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Influence of Various Hydrocolloids Addition on Pan Bread Quality

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ABSTRACT

Three different natural hydrocolloids (xanthan, guar, and Arabic gums) were administered at three different levels 0.5, 1.0, and 1.5% to study their addition effect on bread quality. The obtained results revealed that, the farinograph parameters such as water absorption, stability of dough, extension resistance, energy, and proportion number were increased by increasing the used gums amount from 0.5 to 1.5%. Meanwhile, degree of softening was decreased. The pan bread physical properties like loaf weight, loaf volume, and specific volume were gradually increased with increase gums addition levels in compared to control sample. The results also confirmed the ability of hydrocolloids for improving bread freshness during storage periods. For sensory evaluation, data demonstrated that, there was significant effect on crumb color, texture, general appearance, and overall acceptability pan bread due to addition of high level of hydrocolloids. While crust color and taste were significantly not differed. It could be concluded that, to obtained pan bread with a good quality than control, it should be added xanthan gum with a ratio of 1.0 -1.5% or guar gum with a level of 1.5% of the flour weight.

Keywords: Pan bread - Hydrocolloids – Dough properties- Bread quality.

INTRODUCTION

Bread represents the most critical part of the total daily consumed food. Hydrocolloids have particularly discovered a wide application as added substances in bread formulations. The functional impacts of hydrocolloids originate from their capability to adjust dough or batter rheology and maintenaning the finished baked products qualities. (Yaseen *et al.,* 2010). Briefly, the addition of hydrocolloids to breads is for texture modification (Rodge *et al*., 2012), control water absorption and consequently dough rheology (Mandala *et al*., 2007), improving their shelf life by keeping the moisture content and retarding the process of staling (Kohajdová and Karovičová, 2009). A higher softness forThe final product was obtained however keeping up longer shelf life (Azizi and Rao, 2004). The general mechanism suggests that hydrocolloids causing a better water distribution and retention, and also a decrease in the crumb resistance as a result of its weakening influence on the starch structure (Guarda *et al*., 2004; Kohajdová and Karovičová, 2009). Additionally, gluten network or the created bonds in wheat flour dough was influenced when hydrocolloids were added and consequently change its viscoelastic properties to produce breads with higher volumes, better porosity, and desired crumb texture (Pečivová *et al.,* 2011). In fact xanthan, guar, and arabic gums have been used n previous studies to improve bread quality (Rosell *et al.,* 2001; Sharadanand and Khan, 2003; Guarda *et al*., 2004). Different molecular structure, particle size and amount of hydrocolloids, bread recipe, dough and bread preparation methods as well as bread types are considered the important factors which the hydrocolloids effects on dough and bread properties depended on it. (Majzoobi *et al*., 2007). Hydrocolloids themselves have a low calorific value and are generally effective in a little quantity (Mikuš *et al*., 2011). Gums regulated, and classified as either food additives or generally recognized as safe (GRAS) substances by The Food and Drug Administration (Rodge *et al*., 2012).

Xanthan gum is a heteropoly saccharides microbially produced by *Xanthomonas campestris*. The gum is a white to cream colored free flowing powder soluble in hot and cold water, but insoluble in most organic solvents (Khan *et al.,* 2007). The most important properties of xanthan gum are its high low-shear viscosity and strong shear-thinning character. The relatively low viscosity at high shear rates makes it easy to mix, pour, and swallow. Its high viscosity at low shear rates gives it good suspension properties and stability to colloidal suspensions (Sun *et al*., 2007). Xanthan gum can also induce dough strengthening; it increases water absorption and the ability of the dough to retain gas. It also increases the specific volume of the final bread and the water activity of the crumb (Collar *et al.,* 1999 and Rosell *et al.,* 2001). Xanthan gum is used to improve the texture and moisture retention in cake batters and bread dough's, to increase the volume and shelf life of cereal foods by limiting starch retrogradation, improve their eating quality and appearance, and to enhance the effectiveness of other hydrocolloids (Gimeno *et al.,* 2004).

In food industry, guar gum is used as a thickening and stabilizing agent in a wide variety of foods, usually in amounts less than 1 % of the food weight (Slavin and Greenberg, 2003). The incorporation of guar gum into certain types of foods (eg. wheat bread, biscuits and breakfast cereals) improves their palatability, improves the mouth feel, changes their rheological properties (Turabi *et al*., 2008), and enhances the shelf life through moisture retention (Shalini and Laxmi, 2007; Selomulyo and Zhou, 2007). Moreover, the results of some human studies indicate that guar-containing foods are more effective in improving glycemic control than premeal drinks containing guar gum granules (Ellis *et al*., 1991; Blake *et al*., 1997).

Arabic gum is added into wheat dough to slow aging of bakery products, to improve volume of bakery products, to milder consistence in ice creams, and to stop sugar crystallization in confectionery (Dickinson, 2003; Yadav *et al*., 2007; Ali *et al*., 2009).

The object of the existing study was to investigate effect of adding some of the most prevalent hydrocolloids i.e. xanthan, guar and arabic gums with different levels on the properties of the dough as well as the pan bread qualities

MATERIALS AND METHODS

Materials:

Wheat flour (72%) from the Company of Five Stars Flour Mills, Suez, Egypt was used in the current study. Instant active dry yeast, sugar, salt and corn oil were obtained from local market, Mansoura, Egypt. Xanthan, Guar and Arabic gums were obtained from Crystal Food Additives Company, Giza, Egypt.

Methods:

Analytical methods:

Moisture, ash, crude fiber, lipids, and nitrogen contents were determined in wheat flour according to the A.O.A.C (2000) methods. The protein content was calculated by multiplying total nitrogen percentage by 5.70. Lipids were extracted in Soxhlet apparatus using *N*-hexane as a solvent. The total available carbohydrates were calculated by differences.

Rheological Characteristic:

Wet gluten, dry gluten, and gluten index:

Wet and dry gluten as well as gluten index of wheat flour were determined using Glutomatic perten instruments (AB type 2200 No. 005092, Huddling, Sweden) as described by Perten (1990).

Farinograph test:

Water absorption, the development time of dough, arrival time, stability of dough and softening degree for control (flour 72%) as well as samples after adding 0.5, 1.0, or 1.5% for each of the three gums under investigation were measured using Farinograph (Brabender Duis Bur G, type 810105001 No. 941026 made in West Germany) according to the method of A.A.C.C. (2000).

Extensograph test:

Dough extensibility, dough resistance to extension (Elasticity), proportional number, and dough energy were measured for the same samples that described above using Extensograph (Barabender Duis Bur G type 860001 No. 946003 made in West Germany) according to A.A.C.C. (2000).

Preparation of pan bread:

The preparation method of pan bread described in A.A.C.C. (2000) was used with some modification; the pan bread formula was 100 g flour, 2% w/w dry yeast, fat (4% w/w), sugar (4% w/w), powder of skim milk (2% w/w), NaCl (1.5% w/w), Different gums (xanthan, guar or arabic gum) were added as a powder with a ratio of 0.5, 1.0 and 1.5% based on the flour weight, water (depend on water absorption of farinograph). All these ingredients were mixed until they reached maximum dough development. The dough's were relaxed for 20 min at 30±2˚C, then split into three pieces of 250 g, moulded manually by hand, and end proofed in pans for 60 min. at 30±2˚C and 80 -85% relative humidity. Finally, it was baked for 15-20 min. at 210 -220˚C.

Pan bread physical properties:

The loaves weight, volume, and specific volume were measured after it was cooled for 1 hr at ambient temperature (A.A.C.C., 2000).

Determination of pan bread staling:

It was determined using Kitterman and Rubanthaler (1971) method.

Sensory evaluation of pan bread:

Organoleptically evaluation (Gelinas and Lachance, 1995) was estimated using ten panelists from the Food Science and Technology Department, Faculty of Agriculture, Mansoura University.

Pan bread samples were left to cool at room temperature for 1hr after baking. Then bread was cut with a sharp knife and subjected to panel test.

Statistical analysis:

Variances were analyzed using General Liner Model (GLM, Sendecor and Cochran, 1997). ANOVA were analyzed according to the Statistical analysis system (SAS, 2010) software program.

RESULTS AND DISCUSSION

Proximate chemical composition of wheat flour:

The chemical composition of wheat flour is presented in table (1). The obtained results revealed that wheat flour (72%) recorded the percentages of moisture, crude protein, lipids, ash, crude fiber and total carbohydrate content being 12.38, 12.50, 0.87, 0.61, 0.90, and 85.12%, respectively. These results are nearest to the results obtained by Jia *et al*. (2014), who reported that moisture, crude protein, crude fat, and ash content were 13.4%, 9.0%, 1.5%, and 0.8%.

Table 1. Proximate chemical composition of wheat flour 72% extraction (% based on dry weight)

Chemical composition (%)	Wheat flour (72% extraction)	
Moisture	12.4	± 0.28
Crude protein	12.5	± 0.04
Lipids	0.9	± 0.01
Ash	0.6	± 0.02
Crude fiber	0.9	± 0.01
* Total available carbohydrates	85.1	± 0.17

The values are present the means of triplicate ± SD.
*** Calculated by difference.**

Wet gluten, dry gluten, and gluten index:

Wet gluten, dry gluten, and gluten index of wheat flour used in the current study were 28.64, 9.92 and 91.30%, respectively (Table, 2). These results are in the same line with that obtained by Dagdelen and Gocmen (2007). They found that, wheat flour contained 27.2% wet gluten and 91.0% gluten index. Also, Rebotta *et al.* (2010) mentioned that, wheat flour (72% ext.) had 27.4% wet gluten. Since, Chung *et al*. (2002) stated that the flour (72% ext.) with gluten index value more than 90% could be considered as good bread flour. According to this status, the current wheat flour type is strong with a high gluten index that is good enough for bread manufacturing.

Table 2. Wet gluten, dry gluten, and gluten index

Parameter	Results	
Wet gluten (%)	28.6	± 0.18
Dry gluten (%)	9.9	± 0.08
Gluten index (%)	91.3	± 0.12

The values are present the means of triplicate ± SD.

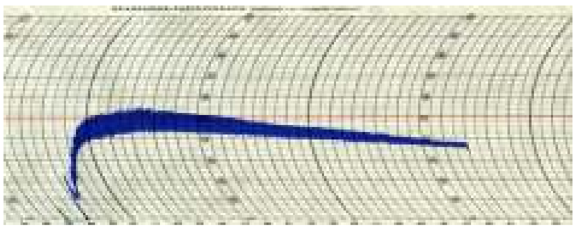
Farinograph parameters of wheat flour supplemented with different gums

Farinograph parameters were determined for wheat flour without or with added three different gums (i.e. xanthan, guar, and arabic gum) at various levels and the results are presented in table (3) and illustrated in figure (1).

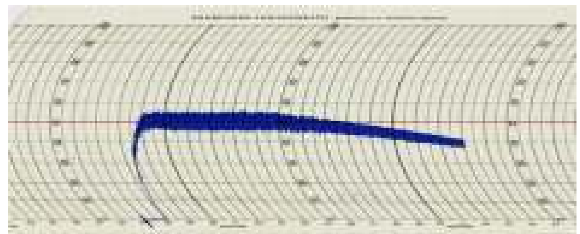
Table 3. Farinograph parameters of wheat flour supplemented with different gums

Parameters Samples		*Water absorption (%)	Arrival time (min)	Development time (min)	Dough stability (min)	Degree of softening(BU)
Control		60.7	1.5	3.5	7.0	100
Xanthan gum	0.5 %	62.1	2.0	4.0	9.0	70
	1.0 %	64.8	2.0	4.0	10.0	50
	1.5 %	66.4	2.5	4.5	11.5	30
Guar gum	0.5 %	61.8	1.5	3.5	8.0	85
	1.0 %	62.5	1.5	3.5	9.5	70
	1.5 %	64.2	2.0	4.0	10.5	50
Arabic gum	0.5 %	61.3	1.5	3.5	7.5	95
	1.0 %	62.2	1.5	3.5	9.0	75
	1.5 %	63.5	2.0	4.0	10.0	60

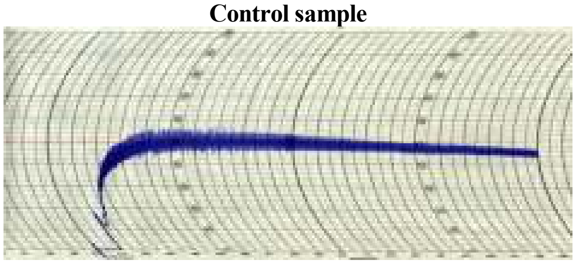
*** Expressed on 14% moisture basis. BU = Brabender unit.**



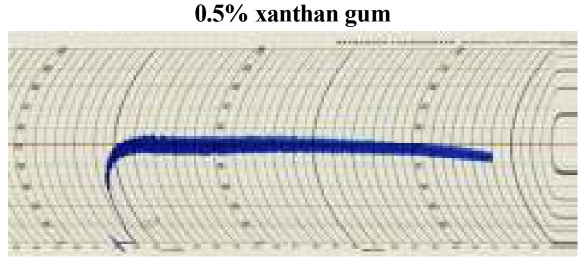
Control sample



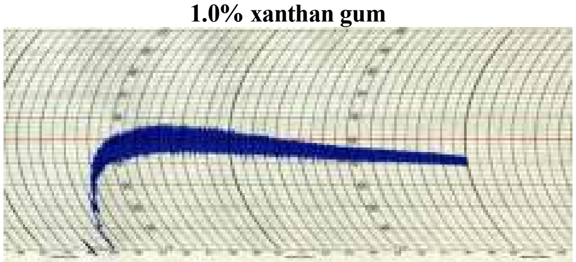
0.5% xanthan gum



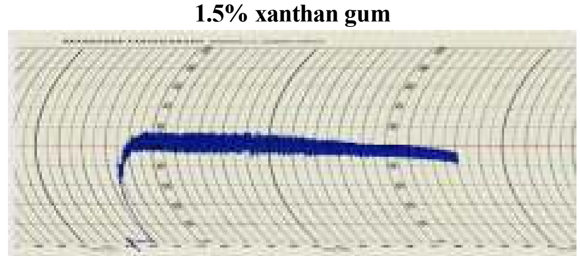
1.0% xanthan gum



1.5% xanthan gum



0.5% Guar gum



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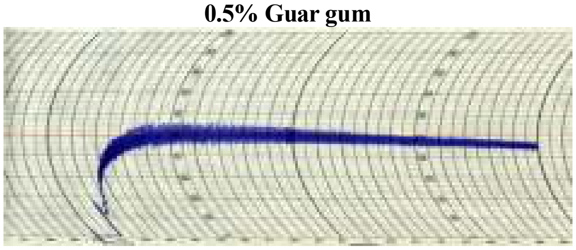
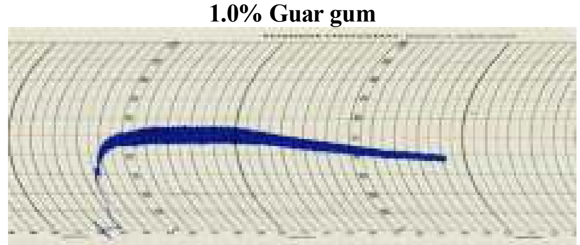
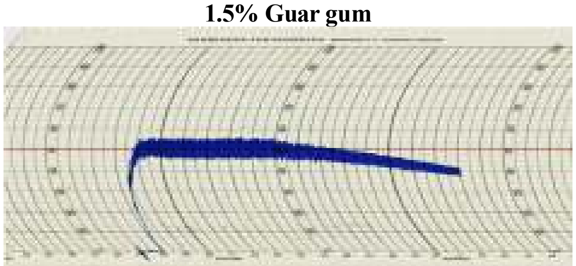


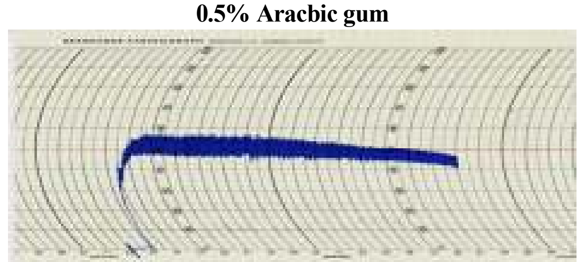
1.5% Guar gum



0.5% Aracbic gum



1.0% Arabic gum



1.5% Arabic gum

Figure 1. Farinogram parameters of dough behavior of wheat flour supplemented without or with 0.5, 1.0 and 1.5% of xanthan, guar and arabic gums

From the obtained data, it could be noticed that the water absorption of wheat flour was gradually increased as the addition level of different gums increased. The highest value was 66.4% for 1.5% xanthan gum sample following by 64.8%, 64.2%, and 63.5% for 1.0% xanthan, 1.5% guar, and 1.5 arabic gum samples, respectively in compared with 60.7% for control sample. This increasing in the water absorption reflects the hydrocolloids mechanism for better water distribution and retention (Kohajdová and Karovičová, 2009).

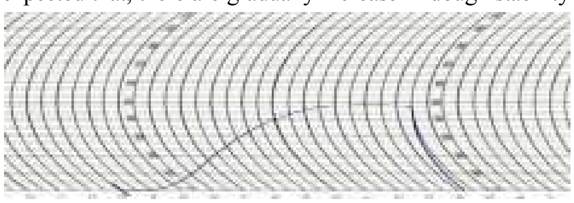
Also, from the same table, it could be revealed that both of arrival time and development time were increased with xanthan gum even with the lowest concentration (0.5%), while with guar or arabic gums they were only increased with the highest addition level (1.5%) in compared to control.

Dough stability time is an important index for the dough strength based on the quantity and quality of dough gluten. Another factor is the hydrocolloids addition which influences the gluten net work or creates bonds in dough that change its properties (Pečivová *et al*., 2011). So it could be expected that, there are gradually increase in dough stability with increase the levels of addition of different gums. The observed data confirmed that a high stability could be reached with 1.0 and 1.5% gum regardless the types. The stability times were 10.0 and 11.5 min for xanthan gum; 9.5 and 10.5 min for guar gum; 9.0 and 10.0 min for arabic gum, respectively in compared with 7.0 min for control. These data are in accordance with Collar *et al.* (1999); Rosell *et al.* (2001); and Linlaud *et al.* (2009) results.

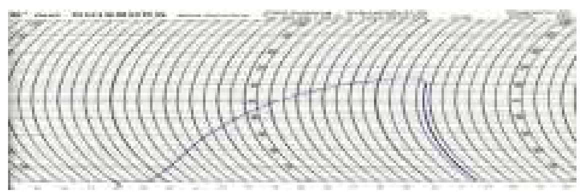
Concerning to degree of softening, it could be observed that the treatments which given high stability time value had lower degree of softening. Usually, flour with good bread making properties has high stability time and is more tolerant to mixing. Weaker flours tend to have higher values of degree of softening and it generally gives the rate of dough breakdown and the strength of flour Bonet *et al.* (2006).

Extensograph parameters of wheat flour supplemented with different gums:

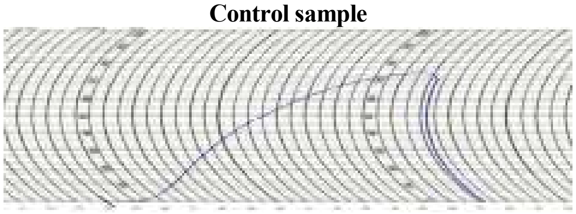
Extensograph parameters were determined for wheat flour with added different gum types (i.e. xanthan, guar and arabic) at various levels (Figure,2 and Table, 4).



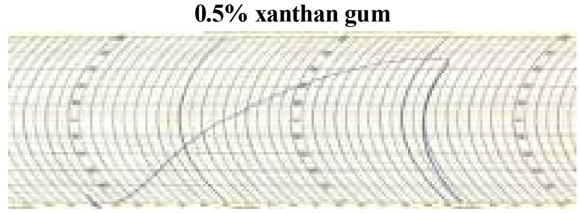
Control sample



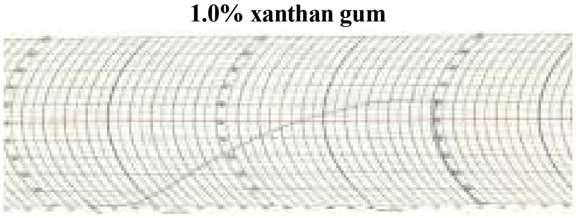
0.5% xanthan gum



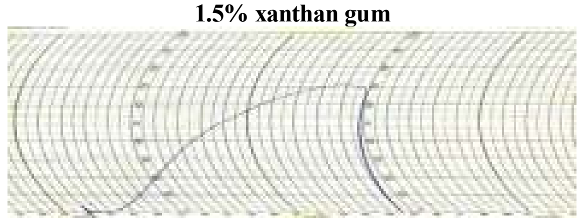
1.0% xanthan gum



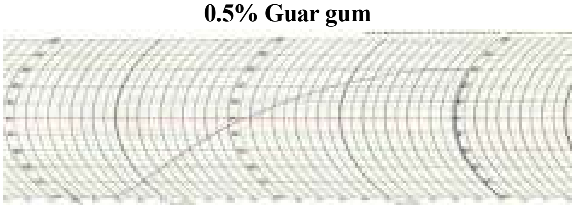
1.5% xanthan gum



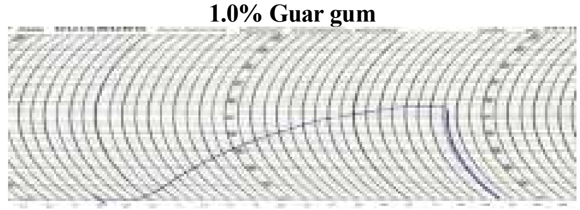
0.5% Guar gum



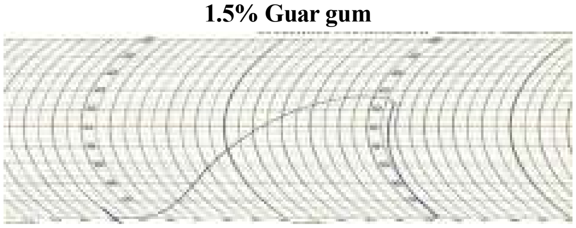
1.0% Guar gum



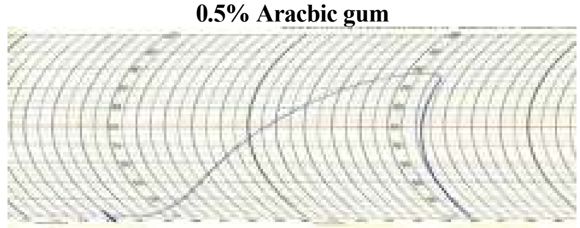
1.5% Guar gum



0.5% Aracbic gum



1.0% Arabic gum



1.5% Arabic gum

Figure 2. Extensogram of dough behavior of wheat flour supplemented with 0.5, 1.0 and 1.5% of xanthan, guar and arabic gums

Table 4. Extensograph parameters of wheat flour supplemented with different gums

Parameters Samples		Maximum extension Resistance "R" (BU)	Extensibility "E" (mm)	Proportional number (R/E)	Energy (Cm^2)
Control		480	100	4.80	87
Xanthan gum	0.5 %	640	120	5.33	124
	1.0 %	740	135	5.48	136
	1.5 %	870	150	5.80	175
Guar gum	0.5 %	620	125	4.96	116
	1.0 %	710	150	4.73	127
	1.5 %	800	175	4.57	164
Arabic gum	0.5 %	520	110	4.73	95
	1.0 %	670	120	5.58	112
	1.5 %	780	125	6.24	148

*** BU= Brabender unit. mm= Millimeter. R/E= resistance/ Extensibility.**

It could notice that the extensograph parameters are correlated to both the gum types and the addition levels. In general, maximum resistance to extension, extensibility, and energy were increased when the level of addition was increased. Regard to the gum types, the ordered was xanthan gum> guar gum> arabic gum. There are agreement with the result of Collar *et al.* (1999); Gómez-Díaz and Navaza (2003) and Ribotta *et al.* (2004).

On the opposite side, proportional number show a strange behavior, in which the guar gum came at the third position after xanthan and arabic gums. Also, it had an opposite correlation with the addition levels only with guar gum due to the high increased of extensibility values. While it had a direct correlation with xanthan and arabic gums like other parameters. This effect may be due to the gradually increase of resistance to extension with increasing the extensibility values. These results are in agreement with that obtained by Rosell *et al.* (2001).

Baking quality of pan bread:

Physical properties:

The effect of adding different hydrocolloids with various levels on physical properties of pan bread (i.e., weight, volume, and specific volume) were studied (Table, 5).

Table 5. Pan bread physical properties:

Parameters Samples		Loaf weight(g)	Loaf volume (cm^3)	Specific volume (cm^3/g)
Control		235	625	2.66
Xanthan gum	0.5 %	240	785	3.27
	1.0 %	245	810	3.31
	1.5 %	245	875	3.57
Guar gum	0.5 %	238	765	3.21
	1.0 %	240	780	3.25
	1.5 %	240	810	3.38
Arabic gum	0.5 %	235	750	3.19
	1.0 %	240	775	3.23
	1.5 %	240	800	3.33

Control without any gum had a loaf weight of 235 g. The addition of xanthan, guar, and arabic gums caused a slightly increase in loaf weight. The increase loaf weight ratio was ranged from 0.0% for arabic gum (0.5%) to 4.3% for 1.5% xanthan gum. This ratio could be a good reflection for the water adsorption (Table,3) and the capacity of the gum to retain the water.

On the other hand, the impact of the hydrocolloids on the gluten network (Pečivová *et al.,* 2011) that was presented in tables (3 and 4) was strongly appears in the loaf volume. The increase in bread volume being 20% with 0.5% arabic gum, while the highest achievement was 40% in the bread volume with 1.5% xanthan gum against control.

As expected, the values of specific volume recorded the similar trend as that of bread loaf volume. It was recorded a changeable ratio between 20 to 34.2%. It is clear that xanthan gum give the highest ratio for all physical properties than guar or arabic gum in line with the addition levels. These results are in accordance with Ozkoc *et al.* (2009) and Rodge *et al.* (2012).

Bread staling:

Staling rate of pan bread prepared with adding different gums at various concentrations (0.5, 1.0 and 1.5%) to wheat flour and stored for 3 days are given in table (6) and illustrated by figure (3).

Table 6. Alkaline water retention capacity (AWRC) of pan bread.

Addition level		Storage periods (days)			
		Zero time	24 h	48 h	72 h
Control sample		300 ± 8.1	243 ± 2.6	232 ± 5.1	224 ± 4.4
Xanthan gum	0.5 %	328 ± 5.5	263 ± 5.3	253± 5.4	239 ± 3.1
	1.0 %	340 ± 4.5	276 ± 2.3	266 ± 4.5	245 ± 0.9
	1.5 %	357 ± 6.7	281 ± 3.1	274 ± 2.5	252 ± 1.5
Guar gum	0.5 %	324 ± 3.5	258 ± 2.6	246 ± 1.5	234 ± 2.5
	1.0 %	338 ± 2.8	265 ± 7.7	255 ± 1.7	241 ± 7.1
	1.5 %	352 ± 3.8	277 ± 9.4	274 ± 3.7	248 ± 1.6
Arabic gum	0.5 %	310 ± 3.1	253 ± 2.6	242 ± 4.9	230 ± 9.8
	1.0 %	332 ± 6.9	261 ± 1.1	253 ± 9.8	239 ± 0.5
	1.5 %	348 ± 5.1	273 ± 0.9	269 ± 3.7	248 ± 6.2

*** The values are present the means of triplicate ± SD.**

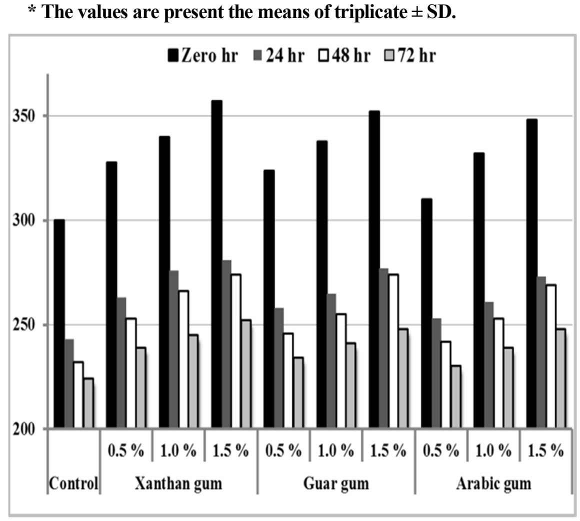


Figure 3. Alkaline water retention capacity (AWRC) of pan bread.

Results showed that at zero time all tested hydrocolloids (xanthan, guar, and arabic gum) caused a high range in the increment of freshness values from 3.3% with 0.5 arabic gum to 19% with 1.5% xanthan gum. This increment of AWRC was continued until the end of the storage period as compared with control. There are agreement with Cauvain and Young (2007) and Maleki and Milani (2014). Since gums able to adsorbed more water and they are able to retain more water, this is the reason to observe more freshens with gums. These observations are in agreement with those obtained by Stauffer (2000) who mentioned that, increasing the moisture content of bread increases its shelf life by alter the rate of bread firming than did bread containing lower moisture.

From these results, it could be observed that, there was a gradual decrease in alkaline water retention capacity values (low freshness) for all different pan bread samples during storage periods. This observation had been reported before by He and Hoseney (1990).

Sensory evaluation of pan bread:

The results in table (7) showed that, no significant differences in taste and crust color could be observed between all samples. The significant differences in crumb color only were observed with samples prepared by adding 1.0, and 1.5% of xanthan gum, and 1.5% of guar or arabic gum. Concerning the texture, significant difference was recorded between control and all of the studied gums.

For flavor, the obtained results indicated that there were significant differences between samples prepared by adding 1.5 xanthan and 0.5, 1.0, and 1.5% guar gum than other bread samples. On the other hand, there were no significant differences between control and bread samples of 0.5% xanthan, 0.5 or 1.0% arabic gum for general appearance.

The overall acceptability values, which is a reflection of all the tested quality attributes and acceptability of the studied pan bread, were calculated as a sum of received sensory score. The results demonstrated that, the good quality of the prepared pan bread could be obtained by adding xanthan gum with a concentration of 1.0 and 1.5% or by adding 1.5% guar gum. While using arabic gum give almost the same properties as control. These results are in agreement with Shittu *et al.* (2007) and Polaki *et al*. (2010).

Table 7. Sensory characteristics of pan bread.

Parameters Samples		Crust color (10)	Crumb color (10)	Texture (20)	Taste (20)	Flavor (20)	General appearance (20)	Overall acceptability (100)
Control		8.40±1.17^{A}	8.10±1.29^{AB}	17.50±0.85^{B}	17.80±0.63^{A}	17.60±1.06^{AB}	17.20±0.79^{AB}	86.60±1.77^{B}
Xanthan gum	0.5 %	8.40±1.26^{A}	8.40±1.43^{AB}	18.40±0.52^{AB}	18.10±0.99^{A}	17.70±0.95^{AB}	17.30±0.67^{AB}	88.30±2.72^{AB}
	1.0%	8.70±1.34^{A}	8.90±0.74^{A}	18.80±1.03^{A}	18.40±0.70^{A}	18.10±0.99^{AB}	17.50±1.27^{A}	90.40±2.96^{A}
	1.5 %	8.40±1.07^{A}	9.10±0.74^{A}	19.00±0.82^{A}	18.20±1.55^{A}	18.40±1.35^{A}	18.10±0.74^{A}	91.20±2.54^{A}
Guar gum	0.5 %	8.30±0.95^{A}	8.10±1.20^{AB}	18.20±0.79^{AB}	18.30±1.42^{A}	18.20±1.32^{A}	17.50±0.70^{A}	88.60±2.00^{AB}
	1.0 %	8.10±1.29^{A}	8.40±1.07^{AB}	18.70±1.25^{A}	18.20±1.14^{A}	18.50±0.85^{A}	17.60±0.53^{A}	89.50±2.41^{AB}
	1.5 %	8.50±0.85^{A}	8.60±1.07^{A}	19.00±0.82^{A}	18.20±1.23^{A}	18.30±0.67^{A}	17.60±0.84^{A}	90.20±1.75^{A}
Arabic gum	0.5 %	8.40±0.84^{A}	8.50±0.85^{AB}	17.60±0.84^{B}	17.80±0.79^{A}	17.80±0.79^{AB}	17.20±0.92^{AB}	87.30±1.45^{B}
	1.0 %	8.60±0.70^{A}	8.40±0.84^{AB}	18.30±1.06^{AB}	17.50±0.97^{A}	17.70±1.07^{AB}	17.30±0.95^{AB}	87.80±2.09^{B}
	1.5 %	8.50±0.97^{A}	8.60±0.84^{A}	18.80±0.79^{A}	17.80±1.23^{A}	17.80±1.23^{AB}	17.50±0.53^{A}	89.00±2.74^{AB}

*** Differences were analyzed by SAS ($p<0.05$).**

CONCLUSION

Addition of hydrocolloids in bread-making resulted in improvement bread quality, namely moisture content, and crumb hardness of the fresh bread compared with control. The addition of 1.0 and 1.5% of xanthan, 1.5% guar, or 1.5% arabic gum produced the softest crumb and smoothest texture. The ability of hydrocolloids to retain moisture and gas resulted in a softer and porous texture. Applications of hydrocolloids also caused retard the bread staling process. It could be concluded that, good quality pan bread could be obtained by adding xanthan gum with a ratio of 1.0 -1.5% or guar gum with a level of 1.5%.

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تأثير اضافة بعض الصموغ كمحسنات للخبز

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تم دراسة تأثير اضافة ثلاث أنواع من الصموغ الطبيعية (صمغ الزانثان، صمغ الجوار والصمغ العربي) بمستويات مختلفة ٠.٥، ١.٠ ، ١.٥٪ علي صفات الخبز. وقد أوضحت النتائج المتحصل عليها انه بزيادة مستوي الاضافة من هذه الصموغ من ٠.٥ إلي ١.٥٪ أدي إلي زيادة كلا من معدل أمتصاص الماء، درجة ثبات العجين، مرونة العجين، الرقم النسبي وكذلك المساحة أسفل المنحي (الطاقة). بينما لوحظ حدوث انخفاض تدريجي بالنسبة لدرجة ضعف العجين.فيما يتعلق بالخصائص الطبيعية للخبز مثل (وزن الرغيف ،حجم الرغيف ، الحجم النوعي للرغيف) فقد لوحظ حدوث زيادة تدريجية بالنسبة لكلا من هذه الصفات بزيادة نسبة الاضافة من تلك الصموغ الثلاثة مقارنة بعينة الكنترول. كذلك أوضحت النتائج قدرة هذه الصموغ في تحسين درجة الطازجة للخبز خلال فترة التخزين. بالنسبة للتقييم الحسي، فقد اظهرت النتائج عدم تأثر لون القشرة الخارجية وطعم الخبز بإضافة هذه الصموغ، ولكنه كان يوجد اختلاف معنوي في الخصائص الأخرى مثل لون الكسرة، القوام، المظهر العام، القبول العام عند إضافة مستوى عال من الصموغ.ونخلص من هذه الدراسة أنه للحصول علي خبز قوالب ذو جودة عالية، فإنه يجب ان يضاف صمغ الزانثان بنسبة من ١.٠ الي ١.٥% أو صمغ الجوار بنسبة ١.٥% من وزن الدقيق.

الكلمات الدالة: خبز القوالب – الغرويات المائية – خواص العجين- جودة الخبز.