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Quality improvement and shelf-life of Kareish cheese using some mutants of *Streptococcus thermophilus* and *Lactobacillus delbruekii* subsp. *bulgaricus*

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Abstract

Utilization of mutant *Streptococcus thermophillus* and *Lactobacillus delbreukii* subsp. *bulgaricus* for improving the quality and shelf-life of Kareish cheese was the aim of this research. Kareish cheese was made with different mutant starter cultures and analysed when fresh and during storage (28 days) every week for chemical, bacteriological and organoleptic properties. The results indicated that using mutant strain culture especially T_3 and T_6 led to increase the yield and the moisture content compared with the control. Acidity and acid development in Kareish cheese treated with T_3 and T_6 during storage were lower than those of other treatments. Kareish cheese made with T_2 and T_5 record the highest values of acetaldehyde content when fresh or during storage. Acetaldehyde content increased to reach maximum values up to 7 days then decreased until the end of storage. It was observed that Kareish cheese made with mutant strain culture had the lower viable bacteria and moulds and yeasts count than the control. The count of viable bacteria increased during storage to reach a maximum after 14 days then decreased until the end of storage. The results revealed that using mutant of strain culture in Kareish cheese manufacture improved the yield, quality and shelf-life of the cheese.

Key words: Kareish cheese, Mutants, *Streptococcus thermophillus* , *Lactobacillus delbreukii* subsp. *bulgaricus*.

Introduction

Kareish cheese in Egypt consider one of the most popular white soft cheese which are mostly produced from skimmed buffalo's or cows milk and depends on acid coagulation by the action of lactic acid bacteria. Kareish cheese production is about 50% of white soft cheese produced in Egypt (Hegazy *et al.*, 2012) Kareish cheese has high nutritive value and high protein content and makes a balanced meal when mixed with some vegetable oils and fresh pieces of vegetables and can be recommended as a special diet for may persons suffered from obesity, cholesterol and heart diseases. The quality and composition of Kareish cheese may vary considerably due to such factors as the quality and composition of the clotted skimmed milk, the method of manufacture, the starter cultures, the time required to complete the whey drainage, the quality of salt added and the method of handling the finished cheese (Abou-Donia, 1984 and El-Gendy, 1983). Nevertheless, the low fat cheese in general, has a low intensity of typical flavour, taste and hard rubbery dry grainy texture (Ardo, 1997). The firm texture of low fat cheese is due to the high density of the protein network (Hassan *et al.*, 2004). The challenge in development of low fat cheese is to improve both flavour and texture attributes of product to introduce a cheese comparable to that of full fat. Therefore, several strategies have been proposed in order to improve the flavour and texture of such low fat cheeses. These strategies can be collected in three titles (Mistry, 2012), making process modifications, starter cultures selection and use of fat replacers.

The use of dried skimmed milk for traditional kareish cheese manufacture was studied by El-safty *et al* (1977a &b). They found that using dried milk in cheese making cheese increased the yield, moisture and acidity of resultant cheese.

As kareish cheese commonly contains high moisture content and is not pickled after processing, it must consumed in a few days. Its maximum shelf-life does not exceed 12 days at 5ºC (Abou Donia and Gomai, 1977).

The use of starter cultures containing lactic acid bacteria is an essential requirement in manufacture of most cheeses including kareish cheese. Their major function is to produce lactic acid and flavour components (Fox *et al.*, 2000) and increase the shelf life of such cheese.

It is well known that reduction of milk pH due to acidification by starter cells or any other factor is accompanied by micellar demineralization (Banon and Hardy, 1992) which affects cheese curd strength (Khosroshalir et al, 2006). Domination the growth of *Lactobacillus delbreukii* subsp. *bulgaricus* at low pH is one of the reasons why *Lactobacillus delbreukii* subsp. *bulgaricus* is considered responsible for post acidification and because of its higher proteolytic activity, for the generation of bitter peptides Renz, ***et al.,*** 1975.

So, the objective of the present study was to improvement of both shelf life and falvour & taste of Kareish cheese by using some mutant of *Streptococcus thermophilus* and *Lactobacillus delbruekii* subsp. *bulgaricus* selected for pH sensitivity of proteolysis and for post acidification and these mutants are almost ideally suited for production of a product with mild taste.

Materials and Methods

1. Materials

1.1. Bacterial strains:

Sreptococcus thermophillus (St), *Lactobacillus delbreuckii* subsp. *bulgaricus* (Lb), *St. thermophillus* J 34-6 (St. 6) , *St. thermophillus* J 34-12 (St.12). *Lactobacillus delbreuckii* subsp *bulgaricus* 92063 (Lb.63), *Lb. delbreuckii* subsp *bulgaricus* pH-S-mutant 64 (Lb.64), *Lb. delbreuckii* subsp *bulgaricus* pH-P 11 mutant (Lb.pH 11). were obtained from the culture collection of the Fedral Research Center for Nutrition and Food, Kiel (Germany). All strains were activated by grown three times overnight in 10 % skimmed-milk at 42°C.

1.2. skimmed milk powder was obtained from Nestle Deutschland AG, Lyoner strasse 23 Frankfurt AM Main He Germany.

1.3. Food grade edible salt and poly ethylene bags were obtained from a local market, Keil, Germany.

Kareish cheese manufacture:

Skimmed milk powder was reconstituted at the rate of ~11% SNF. Milk was heated to 80°C for one minute and cooled to 45°C. Divided into 7 portions. The starter cultures were added at the rate of 1% in a combination with the control as the following:

Control, St.+Lb.,
(T_1), St.6+Lb.63,
(T_2), St.6+Lb.64,
(T_3), St.6+Lb.pH.11,
(T_4), St.12+Lb.63,
(T_5) St.12+Lb.64 and
(T_6) St.12+Lb.pH.11.

They were left to complete the coagulation, the curd was scooped in cheese cups with addition of 3% of edible food grade salt between the layers and left overnight to drain the whey and then filled in polyethylene bags then stored in refrigerator for 4 weeks and analysed at 0, 7, 14, 21 and 28 days.

Chemical analysis:

Total solids (T.S.), fat, total protein, ash, and titratble acidity was determined according to the methods AOAC (2007). pH values were measured using pH meter (Metter Delta 320, Germany) according to the method described by BSI (1985. The cheese yield was calculated according to Vandeweghe and Maubois (1987). Acetaldehyde content was determined according to UV-method, Cat. No 10 668 613 035, R-BIOPHARM AG, Landwehrstr 5, D-64293 Darmstadt, Germany.

Viscosity: The viscosity was determined using Physica UDS 200 (Universal Dynamic Spectrometer, Paar Physica, Spindle MK 22/202). Viscosity expressed in mPa.S.

Microbiological analysis:

Cheese samples were analysed for total bacterial count, *Streptococcus*, *Lactobacillus* and moulds & yeasts counts according to the methods described by the American Public Health Association (APHA 1992).

Sensory evaluation:

The organoleptic properties included flavour (50 points); body and texture (35 points) and appearance (15points). The organoleptic evaluation was done by trained panelists of a sensory group at the Federal Research Center for Nutrition and Food at Kiel, Germany.

Statistical analysis:

The statistical analysis was carried out using ANOVA two factors under significance level of *0.05* for the whole results using **SPSS (ver. 22).** Data were treated as complete randomization design according to **Steel *et al.* (1997).**

Results and Discussion

Coagulation time:

Data presented in Table (1) show the effect of using different mutants of starter cultures on pH, coagulation time and yield of Kareish cheese. The data revealed that using starter cultures led to increase the coagulation time and the yield of Kareish cheese. T_3 recorded the longest coagulation time (13 hr) and yield (18.6%) followed by T_6 which recorded about (12.50 hr) and 18.0% for coagulation time and yield, respectively. The increase of moisture led to increase the yield of cheese in all cheese treatments made with different types of mutant lactic acid bacteria. The used mutant lactic acid bacteria gives a low rate of acidity which slow the formation of the gel network, thus, increased the water holding ability (Oliveria *et al.*, 2010).

Chemical composition of Kareish cheese:

The chemical composition of Kareish cheese (T.S, protein, ash, acidity) during storage in refrigerator are presented in Table (2). The control cheese had higher values of T.S, protein, fat and ash content as compared with other treatments. T3 and T6 had the lowest T.S, fat, protein and ash contents. This was due to the different ability of strain culture to produce acidity consequently producing cheese with different high water holding capacity. The present data are similar to that reported by Abou-Dawood *et al.* (2005) and Metwalli (2011) and they are in agreement with those obtained by Alnemr *et al.* (2013).

Kareish cheese produced in treatments T3 and T6 had a lower total acidity than that those all treatments, thus could be attributed to the relatively lower activity of bacteria that produce acidity. The acidity of Kareish cheese increased with the increase of storage period. The obtained results are in harmony with those obtained by Magdoub *et al.*

(1995) who reported that the increase of the acidity may be due to the converting of the residual lactose in cheese to lactic acid and free fatty acids which developed in cheese at the end of storage period.

Table1. Effect of using different starter cultures on pH and yield of Kareish cheese during coagulation at 40°C.

Treatments	pH during coagulation time (hr)							Coagulation end time (hr)	Yield (%)
	0	2	4	6	8	10	12		
Control	**6.50**	**6.02**	**5.11**	**4.85**				**7.0**	**17.10**
T1	**6.51**	**6.42**	**5.88**	**5.37**	**5.11**	**4.86**		**11.0**	**18.20**
T2	**6.50**	**6.38**	**5.39**	**5.1**	**5.00**	**4.72**		**10.0**	**17.90**
T3	**6.53**	**6..48**	**6.22**	**5.84**	**5.56**	**5.34**	**5.06**	**13.0**	**18.86**
T4	**6.50**	**6.40**	**5.69**	**5.31**	**5.00**	**4.70**		**10.0**	**18.00**
T5	**6.50**	**6.35**	**5.28**	**4.98**	**4.82**	**4.65**		**9.0**	**17.56**
T6	**6.52**	**6.47**	**6.17**	**5.70**	**5.49**	**5.23**	**4.94**	**12.5**	**18.65**

Data in Table (2) showed the effect of different mutant starter cultures on acetaldehyde content of Kariesh cheese. Kareish cheese treated with mutant culture T2 and T5 had the highest values of acetaldehyde content when fresh or during storage, while the control cheese had the lower acetaldehyde content among the other treatments followed by T6 and T3 when fresh or during storage.

Table 2. Chemical composition of Karesh cheese during storage at refrigerator

Parameter	Treatment	Storage period (days)					
		0 (fresh)	7	14	21	28	Mean
T.S. (%)	Control	31.16^{dA}	32.00^{dB}	33.09^{eC}	33.69^{dD}	34.01^{dE}	32.79^{d}
	T1	29.00^{bcA}	30.19^{bcB}	31.35^{cdC}	31.81^{cD}	32.12^{bcE}	30.89^{c}
	T2	29.10^{bcA}	29.95^{bB}	31.20^{cC}	31.72^{cD}	32.00^{bE}	30.79^{c}
	T3	28.82^{bA}	29.14^{aB}	30.12^{bC}	30.40^{bD}	30.81^{aE}	29.86^{b}
	T4	29.28^{cA}	30.27^{cB}	31.65^{dC}	32.00^{cD}	32.26^{bcD}	31.09^{c}
	T5	29.00^{bcA}	30.11b^{cB}	31.25^{cC}	31.75^{cD}	32.38^{cE}	30.90^{c}
	T6	28.43^{aA}	28.99^{aB}	29.65^{aC}	30.01^{aD}	30.51^{aE}	29.52^{a}
	Mean	29.26^{A}	30.09^{B}	31.19^{C}	31.63^{D}	32.01^{E}	
Protein (%)	Control	20.15^{dA}	21.16^{dB}	22.12^{dC}	23.31^{dD}	24.01^{dE}	22.15^{c}
	T1	18.94^{cA}	19.84^{cdB}	20.66^{bcC}	21.13^{bD}	21.86^{cE}	20.49^{b}
	T2	18.80^{bcA}	19.70^{cB}	20.48^{bC}	20.96^{bD}	21.46^{bE}	20.28^{b}
	T3	18.54^{bA}	18.86^{bA}	19.61^{aB}	19.98^{aC}	20.40^{aD}	19.48^{a}
	T4	18.90^{bcA}	19.86^{cdB}	20.70^{bcC}	21.27^{bcD}	21.68^{bcE}	20.48^{b}
	T5	19.00^{cA}	20.11^{dB}	20.99^{cC}	21.56^{cD}	21.70^{bcD}	20.67^{b}
	T6	18.11^{aA}	18.56^{aB}	19.30^{aC}	19.65^{aD}	20.11^{aE}	19.15^{a}
	Mean	18.92^{A}	19.73^{B}	20.55^{C}	21.12^{D}	21.60^{E}	
Ash (%)	Control	3.31^{eA}	3.46^{eB}	3.56^{fC}	3.61^{fD}	3.69^{eE}	3.53^{f}
	T1	3.11^{dA}	3.21^{dB}	3.32^{eC}	3.41^{eD}	3.51^{dE}	3.31^{e}
	T2	3.02^{bcA}	3.12^{cB}	3.21^{cC}	3.30^{cD}	3.40^{cE}	3.21^{c}
	T3	2.96^{aA}	3.06^{bB}	3.10^{bB}	3.21^{bC}	3.27^{bD}	3.12^{b}
	T4	3.09^{dA}	3.20^{dB}	3.29^{deC}	3.38^{deD}	3.44^{cE}	3.28^{de}
	T5	3.04^{cA}	3.17^{dB}	3.27^{dC}	3.36^{dD}	3.42^{cE}	3.25^{cd}
	T6	2.99^{abA}	3.01^{aAB}	3.05^{aB}	3.10^{aC}	3.16^{aD}	3.06^{a}
	Mean	3.07^{A}	3.18^{B}	3.26^{C}	3.34^{D}	3.41^{E}	
Acidity (%)	Control	0.91^{cA}	1.17^{dB}	1.25^{dC}	1.32^{dD}	1.35^{fD}	1.20^{d}
	T1	0.84^{bA}	0.94^{bcB}	0.98^{bBC}	1.00^{bCD}	1.04^{cD}	0.96^{b}
	T2	0.81^{bA}	0.90^{bB}	0.96^{bC}	1.00^{bCD}	1.02^{cD}	0.94^{b}
	T3	0.70^{aA}	0.77^{aB}	0.81^{aBC}	0.84^{aBD}	0.88^{aD}	0.80^{a}
	T4	0.86^{bcA}	0.99^{cB}	1.06^{cC}	1.12^{cD}	1.16^{eD}	1.04^{c}
	T5	0.82^{bA}	0.92^{bB}	1.04^{cC}	1.08^{cCD}	1.10^{dD}	0.99^{bc}
	T6	0.73^{aA}	0.81^{aB}	0.86^{aC}	0.89^{aCD}	0.91^{bD}	0.84^{a}
	Mean	0.81^{A}	0.93^{B}	0.99^{C}	1.04^{CD}	1.07^{D}	
Acetaldehyde (mg/100 g)	Control	1.23^{aBC}	1.47^{aD}	1.44^{aCD}	1.12^{aAB}	0.96^{aA}	1.24^{a}
	T1	2.10^{cA}	2.70^{cB}	2.67^{cB}	2.61^{dB}	2.30^{dA}	2.48^{c}
	T2	6.06^{eBC}	6.57^{eD}	6.12^{eC}	5.88^{fB}	5.04^{fA}	5.93^{e}
	T3	1.38^{aA}	1.65^{aB}	1.58^{AB}	1.49^{bAB}	1.42^{bAB}	1.50^{a}
	T4	1.86^{bAB}	2.07^{bB}	1.96^{bAB}	1.91^{cAB}	1.81^{cA}	1.92^{b}
	T5	5.20^{dBC}	5.31^{dC}	5.13^{dBC}	4.98^{eB}	4.68^{eA}	5.06^{d}
	T6	1.34^{aA}	1.53^{aA}	1.50^{aA}	1.46^{bA}	1.39^{bA}	1.44^{a}
	Mean	2.74^{B}	3.04^{C}	2.91^{BC}	2.78^{B}	2.51^{A}	

A, b & c: Superscripts to be compared statistically within the same column. Values with different letter superscripts are significantly different (*P<0.05).*

A, B & C: Superscripts to be compared statistically within the same row. Values with different letter superscripts are significantly different (*P<0.05)*.

Acetaldehyde content increased to reach its maximum values after 7 days, and then decreased until the end of storage in all treatments. The concentration of acetaldehyde content is dependant on the growth conditions and the specific activity of bacteria and their enzymes. These results are in accordance with El-Nagar *et al.* (2007), Salem *et al.* (2007) and Nasr (2015).

Viscosity of Kareish cheese:

Data presented in Table (3) illustrate the values of viscosity of Kareish cheese when fresh and during storage period. Values of viscosity were higher in control than those in other treatments. It could be related to its lower moisture content and compact structure previously reported by Hassan *et al.* (2003b) and Korish and Abd-Elhamid (2012). It was clear that using some mutants of *St. thermophillus* and *L. delbreukii* subsp. *bulgaricus* improved most of the reheological properties. These results are in line with those reported by El-Baz *et al.* (2011). Moreover, Ahmed *et al.* (2005) reported that the reheological properties were significantly lower in Kareish cheese using EPS-producing culture.

Table 3. Viscosity of Karesh cheese during storage at refrigerator**.**

Parameter	Treatment	Storage period (days)					
		0 (fresh)	7	14	21	28	Mean
Viscosity (mPa.s)	Control	34.1^{eA}	36.6^{cB}	38.2^{dC}	39.9^{dD}	40.2^{dD}	37.80d
	T1	32.6^{cdA}	34.8^{bB}	35.2^{aB}	36.1^{abC}	37.1^{bcD}	35.16bc
	T2	31.9^{abA}	34.2^{aB}	35.8^{bC}	36.4^{bcD}	36.9^{bE}	35.04bc
	T3	31.4^{aA}	34.0^{aB}	34.9^{aC}	35.7^{aD}	36.2^{aE}	34.44a
	T4	32.7^{dA}	34.2^{aB}	36.5^{cC}	36.9^{cC}	37.5^{cD}	35.56c
	T5	32.9^{dA}	34.9^{bB}	36.0^{bcC}	36.7^{cD}	37.4^{cE}	35.58c
	T6	32.1^{bcA}	34.1^{aB}	34.8^{aC}	35.8^{aD}	36.6^{abE}	34.68ab
	Mean	32.53^{A}	34.69^{B}	35.91^{C}	36.79^{D}	37.41^{E}	

A, b & c: Superscripts to be compared statistically within the same column. Values with different letter superscripts are significantly different *(P<0.05)*.

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Microbiological examination:

Changes in the account of the viable total bacterial counts, *St. thermophillus* and *Lb. delbreukii* subsp. *bulgaricus* and moulds and yeasts during storage of Kareish cheese are recorded in Tables 4 and 5. It is clear that the total bacterial count, *St. thermophillus* and *Lb. delbreukii* subsp. *bulgaricus* during refrigerated Kareish cheese increased up to 7 days of storage and then decreased gradually with increasing the storage period until the end of storage. Our findings are in accordance with Mahmoud *et al.* (2013) and Nasr (2015). Concerning moulds and yeasts, they were not detected when fresh in the control and all treatments. After 14 days of storage, they starts to appear in the control 2.2 X 10^1cfu/g. Yeasts and moulds were detected in the cheese manufactured with mutant cultures after 21 days of storage with a very low level.

Similar results were reported by Sagoo *et al.* (2002). Depending on cheese findings, it is clear that the shelf-life of cheese prolonged with using the mutant culture of *Streptococcus thermophillus* and *Lactobacillus delbreukii* subsp. *bulgaricus* in its manufacture.

Table 4. Effect of storage on total bacterial count and yeast and mould of Kareish cheese.

Micro-organism	Treatments	Storage period (days)				
		0 (Fresh)	7	14	21	28
Total bacterial count cfu/g ($x10^7$)	Control	6.5	8.8	7.6	5.2	2.5
	T1	5.4	7.2	6.3	5.3	4.4
	T2	5.0	6.9	5.8	5.0	4.0
	T3	3.5	5.5	4.8	3.8	3.2
	T4	5.8	7.8	6.7	5.5	3.5
	T5	5.8	7.5	6.3	5.6	3.9
	T6	4.0	6.0	5.4	4.4	3.6
Yeast and mould cfu/g ($x10^1$)	Control	ND	ND	2.2	3.8	4.7
	T1	ND	ND	ND	0.5	1.8
	T2	ND	ND	ND	0.4	1.5
	T3	ND	ND	ND	0.2	0.9
	T4	ND	ND	ND	0.8	2.0

	T5	**ND**	**ND**	**0.6**	**1.0**	**2.1**
	T6	**ND**	**ND**	**ND**	**0.3**	**0.8**

Table 5. Effect of storage on *St. thermophillus* and *Lactobacillus delbruekii* subsp. *bulgaricus* of Kareish cheese.

Micro-organism	**Treatments**	**Storage period (days)**				
		0 (Fresh)	**7**	**14**	**21**	**28**
***St. thermophillus* cfu/g (x10^7)**	**Control**	**3.9**	**5.0**	**4.4**	**3.2**	**2.0**
	T1	**3.3**	**4.0**	**3.7**	**3.5**	**3.0**
	T2	**3.1**	**4.0**	**3.6**	**3.4**	**2.9**
	T3	**2.1**	**3.2**	**3.0**	**2.8**	**2.5**
	T4	**3.5**	**4.4**	**3.9**	**3.4**	**2.6**
	T5	**3.6**	**4.2**	**3.7**	**3.3**	**3.0**
	T6	**2.4**	**3.5**	**3.4**	**3.2**	**2.7**
***Lactobacillus bulgaricus* cfu/g (x10^7)**	**Control**	**3.6**	**4.8**	**4.2**	**3.0**	**1.5**
	T1	**3.1**	**4.2**	**3.3**	**2.8**	**2.4**
	T2	**2.9**	**3.9**	**3.2**	**2.6**	**2.1**
	T3	**1.8**	**3.3**	**2.8**	**2.0**	**1.7**
	T4	**3.3**	**4.4**	**3.8**	**3.1**	**2.9**
	T5	**3.2**	**4.3**	**3.9**	**3.3**	**3.0**
	T6	**2.1**	**3.5**	**3.0**	**2.2**	**1.9**

Organoleptic properties:

Data in Table (6) show the organoleptic properties of Kareish cheese when fresh and during storage. The mean scores for all organoleptic properties (Flavour, body and texture, appearance and overall acceptability of Kareish cheese prepared with mutant starter culture were higher than the control when fresh and during the storage period.

Table 6. Organoleptic of Kareish cheese fresh and during storage at refrigerator.

Properties	**Treatments**	**Storage periods (days)**					
		0 (fresh)	**7**	**14**	**21**	**28**	**Mean**
Flavour (50)	**Control**	46^{aD}	46^{aD}	44^{aC}	40^{aB}	37^{aA}	42.60^{a}
	T1	47^{abAB}	48^{bcB}	48^{bcB}	47^{bcAB}	46^{bcA}	47.20^{b}
	T2	47^{abA}	47^{abA}	47^{bA}	46^{bA}	46^{bcA}	46.60^{b}
	T3	48^{bAB}	49^{cB}	49^{cB}	48^{cAB}	47^{cdA}	48.20^{b}
	T4	47^{abAB}	48^{bcB}	48^{bcB}	47^{bcAB}	46^{bcA}	47.20^{b}
	T5	46^{aAB}	47^{abB}	47^{bB}	47^{bcB}	45^{bA}	46.40^{b}
	T6	47^{abA}	48^{bcA}	48^{bcA}	48^{cA}	48^{dA}	47.80^{b}
	Mean	46.86^{B}	47.57^{B}	47.29^{B}	46.14^{AB}	45.00^{A}	
Body and texture (35)	**Control**	30^{aD}	29^{aD}	26^{aC}	23^{aB}	21^{aA}	25.80^{a}
	T1	31^{abA}	32^{bA}	32^{bA}	32^{bA}	31^{bA}	31.60^{b}
	T2	32^{abAB}	33^{bB}	33^{bB}	32^{bAB}	32^{bcA}	32.40^{bc}
	T3	33^{bA}	34^{bA}	34^{bA}	34^{bA}	34^{cA}	33.80^{c}
	T4	32^{abA}	33^{bA}	33^{bA}	32^{bA}	32^{bcA}	32.40^{bc}
	T5	31^{abA}	32^{bAB}	33^{bB}	33^{bB}	31^{bA}	32.00^{bc}
	T6	33^{bA}	34^{bA}	34^{bA}	34^{bA}	33^{bcA}	33.60^{bc}
	Mean	31.71^{AB}	32.43^{B}	32.14^{AB}	31.42^{AB}	30.57^{A}	
Appearance (15)	**Control**	15^{aD}	15^{aD}	13^{aC}	11^{aB}	8^{aA}	12.40^{a}
	T1	15^{aC}	15^{aC}	15^{bC}	14^{bB}	12^{bcA}	14.20^{b}
	T2	15^{aC}	15^{aC}	15^{bC}	14^{bB}	12^{bcA}	14.20^{b}
	T3	15^{aC}	15^{aC}	15^{bC}	14^{bB}	13^{cA}	14.40^{b}
	T4	15^{aC}	15^{aC}	15^{bC}	13^{bB}	12^{bcA}	14.00^{b}
	T5	15^{aD}	15^{aD}	14^{abC}	13^{bB}	11^{bA}	13.60^{b}
	T6	15^{aC}	15^{aC}	15^{bC}	14^{bB}	13^{cA}	14.40^{b}
	Mean	15.00^{C}	15.00^{C}	14.57^{C}	13.29^{B}	11.57^{A}	
Overall acceptability (100)	**Control**	91^{aD}	90^{aD}	83^{aC}	74^{aB}	66^{aA}	**80.80a**
	T1	93^{abB}	95^{bB}	95^{bB}	93^{bB}	89^{bA}	**93.00b**
	T2	94^{aB}	95^{bB}	95^{bB}	92^{bAB}	90^{bcA}	**93.20b**
	T3	96^{bAB}	98^{B}	98^{bB}	96^{bAB}	94^{cA}	**96.40b**
	T4	94^{abB}	96^{bB}	96^{bB}	92^{bAB}	90^{bcA}	**93.60b**
	T5	92^{abB}	94^{abB}	94^{bB}	93^{bB}	87^{bA}	**92.00b**
	T6	95^{abA}	97^{bA}	97^{bA}	96^{bA}	$94c^{A}$	**95.80b**
	Mean	93.57^{B}	95.00^{B}	94.00^{B}	90.85^{B}	87.14^{A}	

A, b & c: Superscripts to be compared statistically within the same column. Values with different letter superscripts are significantly different *(P<0.05)*.

A, B & C: Superscripts to be compared statistically within the same row. Values with different letter superscripts are significantly different ($P<0.05$).

The scores of all sensorial properties increased up to 14 days of storage of all treatments and then decreased until the end of storage period, except the control cheese had only high score when fresh and decreased to the prolonging storage period. Kareish cheese made by T3 and T6 had the highest score values of flavour and body and texture when fresh and at the end of storage period. This could be attributed to the higher moisture content than the other treatments. These results are in agreement with those reported by El-Diasty *et al.* (2012) and Vajiheh *et al.* (2012).

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تحسين جودة وصلاحية الجبن القريش باستخدام بعض الطفرات لميكروبات

Streptococcus thermophillus, Lactobacillus delbreukii* subsp. *bulgaricus

تهدف هذه الدراسة إلى إمكانية استخدام بعض الطفرات لميكروبات *Streptococcus thermophillus, Lactobacillus delbreukii* subsp. *bulgaricus* فى تحسين خواص وجودة ومدة صلاحية الجبن القريش. حيث تم تصنيع الجبن القريش باستخدام بادئات هذه الطفرات وتم تخزينها لمدة 28 يوم وتحليلها كيماويا وحسيا وميكروبيولوجيا كل أسبوع من التخزين. وأوضحت النتائج المتحصل عليها أن الجبن القريش المعامل بالطفرات خاصة المعاملتين رقم 3، رقم 6 كانتا أعلى فى نسبة الرطوبة والتصافى وأقل فى الحموضة وتطورها أثناء التخزين عن باقى المعاملات الآخرى خاصة الكنترول.

الجبن القريش الناتج من المعاملتين رقم 2، رقم 5 كانتا أعلى فى محتواهما من الأسيتالدهيد وأن نسبة الأسيتالدهيد تزداد بالتخزين حتى وصلت إلى أقّصاها بعد الأسبوع الأول ثم بدأت تقل تدريجيا حتى نهاية التخزين.

أما بالنسبة لأعداد البكتريا والفطر والخميرة فى الجبن القريش المعامل ببادئات الطفرات فكانت فى جميع المعاملات أقل من الكنترول. ولوحظ أن محتوى الجبن من البكتريا يزداد تدريجيا حتى وصل إلى أكبر عدد لها بعد الأسبوع الثانى ثم بدأ يتناقص تدرجيا حتى نهاية التخزين. بينما محتواها من الفطر والخميرة كان يزداد بزيادة مدة التخزين.

ومن هذه النتائج يتضح لنا أن استخدام بعض الطفرات من هذه السلالات كبادئات أدى إلى تحسين التصافى وجودة الجبن القريش وكذلك أطال مدة صلاحيتها.