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PHYSICO-CHEMICAL AND SENSORY PROPERTIES OF KISHK SUPPLEMENTED WITH MICROENCAPSULATED PROBIOTIC CULTURES

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ABSTRACT: *Kishk was prepared with two different types of cereals, namely wheat and barley and free and encapsulated probiotic culture, bifidobacterium lactis BL-12 and stored at 25-30°C for 90 days. To analyze the effect of two different cereals on the properties of kishk, different physio-chemical tests (protein (total and soluble nitrogen), fiber, fat, ash, acidity, pH and moisture) were performed. The results showed that soluble nitrogen, ash, acidity and fiber were slightly increased while pH and moisture, total nitrogen values gradually decreased during storage period of 90 days. Microbiological counts revealed the comparative study of cereal substrates: Wheat and barley showed that encapsulated probiotic culture produced good q*uality kishk as compared to the corresponding free probiotic culture.

Key words: *Kishk, Probiotics, Encapsulation*

INTRODUCTION

Kishk is a traditional Egyptian fermented milk-wheat mixture containing lactic acid bacteria that have some probiotic properties and are considered as important foods in the diet of many Egyptians (Morcos *et al.,* 1973). Probiotics are live microorganisms that, when administrated in adequate amounts (10^6 to 10^9 viable cells per day), confer health benefits on the host (FAO/WHO, 2001). Lactobacillus and Bifidobacterium are common species of bacteria used as probiotics for the production of dairy products (Fuller, 1989). Viable microorganisms could have probiotic properties (reference recent). The global market for probiotics is expected to record a CAGR (Compound Annual Growth Rate) of 17% 2009 to 2014 (Kanade, 2010). The viability and metabolic activity must be maintained in all the steps of food processing operation includind and they must be able to survive (tolerate) in the gastrointestinal tract to confer health benefits to the host (Sanz, 2007). Survival of probiotics is affected in dairy and fermented products by a range of factors including processing conditions, pH, and acidification during storage in fermented products, hydrogen peroxide production, oxygen toxicity, storage temperatures, stability in dried or frozen form, and compatibility with traditional starter culture during fermentation (Shah, 2000). An approach to overcome some of these challenges is using encapsulation in which cells are retained survivability and viability.

A prebiotics is selectively non digestible ingredient that allows specific changes, both in the composition and /or activity in the gastrointestinal microflora that confers benefits upon host's well-being and health (Roberfroid, 2007). Kishk can serve as a good carrier for the functional ingredients viz., probiotics and prebiotics resulting in the development of symbiotic kishk.

This work carried out to assess the possibility of incorporation of probiotics in free and encapsulated phase on physcio-chemical and microbiological properties of kishk.

MATERIALS AND METHODS

Material:

Fresh bulk buffalo's milk was obtained from the herd of Faculty of Agriculture,

Menoufia University, Shibin El-kom, Egypt. Whole buffalo's was separated in the pilot plant at the Department of Dairy Science and Technology. Faculty of Agriculture, Menoufia University, Shibin El-kom, Egypt. Wheat was obtained from local market in Egypt (carbohydrate 74.1%, protein 16%, fat 2.9%, fiber 2.6% and ash 1.8%). Barley was obtained from Department of Crop Science, Faculty of Agriculture, Menoufia University, Shibin El-kom, Egypt (Carbohydrate 78.1%, protein 11.8%, fiber 5.3%, ash 3.1% and fat 1.8%).

Bacterial Strains and Propagation:

Bifidobacterium lactis (BL-12), Lactobacillus delbrueckiisubsp.bulgaricus EMCC 1102 and *Streptococcus thermopbilus* EMCC 1043 were obtained from Cairo Mircen, Ain Shams University, Egypt. *Bifidobacterium lactis (BL-12)* was activated individually by three successive transfers in modified MRS which was supplemented with 0.05% L-cystein- HCl according to Ventling and Mistry (1993) followed by three successive transfers in sterile 10% reconstituted non- fat dry milk under anaerobic conditions .*Lactobacillus delbruelkii subsp. bulgaricus and Streptococcus thermophuilus were* activated individually by three successive transfers in sterile 10% reconstituted non-fat dry milk.

Encapsulation procedure: Probiotic cells were encapsulated in alginate beads as following the encapsulation technique of Samy *et al.* (2013).

Kishk preparation:

Kishk was made from buffalos' skim milk that heated to 90 ˚C then cooled to 40 ˚C, inoculated with 2% starter (*Lb.bulgaricus* and *streptococcus thermophilus* 1:1) incubated at 42 ˚C for 4h. The fermented buffalos' skim divided into two equal portions, the first portion was mixed with crushed wheat at a ratio of (2:1). Then this part was divided into three batches, one of them was served as control (T1). T2 wheat kishk made with free cells of BL-12, T3 wheat kishk made with encapsulated BL-12. The second portion was mixed with crushed barley at a ratio of (2:1). Then this part was divided into 3 batches, one of them was served as control (T4), T5 barley Kishk made with free cells of BL-12, T6 barley kishk made with encapsulated BL-12.

Comparative survival of probiotic bifidobacteria (free and encapsulated) in a simulated gastric and intestinal juices environment.

Simulated gastric and intestinal juices were prepared as described by Rao *et al.* (1989). Simulated gastric juices pH 1.33, 0.08M HCl containing 0.2% (w/v) NaCl was inoculated with kishk (wheat or barley) containing free or encapsulated cells and were incubated at 37°C. Survival *bifidobacterium lactis* counts were analyzed at 1, 2 and 3 hours. The above mentioned experiment was preformed with simulated intestinal juice prepared by 0.05M KH_2PO_4 adjusted to pH 7.43 with 0.1 N NaOH. *B. lactis* counts were assayed and the time for complete dissolution of encapsulated cells was recorded.

Physico-chemical analysis

Different physico-chemical parameters such as moisture, ash, fat, protein and lactose and fiber in all prepared yoghurt samples were estimated by the methods as described in A.O.A.C. (2005). Acidity was determined by using phenolphthalein as indicator by titration of 0.1 N NaOH. pH was determined by using pH meter.

Microbiological analysis

Viable counts of bifidobacteria were determined in duplicate by pour plate method on modified MRS agar containing solution of antibiotics and lithium chloride (Wijsman *et al.,* 1989). Plates were incubated under anaerobic conditions at 37^{o}C for 2 - 3 days. Total bacterial count and coliform group and yeast and mold were examined as suggested by Harrigan and McCance (1990).

Sensory evaluation:

The sensory properties of soup made from wheat and barley Kishk were evaluated by Six panelists who asked to score kishk soup in terms of taste, color, odor, consistency and mouth feel using a five-point scale, with 1 being " dislike extremely" and 5 being " like extremely" Kishk soups were prepared by mixing 80g kishk sample with 1 liter water and simmering for 10 min with constant stirring. The cooked samples were served to the panelists at room temperature in random order (Handan *et al.,* 2006).

Statistical analysis:

Data were analyzed using 2 X 3 factorial designs. Newman keuls' Test was used to make the multiple comparisons (Steel and Torrie, 1980) using Costat program.

Significant differences were determined at $P \leq 0.05$.

RESULTS AND DISCUSSION

Physiochemical changes occurring in two types of kishk samples manufactured from Wheat or Barley during storage for 90 days are shown in Tables (1 – 2). It was found that there was a gradual decrease in moisture contents in all kishk samples with the progression of storage period. The results clear that the moisture contents from different treatments no appreciable change during the storage period. The moisture was within figure given by El Nawawy *et al.* (2012) and Kebary *et al.* (2014). It was, also observed that all kishk (wheat or barley) treatments-containing encapsulated cells had moisture content slightly higher than those of corresponding treatments containing free cells. This can be explained by the fact that alginate has participated along with the protein to gel network formation at slightly acid pH (Lin, 1977). Furthermore, alginate possesses hydrophilic and water-binding potential properties (Berger *et al.*, 1953). Additionally, barley contains high percentage of β-glucan (dietary fibers) that binds tightly appreciable amounts of water (Bhatty, 1992) and in wheat (Wood, *et al.*1984).

Acid content is one of these confounding factors in determining kishk flavor. Changes in titratable acidity increased significantly ($P < 0.05$) with the extension of storage period (Table 1 and Table 6). This is in accordance with other researchers Elewa and Metry, (2006), El-Nawawy *et al.* (2012) and Kebary *et al.* (2014). The change in acidity was significantly ($P < 0.05$) higher in kishk cereals- containing free probiotic culture than with those containing encapsulated cells. After 90 th days of storage, the acidity of treatments T2 and T5 was the highest (1.31 and 1.30), and lowest with free cells (1.17 and 1.13) which shows that encapsulation of bifidobacteria in kishk effectively contribute to the flavor retention. Furthermore, alginate beads do not exert a diffusion limitation for substrate such as lactose or other metabolites (Larisch *et al.,* 1994). Also, wheat and barley matrices may compensate alginate microparticle porosity (Gouin, 2004) by offering a cell barrier to higher local detrimental acidity encountered in its environment (Prevost and Divies, 1992).

Tables (1 and 6) showed decline in pH values of all kishk treatments being more pronounced in wheat and barley containing free cells comparing to those kishk samples containing encapsulated cells. This confirmed as pointed in acidity and could be attributed to produce a number of breakdown products, including the short-chain fatty acids; acetic, propionic, butyric acids and formic, lactic and succinic acids in kishk (Damir *et al.*, 1992).

Tables (1 and 6) represented fat content changes in wheat and barley kishk samples. Fat as macro- constituent of wheat kishk was higher than that counted in barley kishk. At the end of 90th day of storage, fat contents in wheat kishk and barley kishk with encapsulated probiotic culture cells were 2.38 and 1.71 %, respectively. Several authors have been noticed the breakdown of

Table (1): Effect of treatment of kishk (Wheat or Barley) with free and encapsulated probioti Bifidobacteria during storage.

Treatment	Moisture			pH			Titratable acidity (%)			Fat Content (%)		
	Storage period (days)											
	0	56	90	0	56	90	0	56	90	0	56	90
*T_1 (Control)	8.80	8.74	8.59	5.02	4.95	4.93	1.01	1.12	1.28	2.47	2.43	2.39
T_2	8.86	8.73	8.63	4.90	4.82	4.80	1.04	1.16	1.31	2.48	2.43	2.41
T_3	8.95	8.80	8.74	4.92	4.85	4.82	1.04	1.11	1.17	2.44	2.39	2.38
T_4 (Control)	8.65	8.48	8.40	5.00	4.91	4.88	1.00	1.12	1.26	1.74	1.68	1.65
T_5	8.60	8.45	8.36	4.84	4.76	4.70	1.05	1.18	1.30	1.78	1.74	1.70
T_6	8.62	8.46	8.45	4.85	4.82	4.78	1.05	1.13	1.19	1.78	1.74	1.71

*T1: Wheat kishk (Control, with no *Bifidobacterium lactis* BL12).
T2: Weat kishk with free cells Bifidobacterium *lactis* BL12
T3: Weat kishk with encapsulated cells *Bifidobacterium lactis* BL12
T4: Barley kishk (Control, with no *Bifidobacterium lactis* BL12).
T5: Barley kishk with free cells *Bifidobacterium lactis* BL12
T6: Barley kishk with encapsulated cells *Bifidobacterium lactis* BL12

Table (2) Effect of treatment of kishk with free and encapsulated probiotic Bifidobacteria during storage.

Treatment	Storage period (days)											
	Total Nitrogen TN (%)			Soluble Nitrogen (%)			Ash (%)			Fiber (%)		
	0	56	90	0	56	90	0	56	90	0	56	90
*T_1 (Control)	15.92	15.43	14.90	0.09	0.21	0.36	6.26	6.33	6.35	2.26	2.31	2.35
T_2	15.96	15.42	14.88	0.08	0.28	0.41	6.29	6.34	6.37	2.24	2.28	2.31
T_3	15.90	15.40	14.86	0.09	0.22	0.37	6.31	6.37	6.39	2.48	2.53	2.57
T_4(Control)	10.90	10.46	9.90	0.08	0.18	0.30	7.30	7.35	7.38	5.25	5.30	5.33
T_5	10.96	10.44	9.93	0.08	0.25	0.39	7.33	7.39	7.41	5.24	5.30	5.34
T_6	10.87	10.39	9.90	0.09	0.20	0.34	7.37	7.44	7.46	5.40	5.44	5.48

See footnote Table (1).

fat and identified the profile of amino acids and fatty acids in kishk (Damir *et al,*1992 , and Bahgaat and Abd El Ghani , 2016).

Changes in ash content of kishk (wheat or barley) made with free and encapsulated probiotic culture is presented in (Table 2 and Table 6). Results indicated that there were no significant ($p \geq 0.05$) differences among kishk treatments. Similar results were reported by Elewa and Metry, (2006), El-Nawawy *et al.* (2012) and Kebary *et al.* (2014).

The fiber content of kishk treatments did not change significantly ($p \geq 0.05$) throughout the storage period (Table 2 and Table 6). These results are in accordance with Tamime *et al.* (1997), Elewa and Metry (2006) and El-Nawawy *et al.* (2012). It is noteworthy that barley Kishk had 2 times of fiber content as compared to wheat kishk, which may reflect compositional variation of cereal types (Marklinder *et al.* 1992 and Tamime *et al.* (1997). Also, alginate is considered as a supplemental source of dietary fiber (Havler *et al.*, 2005).

Changes in total nitrogen (TN) and soluble nitrogen (SN) are presented in (Table 2 and Table 6). TN content did not change significantly ($p \geq 0.05$) in kishk (wheat or barley) containing free and encapsulated probiotic bacteria as the storage period progressed. Similar results were reported by El-Nawawy *et al.* (2012) and Kebary *et al.* (2014).

Changes in soluble nitrogen increased significantly ($p < 0.05$) with treatment and advanced with the storage period) (Table 2 and Table 6). Change SN % in kishk (wheat and barley) with free cells increased significantly ($p \geq 0.05$) and valued 5.1 and 4.5 times of their initial values, respectively. SN % of kisk treatments (wheat and barley) with encapsulated cells were 4.1 and 3.7 times of their initial contents. Previous studies in kishk revealed the same conclusion Elewa and Metry, (2006), El-Nawawy *et al.* (2012) and Kebary *et al.* (2014). The increase in soluble nitrogen in kishk treatments with free cells compared to those with encapsulated could be attributed to the higher acidity of the former (free cells) (Table 1), which provides more convenience condition to perform certain cellular activities, i.e., proteolysis Fox (1969). Even though, the diffusion limitation encountered by the gel matrix for macromolecules such as a protein has been observed by Tanaka (1984). Encapsulated cells did not exert complete prevention of modulating the accessibility of bacteria cells to protein hydrolyzing enzymes interaction in kishk matrices, since active cells of probiotic bacteria would be preferentially oriented at the peripheral area of the beads (Arnaud *et al.* (1992).

Table (3) represents total viable count during storage. The populations of viable count showed a gradual increase until 15th day of storage with counting values (Log_{10}CFL /g) varying from 2.00 in the control (T1) to 9.58 in (T6). After 90th days of storage, the counts were reduced being maximum 8.00 and 8.90 for control (T3) and (T6), respectively. These results indicate that encapsulation enhances the viability of total bacterial counts.

B. lactis BL12 count gradually increased till the 30th day of storage being (Log_{10}CFU/g) 8.20 and 8.24 for kishk samples (T2 and T3) and 8.2 for barley kishk (T5 and T6). At the 90th day of storage, bifidobacteria count declined by 2.66 and 2.80 log units in kishk (wheat and barley) with free cells (T2 and T5) , respectively, while the reduction in counts were 0.05 and .012 log units for kishk (wheat and barley) with encapsulate cells (T3 and T6), respectively. The survivability of bifidobacteria bacteria encountered in encapsulated probiotic cells-treated kishk may be attributed to limited aeration within the kishk ecosystem. Also, Encapsulation may cause reduction of oxygen partial pressure (pO_2) of the kishk matrices (Shah , 2007).

Table (3): Microbiological counts (Log_{10} (CFU/g) in kishk (Wheat or Barley) with free and encapsulated Bifidobacteria during storage.

Treatments	Total viable count				
	Storage period (days)				
	0	15	30	60	90
*T_1 (Control)	1.65	2.00	1.63	1.32	1.10
T_2	9.65	10.08	9.84	8.20	6.05
T_3	9.50	9.87	9.71	9.34	8.00
T_4(Control)	1.70	2.08	1.65	1.36	1.20
T_5	9.58	10.00	9.77	8.08	5.90
T_6	9.41	9.72	9.60	9.25	8.92
Bifidobacteria count					
*T_1 (Control)	-	-	-	-	-
T_2	8.10	8.21	8.30	7.43	5.44
T_3	8.08	8.18	8.24	8.12	8.03
T_4(Control)	-	-	-	-	-
T_5	8.00	8.09	8.20	7.22	5.20
T_6	8.02	8.10	8.20	8.07	7.90
Spore forming bacteria count					
*T_1 (Control)	ND	2.4	1.72	1.66	1.42
T_2	ND	2.30	1.62	1.49	1.33
T_3	ND	2.75	2.56	2.17	1.49
T_4(Control)	ND	2.30	1.59	1.54	1.35
T_5	ND	2.21	1.50	1.36	1.29
T_6	ND	2.48	2.25	2.10	1.61
Mold and yeast count					
*T_1 (Control)	< 1	< 1	< 1	< 1	1.5
T_2	< 1	< 1	< 1	< 1	1.2
T_3	< 1	< 1	< 1	< 1	1.3
T_4(Control)	< 1	< 1	< 1	1.2	1.6
T_5	< 1	< 1	< 1	< 1	1.3
T_6	< 1	< 1	< 1	< 1	1.3

*See foot note Table (1).
**: Not detected

Counts of spore forming bacteria are presented in Table (3 and Table 6). . At the 15th day of storage, spore forming counts ranged from 2.21 to 2.75 Log_{10} CFU/g. The presence of spore forming counts in kishk (wheat and barley) could be due to the microflora of wheat and milk base. At the 90th day of storage period, Spore forming counts declined to range between 1.29 and 1.61. The reduction of spore forming

bacteria could be explained by the development of acidity and antagonistic activity of lactic acid bacteria (Lindgren, 1983).

Moulds and yeasts count represented in Table (3) show that kishk treatments were not free from moulds and yeasts during storage period. At the 90th days of storage, it counted from 1.2 to 1.6 Log_{10} CFU/g. These may be due to the post contamination. a These results are in agreement with those reported by Hussein *et al.* (2006).

Organoleptic evaluation results of soup made from Kishk treatments were accepted by panelists at the end of storage period (Table 4 and Table 6).

Kishk either wheat or barely containing encapsulated *befibacterium lactis* gained higher scores as compared to kishk (wheat or barely) containing free cells and control. The incorporation of *bifidobacterium lactis* BL12 augmented the constituents that affect palatability and acceptability of Kishk. This is possibly attributed to variation in sensory and nutritional properties of wheat and barley (Tamime *et al.*, 1997 and Charalampopoulos ,*et al.* 2002).

Fig. 1. Illustrates the Survivability of free and encapsulated cells of *Bifidobacteria lactis* BL12 containing – wheat kishk or – containing barely kishk and free cells alone in simulated gastric juice over 3 h incubation times. Survivability of free State cells is dropped sharply ($p \leq 0.05$) and they were 34.1, 20,2 and 7.3% at 1, 2, and 3 h incubation times, respectively. It has been reported earlier that free cells of some bifidobacteria strains were not recovered from fermented cow milk after I h at pH 1.0 (Pochart et al., 1992) and in HCl solution (Clark et al., 1993). Kamaly (1998) noted a drop in survival rate of free cells of *Bifidobacterium bifidum* equivalent to 7.5%. At 3h of incubation, the drop of survival rate of *Bifidobacterium lactis* BL12 was in the following order T6 (55.0%) > T3 (52.0% > T5 (29.7%) > T2 (20.2%) as compared to free cells (without kishk) 7.3%. Variation in survivability could be due to encapsulation of cells. Additionally, cereal varieties matreses could provide barrier against acidic condition of stomach (Charalampopoulos ,*et al.* 2002).

Table 5. represented viability of free and encapsulated *Bifidobacterium lactis* BL12 in simulated intestinal juice (pH 7.47) or sequential inoculated and incubated in simulated gastric juice (pH 1.33 for 60 min) followed by simulated intestinal juice (pH 7.43).

Survivability of kishk (wheat and barley) with free and encapsulated cells in alginate beads subjected to simulated intestinal juice was not significantly ($p > 0.05$) changed and the time required for complete disintegrate of encapsulated alginate beads in kishk were comparable for Wheat (62h) and for barley (74h)). sequential incubation in simulated gastric for 60 min followed by simulated intestinal juice resulted in significant ($p \leq 0.05$) reduction in survivability for free cells (without kishk) by 6.23 Log_{10} CFU/g . The drop in viability (Log10 CFU/g) for wheat kishk with free cells 2.23 and with encapsulated cells 0.20 and for barley kishk with free cells 1.27 and for encapsulated cells 1.08. It is noted that the time required for complete dissolution of alginate beads upon sequential incubation in simulated gastric and intestinal juices was doubled compared to that time required for incubation in intestinal juice only. In a study carried out by Rao *et al.*, (1989), the encapsulated *B. pseudolongum* was declined by approximately 3 orders of magnitude when successively incubated in gastric juice (pH 1.33) for 30 min followed by holding in intestinal juice (pH 7.43).

These results demonstrate that the possible use of cereals as adequate matrix containing prebiotic ingredients in making kishk and incorporation of probiotic culture would applicable to deliver the apropriate number of probiotics .

Table (4): Changes in total organoleptic quality score of kishk (Wheat or Barley) with free and encapsulated Bifidobacteria during storage.

Treatments	Organoleptic properties					Total
	Color	Taste	Odor	Mouth feel	Consistency	
*T_1 (Control)	3.8	4.2	3.4	4.5	4.0	20.8
T_2	4.0	4.5	4.0	4.5	4.2	21.2
T_3	4.0	4.7	4.5	4.7	4.3	22.2
T_4(Control)	4.0	4.0	4.3	4.4	4.0	20.7
T_5	4.1	4.2	4.2	4.3	4.1	20.9
T_6	4.1	4.5	4.4	4.5	4.3	21.8

See footnote Table (1).

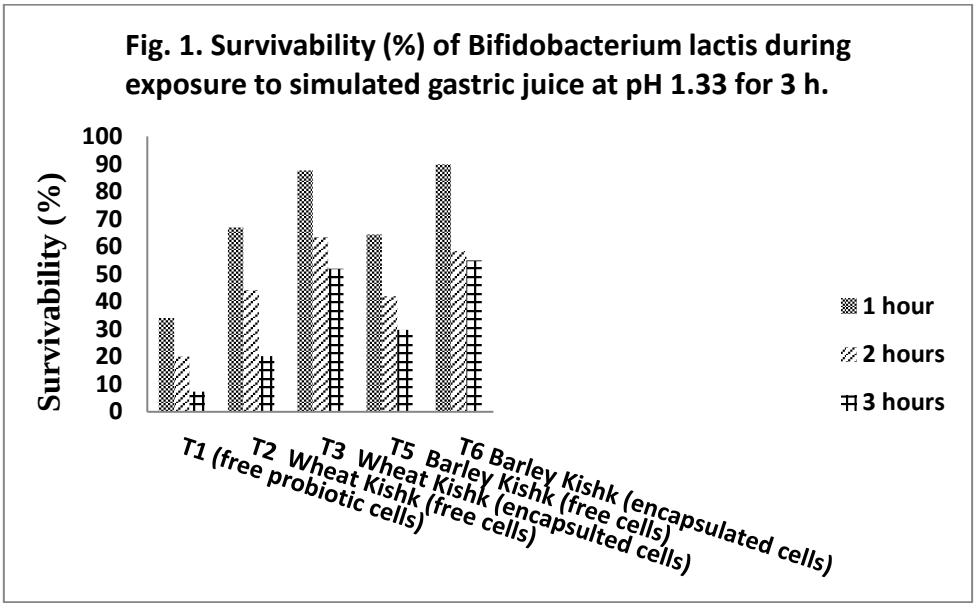

Table (5). Viability of free and encapsulated *Bifidobacterium lactis* BL12 in simulated intestinal juice (pH 7.47) or sequential inoculated and incubated in simulated gastric juice (pH 1.33 for 60 min) followed by simulated intestinal juice (pH 7.43).

State of culture in kishk	PH 7.43		Sequential incubation in pH 1.33 and pH 7.43	
	Time*	Log_{10}CFU/ml	Time	Log_{10}CFU/ml
Wheat kishk				
Free Cells	-	8.31 ± 2.22	-	1.92 ± 2.60
Encapsulated Cells	56	8.20 ± 1.20	110	7.80 ± 2.40
Barely kishk				
Free Cells	-	8.10 ± 2.00	-	1.83± 1.92
Encapsulated Cells	54	8.00 ±1.88	110	7.92 ± 2.2o

* Time recorded for complete disintegrate of encapsulated alginate beads in kishk

Table (6). Statistical analysis of kishk properties.

Kishk Properties	Effect of kishk treatments							Effect of storage period (days)			
	Mean squares	Multiple comparisons						Mean squares	Multiple comparisons$^{\Delta}$		
		$T_1$$^{\Delta}$	T_2	T_3	T_4	T_5	T_6		0	45	90
Moisture (%)	0.203	A**	A	A	A	A	A	0.219	A	A	A
PH values	0.307*	A	B	A	A	B	A	0.164*	A	B	C
Titratable acidity(%)	0.069*	B	A	B	B	A	B	0.218*	C	B	A
Ash (%)	0.965	B	B	B	A	A	A	0.33	A	A	A
Fat (%)	1.328	A	A	A	B	B	B	0.026*	A	A B	B
Fiber (%)	23.945*	D	D	C	B	B	A	0.033	A	A	A
Total nitrogen (%)	67.264*	A	A	A	B	B	B	4.714*	A	A B	B
Soluble nitrogen(%)	0.063*	B	B	B	A	A	A	1.951*	B	A B	A
Sensory evaluation	0.0195	CD	BC	A	D	C	B	-	-	-	-
	Mean squares	Multiple comparisons						Mean squares	Multiple comparisons				
		T_1	T_2	T_3	T_4	T_5	T_6		0	15	30	60	90
Total Counts	223.454*	C	B	A	C	B	A	12.768*	A	A	A	B	C
Bifidobacterial counts	242.063*	D	B	A	D	C	A	3.418*	A	A	A	B	C
Spore forming counts	0.658*	C	D	A	D	E	B	14.695*	E	A	B	C	D

Δ: See foot note table (1).

* : Significant at 0.05 levels.

* *: For each effect the different letters in the means of the multiple comparisons are different from each. Letter A is the highest mean followed by B, C…..etc.

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الخصائص الكيماويه–الطبيعيه و الحسيه للكشك المدعم بمزارع البكتيريا الداعمه للحيويه

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الملخص العربي

تهدف الدراسة إلى انتاج مادة غذائية تجمع بين فوائد الحبوب الكاملة وفوائد اللبن والبكتريا الداعمة الحيوية، حيث تم تصنيع كشك (قمح & شعير) وإضافة لكل منها بكتريا بروبيوتيك BL–12 في صورة حرة واخري في صورة مكبسلة.

تم دراسة تأثير هذه الخلايا البكتيرية في كلا الصورتين علي كلاً من الخواص الكيميائية الطبيعيه والميكروبيولوجية والحسية لعينات الكشك أثناء التخزين (٩٠ يوم) علي درجة حرارة الغرفة . تم اختبار حيوية ميكروب BL–12 تحت ظروف مشابهة لتلك بالجهاز الهضمي (المعدى و المعوى).

وأوضحت النتائج تطور الحموضة بشكل واضح في الكشك المحتوي علي الخلايا في صورة حرة عنه في حالة المحتوي علي خلايا مكبسلة، انخفض pH بشكل كبير في حالة العينات المحتوية علي الخلايا الحرة عنه في حالة المضاف إليها خلايا مكبسلة، لم يحدث اختلاف واضح في كلاً من الدهن والرماد والالياف باختلاف المعاملات .

أعطت العينات المحتوية علي الخلايا المكبسلة درجات تحكيم أعلي من المحتوية علي الخلايا الحرة .

أدي اضافة الخلايا في صورة كبسولات إلى الحفاظ علي حيوية الخلايا البكتيرية أثناء التخزين بصورة أعلي من الخلايا الحرة .

أنخفضت اعداد الخمائر والفطريات في جميع العينات المحتوي علي الخلايا BL 12 في صورة حرة و خلايا مكبسلة.

لم تظهر بكتريا مجموعة الكوليفورم طوال فترة التخزين.

واوضحت النتائج انخفاض اعداد الخلايا الحرة للبكتيريا BL.12 معنوياً بعد تعرضه لمحلول مشابه للعصاره المعدية عند درجة pH ١,٣٣ وكذلك العصارة المعوية pH ٧,٤٣ مقارنة بالخلايا المكبسلة .