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Research Article

EFFECTS OF MALTODEXTRIN AS FAT REPLACER ON THE CHEMICAL AND SENSORY PROPERTIES OF BARAZEQ, GHURIBEH, AND MA'AMUL

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ABSTRACT

Objective: The objective of this study was to assess the effect of maltodextrin as fat replacer at various levels on some structural and sensory properties of Ma'amul, Barazeq, and Ghuribeh.

Methods: This study was conducted to evaluate the effects of fat replacing with maltodextrin at various levels (i.e., 10, 20, 30, and 40%) on Ma'amul, Barazeq, and Ghuribeh chemical and quality characteristics.

Results: Fat and energy were significantly ($p<0.05$) reduced with the increase of maltodextrin level in these bakery products. Overall acceptance, flavor, color, and softness of Ma'amul, Barazeq, and Ghuribeh were not significantly affected by the replacement in ratio ranging from 10% to 20% when compared to controls. Greater replacements (i.e., 30 and 40% maltodextrin) showed a significant reduction on sensory acceptability of the three products.

Conclusion: Ma'amul, Barazeq, and Ghuribeh are rich fat traditional sweet bakery products that are usually consumed in the Middle East. The maximum fat level that could be replaced in Ma'amul, Barazeq, and Ghuribeh were 40%, 30%, and 20%, respectively.

Keywords: Fat Replacer, Barazeq, Ma'amul, Ghuribeh, Maltodextrin, Sensory properties.

INTRODUCTION

Bakery products are one of the most common foods consumed in the world in relation to their nutritional values, variability, and organoleptic properties [1]. Barazeq, Ma'amul, and Ghuribeh are traditional sweet bakery products that are consumed by most of the population in Jordan, Lebanon, Syria, Palestine, Turkey, and Eastern Europe. These products are generally prepared from the same ingredients that include low protein flour, sugar, and fat. Fat content of these products ranges from 20% to 40%, which influences the products rheological properties and overall quality. It is known that fats are responsible for the texture, mouthfeel, and overall smoothness of the baked products. For example, fat in baking aids is creating a tenderized product, shorter dough, and lubricate the structure by dispersed during dough mixing. This is believed to prevent the starch and protein from forming a continuous network [1].

The awareness of the relationship between food and health had dramatically risen recently in health sector and food industry. The efforts of the food industry have been directed toward the production of healthy food. Fat, for example, is the most recognized food component with a proven relationship with diseases such as cardiovascular diseases, obesity, hypertension, colon cancer, and headaches [2]. Therefore, great effort has been made to reduce the fat from food formulations without affecting their flavor and texture [3].

At present, the tendency in the food sector is to utilize fat replacers in different foods to mimic the textural and sensory attributes provided by fat but give considerably lower number of calories [4]. Of these, fat replacers are the carbohydrate-based replacers including maltodextrin, modified starches, inulin, and hydrocolloids. These replacers have been reported to mimic fat by binding water, retard staling and still providing smoothness, and the desired product's mouthfeel [5,6].

Based on these benefits of these replacers, the objective of this study was to assess the effect of maltodextrin as fat replacer at various levels on some structural and sensory properties of Ma'amul, Barazeq, and Ghuribeh.

MATERIALS AND METHODS

Materials

The preparation of the three sweet bakery products was done using the following ingredients: For Ghuribeh, 1 kg wheat flour, margarine, ghee (in different levels based on addition of fat replacers), 500 g table sugar, and 2.5 g vanilla, colorant; for Barazeq, 1 kg wheat flour, margarine, ghee, 500 g table sugar, 2.5 g vanilla, 250 ml skim milk, and 600 g sesame; and for Ma'amul, 1 kg wheat flour, margarine, ghee, 250 g table sugar, 2.5 g vanilla, and 250 ml skim milk. Mahaleb and anise colorant are including 100 g butter, 700g ground dates, 30 g anise, and 15 g cinnamon for the fillings. Pistachio and almonds were purchased from local market in Irbid, Jordan.

Replacement of fat in Ma'amul, Barazeq, and Ghuribeh using maltodextrin

Table 1 presents the percentages of maltodextrin of margarine content used as fat replacer in Ma'amul, Barazeq, and Ghuribeh.

Preparation of Barazeq

Vegetable fat, ghee, fat replacer, and sugar were placed in a bowl and mixed well. Milk, flour, vanilla, and half the amount of sesame, and salt were added to the mix and mixed well until having a flexible paste was formed. The dough is placed in the fridge for 1 h. The dough was shaped into small balls. These balls were pressed by hand to take a flat shape (i.e., 5 cm in diameter) and then are dipped in sesame before baking at 180°C for 15 min.

Preparation of Ghuribeh

Melted vegetable fat, ghee, fat replacer, and sugar were placed and mixed well in a bowl. Flour and colorant were then added gradually with continuous kneading using electrical mixer to produce a thick paste. The dough was formed into different shapes according to the traditional and known shapes of Ghuribeh, spiral shape. A piece of pistachios or almonds was placed in the middle of the formed paste for decoration. The formed dough pieces are placed on a tray and baked in an oven at 185°C for 15 min.

Table 1: Level of fat replacers with maltodextrins in the three products

Product	Treatments	Percentage of fat replacement
Ma'amul	1	0
	2	10
	3	20
	4	30
	5	40
Barazeq	6	0
	7	10
	8	20
	9	30
Ghuribeh	10	0
	11	20

Preparation of Ma'amul

Flour and mahleb were mixed well followed by the addition of melted fat and fat replacer with continuous mixing. Sugar and baking powder dissolved in milk were added to the dough with a mild mixing. The dough was covered with a nylon bag, placed in a warm place (i.e., 40°C), and left to rest for a full hour. The dough was then formed into a size of walnut and filled using dates before sealed. The filled balls were then placed into a specific mold for decoration. The prepared pieces were baked in a preheated oven at 180°C for 20 min before flipping them until developing a golden color (i.e., 5–10 min).

Chemical composition

Protein, fat, ash, moisture, and carbohydrate were determined using approximate analysis based on AOAC methods (AOAC 2011).

Sensory evaluation

Consumer testing was conducted at the Department of Nutrition and Food Technology, The University of Jordan, Amman, Jordan, and at Husun collages and Yubla secondary school. A total of 35 consumers were recruited among students and staff at The University of Jordan, Husun collage, and teachers of Yubla secondary school. Each participant was assigned a log number, given a brief explanation of the test objectives. A randomized complete block design was used, whereby each panelist evaluated all the samples. For evaluation, samples presented and identified by a three-digit code and each consumer evaluated six different samples in each session. Consumers were asked to record their degree of liking of the particular regarding Ma'amul, Barazeq, and Ghuribeh. The ballot consisted of a maximum of six questions designed to evaluate the consumer s' liking of various aspects of Ma'amul, Barazeq, and Ghuribeh. A 9-point verbal hedonic scale labeled from "dislike extremely" to "like extremely" was used and consumers were first asked to express their overall liking, liking degree of the product's softness, flavor, and color.

Statistical analysis

All measurements were performed either in triplicates and mean values were reported using analysis of variance to determine any significant differences among treatment parameters. A t-test at 95% confidence level and the difference between mean value between groups were compared by Duncan's new multiple range tests analyzed using the SPSS program version 21.0 [7].

RESULTS AND DISCUSSION

Chemical composition of the reduced fat Ma'amul, Barazeq, and Ghuribeh

The compositions of Ma'amul, Barazeq, and Ghuribeh using maltodextrin as fat replacer are reported in Table 2. Fat contents of Ma'amul, Barazeq, and Ghuribeh were 26.8%, 25.2%, and 26.5%, respectively. The total energy contents of the three products were 490.4, 512, and 520 Kcal/100 g, respectively. The use of maltodextrin resulted in a significant decrease in fat and energy content of the final products. For example, the use of maltodextrin as fat replacer in ratio of 10, 20, 30, and 40% of the margarine resulted in a reduction of Ma'amul fat content by 12.3, 20.9, 28.4, and 35.8%, respectively. Moreover, energy content was reduced by 4.3, 7.1, 9.8, and 12.5%, respectively. The maximum amount of maltodextrin that could be used to replace fat was 30% due to difficulties in mixing, kneading, and formulation of the product. Similarly, the use of maltodextrin in Barazeq as fat replacer at 10, 20, and 30% of margarine resulted in 8.3, 23.4, and 31.7% fat reduction. A decrease in energy by 2, 3.0, and 4.7%, respectively, was also reported. With a maximum level of 20% maltodextrin that could be used in Ghuribeh; this replacement resulted in a fat and energy reduction of about 17% and 7%, respectively, when compared to control samples.

The data in Table 2 also show that moisture content of Ma'amul was greater than Barazeq and Ghuribeh. The greater moisture content was related to the use of dates, which is rich in polysaccharides that may form a network that entraps water preventing or delaying the evaporation of all entrapped water. Protein content of Barazeq is greater than other products that were related to the addition of sesame seeds which have a good level of protein (i.e., 18%). These results were consistent with those of Psimouli and Oreopoulou [8] who reported more than 25% reduction in fat content of puff pastry as a result of using of maltodextrin at 25% as fat replacer. Moisture in all experimental samples increases with increasing maltodextrin, which might be due to high water-binding capacity of maltodextrin. This result agrees with the results of Serin and Sayar who reported a decrease in fat and an increase in moisture when inulin and maltodextrin were used as fat replacers in baked pogaca.

Sensory evaluation of the Ma'amul, Barazeq, and Ghuribeh

As the success of modifying of one or more of ingredients of food largely depends on the sensory acceptability and their similarity to the original product, reduced fat products need to be at least as acceptable as the full-fat ones. Therefore, the sensory evaluation of the bakery sweet studied in this study was conducted using composite scoring test of about 35 of students or staff members who have a good experience on food sensory analysis.

Color is one of the most important attributes of the product that draws the attention of consumers. Thus, the color of all the experimental and control of these products was evaluated by the panels and the mean values of score given by them are presented in Table 3. There was no significant effect on color of Ma'amul as the fat replaced with maltodextrin up to 20%. However, the color of Ma'amul score decreased when 30% and 40% fat replacement level with maltodextrin was used. Color of the product was them became slightly darker than that of control. The slight darkness color was attributed to Millard reaction development [8]. There was no significant effect on the color for fat replacement with maltodextrins in Barazeq and Ghuribeh at all levels used.

Consumer softness scored of Ma'amul, Barazeq, and Ghuribeh is presented in Table 3. There were no significant effects of maltodextrin replacements on product's softness when replaced by 10% in Ma'amul and 20% in Barazeq. However, greater replacements of maltodextrin (i.e., 20%, 30%, and 40% in Ma'amul and at 30% and 40% in Barazeq resulted in significant decrease in softness scores of the products. Replacement of 30% fat with maltodextrin resulted in significant reduction of Ghuribeh softness. The insignificant effect of the fat replacement at the level of 10 and 20% might be explained by the moisture holding properties of maltodextrin, which was able to provide the same softness properties with the fat in these formulations Serin and Sayar. However, the decrease in softness as a result of the fat replacement of fat with maltodextrins at levels greater than 30% agrees with Grigelmo-Miguel *et al*., Khouryieh *et al*., Zahn *et al*., and Zoulias *et al*., [9-11] who indicated that replacing fat with carbohydrate-based fat replacers results in harder texture in the bakery products.

Taste is the most desirable sensory attribute in bakery and confectionary group of food products. Any manipulations that reduce the fat level of cookies, therefore, will result in diminished acceptance. Overall, taste and aroma liking scores of the three products are presented in Table 3. Control samples of Ma'amul, Barazeq, and Ghuribeh and those

Table 2: Effect of fat replacement on Jordanian traditional bakery products chemical parameters using maltodextrin

Concentration	ASH*	Moisture*	Fat*	Protein*	CHO*	Energy†
Ma'amul						
0	0.81±0.02	10.4±0.2	26.8±0.6	6.2±0.23	56.1±0.5	490.4
10	1.05±0.08	11.1±0.2	23.5±0.5	6.8±0.19	57.6±0.6	469.1
20	0.93±0.04	11.8±0.2	21.1±0.3	6.6±0.50	59.8±0.8	455.5
30	0.87±0.02	12.5±0.2	19.2±0.4	6.4±0.17	61.0±0.3	442.4
40	0.91±0.13	13.3±0.1	17.2±0.40	6.3±0.21	62.3±0.4	429
Barazeq						
0	0.82±0.02	2.1±0.1	25.2±0.73	9.2±0.32	62.3±0.73	512
10	0.80±0.07	2.5±0.05	23.1±0.2	9.7±0.67	64.2±0.43	502
20	0.81±0.01	2.9±0.03	19.3±0.4	9.5±0.06	65.3±0.43	497
30	0.84±0.02	3.3±0.06	17.2±1.46	9.3±0.06	66.7±1.35	488
Ghuribeh						
0	0.24±0.03	2.1±0.08	26.6±0.5	4.9±0.03	66.2±0.2	523.8
	0.21±0.04	2.6±0.03	23.9±0.4	5.2±0.03	68.1±1.0	508.3
20	0.18±0.03	3.2±0.02	22.0±0.5	5.5±0.14	69.1±0.4	490

*Values are means (%) of n=2 measurements, ± standard deviation, †Values are presented in Kcal and calculated from fat (9 Kcal/g), protein (4 Kcal/g), and CHO (carbohydrate) (4 Kcal/g), Values within a column followed by a common letter are not significantly different (p>0.05)

Table 3: Sensory properties (i.e., overall liking, softness, flavor, and color) of Ma'amul, Barazeq, and Ghuribeh made using fractions (i.e., 10, 20, 30, and 40%) maltodextrin as fat replacer

Properties	0	10	20	30	40
	Ma'amul				
Overall acceptance	6.9±1.4^{a}	6.8±1.2^{a}	6.0±1.7^{b}	5.6±1.8^{b}	5.4±1.9^{b}
Softness	7.4±1.5^{a}	6.6±1.3^{a}	5.5±1.7^{b}	4.6±2.1^{b}	4.8±2.0^{b}
Flavor	6.9±1.5^{a}	6.7±1.5^{a}	5.7±2.0^{b}	5.1±1.9^{b}	5.3±2.1^{b}
Color	6.9±1.6^{a}	6.8±1.6^{a}	6.5±1.6^{ab}	5.5±1.9^{bc}	5.7±1.9^{c}
	Barazeq				
Overall acceptance	7.2±1.6^{a}	7.1±1.6^{a}	5.5±2.0^{b}	6.3±2.0^{ab}	NA
Softness	7.3±1.8^{a}	6.8±2.3^{a}	5.1±2.2^{b}	5.7±2.1^{b}	NA
Flavor	7.6±1.9^{a}	6.8±1.6^{a}	5.3±2.3^{b}	6.6±2.2^{a}	NA
Color	7.2±1.6^{a}	7.1±1.6^{a}	5.5±2.0^{b}	6.3±2.0^{ab}	NA
	Ghuribeh				
Overall acceptance	8.1±0.7	7.7±0.7^{a}	7.1±1.0^{b}	NA	NA
Softness	7.5±1.3^{a}	7.3±1.3^{a}	6.9±1.1^{a}	NA	NA
Flavor	7.6±1.3^{a}	7.3±1.3^{a}	6.8±0.79^{b}	NA	NA
Color	8.2±1.0^{a}	7.9±1.0^{a}	7.2±1.49^{b}	NA	NA

*Values within a column followed by a common letter are not significantly different (p>0.05)

in which fat replaced maltodextrins at 10% showed the highest and the most significant liking scores. A significant decrease in the flavor scores was observed in the samples in which fat replaced with 20, 30, and 40% with maltodextrins when compared to those of controls. Furthermore, no significant difference in the flavor between the Ma'amul samples in which fat was replaced by maltodextrins at 20, 30, and 40% and in the Barazeq samples in which fat was replaced by maltodextrins at 20 and 30%. The decrease in flavor of these products might be due to the fact that flavors in food are either lipid soluble or water soluble. Fat acts as carrier of lipid-soluble flavors acts. Moreover, fat acts as flavor precursor during baking, frying, and lipolysis. Therefore, replacement of fat in food with maltodextrins results in the decrease in flavor medium; thus, many fat-soluble flavors may leave the product [12]. Furthermore, replacing fat with maltodextrins is expecting to increase the retention of water-soluble flavor compounds.

No significant differences between overall acceptability liking scores of controls and Ma'amul and Barazeq treatments when replaced with 10% maltodextrin and with 20% maltodextrin in Ghuribeh.

AUTHORS' CONTRIBUTIONS

MS helped in collection of data and information, KA supervised MS, and HA formulated and wrote the manuscript.

CONFLICTS OF INTEREST

The authors have no conflicts of interest.

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