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PRODUCTION OF FUNCTIONAL CAMEL MILK ICE CREAM FORTIFIED WITH DATE DIBS AND DATE POWDER

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ABSTRACT

Date dibs or date powder was partially substituted to sugar content at 20, 40 and 60% on the physiochemical and quality characteristics of functional camel milk ice cream was studied. These physiochemical properties and quality characteristics included the specific gravity, weight per gallon, and rheological analysis of ice cream mixes, as well as on the specific gravity, weight per gallon, overrun, physiochemical characteristics and sensory evaluation of final ice cream. Results referred to that with increasing addition of date powder and date dibs, the resultant ice cream's specific gravity and weight per gallon were increased. Also, increased ratios of date dibs or date powder caused an increase for the rheological characteristics such as yield stress; plastic viscosity, consistency coefficient, and viscosity at 50 rpm with decreases in the flow behavior index compared to the control sample. By adding more date powder and date dibs, the final ice cream samples' specific gravity and weight per gallon increased and overrun decreased. Physicochemical and sensory characteristics were affected for up to 40 days of storage. The pH value and moisture content were decreased as the ratio of date products increased during storage period, while the value of titratable acidity, total protein fat(%), carbohydrate(%) and ash(%) were increased during storage period, also all samples' initial drip times measured while melting rates shrank. Finally, sensory scores of camel milk ice cream demonstrated that, the samples with 20% date dibs and 20% date powder were remarkably similar to the control sample; also, it can be concluded that date dibs and date powder could be used as sugar replacer.

INTRODUCTION

Ice cream is known as a frozen dessert made of dairy ingredients, flavorings, and sweeteners. The amount of air present, the size of the air cells, the viscosity of the aqueous phase, and the size and condition of fat globule aggregation all have an impact on the texture of the ice cream **(El Zubeir and Ahmed, 2015).**

The type of milk used in the mix preparation, has a significant impact on the product's characteristics, as well as the physical properties of the ice cream mixture resulting from different manufacturing processes, which may change its texture and consequently its physical appearance, all of these factors that affect the quality of ice cream. Along with having significant nutritional and health benefits, the global demand for frozen dairy products necessitates increased production from a readily available source such as camel milk **(Salem *et al.*, 2017).**

Date fruits are natural food products with a great nutritional value; they contain carbohydrates, proteins, fiber, vitamins, and minerals. Add different flavors to the ice cream, which is mostly imported and lacks nutrients complementary components of

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milk, high nutritional value, and has important religious and national dimensions **(Salem *et al.*, 2017).**

In addition to fresh dates, they go through many processing steps to create products including powder, syrup juice, jam, relish, pickles, vinegar, and alcohol **(Vijayanand and Kulkarni, 2012).**

Date dibs is the most popular processed date product produced in Egypt from the surplus of dates. Date dibs contained significant in glucose and fructose, as well as potassium, calcium, sodium, magnesium, citric, acetic, malic, oxalic, and succinic acids, and it has antioxidant and anti-hemolytic properties **(Bouhlali *et al.*, 2016; Derouich *et al.*, 2020).** As a result, date syrup is essential from a nutritional and medicinal viewpoint when used as a flavoring and sweetening ingredient in food products.

Hamad *et al.* (1983) investigated the use of date dibs as a sweetener and flavoring component in the production of ice cream. 50% of the sugar was replaced with combined with date syrup and 40% with water with satisfactory product was obtained.

The addition of dates and date syrup to ice cream increases its nutritional value by adding proteins, minerals, and vitamins **(Tammam *et al.*, 2014).**

The aim of this study was to produce camel milk ice cream supplemented with date dibs and date powder, and the effect of various levels of them on the ice cream's physiochemical, rheological, microbiological and several quality parameters of the ice cream were followed.

MATERIALS AND METHODS

Materials

Fresh camel's milk samples (3.17% fat) were collected from the herd of desert of Arish, Egypt. Skim milk powder (95% SNF) and Gelatin was obtained from local market of Arish, Egypt. Dried Sewi date was obtained from local market of Arish, Egypt. Date dibs were obtained from El-Tahan for Dates Company from local market of Arish, Egypt. Fresh cream (45% fat) was extracted from buffalo's milk, which was taken from the herd of Sharkia Governorate.

Ice Cream Mix Preparation

According to **Egyptian Standards (2005)**, the basic ice cream mix contained 0.5% gelatin, 8% fat, and 10.5% milk solids non-fat (MSNF). In the control mixture, sucrose was used to adjust the sugar content to 16%. Three replicates of seven ice cream mix treatments were created in accordance with **Youssef *et al.*, (2014)**. Date dips and date powder were used as sugar substitutes at 20, 40, and 60 *W/W*.

Methods of Manufacture Ice Cream

Seven experimental mixtures were prepared by using the ingredients mentioned above, and their compositions are shown in Table 1 and Fig. 1. In a blender, all mixes were blended for 2 minutes with the cooled basic mixes. The combinations (4 kg for each treatment) were aged at 4°C for 24 hours before being frozen in an ice cream maker. Eventually, before testing, the resultant ice cream was packaged in 120 mL cups and kept in a freezer at -18°C for at least 24 hours.

Resultant ice cream from camel milk was manufacture according to **Youssef *et al.* (2014)**. Seven treatments of ice cream were prepared as follows in **Fig. 1**

Physicochemical, Rheological Analysis and Sensory Evaluation if Ice Cream

Resultant ice cream treatments were analyzed for pH value, Titratable acidity, total solids (%), crude protein, fat, ash and total sugar according to **AOAC (2016)** after 0, 10, 20, 30 and 40 days of storage at -18°C. The obtained results were statistically

Table 1. Different formulas of ice cream replacer sugar with date dibs and date powder (amount per 100 kg mixture)

Formula	Milk (kg)	Cream (kg)	Skim milk powder (kg)	Gelatin (kg)	Sugar (kg)	Date dips (kg)	Date powder (kg)
T0	67	13.2	3.3	0.5	16	-	-
T1	67	13.2	3.3	0.5	12.8	3.2	-
T2	67	13.2	3.3	0.5	9.6	6.4	-
T3	67	13.2	3.3	0.5	6.4	9.6	-
T4	67	13.2	3.3	0.5	12.8	-	3.2
T5	67	13.2	3.3	0.5	9.6	-	6.4
T6	67	13.2	3.3	0.5	6.4	-	9.6

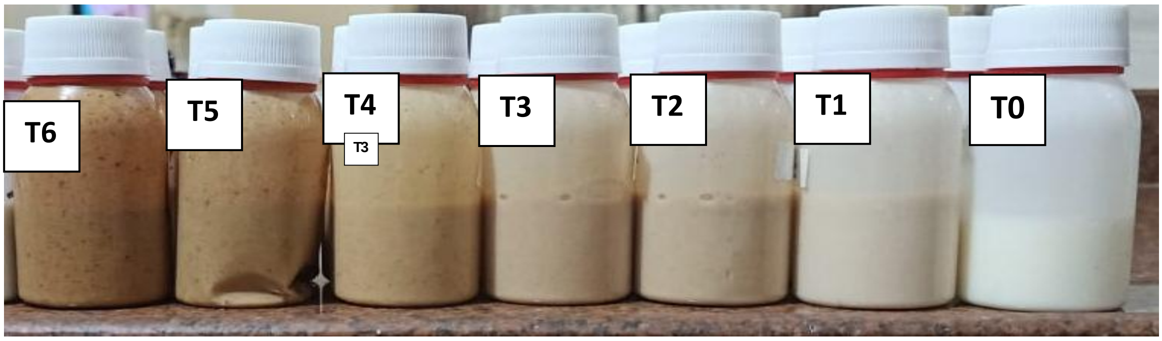

Fig. 1. Representation of dairy products developed by replacer sugar with date dibs and date powder, T0: control, T1: 20% dibs + 80% sugar, T2: 40% dibs+ 60% sugar, T3: 60% dibs + 40% sugar, T4: 20% date powder+ 80% sugar, T5: 40% date powder + 60% sugar, T6:60% date powder+ 40% sugar, were added as sugar substitutions

evaluated **(Murtaza *et al.,* 2004).** Specific gravity and weight per gallon of the mixture was established using the method outlined by **Youssef *et al.* (2014)**. Rheological properties of ice cream mix were described by **Hegedusic *et al.* (1993) and Youssef *et al.* (2014).** Specific gravity and weight per gallon of resultant ice cream was established according to **Youssef *et al.* (2014)**. Overrun was determined according to **Daw and Hartel (2015)**. First dripping time was recorded according to **Sert *et al.* (2021).** The sensory evaluation of camel milk resultant ice cream was evaluated by 10 panelists and evaluted according to the following parameters: 40 for flavour, 30 for texture, 10 for melting, 10 for colour, and 10 for appearance, and 100 for overall acceptability. This was determined according to **Salem *et al.* (2017) and Mostafa *et al.* (2020).**

Statistical Analysis

Data were statistically analyzed with a randomized complete block design (RCBD) by using Co-STAT software, V.6.13 (CoHort software, Berkeley, CA 94701) with three replicates and each replicate was represented by two trees. Mean values of treatments were differentiated by using least significant range (Duncan's multiple range tests) at 0.05% level probability.

RESULTS AND DISCUSSION

Effect Addition of Date Dibs and Date Powder on some Characteristics of Ice Cream Mix

The effect of addition of date dibs and date powder on some characteristics of ice cream mixes are showed in Table 2. These results showed that the varying percentage ratios of date powder and date dibs used to replace sugar in ice cream mixes had a significant impact on their specific gravity and weight per gallon. These were gradually increased with different percentage of date dibs and date compared to the control treatment.

From these results, it could be noticed that addition of date dibs and date powder caused an increase in ice cream mix's specific gravity and weight per gallon. These results are in a similar trend with the result of **Ismail *et al.* (2020)**.

Effect of Addition Date Dibs and Date Powder on Rheological Properties of Ice Cream Mixes before and after Aging

Ice cream's viscosity is a crucial Viscosity not a component that contributes to its attractive texture **(Innocente *et al.*, 2002).** On the other hand, Viscosity significantly affected ice cream's ability to melting resistance and overrun **(Muse and Hartel, 2004)**. Since the beginning of time, food has been produced using foams (the whipping process). Foams produce distinct textures and feelings that range from light and airy (like beer) to deep and substantial (like bread or ice cream).

In addition, foams are categorized as either solid or liquid based on their rheological characteristics. When manufacturing confections, engineering features like pumping and mixing are crucial, as is the ability to characterize foam through its rheology **(Youssef *et al.*, 2014).**

The results in Table 3 demonstrating the changes in consistency coefficient, plastic viscosity, yield stress and 50 rpm viscosity for ice cream mixes with different sweeteners before aging.

It could be noticed that consistency coefficient, plastic viscosity, yield stress, 50 rpm viscosity and shear sensitivity، increased by adding date dibs or date powder to ice cream mix, but flow behavior index (n) decreased.

Shukr and Muhsin (1984) found that ice cream mix viscosity was increased as the date juice concentration was increased. Also, **Hamad *et al.* (1989)** found that date syrup (dibs) was added to the ice cream mixture to increase viscosity. According to Table 3, ice cream mix date dibs 20% had the minimum viscosity (T1) and the maximum in the date powder 60% ice cream mix (T6).

The sugar substitution by date powder in Treatments (T4, T5 and T6) had maximum rheological characteristics expressed as apparent viscosity, plastic viscosity, yield stress and consistency coefficient index among treatments ice cream mixes but flow behavior index was decrease with increase of sugar substitution by date powder. Generally, viscosity values in date dibs and date powder ice cream increased in parallel with increased concentration.

The increase in date dibs ratio also demonstrated a linear increase on viscosity. Similar results were reported by **Guven *et al.* (2003)** who showed that as fruit concentration increased, as the viscosity values in fruit frozen yoghurt were increased.

Table 2. Effect of addition date dibs and date powder on specific gravity and weight per gallon of ice cream Mix (average of three replicates)

Mix properties	Specific gravity (g cm^{-3})	Weight per gallon (kg)
T0	1.1037 d ±0.019	5.018 d ± 0.084
T1	1.113 cd ±0.018	5.059 cd ±0.230
T2	1.116 c ±0.002	5.073 c ±0.007
T3	1.122 b±0.015	5.101 b ±0.068
T4	1.119 c ± 0.018	5.087 c ±0.082
T5	1.121 bc ±0.01	5.096 bc ±0.045
T6	1.135 a ±0.003	5.159 a ±0.014

T0 control; T1 20% dibs + 80% sugar; T2 40% dibs+ 60% sugar; T3 60% dibs + 40% sugar; T4 20% date powder+ 80% sugar; T5 40% date powder+ 60% sugar; T6 60% date powder+ 40% sugar. Data are means with three replicates ± SD

a,b,c,d,e,f,g,h: means with the same letter among the treatments or storage periods are significantly different (p≤ 0.05).

Table 3. Rheological properties (at 10°C) before and after aging of camel milk ice cream mixes 24 hours at 4°C

Ice cream mix	Parameters for different models				
	Power law		Bingham		IPC paste
	K	n	η	τ °	50 rpm viscosity
			before aging		
T0	240.867e ±20.65	0.8 bc±0.03	950.9 c± 14.5	6.167 d ±0.35	1365 d±10
T1	223.3 f ±33.1	0.72 c±0.03	663.267 f ±21.55	6.973 d±3.10	987.5 f± 62.5
T2	319.73 cd±34.10	0.68 cd ±0.01	824.6 e± 64.8	7.58 cd±0.85	1287.33 e ± 112.50
T3	399.93 c ±57.10	0.65 cd ±0.04	864.4 d ±36.4	9.22 c ±1.09	1425 d ±25
T4	504.13 b± 0.81	0.65 cd±0.05	924.667 c± 26.00	11.03 bc± 0.15	1572.33 c± 22.50
T5	500.867 b± 3.78	0.65 cd±0.01	1158.33 b±41.50	12.067 b± 0.12	1913.33 b± 37.53
T6	1394.67a± 109.50	0.51 d ±0.01	1622 a ± 17	29.067 a± 2.10	3312.3 a ± 112.50
			after aging		
T0	486.3 bc± 42.8	0.62 b ±0.025	919.3 d± 14	11.15 bc ±0.55	1587.5 c± 12.5
T1	366.767 cd±53.65	0.677 b± 0.03	762 e± 35	8.49 cd ±1.02	1272.67 d ±22.50
T2	475.167bc ±49.55	0.64 b±0.01	1002.33 c± 77.50	11 bc±1	1675 c± 125
T3	461.167 bc±68.35	0.64 b±0.04	1126 b± 37	11.467 b± 1.45	1835 b ±115
T4	548.73 c ± 1.15	0.62 b± 0.01	1035.33c ± 27.50	12.6 b± 0.2	1800 b± 25
T5	1021.33 b ± 4.51	0.55 c ± 0.01	1373.67ab± 50.01	22.3ab ± 0.265	2700 ab± 50
T6	2132 a±168	0.53 c±0.02	2256.3 a± 23.50	44.07 a± 3.20	4775 a± 175

K= Consistency index (mPa.s), n= Flow index (dimensionless), η= Plastic viscosity (mPa.s),
τ= Yield stress (N m-2), 50 rpm viscosity, (mPa.s).

Due to the hardening of fat particles and the potential formation of complexes between components like gelatin and sugars with ageing, viscosity and other rheological parameters such as flow behavior index (n) were increased with ageing.

The consistency coefficient, plastic viscosity, yield stress, 50 rpm viscosity and shear sensitivity were increased for control. While, flow behavior index (n) decreased from 0.8 before aging to 0.62 after aging of control. The mixes that contained date powder and date dibs showed the same pattern.

The cause of higher viscosity is related to a higher water binding capacity of stabilizers (**Kurultay *et al.*, 2010**).

Effect of Addition Date Dibs and Date Powder on Physicochemical Attributes of Camel Milk Resultant Ice Cream

Specific gravity and weight per gallon

Table 4 illustrates specific gravity and weight per gallon of resultant ice cream made from camel milk**.** These values were affected by the different percentage ratio of sugar substitution. Comparatively to the control, the specific gravity as well as weight per gallon of the ice cream increased when dibs and date powder were added **(Salem *et al.*, 2005)**.

Table 4 demonstrates some properties of the resultant ice cream as affected by using different percentage ratio of sugar substitution on the ice cream mix.

Specific gravity and weight per gallon of camel milk ice cream increased significantly ($p<0.05$) with the addition of dibs as sugar replacement. These results agree with **Youssef *et al.* (2014)**.

The inclusion of air during the pre-freezing process decreased the specific gravity of the resulting ice cream, causing the specific gravity of the ice cream mix to be higher than that of the resulting ice cream, which had a significant impact on the density of the ice cream. This may be caused by the specific gravity of the formula's ingredients as well as the mix's capacity to retain air bubbles and the percentage of overrun in the resulting ice cream. These results were consistent with those mentioned by **Abd El-Rashid and Hassan (2005)**.

Overrun (%)

Overrun is a measurement that depicts an increase in ice cream volume **(Marshall, 2003).**The overrun (%) values of treatments are reported in Table 4. These values were decreased as the date dibs and date powder level increased in the mix.

It was noticed from the same Table that the overrun values of ice creams being highest in control compared with other treatments. There are significantly differences for overrun values ($p <0.05$) between control and those of other ice cream enrichment. The highest mean overrun value was observed in the control, it was followed by (T1), (T2) and (T3) samples for date dibs. Also, (T4), (T5) and (T6) samples had overrun values down. Depending on the results, increasing the ratio of date dips and date powder decreasing the overrun values.

Highest overrun was observed in T0 sample whereas the lowest overrun was obtained in T3 sample.

The decreasing of overrun and increasing of both specific gravity and weight per gallon of ice cream by increment of levels of date dibs and date powder ratio may be due to increasing of mix’s viscosity.

By raising the viscosity of the mix, which has significant effects on the mixing rate, the overrun decreased while the specific gravity as well as weight per gallon of resultant ice cream increased **(Arbuckle, 1986)**.

Table 4. Effect of addition date dibs and date powder on specific gravity and weight per gallon of camel milk resultant ice cream

Ice cream resultant	Specific gravity (g cm^{-3})	Weight per gallon (kg)	Overrun (%)
T0	0.664 c ±0.008	3.019 c±0.037	55.31 a ± 2.17
T1	0.694 b ± 0.001	3.155 b ±0.003	36.31 bc ± 2.31
T2	0.698 b ±0.008	3.173 b ±0.039	31.57 de ± 1.88
T3	0.723 a ± 0.002	3.287 a ±0.01	29.64 f ± 1.77
T4	0.674 c ±0.007	3.064 c ±0.033	38.74 b ± 1.57
T5	0.687 b ±0.005	3.123 b ±0.020	36.69 bc ± 2.45
T6	0.695 b ±0.016	3.159 b ±0.070	32.33 de ±3.36

Youssef *et al.* (2014) reported that the addition of more date products increased the specific gravity as well as weight per gallon of the resultant ice cream samples, but decreased overrun percentage.

The percentage of overrun grows with the number of total solids employed in the formulation, and the overrun for frozen dairy dessert depends on those total solids **(Marshall, 2003).**

This pattern is consistent with earlier studies that the overrun was greatly exacerbated by sugar concentration **(Güven and Karaca, 2002).**

pH value and titratable acidity (%) values

The pH values were significantly affected by resultant ice cream samples with variety ratio of date dibs and date powder as sugar substitution as well as storage period (Table 5). This data confirms that the pH of treatments gradually decreased significantly during storage (40 days). After 40 days of storage, the pH value decreased by the most in the T5 sample (6.247), and in the T0 sample (6.54).

Moreover, the highest value of pH was observed in (T0) and (T1), while the minimum value of pH was observed in (T5) at zero time of storage. Similar results were recorded at 10, 20, 30, and 40 days of storage period.

The reason for the decrease in pH might be due to increase in acidity. Acidity causes changes during storage which affects the pH a well as acceptance of ice cream.

According to the findings of the ANOVA test, the addition of date palm products significantly changes the pH of the resultant ice cream during storage compared to the control sample without additives (p-value < 0.05).

During storage, the acidity of every sample of ice cream significantly increased ($p< 0.05$) (Table 5). The date dibs samples had the greatest levels of acidity, which were then followed by date powder and the control at zero day.

In accordance with pH values, the highest acidity values were determined for T3 followed by T6 sample.

The highest value of acidity (0.248) was observed in (T5), while (T0) at the beginning of storage time had the lowest acidity value.

Similar results were recorded at 10, 20, 30, and 40 days of storage period. In this investigation, pH was looked at as a number that was solely tied to the product's acidity. With the amount of date palm products in the blend, titratable acidity values tended to slightly increase and pH values to decrease. Similar results reported by **Youssef *et al.* (2014).** Because of acid

Table 5. pH value and titratable acidity of camel milk resultant ice cream fortified with date dibs and date powder during storage period up to 40 days at -18 °C

Treat.	storage period (day)									
	pH					Titratable acidity				
	0	10	20	30	40	0	10	20	30	40
T0	6.78a ±0.01	6.7 a ±0.01	6.66 a ±0.01	6.58 a ±0.01	6.54 a ±0.01	0.17 c ±0.01	0.174e ±0.006	0.178 e ±0.004	0.184e ±0.001	0.189e ±0.005
T1	6.5 b ±0.03	6.43 bc ±0.02	6.39 c ±0.01	6.35 c ±0.00	6.31 b ±0.012	0.221b± 0.002	0.226cd ± 0.005	0.231 d ± 0.004	0.235d ± 0.004	0.246d ±0.005
T2	6.49bc ±0.01	6.42c ±0.015	6.39 c ±0.01	6.36 b ±0.03	6.30 c ±0.01	0.235b ±0.005	0.241 b ± 0.004	0.245 c ± 0.002	0.252c ±0.004	0.26 c ±0.005
T3	6.48bc ±0.01	6.44 b ±0.01	6.39 c ±0.01	6.34 d ±0.01	6.30 c ±0.01	0.245 a ±0.015	0.245 ab ± 0.01	0.258 b ± 0.005	0.266b ±0.006	0.271b ±0.007
T4	6.48bc ±0.01	6.407c ±0.006	6.377d ±0.021	6.35 c ±0.01	6.30 c ±0.01	0.24 a ± 0.01	0.234bc ±0.011	0.236 d ± 0.005	0.239d ± 0.005	0.245d ±0.001
T5	6.44 c ±0.01	6.39 cd ±0.01	6.35 e ±0.01	6.29 e ±0.01	6.247 d ±0.006	0.248a ± 0.01	0.259 a ± 0.01	0.262 ab ± 0.003	0.266b ±0.007	0.27 b ±0.005
T6	6.49 bc ±0.01	6.447b ±0.006	6.4 b ±0.01	6.34 d ±0.036	6.30 c ±0.00	0.24 a ± 0.01	0.248 ab ± 0.016	0.267 a ± 0.003	0.275a ±0.006	0.283a ±0.003

coagulation during the synthesis of lactic acid, ice cream's pH was lower **(Tobaruela *et al.*, 2018)**.

Moisture (%)

It is clear from the data presented in Fig. 2 that, between the treatments and the control, there were significant differences in ($p \leq 0.05$) moisture, total solid, total proteins, fat, carbohydrates, and ash between treatments and control.

The 40 days storage period were accompanied by a decreasing trend in the moisture levels, which had an opposite effect on total solids. Similar, results were previously reported by **Bajwa *et al.* (2003)**.

Total proteins

It was clear from Fig. 3 that total proteins content of all treatments were significant different ($p \leq 0.05$) and gradually increased during storage period resultant Ice cream (T4) had the highest TP content valued 4.19%, while the lowest value obtained 3.0167 % was in (T3) at zero time of storage.

The highest TP content was recorded of ice cream resultant with (T4) 4.4% followed by Ice cream resultant with (T6) 3.997%, while the lowest value was in (T3) 3.09 % often 10 days of storage and similar results were recorded at 20, 30, and 40 days of storage period. The increase in TP content of all treatments through the storage period was probably due to the increase in total solid as shown in Fig. 3 and the decrease in moisture during storage period.

The ability of proteins to enclose the air cells during the freezing process is one of the key functions of proteins in ice cream. In the case of ice cream, the protein standard was specified as 3.28% by **Keller *et al.* (1987)**.

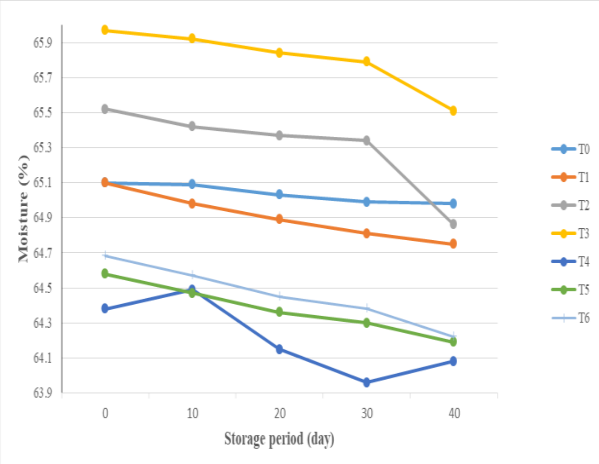

Fig. 2. Moisture (%) of camel milk resultant ice cream made by replacing of sucrose with different ratios of date dibs and date powder during storage for 40 days

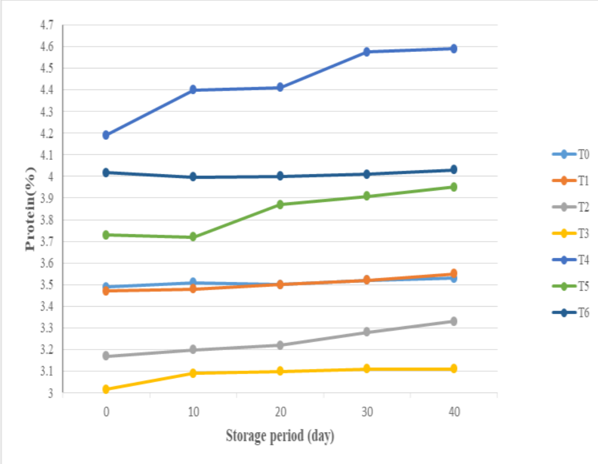

Fig. 3. Proteins (%) of camel milk resultant ice cream made by replacing of sucrose with different ratios of date dibs and date powder during storage for 40 days

Fat (%)

It was clear from Fig. 4 that the fats % value of all treatments were significant different ($p \leq 0.05$) and gradually increased during storage period, whereas the value of control treatment was lower than the others over the storage period.

Ice cream with (T4) had the highest value 8.96%, whereas the lowest of 8.17% was found in control at zero time.

The highest fat content 8.97% was in (T4) followed by resultant ice cream with (T1) 8.76 %, while the lowest value was in (T6) 8.17 % often 10 days of storage and similar results were recorded at 20, 30, and 40 days of storage period.

All elements of food perception, such as appearance, texture, flavor, and mouth feel, were impacted by fat. The fats were a significant source of calories and another concentrated source of energy in ice cream **(Abdullah *et al.*, 2003)**.

Ash content (%)

Fig. 5 shows a rising trend in the amount of ash recorded across all treatments as storage time increased, but statistical analysis indicated no statistically significant relationship between treatments and storage times**,** whereas the value of (T4) treatment was lower than the others over of storage period.

The ash content of the resultant ice cream increased with incorporation of date powder ratio as sugar substitutions, whereas the dibs ratio as sugar substitutions caused a decrease in ash content because of the increased or decreased amount of ash in added preparations.

These results are similar to those previously reported by **Gabbi *et al.* (2018)**.

Carbohydrates (%)

It was clear from this Fig. 6 that the total carbohydrates content of all treatments were significant different ($p \leq 0.05$) and gradually increased during storage period, whereas the value of (T6) treatment was lower than the others over the storage period.

Total carbohydrates (%) content of camel milk ice cream resultant were decreased significantly with the incorporation of ratio of date powder and dibs as a sugar substitution.

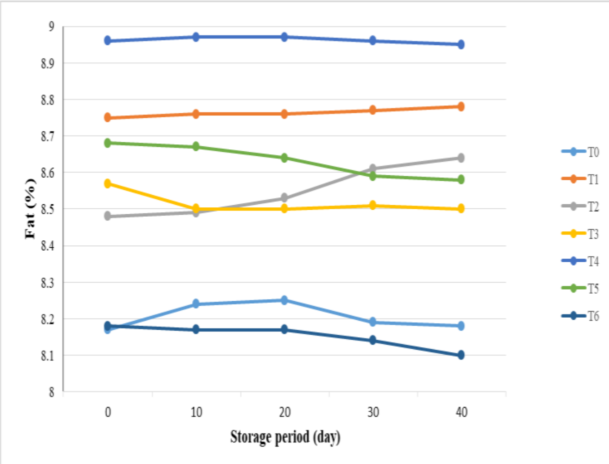

Fig. 4. Fat (%) of camel milk resultant ice cream made by replacing of sucrose with different ratios of date dibs and date powder during storage for 40 days

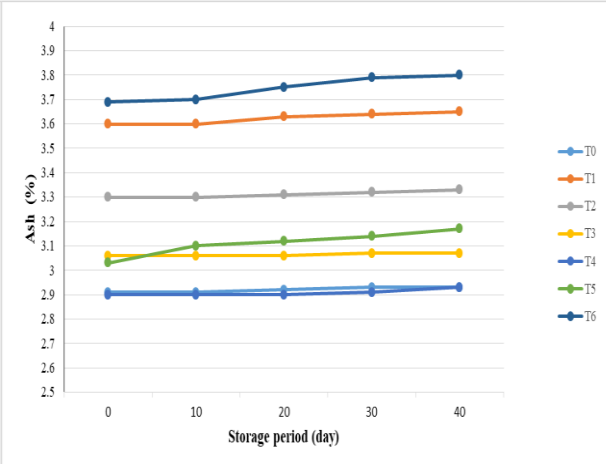

Fig. 5. Ash (%) of camel milk resultant ice cream made by replacing of sucrose with different ratios of date dibs and date powder during storage for 40 days

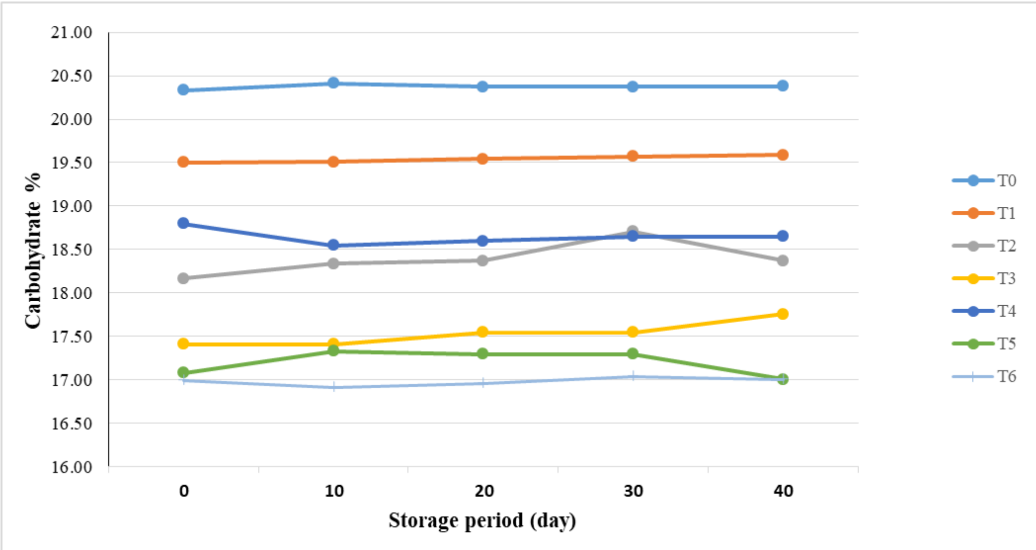

Fig. 6. Carbohydrates (%) of camel milk resultant ice cream made by replacing of sucrose with different ratios of date dibs and date powder during storage for 40 days

Control ice cream resultant (T_0) had the highest value 20.33 %, whereas the lowest of 16.99 % was found in (T6) at zero time. Similar results were recorded at 20, 30, and 40 days of storage period.

Because it lowers the freezing point, increases the quantity of unfrozen material, increases viscosity, and decreases the amount of free water, adding sugar to ice cream gives it a smooth texture. Ice cream mix's freezing point was lowered by sugar, which also gave the product more sweetness and prevented it from freezing solid in the freezer **(Abdullah *et al.*, 2003).**

Melting rate of camel milk ice cream

The time for the first drip significantly ($P \leq 0.05$) increased with the addition of date dibs and date powder as well as storage period.

The shortest melting time 17.9 min was recorded for (T0) sample, whereas the longest 27.7 min for the ice cream resultant (T6) (Fig. 7) at zero time. Similar results during storage for 40 days.

The First dropping time (minutes) of ice cream was reduced (Fig. 7) as the storage period rose from 0 to 40 days.

According to the results, by increasing the amount of date dibs and date powder as sugar substitution the first dripping times of samples were prolonged.

The results showed that the first dripping times decreased 27.7, 23.37, and 19.27 minutes, respectively, and also decreased 19.25, 19.23 and 18.36 minutes, respectively, by increasing ratio of date dibs and date powder as sugar substitution of ice cream from 20, 40 to 60% *W/W*. The melting of the ice cream was retarded by date dibs and date powder.

Initial drip time increased with storage due to a decrease in moisture content and formation of ice crystals, which required longer melting **(Muse and Hartel, 2004).**

When assessing ice cream's quality, the appropriateness of the technology chosen, and the freezing settings, melting is a crucial consideration **(Góral *et al.*, 2018)**

As the sugar amount and fruit concentration were increased, the first dripping time lengthened and the melting rate decreased **(Güven and Karaca, 2002).**

Sensory Evaluation of Ice Cream Formulas from Camel Milk

Sensory evaluation of camel milk resultant ice cream as impacted by fortified with date dibs and date powder. It is a crucial factor in determining the ice cream's quality and shelf life.

Flavor

Fig. 8 presents the result of flavor score of camel milk resultant ice cream as impacted by replacement of sugar by date dibs and date powder, results showed that's flavor values during storage period 40 days in all treatments gradually decreasing.

There was significant different ($P \leq 0.05$) among treatments. The highest score of flavor was detected in (T0) ice cream, followed by ice cream resultant with dibs (T1 and T2), while the lowest value was in ice cream with (T6) at zero time.

Similar results were obtained at 40 days of storage, and the value gradually decreased until the end of storage for all treatments.

The best flavor scores for camel milk ice cream samples were obtained for (T0) followed by (T1) and (T4) ice cream samples. date products like date dibs and date powder give the ice cream made from camel milk good taste and flavor because it has flavoring substance. The present study observed that camel milk had sharp taste (mineral like) and predominant grassy flavor, with slightly salty taste and the addition of date dibs and date powder in ice cream has hidden the grassy taste of camel milk.

One of the most crucial elements affecting the viability of ice cream products is flavor **(Abdullah *et al.*, 2003).**

El-Owni and Khater (2010) reported that color, texture, taste and overall acceptability were significantly affected by the flavor.

Texture

Fig. 9 show the given texture scores by panelists results exhibited significant ($P<0.05$) variations between the various flavors of camel milk ice cream during the

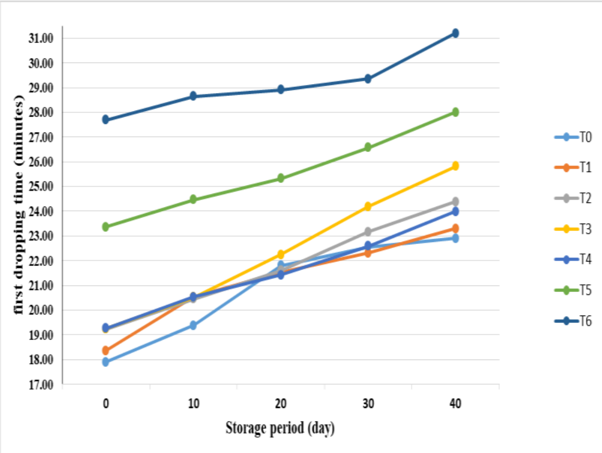

Fig. 7. First dropping time (minutes) of ice cream resultant formulas from camel milk during storage for 40 days

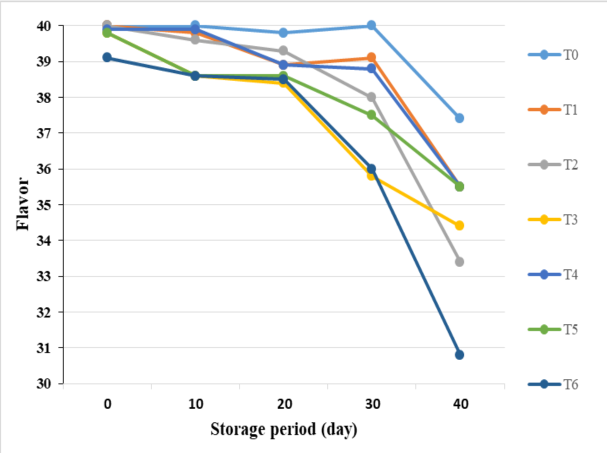

Fig. 8. Average flavor score of camel milk ice cream with date dibs and date powder as sugar substitution during storage 40 days

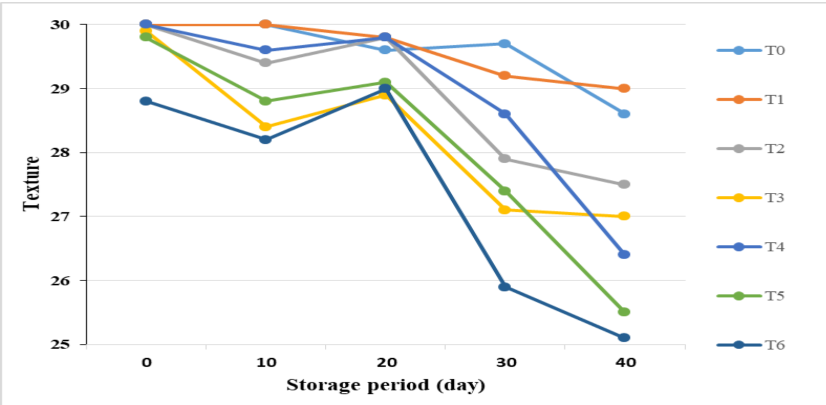

Fig. 9. Average texture score of camel milk ice cream with date dibs and date powder as sugar substitution during storage for 40 days

40 days of storage period. Treatments (T0), (T1), (T2), and (T4) had the highest scores, while ice cream (T6) at zero time had the lowest value. Similar results during storage for 40 days were observed.

The size, quantity, and arrangement of air cells, ice crystals, lactose crystals, and fat concentrations all directly influence the texture of the ice cream **(Granger *et al.*, 2005).**

One of the key characteristics of ice cream is its texture, and the most problematic texture is abrasive or harsh because of the huge size of the ice crystals, which are mostly brought on by thermal shock **(Lindamood *et al.*, 1989).**

Color

In terms of the effect of different treatments on the color of resultant ice cream the results in Fig. 10 show that there were significant variations between the treatments and the control sample during storage period for 40 days.

The best samples were recorded for the control sample color, followed by (T1), (T2), (T4), (T5), while the lowest (T6) was at zero time. Similar results were recorded at 10, 20, 30 and 40 days of storage.

Regarding color, the substitution with date dibs and date powder 20% significantly enhance the color acceptability compared to control. By increasing the ratio of date dibs and date powder at 40 and 60% the ice cream color became less white and less acceptable and this is may be due to the color of the date products.

Melting

Fig. 11 shows that the best samples were recorded for the control sample Melting, followed by (T1), and (T4), while the lowest (T6) was at zero time.

The value of melting score gradually decreased until the end of storage for all treatments.

Substitution of sugar with date dibs and date powder at 40 and 60% significantly lower the melting quality of the resultant ice cream.

Appearance

Fig. 12 indicate that, there is a significant different ($P \leq 0.05$) among treatments and control during storage.

The best samples were recorded for the control sample appearance, which might be due to its white color. followed by (T1), (T4), (T5) While the lowest (T6) was at zero time.

The value gradually decreased until the end of storage for all treatments.

Acceptability

Fig. 13 shows that the best samples were recorded for the control sample acceptability score (100), followed by (T1), and (T4), While the lowest (T6) was at zero time.

The value of acceptability score gradually decreased until the end of storage for all treatments.

From these results, resultant ice cream with date dibs (T1) and control had the highest acceptance followed by (T2), and (T4) while the lowest total acceptance was in (T6) during storage period for 40 days at -18°C and there were a significant different ($p \leq 0.05$) among treatment.

With regard to the overall scores, products made with 20% date dibs and date powder as sugar substitution had higher flavor, higher body and texture scores and excellent melting quality.

Tammam *et al.* (2014) showed possibility of using date dibs in the production of ice cream as a flavoring additive and in partial sugar substations of up to 60 %. Moreover, date syrup (dibs) will increase the nutritional values of final products.

The flavor, texture, and overall acceptability of the samples were rated lower as the concentration of date syrup increased **(Milani and Koocheki, 2011).**

Salem *et al.* (2017) concluded that after being stored for two months, the camel milk resultant ice cream fortified with pass, or genitive pass, was extremely well-liked and praised by the arbitrators. It also received widespread approval for all good treatments and had lower values than any other ice cream ever.

Conclusion

It can be concluded that the value of date products as an excellent natural source of nutrients. Moreover, date products can be utilized as a good source of natural additives or as sugar substitutes for a variety of products, including ice cream, based on their sweetness and nutritional value.

The products do not require the addition of synthetic flavorings or colorants. Although, addition of date products to ice cream mix resulted extremely in desirable product especially at 20% substitution, so it is possible to produce nutritious date product ice cream on a large scale. Therefore, consuming some functional foods can help to boost the nutritional value of products like ice cream. As a result, our findings might serve as a foundation for further research.

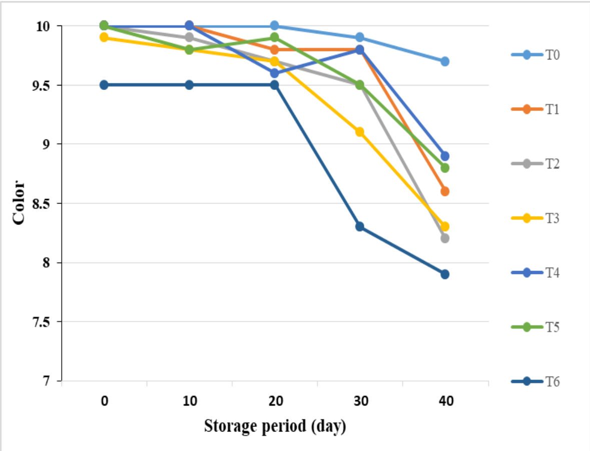

Fig. 10. Average color score of camel milk ice cream with date dibs and date powder as sugar substitution during storage 40 days

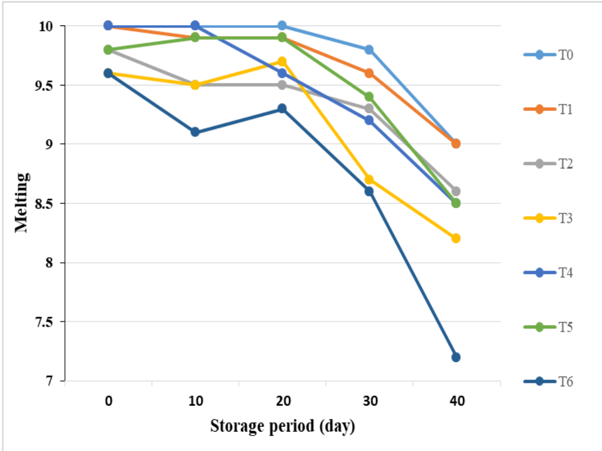

Fig. 11. Average melting score of camel milk ice cream with date dibs and date powder as sugar substitution during storage 40 days

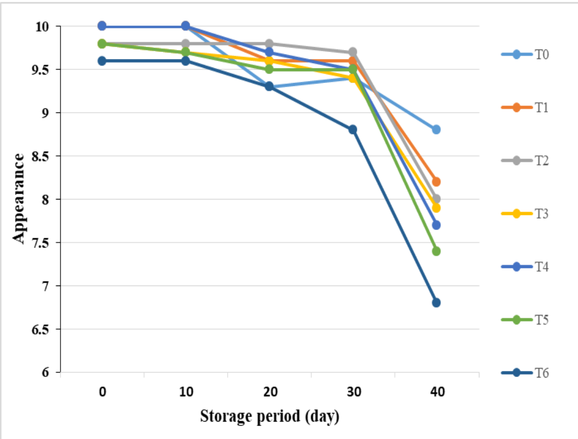

Fig. 12. Average appearance score of camel milk ice cream with date dibs and date powder as sugar substitution during storage 40 days

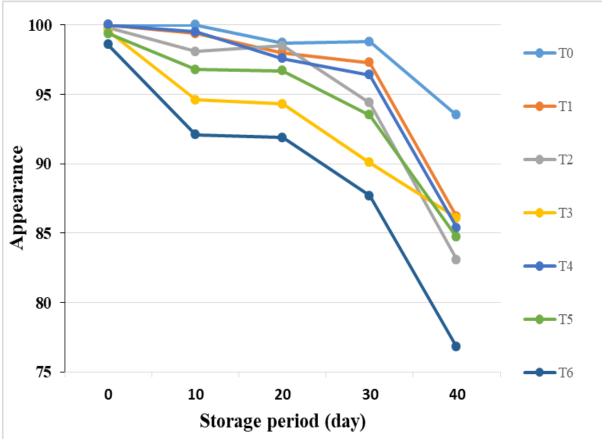

Fig. 13. Average acceptability score of camel milk ice cream with date dibs and date powder as sugar substitution during storage 40 days

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الملخص العربي

إنتاج الآيس كريم من حليب الأبل والمدعم بدبس التمر وبودرة التمر

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تم استخدام حليب الإبل لإنتاج الآيس كريم المدعم بدبس التمر ومسحوق التمر (*Phoenix dactylifera*) كبديل للسكر في صناعة الآيس كريم بنسبة 20 و40 و60% (وزن/ وزن). ودراسة تأثير هذه البدائل على الكثافة النوعية، والوزن لكل جالون، والتحليل الريولوجي لمخلوط الآيس كريم، والكثافة النوعية، والوزن لكل جالون، والريع، والخصائص الفيزيائية والكيميائية والتقييم الحسي للآيس كريم الناتج. زادت قيم الكثافة النوعية والوزن لكل جالون من الآيس كريم الناتج مع زيادة إضافة دبس التمر ومسحوق التمر، كما زادت الخصائص الانسيابية لخلطات الآيس كريم من معامل الاتساق واللزوجة البلاستيكية وإجهاد الخضوع واللزوجة عند 50 دورة في الدقيقة بينما انخفضت مؤشر سلوك التدفق مقارنة بعينة الكنترول. تمت زيادة الكثافة النوعية والوزن لكل جالون من عينات الآيس كريم الناتجة بزيادة دبس التمر المضاف ومسحوق التمر، وانخفاض التجاوز. تم تأثر الخصائص الفيزيائية والكيميائية والحسية لمدة تصل إلى 40 يومًا من التخزين. انخفض رقمpH والرطوبة في مستوى إضافة منتجات التمور خلال فترة التخزين، بينما زادت قيمة الحموضة، البروتين والدهون والكربوهيدرات والرماد خلال فترة التخزين، كما زاد وقت التنقيط الأول لجميع العينات بينما انخفض معدل الانصهار. أخيرًا، أظهرت النتائج الحسية للآيس كريم الناتج من حليب الإبل أن العينات التي تحتوي على 20% دبس التمر و20% بودرة التمر كانت قريبة جدًا من الكنترول. كما نستنتج أنه يمكن استخدام دبس التمر ومسحوق التمر كبديل للسكر.

الكلمات الاسترشادية: حليب الابل، مثلج لبنى، فيزوكيميائية، ريولوجية، خواص حسية.

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