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Improvement of the Nutritional Value of a Cereal Fermented Milk: 2-Dried Kishk Like

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Abstract

The present study has been conducted to produce fermented milk fortified with different cereals like whole wheat, barley and freek (green wheat) burghul have been selected for their known nutrition benefits. The fermentation was occurred by using three types of cultures, yogurt starter, yogurt starter + Bio-yogurt or yogurt starter + *Lactobacillus plantarum*. All samples were stored at room temperature (25 ± 2°C) for three months and have been subjected to consumer sensory testing; dried kishk-like products were highly accepted by the tasting panel, furthermore fermented dairy products containing Freek gained the highest score of judging followed by wheat. Proximate composition, Colour, Organic acids and microbiologically analysis have been monitored in the fresh soft product and during storage. Nevertheless, the combined levels of organic acids, low pH, salt additive and low moisture content in the kishk samples were sufficient to ensure the microbial safety of the product. Thus, long shelf-life of all samples without changing in their chemical during the storage period has been noticed.

Keywords: Burghul; Probiotic bacteria; Dried kishk; Organic acids; Colour; Skim milk

Introduction

Fermentation is one of the oldest and most economical methods of producing and preserving food. Also, leads to a general improvement in the shelf life, texture, taste and aroma of the final product. Fermented foods are produced world-wide using various manufacturing techniques, raw materials and microorganisms [1]. Kishk is an extremely popular fermented food in many parts of the Middle East. In Egypt, Kishk is one of the traditional food products in Upper Egypt [2,3]. There are some other products similar to kishk such as tarhana (mixing yogurt, wheat flour, baker's yeast and variety of vegetables and spices in turkey), kushuk (milk- sour dough mixture with turnips in Iraq), atole (fermented cereal–milk porridge in Scotland and Greece) and tahonya/talkuna (fermented cereal mixture with vegetables in Finland and Hungary) [4]. Kishk is a natural, healthy, respect the environment and have great taste and cultural values that are increasingly attractive to the Egyptian consumers. Kishk made by mixing wheat with fermented milk (Laban zeer) and sun-drying the mixture to 8% to 12% moisture content [2,5] or made from different cereal products and fermented milk base by traditional methods of manufacture [6,7]. Kishk is usually reconstituted with water and served as a hot gruel, but with the incorporation of vegetables, spices, garlic or herbs, can form the base of savory and sweet dishes [8]. The aim of the present study was to focus some light on the chemical, biochemical, physical and sensory aspects of dried fermented milk made from various types of cereal and starter cultures.

Materials and Methods

In the previous paper, the preparation kishk-like from reconstituted skim milk and burghul from whole wheat, whole barley and fereek was described in Nassar et al. [9].

Dried Kishk-like manufacturing

Each type of burghul was mixed with reconstituted skim milk in a ratio of 1:4 (w/w) in addition to, 2% sodium chloride and then mixed thoroughly each 26%. Mixture was heated to 95°C for 10 seconds, and then rapidly cooled to 45°C, addition 3% of each Starter. The resultant paste was filled in polystyrene cups and covered then incubated at (43°C for W1, B1 and F1) and (37°C for W2, W3, B2, B3, F2 and F3) to 6 hours (Table 1). After that, the fermented paste was formed into nuggets (3-5 cm), placed into stainless steel trays and dried in air oven at 50°C for 15-18 h. the dried nuggets were milled by using a hammer mill. After that, the dried kishk were stored in airtight glass containers and kept at room temperature until tested (Figure 1).

Chemical analysis

In the previous paper, the same methods were adopted for cereal and dairy base analysis as described in Nassar et al. [9].

Dried Kishk-like analysis

Proximate composition: Total solids, protein, ash and fiber content were determined according to procedures described by AOAC [10]. The fat content, salt percentage, acidity and pH value were determined according to Ling [11]. Finally, carbohydrate was calculated as follows [12]:

Carbohydrate = total solids - (protein + fat + ash)

Colour of kishk-like samples: Colour of dried kishk samples was evaluated by Lovibond Schofield Tintometer (the Tintometer Ltd. Salisbury, England). Colours of samples were assessed. Reading obtained was further converted into C.I.E. (Commission International de L'E Clairage) units using the visual density graphs and direction booklet supplied with apparatus as described in AOCS [13].

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Treatments	Cereals			Dairy base	Salt 2%
	Whole Wheat Burghul (W)	Whole Barley Burghul (B)	Freek Burghul (F)	Re-constituted Skim milk (15%)	
1	√			√	√
		√		√	√
			√	√	√
2	√			√	√
		√		√	√
			√	√	√
3	√			√	√
		√		√	√
			√	√	√

1: (3% Yoghurt starter)
2: (2% Yoghurt starter + 1% Bio-yoghurt starter)
3: (2% Yoghurt starter + 1% *Lactobacillus plantarum*)

Table 1: Experimental treatments.

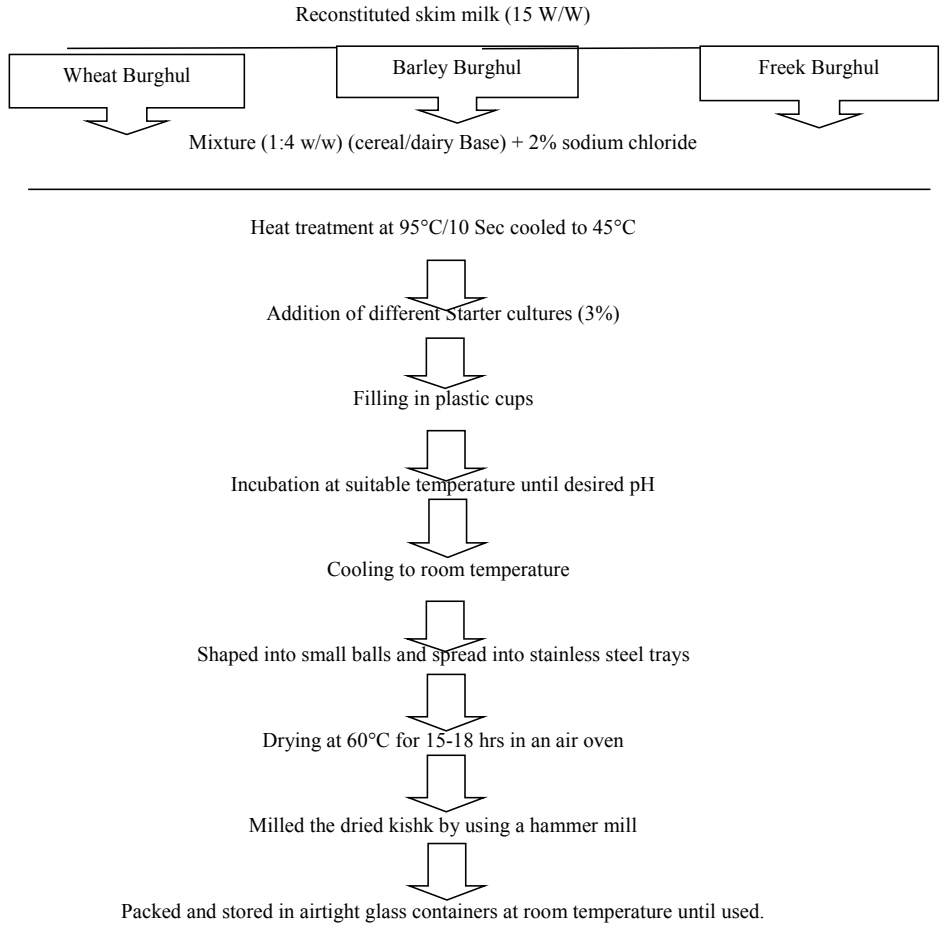

Figure 1: Dried kishk-like preparation by using different substrates and starters.

Organic acid determination: The concentrations of organic acids (Lactic, Propionic, acetic, and formic) in different dried Kishk samples were determined by HPLC (Spectra-Physics system, San Jose, CA, USA) method as described by Barrantes et al. [14]. Organic acids were extracted from dried Kishk (5 g) in a 50 mL beaker using 25 mL water-acetonitrile (1:4 v/v) (analytical grade, BDH Chemicals Ltd., Poole, UK). The extract after filtration through a Whatman No. 1 filter paper (Whatman Ltd., Maidstone, UK) was injected (20 µL) into the HPLC column. The flow rate of the solvent was 0.7 $\mu L.min^{-1}$ at 65°C and the wave length of the detector was 220 nm [15].

Sensory evaluation

Organoleptic evaluation was carried out according to Abou-Donia et al. [16]. The samples were subjected to organoleptic analysis by 15 well-trained members of the Dairy Science and Technology Department (Fac. Agric. Alexandria Univ., Egypt). The sensory attributes evaluated were: The Flavor (1-45 points), Body and Texture (1-30 points), appearance and Colour (1-15 points) and acidity (1- 10 points). Soups were prepared by adding 20 g dried kishk to 170 mL of water and heating with gentle stirring to boiling, simmering for few

min and cooling to 40°C. The samples (20 g) were placed in identical glass containers (8 cm diameter, 3.5 cm height) and served at 40°C [17].

Enumeration of microorganisms

The counts of lactic acid bacteria were enumerated as (CFU/g) using MRS agar according to De man et al. [18]. Proteolytic bacteria, coliforms, yeast and mould were enumerated respectively [19-21]. Whereas aerobic spore forming bacteria were enumerated according to the method described by Harrigan and McCance [22]. *Lactobacillus acidophilus* was enumerated according to the method described by Lapierra [23].

Statistical analysis

Statistical analysis was performed by applying three-way ANOVA and multiple comparisons of means of each treatment (cereals, starter cultures and storage time) using the Least Significant Difference (LSD) test at the confidence level of 95% [24].

Results and Discussion

Proximate composition

Proximate analysis of kishk-like products is presented in Tables 2-4. The results revealed that the effect of cereal type on the proximate analysis of the resultant dried kishk-like products was more pronounced ($P \leq 0.05$) than that of type of starter culture used.

There were significant differences ($P \leq 0.05$) in acidity and pH values between different cereals fermented milk products, depending on the type of cereal or starter culture. The fresh soft cereal fermented

Samples	Storage period (Days)	Acidity as lactic acid	pH	Total Solids%	Fat content%	Ash%	Crude Fiber%	Crude protein%	Carbohydrates%	Salt%
W1	Fresh soft pro.	0.300^{PQR}	5.44^{A}	27.42^{RS}	0.280^{L}	2.98^{J}	0.36^{E}	4.99^{K}	18.80^{NOP}	2.06^{B}
	Fresh dried pro.	1.803^{IJKL}	5.23^{D}	93.27^{A}	0.95^{A}	10.15^{A}	1.21^{B}	16.97^{ABCDEFG}	63.98^{CDE}	7.00^{A}
	30	1.880^{HIJK}	5.17^{EF}	92.65^{AB}	0.95^{A}	10.08^{A}	1.206^{B}	16.86^{ABCDEFGH}	63.56^{DEF}	6.96^{A}
	60	2.080^{CDEFG}	5.05^{J}	92.25^{BCDEFG}	0.94^{B}	10.04^{A}	1.20^{B}	16.79^{ABCDEFGH}	63.28^{EFG}	6.93^{A}
	90	2.136^{BCDE}	5.02^{K}	91.46^{HIJKLM}	0.933^{BC}	9.95^{AB}	1.19^{B}	16.64^{BCDEFGHI}	62.74^{FGH}	6.87^{A}
W2	Fresh soft pro.	0.223^{R}	5.23^{D}	28.92P	0.290^{K}	2.88^{J}	0.36^{E}	5.03^{K}	20.36^{M}	2.14^{B}
	Fresh dried pro.	1.963^{FGH}	5.14^{GH}	92.35^{BCDE}	0.94^{B}	9.206^{GHI}	1.15^{B}	16.06^{IJ}	64.99^{ABC}	6.85^{A}
	30	1.976^{FGH}	5.12^{H}	92.29^{BCDEF}	0.94^{B}	9.20^{GHI}	1.15^{B}	16.05^{IJ}	64.95^{ABC}	6.85^{A}
	60	2.220^{ABC}	5.01^{K}	91.86^{CDEFGHIJ}	0.933^{BC}	9.16^{GHI}	1.14^{B}	15.97^{J}	64.64^{ABCD}	6.82^{A}
	90	2.336A	4.93^{M}	91.70^{FGHIJKL}	0.930^{C}	9.14^{GHI}	1.14^{B}	15.94^{J}	64.53^{ABCD}	6.80^{A}
W3	Fresh soft pro.	0.226^{QR}	5.32^{C}	28.11^{Q}	0.290^{K}	2.85^{J}	0.36^{E}	5.02^{K}	19.58^{MN}	2.10^{B}
	Fresh dried pro.	1.896^{HIJ}	5.19^{E}	92.28^{BCDEF}	0.94^{B}	9.36^{EDFG}	1.18^{B}	16.48^{FGHIJ}	64.31^{ABCDE}	6.91^{A}
	30	1.926^{GHI}	5.16^{FG}	91.93^{CDEFGHI}	0.94^{B}	9.33^{FGH}	1.17^{B}	16.42^{GHIJ}	64.07^{CDE}	6.88^{A}
	60	2.146^{BCD}	5.08^{I}	91.78^{EFGHIJK}	0.94^{B}	9.31^{GH}	1.17^{B}	16.39^{GHIJ}	63.96^{CDE}	6.87^{A}
	90	2.226^{AB}	4.92^{M}	91.33^{IJKLM}	0.933^{BC}	9.27^{GHI}	1.17^{B}	16.31^{HIJ}	63.65^{DEF}	6.84^{A}
SED		0.026	0.004	0.108	0.001	0.048	0.012	0.111	0.191	0.085
R-Square		0.996	0.999	0.999	0.998	0.999	0.9993	0.998	0.9997	0.996
Coeff. Var.		2.844	0.141	0.238	0.367	1.041	1.683	1.35	0.609	2.501

$^{A-M}$: All the means were differentiated by a standard deviation (p<0.05).

Table 2: Chemical properties of cereal fermented milks using burghul from whole wheat.

Samples	Storage period (Days)	Acidity as lactic acid	pH	Total Solids%	Fat content%	Ash%	Crude Fiber%	Crude protein%	Carbohydrates%	Salt%
B1	Fresh soft pro.	0.423^{P}	5.23^{D}	27.96^{QR}	0.266^{MN}	2.86^{J}	0.70^{D}	5.10^{K}	18.19^{OP}	2.07^{B}
	Fresh dried pro.	1.910^{HIJ}	4.97^{L}	91.98^{CDEFGH}	0.900^{DE}	9.71^{BC}	2.38^{A}	17.31^{A}	61.68^{HIJK}	7.01^{A}
	30	1.986^{EFGH}	4.93^{M}	91.85^{CDEFGHIJ}	0.900^{DE}	9.70^{BC}	2.38^{A}	17.28^{AB}	61.58^{IJK}	7.00^{A}
	60	2.233^{ABC}	4.87^{NO}	91.55^{HIJKLM}	0.893^{EF}	9.66^{C}	2.37^{A}	17.23^{ABC}	61.39^{IJKL}	6.98^{A}
	90	2.310^{A}	4.46^{U}	91.43^{HIJKLM}	0.890^{F}	9.65^{C}	2.37^{A}	17.20^{ABCD}	61.30^{IJKL}	6.97^{A}
B2	Fresh soft pro.	0.440^{P}	4.94^{M}	26.70^{T}	0.260^{N}	2.83^{J}	0.70^{D}	5.05^{K}	17.85^{P}	2.03^{B}
	Fresh dried pro.	1.970^{FGH}	4.87^{NO}	91.09^{LMN}	0.900^{DE}	9.65^{C}	2.40^{A}	17.24^{ABC}	60.90^{JKL}	6.95^{A}
	30	2.086^{CDEF}	4.74^{Q}	90.96^{MN}	0.900^{DE}	9.64^{C}	2.39^{A}	17.21^{ABCD}	60.81^{JKL}	6.93^{A}
	60	2.250^{AB}	4.66^{S}	90.63^{NO}	0.890^{F}	9.62^{CDE}	2.38^{A}	17.15^{ABCDE}	60.58^{KL}	6.91^{A}
	90	2.336^{A}	4.52^{T}	90.30^{O}	0.890^{F}	9.59^{CDEF}	2.37^{A}	17.09^{ABCDEF}	60.35^{L}	6.88^{A}
B3	Fresh soft pro.	0.413^{PQ}	5.43^{AB}	27.29ST	0.270^{M}	2.85^{J}	0.70^{D}	5.10^{K}	17.94^{P}	2.03^{B}
	Fresh dried pro.	1.926^{GHI}	5.22^{D}	92.69^{AB}	0.903^{D}	9.70^{BC}	2.38^{A}	17.32^{A}	62.38^{GHI}	6.88^{A}
	30	2.033^{DEFGH}	5.07^{IJ}	92.21^{BCDEFG}	0.900^{DE}	9.65^{C}	2.37^{A}	17.23^{ABC}	62.05^{HI}	6.85^{A}
	60	2.190^{ABC}	5.01^{K}	91.84^{DEFGHIJK}	0.896^{DEF}	9.61^{CDE}	2.36^{A}	17.16^{ABCDE}	61.80^{HIJ}	6.82^{A}
	90	2.266^{AB}	4.89^{N}	91.64^{GHIJKL}	0.890^{F}	9.62^{CD}	2.35^{A}	17.12^{ABCDE}	61.64^{HIJK}	6.81^{A}
SED		0.026	0.004	0.108	0.001	0.048	0.012	0.111	0.191	0.085
R-Square		0.996	0.999	0.999	0.998	0.999	0.9993	0.998	0.9997	0.996
Coeff. Var.		2.844	0.141	0.238	0.367	1.041	1.683	1.35	0.609	2.501

$^{A-M}$: All the means were differentiated by a standard deviation (p < 0.05)

Table 3: Chemical properties of cereal fermented milks using burghul from whole barely.

Samples	Storage period (Days)	Acidity as lactic acid	pH	Total Solids%	Fat content%	Ash%	Crude Fiber%	Crude protein%	Carbohydrates%	Salt%
F1	Fresh soft pro.	0.306^{PQR}	5.41^{B}	27.20^{ST}	0.220^{P}	2.72^{J}	0.27^{F}	4.93^{K}	19.05^{NO}	2.03^{B}
	Fresh dried pro.	1.490^{O}	5.24^{D}	92.46^{BCD}	0.733^{I}	9.24^{GHI}	0.93^{C}	$16.77^{ABCDEFGH}$	64.77^{ABC}	6.90^{A}
	30	1.596^{NO}	5.09^{I}	$91.67^{FGHIJKL}$	0.730I	9.166^{GHI}	0.92^{C}	$16.63^{CDEFGHI}$	64.22^{BCDE}	6.85^{A}
	60	1.690^{LMN}	5.01^{K}	91.36^{HIJKLM}	0.730^{I}	9.136^{GHI}	0.92^{C}	$16.58^{DEFGHIJ}$	64.00^{CDE}	6.82^{A}
	90	1.790^{IJKL}	4.92^{M}	91.22^{KLMN}	0.720J	9.12^{GHI}	0.92^{C}	16.55^{EFGHIJ}	63.90^{CDE}	6.80^{A}
F2	Fresh soft pro.	0.296^{PQR}	5.33^{C}	27.93^{QR}	0.230^{O}	2.74^{J}	0.27^{F}	4.94^{K}	19.74^{MN}	2.05^{B}
	Fresh dried pro.	1.593^{NO}	5.14^{GH}	92.47^{BC}	0.750^{H}	9.09^{GHI}	0.91^{C}	16.37^{GHIJ}	65.33^{A}	6.81^{A}
	30	1.740^{KLMN}	5.08^{I}	92.28^{BCDEF}	0.750^{H}	9.07^{HI}	0.91^{C}	16.34^{GHIJ}	65.20^{AB}	6.79^{A}
	60	1.806^{IJKL}	4.82^{P}	$91.89^{CDEFGHI}$	0.750^{H}	9.13^{GHI}	0.90^{C}	16.27^{HIJ}	64.82^{ABC}	6.76^{A}
	90	1.940^{FGHI}	4.70^{R}	$91.72^{EFGHIJK}$	0.750^{H}	9.02^{I}	0.90^{C}	16.24^{HIJ}	64.80^{ABC}	6.66^{A}
F3	Fresh soft pro.	0.310^{PQR}	5.41^{B}	27.12^{ST}	0.290^{O}	2.86^{J}	0.27^{F}	4.92^{K}	19.67^{MN}	2.05^{B}
	Fresh dried pro.	1.500^{O}	5.05^{J}	91.44^{HIJKLM}	0.766^{G}	9.35^{EDFGH}	0.89^{C}	16.11^{IJ}	64.31^{ABCDE}	6.71^{A}
	30	1.516^{O}	5.02^{K}	91.34^{IJKLM}	0.763^{G}	9.34^{EDFGH}	0.88^{C}	16.09^{IJ}	64.25^{ABCDE}	6.71^{A}
	60	1.623^{MNO}	4.88^{N}	91.32^{IJKLM}	0.760^{G}	9.34^{EDFGH}	0.88^{C}	16.09^{IJ}	64.24^{ABCDE}	6.70^{A}
	90	1.766^{JKLM}	4.85^{O}	91.25^{JKLMN}	0.760^{G}	9.333^{FGH}	0.88^{C}	16.08^{IJ}	64.18^{BCDE}	6.67^{A}
SED		0.026	0.004	0.108	0.001	0.048	0.012	0.111	0.191	0.085
R-Square		0.996	0.999	0.999	0.998	0.999	0.9993	0.998	0.9997	0.996
Coeff. Var.		2.844	0.141	0.238	0.367	1.041	1.683	1.35	0.609	2.501

$^{A-T}$: All the means were differentiated by a standard deviation ($p < 0.05$)

Table 4: Chemical properties of cereal fermented milks using burghul from freek (green wheat).

milk products containing Barely (B2, B1 and B3, Respectively) were characterized by higher acidity as compared with their containing of freek (F3, F1 and F2) and wheat (W1, W3 and W2, Respectively). These results are in agreement with [9,16,25-28]. There is no significant difference ($P \leq 0.05$) between the values of ash, salt, protein and carbohydrate of kishk-like before draying. While, ranged as follow: (2.72-2.98), (2.03-2.14), (4.92-5.10) and (17.85-20.36), respectively. The crude fibers content was significant ($P \leq 0.05$) depending on the type of cereal used. Whereas, the barley kishk products had higher its values (0.70%) than other samples, this is due to the higher content of crude fiber which reached 2.51% [9,25]. As expected the type of starter culture used in the fermentation did not effect on the total solids and fat contents but the variation could be attributed to the fat content of kishk components and blends. These results were in agreement with those obtained by [2,9,25,29].

There was a significant ($P \leq 0.05$) increase in pH and acidity percentages for all fresh samples incorporation with the corresponding values of dry products (Tables 2-4). However, the samples of dried cereal fermented milk products which fermented with Yoghurt and Bio-Yoghurt starter (2) were characterized with higher acidity rates than either fermented with mixed cultures contained only Yoghurt starter culture (1) or fermented by mixed cultures of Yoghurt starter culture and *Lactobacillus plantarum* (3), respectively. During storage at (25 ± 2°C) for 90 days, significant decrease ($P \leq 0.05$) were recorded in pH of different dried kishk-like products. Moreover, gradual decrease in pH could be observed in all samples, with extending the storage period (3 months), that due to limit growth of various bacterial starter cultures and the slow fermentation of residual lactose [9,25,29-31].

Dried kishk-like samples had slightly decrease in total solids, fat, Ash, crude fibers, protein, carbohydrate and salt contents until the end of storage period [16,31]. The ranges of previous contents were as follow: (90.30% to 93.27%), (0.720% to 0.950%), (9.02% to 10.15%), (0.89% to 2.40%), (15.94% to 17.31%), (60.35% to 65.33%) and (6.66% to 7%) respectively. These results are in agreement with previous studies [2,16,31-35].

Colour of kishk samples

Data presented in Table 3 show the colour of dried kishk samples as obtained using Lovibond Tintometer. The values of the primary Colours (Red, yellow and blue) showed that all dried kishk samples as ranged (3 - 5), (6 - 6.9) and (1.9 - 4.9), respectively. The data for primary colours reflects the values of X, Y and Z coordinates. The X value for (B1) treatment had significantly higher than among of samples (0.395) while the (F3) sample had the highest value of Y coordinate (0.544). Whereas, the Z coordinate showed the opposite figure. As a result of saturation and visual density, the brightness of (W1) sample was the highest percentage (66.07%). on contrary, (F3) treatment had lower brightness (42.66%) than other samples. These results are in agreements with Toufeli et al. [17], Bilgicli and Ibanoglu [36].

Organic acids determination

The concentrations (*ppm*) of organic acids (Lactic acid, Propionic acid, Acetic acid and formic acid) in the dried Kishk samples after 90 days of storage made with wheat, barley and Freek Burghul Skim milk is shown in Table 4. Lactic, propionic and acetic acid formed during lactic fermentation. The (W1) treatment had the highest levels of Propionic, Acetic and Lactic acids respectively, except formic acid comparing to among of samples [6,15]. Furthermore, propionic acid had the lowest or not detected in kishk samples made with barley, and these results are in agreement with Tamime et al. [37].

Microbiological analysis

Microbiological composition of kishk-like products are shown in Table 5. To produce healthy and safety of kishk that it's based on the critical control points during the making of kishk were cooking, fermentation, drying and storage [35,38]. The fermented fresh soft products had 2.30-2.48 and 1.60-2.44 c.f.u $\times 10^{-3}$/ gm. for lactic acid bacteria and *Lactobacillus acidophilus*, respectively. However, the drying treatment gets rid of the bacterial starter, and these results agreement with [2,16]. Furthermore, all the samples did not contain any growth in 0.1 gm on SDA, VRBA, NA and MSA media in either fresh or dried products through the storage period. These results are revealed

Samples	Red	Yellow	Blue	X	Y	Z	Visual density	Saturation%	Brightness%
W1	3	6	1.9	0.355	0.415	0.23	0.18	38.64	66.07
W2	4	6	2.6	0.34	0.425	0.235	0.23	45.45	58.88
W3	4	6	2.7	0.355	0.475	0.19	0.235	59.57	58.21
B1	4	6	2.7	0.395	0.415	0.19	0.235	59.57	58.21
B2	4.6	6.9	3.3	0.385	0.465	0.15	0.28	66.67	52.48
B3	4.4	6.9	3.3	0.35	0.53	0.12	0.25	70.21	56.23
F1	5	6.9	3.9	0.36	0.53	0.11	0.33	79.07	46.77
F2	4.6	6.9	3.9	0.36	0.525	0.115	0.35	70.21	44.76
F3	4.9	6.9	4.9	0.356	0.544	0.1	0.37	83.72	42.66

B: Dried kishk like manufactured from fermented whole barley burghul skim milk.
F: Dried kishk like manufactured from fermented freek burghul skim milk.
W: Dried kishk-like manufactured from fermented whole wheat burghul skim milk.
Starters: 1: (3% Yoghurt starter); 2: (2% Yoghurt starter + 1% Bio-yoghurt starter); 3: (2% Yoghurt starter + 1% *Lactobacillus plantarum*).

Table 5: Colour of dried kishk-like samples as measured by Lovibond and C.I.E system.

Samples	Organic acids			
	Lactic acid *ppm*	Propionic acid *ppm*	Acetic acid *ppm*	Formic acid *ppm*
W1	1134.57	3522.16	2930.35	< 50
W2	908.94	3341.66	2728.21	< 50
W3	901.86	3451.5	973.285	< 50
B1	903.9	< 50	2147.14	< 50
B2	889. 16	< 50	< 50	320.05
B3	717.5	< 50	2153.64	366.248
F1	601.25	562.33	< 50	738.954
F2	691.52	562.7	481.357	< 50
F3	638.33	598.72	< 50	< 50

B: Dried kishk-like manufactured from fermented whole barley burghul skim milk.
F: Dried kishk-like manufactured from fermented freek burghul skim milk.
W: Dried kishk-like manufactured from fermented whole wheat burghul skim milk.
Starter: 1: (3% Yoghurt starter), 2: (2% Yoghurt starter + 1% Bio-yoghurt starter) and 3: (2% Yoghurt starter + 1% *Lactobacillus plantarum*).

Table 6: Organic acids concentrations of dried cereal fermented milks.

Storage Period			Media				
Samples	(Days)	MRS	MRS+L-Cysteine	NA	SDA	VRBA	MSA
W1	Fresh soft pro.	2.3		Not detected in 0.1 gm.			
	Fresh dried pro. 90	< 0.001	----				
W2	Fresh soft pro.	2.56	1.6				
	Fresh dried pro. 90	< 0.001	< 0.001				
W3	Fresh soft pro.	2.84					
	Fresh dried pro. 90	< 0.001	----				
B1	Fresh soft pro.	2.32					
	Fresh dried pro. 90	< 0.001	----				
B2	Fresh soft pro.	2.31	1.8				
	Fresh dried pro. 90	< 0.001	< 0.001				
B3	Fresh soft pro.	2.76					
	Fresh dried pro. 90	< 0.001	----				
F1	Fresh soft pro.	2.48					
	Fresh dried pro. 90	< 0.001	----				
F2	Fresh soft pro.	2.68	2.44				
	Fresh dried pro. 90	< 0.001	< 0.001				
F3	Fresh soft pro.	2.64					
	Fresh dried pro. 90	< 0.001	----				

W: Soft kishk-like manufactured from fermented whole wheat burghul skim milk.
B: Soft kishk-like manufactured from fermented whole barley burghul skim milk.
F: Soft kishk-like manufactured from fermented freek burghul skim milk.
Starter: 1: (3% Yoghurt starter), 2: (2% Yoghurt starter + 1% Bio-yoghurt starter) and 3: (2% Yoghurt starter + 1% *Lactobacillus plantarum*). (--): Not determined.
NA: nutrient agar; MSA: manitol salt agar; SDA: Sabouraud dextrose agar; MRS: Man rogosa sharpe agar; MRS: Man rogosa sharpe agar.
VRBA: Violet Red Bile Agar.

Table 7: Changes in viable microbial counts (c.f.u × 10^{-3}/ gm.) in dried cereal fermented milks.

the good hygiene sanitation during manufacture different products. The low pH (4.46-5.23), release of organic acids due to fermentation, salt additive and low moisture content (6.73% to 9.70%) lead to a harsh environment (bacteriostatic effect) for pathogenic microorganisms, in which food spoilage may not occur and shelf life increases [35].

Sensory evaluation of recombined dried kishk like

Sensorial evaluation of recombined dried kishk samples is given in Tables 6-8. There were no significant differences ($P \leq 0.05$) between the soup samples in flavour and body and texture scores. However, significant difference existed with regard to appearance and color and acidity, with barley skimmed milk Kishk soup having the lowest score. It was clear that, the addition of wheat or freek burghul didn't affect the general acceptability of them, whereas the addition of barley burghul had lowering the total score acceptability (Figure 2) [16,17,37]. These products could be used to feed infants to 6 months as a complementary diet, children and elderly persons who need special care instead of the commercial extracts because the nutritive value of cereal fermented milks higher than of cereal alone. On the other hand the therapeutic effect of crude fibers and wheat bran in diets [16] (Tables 7 and 8).

Sample	Flavour -45	Body / texture -30	Appearance and colour -15	Acidity -10	Total -100
W1	38^{AB}	25^{A}	13^{A}	7^{BC}	83^{A}
W2	39^{AB}	25^{A}	12^{A}	7^{BC}	83^{A}
W3	40^{A}	26^{A}	11^{A}	6^{C}	82^{A}
B1	33^{C}	24^{A}	8^{B}	6^{C}	71^{B}
B2	36^{BC}	24^{A}	8^{B}	5^{D}	70^{B}
B3	34^{C}	24^{A}	9^{B}	6^{C}	74^{B}
F1	40^{A}	25^{A}	13^{A}	9^{A}	87^{A}
F2	40^{A}	24^{A}	12^{A}	8^{AB}	84^{A}
F3	40^{A}	24^{A}	13^{A}	8^{AB}	85^{A}
SED	0.555	0.368	0.43	0.248	0.881
R-Square	0.897	0.53	0.928	0.883	0.95
Coeff. Var.	2.534	2.583	6.663	6.246	1.891

W: Dried kishk-like manufactured from fermented whole wheat burghul skim milk.
B: Dried kishk-like manufactured from fermented whole barley burghul skim milk.
F: Dried kishk-like manufactured from fermented freek burghul skim milk.
Starter: 1: (3% Yoghurt starter); 2: (2% Yoghurt starter + 1% Bio-yoghurt starter); 3: (2% Yoghurt starter + 1% *Lactobacillus plantarum*)
SED: Standard Error of Difference.

Table 8: Organoleptic properties of recombined mixtures.

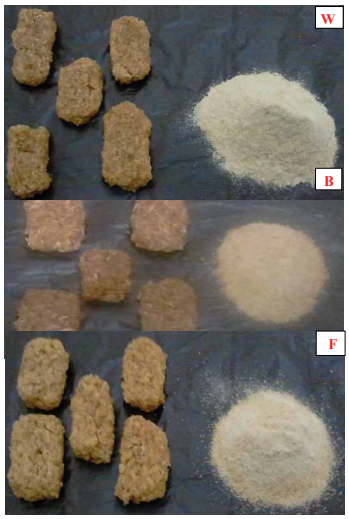

Figure 2: The pictures of dried Kishk-like products.
W: Dried kishk-like manufactured from fermented whole wheat burghul Skim milk with different types of starter cultures.
B: Dried kishk-like manufactured from fermented whole barley burghul Skim milk with different types of starter cultures.
F: Dried kishk-like manufactured from fermented freek burghul Skim milk with different types of starter cultures.

Conclusion

The cereal fermented skim milk shown long shelf-life without changing in either chemical or microbial characteristics during the storage period at room temperature. This phenomenon is accepted as result of those mixtures.

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