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# Effects of Carboxymethyl Cellulose, Pectin and Guar on Dough Rheology and Quality of Toast Breads

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ABSTRACT: Bread and other baked goods tend to undergo physicochemical changes after the baking process is completed. These changes are generally called staling. Authors have suggested a variety of methods for improving the technological and sensory properties of all sorts of bread, particularly voluminous and semi-voluminous breads. One of the most important one of these methods is the use of hydrocolloids in strategic products. This study analyzed the effect of different levels (0, 0.5 and 1%) of three hydrocolloids (pectin, carboxymethyl cellulose, and guar) on the rheology of dough and the quality of toast bread samples. The results revealed that changes in Farinograph attributes of dough depend on the chemical structure of the hydrocolloids. The largest effect belonged to the 1% guar, 1% pectin, and 1% CMC treatments. In general, hydrocolloids enhanced the dough samples. All hydrocolloids improved the qualitative properties of breads, delayed staleness, and provided better breads than the control sample. The largest effect was observed by the addition of 1% guar. According to the results, the opinions of the panelists, the treatment containing 1% guar was selected as the best additive as compared to the other two hydrocolloids.

**Keywords**: Carboxymethyl Cellulose, Farinograph, Guar, Pectin, Toast bread.

## Introduction

Since centuries ago, different forms of grains have been the basic nutrition of a large part of the world's population. Wheat is the most popular grain for making breads and most cuisines in the world. There is hardly a food in the human history that can be regarded as the fruit of human thoughts and endeavor as much as bread has been, and can be more praiseworthy as much as bread has been (Movahed, 2011). Food wastes are turning into an ever-increasing concern in most countries, and the developing countries in particular. The source of bakery wastes is the undesirable microbial, physicochemical and organoleptic changes, which can degrade bread safety and marketability (Altamirano-Fortoul & Rosell, 2011). Therefore, there is a large body of literature on reducing bread losses and improving its quality. Industrially baked breads have fewer losses than other types of breads. They also have a special position in the nutrition due to their high

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quality baking, diversity, good shelf life, and complete proofing processes. One of the most important industrial breads is the toast bread with large consumption worldwide (Aparicio *et al.*, 2007). Bread and other baked goods tend to undergo physicochemical changes after being baked. This process is generally known as staling. A concern of this industry is to delay staling, which has great financial consequences. It also affects the appearance and core properties of the bread besides its aroma, flavor and chewiness. All these changes can translate into lack freshness of breads (Ravi *et al.*, 2000). No one can deny the significance of bread for the nutrition and health of communities. It is the staple food of people in most parts of the world that can provide them with a large portion of their daily energy, protein, mineral, B-group vitamin needs. Iranians also obtain 60-65% of their daily protein and calorie needs plus 2-3 g minerals and the good part of their body salt needs from bread (Anton & Artfield, 2008). The quality of bread is subject to different factors such as its additives and improvers. Gums (hydrocolloids) are a category of such improvers. Hydrocolloids are a class of additives widely used in the food industry. They are generally known under the umbrella term "gums) "Kohajdová & Karovičová, 2008.( Pectin is a hydrocolloid with most applications in the food industry. It has a numerous hydrophilic groups that allow for absorption of large amounts of water and enhance water holding capacity of bread that allows it to maintain more water (Majzoubi *et al.*, 2010). Carboxymethyl cellulose (CMC) is another gum with applications in the food industry and particularly in baking. It is an important derivative of cellulose. It improves the appearance and internal properties of baked goods, reduces their hardness, and enhances dough adhesiveness (Lazaridoua *et al.*, 2007). Guar easily absorbs water and can largely increase viscosity even in small amounts. It is resistant against freezing/thawing, is unexpensive, and can spread easily (Mohamed & Jingyuan, 2010). The objective of this study was to compare the effect of CMC, pectin and guar hydrocolloids on the dough rheology and quality of toast breads, and to determine the best type and level of hydrocolloids that can provide the highest levels of qualitative, rheological and sensory properties in this type of bread.

## Materials and Methods

- ***Materials***

The materials used in this study were wheat flour (specific to toast bread) with an extraction rate of 68% (Alborz Ard Co.), pectin, CMC and guar (Tellon, China), dry baker's yeast (*Saccharomyces cerevisiae*) (Iran Melas Co.), salt (Sadaf Co.), water, sugar (Ghand-i Karaj), and oil (Mahgol) (Table 3-1).

- ***Methods***
- ***Physical and chemical assays on wheat flour and toast bread samples***

Chemical assays on wheat flour used in this study and toast bread samples included ash measurement (AACC Method 08-01), moisture content (AACC Method 44-16), protein (AACC Method 46-12), and pH (Iranian National Standard #37). The density of the samples was determined using the rapeseed grain method (Anonymous, 2000).

- ***Toast bread dough testing***

Rheological tests show the properties and stability of dough samples. The Farinograph test (Standard AACC Method No. 54-21) is one of the rheological tests performed using a device made by

Brabender, Germany. Water absorption, dough development time, dough stability, valorimetry value (bakery value), and dough softening degree at 10 and 20 min (according to Standard AACC Method No. 54-21) were measured (Anonymous, 2000).

### - *Toast bread baking method*

In order to produce toast breads, firstly, pectin, CMC and guar were separately added to wheat flour each at three different concentrations (0, 0.5 and 1% of flour weight) and were mixed slowly for 10 min in the dough container. The rest of the flour and powders were then added to the mix. Water was added to the mix. Once fully mixed, the deformable mass was left for 10 min for its first proofing. Dough rolls (approx. 450 g) were cut and were again left for 10 min for their intermediate proofing. The dough rolls were then transferred to the dough proofer for final proofing at 30 °C and 80% RH for 40 min. The baking molds were placed inside a rotating oven heated up to 220 °C and were baked for 45 min (Anonymous, 2009). The baked toast breads were cooled down at ambient temperature and were then ready for experiments.

### - *Instrumental staleness of toast breads*

The hardness of internal texture of breads (AACC Method 09-74) was measured by a texture analyzer (Instron). The tests were carried out in one- to three-day intervals from baking in three replications. The samples were held in plastic bags at room temperature. Before texture analysis, slices were cut from the core of the samples with an approximate size of 2 cm × 2 cm. Force levels (forces imposed by the upper clamp to the sample) were equal to 40% of the bread sample thickness. Accordingly, the samples were compressed for 8 mm. The moving speed of the upper clamp was 30 mm/min (Anonymous, 2000).

### - *Color analysis of toast bread samples*

A HunterLab colorimeter was used to determine the three color parameters of L*, a* and b*. L* represents lightness and ranges from zero (pure black) to 100 (pure white). The closeness of sample color to green and red is determined by a*. It ranges from -120 (pure green) to +120 (pure red). Finally, b* shows how close the sample color is to blue and yellow with -120 indicating pure blue and +120 representing pure yellow (Anonymous, 2000).

### - *Organoleptic profile assays of bread samples*

For this testing, bread samples were sliced and coded. A panel (10 members) for sensory testing was selected to test and rate the samples on the first day of baking using specifically designed forms. Bread crust color, core color, aroma, flavor, chewiness, and total acceptance were evaluated using a five-point hedonic scale (Anonymous, 2000).

### - *Statistical Analysis*

Data were analyzed using a completely randomized design. Experiments were carried out in triplicate order. The study had seven treatments. In order to compare the mean values, Duncan's multiple range test was used ($p<0.05$) in SPSS 21.

## Results and Discussion

### - *Analysis of chemical assays of wheat flour used in toast bread samples*

The results of chemical assays showed that the wheat flour used for the experiments had 12.95% moisture content (MC), 0.6% ash, 10.02% protein, 0.41% fat, and 6.81 pH. Accordingly, it was suitable for baking toast breads.

- ***Analysis of rheological tests on dough samples***

According to Table 1, it was found that addition of the studied gums led to a significant increase in dough water absorption ($p<0.05$) as doughs containing 1% guar, pectin and CMC had the highest water absorption followed by the samples containing 0.5% gums, as compared to the control samples (C). The dough sample with 1% guar (G2) had the highest water absorption whereas C had the lowest score. The higher water absorption of these treatments than control (without gum) is due to the presence of the gums that rapidly absorb water when they are in contact with water because of their hydrophilic nature. They contributed to the increased MC of dough by creating a viscous solution (Lazaridoua *et al.,* 2007). Table 1 shows that addition of the gums significantly increased the development time ($p<0.05$) as doughs containing 1% guar, pectin and CMC had the highest development time than the control samples followed by the samples containing 0.5% gums. Toast doughs containing 1% guar (G2) had the highest development time and C samples had the lowest value in this parameter. In other words, higher levels of gums increased dough development time due to higher water absorption.

The results in Table 1 revealed that the addition of the gums significantly increased dough development time ($p<0.05$) as doughs containing 1% guar, pectin and CMC had the highest development time followed by the samples containing 0.5% gums, as compared to the control samples (C). The dough sample with 1% guar (G2) had the highest development time whereas the control sample (C) had the lowest score. This means that the applied gums played a role in modifying the flour structure and increasing dough stability. Particularly, higher levels of the gums further increased dough stability of toast breads. It was found that the gums significantly decreased dough softening at 10 and 20 min ($p<0.05$) (Table 1). In this regard, doughs containing 0.5% guar, pectin and CMC had the lowest dough softening at 20 min followed by the samples containing 1% gums, as compared to the control samples (C). Control and G2 dough samples had the highest and lowest dough softening degrees at 10 and 20 min. This shows that, by applying these gums, the structure of the dough was enhanced compared to the control, and dough softening degrees at 10 and 20 min were decreased. In other words, the addition of the gums enhanced dough structure and reduced dough softening degree. The firm structure of the doughs containing gums was formed because of the hydrophilicity of these compounds and formation of strong bonds with flour proteinm which in turn improved the gluten lattice of the dough and reduced its softening (Rodriguez *et al.,* 2008). Results also showed that the gums significantly increased the valorimetry value of the dough ($p<0.05$) (Table 1). Doughs containing 1% guar, pectin and CMC—followed by those containing 0.05% gums—had the highest valorimetry value compared to the control. The dough sample with 1% guar (G2) had the highest valorimetry value whereas the control samples had the lowest score. The increase in this value might be explained by the improved rheology of the dough. This shows that how good the flour is for baking breads (Rodge *et al.,* 2012).

- ***Analysis of the results from physicochemical and staleness assays of toast breads***
- ***Analysis of the effects of gums on moisture content***

According to Table 2, addition of the gums led to a significant increase in MC ($p<0.05$) as the toast breads containing 1% guar, pectin and CMC had the highest MC followed by the samples containing 0.5% gums, as compared to the control samples (C). There was no significant difference between the treatments containing 0.5% gum, and also treatments containing 1% pectin, 1% CMC and 0.05% guar had no significant difference ($p<0.05$). This is due to the high water holding capacity of guar.

**Table1.** The results of mean comparisons of the effect of different concentrations of guar, CMC and pectin on rheological properties of dough in toast bread samples

| Treatment | Water absorption (percent) | Dough development time (min) | Dough stability time (min) | Farinograph quality number (FQN) | Dough softening degree at 10 min (BU) | Dough softening degree at 20 min (BU) |
|---|---|---|---|---|---|---|
| G2 | 63 ± 0.5[a] | 5.5 ± 0.04[a] | 6 ± 0.2[a] | 57 ± 3[a] | 120 ± 5[a] | 180 ± 5[a] |
| P2 | 62 ± 0.2[b] | 3.5 ± 0.1[b] | 5.5 ± 0.2[b] | 46 ± 2[b] | 92 ± 5[b] | 165 ± 5[b] |
| C2 | 62 ± 0.2[b] | 3.2 ± 1.0[c] | 5.4 ± 3.0[c] | 45 ± 2[bc] | 90 ± 5[b] | 160 ± 5[bc] |
| G1 | 60.50 ± 0.5[c] | 2 ± 0.1[d] | 3.75 ± 0.2[d] | 42 ± 2[cd] | 90 ± 5[b] | 150 ± 5[cd] |
| P1 | 59.50 ± 0.5[cd] | 1.75 ± 0.2[d] | 3 ± 0.2[e] | 39 ± 1[d] | 70 ± 5[c] | 150 ± 5[cd] |
| C1 | 59.30 ± 0.5[d] | 1.75 ± 0.2[d] | 3 ± 0.2[e] | 36 ± 1[e] | 60 ± 7[c] | 140 ± 5[de] |
| C | 58 ± 0.5[e] | 1.3 ± 0.2[e] | 1.5 ± 0.1[f] | 29 ± 1[f] | 50 ± 7[c] | 130 ± 5[e] |

Mean values in a same column with at least one letter in common have no significant difference with each other ($p < 0.05$). C = Control toast bread, G1 = Toast bread containing 0.5 wt% guar, G2 = Bread Toast bread containing 1 wt% guar, P1 = Toast bread containing 0.5 wt% pectin, P2 = Toast bread containing 1% pectin, C1 = Toast bread containing 0.5 wt% CMC, and C2 = Toast bread containing 1 wt% CMC.

**Table2 .**The results of mean comparisons of the effect of different concentrations of guar, CMC and pectin on physicochemical and staleness profile of toast bread

| Treatment | Moisture content (%) | Ash (%) | Protein (%) | pH | Volume ($m^3$) | Staleness (h) | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | 24 | 48 | 72 |
| G2 | 48.81 ± 0.23[a] | 0.76 ± 0.02[a] | 6.69 ± 0.04[c] | 7.42 ± 0.01[c] | 375.3 ± 0.58[a] | 5.54 ± 0.04[p] | 6.43 ± 0.04[o] | 9.64 ± 0.02[n] |
| P2 | 45.55 ± 0.61[b] | 0.75 ± 0.03[a] | 6.69 ± 0.03[c] | 7.29 ± 0.01[e] | 366.8 ± 18.49[a] | 9.62 ± 0.02[n] | 9.95 ± 0.03[m] | 11.03 ± 0.04[k] |
| C2 | 45.07 ± 0.23[bc] | 0.75 ± 0.03[a] | 9.69 ± 01/0[c] | 7.27 ± 0.01[f] | 300.2 ± 0.83[b] | 10.61 ± 0.03[l] | 10.97 ± 0.06[k] | 12.60 ± 0.03[h] |
| G1 | 44.67 ± 0.48[bc] | 0.65 ± 0.03[b] | 9.94 ± 0.03[b] | 7.49 ± 0.01[b] | 280.7 ± 0.11[c] | 11.62 ± 0.03[j] | 12.37 ± 0.03[i] | 13.40 ± 0.04[fg] |
| P1 | 44.42 ± 0.78[c] | 0.65 ± 0.03[b] | 0.93 ± 0.01[b] | 7.38 ± 0.01[d] | 265.2 ± 1.96[d] | 13.38 ± 0.05[g] | 13.44 ± 0.03[f] | 11.69 ± 0.03[e] |
| C1 | 44.34 ± 0.69[c] | 0.65 ± 0.03[b] | 9.95 ± 0.02[b] | 7.29 ± 0.01[e] | 260.1 ± 1.35[d] | 12.42 ± 0.03[i] | 13.63 ± 0.04[e] | 13.90 ± 0.06[d] |
| C | 41.44 ± 0.73[d] | 0.6 ± 0.03[c] | 10.04 ± 0.02[a] | 7.52 ± 0.01[a] | 249.5 ± 0.78[e] | 14.79 ± 0.05[c] | 15.10 ± 0.03[b] | 16.20 ± 0.07[a] |

Mean values in a same column with at least one letter in common have no significant difference with each other ($p < 0.05$). C = Control toast bread, G1 = Toast bread containing 0.5 wt% guar, G2 = Bread Toast bread containing 1 wt% guar, P1 = Toast bread containing 0.5 wt% pectin, P2 = Toast bread containing 1% pectin, C1 = Toast bread containing 0.5 wt% CMC, and C2 = Toast bread containing 1 wt% CMC.

- ***Analysis of the effects of gums on ash content***

According to the results in Table 2, addition of the gums significantly increased ash content ($p<0.05$) as the toast breads containing 1% guar, pectin and CMC had the highest ash content followed by the samples containing 0.5% gums, compared to the C samples. No significant difference was found between the treatments containing 1% gums. Moreover, treatments with 0.5% gums showed no significant differences ($p<0.05$). The G2 sample had the highest ash content whereas C had the lowest score in this parameter. The higher ash content of toast breads containing guar than other control might be due to the high minerals in guar (Rosell *et al.*, 2009).

- ***Analysis of the effects of gums on protein content***

According to the results in Table 2, addition of the gums significantly decreased protein content ($p<0.05$) as the toast breads containing 0.5% guar, pectin and CMC had the lowest protein content followed by the samples containing 0.5% gums, compared to the C samples. Among experimental treatments, C had the highest and G2 had the lowest protein content. The decreased protein content of treated breads can be due to the replacement of the flour with a percent of gums, which reduced the protein content of the breads (Lazaridoua *et al.*, 2007).

- ***Analysis of the effects of gums on pH***

The results showed that these gums significantly decreased pH ($p<0.05$) as the toast breads containing 1% and 0.5% guar, pectin and CMC had the lowest pH, compared to the C samples (Table 2). Mean while, significant differences were found between all treatments and control ($p\geq0.05$). By increasing each gums from 0.5% to 1%, the pH showed a significant decrease. Control samples had the highest pH, whereas the lowest pH was found in C2 toast breads. These compounds had acidic contents such as galacturonic acid and carboxylic acid, which can reduce pH of treated treatments lower than that of control (Mohamed & Jingyuan, 2010).

- ***Analysis of effects of gums on volume***

As shown in Table 2, volume of the toast bread increased significantly ($p<0.05$) in treatments containing the gums. Accordingly, the toast breads containing 1% guar, pectin and CMC had the highest ash content followed by the samples containing 0.5% gums, compared to the C samples. Significant differences were also found between all treatments and control. The G2 sample had the highest volume whereas C had the lowest score in this parameter. This increased volume in hydrocolloid-treated samples can be explained by the fact that hydrocolloids improve dough development and gas holding capacity through increasing the dough viscosity (Lazaridoua *et al.*, 2007).

- ***Analysis of the effects of gums on instrumental staleness (texture analyzer) of toast breads afer 24, 48 and 72 hours***

The results in Table 2 revealed that staleness increased with higher storage time ($p<0.05$). The addition of gums had a significant effect in reduced staling as compared to C samples ($p<0.05$) as samples with 1% guar, pectin and CMC—followed by those with 0.05% of these gums—had the lowest staleness score compared to the C samples. Among all treatments, G2 and C had the lowest and highest staleness scores. Bread samples containing 1% guar, pectin and CMC—followed by those containing 0.05%

gums—had the highest staleness score compared to the control after baking. During the storage period (for 24, 48 and 72 hours after baking), the highest staleness score was recorded in C samples, whereas G2 showed the lowest score. Bread hardness developed during storage is due to the drying of its core, which is the result of two factors: moisture migration from bread core to its surface, and the intrinsic hardening of cellular materials due to re-crystallization of starch (Maleki & Mohammadzadeh Milani, 2013). The reduced rate of hardening in samples containing hydrocolloids during shelf life can be due to the following mechanisms:

1. Higher gas holding—as hydrocolloids increase dough consistency, form a temporary gelatin network, and enhance the rigidity of the wall around the gas-containing cells in the bread, and thus improve $CO_2$ and water vapor holding capacity. In addition, some gums have an emulsifying effect and can create layers around gas bubbles inside the dough, which further improve gas holding;

2. Higher water holding in bread core—this contribute to the softness and freshness of the bread core and reduce its rubber-like feeling;

3. Preventing the formation of gluten–starch bond; and 4. Preventing re-distribution of moisture and its migration from gluten to starch using hydrocolloids, which in turn prevents the holding of moisture by starch (Barcenas *et al.,* 2004).

- ***Analysis of sensory profile results of toast bread samples containing gums***

The results showed that addition of the gums significantly increased $L^*$ ($p<0.05$) as the toast breads containing 1% and 0.5% guar, pectin and CMC had the highest $L^*$ scores, compared to the C samples (Table 3). At the same time, by increasing each gum level from 0.5 to 1%, $L^*$ decreased in toast bread samples. No significant difference was found between treatments with 0.5 and 1% guar, pectin and CMC ($p\leq0.01$). However, there were significant differences between all gum-treated and C samples. The toast bread samples containing 0.5% guar (G2) had the highest $L^*$ and the control samples had lowest score in this respect. This means that addition of hydrocolloids increased the whiteness and brightness of the crust, which is a desirable quality in toast breads. Here, it seems that $L^*$ of the crust is affected by the texture and its characteristics of its upper layer (in terms of wrinkles and surface uniformity). The samples with the highest crust $L^*$ had better textures and qualities at their upper layer. According to the results in Table 3, it was found that addition the gums significantly decreased $a^*$ ($p<0.05$). Accordingly, samples containing 0.05 and 1% pectin, CMC and guar had the lowest scores in this parameter as compared to the C samples. In addition, significant differences were found between all treatments and control ($p\geq0.05$). Among all experimental treatments, C had the highest and G1 had the lowest scores in $a^*$. This shows that the crust redness was reduced by addition of the gums, which is a desirable quality. According to Table 3, these gums significantly decreased $b^*$ ($p<0.05$) and the toast breads containing 1% and 0.5% guar, pectin and CMC had the lowest $b^*$, compared to the C samples. Significant differences were also found between all treatments and control. Among all experimental treatments, C had the highest and G1 had the lowest scores in $b^*$. This indicated that the hydrocolloids reduced crust yellowness in all toast breads. Purlis and Salvadori (2009) stated that crust changes are responsible for its brightness, and smooth regular surfaces

**Table3** The **.**results of mean comparisons of the effect of different concentrations of guar, CMC and pectin on color parameters and sensory profile in toast bread samples

| Treatment | Color index (instrumental) | | | Sensory profile | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | L* | a* | b* | Crust color | Core color | Aroma | Taste | Chewiness | Total acceptance |
| G2 | 74.03 ± 0.49[a] | 8.76 ± 0.46[a] | 31.83 ± 0.85[a] | 4.8 ± 0.01[a] | 4.6 ± 0.02[a] | 4.2 ± 0.02[a] | 4.2 ± 0.02[a] | 4.2 ± 0.02[a] | 4.2 ± 0.01[a] |
| P2 | 73.27 ± 0.60[a] | 6.16 ± 0.73[b] | 29.24 ± 0.15[b] | 4.6 ± 0.01[b] | 4.6 ± 0.02[a] | 4.2 ± 0.02[a] | 4.2 ± 0.02[a] | 4.2 ± 0.02[a] | 4 ± 0.02[b] |
| C2 | 71.43 ± 0.64[b] | 3.02 ± 0/66[c] | 26.91 ± 1[c] | 4.1 ± 0.05[c] | 4 ± 0.05[b] | 3.6 ± 0.03[b] | 3.6 ± 0.03[b] | 3.8 ± 0.01[b] | 3.6 ± 0.02[c] |
| G1 | 71.25 ± 0.14[b] | 2.39 ± 0.36[cd] | 20.91 ± 0.58[d] | 4.1 ± 0.05[c] | 4 ± 0.05[b] | 3.4 ± 0.02[c] | 3.4 ± 0.02[c] | 3.8 ± 0.01[b] | 3.4 ± 0.01[d] |
| P1 | 64.79 ± 1.69[c] | 1.95 ± 0.09[d] | 20.54 ± 0.02[d] | 4.1 ± 0.05[c] | 3.8 ± 0.01[c] | 3 ± 0.01[d] | 3 ± 0.01[d] | 3.6 ± 0.02[c] | 3.2 ± 0.02[e] |
| C1 | 63.63 ± 0.84[c] | -0.16 ± 0.01[e] | 16.04 ± 0.63[e] | 4 ± 0.04[c] | 3.8 ± 0.01[c] | 3 ± 0.01[d] | 3 ± 0.01[d] | 3.6 ± 0.02[c] | 3.0 ± 0.02[f] |
| C | 60 ± 0.28[d] | -0.58 ± 0.08[e] | 15.84 ± 0.025[e] | 3.1 ± 0.04[e] | 3.2 ± 0.02[d] | 2.5 ± 0.01[e] | 2.5 ± 0.01[e] | 3.1 ± 0.01[d] | 2.7 ± 0.02[g] |

Mean values in a same column with at least one letter in common have no significant difference with each other ($p < 0.05$). C = Control toast bread, G1 = Toast bread containing 0.5 wt% guar, G2 = Bread Toast bread containing 1 wt% guar, P1 = Toast bread containing 0.5 wt% pectin, P2 = Toast bread containing 1% pectin, C1 = Toast bread containing 0.5 wt% CMC, and C2 = Toast bread containing 1 wt% CMC.

have potentially higher $L^*$ than wrinkled crusts. It was also found that $L^*$ (brightness) is in direct relationship with $b^*$ (yellowness) (Purlis & Salvadori, 2009).

According to Table 3, the addition of the gums significantly increased color sensory profile of the crust ($p<0.05$) as the toast breads containing 0.5% and 1% guar, pectin and CMC had the lowest scores in this regard, as compared to the C samples. By increasing the level of each gum from 0.5% to 1%, crust color sensory profile showed a significant decrease. G1 and C samples had the highest and lowest scores in crust color scores. The improved crust color scores of gum-treated samples were due to the increase in gum-induced browning (amino acids in their structure) and reaction with reducing sugar compounds (Movahed, 2011). Crust color of bakery goods is mainly affected by the Maillard reaction and caramelization. During the bread baking process, the crust color changes as the result of Maillard reactions (interactions between reducing sugars and amino protein groups) and caramelization reactions (interactions between sugars). The brownish–golden color of the crust is the result of these reactions (Shahidi *et al.*, 2011). It was found that the addition of the gums significantly increased the bread core color sensory profile ($p<0.05$) as the toast breads containing 0.5% and 1% guar, pectin and CMC had the highest scores in this aspecr, as compared to the C samples. By increasing the level of each gum from 0.5% to 1%, bread core color sensory profile showed no differences. The G1 and G2 samples had the highest and whereas C had the lowest score in bread core color. The difference in core color scores of treated bread samples with control samples was due to the structural nature of the gums. The higher color intensity of the core can be due to the interactions of the gums and their reactions with aldehydic compounds in dough and finally the Maillard reactions (Lebesi & Tzia, 2011). As shown in Table 3, aroma showed a significant increase in samples containing the gums ($p<0.05$) as the toast breads containing 1% guar, pectin and CMC had the highest scores in this aspect followed by those containing 0.05% gums, compared to the C samples. By increasing each gum concentration from 0.5 to 1%, the aroma has also increased significantly. Toast bread samples containing 1% guar (G2) and 1% pectin (P2) had the highest aroma score, and C samples had the lowest score in this respect. The higher aroma levels of gum-treated samples were due to the aroma of the gum structure, which was detected by the panelists. This can be the result of Maillard (browning) reaction during bread baking. The results in Table 3 revealed that flavor increased significantly by addition of the gums ($p<0.05$). Accordingly, the toast breads containing 1% guar, pectin and CMC had the highest flavor scores followed by those containing 0.05% gums, as compared to the C samples. By increasing each gum from 0.5% to 1%, flavor scores showed a significant increase. The highest flavor score was in G2 and P2 samples whereas C had the lowest flavor score. This can be due to the interactions between the gums and formation of aromatic compounds by the Maillard reactions during the baking process (Barcenas *et al.*, 2004). As shown in Table 3, chewiness showed a significant increase in samples containing the gums ($p<0.05$) as the toast breads containing 1% guar, pectin and CMC had the highest scores in this regard followed by those containing 0.05% gums, as compared to the C samples. Moreover, chewiness increased significantly when the gum level was increased from 0.5 to 1%. G2 and P2 had the highest chewiness scores, and C samples had the lowest score in this respect. The reason behind the increased chewiness scores of gum-treated breads as compared to the C samples was the presence of gums and their higher water absorption bringing about smoother breads and higher panelist scores for this parameter. Total acceptance of the toast bread samples increased significantly ($p<0.05$) in treatments containing the gums. Accordingly, the toast breads containing 1% guar, pectin and CMC had the highest acceptance followed by the samples containing 0.5% gums, compared to the C samples. Significant differences were found between all treatments and control ($p\geq0.05$). By increasing each gum level from 0.5% to 1%, total acceptance score showed a significant increase. The G2 sample had the highest acceptance score whereas C had the lowest score. This result can be explained by the improvement in the sensory profile by the gums, which led to higher panelist score during their sensory profile (Demirkesen *et al.*, 2010).

## Conclusion

Industrially baked breads such toast breads have less losses than other types of breads. They also have a special position in the nutrition due to their high quality baking, diversity, good shelf life, and complete processes. Toast breads are an important type of industrial bread with high consumption worldwide. Bread quality is a function of different additives and improvers. The most important items in this list are gums or hydrocolloids. The present study compared the effect of different hydrocolloids (CMC, pectin and guar) on the rheology of toast dough and breads. It was found that addition of zero, 0.5 and 1% of these three gums can have different effects on the rheological parameters of dough, chemical properties, staleness, and sensory profile of toast bread samples. The chemical assays were first conducted to determine moisture content, ash, protein, and pH of the wheat flour used for baking toast breads. The rheological tests in Farinograph were then carried out on dough samples containing 0.5 and 1% gums and on the control samples (C). The physicochemical profile—i.e. moisture content, ash, protein, pH, density, instrumental staleness, and color analysis—and sensory (organoleptic) properties of all toast bread samples were determined using standard methods. The results from the chemical assays on the flour showed that the wheat flour was suitable for baking toast breads. Rheology results indicated that the gums increased water absorption, development time, dough stability time, and valorimetry value of the treatments compared to C (no-gum). Accordingly, G2 (1% guar), P2 (1% pectin) and C2 (1% CMC) had the highest water absorption, dough development time, dough stability, and valorimetry value than C samples. However, these gums reduced dough softening at 10 and 20 min, and G2, P2 and C2 had the lowest results in this parameter. From physicochemical testing, it was found that G2, P2 and C2 had higher moisture content, ash and volume and lower protein content than the control. In addition, G2 had the highest moisture content, ash and volume and the lowest protein content. The lowest pH was also found in gum-treated samples. The addition of the gums was effective in reducing staling compared to the control sample as G2, P2 and C2 had the lowest levels of staleness after 72 hours from baking. Staleness increased with time. G2 had the lowest staleness after 24, 48 and 72 hours after baking. Color analysis results showed that G1 and G2 (0.5 and 1% guar), P1 and P2 (0.5 and 1% pectin), and C1 and C2 (0.5 and 1% CMC) had better color scores than C samples. In this respect, crust brightness was higher whereas crust redness and yellowness were lower, which are good qualities for toast breads. G1 had the highest $L^*$ and the lowest $a^*$ and $b^*$. The sensory analysis by the panelists showed that G2, P2 and C2 had the highest scores in all sensory properties such as crust color, core color, aroma, flavor, chewiness, and total acceptance as compared to the C samples. Among all gum-treated samples, G2 had the best organoleptic properties.

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