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Functional Low and Free-Fat Fermented Milk Drink Supplemented with Oats

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ABSTRACT

This study aimed to evaluate the effect of adding different ratios of oats on the properties and nutritional value of low and free-fat fermented milk drink as a functional dairy product for enhancing human health. The product was fermented using mixed starter of *L. casei* HQ177095 and *L. paracasei* HQ177096.1 (1:1) and supplemented with oats at ratios of 1 and 2%. Samples of fermented milk drinks were stored at 5±1°C for 21 days. Microbiological, chemical, physical, organoleptic properties and nutritional value were carried out during storage period. Results indicated that there were slight changes in some chemical composition during storage, while changes in lactose content, pH values and titratable acidity were significant. Also, the microbiological examination indicated that treatments significantly enhanced the viability of LAB and affected total viable counts and psychrophilic bacteria during storage. Regarding to organoleptic properties, it was noticed that fermented milk drinks which supplemented with oats had the higher total scores than controls. Moreover, fermented drinks supplemented with 2% oats showed better physical characteristics (viscosity and syneresis) than other treatments. The product can be recommended as a good source of iron, protein and can be considered as healthy foods, contain low fat and low calories.

Keywords: Probiotics, *L. casei, L. paracasei*, fermented milk drink and oats.

INTRODUCTION

Functional dairy products, specially fermented milk; recently its availability and popularity increased in the daily-life. Consumers' interest about personal health is reasons in establishing markets for these functional products (Gasmalla *et al.,* 2017). However, probiotics include several microorganisms, mostly within the genus of *Lactobacillus*; such as *L. casei* and *L. paracasei*, which can be grouped under that definition. The beneficial effects of probiotics on gastrointestinal diseases have been widely described specially inflammations caused by *Helicobacter pylori* (Behnsen *et al.* 2013; Sarowska *et al.* 2013 and Nasr *et al.* 2017). Moreover, the growth and survival of probiotic strains depends on available nutrients in dairy products and some functional ingredients such as oat which may act as prebiotic agents (Soltani *et al.,* 2017). Oat is associated with many health benefits as it contains major sources of β-glucan which is considered as the main functional component of cereal fibers. It can reduce the risk of cancer, lower cholesterol and alleviate diabetes. In addition, β-glucan acts as a prebiotic; stimulating the growth of some beneficial residential colon probiotic microorganisms. Furthermore, oat has been shown to be suitable substrates for fermentation with lactic acid bacteria. In addition, oat grains are a rich source of manganese, molybdenum, phosphorus, biotin, vitamin B1, magnesium, zinc and dietary fiber. (Russo *et al.* 2012; Soong *et al.* 2014 and Soltani *et al*., 2017). Probiotic yoghurts fortified with whole grains have the potential to help consumers incorporate nutritious foods with added health benefits to their diet. It may also attract new yoghurt consumers as it can be used as a vehicle to deliver good bacteria as well as other nutrients found in whole grains to consumers. Therapeutic foods are usually made of a mixture of protein, carbohydrate, lipid and vitamins and minerals. These types of foods are usually produced by grinding all ingredients together and mixing them (Manary, 2006). So, the main aim of this work was to evaluate the effect of adding different ratios of oats on the properties and nutritional value of low and free-fat fermented milk drink.

MATERIALS AND METHODS

Raw milk

Fresh raw buffaloes' milk was obtained from the farm of Faculty of Agriculture, Fayoum University.

Lactic acid bacteria (LAB)

Fresh activated cultures were used in this study; *L. casei* HQ177095 and *L. paracasei* HQ177096.1 which were isolated and identified by Elbanna *et al*. (2010, 2017) and Khider & Elbanna (2017). The isolates were activated first in MRS broth medium, then inoculated in 10 % (w/v) sterilized skim milk at 37°C for 24 h under microaerophilic conditions.

Oats

Oats (*Avena sativa*), Santé oat flakes, made of whole grain oats (produced by Santé Company, Poland) was obtained from local markets. Oat flakes (7% fat, 66% carbohydrates, 11% fibers, 17% protein and 26% iron, according to the chemical composition of the manufacturer package) was grinded using the grinder of electrical blender and kept till use as a powder in clean and sterilized plastic cups to avoid moisture absorption.

Preparation of functional fermented milk drink supplemented with oats

Standardized homogenized buffalo's milk (3% fat) and skimmed milk (0.1% fat) were used to make the fermented milk drink according to Luana *et al*. (2014). Milk was divided to six portions as shown in Fig. (1). The prepared drinks were filled into 100 ml sterilized plastic cups, stored in cooling incubator at 5±1ºC and then were analyzed for some chemical composition in fresh age and at 21 days of storage, while the pH values, TA%, microbiological examination and sensory evaluation were determined when fresh, 7, 14 and at 21 days of storage. The apparent viscosity, syneresis rate and nutritional values of the fresh fermented milk drinks were also measured. All analyses were carried out in triplicate**.**

Chemical analysis

Raw milk and resultant fermented milk drink samples were analyzed for their total solids, titratable acidity, fat, total protein contents, lactose content, total dietary fibers and total ash, as described in A.O.A.C

(2009). The pH values of the samples of each treatment were determined by using pH meter Thermo Scientific Orion Star (A214). Minerals content (Ca, P, K, Mg, Fe, Zn, Cu and Mn) of fermented drinks' ash was determined using Inductively Coupled Plasma (ICP) equipment (Model 6300 Duo UK, England) according to APHA (2012). All chemicals and reagents that used for this study were analytical grade (A.R) and obtained from Sigma, Merck, El-Nasser and El-Gomhouria companies.

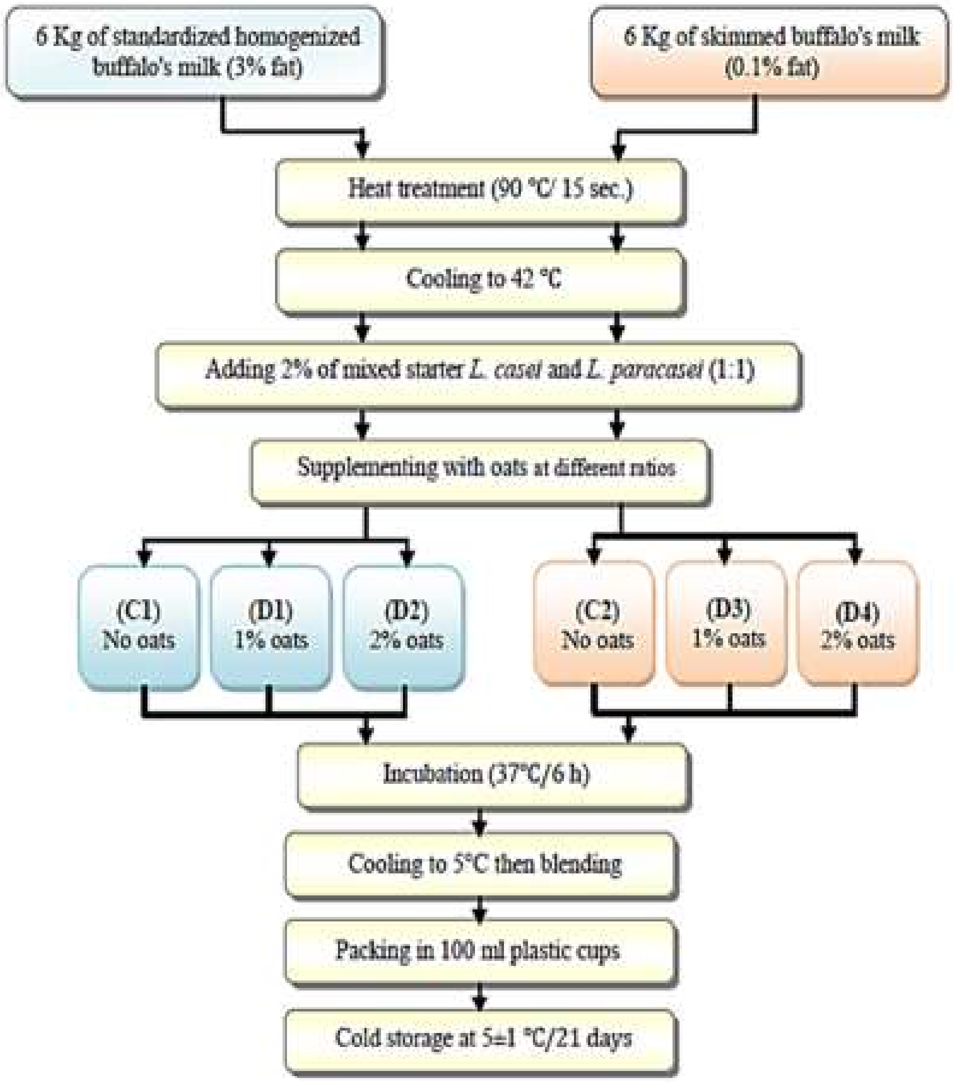

Fig. 1. Schematic flow diagram of the basic steps involved in making functional fermented milk drink supplemented with oats.

Nutritional value

Calculations of the energy content of experimental fermented milk drinks were done accordingly to FAO (2004). The daily values (%DV) are based on the Daily Values for key nutrients which is calculated using Food and Drug Administration list of %DVs based on a caloric intake of 2000 Kcal, for adults and children aged 4 years and older (FDA, 2016).

Physical properties

Syneresis was determined as described by Akin (2014). Syneresis (%) was expressed as volume of drained whey per 100 ml drink. The apparent viscosity of the prepared drinks was measured according to Atallah (2015) using a Brookfield viscometer Model DV11 + Pro (Brookfield unit, MA, USA) at 25ºC with a rotation speed of 30 rpm for 100 ml of each sample. The results are presented in milli-pascal seconds (mPa.s).

Microbiological examination

Enumerations of all microbial counts were done as described in Oxoid (2006). LAB including *L. casei* and *L. paracasei* in fermented drink samples were grown on MRS agar media. The total viable counts (TVC) were determined using PCA medium. Coliform bacterial counts were determined on MacConkey agar media, Fungi counts were determined on PDA and psychrophilic bacteria were enumerated on PCA medium.

Organoleptic properties

The organoleptic properties of samples were evaluated during storage by 10 panels of staff members of Dairy Science Department and Food Science and Technology Department, Faculty of Agriculture, Fayoum

University. Fermented drink samples were evaluated according to the score card sheet of Bodyfelt *et al.* (1988) intervals storage period: fresh, 7, 15 and 21 days.

Statistical analysis

Data were statistically analyzed using General Linear Models procedure of Statistical Package for Social Sciences (SPSS, 2008) Version 17.0.0 software. Duncan's (1955) multiple range tests were used to compare between the means.

RESULTS AND DISCUSSION

1. Gross chemical composition

Statistical analysis indicated that treatment and storage period significantly ($p<0.001$) affected the fermented drink's content of moisture (Table 1). The moisture content of all drinks' samples decreased slightly with the progressing of the period of storage. Fresh free-fat drink (C_2) contained higher moisture content (88.85%), while low-fat fermented drink which supplemented with 2% oats (D_2) after 21 days contained the lowest moisture content (83.63%). These results are in accordance with Sayed (2012), Abou-Dobara *et al.,* (2016) and Nassar *et al.* (2016).

Fat content of all fermented drinks insignificantly ($p>0.001$) affected neither by supplementation with oats nor storage period. All low-fat drinks recorded the same fat content (3%) when it fresh and at 21 days of storage period, while, all fresh and stored (21 days) free-fat treatments contained 0.1% fat.

There was a significant increase in total protein of all drinks. The lowest protein content was for the fresh control low-fat fermented drink (C_1) of 5.80%. Free-fat fermented milk drink supplemented with 2% oat (D_4) at 21 days recorded the highest percentage of protein (6.92%), as oat has a unique protein composition along with high protein content of 11-15 % (Rasane *et al.,* 2015). The results indicate that Fat and protein contents of all samples obtained satisfied the Egyptian legal standards for fermented milk (ES, 2016).

The same trend was for ash content; fresh free-fat drink without oats (C_2) recorded the lowest ash content (0.71%), while the highest number was for D_2 after 21 days (low-fat fermented drink with 2% oats) of 2.31%. it may be due to the addition of oats as found by Nassar *et al.* (2016).

- **Lactose content and rate of its hydrolysis**

Results in Fig. (2) indicated that lactose content of fresh samples was higher than lactose contents after 21 days of storage. Also after 21 days of storage, treatments were significantly ($p <0.001$) different in lactose content where low-fat (D_2) and free-fat (D_4) drinks contains 2% grinded oats recorded the lowest lactose readings; 4.01 and 4.00, respectively. The high rate of fermentation is because of increasing the viability of LAB by oat and as a result, more degradation of lactose (Reid, 2008). Rate of lactose hydrolysis depends on both lactose content of fresh sample and storage period. The highest rate of lactose hydrolysis was for treatment free-fat fermented drink supplemented with 2% oats (D_4); 11.89%, while the lowest rate of hydrolysis was for low-fat fermented drink with no oats (C_1) which recorded 5.09%.

- **The pH values and titratable acidity**

Results showed that treatments and storage periods affected both pH and the TA (%) significantly ($p <0.001$), the pH ranged between 4.6 – 4.51 % in fresh samples (Fig. 3). The pH values were reduced during storage and reached to 4.20 – 3.93 at the age of 21 days. The lowest pH number was for free-fat fermented drink which supplemented with 2% oat (D_4) stored for 21 days of 3.93. Results of pH values are in accordance with Soltani *et al.* (2017).

The TA (%) of all treatments increased during storage; this attributed to lactose hydrolysis and production of lactic acid by LAB. Results revealed that TA was increased as the pH decreased. The presents of TA% were ranged from 0.7 – 0.85% in fresh drinks with no significant differences between them. The highest TA% number was for free-fat fermented drink which supplemented with 2% oat (D_4) stored for 21 days (1.98%). Although, it didn't significantly differs from D3 (free-fat drink with 1% oat) and D_2 (low-fat drink with 2% oat) which have TA% numbers of 1.93 and 1.87%, respectively. These results are in accordance with Sayed (2012), Coman *et al.* (2013), Abou-Dobara *et al.* (2016) and Haddad (2017).

Table 1. Moisture, fat, protein and ash content of functional free and low-fat fermented milk drink as affected by adding different ratios of oats and storage periods at 5°C±1

Components (%)	Storage Period (days)	Treatments						Sig.
		Low-fat drink			Free-fat drink			
		C_1	D_1	D_2	C_2	D_3	D_4	
Moisture	Fresh	85.46^{g}	84.67^{i}	83.92^{k}	88.85^{a}	88.03^{c}	87.24^{e}	p<0.01
	21	85.26^{h}	84.50^{j}	83.63^{l}	88.76^{b}	87.85^{d}	87.13^{f}	
Fat	Fresh	3.00	3.00	3.00	0.1	0.1	0.1	NS
	21	3.00	3.00	3.00	0.1	0.1	0.1	
Total Protein	Fresh	5.80^{l}	6.11^{h}	6.70^{c}	5.90^{k}	6.21^{g}	6.51^{d}	p<0.001
	21	5.91^{j}	6.32^{f}	6.84^{b}	5.98^{i}	6.43^{e}	6.92^{a}	
Ash	Fresh	1.11^{f}	1.64^{c}	1.83^{b}	0.71^{i}	1.01^{g}	1.57^{d}	p<0.001
	21	1.36^{e}	1.79^{b}	2.31^{a}	0.93^{h}	1.33^{e}	1.85^{b}	

a, b,…. and k: Means having different superscripts within each column are significantly different.
C_1: Low-fat fermented milk drink (control, without oats)
C_2: Free-fat fermented milk drink (control 2, without oats)
D_1: Low-fat fermented milk drink supplemented with 1% oats,
D_2: Low-fat fermented milk drink supplemented with 2% oats
D_3: Free-fat fermented milk drink supplemented with 1% oats,
D_4: Free-fat fermented milk drink supplemented with 2% oats
NS: Not significant

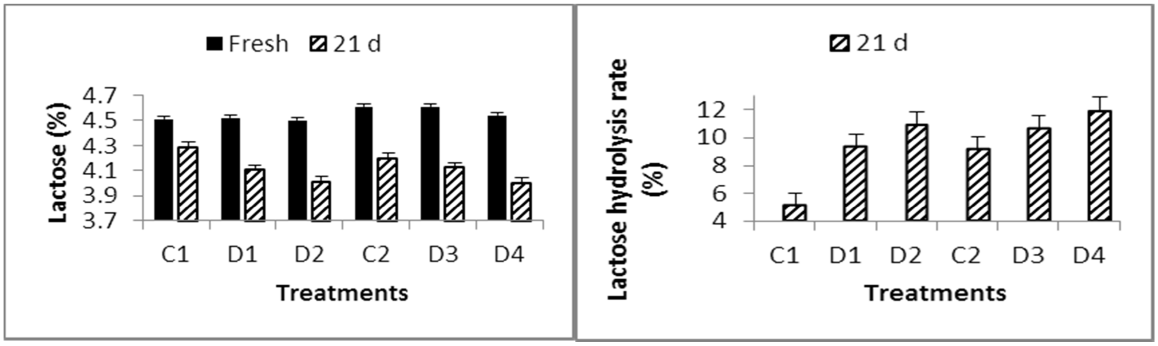

Fig. 2. Changes in lactose content and rate of lactose hydrolysis of functional free and low-fat fermented milk drink supplemented with different ratios of oats during storage at 5°C±1.

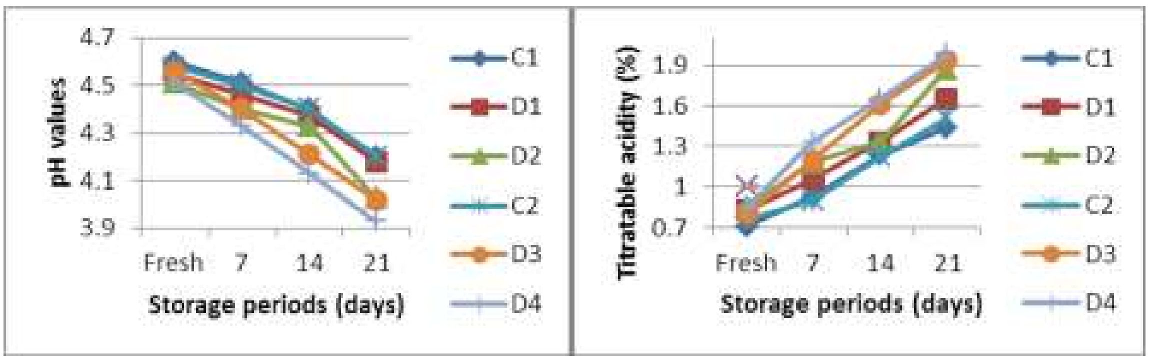

Fig. 3. Changes in pH values and titratable acidity (TA%) of functional free and low-fat fermented milk drink as affected by adding different ratios of oats and storage periods at 5°C±1.

2. Nutritional value of experimental fermented milk drink

All low-fat and free-fat drinks were low in calories as all of them gives energy less than 100 Kcal (100 calories per serving is moderate while 400 calories per serving is high, FDA, 2016) as shown in Table (2). The lowest number was for control free-fat drink (C_2) of 42.49 Kcal while; the low-fat drink supplemented with 2% oats (D_2) had the highest energy of 77.20 Kcal. Moreover, D_2 recorded the highest % DV of protein (13.40%). While, the lowest reading for % DV protein was recorded for control low-fat drink (C_1); of 11.60%. On the other hand, all treatments were low in %DV of fat as all of them didn't provide 5%DV (FDA, 2016).

Table 2. Nutritional value and daily value (%DV) of nutrients and minerals in functional low and free-fat fermented milk drink.

Items	Unit	Treatments* (Value / 100 ml)											
		C_1	%DV	D_1	%DV	D_2	%DV	C_2	%DV	D_3	%DV	D_4	%DV
Nutrients													
Energy	Kcal	68.24	NC	71.64	NC	77.20	NC	42.94	NC	47.70	NC	52.14	NC
Protein	g	5.80^{l}	11.60	6.11^{h}	12.22	6.70^{c}	13.40	5.90^{k}	11.80	6.21^{g}	12.42	6.51^{d}	13.02
Total fat	g	3.00	4.61	3.00	4.61	3.00	4.61	0.10	0.15	0.10	0.15	0.10	0.15
Total carbohydrates	g	4.51	1.50	5.05	1.68	5.85	1.95	4.61	1.53	5.50	1.83	6.30	2.10
Dietary fibers	g	0.00^{c}	0.00	0.11^{b}	0.44	0.20^{a}	0.80	0.00^{c}	0.00	0.10^{b}	0.40	0.20^{a}	0.80
Minerals													
Calcium	mg	100.85^{ab}	10.08	100.50^{ab}	10.05	102.91^{a}	10.29	83.21^{c}	8.32	84.85^{c}	8.48	84.98^{c}	8.49
Phosphorus	mg	65.50^{c}	6.55	68.47^{b}	6.84	73.61^{a}	7.36	59.14^{d}	5.91	63.45^{c}	6.34	64.70^{c}	6.47
Potassium	mg	97.59^{d}	2.78	113.65^{c}	3.24	146.68^{a}	4.19	91.52^{d}	2.61	110.55^{c}	3.15	131.61^{b}	3.76
Magnesium	mg	17.35^{e}	4.33	19.75^{c}	4.93	25.62^{a}	6.40	16.93^{f}	4.23	17.69^{d}	4.42	20.14^{b}	5.03
Iron	mg	0.00^{c}	0.00	2.00^{b}	11.11	3.18^{a}	17.66	0.00^{c}	0.00	1.92^{b}	10.66	2.80^{a}	15.55
Zinc	mg	0.59^{d}	3.93	0.71^{b}	4.73	0.83^{a}	5.53	0.54^{d}	3.60	0.62^{c}	4.13	0.72^{b}	4.80
Copper	mg	0.12^{c}	6.00	0.28^{ab}	14.00	0.36^{a}	18.00	0.09^{c}	4.50	0.25^{b}	12.50	0.29^{ab}	14.50
Manganese	mg	0.02^{d}	1.00	0.15^{b}	7.50	0.20^{a}	10.00	0.01^{d}	0.50	0.08^{c}	4.00	0.08^{c}	4.00

a, b,…. and f: Means having different superscripts within each column are significantly different ($p < 0.001$).
***See Table (1), NC: Not calculated**
%DV: Is the ratio of recommended amount of the nutrients and daily maximum recommended amount of these nutrients multiplying by 100.

Free-fat treatments provide human with 0.15% of DV, whereas low-fat treatments give 4.61% of daily fat needs. Similarly, all treatments were low in total carbohydrates and dietary fibers. The lowest carbohydrates value was 1.50%, it recorded by low-fat control drink (C_1). While, the highest value (2.10%) was recorded for treatment D_4. It may due to supplementing drink with 2% oats which is rich in total carbohydrates (Sangwan *et al.*, 2014). Both D_2 and D_4 (low-fat and free-fat drinks contain 2% oats) recorded higher %DV of dietary fibers than other treatments of 0.44%, while control treatments (C_1 and C_2) which made without oats, were free of dietary fibers.

Minerals' results showed that low-fat drink with 2% oats (D_2) contains higher levels of all studied minerals (Ca, P, K, Mg, Fe, Zn, Cu and Mn) than other treatments include control. Only 100 g of previous fermented drink provide human with 10.29, 7.36, 4.19, 6.40, 5.53 and 10.00% DV of calcium, phosphorus, potassium, magnesium, zinc and manganese, respectively. While it gives high %DV of iron and copper (17.66 and 18%). It may due to that oat contain high percentage of minerals (Head *et al.* 2010). On the other hand, free-fat control drink (C_2) had the lowest values of all minerals and its %DV in addition, both control treatments (C_1 and C_2) were free of iron.

3. Physical properties

Physical properties are important for foods (such as fermented dairy products) in the design of flow processes, quality control, storage and processing and in predicting the texture of foods (Benezech and Maingonnat, 1994; Aichinger *et al.*, 2003). Results presented in Fig. (4) illustrate the measurements of apparent viscosity and syneresis for fresh fermented milk drink samples. There is a significant difference ($p < 0.001$) in viscosity between the treatments; the highest viscosity value (602.3 mPa) was recorded for treatment D_2 (fermented milk drink contains 3% fat and supplemented with 2% oats). Whereas, the lowest reading (431.3 mPa) was recorded for control free-fat (C_2). It may be due to the presence of stabilizing agents (dietary fibers) in oats. Several authors reported that dietary fiber in fermented milk products increase the viscosity of the end product (Guven *et al.,* 2005; Gee *et al.*, 2007 and Kearney *et al.,* 2011). Also, Sahan *et al.* (2008) reported that β-glucan which is one of the most important content of oats, increase the viscosity values of the yoghurts; it acts as a stabilizing agent. In general, the higher total solid content of milk, the higher viscosity values in the samples.

The syneresis values (the quantity of whey which has separated from samples) of fresh samples are recorded (Fig. 4). The treatment D_2 recorded the lowest Syneresis value (2.5 ml/100ml), while the highest syneresis value was for free-fat control treatment (C_2); 9 ml/100ml. Low Syneresis value may due to the high total solids and Mahdian and Tehrani (2007) and concluded that degree of syneresis decreased with increasing T.S significantly as samples with higher T.S had better textural properties than those with lower T.S content.

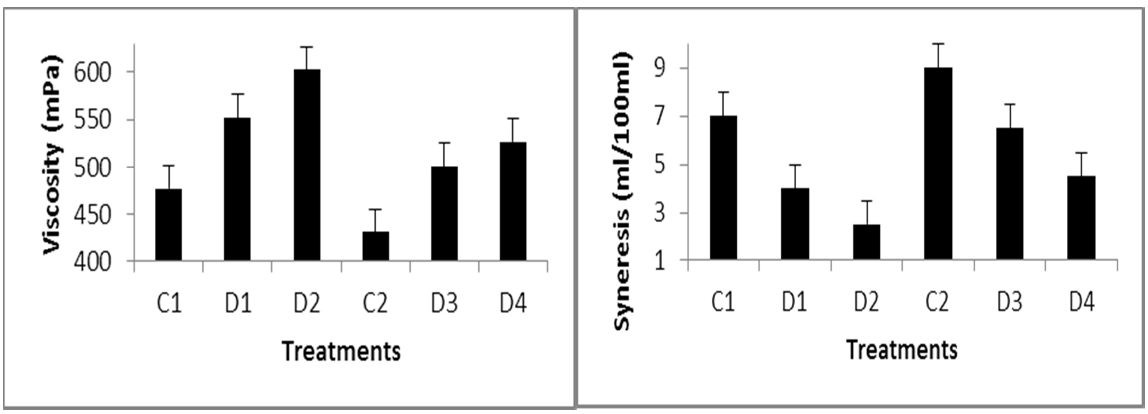

Fig. 4. Viscosity and syneresis of functional free and low-fat fermented milk drink as affected by adding different ratios of oats

4. Microbiological examination

1. Viability of lactic acid bacteria

The probiotic starter used in manufacturing different fermented drinks was *L. casei* HQ177095 and *L. paracasei* HQ177096.1 (1:1). The viability of LAB was affected significantly by treatments and storage period as shown in Fig. (5). Results show the effect of treatments and storage period on LAB counts. The highest LAB viability was in free-fat drink with addition of 2% oats (D_4) that stored for 21 days (353.67×10^8 CFU/ml), whereas, fresh low-fat fermented drink without oat (C_1) had the significantly ($P<0.001$) lowest LAB count of 17.33×10^8 CFU/ml. These results might be due to great prebiotic effect of oats beta-glucan, as it has potential advantages over inulin as a prebiotic (Rosburg *et al.,* 2010 and Bianchi *et al*. 2015). Moreover, beta-glucan is postulated to improve probiotic survival in foods, such as yogurt (Vasiljevic *et al.*, 2007). Furthermore, Coman *et al.* (2013) found that supplementation of whole milk with probiotic strains results in a significant faster lowering of the pH because of the high viability of probiotic bacteria. They also found that oat fibers act as prebiotics on the production of probiotic fiber-enriched fermented milks. Similarly, Lazaridou *et al*. (2014), Luana *et al*. (2014) and Soltani *et al.* (2017) reported that fermentation of cereals such as oat with *L. plantarum* and *L. paracasei* in yoghurt or water-based oat beverages have recorded mean microbial counts of at least 1.9×10^6 CFU/ml.

2. Total viable counts

Statistical analysis of the interaction between treatments and storage period showed that the effect of treatments and storage period was significant ($P<0.001$) on TVC (Fig. 5). The Free-fat drink which supplemented with 2% oat (D_4) stored for 21 days had the highest TVC of 171.67×10^8 CFU/ml, while both fresh reduced and free-fat control drinks (C_1 and C_2) had significantly lower TVC (9.33×10^8 and 13.33×10^8 CFU/ml, $P<0.001$) than other treatments at different storage periods. O'Connell *et al.,* (2015) reported that total bacterial count of milk stored at 6°C increased as storage duration increased.

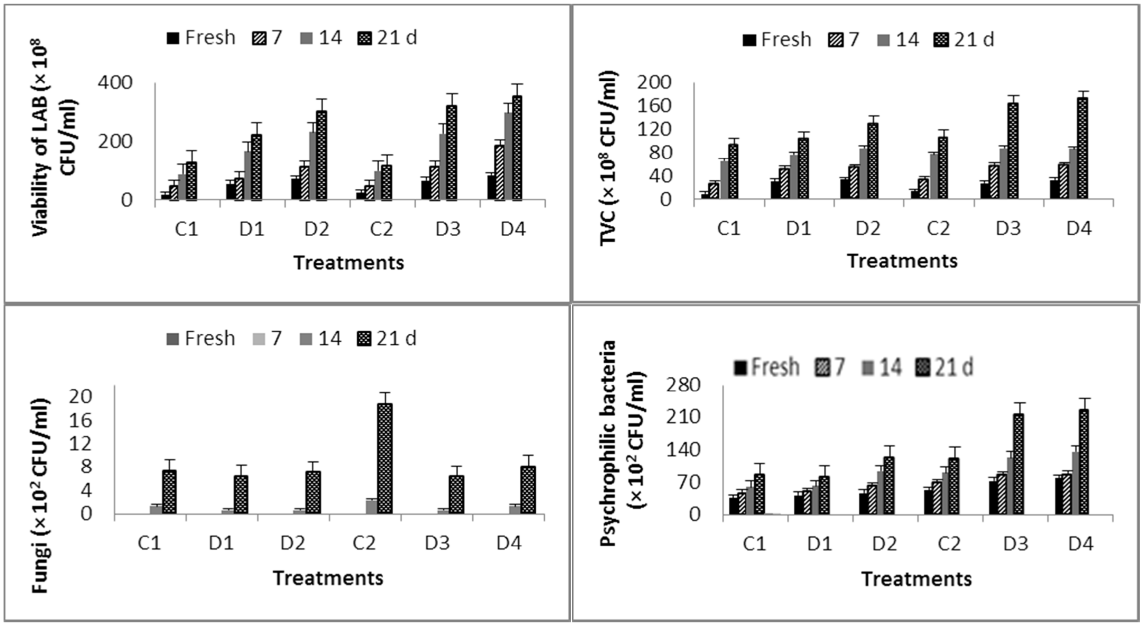

Fig. 5. Changes in microbiological treats (CFU/ml) of functional free and low-fat fermented milk drink as affected by adding different ratios of oats and storage periods at 5°C±1.

3. Fungi counts

The free-fat control treatment (C_2) that stored for 21 days had the significantly ($P<0.001$) the highest fungi count (18.67×10^2 CFU/ml), while the fresh treatments and after 7 days of storage were free of fungi (Fig. 5). It may due to the antifungal effect of *L. casei* and *L. paracasei* as reported by Jeevaratnam *et al.* (2005) and Hassan and Bullerman (2008).

4. Psychrophilic bacteria counts

The free-fat drink with 2% oat (D_4) stored for 21 days had the significantly ($P<0.001$) highest bacterial count of 226.00×10^2 CFU/ml, while fresh low-fat control (C_1) recorded the lowest count of 35.33×10^2 CFU/ml. Same results were found by O'Connell *et al.,* (2015), they reported that psychrophilic bacteria of milk stored at 6°C increased as storage duration increased. Moreover when milk stored at 4°C, psychrophilic bacteria increased significantly between 0 and 96 h.

5. Coliform group counts

All treatments were free from coliform bacteria along the storage period. It is due to the good hygienic practice in manufacturing fermented drinks and it may be because of the antibacterial activity of the used probiotic starter (*L. casei* HQ177095 and *L. paracasei* HQ177096.1), indicating good hygienic and sanitary conditions in the beginning and along the storage period. This result is in accordance that obtained by Metry, *et al.* (2017).

5. Organoleptic properties

Results presented in Fig. (6) showed the effect of the interaction between treatment and storage period on organoleptic properties of plain fermented dairy drink.

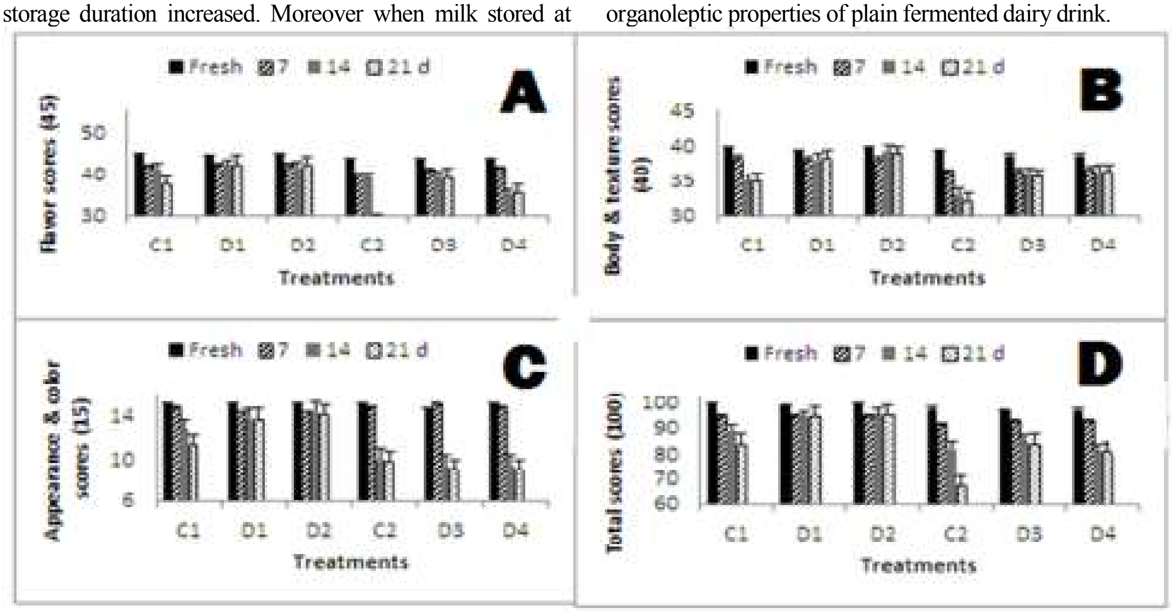

Fig. 6. Scores of sensory evaluation for functional free and low-fat fermented milk drink as affected by adding different ratios of oats and storage periods at 5°C±1, (A) Flavor, (B) Body & texture, (C) Appearance & color and (D) Total scores.

It is significantly affected flavor, appearance and color and total score, while it is insignificantly affected body & texture. There were insignificant differences found among all fresh treatments regarding total score for organoleptic properties of fermented milk drink that ranged between 96.66 and 99.33 points as shown in the same table. Both fresh C_1 and fresh D_2 had high total score of 99.33 points; however C_2 stored for 21 days gained lower total score of 67.00 points.

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انتاج مشروب لبني متخمر وظيفي منخفض و خالي الدسم ومدعم بالشوفان

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تهدف هذه الدراسة إلى تقييم تأثير إضافة نسب مختلفة من الشوفان على الخواص المختلفة والقيمة الغذائية للمشروبات اللبنية المتخمرة خالية ومنخفضة الدسم باعتبارها منتجات وظيفية تحسن من صحة الإنسان. تم تخمير المنتج بواسطة بادئ مختلط من *L. casei* HQ177095 و *L. paracasei* HQ177096.1 بنسبة ١:١ وتدعيم هذا المنتج بالشوفان بنسب ١ & ٢%. تم تخزين عينات المشروبات اللبنية الناتجه لمدة ٢١ يوم على درجة حرارة ٥±١°م ثم أجريت التحليلات الميكروبيولوجية، الكيميائية، الطبيعية، الخصائص الحسية والقيمة الغذائية خلال فترة التخزين. وقد دلت النتائج على حدوث تغيرات طفيفة في التركيب الكيميائى خلال فترة التخزين باستثناء التغير في محتوى العينات من اللاكتوز، % للحموضة والـ pH كان تغير معنوي. ومن ناحية أخرى، إختلاف المعاملات كان له تأثير معنوي على حيوية بكتريا حمض اللاكتيك المستخدمة كبادئ، قيم العدد الكلى للميكروبات والبكتريا المحبة للبرودة. كما لوحظ أن المعاملات المدعمة بالشوفان حصلت على أعلى قيم للمجموع الكلي للخصائص الحسية بالمقارنة بالمعاملات الاخرى. كما أظهرت المعاملة المدعمة بالشوفان (٢٪) خصائص طبيعية (اللزوجة ومعدل انفصال الشرش) أفضل من المعاملات الأخرى والكنترول. وأشارت نتائج حساب القيمة الغذائية إلى أن المعاملات المدعمة بالشوفان في هذه الدراسة يمكن إعتبارها كمصدر جيد للحديد والبروتين كما يمكن إعتبارها من الأغذية الصحية حيث أنها تحتوي على نسبة منخفضة من الدهون والسعرات الحرارية.

الكلمات الدالة: البكتريا الحيوية، *L. casei* ، *L. paracasei* ، المشروبات اللبنية المتخمرة، الشوفان.