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Effect of Fermentation Systems on Quality Characteristics of Frozen Dough Containing Some Food Additives

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ABSTRACT

This study was carried out to investigate the effect of fermentation systems (full fermentation for 2hrs before freezing and prefermentation for 1hr before freezing and 1hr after freezing) on quality characteristics of baked and unbaked dough which contained some food additives, namely, xanthan, whey proteins and glucose syrup. The yeast count as log cfu/g (yeast viability) of different frozen and unfrozen dough was determined. The highest log cfu/g was detected in the dough containing 2 % and 1 % whey proteins, followed by 0.5 % and 1 % xanthan and finally 4 % glucose syrup. On the other hand, dough containing 6 % glucose syrup was mostly similar to the control dough (without additives) in yeast count. Pre-fermentation was more effective for increasing gas volume. Addition of 2% and 1% whey proteins followed by0.5% and 1% xanthan improved the gassing power of yeast than that of the control. The dough height was increased as the time of fermentation was elongated. Dough containing different concentrations of the aforementioned food additives showed more height than the control dough, especially with the addition of 2% whey protein. Full fermented frozen dough showed higher moisture content than the unfrozen dough. The dough containing xanthan and whey proteins had great ability to retain moisture. The highest moisture content was observed in pre-fermented baked frozen dough containing 2% whey proteins followed by that of 1% xanthan, 1% whey proteins and 0.5% xanthan. In conclusion, pre-fermentation for 1hr and complete fermentation time for another 1 hr after freezing was necessary to improve the final specific volume of baked frozen dough as compared with full fermentation for 2 hrs. The pre-fermented frozen dough recorded the highest scores in sensory properties after baking compared to the full fermented baked frozen dough especially with the addition of 2% whey proteins and 1% xanthan.

Key words: ***Frozen dough, fermentation systems, additives, quality characteristics, yeast viability.***

INTRODUCTION

The production of frozen dough has increased greatly due to consumers demand and the rapid growing number of in-store bakeries. Surfactants, hydrocolloids and other compounds that usually have water binding properties are added in frozen dough production (Asghar *et al.*, 2006).Freezing and frozen storage can affect dough and bread quality in a number of ways. Maintenance of yeast viability and gas retention during freezing and frozen storage of dough are important if proofing is to be fast and effective leading to high quality bread (Phimolsiripol *et al.*, 2008).

For ages, it has been believed that there is no substitute for fresh baked product develops a moist and leathery texture while the soft crumb becomes firm and dry. The fresh flavour that is also lost within hours of baking, accordingly bakers work at midnight or early morning to provide the consumers with fresh bread on a daily basis. Mixed and molded frozen dough that could be quickly transformed into fresh- baked product was suggested. (Giannou *et al.*, 2003, Sharadanant & Khan, 2003).

In frozen dough manufacturing, yeast survival and gas retention are major problems. Poor gas retention during proofing can result from the damage of the three- dimensional gluten protein network as mentioned by Teunissen *et al.*, 2002 and Ribotta *et al.*, 2003. Dough weakening during frozen storage is attributed to the release of reducing substance such as glutathione from yeast during freezing. Gradual loss of dough strength during frozen storage has been attributed to the water redistribution provoked by a modification in the water binding capacity of dough constituents (Ribotta *et al.*, 2001). The use of partially fermented dough could solve some problems, such as the loss of volume which could be recovered during the thawing and baking phases and also the tolerance of yeast to freezing is much better in such conditions as shown by Zounis *et al.*, 2002 and Le- Bail *et al.*, (2010).

Some additives are used in bakeries to facilitate processing, to compensate for variations in raw materials, to guarantee constant quality and to preserve freshness and good properties. In the scientific literature, different additives and ingredients have been used to modify the dough behaviour during freezing (Ribotta *et al.*, 2004). The use of additive has become a common practice in the baking industry. The need for their use arises due to the fact that numerous benefits are associated with their use, which not only result in improving the bread quality but also in an elongation of shelf- life. Since its inception, the baking industry has undergone several evolutionary steps, which have resulted in proper storage of dough under freezing conditions.

The compounds that interact with water can affect the quality of the resulting bakery product. Additives that are natural and have water binding and gelling properties are needed to meet current consumer concepts of good nutrition. Proteins from dairy sources, like whey proteins, also have the potential of thickening functionality just like other ingredients as hydrocolloids, starches, and other thickeners in food systems (Hudson *et al.*, 2000). Surfactants and emulsifiers are also considered safe and natural food additives.

Whey products are used by the baking industry because of their functional benefits. Some of the benefits recognized by consumers include good crust colour developed through the Maillard browning reaction, good dairy flavour, softer crumb and extended shelf-life. Additional benefits that the baker may recognize are the ability to reduce ingredient costs by partially or completely replacing egg products, milk powder or other ingredients such as shortening. Less commonly recognized are the nutritional benefits of adding whey proteins to bakery products. Whey proteins have a high concentration of lysine, the deficient amino acid in wheat protein. Increasing the ratio of whey proteins to wheat protein results in an improved amino-acid profile. Bread, soft rolls and buns are the major applications for whey products. A typical use level of whey or lactose in bread, soft rolls and buns is 2-4% of the flour weight. Whey or lactose can be added to pie crusts. Whey at approximately, 2-3% or lactose at 6-8% of flour weight aid in emulsifying the shortening (Burrington & Gerdes, 2003, Asghar *et al* 2011).

Gums are a group of naturally occurring polysaccharides. They have water holding capacity and retard moisture migration in the dough. Gums improve the cruelty of frozen dough and the final baked product. These hydrocolloids have been used in many other types of bakery product (Lee *et al.*, 2002, Sharadanant & Khan, 2003, Guarda *et al.*, 2004, Ribotta *et al.*, 2004, Mandala *et al.*, 2008). Xanthan is an excellent cellular polysaccharide (secreted by bacterium *Xanthomonas compestris*) that confers its solutions high viscosity, which is almost constant over a range of pH and temperature conditions. The use of xanthan gum in bread dough results in a strengthening of the dough due to a strong interaction between xanthan and protein. Xanthan also increase water absorption enhances the ability of the dough to retain and increase the water activity of crumb (Rosell *et al.*, 2001).

Honey could be added to frozen dough due to its effect on protection of gluten proteins from damage during freezing. The addition of honey at level from 4 to 12% improved the baking quality of frozen dough. Honey also has a desirable effect on the colour development of crust and crumb of bread from frozen dough as found by Addo, (1997).

There are few studies available on the theme of prefermented frozen dough systems. So, this work presents an original work to investigate the effect of fermentation systems (full fermentation for 2hrs before freezing and pre- fermentation for 1hr before freezing followed by 1hr after freezing) on the quality characteristics of baked and unbaked dough which contained some food additives as xanthan, whey proteins and glucose syrup.

MATERIALS AND METHODS

Materials:

Xanthan, whey proteins and glucose syrup were used in the present study. Xanthan was obtained from Sigma Chemical CO.(St. Louis. Mo, USA), whey protein (non fat milk) was purchased from Dena Farm, Egypt and glucose syrup was purchased from Glucose & Starch Co., Cairo, Egypt.

Methods:

Dough formulation:

Dough formulation was as follows: wheat flour 72% extraction ratio (100 g), active dry yeast (3.3 g), sugar (3.3 g), salt (1.7 g), oil (3.3 g), water (55 g), (Phimolsiripol, 2009), 0.5, 1 % xanthan, 1, 2 % whey proteins and 4, 6 % glucose syrup were used on flour weight basis as food additives.

Dough preparation and freezing:

All the dry ingredients were mixed well together before added to the remaining wet ingredients. Active dry yeast was previously mixed with sugar and dissolved in a little amount of water. All ingredients were transferred to dough mixer (Moulinex) and mixed for 4 min at low speed and for 10 min at high speed. After mixing, the dough was rested for 10 min and then divided into pieces, manually molded into round shapes and divided into two groups. The first group was fermented for 2 hrs at 25°C (full fermentation time), while the second group was fermented for only 1 hr at the same temperature (pre - fermentation) and the dough samples were kept in polyethylene bags then frozen in an air blast freezer (Koma Chuk Freezer) at about - 30 °C for 40 min in Rehana Company for food processing, 6 October Egypt, then, the samples were stored only for 1 day at -18 °C to focus on the effect of freezing on some of the quality characteristics of the prepared dough samples. The frozen second group was defrosted at room temperature for 20 min and then conducted to further fermentation period for 1 hr where, the total fermentation time was 2 hrs as mentioned by Le-Bail *et al.*, (2010). The frozen dough samples were thawed at room temperature for 20 min, and then baked at 240 °C for 25 min in LUXELL air oven model LX- 3575 made in Turkey.

Analytical methods:

Yeast viability

Yeast viability (log cfu/g) was measured by using AACC approved method (AACC, 2000). Logarithmic dilutions were prepared according to Oxoid Manual, (1979). The counts of surviving yeast in the dough were determined according to Phimolsiripol *et al.*, (2008).

Gassing power

Gassing power was determined according to Phimolsiripol *et al.*, (2008).

Dough height

Dough height during proofing was determined according to the method described by Matuda *et al.*, (2008).

Moisture content:

Moisture content was determined according to the AACC, (2000).

Specific volume

Specific volume (cm^3 / g) of baked samples were determined according to Sharadanant & Khan, (2003).

Sensory evaluation

Sensory evaluation was conducted on different baked dough according to the method described by Zounis *et al.*, (2002). The sensorial attributes evaluated were loaf volume (30), external appearance (10), crumb texture (20), crumb colour (10), crumb structure (20), flavour (10) and overall acceptability (100).

Statistical analysis:

Data were expressed as the mean values for three replicates and statistically analyzed by performing analysis of variance technique using the Statistical Analysis System program (SAS, 1996). Differences among means were compared using Duncan's Multiple Range Test at significant level 95% ($P \leq 0.05$).

RESULTS AND DISCUSSION

Yeast viability

Yeast viability of fresh (unfrozen) and frozen dough is summarized in Table (1). The full fermented dough had higher yeast count than the frozen one. This means that yeast viability decreased by freezing. This is attributed to the release of reducing substance such as glutathione from yeast during freezing, to ice recrystallization causing loss in yeast activity and leathal effect of freezing (Ribotta *et al.*, 2001). Pre-fermented dough after 1 hour of fermentation (fresh) had lower yeast count than those after full fermentation (2hrs). Defrosted dough allowed to complete fermentation to another 1 hour, resulted in yeast count greater than the full fermented dough. This means that yeast cells could be recovered their viability during the thawing and the tolerance of yeast to freezing is much better in such conditions as shown by Zounis *et al.*, (2002).

The highest log cfu/g appeared in dough containing 2% and 1% whey proteins followed by 0.5 % and 1 % xanthan and finally 4 % glucose syrup. On the other hand, 6 % glucose syrup was mostly similar to the control dough (without additives) in yeast count.

Gassing power

The effect of fermentation system on gas volume is illustrated in Figs 1 and 2. As shown, as the fermentation period was elongated the gas power

Table 1: Yeast count (log cfu/g) of fresh and frozen dough containing various concentrations of some food additives under two fermentation systems

Concentration of food additives (%)	Log cfu/g				
	Full fermentation		Prefermentation		
	Fresh* (unfrozen)	Frozen	Fresh** (unfrozen)	Frozen***	Defrosted dough after another 1 hr of fermentation.
Control(without additives)	6.65	5.00	4.92	2.34	6.88
Xanthan (0.5%)	6.77	5.21	5.16	2.45	7.13
Xanthan (1%)	6.79	5.30	5.17	2.45	7.10
Whey proteins (1%)	6.84	5.73	5.25	2.52	7.19
Whey proteins (2%)	6.89	5.65	5.22	2.62	7.22
Glucose syrup (4%)	6.74	5.10	5.11	2.40	7.06
Glucose syrup (6%)	6.72	5.01	5.07	2.40	6.99

* After 2hrs of fermentation before freezing

** After 1hr of fermentation before freezing

*** Defrosted dough after first 1 hr of fermentation.

of yeast increased (Fig.1). The gas production was lower, particularly during the first 20 min after thawing and gradually increased through the second hour of fermentation (Fig. 2). This is due to the effect of freezing which causes a loss in the number of yeast cells as well as loss in their capacity to produce gas by the surviving cells. These results are in accordance with Phimolsiripol, (2009). The pre- fermentation was more important to increase gas volume, since fermentation of dough before freezing impairs the viability of the yeast cells as mentioned by Hino *et al.*, (1990).

From Figs (1) and (2), it could be concluded that addition of some food additives improved the gassing power of yeast than that of the control (without any additives) .The best addition was that of 2% and 1% whey proteins followed by samples containing0.5% xanthan followed by 1% xanthan.

Dough height

The effect of full fermentation system on dough height is shown in Fig (3). It was obvious that the dough height increased as the time of fermentation was preceded. Dough containing various concentrations of some food additives showed more height than the control dough (without additives). The addition of whey protein was more effective than the other additives in the height of dough. Whey proteins have the potential of thickening functionality just like other ingredients as hydrocolloids, starches, and other thickeners in food systems (Hudson *et al.*, 2000).

From the data presented in Fig (4), it could be seen that the height of different dough after 30 min of the second hour of fermentation ranged from 60 to 90 mm. Meanwhile, when it compared to the height of unfrozen dough samples after 30 min as shown in Fig(3), it seemed that the yeast did not be active (decreasing of dough height). As the fermentation time was extended, there was a considerable increase of the solubility of CO_2 in the dough took place. So, there was a gradually increase in this parameter.

The highest height appeared in full fermented dough containing 2% whey protein followed by dough containing 4% glucose syrup and then 1% whey proteins .On the other hand, the highest dough height was traced in pre- fermented dough containing 2% whey protein followed by 4% glucose syrup and then 0.5% xanthan. These results are in accordance with those obtained by Rasanen *et al.*, (1995).

Moisture content

The moisture content of unfrozen and frozen (baked- unbaked) dough containing some food additives after full fermentation are presented in Fig (5). As appeared, the moisture content of the unbaked dough before freezing ranged between 37.79 to 43.66 %. Unbaked dough before freezing containing 1% xanthan retained the highest moisture content (43.66%) followed by 0.5% xanthan (41.72%) then 2% whey protein (41.59%). On the other hand, the lowest moisture content (37.79%)

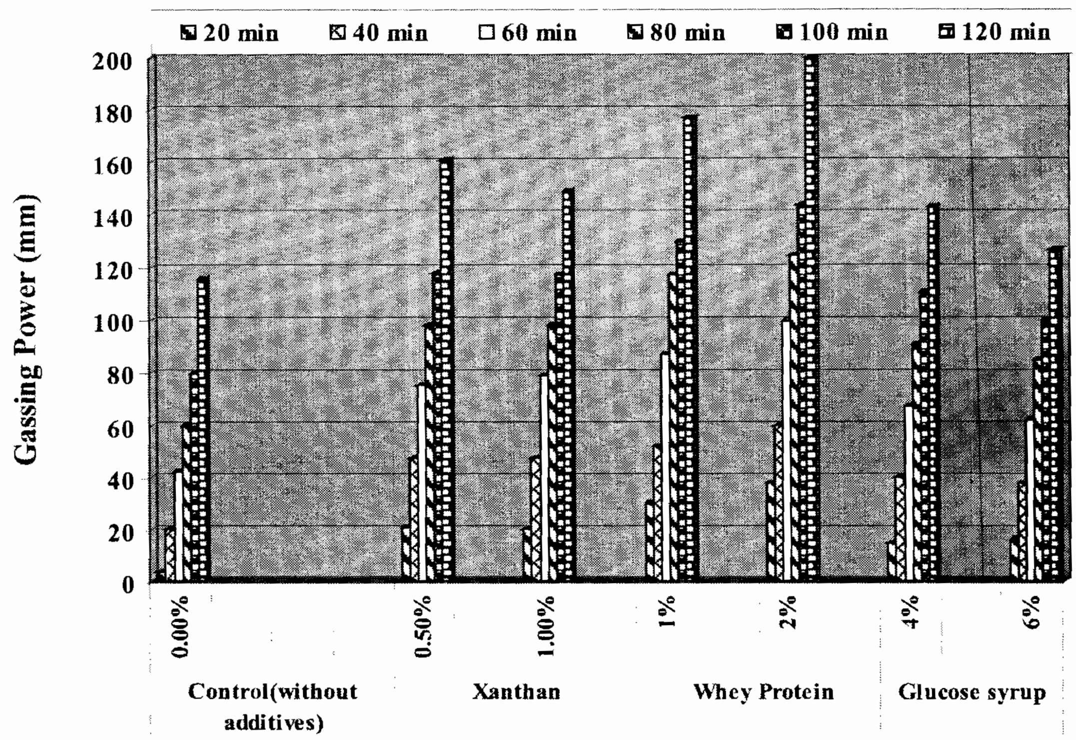

Fig. 1: Gassing power of unfrozen dough containing various concentrations of some food additives during full -fermentation (2hr)

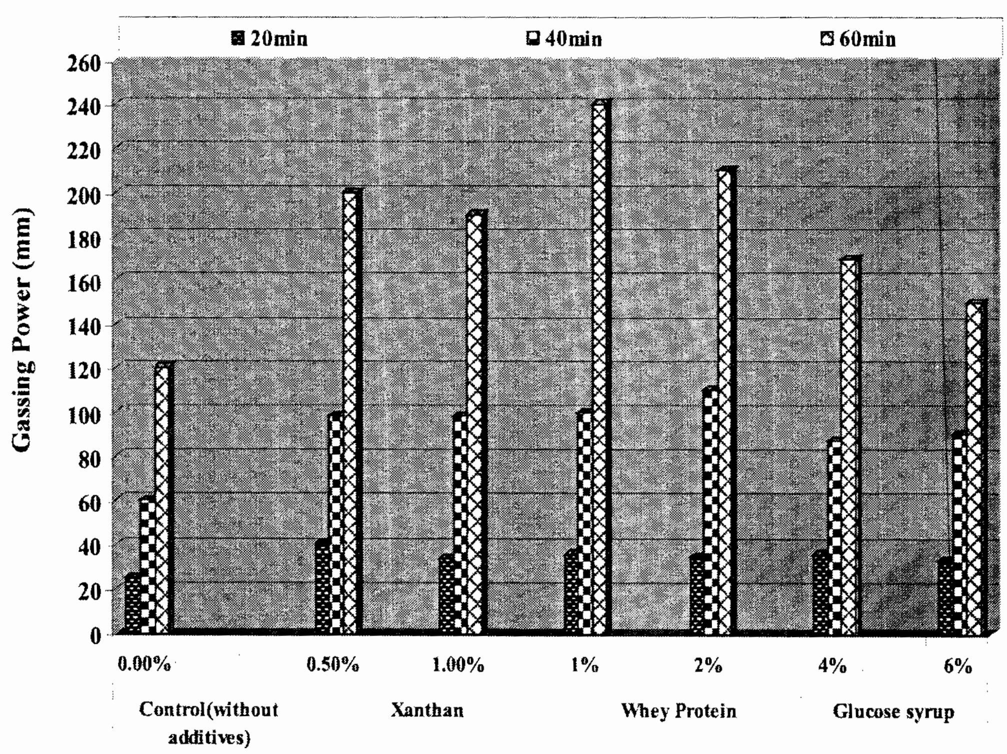

Fig. 2: Gassing power of frozen dough containing various concentrations of some food additives during prefermentation (another 1hr) after freezing.

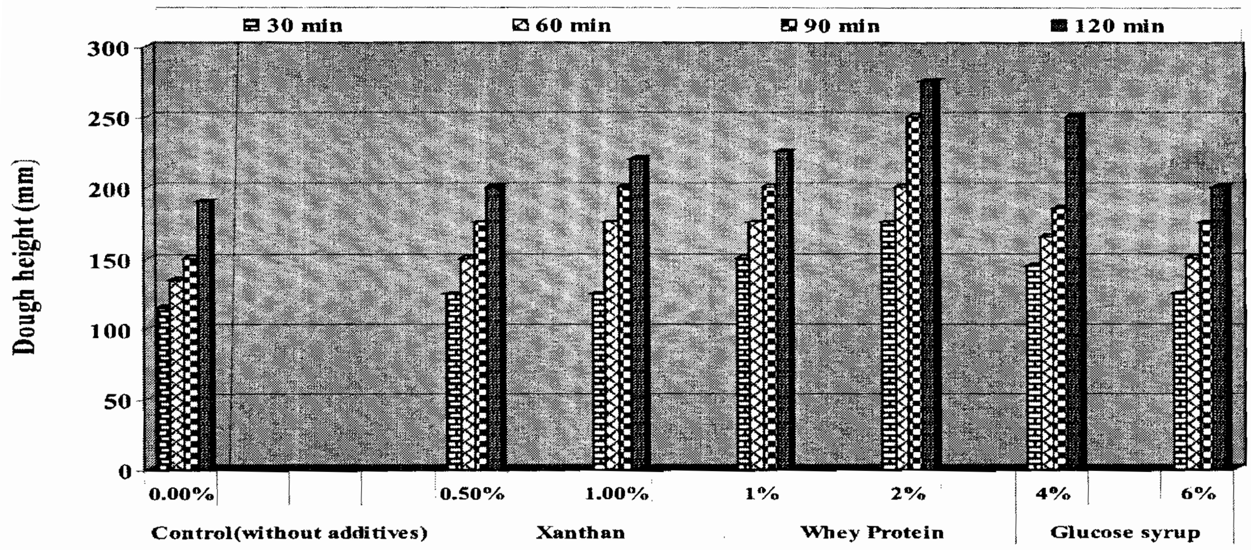

Fig. 3: Dough height of unfrozen dough containing various concentrations of some food additives during full fermentation (2hr).

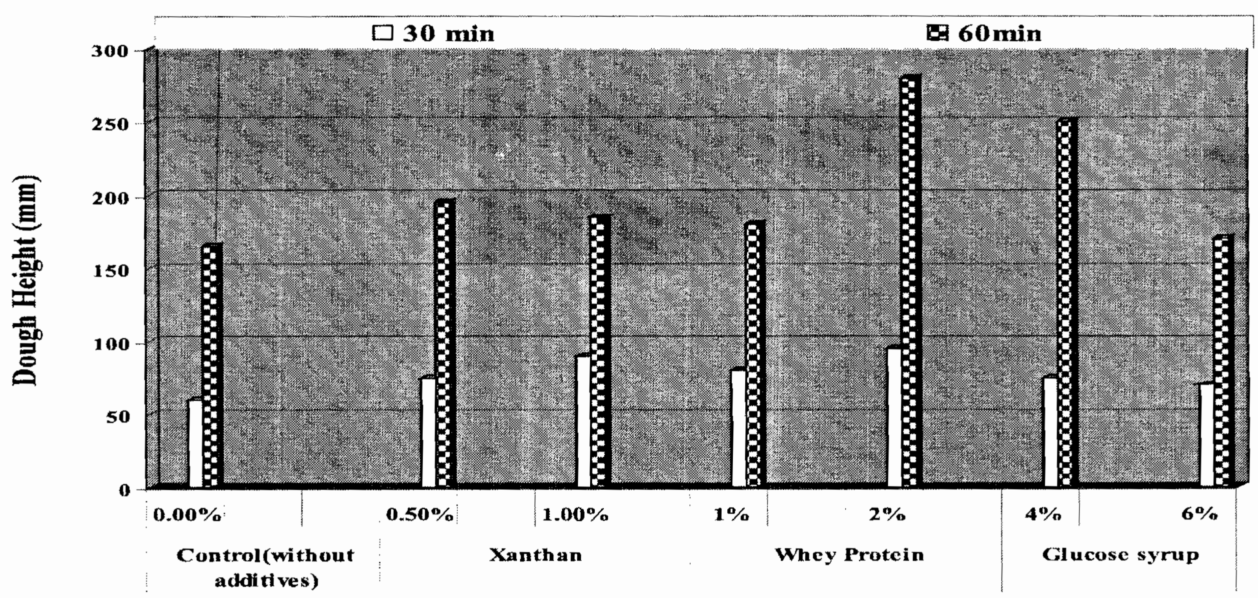

Fig.4: Dough height of frozen dough containing various concentrations of some food additives during prefermentation (another 1hr) after freezing.

was appeared in the unbaked dough before freezing containing 6 % glucose syrup. Full fermented frozen dough showed higher moisture content than unfrozen dough samples. The highest moisture content was found for the unbaked frozen dough containing 1% xanthan being 44.57% and 0.5% xanthan being 42.34% followed by 2% whey protein being 41.84%. From these results, it could be concluded that full fermented frozen dough containing xanthan and whey protein had a great ability to retain moisture. As a result of baking, the dough lost moisture. The most reduction appeared in the control dough which baked and frozen (32.77%) as shown in Fig (5).

The moisture content of prefermented (baked-unbaked) dough containing some food additives before and after freezing are shown in Fig (6). The moisture content of prefermented unbaked dough before freezing (1hr) ranged from 38.01 to 43.40 %. Unfrozen dough containing 1% xanthan retained the highest moisture content (43.40 %) followed by 2% whey protein (42.65 %). On the other hand, the lowest moisture content appeared in unfrozen

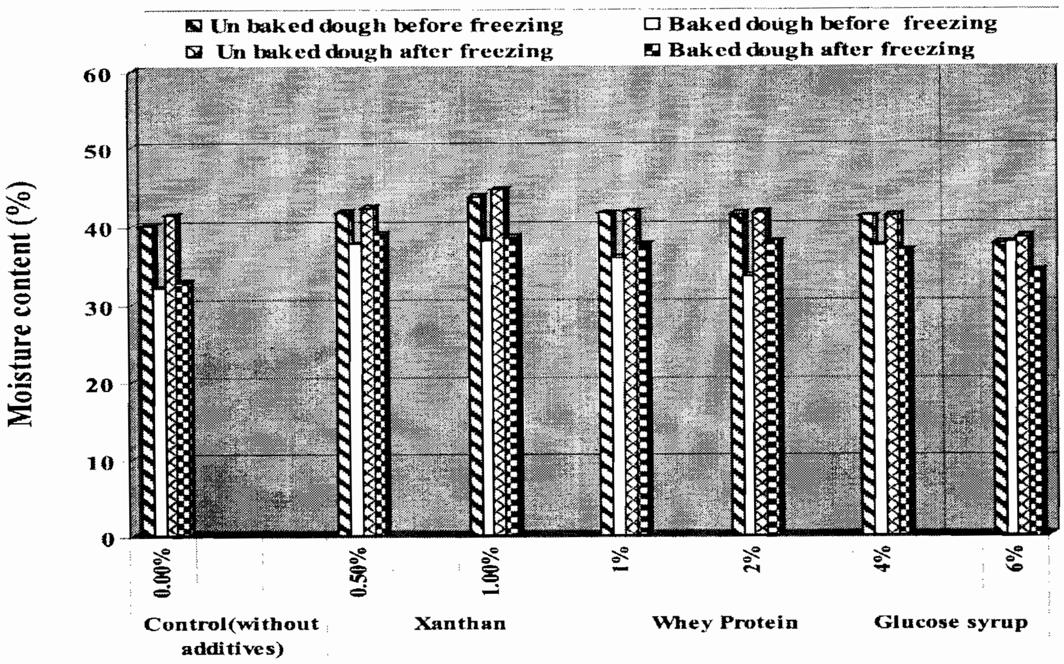

Fig. 5: The moisture content of (baked -unbaked) full fermented dough containing various concentrations of some food additives before and after freezing

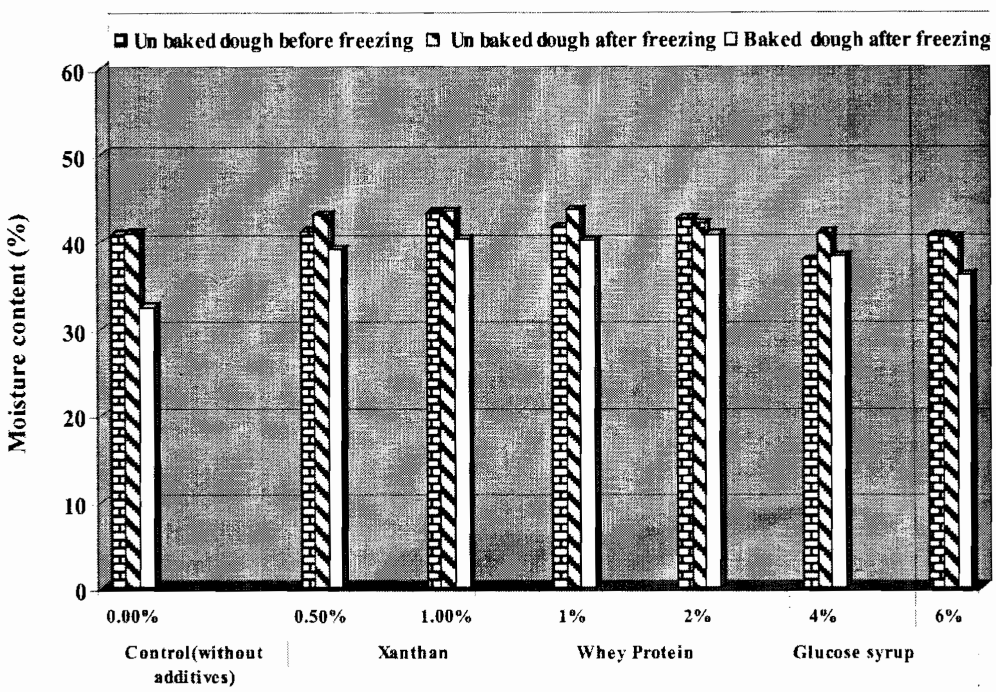

Fig. 6: The moisture content of (baked -unbaked) prefermented dough containing various concentrations of some food additives before and after freezing.

dough containing 4% glucose syrup (38.01 %). The highest moisture content was observed in prefermented baked dough after freezing containing 2% whey protein followed by 1% xanthan as well as 1% whey protein and finally 0.5% xanthan. These results are in agreement with that of Sharadanant & Khan, (2003).

Specific volume

The specific volume of fresh (unfrozen) and defrosted baked dough is illustrated in Fig (7). Bakery volume is positively correlated with a number of consumer- preferred quality characteristics and is used to identify the quality changes in dough

Table 2: Mean scores of sensory properties of full and prefermented baked dough containing various concentrations of food additives before and after freezing.

Concentration (%)	Means* scores of sensory properties						
	Loaf volume (30)	Appearance (10)	Crumb Texture (20)	Crumb Color (10)	Crumb Structure (20)	Flavour (10)	Overall acceptability (100)
Full fermented baked dough before freezing							
Control (0.0%)	26.4^{B}	9.0^{A}	16.6^{C}	9.0^{A}	17.6^{C}	8.0^{B}	86.6^{E}
Xanthan (0.5%)	25.8^{B}	9.0^{A}	17.8^{B}	9.0^{A}	18.8^{AB}	8.8^{A}	89.2^{D}
Xanthan (1%)	26.4^{B}	9.0^{A}	19.0^{A}	9.0^{A}	19.0^{A}	9.0^{A}	91.4^{B}
Whey protein (1%)	26.2^{B}	8.4^{B}	18.4^{A}	9.0^{A}	19.0^{A}	9.0^{A}	90.0^{CD}
Whey protein (2%)	29.0^{A}	9.0^{A}	19.0^{A}	9.0^{A}	19.0^{A}	9.0^{A}	94.0^{A}
Glucose syrup (4%)	29.0^{A}	9.0^{A}	19.0^{A}	9.0^{A}	18.8^{AB}	8.8^{A}	93.6^{A}
Glucose syrup (6%)	29.0^{A}	8.4^{B}	17.8^{B}	8.4^{B}	18.4^{B}	8.2^{B} 0	90.2^{C}
Full fermented baked dough after freezing							
Control (0.0%)	25.2^{D}	8.4^{AB}	16.2^{C}	9^{A}	16.6^{C}	7.2^{B}	82.6^{E}
Xanthan(0.5%)	23.8^{E}	9.0^{A}	17.8^{B}	9^{A}	18.0^{B}	9.0^{A}	86.6^{D}
Xanthan (1%)	26.2^{C}	9.0^{A}	19.0^{A}	9^{A}	19.0^{A}	9.0^{A}	91.2^{B}
Whey protein (1%)	27.4^{B}	7.0^{C}	18.8^{A}	9^{A}	19.0^{A}	8.8^{A}	90.0^{C}
Whey protein (2%)	29.0^{A}	7.0^{C}	19.0^{A}	9^{A}	19.0^{A}	9.0^{A}	92.0^{B}
Glucose syrup (4%)	29.0^{A}	8.8^{A}	19.0^{A}	9^{A}	18.8^{A}	8.6^{A}	93.2^{A}
Glucose syrup (6%)	29.0^{A}	7.8^{B}	18.2^{B}	9^{A}	18.4^{AB}	7.6^{B}	90.0^{C}
Prefermented baked dough after freezing							
Control (0.0%)	27.6^{C}	7.6^{B}	17.6^{C}	9.0^{A}	18.4^{B}	8.4^{A}	88.6^{C}
Xanthan(0.5%)	28.8^{AB}	8.6^{A}	19.0^{A}	8.8^{AB}	19.0^{A}	8.8^{A}	93.0^{A}
Xanthan (1%)	29.0^{A}	9.0^{A}	19.0^{A}	9.0^{A}	19.0^{A}	9.0^{A}	94.0^{A}
Whey protein (1%)	28.6^{AB}	8.6^{A}	18.6^{AB}	8.4^{AB}	18.4^{B}	8.6^{A}	91.2^{B}
Whey protein (2%)	29.0^{A}	9.0^{A}	19.0^{A}	8.0^{B}	19.0^{A}	9.0^{A}	93.0^{A}
Glucose syrup (4%)	27.6^{C}	8.6^{A}	18.2^{B}	8.8^{AB}	17.6^{C}	8.6^{A}	89.4^{C}
Glucose syrup (6%)	28.2^{B}	8.4^{A}	18.6^{AB}	8.4^{AB}	18.0^{BC}	8.4^{A}	90.0^{BC}

* : Mean in a column showing the same letter are not significantly different ($P \leq 0.05$).

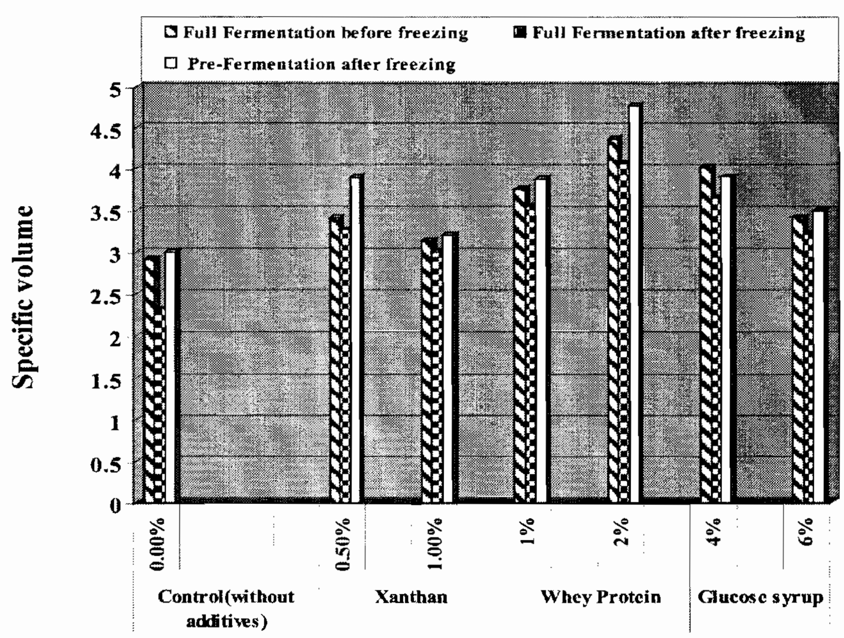

Fig. 7: Specific volume of full and prefermented baked dough containing various concentrations of some additives before and after freezing

(Sharadanan & Khan, 2003). As shown in Fig (7), the greatest specific volume was found in full fermented unfrozen baked dough containing 2% whey protein followed by that containing 4% glucose syrup and finally that containing 1% whey protein. This is due to the protein hydrophobic surface promoting aggregation of gluten proteins in dough. A strong protein network results in better texture and increase volume as reported by Kamel & Ponte, (1993).

The freezing process has clear influence on the specific volume. This could be explained by that the freezing process affects the gassing power of yeast (El- Hady *et al.*, 1996). So, the high gas volume is necessary to increase the specific volume. The reduction in specific volume was probably due to ice recrystallization causing both losses in yeast activity and reduced ability of the dough gluten network to retain CO_2 during proofing (Ribotta *et al.*, 2001).

From Fig (7), it could be noticed that complete fermentation time for another 1 hr in prefermented dough was necessary to improve the final specific volume of baked frozen dough than those full fermented (2 hrs). The rise in volume during the second fermentation period could be attributed to the increase of the solubility of CO_2 in the dough. Therefore, the dough tends to capture some CO_2 contained in the gas cells that have been developed during fermentation. The addition of whey and xanthan help in this respect. These results coincide with those of Le- Bail *et al.*, (2010). From the present results it could be concluded that the addition of 2% whey proteins to full fermented dough before and after freezing as well as prefermented dough after freezing enhanced specific volume compared to the other treatments. Full and prefermented control dough (without additives) showed the less moisture content either frozen or not. These results are parallel with those of Mandala, (2005).

Sensory evaluation:

The mean values of sensory properties of full and pre-fermented baked dough before and after freezing are given in Table (2). Full fermented baked dough before freezing containing 4%glucose syrup, 2% whey protein and 1%xanthan showed significantly ($P \leq 0.05$) superior quality in most sensory properties than those of the control (without additives) and other dough samples. From the same results, it could be noticed that full fermented frozen baked dough samples containing 4% glucose syrup and 2% whey protein followed by 1% xanthan showed significantly the highest overall acceptability than the other samples.

The results showed that the best food additive which received the highest scores given by panelists for overall acceptability, structure, loaf volume and appearance of prefermented baked frozen dough were that of 1% xanthan, 0.5% xanthan and 2% whey protein.

CONCLUSION

It could be concluded that the prefermentation was necessary to improve the quality characteristics (yeast viability, gassing power, and dough height, moisture content and specific volume) of frozen dough. When the different frozen dough defrosted and allowed to complete fermentation for another 1 hour (prefermentation), the yeast count was greater than the other doughs. This means that the yeast count could be recovered during thawing and the tolerance of yeast to freezing is much better in such conditions and the highest log cfu/g appeared in dough containing 2 and 1% whey proteins, 0.5 and 1 % xanthan. The pre-fermented baked dough after freezing recorded the highest scores in sensory properties compared to full fermented baked dough before and after freezing especially with 2% whey proteins and 1% xanthan. The use of the whey proteins and xanthan at suitable concentration in frozen dough after prefermentation is recommended.

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تأثير نظم التخمير على خصائص جودة العجائن المجمدة المحتوية على بعض المضافات الغذائية

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أجريت هذه الدراسة لبحث تأثير نظم التخمير (التخمير كامل لمدة ساعتين و التخمير المبدئى لمدة ساعة قبل التجميد وساعة أخرى بعد التجميد) على خصائص العجائن الطازجة و المخبوزة المحتوية على بعض المضافات الغذائية (زانثان – بروتينات الشرش- شراب الجلوكوز). تم تقدير لوغاريتم أعداد الخميرة (كدلالة على حيوية الخميرة) للعجائن الطازجة و المجمدة. و ظهرت أعلى قيم لوغاريتمية لأعداد الخميرة في العجائن المحتوية على ١ ، ٢٪ بروتينات الشرش يليها ٠,٥ ، ١٪ زانثان و أخيرا ٤٪ شراب الجلوكوز. كما وجد أن العجائن المحتوية على ٦٪ شراب الجلوكوز تشبه عينة المقارنة (بدون اضافات) من حيث أعداد الخميرة. كما لوحظ أن وقت التخمير المبدئى كان أكثر تأثيرا على زيادة حجم الغاز و كذلك إضافة ١ ، ٢٪ بروتينات الشرش يليها ٠,٥ ، ١٪ زانثان حيث حسنت قوة إنتاج الغاز للخميرة. لوحظ زيادة إرتفاع العجينة بزيادة وقت التخمير. و كانت العجائن المحتوية على تركيزات مختلفة من المضافات الغذائية السابقة أكثر إرتفاعا عن عينة المقارنة خاصة المضاف إليها ٢٪ بروتينات الشرش. أظهرت العجائن المجمدة كاملة التخمير أعلى قيم للمحتوى الرطوبى عن العجائن غير المجمدة. كذلك العجائن المحتوية على الزنثان و بروتينات الشرش كانت أكثر مقدرة على الاحتفاظ بمحتواها الرطوبى ، كانت أعلى قيم للمحتوى الرطوبى للعجائن المجمدة المخبوزة التى تم تخميرها مبدئيا و المحتوية على ٢٪ بروتينات الشرش يليها ١٪ زانثان و ١٪ بروتينات الشرش و كذلك ٠,٥٪ زانثان.

تبين أن التخمير المبدئى لمدة ساعة و إكتمال فترة التخمير لمدة ساعة أخرى كان ضروريا لتحسين الحجم النوعى النهائى للعجائن المجمدة المخبوزة مقارنة بتلك التى تم تخميرها كاملا لمدة (٢ ساعة) قبل التجميد. سجلت العجائن المجمدة المخبوزة و التى تم تخميرها مبدئيا أعلى قيم فى الخصائص الحسية مقارنة بالعجائن المخبوزة و التى تم تخميرها تخميراً كاملاً خاصة تلك المحتوية على ٢٪ بروتينات الشرش و ١٪ زانثان.