Journal of Food and Dairy Sciences

Journal homepage: www.jfds.mans.edu.eg
Available online at: www.jfds.journals.ekb.eg

Nutritional Evaluation of Fermented Camels' Milk Permeate Pomegranate Beverage

Marwa H. El-Gendy* and E. M. Abdeen

Dairy Unit, Animal and Poultry Breeding Department, Desert Research Center, Cairo, Egypt

Cross Mark

ABSTRACT

This study aimed to produce fermented beverage from camels' milk permeate mixed with different concentrations (control, 2.5, 5 and 10%) pomegranate syrup. Beverages were evaluated for their physical, chemical, rheological, microbiological and organoleptic properties. Physicochemical compositions of prepared beverages of fermented permeate of camels' milk mixed pomegranate syrup were not significant ($p \geq 0.05$) for protein, fat and ach contents in all the examined treatments. But total solid, total sugar and pH value changed significantly ($p \leq 0.05$). All functional beverages were found rich in many mineral elements. On the other hand, total anthocyanin, phenolic compounds, total antioxidant activity contents, colour and viscosity in all prepared beverages were significantly affected ($p. \leq 0.05$). This was due to effect of exopolysaccharide being produced by probiotic bacteria used in the permeate. *Bif. animalis*, which resulted in the highest levels of viscosity in all the examined beverages throughout storage. Lower lost in the viability of *Str. thermophilus* and *Lb. acidophilus* was detected during storage of the beverages. The coliform bacteria, yeasts and molds were not detected in the control and in all the other treatments during all storage periods. Also, the added pomegranate syrup improved the sensory evaluation compared among all treatment. Finally, fermented permeate camels' milk mixed with different concentrations of pomegranate syrup beverages can be recommended as a functional food product with potential health benefits and it can be marketed and consumed as healthy beverages.

Keywords: Permeate, Pomegranate syrup, Camel milk, Beverage, Antioxidant.

INTRODUCTION

Camels' milk is consumed raw in remote areas and may could be consumed in fermented milk products. Currently, in urban areas, it is preferable to use new dairy products more than raw milk (Faye and Konuspayeva, 2016). Therefore, it has been an improvement in the production of some other products, including cheese, either in the traditional methods or by using new technology (Konuspayeva *et al.*, 2014 and El-Gendy 2018a).

Yield of cheese made by the traditional method of camel milk is 9 kg / 100 kg of milk, and only 8 kg / 25 kg by using ultrafiltration, resulting in large quantities of whey / permeate, rich in some proteins, lactose and minerals (Beucler *et al.*, 2005, Konuspayeva *et al.*, 2017, and El-Gendy, 2018a).

By-products of dairy began to be re-evaluated in order to comply with environmental trends. When using these modern biotechnologies with probiotic bacteria to improve the nutritional value of both humans and animals (Stanciu *et al*., 2005).

Food industry development and consumers' awareness has contributed to increasing the quality of food and food manufacturing. Emergence of known functional foods that contain bioactive compounds, such as phytochemicals, oligosaccharides, dietary fibers and probiotic bacteria was claimed by Jankovic *et al.*, (2010) and Thakur and Sharma, (2017). Using of probiotic bacteria increases the nutritional quality of dairy beverages, due to their health benefits. The commercial probiotic product is considered as functional only if it contains 10^6-10^7 CFU/ml at the time of consumption (FAO/ WHO, 2002, Divya *et al.*, 2012, Castro *et al.*, 2013 and Sarkar, 2019). *Lb. acidophilus* and *Bifidobacterium* spp are the most common types of bacteria used as probiotics.

Pomegranate (*Punica granatum*) contain large amount of acids, sugars, vitamins, polyphenols, and important minerals. It also contains high concentrations of phenolic compounds including anthocyanins, antioxidants, ellagic tannins, gallic, ellagic acids and flavonol glycosides, and procyanidins (Al-Maiman and Ahmad, 2002; Murthy *et al.*, 2002; Poyrazoglu *et al.*, 2002; Negi and Jayaprakasha, 2003 and Gumienna *et al*., 2016). Its juice is also used in beverages as a flavoring and coloring, while syrup in flavoring, a salad dressing or soft drink ingredient (Yilmaz *et al.*, 2007). In general, the thermal treatments affect in food processing on the amount and structure of phenols. An increase of the phenolic compounds in fruit juice adversely affect the appearance, astringency, color and bitterness of fruit juices (Alper *et al.*, 2005 and Adhami and Mukhtar, 2006). Due to its antioxidant and anti-inflammatory activity, phenolic compounds have been considered of medical and industrial importance. Pomegranate juice has potent effects against some diseases, it was anti-cardiovascular, anti-inflammatory antimicrobial and anticarcinogenic (Negi *et al.* 2003; Adhami and Mukhtar, 2006; Sepúlveda *et al.*, 2010 and Rios-Corripio *et al.* 2019). It is considered an indicator of the pigment concentration and the reactions

* **Corresponding author.**
E-mail address: marwaelgendy616@gmail.com
DOI: 10.21608/jfds.2021.55265.1012

resulting from heat treatment (Yildiz *et al.*, 2009). Rheological behavior of pomegranate juice must be known during/ after the heating process to evaluate the total phenolic compounds and the color changes resulting from the effect of temperature and concentration. And so, pomegranate syrup manufactured because its affect to the ability to market processed pomegranate products (Yildiz *et al.*, 2009, Turfan *et al.*, 2011 and Caleb *et al.*, 2012).

In this context, our research aimed to produce and evaluate a beverage from permeate camels' milk fermented with probiotics and mixed with pomegranate syrup in different concentrations. The products were evaluated for the physiochemical, rheological, microbiological and sensory properties during storage.

MATERIALS AND METHOD

Fresh Camels' milk used in this study was collected from a herd located at North West Coast Zone, Matrouh Governorate, Egypt. The UF by-product (Permeate camels' milk) was extracted from the collected camels' milk. Also, Fresh mature pomegranate and sugar were purchased from local market. Carboxy methyl cellulose (CMC) as a stabilizer agent was obtained from Sigma-Aldrich.

Lactobacillus acidophilus 31CM, *St*reptococcus *thermophilus* 33CM and *Bifdobacterium animalis* 14CM were characterized in a previous work by Mohammed *et al.*, (2018). All use strains produce exopolysaccharides.

For the Preparation of pomegranate syrup, mature fresh pomegranate fruits were selected and washed well. After removing the outer husk and separating it from the seeds. The juice was extracted by grinding the seeds and filtering them through a clean cloth (Gorachiya *et al.*, 2018) (pH=3.78). Pomegranate syrup was prepared according to method of Maskan (2006) by heating process at 85°C the filtered dark red juice. The juice concentration was 15.25 °Brix and the final concentration was 75°Brix.

Probiotic strains were prepared according to the method of Thakur and Sharma (2017) with some modifications. Each strain was activated separately in MRS broth medium at 37 °C / 16 hrs to obtain biomass. The biomass was washed with saline solution to remove the remainder of the MRS to obtain a pure biomass. Then each strain was activated separately in pasteurized whey (100 ml) at a concentration of 10% from each strain. Thus, the mother's culture was obtained to prepare the beverages by incubation at 37 °C for 24 hrs.

Probiotic beverages were prepared from permeate camels' milk and pomegranate syrup in different concentrations, with stability of 4 % sugar with 0.2% stabilizer. Sugar and stabilizer were added to permeate camels' milk, mixed well, and filtered. After that the heat treatment of the mixtures was carried out at 80 °C for 15 minutes, followed by cooled to 42 °C. Mixtures were then inoculated with 3% mixture (1: 1: 1) starter culture *Lb. acidophilus* 31CM, *St*r. *thermophilus* 33CM and *Bif. animalis* 14CM, then incubated at 42 °C until pH was decreased to 5 and cooled to 4°C. Then, pomegranate syrup in different concentrations was added to the permeate viz control= 0% pomegranate syrup + 95.8% camels' milk permeate, T1= 2.5% pomegranate syrup + 93.3% camels' milk permeate, T2= 5% pomegranate syrup + 90.8% camels' milk permeate, and T3= 10% pomegranate syrup + 85.8% camels' milk permeate. To complete the fermentation process, the mixtures were incubated at 45 ° C until the pH reached 4.7. After that, the beverage was packed in sterile bottles and cooled to 5 ± 1 ° C and stored for a month. The beverages chemical properties were determined in fresh, but microbiological, rheological and sensory properties were measured when 1st day and 10, 20 and 30 days of storage.

All material and beverages were physiochemically analyzed for by measuring the total solids, fat, ash, total protein, total sugar, ascorbic acid content and minerals content according to AOAC (2012). pH value was measured by using pH meter (SA520 / 3310, USA). Total soluble solids (TSS) were estimated using a manual refractometer and expressed in terms of ° Brix. Total phenolic contents were determined with Folin-Ciocalteu reagent according to Thakur and Sharma (2017) using gallic acid as a standard. The antioxidant activity was determined by using the 2,2- diphenylpicrylhydrazyl (DPPH) radical as reported by Dhumal *et al.*, (2015).

Viscosity was determined using the Brookfild viscometer (Brookfield Engineering Laboratory Inc., Stoughton, MA, USA) Model DV- II with a helipath stand mounted with spindle (No. 4), as formerly described by Dhumal *et al.*, (2015) at 20 °C.

Colour was measured was determined according to the tristimulus Colour system described by Ashoush and Gadallah (2012) using spectrophotometer (MOM, 100 D, Hungary). The Hunter *L**, *a** and *b** values were determined according to formula given by manufacturer.

All samples were prepared for microbiological examination according to the Standard Methods for the Examination of Dairy Products (Wehr and Frank, 2004). Total viable count on stander plate count agar (37°C/24h), viable cells count *L*b. *acidophilus* on MRS-sorbitol agar (Anaerobic incubation at 37°C for 72 h), *Str*. *thermophiles* on ST agar (Aerobic incubation at 42°C for 24 h) and bifidobacteria on MRS agar (Oxoid) supplemented with L-cystein and lithium chloride (Sigma Chemical Co., USA) (Anaerobic incubation at 37°C for 72 h) were enumerated as described by Dave and Shah (1996). The plates were incubated in an anaerobic environment (BBL Gas Pak, Becton Dickinson Microbiology Systems). Yeasts and molds on acidified potato dextrose agar were enumerated as described by Difco (1984).

Sensory evaluation of the beverages was subjected by 20 panelists of the staff member of Animal Production Division, Desert Research Center, Cairo, Egypt using 9-point hedonic scale according to the scheme described by Sthavarmath and Puranik (2018). All treatments were evaluated when fresh and during storage period at 10, 20 and 30 days.

All data obtained in the study were statistical analyzed using software SAS (2013).

RESULTS AND DISCUSSION

Physicochemical composition of permeate and pomegranate syrup were presented in Table (1). It could be observed that total solid, protein, fat, total sugar, ash contents and pH value of permeate were 5.50, 0.25, 0.14,

5.11, 0.275% and 6.46, respectively. Heat processing used for the preparation of pomegranate syrup resulted in an increase of the total solids and sugars, and a decrease in moisture due to the water evaporation. Data shown in Table (1) revealed that pomegranate syrup contains 20.65, 0.84 and 75.8% of moisture, protein and total sugars, respectively. The carbohydrates increase was resulted due to the water evaporation process during the preparation the of syrup, which came in consistent with Yilmaz *et al.*, (2007). The results also showed that by concentration of pomegranate juice (total soluble solids (TSS) of 15.25 °Brix) by heating during preparation of pomegranate syrup contributed to the increase of the TSS content to 75°Brix, which led to a significant increase in sugar content, which came in harmony with İncedayi *et al*., 2010; Ashoush and Gadallah 2012 and Dhumal *et al.*, (2015).

Results also show that protein content in pomegranate syrup was 0.84%, which is in the range between 0.08 to 1.54%, which being obtained by İncedayi *et al.*, (2010). As the mineral content of the raw materials varied, so the permeate content was high in calcium, potassium and sodium, but it was low in iron and zinc. These results are in agreement with Hattem *et al.*, (2011). While pomegranate syrup was high in calcium, sodium and iron, as accordance with that result of İncedayi *et al.*, (2010).

The pH of pomegranate syrup decreased as it was 3.52, compared to initial pH of the juice of 3.78, due to the concentration process. This result was agreement with those obtained by Ashoush and Gadallah (2012) and Dhumal *et al.*, (2015). While the lowest of pH was about 1.74 and 2.05 for pomegranate syrup, which was made with Kaya and Sozer (2005) and Yilmaz *et al.*, (2007), and this difference is due to the methods used in the preparation, clarification and filtration of pomegranate syrup.

Antioxidant activity was affected by total anthocyanin and phenol components (Table 1), where it was 75.45%, 225.61 and15 mg/100g in pomegranate syrup, respectively. These results were close to the those revealed by Ashoush and Gadallah (2012) and Dhumal *et al.*, (2015), who treated pomegranate juice with heat to prepare its syrup.

Table 1. Physicochemical composition of raw material and permeate pomegranate beverages in fresh

Components		Permeate	Pomegranate syrup	Control	T1	T2	T3	SE
Total solid%		5.50^{e}	79.35^{a}	9.18^{d}	10.76^{c}	12.60^{bc}	16.40^{b}	±0.197
Moisture%		94.48^{a}	20.65^{b}	90.80^{d}	89.21^{c}	87.40^{bc}	83.56^{b}	±1.552
Protein%		0.25^{b}	0.84^{a}	0.24^{b}	0.25^{b}	0.27^{b}	0.30^{b}	±0.050
Fat%		0.14	0.00	0.13	0.13	0.13	0.12	±0.019
Total sugar %		5.11^{c}	75.80^{a}	8.63^{bc}	10.30^{bc}	12.11^{b}	15.92^{b}	±1.318
Ash%		0.275^{a}	0.036^{b}	0.283^{a}	0.309^{a}	0.325^{a}	0.344^{a}	±0.044
pH value		6.46^{a}	3.52^{c}	4.70^{b}	4.70^{b}	4.70^{b}	4.70^{b}	±0.051
Total anthocyanin(mg/100g)		ND	225.60^{a}	ND	5.67^{b}	11.31^{b}	22.59^{b}	±15.890
Total phenolic(mg/100g)		ND	557.21^{a}	ND	14.00^{c}	27.93^{c}	55.79^{b}	±6.617
Antioxidant activity %		ND	75.45^{a}	10.95^{b}	12.12^{b}	13.67^{b}	16.90^{b}	±2.058
Colour	L	22.46^{b}	22.60^{b}	22.09^{b}	25.08^{ab}	26.73^{a}	27.30^{a}	±1.079
	a	-15.90^{d}	15.50^{a}	-14.13^{d}	1.95^{c}	3.64^{c}	8.18^{b}	±1.079
	b	5.60^{a}	5.20^{ab}	4.40^{abc}	1.24^{c}	1.76^{c}	1.44^{c}	±1.079
Mineral (ppm)	K	70.04^{a}	23.12^{b}	71.22^{a}	65.72^{a}	64.19^{a}	61.85^{a}	±3.652
	Ca	275.69	260.33	270.47	262.90	261.14	260.37	±39.193
	Na	110.55	187.0	111.49	107.49	108.85	112.67	±30.091
	Zn	0.66^{b}	7.0^{a}	0.64^{b}	0.79^{b}	0.94^{b}	1.26^{b}	±0.396
	Cu	0.42	0.54	0.46	0.40	0.41	0.41	±0.105
	Fe	3.11^{c}	22.50^{a}	3.01^{c}	3.45^{c}	3.92^{bc}	4.89^{b}	±0.379
	Mg	23.55^{b}	30.0^{a}	24.02^{b}	22.65^{b}	22.70^{b}	23.02^{b}	±1.270

^{a,b,c,d} Means in same row at each parameter with different lowercase letters differed significantly ($p < 0.05$).
Control= 0% pomegranate syrup + 95.8% permeate camels' milk, T1= 2.5% pomegranate syrup + 93.3% permeate camels' milk, T2= 5% pomegranate syrup + 90.8% permeate camels' milk, and T3= 10% pomegranate syrup + 85.8% permeate camels' milk. ND= not detect.

Results in (Table 1) showed that the Hunter color parameters *L**, *a**, and *b** of pomegranate syrup increased reddish brown as a result of the thermal treatment due to brown color reaction such as Maillard reaction and the destruction of anthocyanin pigment and increased Soluble solids. This was evident when measuring the values of Hunter *L** and *a**. This result was similar as the result of Orak (2009) who reported that the Hunter colour values decreased during heat treatments. Similar results were obtained by Ashoush and Gadallah 2012 and Dhumal *et al.*, (2015).

Physicochemical compositions of prepared permeate of camels' milk mixed with pomegranate syrup and probiotic starters as functional beverages are presented in Table (1). No significant ($p \geq 0.05$) variations could be detected in protein, fat and ach contents in all treatments of fermented beverages. Meanwhile, total solid, total sugar and pH values significantly varied ($p \leq 0.05$). Total solid and total sugar contents increased in fresh for all fermented beverages. An inverse relationship could be established between the increase of the total solids, protein and fat contents, where the solids content increased with increasing the concentration of pomegranate syrup, and the protein and fat content decreased in the fermented beverages, compared to the control. These results were in agreement with Teshome *et al.* (2017) and Hallim *et al.* (2019).

As with the mineral contents of prepared beverages, results in of the preliminary analysis of concentrated and permeate pomegranate syrup are shown in Table (1). Mineral contents were similar in both of them, but it was greater in Na, Zn and Fe in pomegranate syrup than

permeate, while K and Ca were lower in concentrated pomegranate syrup than permeate. These results are in agreement with Yilmaz *et al.,* (2007) and Orak (2009). As evident from data presented in Table 1, highly significantly (P≤0.005) variation in K, Na, Zn, Fe and Mg contents were found in pomegranate syrup concentrated beverages due to the high mineral content in pomegranate syrup. Ca and Cu content was not significantly (P≥0.05) among all treatments in fresh.

On the whole, the content of fermented beverages from camels' milk permeate, mixed with different concentrations of pomegranate syrup increased in their mineral content due to their high concentration in the main component, whether concentrated syrup or permeate. Hence, it could be concluded that the prepared functional beverages might be used as a good source of some minerals (Miller, 2000; Fadavi *et al.,* 2005 and Yilmaz *et al.,* 2007).

The pH value is of important effect on the fermentation process with the initiator, affecting the properties of the product in terms of flavor, colour and aroma (Zarei *et al,.* 2011, Rios-Corripio and Guerrero-Beltran 2019). The pH should be between 2.8 to 4.0, as it was found that the closer to 4 (syrup), the more sweet properties were given which affects the final product (Table 1). The effect of adding pomegranate syrup at different concentrations on the pH values was significant (P≤0.05), as it led to decrease between treatments and compared to control as a result of fermentation (Atallah, 2015 and Hallim *et al.,* 2019).

As could be seen from the result in Table 2 showed that increasing the concentration of the added pomegranate syrup, led to slight and gradual decrease (p≥0.05) in the pH values of all fermented beverage comparing with the control group. This could be attributed to the high activity of the initiator of lactose fermentation. Moreover, a variable gradual decrease (p≥0.05) in pH values could be observed in all treatments up to the 30th day of the cold storage duration, which could be attributed to the limited growth of different initiator cultures and the slow fermentation of lactose residue, which is consistent with this by Baithazar *et al*., (2019).

Table 2. pH values of fermented beverages produced from camels' milk permeate mixed pomegranate syrup during storage at (6±0.5°C for 30 days)

Storage period (day)	Control	T1	T2	T3	±SE
Fresh	4.70	4.70	4.70	4.70	±0.266
10	4.68	4.69	4.68	4.67	±0.266
20	4.67	4.66	4.65	4.65	±0.266
30	4.58	4.59	4.6	4.57	±0.266

Control= 0% pomegranate syrup + 95.8% permeate camels' milk, T1= 2.5% pomegranate syrup + 93.3% permeate camels' milk, T2= 5% pomegranate syrup + 90.8% permeate camels' milk, and T3= 10% pomegranate syrup + 85.8% permeate camels' milk.

Total anthocyanin, (mg/100g) phenolic compounds (mg gallic acid equivalents/100g), and total antioxidant activity (%) content in all prepared functional beverages significantly affected (p.≤0.05) as shown in Table (3). However, it was not significantly affected during storage (p. ≥ 0.05).

The anthocyanin, phenols and antioxidants contents increased (p ≤ 0.05) was observed with an increase in the levels of pomegranate syrup; due to its increase in pomegranate syrup (Table 1). It was noticed that the highest level of anthocyanin, phenols and antioxidants were found in the permeate beverages containing 10% of pomegranate syrup and probiotics (T3), followed by those containing 5% (T2) and probiotics. The same trend was the length of the storage period. Where this was evident when the fresh fermented beverage to control was 5.67, 11.31 and 22.59 mg / 100 g (anthocyanin) and 14.00, 27.93 and 55.79 mg / 100 g (phenolic compounds), 13.67, 13.67 and 16.90%. (antioxidants) of 5, 10 and 15% pomegranate syrup, respectively. These results were similar to those obtained by Matter *et al*., (2016) and Hallim *et al.,* (2019). But during storage periods, in general, there was a decrease in the values of anthocyanin, phenols and antioxidants.

Colour characteristics shows in Tables 1 and 4, reveal the colour intensity of fresh and stored with different concentrations of pomegranate syrup. Both color parameters *L**, *a** (p≤0.05) were influenced by the concentration of the added pomegranate syrup as well as during the 30-day storage period at 6 ± 0.5 ° C. In general, the color of permeate was affected by the addition of pomegranate syrup in different concentrations.

Table 3.Total anthocyanin (mg/100g), phenolic compounds (mg gallic acid equivalents (GAE) /100 g) and total antioxidant activity (%) of fermented permeate beverages and pomegranate syrup mixtures during storage at (6±0.5°C for 30 days)

Storage period (day)	Control	T1	T2	T3	±SE
	Total anthocyanin (mg/100g)				
Fresh	ND	5.67^{C}	11.31^{B}	22.59^{A}	±1.080
10	ND	5.41^{C}	10.95^{B}	22.10^{A}	±1.080
20	ND	5.30^{C}	10.82^{B}	21.96^{A}	±1.080
30	ND	5.22^{C}	10.75^{B}	21.74^{A}	±1.080
	Total phenolic (mg GAE /100 g)				
Fresh	ND	14.00^{C}	27.93^{B}	55.79^{A}	±1.620
10	ND	13.94^{C}	27.88^{B}	55.70^{A}	±1.620
20	ND	13.89^{C}	27.80^{B}	55.66^{A}	±1.620
30	ND	13.81^{C}	27.75^{B}	55.60^{A}	±1.620
	Antioxidant activity %				
Fresh	10.95^{C}	12.12^{BC}	13.67^{B}	16.90^{A}	±1.509
10	10.82^{C}	12.00^{BC}	13.54^{B}	16.85^{A}	±1.509
20	10.75^{C}	11.92^{BC}	13.42^{B}	16.80^{A}	±1.509
30	10.66^{C}	11.79^{BC}	13.41^{B}	16.78^{A}	±1.509

^{A,B,C} Means in same at each parameter of treatment with different uppercase letters differed significantly (p < 0.05).

Control= 0% pomegranate syrup + 95.8% permeate camels' milk, T1= 2.5% pomegranate syrup + 93.3% permeate camels' milk, T2= 5% pomegranate syrup + 90.8% permeate camels' milk, and T3= 10% pomegranate syrup + 85.8% permeate camels' milk. ND= not detect.

The lightness values (*L**) to dark pomegranate syrup (0 = white and 100 = black) for all samples of permeate beverages mixed with concentrations of pomegranate were greater than the control samples. The samples were significant (p≤0.05) with different concentration and were not significantly (p≥0.05) during storage. Inversely, the redness values (*a**) (red-green) increased with the addition of pomegranate syrup to the permeate samples. This was a significant (p≤0.05) increase

for all treatments mixed with pomegranate syrup during storage and with increasing concentration of pomegranate syrup. The values of (*b**) (blue – yellow) for all permeate beverages were significantly ($p \leq 0.05$) lower than the control. However, all samples were not significant ($P \geq 0.05$) by comparing the control during the storage period or by increasing the concentration of pomegranate syrup. Similar observations have been reported by Hallim *et al.,* (2019) and Rios-Corripio and Guerrero-Beltran (2019).

Table 4. Colour properties of fermented permeate beverages pomegranate syrup mixtures during storage at (6±0.5°C for 30 days)

Storage period (day)		Control	T1	T2	T3	±SE
*L**	Fresh	22.09^{B}	25.08^{B}	26.73^{B}	27.30^{B}	±1.135
	10	22.12^{B}	25.17^{B}	26.76^{B}	27.30^{B}	±1.135
	20	21.58^{A}	25.20^{A}	27.02^{A}	27.02^{A}	±1.135
	30	20.04^{A}	25.26^{A}	27.30^{A}	27.57^{A}	±1.135
*a**	Fresh	-14.13^{Cc}	1.95^{Cc}	3.64^{Cc}	8.18^{Cc}	±1.132
	10	-12.61^{Bb}	3.13^{Bb}	3.76^{Bb}	10.39^{Bb}	±1.132
	20	-9.16^{Bab}	3.39^{Bab}	3.97^{Bab}	12.69^{Bab}	±1.132
	30	-9.79^{Aa}	4.54^{Aa}	2.77^{Aa}	11.37^{Aa}	±1.132
*b**	Fresh	4.40	1.24	1.67	1.40	±1.130
	10	4.22	1.54	1.76	1.44	±1.130
	20	3.58	1.59	2.25	1.88	±1.130
	30	0.88	1.93	2.64	1.92	±1.130

^{A,B,C} Means in same at each parameter of storage with different uppercase letters differed significantly ($p < 0.05$).
^{a,b,c} Means in same at each parameter of treatment with different lowercase letters differed significantly ($p < 0.05$).
Control= 0% pomegranate syrup + 95.8% permeate camels' milk, T1= 2.5% pomegranate syrup + 93.3% permeate camels' milk, T2= 5% pomegranate syrup + 90.8% permeate camels' milk, and T3= 10% pomegranate syrup + 85.8% permeate camels' milk.

Data in Table (5) revealed that fermented camels' milk permeate beverages mixed with pomegranate syrup highly significantly ($p \leq 0.05$) viscosity during storage and all treatments.

Table 5. Viscosity properties of fermented camels' milk permeate beverages and pomegranate syrup mixtures during storage at (6±0.5°C for 30 days)

Storage period (day)	Control	T1	T2	T3	±SE
Fresh	114.00^{Dd}	150^{Cc}	200^{Bb}	225^{Aa}	±3.521
10	145.00^{Dd}	179^{Cc}	219^{Bb}	244^{Aa}	±3.521
20	176.00^{Dd}	192^{Cc}	231^{Bb}	259^{Aa}	±3.521
30	186.00^{Dd}	206^{Cc}	239^{Bb}	262^{Aa}	±3.521

^{A,B,C} Means in same at each parameter of storage with different uppercase letters differed significantly ($p < 0.05$).
^{a,b,c} Means in same at each parameter of treatment with different lowercase letters differed significantly ($p < 0.05$).
Control= 0% pomegranate syrup + 95.8% permeate camels' milk, T1= 2.5% pomegranate syrup + 93.3% permeate camels' milk, T2= 5% pomegranate syrup + 90.8% permeate camels' milk, and T3= 10% pomegranate syrup + 85.8% permeate camels' milk.

This can be explained by the effect of exopolysaccharide (EPS) produced by the used EPS producing bacteria in the fermentation of permeate. This result was consistent with those reported by El-Gendy (2018b). Folkenberg *et al.,* (2005) demonstrated that the EPS produced from the *Str. thermophiles* improve the texture of yoghurt and drinks. Also, the addition of fruits syrup led further increase in the viscosity of prepared beverage as compared to all treatment, these findings could be related to the high total solids in beverages. The highest viscosity values recorded in T3. Similar trend was recorded by Akalin *et al.,* (2008).

Microbiological analysis is shown from Table 6, that the bacterial count of fermented permeate pomegranate beverages was larger than the control samples during all storage periods up to 30 days. The fermented beverages contained 10% pomegranate syrup had the lowest bacterial count. No significant differences ($p \geq 0.05$) were found in the record of bacterial cell counts between all treatments during the storage period (6 ± 0.5 ° C for 30 days)

In general, the count decreased in all treatments until the end of the storage period, and this may be due to acid accumulation and a decrease in nutrients needed for growth (Kabeir *et al.,* 2015). *Bif. animalis* showed the highest levels in all beverages throughout storage. Conversely, it has lost the viability levels of *Str. thermophilus* and *Lb. acidophilus* during storage was lower in beverages. Similar trends were obtained by Marhamatizadeh *et al.,* (2012). Vinderola *et al.,* (2000) explained that in practical application the pH value of the final product should be kept above 4.6, to reduce the decrease in the count of bacteria.

FAO/ WHO (2002) The probiotic food with health claims must contain per gram at least 10^6 -10^7 cfu at the time of consumption. Results also showed that all the examined treatments were found completely free from yeasts and molds at the end of storage period. Meanwhile, the coliform bacteria were not detected in the control and all the other treatments during all storage periods. In general, these results were consistent with those referred to Matter *et al.* (2016) and Hallim *et al.* (2019).

Table 6. Microbiological of fermented camels' milk permeate pomegranate beverages during storage at (6±0.5°C for 30 days) (log cfu/ml)

Storage period (day)	Control	T1	T2	T3	±SE
Fresh	6.89	7.29	7.22	7.18	±0.727
10	6.84	7.24	7.19	7.13	±0.727
20	6.80	7.21	7.13	7.09	±0.727
30	6.77	7.18	7.08	7.04	±0.727
Fresh	7.00	7.85	7.77	7.64	±0.722
10	6.92	7.8	7.74	7.61	±0.722
20	6.88	7.76	7.70	7.58	±0.722
30	6.80	7.72	7.68	7.55	±0.722
Fresh	7.29	8.1	8.06	8.00	±0.757
10	7.22	7.98	8.01	7.96	±0.757
20	7.18	7.92	7.96	7.90	±0.757
30	7.15	7.86	7.91	7.87	±0.757

Control= 0% pomegranate syrup + 95.8% permeate camels' milk, T1= 2.5% pomegranate syrup + 93.3% permeate camels' milk, T2= 5% pomegranate syrup + 90.8% permeate camels' milk, and T3= 10% pomegranate syrup + 85.8% permeate camels' milk.

Table (7) shows the changes in sensory evaluation of functional fermented camels' milk permeate pomegranate beverages during storage at 6°C for 30 days. Significant difference ($p \leq 0.05$) was found in scores for different sensory attributes between all treatments and during storage. The obtained results revealed that all the functional beverages recorded higher scores than control when fresh and throughout the storage.

It was interest that beverages based on fermented permeate gained close score points for the different attributes and the total score points. This can be explained on the basis of the slight changes in the composition of the products during storage. During cold storage, the organoleptic scores increased for all treatments after 10 days. No changes were observed among the treatments all sensory characteristics up to 20 days of storage. After 30 days of storage, the same trend was observed for all the tested products with slight decreases in the obtained scores. On the other hand, a functional beverage contains probiotic strains and syrup improved the sensory evaluation due to their high level of the produced syrup compounds. Similar trend was recorded by Gorachiya *et al.*, (2019) and Hallim *et al.,* (2019). In general, T3 was the best in sensory evaluation compared among all treatment.

Table 7. Sensory evaluation of fermented camels' milk permeate pomegranate beverages during storage at (6±0.5°C for 30 days)

Storage period (day)	Control	T1	T2	T3	±SE
Fresh	4.6^{Bab}	9.0^{Aab}	8.6^{Aab}	9.0^{Aab}	±0.186
10	5.3^{Ba}	9.0^{Aa}	9.0^{Aa}	9.0^{Aa}	±0.186
20	5.0^{Bab}	8.7^{Aab}	9.0^{Aab}	9.0^{Aab}	±0.186
30	5.0^{Bb}	9.0^{Ab}	8.6^{Ab}	8.0^{Ab}	±0.186
Fresh	6.5^{Db}	8.1^{Cb}	8.7^{Bb}	9.0^{Ab}	±0.187
10	6.3^{Da}	8.0^{Ca}	8.3^{Ba}	9.0^{Aa}	±0.187
20	5.6^{Dab}	7.6^{Cab}	8.2^{Bab}	8.8^{Aab}	±0.187
30	5.0^{Db}	7.5^{Cb}	8.0^{Bb}	8.6^{Ab}	±0.187
Fresh	6.5^{Da}	7.5^{Ca}	8.5^{Ba}	9.0^{Aa}	±0.195
10	6.0^{Da}	7.3^{Ca}	8.3^{Ba}	9.0^{Aa}	±0.195
20	5.8^{Da}	7.3^{Ca}	8.3^{Ba}	9.0^{Aa}	±0.195
30	5.6^{Db}	7.2^{Cb}	8.2^{Bb}	8.3^{Ab}	±0.195
Fresh	6.0^{C}	8.0^{B}	8.0^{B}	9.0^{A}	±0.208
10	5.6^{C}	7.8^{B}	7.8^{B}	8.3^{A}	±0.208
20	5.5^{C}	7.6^{B}	7.6^{B}	8.0^{A}	±0.208
30	5.0^{C}	7.0^{B}	7.3^{B}	8.0^{A}	±0.208

^{A,B,C} Means in same at each parameter of storage with different uppercase letters differed significantly (p < 0.05).

^{a,b,c} Means in same at each parameter of treatment with different lowercase letters differed significantly (p < 0.05).

Control= 0% pomegranate syrup + 95.8% permeate camels' milk, T1= 2.5% pomegranate syrup + 93.3% permeate camels' milk, T2= 5% pomegranate syrup + 90.8% permeate camels' milk, and T3= 10% pomegranate syrup + 85.8% permeate camels' milk.

CONCLUSIONS

In this study, the camels' milk permeate was used and an attempt was made to improve its properties and benefit from it. By evaluated the addition of different concentrations of pomegranate syrup to fermented milk permeate produced using *Lactobacillus acidophilus* 31CM, *Streptococcus thermophilus* 33CM and *Bifidobacterium animalis* 14CM at 3% mixed (1: 1: 1) classified as probiotic bacteria producing exopolysaccharides. Pomegranate syrup was evaluated at the outset for its physicochemical properties and colour and mineral component. Then evaluate the manufactured product with its different concentrations of chemical composition, pH, total anthocyanin**,** total phenol compounds, antioxidant activity, colour, viscosity characteristics, microbiological counting and sensory evaluation during the storage 30 days.

Generally, chemical, rheological, anthocyanin, phenolic compounds antioxidant activity microbiological and sensory evaluation, indicated that the use of pomegranate syrup in the manufacture of fermented permeate improved several important characteristics. It is provides a source of energy, antioxidants and minerals. It was recommended to produce this beverage as a functional food beverage with potential health benefits. And it can be marketed and consumed as healthy beverages as a nutritional supplement for healthy individuals**.**

REFERENCE

Adhami V.M. and Mukhtar H. 2006. Polyphenols from green tea and pomegranate for prevention of prostate cancer. Free Radical Research 40: 1095-1104.

Akalın, A. S., Unal G., Gonc S.and Fenderya S. 2008. Effects of whey protein concentrate and fructooligosaccharide on the rheological and sensory properties of reduced-fat probiotic yoghurt. Milchwissenschaft. 63(2):171-174

Al-Maiman S.A. and Ahmad S. 2002. Changes in physical and chemical properties during pomegranate (*Punica granatum L.*) fruit maturation. Food Chemistry 76: 437-441.

Alper, A., Bahceci K.S. and Acar J. 2005. Influence of processing and pasteurization on colour values and total phenolic compounds of pomegranate juice. Journal of Food Processing and Preservation 29: 357-368.

AOAC 2012. Official Methods of Analysis of Association of Official Analytical Chemists. Published by the AOAC Int. 19th Ed. Gaithersburg, MD, USA.

Ashoush, I.S. and Gadallah M.G.E 2012. Effects of different heating methods on the quality characteristics of pomegranate juice concentrates. Egypt. J. Food Sci.40:1-12

Atallah, A.A. 2015. Preparation and properties of functional beverages based on probiotic milk permeate with carrot or mango pulps. Egyptian Journal of Dairy Science, 43, 147–158.

Balthazar, C F, Santillo A, Guimarães J T, Capozzi V, Russo P, Caroprese M, Marino R, Esmerino E A, Renata S L Raices, Silva M C, Silva H L A, Freitas M Q, Granato D, Cruz A.G. and Albenzio M. 2019. Novel milk–juice beverage with fermented sheep milk and strawberry (*Fragaria* × *ananassa*): Nutritional and functional characterization. J. Dairy Sci. 102(12):10724-10736

Beucler, J., Drake M., and Foegeding E. A. 2005. Design of a beverage from whey permeate. Journal of food science. 70 (4):S277-S285.

Caleb, O. J, Opara, U.L. and Witthuhn C.R. 2012. Modified atmosphere packaging of pomegranate fruit and arils: a review. Food Bioprocess Technol. 5:15-30

Castro, W.F., Cruz A.G., Bisinotto M.S., Guerreiro L M.R., Faria J.A.F., Bolini H.M.A., Cunha R.L. and Deliza R. 2013. Development of probiotic dairy beverages: Rheological properties and application of mathematical models in sensory evaluation. J. Dairy Sci. 96:1–10.

Dave, R.I. and Shah, N.P. 1996. Evaluation of media for selective enumeration of *Streptococcus thermophilus, Lactobacillus delbrueckii* ssp. *bulgaricus, Lactobacillus acidophilus* and *bifidobacteria*. J. Dairy Sci., 79: 1529-1536.

Dhumal, S.S., Karale A.R., More T.A., Nimbalkar C.A., Chavan U.D. and Jadhav S.B. 2015. Preparation of pomegranate juice concentrate by various heating methods and appraisal of its physicochemical characteristics. Acta horticulturae 1089, 473-484.

Difco, M. 1984. Difco manual of dehydrated culture media and reagent. Difco laboratories, Ed. Detroit, Michigan, USA.

Divya, JB, Varsha KK., Nampoothiri KM., Ismail B. and Pandey A. 2012. Probiotic fermented foods for health benefits. Eng Life Sci 12:377-90.

El-Gendy, Marwa H. 2018a. Impact of Manufacturing Processes on the Industry Soft Cheese from Camel Milk. J. Biol. Chem Enviro. Sci. 13 (2) 491 – 510.

El-Gendy, Marwa H. 2018b. Influence of probiotic bacteria isolated from camels' milk on the physicochemical properties of camels' milk stirred yoghurt. Research Journal of Animal and Veterinary Sciences. 10 (3): 1-7

Fadavi A., Barzegar M., Azizi, M.H. and Bayat M. 2005. Physicochemical composition of ten pomegranate cultivars (*Punica granatum* L.) grown in Iran. Food Science and Technology International. 11(2):113-119.

FAO/ WHO 2002. Probiotics in Food Health and Nutrition Properties and Guidelines for Evaluation. London Ontario, Canada. Available from: http://www.fao .org/3/a-a0512e.pdf

Faye, B. and Konuspayeva G. 2016. Innovations in camel milk processing, The new challenges for marketing camel dairy products and the consequences on genetic selection. In Regional conf. for animal genetic resources conservation Towards Sustainable Utilization. Available on: https:// oapgrc. gov.om /Documents/ The%20new% 20 challenges %20for %20marketing%20camel%20dairy%20products%2 0and%20the%20consequences%20on%20genetic% 20selection_Bernard%20Fye.pdf

Folkenberg, D.M., Dejmek P., Skriver A. and Ipsen R. 2005. Relation between sensory texture properties and exopolysaccharide distribution in set and in stirred yoghurts produced with different starter cultures. J. texture studies. 36 (2):174-189.

Gorachiya, P. R., Bais B., Kumar D., and Basant B. 2019. Development and Evaluation of Pomegranate Based Whey Beverage Prepared from Camels' and Buffalo Milk. International Journal of Livestock Research 9 (01): 220-225.

Gorachiya, P. R., Bais B., Kumar D., Basant and Singh S. 2018. Study of Formulation, Sensory Evaluation and Microbiological Study of Whey Beverage from Camels' and Buffalo Milk. Int.J.Curr. Microbiol. App.Sci . 7(9): 2630-2635

Gumienna M, Szwengiel A, Górna B 2016 Bioactive components of pomegranate fruit and their transformation by fermentation processes. Eur Food Res Technol 242(5):631–640

Hallim, Amany M., Rabie A., El-Shewey Madiha A. and Abdel-Ghany Azza S. 2019. Evaluation of physico-chemical properties and antioxidant activity of stirred yoghurt fortified with pomegranate and cactus pear juices. Zagazig J. Agric. Res., 46 (6A): 1-14.

Hattem, H.E.A., Abouel-Einin Elham H. and Mehanna N.M. 2011. Utilization of milk permeate in the manufacture of sport drink Journal of Agricultural Technology. 7(5): 1247-1254

İncedayi, B., Tamer C. E. and Çopur Ö. U. 2010. A Research on the Composition of Pomegranate Syrup. U. Ü. ZİRAAT FAKÜLTESİ DERGİSİ, Cilt 24, Sayı 2, 37-47

Jankovic, I., Sybesma W., Phothirath P., Ananta E., and Mercenier A. 2010. Application of probiotics in food products-challenges and new approaches. Curr. Opin. Biotechnol., 21: 175-181

Kabeir, B. M., Ibraheem S. E., Limia, H., Mohammed, B. and Bhagiel T. 2015. Roasted peanut milk partially substituted with millet thin porridge as a carrier for *Bifidobacterium longum* BaB536," International J. Current Microbiology and Applied Science. 4, 299-308.

Kaya, A. and Sozer, N. 2005. Rheological behaviour of sour pomegranate juice concentrates (*Punica granatum* L.). International Journal of Food Science and Technology. 40:223-227.

Konuspayeva G., Camier B., Gaucheron F., and Faye B. 2014. Some parameters to process camel milk into cheese. Emir. J. Food Agric., 26, 354-358

Konuspayeva, G., Camier B., Aleilawi N., Al-Shumeimyri M., Al-Hammad K., Algruin K., Alshammari F., Beaucher E. and Faye B. 2017. Manufacture of dry and brine salted soft camel cheeses for the camel dairy industry. Int. J. Dairy. Technol. E.70(1)92-101.

Marhamatizadeh, M.H., Ehsandoost, P. Gholami, Moshiri H. and Nazemi M. 2012. Effect of Permeate on Growth and Survival of *Lactobacillus acidophilus* and *Bifidobacterium bifidum* for Production of Probiotic Nutritive Beverages. World Applied Sciences Journal 18 (10): 1389-1393

Maskan, M. 2006. Production of pomegranate (*Punica granatum* L.) juice concentrate by various heating methods: colour degradation and kinetics. *Journal of Food Engineering*, 72, 218–224.

Matter, A.A., Mahmoud E.A.M.and Zidan N.S. 2016. Fruit flavored yoghurt: chemical, functional and rheological properties. Int. J. Environ. Agric. Res., 2 (5): 57-66.

Miller, G. D. (2000). Handbook of dairy food and nutrition. 2nd ed CRC Press LLC. Boca Raton, florida 334331. P 24-28.

Mohammed, Mariam, Marwa H. El-Gendy, Aida S. Salem and Mikhail W. Z. A. 2018. The effect of camels' milk whey proteins on lactic acid bacteria isolated from camels' and cow milks in Egypt: A comparative study. Int. J. Adv. Res. 6 (2), 986-998.

Murthy K.N.C., Jayaprakasha G.K. and Singh R.P. 2002. Studies on antioxidant activity of pomegranate (*Punica granatum*) peel extract using in vivo models. Journal of Agriculture and Food Chemistry 50: 4791-4795.

Negi, P. S. and Jayaprakasha, G. K. 2003. Antioxidant and antibacterial activities of *Punica granatum* peel extracts. Journal of Food Science, 68, 1473–1477.

Negi, P. S., Jayaprakasha, G. K., and Jena B. S. 2003. Antioxidant and antimutagenic activities of pomegranate peel extracts.Food Chem., 80 (3): 393-397.

Orak, H. H. 2009. Evaluation of antioxidant activity, colour and some nutritional characteristics of pomegranate (*Punica granatum* L.) juice and its sour concentrate processed by conventional evaporation. International Journal of Food Sciences and Nutrition. 60(1): 1-11.

Poyrazoglu E., Gokmen V. and Artik N. 2002. Organic acids and phenolic compounds in pomegranates (*Punica granatum L.*) grown in Turkey. Journal of Food Composition and Analysis 15: 567-575.

Rios-Corripio, Gabriela and Guerrero-Beltran J. A. 2019. Antioxidant and physicochemical characteristics of unfermented and fermented pomegranate (*Punica granatum* L.) beverages. J Food Sci Technol. 56(1):132–139

Sarkar, S. 2019. Potentiality of Probiotic Fruit Yoghurt as a Functional Food - A Review. J Nutr Food Sci 2(1) :1-10

SAS, 2013. SAS / Stat. User's Guide: statistics, system for windows, version 9.4, SAS Inst., Inc. Cary, North Carolina, USA.

Sepálveda E, Sáenz C, Penã A, Robert P, Bartolomé B and Gómez-Cordovás C. 2010. Influence of the genotype on the anthocyanin composition, antioxidant capacity and color of Chilean pomegranate (*Punica granatum L.*) juices. Chil J Agric Res.70 (1):50–57

Stanciu S., Militaru M., Rotaru G. and Şerbancea F. 2005. Using the permeate from whey ultrafiltration to obtain synbiotic products for human and animal use. Annals of the University Dunarea de Jos of Galati. Fascicle VI: Food Technology. 2:57-62

Sthavarmath, Shankarlingayya and Puranik D.B. 2018. Development of Pomegranate Blended Whey Beverage. International Journal of Science, Environment and Technology, 7(3): 1040 – 1046

Teshome, G., Keba A., Assefa Z., Agza B. and Kassa F. 2017. Development of fruit flavored yoghurt with mango (*Mangiferaindica* L.) and papaya (*Carica papaya* L.) fruits juices. Food Sci. and Quality Manag, 67: 40-45.

Thakur, M. and Sharma R. K. 2017. Development of Probiotic Pomegranate Beverage and Its Physico-Chemical and Microbial Characterization. Int. J. Pure App. Biosci. 5 (1): 35-41

Turfan, Ö., Türkyılmaz M., Yemis O. and Özkan M. 2011. Anthocyanin and colour changes during processing of pomegranate (*Punica granatum* L., cv. *Hicaznar*) juice from sacs and whole fruit. Food Chemistry 129:1644–1651

Vinderola, C.G., Bailo, N. and Reinheimer, J. A. 2000. Survival of probiotic microflora in Argentinian yogurts during refrigerated storage. Food Res. Int., 33, 97-102.

Wehr, H.M. and Frank, J.H. 2004. Standard Methods for the Examination of Dairy Products. 17th Edn., American Public Health Association, Washington, DC., USA., ISBN-13: 978-0875530024, Pages: 570.

Yildiz, H., Bozkurt H. and Icier F. 2009. Ohmic and Conventional Heating of Pomegranate Juice: Effects on Rheology, Color, and Total Phenolics. Food Sci Tech Int. 15(5):503-512.

Yilmaz, Y, Ilyas Çelik and Fatma Isik 2007. Mineral composition and total phenolic content of pomegranate syrup. Journal of Food, Agriculture and Environment.5 (3&4): 102 - 104.

Zarei M, Azizi M, Bashir-Sadr Z. 2011 Evaluation of physicochemical characteristics of pomegranate (*Punica granatum* L.) fruit during ripening. Fruits 66:121–129.

تقييم الخواص التغذوية لمشروب راشح لبن النوق ودبس الرمان

مروة حاتم الجندى و السيد محمد عابدين

وحدة الالبان، قسم تربيه الحيوان والدواجن، مركز بحوث الصحراء، القاهرة، مصر

هدفت هذه الدراسة إلى تصنيع مشروب متخمر من راشح لبن النوق المدعم بتركيزات مختلفة من دبس الرمان. تم تقييم المشروبات المنتجة من حيث خصائصها الفيزيائية والكيميائية والريولوجية والميكروبيولوجية والحسية. لم تظهر خواص المخاليط الفيزيائية والكيميائية المحضرة بواسطة راشح لبن النوق المتخمر المخلوط بدبس الرمان فروق معنوية ($p\leq0.05$) في محتوى البروتين والدهون والرماد بين جميع المعاملات. بينما كانت الفروق معنويه ($p\leq0.05$) فى المواد الصلبة الكلية والسكريات الكلية وقيمة الأس الهيدروجيني. كانت جميع المشروبات الوظيفية غنية بالعديد من العناصر المعدنية. من ناحية أخرى كان تأثير إضافة دبس الرمان بتركيزات مختلفة على قيم الأس الهيدروجيني معنويه ($P\leq0.05$). وكان تأثر الانثوسيانين الكلي والمركبات الفينولية ومحتوى النشاط الكلي لمضادات الأكسدة في جميع المشروبات المتخمرة من راشح لبن النوق المخلوطه بدبس الرمان معنويا ($p\leq0.05$). كما تأثر لون الراشح بإضافة دبس الرمان بتركيزات مختلفة، وعند قياس اللزوجة وجد أن مشروب الراشح المتخمر المدعم بدبس الرمان كان معنويا ($p\leq0.05$) أثناء التخزين وجميع المعاملات. كان هذا بسبب قدرة بكتيريا البروبيوتيك على انتاج السكريات العديدة. أظهرت *Bif. animalis* أعلى مستويات في جميع المشروبات طوال فترة التخزين. على العكس من ذلك، فقد كانت مستويات *Str. thermophilus* و *Lb. acidophilus* أثناء التخزين أقل. لم يتم الكشف عن بكتيريا القولون والخميرة والعفن في المجموعة الضابطة وجميع المعاملات الأخرى خلال جميع فترات التخزين. كان التقييم الحسي معنويا ($p\leq0.05$) في درجات الصفات الحسية المختلفة بين جميع المعاملات وأثناء التخزين. وكان أعلى تركيز من دبس الرمان هو الأفضل في التقييم الحسي مقارنة بجميع المعاملات، ولذلك يمكن التوصية بانتاج مشروبات من راشح لبن النوق المتخمر المخلوط بتركيزات مختلفة من بدبس الرمان كمشروب وظيفي له فوائد صحية محتملة. ويمكن استخدامه في تغذية الرياضيين واغذية الحمية والحماية من العطش.