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Effect of microencapsulated date pit (*Phoenix dactylifera* L.) extract on staling and organoleptic properties of Baguette bread

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ABSTRACT

In general, various physicochemical changes can occur in bread in post-baking conditions, known as staleness. Certain additives and improvers are seemingly practical for retarding the staleness of bread. Therefore, the present study investigates the effect of different concentrations (50% and 40%) of date pit microencapsulated with the fluidized-bed method and using maltodextrin, mangosteen gum, and MCT oil (Medium Chain Triglyceride) as coating materials added in the formulation of Baguette bread on staleness and organoleptic properties of the bread. According to the results, bread samples with 1% nanocapsules containing 40% concentration of date pit extract showed the highest moisture (38.41%), highest volume (284.21 cm3), minimum staleness in periods of 24, 48, and 72 h after baking, lowest changes in the temperature of bread center (20 to 132 ℃), and the most desirable organoleptic properties (α=1%). However, the highest phenolic content (231.12 mg GAE/µl) was measured in bread samples with 3% nanocapsules containing a 50% concentration of date pit extract (α=1%).

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1- Introduction

Bread is the main and basic food of the people of many countries of the world and provides a large part of daily energy, protein, mineral salts and group vitamins.B It provides their needs]1 and 2[. According to their size, breads are divided into three groups: bulky, medium and small breads. Bulky breads have many variations due to the variety in shape, size, skin, core texture, processing method and formulation. The quality of bulky breads depends on the baking ability of the flour used, the fermentation time, the amount of protein and the type of additives. In addition, its baking ability is mainly dependent on the characteristics of the flour, the type of industrial measures, the preparation method and the preparation steps of the dough.

Baguette bread is a type of bulky bread that has a favorable nutritional position among bakery products due to its high baking quality, suitable formulation, product variety, complete fermentation and proper shelf life.]3[.

Bread and bakery products usually undergo various physical and chemical changes after the baking process, which are generally called stale. Delaying staleness is one of the important issues of the baking industry and is important from an economic point of view. In addition, staleness is a process during which the external and internal characteristics, smell, taste, aroma, and chewability of bread change, and the result of these changes is the aging or, in other words, the lack of freshness of bread. Many researchers have attributed the main cause of bread staleness to starch retrogradation. During retrogradation, starch changes and changes from a gel-like and soluble form to a crystalline structure. Therefore, any factor that can reduce the retrogradation of starch will reduce the staleness of bread]4 and 5[.

To delay the staleness of bread, it is very effective to apply methods such as improving dough preparation methods, improving baking quality, bread packaging and using some additives. Important additives include gelatinous starches, pentosans, fats, emulsifiers, enzymes, especially alpha-amylase, antioxidants and some hydrocolloids. In this regard, various researches have been conducted in connection with the effect of antioxidant compounds on starch retrogradation.]6[. But the main limitations of using extracts and essential oils with antimicrobial and antioxidant properties in food products are the instability of these compounds against adverse environmental conditions such as high temperature, light and oxygen. Also, the rate of release of these compounds is considered to be one of the main challenges in their effectiveness.7 and 8[. In this regard, various strategies such as encapsulation have been proposed to deal with these problems.

Encapsulation or microencapsulation includes covering or enclosing a wide range of compounds used in the food industry, such as acids, alkalis, buffers, essential oils, flavorings, oils, regenerators (bleaching agents and agents), enzymes, microorganisms, substances Minerals and materials with an inappropriate taste inside a secondary material (shell or wall) to prevent or delay the release of the beneficial material until a specific time and place or to achieve a set of suitable conditions. Therefore, their properties are preserved against environmental factors such as oxygen, heat, chemical and biological factors during the food storage period.]9[. The size and shape of the produced capsule depends on the materials and methods used to produce them. The capsule wall may be monomer, polymer or mixed. The capsule cover may be one or more layers and the shelf life of the capsule center materials depends on their chemical

activity, solubility, polarity and volatility.]10[. In fact, this technique provides a barrier between the sensitive bioactive substances and the environment to ensure the biological availability of the substances at the right time and place. Further, the encapsulated components under conditions such as changespH, shear stress, temperature, enzyme activity, time and osmotic pressure release their contents. Fluidized bed coating is an efficient method in the microcoating process. In this method, solid particles are suspended in the environment of the device with the help of an air stream that has a specific temperature and humidity. Then the nozzle sprays the hot covering material in the environment of the device. Further, with the passage of time and after cooling, a thin coating is formed on the surface of suspended particles]11[. In this technology, the selection of covering materials is particularly important. The materials used in the capsule coating should have high emulsifying ability and low viscosity in high concentrations and also have the ability to easily release the core material at the right time. In the process of encapsulating phenolic materials with spray dryer and fluid bed method, the use of polysaccharides is more common than proteins. Low viscosity, solubility, emulsification and good storage ability of volatile compounds are some of the reasons that make polysaccharides attractive for the encapsulation process. Therefore, in the present study, the combination of three substances maltodextrin, mangrove gum and oilMCT (as a water-repellent layer) has been used to cover the date kernel extract]12 and 13[.

dates with scientific name (*Phoneix dactylifera* L.) from familyPalmaceae It is a stone fruit. Date kernel is about 20% of the whole fruit and according to the type of variety and its quality, it constitutes 16-20% of the total weight of the fruit. It is also rich in protein (5.8 g/100 g), fat (0.9 g/100 g), nutritional fibers (1.73 g/100 g), phenolics (3942 mg/100 g), and antioxidants (400 80 micromol/100 grams). Phenolic compounds in ripe dates constitute about 3% of dry weight. These compounds, having antioxidant and antiradical properties, can play an important role in the shelf life of food products and maintaining human health.14[. According to the investigations, in the use of by-products of agricultural production, until now, no acceptable attention has been paid to the waste of date fruit such as its kernel, which is a rich source of phenolic compounds. Now, since extracts containing phenolic compounds, as natural antioxidants, can play an essential role in reducing the staleness of bakery products, therefore, in this research, the effect of microcoated date kernel extract using the fluid bed method on the staleness and organoleptic properties of baguette bread was investigated.

2- materials and methods

2-1- Preparation of samples

Date kernels of the Estamaran variety (sayer dates)[1] Produced from Parsian Date Chocolate Company, Ahvaz, Khuzestan Province, and after washing, in a pot under vacuum conditions and at a temperature of 70 degrees Celsius until the moisture content is 5%, dry and using an industrial mill (model SG-500 Swantech, made in Germany)) were milled. The resulting powder was passed through a sieve with a diameter of 710 microns (mesh 25) and stored in polyethylene bags.Maltodextrin (20= OF), mangosteen gum, oilMCT, microcrystalline cellulose (Avicel ph-20)، All reagents and standards are from Sigma[2], chemicals and solvents from Merck[3] were purchased To extract the extract, use a two-component solvent of water 25: ethanol 75

[1]-Sayer date or Estameran date

[2] -Sigma aldrich

[3]- Merck

percentage and according to Jayaprakasha method[4], used with slight modifications]15[. 10 grams of powder inside Erlenmeyer[5] containing 100 ml of the desired solvents was poured and in the shaker incubator[6] And it was stirred at a temperature of 25 degrees Celsius, at a speed of 280 rpm and for 5 hours. In continuation of the content of Erlen using the Buchner funnel[7] and Whatman filter paper[8] Number 4 was filtered. Extracts obtained by vacuum rotary evaporator (FINGER-RV05, Germany) at a temperature of 40 degrees Celsius and at 200 degrees per minute, concentration and finally by a freeze dryer (Operun-FDB550, South Korea) and dried at -50 degrees Celsius and turned into powder. The powders were poured into polyethylene containers impermeable to air and moisture and stored in a home freezer until the beginning of the experiments.

2-2- Extract microcoating by fluid bed drying method

Microcoating of extracts using coating materials including maltodextrin (first coating), mangrove gum (second coating) and oilMCT (Third coating) was done at a temperature of 45 degrees Celsius and a fluid bed drying system. 5 grams of microcrystalline cellulose powder[9] (Avicel ph-20) (neutral carrier) was poured into the bottom of the fluid bed, then, in order to produce non-agglomerated granules, 5 ml of input solution containing date kernel extract (with concentrations of 40 and 50%) and distilled water (with a concentration of 20% by weight/volume), with a flow 0.25 ml/min, which were floated by the air stream with a pressure of 150 mbar and a temperature of 45 degrees Celsius, were sprayed. For the first coating, first 5 grams of maltodextrin with (20= OF) and distilled water with a concentration of 10% (weight/volume) was prepared and sprayed by a pump with a pressure of 300 mbar, at a temperature of 45 degrees Celsius, with a flow rate of 0.25 ml/min on the granules of the previous step, which were floated with a pressure of 150 mbar . For the second coating, a solution of Manjabin gum with Brix grade[10] 12 and it was prepared at a concentration of 20% and was sprayed with a pressure of 300 millibars and a flow rate of 0.25 ml/min on the granules of the previous step, which were floated at a pressure of 100 millibars and a temperature of 45 degrees Celsius. Next, in order to prevent the dissolution of the capsule, a layer of hydrophobic oilMCT It was sprayed on the capsules with a concentration of 15%.

2-3- Preparation of samples (preparation of bread)

First, chemical tests including humidity (AACC, No. 44-16), ash (AACC, to number 01-08), protein (AACC, No. 18-46), fat (AACCNo. 30-10), fiber (AACCNo. 32-10), wet gluten (AACC, A12-38) andpH (AACC, No. 52-2) were performed on wheat flour samples]16[. Then, based on the formulation of bulk breads, raw materials include 1.5% baker's yeast, 1.5% salt and sugar, 0.7% improving powder, microcoated samples (1% and 3%) (extract coated with maltodextrin, gum Mangosteen and oil hydrophobic layerMCT) and 500 grams of flour were mixed together and after adding water, they were mixed for 3 minutes in Pars Khazar model household mixer at medium speed (No. 2). Primary fermentation was done in relative humidity of 80% and temperature of 30 degrees Celsius for 30 minutes. Next, divide the obtained dough into 50 grams chins and into small molds of 35 grams.×40×80 mm whose walls were greased were placed. Also, the final fermentation was done for 40 minutes at a temperature of 30

[4] Jayaprakash
[5] Erlenmeyer
[6] Incubator with shaker
[7] Büchner funnel
[8] Whatman filter paper
[9] Microcrystalline cellulose (MCC)
[10] Brix

degrees Celsius and a relative humidity of 80%. It is noteworthy that the baking temperature of bulky bread in the industry is higher than 200 degrees Celsius (250– 230 degrees Celsius). Considering the effect of low temperature and long heating time in preventing the degradation of phenolic compounds, in this research, we tried to use low temperature as much as possible in baking bread. After checking several baking temperatures and times, with the aim of maintaining the quality of the bread and also checking the studies, finally the temperature of 180 degrees Celsius for 20 minutes and the relative humidity of 60-70% was selected for baking.]2[. After baking, the breads were removed from the mold and cooled at room temperature for half an hour, and after measuring the weight and volume, they were packed in polyethylene bags and stored at room temperature. In the following, the research treatments are presented in Table 1.

Table1. Research treatment

Treatments	Codes
1% of microencapsulated samples with 40% concentration of extract	At 40%-1%
3% of microencapsulated samples with 40% concentration of extract	At 40%-3%
1% of microencapsulated samples with 50% concentration of extract	At 50%-1%
3% of microencapsulated samples with 50% concentration of extract	At 50%-3%
Control (no microencapsulated samples)	C

2-4- Tests performed on bread samples

2-4-1- Measurement of humidity

Moisture content of bread samples according to the standard methodAACC (44-16) and was determined by the method of ionization]16[.

2-4-2- Measuring the volume of bread

To measure the volume of baguette bread samples using the volume replacement method with rapeseed (Henry Simon's method) according to the standardAACC No. 05-10 was used]16[.

2-4-3- Measurement of phenolic compounds

2-4-3-1- Extraction of bread extract

The desired samples by thicknesscm10 cut and kept for 24 hours in a pot with temperatureC°40 were dried. Then, the samples are used with the help of a laboratory mill (modelA11 made in Germany) were milled and passed through a sieve with 80 mesh until bread powder was obtained. 80% methanol was used for extraction. In this way, 10 ml of solvent was used for 1 gram of sample. Then the resulting solution for 2 hours by the shaker at speedRPM50 was stirred. Finally, using a centrifuge (speedg2600 for 15 minutes) the extracts of the samples were extracted and stored in test tubes at refrigerator temperature.]17[.

2-4-3-2- Measurement of phenolic compounds of the extract

Amount of phenolic compounds by Folin Ciocalto method(Folin-Ciocalteu) It was measured. 20 microliters of the extract solution was mixed with 1.16 milliliters of distilled water and 100 microliters of Folin Ciocalto reagent. After 8 minutes, 300 microliters of 20% sodium carbonate solution was added to it. After shaking the test tubes in a water bath with temperatureC°40 were placed and after 30 minutes, their absorbance was read with a spectrophotometer at a wavelength of 760 nm. In order to draw the calibration curve, first a basic solution of gallic acid with a concentration of 100 mg/ml was prepared. In the following, after performing all the above steps with different concentrations of gallic acid instead of the extract, the absorption curve was drawn

against different concentrations of gallic acid and its equation was determined. According to the obtained equation and putting the absorption value of each sample in the equation, the total amount of phenol in the extract is determined and according tomg of gallic acid per microliter of extract was presented]18[.

2-4-4- Measurement of color changes

In order to perform the colorimetry test, bread samples with thicknesscm 3 were cut, placed in the Hunter Lab device, and then the components L^*، a^* Andb^* were read ComponentL^* It is equivalent to the brightness of the sample image, where 0 is equivalent to black and 100 is equivalent to full light reflection. Positive valuesa^* It is equivalent to red color and its negative values are equivalent to green color and on the other hand positive valuesb^* It is equivalent to yellow color and its negative values are equivalent to blue color.In the following, the total color difference (ΔE) was calculated using equation (1)]19[.

$$\Delta E = \sqrt{(L - L_o)^2 + (a - a_o)^2 + (b - b_o)^2} \quad (1)$$

In this regard:b_0* ، a_0* ، L_0* The initial values of these parameters are

2-4-5- Measurement of temperature changes in the center of the bread

The tip of the needle thermometer probe was placed in the center of the chin before baking, and the temperature changes of the dough during the baking process (temperature of 180 degrees Celsius for 20 minutes) were recorded in three repetitions.]20[.

2-4-6- Sterility test of baguette bread samples

To evaluate the staleness of baguette bread samples using a device method (according to the international standardAACC to number 74-09), from the Instran device (Testometric M350-10CT Made in England) equipped with a 5 Newton load cell and a plate probe was used. This test was performed at time intervals of 24, 48 and 72 hours after baking the samples. To perform the test, from the brain part of the samples, cuts to dimensionscm 2x2 was prepared. The force values (the force that the upper jaw of the device must apply to the sample) were considered to be 20% of the thickness of the bread samples so that the samplemm 8 to be compressed. Also, the speed of the moving jaw$\frac{mm}{min}$30 was considered]16[.

2-4-7- Sensory evaluation

In order to evaluate the sensory characteristics of baguette bread samples, from the analysis of bread characteristics (Including form and shape, upper surface characteristics, lower surface characteristics, porosity and porosity, firmness and softness of texture, chewability, taste and taste), with the help of five senses, 10 trained evaluators were used according to the 5-point hedonic method.Attribute evaluation coefficients were considered from 1 (very bad) to 5 (very good).]2[.

5-2- Data analysis

In order to analyze the data, a completely random design was used in three replications, and the averages were compared by Duncan's multiple range test at the level of probability.α=1% And using softwareSPSS Version 14 is done.

3- Results and discussion

3-1- Evaluation of moisture content of bread samples

According to Figure 1, the effect of different treatments on the moisture content of bread samples is significant (P<0.01). In this regard, the highest amount of moisture (38.41%) in the sampleAt 40%-1% and its lowest amount (27.86%) in the sampleAt 50%-3% seen.

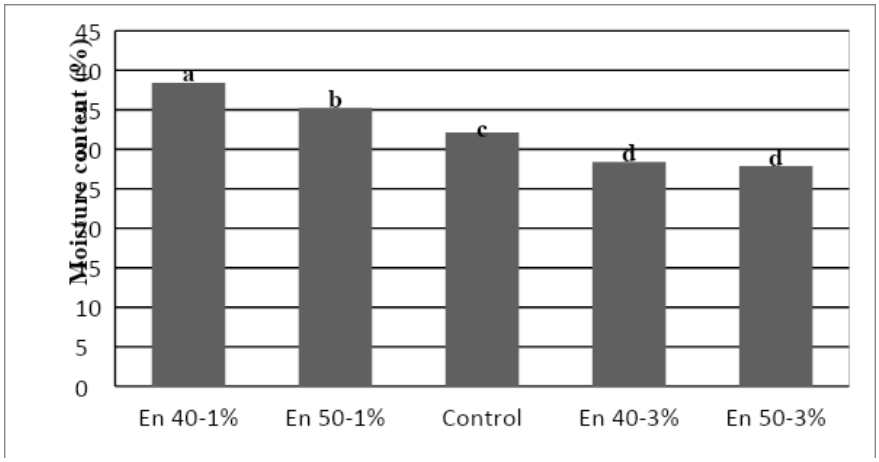

Fig1. Mean comparison of different treatments effect on the moisture content of Baguette bread (α=1%)

As the results show, the use of 1% of nanocapsules in the dough formulation increased the moisture content of the bread samples, but with the increase in the use of nanocapsules from 1% to 3%, the moisture level of the bread samples decreased. The reason for increasing the moisture content of bread samples at low concentrations of nanocapsules in the formulation is attributed to the content of its polyphenolic compounds. Polyphenolic compounds have active polyhydroxyl structures that have a strong tendency to establish hydrogen bonds with water. Also, polyphenols are considered a regenerating substance, but it is possible that during the preparation of the dough, due to the entry of air and the occurrence of oxidation, compounds have been obtained that have oxidizing properties and as a result, by oxidizing the thiol group (S-H(Gluten and the increase of disulfide groups)S-S), have improved the gluten network]21[. On the other hand, as stated, with the increase in the use of nanocapsules from 1 to 3%, the moisture level of the samples decreased. The reason for the result is that with the increase in the concentration of the extract, the hydrophilic polyphenol compounds compete with the gluten protein in water absorption and eventually lead to its hardening. Also, other effective factors in reducing water absorption can be attributed to the increase of hydrophobic compounds in the extract, such as non-polar amino acids and monoterpenes in the extract.]22 and 23[. On the other hand, it is possible by increasing the consumption levels of the extract,pH The environment has increased, as a result of which the efficiency of gliadin protein and ultimately water absorption has decreased]24[.

3-2- Evaluation of the volume of bread samples

According to Figure 2, the effect of different treatments on the volume of bread samples is significant ($P<0.01$). In this regard, the largest amount of volume (cm^3 21/284) in the sampleAt 40%-1% and its lowest value (cm^3 31/164) in the sampleIn 50%-3% seen.

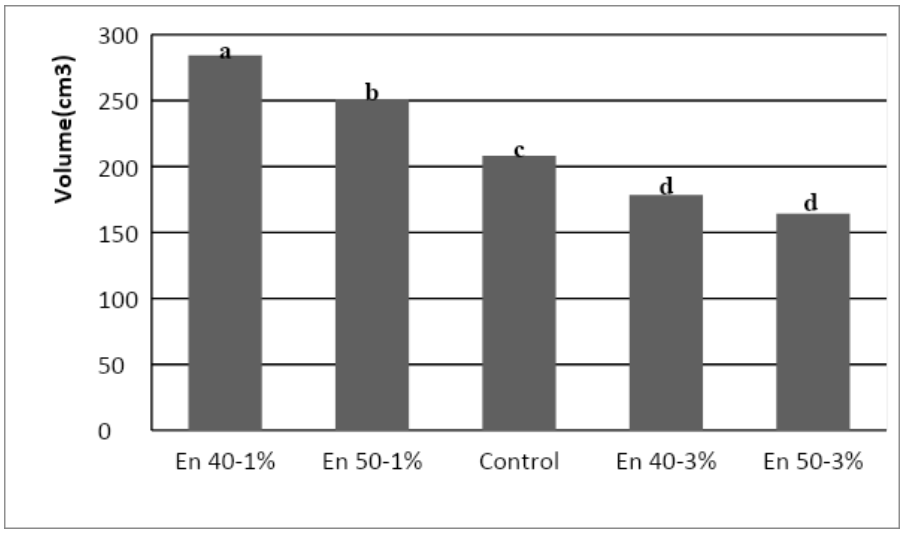

Fig2. Mean comparison of different treatments effect on the volume of Baguette bread (α=1%)

Volume is a qualitative parameter that indicates the ability of the dough to hold gasCO_2 And its expansion is during the cooking process. According to Figure 2, the use of 1% of nanocapsules in the dough formulation increased the volume of bread samples, but by increasing its use to 3%, the volume of the samples decreased. The reason for the volume increase in the samples containing 1% nanocapsules containing the extract can be attributed to the improvement of the gluten network of the bread samples. As mentioned earlier, the extracts are considered a regenerating substance due to their antioxidant compounds, but during the process of mixing and preparing the dough, due to the entry of oxygen and reaction with phenolic compounds, oxidizing properties were found, which resulted in the improvement of the gluten network, increasing the time Dough expansion and stability. Also, the extracts contain various mineral compounds, including iron. By strengthening the disulfide bonds between gliadin and glutenin and increasing the gluten protein, these substances can increase the water absorption of the dough, improve the expansion of the dough and its stability, and thus increase the volume of bread.]21 and 22[.

3-3- Evaluation of the amount of phenolic compounds

As Figure 3 shows, the effect of different treatments on the amount of phenolic compounds of baguette bread samples is significant ($P<0.01$). Accordingly, the highest amount of phenolic compounds (mg GAE/µl 12/231) in the sampleAt 50%-3% and its lowest value (mg GAE/µl 25/103) in the sampleAt 40%-1% It was observed (of course, the control samples did not contain phenolic compounds).

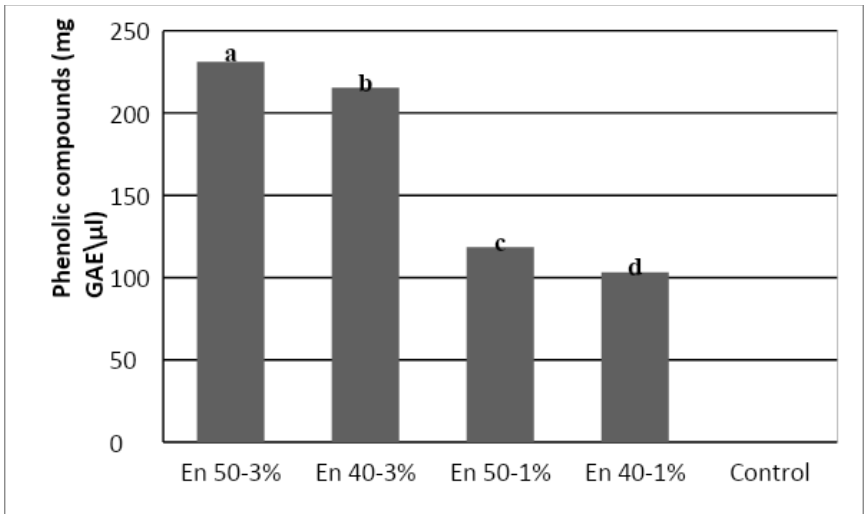

Fig3. Mean comparison of different treatments effect on the phenolic compounds of Baguette bread (α=1%)

It is noteworthy that before the cooking process, the amount of phenolic compounds measured in dough samples containing different amounts of encapsulated extracts in the rangemg GAE/µl 41/528 tomg GAE/µl 321/35 was found that after the cooking process, the amounts of phenolic compounds in the rangemg GAE/µl 12/231 tomg GAE/µl It was placed 25/103. In other words, the amount of phenolic compounds decreased during the cooking process.DecreasePhenolic compoundsIt shows that these compounds are sensitive to high temperatures. In other words, the increase in temperature has caused the destruction and oxidation of some heat-sensitive phenols. Also, the decrease of phenolic compounds with increasing temperature can be attributed to the formation of sonochemical compounds]25[.

3-4- Evaluation of color changes

The color of the bread crust is an important factor during the baking process. The creation of brown color is related to a series of reactions, especially caramelization and Maillard, which play a significant role in the skin color.Figure 4 shows the results of the average data comparison of the effect of different treatments on the amount of color changes of the samples, according to which the highest amountEΔ in treatmentAt 50%-3% It was measured. As the results show, increasing the concentration of the extract inside the nanocapsules (from 40 to 50%) and also increasing the use of nanocapsules in the bread formulation (from 1 to 3%) caused the color of the bread crust to darken compared to the control, which is the reason for the darkening of the crust color. Bread samples, especially at high levels of hydroalcoholic extract consumption, can be attributed to the increase in the concentration of amino acids and flavonoid compounds in the extract and their participation in the Maillard reaction.]22 and 26[.

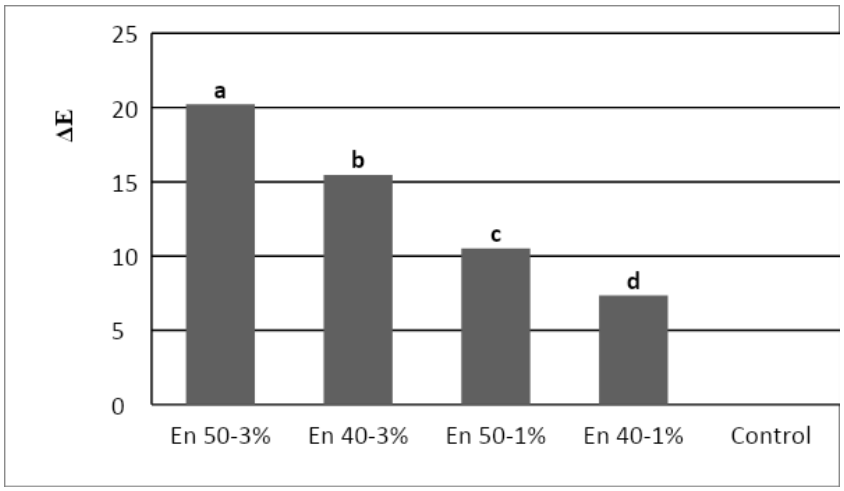

Fig4. Mean comparison of different treatments effect on the color changes of Baguette bread (α=1%)

5-3- Evaluation of temperature changes in the center of the bread

In Table 2, the laboratory data related to the temperature changes of the control baguette bread and breads containing different percentages of nanocapsules with different concentrations of date kernel extract, from the moment of baking to the 20th minute, are shown.In this regard, in all the bread samples, with the increase of time, the temperature of the center of the bread increased so that within 20 minutes, the temperature of the center of the control bread samples increased from 20 to 132 and in the samplesEn50-3%, En50-1%, En40-3% AndEn40-1% They increased from 20 to 154, 20 to 112, 20 to 142 and 20 to 109 degrees Celsius, respectively.

Table2. Mean comparison of different treatments effect on the center temperature changes of baguette bread

	hour(min)									
	2	**4**	**6**	**8**	**10**	**12**	**14**	**16**	**18**	**20**
En40-1%	22±3.2^{k}	30±3.3^{j}	35±2.2^{ij}	48±2.5^{gh}	49±2.7^{gh}	57±2.6^{g}	75±4.1^{f}	80±2.2^{f}	96±4.8$^{It\ is}$	109±5.7^{d}
En40-3%	27±2.5^{k}	40±2.2^{hi}	51±2.6^{gh}	70±4.7^{f}	74±3.9^{f}	90±3.4$^{It\ is}$	92±4.2$^{It\ is}$	98±3.4$^{It\ is}$	120±6.5^{cd}	142±5.4^{b}
En50-1%	25±2.2^{k}	31±2.5^{j}	37±2.5^{i}	46±3.3^{h}	52±2.3^{g}	59±3.5^{g}	77±3.7^{f}	79±3.4^{f}	93±4.7$^{It\ is}$	112±5.4^{d}
En50-3%	33±2.3^{jk}	49±2.5^{gh}	60±3.2^{g}	76±3.2^{f}	93±3.4$^{It\ is}$	95±4.2$^{It\ is}$	109±4.8^{d}	124±3.1^{c}	136±4.1^{b}	154±3.7^{a}
Control	27±3.4^{k}	35±2.7^{ij}	43±3.6^{hi}	50±2.1^{gh}	54±2.7^{g}	76±3.6^{f}	77±2.2^{f}	95±3.2$^{It\ is}$	97±4.3$^{It\ is}$	132±6.3^{b}

Mean that at least one letter in common, not significant difference at α=1%

In the analysis of the obtained results, it should be said that when the bread is placed in the oven, Because the water content decreases rapidlyThe surface temperature of the bread increases rapidly, while these changes are slower in its inner parts But in the case of the core of the bread, due to the presence of water, the temperature changes slowly until the final moments of baking. As the temperature increases, the partial vapor pressure in the pores increasesIt is found that this pressure increases in the inner and colder parts of the breadAnd the moisture is transferred in the form of steam to the internal points so that the steam pressure

reaches an equilibrium value. Due to the fact that the temperature of the external environment of the bread is higher, it is far from the saturated state, and the moisture of the surface is spread out and the surface becomes dry. Also, liquid moisture penetrates towards the surface due to the concentration gradient of internal and surface points, but due to the fact that the speed of vapor diffusion is much higher than that of water, the amount of water in the brain increases. In this direction, water vapor penetrates and condenses in the cold spots inside]20 and 27[.

6-3- Staleness evaluation of bread samples

The comparison results of the average interaction effect of treatment and time on the staleness of baguette bread samples are shown in Table 3. According to the results, treatmentsEn40-1% AndEn50-3% respectively, they had the lowest and highest rate of staleness in all three time periods.

Table3. Mean comparison of interaction between (Treatment × Time) on sailing of baguette samples (N)

	Time (h)		
	24	**48**	**72**
En40-1%	1.4±0.2^{g}	2.1±0.2^{if}	2.8±0.3^{d}
En50-1%	1.8±0.2^{fg}	2.5±0.3^{of}	3.2±0.3^{bc}
Control	2.1±0.2^{if}	2.8±0.3^{d}	4±0.6^{ab}
En40-3%	2.7±0.3^{of}	3.4±0.3^{bc}	4.4±0.4^{a}
En50-3%	3±0.4^{cd}	4.2±0.5^{a}	5.1±0.5^{a}

Mean that at least one letter in common, not significant difference at α=1%

The reason for the low level of staleness in the bread samples due to the low percentage of nanocapsules containing date kernel extract (1 percent) compared to the witness sample is that the hydroxyl radicals of polyphenols in the hydroalcoholic extract of date kernels establish hydrogen bonds with starch, therefore, from the interconnection of starch chains (amylose and amylopectin) and delay the retrogradation of starch. On the other hand, the polyhydroxyl structure related to phenols is connected to water through a hydrogen bond, which inhibits the leaching of amylose and the swelling of amylopectin, which results in a reduction in viscosity and then in the reduction of retrogradation of starch, which ultimately causes a reduction in brain stiffness. It becomes bread. It is noteworthy that the reason for the softness of the bread texture in the treatmentsEn40-1% AndEn50-1% can be attributed to the high capacity of water retention by the hydroalcoholic extract of date kernel]22 and 26[.

7-3- Evaluation of sensory characteristics

The results of the average data comparison of the effect of different treatments on the organoleptic characteristics of baguette bread samples are shown in Table 4.

Table4. Mean comparison of different treatments effect on the organoleptic properties of baguette bread

	Shape	**Upper surface of bread**	**Bottom surface of bread**	**Porosity**	**Texture**	**Chewiness**	**Taste**
En40-1%	4±0.2^{a}	3.5±0.3^{a}	4.3±0.2^{a}	3.7±0.2^{a}	4.3±0.2^{a}	4.2±0.1^{a}	4±0.2^{a}
En50-1%	4±0.2^{a}	3.5±0.3^{a}	4.3±0.2^{a}	3.5±0.2^{a}	4±0.2^{a}	4±0.1^{a}	3.2±0.2^{b}
Control	2.7±0.3^{b}	3±0.2^{a}	4.3±0.2^{a}	2±0.2^{b}	3.3±0.2^{b}	3.2±0.1^{b}	2.5±0.2^{c}
En40-3%	2±0.3^{bc}	3±0.2^{a}	4±0.1^{a}	1.7±0.2^{b}	2.5±0.2^{c}	3±0.1^{b}	1.3±0.2^{d}

En50-3%	1.5±0.2[c]	3±0.2[a]	4±0.1[a]	1.3±0.2[c]	2±0.1[d]	2±0.1[c]	1±0.1[d]

In each column, mean that at least one letter in common, not significant difference at α=1%

According to the results, the samples that contained a low percentage (one percent) of nanocapsules containing date kernel extract had a more favorable form and shape, which can be attributed to the improvement of the gluten network, the increase in dough water absorption, and its stability due to the addition of the extract. . The combination of these factors increases the viscosity, which improves gas retention in the dough and bread, and ultimately improves the volume and shape of the bread.]28[. However, no statistically significant difference was observed between the characteristics of the upper and lower levels of different samples. On the other hand, examplesEn40-1% AndEn50-1% Compared to the control and other treatments, they had better porosity, texture softness and chewability. The improvement of porosity and porosity can be attributed to the greater ability to store carbon dioxide gas and also to increase the volume of these samples, and on the other hand, the softness of the texture and the improvement of chewing ability can be attributed to the absorption of more water in these treatments.The polyhydroxyl structure of polyphenolic compounds has a strong tendency to establish hydrogen bonds with water) Attributed. Aroma and flavor as well as taste in bread depend on caramelization and Maillard reaction. Because the treatmentsEn40-1% AndEn50-1% They had a significant effect on the distribution and absorption of water, therefore, they intensified the reaction between the combination of t-glycosylamine and reducing sugars, which increased the intensity of browning and Maillard, and it seems to have improved the aroma and smell in the samples.]29[. Of course, the decrease in aroma and flavor scores at high levels of nanocapsules consumption (3%) can be attributed to the increase in the concentration of bitter-tasting compounds such as polyphenols and the excessive participation of amino acids and flavonoid compounds in the extract in the Maillard reaction.]22[.

4- Conclusion

During the microencapsulation process, small solid particles, liquid droplets and gas bubbles are placed inside a thin coating and produce a capsule that releases its contents at controlled speeds and under special conditions. Therefore, their properties are preserved against environmental factors such as oxygen, heat, chemical and biological factors during the food storage period.In the present study, the effect of adding nanocapsules containing date kernel extract at the rate of 1 and 3% to baguette bread formulation was investigated on the staleness and organoleptic characteristics of this bread. According to the results, the addition of 1% of nanocapsules containing 40% of date kernel extract, due to the improvement of the gluten network, caused moisture retention, increased volume, reduced staleness, reduced changes in the temperature of the center of the bread and improved the organoleptic characteristics of this bread. It is noteworthy that the addition of extract compounds in the form of nanocapsules preserves polyphenol compoundsProcess It was cooked. ActuallyThis technique provided a barrier between the sensitive bioactive substances and the environment to ensure the biological availability of the substance at the right time and place, even after its consumption and in the human digestive system.

4- Resources

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مقاله علمی_پژوهشی

تاثیر عصاره ریزپوشانی‌شده هسته خرما (*Phoenix dactylifera* L.) بر بیاتی و ویژگی‌های ارگانولپتیکی نان باگت

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چکیده

نان معمولاً پس از پخت، دستخوش تغییرات فیزیکوشیمیایی مختلفی می‌شود که در مفهوم کلی آن‌را بیاتی می‌نامند. برای به تاخیر انداختن بیاتی نان، استفاده از برخی افزودنی‌ها و بهبوددهنده‌ها موثر به نظر می‌رسد. لذا در پژوهش حاضر، تاثیر غلظت‌های مختلف عصاره (۴۰ و ۵۰ درصد) ریزپوشانی‌شده هسته خرما به روش بستر سیال و با استفاده از مواد پوشش دهنده شامل مالتودکسترین، صمغ ترنجبین و روغن (Medium Chain Triglyceride) MCT همان تری‌گلیسریدهای با زنجیره متوسط، که به مقدار ۱ و ۳ درصد به فرمولاسیون نان باگت افزوده شده بودند، بر بیاتی و خواص ارگانولپتیکی آن مورد بررسی قرار گرفت. طبق نتایج، نمونه‌های نان باگتی که نانوکپسول‌های حاوی عصاره هسته خرما با غلظت ۴۰ درصد و به میزان ۱ درصد به آن‌ها افزوده شده بودند از بیشترین میزان رطوبت (۳۸/۴۱٪) و حجم (cm^3 ۲۸۴/۲۱)، کمترین میزان بیاتی در سه بازه زمانی ۲۴، ۴۸ و ۷۲ ساعت پس از پخت، کمترین تغییرات دمای مرکز نان (از ۲۰ تا ۱۳۲ درجه سلسیوس) و مطلوب‌ترین ویژگی‌های ارگانولپتیکی برخوردار بودند (α=1%). اما بیشترین مقدار ترکیبات فنلی (mg GAE/µl ۲۳۱/۱۲) پس از پخت، در نان‌هایی که به آن‌ها نانوکپسول‌های حاوی عصاره هسته خرما با غلظت ۵۰ درصد و به میزان ۳ درصد افزوده شده بود، مشاهده گردید (α=1%).