Production of Novel Functional Yoghurt Fortified with Bovine Colostrum and Date Syrup for Children

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ABSTRACT

The aim of this work was to study the effect of adding bovine colostrum and date syrup as natural ingredients on the nutritional value of yoghurt and it's quality during cold storage period. Functional yoghurt was prepared by using buffalo milk 3% fat, date syrup 5% for all treatments except the control and bovine colostrum was added at different ratios 5% (T2), 10% (T3) and 15% (T4). Then, all treatments were inoculated with 2% of yoghurt starter and stored at 5°C for 12 days. Samples of yoghurt were chemically, organoleptically, and microbiologically analyzed at 1st, 4th, 8th and 12th days of cold storage. It was observed that addition of date syrup and bovine colostrum for yoghurt were found to enhance significantly the content of total Solids (TS), total protein, immunoglobulin G (IgG), lactoferrin and minerals compared to the control. Also, most nutrients hade a slight increment during advanced storage period. The titratable acidity% of yoghurt samples slightly increased during storage periods, while the pH values decreased significantly. Yoghurt fortified with 10% (T3) and 15% (T4) of bovine colostrum had significantly higher viscosity values than that in the other treatments. Also, T4 had significantly lower syneresis than the other yoghurt treatments on 12th day of storage. No significant differences could be traced in flavour, appearance, body and texture and overall acceptability scores among all yoghurt treatments. The grams consumed of yoghurt to meet the daily requirement (GDR) for children aged 1-3 years of protein and (calcium, phosphorus, iron and zinc) significantly decreased by fortification of yoghurt with date syrup and bovine colostrum, while percent satisfaction (P.S.%/100g) of the daily needs in these nutrients significantly increased. In conclusion, fortification of yoghurt by adding date syrup and bovine colostrum enhanced nutritional value and quality of yoghurt.

Keywords: Functional dairy food, yoghurt, bovine colostrum, date syrup, sensory evaluation.

INTRODUCTION

Colostrum is the first milk secreted from the mammary glands of mammals during the first 3-4 days post-parturition. It is a complex biological fluid provides to the newborn all necessary nutrients and immune and growth factors that differ substantially from mature milk (Godhia and Patel, 2013). Colostrum is rich in proteins, fats, essential fatty acids and amino acids. Also, it is a rich source of oligosaccharides, lactoferrin, lysozyme, immunoglobulins, growth factors, cytokines and nucleosides, which act as natural anti-microbial agents to stimulate development of immunity in the newborn (Kelly, 2003, Georgiev, 2008 and McGrath *et al*., 2016)

The colostrum provides passive immunity to newborn of human and cattle, thus led to interest developing in the potential of bovine colostrum to prevent infection and illness in humans (Sahana *et al*., 2018). Colostrum preparations obtained from cows vaccinated against particular pathogens have been used successfully to treat or prevent enteric infections in the gastrointestinal tract of humans (Brinkworth and Buckley, 2003). The immunoglobulins (especially IgG) in colostrum provide immunological balance and reduce inflammation and illness. Besides providing immune support, colostrum growth factors have significant characteristics such as muscle and cartilage repair, promote wound healing from practical implications for surgical (Godhia and Patel, 2013). Currently, the use of bovine colostrum as a dietary supplement has increased substantially. Colostrum preparations may play a significant role in healthcare in the future to specific consumers or some patients.

Colostrum has a salty taste, when added to some foods, some sweeteners such as sugar or date syrup can be added to make it more acceptable. Date syrup is one of the natural and nutritional additives used in food products such as ice cream, confectionery, dairy products, drink, bakery products and some other (Ardali *et al*., 2014). Date syrup obtained from matured date contains 67-72% total solids and 95% from sugars are reducing sugars as fructose and glucose. Date syrup is a good source of minerals, rich in carbohydrate, polyphenols, carotenoids, amino and organic acids (Abbes *et al*., 2013). But it contains small amount of protein, sucrose, calcium, and pectin (Khosravanipour *et al*., 2011). Moustafa *et al*. (2016) used date syrup as a natural source of sweeteners, colours and flavouring agents in the production of flavouring yoghurt. They found that the addition of date syrup to yoghurt led to improve the organoleptic characteristics of it.

The present study aimed to utilize the bovine colostrum and date syrup as natural ingredients to

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improve the nutritional value, healthy and immune benefits of yoghurt as a novel functional dairy food.

MATERIALS AND METHODS

Materials and chemicals:

Fresh low fat buffalo milk (3% fat) used in this study was obtained from Dairy Unit, Faculty of Agriculture, Zagazig University, Egypt. Bovine colostrum sample was collected at 12 h after parturition. Commercial date syrup was obtained from local market at Cairo, Egypt. *Streptococcus salivavarius subsp thermophiles* (EMCC1044- DSM20479) and *Lactobacillus delbrueckii subsp bulgaricus* (EMCC1102-DSM20080) were used as a yoghurt starter which was obtained from Egyptian Microbial Culture Collection of Cairo MIRCEN (EMCC), Faculty of Agriculture, Ain Shams, University, Egypt. All chemicals used in this study were purchased from El-Gamhouria Co. for Chemicals and Medical Requisites.

Preparation of yoghurt:

Fresh low fat buffalo milk(3 % fat) was heated at 90ºC for 15min, then cooled to 40±3ºC then divided to 5 equal portions. Bovine colostrum sample was heated at 63ºC for 30min then cooled to 40±3ºC. First, each portion was stirred with equal level of cooled pasteurized date syrup (5%) except the control (C). One of the four portions was fortified with 5% date syrup (T1) whereas, the other 3 portions were stirred with colostrum at different levels 5% (T2), 10% (T3) and 15% **(**T4). All treatments were inoculated with 2% of yoghurt starter, then were transferred to plastic cups, incubated at 40ºC till complete coagulation then stored at 5ºC for 12 days. Samples of yoghurt were organoleptically, chemically and microbiologically analyzed at different storage periods at 1st, 4th, 8th and 12th days.

Chemical analysis:

All materials and yoghurt samples were chemically analyzed for total solids, protein, fat and titratable acidity according to AOAC (2000). The pH of yoghurt samples was determined by using pocket pH meter (IQ Scientific USA, Model IQ 125) at 4ºC. Calcium, iron and zinc were estimated by inductively coupled plasma atomic emission spectrometry (ICP-AES) using ICAP 6000 Series; Thermo Scientific. While phosphorus was determined colorimetrically according to El-Merzabani *et al.* (1977).

Evaluation of nutritional value of yoghurt:

The grams consumed of yoghurt to cover the recommended daily requirements (GDR) for children aged 1-3 years were calculated by using RDA (1989) for protein (16 g), calcium (800 mg), phosphorus (800 mg), iron (10 mg) and zinc (10 mg). Percent satisfaction (P.S.%) of the daily requirements for children aged 1-3 years of protein and minerals when consuming 100 g yoghurt samples was calculated.

Total IgG and lactoferrin determination:

Total IgG and lactoferrin were determined by using whey of buffalo milk, bovine colostrum and yoghurt samples at 1st and 12th days. The fat was removed from samples by centrifugation at 4000 rpm/3 min. To separate the whey, the casein was precipitated by adjusting pH at 4.6 using one N HCl solution and centrifuged at 10000 rpm/15 min, then the precipitated casein was removed. The whey of samples was stored at –20°C until to analysis.

The IgG was determined by using Enzyme Linked Immuno Sorbent Assay (ELISA) reader, elx 808, USA. The ELISA plates containing antibodies to bovine IgG (Sino GeneClon Biotech Co., Ltd) were used according to Chen and Mao (2004). Lactoferrin determination was achieved in National Research Centre, Egypt, using HPLC method according to Dračková *et al*. (2009). The results were reported as mg of IgG or lactoferrin /ml of whey.

Rheological properties:

Viscosity of yoghurt samples was measured according to Aryana (2003) using rotational viscometer type Lab. Line model 5437. The results were expressed as cps. Crud syneresis of yoghurt samples was determined using draining methods as described by Farouq and Haque (1992) as the amount of spontaneous whey (ml /100g) drained off after 2 h at room temperature.

Colour measurement was conducted for all yoghurt samples (*L**, *a** and *b**) by using Hunter lab colour analyzer (Hunterlab Colour Flex EZ, USA).

Microbiological analysis:

All yoghurt samples were enumerated for total bacterial count according to American Public Health Association (1992a) by using tryptone glucose extract agar medium. The plates were incubated at 37 ºC for 2 to 3 days. The MRS agar with pH 6.2±0.1 was used for enumeration of *Lactobacillius delbrueckii* subsp *bulgaricus* according to Dave and Shah (1996). The plates were incubated at 45 ºC for 72 h. Moulds and yeasts were enumerated on acidified potato dextrose agar medium according to Difco (1984). The plates were incubated at 25 ºC for 4-5 days. Total coliforms count was estimated by plating suitable dilution on violet red bile agar medium (VRBA) according to American Public Health Association (1992b). The plates

were incubated at 35 ºC for 24 h. The small non mucous red colonies were counted.

Sensory Evaluation:

The sensory evaluation of yoghurt samples included flavour 50 points, body and texture 40 points, appearance 10 points and overall acceptability from 100 points . Yoghurt samples were evaluated by 10 panelists from the staff members of Food Science Department, Faculty of Agriculture, Zagazig University according to Keating and Randwhit (1990).

Statistical analysis:

All data were statistically analysed using Statistix 8.1 Package Program (Statistix, 2009). The data were expressed as mean ± SD. Statistical differences among all treatments and storage periods were analyzed by least significant difference (LSD).

RESULTS AND DISCUSSION

Chemical composition of raw materials:

The chemical composition of buffalo milk (3%fat), bovine colostrum and date syrup are presented in Table (1). It was observed that the bovine colostrum had high amounts of total solids, protein, fat, minerals, IgG and lactoferrin compared to buffalo milk. The results are in agreement with Stelwagen *et al.* (2009), Ahmadi *et al.* (2011) and Patoo *et al*. (2014) who stated that bovine colostrum is considered as richer in proteins and immunoglobulins compared to mature milk. Also, the obtained results are higher than that found by Abd El – Fattah *et al.* (2012) who found that bovine colostrum contained 1.196 mg/ml lactoferrin and 32.33 mg/ml IgG. Aydogdu and Guzelbektes (2018) found that the protein, fat and IgG levels in bovine colostrum were 16.51-18.12%, 5.44 - 7.46% and 73.81 - 117.45 g/l, respectively. There was a positive correlation among colostrum IgG and total protein.

On the other hand, the date syrup had the highest total solids being 78.73±1.04%, iron 1.83±0.07mg/100g and zinc 0.42±0.09mg/100g. So, the obtained results matched with Hussein *et al.* (2017) who found that all date syrup varieties were poor in protein and fat while it was rich in sugar, calcium, iron, zinc and vitamin C.

Chemical composition of yoghurt:

The results of total solids, proteins and fat contents of yoghurt samples are shown in Table (2). The data indicated that the control had significantly ($P \leq 0.05$) lower value of total solids than samples containing date syrup only or with different levels of bovine colostrum. This may be refer to the higher total solids of date syrup and colostrum. During storage, the total solids of the control and T3 samples were significantly increased, while the other samples had insignificant increase with advanced storage . Also, it could be seen from the results that the protein content of yoghurt samples were affected significantly by adding date syrup and colostrum. The control sample had the lowest content being 3.91±0.04%, while T4 containing 5% syrup and 15% colostrum had the highest total protein (6.70±0.09%). Moreover, fat content showed similar trend as the total protein. So, the obtained results agree with Ayar *et al.* (2016) who found that the percentage of protein and fat in yoghurt samples increased slightly with increasing amount of colostrum. During cold storage period, limited increase in TS, protein and fat could be traced. This may be refer to the evaporation of some moisture during cold storage period. The obtained results are in accordance with El-Nagga and Abd El–Tawab (2012) who found that fermented milk with 2% dips caused a gradually increase in total solids throughout storage periods and a slight decrease in total protein and fat. Also, Moustafa, *et al.* (2016) found that adding date syrup at different ratio (6, 8 and 10%) caused a slight increase in TS, total protein and a decrease in fat content with advanced storage period. Also, Das and Seth (2017) found that adding 2% bovine colostrum whey powder to curd which is a traditional fermented milk manufactured in India caused a significant increase of total protein compared to the control curd (Elkot, 2017).

Table 1. Chemical composition of bovine colostrum, buffalo milk and date syrup.

Chemical composition	Bovine colostrum	Buffalo milk	Date syrup
Total solids (%)	23.18±1.49	11.88±1.00	78.73±1.04
Total protein (%)	11.71±0.38	3.93±0.15	2.12±0.31
Fat (%)	7.00±1.00	3.07±0.06	0.61±0.15
Calcium (mg/100g)	246.68±2.62	158.60±2.86	38.61±0.32
Phosphorus (mg/100g)	84.22±2.91	34.03±1.98	34.89±0.79
Iron (mg/100g)	1.39±0.08	0.42±0.04	1.83±0.07
Zinc (mg/100g)	0.41±0.02	0.17±0.03	0.42±0.09
IgG (mg/ml)	117.27±0.59[a]	0.69±0.10[b]	-
Lactoferrin (mg/ml)	3.01±0.06[a]	0.17±0.01[b]	-

Table 2. Total solids, protein and fat contents of yoghurt fortified with 5% date syrup and different levels of bovine colostrum during storage at 5°C for 12 days.

Components	Storage periods (days)	C	T1	T2	T3	T4	LSD
Total solids (%)	1	14.67±0.03^{D,b}	17.84±0.33^{C,a}	18.11±0.11^{BC,a}	18.34±0.07^{B,c}	18.80±0.40^{A,a}	0.44
	4	14.73±0.03^{C,ab}	18.03±0.40^{B,a}	18.12±0.30^{B,a}	18.43±0.06^{AB,bc}	18.84±0.29^{A,a}	0.47
	8	14.80±0.07^{C,ab}	18.11±0.44^{B,a}	18.19±0.37^{B,a}	18.49±0.04^{AB,b}	18.88±0.31^{A,a}	0.53
	12	14.94±0.24^{C,a}	18.23±0.52^{B,a}	18.42±0.46^{B,a}	18.78±0.06^{AB,a}	19.19±0.20A,a	0.62
LSD		0.24	0.80	0.63	0.11	0.58	
Protein (%)	1	3.91±0.04^{D,a}	4.77±0.16^{C,c}	4.89±0.13^{C,c}	6.09±0.07^{B,a}	6.70±0.19^{A,a}	0.23
	4	4.08±0.16^{D,a}	4.91±0.11^{C,bc}	4.99±0.07^{C,bc}	6.28±0.16^{B,a}	6.82±0.52^{A,a}	0.47
	8	4.15±0.24^{D,a}	5.04±0.13^{C,ab}	5.20±0.17^{C,ab}	6.34±0.33^{B,a}	6.92±0.43^{A,a}	0.51
	12	4.26±0.29^{D,a}	5.14±0.06^{C,a}	5.38±0.20^{C,a}	6.38±0.38^{B,a}	6.99±0.44^{A,a}	0.55
LSD		0.38	0.23	0.28	0.50	0.78	
Fat (%)	1	3.03±0.06^{CD,a}	2.93±0.15^{D,a}	3.13±0.06^{C,a}	3.40±0.10^{B,a}	3.60±0.10^{A,a}	0.18
	4	3.03±0.15^{C,a}	2.90±0.10^{C,a}	3.13±0.15^{BC,a}	3.40±0.17^{AB,a}	3.65±0.15^{A,a}	0.27
	8	3.07±0.12^{C,a}	2.97±0.15^{C,a}	3.15±0.15^{BC,a}	3.41±0.17^{AB,a}	3.67±0.15^{A,a}	0.27
	12	3.08±0.30^{BC,a}	2.97±0.23^{C,a}	3.14±0.13^{BC,a}	3.43±0.25^{AB,a}	3.65±0.28^{A,a}	0.44
LSD		0.34	0.31	0.24	0.34	0.34	

Means followed by different capital letters in the same row are significantly different ($P \leq 0.05$).
Means followed by different small letters in the same column are significantly different ($P \leq 0.05$).

Some minerals, IgG and lactoferrin contents of yoghurt:

Nowadays, fortification of milk and its products with sources rich with micronutrients is an important strategy for public health and improving dietary balance, (Crawley and Westland, 2013). From the results in Table (3), it could be noted that the quantity of Ca^{++} was found to increase significantly ($P \leq 0.05$) by adding date syrup and bovine colostrum. T4 had 191.63±0.14 mg/100g Ca^{++} compared to the control sample being 159.13±0.0614 mg/100g.

Table 3. Some minerals, immunoglobulin G (IgG) and lactoferrin contents of yoghurt fortified with 5% date syrup and different levels of bovine colostrum during storage at 5°C for 12 days.

Components (mg/100g)	Storage periods (days)	C	T1	T2	T3	T4	LSD
Calcium	1	159.13±0.06^{E,b}	161.86±1.05^{D,a}	173.79±0.17^{C,b}	178.51±0.19^{B,b}	191.63±014^{A,b}	0.88
	12	161.23±0.20^{E,a}	162.30±0.16^{D,a}	175.35±0.23^{C,a}	180.45±0.19^{B,a}	192.65±0.57^{A,a}	0.57
LSD		0.33	1.69	0.45	0.43	0.95	
Phosphorus	1	82.86±0.05^{E,a}	83.24±0.15^{D,b}	85.42±0.11^{C,b}	99.57±0.15^{B,b}	111.62±0.05^{A,b}	0.20
	12	82.95±0.30^{E,a}	84.25±0.06^{D,a}	86.36±0.37^{C,a}	101.04±0.15^{B,a}	111.93±0.06^{A,a}	0.42
LSD		0.49	0.26	0.62	0.34	0.12	
Iron	1	0.45±0.02^{E,a}	0.57±0.01^{D,a}	0.74±0.04^{C,a}	0.79±0.01^{B,a}	0.84±0.01^{A,a}	0.03
	12	0.45±0.03^{C,a}	0.58±0.04^{B,a}	0.74±0.03^{A,a}	0.80±0.10^{A,a}	0.85±0.08^{A,a}	0.11
LSD		0.05	0.06	0.07	0.16	0.12	
Zinc	1	0.24±0.04^{D,a}	0.36±0.05^{C,a}	0.43±0.03^{BC,a}	0.48±0.06^{AB,a}	0.52±0.02^{A,a}	0.07
	12	0.24±0.03^{D,a}	0.36±0.01^{C,a}	0.43±0.07^{BC,a}	0.48±0.08^{AB,a}	0.53±0.02^{A,a}	0.09
LSD		0.08	0.07	0.12	0.15	0.05	
IgG	1	0.657±0.146^{D,a}	0.610±0.113^{D,a}	8.440±0.020^{C,a}	9.300±0.026^{B,a}	10.800±0.020^{A,a}	0.15
	12	0.659±0.034^{D,a}	0.611±0.156^{D,a}	8.447±0.032^{C,a}	9.300±0.173^{B,a}	10.813±0.015^{A,a}	0.19
LSD		0.24	0.31	0.06	0.28	0.04	
Lactoferrin	1	0.179±0.004^{D,a}	0.165±0.007^{E,a}	0.346±0.005^{C,a}	0.843±0.011^{B,a}	0.967±0.004^{A,a}	0.01
	12	0.182±0.007^{D,a}	0.165±0.009^{D,a}	0.341±0.065^{C,a}	0.844±0.038^{B,a}	0.968±0.013^{A,a}	0.06
LSD		0.01	0.02	0.10	0.06	0.02	

Means followed by different capital letters in the same row are significantly different ($P \leq 0.05$).
Means followed by different small letters in the same column are significantly different ($P \leq 0.05$).

Also, the addition of date syrup and bovine colostrum caused a significant ($P \leq 0.05$) increase in phosphorus content compared to the control. The content of iron and zinc of the processed yoghurt increased significantly ($P \leq 0.05$) compared to the control sample. So, date syrup and bovine colostrum are a good source of iron which can correct iron deficiencies (anemia), zinc and another essential minerals. The obtained results took an opposite trend with El-Nagga and Abd El–Tawab (2012) who found that the amount of iron and zinc decreased in drinking yoghurt treatment with 2% syrup compared with the control.

As shown in Table (3), adding bovine colostrum at different ratio (5, 10 and 15%) enhanced the yoghurt content of IgG and lactoferrin compared to the control and T1 samples. The obtained results are in line with Das *et al.* (2013) and Das and Seth. (2017). In general, it was observed that the addition of date syrup and bovine colostrum to yoghurt enhanced the content of minerals, IgG and lactoferrin. Also, most nutrients had a slight increase during advanced storage period.

The GDR and P.S.% of protein and some minerals:

It was shown from Table (4) that the grams consumed of yoghurt to meet the daily requirement (GDR) for children aged 1-3years of protein and determined minerals (calcium, phosphorus, iron and zinc) significantly ($P \leq 0.05$) decreased by fortification of yoghurt with date syrup and bovine colostrum, while percent satisfaction (P.S.%/100g) of the daily needs in these nutrients significantly increased. The decrease in GDR values and increase in P.S.% were a result of increase protein and mineral contents of yoghurt containing date syrup and bovine colostrum. The T4 followed by T3 had significantly ($P \leq 0.05$) higher P.S.% compared to the control and T1.

The pH values of yoghurt samples during storage at 5°C for 12 days are shown in Fig. (1). It was obvious that T1 sample containing date syrup caused slight insignificant decrease in pH values compared to the control, while adding colostrum at different ratios enhanced the development of pH value but this increment was insignificant among all treatments at 1st day. These results are in line with Hussein *et al.* (2017) who found that date syrup had no significant effect on pH values. In general, it was noted that all pH values of yoghurt samples showed significant ($P \leq 0.05$) decrease with advanced storage period until 12th day as a result of post- fermentation of lactose to lactic acid.

Titratable acidity:

The relation between titratable acidity and pH always opposite. Titratable acidity contents of yoghurt for all treatments slightly increased during storage periods and there was significant ($P \leq 0.05$) increase in titratable acidity% for T1 compared with the control and the other yoghurt samples (Fig. 1). This could be explained on the basis that date syrup had higher content of essential nutrients such as simple sugar, minerals and vitamins, which might enhance the growth of yoghurt culture **(**Al- Farsi and Lee, 2008). The obtained results are in line with Al- Jasass *et al.* (2010), El-Nagga and Abd El–Tawab (2012), Elkot (2017) and Khalil and Blassy (2017). Also, These findings are in accordance with those mentioned by Jafarpoura *et al.* (2017) who found that drinking yoghurt containing date and fig syrups had a significantly higher acidity compared with the control samples.

Viscosity:

Viscosity values of yoghurt samples during storage at 5°C for 12 days are shown in Fig. (2). It is evident that the viscosity values of yoghurt increased by increasing the levels of bovine colostrum compared with the control or T1. In particular, yoghurt fortified with 10% (T3) and 15% (T4) of bovine colostrum had significantly ($P \leq 0.05$) higher viscosity values than that for other treatments during all storage periods.

Table 4. GDR (g) and P.S.% of protein and some minerals of yoghurt fortified with 5% date syrup and different levels of bovine colostrum.

Item		C	T1	T2	T3	T4	LSD
Protein	GDR	409.23±0.04^{A}	335.44±11.07^{B}	327.59±9.02^{B}	262.89±3.07^{C}	239.05±6.60^{D}	13.39
	P.S.%	24.44±0.23^{D}	29.83±0.97^{C}	30.54±0.83^{C}	38.04±0.44^{B}	41.85±1.16^{A}	1.46
Calcium	GDR	502.74±0.20^{A}	494.27±3.20^{B}	460.32±0.45^{C}	448.16±0.48^{D}	417.46±0.29^{E}	2.67
	P.S.%	19.89±0.01^{E}	20.24±0.13^{D}	21.73±0.02^{C}	22.31±0.02^{B}	23.95±0.02^{A}	0.11
Phosphorus	GDR	965.52±0.53^{A}	961.04±1.73^{B}	936.55±1.22^{C}	803.48±1.22^{D}	716.70±0.32^{E}	2.05
	P.S.%	10.36±0.01^{E}	10.41±0.02^{D}	10.68±0.01^{C}	12.45±0.02^{B}	13.95±0.01^{A}	0.03
Iron	GDR	2225.15±98.99^{A}	1744.30±17.46^{B}	1359.54±65.32^{C}	1272.30±8.09^{CD}	1190.59±14.17^{D}	98.43
	P.S.%	4.50±0.20^{E}	5.73±0.06^{D}	7.37±0.35^{C}	7.86±0.05^{B}	8.40±0.10^{A}	0.34
Zinc	GDR	4234.57±679.24^{A}	2784.67±382.03^{B}	2349.27±140.40^{BC}	2088.27±239.07^{C}	1912.88±77.44^{C}	675.92
	P.S.%	2.40±0.36^{D}	3.63±0.46^{C}	4.27±0.25^{BC}	4.83±0.59^{AB}	5.23±0.21^{A}	0.72

Means followed by different capital letters in the same row are significantly different ($P \leq 0.05$).

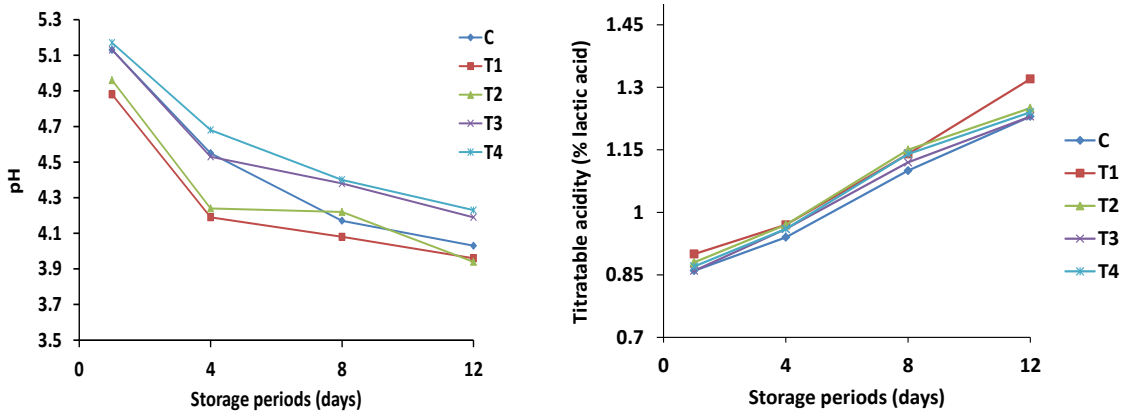

Fig. 1. The pH and titratable acidity values of yoghurt fortified with 5% date syrup and different levels of bovine colostrum during storage at 5°C for 12 days.

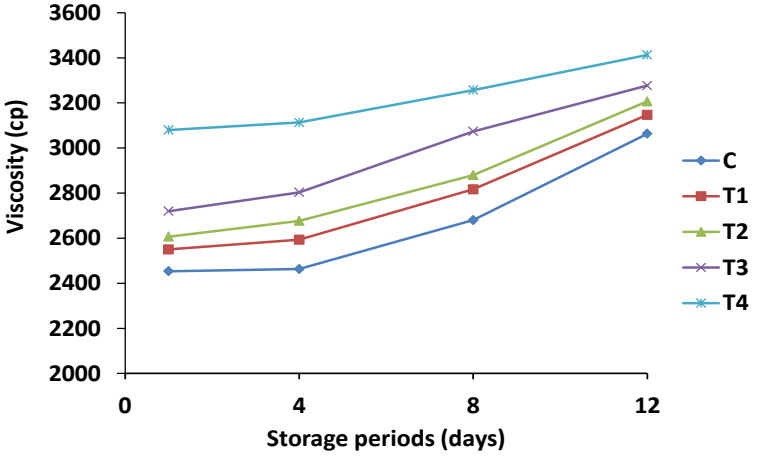

Fig. 2. Viscosity values of yoghurt fortified with 5% date syrup and different levels of bovine colostrum during storage at 5°C for 12 days.

These results match well with those obtained by Arana *et al*. (2008) and Ayar *et al*. (2016) who stated that colostrum contains high content of protein and fat which can be the reason of viscosity changes where the viscosity increases with increasing the total solids in liquid food.

Furthermore, there were no significant differences (P >0.05) between T1 and T2 and the lowest values of viscosity were observed in the control treatment. This may be due to the lower protein content in the control, T1 and T2 which led to decrease the intermolecular links between micelles of casein (Hussein *et al*., 2017). Also, viscosity values of the control and all the other treatments increased with progressing storage periods. This increment was significant ($P \leq 0.05$) on 8th and 12th days of all yoghurt treatments. This increment in viscosity through storage periods may be attributed to the development of gel structure and changes in protein-protein bound in a three-dimensional protein net of yoghurt and their rearrangement (Shahbandari *et al*., 2016).

Whey syneresis:

The syneresis of yoghurt fortified with 5% date syrup and different levels of bovine colostrum are shown in Fig. (3). There were no significant differences in the amount of syneresis among the control and all the other yoghurt treatments during the storage periods except T4 that had significantly ($P \leq 0.05$) lower syneresis than other yoghurt treatments on 12th day of storage. On the other hand, the amount of syneresis increased by progressing storage periods. This increment was not significant ($P \leq 0.05$) on 1st and 4th day then it was significant ($P \leq 0.05$) on 8th and 12th day of storage.

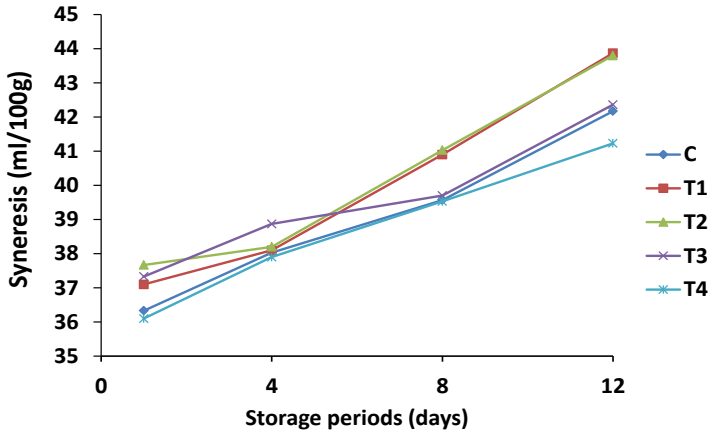

Fig. 3. Whey syneresis of yoghurt fortified with 5% date syrup and different levels of bovine colostrum during storage at 5°C for 12 days.

The increment of syneresis by progressing storage periods may be attributed to the damage and substantial structural reorganization of the gel network (Amerinasab *et al*., 2015) because the proteins making a desired texture loss their property and their bond with water is degenerated (Shahbandari *et al*., 2016). These results are in agreement with those reported by Das *et al*. (2013) who found that the syneresis increased on 12th day of storage in dahi fortified with colostrum.

Colour characteristics:

Colour characteristics of yoghurt fortified with 5% date syrup and bovine colostrum are given in Table (5). In general, colour of yoghurt is affected by addition of date syrup. Lightness values (L^*) of all yoghurt samples fortified with 5% date syrup and different levels of bovine colostrum were significantly lower than the control. Inversely, the redness values (a^*) were significantly higher in all treatments compared with the control and was decreased with increasing levels of bovine colostrum compared with T1. The yellowness values (b^*) of all yoghurt treatments were significantly higher than the control. This may be due to yellow colour of colostrum which led to increase the yellow colour of all yoghurt fortified with colostrum more than the control and T1 (Ayar *et al*., 2016). Similar results are observed by Hussein *et al*. (2017) when they made yoghurt with date syrup. Also, These results are in agreement with those reported by Arana *et al*. (2008) who found that addition of colostrum powder to yoghurt increased yellowness values and decreased lightness and redness values.

Sensory evaluation:

Sensory evaluation is an important indicator of consumer acceptance of healthy food products. The popularity of yoghurt is strongly dependent on their sensory characteristic which helps in marketing yoghurt and retaining consumer acceptance (Ares *et al*., 2011 and Routray & Mishra, 2011). The results of sensory evaluation of the prepared yoghurt samples (Table 6) revealed that, there were no significant differences in flavour, appearance, body and texture and overall acceptability scores among all yoghurt treatments except the control sample that had significantly higher appearance score compared to T1 and T2 on 4th day of storage.

Table 5. Colour characteristics of yoghurt fortified with 5% date syrup and different levels of bovine colostrum.

Treatments	L^*	a^*	b^*
C	87.73±0.67^{a}	-4.12±0.24^{d}	9.42±0.26^{c}
T1	73.14±1.15^{b}	0.41±0.07^{a}	18.24±0.22^{b}
T2	73.39±0.57^{b}	0.29±0.05^{ab}	18.58±0.05^{ab}
T3	74.12±0.58^{b}	0.16±0.10^{bc}	18.69±0.03^{a}
T4	74.58±1.15^{b}	0.06±0.01^{c}	18.89±0.24^{a}
LSD	1.58	0.22	0.34

L^*: lightness, a^*: redness, b^*: yellowness.

Means with the different small letters in each column are significantly at $P \leq 0.05$.

Table 6. Sensory evaluation of yoghurt fortified with 5% date syrup and different levels of bovine colostrum during storage at 5°C for 12 days.

Treatments	Storage periods (days)	C	T1	T2	T3	T4	LSD
Flavour (50)	1	45.40±2.88^{A,a}	45.80±3.70^{A,ab}	46.00±2.55^{A,a}	45.00±3.08^{A,a}	46.80±1.79^{A,a}	3.79
	4	46.00±1.87^{A,a}	47.60±2.70^{A,a}	47.80±0.84^{A,a}	46.20±1.64^{A,a}	47.00±0.71^{A,a}	2.26
	8	44.20±1.48^{A,a}	46.00±2.24^{A,ab}	45.80±1.79^{A,a}	45.20±0.84^{A,a}	45.60±1.34^{A,ab}	2.12
	12	43.60±1.14^{A,a}	43.80±1.64^{A,b}	45.60±2.30^{A,a}	45.00±1.87^{A,a}	44.80±1.48^{A,b}	2.29
LSD		2.62	3.59	2.66	2.71	1.86	
Appearance (10)	1	8.40±0.89^{A,ab}	7.60±1.14^{A,a}	7.40±1.52^{A,a}	8.00±1.73^{A,a}	8.20±0.84^{A,a}	1.68
	4	8.80±0.84^{A,a}	7.80±0.84^{B,a}	7.40±0.55^{B,a}	8.00±0.71^{AB,a}	8.20±0.45^{AB,a}	0.91
	8	7.80±0.45^{A,ab}	7.60±1.14^{A,a}	6.80±1.10^{A,a}	7.60±1.52^{A,a}	7.80±1.10^{A,a}	1.47
	12	7.60±1.14^{A,b}	7.40±0.89^{A,a}	6.60±1.14^{A,a}	7.40±0.55^{A,a}	7.60±0.55^{A,a}	1.18
LSD		1.16	1.36	1.51	1.66	1.04	
Body& texture (40)	1	36.60±3.78^{A,a}	36.40±1.67^{A,a}	37.80±1.64^{A,a}	38.00±1.22^{A,a}	38.60±0.89^{A,a}	2.77
	4	36.80±2.39^{A,a}	38.20±1.30^{A,a}	38.40±1.52^{A,a}	38.40±1.14^{A,a}	38.80±1.10^{A,a}	2.06
	8	36.00±3.81^{A,a}	38.00±1.58^{A,a}	38.00±2.35^{A,a}	38.00±2.12^{A,a}	37.80±2.59^{A,a}	3.43
	12	35.60±1.95^{A,a}	37.20±1.48^{A,a}	37.00±1.73^{A,a}	37.60±0.55^{A,a}	37.60±2.41^{A,a}	2.29
LSD		4.15	2.03	2.46	1.85	2.55	
Overall acceptability (100)	1	90.40±3.97^{A,a}	89.80±4.92^{A,a}	91.20±1.92^{A,ab}	91.00±4.85^{A,a}	93.60±2.97^{A,ab}	5.14
	4	91.60±3.65^{A,a}	93.60±4.16^{A,a}	93.60±1.67^{A,a}	92.60±2.70^{A,a}	94.00±1.87^{A,a}	3.92
	8	88.00±4.30^{A,a}	91.60±4.04^{A,a}	90.60±1.14^{A,b}	90.80±2.68^{A,a}	91.20±3.42^{A,ab}	4.38
	12	86.80±2.77^{A,a}	88.40±2.41^{A,a}	89.20±3.49^{A,b}	90.00±2.00^{A,a}	90.00±3.39^{A,b}	3.79
LSD		4.99	5.35	2.10	4.34	3.99	

Means followed by different capital letters in the same row are significantly different ($P \leq 0.05$).
Means followed by different small letters in the same column are significantly different ($P \leq 0.05$).

Also, there was no significant change in the most scores of sensory evaluation among all yoghurt treatments during storage at 5°C for 12 days except scores of flavour of T1 and T4, appearance in the control and overall acceptability in T2 and T4 were significantly lower on 12th day of storage in comparison to the 1st day. These results are in agreement with those reported by Hussein *et al*. (2017). Moreover, Das and Seth (2017) indicated that the scores of body and texture, colour, appearance and overall acceptability of curd samples fortified with colostrum whey powder were significantly higher than the control, while the flavour scores did not change significantly when compared to the control.

Microbiological analysis:

The results in Table (7) illustrate the total bacterial, lactic acid bacteria, yeasts and moulds, coliform counts of yoghurt containing date syrup and bovine colostrum during storage at 5°C for 12 days. It could be noted from the Table that the total bacterial count of yoghurt fortified with 5% date syrup and different levels of bovine colostrum was significantly (P ≤0.05) lower than the control during the storage periods on 4th, 8th, and 12th days. Also, the total bacterial count of the control and all the other treatments increased with progressing storage periods. The yoghurt sample fortified with 5% date syrup showed significantly (P ≤0.05) the lowest total bacterial count. This might be attributed to the higher level of sugars presented in date syrup which resulted in enhancing acidity development that decrease the growth rate of some bacteria (Moustafa *et al*., 2016) or due to the presence of immune factors found in colostrum which block the rapid of microorganisms growth (Das *et al*., 2013).

Lactic acid bacteria count of yoghurt fortified with different levels of bovine colostrum was significantly higher than the control and T1 during all storage periods. This may be attributed to the higher content of micronutrients in colostrum such as vitamins and minerals, which enhance the growth and activity of yoghurt culture (Coroian *et al*., 2013 and McGrath *et al*., 2016). Also, lactic acid bacteria count of the control and all the other treatments increased with progressing storage periods. Arana *et al*. (2008) found that fortification of yoghurt by colostrum powder with 4 or 8 g per 228 g yogurt led to increase in lactobacilli counts while using 12 g of colostrum led to significantly decrement in lactobacilli counts at storage period for 35 days.

The yeasts and moulds were not detected on the 1st and the 4th days of storage periods for the control and all the other treatments.

Table 7. Changes in some bacterial groups (cfu/g) of yoghurt fortified with 5% date syrup and different levels of bovine colostrum during storage at 5°C for 12 days.

Treatments	Storage periods (days)	C	T1	T2	T3	T4	LSD
Total bacterial count ($\times10^7$)	1	$12.63\pm0.85^{A,d}$	$10.97\pm0.38^{A,c}$	$10.50\pm2.18^{A,d}$	$11.57\pm1.33^{A,d}$	$12.53\pm1.21^{A,d}$	2.42
	4	$23.27\pm0.80^{A,c}$	$18.70\pm3.65^{B,b}$	$18.00\pm0.92^{B,c}$	$18.33\pm0.49^{B,c}$	$17.87\pm3.09^{B,c}$	4.03
	8	$44.40\pm2.33^{A,b}$	$26.47\pm1.19^{D,a}$	$23.70\pm1.47^{D,b}$	$31.43\pm4.11^{C,b}$	$36.07\pm1.53^{B,b}$	4.32
	12	$50.10\pm5.10^{A,a}$	$29.13\pm0.80^{C,a}$	$32.73\pm2.53^{C,a}$	$41.73\pm1.22^{B,a}$	$40.20\pm1.06^{B,a}$	4.86
LSD		5.39	3.71	3.54	4.25	3.58	
Lactic acid bacteria ($\times10^6$)	1	$7.13\pm0.93^{D,c}$	$5.83\pm0.80^{D,c}$	$17.00\pm1.80^{C,d}$	$22.43\pm3.14^{B,d}$	$26.13\pm1.06^{A,d}$	3.23
	4	$10.57\pm0.71^{C,c}$	$7.20\pm0.30^{C,c}$	$37.97\pm6.09^{B,c}$	$47.33\pm3.34^{A,c}$	$49.30\pm4.07^{A,c}$	6.58
	8	$23.90\pm1.85^{D,b}$	$17.83\pm2.75^{E,b}$	$47.80\pm4.23^{C,b}$	$55.90\pm3.05^{B,b}$	$67.60\pm2.35^{A,b}$	5.38
	12	$42.80\pm3.44^{C,a}$	$32.50\pm1.25^{D,a}$	$58.50\pm2.78^{B,a}$	$68.80\pm4.76^{A,a}$	$74.00\pm3.64^{A,a}$	6.14
LSD		3.84	2.96	7.65	6.85	5.68	
Yeasts & moulds ($\times10^2$)	1	ND	ND	ND	ND	ND	-
	4	ND	ND	ND	ND	ND	-
	8	$8.00\pm1.00^{AB,a}$	$10.00\pm3.46^{A,a}$	$5.33\pm2.08^{BC,b}$	$4.00\pm1.00^{C,b}$	$3.00\pm1.73^{C,a}$	3.76
	12	$11.00\pm2.65^{AB,a}$	$16.33\pm3.21^{A,a}$	$12.00\pm3.00^{AB,a}$	$10.00\pm3.00^{B,a}$	$9.00\pm3.61^{B,a}$	5.66
LSD		4.53	7.56	5.85	5.07	6.41	
Coliform bacteria ($\times10^2$)	1	ND	ND	ND	ND	ND	-
	4	ND	ND	ND	ND	ND	-
	8	ND	ND	ND	ND	ND	-
	12	ND	ND	ND	ND	ND	-
LSD		-	-	-	-	-	

ND: Not detected

Means followed by different capital letters in the same row are significantly different ($P \leq 0.05$).

Means followed by different small letters in the same column are significantly different ($P \leq 0.05$).

The yeast and mould counts of the control and all the other treatments were detected on the 8th day of storage period and then increased till the end of storage period. The lowest count of yeasts and moulds was observed in T4 followed by T3 on the 8th and the 12th days of storage period. Meanwhile, the coliform bacteria was not detected in the control and all the other treatments during all storage periods. The general trend of these results is in agreement with those reported by Ayar *et al.* (2016).

CONCLUSION

From the current study, it could be concluded that the enrichment of yoghurt by addition of bovine colostrum and date syrup will increase the nutritional value, healthy and immune benefits of yoghurt and thus enhances the quality and overall acceptability of the product that can be consumed as a new functional dairy food especially for children.

REFERENCES

Abbes, F., W. Kchaou, C. Blecker, M. Ongena, G. Lognay, H. Attia and S. Besbes.2013. Effect of processing conditions on phenolic compounds & antioxidant properties of date syrup". Industrial crop & product. 44: 634-642.

Abd El-Fattah, A. M ., F. H. R. Abd Rabo, S. M. EL-Dieb and H. A. El-Kashef. 2012. Changes in composition of colostrum of Egyptian buffaloes and Holstein cows. B. M. C. Vet. Res. 8(19): 1-7.

Ahmadi, M., A. B. Velciov, M. Scurtu, T. Ahmadi and L. Olariu. 2011. Benefits of bovine colostrum in nutraceutical products. J. Agroalimentary Processes and Technol. 17(1): 42-45.

Al-Farsi, M. A. and C. Y. Lee. 2008. Nutritional and functional properties of date. A review. Crit. Rev. Food Sci. Nutr. 84: 877-887.

Al-Jasass, F. M., S. M. Aleid, and A. A. El-Neshwy. 2010. Utilization of dates in the manufacture of new probiotic dairy food. First annual report, Date Palm Res, Cent., King Faisal Univ.Al-Ahsa, Project. PR3.

American Public Health Association. 1992a. Compendium of methods for the microbiological examination of foods, 3rd. Ed. APHA, Wasington, DC.

American Public Health Association. 1992b. Standard methods for the examination of dairy products, Inc. 16th Ed. NewYork.

Amerinasab, A., M. Labbafi, M. Mousavi and F. Khodaiyan. 2015. Development of a novel yoghurt based on date liquid sugar: physicochemical and sensory characterization. J. Food Sci. Technol. 52(10):6583–6590.

AOAC . 2000. Official Methods of Analysis of Association of Official Analytical Chemists. Published by the A.O.A.C international 17th Ed. Gaithersburg,, MD. USA.

Arana, K. J., E. Albers and O. Cueva. 2008. Colostrum fortified probiotic fat free yogurt. Milchwissenschaft. 63(1): 64-68.

Ardali, F. R., E. Rahimi, S. Tahery and M. A. Shariati. 2014. Production of a new drink by using date syrup and milk. J. Food Biosci. & Techno. 4(2): 67-72.

Ares, G., P. Varela, G. Rado and A. Gimenez. 2011. Are consumer profiling techniques equivalent for some product categories? The case of orange- flavoured powdered drinks. Intr. J. food Sci. & Techno. 46(8): 1600-1608.

Aryana, K. J. 2003. Folic acid fortified fat free plain set yoghurts. Int. J. Dairy Technol. 56 (4): 219-222.

Ayar, A., H. Sıçramaz and İ. Çetin. 2016. The effect of bovine colostrum on the lactic flora of yoghurt and kefir. J. S. M. Biotechnol. Bioeng. 3(4): 1063-1068.

Aydogdu, U. and H. Guzelbektes. 2018. Eff ect of colostrum composition on passive calf immunity in primiparous and multiparous dairy cows. Veterinarni Medicina. 63(01): 1-11.

Brinkworth, G. D. and J. D. Buckley. 2003. Concentrated bovine colostrum protein supplementation reduces the incidence of self-reported symptoms of upper respiratory tract infection in adult males. Eur. J. Nutr. 42: 228-232.

Chen, P. and F. C. Mao. 2004. Detection of lactoferrin in bovine and goat milk by Enzyme-Linked Immunosorbrnt Assay. J. Food Drug and Anal. 12(2): 133-139.

Coroian, A., S. Erler, C. T. Matea, V. Mireșan, C. Răducu, C. Bele and C. O. Coroian. 2013. Seasonal changes of buffalo colostrum: physicochemical parameters, fatty acids and cholesterol variation. Chem. Central J. 7(40): 1-9.

Crawley, H. and S. Westland. 2013. Fortified milks for children. A worldwide review of fortified milks marketed for children over 1 year ago. First steps, Nutrition Trust. Report. ISBN 978-908924-0. pp88.

Das, A. and R. Seth. 2017. Chemical compositional analysis and physical attributes of curd fortified with bovine colostrum whey powder. Int. J. Chem. Studies. 5(1): 334-338.

Das, A., R. Seth, D. Lal and V. Sharma. 2013. Evaluation of physico-chemical properties of colostrum supplemented dahi. Int. J. Food & Nutr. Sci. 2(4): 40-44.

Dave, R. I. and N. P. Shah. 1996. Evaluation of Media for selective enumeration of Streptococcus thermophiles, lactobacillus delbrueckii ssp. bulgaricus, lactobacillus acidophilus and bifidobacterium ssp. J. Dairy Sci. 79: 1529-1536.

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

Drackova, M., I. Borkovcova, B. Janstova, M. Naiserova, H. Pridalova, P. Navratilova, L. Vorlova. 2009. Determination of lactoferrin in goat milk by HPLC method. Czech J. Food Sci. 27: S102-S104.

Elkot, W.F. 2017. Preparation and properties of bio-yoghurt using Jerusalem artichoke tubers and different probiotic strains. Egyptian J. Dairy Sci. 45(1): 55-66.

El-Merzabani, M. M., A. A. El-Aaser and N. I. Zakhary. 1977. Determination of inorganic phosphorus in serum. J. Clin. Chem. Clin. Biochem., 15: 715-718.

El-Nagga, E. A. and Y. A. Abd El–Tawab. 2012. Compositional characteristics of date syrup extracted by different methods in some fermented dairy products. Annals of Agricultural Sci. 57(1): 29–36.

Farouq, K. and Z. U. Haque. 1992. Effect of sugar esters on the textural properties of the nonfat low caloric yoghurt. J. Dairy Sci. 75: 26-76.

Georgiev, P. 2008. Differences in chemical composition between cow colostrum and milk. Bulgarian J. Veterin. Medicine. 11(1): 3-12.

Godhia, M. L. and N. Patel. 2013. Colostrum. its composition, benefits as a nutraceutical : a review. Current Res. Nutr. Food Sci. 1(1): 37-47.

Hussein, A. M. S., M. T. Fouad, M. Abd El-Aziz, N. E. Ashour, and E. A. M. Mostafa. 2017. Evaluation of physico-chemical properties of some date varieties and yoghurt made with its syrups. J. Biol. Sci. 17(5): 213-221.

Jafarpoura, D., A. Amirzadeha, M. Malekia and M. R. Mahmoudib. 2017. Comparison of physicochemical properties and general acceptance of flavored drinking yogurt containing date and fig syrups. Foods and Raw Materials. 5(2): 36-43.

Keating, K. and C.H. Randwhit. 1990. Effect of alternative sweeteners in plain and fruit flavoured yoghurt. J. Dairy Sci. 37: 54-59.

Kelly, G. S. 2003. Bovine colostrum: a review of clinical uses. Altern. Med. Rev. 8(4): 378-394.

Khalil, R. A. M. and K. I. Blassy. 2017. Preparation and properties of free fat yoghurt supplemented with oat and flavoured with pomegranate juice and soursop pulp. Egyptian J. Dairy Sci. 45(2): 143-154.

Khosravanipour, M. A., M. Sarshar, Sh. Javadian, M. R. Zarefard and H. Z. Amirifard. 2011. Separation of fructose & glucose form date syrup using resin chromatographic method: experimental data & mathematical modeling. Separation & purification technology.79: 72-78.

McGrath, B. A., P. F. Fox, P. L. H. McSweeney and A. L. Kelly. 2016. Composition and properties of bovine colostrum: a review. Dairy Sci. & Technol. 96:133–158.

Moustafa, R. M. A., E. M.Abdelwahed, A. A. El-Neshwy, and S. N. Taha. 2016. Utilization of date syrup (dips) in production of flavoured yoghurt. Zagazig J. Food & Dairy Res. 43(6B): 2463-2471.

Patoo, R. A., D. V.Singh, Rukshan, S. Kaushl and M. K. Singh. 2014. Compositional changes in colostrum and milk of Hill cows of Uttarakhand during different lactation stages. Indian J. Hill Farming. 27(2): 54-58.

R.D.A. 1989. Recommended dietary allowance, food nutrition board,National Academy of science press, Washington. D.C. USA.

Routray, W. and H. N. Mishra. 2011. Scientific and technical aspects of yoghurt aroma and taste, a review. Compr. Rev. Food Sci. Food Safety. 10: 208- 220.

Sahana, N., D. Ramasamy, T.R. Pugazhenthi and I. Manikkavasagan. 2018. Studies on physical and microbial parameters of bovine colostrum powder. Int. J. Curr. Microbiol. App.Sci.7(8): 2766-2771.

Shahbandari, J., A. Golkar, S. M. Taghavi, and A. Amiri. 2016. Effect of storage period on physicochemical, textural, microbial and sensory characteristics of stirred soy yoghurt. Int. J. Farm. & Alli. Sci. 5(6): 476-484.

Statistix. 2009. User's Manual. Analytical Software, Tallahassee FL 32317, USA.

Stelwagen, K., E. Carpente, B. Haigh, A. Hodgkinson and T. T. Wheeler. 2009. Immune components of bovine colostrum and milk. J. Anim. Sci. 87: 3-9.

الملخص العربي

انتاج زبادي وظيفي جديد للأطفال مدعم بالسرسوب البقري وشراب البلح

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يهدف هذا البحث الى دراسة تأثير إضافة كل من السرسوب البقري وشراب البلح كمواد طبيعية على القيمة الغذائية والتصنيعية للزبادى. وقد تم تصنيع الزبادى بإستخدام لبن جاموسى يحتوى على ٣% دهن وتم تقسيم المعاملات كالتالى المعاملة الكنترول(C) مصنعة من لبن جاموسى ٣% دهن فقط، المعاملة T1 هى مكونة من (لبن جاموسى ٣% دهن + ٥% شراب البلح)، المعاملة T2 مكونة من (لبن جاموسى ٣% دهن + ٥% شراب البلح + ٥% سرسوب بقرى)، المعاملةT3 مكونة من (لبن جاموسى ٣% دهن + ٥% شراب البلح + 10% سرسوب بقرى) بينما المعاملة T4 مكونة من (لبن جاموسى ٣% دهن + ٥% شراب البلح + ١٥% سرسوب بقرى) وتم خلط المكونات جيدا، ثم اضيف البادىء بنسبة ٢% لكل المعاملات واجراء عملية التحضين ثم التخزين على درجة ٥°م لمدة ١٢ يوم، وعلى فترات مختلفة اثناء التخزين تم اجراء بعض التحليلات الكيميائية، والحسية والميكروبيولوجية لكل المعاملات، واوضحت النتائج المتحصل عليها ان إضافة كلا من شراب البلح والسرسوب البقرى ادى الى تعزيز محتوى الزبادى المصنع من المواد الصلبة الكلية، البروتين، الدهون، الأجسام المناعية(IgG)، اللاكتوفيرين وكذلك العناصر المعدنية الهامة وكانت هذه الزيادة معنوية مقارنة بالعينة الكنترول. وازدادت نسبة الحموضة بتقدم فترة التخزين مع حدوث انخفاض فى رقم الـ pH وذلك عند مستوى معنوية ($P \leq 0.05$). وكذلك لوحظ ارتفاعا معنويا فى مقدار اللزوجة بالنسبة للمعاملات T3وT4 مقارنة بالمعاملات الأخرى وسجلت المعاملة T4 انخفاضا معنويا فى مقدار الشرش المنفصل مقارنة بباقى المعاملات وذلك عند انتهاء فترة التخزين. وأظهر التقييم الحسى عدم وجود فروق معنوية بين المعاملات والعينة الكنترول بالنسبة للطعم والنكهة، القوام، المظهر ودرجة القبول العام. كما أدى تدعيم الزبادى بكل من السرسوب البقرى وشراب البلح الى حدوث زيادة معنوية فى نسبة الأشباع لكلا من البروتين، الكالسيوم، الفسفور، الحديد والزنك لمقابلة الإحتياجات الغذائية بالنسبة للاطفال من عمر ١-٣ أعوام، مع انخفاضا معنويا لكمية الزبادى المستهلكة وخاصة فى المعاملة T4 لتغطية تلك الاحتياجات. كاستنتاج عام يمكن تدعيم الزبادى بإضافة كلا من السرسوب البقرى وشراب البلح من اجل تعزيز القيمة الغذائية والصحية له وتحسين الجودة التصنيعية.

الكلمات المفتاحية: الزبادى، السرسوب البقرى، شراب البلح، الخواص الحسية.