Egypt. J. Food. Sci. **Vol. 50,** No. 2, pp. 299-312 (2022)

Egyptian Journal of Food Science
http://ejfs.journals.ekb.eg/

A Study on The Use of Carrot Powder and Probiotic Bacteria in Making Functional Cream Cheese

Enas A. Baker[1] , Heba H. Salama[2] , Amany M. El-Deeb[1] , and Nahed A. Elwahsh[1]
[1]Dairy Research Department, Food Technology Research Institute, Agricultural Research Centre , 12619, Giza, Egypt
[2]Department of Dairy Science, Food Industries and Nutrition Research Institute, National Research Centre, 12622, Dokki, Egypt

CARROT powder (CP) was prepared and used at levels of 0.0, 1.0, 2.0 and 4.0% with probiotic bacteria in making cream cheese (CCh). The attained results revealed richness of CP with ash (9.32%), fibers (23.9%), *β*-Carotenes(493.54µg/g) and many minerals. Analysis of fresh CCh showed addition of CP had no effect on its gross composition but significantly increased minerals content, values of antioxidants, phenols and *β*-Carotenes as well as acidity, acetaldehyde and diacetyl. This was accompanied by some improvement in cheese colour, water holding capacity (WHC) and viscosity. However, during cold storage of all cheese samples pH, acetaldehyde and WHC decreased while, total volatile fatty acids, acidity and viscosity increased. The rheological properties of CCh were almost not significantly affected by the used CP or storage, while both enhanced viability of bacteria especially the probiotic strain which showed always counts higher than 6 log cfu /g. In spite of the control cheese had always the highest scores for the different sensorial properties when fresh or during storage, the CP supplemented cheese ranked at least 84 out of 100 for the total score as shown in T3 of the highest amount of CP.

Keywords: Carrot, Probiotic bacteria, Cream cheese

Introduction

Cream cheese (CCh) is one of the favorite dairy products in many countries and can also be used in many products (Akl et al., 2020). It can be supplemented by many plant materials rich in many nutrients that lack milk and its products such as beta-carotenes and dietary fiber (Que et al., 2019; Venica et al., 2020). Cream cheese is a good medium for the transfer of nutrients dissolved in fat such as *β*-Carotenes and vitamin A because of its high fat content, which improves its absorption and increases utilization (Salama et al., 2016). This is of great importance since vitamin A deficiency causes many health problems for infants, children, pregnant women, nursing mothers and young people, who represent different age groups in society (Conboy Stephenson et al., 2021; West, 2003).

On the other hand, vegetables and fruits are a suitable environment for probiotics due to their content from elements that enhance their growth (Rafiq et al., 2016). Research in recent years has focused on the addition of probiotics and one of the most commonly used probiotics is *Bifidobacterium* (Alwis et al., 2016) and measuring their effect as probiotics and prebiotic (Evangelista et al., 2012). Carrots are the most important vegetables in this respect.

Carrots are known to be one of the richest vegetables in *β*-Carotenes, provitamin A (Madora et al., 2016), tocopherol and ascorbic acid, iron, dietary fiber and other important nutrients needed to prevent many diseases (Aly et al., 2004; Hashimoto & Nagayama, 2004). In addition, the carrot plays an important prebiotic role in containing Fructo-oligosaccharide (FOS) and

*Corresponding author: hebasalama11@yahoo.com
Received :25/11/2022; Accepted :21/12/ 2022
DOI : 10.21608/EJFS.2022.176889.1148

inulin (Alwis et al., 2016; Bandyopadhyay et al., 2008; Kun et al., 2008). Therefore, it was used in the manufacture of low-fat yoghurt (Madora et al., 2016), while Venica et al. (2020) used the carrots powder (CP) as a rich fiber source in stirred yoghurt. Carrot powder (CP) was also used to support soybean milk (Madukwe & Eme, 2012). There are many other studies that have used carrots in different forms, such as the supplementation of ice cream with *β*-Carotenes in the form of carrot juice (Rajarajan, 2018); fermented beverages and low-fat Cottage cheese in the form of carrot pulp (Dayal et al., 2013; Kaur et al., 2019); soymilk fortified with CP (Madukwe & Eme, 2012). Carrots are attractive vegetables that improve the acceptance of dairy products and gain an attractive colour and taste especially for children and a good transporter for beneficial bacteria (Rafiq et al., 2016).

According to the above information, cream cheese (CCh) is a good choice for the transfer of nutrients and important elements from carrot as well as probiotic bacteria, So this work aimed to study importance of adding CP in different concentrations in the presence of the probiotic bacteria on the chemical, microbiological and rheological properties as well as the sensory evaluation of fresh CCh and during the cold storage period.

Materials and Methods

Materials

Fresh carrot was obtained from the local market. Fresh skimmed UF-retentate and fresh cream were obtained from Animal Production Research Institute, Agricultural Research Centre, Dokki, Giza, Egypt.Commercial starter of mesophilic culture FD-DVS R-704 (consisting of *Lactococcus lactis subsp. lactis* and *Lactococcus lactis subsp. cremoris)* and the probiotic bacteria of *B. bifidum* EMCC1334 were obtained from the Egyptian Microbial Culture Collection (EMCC) aging to Cairo Microbial Resources Centre (MIRCEN), Faculty of Agriculture, Ain Shams University, Egypt.

Methods

Preparation of carrot powder

Carrot powder (CP) was prepared as described by Gazalli et al. (2013). Carrot was washed with tap water and cut into slices. These slices were then spread evenly on trays and dried in an oven under vaccum at 50 ± 5°C. The dried slices were powdered, sieved and stored in air tight food grade plastic containers until use.

Cream cheese making

Cream cheese (CCh) was made according to the methods described by Lucey, (2003) and Akl et al. (2020) using fresh skimmed UF-retentate (13.6% T.S) standardized to 20% fat. The retentate was heated at 72ºC for 15 sec., cooled and then adjusted to 42 ºC for the addition of the starter. Different concentrations of CP ranging from 0, 1, 2, and 4% (C, T1, T2, T3) respectively, were mixed with retentate and inoculated with the starter culture and the probiotic bacteria (*B. bifidum* EMCC1334) (1:1), then incubated at 42°C. After coagulation, the cheese was salted with 0.5% NaCl, stirred, and packaged in plastic cups (100 mL). before storage in the refrigerator at 5±1°C for 4 weeks.

Chemical analysis of cream cheese (CCh) and carrot powder (CP)

Fat, titratable acidity (TA), total solids (TS), total nitrogen (TN) and ash content of the cheese samples and fiber content in CP were determined according to AOAC (2012). The total volatile fatty acids (TVFA) content of cheese was determined by the distillation method described by Kosikowski, (1978); whereas values were expressed as ml (0.1N) NaOH/100g cheese. pH values were measured using a digital laboratory Jenway 3510 pH meter, UK. Bibby Scientific LTD. Stone, Stafford shire, ST 15 OSA. Diacetyl and acetaldehyde were determined according to Less & Jago (1969). Minerals content was also determined as described by Hankinson (1975) using Atomic absorption spectrophotometer NO.3300 (Perkin Elmer, US instrument Division Norwalk, CT, USA.).

Determination of antioxidant capacity

The DPPH radical-scavenging activity was determined using the method proposed by Brand-Williams et al. (1995). An aliquot (100 µL) of the sample solution was mixed with 2.9 mL of 1,1-diphenyl-2-pycrylhydrazyl (DPPH) in methanol. The mixture was shaken vigorously and left to stand for 30 min. Absorbance of the resulting solution was measured at 517 nm and the results were expressed as mmol trolox equivalent/g.

Determination of phenolic content

The method described by Naczk & Shahidi (1989) was used and the results were expressed as mg catechin equivalents per 100 g of the extract of CP or CCh.

Determination of β-carotene

β-carotene in CP and CCh was determined according to the method described by Carvalho et al. (2012).

Determination of colour

Colour of cheese samples was measured using a Hunter colorimeter model D2s A-2 (Hunter Assoc. Lab Inc., VA, USA) following the instruction of the user manual Hunter colorimeter. The results were given in the following:

L: Value represents darkness from black (0) to white (100)

a: Value represents color ranging from red (+) to green (-)

b: Value represents yellow (+) to blue

Water holding capacity

The water holding capacity (WHC) was determined using the method developed by Ladjevardi et al. (2016). Cream cheese (10 g) were weighed into a test tube and then centrifuged in a laboratory centrifuge at 5 ºC for 30 min at 5000 rpm. After the indicated time, the precipitated whey was weighed. WHC was calculated based on the following equation:

$$WHC\ (\%) = (10 - W)/10 \times 100\%$$

Where (W) mass of the separated whey (g)

Apparent viscosity of cheese

Apparent viscosity was measured at room temperature using a Brookfield digital viscometer (Middleboro, MA 02346, U.S.A). The samples were subjected to shear rates ranging from 5 to 100 S^{-93} for the upward curve. Viscosity measurements were expressed as centipoise (cp) (Salama et al., 2020).

Textural properties

Texture profile analysis (TPA) of cheese samples was carried out using an Instron Universal Testing Machine (Model 4302, Instron Corporation, Canton M.A, England) according to the procedure of Bourne (1978).

Microbiological examination

Total bacterial counts (TBC), yeasts & moulds and coliforms of CCh were counted according to Marshall (1992), while count of *B. bifidum* EMCC1334 was determined according to IDF (1988).

Sensory evaluation

This was done using scoring card suggested on the basis of cream cheese attributes mentioned by Nelson & Trout (1981) and Wendin et al. (2000).

Statistical analysis

This was carried out using the GLM procedure of the SAS software (2006).

Results and Discussion

Chemical composition of carrot powder and cheese

Chemical analysis of carrot powder (CP) is shown in Table 1, whereas the same for the prepared cream cheese (CCh) is shown in Tables 2 and 3. It seems from Table 1 that CP is a good source for ash, fiber, *β*-carotenes and a lot of minerals. This agrees with the trends given in literature by Gazalli et al. (2013) who gave values of 6.16% and 24.66% for protein and fiber contents of CP, whereas Arscot & Tanumihardio (2010) and Sharma et al. (2012) reported richness of CP with Ca, Fe, Na, K, Mg, Cu and Zn.

Such valuable composition of CP affected the composition and quality of the prepared protein and ash content of treated cheese due to the applied treatments, whereas moisture and fat content were not affected. Similar results were given by Madora et al. (2016) for yoghurt and by Akl et al. (2020) for fat-free CCh. On the other hand, CP significantly ($P \leq 0.05$) increased minerals content of CCh and such increase was proportional with the amount of CP added (Table 3). Such impact of CP was previously given by Sule et al. (2019) and Assenova et al. (2021) for some other foods.

Due to importance of antioxidants, phenols and *β*-carotenes for the public health (El-Messery et al., 2021; El- Said et al., 2021). Table 4 shows our results of supplementation of CCh with CP in this respect. A significant increase ($P \leq 0.05$) was recorded due to such addition and this increase was proportional with the amount of CP used. Richness of CP with such materials is well-known, while our results in Table 1 showed CP contained *β*-carotenes as 493.54 (µg/g). Similar trends of results were previously given by Sharma et al. (2012); Seregelj et al. (2021) and Stephenson et al. (2021).

TABLE 1. Chemical composition of carrot powder

Components	Moisture (%)	Protein (%)	Fat (%)	Ash (%)	Fiber (%)	*β*-carotene (μg/g)	Minerals (ppm) Na	K	Cu	Mg	Fe	Zn	Mn
	7.63	6.17	1.7	9.32	23.9	493.54	13124.5	28248.8	12.9	12230.2	66.4	121.5	22.3

TABLE 2. Chemical composition of fresh cream cheese

Treatments	Moisture (%)	Protein (%)	Fat (%)	Ash (%)
Control	64.89 ± 0.30^{A}	9.72 ± 0.12^{A}	20.4 ± 0.0^{A}	2.21 ± 0.15^{A}
T1	63.42 ± 0.11^{AB}	9.94 ± 0.089^{A}	20.2 ± 0.0^{A}	2.23 ± 0.057^{A}
T2	62.23 ± 0.098^{B}	10.10 ± 0.11^{A}	20.0 ± 0.0^{A}	2.37 ± 0.18^{A}
T3	60.01 ± 0.14^{B}	11.77 ± 0.012^{A}	19.7 ± 0.0^{B}	2.42 ± 0.012^{A}

Means (± *SD*, *n* = 3) with different superscripts (A,B,..) within the same column indicate significant ($p \le 0.05$) differences between treatments.

C: Control - cheese T1: Cheese with 1% carrot powder

T2: Cheese with 2% carrot powder T3: Cheese with 4% carrot powder

TABLE 3. Minerals content of fresh cream cheese*

Minerals (ppm)	Cheese treatments Control	T1	T2	T3
Na	4888.3 ± 0.173^{D}	5463.8 ± 0.057^{C}	5535.4 ± 0.058^{B}	5794.9 ± 0.98^{A}
K	1789.6 ± 0.12^{D}	1828.0 ± 0.057^{C}	1904.0 ± 0.12^{B}	2521.0 ± 0.12^{A}
Cu	1.5 ± 0.12^{D}	3.0 ± 0.23^{C}	4.4 ± 0.12^{B}	5.0 ± 0.12^{A}
Mg	1878.5 ± 0.11^{D}	2218.7 ± 0.11^{C}	2383.7 ± 0.12^{B}	2787.22 ± 0.058^{A}
Fe	8.3 ± 0.12^{D}	8.8 ± 0.12^{C}	9.2 ± 0.058^{B}	10 ± 0.12^{A}
Zn	10.4 ± 0.12^{D}	13.0 ± 0.057^{C}	19.5 ± 0.12^{B}	22.1 ± 0.058^{A}
Mn	0.41 ± 0.005^{C}	0.46 ± 0.055^{BC}	0.52 ± 0.12^{B}	0.73 ± 0.017^{A}

*Means (± SD, n = 3) with different superscripts (A,B,..) within the same row indicate significant ($p \le 0.05$) differences between treatments**.** See footnote of Table 2 for cheese treatments.

TABLE 4. Antioxidant, total phenols and *β*-carotene contents of cream cheese* .

Treatments	Antioxidant (DPPH mmol/g)	Total phenol (mg/100g)	*β*-carotenes (μg/g)
Control	9.02 ± 0.65^{D}	6.81 ± 0.15^{D}	0.43 ± 0.02^{D}
T1	13.58 ± 0.41^{C}	9.07 ± 0.07^{C}	3.24 ± 0.01^{C}
T2	15.09 ± 0.00^{B}	9.37 ± 0.24^{B}	6.86 ± 0.01^{B}
T3	20.69 ± 0.33^{A}	9.48 ± 0.01^{A}	9.30 ± 0.05^{A}

*See footnote of Table 2 for cheese treatments.

It was quite important to follow up the changes in the chemical composition of the prepared CCh during cold storage period. This was recorded in Table 5. The pH values gradually decreased and the acidity increased during storage of the control and the CP-treated CCh. Such changes were statistically significant in most cases and were accompanied by significant increase in total volatile fatty acids (TVFA) content (Table 5). Such changes are in agreement with those given by Saad et al. (2015) and Mohamed et al. (2018) and could be due in general to impact of the starter and the probiotic bacteria used.

TABLE 5. Physio-chemical analysis of cream cheese during storage period*

Treatments	pH values				
	Storage time (week)				
	Fresh	1	2	3	4
Control	5.18±0.005^{Aa}	4.89±0.21^{Ab}	4.75±0.08^{Ac}	4.62±0.21^{Ad}	4.54±0.15^{Ae}
T1	5.07±0.14^{Ba}	4.77±0.11^{Bb}	4.62±0.12^{Bc}	4.57±0.13^{Bd}	4.49±0.11^{Be}
T2	5.03±0.07^{Ba}	4.70±0.09^{Cb}	4.59±0.22^{Cc}	4.48±0.08^{Cd}	4.44±0.07^{Ce}
T3	5.00±0.17^{Ba}	4.63±0.13^{Db}	4.54±0.14^{Dc}	4.43±0.05^{Dd}	4.39±0.057^{Dd}
Treatments	**Titratable acidity (%)**				
	Storage time (week)				
	Fresh	**1**	**2**	**3**	**4**
Control	0.85±0.11^{Ce}	1.38±0.05^{Dd}	1.54±0.15^{Dc}	1.63±0.21^{Db}	1.71±0.12^{Da}
T1	0.93±0.12^{BCd}	1.49±0.07^{Cc}	1.61±0.09^{Cbc}	1.68±0.14^{Cb}	1.79±0.04^{Ca}
T2	1.00±0.23^{Bd}	1.51±0.12^{Bc}	1.67±0.11^{Bb}	1.72±0.08^{Bb}	1.86±0.11^{Ba}
T3	1.20±0.13^{Ae}	1.56±0.10^{Ad}	1.75±0.06^{Ac}	1.84±0.11^{Ab}	1.95±0.09^{Aa}
Treatments	**Total Volatile Fatty Acids (ml 0.1 N NaOH/100 g)**				
	Storage time (week)				
	Fresh	**1**	**2**	**3**	**4**
Control	14.5±0.11^{Ae}	16.0±0.12^{Ad}	18.2±0.21^{Ac}	21.7±0.12^{Ab}	23.4±0.10^{Aa}
T1	14.1±0.09^{Be}	15.5±0.16^{Bd}	17.8±0.17^{Bc}	19.6±0.08^{Bb}	22.9±0.06^{Ba}
T2	12.6±0.22^{Ce}	14.2±0.18^{Cd}	16.0±0.12^{Cc}	18.2±0.07^{Cb}	20.0±0.13^{Ca}
T3	10.2±0.15^{De}	12.3±0.14^{Dd}	14.5±0.23^{Dc}	16.0±0.16^{Db}	18.1±0.09^{Da}
Treatments	**Acetaldehyde (µM/100 g)**				
	Storage time (week)				
	Fresh	**1**	**2**	**3**	**4**
Control	19.22±0.17^{Da}	13.52±0.13^{Db}	13.06±0.16^{Dc}	12.8±0.19^{Dd}	5.8±0.13^{De}
T1	57.02±0.13^{Ca}	38.2±0.22^{Cb}	20.84±0.14^{Cc}	14.08±0.15^{Cd}	12.48±0.23^{Ce}
T2	62.6±0.24^{Ba}	43.68±0.18^{Bb}	32.16±0.23^{Bc}	16.32±0.12^{Bd}	13.08±0.20^{Be}
T3	65.96±0.17^{Aa}	46.98±0.15^{Ab}	33.66±0.19^{Ac}	21.82±0.17^{Ad}	14.28±0.18^{Ae}
Treatments	**Diacetyl (µM/100 g)**				
	Storage time (week)				
	Fresh	**1**	**2**	**3**	**4**
Control	21.6±0.11^{De}	46.0±0.23^{Dd}	87.2±0.21^{Dc}	93.2±0.16^{Db}	117.2±0.12^{Da}
T1	33.6±0.17^{Ce}	62.4±0.15^{Cd}	88.8±0.19^{Cc}	109.2±0.14^{Cb}	121.0±0.18^{Ca}
T2	45.6±0.25^{Be}	66.8±0.18^{Bd}	91.6±0.17^{Bc}	112.8±0.19^{Bb}	126.4±0.15^{Ba}
T3	51.2±0.21^{Ae}	80.8±0.14^{Ad}	111.8±0.24^{Ac}	125.2±0.22^{Ab}	133.4±0.19^{Aa}

*Means (± *SD*, $n = 3$) with different capital superscripts (A, B,…) within the same column indicate significant ($p \leq 0.05$) differences between treatments. Means with the different small superscripts (a, b, and c) within the same row are significantly ($p \leq 0.05$) different due to the storage period. See footnote of Table 2 for cheese treatments.

Adding CP significantly decreased TVFA and increased acetaldehyde and diacetyl content (P ≤ 0.05). This was true in the fresh and stored cheese (Table 5). Both TVFA and diacetyl significantly increased during storage, whereas acetaldehyde gradually decreased. This was true in the control and the CP-supplemented cheese. Quality of the UF-retentate and the corresponding changes due to the used bacteria could be responsible for the present changes in CP-treated cheese especially during cold storage (Saad et al., 2015). Enhancing effect of CP may be was the main factor in production of the flavour components, whereas the recdorded decrease in acetaldehyde during storage could be attributed to transformation of it to ethanol as prementioned by Salama et al. (2020a) and Salama et al. (2021).

Quality of cream cheese

Quality of soft cheese from the consumer point of view is related to some properties like colour, softness and viscosity. In the present study, the pleasant colour of the CP significantly affected the appeareance and colour of the prepared CCh as shown in Table 6. The control had a higher L* which represents lightness value and the lower a* and b* which constitute redness and yellowness values compared to the CP-treated samples. Adding more CP significantly decreased L*and increased a* and b* in the prepared CCh. This impact agrees with results of Modora et al. (2016).

Softness of cheese is related to ability of it to keep water. Figure 1 reveals water holding capacity (WHC) of CCh as affected by the amount of CP used. Adding CP had a positive effect on WHC of CCh, science the higher was the amount of CP added, the higher was WHC. This was true in the fresh and stored CCh. Richness of CP with fibers (23.9% Table 1) was responsible for such impact, while the decrease on WHC during storage could be due to the more acidification reduces the net negative electric charge of casein micelles by steadily dissolving calcium and inorganic phosphate, which reduces the colloids stability causing further decrease in the WHC (Fox et al., 2000).

Figure 2 reveals viscosity of the fresh (A) and after 4 weeks of cold storage (B). Viscosity was improved and increased by the addition of CP and the higher was the amount of CP added, the higher was viscosity. Such increase is mainly due to presence of fibers in the prepared CP as shown in Table 1. Also, an increase was observed during storage which could be explained on the basis of loss some water. Our results are in agreement with those of Mohamed et al. (2018) and Akl et al. (2020).

TABLE 6. Colour Measurements of functional cream cheese

Treatments	L*	a*	b*
Control	93.0050.005 ±^{A}	-1.280.005 ±^{D}	10.56±0.005^{C}
T1	87.540.005±^{B}	6.82±0.005^{C}	23.49±0.0^{C}
T2	83.56±0.035^{C}	10.55±0.005^{B}	33.06±0.030^{B}
T3	78.14±0.10^{D}	14.44±0.005^{A}	40.63±0.03^{A}

Means (± *SD*, *n* = 3) with the different capital superscripts letters (A,B,..) within the same column indicate significant (*p* ≤ 0.05) differences between treatments.

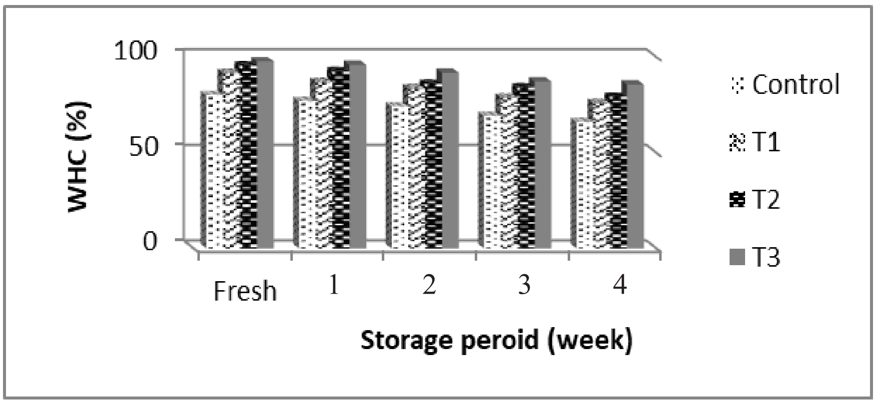

Fig. 1. Measurement of water holding capacity (WHC).

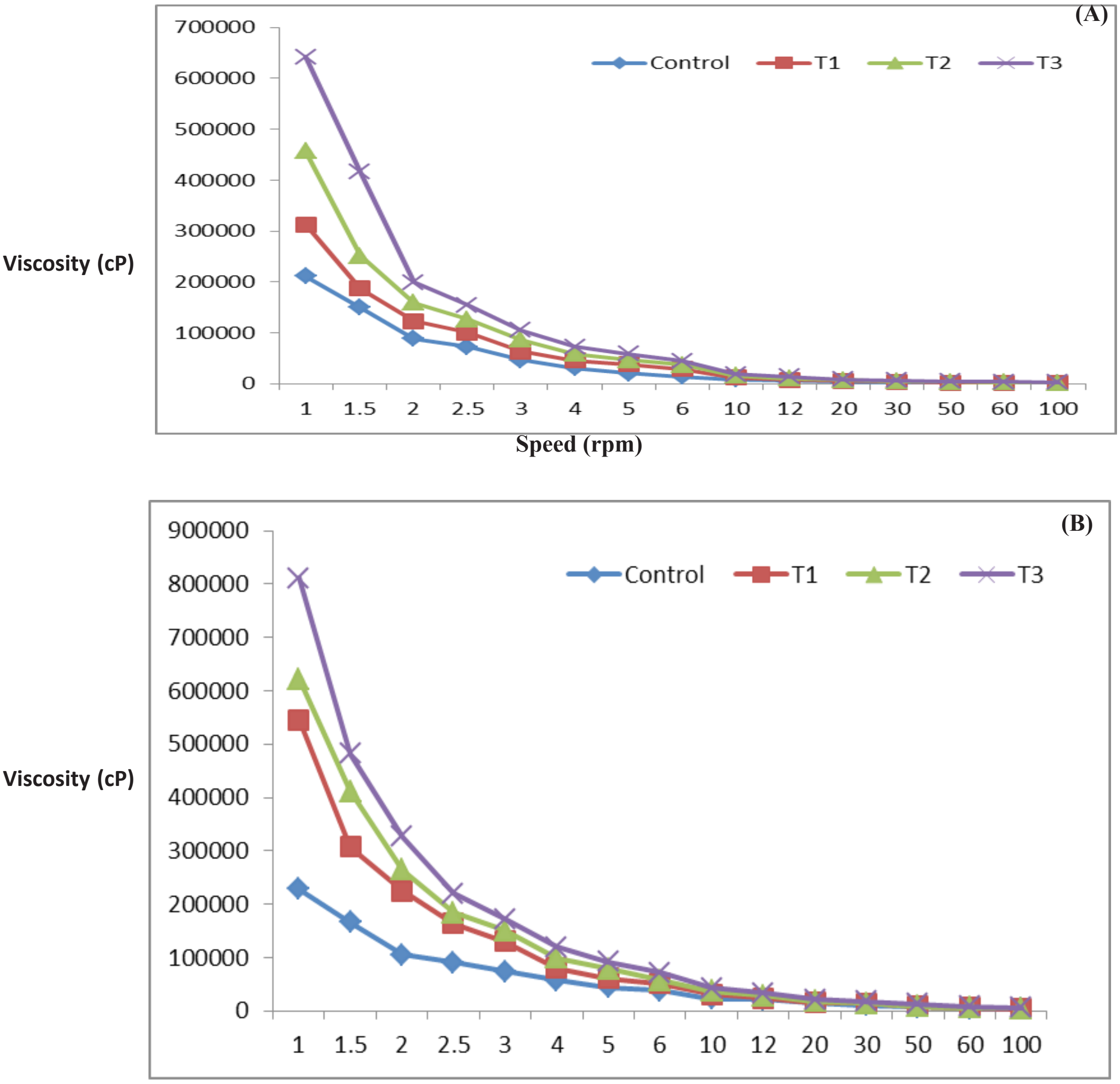

Fig. 2. Viscosity of fresh (A) and 4 weeks old cream cheese (B) as affected by the addition of 0.0 (control), 1.0% (T1) 2.0% (T2), and 4.0 % (T3) carrot powder.

The texture properties are also important characteristics of food products that participate in determining quality and acceptability of this product. Data presented in Table 7 display the texture parameters of the fresh and stored CCh. The results indicated that hardness values slightly increased with adding CP and during storage period ($P \geq 0.05$). Hardness was the lowest in the control which was characterized by the highest moisture content as given in Table 2.

Hardness of the CCh was influenced by pH. (Kim et al., 2022) and increased by storage (Mehanna & Posztor- Huszar, 2012). Cohesiveness is the attraction between intermolecular by which the elements of a body are held together. The results showed decrease in the cohesiveness value of both fresh and stored samples due to CP. Springiness is the ability of cheese to return back to its original shape after partial compression between tongue and palate. Adding CP caused a decrease in the springiness values, with more decrease during storage period. Regarding gumminess which energy required to disintegrate food until it is ready to swallow, the addition of CP and storage led to significant increase in the gumminess values. Chewiness the energy needed to chew solid food to be ready for swallowing. Chewiness values increased with the CP addition, but decreased during storage period. Such decrease was almost insignificant ($p \leq 0.05$).

TABLE 7. Texture profile analysis of fresh and stored cream cheese

Property	Storage (Week)	Control	T1	T2	T3
Hardness (N)	Fresh	1.2^{Aa}±0.1	1.2^{Aa}±0.3	1.4^{Aa}±0.4	1.6^{Aa}±0.4
	4	1.3^{Ba}±0.3	1.4^{ABa}±0.1	1.7^{ABa}±0.3	1.9^{Aa}±0.4
Cohesiveness (ratio)	Fresh	0.36^{Aa}±0.01	0.35^{Aa}±0.04	0.32^{ABa}±0.01	0.29^{Ba}±0.01
	4	0.34^{Aa}±0.03	0.33^{Aa}±0.03	0.31^{ABa}±0.01	0.28^{Ba}±0.02
Springiness (mm)	Fresh	5.20^{Aa}±0.2	5.19^{Aa}±0.11	5.17^{Aa}±0.13	5.16^{Aa}±0.16
	4	5.17^{Aa}±0.12	5.16^{Aa}±0.035	4.79^{Bb}±0.04	4.67^{Bb}±0.01
Gumminess (N)	Fresh	0.41^{Bb}±0.02	0.42^{Bb}±0.01	0.44^{ABa}±0.04	0.47^{Ab}±0.43
	4	0.48^{ABa}±0.01	0.46^{Ba}±0.02	0.51^{Aa}±0.02	0.53^{Aa}±0.03
Chewiness (mJ)	Fresh	2.26^{Ca}±0.02	2.32^{BCa}±0.02	2.36^{ABa}±0.03	2.43^{Aa}±0.07
	4	2.17^{Bb}±0.02	2.31^{Aa}±0.01	2.34^{Aa}±0.04	2.37^{Aa}±0.07

Means (± *SD*, n = 3) with different capital superscripts (A, B,…) within the same row indicate significant ($P \leq 0.05$) differences between treatments. Means with the different small superscripts (a, b, and c) within the same colums are significantly ($p \leq 0.05$) different due to storage period.

Microbiological properties of cream cheese

The changes in total viable bacterial count during the storage period of cheese are shown in Fig. 3. The viability of the count exhibited changes between the control and other treatments (T1, T2 and T3) and there was high significant difference in the count between the control and 4% CP cream cheese (T3) when fresh (from 5.27 to 5.89 log cfu/g). The total counts increased during storage in all treatments, while decreased after 2 weeks in the control sample. The highest bacterial counts showed at the end of storage in T3 followed by T2 treatments (6.41 and 6.18 log cfu/g) supplemented by 4% and 2% CP could be due to the high energy sources supplied by the CP. This agrees with the results reported by Madora et al. (2016). The prepared synbiotic lassi with carrot extract showed good microbial quality and better probiotic viability than the control and probiotic lassi founded by Mohanapriya et al. (2019).

No coliform bacteria were detected in the control and all cheese samples, while yeasts and mould were not detected in fresh control and all treatments, but counts increased along the storage period in control samples (Fig. 3). The counts decreased with increase CP concentration and during storage. This result agrees with Höhn et al. (2003) who reported that the inhibition of the growth of mould and yeast in carrot yoghurt may be attributed to the action of isocoumarine which naturally present in traces in carrot. Sulieman et al. (2018) found that the number of total yeasts and moulds decreased after storage for 7 and 14 days in all carrot yoghurt samples when compared with that of control yoghurt. Also, our data agree with Aly et al. (2004) who recorded that there was significant difference ($P \leq 0.05$) in moulds and yeasts count between plain and yoghurt treatments, whereas the count decreased and completely disappeared with 15 and 20% carrot juice at the end of storage. On the other hand, there was no significant difference in the yeast and mould count of control, probiotic and carrot added synbiotic lassi (Mohanapriya et al., 2019).

Viability of Bifidobactirum bifidum in cream cheese

It is very important that probiotic strains retain their viability and functional activity throughout the shelf life of product. Figure 4 shows the effect of adding different concentrations of CP on the viability of *Bifidobactirum bifidum* EMCC1334 in CCh during cold storage. Count maintained levels above 6 log cfu/g for all the trials up to 4 weeks of refrigerated storage. Data showed that the counts of the probiotic culture were similar among the cheese formulations (Control, T1, T2 and T3) on the first day of storage. There was a significant increase in the counts in cheese from T1, T2 and T3 compared to the control with an increase in storage time. The highest counts of probiotic bacteria were 7.78, 7.56, 7.14 log cfu/g in T3, T2 and T1, respectively after 4 weeks of storage. Pimentel et al. (2012) indicated that there was good compatibility between the probiotic, the starter culture and the vegetables used. The use of organic beet with carrot, to flavor yoghurt resulted in product with appropriates nutritional and an adequate probiotic viability (*Lactobacillus paracasei* ssp. *paracasei*) for 28 days of refrigerated storage (Januário et al., 2017). In addition, Ningtyas et al. (2019) founded that the probiotic bacteria *(L. rhamnosus)* added to reduced-fat cream cheese, remained viable after 5 weeks of the refrigerated storage.

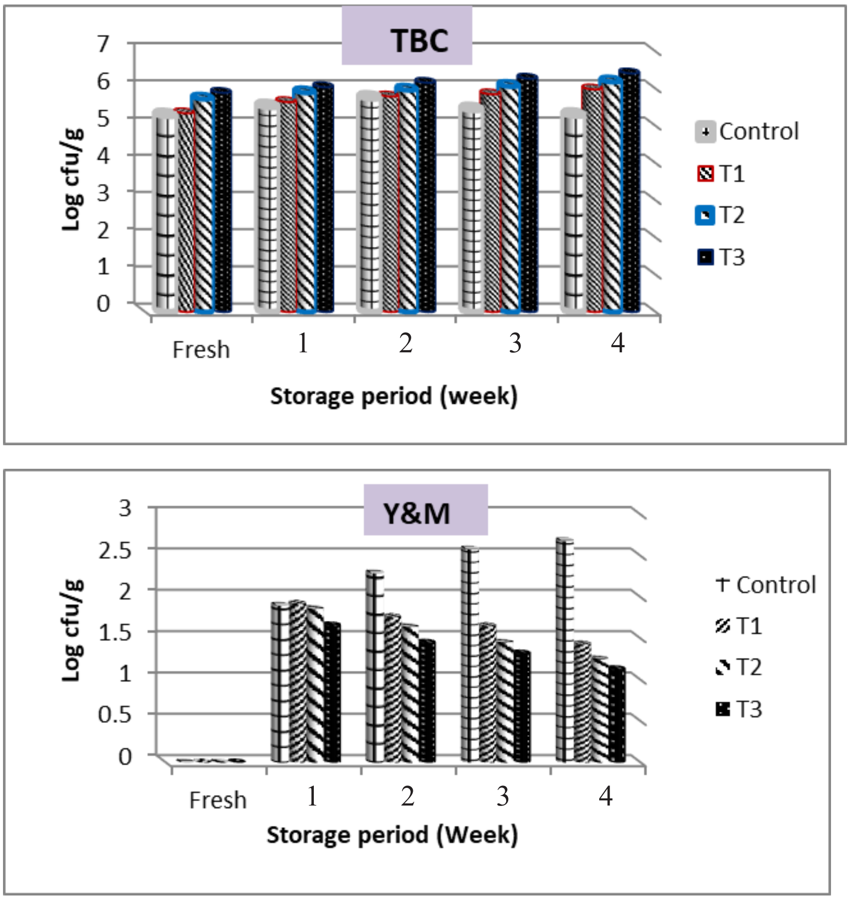

Fig 3. Total bacterial count (TBC) and yeasts & moulds counts (Y&M) (log cfu/g) of probiotic cream cheese supplemented with 0.0 (Control), 1.0, 2.0, and 4.0% carrot powder for T1, T2 and T3 respectively.

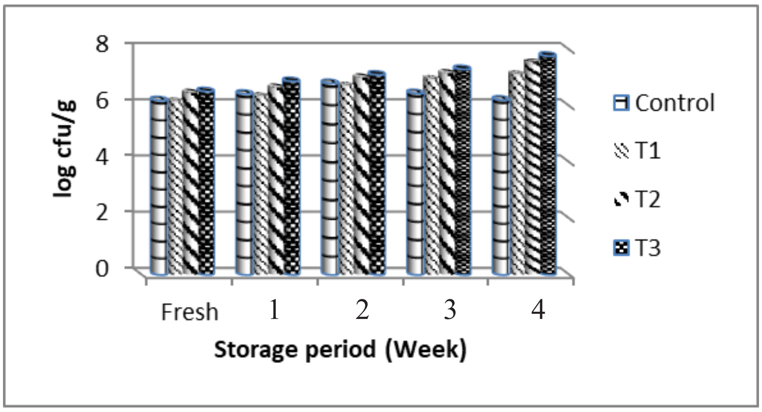

Fig. 4. Counts (log cfu/g) of *B. bifidium* during storage of Cream cheese as affected by the additionof 0.0 (control), 1.0% (T1), 2.0 % (T2) and 4.0 % (T3) carrot powder.

Sensory evaluation of functional cream cheese

Table 8 refers to the results of the sensory assessment of cream cheese supported by CP (1, 2 and 4%). The scores for sensory attributes, general appearance, body and texture flavour and total score of CCh differed significantly (p ≤ 0.05) between the samples. These variations were actually related to the amount of carrot CP added.

The sensory evaluation of cheese decreased by increasing the amount of CP, so the control sample had the highest scores, while T3 (4% CP) had the lowest scores. During storage up to 4 weeks, all the scoring points decreased. Although all the scoring values of the sensory properties decreased by the increase of CP added, the values were still high and all samples were sensory and totally acceptable and the lowest total acceptance value was recorded at 84% (T3). On the other hand, the use of CP led to creating an attractive orange colour in the product. Venica et al. (2020) reported that adding 1% CP was accepted for flavour and colour. The study by Aly et al. (2004) confirmed that the addition of carrot had positive effects on the sensory acceptability of yoghurt.

Conclusion

The present study revealed richness of carrot powder (CP) with protein, ash, fiber, β-carotenes and mineral contents and importance of cream cheese as an adequate food matrix for supplementation with probiotic bacteria and prebiotic ingredient (CP) during 4 weeks of refrigerated storage. Incorporation of CP improved the nutritional value of cheese and it can be suggested as a promising method to enhance the consumer preference towards cream cheese.

TABLE 8. The organoleptic properties of cream cheese

Treatments	Property	Storage period (week)				
		Fresh	1	2	3	4
Control	General appearance (10)	9.6±0.06^{Aa}	9.3±0.11^{Aab}	8.9±0.08^{Ab}	8.5±0.13^{Abc}	7.8±0.15^{Ac}
T1		8.8±0.11^{Ba}	8.1±0.09^{Bb}	7.9±0.057^{Bb}	7.4±0.11^{Bc}	7.0±0.05^{Bc}
T2		7.5±0.11^{Da}	7.2±0.05^{Da}	6.5±0.12^{Db}	6.3±0.14^{Dc}	6.1±0.08^{Dc}
T3		8.5±0.05^{Ca}	7.8±0.13^{Cb}	7.5±0.07^{Cbc}	7.0±0.09^{Cc}	6.6±0.12^{Cd}
Control	Body and Texture (40)	38.7±0.02^{Aa}	38.4±0.04^{Aa}	37.6±0.11^{Ab}	37.5±0.06^{Ab}	37.1±0.13^{Ac}
T1		38.5±0.04^{Ba}	37.9±0.12^{Bb}	36.8±0.05^{Bc}	36.0±0.11^{Bd}	35.5±0.07^{Be}
T2		37.6±0.11^{Ca}	36.8±0.08^{Cb}	36.1±0.14^{Cc}	35.7±0.05^{Cd}	35.0±0.04^{Ce}
T3		37.3±0.14^{Da}	36.1±0.05^{Db}	35.5±0.13^{Dc}	34.8±0.15^{Dd}	33.7±0.08^{De}
Control	Flavour (50)	49.2±0.12^{Aa}	49.0±0.04^{Aa}	48.5±0.05^{Ab}	47.7±0.14^{Ac}	47.3±0.13^{Ac}
T1		48.4±0.07^{Ba}	47.5±0.09^{Ab}	46.9±0.11^{Bc}	45.5±0.05^{Bd}	45.0±0.11^{Be}
T2		47.6±0.01^{Ca}	46.8±0.13^{Ab}	45.7±0.11^{Cc}	45.2±0.14^{Cd}	44.6±0.09^{Ce}
T3		47.0±0.03^{Da}	46.3±0.15^{Ab}	44.4±0.06^{Dc}	43.7±0.12^{Dd}	44.2±0.07^{Dc}
Control	Total score (100)	97.5±0.05^{Aa}	96.7±0.11^{Ab}	95.0±0.09^{Ac}	93.7±0.0.13^{Ad}	92.2±0.11^{Ad}
T1		95.7±0.12^{Ba}	93.5±0.07^{Bb}	91.6±0.13^{Bc}	88.9±0.05^{Bd}	87.5±0.11^{Bd}
T2		93.7±0.08^{Ca}	91.4±0.11^{Cb}	89.3±0.15^{Cc}	87.9±0.07^{Cd}	86.2±0.06^{Ce}
T3		91.8±0.13^{Da}	89.6±0.09^{Db}	86.4±0.06^{Dc}	84.8±0.11^{Dd}	84.0±0.12^{De}

*Means (± *SD*, *n* = 3) with different capital superscripts (A, B,…) within the same column indicate significant ($p \le 0.05$) differences between treatments. Means with the different small superscripts (a, b, and c) within the same row are significantly ($p \le 0.05$) different due to the storage period. See footnote of Table 2 for cheese treatments.

References

Akl, E.M., Abdelhamid, S.M., Wagdy, S.M. and Salama, H. H. (2020) Manufacture of functional fat-free cream cheese fortified with probiotic bacteria and flaxseed mucilage as fat replacing agent. *Current Nutrition and Food Science,* **16** (9), 1393–1403. https://doi.org/10.2174/1573401316666200227112157

Alwis, A.D.P.S., Perera, O.D.A.N. and Weerahewa, H.L.D. (2016) Development of a novel carrot-based synbiotic beverage using *Lactobacillus casei* 431. *The Journal of Agricultural Sciences,* **11** (3), 178-185. http://dx.doi.org/10.4038/jas.v11i3.8171

Aly, S.A., Galal, E.A. and Elewa, N.A. (2004) Carrot yoghurt: sensory, chemical, microbiological properties and consumer acceptance. *Pakistan Journal of Nutrition,* **3** (6), 322-330. https://doi.org/10.3923/pjn.2004.322.330

AOAC. (2012) Official Methods of Analysis, 19th ed. Association of Official Analytical Chemists, Washington, USA.

Arscot, S.A. and Tanumihardio, S.A. (2010) Carrots of many colors provide basic nutrition and bioavailable phytochemicals acting as a functional food. *Comprehensive Review in Food Science and Food Safety,* **9** (2), 223 – 239.

Assenova, B., Okuskhanova, E., Smolnikova, F., Nikolaeva, N., Vlasova, K., Gayvas, A., Konovalov, S., Vorobyev, D. and Rotanov, E. (2021) Study of the chemical composition of carrot powder and its effect on the nutritional value of sausage products. *International Journal of Modern Agriculture,* **10** (2), 3659-3669. http://www.modernjournals.com/index.php/ijma/article/view/1224

Bandyopadhyay, M., Chakraborty, R. and Raychaudhuri, U. (2008) Effect of beet and honey on quality improvement and carotene retention in a carrot fortified milk product. *Innovative Food Science and Emerging Technologies* **9** (1), 9-17. https://doi.org/10.1016/j.ifset.2007.04.007

Bourne, M.C. (1978) Food Texture and Viscosity. Academic Press, New York.

Brand-Williams W., Cuvelier M.E. and Berset C. (1995) Use of a free radical method to evaluate antioxidant activity. *LWT-Food Science and Technology,* **28** (1), 25–30. https://doi.org/10.1016/S0023-6438(95)80008-5

Carvalho, L.M.J.D., Gomes, P.B., Godoy, R.L.D.O., Pacheco, S., Monte, P.H.F.D., Carvalho, J.L.V.D., Nutti, M.R.U. and Neves, A.C.L. (2012) Total carotenoid content, α-carotene and β-carotene, of landrace pumpkins (Cucurbita moschata Duch): A preliminary study. *Food Research International,* **47** (2),337–340. https://doi.org/10.1016/j.foodres.2011.07.040

Conboy Stephenson, R., Ross, R.P. and Stanton, C. (2021) Carotenoids in milk and the potential for dairy based functional foods. *Foods,* **10** (6), 1263-1285. https://doi.org/10.3390/ foods10061263

Dayal, B., Daniel, M. and Zaidi, G. (2013) Development of vitamin a rich low fat cottage cheese using carrot pulp. *International Journal of Agriculture and Food Science Technology,* **4** (3), 269-274. http://www.ripublication.com/ ijafst.htm

El-Messery, T.M., El-Said, M.M., Salama, H.H., Mohammed, D.M. and Ros, G. (2021) Functional properties of milk beverage incorporated with encapsulated mango peel phenolic extract: in vitro and in vivo studies. *International Journal of Dairy Science,* **16** (1), 29-40. https://doi.org/10.3923/ijds.2021.29.40

El-Said, M.M., El-Messery, T.M. and Salama, H.H. (2021) Functional properties and in vitro bioaccessibility attributes of light ice cream incorporated with purple rice bran. *International Journal of Dairy Science,* **16** (1), 1-10. https://doi.org/10.3923/ijds.2021.1.10

Evangelista, S.R., Ghiselli, G. and Filho, F.M. (2012) Development of a soy-based sybiotic beverage. *Food and Nutrition Sciences,* **3** (8),1128-1135. http://dx.doi.org/10.4236/fns.2012.38148

Fox, P.F., Guinee, T.P., Cogan, T.M. and Mcsweeney, P.L.H. (2000) Fundamentals of Cheese Science. 1st ed., Springer, Boston, MA, USA .

Gazalli, H., Malik, A.H., Jalal, H., Afshan, S. and Mir, A. (2013) Proximate composition of carrot powder and apple pomace powder. *International Journal of Food Nutrition and Safety,* **3** (1), 25-28.

Hankinson, D.J. (1975). Potential source of copper contamination of farm milk supplies measured by Atomic Absorption Spectrophotometer. *Journal of Dairy Science,* **58** (3), 326-33

Hashimoto, T. and Nagayama, T. (2004) Chemical composition of ready to eat fresh carrot. *Journal of the Food Hygienic Society of Japan,* 39, 324–328.

HÖhn, E., Schaerer, H. and Kuensch, U. (2003) Carrot flavour-acceptance, sweetness and bitterness. *Agrarforschung (Switzerland),* **10** (4), 144-149.

IDF (1988) Estimation of thermophilic lactobacilli. International Standard 117a International Dairy Federation. Brussels, Belgium.

Januário, J.G.B., da Silva, I.C.F., De Oliveira, A.S., De Oliveira, J.F., Dionísio, J.N., Klososki, S.J. and Pimentel, T.C. (2017) Probiotic yoghurt flavored with organic beet with carrot, cassava, sweet potato or corn juice: Physicochemical and texture evaluation, probiotic viability and acceptance. *International Food Research Journal,* **24** (1), 359-366.

Kaur, I., Chawla, R., Kumar, S., Goel, N. and Mishra, S. K. (2019) Screening of optimized carrot pulp concentration for development of vitamin a fortified Lassi. *Indian Journal of Pure and Applied Biosciences,* **7** (4), 231-237. http://dx.doi.org/10.18782/2320-7051.7634

Kim, J., Watkinson, P., Lad, M., Merino L., Smith, J. and Golding M. (2022) Effect of process and formulation variables on the structural and physical properties in cream cheese using GDL. Acidulant. *Food Biophysics,* **17** (2), 273-287. https://doi.org/10.1007/s11483-022-09719-w

Kosikowski, F.V. (1978) Cheese and Fermented Milk Foods. Published by the Auther. Camell, Univ. Ithaca, New York, USA.

Kun, S., Rezessy-Szabó, J.M., Nguyen, Q.D. and Hoschke, Á. (2008) Changes of microbial population and some components in carrot juice during fermentation with selected Bifidobacterium strains. *Process Biochemistry,* **43**, 816-821. https://doi.org/10.1016/j.procbio.2008.03.008

Ladjevardi Z.S., Yarmand, M., Emam-Djomeh, Z. and Niasari-Naslaji, A. (2016) Physicochemical properties and viability of probiotic bacteria of functional synbiotic camel yogurt affected by oat *β*-glucan during storage. Journal of Agricultural Science and Technology, **18** (5), 1233-1246.

Less, G.J. and Jago, G.R. (1969) Method for the estimation of acetaldehyde in culture dairy products. *Australian Journal of Dairy Technology,* **24** (4), 181-185. http://hdl.handle.net/102.100.100/320503?index=1

Lucey, J.A. (2003) Acid and acid/heat coagulated cheese. In: Encyclopedia of Dairy Sciences, Vol. 1, Roginski, H., J.W. Fuquay and P.F. Fox Eds. Academic Press: London; pp. 350-56.

Madora, E.P., Takalani, T.K. and Mashau, M.E. (2016) Physicochemical, microbiological and sensory properties of low fat yoghurt fortified with carrot powder. *International Journal of Agricultural and Biological Engineering,* **9** (1), 118－124. https://doi.org/10.3965/j.ijabe.20160901.1874

Madukwe, E. and Eme, P.E. (2012) Chemical evaluation and sensory attributes of soymilk fortified with carrot powder. *African Journal of Food Science,* **6** (20), 483-486. https://doi.org/10.5897/AJFS12.040

Marshall, R.T. (1992) Standard Methods for the Examination of Dairy Products. American Public Health Association (APHA), Washington, D.C., USA

Mehanna, N.M. and Pasztor-Huszar, K. (2012) Attributes and the rheological properties of body and texture of Egyptian Ras cheese. *Egyptian Journal of Dairy Science,* **40** (2), 181-190.

Mohamed, F.A.R.F., Salama, H.H., El-Sayed, S.M., El-Sayed, H.S. and Zahran, H.A. (2018) Utilization of natural antimicrobial and antioxidant *of Moringa oleifera* leaves extract in manufacture of cream cheese. *Journal of Biological Sciences,* **18** (2), 92 -106._https://doi.org/10.3923/jbs.2018.92.106

Mohanapriya, M., Kumaresan, G., Karthikeyan, N. and Suresh, P. (2019) Development of carrot extract incorporated synbiotic lassi. *International Journal of Current Microbiology and Applied Sciences,* **8** (1), 1695-1699. https://doi.org/10.20546/ijcmas.2019.801.179

Naczk M. and Shahidi, F. (1989) The effect of methanol-ammonia-water treatment on the content of phenolic acids of canola. *Food Chemistry,* **31** (2), 159-164. https://doi.org/10.1016/0308-8146(89)90026-5

Nelson, J.A. and Trout, G.M. (1981) Judging Dairy Products. 4th Ed., AVI Publishing Comp. INC,Westport, Connecticut.

Ningtyas, D.W., Bhandari, B., Bansal, N. and Prakash, S. (2019) The viability of probiotic Lactobacillus rhamnosus (non-encapsulated and encapsulated) in functional reduced-fat cream cheese and its textural properties during storage. *Food Control,* **100** (6). 8-16. https://doi.org/10.1016/j.foodcont.2018.12.048

Pimentel, T.C., Garcia, S. and Prudencio, S.H. (2012) Effect of long-chain inulin on the texture profile and survival of *Lactobacillus paracasei ssp. paracasei* in set yoghurts during refrigerated storage. *International Journal of Dairy Technology,* **65** (1), 104-110. https://doi.org/10.1111/j.1471-0307.2011.00739.x

Que, F., Hou, X.L., Wang, G.L. and et al. (2019) Advances in research on the carrot, an important root vegetable in the Apiaceae family. *Horticulture Research,* **1**

(6), 69. https://doi.org/10.1038/s41438-019-0150-6

Rafiq, S., Sharma, V., Nazir, A., Rashid, R., Sofi, S.A., Nazir, F. and Nayik, G.A. (2016) Development of probiotic carrot juice. *Journal of Nutrition and Food Science,* **6** (4), 1000534. https://doi.org/10.4172/2155-9600.1000534

Rajarajan, G. (2018) Development of carotene enriched functional ice cream. *International Journal of Livestock Research,* **9** (1), 226-230. https://doi.org/10.5455/ijlr.20180711110826

Saad, S.A., Salama, H.H. and EL-Sayed, H.S. (2015) Manufacture of functional labneh from UF-retentate with artichoke puree. *International Journal of Dairy Science,* **10** (4), 186-197. https://doi.org/10.3923/ijds.2015.186.197

Salama, H.H., Abdelhamid, S.M. and Abd-Rabou, N.S. (2020a). Probiotic frozen yoghurt supplemented with coconut flour green nanoparticles. *Current Bioactive Compounds,* **16** (5), 661-670. https://doi.org/10.2174/1573407215666191111121553.

Salama; H.H., El-Said, M.M., Abdelhamid, S.M., Abozed, S.S. and Mounier, M.M. (2020b) Effect of fortification with sage Loaded liposomes on the chemical, physical, microbiological properties and cytotoxicity of yoghurt. *Egyptian Journal of Chemistry,* **63** (10), 3879 – 3890. https://doi.org/10.21608/EJCHEM.2020.27321.2572

Salama, H.H., Abd El-Salam, M.H. and El-Sayed, M.M. (2016) Preparation of ß-carotene enriched nanoemulsion by spontaneous emulsification using oleic acid as nano carrier. *Research Journal of Pharmaceutical, Biological and Chemical Sciences,* **7** (4), 585 – 593.

Salama, H.H., El-Sayed, H.S., Abdrabou, N. and Hassan, Z. R. (2021) Production and use of eco-friendly selenium nanoparticles in the fortification of yoghurt. *Journal of Food Processing and Preservation,* **45**, e15510. https://doi.org/10.1111/JFPP.15510

SAS (2006) Statistical Analysis Systems, Version 9.2. SAS Institute Inc., Cary, NC., USA.

Šeregelj, V., Pezo, L., Šovljanski, O., Lević, S., Nedović, V., Markov, S., Tomić, A., Čanadanović-Brunet, J., Vulić, J., Šaponjac, V. T. and Ćetković, G. (2021) New concept of fortified yogurt formulation with encapsulated carrot waste extract. *LWT - Food Science and Technology,* **138** (3), 110732. https://doi.org/10.1016/j.lwt.2020.110732

Sharma, K.D., Karki, S., Thakur, N.S. and Attri, S. (2012) Chemical composition, functional properties and processing of carrot—a review. *Journal of Food Science and Technology,* **49** (1), 22–32. https://doi.org/10.1007/s13197-011-0310-7

Stephenson, C.R., Ross, R.P. & Stanton, C. (2021) Carotenoids in milk and the potential for dairy based functional foods. *Foods,* **10** (6), 1263. https://doi.org/10.3390/foods10061263

Sule, S., Oneh, A.J. and Agba, I.M. (2019) Effect of carrot powder incorporation on the quality of pasta. MOJ Food Processing and Technology, **7** (3), 99–103. https://doi.org/10.15406/mojfpt.2019.07.00227

Sulieman, A.M.E., Abdelrahman, M.M. and Elkhalifa, E.A. (2018) Quality evaluation of yoghurt supplemented with carrot juice. *Gezira Journal of Engineering and Applied Sciences,* **6** (1), 89-106. http://journals.uofg.edu.sd/index.php/gjeas/article/view/561

Vénica, C.I., Spotti, M.J., Pavón, Y.L., Molli, J.S. and Perotti, M.C. (2020) Influence of carrot fibre powder addition on rheological, microstructure and sensory characteristics of stirred-type yogurt. *International Journal of Food Science and Technology,* **55** (5), 1916-1923. https://doi.org/10.1111/ijfs.14415

Wendin, K., Langton, M., Caous, L. and Hall, G. (2000) Dynamic analysis of sensory and microstructural properties of cream cheese. *Food Chemistry,* **71** (3), 363-378. https://doi.org/10.1016/S0308-8146(00)00200-4

West, KP. Jr. (2003) Vitamin A deficiency disorders in children and women. *Food and Nutrition Bulletin,* **24** (4), S78-S89. https://doi.org/10.1177/15648265030244S204 ·

دراسة علي استخدام مسحوق الجزر والبكتيريا الداعمة الحيوية في تصنيع جبن كريمي وظيفي

إيناس علي بكير[١] ، هبة حسن سلامة[٢] ، أماني محمد الديب[١] و ناهد عبد المقتدر الوحش[١]

[١] معهد بحوث تكنولوجيا الأغذية – مركز البحوث الزراعية – الجيزة – مصر

[٢] المركز ابلقومي للبحوث– الجيزة – مصر

في هذه الدراسة تم اعداد مسحوق الجزر (CP) واستخدامه بمستويات صفر ،1، 2 و 4% مع بكتيريا البروبايوتيك في تصنيع الجبن الكريمي (CCh). أشارت النتائج إلي أن مسحوق الجزر غني بالرماد (9,23%) ، الألياف (32,9%) والبيتاكاروتينات (394,45ميكروجرام/جم) وعديد من المعادن. أظهرت النتائج أن إضافة مسحوق الجزر للجبن الكريمي الطازج ليس له تأثير علي المكونات الكلية ولكن هناك زيادة معنوية في محتوي المعادن، قيم مضادات الأكسدة، الفينولات والبيتاكاروتينيدات بالإضافة إلي الحموضة والاسيتالداهيد والداي اسيتايل. وقد ترافق ذلك مع بعض التحسن في لون الجبن والقدرة علي الاحتفاظ بالماء (WHC) واللزوجة. ومع ذلك أثناء التخزين البارد لجميع عينات الجبن إنخفض الأس الهيدروجيني والاسيتالداهيد وWHC، بينما زادت الحموضة والاحماض الدهنية الطيارة الكلية واللزوجة. ولم تتأثر الخصائص الريولوجية للجبن الكريمي بشكل كبيرسواء بإضافة مسحوق الجزر (CP) أو بالتخزين ، بينما عزز كلاهما بقاء البكتيريا خاصة بكتيريا البروبايوتيك التي اظهرت دائماً أعلي من 6 log cfu/gm.

وعلي الرغم من أن جبن الكنترول دائما أعلي الدرجات في الخصائص الحسية المختلفة عندما يكون طازجاَ أو أثناء التخزين ،إلا أن الجبن المدعم بمسحوق الجزرسجل 84 من اجمالي الدرجة (100) كما هو موضح في المعاملة T3 المحتوية علي أعلي كمية من مسحوق الجزر