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Compositional characteristics of date syrup extracted by different methods in some fermented dairy products

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Methods and zabady

Abstract This study was conducted to select the best method of extraction. Different methods have been used to extract and concentrate the date syrup "Dibs". Minced date flesh of Saidy variety was extracted twice using minced flesh at a water rate of 1:2 at 70 °C for 30 min using microwave, rotary evaporator and water bath and concentrated in a rotary evaporator and microwave. Apparently, use of microwave method for extraction and concentration of date syrup had a significant ($p \geqslant 0.05$) difference higher in the content of moisture, protein, total sugars, dietary fiber, total phenolics, hydroxymethylfurfural and ash, but it had no significant ($p < 0.05$) difference in insoluble solids and fat content. The organoleptic evaluation of zabady and biogarde prepared with dibs are correlated with the chemical characteristics and microbiological tests. Results could be concluded that the caloric values of fermented milk products with 2% Dibs attained the highest values, actually 65.62 and 64.78 K Cal/100 g for zabady and biogarde respectively. Total solids, S.N., T.A. and ash contents were gradually increased during storage periods. Also, zabady and biogarde with 2% dibs were found to be rich in all essential amino acids excluding lysine, histidine, threonine, and leucine + isoleucine.

Introduction

Date palm (*Phoenix dactylifera* L.) is one of the major fruit trees in Egypt. It has been used as food for 6000 years. (Al-Shahib and Marshall, 2003). The importance of the date in human nutrition comes from its rich composition of carbohydrates (70–80%), salts and minerals, dietary fiber, vitamins, fatty acids, amino acids and protein. (El-Beltagy et al., 2009; Al-Shahib and Marshall, 2003). Research proves that when dates are eaten alone or as mixed meals with yoghurts they have low glycemic indexes (Gad et al., 2010). Epidemiological studies have consistently shown that high date fruit consump-

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tion is associated with a reduced risk of several chronic diseases such as coronary heart disease, cardiovascular disease, cancer, aging, atherosclerosis, neurodegenerative disease, tumor, and mutagens (Al-Farsi et al 2007; El-Beltagy et al 2009; Gad et al 2010). Extracts of the dates provided to the women after childbirth stimulate their immune system (Gad et al., 2010). On the other hand, a polysaccharide isolated from dates presented an antitumor activity (Ishurd and Kennedy, 2005). Egypt lies among the first largest producers of Arab countries (1,151,000 tons) means 17% of world production (FAO, 2004). Industrially, it is utilized to produce several products such as syrup, jam, jelly, chutney, candy and date bars, Yousif and Alghamdi (1998) and Ramadan (1998). Date syrup (dibs) is the most commonly derived date product. In date syrup industry the fruits are mixed with water and heated, when the sugars are extracted. This method destroys some nutritive components and darkens the product's color. Zabady is pasteurized milk coagulated to a cluster-like consistency with a mixed lactic acid culture containing *Lactobacillus bulgaricus* and *Streptococcus thermophilus*. It is most often used with fruit preserves or date palm syrup (dibs), in a variety of food products, including their use as functional food and ingredients in nutraceuticals. This is attributed to the fact that these foods may provide an optimal mixture of phytochemicals such as dietary fiber, phenolics, natural antioxidants and other bioactive compounds (Al-Farsi et al., 2007; Mansouri et al., 2005). In Several studies attempts have been made to improve the health status by the incorporation of *Lactobacillus acidophilus* or/and *Bifidobacterium bifidum* in the manufacture of yoghurt. These bacteria may have several therapeutic functions, including antimicrobial activity, its ability to assimilate cholesterol and carcinogenic activity (Chou and Weimer, 1999). The objective of this study was to compare existing differences in compositional and functional characteristics of three different methods to prepare the date syrup (dibs) of the Saidy date variety and to investigate the influence of date syrup (dibs) on chemical characteristics, microbiological tests, sensory evaluation and acceptability of zabady and biogarde.

Materials and methods

Materials

Saidy variety of date *P. dactylifera* L was used to prepare the date syrup in this investigation. The former, Saidy, is one of the finest cultivars (Semi-dry) in Egypt. It was obtained from the Kharja Date Packing Factory during the sorting operations of the high quality fruits. The fruits were pitted and the flesh was minced just before chemical analysis, and kept refrigerated in sealed polyethylene bags for further analysis and processing.

Chemicals

All chemicals and solvents were obtained from Sigma Aldrich Co. Ltd. (Dorset, UK).

Date syrup production

Date flesh (Semi-dry) Saidy date variety was pitted, crushed and cut to small pieces with a sharp knife and dry – blended for 3 min. with a blender, and extracted twice using 1:2 of flesh powder water rate at 70 °C for 30 min. by using microwave and rotary evaporator. But in water bath method the date flesh powder sample was heated in 1: 2 of flesh powder water rate at 70 °C for 30 min. and blended. The raw syrups were collected separately from each method, centrifuged at 4000 rpm for 15 min and filtered through a whatman No. 41 filter paper divided in two flashes and concentrated in a rotary evaporator under vacuum at 70 °C and a microwave to about 72 Brix. The produced date syrup (dibs) was packed in sealed glass bottles and stored inside the freezer until use.

Milk

Fresh whole buffalo's milk was obtained from the herd of Assiut experimental farm, the Faculty of Agriculture, Al-Azhar University, Assiut Branch.

Starter cultures

B. bifidum ATCC 15696, *Lactobacillus delbruekii* subsp. *bulgaricus* EMCC 11102, *Lb. acidophilus* ATCC 4356 and *S.* thermophilus EMCC 11044 were secured from Cairo MIRCEN, the Ain Shams University.

Proximate analysis

Percentages of moisture by a vacuum oven at 70 °C to a constant weight, protein by Kjeldahl nitrogen and ash by direct analysis were determined according to the Association of Official Analytical Chemists methods (AOAC, 2003). The Bligh and Dyer method (Al-Farsi et al., 2007) was used to determine the fat content. Total sugars and reducing sugars were determined according to Lan and Eynon method. Non reducing sugars were calculated by difference. Dietary fibers were carried out according to (Al-Farsi et al., 2007). The sample was de-sugared by three extractions, each with 85% ethanol (10 m1/g), and then dried overnight at 40 °C. Otherwise the total dietary fiber content would have been overestimated. Contents of crude protein (percentage total nitrogen X 6.25) and ash determined by using the methods described above were used to correct the fiber content. Dietary fiber was expressed as grams per 100 g of fresh weight. Proximate analysis was expressed as grams per 100 g of fresh weight. Total phenolics were determined calorimetrically using Folin – Ciocaltaeu reagent as described by (Al-Farsi et al., 2005), using a UV – 1601 spectrophotometer (Japan), the concentrations are expressed as milligrams of gallic acid equivalents (GA) per 100 g of fresh weight. Minerals i.e. Na, Ca, Mg and K were estimated using emission flame photometer (England), the other minerals (Fe, and Zinc) were determined according to AOAC (2003) using absorption spectrophotometer (Perkin – Elmer Instrument Model 2380, USA). Amino acids of date syrup concentrations (dibs) and fermented milk products were determined using a Beckman Amino Acid Analyzer Model 7300. The results were expressed as gram per 100 g protein or mg/100 g dry date basis. Hydroxymethylfurfural (HMF), titratable acidity, pH and total soluble solids (TSS) were determined in dibs according to the method of Rangana (1986) and results of Browning – index of HMF was expressed as absorbance values (at 420 nm). Total soluble solids (TSS) were determined by an ''Abbe'' refractometer at 20 °C (Rangana, 1986). The pH value was determined using a research pH meter. Titratable acidity (T.A) was determined by direct titration with NaOH (0.1 N) to a pH value 8.1 using a pH meter. The

results were expressed as percent of acetic acid (Rangana 1986). Caloric value: was calculated using Atwater and Bryant factor which was reported by Hawk et al. (1949) as follows:

$$\text{Total caloric value} = (\%\ \text{protein} \times 4) + (\%\ \text{carbohydrates} \times 4) + (\%\ \text{Fat} \times 9)$$

Total solids (TS) were calculated as 100 – moisture content.

Total insoluble solids (TIS) were determined gravimetrically after washing away the soluble solids by hot water (El-Shaarawy, 1986).

Recovery of soluble solids (RSS) was computed from the equation:

$$\text{RSS} = \frac{\text{Weight of ext.} \times \%\ \text{TSS of ext.}}{\text{Weight of date pulp}} \times 100$$

The color of the diluted date syrup was measured as optical density at 520 nm using a spectrophotometer (Ramadan, 1998).

Preparation of fermented milks

Fermented milk was prepared as mentioned by Abd El-Tawab (2009) with some modifications. The fresh standardized buffalo's milk (3.0% fat) was heated to 90 °C/15 min., then concentrated date syrup (dibs) was added at different levels (1%, 2%, and 3%) at 50 °C., rapidly cooled to 42 °C., divided into eight equal portions and each portion was separately inoculated with starter cultures as follows:

Zabady

Inoculated with 2% active growing culture (mixed 1: 1 *S. thermophilus EMCC 1104* and *Lb. delbruekii* subsp. *bulgaricus EMCC 11102*), according to Tawfik et al. (2003).

Biogarde

Used 6% active starter cultures of *B.* bifidum ATCC 15696, *Lb. acidophilus* ATCC 4356 and *S. thermophilus EMCC 1104* (2: 1: 2), described by Klupsch (1985).

Chemical analysis

Fat, soluble nitrogen, total solids, protein, ash, pH and titratable acidity contents in fermented milks were estimated by Ling (1963).

Amino acid scores (AAS): AAS were calculated according to FAO/WHO (1973).

$$\text{ASS}\% = \frac{\text{Mg of amino acid in each sample (100 g)}}{\text{Mg of amino acid in reference protein}} \times 100$$

Microbiological tests

The total bacterial count that was examined on T.S.A. medium by (A.P.H.A., 1978), lactobacilli was enumerated on MRS medium (De Man et al., 1960). While *S. thermophilus* was estimated by Lee et al. (1974) in Lee agar medium. *B. bifidum* were enumerated according to Dave and Shah (1996). Concerning molds and yeasts, malt extract agar medium (A.P.H.A., 1978) was used, for *E. coli* violet red bile agar (V.R.B.A.) medium was used as recommended by Klein and Fung (1978).

Organoleptic scoring

The organoleptic evaluation of fermented milks was assessed by a panel of 10 persons of staff members of the Dairy and Food Science Technology Departments, the Faculty of Agriculture, Al-Azhar University, Assiut Branch, according to Pearce and Heap (1974).

Statistical analysis

The obtained data were statistically analyzed using one way analysis of variance procedure of SPSS to determine whether significant ($p < 0.05$) variation occurred among the means of each experiment (Gray and Kinnear, 2000).

Results and discussion

Gross physicochemical composition of date flesh and date syrup concentrated (dibs) produced by different methods

Date flesh obtained from Saidy date (semi dry) variety was analyzed for their constituents and compared with the date syrup extracted by different methods (water bath, rotary evaporator and microwave), which concentrated by rotary and microwave. The results obtained are given in Table 1. It was found that the moisture content was 9.75%, while, the moisture content of date syrup concentrated was highest in water bath method, and lowest in microwave method. These differences were due to the type of the used method (Ramadan, 1998; Entezari et al., 2004). Significant ($p \geqslant 0.05$) differences were observed in moisture content with all different methods of extraction. These data are in same line with those reported by (El-Beltagy et al., 2009). The different extraction methods tested no significant ($p < 0.05$) differences between rotary evaporator and microwave methods in dry matter, total sugars and reducing sugars, dry matter, total sugars and reducing sugars of date flesh were 89.99%, 77.70% and 75.2%, respectively. Reducing sugars were the predominate sugars in the Saidy date variety (75.2%). A considerable amount of non reducing sugar was found, as their content was 2.50% of its total sugar content in date flesh. Meanwhile, significant ($p \geqslant 0.05$) differences were observed in non reducing sugars. Within each row means that those with the same letter are not significantly different ($p < 0.05$). Sugars were determined with all used methods of extraction. The used extraction methods cleared that no significant ($p < 0.05$) differences in insoluble solid and fat content were present.

Similar results are found with other types of dates (Mustafa et al., 1983; El-Shaarawy et al., 1986; Al-Farsi et al., 2007). Total dietary fiber content in date flesh was 8.7%. Date flesh was a good source of dietary fiber. In contrast, dibs contained trace amounts of total dietary fiber in all the used extraction methods. These data are close to Al-Farsi et al. (2007) and El-Beltagy et al. (2009) with other types of date. Microwave method had the highest amount of total phenolics (173 mg/100 g of fresh weight), followed by rotary evaporator method (165), and then the water bath method (144). Date flesh had the highest amount of total phenolics (190 mg/100 g of fresh weight). Also, of the different extraction methods tested, significance ($p \geqslant 0.05$) in hydroxymethylfurfural was observed. Microwave method had the lowest amount of hydroxymethylfurfural

Table 1 Physicochemical composition of date flesh and concentrated syrup extracted by different methods.

Treatments	Date flesh	Water bath		Rotary method		Microwave method	
		Rotary evaporator	Microwave	Rotary evaporator	Microwave	Rotary evaporator	Microwave
Components							
Moisture	10.01	24.35 c	22.0 b	21.23 b	20.02 b	20.89 a	19.66 a
Dry Matter*	89.99	75.65 c	78.0 b	78.77 b	79.98 a	79.11 b	80.34 a
Insoluble Solid*	6.00	6.0 a	4.0 a	5.0 a	4.0 a	4.0 a	3.0 b
Total soluble solid*	83.49	69.65 c	74.0 b	73.77 b	75.98 a	75.11 b	77.34 a
Protein*	1.79	1.00 c	1.05 c	1.60 b	1.70 a	1.64 b	1.75 a
Fat*	2.10	2.40 a	2.44 a	2.42 a	2.41 a	2.40 a	2.40 a
Total sugars*	77.70	64.5 c	68.75 b	67.95 b	70.05 a	69.25 b	71.35 a
Reducing Sugar*	75.2	62.0 c	66.15 b	64.95 b	67.75 a	65.85 b	67.85 a
Non reducing sugar*	2.50	2.50 c	2.6 c	3.0 b	2.30 c	3.4 a	3.5a
Dietary fiber*	8.70	0.50 a	0.75 a	0.45 b	0.55 a	0.25 c	0.35 b
Total phenolics*	190	140 c	144 c	155 b	165 b	165 b	173 a
Hydroxymethylfurfural***	–	120 a	112 a	100 b	90 c	50 c	30 c
pH	6.00	6.1 c	6.5 a	6 c	6.3 a	6.3 a	6.5a
Titratable acidity**	7.9	7.5 a	7.0 a	6.85 a	6.70 b	5.99 b	5.75 c
Ash*	1.90	1.75 c	1.77 c	1.80 b	1.82 a	1.82 a	1.84 a
Na***	90.5	72.0 c	73.8 b	81.0 b	83.7 b	85.5 a	87.75 a
Ca***	28.5	20.0 c	21.0 c	25.0 b	26.75 a	25.5 b	27.5 a
K***	1000	900 c	925 b	950 a	960 a	970 a	981 a
Mg***	52.0	39.0 c	41.0 b	45.0 b	48.0 a	48.0 a	50.0 a
Fe***	10.0	8.70 c	8.8 b	9.25 b	9.5 b	9.60 a	9.8 a
Zinc***	0.95	0.70 b	0.77 b	0.80 b	0.83 b	0.90 a	0.93 a

Pairwise comparisons:
a = mixed, b = hyperactive & c = hypoactive.
* Data are expressed as grams per l00 g of fresh weight.
** Data are expressed as milligrams of gallic acid equivalents (GA) per 100 g on a fresh weight basis.
*** Data are expressed as milligrams per 100 g of fresh weight.

(30 mg/100 g of fresh weight) followed by rotary evaporator method (100), and then the water bath method (120 mg/100 g of fresh weight). Date flesh did not contain hydroxymethylfurfural. Microwave extracts significantly had higher protein content (1.79) compared with the extraction by water bath (1.05) while extraction with microwave had significant ($p \geqslant 0.05$) difference compared with water bath and rotary evaporator method. Significant ($p \geqslant 0.05$) difference was observed in ash content, pH and titratable acidity between all different methods. Also, microwave extracted and concentrated juice had a significantly ($p \geqslant 0.05$) higher content of total soluble solids (77.34%) followed by rotary evaporator method (75.98%) and then water bath method (74%). Similar results are found with other types of methods (El-Beltagy et al., 2009). Data showed that Saidy date flesh was a good source for many metals, such as K (1000 mg/100 g of fresh weight), Ca (28.5), Mg (52.0), Na (90.5), Zn (0.95) and Fe (10.0). Potassium was found to be the predominant element. The date is considered as a practical supplement for iron rather than iron tablets for those who have iron deficiency because it does not show side effects. Meanwhile, significant ($p \geqslant 0.05$) differences were observed in all metals with all the used methods of extraction. Similar results are found with other types of dates (Al-Shahib and Marshall, 2003).

Effect of different methods on extraction of 100 g dates with equal volume of water

Portions of 100 g of Saidy date were extracted with different methods at 70 °C (water bath, rotary evaporator and microwave). Table 2 shows that the recovery of soluble solids generally varies with used methods of extraction. Microwaving 70 °C had yielded highest recovery and darkest color (70% and 0.29, respectively) followed by rotary evaporator with improvement in color (56.1 and 0.13, respectively) and then the water bath method (42 and 0.09). The reason for the low extraction rate in water bath method can be due to the formation of saturated layer of extracted materials around the minced date and this phenomenon can almost stop the extraction of materials. The rotary evaporator and microwave removes this layer from around the minced date and contacts with the new solvent, resulting in a higher extraction rate (Entezari et al., 2004). The heat treatment helps to flocculate turbidity, causing easier separation by centrifugation, thus leaving a more clear extract, the higher absorbance of the more clear extract indicated the occurrence of browning reactions by heating (El-Shaarawy, 1986). Hence, it was limited to the best method of date syrup extraction (microwave method) to proceed to amino acids analyzing.

Mean values of amino acids content of date flesh and concentrated syrup extracted by microwave

Table 3 shows the amino acids content of date flesh and date syrup extracted and concentrated by microwave method. The date flesh contained (175.86 mg/100 g dry date) sulfur containing amino acids, and (523.22 mg/100 g dry date) total essential amino acids, compared with the extraction by microwave method that contained (172.05 mg/100 g dry date) sulfur containing amino acids, and (509.25 mg/100 g dry date) total essential

Table 2 Effects of different methods on extraction of 100 g dates with equal volume of water.

	Date flesh	Water bath		Rotary method		Microwave method	
		Rotary evaporator	Microwave	Rotary evaporator	Microwave	Rotary evaporator	Microwave
Extraction weight (g)	–	280	300	320	330	340	350
Total soluble solid of diluted extraction.	–	12	14	15	17	18	20
Recovery of soluble solids	–	33.6	42	48	56.1	61.2	70
Absorbance at 520 nm	–	0.11	0.09	0.15	0.13	0.20	0.29
r[a]	–	0.989	0.991	0.993	0.994	0.998	0.999

[a] coefficient of correlation.

Table 3 Means values of amino acids content of date flesh and concentrated syrup extracted by microwave.

Amino acids	Date flesh		Concentrated syrup extracted by microwave "microwave method"	
	a	b	a	b
Lysine	95.20	5.46	92.50	5.28
Histidine	28.26	1.61	26.85	1.53
Threonine	89.40	5.10	87.50	4.99
Valine	62.50	3.57	61.05	3.48
Methionine	59.61	3.40	58.50	3.34
Leucine + Isoleucine	136.25	7.78	132.15	7.55
Phenylalanine	52.0	2.97	50.70	2.89
Total essential amino acids	523.22	29.89	509.25	29.06
Arg.	74.50	4.25	72.45	4.14
Alanine	107.40	6.16	100.50	5.74
Aspartic acid	90.85	5.19	90.00	5.14
Cysteine	60.50	3.45	59.70	3.41
Cystine	55.75	3.18	53.85	3.07
Glumatic acid	70.15	4.00	68.95	3.93
Serine	90.65	5.17	88.75	5.07
Tyrosine	85.70	4.89	83.45	4.76
Total non essential amino acids	635.5	36.29	617.65	35.26

[a] Amino acids mg/100 g dry basis.
[b] Amino acid g/100 g protein.

amino acids. Similar results are found with other types of dates (Al-Shahib and Marshall, 2003; Gad et al., 2010).

Organoleptic scoring of fermented milk products prepared with dibs

The organoleptic properties of resultant fermented milk made with/or without adding of dibs (date syrup) are shown in Table 4. Zabady with 2% dibs and biogarde with 2% dibs had the highest ($p \geqslant 0.05$) scores for flavor, appearance and body textures with those of control; this may be due to the increasing gel firmness and also improved the body textures. Fortification with dibs up to 3% increased the organoleptic properties compared with controls. The obtained data revealed that fermented milks (zabady and biogarde) fortified with 2% dibs gained the highest scores of organoleptic properties. Furthermore, the average total score points of both tested treatments gradually decreased by the prolongation of storage periods. However, the panelists described the flavor of fermented milks prepared with 2% dibs as more acceptable. These results may be maintained by the data of HMF and Fe in Table 1., sulfur amino acids in Table 3. Hence, it was limited to the highest average score points of treatments to the proceeding chemical characteristics, amino acid contents and microbiological tests.

Chemical analysis and caloric value of resultant fermented milk products prepared with dibs

Table 5 summarizes the chemical composition in the resultant fermented milks with 2% dibs during storage periods. It is clear that T.S., S.N., T.A., Ash, Na, K and Mg contents were gradually increased in all tested samples throughout storage periods. These increases (except acidity) during storage could be attributed to the losses in moisture content of different treatments by evaporation. The pH values took an opposite trend of acidity whereas, fat, protein, pH, total sugars and caloric values were slightly decreased. However, the changes in the pH values of resultant products coincided with the decrease in total sugars. This decrease in the main fermented milk components gradually decreased the caloric value. In addition, Fe and Zinc values decreased in treatment with 2% dibs compared with control, it was of interest to use Fe and Zinc in starter cultures and it has been found that iron is involved in the production of acetic acid by *B. Bifidum* (Salminen et al., 2004). As a matter of fact, the increase in total solids was one of the principal factors influencing the firmness and body & texture of the resultant product (Abd El-Tawab, 2009). Moreover, from the previous results, it could be concluded that the caloric values of fermented milk products with 2%

Table 4 Organoleptic scoring of Zabady and Biogarde under different levels of Dibs during storage periods.

Treatments	Zabady												
	Control			Zabady + 1% Dibs			Zabady + 2% Dibs			Zabady + 3% Dibs			LSD 5%
	Storage periods (days)												
	0	5	10	0	5	10	0	5	10	0	5	10	
Properties (Score)													
Flavor (5)	4.1	3.8	3.6	4.4	4.5	4.0	4.7	4.8	4.8	4.5	4.7	4.5	0.95
Appearance (5)	4.4	3.6	3.5	4.3	4.1	3.8	4.5	4.3	4.2	4.3	4.0	3.7	0.65
B&T (5)	3.5	3.6	3.2	4.2	4.4	4.1	4.4	4.5	4.2	4.1	4.2	3.5	1.00
Total scoring (15)	12	11	10.3	12.9	13	11.9	13.6	13.6	13.2	12.9	12.9	11.7	
Treatments	Biogarde												
	Control			Biograde + 1% Dibs			Biograde + 2% Dibs			Biograde + 3% Dibs			
Properties (Score)													
Flavor (5)	4.4	4.6	4.5	4.7	4.7	4.5	4.8	4.9	4.7	4.0	4.2	3.9	0.6
Appearance (5)	4.2	4.4	3.9	4.0	4.1	3.8	4.1	4.2	4.0	3.9	3.6	3.5	0.65
B&T (5)	4.3	4.4	4.0	4.5	4.5	4.2	4.7	4.8	4.6	3.9	3.8	3.6	0.62
Total scoring (15)	12.9	13.4	12.4	13.2	13.3	12.5	13.6	14.0	13.3	11.8	11.6	11.0	

B&T = Body and Texture. LSD = Least significant difference at 0.05.

Table 5 Chemical analysis and caloric value of zabady and biogarde with 2% dibs during storage periods.

Treatments	Zabady						Biograde					
	Storage periods (days)											
	Control			With 2% dibs			Control			With 2% dibs		
	0	5	10	0	5	10	0	5	10	0	5	10
Components												
Total solids%	12.20	12.37	12.67	13.34	13.44	13.60	12.30	12.46	12.68	13.36	13.51	13.73
Fat%	3.00	2.90	2.80	3.10	3.00	2.90	2.90	2.80	2.70	3.00	2.90	2.70
Protein%	4.44	4.10	4.00	4.48	4.23	4.11	4.41	4.27	4.17	4.48	4.40	4.27
Soluble Nitrogen%	0.173	0.180	0.20	0.187	0.190	0.235	0.149	0.168	0.180	0.178	0.194	0.244
T.A.%	0.81	0.90	0.95	0.90	1.12	1.16	0.85	0.95	1.07	0.97	1.18	1.23
pH	4.80	4.51	4.22	4.76	4.43	4.18	4.69	4.50	4.32	4.69	4.40	4.12
Total sugars as reducing sugar%	3.96	3.69	3.50	4.86	4.70	4.62	4.00	3.68	3.30	4.87	4.34	4.10
Ash%	0.80	0.92	0.97	0.85	0.99	1.19	0.91	1.12	1.18	0.96	1.10	1.22
Na mg/100 g	62.5	64.3	65.0	65.4	67.2	68.0	60.4	62.4	63.9	63.1	65.3	67.5
Ca mg/100 g	154.0	160.0	163.0	155.8	162.2	165.0	155.3	158.2	160.5	157.1	159.7	162.2
K mg/100 g	180.3	181.9	183.0	209.0	211.7	213.3	186.2	187.1	188.3	211.0	215.3	216.9
Mg mg/100 g	19.0	22.1	24.0	20.4	23.6	25.5	21.4	21.9	22.8	23.1	24.5	25.8
Fe mg/100 g	0.60	0.62	0.64	1.12	0.99	1.10	0.68	0.60	0.20	0.87	0.75	0.42
Zinc mg /100 g	6.00	6.70	6.80	6.03	6.75	6.88	5.30	4.90	4.20	5.34	4.96	4.28
Caloric Value K Cal/100 g	59.63	59.19	55.55	65.62	63.08	61.38	60.11	57.37	54.55	64.78	61.44	58.18

dibs attained the highest values, actually 65.62 and 64.78 K cal/100 g for zabady and biogarde, respectively. The present results are in agreement with the findings of Abd El-Tawab (2009) and Mohamed (2002).

Amino acid content and amino acid scores (AAS) in fermented milk products prepared with 2% dibs in fresh stage

As shown in Table 6, most amino acids occur in fermented milk products but not in different relative percentages. It could be gathered that the total amino acids content in fermented milk products with 2% dibs are higher than those in the rest of products. Also, it will be seen that sulfur amino acid content attained the least concentration as compared with the rest amino acids. Moreover, it is clear that lysine and leucine + isoleucine are the predominant amino acids followed by alanine. In this connection, it was of interest to notice that all amino acids except cysteine and cystine were detected in biogarde. Undoubtedly, the absence of some amino acids may be due to the decomposition of these acids by microorganisms, (Abd El-Tawab, 2009). In this connection, Noeman and Shalaby (1992) reported that aspartic acid, cystine and ornithine were not detected in acidophilus milk, while in zabady only cystine was absent. Additionally, it was evident from the tabulated data that zabady with 2% dibs and biogarde with dibs possessed the highest content of essential amino acids, being 22.58 and 21.93 g/100 g, respectively as compared with the controls. However, Table 6 represents the amino acid scores (AAS)

Table 6 Amino acids content (g/100 g protein) and amino acid scores (g/100 g of sample) in zabady and biogarde with 2% Dibs in fresh stage.

Treatments	Reference protein FAO/WHO	Milk with 2% Dibs g/100g protein	Zabady				Biogarde			
			Control	AAs%	With 2% Dibs	AAS%	Control	AAS%	With 2% Dibs	AAS%
Components										
Lysine	5.1	10.12	5.60	4.92	8.49	7.39	2.74	2.1	5.27	4.56
Histidine	1.7	2.10	1.70	4.48	1.81	4.73	1.96	5.16	2.02	5.24
Threonine	3.5	2.85	2.01	2.57	2.08	2.64	2.37	3.03	2.57	3.24
Valine	4.8	2.50	1.84	1.72	2.26	2.09	1.68	1.57	2.35	2.16
Methionine	2.6	0.93	0.32	0.55	0.67	1.14	0.15	0.26	0.48	0.81
Leucine + Isoleucine	11.2	8.42	5.39	2.16	5.68	2.25	6.17	2.41	7.26	2.86
Phenylalanine	7.3	1.96	0.62	0.38	1.59	0.97	1.25	0.77	1.80	1.09
Total E.A.A. or Total AAS%	36.2	28.0	17.48	2.16	22.58	2.77	16.32	2.02	21.93	2.67
Arginine	–	1.94	1.09	–	1.25	–	1.05	–	1.40	–
Alanine	–	3.41	2.35	–	3.18	–	1.72	–	2.97	–
Aspartic acid	–	3.34	1.39	–	1.75	–	1.62	–	2.46	–
Cysteine	–	0.37	0.12	–	0.25	–	ND	–	ND	–
Cystine	–	0.31	0.15	–	0.18	–	ND	–	ND	–
Glutamic acid	–	2.75	2.32	–	2.43	–	2.35	–	2.60	–
Serine	–	1.97	1.50	–	1.75	–	1.45	–	1.86	–
Tyrosine	–	3.05	1.66.	–	2.66	–	1.33	–	2.81	–
Proline	–	1.92	1.62	–	1.88	–	1.24	–	1.72	–
Non E.A.A.	–	19.06	13.0	–	15.33	–	10.76	–	13.23	–
Total A.A.	–	47.06	29.68	–	37.91	–	27.08	–	35.16	–

E.A.A = Essential amino acids. A.A.S = Amino acid scores. ND = Not detected.

of different cultured milk products, it could be considered that zabady with 2% dibs and biogarde with 2% dibs are good sources of lysine, histidine, threonine and leucine + Isoleucine.

Microbiological tests

Table 7 represented the changes in total, *S. thermophilus* lactobacilli and *B. bifidum* counts of resultant fermented milk products with 2% dibs during storage periods. Viable counts of total bacteria, *S. thermophilus* lactobacilli were gradually decreased with the prolongation of storage periods. This decline in viable bacterial count was likely due to the developing acidity of resultant products (Abd El-Tawab, 2009). Moreover, the present data declared that biogarde with 2% dibs attained the greatest population of *B. bifidum* at the end of storage as compared with control. In this respect, the increasing of cysteine improved the viability of *B. bifidum* and *Lb. delbruechii* subsp. *bulgaricus* (Bari et al., 2009). As shown in Table 7., the yeasts & Molds and *Escherichia coli* were completely absent in either fresh and stored samples of different products. This finding may be due to the production of antimicrobial agents by bifidobacteria, which suppress the growth of yeasts (Mohamed, 2002; Abd El-Tawab, 2009).

Table 7 Microbiological tests (Log cfu/ml) of zabady and biogarde with 2% Dibs during storage periods.

Treatments	Zabady						Biogarde					
	Control			With 2% dibs			Control			With 2% dibs		
	Storage periods (days)											
	0	5	10	0	5	10	0	5	10	0	5	10
Properties (Score)												
Total bacterial count	9.90	9.38	9.13	10.41	10.0[a]	9.7[a]	10.3	10.1	9.46	10.62[a]	10.40[b]	10.0[a]
S. thermophilus count	6.70	6.82	6.50	6.92[a]	6.86	6.60	7.49	7.40	7.33	7.60[a]	7.52[a]	7.40
Lactobacilli count	6.74	6.62	6.41	6.88[a]	6.70[b]	6.58[b]	6.84	6.80	6.62	6.94[a]	7.00[b]	6.73[a]
B. bifidum count	–	–	–	–	–	–	7.11	7.00	6.81	7.25	7.30[b]	7.10[b]
Molds & yeast count	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
E. coli count	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

ND: Not detected. –: Not determined.
[a] Significant at 0.05.
[b] Highly Significant at 0.05.

Conclusion

The results presented here suggest that microwave extraction was the best extraction method with high recovery and highly correlated with date flesh. Also, dibs was a good source of reducing sugars, minerals and total phenolics that can be used as a functional food ingredient. The use of 2% dibs in the preparation of zabady and biogarde improved the organoleptic and chemical characteristics of them. From the foregoing it could be concluded that both zabady and biogarde with 2% dibs are very nutritive fermented milk products.

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