosity and the final product moisture increased and its water activity decreased. Also, the results indicated that among produced samples, the sample containing 10% isolated soybean protein and 2% basil powder had the least texture hardness within two hours and one week after baking and the most specific volume among the produced samples. Finally, evaluating parameters like sensory properties, cake batter viscosity, moisture, water activity, texture hardness, specific volume and porosity of the cake samples, we introduced the sample containing 10% isolated soybean protein and 2% basil powder as the best sample.Then, the second phase of the study was performed to compare level of hardness, fat and protein contents of the best sample of the first phase with the samples in which there was not any oil removal. Based on this phase results, the hardness level in both samples was equal within 2 hours after baking, but the sample containing 10% isolated soy protein and 2% basil powder had softer texture within one week after baking. In addition, the results showed an increase and decrease in protein and fat contents of the sample containing 10% isolated soy protein and 2% basil powder respectively. Based on the positive results of this study, the possibility to produce low-fat muffin cakes full of proteins and desired quantitative and qualitative properties is confirmed.

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