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Evaluation the physicochemical and sensory properties of functional yogurt prepared from soy milk and hazelnut milk

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ABSTRACT

In this study, the physicochemical properties (pH, acidity, dry matter, ash, protein, fat, syneresis, viscosity), sensory properties and viability of *Lactobacillus plantarum* of yogurt samples prepared from cow's milk (100%) and vegetarian yogurt samples prepared from soy-hazelnut milk in different ratios (0:100, 5:95, 10:90 and 15:85) were evaluated in a completely randomized design with three replications and during 20 days of storage. The ash (1/6%), dry matter (15/8%), fat (3/5%) and protein (3/6%) content of cow's milk yogurt samples were significantly higher than those of soy milk yogurt samples (1/14%, 13/04%, 2% and 3/15%, respectively), and in plant-based yogurt samples, all the factors studied except fat decreased with increasing hazelnut milk content ($p<0/05$). The viscosity of cow's milk yogurt samples (2532 mPas) was higher compared to plant-based yogurts (554 mPas). Also, in plant-based yogurt, the syneresis of soy milk yogurt samples (11/41) was lower than that of yogurt samples prepared from soy milk-hazelnut milk mixture (1/54). The survival of *Lactobacillus plantarum* bacteria in cow's yogurt samples (8/65 log cfu/g) was higher than that of yogurt samples prepared from plant-based milks (7/69 log cfu/g), and in plant-based yogurt samples, the survival of *Lactobacillus plantarum* bacteria improved with increasing percentage of hazelnut milk (8/39 log cfu/g) ($p<0/05$). According to the sensory evaluation results, in all factors studied, yogurt samples prepared from cow's milk had a higher score compared to plant-based yogurt samples. Also, according to the evaluators, treatments T_1 (100% soy milk) and T_2 (95% soy milk and 5% hazelnut milk) were the most acceptable among the plant-based yogurt treatment samples. Finally, yogurt samples prepared from cow's milk had better nutritional, textural, microbial and sensory quality compared to plant-based alternatives. However, for vegetarians, yogurt production from soy milk or soy milk-hazelnut milk blends, especially samples with a lower proportion of hazelnut milk, could be considered.

1-Introduction

In recent years, plant-based food and beverage products have been formulated and marketed to meet the growing demand for alternatives to animal products. Although milk and dairy products have unique nutritional and health-promoting properties, some people face medical restrictions in consuming milk and dairy products due to high cholesterol content, lactose, and allergenic proteins in milk and must consume alternative products. In addition, general consumer awareness of the environmental and health impacts of food choices, and the growing trend of vegetarianism, limited access to dairy products in some regions have led to an increasing demand for alternatives to animal-based dairy products [1].

Plant-based yogurts are generally produced by fermenting suspensions of cereal flours in water, pseudo-cereals, legumes, and nut flours. The most important challenge in the production of plant-based yogurts is to create a protein gel comparable to yogurts produced from cow's milk. However, the low protein content, different coagulation properties of plant-based proteins, and the need to add thickening agents and emulsifiers in the yogurt production process make the production of plant-based yogurts time-consuming and expensive. In addition, the instability of the plant-based protein structure during fermentation and acidification leads to a weakening of the protein structure and syneresis during storage [2, 3].

Among legumes, soybean is widely used for the production of plant-based yogurts due to its high protein content, desirable quality, functional properties, and good efficiency during fermentation. Commercial soy milk is a suitable substrate for the growth of yogurt starters, *Lactobacillus delbrueckii* and *Streptococcus thermophilus*. However, the bean flavor of soy milk and the presence of allergenic compounds are problems in the use of soy milk [1, 4]. Hazelnut milk contains protein, carbohydrates, lipids, vitamins, minerals, dietary fibers, tocopherols, phytosterols, squalene, and phenolic compounds. Soy milk is rich in monounsaturated fatty acids, beta-sitosterol, and antioxidant compounds. Hazelnut milk is used in the production of plant-based yogurt due to its health-promoting properties and high nutritional value [5].

Nowadays, probiotic foods have attracted the attention of consumers due to their therapeutic and health-promoting properties. Plant-based yogurt is also an ideal food system that can carry probiotic bacteria, providing a basis for their growth and survival. In 2005, Donner et al. reported in a study on the functional properties of probiotic soy yogurt that the presence of probiotic bacteria in yogurt improves the growth and survival of yogurt starters [6]. In a study by Joel et al. in 2019, in examining the changes in the physicochemical and microbial properties of probiotic soy yogurt during storage, they reported greater survival of Lactobacilli compared to Bifidobacterium [7]. In 2007, Farnworth et al. reported in a study on the properties of probiotic soy yogurt, the lack of effect of probiotic bacteria on yogurt starters [8].
Although limited research has been conducted on the production of plant-based probiotic yogurt, no research has been conducted to date on the physicochemical, microbial, and sensory properties of functional plant-based yogurt made from soy milk and hazelnut milk, which is addressed in the current study.

2- Materials and Methods

2-1- Materials

In order to conduct this research, high-fat milk prepared at Pegah Company in Tehran was used. Starch was obtained from Golha Company, non-fat dry milk from Pegah Company, lecithin from Tito Company in Turkey, MRS Broth, MRS Agar, MRS Bile Agar culture medium, sulfuric acid, sodium hydroxide, hydrochloric acid, and boric acid were obtained from Merck Company.

2-1- Methods

2-2-1- Preparing probiotic yogurt from cow's milk

To produce probiotic yogurt from pasteurized high-fat milk (3%), first the milk solids were adjusted by adding skim milk powder and the milk was heated at 90°C for 15 minutes. Then, the mixture was cooled to 44-45°C and after cooling, 0.03% by weight of natural yogurt starters (*Lactobacillus delbrueckii* and *Streptococcus thermophilus*) and *Lactobacillus plantarum* (107 cfu/g) were added. Then, the samples were incubated at 42°C until reaching a pH of 4.6 [9].

2-2-2- Preparing probiotic yogurt from soy milk and hazelnut milk

To prepare soy milk and hazelnut milk, soy and hazelnut seeds were washed and soaked in clean water for 12 hours, then the seeds were drained and mixed in a 10:1 grain to water ratio in a blender for 10 minutes until completely smooth. The homogenized mass was filtered through a cloth strainer to separate the milk from the waste. Soy-hazelnut milk was mixed in different ratios (0:100, 5:95, 10:90, and 15:85), starch (2%) and lecithin (0.5%) were added to the mixture, pasteurized at 85°C for 15 minutes, and cooled to 42±1°C. The resulting mixtures were inoculated with starter cultures (*Lactobacillus delbrueckii* and *Streptococcus thermophilus*) at a rate of 0.03% by weight and *Lactobacillus plantarum* (10^7 cfu/g) and incubated at 42±1°C for 7 hours. After incubation, the yogurt samples were cooled and stored in a refrigerator at 4±1°C. The desired indicators were evaluated at intervals of 1 and 20 days with storage at 4°C. All experiments were performed with three replicates for the production treatments [10].

2-2-3- Physicochemical tests of probiotic yogurt

The pH of the control and treated samples was measured using a digital pH meter (Metrohm, Switzerland) and dry matter was measured with an oven (Memmert, Germany) [7]. The Kjeldahl method was used to measure protein and the Gerber method was used to measure fat [11]. To evaluate the syneresis percentage, 30 g of yogurt samples were centrifuged at 1250 rpm for 10 minutes (Hettich, Germany) and the serum phase was separated, weighed, and the syneresis percentage was calculated from the weight ratio of the serum phase to the yogurt sample. The viscosity of the samples was then measured using a Brookfield viscometer (DVII, USA), using spindle number 4 at a temperature of 20 °C and applying shear stress ((1/S) 0.1 to 500) [11].

2-2-4-Probiotic bacteria counting

To enumerate probiotic bacteria *Lactobacillus plantarum*, serial dilutions were prepared from probiotic yogurt samples using physiological serum and the samples were cultured in MRS Bile agar medium using the pour plate method. The plates were incubated for 72 hours in a CO_2 incubator (Memmert, Germany) at 37°C and the counting results were reported as Log cfu/g [12].

2-2-5-Sensory evaluation

Sensory evaluation was performed by 12 trained evaluators (6 women and 6 men, food science specialists, 25 to 35 years old) using a 5-point hedonic method in terms of taste, color, odor, texture, and overall acceptability. The scores included the highest score, 5, indicating excellent quality of the sample, and the lowest score, 1, indicating poor quality of the sample. Sensory evaluation of the yogurt samples was performed on day 20 of the storage period [13].

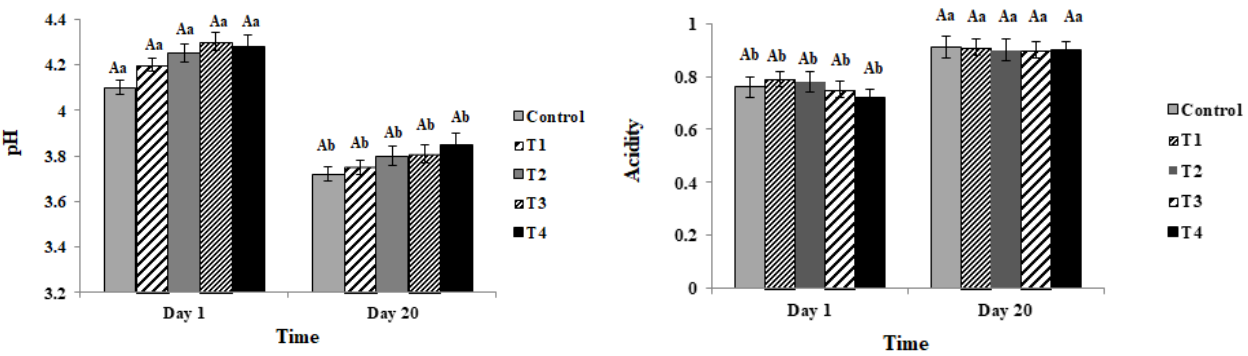
2-2-6-Statistical analysis

In this study, the physicochemical, microbial and sensory properties of functional plant yogurt samples were investigated based on a completely randomized design with three replications. All data in this study were evaluated for normal distribution using the K-S test. Analysis of variance and comparison of means were performed using the ANOVA method and Duncan's multiple range test at the 95% probability level using SPSS software (version 16), and graphs were drawn using Excel 2016 software.

3- Results and discussion

3-1-pH and acidity

The pH level and acidity content in yogurt are among the quality indicators in yogurt production that affect the organoleptic and rheological properties [14]. The pH and acidity of different functional yogurt samples during the storage period are shown in Figures 1 and 2. According to the results, although the pH decreased during the storage period, the acidity of the sample increased during storage. The lowest pH and highest acidity were observed on the twentieth day and in the control sample, and the highest pH and lowest acidity were observed on the first day of the test in the fourth treatment containing 85% soy milk and 15% hazelnut milk. The pH and acidity of the milk samples were in the range of 3.72-4.28 and 0.72-0.91%, respectively. The results showed that increasing the percentage of hazelnut milk did not have a significant effect on the pH and acidity of the treated samples ($p>0.05$), but the pH decreased significantly over time and the acidity increased significantly ($p<0.05$). It seems that the reason for the decrease in pH and increase in acidity of the yogurt samples during the storage period is due to acidification after yogurt fermentation due to the metabolic activity of starter cultures and probiotic bacteria during the storage period in the product [14]. Given the non-significant difference in pH and acidity of the samples treated with hazelnut milk compared to soy milk, increasing the concentration of hazelnut milk did not have an effect on the growth of probiotic bacteria during the storage period, which is consistent with the results of the probiotic bacteria count.



a b

Fig 1. The pH (a) and acidity (b) changes in samples of probiotic yogurt containing during the storage period ((Control (100% Cow milk), T_1 (100% Soy milk), T_2 (95% Soy milk & 5% Hazelnut milk), T_3 (90% Soy milk & 10% Hazelnut milk) and T_4 (85% Soy milk & 15% Hazelnut milk))

[a]Means followed by different letters (A–D) show significant different ($p<0.05$) between treatments at one time

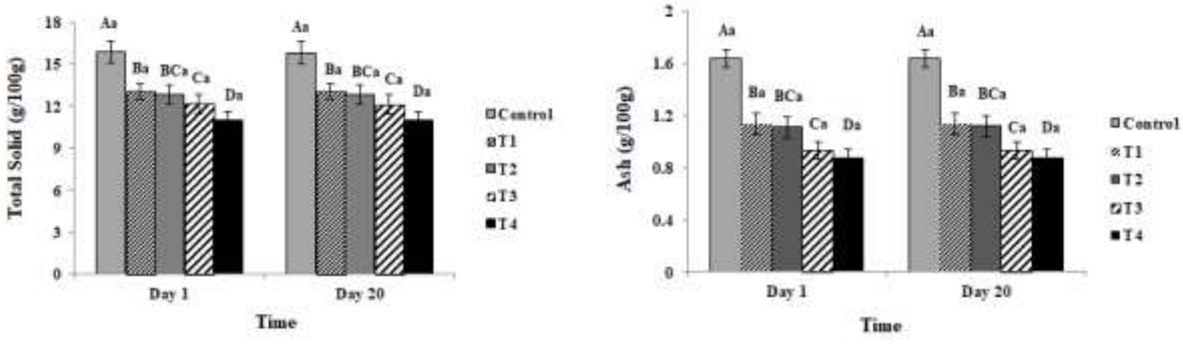
[b]Means followed by different letters (a–d) show significant different ($p<0.05$) during time in one treatment

Similarly, Ponca et al. in 2022, in their study of the physicochemical properties of soy milk yogurt enriched with Moringa oleifera, reported the pH of yogurt samples to be in the range of 3.66-4.36 [15]. Rui et al. in 2019 also reported a decrease in the pH of soy yogurt samples to 1.5 during the storage period [16]. Li et al. in 2024 also reported a decrease in pH from 6.75 to 4.6 in probiotic soy yogurt during the storage period and attributed this decrease to the production of organic acids due to the activity of probiotic bacteria [17].

3-2- Ash and dry matter content

Dry matter content is an important quality parameter in yogurt production that affects textural, aroma, flavor, and nutritional properties. The ash content of yogurt indicates the content of minerals that are essential for health and play a fundamental role in body functions such as bone health, muscle function, and the nervous system [15, 17]. According to the results, the dry matter and ash content of plant-based yogurts was significantly lower than that of yogurt made from cow's milk ($p<0.05$). With increasing percentage of hazelnut milk, the dry matter and ash content of plant-based yogurt samples decreased significantly compared to soy milk ($p<0.05$). The results showed that the passage of time did not have a significant effect on the dry matter and ash content of the tested samples ($p>0.05$). The total solids content of milk includes protein, carbohydrates, fat, and minerals. It is likely that the higher levels of fat and protein in cow's milk compared to plant-based milks are the reason for the significant difference in total solids in the tested samples. Also, according to previous research results, soy milk has higher levels of protein, carbohydrates, fat, and minerals compared to hazelnut milk, which is effective in increasing the total solids content of samples containing higher levels of soy milk.

Similarly, in 2019, Amou et al., in their study of the physicochemical properties of cow's milk yogurt enriched with soy flour, reported that the ash content of yogurt samples prepared from cow's milk was 1.4%, and with an increase in the percentage of soy flour, the ash content of yogurt samples decreased. Also, the dry matter percentage of cow's milk samples was reported to be 22.21%, which decreased to 10.66% with an increase in the percentage of soy flour [18]. In 2013, Stipik et al., in their study of the physicochemical properties of probiotic soy yogurt, reported a higher dry matter and ash content in cow's milk yogurt samples compared to soy milk yogurt samples [19].



a **b**

Fig 2. The Total Solid (a) and Ash (b) content changes in samples of probiotic yogurt containing during the storage period ((Control (100% Cow milk), T_1 (100% Soy milk), T_2 (95% Soy milk & 5% Hazelnut milk), T_3 (90% Soy milk & 10% Hazelnut milk) and T_4 (85% Soy milk & 15% Hazelnut milk))

[a]Means followed by different letters (A–D) show significant different ($p<0.05$) between treatments at one time

[b]Means followed by different letters (a–d) show significant different ($p<0.05$) during time in one treatment

3-3-Fat and protein content

Protein and fat are the most important nutrients in yogurt production and are important in creating nutritional, physicochemical, sensory and textural properties of yogurt [13]. The results (Figure 3) show that the protein and fat content of yogurt prepared from cow's milk is significantly different compared to plant-based yogurts ($p<0.05$). Yogurt prepared from cow's milk, with 62.3% and 66.3% protein and fat, had the highest protein and fat content among the yogurt samples. According to the results, with increasing the percentage of hazelnut milk, the protein content in plant-based yogurt samples decreased insignificantly ($p>0.05$), while increasing the percentage of hazelnut milk caused a significant increase in fat in plant-based yogurt samples ($p<0.05$). On the other hand, the passage of time did not have a significant effect on the fat and protein content of yogurt samples ($p>0.05$).

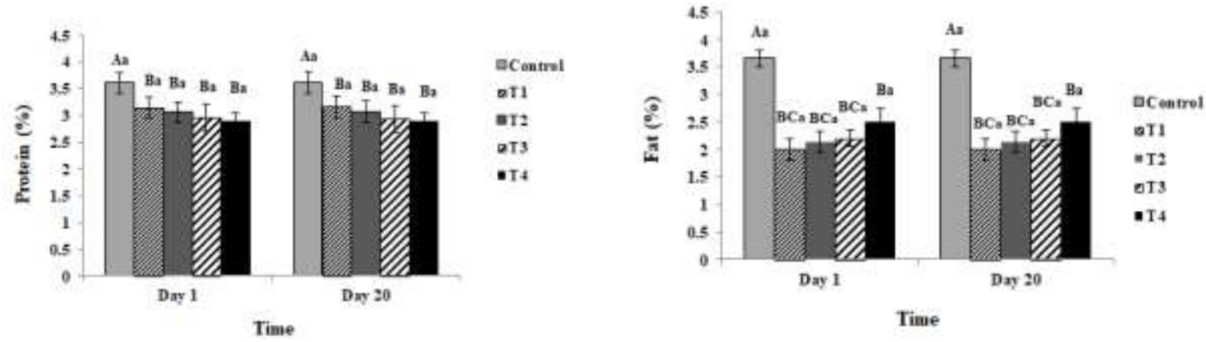


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Fig 3. The Protein (a) and Fat (b) content changes in samples of probiotic yogurt containing during the storage period ((Control (100% Cow milk), T_1 (100% Soy milk), T_2 (95% Soy milk & 5% Hazelnut milk), T_3 (90% Soy milk & 10% Hazelnut milk) and T_4 (85% Soy milk & 15% Hazelnut milk))

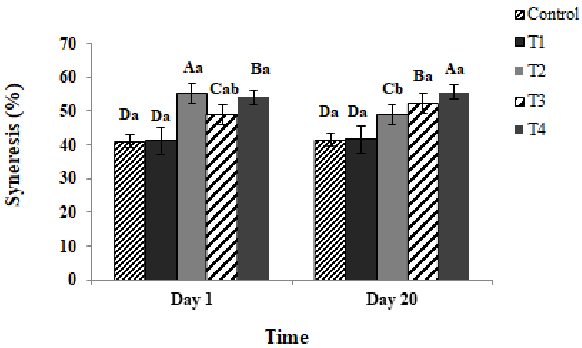
[a]Means followed by different letters (A–D) show significant different ($p<0.05$) between treatments at one time

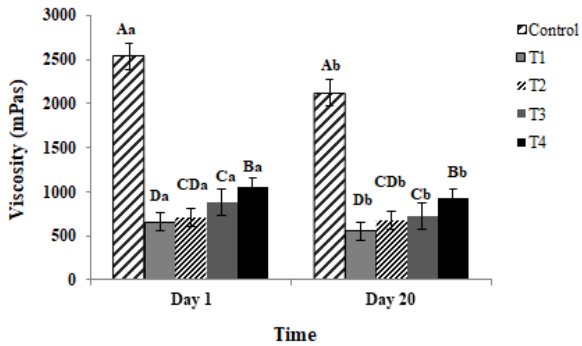
[b]Means followed by different letters (a–d) show significant different ($p<0.05$) during time in one treatment

Soy milk is a rich source of protein and fat, but the amount of these nutrients varies depending on the variety of soy. Soy milk yogurt has lower protein and fat content compared to yogurt made from cow's milk because soybeans have lower protein and fat content compared to cow's milk. Hazelnut milk has higher fat (monounsaturated and polyunsaturated fatty acids) and lower protein content compared to soy milk, so with increasing its concentration, the protein content of yogurt decreases and its fat increases [20]. Similarly, Ejinkoni and Fabian in 2018 reported higher protein and fat content in cow's milk compared to soy milk [21]. Singhal et al. in 2017, in a review of the nutritional properties of plant-based and non-plant-based milks, reported higher protein content in cow's milk compared to soy milk, and hazelnut milk also had lower protein content than soy milk [22].

3-4-Changes in syneresis and viscosity

Changes in syneresis and viscosity of different probiotic yogurt samples during storage are shown in Figure 4. According to the results, the viscosity of plant-based yogurt samples was significantly lower than that of yogurt samples prepared from cow's milk ($p<0.05$). With increasing percentage of hazelnut milk, the viscosity of the resulting yogurt increased significantly, while the viscosity of all samples decreased significantly over time ($p<0.05$). Although yogurt prepared from cow's milk and soy milk had similar syneresis levels, with increasing percentage of hazelnut milk, the syneresis level of yogurt samples increased significantly compared to soy milk yogurt ($p<0.05$). According to the results, with increasing percentage of hazelnut milk, the syneresis level increased significantly over time in some samples ($p<0.05$). It seems that the higher level of protein in cow's milk compared to soy milk is effective in increasing the viscosity of yogurt prepared from cow's milk. Proteins in cow's milk and soy milk form protein gels in yogurt that trap water and thicken and increase the viscosity of yogurt. On the other hand, hazelnut milk is a rich source of dietary fiber that can thicken and increase the viscosity of yogurt samples. In addition, the high fat content in hazelnut milk is effective in increasing the viscosity of yogurt [21, 23]. Syneresis is considered as one of the important factors determining the quality of yogurt by consumers. Syneresis is one of the important physical problems of yogurt that is associated with serum separation, reduced stability, and increased waterlogging in yogurt. According to reports, hazelnut milk has less protein compared to soy milk, and when hazelnut milk is added to soy milk, the total protein content of milk decreases. Protein is essential for the formation of a strong gel network in yogurt. The lower protein content in hazelnut milk causes the formation of a weaker gel network, resulting in increased syneresis. On the other hand, hazelnut milk has a higher fat content compared to soy milk, and when hazelnut milk is added to soy milk, the total fat content increases. However, fat molecules interfere with the formation of the gel network, weakening the network and increasing syneresis [24].





a b

Fig 4. The Syneresis (a) and Viscosity (b) changes in samples of probiotic yogurt containing during the storage period ((Control (100% Cow milk), T_1 (100% Soy milk), T_2 (95% Soy milk & 5% Hazelnut milk), T_3 (90% Soy milk & 10% Hazelnut milk) and T_4 (85% Soy milk & 15% Hazelnut milk))

[a]Means followed by different letters (A–D) show significant different ($p<0.05$) between treatments at one time

[b]Means followed by different letters (a–d) show significant different ($p<0.05$) during time in one treatment

In 2019, Ilyasoglu and Yilmaz reported an increase in syneresis in yogurt samples with increasing hazelnut milk concentration in their study of yogurt enriched with hazelnut milk [25]. Similarly, in 2022, Gul et al. reported that the viscosity of yogurt samples increased with increasing hazelnut milk concentration in their study of yogurt enriched with hazelnut milk [26]. In 2014, Afwaqua reported that yogurt samples prepared from plant-based milk had lower viscosity than cow's milk yogurt samples [27].

3-5- Changes in the viability of probiotic bacteria

Figure 5 shows the changes in the viability of *Lactobacillus plantarum* in different yogurt samples during storage. According to the results, there is a significant difference between the different treatments in terms of the viability of *Lactobacillus plantarum* in yogurt samples ($p<0.05$). The yogurt sample prepared from cow's milk showed the highest level of viability on the first day and the soy milk yogurt sample showed the lowest level of viability on the twentieth day of storage. According to the results, the viability of *Lactobacillus plantarum* decreased significantly over time in yogurt samples ($p<0.05$). It is likely that antimicrobial factors such as pH reduction, the presence of organic acids, high oxidation-reduction potential, hydrogen peroxide, molecular oxygen, and bacterial competition in dairy products affect the decrease in the viability of probiotic bacteria over time [28]. According to reports, the survival of probiotic bacteria in non-dairy and plant-based products is lower compared to dairy products due to lower nutrients, lack of buffering capacity and anti-nutritional compounds [29]. It seems that the higher survival of probiotic bacteria in cow's milk yogurt compared to soy milk is due to the higher content of dry matter, protein and minerals in cow's milk compared to soy milk. On the other hand, the higher pH in hazelnut milk samples and the difference in nutrients and fiber content in hazelnut milk that have a promoting effect on the growth of probiotic bacteria are effective in the higher survival of probiotic bacteria in hazelnut milk compared to soy milk [30, 31]. In 2021, Ko et al. reported that the survival rate of probiotic bacteria in cow's milk and soy milk depended on the probiotic bacterial species [32]. In 2018, Kumar et al. reported a decrease in the survival rate of the probiotic bacteria Lactobacillus casei during the storage period in a study of the qualitative and microbial characteristics of fermented soy milk [33]. According to the results, the survival rate of probiotic bacteria on the twentieth day of storage in all plant-based milks was lower than the standard level (10^6cfu/g). Therefore, increasing the level of probiotic bacteria inoculation in the production stage, using other strains of probiotic bacteria, and reducing the storage time of samples after production should be considered in future research.

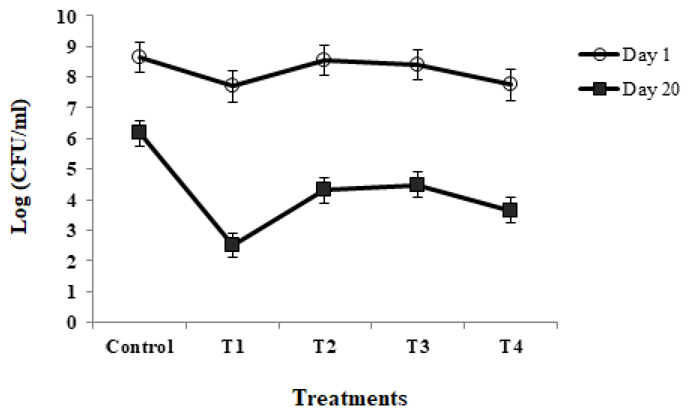


Fig 5. The Survival changes of *L.Plantarum* in yogurt samples during the storage period ((Control (100% Cow milk), T_1 (100% Soy milk), T_2 (95% Soy milk & 5% Hazelnut milk), T_3 (90% Soy milk & 10% Hazelnut milk) and T_4 (85% Soy milk & 15% Hazelnut milk))

3.6-Changes in sensory evaluation

One of the most important factors in consumer acceptance and preference for yogurt is the sensory properties of these products. Figure 6 shows the changes in the sensory properties of yogurt samples made from cow's milk compared to plant-based yogurts made from soy milk and hazelnut milk on day 20 of storage. According to the results of the sensory evaluation using the Chi-square test, there is a significant difference between the factors of color, taste, odor, texture, and overall acceptance in the tested treatments (*p<0.05*). In all the factors examined, the yogurt sample made from cow's milk had a higher score compared to the plant-based yogurt samples. In the evaluation of the color, odor, and taste factors, treatment T1 (plant-based yogurt sample made from 100% soy milk) and treatment T2 (plant-based yogurt sample made from 95% soy milk and 5% hazelnut milk) had a higher acceptance among plant-based milks. It seems that increasing hazelnut milk by more than 5% had a negative effect on the color, odor, and taste of the plant-based yogurt samples. While T1 and T2 samples had the highest texture scores, T3 (a vegetarian yogurt sample made from 90% soy milk and 10% hazelnut milk) and T4 (a vegetarian yogurt sample made from 85% soy milk and 15% hazelnut milk) had the lowest texture scores. Overall acceptance evaluation revealed that T1 and T2 treatments were the most acceptable among the tested treatments. In 2018, in a study of the quality characteristics of fermented hazelnut milk, Irmiz et al. reported a higher overall acceptance score for samples made from cow's milk than hazelnut milk [34]. Similarly, Ilyaoglu and Yilmaz reported a decrease in sensory evaluation scores at high concentrations of hazelnut milk in a study of yogurt enriched with hazelnut milk [35].

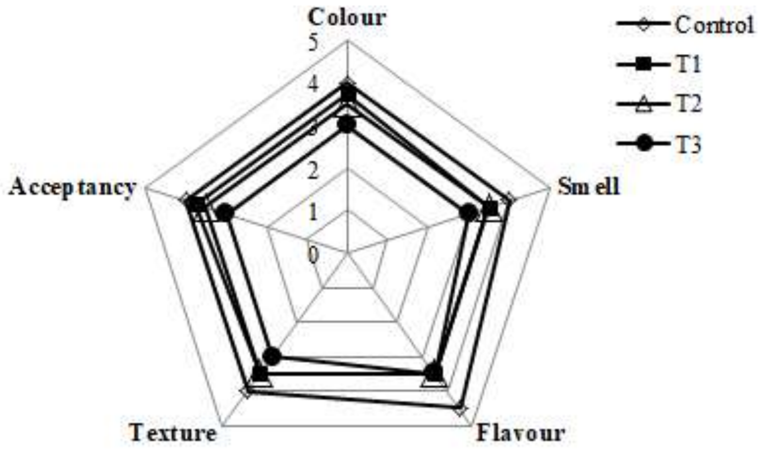


Fig 6. The Sensory evaluation in yogurt samples on 20th day of storage ((Control (100% Cow milk), T_1 (100% Soy milk), T_2 (95% Soy milk & 5% Hazelnut milk), T_3 (90% Soy milk & 10% Hazelnut milk) and T_4 (85% Soy milk & 15% Hazelnut milk))

4-Conclusion

In this study, it was found that time significantly (*p<0.05*) affected most of the physicochemical properties evaluated. A decrease in pH was associated with an increase in acidity, a decrease in viscosity, and a decrease in the viability of probiotic bacteria during the storage period. According to the results, the dry matter, ash, fat, and protein content of yogurt made from cow's milk was higher than that of plant-based milk. Although yogurt made from soy milk also had a higher ash, dry matter, and protein content than other yogurts made from plant-based milk, the plant-based yogurt sample containing 15% hazelnut milk had the highest fat content among the plant-based yogurts. According to the results, in plant-based yogurt samples, viscosity increased significantly with increasing hazelnut milk percentage. Despite the higher protein level in cow's milk compared to soy milk, yogurt made from soy milk had a similar stability to yogurt made from cow's milk. The survival rate of probiotic bacteria in yogurt samples prepared from cow's milk was higher than that of plant-based yogurt, and increasing the percentage of hazelnut milk had a positive effect on the survival of probiotic bacteria. Finally, given the increasing tendency of consumers to use plant-based products, the production of plant-based yogurt containing soy milk and hazelnut milk, especially types with a low percentage of hazelnut milk, needs to be considered.

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بررسی خواص فیزیکوشیمیایی و حسی ماست فراسودمند تهیه شده از شیر سویا و شیرفندق

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چکیده

در این پژوهش ویژگی‌های فیزیکوشیمیایی (pH، اسیدیته، درصد ماده خشک، خاکستر، پروتئین، چربی، سینرسیس، ویسکوزیته)، خصوصیات حسی و زنده‌مانی *لاکتوباسیلوس پلانتاروم* نمونه‌های ماست تهیه شده از شیر گاو (۱۰۰٪) و نمونه‌های ماست گیاهی تهیه شده از شیر سویا-فندق به نسبت-های مختلف (۱۰۰:۰، ۹۵:۵، ۹۰:۱۰ و ۸۵:۱۵) در قالب طرح کاملا تصادفی با سه تیمار، در سه تکرار و در طول ۲۰ روز نگهداری ارزیابی شدند. میزان خاکستر (۱/٦٪)، ماده خشک (۱۵/۸٪)، چربی (۳/۵٪) و پروتئین (۳/٦٪) نمونه‌های ماست گاوی به صورت معنی‌داری بالاتر از نمونه‌های ماست شیر سویا (به ترتیب ۱/۱٤٪، ۱۳/۰٤٪، ۲٪ و ۳/۱۵٪) بود و در نمونه‌های ماست گیاهی کلیه فاکتورهای مورد بررسی به جز چربی با افزایش میزان شیر فندق کاهش یافت ($p<0.05$). طبق نتایج حاصل ویسکوزیته نمونه‌های ماست گاوی (۲۵۳۲ mPas) در مقایسه با ماست‌های گیاهی بالاتر (٥٥٤ mPas) بود. همچنین در نمونه‌های ماست گیاهی، سینرسیس نمونه‌های ماست شیر سویا (٤۱/۱۱) کمتر از نمونه‌های ماست تهیه شده از مخلوط شیر سویا-شیر فندق (٥٤/۱) بودند. زنده‌مانی باکتری *لاکتوباسیلوس پلانتاروم* در نمونه‌های ماست گاوی (۸/٦٥ log cfu/g) بالاتر از نمونه‌های ماست تهیه شده از شیرهای گیاهی (۷/٦۹ log cfu/g) بود و در نمونه‌های ماست گیاهی نیز با افزایش درصد شیر فندق زنده‌مانی باکتری *لاکتوباسیلوس پلانتاروم* بهبود یافت (۸/۳۹ log cfu/g). مطابق نتایج ارزیابی حسی در کلیه فاکتورهای مورد بررسی نمونه‌های ماست گاوی از امتیاز بالاتری در مقایسه با نمونه‌های ماست گیاهی برخوردار بودند. همچنین از نظر ارزیاب‌ها تیمارهای T_1 (۱۰۰٪ شیر سویا) و T_2 (۹۵٪ شیر سویا و ۵٪ شیر فندق) در بین نمونه‌های تیمار ماست گیاهی بیشترین مقبولیت را دارا بودند. نهایتا، نمونه‌های ماست گاوی در مقایسه با جایگزین‌های گیاهی، کیفیت تغذیه‌ای، بافتی، میکروبی و حسی بهتری داشتند. با این وجود، برای افراد گیاهخوار، تولید ماست از شیر سویا یا مخلوط شیر سویا- شیر فندق، به ویژه نمونه‌هایی که نسبت کمتری شیر فندق دارند لازم است مورد توجه قرار گیرد.