J. Food and Dairy Sci., Mansoura Univ., Vol. 7 (4): 265 -272, 2016

Production of Functional Kareish Cheese by Using Plant Stabilizer

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ABSTRACT

Okra mucilage (OM) was used as plant stabilizers at levels of 0 (control), 0.0125%, 0.025%, 0.05%, 0.1% and 0.2% (w/w) in making Kareish cheese. The resultant cheese treatments were examined for their physicochemical, microstructural, textural, water holding capacity (WHC), emulsion capacity (EC), emulsion stability (ES), scanning electron microscopy, textural, and sensory characteristics. Viability of probiotic in the resultant cheese treatments was also detected. Moisture and yield of treated cheese with 0.2 and 0.1% OM were higher, compared with control. Total solids were not influenced, as compared with the control at 4^{o}C as a result of OM addition. The pH values of Kareish cheeses with OM were higher than that of the control, when fresh or during the storage period (4^{o}C /14 days). It could also be noticed that OM levels are of bifidogenic effect, as they enhanced the development of probiotic bacteria in the examined cheese treatments.. Texture profile analysis (TPA) indicated that all levels of OM resulted in variation of TPA, as hardness; adhesiveness, and gumminess, decreased while chewiness, cohesiveness & springiness increased within the examined treatments, when fresh and during storage. The addition of OM improved Kareish cheese texture, by using 0.05%, which was the most accepted treatment. Cheese microstructure was intensified by the addition of high level of OM, as it promoted regularly aggregation of protein matrices, characterized by a finer-meshed network, compared with that of the control. Generally, it is recommended to use 0.05% and 0.025% OM in Kareish cheese making to enhance its organoleptic properties with good nutritional value of fiber.

Keywords: Kareish Cheese – Probiotic – Okra Mucilage – Stabilizers.

INTRODUCTION

Kareish cheese, which is rich in protein and calcium, and of low fat content is considered as one of the most popular types of soft cheese being consumed in Egypt. It contains most of the skim milk constituents' including protein, sugar, water and low fat content. Kareish cheese is usually made from skimmed buffalo's, cow's milk or from a mixture of them. An increase demand for this type of cheese by the Egyptian consumers is mainly attributed to its rich content of proteins and calcium, to its low fat content, and in particular to its low price (Abd-El-Salam et al., 1984; Abou-Donia, 2008). Kareish cheese is an acid coagulated soft fresh cheese, with soft texture, and it is characterized with its slightly salty flavor. Bitter off-flavor and hard rubbery and grainy textures may develop in cheese being made or stored improperly (Barr, (1990); Olson & Johnson, (1990); Coulson, et al., (1991); Broadbent et al., (1997) and Francois et al., (2004). Many approaches have been suggested to improve the cheese texture, one of which is to modify the method of its manufacturing process to increase its moisture content, which can partially substitute fat, and to improve its structure(Wilkinson, et al., 2001).

Okra (*Abelmoschus esculentus L. Moench*, family *Malvaceae*), is an African plant origin, that is of an acidic polysaccharide, with further protein, minerals and complex carbohydrates contents, which are not pronouncedly affected throughout purification. Gums and OM's yield upon hydrolysis arabinose, galactose, glucose, manose, xylose(Paulsen and. Lund (1979), Sepúlveda et al., (2007), Sáenz, et al.,(2004). OM have been successfully used as thickeners, emulsifiers, and binders Bharadia et al., (2004). Its chemical structure is one of the main factors that affecting its functional properties (Mirhosseini and Amid,(2012). Furthermore, OM can play an important role as stabilizer. Stabilizers play two important roles in yoghurt manufacturing, as they bind water and improve its texture.

The action of a stabilizers in yoghurt depends mainly on their composition, rheological properties and their ability to interact with milk protein.(Awan, (1995), Mirhosseini and Amid,(2012).

Therefore, the aim of the present study is to investigate the possibility of using OM as a stabilizer in making Kareish cheese. as well as a source of probiotic bacteria as a functional food ingredient that enhances functionality and the different properties of Kareish cheese.

MATERIALS AND METHODS

Fresh buffalo skim milk was obtained from Animal Production Institute, Agricultural Research Center Giza, Egypt. Commercial sodium chloride was obtained from El-Nasr Company for Salt.

The starter culture strains *L. delbrueckii subsp. bulgaricus* and *Streptococcus thermophilus*, and also commercial strain of *L. rhamnosus GG* were obtained from (Valio Ltd, Finland). *Bifidobacterium ssp. lactis Bb-12* was obtained from (Chr. Hansen Denmark). All of the above mentioned bacterial cultures were maintained as frozen stocks in 40% glycerol and stored at -20 °C. A pre-starter culture (PSC) was prepared by weighting each culture in sufficient amounts to attain an initial count of 10^8 colony forming units (cfu) mL^{-1}, and diluting in 50 mL skimmed milk sterilized and cooled to5^{o}C. The pre-cultures were warmed at 42^{o}C for 20 min before inoculation. Starter cultures (2% v/v) were transferred to the PSC in skim milk before adding them to milk used in cheese making. *B. lactis Bb-12* & *L. rhamnosus GG* probiotic culture, on the other hand, was first grown for 48h., followed by sub-culturing and incubating for further 17 h., and harvested by centrifugation (3200x g, 10 min at 4^{O}C). The pellets were washed twice in one-quarter-strength Ringer's solution (Oxoid manual 1998), and concentrated 10-fold in the same diluent. A 1% of probiotic culture was inoculated into the SM to achieve a final concentration of ~10^8CFU/ml.

For Extraction of Okra, the okra was washed to get red of any dirt accumulated on their surfaces, and was subsequently frozen and kept at -20°C to avoid any color changes resulting from oxidation and browning process.(Ameena et al. (2010) with little modification. Sliced okra was blended using tap water containing 1% (w/v) of sodium metabisulphite (Sigma-Aldrich,UK), centrifuged at 3000 rpm for 5 minutes, and precipitated by using pure ethanol (99.5%) (Sigma-Aldrich, UK). The resultant OM was properly washed with ethanol, and was dried under vaccum(Sl-SHEL LAB-1410-USA), followed by grinding

Kareish cheese was manufactured by the conventional method described by Fahmi, (1960). OM was added (zero % (control), 0.0125, 0.025, 0.05, 0.1 and 0.2%) to warm skim milk. Activated cultures of lactic acid bacteria (2%) were added to warmed (30°C) milk overnight until curdling, followed by ladling into plastic frames lined with muslin cloth. Salt 1% was dispersed on the curd, and it was then pressed by using proper weights. The resultant cheeses were stored at 4^{o}C for 14 days.

The yield was determined as described by (Fox, et al., 2000), pH, moisture, total solids, and ash were determined according to AOAC (2000). All chemical measurements were done in triplicates. The WHC of OM was determined as described by Galla and Dubasi (2010), and The emulsifying properties of OM were detected by evaluating its emulsifying capacity (EC) and emulsifying stability (ES), which were done as described by Naji *et al.* (2013). The EC and ES of OM were calculated using following formula:

$$\textbf{EC or ES (\%)} = e_v / t_v \times 100$$

where, e_v is the volume of emulsion after being centrifuged and t_v is total volume of mixture.

The WHC of OM was determined for both skim milk (SM) and distilled water (DW), according to the method of Galla and Dubasi (2010) with little modification. Different levels of added OM (0%, 0.0125%, 0.025%, 0.05%, 0.1% and 0.2%) in (SM), and one gram of okra powder was added into 10 ml of (DW) for WHC. The mixture was then vortexed for 2 minutes. Next, the mixture was centrifuged at 3000 rpm for 30 minutes before any excessive of water was decanted. The WHC was then calculated by dividing the weight (g) of water absorbed by 100 g of OM.

Texture profile analysis test of cheese samples was done using a Universal Testing Machine (TMS-Pro) Food Technology Corporation, Sterling, Verginia, USA) equipped with 1000 N (250 lbf) load cell and connected to a computer programmed with Texture ProTM texture analysis software (program, DEV TPA With holding time between cycle two second). Data were collected on computer and the texture profile parameters were calculated from DEV TPA texture analyzer and computer interface. (Szczesniak et al (1963) and Bourne (1978) Following texture profile parameters to obtain hardness, cohesiveness, springiness , gumminess and chewiness.

Kareish cheese blocks (5–6 mm^3) were prepared for scanning electron microscopy (SEM) following the method of Brooker and Wells (1984). For scanning electron microscope of the samples, SEM Model Quanta 250 FEG (Field Emission Gun) attached with EDX Unit (Energy Dispersive X-ray Analyses) was used, with accelerating voltage 30 K.V., magnification14x up to 1000000 and resolution for Gun.1n).

Viable cell counts were recorded prior to cold storage and at appropriate intervals. Enumeration of *Strep. thermophilus* was carried out using M17 agar; Difco, Detroit, MI, plates incubated aerobically for 2 d at 37°C; *Lactobacillus bulgaricus* by using [deMan, Rogosa, Sharpe (MRS) agar; Oxoid, Basingstoke, UK], pH 5.2, incubated anaerobically for 3 d at 45°C (Cruz et al., 2012). Counting of *lactobacilli* species and bifidobacteria were detected on MRS agar (Merck, Darmstadt, Germany) adjusted to pH 5.4 with glacial acetic acid and by aerobic incubation at 37°C for 48 h. T.

Sensory evaluation was carried out by means of ten panelists from the staff members of the Dairy Research Department, Food Technology Research Institute, Egypt used a quality rating score card for evaluation of flavor (30 points) and body and texture (60 points) and appearance (10 points) (Bodyfelt et al., 1988).

Data were analyzed using the Statistical Analysis System software package (SAS, 2000).
Analyses of variance were performed using ANOVA procedures. Least significant difference

Test was performed to determine differences in means at $P < 0.05$.

RESULTS AND DISCUSSION

Adding different levels of OM on moisture, yield and total solids content of treated with different concentrations of OM Kareish cheese during storage are illustrated in Table (1).The moisture content of Kareish cheese with adding different levels of OM was higher, compared with the control. Kareish cheese prepared with adding 0.2 and 0.1 % of OM had the highest moisture content, followed by that with adding 0.05, 0.025 and 0.0125 % of OM and control, respectively. The increase in cheese yield was parallel to the increase in moisture cotent of cheese. The presence of 0.2% and 0.1% levels of OM was of significantly higher yield of cheeses with an average of 5% ($P < 0.05$), compared with the control cheese. These data are similar to those of Ahmed et al (2005). The increase in yield in cheeses containing OM might be due to the form the gel, thus increasing the water holding capacity (Oliveira et al.2010). The control cheese had higher content of total solids, compared with the treated with OM cheese at zero time. Data obtained showed slight increase in total solids content of all cheeses at the end of the storage period.

Table (1). Effect of different levels of OM on moisture, yield and total solids content of Kareish cheese during storage periods.

Treatments	Storage periods Fresh	7 days	14 days
		Cheese yield	
0.0%	18.71fA	18.54fA	18.42fA
0.0125%	19.36eA	19.15eA	19.09eA
0.025%	21.12dA	20.83dAB	20.61dB
0.05%	23.74cA	23.53cA	23.36cA
0.1%	25.43bA	25.24bA	25.06bA
0.2%	26.15aA	26.02aA	25.70aA
Moisture			
0.0%	71.31dA	71.24dA	71.08dA
0.0125%	72.96cdA	71.74dA	71.57cdA
0.025%	73.81cA	72.76cdA	72.52cdA
0.05%	74.61bcA	73.54bcA	73.27bcA
0.1%	75.78abA	74.61abA	74.25abA
0.2%	76.44aA	75.28aA	74.98aA
		Total solids	
0.0%	28.74aA	28.84aA	29.22aA
0.0125%	28.08abA	28.14abA	28.48abA
0.025%	27.26bcA	27.40bcA	27.55bcA
0.05%	26.72cdA	26.87cdA	27.53bcA
0.1%	26.14deA	26.35deA	26.69cdA
0.2%	25.63eA	25.79eA	26.38dA

Means (n =3) with the same capital letters in the same column or the same small letters in the same row are not significantly different at P ≤ 0.05.

The effect of adding different levels of OM on the pH values of treating Kareish cheese with different concentrations of OM during storage at 4^0C are given in Table (2). The change in the pH values of treated Kareish cheeses was insignificant. However it was higher in the treated cheese than that of the control cheese, either when fresh or during the storage period (4^oC /14 days).

Kareish cheese manufactured without OM had the lowest pH value, especially at the end of storage period. It could also be noticed that the pH values of all cheeses gradually decreased during the storage. Similar observations were detected by (Hassan et al. 2014; Ahmed et al. 2005).

Table (2). The effect of adding different levels of OM on pH values of Kareish cheese during storage period.

Treatments	Storage periods Fresh	7 days	14 days
Control	4.53aA	4.45aA	4.32bA
0.0125%	4.65aA	4.64aA	4.60abA
0.025%	4.72aA	4.68aA	4.61abA
0.05%	4.76aA	4.75aA	4.73aA
0.1%	4.81aA	4.78aA	4.75aA
0.2%	4.85aA	4.81aA	4.79aA

Means (n =3) with the same capital letters in the same column or the same small letters in the same row are not significantly different at P ≤ 0.05

Water holding capacity (WHC) was defined as the ability of a substance to associate with water under limited water conditions (Singh, 2001). It was measured to determine the water holding capacity of both SM & DW. As shown in Fig.1, the WHC of OM at level 0.2% was significantly highest (p<0.05) as compared to other levels 0.1, 0.05, 0.025, 0.0125% and control. These are in agreement with (Hassan et al., 2003b), they reported that ability of EPS-producing cultures to produce cheese with high water holding capacity in Kareish cheese. WHC in DW was highest than in SM. These results are in agreement with (Noorlaila 2015). I noticed that the close results of WHC in both SM and DW may due to represent the percentage of hydrophilic fraction, which has a strong binding to absorb water Miguel and Belloso (1999). The increase in WHC of OM can be related to the thickness and slimy texture of okra water extracts; this is due to its polysaccharide content (BeMiller, et al. 1993). Also the cross-linking of milk proteins triggered by OM leads to a stabilization of the three-dimensional network and a decrease in curd gel permeability which in turn prevent cheese whey expulsion (Lorenzen et al.2002).

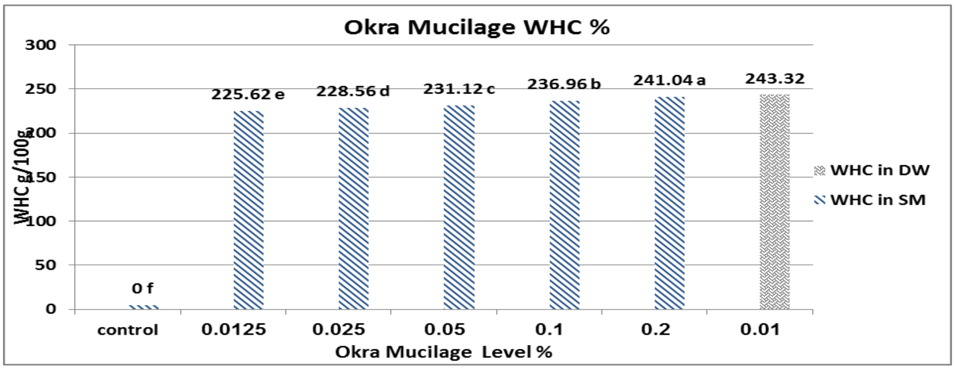

Fig.1. Water holding capacity (WHC) of OM with different levels%.

The ability to stabilize skim milk (Fig.2) by thickening its aqueous dispersion, of skim milk at different levels of OM, ranged from 66.32 – 77.92% and 54.14 – 70.89%, respectively, for EC and ES.

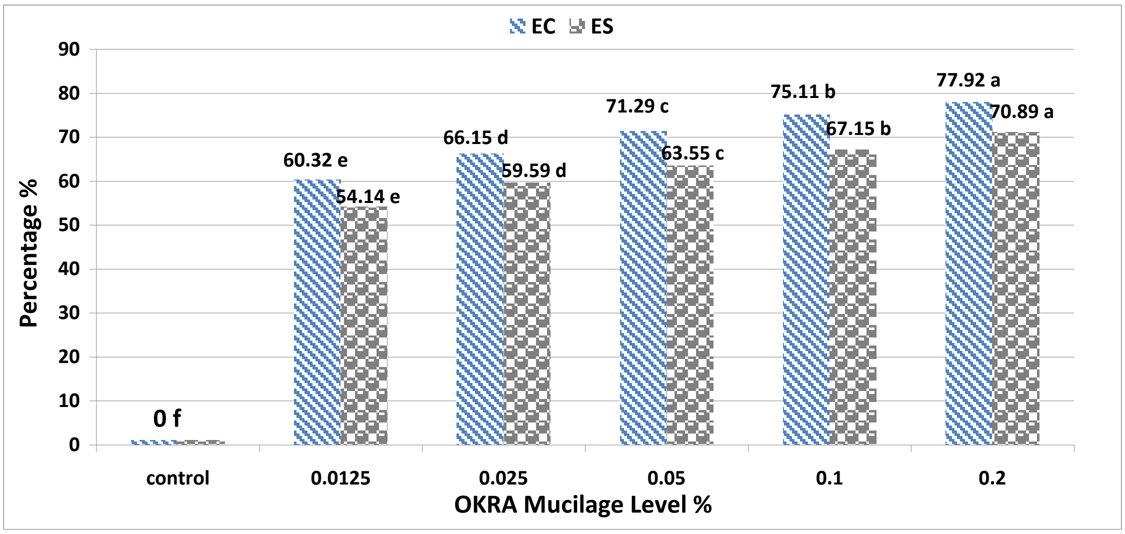

Fig.2. Emulsion Capacity (EC) & Emulsion Stability (ES) of OM with different levels%.

The emulsifying properties of OM were detected by evaluating its emulsifying capacity (EC) and emulsifying stability (ES), which were done as described by Naji *et al.* (2013). The EC and ES of OM were calculated using following formula:

$$\textbf{EC or ES (\%)} = e_v / t_v \times 100$$

where, e_v is the volume of emulsion after being centrifuged and t_v is total volume of mixture.

Microstructures of fresh Kareish cheese made by various levels of OM were examined by scanning electron microscopy (SEM) (Fig.3). Differences between cheeses could be visually observed in images.

The obtained data concerning the microstrucure of treated with OM Kariesh cheese were shown In Figs.(3). Protein matrix (gray area) of control formed a continuous phase permeated by an amorphous system of voids filled with serum (black area), which in turn revealed the spatial dimensions of these images. Moreover, clear image of clusters of cross-linked strands and fibrous-like protein aggregates (black circles) were observed. As it might be seen in Fig. 3B, C&D. The effect of addition of OM on the microstrucure of treated with OM 0.0125%, 0.025% & 0.05% cheese promoted regularly the aggregation of protein matrices, resulting in a finer-meshed network accompanied by rare pores, compared control (Fig.3A). The present data in Fig. 3 E&F reveal that the cheese with added OM (0.1% & 0.2%) exhibited an enlarged and dense structure, accompanied by irregularly clustered protein folds (pointed with white circles, which could be probably attributed to its polysaccharide components as well as protein content that increasing WHC, EC and ES of treatments These results are in agreement with (Hassan *et al.* 2004).

The effect of OM on cheese microstructure was more obvious and further intensified by the high level addition as illustrated in SEM micrographs of 0.1% & 0.2% cheese treatments (Fig.3 E&F respectively. Our findings is similar to that found by Hassan & Frank (1997).

The effect of adding different levels of OM on the presence and enumeration of *Bifidobacterium lactis* and *L. rhamnosus* in treated with Om Kareish cheese during storage periods are presented in Table (3). Similar range of numbers of 7.0 log cfu/g was detected in all samples in the first day of making cheese, with significantly ($P < 0.05$) differences. The viability of *Bifidobacterium lactis, L. rhamnosus* markedly increased after 7 days of storage in all treatments (8.0 log cfu/g), compared with the control (6.0 log cfu/g,), which might be due to the lactose fermentation by the examined bacteria after day 7 of refrigerated storage.. These results are in agreement with Capelaaet al., 2006, Nezhad et al. 2013 and Mahmoud et al. 2013), who reported that prebiotic polysaccharide content has synergic effect on improving viability of probiotic. By day 14, the Treatments cheese with 0.2% & 0.1% OM resulted in significantly ($P< 0.05$) higher count of 7.0 log cfu/g of *Bifidobacterium lactis* at the end of storage period, compared with the cheese treatmed with 0.05%, 0.25%, 0.0125% (6.0 log cfu/g), and with the control cheese (5.0 log cfu/g) It could also be concluded that the OM levels are of bifidogenic effect, which stimulate the increase of probiotic bacteria. These results are in a harmony with those obtained with Crittenden & Playne, 1996). *L. rhamnosus*, meanwhile is still of significantly ($P< 0.05$) higher count (8.0 log cfu/g), compared with control (6.0 log cfu/g) at the end of storage period, which agreed with Sheehan et al. (2007).

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Fig.3 Scanning electron microscopy of Kareish cheese manufactured by different levels of OM A=Control, B=0.0125% of OM, C=0.025% of OM, D=0.05% of OM, E=0.1% of OM and F=0.2% of OM .

Table (3). The effect adding different levels of OM on *B. bifidum* counts and *L. rhamnosus* of Kareish cheese during refrigerated storage periods

Treatments	*Bifidobacterium lactis*			*L. rahmnosus*		
	0	**7**	**14**	**0**	**7**	**14**
Control	$19x10^{7}$ dB	$25x10^{6}$ dA	$20x10^{5}$cB	$22x10^{7}$abB	$38x10^{7}$dA	$35x10^{6}$cA
0.0125%	$20x10^{7}$ bcdB	$29x10^{8}$ cA	$22x10^{6}$bcB	$18x10^{7}$bcB	$40x10^{8}$cdA	$37x10^{8}$bcA
0.025%	$23x10^{7}$ abcB	$31x10^{8}$ bcA	$25x10^{6}$bB	$20x10^{7}$abcB	$43x10^{8}$bcA	$42x10^{8}$aA
0.05%	$20x10^{7}$ cdB	$32x10^{8}$ bcA	$30x10^{6}$aA	$16x10^{7}$cB	$44x10^{8}$bcA	$40x10^{8}$abA
0.1%	$25x10^{7}$ aB	$33x10^{8}$ abA	$30x10^{7}$aA	$19x10^{7}$abcB	$46x10^{8}$bA	$43x10^{8}$aA
0.2%	$24x10^{7}$ abB	$36x10^{8}$ aA	$33x10^{7}$aA	$24x10^{7}$aC	$49x10^{8}$aA	$39x10^{8}$abB

Means (n =3) with the same capital letters in the same column or the same small letters in the same row are not significantly different at $P \leq 0.05$

Changes in texture profile analysis (TPA) of fresh and stored Kareish cheese prepared with different levels of OM Results in Table (4) illustrate the changes in the texture profile (TPA) of fresh and stored Kareish cheese treated with different levels of OM. Results showed that all levels of OM considerably increased hardness; adhesiveness, and gumminess, whereas decreased chewiness, cohesiveness & springiness between treatments when fresh. These data are similar to those observed by Beal and Mittal, (2000). Ahmed et al. (2005), Korish and Abdel-hamid (2012).

Hardness and adhesiveness increased while cohesiveness, gumminess springiness, and chewiness values decreased in all treatments at the end of storage periods, The hardness, adhesiveness, cohesiveness, springiness, gumminess and chewiness values were influenced by storage period in all treatments, which might be due to the proteolysis during storage, bringing about a finer; smoother–bodies cheese (Molander et al., (1990)..

Table (4) Textural characterises of fresh Kareish cheese manufactured by different levels of OM.

Property	Storage period (days)	Treatments					
		Control	0.0125%	0.025%	0.05%	0.1%	0.2%
Hardness (g)	Fresh	1.66aA	1.56aA	1.43abA	1.23abA	1.03abA	0.80bA
	7	1.77aA	1.68 aA	1.52abA	1.35abA	1.23abA	0.83bA
	14	1.93aA	1.78 abA	1.64abA	1.53abA	1.30abA	0.89bA
Adhesiveness (g/sec.)	Fresh	0.62aB	0.47aB	0.37aA	0.29aA	0.16aA	0.12aA
	7	0.95aAB	0.77abAB	0.57abcA	0.37bcA	0.22cA	0.19cA
	14	1.16aA	1.03aA	0.80abA	0.52bcA	0.33bcA	0.28cA
Cohesiveness (~)	Fresh	0.66dA	1.13cdA	1.35bcdA	1.72abcA	2.00abA	2.23aA
	7	0.47cA	0.90bcA	1.13abcA	1.36abA	1.73aA	1.90aA
	14	0.36cA	0.70bcA	0.97abcA	1.30abA	1.55aA	1.61aA
Springiness (mm)	Fresh	1.66dA	1.90 cdA	2.03bcdA	2.20bcA	2.43abA	2.65aA
	7	1.50cA	1.60cAB	1.80bcA	2.03abA	2.26aA	2.39aA
	14	1.33dA	1.40cdB	1.76bcA	1.90abA	2.10abA	2.27aA
Gumminess (g)	Fresh	1.23aA	0.73abA	0.66bA	0.51bA	0.46bA	0.40bA
	7	0.76aAB	0.61aA	0.40aA	0.36aA	0.30aA	0.26aA
	14	0.58aB	0.46aA	0.33aA	0.27aA	0.22aA	0.18aA
Chewiness (g/mm.)	Fresh	1.96bA	2.82abA	3.49abA	3.96aA	4.58aA	4.67aA
	7	0.97bA	1.97abA	2.66abA	3.08aA	3.34aA	3.80aA
	14	0.92cA	1.34bcA	2.15abcA	2.86abcA	3.27abA	3.29aA

Means (n =3) with the same capital letters in the same column or the same small letters in the same row are not significantly different at P ≤ 0.05

Table (5). Effect of different levels of OM on sensory properties of Kareish cheese during storage periods

Property	Storage period (days)	Treatments					
		Control	0.0125%	0.025%	0.05%	0.1%	0.2%
Body & Texture	Fresh	26.62abA	27.62aA	27.50aA	27.62aA	24.37bcA	23.50cA
	7	24.6250aA	24.75aB	24.50aB	25.00aAB	21.50bB	19.37bB
	14	21.62abB	22.00aB	22.12aB	23.37aB	19.12bcB	16.87cB
Flavor & odor	Fresh	46.25aA	45.62aA	45.37abA	44.87abA	41.37bcA	39.87cA
	7	43.12aAB	43.00aAB	42.50aAB	43.00aA	36.62bB	35.12bB
	14	39.50aB	39.75aB	39.87aB	41.12aA	34.50bB	32.00bB
Color	Fresh	18.12aA	18.25aA	17.87aA	18.00aA	17.00abA	15.50bA
	7	16.12abB	16.12abB	16.12abB	16.75aAB	14.50bB	12.75cB
	14	14.00aC	14.25aC	14.12aC	15.12aB	12.12bC	10.62bC

Means (n =3) with the same capital letters in the same column or the same small letters in the same row are not significantly different at P ≤ 0.05

The results of the sensory characteristics of the treated with different levels of OM Kareish cheese are shown in Table (5). Significant differences (P≤0.05) were found between cheeses fresh and stored cheeses. Incorporation of OM powder in Kareish cheese had pronounced statistical variations. Cheese body & texture in the presence of 0.2%, 0.1% gained similar score, whereas the cheese treated with the addition of 0.05%, 0.025% and 0.0125% OM which achieved higher scores than the control. Higher flavor score was obtained by using 0.05%, and the most acceptable treatments were when 0.0125%, 0.025% are added, followed by control. The lowest score achieved in Kareish cheese made with 0.1 & 0.2% OM. This probably could be due to the degradation of carbohydrates to lactic acid, and to the releases of flavor components such as acetaldehyde and short chain fatty acids (Van Laere et al.,1997). Insignificant (P≤0.05) differences were observed in the appearance & color of Kareish cheese for all treatments, except that made with the addition of 0.2% OM.. Generally, Kareish cheeses made The highest scores were gained for the body and the texture (smooth and compact), which could be attributed to WHC and EC properties of OM. Higher score of flavor might also be correlated to the added probiotic *Bifidobacterium lactis*, *L. rhamnosus* with different level of OM powder, which resulted in a combination of lactic and acetic acids and of free amino acids and soluble peptides, which agreed with Gobbetti et al. (1998).

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انتاج جبن قريش وظيفى باستخدام المثبتات النباتية

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تم دراسة تأثير إضافة الميوسيلاج (OM) بنسب 0% الكونترول (، 0.0125٪، 0.025٪، 0.05٪، 0.1٪ و ٠.٢٪ (w/w) على الخصائص الفيزيائية، التركيب البنائى باستخدام الميكروسكوب الإلكتروني، والقدرة على الاحتفاظ بالمياه (WHC) حيوية و عد بكتريا البروبيوتيك ، والقدرة على الاستحلاب (EC) ، وثبات المستحلب (ES) والخصائص الحسية .ووجد ان الرطوبة والتصافى فى عينات الجبن 0.2و ٠.١٪ قد زادت بحوالي ٤٪ مقارنة مع الكونترول. و لم تتأثر نسبة المواد الصلبة بشكل ملحوظ مقارنة مع الكونترول خلال فترة التخزين نتيجة اضافة الميوسيلاج .و ارتفعت قيم الـ pH فى عينات الجبن القريش باضافة الميوسيلاج مقارنة بالكونترول بعد التصنيع وخلال فترة التخزين على4^0 م / ١٤يوم. وكانت القدرة على الاحتفاظ بالماء فى عينة ٠.٢% اعلى معنويا مقارنة بالنسب الاخرى. وكان تاثير نسب اضافة الميوسيلاج على حيوية بكتريا البروبيوتيك تاثير بيفيدوجينك (مدعم نمو) بالنسبة لكل المعاملات. و كانت هناك فروق احصائية فى نتائج قياس القوام حيث انخفضت قيم كل من الصلابة و التماسك و الالتصاق و ارتفعت قيم القابلية للمضغ و التماسك و المطاطية (المرونة) مقارنة بالكونترول. و اكدت نتائج التحكيم الحسى ان اضافة النسب المختلفة من الميوسيلاج عمل على تحسين القوام و كانت افضل النتائج للمحكمين هى نسبة ٠.٠٥%. ودعمت صور الميكروسكوب الاليكترونى نتائج قياس القوام و التحكيم الحسى حيث اوضحت التركيب البنائى المكثف الممتد (حدوث استطالة) لشبكة البروتين فى معاملات ٠.٢% و ٠.١% كما فى الشكل (هـ , و) بينما اثرت نسب الاضافة ٠.٠١٢٥%, ٠.٠٢٥% و ٠.٠٥% على التركيب البنائى حيث شبكة البروتين المنتظمة و ذات الشبكة الدقيقة و متناغمة كما فى الشكل (أ, ب, ج, د). توصى الدراسة باستخدام نسب اضافة من الميوسيلاج ٠.٠٥% و ٠.٠٢٥% لانتاج جبن قريش وظيفى.