

Physicochemical, Microbiological and Sensory Evaluation of Yogurt Prepared with Date paste

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ABSTRACT

The objective of this study was to increase the nutritional value and acceptability of yogurt by adding different ratios of date paste. The physicochemical properties of yogurt samples prepared with different percentages of date paste included Total solids, pH, titratable acidity, syneresis, total phenolic content, antioxidant activity, sensory evaluation and microbiological analysis were determined during cold storage for 21 days at 4°C. Results indicated were increased of total solids, pH values, phenolic content and antioxidant activity with increasing percentages of date paste, while, the decreased in acidity and syneresis with increasing percentages of date paste. During storage periods the total solids and pH values were decreased gradually and increasing gradually of acidity and syneresis in all treatments throughout storage period of 21 days. The results also revealed a gradual decrease in total phenolic content and antioxidant activity at 7, 14 and 21 days, respectively. The highest decrease was in total phenolic content and antioxidant activity shown in yogurt samples after 21 days of storage. On the other hand, total bacterial, lactobacillus and streptococcus counts increased in all yogurt samples during the first 7 days of storage then decreased at that increasing the amount of date paste added led to higher total bacterial, lacto bacillus and streptococcus counts up to 7 days of storage then decreased. Mold and yeast were not detected in control yogurt and the yogurt prepared with date paste up to 7 days of storage. The sensory properties of yogurt prepared by adding 15% date paste received the highest score followed by the one with 10%, 20%, 5% respectively compared with control.

Keywords: Date paste, physicochemical, microbiological analysis and sensory properties of yogurt, syneresis, and antioxidant activity.

1. INTRODUCTION

Yogurt is an important healthier dairy product, especially for consumers who have lactose tolerance. Yogurt is produced by fermentation of milk with bacterial cultures consisting of a mixture of *Streptococcus* subsp. thermophiles and *Lactobacillus delbrueckii* subsp. bulgaricus [28]. Milk and dairy products do not contain fiber. Fiber of different sources is added to dairy products to increase the water-holding capacity, reduce fat retention and enhance textural characteristic and structure [27].

The importance of the date in human nutrition comes from its rich composition of carbohydrates, minerals, dietary fiber, vitamins, fatty acids, amino acids and protein and provide a good source of rapid energy due to their high carbohydrate content, especially fructose and glucose which are easily absorbed by human body [8]. Dates are a good of dietary fiber ranging from 4.4-11.4% [10], and enclose less proteins and fats [13]. Date fiber a by-product remaining after date syrup processing contains 51.57% total dietary fiber [6], [9] and [23]. Inclusion of both date fruit and its by-products (its syrup and pomace) in food will increase the content of antioxidants and thus probably prevent oxidative deterioration of food. Furthermore, they concluded that date palm fruit can be used to produce novel natural antioxidants as well as flavoring agent that can be used in various food products [21]. Dates are rich in dietary fiber, phenolic compounds, minerals, vitamins and antioxidant compounds [8] and [35]. [19], reported that the dietary fiber content of dates ranged from 8.1 to 12.7% (w/w).

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It has been determined that date fruits have potent antioxidant and antimutagenic qualities [39]. The presence of insoluble fibers such as cellulose, hemicellulose, pectin, and lignin's in dates, reduces the chances of bowel cancer and increases cardiac vitality [15].

Epidemiological studies have consistently shown that date fiber could be diabetic and have and reduced risk of chronic diseases such as coronary heart, and cardiovascular disease, cancer, aging, atherosclerosis, and inflammation, among others [19] and [32]. Therefore, plant fiber and protein products play significant roles as ingredient food systems for human health. This is attributed to the fact that dietary fiber may provide an excellent mixture of phytochemicals such as phenolic, carotenoids, natural antioxidants and other bioactive compound. Dates are excellent raw materials for the production of value-added products such as medical and industrial ethanol, bakery yeast, single-cell protein as a fodder yeast, citric acid, and date flavored probiotic fermented dairy products [5].

2. THE AIM OF THIS RESEARCH to study the physiochemical properties of yogurt samples prepared with different ratios of date paste

3. MATERIAL AND METHODS

Fresh buffalo's milk was obtained from Almarai Farm, Kingdom Saudi Arabia.

Streptococcus thermophiles, *Lactobacillus delbrueckii* spp. *Bulgaricus*, were obtained from Chr. Hansens Lab. Copenhagen, Denmark. The cultures were propagated in sterilized skim milk and then incubated at 37°C for 16 hrs.

Gallic acid 1.1 – diphenyl 1-2-picrylhydrazyl (DPPH) were purchased from sigma chemical co. USA.

Dates were obtained from Al Alwani Memoni Dates Factory located in Al Khumra Industrial City, Jeddah

3.1. Preparation of date paste:

Date fruits were washed under running water at 40 ° C to remove dust and macroscopic contamination, and afterwards scalded at 100 ° C (1:1 water/fruit) for three minutes. After that, the seeds and the peels were manually removed and the flesh was ground in the mixer grinder (Preethi Chennai, India) until a smooth homogenous paste was obtained [33].

3.1.1. Yogurt Production:

Milk was standardized to 3.5 % fat, 11% Solid nonfat and homogenized to improve texture and quality. Milk was heated to boiling to destroy the pathogenic organisms at 85°C for 10 minutes. It was then transferred to a container and cooled to 39±1°C. Starter culture of yogurt (*L.bulgaricus* and *S.thermophilis*) was added in ratio 1.5% to the milk and completely mixed, then incubated at 40 °C for about 3 hr. to coagulate at pH4.5. The Date paste was added to the yogurts at ratio of 0% (control), 5%, 10%, 15% and 20% respectively. The final product was mixed then filled in 150-ml sterile glass jars and stored at 4°C. All samples were subjected to chemical, syneresis and sensory analyses at 0, 7, 14 and 21 days.

3. 2. Chemical analysis:-

Moisture, ash, fat, protein, titratable and acidity were determined according to the Official Methods of Analysis [11]. The pH samples were measured using digital pH meter (Hanna, Italy).

The mineral elements including potassium (K), phosphorus (P), calcium (Ca), zinc (Zn) and iron (Fe), according to the method of [11] using Atomic Absorption Spectrophotometer, Perkin-Elmer Model 2380 manufacture (USA). Each sample (0.2 g) was digested with 8 ml mixture of HNO₃ and HClO₄ (4:1, v/v) at room temperature overnight and heated at 130°C for 1 h till a clear solution was obtained (about 2 ml). The solution was subsequently transferred to a 25 ml volumetric flask with ultrapure water after cooling down. The method described by [30].

Synersis index:

Synersis can be defined as the spontaneous water release from a gel due to gel shrinkage. The released whey in the yoghurt samples was measured according to [28] by inverting a 100-g sample on a Buchner funnel lined with a Whatman filter paper number #1. The quantity of whey collected in a graduated cylinder after 3h of drainage at 8 °C was used as an index of synersis. Synersis was determined on 3 cups of yoghurt per triplication.

Total phenolic contents

Total phenolic compounds were determined According to [41] by using Folin-Ciocalteu reagent and expressed as milligrams of Gallic acid equivalents (GAE) per 100 gm.

Antioxidant Capacity

Radical Scavenging Activity (RSA %) assay Free radical Scavenging activity (RSA) of the samples was measured using the method of [16]. and expressed as percentage inhibition of the DPPH radical and was determined by the following equation:

$$RSA = \frac{\text{Abs control} - \text{Abs sample}}{\text{Abs control}} \times 100$$

3.3. Microbiological analysis:

Yoghurt samples were prepared according to the method recommended by [2] and analyzed at 0, 7, 14 and 21 days of storage at 4°C. Streptococcus thermophilus M17 agar (DIFCO) was used to enumerate Streptococcus in yoghurt samples and incubated aerobically at 37°C for 72 hours according to [37]. MRS Rogasa agar (DIFCO) was used to enumerate Lactobacillus delbrueckii according to [36]. Plates were incubated under anaerobic condition at 37°C for 72 hours. Sabouroud agar media was used for the enumeration of mold and yeast according to [1] and [31].

3.4. Sensory Evaluation:

Ten panelists from Food and Nutrition Department, Faculty of Home Economics, King Abdulaziz University, Kingdom Saudi Arabia were selected on the bases of their training and expertise in the use and evaluation of control of yogurt prepared with 0, 5, 10 and 20% date paste. They evaluated 20 g portions of each yogurt sample and used a quality rating score card for evaluation of flavor (45 points), body texture (30 points), color and appearance (15 points) and acidity (10 points) as described by [29].

3.5. Statistical Analysis

Statistical analysis of the data was carried out by ANOVA using SAS statistical software [34]. The significant differences among means were assessed by Duncan's multiple range tests [20].

4. RESULTS AND DISCUSSION

4.1. Chemical composition of date palm:-

Chemical composition of Khalas date palm were determined and presented in Table 1. The obtained results showed that moisture, protein, ash, reducing sugars, non-reducing sugars, crude fiber and fat content, were 40.80, 3.62, 1.73, 25.72, 51.83, 4.48, 1.54% respectively. While the acidity and pH values were 0.08 and 5.40 respectively. On the other hand, Minerals content of Khalas date pulp were 50.32, 52.78, 60.23, 1.44, 2.64 and 14.73 mg /100g for Potassium, Sodium, Phosphorus, Calcium, Zinc and Iron respectively. The Khalas date pulp contained 30.85 and 250 mg /100g for Vitamin C and Total Phenolics respectively. These results are agreements with [8], [18], [4] and [3].

Table 1. Chemical composition of date pulp (on dry weight basis)

Components	%
Moisture Content	40.80
Total Sugar	77.55
Reducing sugar (%)	25.72
Non reducing sugar (%)	51.83
Protein (%)	3.62
Fat Content (%)	1.54
Ash Content (%)	1.73
Crud Fiber (%)	4.48
Acidity %	0.08

PH value	5.40
Potassium (mg/100g)	50.32
Sodium (mg/100g)	52.78
Phosphorus (mg/100g)	60.23
Calcium (mg/100g)	1.44
Zinc(mg/100g)	2.64
Iron (mg/100g)	14.73
Vitamin C (mg/100g)	30.85
Total Phenolics (mg/100g)	250

4.2. Total solids:-

The effect of adding different percentages of dates pastes on total solids of yogurt samples during cold storage periods are also shown in Table 2. Total solids of yogurts were increased with the increasing percentages of date paste. While during storage periods, the total solids of yogurt were decreased in all treatments. The yogurt prepared with 20% date paste showed the highest total solids followed by 15, 10, 5% and control, respectively. These results are similar to the results obtained by [23] and [24].

Table 2. The effect of adding different percentages of date paste on the Total solids (% of yogurt during cold storage periods after 21 days at (4±1°C).

Treatments	Storage period (days)			
	Zero time	7 days	14 days	21 days
Control	14.00^e	13.81^e	13.73^e	13.64^e
Yogurt with 5% date paste	18.30^d	18.12^d	18.01^d	17.92^d
Yogurt with 10% date paste	21.60^c	21.43^c	21.25^{bc}	21.07^{bc}
Yogurt with 15% date paste	23.20^b	23.10^b	22.92^b	22.73^b
Yogurt with 20% date paste	25.30^a	25.11^a	25.00^a	24.86^a

Values with different letters in the same column are significantly different at P>.0.05.

4.3. Acidity:-

The effect of adding different percentages of date paste on acidity of yogurt samples during cold storage periods after 21 days at ($4\pm 1^\circ\text{C}$) are presented in Fig 1. The acidity of were decreased by increasing percentages of date paste. The acidity further increased gradually during storage in all treatments. The development in acidity of yogurt is mainly due to the conversion of lactose into lactic acid by lactic acid bacteria of yoghurt culture. [14]. [24], observed an increase in acidity with increasing the ratios of date palm past may be due to the more carbohydrate content of date paste converted into acid in fermentation process.

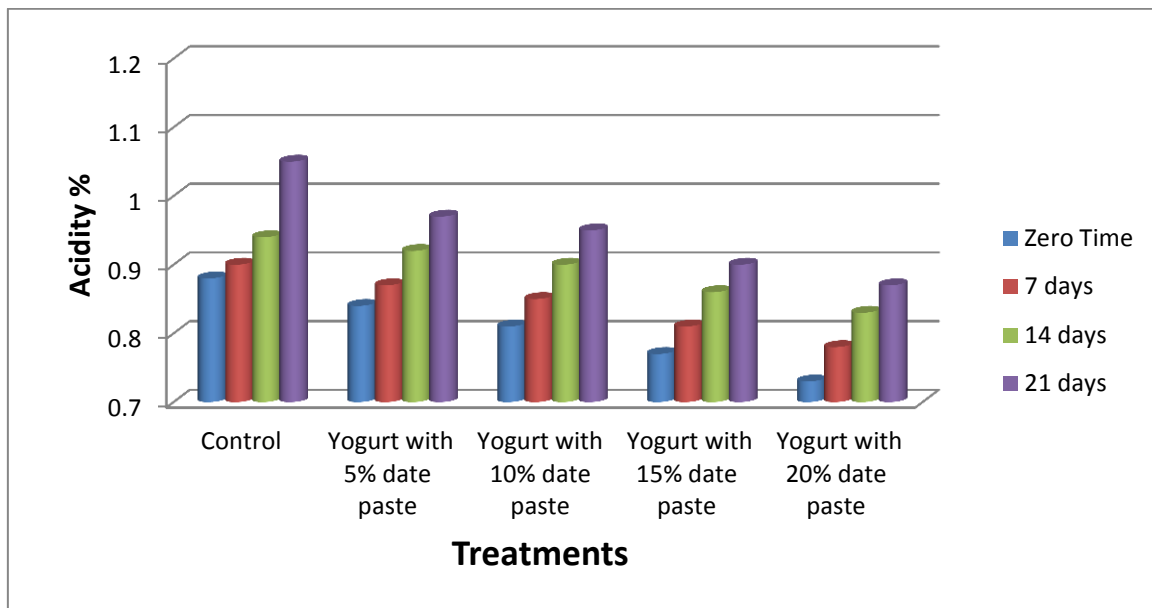


Fig 1. The effect of adding different percentages of date paste on titratable acidity of yogurt samples during cold storage periods after 21 days at ($4\pm 1^\circ\text{C}$).

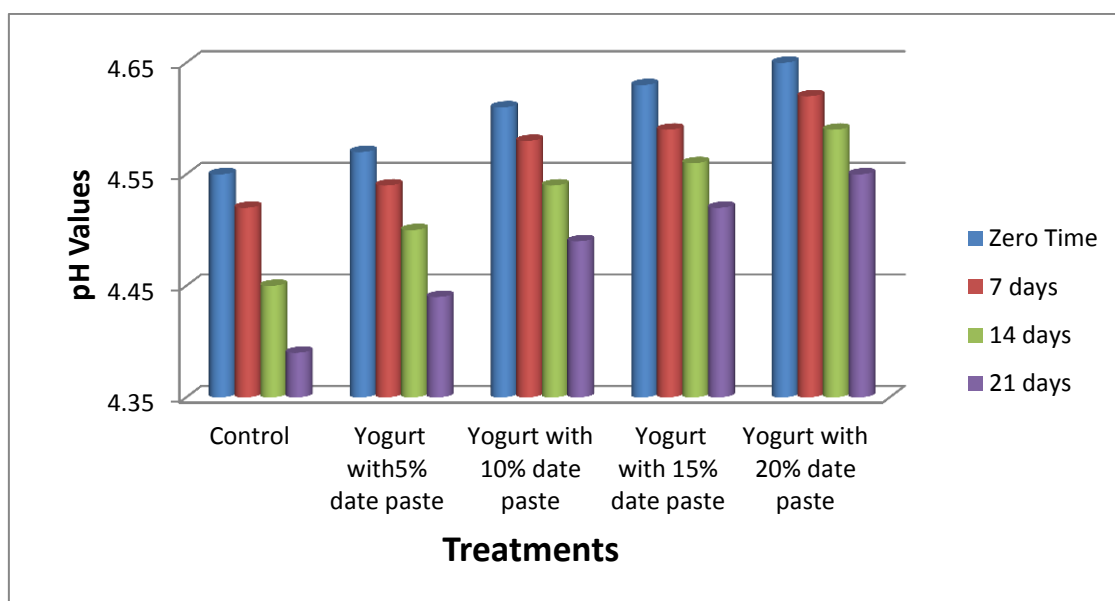


Fig 2. The effect of adding different percentages of date paste on the pH values of yogurt samples during cold storage periods after 21 days at ($4\pm 1^\circ\text{C}$).

4.4. pH values :-

The effect of adding different percentages of date paste on the pH values of the yogurt samples during cold storage periods after 21 days at ($4\pm 1^{\circ}\text{C}$) are also shown in Fig 2. The pH values were increased with increasing percentages of date paste of yogurts samples. The pH values decreased gradually in all treatments throughout storage periods. The decrease in the pH values was apparently due to the increase in the acidity resulted from the conversion of lactose to lactic acid during the storage period [25]. The decrease of pH during the storage can be attributed to the high bacterial metabolic activity with the consumption of lactose and lactic acid production [14].

4.5. Syneresis:-

The effect of adding different percentages of date paste on syneresis of yogurt samples during cold storage periods after 21 days at ($4\pm 1^{\circ}\text{C}$) are presented in Fig 3. The Syneresis were decreased by increasing percentages of date paste ratios compared with control. It can be seen that control yogurt has presented a higher index of syneresis than other treatment. These results are in agreement with those founded by [17], who reported that the inclusion of the carbohydrate components reduced product syneresis and improved the texture and rheological properties of the supplemented yogurt.

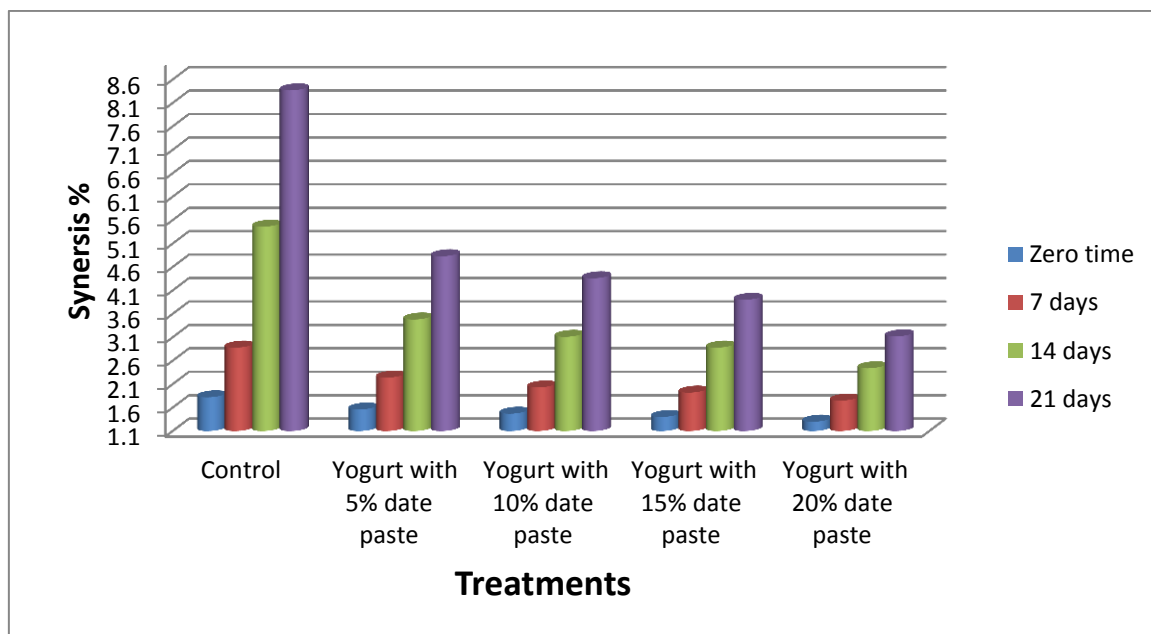


Fig 3. The effect of adding different percentages of date pastes on the syneresis (%) of yogurt samples during cold storage periods after 21 days at ($4\pm 1^{\circ}\text{C}$).

4.6. Total phenolic content:

Total phenolic content of yogurt prepared with different percentages of date paste during cold storage periods after 21 days at ($4\pm 1^{\circ}\text{C}$) are illustrated in Fig 4. Total phenolic content of yogurt prepared with date paste were increased by increasing percentages of date paste in the yogurt product. On the other hand, during storage periods, the total phenolic content of yogurt was decreased gradually in all treatments throughout storage period of 21 days.

These results are agreement with [40], also reported that total phenolic content degrades rapidly during the first week of storage, but is relatively stable after weeks in yoghurt fortified with berry and purple carrot extracts.

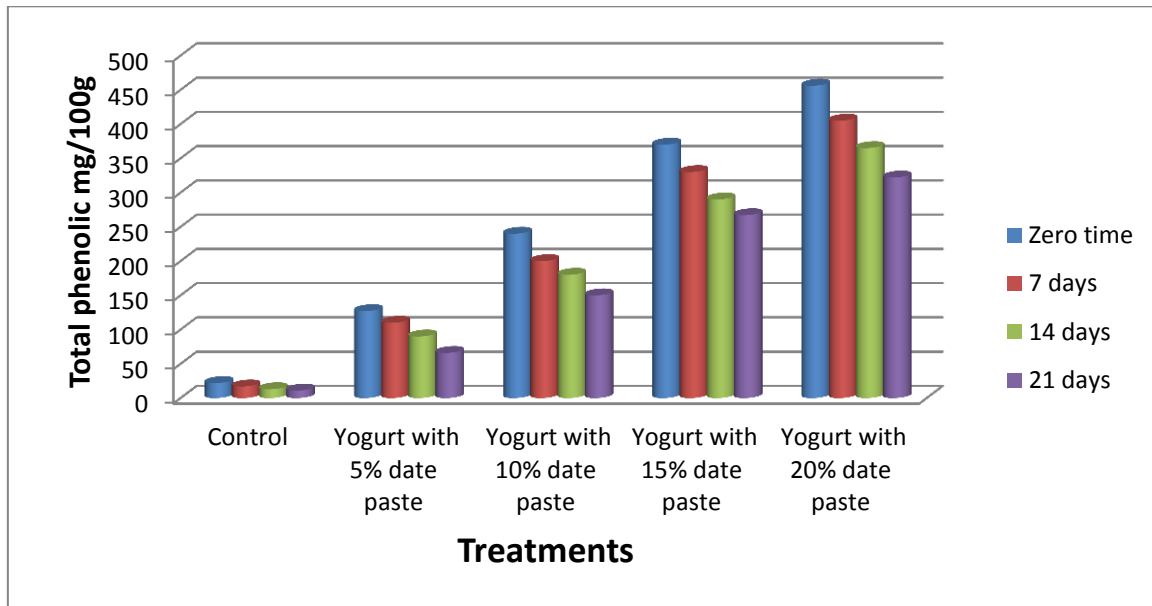


Fig 4 .The effect of different percentages of date pastes on total phenolic content of yogurt during cold storage periods after 21 days at ($4\pm 1^{\circ}\text{C}$).

4.7. Radical scavenging activity:-

Radical scavenging activity of yogurt samples prepared with different percentages of date paste during cold storage periods at 4°C are shown in Fig 5. Radical scavenging activity of yogurt samples prepared with date paste was increasing with increasing percentages of date paste in the yogurt product. On the other hand, during storage periods, the radical scavenging activities were decreased gradually in all treatments throughout storage period of 21 days.

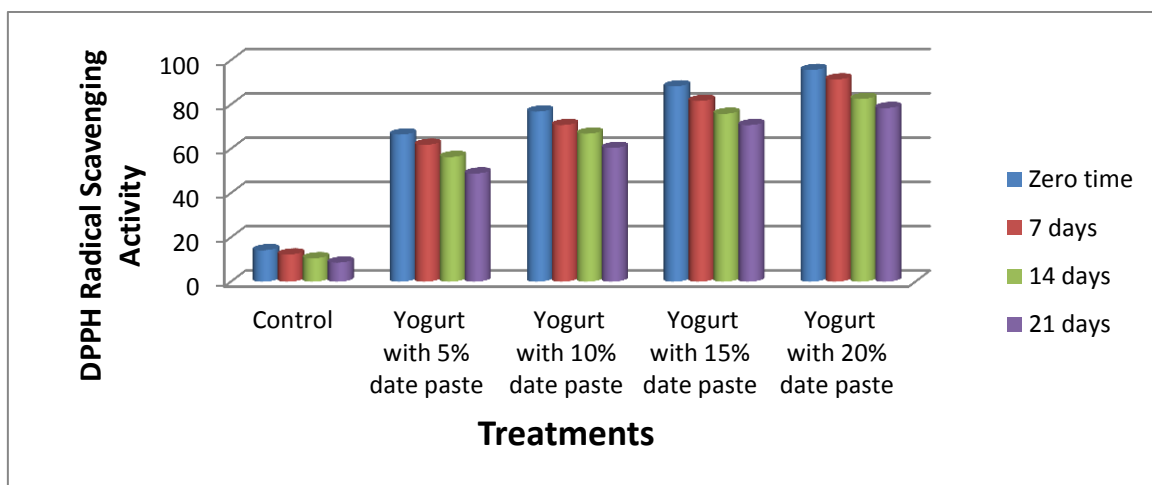


Fig 5. DPPH radical scavenging activity of yogurt samples prepared with different percentages of date paste during cold storage periods after 21 days at ($4\pm 1^{\circ}\text{C}$).

4.8. Microbiological analysis:-

The effect of adding different percentages of date paste on the total bacterial counts of yogurt samples during the storage periods after 21 days at (4±1° C) are shown in Table 3. It is noticed that the total bacterial counts of all samples increased during the early days of storage, then decreased gradually till the end of the storage period. This decrease could be attributed to the developed acidity. The results are in agreement with [26].

The increasing percentages of date paste in yogurt samples led to increase the total bacterial count at zero time and 7 days of storage. This might be due to the presence of some growth promoter such as some salts and vitamins that have been provided by the added date paste. Such compounds may stimulate the growth of bacteria. On the other hand, the total bacterial counts in yogurt samples prepared with 5, 10, 15 and 20% date paste after 14 and 21 days of storage rapidly declined, which might be due to the developed acidity.

Table 3. The effect of different percentages of date paste on the total bacterial count (CFU X 10⁷) in the yogurt samples during cold storage periods after 21 days at (4±1°C).

Treatments	Storage period (days)			
	Zero time	7	14	21
Control	13.1 ^e	18.6 ^e	12.4 ^e	4.2 ^d
Yogurt with 5% date paste	14.2 ^d	24.2 ^d	17.8 ^d	6.3 ^{cd}
Yogurt with 10% date paste	16.5 ^c	28.3 ^c	19.2 ^c	6.8 ^c
Yogurt with 15% date paste	19.2 ^b	32.2 ^b	23.7 ^{ab}	8.7 ^{ab}
Yogurt with 20% date paste	23.7 ^a	36.4 ^a	24.1 ^a	9.3 ^a

Values with different letters in the same column are significantly different at P<0.05.

4.8.1. *Streptococcus thermophilus* counts:-

The effect of different percentages of date paste on the *str. thermophilus* counts (CFUX 10⁶/g) in the yogurt samples during cold storage periods after 21 days at (4±1° C) are shown in Table 4. The streptococcus counts were increased until 7 days of storage then decreased gradually in all samples until 21 days of storage periods. These results are in agreement with the findings of [12]. From the aforementioned data, yogurt samples prepared with 20 % date paste exhibited higher lactobacillus and streptococcus counts. On the other hand, after 14 and 21 days of storage, the count of streptococcus were markedly decreased, this could be due to the higher acidity development in yogurt prepared date paste.

Table 4. Effect of different percentages of date paste on thermophilus counts

(CFU X 10⁶/g) in the yogurt samples during the storage period after 21 days at (4±1°C).

Treatments	Storage period (days)			
	Zero time	7	14	21
Control	50 ^d	73 ^d	40 ^c	20 ^c
Yogurt with 5% date paste	57 ^d	81 ^c	46 ^b	26 ^b
Yogurt with 10% date paste	65 ^c	90 ^b	52 ^b	30 ^b
Yogurt with 15% date paste	73 ^b	96 ^a	65 ^a	34 ^a
Yogurt with 20% date paste	78 ^a	99 ^a	67 ^a	36 ^a

Values with different letters in the same column are significantly different at P<.0.05.

4.8.2. *lactobacillus bulgaricus* counts :-

The effect of different percentages of date paste on the *lactobacillus bulgaricus* counts (CFUX 10⁶/g) in yogurt samples during cold storage periods after 21 days at (4±1° C) are presented in Table 5. Lactobacillus counts increased until 7 days of storage and then decreased gradually in all yogurt samples till the end of storage period. These results are in agreement with the results of [12] and [25].

Table 5. The effect of different percentages of date paste on lactobacillus count in the stirred yogurt during the storage periods after 21 days at (4±1° C).

Treatments	Storage period (days)			
	Zero time	7	14	21
Control	55 ^d	89 ^c	60 ^c	40 ^c
Yogurt with 5% date paste	77 ^c	118 ^d	77 ^d	54 ^d
Yogurt with 10% date paste	88 ^b	130 ^c	80 ^c	60 ^c
Yogurt with 15% date paste	95 ^{ab}	153 ^{ab}	91 ^{ab}	74 ^{ab}
Yogurt with 20% date paste	99 ^a	164 ^a	98 ^a	80 ^a

Values with different letters in the same column are significantly different at P<.0.05.

Table 6. Effects of different percentages of date paste on mold and yeast (CFUX $10^3/g$) of yogurt samples during storage period after 21 days at ($4\pm 1^\circ C$).

Treatments	Storage period (days)			
	Zero time	7	14	21
Control	ND	30 ^c	38 ^a	66 ^a
Yogurt with 5% date paste	ND	ND	34 ^b	50 ^b
Yogurt with 10% date paste	ND	ND	30 ^b	44 ^c
Yogurt with 15% date paste	ND	ND	20 ^c	35 ^d
Yogurt with 20% date paste	ND	ND	18 ^c	29 ^e

Values with different letters in the same column are significantly different at $P < 0.05$.

4.8.3. Mold and yeast count:-

The effect of different percentages of date paste on mold and yeast count (CFUX $10^3/g$) in yogurt samples during cold storage periods after 21 days at ($4\pm 1^\circ C$) is presented in Table 6. All samples were free of yeast and molds at zero time of storage. On the other hand, mold and yeast were detected in yogurt samples prepared with date paste after 14 days of storage. These results are in agreement with the findings of [14].

4.9. Sensory evaluation:-

Sensory evaluation of yogurt prepared with different percentages of date paste during cold storage periods after 21 days at ($4\pm 1^\circ C$) are presented in Table 7. Analysis of variance showed significant differences in color & appearance, body & texture, flavor and acidity for both control and yogurt samples prepared by added different ratio of date paste. The yoghurt prepared with adding 15% date paste received the highest score followed by 10% compared to control when fresh and during storage periods.

A noticeable decrease in all sensory characteristics was showed during storage periods could be due to proteolytic activity of bacteria and the production of higher acidity [14].

5. CONCLUSION

Fortifying yoghurt or dairy products with date paste is of great interest to improve the functionality and create functional foods with health benefits. The addition of date paste to yoghurt would complement its healthy characteristics. This study has shown that fortifying yoghurt with 10 to 15 % date paste produced an acceptable product with potential beneficial health effects.

Table 7. Sensory properties of yogurt samples prepared with different percentages of date past during cold storage periods after 21 days at (4±1°C).

Properties	Treatment	Storage time (days)			
		Zero time	7	14	21
Color and appearance (15 points)	Control	10.12 ^d	9.65 ^d	8.64 ^e	6.21 ^d
	Yogurt with 5% Date paste	11.44 ^c	10.34 ^c	9.21 ^d	6.92 ^c
	Yogurt with 10% Date paste	13.33 ^{ab}	12.50 ^{ab}	11.65 ^{ab}	9.60 ^{ab}
	Yogurt with 15% Date paste	14.56 ^a	13.48 ^a	12.30 ^a	10.50 ^a
	Yogurt with 20% Date paste	12.27 ^b	11.34 ^b	9.50 ^c	8.52 ^b
Body and texture (30 points)	Control	18.93 ^e	16.42 ^d	15.13 ^d	13.47 ^e
	Yogurt with 5% Date paste	20.32 ^d	18.82 ^c	16.33 ^c	14.96 ^d
	Yogurt with 10% Date paste	25.86 ^b	23.55 ^b	22.43 ^b	19.66 ^b
	Yogurt with 15% Date paste	27.33 ^a	26.85 ^a	25.32 ^a	20.35 ^a
	Yogurt with 20% Date paste	23.35 ^c	22.30 ^b	19.00 ^b	16.30 ^c
Flavor points (45)	Control	35.21 ^e	33.11 ^e	30.15 ^e	25.82 ^e
	Yogurt with 5% Date paste	38.63 ^c	35.45 ^c	32.13 ^c	30.55 ^{cd}
	Yogurt with 10% Date paste	42.33 ^b	39.55 ^b	37.45 ^b	35.87 ^b
	Yogurt with 15% Date paste	44.61 ^a	43.23 ^a	41.66 ^a	38.55 ^a
	Yogurt with 20% Date paste	40.11 ^b	36.98 ^b	35.12 ^b	32.44 ^c
Acidity points (10)	Control	4.63 ^e	4.33 ^e	4.00 ^e	3.86 ^e
	Yogurt with 5% Date paste	5.32 ^d	5.12 ^d	4.60 ^d	4.00 ^d
	Yogurt with 10% Date paste	8.85 ^b	8.42 ^b	8.00 ^b	7.50 ^b
	Yogurt with 15% Date paste	9.33 ^a	9.12 ^a	8.50 ^a	8.00 ^a
	Yogurt with 20% Date paste	7.32 ^c	7.21 ^c	6.82 ^c	6.11 ^c

Values with different letters in the same column are significantly different at P<0.05.

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