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### Dairy Ices with High Nutritional Value Fortified with Date and Pomegranate Dibs and Red Beet Root Juice Concentrate as Natural Colorant

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#### ABSTRACT

In this study a healthy functional dairy ices fortified with either date dibs or pomegranate dibs was made, as well using concentrated juice of red beet root as natural colorant in the latter ice milk, phenolic compounds and antioxidant activity were determined. Date dibs used as fortifier and sugar replacer in making the ice milk; the sugar was replaced by 0, 25, 45 and 65% of date dibs. On the other hand the pomegranate ice milk was made by adding pomegranate dibs at levels of 0, 2.5, 5 and 7.5% also adding 0.5% of concentrated red beet root juice. The ice milk made free of dibs served as control, the chemical, physical and sensory properties of the resultant ice milk samples during storage at -22°C were studied. Date dibs ice milk treatments showed that increasing the proportion of replacement leads to significantly increase in the standup time, viscosity, specific gravity, weight per gallon, acidity, ash and minerals, while a decrease was occurred in meltdown and pH compared to control (C<sub>1</sub>). The values of a\* (redness) and b\* (yellowness) were positively affected while, L\* (lightness) value was negatively affected. Also the sensory evaluation showed that the best treatment is the one that was made by adding date dibs at a rate of 45%. The results of pomegranate ice milk showed similar trends as the ice milk made with date dibs comparing with the control (C<sub>2</sub>). Also the sensory evaluation showed that the best treatment was that fortified with 2.5% pomegranate dibs.

**Keywords:** Functional ice milk, Natural colorant, Date and Pomegranate dibs, Red Beet root, phenolic compounds and antioxidant activity.

#### INTRODUCTION

Ice cream is one of the most consuming dairy products in the world but the available commercial ice cream is generally poor in the antioxidants, vitamins, natural colorant, and phenolic compounds (Sun-Waterhouse *et al.*, 2013). Meanwhile, consumers realize the important of using healthy and functional food and led to use certain materials with nutritional value, natural colorants, dietary fibers, alternative sweeteners and natural antioxidants in the manufacture of ice cream. This product may also contain other food products such as fruits, which enhances its nutritive value. Therefore, using of natural additives for making ice cream had an important role (El-Kholy and Abbas, 2015).

Several studies indicated that ice cream plays an essential role in the diet of children. So presence of some additives particularly dyes, can introduce a risk factor which due to the high prevalence of obesity and Type 2 diabetes among children and adolescents, therefore using of natural additives for ice milk have an important role in the development of new products (Del Giovine and Piccioli, 2003).

Sugar is a sweetener agent that uses in formulations of many foods and drinks to give these products a sweet taste as well as texture, body and bulk. On the other hand increasing the intake of added sugar might increase the risks for obesity, cardiovascular diseases, dental caries, glucose

intolerance, diabetes mellitus, hypertension and behavioral complications such as hyperactivity in children (Johnson and Yon, 2010). World Health Organization recommends limiting added sugar intake to <10% of total energy. The American Heart Association recommends limiting the daily added sugar intake to 100 calories for women, 150 calories for men and experts recommend children consume less than 100 calories or 25 grams of added sugars per day (Kranz *et al.*, 2005, Johnson and Yon, 2010).

Date dibs is probably the most common derived date product. Dibs is considered to have functional properties such as the ability to act as a natural sweetener to substitute sugar in formulation of food products to reduce the harmful effect of sugar, and improving the nutrient properties (Barrevel, 1993, AL-Farsi *et al.*, 2005 and Al-Farsi and Lee, 2008). The dibs is produced by the extraction and boiling down of the juice (FAO, 2004).

Pomegranate (*Punica granatum L.*) consumed as fresh fruit and juice. It is also being used in the production of jam, liqueur, food coloring agent and flavor enhancer. It is a rich source of minerals, anthocyanins and other phenolic compounds which are already proved to have antioxidant and antitumor activity and important for human health (Perez-Vicente *et al.*, 2004, Kumar *et al.*, 2016 and Syed *et al.*, 2018).

Color is one of the most important attributes of foods, being considered as a quality indicator. The demand for natural source of such attribute is increasing because of

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the consumer awareness with positive health benefit for natural compounds. Therefore, necessitates of looking into natural sources of food grade as colorants are potential; betalains are natural dyes extracted from different fruits and vegetables. They are largely used as food colorants in food products like yogurts, ice cream and other products. Recent studies have shown that betalains have antioxidant, antimicrobial and antiviral activity. Red beet (*Beta vulgaris*) is a potential source of valuable water soluble nitrogenous pigments, called betalains, which are composed of two main groups, the red betacyanins and the yellow betaxanthins.

They are free radical scavengers that prevent active oxygen induction and free radicals mediated oxidation (Pedreno and Escribano, 2001 and Zhong *et al.*, 2005).

Thus, the current work aimed to study the effect of using date dibs as a source of nutrients and as a suitable replacement of sugar to reduce its harmful effect, as well using pomegranate dibs as a good source of nutrients and health benefits each separately for making healthy ice milk rich with nutrients, antioxidants, and phenolic compounds and investigate their effects on the chemical, organoleptic and physical properties of the resulted ice milk during frozen storage at  $-22^{\circ}\text{C} \pm 2$ . Moreover using the red beet root juice concentrate as a source of natural colorant to strengthen the red color in pomegranate ice milk and also as a source of phenolic compounds.

## MATERIALS AND METHODS

### Materials

#### Milk and Skim milk powder

Fresh raw buffalo's milk (SNF 9%, fat 6.2%, protein 4.1%, and 0.17 % acidity) and low heat skim milk powder (imported from European Economic Community, Holland) used in this study was obtained from the herd of animal production farm, and Dairy Processing Pilot Plant, respectively, Fac. Agric., Fayoum Univ.

#### Date dibs and Pomegranate dibs

The dibs of both Date (Al-Gassim-Al-Badaya) and pomegranate (Lebanon, El-Fars Arabian for limited trade) were obtained from local market, in Makka city, Kingdom of Saudi Arabia.

#### Stabilizer, Sugar, Red beet root and vanilla

The stabilizer used in this study; carboxyl methyl cellulose (CMC) was purchased from Sigma Company, Cairo, Egypt. Sugar, vanilla powder and red beet root were purchased from the local market, Fayoum, Egypt.

#### Chemicals and reagents

All the chemicals used in this study were analytical grade and were purchased from El- Nasser, Merck and Sigma Companies, Cairo, Egypt.

### Methods

#### Preparation of Red Beet Root Juice Concentrate

Red beetroot juice concentrate was prepared using the method described by FAO (1986). After cleaning of the red beetroot, it was cut into slices of about 2-3 mm thick, and subjected to extraction process using juice extractor (Binatone, model JE-500). The resulted juice was filtered through a muslin cloth and then heat treated at  $73^{\circ}\text{C}/3$  min. After that concentrated under vacuum according to Esselen and Sammy (1973) and stored at  $-22^{\circ}\text{C}$  in an air-tight container until use.

#### Extraction of phenolic compounds from the raw materials

The phenolic compounds were extracted from date and pomegranate dibs as well as the concentrated juice of red beetroot according to Wang *et al.* (2011).

#### Determination of total phenolic content in the raw materials

The total phenolic contents were determined in the raw materials using Folin Ciocalteu colorimetric method according to Shin *et al.*, (2007) and the absorbance of each sample was measured at 765 nm using Chrome Tech model: CT-2400 UV-Vis Spectrophotometer. The total phenolic content was determined by comparing with a standard curve prepared using Gallic acid ( $10\text{--}200 \mu\text{g/ml}$ ;  $Y = 0.025X + 0.2347$ ;  $R^2 = 0.9986$ ). The mean of three readings were calculated and expressed as mg of Gallic acid equivalents (mg GAE)/100 g of the extract.

#### Determination of radical scavenging activity of the raw materials

The free radical scavenging activity of the anthocyanins was analyzed by using the 1,1-diphenyl-2-picrylhydrazyl (DPPH) assay according to Abba Pacôme *et al.* (2014). The antioxidant activity is measured by the decrease occurred in the absorption at 517 nm. The scavenging or inhibition percentage was calculated according to the following equation:

$$\text{Scavenging inhibition (\%)} = \frac{(\text{Abs. control} - \text{Abs. sample})}{\text{Abs. control}} \times 100$$

Where: Abs.; the absorbance at 517nm

$$\text{Antiradical efficiency} = 1/\text{EC}_{50}$$

$\text{EC}_{50}$  (Inhibitory Scavenge) is the concentration of extract required to scavenge 50% of the DPPH free radical.

The actual decrease in absorption inferred by the tested compounds and compared with the positive control. Measurement was performed at least in triplicate, and expressing the inhibition of coloration as percentage, and obtained the effective concentration 50% ( $\text{EC}_{50}$ ) from the inhibition curve.

#### Experimental procedures

Preliminary experiments were conducted to determine the suitable added amounts of either date dibs (20-70%) or pomegranate dibs (2-10%) used for making the different ice milk treatments.

#### Preparation of ice milk mixes

From the preliminary experiments the basic ice milk mixes were made as shown in Figs. (1 and 2); the plain ice milk mix (control) was prepared according to Arbuckle (1977) after standardization of the milk mix to contain 5% fat, 12.5% SNF, 15 % sugar, and 0.5 % stabilizer (CMC). All ingredients of the ice milk mixes of control and other treatments are mixed well then heat treated at  $85^{\circ}\text{C}$  for 15 min. After that the different dibs were added to the basic mixes at  $55^{\circ}\text{C}$ . All basic mixes and control were cooled and aged for about 24h at  $4^{\circ}\text{C}$ . Regarding the natural colorant red beet root juice concentrate was added to pomegranate ice milk mixes at ratio of 0.5% after aging and 4 hr. before whipping.

The ice milk treatments that made with date dibs (Fig. 1) as a replacement of sucrose were,  $D_1$  (25%),  $D_2$  (45%) and  $D_3$  (65%). While ice milk treatments that fortified with pomegranate dibs (Fig. 2); were  $P_1$  (2.5%),  $P_2$  (5.0%) and  $P_3$  (7.5%). After aging the ice milk mixes of all previous treatments and control were whipped for about 10-15 mins

at  $-5^{\circ}\text{C}$  using an automatically operating batch freezer (Frigomat macchina per Gelato Guradamiglio, model Milano-Italian). The frozen ice milk was filled into dry plastic cups (120ml) and hardened at  $-22\pm 2^{\circ}\text{C}$  for 24 hr. (Fawzia and Omama, 2017).

**Methods of analysis**

**Chemical analysis**

The titratable acidity and total soluble solids (T.S.S) of each dibs sample were determined according to AOAC (2005). The total soluble solids was measured at room temperature ( $25\pm 2^{\circ}\text{C}$ ) using Refractometer (ATAGO, Japan) and expressed as  $^{\circ}\text{Brix}$  (0 - 90).

**Determination of ash and pH values**

The ash content and pH values (pH meter with a glass electrode Model pH-Kent EIL 7020) were determined according to AOAC (2005).

**Minerals determination**

After ashing was completed the minerals (potassium, calcium, phosphorus, magnesium, iron and zinc) were determined by Inductively Coupled Plasma (ICP) Equipment modal 6300 Duo UK, England according to APHA (2012). Ash samples were dissolved in diluted HCl (6.0 N) then completed to 100 ml in volumetric flask by distilled water.

**Measurement of Sugars Content**

Lane and Eynon method was used to estimate the total sugars as described in method No. 925.36 of AOAC (2005).

**Physical analysis**

**Viscosity**

The apparent viscosity of the ice milk measured using a digital Brookfield viscometer Model DV11 + Pro (Brookfield unit, MA, USA) at  $6^{\circ}\text{C}$  with a rotation speed at 20 rpm (spindle No.4). The results were expressed as centipoises (CP) after 30 s of rotation (Akesowan, 2009).

**Specific gravity**

The specific gravity ( $\text{g}/\text{cm}^3$ ) of the ice milk mixes was determined at  $20\pm 2^{\circ}\text{C}$  as described by Winton (1958).

**Standup Time (point) and Melting Rate**

The standup time of prepared ice milk samples were estimated according to Bhandari (2001). The Melting rate of ice milk samples was determined according to Olson *et al.* (2003).

**Color measurements**

The colors of different samples were measured using a Chroma Meter; CR-400 optical sensor (Konica Minolta Sensing, Inc., Osaka, Japan) according to Park *et al.*, (2015).

The system provides triplicate measurements of  $L^*$ ,  $a^*$ , and  $b^*$  were recorded for each sample. The ( $L^*$  parameter lightness index scale ranges from 0 (black) to 100 (white) and the chromaticity coordinates. The parameter  $a^*$  indicates the degree of red ( $+a^*$ ) or green ( $-a^*$ ) color component and the parameter  $b^*$  measures the degree of yellow ( $+b^*$ ) or blue ( $-b^*$ ) color component. The samples were placed in a 34mm optical glass cell and illuminated with D65-artificial daylight (10 standard angles) in accordance with the instructions of the manufacturer.

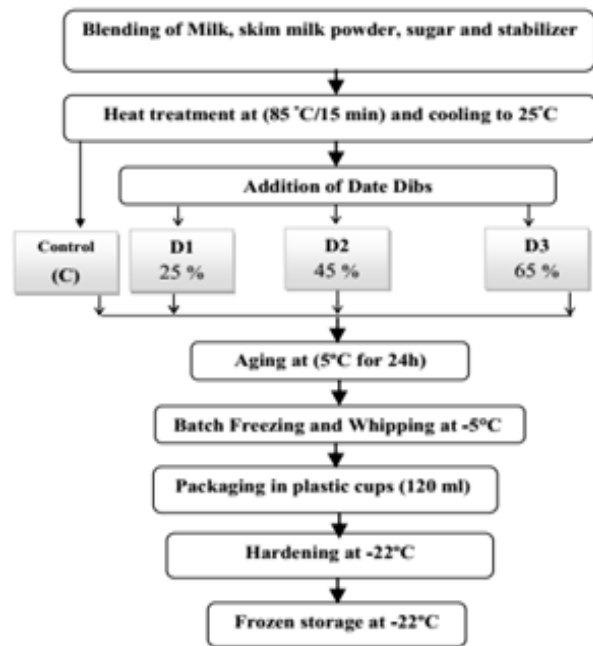
**Sensory evaluation**

The organoleptic properties of the ice milk samples were assessed during the storage period at  $-22^{\circ}\text{C}$  by panelists of 10 persons of staff members of the Dairy and Food

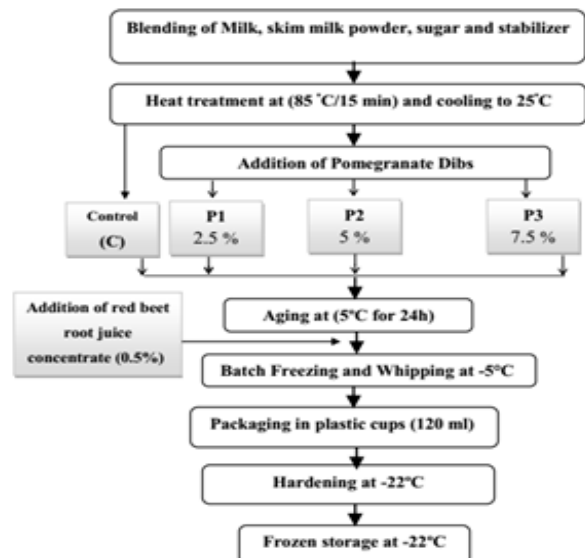
Science and Technology Departments, Faculty of Agriculture, Fayoum Univ. The ice milk samples were evaluated according to the score card sheet of Marshall *et al.*, (2003). The total score (100 points) was divided into flavor (50 points), Body and texture (30 points), appearance and color (10 points) and melting quality (10 points).

**Statistical analysis**

All Data were analyzed using General Linear Models (GLM) procedure of SPSS Software (SPSS, 2008 version 17.0.0). Duncan's multiple range tests was used to compare between the means (Duncan, 1955). The data of chemical and physical properties for each mix and the resultant ice milk of all different treatments that fortified with either date or pomegranate dibs are statistically analyzed in separate.



**Fig. 1. Flow Diagram Showing Steps of making Functional Ice Milk Fortified with Date Dibs**



**Fig. 2. Flow Diagram Showing the Steps of Making Ice Milk Fortified with Pomegranate Dibs and Concentrated Juice of Red Beet Root**

## RESULTS AND DISCUSSION

### Physicochemical properties of the different types of dibs

Date dibs contained high amounts of total sugar, invert sugar and this is very important in human nutrition (Kavas *et al.*, 1990). The results obtained for the physicochemical analysis of both date dibs and pomegranate dibs are given in Table (3). The water soluble dry matter of date dibs was 74-76%. These results were in agreement with those reported by Al-Hooti *et al.* (2002) and El-Sharnouby *et al.* (2009). Regarding pomegranate dibs; it contain about 75% water soluble dry matter and that close to what reported by Vardin *et al.* (2008).

The pH values of date dibs and pomegranate dibs were 4.3 and 2.2, respectively; this may be due to the high content of organic acids in pomegranate comparing with date fruits which hence lower the pH of these products. Besides, the evaporation applied in the production may cause an increase in the acidity (Afshari-Jouibari and Farahnaky, 2011 and Farahnaky *et al.*, 2016). This also was confirmed by Vardin *et al.* (2008) as they mention that pH of the pomegranate juice concentrate was 1.34 – 2.90.

The apparent viscosity of the date dibs was measured using spindle No. 3 and RPM of 10. The apparent viscosity values for the date dibs were 12939 CP.

Results in Table (1) show color measurement of both dibs. A high redness (a) value is not desired because it occurs as a result of excessive caramelization of sugars. Therefore, a low redness (a) and a high brightness (L) values indicate a good quality (Rofehgari *et al.*, 2010).

### Total polyphenolic content and antioxidant activity of the raw materials

Polyphenolic contents were determined according to Kchaou *et al.* (2013). The total phenolic contents in both date and pomegranate dibs, expressed as Gallic acid equivalent are presented in Table (1).

**Table 1. Some Chemical and Physical Properties of the Different Types of Dibs**

Parameters	Date dibs	pomegranate dibs
Moisture (%)	18.22	22.20
Soluble dry matter (%)	74-76	75
Titratable acidity (%)	0.43**	6.15***
pH	4.3	2.20
Ash (%)	1.69	1.60
The total sugar (%)	63	61
Viscosity (CP)	12939	12932
Total phenolic mg GAE/100 g	853±4.38	870.635±4.38
Total flavonoids (mg QE/100 g dibs)	61.6±2.843	ND
Color coordinate	L* 5.02	L* 1.89
	a* 0.80	a* 0.54
	b* 0.60	b* - 0.33

L\* denotes lightness from black (0) to white (100), a\* redness (+) to greenness (-), b\* yellowness (+) to blueness (-), (\*\*), determined as lactic acid, (\*\*\*), determined as citric acid. ND: Not determined.

The present results showed that the total phenolic contents in date dibs was 853 expressed as mg GAE/100 g of dibs, while the total flavonoids was 61.6±2.843 (mg QE/100 g of date dibs). These results were close to that obtained by Al-Mamary *et al.* (2010) and Wu *et al.* (2004). These results are higher than that reported by Abbès *et al.* (2013); who reported that phenolic and flavonoid content of Birhi and Safri, date fruit syrup ranged between 368.35 - 529.28 (mg GAE/100 g FW) and 39.56 - 194.51 (mg QE /100g of syrup FW), respectively, and that

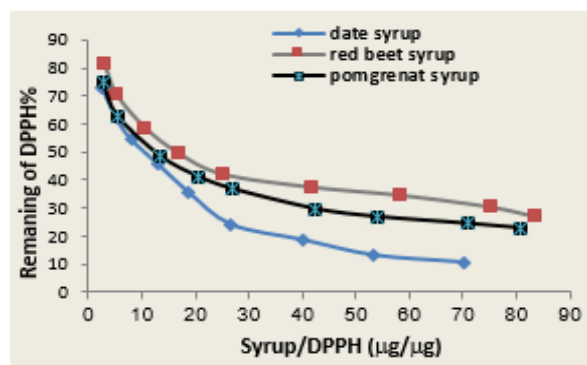
also mentioned by Farahnaky *et al.* (2016). This differences in phenolic content may be due to the method of dibs preparation include temperature, time of incubation, pH as well as the variety of dates. The results showed that pomegranate dibs; recorded phenolic content of 870.635 mg GAE/100 g of dibs, which is close to that reported by Incedayi *et al.* (2010) and Akpınar-Bayizid *et al.* (2016).

### DPPH radical scavenging activity of the date dibs and pomegranate dibs as well as red beet root juice concentrate

In this regard, the antioxidant activity was determined using 1,1-diphenyl-2-picryl hydrazyl (DPPH). The reduction capability of DPPH radical is determined by the decrease in absorbance at 517 nm (Mensor *et al.*, 2001 and Sirag *et al.*, 2014). The results in Table (2) and Fig. (3) illustrate the scavenging activities of both date dibs and pomegranate dibs as well concentrated juice of red beet on inhibition of DPPH radical. The present work shows that, the different dibs exhibited a marked DPPH scavenging activity; as the concentration of the dibs increased a significant decrease in the concentration of DPPH was occur; this may be due to the free radical scavenging effect of the dibs. The lower EC<sub>50</sub> indicates better radical scavenging. These results are in agreement with Bouhlali *et al.* (2015) and Al-Harhi *et al.* (2015).

**Table 2. Effect of different dibs concentration and red beet root juice concentrate on the inhibition ratio of DPPH**

Conc. date dibs / DPPH (µg/µg)	Inhibition ratio / DPPH (%)	Conc. pomegranate dibs / DPPH (µg/µg)	Inhibition ratio / DPPH (%)	Conc. red beet root juice /DPPH (µg/µg)	Inhibition ratio / DPPH (%)
2.67	27.33	2.697	24.88	3.024	18.355
5.34	38.18	5.40	37.1	5.24	29.12
8.02	45.501	13.49	51.56	10.58	41.03
13.01	54.28	20.44	58.71	16.66	49.91
18.7	64.217	26.81	63.14	25	57.62
26.72	75.881	42.49	70.39	41.66	62.32
40.08	81.3	53.95	73.17	58.33	65.21
53.44	86.8	70.81	75.61	75	69.38
70.14	89.33	80.93	77.24	83.3	72.71



**Fig. 3. The percent of remaining DPPH as function of extracts of date dibs, pomegranate dibs and concentrate juice of red beet root**

The results showed that the inhibition ratio was 27.33% when the used concentration of date dibs was 2.67 /µg DPPH. When the concentration of dibs increased to 40.08µg/µg DPPH, the inhibition ratio increased to 81.3%. The results also show that date dibs had antiradical efficiency of 0.10 and the amount of date dibs that required

scavenging 50% of DPPH radical ( $EC_{50}$ ) was 10.58  $\mu\text{g}$  date dibs. These results are in agreement with that reported by Mansouri *et al.* (2005). Regarding pomegranate dibs; the amount of the dibs required to scavenge 50% of DPPH radical ( $EC_{50}$ ) was 12.58  $\mu\text{g}$  dibs/  $\mu\text{g}$  DPPH. These results agree with that obtained by Sudhir and Ramadevi (2016).

The radical scavenging activity may be due to the existence of numerous hydroxyls in pomegranate phenolic compounds, which could serve as electron donor and transfer of electron to DPPH free radical.

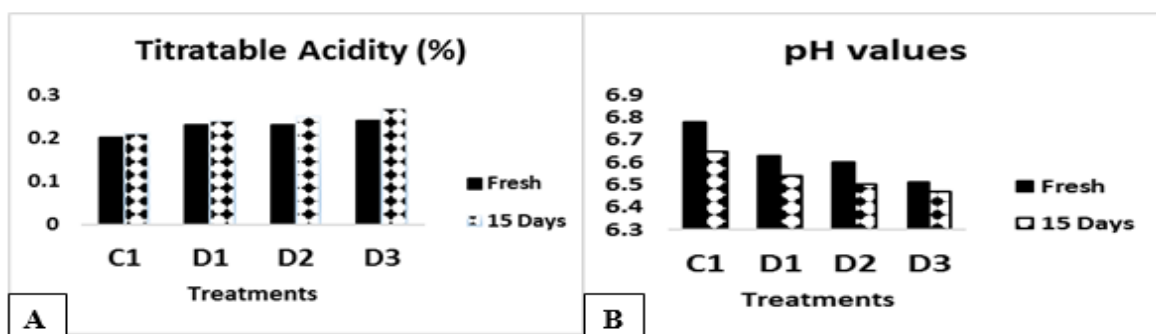
The concentrated juice of red beet root recorded efficient concentration ( $EC_{50}$ ) of 16.25  $\mu\text{g}$  sample / $\mu\text{g}$  DPPH and antiradical efficiency (AE) of 0.06. The antioxidant properties of betacyanins could be attributable to their free phenolic groups and the cyclic amine group of the betalamic acid moiety which is considered to act as a hydrogen donor both in beta-cyanins and betaxanthins (Kanner *et al.*, 2001).

These results are in agreement with that reported by (Sahar *et al.*, 2010 and Slavov *et al.*, 2013).

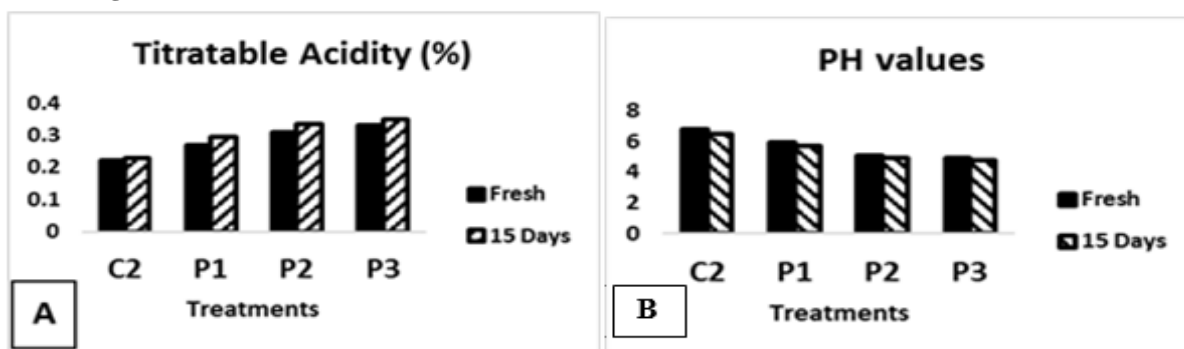
**The physical properties of the ice milk mixes and ice milk treatments fortified with date dibs**

**Changing in titratable acidity and pH values of the ice milk treatments**

The titratable acidity of the ice milk fortified with date dibs (Fig.4A) increased significantly ( $P \leq 0.05$ ) with the increased ratio of added date dibs while, the pH values (Fig.4B) were significantly ( $P \leq 0.05$ ) decreased. The highest acidity value; 0.23%; was recorded for D2 (45% dibs) and D3 (65% dibs) treatments, while, the lowest acidity (0.20 %) was found in control ice milk mix. Similar results were noticed in the titratable acidity and pH values of the ice milk fortified with pomegranate dibs (Figs. 5A and B).



**Fig. 4. Titratable acidity (A) and pH values (B) of the ice milk treatments fortified with date dibs during frozen storage**



**Fig. 5. Titratable acidity (A) and pH values (B) of the ice milk treatments fortified with pomegranate dibs during frozen storage**

The changes in pH may be due to the low pH value of date dibs and pomegranate dibs (see Table 1); which significantly affects the final pH value of the ice milk mixes. These results are in agreement with that reported by (Hamed *et al.*, 1983; Salama, 2004 and Farahat *et al.*, 2011) who stated that, the use of dates in ice cream slightly decreased the pH values of mixes than that of control mix. On the other hand, the results were harmony with Salama *et al.* (2016), who reported that pH values tended to decrease with adding dibs in soy ice cream formula and affect the pH values during storage, due to the varying concentrations of date dibs. The obtained results are in line with Hashim and Al Shamsi, (2016) and Elkot (2017).

**Specific gravity and weight per gallon measurements of ice milk mixes**

Results in Tables (3 and 4) show the physical properties of ice milk mixes and final product fortified with

either date or pomegranate dibs. These results revealed that the specific gravity and weight per gallon of the ice milk mixes were affected by the addition of both dibs. The replacement of sugar with date dibs caused a significant ( $P \leq 0.05$ ) increases in the specific gravity and weight per gallon (Table 3).

The highest specific gravity (1.20  $\text{g}/\text{cm}^3$ ) was observed in D<sub>3</sub> mix (65 % dibs). While, the lowest specific gravity (0.87  $\text{g}/\text{cm}^3$ ); was recorded in control ice milk mix. These results are in same manner with Khalil and Blassy (2011), Salama *et al.* (2016). Date dibs have high Sp.gr. (1.177) according to Khalil and Blassy (2011), and thus would lead to an increase in the Sp.gr. of the ice milk when incorporated into the mix. Salama *et al.* (2016) reported that specific gravity of soy ice cream mixes was increased with adding dibs in the recipes as a substitution of sucrose. The results of pomegranate ice milk (Table 4) take similar trend



and were in agreement with the results reported by Kotan et al. (2012) and El-Samahy et al. (2015).

**Physical properties**

**Viscosity of ice milk mixes**

Estimation of viscosity is very important to measure the effect of date dibs on the properties of the ice milk mixes (Muse and Hartel, 2004). Results in Table (3) show the viscosity of all date dibs ice milk formulations before and after aging. It was increased by adding date dibs; the highest viscosity was 293.10 and 3268 CP which

recorded for D<sub>3</sub> mix, and D<sub>3</sub> treatment as a final product, respectively, while the lowest viscosity was 200.00 and 2080.1 CP was observed in both mix and final ice milk product of the control (C<sub>1</sub>), respectively. These results are in agreement with the results obtained by (Salama et al., 2016). Similar trend for viscosity was noticed for the mixes and ice milk treatments that fortified with pomegranate dibs (Table 4). The highest viscosity value (2533 CP) recorded for P<sub>3</sub> treatment while, the lowest value (2085.7 CP) was recorded for control (C<sub>2</sub>).

**Table 3. Physicochemical properties of mixes and resultant ice milk made by substitution of sucrose with different ratios of date dibs**

Parameters*		Treatments				SE±
		C <sub>1</sub>	D <sub>1</sub>	D <sub>2</sub>	D <sub>3</sub>	
Viscosity (CP)	Mixes	200.00 <sup>d</sup>	206.35 <sup>c</sup>	220.00 <sup>b</sup>	293.10 <sup>a</sup>	0.54
	Resultant Ice Milk	2080.1 <sup>d</sup>	2321.6 <sup>c</sup>	2481.8 <sup>b</sup>	3268 <sup>a</sup>	0.38
Specific Gravity (g/cm <sup>3</sup> )	Mixes	0.87 <sup>d</sup>	1.14 <sup>c</sup>	1.16 <sup>b</sup>	1.20 <sup>a</sup>	0.001
	Resultant Ice Milk	0.728 <sup>d</sup>	0.779 <sup>c</sup>	0.792 <sup>b</sup>	0.822 <sup>a</sup>	0.001
Weight per gallon (kg)	Mixes	3.94 <sup>d</sup>	5.22 <sup>c</sup>	5.27 <sup>b</sup>	5.45 <sup>a</sup>	0.006
	Resultant Ice Milk	3.31 <sup>d</sup>	3.54 <sup>c</sup>	3.60 <sup>b</sup>	3.74 <sup>a</sup>	0.003

a, b,.....and d: Means in the same row with different superscript letters are significantly different (p<0.05), SE±: Standard error, CP: Centipois, C, control (Free of date dibs), D<sub>1</sub>, D<sub>2</sub>, D<sub>3</sub> are the ice milk treatments made with 25, 45 and 65% of date dibs, respectively as sugar replacement, (\*): The parameters statistically analyzed in separate.

**Table 4. Physicochemical properties of mixes and resultant ice milk fortified with different ratios of pomegranate dibs**

Parameters*		Treatments				SE±
		C <sub>2</sub>	P <sub>1</sub>	P <sub>2</sub>	P <sub>3</sub>	
Viscosity (CP)	Mixes	2085.7 <sup>d</sup>	2357.06 <sup>c</sup>	2477.5 <sup>b</sup>	2533 <sup>a</sup>	8.470
	Resultant Ice Milk	199.67 <sup>d</sup>	251.67 <sup>c</sup>	277.00 <sup>b</sup>	289.73 <sup>a</sup>	1.952
Specific Gravity (g/cm <sup>3</sup> )	Mixes	0.726 <sup>d</sup>	0.728 <sup>c</sup>	0.734 <sup>b</sup>	0.743 <sup>a</sup>	0.001
	Resultant Ice Milk	0.84 <sup>d</sup>	0.85 <sup>c</sup>	0.854 <sup>b</sup>	0.87 <sup>a</sup>	0.001
Weight per gallon (kg)	Mixes	3.303 <sup>d</sup>	3.312 <sup>c</sup>	3.339 <sup>b</sup>	3.380 <sup>a</sup>	0.002
	Resultant Ice Milk	3.83 <sup>c</sup>	3.85 <sup>c</sup>	3.88 <sup>b</sup>	3.96 <sup>a</sup>	0.007

a, b,.... and d: Means having different superscripts within each column are significantly different (p<0.05), C: Ice milk mix free of dibs (control), P<sub>1</sub>, P<sub>2</sub> and P<sub>3</sub>: Ice milk fortified with pomegranate dibs at levels of 2.5, 5 and 7.5%, respectively. (\*): The parameters statistically analyzed in separate.

**First dripping time (standup time) melting rate of the ice milk treatments fortified with either date or pomegranate dibs.**

The period (min) which elapsed before the first drop of melted ice milk fell was noted for each sample and registered as standup time or first dripping. Addition of dibs at different concentrations had appreciable effect on the standup time of the ice milk as shown in Table (5). The highest mean value (12.76 min) was recorded in D<sub>3</sub>

treatment, followed by P<sub>3</sub> treatment (12.5 min) and the lowest standup time was observed in both control (C<sub>1</sub>, C<sub>2</sub>) samples. The standup time for normal ice cream is 13 min at 20°C as reported by Marshall and Arbuckle (1996).

Regarding pomegranate ice milk; as compared with the control (C<sub>2</sub>), the first dripping time is significantly (p ≤0.05) increased as the added pomegranate dibs was increased. The highest value (12.5 min) was noted for samples of ice milk treatments that having 7.5% of dibs.

**Table 5. Effect of adding either date dibs or pomegranate dibs on the first dripping time and melting rate of the ice milk treatments**

Treatments	First dripping (min)*	Time (min)				
		15	30	45	60	75
<b>Melting rate different ice milk (g/min)*</b>						
C <sub>1</sub>	11.41 <sup>d</sup>	6.85 <sup>a</sup>	22.35 <sup>a</sup>	36.25 <sup>a</sup>	50.51 <sup>a</sup>	69.28 <sup>a</sup>
D <sub>1</sub>	12.04 <sup>c</sup>	4.92 <sup>b</sup>	18.46 <sup>b</sup>	33.55 <sup>b</sup>	48.49 <sup>c</sup>	59.88 <sup>b</sup>
D <sub>2</sub>	12.46 <sup>b</sup>	4.18 <sup>c</sup>	16.94 <sup>c</sup>	31.84 <sup>c</sup>	47.25 <sup>d</sup>	58.50 <sup>c</sup>
D <sub>3</sub>	12.76 <sup>a</sup>	3.97 <sup>d</sup>	13.64 <sup>d</sup>	29.65 <sup>d</sup>	45.50 <sup>b</sup>	55.26 <sup>d</sup>
SE±	0.009	0.031	0.198	0.312	0.123	0.081
C <sub>2</sub>	11.063 <sup>a</sup>	6.73 <sup>a</sup>	22.4 <sup>a</sup>	36.36 <sup>a</sup>	50.33 <sup>a</sup>	69.50 <sup>a</sup>
P <sub>1</sub>	12.10 <sup>a</sup>	5.91 <sup>b</sup>	18.47 <sup>b</sup>	33.66 <sup>b</sup>	48.59 <sup>b</sup>	59.88 <sup>b</sup>
P <sub>2</sub>	12.46 <sup>b</sup>	4.82 <sup>c</sup>	17.29 <sup>c</sup>	31.35 <sup>c</sup>	46.93 <sup>c</sup>	58.97 <sup>c</sup>
P <sub>3</sub>	12.50 <sup>c</sup>	4.12 <sup>d</sup>	12.85 <sup>d</sup>	29.54 <sup>d</sup>	44.13 <sup>d</sup>	54.10 <sup>d</sup>
SE±	0.025	0.061	0.208	0.283	0.229	0.117

a, b,.... and d: Means having different superscripts within each column are significantly different (p<0.05), C<sub>1</sub>: Control (free of date dibs), C<sub>2</sub>: Control ice milk (free of pomegranate dibs), D<sub>1</sub>, D<sub>2</sub> and D<sub>3</sub> were Ice milk treatments fortified with 25, 45 and 65% of date dibs, P<sub>1</sub>, P<sub>2</sub> and P<sub>3</sub>: Ice milk treatments fortified with 2.5, 5 and 7.5% Pomegranate dibs, respectively.

(\*): The parameters statistically analyzed in separate for different added dibs.

Melting rate (g/min) of the resultant ice milk samples expressed as weight of melted ice milk during 75 minutes at intervals of 15 minutes was explained in Table (5). Salama

(2004) also mentioned that the use of some natural sweeteners instead of sucrose in manufacturing ice cream affected the melting properties. On the other hand, the

melting rate of pomegranate ice milk was decreased as the amount of pomegranate dibs was increased. These results are in accordance with those reported by (El-Kholy, 2005 and Abbas, 2006).

**Color measurements of ice milk fortified with either date or pomegranate dibs**

The changes in color parameters of control and ice milk fortified with date dibs stored at -22°C during 30 days are presented in Table (6). Generally, for all ice milk tested samples, color parameters (L\*, b\* and a\*) values was affected by the date dibs ratios significantly. The results

indicate that a\*, b\* factors increased and L\* factor decreased which was due to the color of product and its oxidation that made product darker and in turn increased the absorption of light. Since the factor of a\* and b\* indicator of samples redness and yellowness; the index of samples containing date dibs is more than control samples and by increasing of date dibs amount in the formulation, L\* parameter of samples has decreased, too. Greenness of samples increased as the level of date dibs was increased, which is reflected in negative 'a' value.

**Table 6. Color measurements of the ice milk fortified with date dibs and pomegranate dibs and red beet root juice concentrate as natural colorant during storage at-22°C**

Parameters	Storage periods (days)	Treatments*							
		C <sub>1</sub>	D <sub>1</sub>	D <sub>2</sub>	D <sub>3</sub>	C <sub>2</sub>	P <sub>1</sub>	P <sub>2</sub>	P <sub>3</sub>
L*	fresh	91.97	82.14	75.26	73.35	92.56	80.00	73.29	71.85
	15	90.16	76.6	69.48	64.48	91.67	75.15	68.48	62.41
	30	88.56	74.11	66.01	60.97	89.59	72.19	65.01	59.17
a*	fresh	-2.43	1.94	3.89	4.7	-2.45	1.98	3.99	4.9
	15	-2.84	2.63	4.47	6.11	-2.87	2.75	4.97	6.19
	30	-3.21	2.69	4.63	6.27	-3.24	3.15	5.20	6.99
b*	fresh	11.43	19.14	23.54	25.5	11.55	8.19	7.20	6.59
	15	11.82	20.71	23.58	24.96	11.42	8.00	7.10	6.00
	30	11.95	20.97	23.99	25.27	11.13	7.90	6.50	5.28

L\* denotes lightness from black (0) to white (100), a\* redness (+) to greenness (-), b\* yellowness (+) to blueness (-), C<sub>1</sub>: Control (free of date dibs), C<sub>2</sub>: Control ice milk (free of pomegranate dibs), D<sub>1</sub>, D<sub>2</sub> and D<sub>3</sub> were Ice milk treatments fortified with 2.5, 45 and 65% of date dibs, P<sub>1</sub>, P<sub>2</sub> and P<sub>3</sub>: Ice milk treatments fortified with 2.5, 5 and 7.5% Pomegranate dibs, respectively.

This indicated that date dibs could be used as natural coloring agent to produce colored ice cream (golden to brown). It was reported that, food colors constitute major additives as it enhances the acceptance and appearance of the food. It is one of the most important qualities of foods and the studies on colorants of date dibs showed that Melanoidin is the major part of colorant of date juice originating from maillard reactions between amino acids and reducing sugars Hashim and Al-Shamsi (2016).

Fathi et al. ( 2013) reported that the yellow and red color of date liquid sugar can be contributed to, the color groups, degradation products of reducing sugars, melanoidines and iron polyphenolic complexes

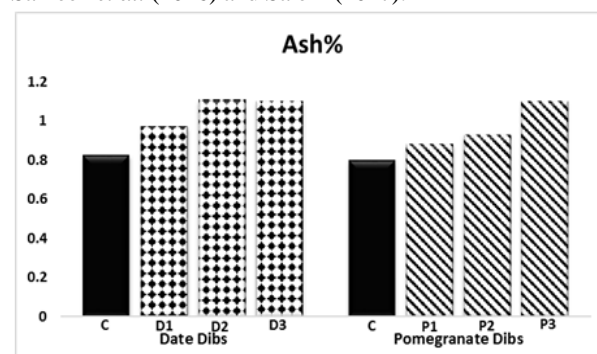
Another study indicated that alkaline degradation products of hexoses and iron-polyphenol complexes are the other colorants as reported by Hashim and Al-Shamsi, (2016) they produced ice cream sweetened with date dibs and found that date dibs had significant effects on its color, as it develops a Browne color. Lightness values (L\*) decreased with increasing the dibs level, while redness (a\*) and yellowness (b\*) increased with increasing date dibs level. This indicated that date dibs could be used as natural coloring agent to produce colored ice cream (golden to brown) depending on date variety, extraction method and concentration level. Similar observations were reported by Amerinasab et al. (2015).

Addition of pomegranate dibs increased the greenness values (-a\*) of the samples, indicating that the ice milk samples fortified with pomegranate dibs had more red color compared to the control samples. Increasing the amount of pomegranate dibs decreased the yellowness values (b\*) of the ice milk samples. The control sample had the highest b\* values, while, the sample of add pomegranate dibs; 7.5% (P<sub>3</sub>); had the lowest b\* value during frozen storage.

**Some chemical composition of the resultant ice milk fortified with either date dibs or pomegranate dibs**

**Ash content of the ice milk fortified with date and pomegranate dibs**

Statistical analysis showed that ash content varied significantly (P ≤ 0.05) in all ice milk treatments. Addition of date or pomegranate dibs to the ice milk (Fig.6) caused an increase in the ash content. This increase could be attributed to the high content of minerals in both dibs. These results were in agreement with that given by Salama *et al.* (2016); Sameen *et al.* (2016) and Salem (2017).



**Fig. 6. Ash contents of the ice milk treatments fortified with either date dibs or pomegranate dibs at different ratios**

**Minerals content of the ice milk fortified with either date dibs or pomegranate dibs**

Milk and milk products are considered as poor sources of iron and therefore, fortification with natural source of iron would be a helpful tool. Results in Table (7) illustrate the minerals content of the ice milk treatments and controls. These results show that calcium, potassium, phosphorus, magnesium and iron increased by increasing the added ratio of the date or pomegranate dibs. This may be due to the high content of these minerals in the added dibs.

The results indicated that samples of D<sub>3</sub> treatment had the highest percentage of all minerals (Fe, P, K, Mg, Ca and Zn) when compared with the other treatments and control (C<sub>1</sub>).

While, the lowest values of all minerals were observed in control (C<sub>1</sub>). These results are in agreement with that reported by Khalil and Blassy (2011). Also the ice milk

treatments that fortified with pomegranate dibs and concentrated juice of red beet root as natural colorant; increased in its content of potassium, magnesium, calcium, iron and zinc, compared with control (C<sub>2</sub>) especially P<sub>3</sub> treatment; which fortified with 7.5% pomegranate dibs.

**Table 7. Minerals content (ppm) of ice milk treatments fortified with date dibs and pomegranate dibs**

Treatments	Elements*					
	Iron	Phosphorus	Potassium	Magnesium	Calcium	Zinc
C <sub>1</sub>	0.793 <sup>d</sup>	420.99 <sup>c</sup>	470.0 <sup>d</sup>	57.10 <sup>d</sup>	406.00 <sup>d</sup>	0.401 <sup>d</sup>
D <sub>1</sub>	1.611 <sup>c</sup>	432.39 <sup>b</sup>	557.80 <sup>c</sup>	60.63 <sup>c</sup>	863.81 <sup>c</sup>	0.546 <sup>c</sup>
D <sub>2</sub>	2.137 <sup>b</sup>	436.67 <sup>b</sup>	573.35 <sup>b</sup>	61.63 <sup>b</sup>	880.11 <sup>b</sup>	0.697 <sup>b</sup>
D <sub>3</sub>	2.276 <sup>a</sup>	447.54 <sup>a</sup>	676.61 <sup>a</sup>	63.97 <sup>a</sup>	910.31 <sup>a</sup>	0.982 <sup>a</sup>
SE±	0.01	1.69	3.34	0.13	1.54	0.01
C <sub>2</sub>	0.79 <sup>d</sup>	422.52 <sup>d</sup>	327.49 <sup>d</sup>	57.10 <sup>d</sup>	404.21 <sup>d</sup>	0.40 <sup>d</sup>
P <sub>1</sub>	1.22 <sup>c</sup>	420.11 <sup>b</sup>	377.06 <sup>c</sup>	58.92 <sup>c</sup>	857.53 <sup>c</sup>	0.55 <sup>c</sup>
P <sub>2</sub>	1.71 <sup>b</sup>	417.58 <sup>c</sup>	381.24 <sup>b</sup>	60.92 <sup>b</sup>	881.78 <sup>b</sup>	0.88 <sup>b</sup>
P <sub>3</sub>	1.9 <sup>a</sup>	403.3 <sup>d</sup>	470.0 <sup>a</sup>	64.7 <sup>a</sup>	986.2 <sup>a</sup>	1.33 <sup>a</sup>
SE±	0.01	0.32	0.12	0.13	0.21	0.004

a, b, .... and d Means having different superscripts within each column are significantly different (p≤ 0.001), C<sub>1</sub>: Control (free of date dibs), C<sub>2</sub>: Control ice milk (free of pomegranate dibs), D<sub>1</sub>, D<sub>2</sub> and D<sub>3</sub> were Ice milk treatments fortified with 25, 45 and 65% of date dibs, P<sub>1</sub>, P<sub>2</sub> and P<sub>3</sub>: Ice milk treatments fortified with 2.5, 5 and 7.5% Pomegranate dibs, respectively. (\*): The parameters statistically analyzed in separate for each added dibs.

**Organoleptic properties of the ice milk treatments fortified with date dibs**

Organoleptic properties during storage of different ice milk treatments were listed in Tables (8 and 9). There were significant differences within some ice milk samples in most of sensory evaluation during storage period (15 days).

The sensory scores for flavor were influenced by the addition of date dibs, the lowest flavor scores at 15 days of frozen storage was recorded for D<sub>3</sub> treatment (40.80 points), while the treatment fortified with 45% date dibs (D<sub>2</sub>) had the highest flavor score (48.27) at fresh age. In general, the flavor scores of resultant ice milk enhanced and became more

preferable to panelists with adding dibs into the ice milk formula up to 45% compared to the control. The texture of the ice milk has a direct relationship with composition, and this depends on the size, number and arrangement of air cells, ice crystals, lactose crystals and fat concentrations. The soft texture is an evidence of the homogeneity of small ice crystals and air cells and the lack of crystals; the snow textures were observed when the air cells are large. There is other many drawbacks to the strength of texture were shown in the ice cream, such as; sticky, fragmentation, coagulation, watery, and so on, generally due to a lack of equations mixtures (Webb *et al.*, 1974).

**Table 8. Organoleptic properties of different ice milk treatments fortified with date dibs during storage at -22°C**

Treatments*	Storage period (days)	Flavor (50)	Body & texture (30)	melting (10)	Color & Appearance (10)	Total score (100)
C <sub>1</sub>	Fresh	44.27 <sup>c</sup>	25.27 <sup>d</sup>	7.20 <sup>c</sup>	9.67 <sup>a</sup>	86.40 <sup>c</sup>
	15	44.20 <sup>c</sup>	25.06 <sup>d</sup>	7.00 <sup>c</sup>	9.60 <sup>a</sup>	85.87 <sup>c</sup>
D <sub>1</sub>	Fresh	46.07 <sup>b</sup>	27.73 <sup>b</sup>	7.67 <sup>c</sup>	9.00 <sup>b</sup>	91.47 <sup>b</sup>
	15	45.93 <sup>b</sup>	27.60 <sup>b</sup>	8.40 <sup>b</sup>	8.87 <sup>b</sup>	90.80 <sup>b</sup>
D <sub>2</sub>	Fresh	48.27 <sup>a</sup>	28.00 <sup>ab</sup>	9.13 <sup>ab</sup>	8.00 <sup>c</sup>	93.40 <sup>a</sup>
	15	47.33 <sup>a</sup>	28.33 <sup>ab</sup>	9.27 <sup>ab</sup>	7.93 <sup>c</sup>	92.87 <sup>a</sup>
D <sub>3</sub>	Fresh	40.87 <sup>d</sup>	28.93 <sup>a</sup>	8.73 <sup>ab</sup>	6.33 <sup>d</sup>	84.87 <sup>cd</sup>
	15	40.80 <sup>d</sup>	28.40 <sup>ab</sup>	8.67 <sup>ab</sup>	6.13 <sup>d</sup>	84.00 <sup>d</sup>
SE±	0.339		0.318	0.254	0.196	0.568

a, b, .... and d: Means having different superscripts within each column are significantly different (P≤0.05). (\*): See Table (3).

**Table 9. Organoleptic properties of different ice milk treatments fortified with pomegranate dibs during storage at -22°C**

Treatment*	Storage period (days)	Flavor (50)	Body and texture (30)	melting (10)	Color and Appearance (10)	Total score (100)
C <sub>2</sub>	Fresh	47.56 <sup>b</sup>	28.56 <sup>a</sup>	8.778 <sup>a</sup>	8.67 <sup>a</sup>	93.56 <sup>ab</sup>
	15	47.33 <sup>b</sup>	27.66 <sup>b</sup>	8.22 <sup>ab</sup>	8.11 <sup>ab</sup>	91.33 <sup>cd</sup>
P <sub>1</sub>	Fresh	48.78 <sup>a</sup>	28.67 <sup>a</sup>	8.88 <sup>a</sup>	8.22 <sup>a</sup>	94.56 <sup>a</sup>
	15	48.11 <sup>ab</sup>	28.00 <sup>ab</sup>	8.55 <sup>ab</sup>	8.02 <sup>ab</sup>	92.67 <sup>bc</sup>
P <sub>2</sub>	Fresh	47.87 <sup>ab</sup>	26.12 <sup>c</sup>	8.13 <sup>abc</sup>	8.00 <sup>ab</sup>	90.13 <sup>d</sup>
	15	47.00 <sup>bc</sup>	25.75 <sup>cd</sup>	7.25 <sup>cd</sup>	7.13 <sup>bc</sup>	87.125 <sup>e</sup>
P <sub>3</sub>	Fresh	47.25 <sup>bc</sup>	25.55 <sup>cd</sup>	7.56 <sup>bc</sup>	7.66 <sup>abc</sup>	88.00 <sup>e</sup>
	15	46.11 <sup>c</sup>	25.00 <sup>d</sup>	6.75 <sup>d</sup>	7.00 <sup>c</sup>	84.67 <sup>f</sup>
SE±		0.374	0.307	0.325	0.309	0.609

a, b, .... and f: Means having different superscripts within each column are significantly different (p≤0.05). (\*): See Table (4).

Regarding body and texture, the results also showed in Table (8) that there is a significant difference between the all treatments. In general the sample fortified with 65% date dibs, recorded t fresh time the highest body & texture scores

of 28.93 while, the control recorded 25.27, but had the lowest score of 25.06 points at 15 days of frozen storage. These results are agreement with Khalil and Blassy (2011)



who mentioned that, addition of date pulp significantly improved the body & texture of resultant low fat ice cream.

Addition of both date and pomegranate dibs had significant effect on the color and appearance; the best samples were recorded for the control sample. Color and appearance of final product was affected by adding date dibs as the white color of control changed to brownish.

Results in Tables (8 and 9) shows also average judging the sensory properties of the melting properties of the ice milk samples for different values of treatments during storage periods (15 days). It was observed from the results that there were significant differences ( $P \leq 0.05$ ) among the various treatments and control samples in melting properties. The highest melting values were obtained when the ratio of added date dibs was 45%. There were significant differences ( $P \leq 0.05$ ) in the total scores of the experimental and control samples. The most acceptable ice milk treatments were the D<sub>2</sub> treatment, followed by D<sub>1</sub> treatment. The treatments that fortified with 25, 45 and 65% date dibs (D<sub>1</sub>, D<sub>2</sub> and D<sub>3</sub>), respectively show slight decrease of total scores throughout storage period. This may be due to the increase in the acidity. On the other hand from the ice milk treatments that fortified with pomegranate dibs the treatment P<sub>1</sub> (2.5%) gained the highest total scores at fresh time comparing with all other treatments and control (C<sub>2</sub>).

## CONCLUSION

**According to previous results the study recommends the following:**

Using of natural additives is expanding due to its high content of minerals, natural antioxidant and phenolic compounds. Moreover, enhance the sensory properties, nutritional value and functional properties. Using of date dibs as a good source to replace sucrose by 45% for the ice milk making and fortification with pomegranate dibs at level of 2.5% to improve the nutrients contents, flavor and texture of the resultant ice milk, as well using concentrated juice of red beet to strengthen the color.

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## متلجات لبنية ذات قيمة غذائية عالية مدعمة بدبس التمر ودبس الرمان مع استخدام مركز عصير البنجر كملون طبيعي منال قطب أحمد خضر<sup>1\*</sup>، خالد عبد الحميد سليم<sup>2</sup>، رتيبة بيومي أحمد الطنطاوي<sup>1</sup> و محمد عبد العظيم إبراهيم<sup>1</sup> <sup>1</sup> قسم الألبان - كلية الزراعة - جامعة الفيوم - جمهورية مصر العربية <sup>2</sup> قسم الصناعات - كلية الزراعة - جامعة الفيوم - جمهورية مصر العربية

تهدف هذه الدراسة إلى تطوير إنتاج متلج لبني ذو قيمة غذائية باستخدام دبس التمر ودبس الرمان ولتحقيق هذه الأهداف تم تصنيع متلجات لبنية وظيفية باستخدام أنواع ونسب مختلفة من الدبس مثل دبس التمر كبدل جزئي للسكرز وكذلك مصدر للمغذيات والمواد المضادة للأكسدة ودراسة تأثير إضافة الدبس على بعض الخواص الكيميائية الطبيعية والحسية للمتلوج الناتج أثناء فترة التخزين على درجة حرارة 22°م. وفي هذا الجزء تم استبدال السكرز في مخاليط المتلجات اللبنة باستخدام دبس التمر بنسب (25، 45، 65%) كبدل للتحلية وكذلك كمدعم غذائي. كما تم دراسة النشاط المضاد للأكسدة والمحتوي من المركبات الفينولية في دبس التمر المستخدم في تصنيع المتلج اللبني. - دلت النتائج أن استخدام نسب مختلفة من دبس التمر كبدل جزئي للسكرز له تأثير على خواص مخاليط المتلجات اللبنة الناتجة، حيث أدى إلى خفض الجوامد الكلية والرقم الهيدروجيني والدهن والبروتين بينما إزدادت نسبة الحموضة والرماد والوزن النوعي والوزن للجالون وزيادة اللزوجة والمحتوى من المعادن وزيادة المقاومة للانصهار مقارنة بالكنترول وكانت الزيادة في تلك المقاييس تتناسب مع الزيادة في نسب الإضافة من دبس التمر كما أظهرت النتائج أثناء التخزين (1، 15، 30 يوم) زيادة قيم الألوان a و b بزيادة نسبة دبس التمر، بينما انخفضت قيمة L بشكل ملحوظ. وأظهرت نتائج التقييم الحسي أثناء التخزين (1، 15 يوم) أن أفضل معاملة هي المضاف لها دبس التمر بنسبة 45%. كذلك أظهرت النتائج زيادة نسب الأملاح المعدنية بجميع المعاملات المدعمة بدبس التمر مقارنة بالكنترول وسجلت المعاملة (D<sub>3</sub>) الأعلى في محتوى المعادن. كذلك تم تصنيع متلج لبني مدعم بدبس الرمان كمصدر غني بمكونات وظيفية طبيعية بنسب (2.5، 5، 7.5%) ومستخلص البنجر الأحمر كملون طبيعي ومصدر للمواد الفينولية والمضادة للأكسدة والمغذيات، وتم إجراء التحليلات الكيميائية والطبيعية والحسية للمنتج. وقد أوضحت النتائج حدوث انخفاض الرقم الهيدروجيني والدهن والبروتين بينما إزدادت الجوامد الكلية ونسبة الحموضة والرماد والوزن النوعي والوزن للجالون وزيادة اللزوجة ومحتوى المعادن وزيادة المقاومة للانصهار مقارنة بالكنترول. كما أظهرت النتائج أثناء التخزين (1، 15، 30 يوم) زيادة في قيم a بزيادة نسبة دبس الرمان، بينما انخفضت قيمة L و b بشكل ملحوظ. أظهرت نتائج التقييم الحسي أثناء التخزين (1، 15 يوم) أن أفضل معاملة التي تحتوي على دبس الرمان بنسبة 2.5%. كذلك أظهرت النتائج زيادة نسب الأملاح المعدنية بجميع المعاملات المدعمة بدبس الرمان ومستخلص البنجر الأحمر مقارنة بالكنترول. كما تم دراسة كإ من النشاط المضاد للأكسدة والمحتوي من المركبات الفينولية في كل من مستخلص البنجر الأحمر، ودبس الرمان المستخدم في تصنيع المتلج اللبني.