Rheological, antioxidant and sensory properties of yoghurt fortified with date pit powder

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Abstract

This study was carried out with the aim of determining the effect of adding Zahdi date pit powder in different concentrations to yoghurt on the chemical, physical and sensory properties of the product. The prepared Zahdi date pit powder was used in proportions of 0.25, 0.5, and 0.75%, respectively. The chemical tests included measuring the percentage of moisture, protein, carbohydrates, fat, and ash, in addition to the percentage of total acidity and pH, while the rheological tested were hardness, cohesion, and flexibility. Sensory evaluation of parameters was also conducted. Yogurt samples treated with date pit powder showed a decrease in the level of moisture over the length of the storage period and an increase in the percentage of protein, carbohydrates and ash compared to the control sample that was without addition. As for the rheological tests, there was a discrepancy in the results of the treatments when compared to the control treatment. The addition rate of 0.5% date pit powder had higher properties than all other treatments, especially in the ability of holding water and spontaneous whey excretion. It was more acceptable in terms of sensory evaluation, as it greatly improved the characteristics of texture, texture, taste, and flavor, in addition to containing good antioxidant properties, especially in the inhibition test. DPPH radical.

Keywords: Antioxidants, Date pit powder, DPPH, Food, Yoghurt

Introduction

Dates are very popular as they are considered an essential fruit in most Middle Eastern countries. Date pits, known as Phoenix dactylifera and also seeds or pits, are by-products of date processing. Despite the valuable nutritional composition of date pits as they are a source of carbohydrates, dietary fiber, protein and oil, they are It is still widely treated as a waste product [1]. However, recent research has focused on how date kernels serve as a potential source of bioactive substances in many products such as nutritional supplements and medical products, as date kernels are collected in large quantities from date fruit processing plants, and they contain valuable bioactive compounds [2], date pits and their processed particles can serve as a cheap additive in food products with functions such as improving their composition in terms of fibre, proteins, fats, vitamins, minerals, polyphenols and antioxidant compounds [3]. Its used as a natural preservative, fat substitute, softening agent, hydrogel and emulsifying agent [4]. Its healthy

ISSN 2072-3857

functions include antioxidant capacity, dietary fiber, caffeine-free, and promoting probiotic bacteria [5]. It is thought to be difficult to include date pit powder into food products without compromising their sensory acceptability. [6], and it has recently been demonstrated that they are a strong source of physiologically active chemicals and have high nutritional values, as date pits have been found to be a rich source of antioxidants, anti-cancer, and anti-mutagenic capabilities. Its composition is rich in minerals, antioxidants, vitamins, dietary fiber, and carbs. [7 .[

Oxidation is defined as the imbalance that occurs between the ability of oxidative systems and the antioxidant ability of a living cell. Oxidation systems are represented by the formation of free radicals, which are an atom whose outer orbit consists of a single electron, which makes it always search for stability with other biological molecules that are responsible for division processes. Cellular, and other vital activities [8], plants produce different types of secondary metabolites (such as polyphenols, flavonoids, phytochemicals), and antioxidants protect them from infection and harsh environments [9], often, these polyphenols provide valuable bioactive properties to plants and animals to maintain their functions and balance as well as prevent diseases [10]. Regular eating of fruits, vegetables, and green fibers has been shown to have preventive effects against aging, cancer, inflammation, and cardiovascular alterations. [11], date kernels can be used as an antioxidant supplement in food, pharmaceutical, and medical products [12], as well as eating fruits that contain polyphenols maintains oral health from caries, gum infections, and many diseases that affect the oral cavity [13]. It has been observed that date kernels contain high levels of phenolic compounds and antioxidants (21.0 - 62.0 mg gallic acid equivalents, GAE / 100 g date kernel) and antioxidants (580 - 929 ml. Trolox equivalents/g [14] [15], and date kernel extract has been shown to weaken the cytotoxicity of cancer in colon tissue in rats [16].This study aimed to determine the effect of adding Al-Zahdi date pit powder on the physical, chemical and sensory properties of yoghurt during storage period of 28 days.

Material and Methods

2.1Materials:

The dried cow's milk powder (sorted and produced by the French company Regilait) were obtained from Hilla markets. As for the starter, strains of Streptococcus Subsp Thermophilus and Lactobacillus delbrueckii Subsp bulgaricus bacteria prepared by the French company Danisco were used, and they were added directly to the milk prepared for making yoghurt, according to the instructions of the preparing company. Al-Zahdi dates were obtained at the full maturity stage from local markets in the city of Al-Hillah - Babylon Governorate, and a weight of 1000 grams was chosen for the purpose of completing the research. The pits were separated from the flesh of the fruit, and the pits were washed several times with tap water for the purpose of getting rid of the remaining fruit. Then they were dried at 40°C and left for the next day. Then they were ground in a suitable grinder, and the powder was stored in refrigerator[35.[

2.2Yoghurt manufacturing:

The yoghurt was made according to the method of Jasim and Al-Saadi [17]. Skim cow milk. The milk was dissolved in water (10%) and distributed into 4 treatments in sterile glass containers with a capacity of 1 liter, where the first three treatments (R1, R2, and R3) contained date pits at concentrations of

ISSN 2072-3857

0.75%, 0.5%, 0.25% respectively, and the last treatment was the control. Date pits were added to milk samples with agitation until complete dissolving, then milk samples were heated at 90°C for 10 minutes, then cool to 43°C, and the starter consisting of Streptococcus subsp thermophilus and Lactobacillus delbrueckii subsp bulgaricus was added, at a rate of 0.02%, and then it was packed in plastic containers with a capacity of (50 ml). The samples were incubated at a temperature of 42±1°C until coagulation, after that, the containers were cooled to the temperature of the refrigerator, and analyzes were performed on days 1, 7, 14, 21, 28.

2.3Chemical of yoghurt and date pitv:

The percentage of moisture, ash, fat, carbohydrate and total nitrogen of date pit powder and yoghurt, and the total acidity percentage of yoghurt were estimated according to what was mentioned in (A.0.A.C, 2010)[18]. The pH -value was determined by placing a pH -value meter electrode directly into the curd sample.

2.4Viscosity estimation

The viscosity value of curd samples was estimated at a temperature of 10 after 1, 7, 14, 21, and 28 days of refrigerated storage using a Brookfield DVIl+ viscometer and according to the method mentioned by (Ibrahim & Al-Saaid)[19]. The gel was broken by stirring with a glass rod (10 time clockwise; 10 time anticlockwise). Rotational viscosity measurements were done using a Brookfield viscometer (model DV- E; Brookfield Engineering laboratories) using spindle No 4. Each measurement was made at room temperature at 10 rpm for 1min.

2.5Whey syneresis

Spontaneous whey separation was determined according to the procedure described by (Laftaa, 2019)[20] A cup of the set yoghurt was removed from refrigerator at 7 ±1 ºC. A needle connected to syringe was used to withdraw the liquid whey from the surface of the sample and the cup of fermented skim was weight again. The process lasted for less than 10s to avoid further leakage of whey from the curd.

Water -Holding Capacity

It was estimated according to the method of (Ali & Al-Saadi, 2019)[21]. Briefly, 10 g of yoghurt was centrifuged at 5000xg for 10 min at 7 ±1 oC. The resulting supernatant was carefully removed, the sediment was weighed, and the water holding capacity was calculated according to the following equation:

Water holding capacity % = weight of precipitate/original weight of sample x 100

Texture analysis of yogurt samples:

The evaluation of textural properties was conducted using a texture analyzer (CT3(4500), Brookfield engineering lab). The texture of samples were measured. The operation conditions were an artificial plastic cylinder (20 mm in diameter) was inserted into each product to a depth of 20 mm with 5.0 g trigger and speed of 1 mm/s [22.[

Measurement of DPPH radical scavenging activity of yoghurt

Free radical scavenging activity was determined using the method of Son and Lewis (2002)[23], where 200 microliters of DPPH reagent was added to 30 microliters of whey (which was prepared by placing the samples at 45 for 15 minutes and transferring them to a centrifuge at 4000 rpm). (It was mixed well and placed in a dark place at room temperature for 30 minutes. Then the absorbance was measured at a wavelength of 517 nm using a spectrophotometer. The free radical scavenging activity of the samples was expressed as a percentage of DPPH absorption

inhibition according to the following equation(1:(

% DPPH scavenging activity=(AC-AS)/AC* 100

Where Ac is the absorbance of ethanol and As is the absorbance of the sample.

Sensory evaluation of yoghurt

At the Department of Dairy Science and Technology - College of Food Sciences / Al-Qasim Green University, eight panellists from among the staff members tested the taste, flavor, texture, color, and appearance of yoghurt samples using a sensory evaluation form developed by (Nelson and Trout, 1964)[24.[

Statistical analysis

Use the statistical program SAS - Statistical Analysis System (2018.(

Results and Discussion

-3.1Chemical composition of al-Zahdi date pit powder

The chemical composition of the powdered date pits used in this study was studied, as shown in Table (1), the percentages of fat, protein, moisture, ash, and carbohydrates were 4.5 ,7,6.27, 2 and 80.23 % respectively, and these values were very close to the results of previous studies on a group of varieties of date pits (Messadi et al., 2023)[25], (Attia et al., 2021)[26.[

Table (1): shows the chemical composition only Al-Zahdi date pit powder.

Component	***%***
Fat	4.5
Protein	7
Moisture	6.27
Ash	2
Carbohydrates	80.23

3.2 Chemical composition of yoghurt

3.2.1Estimating the percentage of fat:

Table (2) shows the chemical composition of the yoghurt. The percentage of fat in all yoghurt treatments and throughout the storage period was 0.1% , and this related to the fact that milk used in preparing yoghurt samples was skimmed. This result is consistent with what was found by (Ibrahim, 2016)[27], who indicated that the percentage of fat in the yoghurt prepared from skim milk powder contained 0.1% fat .

3.2.2 Estimating the percentage moisture

Table (2) shows the percentages of moisture yoghurt samples .In control treatments C, moisture value was 88.81% after the first day of refrigerated storage. This percentage is close to what Al-Abadi (2014)[28] found for fat-free yoghurt, which is 88.10%. The high ratio of water is due to the decrease in total solids due to the reduction of fat, and this is consistent with what was found by (Madadlou et al., 2005)[29], who indicated that the reduction of fat leads to an increase in the moisture content in the yoghurt. The moisture in treatments R1, R2, and R3, were 88.66, 88.54, and 88.30%, respectively , and during storage at 5±1°C, a slight decrease in moisture content was noted, as the percentages reached after 7 days for the control treatment C, to 88.73%, and for R1, R2, and R3 treatments it reached 88.60, 88.45, and 88.23%, respectively. After 14 days, the

ISSN 2072-3857

moisture for the control treatment reached 88.66%, and for the R1, R2, and R3 treatments reached 88.52, 88.34, and 88.15%. Respectively, and after 21 days, moisture in control treatment reached 88.59%, and in R1, R2, and R3 reached 88.46, 88.22, and 88.10%, respectively, while after 28 days moisture in control reached 88.54%, and in R1, R2, and R3 reached 88.39, 88.17, and 88.03. %, respectively. This indicates a decrease in moisture for all treatments after 28 days of storage and this may indicate an evaporation of moisture during the storage period, and these results are close to what was found by (Qureshi et al., 2011)[30], who studied the preparation and nutritional evaluation of yogurt fortified with garlic. The addition of al-Zahdi date pit powder treatments had a minor role in retaining moisture in the samples throughout the storage period compared to the control treatment. The results of the statistical analysis indicated that there was a significant difference as a result of the convergence of the values.

3.2.3 Estimating protein percentage

Table (2) shows the percentage of protein in yoghurt treatments to which al-Zahdi date pit powder was added in comparison with the control treatment. Protein values after the first day in the control treatment was 4.76%, which agrees with the result of Qureshi et.al. (2011)[30]. In yoghurt treatments to which the al-Zahdi date pit powder was added (R3, R2, R1),protein ratio were 4.79, 4.82, and 4.83%, respectively. It was noted from the results that there is slight increase in protein ratio with the increment of the addition rate of Zahdi date pits powder, this increase was attributed to an increase in total solids through the addition of Zahdi date pits powder in different concentrations which also contains 7% protein (table 1).The results in Table (1) also showed an increase in the percentage of protein for all treatments during storage. After 7 days, it was 4.79% for the control treatment, and for treatments R1, R2, and R3 it was 4.81, 4.84, and 4.86%, respectively, and these values changed after 14 days to 4.81% in the control and 4.83, 4.87, and 4.88% for the treatments R1, R2, and R3 respectively. After 21 days of storage, the percentage of protein in the control treatment was 4.85%, and for the treatments R1, R2, and R3 were 4.86, 4.89, and 4.90% respectively, and after 28 days the percentage of protein in the control treatment was 4.87% and for R1, R2, and R3 were 4.88, 4.91, and 4.92 % respectively. This is consistent with the results found by (Qureshi et al., 2011)[30], who indicated an increase in the protein content in the yoghurt from 4.76% after the first day to 4.80%. At the end of the 15-day storage period, and this increase in protein content during storage may be due to the decrease in the moisture content of the curd, which led to an increase in the percentage of total solids, including protein. The results of the statistical analysis indicate that there are non-significant differences at the level ($P>0.05$). in the percentage of protein between different milk treatments after the first day and during the storage period of 28 days.

ISSN 2072-3857

Table (2): Chemical composition of yoghurt treatments to which zahdi date pit powder was added during storage at 5 ºC for 28 day

Treatments		Storage time (day)	Moisture (%)	Protein (%)	Fat (%)	Carbohydrate (%)	Ash (%)	Tactic acidity %	pH
control	C	1	88.81	4.76	0.1	5.70	0.63	0.78	4.94
		7	88.73	4.79	0.1	5.74	0.64	0.80	4.91
		14	88.66	4.81	0.1	5.78	0.65	0.82	4.89
		21	88.59	4.85	0.1	5.80	0.66	0.87	4.85
		28	88.54	4.87	0.1	5.83	0.66	0.95	4.8
Zahdi date pit powder	R1 %0.25	1	88.66	4.79	0.1	5.80	0.65	0.79	4.95
		7	88.60	4.81	0.1	5.83	0.66	0.81	4.93
		14	88. 52	4.83	0.1	5.86	0.69	0.83	4.91
		21	88.46	4.86	0.1	5.89	0.70	0.84	4.9
		28	88.39	4.88	0.1	5.93	0.71	0.88	4.88
	R2 %0.5	1	88.54	4.82	0.1	5.85	0.69	0.80	4.98
		7	88.45	4.84	0.1	5.90	0.71	0.83	4.96
		14	88.34	4.87	0.1	5.97	0.72	0.84	4.92
		21	88.22	4.89	0.1	6.05	0.74	0.85	4.9
		28	88.17	4.91	0.1	6.13	0.75	0.86	4.87
	R3 %0.75	1	88.30	4.83	0.1	6.07	0.70	0.79	5.01
		7	88.23	4.86	0.1	6.10	0.71	0.81	4.83
		14	88.15	4.88	0.1	6.13	0.74	0.82	4.84
		21	88.10	4.90	0.1	6.18	0.75	0.85	4.87
		28	88.03	4.92	0.1	6.23	0.77	0.87	4.7
Value LSD			4.07 NS	0.392 NS	0.03 8 NS	0.661 NS	0.298 NS	0.319 NS	0.388 NS
non-significant.: NS									

3.2.4 Estimating the percentage of carbohydrates

Table (2) shows the percentage of carbohydrates in the yoghurt treatments to which date pit powder was added in comparison with the control treatment. Carbohydrates ratio in control yoghurt was 5.70%, and in treatments R1, R2, and R3 - was 5.80, 5.85, and 6.07%, respectively after 1 day of storage . The percentage of carbohydrates increased in yoghurt with the increment of date pit powder added to milk used for preparation ,and this is related to the fact that date pit powder contain 80.23% carbohydrate (table1). The percentages of carbohydrate after 7 days for the control treatment was 5.74%, and for treatments R1, R2, and R3 were 5.83, 5.90, and 6.10%, respectively. However, after 14 days of refrigerated storage, the percentage of carbohydrates for the control treatment was 5.78%, and for the treatments 5.86 ,5.97 and 6.13%. It is also noted that the percentage of carbohydrates increases with the progression of the storage period for all treatments. this increase is due to the percentage of total solids due to the small evaporation occurring in samples during storage. This result is in good agreement with what was found by (Qureshi et

al., 2011)[30], who indicated an increase in the percentage of carbohydrates in yoghurt during storage. After 21 days, carbohydrate in control reached 5.80%, and for transactions R1, R2, and R3 it was 5.89, 6.05, and 6.18%, respectively, and these values changed after 28 days to 5.83% in control and to 5.93, 6.13, and 6.23%, for R1, R2, and R3 respectively.

3.2.5 Ash percentage for yoghurt treatments

The results in Table (2) show the percentage of ash in the yogurt treatments containing Zahdi date pit powder in comparison with the control treatment. In the first day ash ratio in control treatment was 0.63%, and this percentage is close to what Hatem (2020)[31] found in yoghurt which was 0.65%, while ash ratio in treatments R1, R2, and R3 were 0.65, 0.69, and 0.70%, respectively. The percentage of ash increased in yoghurt with the increment of date pit powder added to milk used for preparation ,and this is related to the fact that date pit powder contain 2% carbohydrate (table1) in comparison with 0.7 % in milk(Al-Saadi, 2002)[32]. It is noted from the results that there was an increase in ash content in all treatments with storage, as the values after 7 days for control treatment was 0.64%, and for the treatments R1, R2, and R3 were 0.65, 0.66, and 0.71. % respectively, while after 14 days ash ratio in control treatment was 0.65%, and to other treatments were 0.69, 0.72, and 0.74%, respectively. This result is consistent with what was found by (Al-Badrani, 2017)[33], who indicated an increase in the percentage of ash in yogurt from 0.81% in the first day to 0.86% in the 14-day of storage period. After 21 days, the percentage of ash in the control was 0.66, and for treatments R1, R2, and R3 were 0.70, 0.74, and 0.75% respectively and these values changed after 28 days of storage to 0.66 for control yoghurt and 0.71, 0.75, and 0.77% for treatments R1, R2, and R3 respectively. These results agree with what was found by (Aziznia et al., 2008)[34], who indicated an increase in the ash percentage of low-fat yogurt treatments to which whey protein concentrates were added during storage .

3.2.6pH analysis:

The results in table (2) show the pH values of the yoghurt treatments .In the first day the pH for control treatment was 4.94, while pH for the treatments R1, R2 and R3 were 4.95, 4.98 and 5.01 respectively. It is noted from the results that the pH increases with the increment of date pit powder added to milk used to prepare yoghurt, and this is agree with the finding of Jambi (2018)[35], who indicated an increase in pH with increment of date pit extract addition to milk used for preparation of yoghurt. After 7 days, pH values for the control treatment was 4.91, and for treatments R1, R2, and R3 were 4.93, 4.96, and 4.83 respectively, while after 14 days of storage, pH for control treatment changed to 4.89 and for other three treatments to 4.91, 4.92, and 4.84, respectively, and after 21 days, the values for the control changed to 4.85 and for R1, R2, and R3 were 4.90, 4.90, and 4.72, respectively. After 28 days of storage, pH value of the control treatment decreased to 4.80 and for R1, R2, and R3 to 4.88, 4.87 and 4.70. This decrease in pH is due to the role of starter culture in conversion lactose to lactic acid during the storage period. These results are consistent with what was reported by (Mani-López et al., 2014: Faraki et al., 2020)[36][37] , who stated a decrease in pH of yoghurt during the 28-day storage period. It is noted from the results of the statistical analysis that there are no significant differences between the control treatment and

the rest of the different treatments during the storage period of 28 days.

3.2.7 Total acidity%

The results of Table (2) show the acidity(%) for the yogurt treatments in this study. Acidity for treatment C after 1 day was 0.78%, and this result is very close to what was found (Nawar et al., 2010)[38] for yogurt, which amounts to 0.8% and is close to what found by Al-Sheikh& Sarraf (2018)[39] found for yogurt, which was 0.81%. Acidity for treatments R1, R2, and R3 were 0.79, 0.80, and 0.79%, respectively. The acidity of all treatments increased during storage to reach 0.80% for control treatment, and 0.81, 0.83, and 0.81% for the other treatments, respectively after 7 days. After 14 days, the acidity for the control treatment changed to 0.82%, and for R1, R2, and R3 treatments to 0.83, 0.84, and 0.82% respectively, while after 21 days, the acidity for the control treatment reached 0.87%, and for the R1, R2, and R3 treatments were 0.84, 0.85, and 0.85%, respectively. After 28 days of refrigerated storage, the acidity for the control was 0.95%, and for R1, R2, and R3 were 0.88, 0.86, and 0.87%. Respectively, it was noted from the statistical analysis that there was a significant difference ($P \leq 0.05$) between the control treatment and yoghurt supplemented with the Zahdi date pit powder in different proportions. These results agreed with what was found by Kaur & Riar (2020)[40] who indicated an increase in acidity percentage in yoghurt treatments ranging during refrigerated storage. Yücer-Karagük, et. al.(2000)[41] stated that the metabolic activity of bacteria leads to the consumption of lactose and production various organic acids, mostly lactic acid, which leads to an increase in the acidity level and a decrease in the pH value in the yogurt between the different treatments during the storage period of 28 days.

3.3 Rheological characteristics of different curd treatments

3.3.1 Spontaneous whey separation

The results in Figure (1) show the amount of whey separated from the yoghurt supported with date pits powder in comparison with the control treatment. In the first day SWS in the control treatment was 0.90 ml/50 ml, which agrees with the finding of Sadiq &Dosh (2019)[42] who notice that SWS in yoghurt was 1.00 ml / 50 g ,while SWS in R1, R2, and R3 were 0.88, 0.86, and 0.92 ml / 50 ml, respectively. SWS in treatment R3 was higher than R1 and R2, and this maybe due to the fact that it contain higher concentration of protein which interact with each other leading to increase their hydrophobicity which allowing for whey to (Tomczyńska-Mleko, 2013)[43]. It is also observed that SWS increased in all treatments with storage, and after 7 days, SWS value for control was 1.3 ml/50 ml and for R1, R2, and R3 were 1.3, 1.0, and 1.2 ml/50 ml, respectively, and these values changed after 14 days to become 2.5 ml/50 ml for control yoghurt, and was 2.2, 2.2 and 2.0 ml/50 ml for R1, R2, and R3 respectively. After 28 days of storage, SWS for control treatment was 4.0, and for other three treatments were 3.4, 2.0, and 3.0 ml/50 ml respectively. From these results it was clear that adding date pits powder had positive in reducing SWS from yoghurt specially treatment R2 .

ISSN 2072-3857

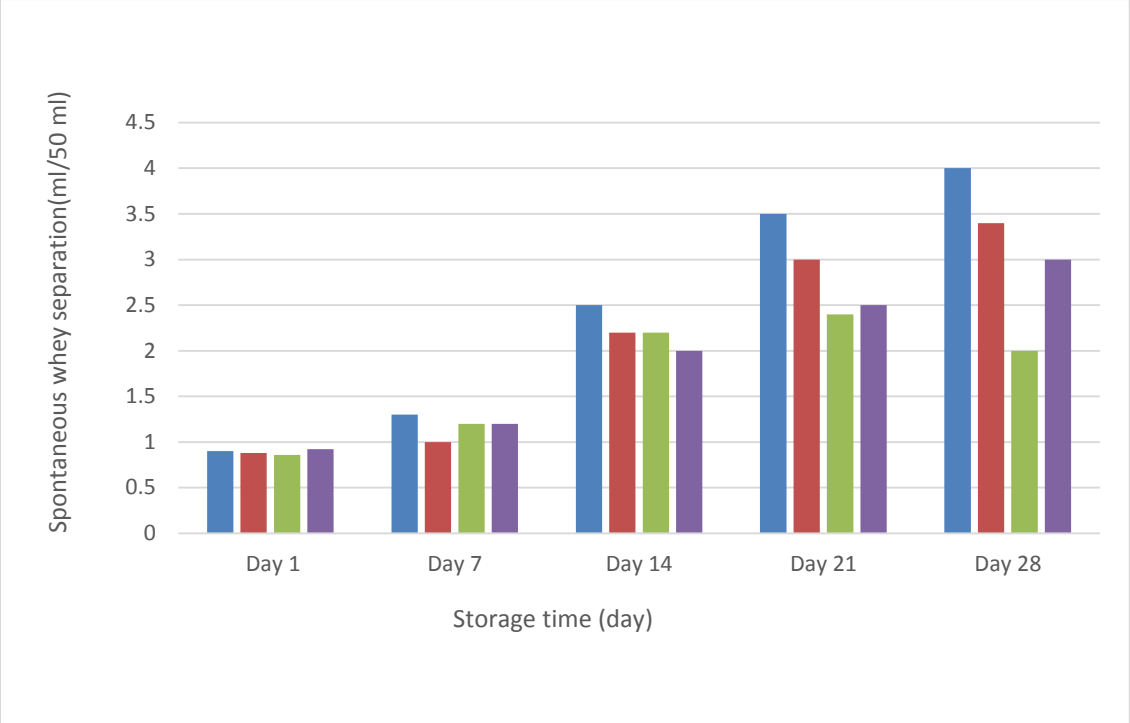

Figure 1. Effect of adding Zahdi date pit powder on spontaneous whey separation of yoghurt during storage at 5 ºC for 28 days . control yoghurt yoghurt with 0.25% date pit powder yoghurt with 0. 5% date pit powder yoghurt with 0.75% date pit powder ,LSD=1.085*

3.3.2 Water holding capacity%

The results in Figure (2) show water holding capacity of yoghurt fortified with date pit powder,. WHC of control treatment after day 1 of refrigerated storage was 56.10%, while its value for treatments R1, R2, and R3 were 51.54, 59.90, and 59.13%, respectively. It was noted from the results that WHC in R2, and R3 increased by adding date pit powder compared to the control sample, and this was confirmed by (Jrad, et al.,2019)[44] who indicated an increase in the WHC of yoghurt produced from goat milk fortified with date pits powder. After 7 days of storage, WHC changed to 59.33% for control treatment and to 59.93, 65.8, and 57.87% for R1, R2 and R3 respectively , and these values changed after 14 days, to 58.25% in control and 66.51, 62.57, and 59.33% for R1, R2 and R3 respectively , and these values changed after 21 to 49.7% for control and 65.87, 60.87, and 57.65% for R1, R2 and R3, respectively. These results consistent with Nanakali, et.al.(2023)[45] who found that the ability of the protein network to bind water is associated with the increasing protein content and increase links with other materials added to milk. However, after 28 day of storage, WHC in all treatments decreased and reached 47.9% in control treatment and 63.75, 59.65 and 55.87% for R1, R2 and R3 respectively , and this maybe related to the high increase in acidity, which affected the polarity of amino acids in proteins and increase its hydrophobicity. The results indicate that there is a significant difference between the different curd treatments during the refrigerated storage period of 28 days

ISSN 2072-3857

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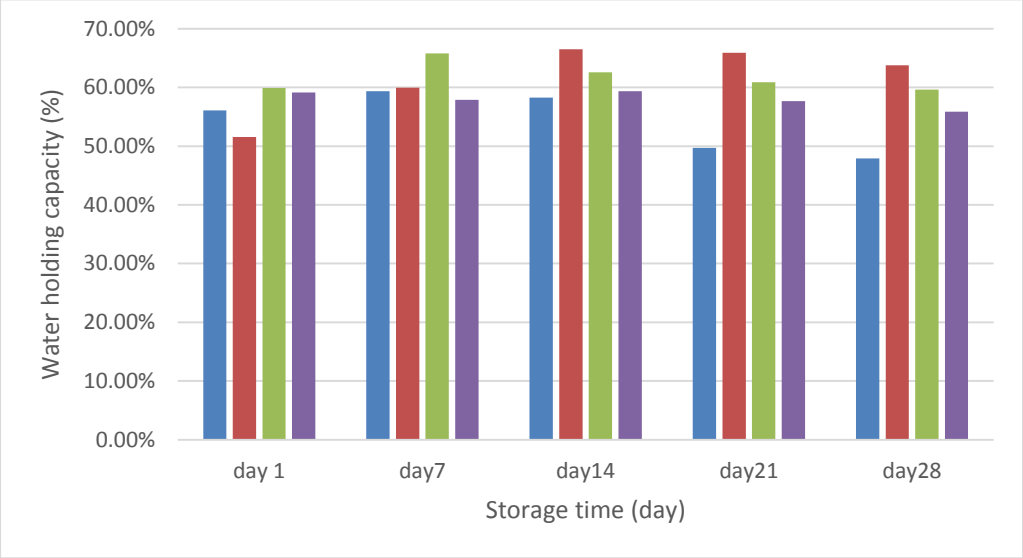

Figure 2. Effect of adding Zahdi date pit powder on Water holding capacity of yoghurt during storage at 5 ºC for 28 days . control yoghurt yoghurt with 0.25% date pit powder yoghurt with 0.5% date pit powder yoghurt with 0.75% date pit powder. LSD=7.088*

3.3.3 Viscosity

Viscosity is one of the factors that determine yoghurt quality and acceptance . The results ae shown in Figure (3) showed that viscosity in the first day of storage was 1360 cp for control yoghurt , and 1290, 1410, and 1520 cp for treatments R1, R2, and R3 respectively. It is noted from the results that the viscosity of yoghurt increased with the increase of date pit powder addition ratio, and this can explained by the role of date pit proteins in strengthening protein network of proteins in yoghurt , which leads to an increase in the size of protein complexes and thus increased viscosity (Siamand & Al-Saadi,2017)[46], beside that the carbohydrate present in date pit powder may play role in increase viscosity(Jambi, 2018)[35]. After 7 days of storage, the viscosity of the control treatment was 1347 cp, and for the treatments R1, R2, and R3 were 1270, 1470, and 1490 cp, respectively, and these values changed after 14 days to 1340 cp for control, and 1295, 1498, and 1482 cp for R1, R2, and R3 respectively. After 21 days, the percentages for the control treatment was 1332 cp, and for R1, R2, and R3 reached 1284, 1502, and 1475 cp respectively, and after 28 days of storage, the viscosity of all treatments decreased to 1310 cp control treatment and 1280, 1500, and 1475 cp for R1, R2, and R3 respectively. The change in viscosity among treatments is due to the role of date pit powder in formation crosslinks with other milk proteins which led to increase of casein micelles size and improve yoghurt viscosity (Nanakali, et.al.2023)[45.[

ISSN 2072-3857

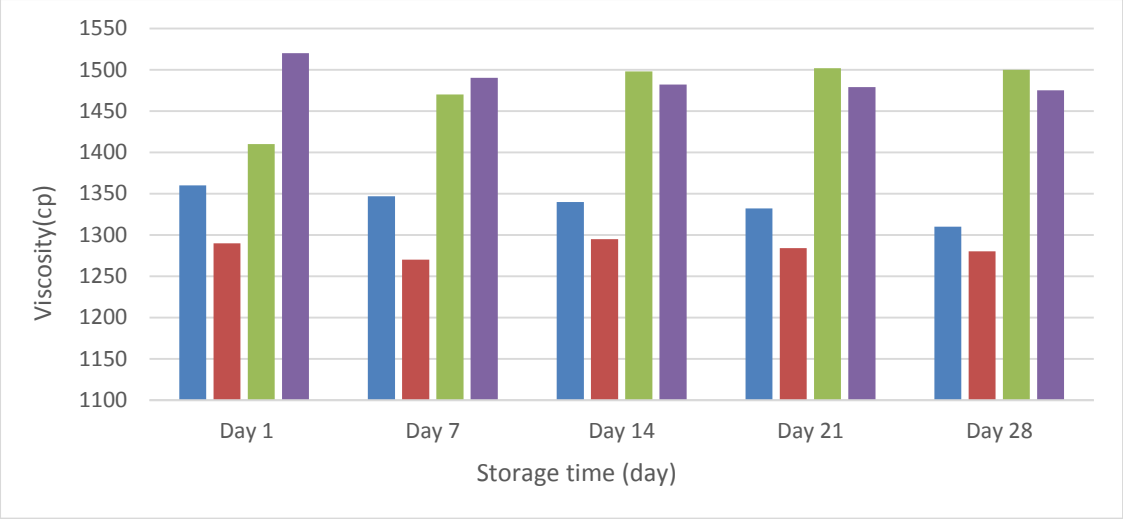

Figure 3. Effect of adding date pit powder on Viscosity of yoghurt during storage at 5 ºC for 28 days

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control yoghurt yoghurt with 0.25% date pit powder yoghurt with 0.5% date pit powder yoghurt with 0.75% date pit powder. LSD=94.175*

3.3.4Hardness

Figure (4) show the results of hardness test for yoghurt treatments to which Zahdi date pit powder was added in comparison with the control treatment. Yoghurt hardness in the first day for control was 71.2 grams and for the treatments R1, R2, R3 were 47.8, 76.5, and 108.9 g, respectively. It is noted from these results that hardness increased with the increment of date pit addition, and this is consistent with what was mentioned by Akalin et al. (2011)[47], who indicated an increase in the hardness of yoghurt with the increment of solids ratio. Hardness values changed during storage of yoghurt treatment until they reached to 46.2 g for control and 43.2, 103.2, and 70.1 g for R1, R2, and R3 respectively after 28 day of storage . It is noted from the results of an increase in the hardness of R2 and R3 treatment in comparison with control , and this is consistent with (Jrad et al., 2019)[44], who indicated that the problem of the weak texture of camel milk products can be solved by using date pit powder. Hardnes of R3 was less than Hardness of R2 iafter day 7 of storage and this may related that the high level of of date pit powder added to milk may affect the denaturation of β-Lg and its interaction with caseins which considered major factor effecting yoghurt hardness (Al-Saadi,2014)[48]. The results of the statistical analysis indicate the presence of significant differences ($P \leq 0.05$). Compared to the control treatment and the rest of yoghurt treatments stored in cold storage for 28 days.

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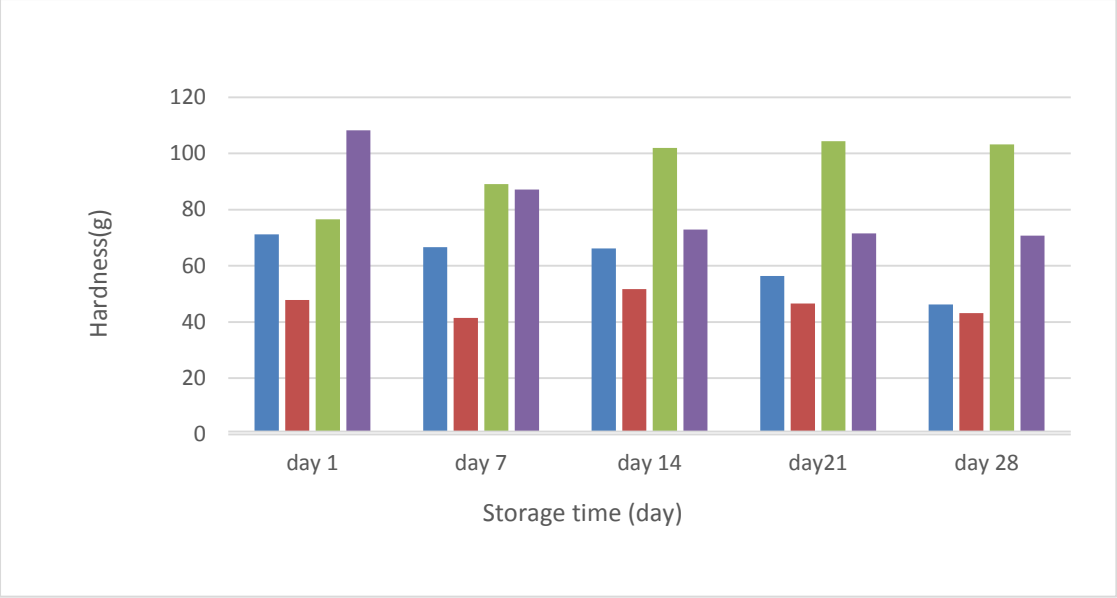

Figure 4. Effect of adding date pit powder on Hardness of yoghurt during storage at 5 ºC for 28 days

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control yoghurt yoghurt with 0.25% date pit powder yoghurt with 0.5% date pit powder yoghurt with 0.75% date pit powder. *(P≤0.05) LSD=2.124

.3.4Measuring the antioxidant activity of yoghurt

Figure (5) show the antioxidant activity of yoghurt treatments measured by the radical suppression percentage (DPPH), where the control yoghurt on the first day was 37.118%, while the treatment R1 , R2 and R3 were 43.147 ,45.848 and 47.557% respectively and these values changed during storage to 34.112 for control and 39.05,40.222 and 42.222 for R1 , R2 and R3 respectively after 28 day of cold storage . Antioxidant activity of control yoghurt related to native milk components and beside that, starter may produce enzymes which attack milk proteins and release peptides with antioxidant properties (Elfahri, et.al. 2016)[49]. From these result , there was an increase in the free radical suppression power with an increase in the concentration of date pit powder added to milk used for preparation yoghurt, and this is consistent with Jamb, (2018)[35] result who found an increase in the percentage of DPPH radical scavenging with an increase in the concentration of date pit powder used. The decrease in antioxidant activity of yoghurt with the progress of storage time occur because of phenolic compounds degradation or increased formation of complex by interaction of polyphenols with milk proteins (Yuksel et al.,2010)[50]. These results is consistent with (Elfahri et al., 2016)[49], who indicated a decrease in the DPPH radical suppression values of yogurt with increasing storage period

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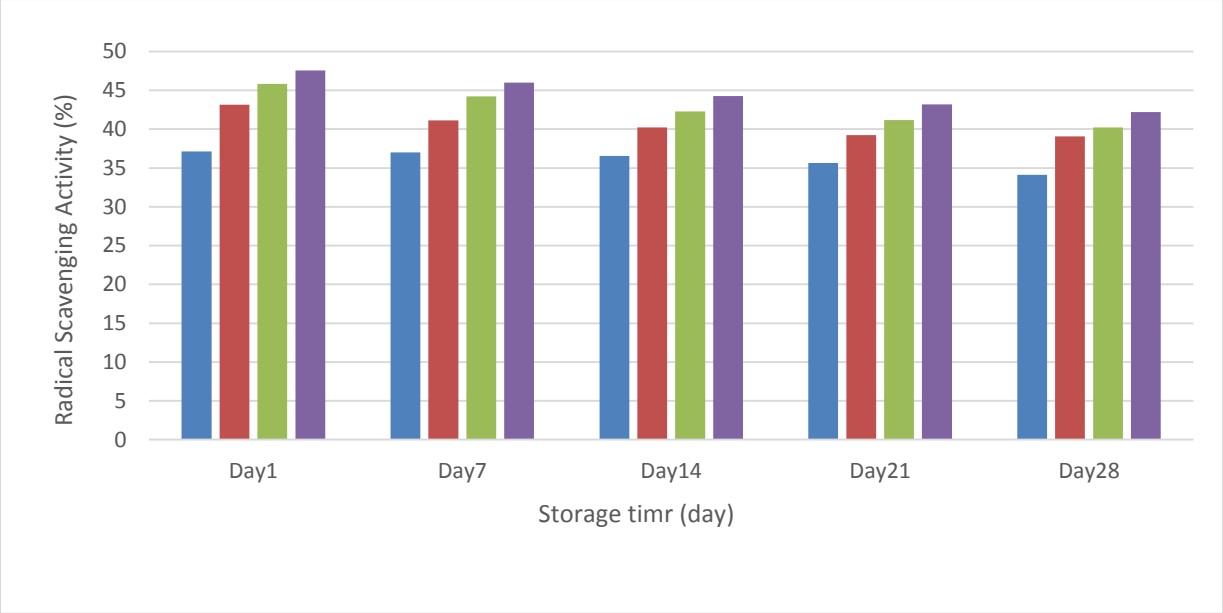

Figure 5. Effect of adding date pit powder on DPPH of yoghurt during storage at 5 ºC for 28 days . control yoghurt yoghurt with 0.25% date pit powder yoghurt with 0.5% date pit powder yoghurt with 0.75% date pit powder.

3.2 Sensory evaluation of yoghurt

Table (3) shows the results of the sensory evaluation of the yoghurt produced with the addition of date pit powder. The sensory evaluation results showed that yoghurt produced from skim milk treated with date pit powder was acceptable at all concentration used in this study. The yoghurt samples were tested for the characteristics of taste, flavor, texture, acidity, and appearance.

The results of the statistical analysis indicate that there were no significant differences between treatments with date pit powder compared to the control treatment at level($P \leq 0.05$) during cold storage at 5ºC for 28 days.

Table 3: Sensory evaluation results for curd treatments added to (Zahdi date pit powder) after the first day during storage at a temperature of (5±1) C for a period of 28 days.

Addition type	Treatment	Storage time (day)	Taste& flavor (45)	Texture (35)	Acidity (10)	Appearance (10)	Total (100)
Without adding	C	1	41	33	8	8	90
		7	42	32	8	8	90
		14	40	30	8	8	86
		21	41	31	8	8	88
		28	42	32	8	8	90
Zahdi date pit powder	R1	1	44	34	9	9	96
		7	43	33	8	8	92
		14	41	31	8	8	88

ISSN 2072-3857

	%0.25	21	41	31	8	8	88
		28	42	32	9	8	91
	R2 %0.5	1	42	32	9	9	92
		7	40	32	8	9	89
		14	40	30	8	9	87
		21	40	31	8	8	87
		28	40	31	9	8	88
	R3 %0.75	1	41	31	10	9	91
		7	40	30	8	9	87
		14	39	30	8	9	86
		21	39	30	8	8	85
		28	38	29	9	8	84
Value LSD			5.337 *	4.982 *	1.056 *	1.875 *	8.163 *
* P≤0.05							

Conclusion

The powder made from dates contains a high concentration of vitamins, minerals, dietary fiber, carbs, and antioxidants. The aim of this study was to add various ratios of date pit powder to yogurt in order to increase its acceptance and nutritional value. The physiochemical characteristics of yogurt samples made with varying proportions of powdered date pits were assessed through sensory evaluation, cold storage for 28 days at 4° C, and included measurements of pH, titratable acidity, synersis, minerals, dietary fiber, content, and antioxidant activity. The results showed that when the ratio of date pit powder was raised, pH levels and antioxidant activity gradually increased. Conversely, when the ratio of date pit powder increased, the acidity and synersis reduced. Over the course of the 28-day storage period, there was a steady reduction in pH values and an increase in acidity and synersis in all treatments. The was raised in the yogurt samples when the amount of date pit powder increased. Antioxidant activity also gradually decreased at 7, 14, 21, and 28 days, according to the results. Following 21 days of storage, the antioxidant activity of the yogurt samples showed the greatest decline. The appearance, flavor, texture, consistency, and general acceptability of the yogurt made with up to 0.25% date pit powder were comparable to that of the control yogurt. When compared to control yogurt, yogurt made with more than 0.25% date pit powder had a lower appearance, flavor, texture, consistency, and overall acceptability.

Acknowledgment: We are grateful to …….Funding sources should be acknowledged.

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