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Effect of Edible Coating with Cinnamon Oil on the Quality of Cake

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ABSTRACT

The present study aimed to studying the effect of the edible coating consisting of methylcellulose, starch and glycerol as a carrier of cinnamon oil on rheological properties, shelf life, nutritional value and lipid oxidation of cake at room temperature and at refrigerator during storage. The edible coating solution was added to cake during preparation the formula of cake, or as a coating after baking cake. Total count of bacteria, yeasts and molds were determined. Chemical composition, acid value, peroxide value, specific volume, firmness were evaluated during different periods of storage. Rheological properties of dough genitive edible coating solution containing cinnamon oil were measured by farinograph, extensograph, and visco-amylograph, the results showed that the addition of the edible coating solution led to improved rheological properties of dough. Microbiological analysis showed that the use of the edible coating solution genitive cinnamon oil led to a decrease in total count of bacteria and yeasts compared to the control sample. Chemical analyses of cake showed that addition of edible coating solution with cinnamon oil resulted in retain moisture more than the control samples during storage period. These results showed also fat content affected by the addition method of the edible coating solution. Added edible coating solution containing cinnamon oil to cake led to a decrease in acid value and peroxide value during storage. Addition edible coating solution led to the improvement of the specific volume and firmness of cake at zero time and maintains it during the storage period.

Key words: Edible coating, innamon oil, cake, rheology, Flour, Farinograph, Extensograph, visco-amylograph, microbiology, Total count, Yeast, Mold

Introduction

Environmental concerns about use of non-degradable plastics, consumer demand for high quality and long shelf life products, disadvantage of plastic films and increase awareness of environmental issues are some of the reasons that have promoted the growing interesting developing edible films from biodegradable materials. Biodegradable materials are including proteins, polysaccharides and lipids or their combinations (Mariniello *et al.* 2007).

Edible films and coatings have been particularly considered in food preservation, because of their capability for improving global food quality (Chillo *et al.* 2008). An edible coating or film has been defined as a thin continuous layer of edible material formed or placed on or between foods or food components (Bravin *et al.* 2006). Edible films can act as mechanical protection, moisture and gas barriers and, at the same time, can preserve the color, texture and moisture of the coated product (Sanchéz-Gonzáles *et al.* 2011).

Methylcellulose (MC) is cellulose ether that has excellent film forming properties. Methylcellulose is formed by the alkali treatment of cellulose, followed by the reaction with methyl chloride (Peressini *et al.* 2003). Methylcellulose exhibits thermal gelation and forms excellent films that can be used in pharmaceutical and food industries. It is used as thickener for aqueous and non-aqueous systems, binders and lubricants, and to make clear films with grease resistance or edible film and coating for food products. As an edible film MC can be used as fat and moisture barrier for breading and deep fat frying starch products (Mallikarjunan *et al.* 1997). Starch is a polymeric carbohydrate composed of anhydroglucose units. This is not a uniform material and most starches contain two types of glucose polymers: a linear chain molecule termed amylose and a branched polymer of glucose termed amylopectin (Rodriguez *et al.* 2006). Starches are often used in industrial foods. they have been used to produce biodegradable films to partially or entirely replace plastic polymers because of its low cost and renew ability, and it has good mechanical properties (Xu *et al.* 2005). Glycerol is a plasticizer and is included in the edible coating formulation with the purpose of modifying the mechanical properties of the base edible components (hydrocolloids and/or lipids), producing more flexible coatings (Chillo *et al.* 2008 and Rivero *et al.* 2009). In fact, glycerol by combining with the edible components and interspersing between polymer chains, moving the chains apart and improve the mechanical properties of edible films, such as rigidity and flexibility (Olivas and Barbosa- Canovas, 2005).

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Cinnamon is often used for medicinal purposes due to its unique properties. The essential oil from its bark is rich in trans-cinnamaldehyde with antimicrobial effects against animal and plant pathogens, food poisoning and spoilage bacteria and fungi (Faix *et al.* 2009). The bark and leaves of cinnamon sp are commonly used as spices in home kitchens and their distilled essential oils are used as flavoring agent in the food and beverage industries (Elumalai *et al.* 2011).Matan *et al.* (2006) reported that, antimicrobial activity of cinnamon bark. The volatile gas phase of combinations of cinnamon oil and clove oil showed good potential to inhibit growth of spoilage fungi, yeast and bacteria normally found on IMF (Intermediate Moisture Foods) when combined with a modified atmosphere comprising a high concentration of CO2 (40%) and low concentration of O2 (<0.05%). *A. flavus*, which is known to produce toxins, was found to be the most resistant microorganism.Mathew and Abraham (2006) reported that methanolic extract of cinnamon contains a number of antioxidant compounds which can effectively scavenge reactive oxygen species including superoxide anions and hydroxyl radicals as well as other free radicals under in vitro conditions. Jayaprakasha *et al.* (2007) showed that cinnamon, an under-utilized and unconventional part of the plant, contains a good amount of phenolic antioxidants to counteract the damaging effects of free radicals and may protect against mutagenesis. Mitochondrial dysfunction, oxidation and free radical generation can fasten the aging process.

Cake one of semi-dry foam foods that have air pockets enclosed in a protein and starch network. It is produced from fluid medium batters using rich characterized formulas that have been expanded by gas resulting from chemicals dissolved in the medium. Cake ingredients are soft wheat of cake flour and variable levels of fat, sugar, eggs, milk, baking powders, emulsifiers and other commonly used ingredients such as cocoa powder, nuts, fruits, icings, and certain flavorings are used for specialty cakes (Cauvain & Cyster, 1996 and Cauvain &Young, 2006).

Baking process consist of three different stages. In the initial stage, batter expansion and moisture loss occurs which is followed by further moisture loss and volume rise reaching to a maximum final stage where air pockets are entrapped inside a food matrix (Megahey *et al.* 2005). A good quality cake should have high volume with a fine uniform moist crumb. The cake structure can be set by formation of a protein-starch network in circumstances where the expansion of each bubble dominates over destructive events such as coalescence and disproportionation (Pernell *et al.* 2002).

This study aimed to prepare the edible coating based on polysaccharide with cinnamon oil and effect of addition it on rheological properties, shelf life, nutritional value, lipid oxidation and freshness of cake.

Materials and Methods

Materials

Methylcellulose (MC) was obtained from Un/1823 chemical comp.,Uk; starch and glycerol (po 5650, El-Gomhoria comp., Egypt); ethanol (Eoo5811, 95% ADWIC, comp., Egypt); cinnamon oil obtained from local market at Mansoura city, Egypt.

Wheat flour 72%, fat, sugar, powder milk, eggs, vanilla and baking powder, were obtained from local market at Giza city, Egypt.

Nutrient agar media and potato dextrose agar media were obtained from Beta Company at Mansoura city, Egypt.

Methods

Preparation of edible coating

Edible film-forming dispersions were obtained by dispersion of MC (1.44 g) in 75 mL of distilled water-ethyl alcohol mixture (2/1, v/v) at 75°C for 10 min, and dispersion and gelatinization of corn starch (3.19 g) in 75 mL of water at 95°C for 30 min. It was homogenized at 4000 rpm for 1 min (Model. SHMZ/EVRO serial No. shmz 1046 made in USA v230). Glycerol (1.16 g) was then added to the MC and the dispersion was homogenized at 4000 rpm for 1 min. The components were mixed with a magnetic stirrer (200 rpm). The prepared MC and starch mixed together, homogenized at 4000 rpm, and maintained at 75°C for 10 min during stirring. Cinnamon oil (1.45 ml) was added to the starch-MC-glycerol dispersion, and the mixture was pre dispersed under magnetic stirring for 2 min at 200 rpm and 75°C before being homogenized at 4000 rpm for 2 min (Bravin *et al.* 2006).

Rheological properties of dough

Farinograph parameters and Extensograph parameters were determined according to the method of A.A.C.C. (2002).

Visco Amylograph parameters were determined according to the method of A.A.C.C. (2000).

Preparation of cake

The ingredients of cakes are given according to Lakshminarayan *et al.* (2006) with some modification, such as adding 3g baking powder, 4g powder milk, 1g vanilla and decreased the amount of water from 30 ml to 12 ml. Sugar, eggs and vanilla were creamed in a planetary mixer at medium speed. The required quantities of powder milk and water were transferred to the whipped sugar-oil and blended (5 min) in the hobart mixer at medium speed into a homogeneous mixture. Previously blended flour and baking powder mixture were transferred to the above cream and mixed for 2 min at medium speed. Required quantities of batter were transferred to the aluminum cup and baked at 190 C° for 20 min in an electric oven. After cooling, the cakes packaged in polyethylene bags and stored at room temperature and refrigerator for four weeks. This method used with the first sample which called "cake control (Cc)".

Similar steps were conducted regarding cake mix (Cm) or cake coating (Cd) except the addition of edible coating with cinnamon oil mixed or spreader coating material with cinnamon oil.

Microbial quality and quantity of cake

Total count of bacteria, yeast and mold were determined according to the method of B.A.M. (1998).

Sensory evaluation

The cakes were evaluated sensory as reported by Chen *et al.* (1999).

Gross chemical composition

Moisture, protein, fat and ash were determined according to the method of A.O.A.C. (2002).

The percentage of carbohydrate was calculated by difference as following equation:

Carbohydrate % = 100 – (moisture %+ protein %+ fat %+ ash %).

Effect of storage on lipids extracted from prepared cake

The Acid value (AV), and Peroxide value (PV) were determined according to the methods of A.O.A.C. (2000).

Specific volume of cake

Specific volume of cake was determined according to methods of Chaiya and Pongsawatmanit, (2011).

Texture profile analysis (firmness)

Firmness of cake was determined according to methods of Bourne,(2003).

Statistical analysis

All data were statistically analyzed according to the technique of analysis variance (ANOVA), Duncan's and the least significant difference (L.S.D) method was used to compare the deference between the means of treatment values according to the methods described by Gomez and Gomez, (1984).

Results and Discussion

Rheological properties of dough

Farinograph parameters

At table (1) found that, the flour control absorbed 58% of water, when the flour with edible coating and cinnamon oil absorbed 58.5% of water, These result indicated to increase in absorption of water when added edible coating solution with cinnamon oil, these result due to effect of methylcellulose and glycerol which added at preparation of edible coating, because methylcellulose and glycerol had the ability to increase the absorption of water.Wayne (2009) said that, Hydroxyl groups of hydrocolloids are bound to water molecules through hydrogen bond and increasing water absorption. Guarda *et al.* (2004) found the effect (increased in water absorption) has been attributed to the hydroxyl groups in the humectants structure which allow more water interactions through hydrogen bonding, these results agree with result of current study.Table (1), showed that, flour control and flour with edible coating and cinnamon oil had the same arrival time which equal 0.5 min.Table (1), showed that, DDT (Dough development) in flour control equal 1.5 min, when flour with edible coating and cinnamon oil had dough development less than flour control which equal 1.0 min.

Karimi *et al.* (2013) reported that, Polysorbate 60 and glycerin considerably increased DDT, Ghanbari and Farmani (2013) also reported that, DDT increased with all hydrocolloids, except for carrageenan, these results doesn't agree with result described in this study.At these study value of dough stability for flour control were 0.4 min which indicated to weak dough, when value of dough stability for flour with edible coating and cinnamon oil were 2.0 min. These results indicate to the flour with edible coating and cinnamon oil had the ability barrier to gas which effects on the freshness of the product. Also these results agree with the result of water absorption.Salama *et al.* (2013) said that, Dough stability (min) with the treatments by 0.5%, 0.75% XG (Xanthan Gum) and 0.5% of the GMS (Glycerol Mono Stearate) gained the highest score and showed the obvious difference in dough stability between the applied treatments; while the control treatment represented the lowest score of dough stability, this result agree with current study.Table (1), showed that, the degree of softening of flour control were 70 B.U, when the degree of softening of flour with edible coating and cinnamon oil were 90 B.U, these mean that flour with edible coating an cinnamon oil had the heights degree of softening, these results indicated to the addition of hydrocolloids to flour increase the degree of softening of dough, This result confirms the previous result for dough stability.From these results can conclude that, the products which edible coating with cinnamon oil added to them will have lowest staling and lowest firmness than control products, because the high softening led to produce product with antistaling and low firmness. Dapčević *et al.* (2009) reported that, degree of softening is predominantly influenced, as it was for the dough stability, by the amount and quality of gluten, these result agree with the result at above.

Table 1: Rheology of farinograph parameters

Samples	Water absorption %	Arrival time (min)	Dough development (min)	Dough stability (min)	Degree of softening (B.U)
FC	58.0 [a]	0.5 [b]	1.5 [a]	0.4 [b]	70 [c]
FECC	58.5 [a]	0.5 [b]	1.0 [b]	2.0 [a]	90 [a]

[a], [b] and [c] means in the same column with different superscripts are different significantly (P< 0.05).
(FC): flour control; (FECC): flour with edible coating and cinnamon oil; (min): minute; (B.U): Bran bender unit.

Extensograph parameters

Table (2), showed the effect of edible coating with cinnamon oil on dough elasticity or dough resistance (R), elasticity or resistance of dough from flour control are higher than the elasticity of dough from flour with edible coating and cinnamon oil, because the elasticity of dough from flour control equal 510 B.U, but the dough from flour with edible coating and cinnamon oil equal 380 B.U, Used of edible coating with cinnamon oil in dough caused a decrease in elasticity or resistance (R_{50}) when compared it with dough control.These results confirm the results of softening degree at farinograph parameters.Karimi *et al.* (2013) reported that, the initial resistance to deformation (R_{50}), i.e. at 45 min proofing time, decreased with the addition of humectants, this result is agree with the result of the current study.Ghanbari and Farmani (2013) showed that, application of hydrocolloids in dough formulation caused a significant increase in R_{50} value of dough samples, compared to the control sample, this result doesn't agree with the result of the current study.Table (2), showed the extensibility of dough control and dough from flour with edible coating and cinnamon oil, the dough which made from flour with edible coating and cinnamon oil had a higher value of extensibility 130 mm than dough control which had 105 mm, that means the addition of edible coating with cinnamon oil can increase the extensibility.Salama *et al.* (2013) found that, dough extensibility (mm) was increased in all treatments with either the XG or the GMS as compared to the control sample with the exception of both the treatment with 0.5% XG which was found to be higher (120 mm) than other treatments and treatment with 0.25% XG which was found to have the same value as the control sample (95 mm), this result agree with current study. Pomeranz (1988) reported that, increasing the water content, an increase in extensibility occurs that accompanies a decrease in resistance, these result confirm the result of current study.Table (2), showed the value of P.N for dough with or without any addition, this result indicated to the flour control had higher ratio of P.N equal 4.86 P.N, then the flour with edible coating and cinnamon oil which had 2.92 P.N, this result agree with the result of elasticity or resistance.These results agree with result of Rosell *et al.* (2001) who said that, the overall effect of hydrocolloids resulted in a decreased R50/E, but the analysis through the time showed better stability of the dough containing hydrocolloids.At table (2), found the value of energy for dough which made from flour control is a higher value 85 cm^2, then the value of flour with edible coating and cinnamon oil 67 cm^2, that means the dough which made from flour control has a higher capacity reservation on gas than the dough made from flour with edible coating and cinnamon oil.Karimi *et al.* (2013) found that, the energy or work input (A) necessary for the deformation was reduced by the addition of humectants, with the exception of glycerin. No clear tendency was observed as proofing time increased,

Table 2: Rheology of extensograph parameters

Samples	Elasticity (B.U)	Extensibility (mm)	proportional number (P.N)	Energy (cm^2)
FC	510 [a]	105 [b]	4.86 [a]	85 [a]
FECC	380 [c]	130 [a]	2.92 [c]	67 [c]

[a], [b] and [c] means in the same column with different superscripts are different significantly (P< 0.05).
(FC): flour control; (FECC): flour with edible coating and cinnamon oil; (B.U): Bran bender unit.

this result doesn't agree with the current study.These results agree with result of Rosell *et al.* (2001) who said that, the energy or work input (A) necessary for the deformation was reduced by the addition of hydrocolloids, no clear tendency was observed as resting time increased.

Visco-amylograph parameters

Table (3), showed the result of visco-amylograph which describes effect of edible coating and cinnamon oil on gelatinization of starch, These results showed that the less temperature of transient point is the temperature of flour with edible coating and cinnamon oil 54.0 °C, then the temperature of flour control 58.5 °C, the temperature of transient point refers to the temperature which the starch beginning to swell at it after the absorb of water.After the starch absorbed water, starch beginning to swell, with the continued increase in temperature the starch swell also increase until explode, at this moment the visco-amylograph record max viscosity of starch, at this study the high max viscosity is flour with edible coating and cinnamon oil were 710 B.U at temperature of 79.5 °C which hasd the lowest temperature of transient point, but the value of max viscosity for flour control were 690 B.U at temperature of 85.5 °C, The difference between the max viscosities for samples is little difference, and the results of the temperature of max viscosity confirm the results of the temperature of the transient point.After reaching to the max viscosity the temperature of amylograph decreased to 95 °C the viscosity at these temperature were 510 B.U for flour with edible coating and cinnamon oil which had heights viscosity at these temperature, but viscosity of flour control were 460 B.U at the same temperature, viscosity at this temperature confirm the results of max viscosity.

Temperature of amylograph reduced once more to 50°C, but at this time all samples give the same result, because the viscosity of all samples were 950 B.U, these result suggests that the viscosity increase when the temperature drop, and vice versa.Set-back refers to the effect of additives on starch during the storage period, the setback of flour with edible coating and cinnamon oil were 240 B.U which had the lowest value of setback, but the setback for flour control were 260 B.U, These results showed that there are slight differences between samples which added to it edible coating with cinnamon oil and the control sample, This result confirm the result of degree of softening for farinograph analysis.

These results agree with result of Rojas *et al.* (1999) who concluded that, hydrocolloids decrease the pasting temperature, increase the maximum viscosity, and decrease the tendency to retrograde. Who also said that, all the hydrocolloids affected the maximum viscosity of the wheat flour suspension, also said that, the changes in maximum viscosity of the wheat flour paste due to the presence of hydrocolloids are caused mostly by the existence of interactions between the hydrocolloid and the starch granules. Who also reported that, the presence of 0.5% hydrocolloid concentration on a wheat flour suspension also produced modifications of the setback and the bump area. During the cooling stage the amylose chains diffused outside the starch granules during cooking, retrograde. This phenomenon is responsible of the firming of bread crumb during the first hours after baking. Thus, it is convenient to have the addition of additives and/or ingredients that promote a reduction of the setback, and in consequence, a delay of the firming crumb.

Table 3: Rheology of visco -amylograph parameters

Samples	Transient point °C	Max viscosity B.U	Temp.at max viscosity °C	Viscosity at 95 °C B.C	Viscosity at 50 °C B.N	Set-back B.U
FC	58.5 [a]	690 [ab]	85.5 [a]	460 [b]	950 [a]	260 [a]
FECC	54.0 [b]	710 [a]	79.5 [b]	510 [a]	950 [a]	240 [b]

[a] and [b] means in the same column with different superscripts are different significantly (P< 0.05). (FC): flour control; (FECC): flour with edible coating and cinnamon oil.

Microbial quality and quantity of cake

Table (4 and 5) represent the result of microbiological analysis for cake (cake control, cake mix with edible coating solution genitive cinnamon oil, and cake coating by edible coating solution genitive cinnamon oil) during storage period which had been identified in four weeks that at room temperature and at refrigerator. The results indicated that the samples of cake samples without any addition had a high count of total bacteria, yeasts and molds during the storage period. These results also showed that these samples at end of storage period at room temperature had unaccounted of bacteria and yeasts, Followed it in the count the samples of cake which coating by edible coating and cinnamon oil after baking, the lowest count of total bacteria or yeasts and molds had with samples of cake which mixing with edible coating and cinnamon oil during the preparation process, also showed that the uses of refrigerator during the storage period reduced the count more than those stored at room temperature.From statistical analysis showed that no difference between total count of bacteria for samples at zero time and after one week from storage period, also showed that no difference between the count of yeast and mold for all samples at zero time. This result may be due to the effect of methylcellulose and glycerol and their ability to retain water which decreased the amount of available water.

Also these result due to the effect of cinnamon oil which added to edible coating solution and specifically due to the effect of his main components (cinnamaldehyde, and eugenol) and antibacterial activities for them.

Noorolahi *et al.* (2013) reported that all of the three concentrations of cinnamon (CVEO-0.05, 0.1 and 0.15) showed very well preventing power on aerobic microorganism, yeast and molds. Strong antimicrobial effect in cinnamon essential oil results from the cinnamaldehyde compound. The amount of this compound in essential oil used in the study was 47.25%, the current studies agree with these results.Matan *et al.* (2006) reported the effects of cinnamon oils on different bacterial (*Pediococcus halophilus and Staphylococcus aureus*), fungal (*Aspergillus flavus, Mucor plumbeus, Penicillium roqueforti, and Eurotium sp.*), and yeast species (*Candida lipolytica, Pichia membranaefaciens, Debaryomyces hansenii, and Zygosaccharomyces rouxii*), indicating that cinnamon is a natural antimicrobial agent.These results are in the line with those obtained by Guynot *et al.* (2003) who reported that, the essential oils of cinnamon, bay, clove, thyme, and lemon grass show good antifungal effect on common fungi causing spoilage of bakery products when they were used in wheat flour based agar medium. Nevertheless, these essential oils had antifungal effects in sponge cake just when water activity was kept in low limit, these results agree with result of current study. Quintavalla, and Vicini (2002) reported that, edible films with antimicrobial properties could prolong the shelf life and safety of foods by preventing growth of pathogenic and spoilage microorganisms as a result of their lag-phase extension and/or their growth rate reduction.

Table 4: Microbial quality and quantity of cake storage at room temperature (Cfu/g 10^2)

Date	Parameters	Cc	Cm	Cd	LSD at 5%
Zero time	Total count	0.33 ^{a} ±0.577	0.67 ^{a} ±0.577	0.3 ^{a} ±0.0	N.S
	Yeast & Mold	0.33 ^{a} ±0.577	0.67 ^{a} ±0.577	0.0 ^{a} ±0.0	N.S
After one week	Total count	15.33 ^{a} ±4.163	4.33 ^{b} ±1.528	6.00 ^{b} ±1.732	N.S
	Yeast & Mold	8.33 ^{a} ±3.055	3.33 ^{bc} ±1.528	6.67 ^{ab} ±3.055	3.97
After two week	Total count	36.33 ^{a} ±6.110	13.33 ^{c} ±4.726	13.67 ^{c} ±3.786	6.81
	Yeast & Mold	23.67 ^{a} ±4.163	6.00 ^{bc} ±1.000	8.67 ^{bc} ±0.577	5.60
After three week	Total count	62.67 ^{a} ±7.024	21.67 ^{cd} ±2.517	26.67 ^{c} ±0.577	9.06
	Yeast & Mold	41.33 ^{a} ±5.132	12.67 ^{cd} ±3.786	17.33 ^{c} ±4.933	6.90
After four week	Total count	Unaccounted	32.67 ^{bc} ±3.512	39.00 ^{b} ±6.000	7.69
	Yeast & Mold	Unaccounted	21.00 ^{c} ±4.000	28.67 ^{b} ±2.082	4.09

*[*a], [b] and [c] means in the same row with different superscripts are different significantly (P< 0.05).(Cc): cake control without any addition; (Cm): edible coating was mixed with components of cake; (Cd): cake which coating by edible coating and cinnamon oil.*

Table 5: Microbial quality and quantity of cake storage at refrigerator (Cfu/g 10^2)

Date	Parameters	Cc+	Cm+	Cd+	LSD at 5%
Zero time	Total count	0.33 ^{a} ±0.577	0.67 ^{a} ±0.577	0.3 ^{a} ±0.0	N.S
	Yeast & Mold	0.33 ^{a} ±0.577	0.67 ^{a} ±0.577	0.0 ^{a} ±0.0	N.S
After one week	Total count	7.67 ^{b} ±4.163	2.67 ^{b} ±1.155	4.33 ^{b} ±2.517	N.S
	Yeast & Mold	5.33 ^{abc} ±2.082	2.33 ^{c} ±0.577	3.33 ^{bc} ±2.082	3.97
After two week	Total count	24.33 ^{b} ±2.309	5.33 ^{d} ±2.57	8.67 ^{cd} ±1.528	6.81
	Yeast & Mold	11.33 ^{b} ±6.028	3.67 ^{c} ±1.528	5.67 ^{bc} ±2.517	5.60
After three week	Total count	36.00 ^{b} ±7.000	16.67 ^{d} ±4.041	16.67 ^{d} ±5.859	9.06
	Yeast & Mold	27.33 ^{b} ±3.055	9.00 ^{d} ±2.000	13.00 ^{cd} ±3.464	6.90
After four week	Total count	47.67 ^{a} ±4.041	24.67 ^{d} ±5.508	28.67 ^{cd} ±4.163	7.69
	Yeast & Mold	36.00 ^{a} ±00.646	15.33 ^{d} ±2.082	20.00 ^{c} ±0.000	4.09

*[*a], [b] and [c] means in the same row with different superscripts are different significantly (P< 0.05). (Cc+): cake control without any addition; (Cm+): edible coating was mixed with components of cake; (Cd+): cake which coating by edible coating and cinnamon oil; (+): Use refrigerator.*

Sensory evaluation

Fig. (1 and 2), showed the sensory evaluation of cake, ten of well-trained panelists were asked to evaluate color, odor, texture, taste and overall acceptability for all samples, Through the figure showed that the samples of cake which batter formula of it mixed with edible coating and cinnamon oil had higher scores for all sensory evaluation, followed by cake which coating by edible coating and cinnamon oil as compared with the control samples, It is noted that the control samples which preserved at room temperature was disposed at fourth week as a result of spoilage and they had unaccounted number of bacteria as explained previously in the results of the microbiological analysis, Also the storage in the refrigerator led to retain the sensory properties of cake more than which preserved at room temperature that for all samples. It could be concluded that the increase of storage period led to a decreased in the organoleptic properties of all the samples that's due to the decreased of microbiological, chemical and physical properties of cake during the storage period. Reason for had Cm and Cd samples a high scores in sensory evaluation is due to the effect of methylcellulose and cinnamon and their role to improving the quality of the product, The difference between the scores of sensory evaluation of Cm and Cd due to the method of adding the solution and the amount added from it, whereas Cm samples had a higher percentage of the solution, in addition the solution in Cd samples were found on the outer surface of the product only, but in the Cm samples edible coating mixture with all components, so that it had the best effect.The results of Lotfinia *et al.* (2013) indicated that time effect on the organoleptic properties (smell, taste, color, texture and overall acceptability) of various breads is significant ($P<0.05$) and contrastive effect of cinnamon essential oil concentration during storage is also significant ($P<0.05$), these result agree with current study.Ahmed and Hussein (2012) are reported, On the other hand, significant differences were reported during storage where, odor and flavor of cakes with added extracts scored higher than control. Moreover, cakes prepared with cinnamon extracts showed higher score at all concentrations, these result confirm the result of current study.

It is well known that in complex systems such as cakes, several ingredients interact with each other and affect the sensory properties (Heenan *et al.* 2010). According to a broad range of research findings, edible coatings may be applied to prolong the shelf-life of food products, control material exchange, improve the products' sensory properties, nutritive value and attractiveness (Kokoszka and Lenart 2007), these result also agree with the result of current study.

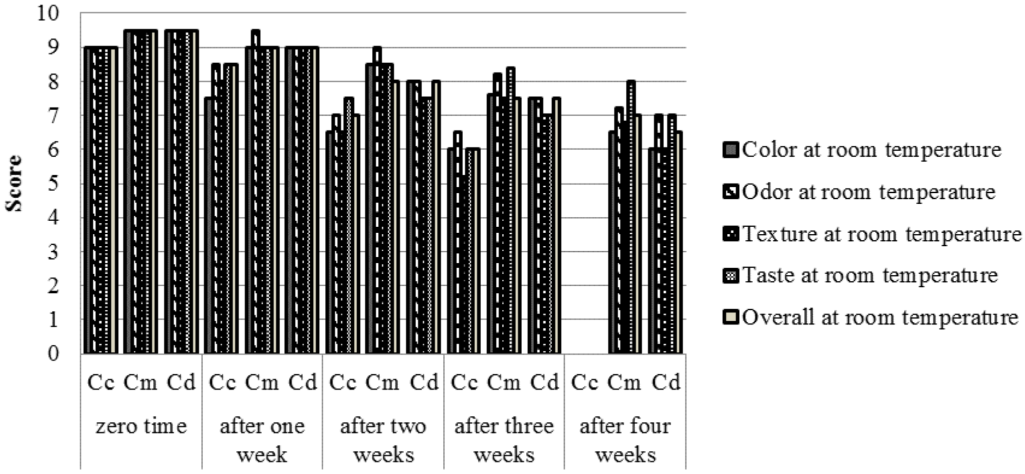

Fig. 1: sensory evaluation of cake stored at room temperature.
(Cc): cake control without any addition; (Cm): edible coating was mixed with components of cake; (Cd): cake which coating by edible coating and cinnamon oil.

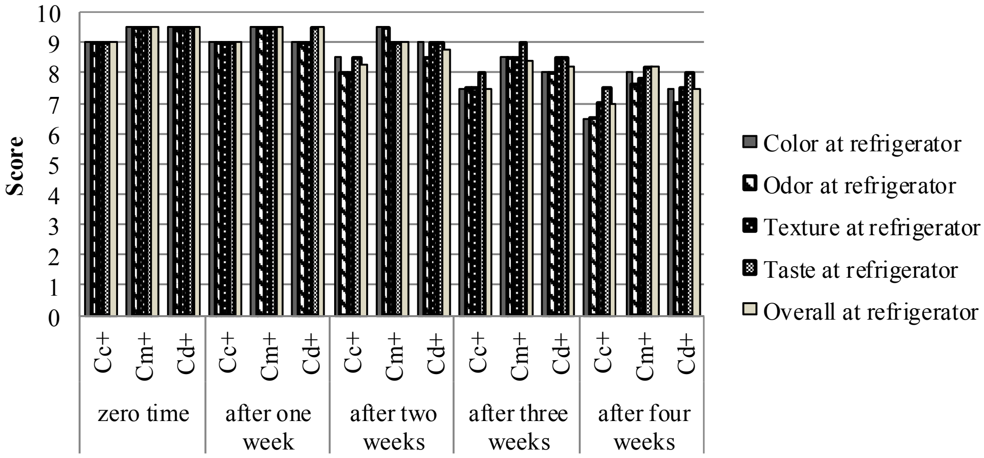

Fig. 2: sensory evaluation of cake stored at refrigerator.
(Cc): cake control without any addition; (Cm): edible coating was mixed with components of cake; (Cd): cake which coating by edible coating and cinnamon oil; (+): Use refrigerator.

Effect of storage at room temperature on chemical composition of cake

Moisture

Fig. (3 and 4) showed the moisture of cake at zero time, mean moisture content of control samples at zero time were 23.33%, while it were 26.81% for the batter cake formula mixed with solution of edible coating and cinnamon oil, the moisture content of cake coating with edible coating and cinnamon oil was 21.69%, from these results showed that, the samples of Cm had a higher mean moisture content followed by samples of Cc, then samples of Cd which have the lowest main content of moisture.Fig. (3) showed the effect of storage at room temperature on moisture of cake during storage period, the moisture content for all samples are decreases during the storage at room temperature, during storage at room temperature the moisture content of control samples decreased to 18.61%, while it decreased to 24.01%, and 18.82% for Cm and Cd respectively.

Fig. (4) showed effect of storage at refrigerator on moisture of cake, the moisture content for all samples were decreased during the storage at refrigerator to 18.2%, 23.67% and 18.41% for Cc+, Cm+ and Cd+ respectively.From this result it is clear that the control samples had the highest percentage of moisture loss (Cc=4.72%) and (Cc+=5.13%), followed by the Cd samples (Cd=2.87%) and (Cd+=3.28%), when the lowest percentage of moisture loss it was in Cm samples (Cm=2.8%) and (Cm+=3.14%), all samples which storage at room temperature had moisture content higher than samples which storage at refrigerator.At zero time the moisture content of Cd samples found to be less than that of Cc samples. This may be due to exposure Cd samples to heat again after baking and coated by edible coating with cinnamon oil. At the end of storage period the moisture content of Cd samples was very close to the moisture content of Cc samples which refer to the capacity of Cd samples to holding water more than Cc samples.Difference between the moisture content of the samples is may be due to the effect of methylcellulose and glycerol which added to samples during preparing or as a coating after baking, methylcellulose and glycerol are hydrocolloids and humectants which had the ability to increase water absorption during the mixing process and holding water or decrease moisture loss after baking and during storage period. Also may be due to the moisture barriers properties of edible coating whereas the addition of glycerol to edible coating based on methylcellulose enhances this property. These results confirm the result of water absorption of farinograph for rheological properties of dough.

The decreased of moisture content during storage period may be effect on physical properties of cake such as volume and texture, also reduction of moisture content effect on sensory evaluation of products.

Protein

Fig. (3 and 4) showed the protein content at zero time, Cc= 6.24%, Cm= 7.18%, and Cd=6.63%, from these results showed that, the samples of Cm had a higher percentage of protein followed by samples of Cd, then samples of Cc which had the lowest percentage of protein. During the storage period the percentage of protein were decreased for all samples that may be due to hydrolysis of peptide bonds.

Fig. (3) showed effect of storage at room temperature on protein of cake after four weeks, the percentage of protein of Cc samples decreased to 4.72% at the end of storage period, meanwhile the percentage of protein for Cm and Cd samples decreased to 5.50% and 5.06% respectively at the end of storage period.Fig. (4) showed effect of storage at refrigerator on protein of cake, the percentage of protein at Cc+ samples decreased to 4.85% at the end of storage period which determined for four weeks, also the percentage of protein for Cm+ samples decreased at the end of storage period to 5.59%, when Cd+ samples decreased to 5.68%.

Cm samples hade high percentage of protein at zero time and during storage period at room temperature or at refrigerator, followed it the Cd samples, that may be due to the effect of edible coating solution with cinnamon oil which delay the spoilage, all Cc samples had the lowest percentage of protein at zero time and during storage period, but the percentage of protein at samples which storage at room temperature was less than the samples which storage at refrigerator, the percentage of protein for all samples decreased during storage period that may be due to the hydrolysis of peptide bonds.

Fat

Fig. (3 and 4) showed the determination of fat at zero time, the percentage of fat at zero time for Cc samples were 26.00%, when percentage of fat for Cm samples were 24.50%, but the samples of Cd had percentage of fat 27.50% at zero time.Fig. (3) showed effect of storage at room temperature on fat of cake, at the opposite trend of moisture and protein the percentage of fat at Cc samples increased at the end of storage period to 27.40%, when samples of Cm the percentage of fat increased during storage period to 25.90%, and the percentage of fat for Cd samples increased during storage period to 28.60%.Fig. (4) showed effect of storage at refrigerator on fat of cake, the percentage of fat at Cc+ samples increased at the end of storage period to 27.50%, but at samples of Cm+ and Cd+ the percentage of fat increased during storage period to 26.30% and 28.90% respectively. These result indicated to that all samples of Cd had the higher percentage of fat, followed by Cc and Cm samples, also indicated to all samples which storage at refrigerator had percentage of fat higher than that storage at room temperature. Indicated also to fat percentage of cake was increased during storage period for all samples. High percentage of fat at Cd samples may be due to the effect of edible coating on lipid migration from product, since edible coating has a property to barrier lipid migration from product during storage period, when low percentage of fat at Cm samples may be due to the effect of methylcellulose on reduced oil uptake, also may be due to the high percentage of moisture at Cm samples at zero time and during the storage period.

Ash

Ash indicate to the amount of minerals which found in the product, at these study fig (3 and 4) showed the percentage of ash at zero time, at zero time the Cd samples had a high percentage of ash which equal 0.365%, and Cc samples had a slightly lower percentage of the ash of the Cd samples whereas percentage of ash for Cc samples equal 0.348%, the Cm samples had the lowest percentage of ash at zero time 0.166%. Fig.(3) showed effect of storage at room temperature on ash of cake, at the end of storage period the percentage of ash increased in Cc samples to 0.682%, at the end of storage period the Cc had the highest value than the other samples, ash in Cd samples increased to 0.582%, when the Cm samples Increased to 0.498% which had the lowest value during the storage period.Fig.(4) showed effect of storage at refrigerator on ash of cake, at the end of storage period the percentage of ash increased in Cc+ samples to 0.657%, Cc samples at the end of storage period had the highest value than the other samples, ash in Cd+ samples increased to 0.539% at the end of storage period, when the Cm+ samples Increased to 0.483 which had the lowest value during the storage period.

At this study the percentage of ash increased during storage period which may be due to the decrease in moisture content during storage period at room temperature or at refrigerator, also these results indicated to the storage at refrigerator decreased ash percentage in the products.

Carbohydrate

Fig. (3 and 4) showed the percentage of carbohydrate at zero time, at zero time the Cc samples had the percentage of carbohydrate 44.08%, when Cm samples had percentage of carbohydrate equal to 41.43%, the percentage of carbohydrate at Cd samples were 43.82% at zero time.Fig. (3) showed effect of storage at room temperature on carbohydrate of cake, at the end of storage period the percentage of carbohydrate increased in Cc samples to 48.59%, when the carbohydrate of Cm samples increased at the end of storage period to 44.09%, the value of carbohydrate at Cd samples increased at the end of storage period to 46.94%.Fig. (4) showed effect of storage at refrigerator on carbohydrate of cake, at the end of storage period the percentage of carbohydrate increased in Cc+ samples to 48.78%, when the Cm+ increased at the end of storage period to 43.96%, the value of carbohydrate at Cd+ samples are increased at the end of storage period to 46.07%.

The percentage of carbohydrate increased during storage period at room temperature and refrigerator, at this study the control samples had the highest value of carbohydrate at zero time and during storage period, when the Cm samples had the lowest value at zero time and during the storage period.Difference between percentage of (protein, fat, ash, and carbohydrate) at cake samples may be due to the difference between moisture percentage for each sample, which due to the effect of method which edible coating added to product by it, also may be due to the method of storage (at room temperature or at refrigerator). These results near from results of Sodchit *et al.* (2013) who found that, chemical composition (moisture, protein, total lipid, ash, fiber and carbohydrate) of control cake were 20.49%, 6.11%, 18.54%, 1.04%, 0.83% and 52.99% respectively.

Olua *et al.* (2014) observed that, the cake samples showed a decrease in crumb moisture content during 5 days of storage. In the cause of storage, the moisture migrates from the crumb toward the crust and evaporates from the surface of the product (Piazza and Masi 1995), these results confirm the results of current study.

On the other hand Salama *et al.* (2013) reported that, results indicated that the additional of either XG or GMS to cake formula led to increase in cake moisture, which was increased from 28.03 to 28.91% as the addition level of XG increased from 0.25 to 0.75%, while the increase of cake moisture was more pronounced by GMS incorporation, where it increased from 29.16 to 31.16% with increasing the addition level of GMS increased from 0.5 to 2.0%, as compared with the control sample (26.11%). The reason of increasing the moisture content in samples containing XG and GMS is related to high capacity of water retention of gums structure as well as amphiphilic property of consumed emulsifiers, these results agree with result of current study.Bhat and Bhat (2013) reported that, the decrease in protein content during storage might be due to hydrolysis of peptide bonds with the help of protease enzyme that cause splitting of protein molecules during storage. Roca *et al.* (2006) said that, increasing the amount of fat in sponge cakes independently of the initial porosity significantly decreased the effective moisture diffusivity, these result confirm the result of current study.Hollingworth, (2010) said that edible film defined as a thin layer, which can be consumed, coated on a food or placed as barrier between the food and the surrounding environment. Hydrocolloids are used to produce edible films on food surfaces and between food components. Such films serve as inhibitors of moisture, gas, aroma and lipid migration. Many gums and derivatives have been used for coating proposes. They include alginate, carrageenan, cellulose and its derivatives, pectin, starch and its derivatives, among others, this result confirm the obtained result. Gray and Be Miller (2003) and Barcenas *et al.* (2004) reported that, hydrocolloids were added to bakery products to extent their shelf-life by keeping the moisture content and retarding the staling, these result agree with result of current study.Kuntz, (1995) found that, retaining moisture leads to lower oil uptake; however, if moisture retention is too high, the cooking process will take longer or the product will be too soft and the quality will be inferior. Armero and Collar, (1996); Rosell *et al.* (2001) and Guarda *et al.* (2004) demonstrated that using of cellulose derivate in bread making improves its quality (loaf volume, moisture content, crumb texture, and their sensorial properties). In addition, this hydrocolloid is a good antistaling agent for retarding the crumb hardening. (Collar *et al.* 1999 and Guarda *et al.* 2004) Its effect should be attributed to their water retention capacity, and a possible inhibition of the amylopectin retrogradation.

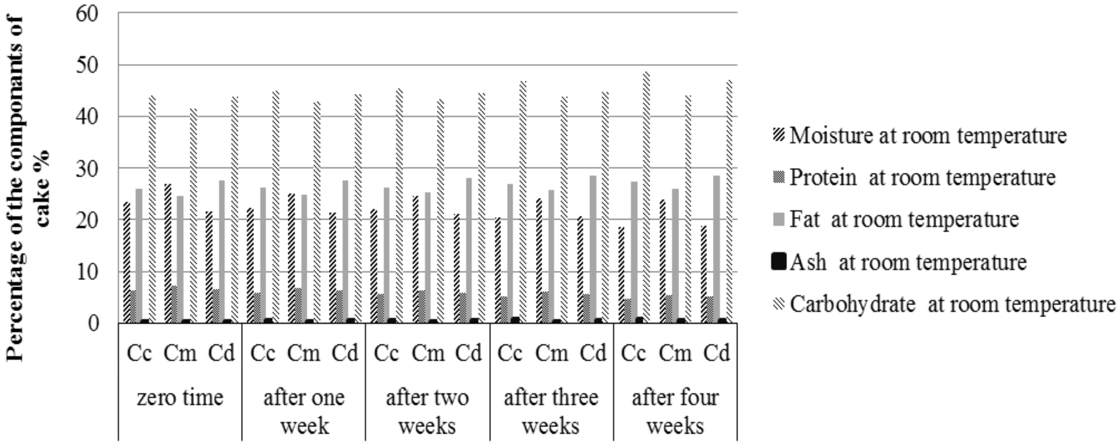

Fig. 3: effect of storage at room temperature on chemical composition of cake.
(Cc): cake control without any addition; (Cm): edible coating was mixed with components of cake; (Cd): cake which coating by edible coating and cinnamon oil.

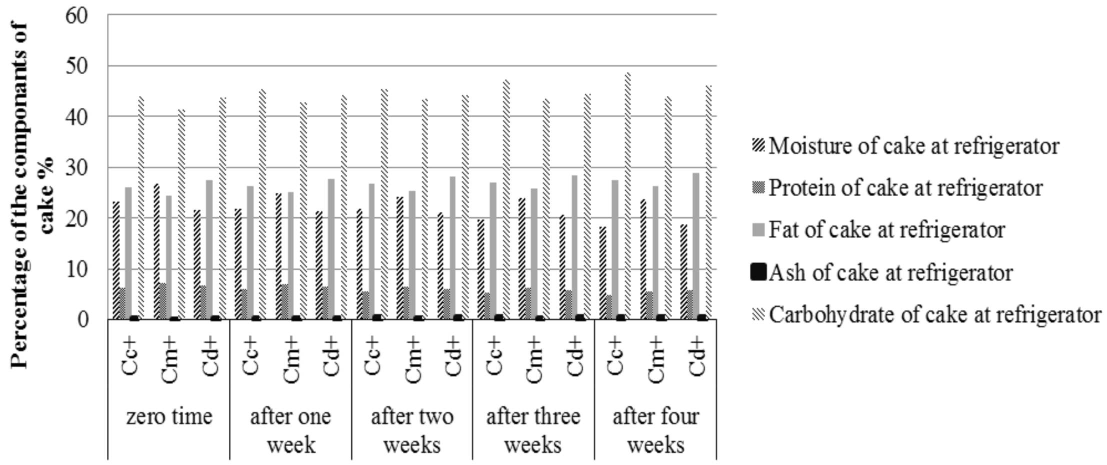

Fig. 4: Effect of storage at refrigerator on chemical composition of cake.
(Cc): cake control without any addition; (Cm): edible coating was mixed with components of cake; (Cd): cake which coating by edible coating and cinnamon oil; (+): Use refrigerator.

Effect of storage on lipids extracted from prepared cake

Acid value

From obtained data at table (6 and 7) found that acid value of Cc samples at zero time were 1.49 mg KOH / gm. oil, while the acid value of samples which treated by edible coating with essential oil during the preparation process or coated by it after baking were 1.33 mg KOH / gm. oil and 1.47 mg KOH / gm. oil for Cm and Cd samples respectively at zero time. Table (6) showed effect of storage at room temperature on acid value of cake, the values of acid value were increased during storage period at room temperature, acid value of Cc samples increased at the end of storage period at room temperature to 3.02 mg KOH / gm. oil, while increased at the end of storage period at room temperature to 1.99 mg KOH / gm. oil for Cm samples, and to 2.31 mg KOH / gm. oil, for Cd samples. Table (7) showed effect of storage at refrigerator on acid value of cake, the values of acid value were increased during storage period at refrigerator, acid value of Cc+ samples increased at the end of storage period at refrigerator to 2.70 mg KOH / gm. oil, while increased at the end of storage period to 1.83 mg KOH / gm. oil, for Cm+ samples, and to 2.24 mg KOH / gm. oil for Cd+ samples. These results indicated to that the values of acid value were increased for all samples during the storage period at room temperature and at refrigerator. From these results it is clear that the control samples had a higher value of acid value at zero time and at the end of the storage period at room temperature and at refrigerator, when samples of Cm had the lowest value at zero time and the end of the storage period.

It also clear from the statistical analysis that no difference between control samples and samples which coated by edible coating with cinnamon oil at zero time, while at the end of the storage period there was a clear difference between them, that may be due to the microbial infection which affects the fat hydrolysis enzymatically

Peroxide value

From data at table (6 and 7) found that peroxide value of Cc samples at zero time were 3.25 meq. Peroxide / Kg oil, and peroxide value of Cm samples at zero time were 2.89 meq. Peroxide / Kg oil, when peroxide value of Cd samples at zero time 3.24 meq. Peroxide / Kg oil, from the statistical analysis showed that no deference between the peroxide value of Cc and Cd at zero time, also they had peroxide value higher than Cm samples.Table (6) showed effect of storage at room temperature on peroxide value of cake, at the end of storage period at room temperature the Cc samples showed the highest value of peroxide than the other samples where it got 6.94 meq. Peroxide / Kg oil, also at the end of storage period Cm samples had the lowest value of peroxide value where it got 3.90 meq. Peroxide / Kg oil, when Cd samples had 4.31 meq. Peroxide / Kg oil, that at the end of storage period at room temperature.Table (7) showed effect of storage at refrigerator on peroxide value of cake, at the end of storage period the Cc+ samples had a higher value of peroxide than the other samples where it got 5.87 meq. Peroxide / Kg oil, also at the end of storage period Cm+ samples had the lowest value of peroxide value where it got 3.63 meq. Peroxide / Kg oil, when Cd+ samples had 3.90 meq. Peroxide / Kg oil, that at the end of storage period at refrigerator.

The results of peroxide value for cake samples indicated to the values of peroxide value increased with increase the storage period which also refers to the changes that happened on lipid during storage period and their negative effect. Table (16 and 17), indicated to the Cm samples and Cd samples have acid value and peroxide value less than the control samples, this may be due to the effect of edible coating solution and cinnamon oil that contains it, since edible coating have oxidation barriers and cinnamon oil contains cinnamaldehyde which have act as antioxidants. Ahmed and Hussein (2012) studied that, changes in the acid value (AV) of control sample and cakes treated with cinnamon and orange extracts at different concentrations during storage for 15 days. The AV of control sample was higher than all treated cake samples at different storage periods and the AV increased gradually during storage periods. For cakes prepared with cinnamon oils the AV of cakes increased from 1.12 mg KOH / gm oil to1.31, from 1.08 to 1.35 and from 1.04 to 1.32 mg KOH / gm oil as well, these result confirm the result of current study. Also found, the peroxide value (PV) increased also steadily during storage; where incorporating oil affected the rate of the PV increase. The lowest PV was reported for cakes prepared with cinnamon oil (2.46 % mequ. Peroxide / Kg oil) compared with the respective initial mean value, also these result confirm the result of current study. Chericoni *et al.* (2005) reported that essential oils and some of the major compounds present in cinnamon, including (E)-cinnamaldehyde, eugenol, and linalool, were investigated in reference to peroxynitrite induced nitration and lipid peroxidation. Eugenol and the essential oils were more effective than the other two compounds. Shan *et al.* (2005) showed that, in a comparative study among 26 spices, cinnamon had the highest antioxidant activity, indicating that it can be applied as an antioxidant used in foods. Erbil and Muftugil, (1986) found that edible films and coatings can improve the appearance of food protect its properties during storage and handling, and extend its shelf life. Edible coatings may be applied to fresh foods to reduce moisture transfer, oxidation and respiration to prolong the shelf life of such foods, these result agree with results of current study.

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Table 6: Effect of storage at room temperature on lipids extracted from prepared cake

Date	Parameters	Cc	Cm	Cd	LSD at 5%
Zero time	Acid value	$1.49^{a} \pm 0.015$	$1.33^{b} \pm 0.027$	$1.47^{a} \pm 0.015$	0.04
	Peroxide value	$3.25^{a} \pm 0.033$	$2.89^{b} \pm 0.058$	$3.24^{a} \pm 0.032$	0.09
After one week	Acid value	$2.00^{a} \pm 0.020$	$1.55^{d} \pm 0.016$	$1.71^{b} \pm 0.017$	0.05
	Peroxide value	$4.19^{a} \pm 0.042$	$3.10^{d} \pm 0.031$	$3.42^{c} \pm 0.034$	0.10
After two week	Acid value	$2.30^{a} \pm 0.032$	$1.68^{e} \pm 0.017$	$1.88^{c} \pm 0.019$	0.05
	Peroxide value	$5.07^{a} \pm 0.051$	$3.34^{e} \pm 0.033$	$3.79^{c} \pm 0.038$	0.11
After three week	Acid value	$2.67^{a} \pm 0.027$	$1.87^{e} \pm 0.019$	$2.07^{c} \pm 0.021$	0.06
	Peroxide value	$5.72^{a} \pm 0..057$	$3.74^{d} \pm 0.037$	$4.08^{c} \pm 0.041$	0.12
After four week	Acid value	$3.02^{a} \pm 0.030$	$1.99^{e} \pm 0.020$	$2.31^{c} \pm 0.023$	0.07
	Peroxide value	$6.94^{a} \pm 0.064$	$3.90^{d} \pm 0.040$	$4.31^{c} \pm 0.043$	0.13

*[*a], [b] and [c] means in the same row with different superscripts are different significantly (P< 0.05).(Cc): cake control without any addition; (Cm): edible coating was mixed with components of cake; (Cd): cake which coating by edible coating and cinnamon oil.*

Table 7: Effect of storage at refrigerator on lipids extracted from prepared cake

Date	Parameters	Cc+	Cm+	Cd+	LSD at 5%
Zero time	Acid value	$1.49^{a} \pm 0.015$	$1.33^{b} \pm 0.027$	$1.47^{a} \pm 0.015$	0.04
	Peroxide value	$3.25^{a} \pm 0.033$	$2.89^{b} \pm 0.058$	$3.24^{a} \pm 0.032$	0.09
After one week	Acid value	$1.73^{b} \pm 0.035$	$1.47^{e} \pm 0.029$	$1.64^{c} \pm 0.033$	0.05
	Peroxide value	$3.85^{b} \pm 0.077$	$3.06^{d} \pm 0.061$	$3.36^{c} \pm 0.067$	0.10
After two week	Acid value	$2.03^{b} \pm 0.041$	$1.58^{f} \pm 0.032$	$1.81^{d} \pm 0.036$	0.05
	Peroxide value	$4.65^{b} \pm 0.093$	$3.20^{f} \pm 0.064$	$3.63^{d} \pm 0.073$	0.11
After three week	Acid value	$2.32^{b} \pm 0.046$	$1.72^{f} \pm 0.034$	$1.97^{d} \pm 0.039$	0.06
	Peroxide value	$5.51^{b} \pm 0.110$	$3.46^{e} \pm 0.069$	$3.79^{d} \pm 0.076$	0.12
After four week	Acid value	$2.70^{b} \pm 0.054$	$1.83^{f} \pm 0.037$	$2.24^{d} \pm 0.045$	0.07
	Peroxide value	$5.87^{b} \pm 0.117$	$3.63^{e} \pm 0.073$	$3.90^{d} \pm 0.078$	0.13

*[*a], [b] and [c] means in the same row with different superscripts are different significantly (P< 0.05).(Cc): cake control without any addition; (Cm): edible coating was mixed with components of cake;(Cd): cake which coating by edible coating and cinnamon oil; (+): Use refrigerator.*

Effect of storage condition on specific volume of cake

Table (8 and 9) showed the specific volume of cake samples at zero time and during the storage period, at zero time Cc samples had the lowest specific volume 2.33 cm^2/g, but Cm samples had a higher specific volume 2.50 cm^2/g, followed by Cd samples 2.38 cm^2/g.Table (8) showed the effect of storage at room temperature on specific volume of cake, at last week of storage period at room temperature Cc samples was eliminated as a result of spoilage, after three week of storage at room temperature specific volume of Cc samples decreased to 2.27 cm^2/g, when specific volume of Cm and Cd samples decreased at the end of storage period to 2.45 cm^2/g and 2.33 cm^2/g respectively.Table (9) showed the effect of storage at refrigerator on specific volume of cake, specific volume of Cc+ samples storage at refrigerator decreased to 2.24 cm^2/g at the end of storage period, also Cm+ and Cd+decreased at the end of storage period at refrigerator to 2.41 cm^2/g, and 2.33 cm^2/g respectively.During the storage period the specific volume for all samples were decreased that may be due to the effect of moisture and gas loss, which lead to shrinkage of cake as a result of starch retrogradation.

At the end of storage period Cm samples had a heights specific volume followed by Cd samples, when Cc samples had the lowest value. Samples storage at room temperature had specific volume higher than samples storage at refrigerator, the high value of specific volume for Cm and Cd samples at zero time and during storage may be due to the effect of methylcellulose which edible coating solution contains it and its ability to prevent the gas, also may be due to the effect of high moisture content.Ahmed and Hussein (2012) showed that increasing storage periods associated with decreasing in cake volume and weight. This result could be due to loss of water and air contents in stored cake, this result confirm the result of current study.Tavakolipour and Kalbasi-Ashtari (2006) said that usually the addition of hydrocolloids to dough improves its stability and quality criteria such as increased water absorption, specific loaf volume and the viscoelastic properties, these result agree with the result of current study.On another hand (Armero and Collar, 1996; Rosell *et al.* 2001 and Guarda *et al.* 2004) said that demonstrated of this cellulose derivative in breadmaking improves its quality (loaf volume, moisture content, crumb texture, and their sensorial properties). In addition, this hydrocolloid is a good antistaling agent for retarding the crumb hardening.

Table 8: Effect of storage at room temperature on specific volume of cake

Date	Cc	Cm	Cd	LSD at 5%
Zero time	$2.33^{c} \pm 0.023$	$2.50^{a} \pm 0.050$	$2.38^{b} \pm 0.024$	0.06
After one week	$2.30^{cd} \pm 0.023$	$2.49^{a} \pm 0.025$	$2.37^{b} \pm 0.024$	0.07
After two week	$2.28^{c} \pm 0.023$	$2.48^{a} \pm 0.025$	$2.36^{b} \pm 0.024$	0.07
After three week	$2.27^{c} \pm 0.023$	$2.47^{a} \pm 0.025$	$2.35^{b} \pm 0.023$	0.07
After four week	-	$2.45^{a} \pm 0.025$	$2.33^{b} \pm 0.023$	0.06

*[*a], [b] and [c] means in the same row with different superscripts are different significantly (P< 0.05).(Cc): cake control without any addition; (Cm): edible coating was mixed with components of cake; (Cd): cake which coating by edible coating and cinnamon oil.*

Table 9: Effect of storage at refrigerator on specific volume of cake

Date	Cc+	Cm+	Cd+	LSD at 5%
Zero time	2.33 ^{c} ±0.023	2.50 ^{a} ±0.050	2.38 ^{b} ±0.024	0.06
After one week	2.28 ^{d} ±0.046	2.46 ^{a} ±0.049	2.35 ^{bc} ±0.047	0.07
After two week	2.26 ^{c} ±0.045	2.44 ^{a} ±0.049	2.32 ^{bc} ±0.046	0.07
After three week	2.26 ^{c} ±0.045	2.42 ^{a} ±0.048	2.31 ^{bc} ±0.046	0.07
After four week	2.24 ^{c} ±0.045	2.41 ^{a} ±0.048	2.28 ^{bc} ±0.046	0.06

^{*a}, ^{b} and ^{c} means in the same row with different superscripts are different significantly (P< 0.05).(Cc): cake control without any addition; (Cm): edible coating was mixed with components of cake; (Cd): cake which coating by edible coating and cinnamon oil; (+): Use refrigerator.

Effect of storage condition on texture profile analysis (firmness) of cake

Table (10 and 11), showed hardness or firmness values of cake samples, from these values can observed that the values of firmness of cake samples were 1.88 N, 1.77 N, and 1.92 N for Cc, Cm, and Cd samples respectively, from these data and its statistical analysis can observed also that no difference between value of Cc and Cd samples at zero time, when Cm samples had the lowest value of firmness which may be due to the high moisture content and high specific volume of it.Table (10) indicated to effect of storage at room temperature on firmness of cake, after three weeks Cc samples had value of firmness equal 2.67 N at room temperature, but after four weeks it was eliminated as a result of spoilage, at the end of storage period at room temperature firmness value of Cm and Cd samples increased to 2.45 N and 2.70 N.

Table (11) showed the effect of storage at refrigerator on firmness of cake, at the end of storage period at refrigerator firmness value for Cc+, Cm+ and Cd+ samples increased to 2.96 N, 2.60 N and 2.77 N respectively.

From previous data showed that, the firmness increased with increased of storage period for all samples that may be due to the staling properties which occur on bakery products during storage. Also can showed that, Cc samples had a high value of firmness during storage period followed by Cd samples, then Cm samples which had the lowest value of firmness at zero time and during the storage period, the samples which stored at refrigerator had firmness value higher than samples which stored at room temperature, that difference in firmness value may be due to the difference between moisture content, specific volume, difference of fat content of samples and effect of edible coating solution which added during preparation process or as a coating after baking.Volume expansion has negative relationship with firmness. Larger volume expansion resulted in lower firmness of cake, this had been reported by Sani *et al.* (2014), and this result confirms the result of current study.Garcia *et al.* (2002) reported that texture analysis was performed on hardness property of doughnut cake. These profiles showed that texture attributes related with total fat content. Uncoated sample had higher hardness values than coated samples. These differences of hardness occurred due to the differences of water retention and oil uptake, which depended on lower values of moisture loss and oil absorption than that of uncoated sample, these result confirm the result of current study. According to Quaglia, (1991), the hydrocolloid methylcellulose has the function of increasing the water absorption and improving the consistency of bread crumb of low gluten content.

Table 10: Effect of storage at room temperature on texture profile analysis (firmness) of cake

Date	Cc	Cm	Cd	LSD at 5%
Zero time	1.88 ^{a} ±0.019	1.77 ^{b} ±0.035	1.92 ^{a} ±0.019	0.05
After one week	2.01 ^{cd} ±0.020	2.00 ^{d} ±0.020	2.06 ^{bc} ±0.021	0.06
After two week	2.29 ^{b} ±0.023	2.11 ^{c} ±0.021	2.16 ^{c} ±0.022	0.07
After three week	2.67 ^{b} ±0.027	2.31 ^{d} ±0.023	2.44 ^{c} ±0.024	0.07
After four week	-	2.45 ^{d} ±0.025	2.70 ^{b} ±0.027	0.07

^{*a}, ^{b} and ^{c} means in the same row with different superscripts are different significantly (P< 0.05).(Cc): cake control without any addition; (Cm): edible coating was mixed with components of cake; (Cd): cake which coating by edible coating and cinnamon oil.

Table 11: Effect of storage at refrigerator on texture profile analysis (firmness) of cake:-

Date	Cc+	Cm+	Cd+	LSD at 5%
Zero time	1.88 ^{a} ±0.019	1.77 ^{b} ±0.035	1.92 ^{a} ±0.019	0.05
After one week	2.26 ^{a} ±0.045	2.06 ^{bc} ±0.041	2.11 ^{b} ±0.042	0.06
After two week	2.55 ^{a} ±0.051	2.35 ^{b} ±0.047	2.50 ^{a} ±0.050	0.07
After three week	2.77 ^{a} ±0.055	2.48 ^{c} ±0.050	2.65 ^{b} ±0.053	0.07
After four week	2.96 ^{a} ±0.059	2.60 ^{c} ±0.052	2.77 ^{b} ±0.055	0.07

^{*a}, ^{b} and ^{c} means in the same row with different superscripts are different significantly (P< 0.05). (Cc): cake control without any addition; m): edible coating was mixed with components of cake; (Cd): cake which coating by edible coating and cinnamon oil; (+): Use refrigerator.

Conclusion

From the results obtained, it could be underline the beneficial effect of using edible coating based on polysaccharide with cinnamon oil can added to cake during preparation process or as a spreaded material after baking. It is improved rheological properties of dough, antibacterial and antioxidant, which delays spoilage of cake, increased specific volume and decreased the firmness of cake which indicated to the freshness of cake.

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