JSAES
Journal of Sustainable Agricultural and Environmental Sciences
Print ISSN : 2735-4377
Online ISSN : 2785-9878
Homepage: https://jsaes.journals.ekb.eg/

Research Article

Harnessing the Power of *Aloe Vera*: A Natural Approach to Preserving Karish Cheese

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Article info: -
- **Received:** 25 May 2025
- **Revised:** 9 July 2025
- **Accepted:** 14 July 2025
- **Published:** 19 July 2025

Keywords:
Aloe vera; Karish cheese; Functional properties; Sensory evolution

Abstract:

This study explores the new application of *Aloe vera* in the production and preservation of Karish cheese, focusing on its preservative and nutritional value. *Aloe vera* is a succulent plant with thick gel-storing leaves, and it contains innumerable active components that provide numerous health benefits. The effectiveness of two preservation techniques: soaking cheese in pure *Aloe vera* gel treatment (T1) and a 30% *Aloe vera* and 70% whey solution treatment (T2), with a control sample (C) was studied. The results showed that *Aloe vera* pulp contained strong antioxidants, preserving Karish cheese's shelf life while maintaining quality. Throughout cold storage lasting four weeks, a number of attributes were analyzed, including chemical composition, texture, and sensory characteristics. Interestingly, *Aloe vera* treatments strongly suppressed mold and yeast growth without eliminating useful starter bacteria. A fascinating enhancement in the chemical composition of the cheese, such as moisture content and total. protein, and antioxidant activity was also noted. *Aloe vera* treatment improved the rheological characteristics of the cheese, particularly the firmness and cheese viscosity. Soaking treatments were the most favored by consumers in the sensory evaluation. The results for week 4 showed scores of 33.4, 12.8, and 45.4 for body & texture, appearance, and flavor, respectively, highlighting its effectiveness as a preservation technique. No mold or yeast count was detected until the fourth week, when it measured 2.64 (log cfμ/g). Our findings indicate the potential use of *Aloe vera* as a natural preservative, which also acts as a nutrient fortifier for milk products, enhancing shelf life and resulting in healthier cheese products.

1. Introduction

Karish cheese is also greatly desired by consumers due to its taste and healthiness. It is the most consumed dairy product in Egypt due to its affordability and is rich in healthy features. It may also include probiotics, which can enhance overall well-being and may support digestive health (El-Nawasany et al., 2015). However, having high water content, Karish cheese is left more vulnerable to attack by fungi and yeasts of foodborne pathogens during production, transport, and storage. Such susceptibility, therefore, calls for effective preservation methods to ensure the extension of shelf life of the cheese despite consumers holding onto natural and sustainable preservatives (El-Nawasany et al., 2023a).

This is where *Aloe Vera* comes in. Renowned for its fleshy, gel-stuffed leaves, this cactus plant is part of the lily family and does wonderfully in dry habitats, where it can store water for weeks without replenishment. Not only does this allow it to live just fine in desert conditions, but it also helps to enrich the soil and eliminate erosion (Adom et al., 2022).

Aloe Vera is a repository of nutrient molecules. It contains high water content and therefore functions as an excellent natural moisturizer. It also contains a combination of vitamins like A, C, and E, which are antioxidants, and vitamin B12, which enables the nervous system to work effectively (Usman and Alam, 2024). *Aloe Vera* has an abundance of essential minerals, including calcium, magnesium, zinc, chromium, and selenium that contribute to an enormous number of functions in the body (Swaraj, 2024).

Apart from vitamins and minerals, *Aloe Vera* also comprises amino acids and enzymes like amylase and lipase, which make hydrolysis of carbohydrates and fats easy. It is packed with high levels of polysaccharides like acemannan, which stimulates immune response. *Aloe Vera* also comprises anthraquinones, anti-inflammatory and laxative phytochemicals, of which aloin is the most important (Usman and Alam, 2024). *Aloe Vera* fatty acids oleic and linoleic acid are beneficial for heart health (Banakar et al., 2023), whereas the plant sterols assist in soothing inflammation and ensuring skin health (Saleem et al., 2022).

Aloe Vera gel is best known therapeutically as a herbal skin moisturizer with properties to heal burns and wounds by soothing inflammation and pain. *Aloe Vera* gel also contributes to the gastrointestinal health by healing constipation and bowel movement relief due to its laxative effect (Filatov et al., 2024). *Aloe Vera* antioxidants such as vitamins A, C, and E also protect cells from damage by fighting free radicals. *Aloe Vera* lowers blood sugar, thus suitable for diabetic patients (Nicolau-Lapeña et al., 2021). It can even be utilized as

a mouthwash to calm gum inflammation (Andhare et al., 2024).

Aloe Vera gel in cheese can be very important in enhancing the texture and nutritional value of cheese. It lowers preservation by acting as an antibacterial and antifungal agent (Kouser et al., 2023). The use of *Aloe Vera* in dairy food holds immense opportunities to improve the quality and nutritional value of food, with higher quantities of healthy food being available to the public. The objective of this study is to research the potential ways in which *Aloe Vera* gel can improve the nutrition of karish cheese and be effective in preservation of such an fundamental product.

2. Materials and Methods

2.1. Materials

The buffalo milk utilized in the study was procured from the experimental station of Mahallat Musa under the Animal Production Research Institute of the Egyptian Ministry of Agriculture. Fresh *Aloe Vera* leaves were procured from the farms associated with the Agricultural Research Center, and carboxymethyl cellulose was sourced from the Egyptian Food Additives Company (MIFAD). The active milk starter culture, which was *Lactobacillus Delbrueckii Subsp. Bulgaricus* and *Streptococcus Thermophilus* in 1:1 ratio, were provided by CHR Hansen Laboratory at Kalundborg, Denmark. Calcium chloride was from El Gomhoria Company.

2.1.1. Preparation of pulp of Aloe vera

A mature, fresh leaf of *Aloe Vera* was obtained from the Agricultural Research Center. The plant was cut using a sharp knife at the base and was properly washed under running water. The sharp edges were removed carefully with the same knife. Transparent gel was extracted from the leaves in such a way that yellow liquid was completely drained from the green tissue (Sabat et al., 2018). *Aloe Vera* pulp was cold stored in water for 10 minutes for cheese manufacture and had 15 minutes cold storage. The proportion of *Aloe Vera* sample analyzed is as follows: Total Solids (TS) 3.82%, Total Protein (TP) 0.95%, ash 0.37%, pH 4.37, and acidity 0.45%. It has Total Polyphenol Content (TPC) of 50.08 mg GAE/g, Total Flavonoid Content (TFC) of 22.73 mg QUE/g, DPPH radical scavenging activity of 51.31%, and FIRP value of 0.92 (700 nm absorbance). It has minerals such as Na 50.12 mg, K 126.91 mg, Mg 20.52 mg, Zn 0.12 mg, Cu 0.038 mg, Ca 72.08 mg, and Fe 34.51 mg.

2.1.2. Aloe Vera Solution

It was made from 0.5% carboxy methyl cellulose of Misr Food Additives Company (MIFAD) and 30% *Aloe Vera*, and the remaining portion was filled with whey obtained from cheese production. The blend was then mixed for 5 minutes and pasteurized at 85 °C for 15 seconds.

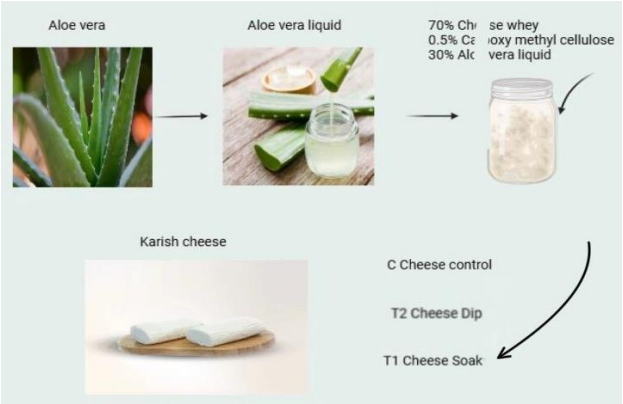


Figure 1. illustrates a simple schematic depicting the use of *Aloe vera* liquid for preserving Karish cheese.

2.1.3. Production of the Karish cheese

Karish cheese was prepared as per the description of (El-Nawasany et al., 2023a). Buffalo milk used in the present study was purchased from the experimental station, Mahallat Musa, Animal Production Research Institute, Ministry of Agriculture, Egypt. The cream was skimmed from milk using a cream separator. Buffalo milk used had TS 21.93%, TP 4.19%, Ash 0.97% and acidity 0.18%.

Pasteurization of milk was done in the laboratory at 85 °C for 15 seconds and immediately cooled. Active milk starter culture of *Lactobacillus Delbrueckii Subsp. Bulgaricus* and *Streptococcus Thermophilus* (2.5%). 0.2% of calcium chloride produced by Al-Gomhoria Company was also added. The curds, when formed, were poured into the same volume vessels with drainage holes for whey drainage and left to drain. Dry salt (3 g for each 100 g of cheese) was applied to the curds.

The unwrapped cheese samples were packaged in plastic containers in accordance with standard manufacturing practices and stored at 4 °C for 40 days. The treatments were: the control treatment C, treatment T1 was the cheese that was submerged in a *Aloe Vera* pure, and treatment T2 was cheese submerged in the *Aloe Vera* solution.

2.2. Methods of analysis

2.2.1. Physicochemical composition

Total solid (TS), total protein (TP), soluble nitrogen (SN) and ash were determined according to (Agroindustriais, 2013). Ferric reducing power (FRAP) and free radical scavenging activity (DPPH) were analyzed following the method suggested by (El-Nawasany et al., 2023b). The pH was measured at 25°C using a Toptronic pH meter (Milano, Italy). 0.1 N NaOH employed as a titrant was quantitated in terms of lactic acid and titratable acidity as percentage lactic acid (%) on determination by titration with 0.1 M NaOH to phenolphthalein endpoint. whereas salt was estimated using the technique of (Bradley et al., 1992).

2.2.2. Texture profile analysis

The texture profile properties of the control test cheeses, along with a locally procured traditional Karish

cheese sample (control cheese), were determined on a texture analyzer (CNS-Farnell, Borehamwood, Hertfordshire, England). The samples of cheeses were placed inside the machine, which were 30 mm in diameter and 20 mm thick. The TA15-451 Perspex cone was utilized as the probe that penetrated to 10 mm in velocity at 1 mm/s. Equilibrium at room temperature was given to the samples before testing for a period of around 30 to 45 minutes. Texture measurements were recorded through the use of the LFRA Texture Analyzer (1000 g) and Computer Interface Software of CNS Farnell (Borehamwood, Hertfordshire, England WD61WG). Textural attributes were determined in accordance with the method described by (Szczesniak et al., 1963).

2.2.3. Viscosity

Viscosity values of Karish cheese samples were determined following the method described by (Viturawong et al., 2008) in a coaxial rotational viscometer Brookfield Engineering Labs DV-III Ultra Rheometer. The analysis was done at shear rates between 0.3333 and 195.8 s^{-1}.

2.2.4. Microbiological analysis

Mold and yeast were counted using Dichloran Rose-Bengal Chloramphenicol (DRBC) agar medium (Oxoid, England), by incubating the plates at 25 °C for 5 days as per ISO 21527-1:2008. *Lactobacilli* and *Streptococci* were enumerated (Log cfu/g) on MRS and M17 media, respectively, as per the procedure described by (Khosravi-Darani et al., 2015).

2.2.5. Sensory evaluation

The cheese was evaluated using a panel of 10 members trained in the Department of Dairy Chemistry, Animal Production Research Institute, Giza, Egypt. It was graded on average 45 points for body and texture, 20 points for color and appearance, and 35 points for flavor. The final scores were established through the summing of individual scores for each of the attributes as stipulated by (Awad et al., 2015).

2.2.6. Statistical analysis

Three replicates of every parameter were noted down, and all values are reported as mean along with their standard errors. One-way analysis of variance and Duncan's test were conducted using SPSS statistical computer package (SPSS 20 for Windows, SPSS INC., IBM, New York).

3. Results and Discussion

3.1. Chemical composition of Karish cheese

Chemical composition is needed to be established to identify the quality of cheese (Zheng et al., 2016). Table 1 illustrates the change that occurred in the cheese when soaked or immersed in an *aloe vera* solution. Interestingly, Total Solids (TS) content decreased in treatment T2, in which cheese was submerged in the *aloe vera* solution, as compared to treatment T1, in which cheese was dipped, and the control sample. Readings of 32.83, 31.36, and 31.02 % were observed for treatments C, T1, and T2, respectively in 4 week. This loss can be justified by the high moisture content of *aloe vera* (Ahmed and Hussain, 2013).

Further, soaking allowed *Aloe vera* to penetrate the cheese effectively, giving rise to moisture absorption from the cheese itself that minimized moisture loss due to the exposure of air and, in turn, minimization of dryness. It was noted that cheese in treatment T2 had improved maintained its water content for storage periods of every duration.

Results indicated the efficiency of *aloe vera* in maintaining the ash content of the cheese during the storage time, while that of the control sample increased. The contents after two weeks were 3.26%, 3.19%, and 3.13% for treatments C, T1, and T2, respectively. This is because the surface of the cheese is exposed to air when it is dipped and soaked in *aloe vera* in order for the mineral content not to be permitted to come into contact with oxygen and other contents that could result in undesirable reduction or increase in ash percentage.

The results showed the total protein (TP) of cheese with the use of *aloe vera* through dipping or soaking of the cheese in sustaining the TP levels during the storage intervals compared to the control. Two weeks, their values were 19.52%, 18.49%, and 18.53% respectively. The total protein content of all cheese samples increased during storage, but that of the control sample increased more. Soluble protein after four weeks was 0.6%, 0.57%, and 0.55% for treatments C, T1, and T2, respectively. It indicates that there is an increase in soluble nitrogen (SN) in the control sample. Soluble and total protein content are altered due to exposure of cheese to air in refrigerator (Guinee, 2016). It was also noticed that soaking provided sufficient time for the proteins to remain intact in the structure.

Table 1. Chemical composition of fresh and stored cheese.

Chemical composition	Time of storage	Treatments		
		C	T1	T2
T.S (%)	Fresh	30.13 ± 0.08^{Ca}	30.13 ± 0.08^{Ca}	30.13 ± 0.08^{Ca}
	2week	31.89 ± 0.07^{Ba}	30.86 ± 0.05^{Bb}	30.55 ± 0.08^{Bc}
	4week	32.83 ± 0.08^{Aa}	31.36 ± 0.06^{Ab}	31.02 ± 0.04^{Ac}
Ash (%)	Fresh	2.95 ± 0.03^{Ca}	2.95 ± 0.03^{Ca}	2.95 ± 0.03^{Ca}
	2week	3.26 ± 0.03^{Ba}	3.19 ± 0.03^{Bb}	3.13 ± 0.02^{Bb}
	4week	3.40 ± 0.02^{Aa}	3.30 ± 0.03^{Ab}	3.28 ± 0.02^{Ab}
T.P (%)	Fresh	18.09 ± 0.07^{Ca}	18.09 ± 0.07^{Ca}	18.09 ± 0.07^{Ca}
	2week	19.52 ± 0.05^{Ba}	18.49 ± 0.04^{Bb}	18.53 ± 0.05^{Bb}
	4week	20.35 ± 0.09^{Aa}	19.17 ± 0.03^{Ab}	19.00 ± 0.53^{Ac}
S.N (%)	Fresh	0.51 ± 0.01^{Ca}	0.51 ± 0.01^{Ca}	0.51 ± 0.01^{Ca}
	2week	0.56 ± 0.02^{Ba}	$o.54\pm0.01^{Bab}$	0.53 ± 0.01^{Bb}
	4week	0.60 ± 0.01^{Aa}	0.57 ± 0.01^{Ab}	0.55 ± 0.01^{Ac}

C: control cheese, T1: cheese dipped in *Aloe Vera* pure, and T2: cheese soaked in the *Aloe Vera* solution. Data are given as mean value ± standard deviation of three replicates for a sample. Statistically different values ($p \leq 0.05$) in the same treatment for storage period are shown as different letters within columns (A-B). Statistically different values ($p \leq 0.05$) in different treatments are shown as different letters in columns (a-b).

3.1.1. Salt % of Karish cheese

Salt is a critical component in cheese making as it imparts a typical taste to cheese, affects its texture, and enhances its shelf life (Bae et al., 2017). Figure 1 shows the determination of salt content in cheese. It was observed that T2 treatment decreased the salt content upon storage compared to the reference treatment. This may be due to the fact that the cheese absorbs the *Aloe Vera* solution, thereby diluting the cheese salt concentration. In addition, there may be an ion exchange between the cheese salt and the components of the *Aloe Vera* solution whereby the sodium ions are traded, reducing the taste of the cheese. The osmotic pressure and external solution concentration of the cheese salt content can also lead to the extraction of cheese salt, i.e., migration of salt from a high to a low concentration (Chandan and Kapoor, 2011). At four weeks, treatments C, T1, and T2 contained 3.35%, 3.17%, and 2.68% salt, respectively. Treatment differences and time within treatments throughout storage were significant statistically. This was not in treatment T2, where storage was not significant statistically up to the second week.

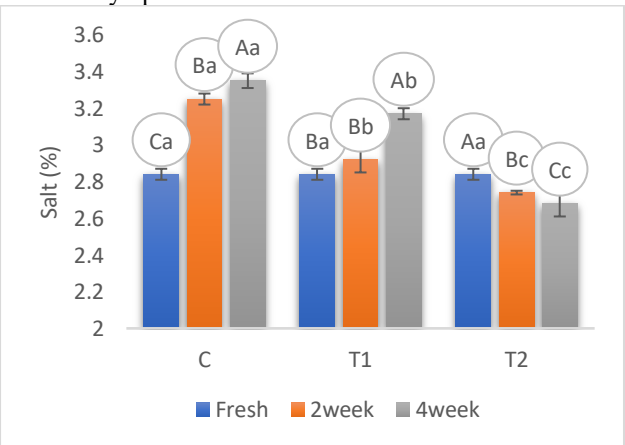
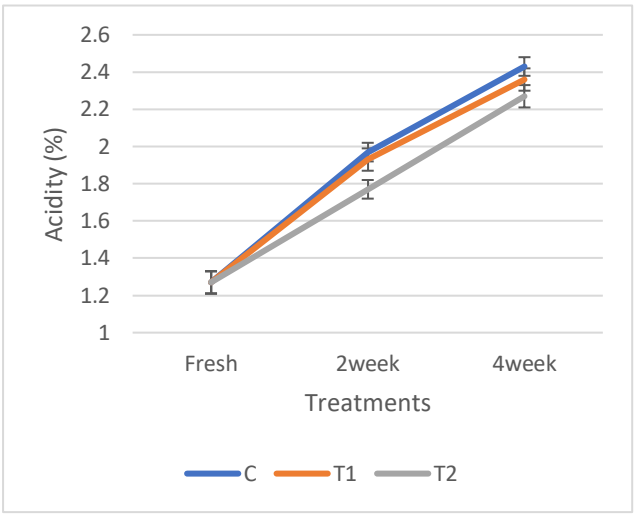


Figure 1. Salt of fresh and stored cheese. C: control cheese, T1: cheese with dipped in an *Aloe Vera* pure, and T2: cheese is soaked in the *Aloe Vera* solution. Statistically different values ($p \leq 0.05$) in the same treatment for storage period are shown as different letters within columns (A-B). Statistically different values ($p \leq 0.05$) in different treatments are shown as different letters in columns (a-b).

3.1.2. Acidity and pH of Karish cheese

Acidity of Karish cheese increases during storage due to the increase in the level of starter bacteria employed in its production. These bacteria ferment sugars and yield lactic acid as a byproduct of their metabolism. The enzymatic and microbial interactions during storage also lead to hydrolysis of proteins and fats, resulting in fatty acids and amino acids, which contribute to increased acidity (Mohamed et al., 2023; Khanal et al., 2019).

The readings in Figure 2 are the impact of *Aloe Vera* on cottage cheese. The results indicated an increase in acidity in the control sample compared to the rest of the treatments for all the storage periods. Acidity readings at the fourth week were 2.43%, 2.36%, and 2.27% for treatments C, T1, and T2, respectively. In contrast, the same treatments at the same fourth week had pH readings of 4.5, 4.59, and 4.63, respectively. The highest probable cause of the rise in acidity of the control treatment compared to other treatments would be because of the exposure of the cheese to air, which provides room for higher microbial growth or product contamination with unwanted microbes, resulting in an increase in the control sample acidity. On the other hand, the lower acidity in the treatments T1 and T2 compared to the control sample may be due to the fact that the *Aloe Vera* has antioxidants, which affect the growth and activity of bacteria (Nejatzadeh-Barandozi, 2013).



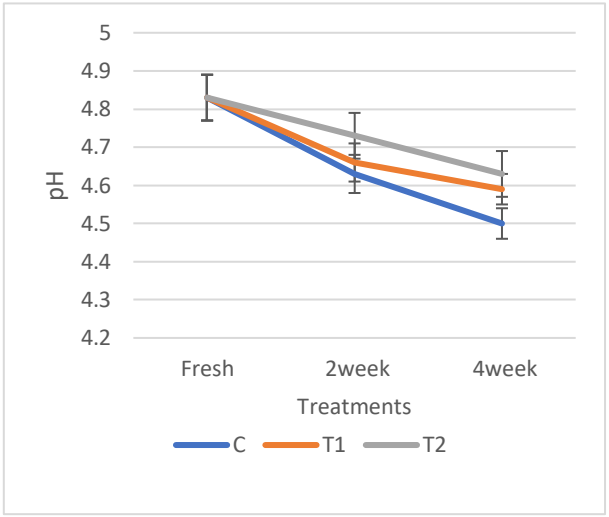
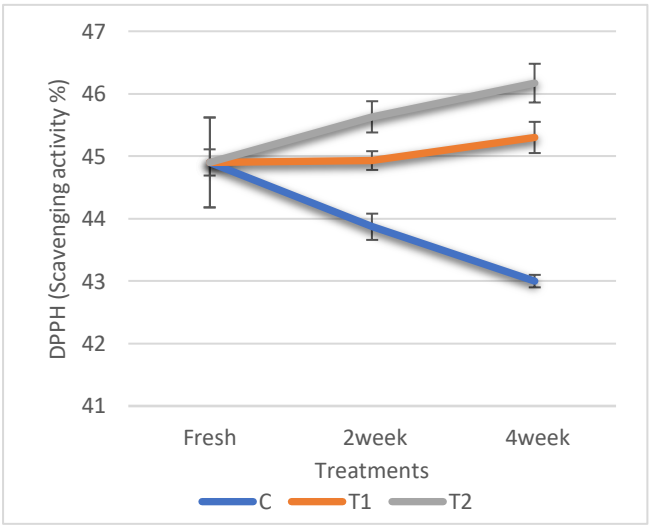


Figure 2. Acidity and pH of fresh and stored cheese. See legend to Figure 1 for details

3.1.3. Antioxidant activity of Karish cheese

DPPH and Ferric Reducing Power are used to determine the antioxidant activity that quenches free radicals (Pulido, 2000). The DPPH is used to determine the effectiveness of the antioxidants present in the samples, while the Ferric Reducing Power determines the iron-reducing power (Pulido et al., 2000). Cheese contains antioxidants due to amino acids and peptides present in it (Stobiecka et al., 2022). After identifying DPPH and Ferric Reducing Power of cheese samples, the outcome achieved in Figure 3 shows an increase in DPPH and Ferric Reducing Power of sample T2, which entailed soaking the cheese in *Aloe Vera* solution, relative to the control sample and treatment T1, wherein the cheese was soaked in *Aloe Vera*. The fourth week's DPPH and Ferric Reducing Power results for treatments C, T1, and T2 were 43%, 45.3%, and 46.17% for DPPH and 0.84, 0.94, and 0.99 (700 nm Absorbance), respectively. This is to be attributed to the presence of antioxidants such as phenols, flavonoids, and vitamins C and E in *Aloe Vera*, while soaking or immersing cheese may have assisted in absorbing the compounds to a certain extent in the cheese (Hęś et al., 2019).



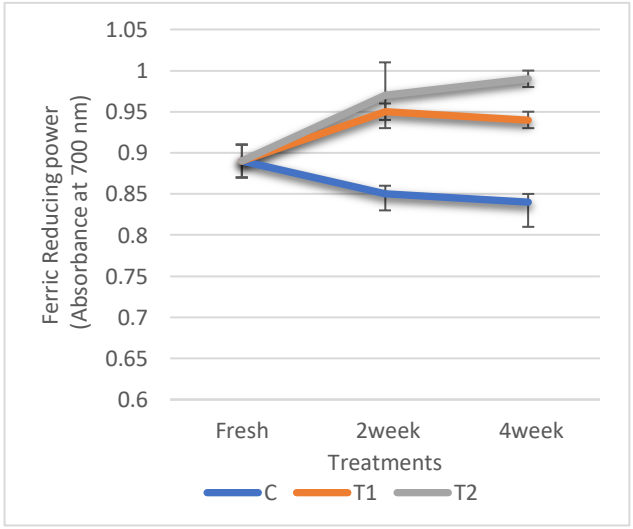


Figure 3. Antioxidant activity of fresh and stored cheese. See legend to Figure 1 for details.

3.2. Microbiological examinations

Lactobacilli and *Streptocci* bacteria play a critical role in the fermentation of Karish cheese as they contribute to the flavor of the cheese through fermenting lactose to lactic acid, which helps increase the acidity of the cheese (Coelho et al., 2022). Their activity also prevents the opportunity for unwanted microorganisms to grow, thereby enhancing the storage life of the cheese and its quality while improving its sensory and health attributes (Falih et al., 2024). Therefore, it is required to maintain the growth of these bacteria in the cheese without damaging their growth. In the analysis of *Lactobacilli And Streptococci* bacteria in the cheese, it was seen that their growth did not stop during the storage periods for treatments T2 and T3, which were treated instead using *Aloe Vera*; however, there was less growth seen in the second week compared to the control sample. Starter bacteria might have a greater ability to adapt and thrive in the

conditions created by *Aloe Vera*, indicating a need for further investigation.

The results for the treatments C, T1, and T2 of Lactobacilli were 8.34, 7.25, and 6.93 log cfμ/g, respectively. For the analysis of Streptococci, levels were 8.54, 7.52, and 7.84 log cfμ/g for the same treatments in the same order. By the fourth week, bacterial numbers in the control sample decreased by 6.57 and 6.88 log cfμ/g for *Lactobacilli* and *Streptococci*, respectively. This decrease occurs due to a depletion of nutrients over time and a gradual increase in the cheese's acidity, both of which impact bacterial growth (El-Nawasany et al., 2015). For Molds & Yeast count, no evidence of the presence of molds and yeasts in the samples with *Aloe Vera* treatment was observed until the second week. This may be attributed to the activity of antioxidants of *Aloe Vera* that prolonged the shelf life of cheese for a greater extent. The count recorded in the fourth week were 6.41, 3.5, and 2.64 log cfμ/g for treatments C, T1, and T2, respectively.

Table 2. Microbiological examinations of fresh and stored cheese.

Microbiological examinations	Time of storage	Treatments		
		C	T1	T2
***Lactobacilli* counts (log cfμ/g)**	Fresh	6.34 ± 0.09^{Ba}	6.34 ± 0.09^{Ca}	6.34 ± 0.09^{Ca}
	2week	8.34 ± 0.11^{Aa}	7.25 ± 0.10^{Bb}	6.93 ± 0.09^{Bc}
	4week	6.57 ± 0.05^{Bc}	8.43 ± 0.05^{Aa}	8.15 ± 0.09^{Ab}
***Streptococci* count (log cfμ/g)**	Fresh	6.77 ± 0.06^{Ba}	6.77 ± 0.06^{Ca}	6.77 ± 0.06^{Ca}
	2week	8.45 ± 0.06^{Aa}	7.52 ± 0.01^{Bb}	7.48 ± 0.03^{Bb}
	4week	6.88 ± 0.08^{Bc}	8.50 ± 0.03^{Aa}	8.38 ± 0.03^{Ab}
Mold & Yeast count (log cfμ/g)	Fresh	ND	ND	ND
	2week	4.34 ± 0.16^{Ba}	ND	ND
	4week	6.41 ± 0.08^{Aa}	3.50 ± 0.10^{Ab}	2.64 ± 0.14^{Ac}

See legend to Table 1 for details.

3.3. Viscosity of Karish cheese

Viscosity refers to a physical property that determines the resistance of a material or substance to flow (Viswanath et al., 2007). It is a good parameter that measures the ability of cheese to hold water and is a good indicator to determine the quality of cheese and the potential use (Fox et al., 2017). Viscosity values determined in Figure 4 show that the T2 treatment (30% *Aloe Vera* and 70% whey solution treatment), in which the cheese was dipped in an *Aloe Vera* solution, is higher in viscosity than other treatments. This may be due to gel-like substances found in *Aloe Vera*, such as polysaccharides, which possess the ability to thicken the liquid when the cheese is soaked (Suon, 2018). Besides that, there is a high water content in *Aloe Vera* that may make the cheese absorb water and become wetter, as shown in the chemical composition of the cheese (El-Sayed and El-Sayed, 2020). The observation also showed a decrease in the viscosity of the cheese under different shear rates. This is because cheese is a network of proteins and fats that is complex, and shear rate increase will break this network and decrease the viscosity of the cheese (Fox et al., 2017).

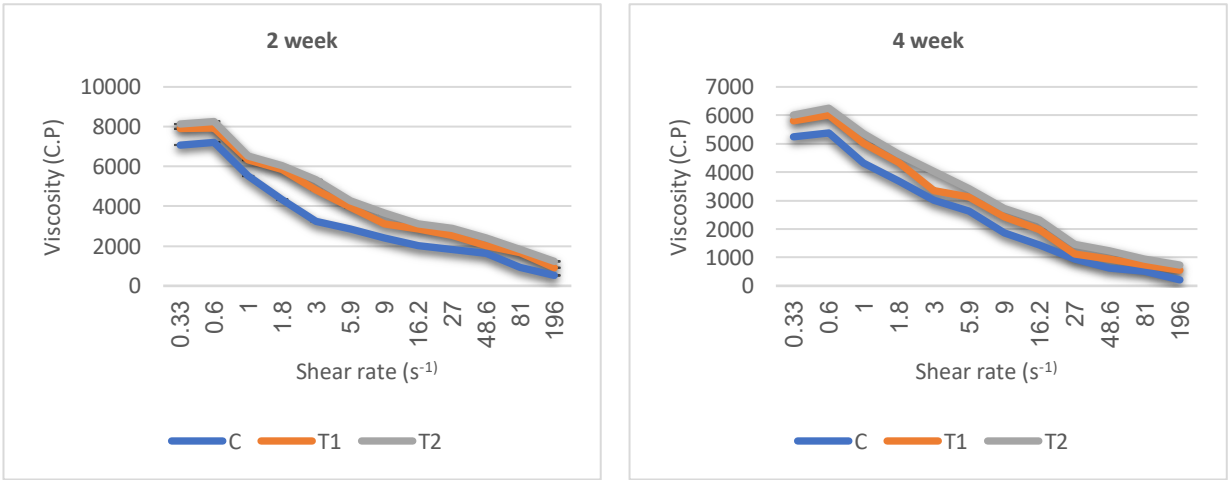


Figure 4. Viscosity of fresh and stored cheese. See legend to Figure 1 for details

3.4. Texture profile analysis of Karish cheese

The Texture Profile Analysis is used in the description and measurement of the sensory texture and consistency properties in cheese, and it is an essential measurement in determining cheese quality (Drake et al., 1999). The Hardness, Cohesiveness, Gumminess, and Adhesiveness were approximated and plotted in Figure 5. Hardness results revealed significant differences among treatments, with Hardness greater in the control treatment compared to other treatments. The week four readings were 28.26, 26.53, and 25.24 (g) for treatments C, T1, and T2, respectively. This is due to an increase in the moisture content of treatment T2 cheese due to the presence of gel-like compounds (polysaccharides) in the *Aloe Vera*, which tend to break

down the cheese texture and soften the hardness (Cakmak et al., 2023). In terms of Cohesiveness, it was greater in treatment T2 compared to the others because a polysaccharide gel network was developed that held the cheese particles together. The measured values of Cohesiveness at week 4 were 0.4, 0.47, and 0.5 (ratio) for the treatments C, T1, and T2, respectively. Gumminess was observed to grow with age; yet, a study of the treatments showed that *Aloe Vera* solution created a notable impact on the cheese because treatment T2 had 7.82, 7.1, and 6.09 (N) at Fresh, 2 weeks, and 4 weeks respectively, which was less compared to the remaining treatments. This may be a result of dilution of concentration during soaking, which results in the cheese becoming wet and protein and fat concentration being diluted within the cheese. In the case of treatment T1, where the cheese was soaked in *Aloe Vera*, the *Aloe Vera* may have influenced the cheese since the gel-like substances contained in it formed a gel structure that impacted the softness of the cheese. In addition, *Aloe Vera* may have formed a protective coat on the cheese, which affected the texture of the cheese to render it rubbery or sticky compared to the control sample that was left to be exposed to air. Adhesiveness results were 8.35, 7.83, and 7.7 (N) for C, T1, and T2 treatments on week four, respectively.

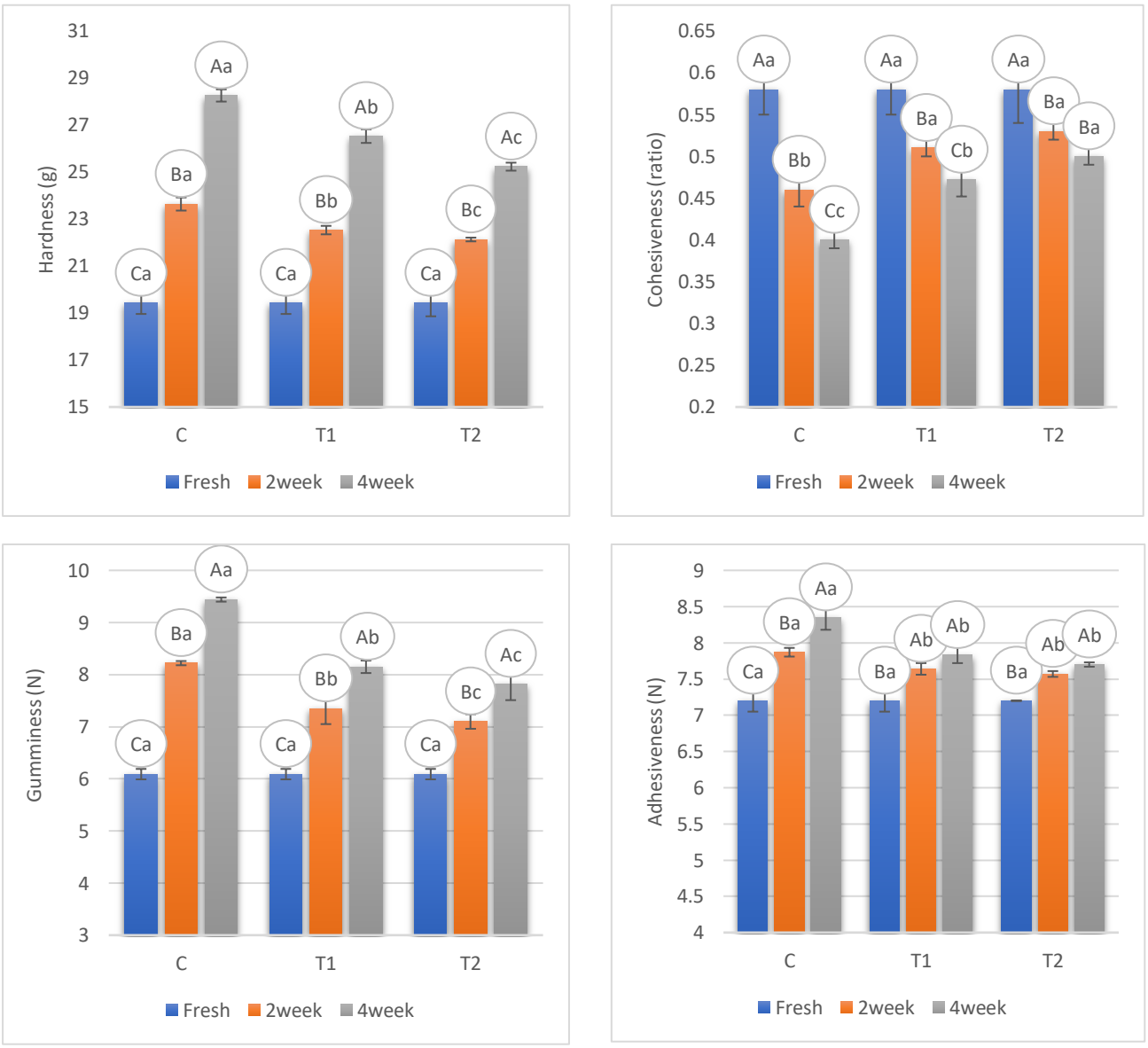


Figure 5. Texture profile analysis of fresh and stored cheese. See legend to Figure 1 for details

3.5. Sensory evaluation of Karish cheese

Sensory evaluation of the cheese was performed using human senses by experienced judges. Sensory evaluation is relevant since it narrates the range of acceptance by the consumer towards the product (Short et al., 2021). Judges favored the soaking treatment for body and texture, and best among the treatments tested was T2. The readings at week four were 28.2, 31.6, and 33.4 for treatments C, T1, and T2, respectively. Soaking cheese in *Aloe Vera* may have an impressive impact on body and texture because the introduced moisture in the *Aloe Vera* treatments tended to have a noticeable impact on the tenderness and smoothness of the cheese, which impressed the judges. Besides, the polysaccharides *In Aloe Vera* can also be credited with the elasticity of the cheese, which enhances the

mouthfeel for the judges. Besides, the appearance of the cheese was also enhanced, especially at week four, where the values were 8.02, 11.2, and 12.8, as mold and yeast developed on the surface of the control sample.

This is because of the antioxidant compounds in *Aloe Vera* (Hęś et al., 2019), which enhanced the appearance. On the flavor aspect, the judges approved T1 and T2, likely because *Aloe Vera* gave a distinct light flavor, which improved the product and provided an acceptable and unique taste to the judges. The values obtained at week four were 37.8, 43.2, and 45.4 for treatments C, T1, and T2, respectively. On comparing the total scores for all the judges, treatment T2 recorded the highest acceptance ratings at all storage periods.

Data are given as mean value ± standard deviation of ten replicates for a sample. Statistically different values ($p \leq 0.05$) in the same treatment for storage period are shown as different letters within columns (A-B). Statistically different values ($p \leq 0.05$) in different treatments are shown as different letters in columns (a-b). See legend to Figure 1 for details.

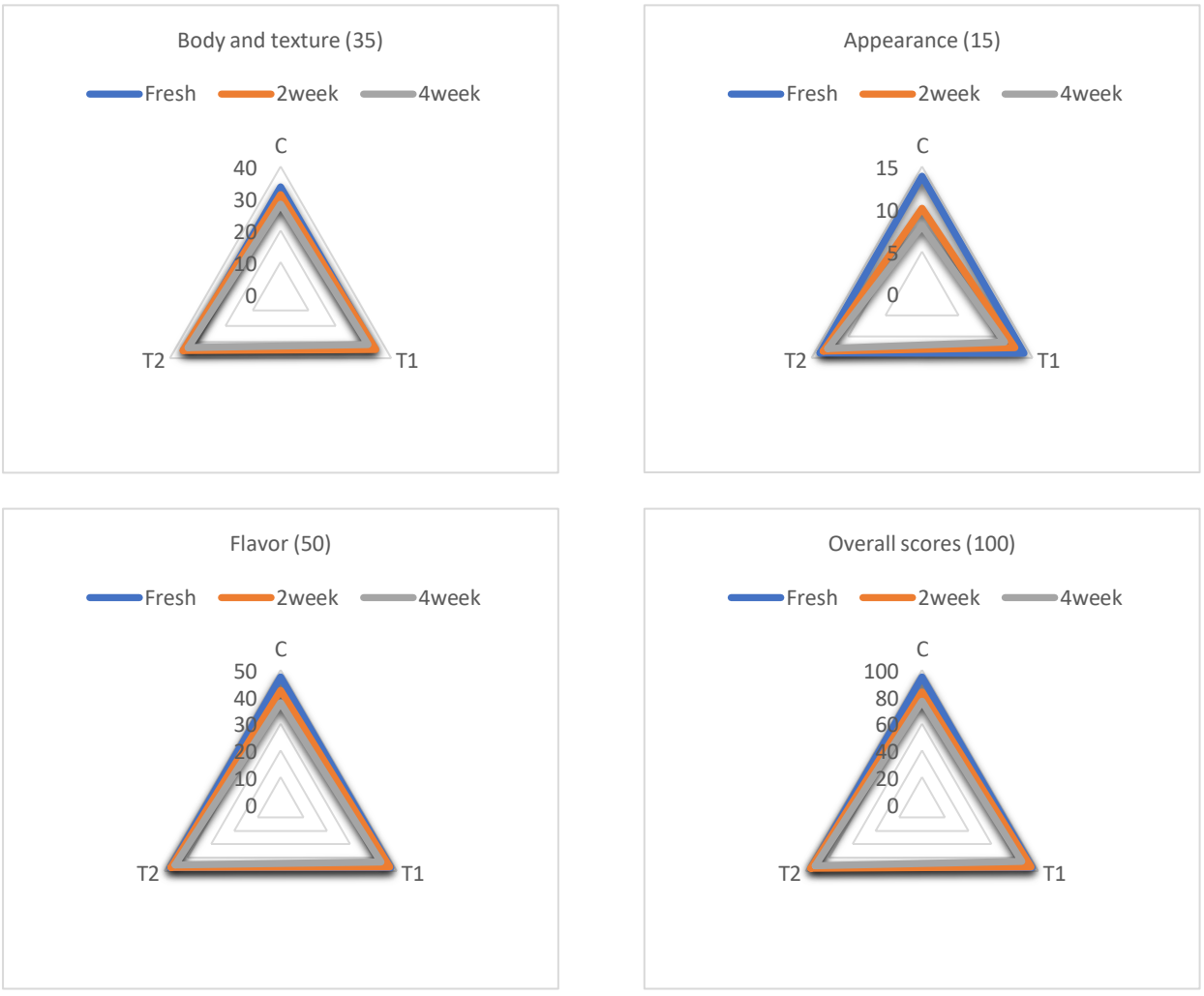


Figure 6. Sensory evaluation of fresh and stored cheese

4. Conclusion

Karish cheese is one of the most prevalent cheeses in Egypt, but also one of the quickest to deteriorate. So we always try to extend its freshness time and enhance its nutritional content. *Aloe Vera* is a valuable and promising component of herbal medicine with many therapeutic uses and a large global market when mixed with milk products. Its use with cheese would help in preparing high-quality cheese nutritionally healthy. *Aloe Vera* gel has also been used in cheese dipping in it or in an aqueous solution preparation to soak cheese. Aloe vera-treated cheese led to the improvement of their nutritional value along with antioxidants. In addition, immersion in *Aloe Vera* solution was effective in extending the shelf life of the cheese and inhibiting the growth of mold and yeast without repressing the activity of the starter bacteria. Immersion also improved the rheological properties of the cheese, especially firmness. Sensory evaluation was overall well received by the panelists for using *Aloe Vera* on cheese, particularly when soaked, and therefore better suited for use as a soaking liquid than for dipping alone.

Author Contributions: Conceptualization, A.S.B., L.I.E., and A.M.E.; Data curation, L.I.E., and E.I.M; Formal analysis, L.I.E. and E.I.M; Investigation, A.M.E., and A.S.B; Methodology, L.I.E.and E.I.M.; Project administration, A.M.E., A.S.B. and L.I.E.;

Resources, L.I.E. and E.I.M.; Software, E.I.M.; Supervision, A.S.B., A.M.E.and L.I.E.; Validation, A.M.E., and A.S.B.; Visualization, L.I.E.; Writing—original draft, L.I.E. and E.I.M.; Writing—review & editing, A.M.E., E.I.M., L.I.E. and A.S.B. funding acquisition, E.I.M. All authors have read and agreed to the published version of the manuscript.

Data Availability Statement: Data is contained within the article.

Conflicts of Interest: The authors declare no conflict of interest.

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