IMPROVING FUNCTIONAL PROPERTIES OF KAREISH CHEESE BY ADDING LOW SODIUM SALT AND DRIED PARSLEY

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Abstract

Kariesh cheese is one of the most traditional Egyptian dairy products, it is known since the phararonic era. Parsley is an important source of phytochemicals such as phenolic, flavonoid compounds and vitamins. Hence, the aim of this study was to produce functional kariesh cheese supplemented with dried parsley by using low sodium salt. Chemical composition of parsley were studied. Furthermore, the effect of addition parsley in Kariesh cheese on physicochemical properties, microbiological count, rheological and sensory properties were evaluated. Results from HPLC showed that parsley contains high percent of rosmarinic, benzoic, E-vanillic & ellagic acids and hesperidin. Also, parsley has found to contain a variety of water soluble vitamins like nicotinic acid, B12, riboflavin and vitamin C. Kariesh cheese was made from skim milk supplemented with parsley (0.25, 0.5 and 0.75 %), and/or 1% low sodium salt (LSS) as substitution for commercial salt. Results indicated that moisture decreased whereas fat and protein contents increased with increasing adding ratio of parsley. Total bacteria count increased in the treatments which have LSS, where it was lower than the other treatments that contain parsley. In textural profile analysis, adding LSS with parsley caused increase in hardness, cohesnivess, springiness, chewiness and gumminess compared with control. From organoleptic view, all treatments were acceptable but the treatment which contains 1% LSS with 0.5% parsley showed the best organoleptic attributes among other treatments compared with control.

Key words: Kariesh cheese, parsley, Low sodium salt (LSS), Minerals, Texture Profile analysis

INTRODUCTION

Kariesh is considered to be one of the most important traditional Egyptian dairy products, commonly made in the Egyptian countryside, especially in small villages, as low-income people such as farmers use Kariesh cheese in their diet owing to its high protein content, low fat and reasonable price. Kariesh cheese is one of the most popular and oldest varieties consumed in Egypt (Abou-Donia, 2008). It is an acid coagulated fresh cheese, made from skim milk with soft composition, white curd and slightly salty. Kareish cheese is also considered one of the most food products rich in calcium and phosphorus. These elements are essential for bones and teeth formation (Francois *et al.,* 2004).

The increasing demand by Egyptian consumers is mainly attributed to its high protein content and low price (Fahmi, 1960).

Parsley (*Petroselinum crispum L.*) grows in Europe and Asia as a wild plant. The fresh and dried herb is widely used as flavouring in many different food products on account of its powerful aromatic odour. Cultivated parsley as a spice is produced in vegetable garden. In Egypt folk medicine, parsley is used to treat a wide variety of conditions. It is a very rich source of vitamins C, B and E, b-carotene, thiamin, phenols, flavonoids and organic minerals. The compounds of parsley are an important nutrient to form a strong immune system. The flavonoids in parsley have been shown to function as antioxidants that combine with highly reactive oxygen species and help in the prevention of oxygen-based damage to cells (Brigitte *et al.,* 2005).

Salt is perhaps the oldest and most commonly used as food additive. It improves the taste of many foods without adding calories. In larger amounts it also inhibits the growth of many microorganisms and has been used to preserve food throughout much of man's recorded history. So important salt was for preserving foods that it was often part of the pay. The average American consumes about 3 to 5 grams of sodium per day or about 7.5 to 12.5 grams of salt daily. Salt is 40% sodium and 60% chloride by weight (James *et al.*, 1987).

Sodium has been of interest in public health nutrition for decades, mainly because of its association with hypertension especially coronary heart disease (CHD) and stroke. Additionally, diets that are high in sodium may have independent but additive harmful effects on left ventricular hypertrophy, progression of renal disease, and risk of cardiovascular disease (CVD) and stroke. High sodium intake also presents a challenge for excretion by the kidneys, which is another potential mechanism for affecting blood pressure and risk of Noncommunicable disease (NCD). Increased sodium intake may lead to increased urinary protein excretion and may thus increase the rate of deterioration of renal function (WHO*,* 2003). A dietary pattern which is low in sodium and high in potassium has been recommended for blood pressure lowering, and is well supported by numerous randomised controlled trials. The World Health Organization (WHO) 2013–2020 global action plan for the prevention and control on non-communicable diseases identifies nine voluntary global targets including a 25% reduction in risk of cardiovascular disease and raised blood pressure, and a 30% reduction in mean population salt intake by 2025 (WHO, 2013).

Therefore, the aim of this study was to produce functional kariesh cheese by using low sodium salt with dried parsley.

MATERIALS AND METHODS

Materials

Fresh skimmed buffaloes' milk was obtained from the Food Technology Research Institute, Agric. Res. Center, Giza, Egypt. Salt (Sodium chloride) and low sodium salt (LSS) were obtained from El-Nasr Company, Egypt. Parsley was obtained from the Fac., of Agric., Cairo univ., at El-Giza and dried at 50°C in oven till it became dried.Youghurt starter culture; which consists *of Streptococcus salivarius subsp. thermophillus* and *Lactobacillus delbruckii subsp*. *bulgaricus* (1:1) (Chr. Hansen's Lab A/s Copenhagen, Denmark) were used.

Cheese manufacture

Kariesh cheese were manufactured according to the method adopted by Fahmi, (1960) and prepared as follows: skim milk (0.5% fat and 8.5% SNF) was heated at 74ºC for 15 sec. and then cooled to 32ºC. Active culture of starter was added (3%) and incubated at 42ºC until curdling. The curd formed was divided into five treatments as follow: control contains 1% commercial salt and without parsley, T1: contains 1% low sodium salt (LSS), T2: contains 0.25 % dried Parsley+1% LSS, T3: contains 0.5 % parsley + 1% LSS and T4: contains 0.75% parsley + 1% LSS. The formed curd was ladled into plastic frames lined with muslin cloth, and then curds pressed by suitable weights. Resultant cheese was stored at 5ºC ±2 for 28 days.

Chemical analysis

Twenty grams of the cheese was solution by mixing with an equivalent amount of distilled water previously warmed at 40ºC±1ºC and the whole mixture kept for 5 minute at room temperature before the assessments. The pH value, titratable acidity, moisture, protein, fat and ash contents were determined according to AOAC (2000). Phenolic and flavonoid compounds were determined using HPLC according to the method of Mattilla *et al.*, (2000). Vitamins B and C were determined using HPLC according to the method of Ciulu *et al.*, (2011).

Minerals content:

The minerals Fe, Ca, Zn, K, Na and Mg were determined after incineration of 1.5 g of parsley at 550 °C, until a constant weight was obtained. Next, the ash was solubilized with 25 ml of HNO_3 50%, heated in a water bath for 30 min, filtered and the minerals were determined by atomic absorption spectrophotometry (Varian Model Spectra AA 100 & 200). (AOAC, 2000).

Microbiological analysis

Microbiological analysis (total bacterial count and coliform group) were carried out following APHA (2005) using different selective media to enumerate different viable microorganism group.

Texture profile analysis

Texture profile analysis of Kariesh cheese was measured at 23ºC as described by Bourne (1982) using an Instron Universal Tasting Machine model 1195, Stable Micro system (SMS) LTD., Godalming, UK, loaded with Dimension software SMS program. Likewise, Penetration value was measured as in Bourne (1982).

Organoleptic evaluation

Samples of Kariesh cheese approximately 30g in duplicates of two different batches, were prepared for sensory evaluation. Samples were tempered at ambient temperature (20±2ºC) according to Scheme described by IDF (1995).

RESULTS AND DISCUSSION

Chemical analysis

Parsley is an important source of phytochemicals such as phenolic, flavenoids compounds and vitamins; Data in Table (1) indicates the presence of different phenolic compounds and flavonoids. Results showed that the highest percent in phenolic compounds were for rosmarinic, benzoic, E-vanillic and ellagic acids. Whereas it was for hesperidin in flavonoids. rosmarinic acid is known for its antioxidant, anti-inflammatory and antimicrobial activities. rosmarinic acid helps to prevent cell damage caused by free radicals, thereby reducing the risk for cancer and atherosclerosis (Hossan *et al.*, 2014). Benzoic acid is a common additive for preserving foods, fats, fruit juices, alkaloid solutions, and curing tobacco. Besides, the flavonoids found in parsley have been shown to function as antioxidants that combine with highly reactive oxygen species and help in the prevention of oxygen-based damage to cells (Brigitte *et al.,* 2005). For example, Hesperidin has several biological functions such as antioxidant, anti-inflammatory, anti-mutagenic activity (Al-Jasabi and Abdullah, 2013).

Table 1. Phenolic and flavonoids compounds (mg/100g) of dried parsley

Phenolic content		Flavonoids content	
Pyrogallol	1.27	Naringin	1.603
Gallic	0.14	Hespirdin	7.945
4-Amino-benzoic	2.43	Rutin	0.136
Protocatchuic	0.62	Quercetrin	0.669
Catechein	0.44	Quercetin	0.255
Catechol	0.08	Naringenin	0.332
Chlorogenic	1.02	Hespirtin	0.185
Epicatechein	0.09	Kaempferol	0.013
P-OH-benzoic	0.36	Apigenin	0.036
Caffeine	0.97		
Vanillic	1.34		
P-Coumaric	2.13		
Rosmarinic	55.09		
Ferulic	0.29		
E- Vanillic	6.98		
Benzoic	12.52		
Ellagic	6.78		
alpha- coumaric	0.23		
Coumarin	1.61		
3,4,5-methoxy-cinnamic	0.10		
Salycilic	2.77		
Cinnamic	0.02		

In addition to its phenolic and flavonoids compounds, parsley is an excellent source of vitamin B and a good source of vitamin C. Studied parsley has found to contain a variety of water soluble vitamins (Table 2). Among these vitamins, nicotinic acid, B12 and riboflavin were found in high amounts, besides a detectable amounts of other vitamins like vitamin C and folic acid. Water-soluble vitamins (vitamins B1, B2, B6, B12, folic acid, pantothenic acid, niacin, biotin and vitamin C) are not normally stored in significant amounts in the body, which leads to the need for a daily supply of these vitamins. Water-soluble vitamins are involved in the metabolism of fats, carbohydrates and proteins at different stages of the reactions (Ball, 1998). Vitamin B2 (riboflavin) has an important role in cell respiration, metabolism of proteins, fats and carbohydrates and has participation in vitamins B6, B9 and B12 metabolism. Riboflavin is stable during food processing and storage and is very sensitive to light. In nature, vitamin B12 (cobalamin) is an essential cofactor in fatty acid, amino acid, carbohydrate and nucleic acid metabolism (Santos Pereira *et al.,* 2010). Vitamin C is the body's primary water-soluble antioxidant, rendering harmless dangerous free radicals in all water-soluble areas of the body. High levels of free radicals contribute to the development and progression of a wide variety of diseases, including atherosclerosis, colon cancer, diabetes, and asthma. Vitamin C is also a powerful anti-inflammatory agent, which explains its usefulness in conditions such as osteoarthritis and rheumatoid arthritis (Pattison *et al.,* 2004).

Table 2. Vitamins B and C contents (mg/100g) of dried parsley

Vitamins	(mg/100g)
V.C	6.271
Nicotinic	41.344
Thiamin	8.387
B6	11.439
Folic	7.982
B12	49.902
Riboflavin	14.093

Minerals plays a vital role in many biological functions such as reproduction, diabetes control, stress level, immune resistance, smell, taste, physical growth, appetite and digestion. Benefits of minerals include transmission of nerve impulses, body temperature regulation, detoxification, energy production, and the formation of healthy bones and teeth iron helps to transport oxygen into the cells. It is also important for muscle proteins (Al-Abdulkarim *et al.,* 2013). Data in Table (3,4) showed that K and Fe were the highest compared to other minerals Also, K was the highest in LSS, while Na was the highest in commercially salt when compared to other minerals. These led to increase K, Fe and Na when added to kariesh cheese.

Table 3. Minerals content % of parsley, salt and LSS

Ingredient	Fe	Zn	Ca	Na	K	Mg
Parsley	2.03	0.19	0.68	1.86	4.09	0.28
Salt	0.14	0.02	0.62	22.99	9.01	0.05
LSS	0.10	0.74	2.22	3.25	28.14	6.73

Salt: commercial salt
LSS: low sodium salt

Table 4. Minerals and Ash content% of fresh Kariesh cheese as affected by using low sodium salt (LSS) and different levels of parsley at 5°C ±2.

Treatments	Fe	Zn	Ca	Na	K	Mg	Ash
Control	0.08	0.07	0.12	0.58	0.11	0.05	1.74
T1	0.08	0.07	0.31	0.28	0.41	0.07	1.84
T2	0.12	0.08	0.32	0.32	0.67	0.08	1.92
T3	0.23	0.09	0.33	0.35	0.74	0.09	1.98
T4	0.35	0.13	0.35	0.40	0.79	0.09	2.05

Control (without parsley + commercial salt)., T1: without parsley + LSS., T2. 0.25 % Parsley+ LSS., T3: 0.5 % Parsley + LSS., T4: 0.75% Parsley + LSS.

Fig (1) represents moisture content of different trails of Kariesh cheese using different levels of parsley and/or LSS. Results revealed that moisture content of Kariesh cheese supplemented with parsley was lower than control when fresh and during the storage period, the treatments with parsley exhibited the lowest level of moisture. This results are a line with El-Sheikh *et al*., (2001). On the other hand, Mc-Mahon *et al.,* (2014) mentioned that cheeses containing KCl have been reported as having softer texture. Kariesh cheese supplemented by parsley has high protein and low fat content when compared with control (Table, 5). Whereas, Mc-Mahon *et al.,* (2014) mentioned that cheese was not significantly different than the normal salted cheese in composition and texture.

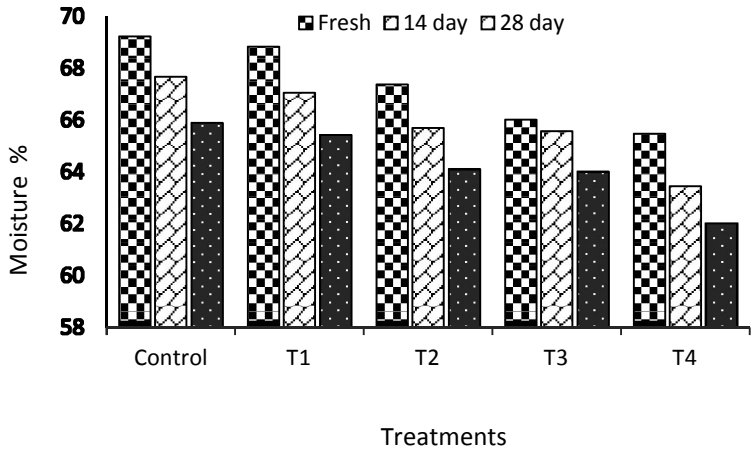

Fig. 1. Moisture content of Kariesh cheese supplemented with parsley and LSS when fresh and during storage periods at 5°c±2 for 28 days .

Table 5. Protein and fat contents of fresh Kariesh cheese supplemented with parsley and LSS.

Treatments	Protein (%)	Fat(%)
Control	21.33	0.80
T1	21.50	0.87
T2	21.88	0.74
T3	21.95	0.73
T4	22.02	0.71

Control (without parsley + commercial salt)., T1: LSS + without parsley., T2. 0.25 % Parsley + LSS., T3: 0.5 % Parsley + LSS., T4: 0.75% Parsley + LSS.

The changes in the titratable acidity and pH values during storage period at 5ºC of different trails of Kariesh cheese LSS using different levels of parsley are given in Figs. (2, 3). The results showed that, addition of low sodium salt (LSS) and/or parsley led to decrease in the pH values of cheese compared to control. This may be due to use of LSS as substitute to commercial salt. In addition, the pH values of all cheeses gradually decreased during the storage period. Similar observations are reported by Janhoj *et al.*, (2008). Apparently, the starters in cheeses with K addition use most of the lactose during the first day and so the pH values decreased during the following 6 d is minimal. Intracellular K+ cations provide a counterion for fermentation acid anions, which accumulate inside bacteria as the pH decreases and can impede viability (Russell and Diez-Gonzalez, 1998). This may explain differences seen in lactic acid concentration and hence, the pH values (Figure 2), as LAB in cheese with increased K produced more lactic acid than was seen from bacteria in cheese containing the highest levels of Na. In addition, cheese containing more K generally had a lower pH values over the storage period (Mc-Mahon *et al.,* 2014). The changes in titratable acidity of cheese treatments followed an opposite trend to pH values. Generally, titratable acidity (%) increased during storage period in all treatments.

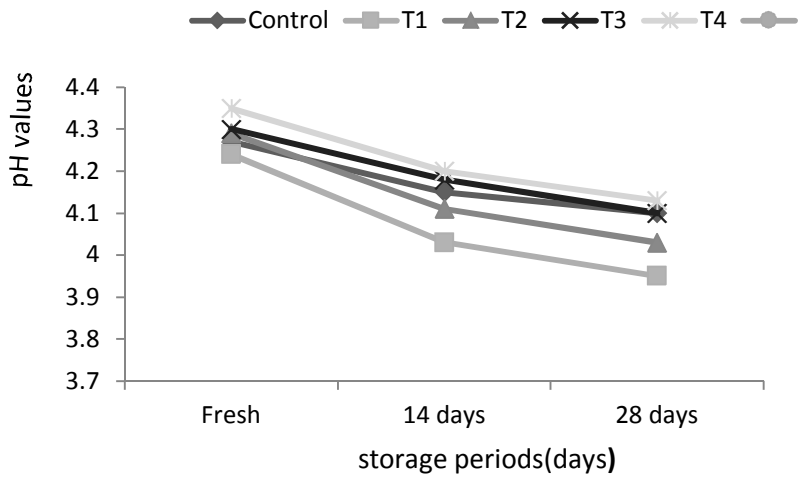

Fig. 2. pH values of Kariesh cheese supplemented with parsley and LSS when fresh and during storage periods at 5°c ±2. For 28 days

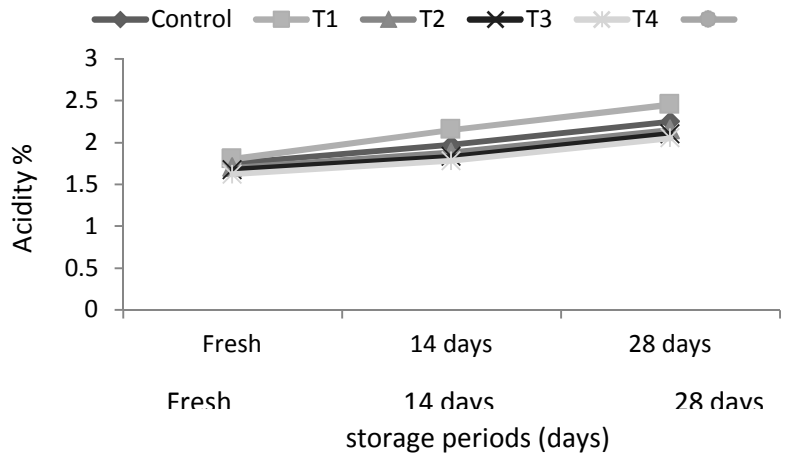

Fig. 3. Acidity of Kariesh cheese supplemented with parsley and LSS when fresh and during storage periods at 5 °c ±2. For 28 days.

Microbiological analysis

The changes in counts of total bacteria during the storage period of Kariesh cheese supplemented with parsley and low sodium salt (LSS) are shown in (Table 6). The viability of total bacterial count with parsley in fresh and during storage period exhibited higher counts in T1 (LSS) than other treatments including control. LSS contain more K than Na. Greater K substitution led to probably a slower die-off or inactivation of the starter bacteria, as K is less inhibitory than Na. On the other hand, total bacterial counts decreased with increased addition ratios of parsley to cheese. These may due to phenols and flavonoids contents found in parsley which are known for their antibacterial activity. Also, the coliform bacteria were not detected in all tested cheese samples. The Egyptian standards for Kariesh cheese No.1008/2000 mentioned no account on the acceptable level of total bacterial count, but they obligate the pasteurization or any equivalent heat treatment of the cheese milk with the addition of powerful starter culture. It indicates that the total coliforms are less than 10 CFU/g. These results harmony with Awad (2016) who stated that the improvement of Kariesh cheese manufacture which is necessary to obtain a safe and homogenous product.

Table 6. Total bacterial counts (log CFU/g) of Kariesh cheese as affected by using low sodium salt (LSS) and different levels of parsley when fresh, and during the storage period at 5 °C ±2.

Storage periods (days)	Treatments				
	Control	T1	T2	T3	T4
Fresh	4.94	5.20	4.87	4.75	4.59
14	5.12	5.65	4.99	4.89	4.74
28	5.40	5.80	5.25	5.11	5.00

Control (without parsley + commercial salt)., T1: LSS+ without parsley., T2. 0.25 % parsley+ LSS., T3: 0.5 % parsley + LSS., T4: 0.75% parsley + LSS.

Textural profile analysis:

Hardness is described as the force required to penetrate the sample with the molar teeth (from soft to firm). From the obtained results (Table, 7), it could be seen that, adding LSS with parsley cause an increase in hardness, cohesiveness, springiness, chewiness and gumminess compared to control in fresh cheese. This may be due to added LSS with parsley led to decrease in cheese moisture content, as a result of water adsorption or binding by LSS and parsley. Because the increase in moisture content weakness the casein curd. Springiness is described to the panelists as bouncing properties of the sample through several consecutive bites. The obtained values of this property (Table, 7) for Kariesh cheese with different treatments ranged from 9.74 to 9.00 mm which means that the springiness took the same trend of hardness. Cohesiveness known as the degree to which the cheese treatments deforms before rupturing, therefore, cohesiveness values is a direct function of the work needed to overcome the internal bonds of the material. Gumminess values had the same direction of hardness and cohesiveness. It can be seen from the obtained data (Table. 7) that the average gumminess of control was the highest than the other treatments. Treatment with 0.75 % parsley and LSS showed the lowest gumminess. Chewiness is described to be the number of chews required to swallow a certain amount of sample. This property expressed mathematically as the product of gumminess & springiness, therefore, it took the same trend of these property. These include those factors that affect the curd moisture content (temperature of coagulation and drain of whey), cheese composition, pH, interactions between casein and serum proteins, Ca content, ionic strength, salt content, and manufacturing protocol, especially rate and extent of acid development. Fat content in the cheese is responsible for its many desirable functional and texture. In addition, decreasing moisture content might result in decrease in the level of free moisture in cheese; this increased the hardness (Awad, 2011).

Table 7. Textural profile analysis of Kariesh cheese as affected by using low sodium salt (LSS) and different levels of parsley when fresh, and during the storage period at 5 °C ±2.

Parameters	Storage Periods (days)	Treatments				
		Control	T_1	T_2	T_3	T_4
Hardness (N)	Fresh	7.86	8.60	8.94	9.0	9.53
	28	6.75	7.34	7.45	7.76	8.66
Cohesiveness (-)	Fresh	0.46	0.53	0.56	0.58	0.68
	28	0.34	0.40	0.45	0.47	0.57
Springiness (mm)	fresh	5.88	5.68	5.48	5.02	4.91
	28	4.95	4.65	4.50	4.20	3.87
Gumminess (N)	fresh	4.96	5.00	5.50	5.45	6.80
	28	4.11	4.42	4.65	4.87	5.20
Chewiness (N/m)	fresh	22.0	26.00	27.39	35.02	37.00
	28	17.0	19.0	23.0	28.10	30.0

Control (without parsley + commercial salt)., T1: without parsley + LSS., T2. 0.25 % parsley+ LSS. T3: 0.5 % parsley + LSS., T4: 0.75% parsley + LSS.

Sensory evaluation:

Sensory evaluation is an important indicator of potential consumer preferences. Sensory evaluation of Kariesh cheese with low sodium salt (LSS) and / or parsley is shown in Table (8) and Fig. (4). The results revealed that, addition of parsley with LSS improved Kariesh cheese till 0.5 % ratios of parsley recorded the highest levels of organoleptic scores compared to other treatments when fresh and during the storage period. Using LSS as substitution for commercial salt led to improve in cheese texture; making it softer. This may be due to added low sodium salt and/ or parsley which enhanced taste and flavor, with additionally body and texture of Kariesh cheese. Among these, flavour is the most notable attribute for the consumer. These data agree with Johnson *et al.,* (2009) who reported that challenges in reducing Na levels in cheese emphasizing the importance of salt in cheese flavor, food safety, and general consumer acceptability. Small reductions (10 to 25% Na) in salt content of cheese are acceptable to consumers.

Table 8. Sensory evaluation of Kariesh cheese as affected by using low sodium salt (LSS) and different levels of parsley when fresh, and during the storage period at 5 °C ±2.

Storage period (days)	Properties		Treatments				
			Control	T_1	T_2	T_3	T4
Fresh	Flavour	(50)	45.55	45.88	46.20	46.40	43.60
	Body&texture	(35)	32.00	32.25	33.28	33.45	30.55
	Appearance	(15)	12.45	12.65	13.13	13.78	11.20
	Total	(100)	90.00	90.78	92.61	93.63	85.35
14	Flavour	(50)	46.00	46.28	46.78	47.17	44.23
	Body&texture	(35)	32.43	32.75	33.45	33.75	31.25
	Appearance	(15)	13.30	13.45	13.67	14.12	11.85
	Total	(100)	91.73	92.48	93.90	95.04	87.33
28	Flavour	(50)	46.82	46.90	47.20	47.82	45.00
	Body&texture	(35)	33.50	33.65	34.01	34.44	31.95
	Appearance	(15)	13.42	13.65	13.89	14.33	12.42
	Total	(100)	93.74	94.20	95.10	96.59	89.37

Control (without parsley + commercial salt)., T1: without parsley + LSS., T2. 0.25 % parsley+ LSS. T3: 0.5 % parsley + LSS. T4: 0.75% parsley + LSS.

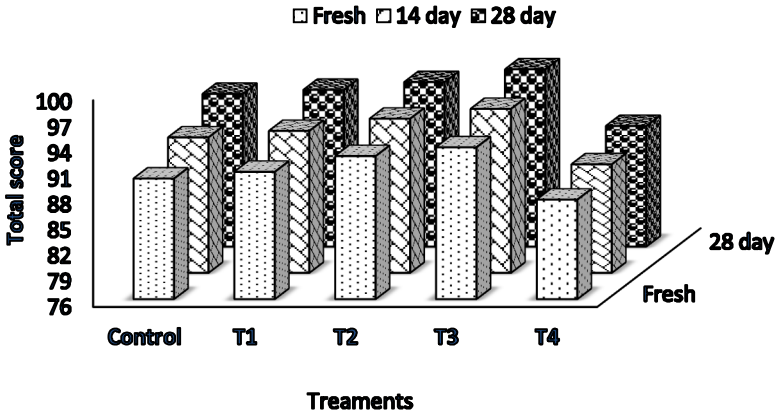

Fig. 4. Sensory evaluation of Kariesh cheese supplemented with parsley and low sodium salt (LSS) when fresh, and during the storage period at 5 °C ±2 for 28 days.

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تحسين الخواص الوظيفية للجبن القريش عن طريق استخدام ملح منخفض الصوديوم والبقدونس المجفف

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تعتبر الجبن القريش واحدة من المنتجات اللبنية المصرية التقليدية، و المعروفة منذ عهد الفراعنة. والبقدونس مصدرا هاما للمركبات الكيميائية النباتية مثل الفينولات ومركبات الفلافونويد والفيتامينات. ومن هنا، كان الهدف من هذه الدراسة إنتاج جبن قريش وظيفي مدعم بالبقدونس المجفف ومع استبدال الملح التجاري بملح منخفض الصوديوم. وتمت دراسة التركيب الكيميائي للبقدونس، تم تقييم تأثير إضافة البقدونس في الجبن القريش على الخصائص الفيزيائية و الريولوجية ، العد الكلي الميكروبي،والخواص الحسية. وأظهرت النتائج من HPLC أن البقدونس يحتوي على نسبة عالية من الروزماريك، البنزويك،–E فانيلين وحمض الاجيك والهيسبيريدين.

وجد أن البقدونس يحتوي على مجموعة متنوعة من الفيتامينات القابلة للذوبان في الماء مثل حمض النيكوتينيك، B12 والريبوفلافين وفيتامين C. و قد صنع الجبن القريش من اللبن الفرز الطازح والمضاف اليه بقدونس مجفف (0.25، 0.5 و 0.75٪)، مع أو بدون 1٪ ملح منخفض الصوديوم كبديل عن الملح التجاري. وأشارت النتائج إلى أن الرطوبة والدهون والبروتين انخفضت مع زيادة نسبة البقدونس المضاف، وزاد المحتوي من البكتيريا في المعاملة ذات الصوديوم المنخفض بدون البقدونس، والذى ادت اضافته الى خفض اعداد البكتريا الكلية. وبالنسبة للتحاليل الريولوجية، فقد ادت اضافة الملح المنخفض في الصوديوم مع البقدونس الى زيادة في الصلابة، التماسك، المرونة، القابلية للمضغ والصمغية لجميع المعاملات فيما عدا جبن المقارنة. و من حيث الخواص الحسية، فقد كانت جميع المعاملات مقبولة بينما أظهرت المعاملة التى احتوت على ملح منخفض الصوديوم مع 0.5٪ بقدونس أفضل الصفات الحسية بين المعاملات الأخرى.