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# EVALUATION OF SOME PROPERTIES OF GOAT YOGHURT ICE CREAM

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## ABSTRACT

The study was conducted in the College of Food Sciences laboratories at the University of AL-Qasim Green from March 1, 2024, to May 15, 2024. Goat's milk yogurt ice cream was prepared by fermenting goat's milk with a YO-MIX 495 starter to produce yogurt, which was then mixed with ice cream made from goat's milk at four replacement ratios: 0:100, 25:75, 75:25, and 50:50 (ice cream to yogurt milk). Additionally, a control sample consisting of 100% ice cream was included to evaluate the physical properties and sensory acceptance of the ice cream treatments. It was observed that the 75:25 mixture had the highest pH of 5.5 and the lowest acidity at 0.32% compared to other treatments. This mixture also had the lowest melting rate, reaching 23.7%, which was close to the control sample's rate of 20.1% after 50 minutes. The flavor and texture scores for this mixture were 8.5 and 5.5, respectively, which were similar to the control sample. In contrast, the 0:100 mixture received the lowest flavor score of 4.3 and the highest texture score of 8.6 compared to the other treatments.

***Keywords:*** Ice Cream, Yoghurt, Goat Milk

## INTRODUCTION

Ice cream is made by mixing the ingredients to obtain a mixture that is placed in the ice cream maker after introducing a proportion of air ranging between 30-40%, which makes it soft to produce a semi-solid mixture that is spreadable, moist, and contains water, sugars, fat-free solids, and milk fat. For soft ice cream, the ice crystals need to be smaller than 50 micrometers (Fiol *et al*., 2017; Hasan *et al*., 2020). Ice cream also provides several vitamins, including vitamin A, which supports eye health, vitamin K, which is important for blood health, and vitamin B12, which aids memory and nerve function. Additionally, it contains carbohydrates, proteins, and fats in proportions of 20.6 g, 4 g, and 12.5 g per 100 g of ice cream, respectively (Nurdin *et al*., 2023). Whipping the ice cream mixture

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adds air, increasing its volume, lightening its composition, and giving it a smooth texture (Goff, 2018). Various types of milk, such as cow's, buffalo's, and goat's milk, can be used to make ice cream. Goat's milk is known to have a superior composition compared to cow's milk, and different varieties of ice cream are crafted using these milk sources (Ürkek *et al*., 2022; Mustafa *et al*., 2023a; Mustafa *et al*., 2023b). Goat's milk contains 3.6 g of protein, 4.2 g of lipids, and 4.5 g of carbohydrates per serving, providing 69 calories per 100 g. Caseins in goat's milk play a role in mineral binding, capturing free radicals, and enhancing antioxidant activity post-breakdown (Navamniraj *et al*., 2023). The fat in goat's milk is also easier for the body to process and absorb due to the smaller size of its fat globules compared to those found in cow's milk (Panta *et al*., 2021).

Goat's milk offers many health benefits, including treating tuberculosis, lowering cholesterol, and promoting skin health (Nayik *et al*., 2022; Rahi *et al*., 2023). Its short- and medium-chain fatty acids, which digest more quickly, give goat's milk its distinctive taste (Currò *et al*., 2019). Additionally, it has been shown to help treat metabolic disorders, improve digestive health, and reduce the risk of cardiovascular disease and cancer (ALKaisy *et al*., 2023). Goat's milk is especially beneficial for individuals who suffer from milk allergies, digestive issues, and lactose intolerance, making it superior to cow's and buffalo's milk in terms of medicinal and nutritional properties (Rai *et al*., 2022; Al-Bedrani *et al*., 2023).

Yogurt, a product made from milk fermented by lactic acid bacteria, has many health benefits and is considered one of the best dairy products for promoting health. It contains high-quality proteins and reduces the risk of cardiovascular disease while boosting immunity (Saadi *et al*., 2022; Al-Bedrani *et al*., 2023). Yogurt also contains important vitamins, such as B1, B2, B6, B12, and D, in addition to fat-soluble vitamins and minerals like calcium, phosphorus, sodium, and potassium (Gómez-Gallego *et al*., 2018).

Yogurt ice cream is prepared by freezing a pasteurized mixture of milk, yogurt, sweeteners, and stabilizers. It achieves optimal sensory acceptance at an acidity level of 0.7%, as higher lactose hydrolysis tends to reduce flavor intensity (Arslaner *et al*., 2019; Saadi and Hasan, 2019). This study aims to determine the effect of mixing ice cream with yogurt made from goat's milk on the physical and sensory properties of the ice cream.

## MATERIALS AND METHOD

### Materials

Raw goat's milk was sourced from a local breeder in the Governorate. Yogurt was produced by pasteurizing the milk and fermenting it with a 2% starter culture (YO-MIX 495) from the French company Danisco. This starter contains strains of *Lactobacillus delbrueckii* subsp. *bulgaricus* and *Streptococcus thermophilus*.

### Methods

#### Manufacture of Yoghurt Ice cream

A total of 1000 g of ice cream was prepared by mixing 897 ml of milk, 100 g of sugar, and 3 g of guar gum stabilizer. The mixture was aged and then frozen for 24 hours at -18°C, following the method of Singo & Beswa (2019). The ice cream was then mixed with yogurt in four ratios according to the method of Nurdin *et al*. (2023): 0:100, 25:75, 75:25, and 50:50 (yogurt to ice cream). The control sample was made with 100% ice cream, and all mixtures were blended for 15 minutes using a mixer. The mixtures were then portioned into cups and frozen again at -18°C for 24 hours before conducting tests.

### Measured Parameter

The pH was measured using a pH meter, and the acidity was estimated following

the AOAC (2016) guidelines. The melting rate of the ice cream was determined according to the method described by Koxholt *et al*. (2001). The total bacterial count and psychrotrophic (cold-loving) bacteria were estimated as reported by Wehr & Frank (2004). Sensory evaluation of all treatments was conducted based on the method used by Saadi *et al*. (2022), with some modifications.

**Statistical analysis**

Statistical analysis was performed using a Completely Randomized Design (CRD), and differences between treatments were compared using the Least Significant Difference (L.S.D.) test at a 0.05 probability level, following the method of Al-Sahoki and Waheeb (1990).

## RESULTS

**pH and Acidity**

Table (1) presents the pH values for the different ice cream treatments. The pH values in the treatments were higher than that of the control sample, with values of 4.7, 5.0, 5.2, and 5.5, respectively. The pH increased as the proportion of yogurt replacement increased. It was also observed that the pH was inversely proportional to acidity.

**Table 1:** pH and acidity of ice cream made from goat's milk yogurt

| Treatment | pH | Acidity |
|---|---|---|
| Control (100% ice cream) | $6.2^{a}$ | $0.09^{e}$ |
| 0:100(ice cream:yogurt) | $4.7^{b}$ | $0.55^{a}$ |
| 25:75(ice cream:yogurt) | $5.0^{c}$ | $0.52^{b}$ |
| 50:50(ice cream:yogurt) | $5.2^{d}$ | $0.47^{c}$ |
| 75:25(ice cream:yogurt) | $5.5^{e}$ | $0.32^{d}$ |
| LSD | 0.4578 | 0.03515 |

* Different letters indicate statistically significant differences at the level of $P < 0.05$.

**Melting Rate**

Table 2 presents the melting rates of the ice cream samples, which were measured at 22°C at 10-minute intervals using a stopwatch. The results showed significant differences in melting rates ($P < 0.05$). It was observed that the melting rate increased with time. However, the melting rate decreased as the percentage of ice cream increased relative to the yogurt content. This trend corresponds to a decrease in acidity, with the mixtures containing higher amounts of yogurt melting faster compared to the control sample, which was made entirely from goat's milk (100% ice cream without yogurt).

**Table 2:** Melting rate of ice cream mixes made from goat's milk yogurt.

| | Melting Rate % | | | | |
|---|---|---|---|---|---|
| **Treatment** | 10 min | 20 min | 30 min | 40 min | 50 min |
| **Control (100%** | $2.7^{e}$ | $4.5^{ed}$ | $8.8^{ec}$ | $13.9^{eb}$ | $20.1^{ea}$ |
| **0:100(ice cream:yogurt)** | $10.6^{ae}$ | $11.2^{ad}$ | $20.3^{ac}$ | $32.5^{ab}$ | $36.0^{a}$ |
| **25:75(ice cream:yogurt)** | $9.5^{be}$ | $10.7^{bd}$ | $19.6^{bc}$ | $31.5^{b}$ | $33.6^{ba}$ |
| **50:50(icecream:yogurt)** | $9.0^{ce}$ | $10.0^{cd}$ | $17.5^{c}$ | $29.1^{cb}$ | $31.0^{ca}$ |
| **75:25(ice cream:yogurt)** | $4.5^{de}$ | $8.0^{d}$ | $11.0^{dc}$ | $16.3^{db}$ | $23.7^{da}$ |

* Different letters indicate statistically significant differences at the **P < 0.05** level. LSD (**P < 0.05**) = 0.3329.

**Microbial tests**

Table 3 shows a decrease in the total bacterial count and psychrophilic (cold-loving) bacteria in the ice cream samples. A lower percentage of yogurt addition resulted in a reduction in bacterial content. The total bacterial count was $18\times10^3$ in the sample with a 0:100 ice cream-to-yogurt ratio, which decreased to $11\times10^3$ in the sample with a 75:25 ice cream-to-yogurt ratio. This may be due to the higher bacterial content in yogurt, which decreases the total bacterial count in the ice cream as the yogurt percentage decreases (Mostafavi *et al*., 2017). Additionally, the significant reduction in psychrophilic bacteria could be attributed to temperature fluctuations during freezing, which can damage cell membranes, cell walls, and cytoplasms, leading to the rupture and death of microorganisms (Ranadheera *et al*., 2013).

**Table 3:** The total count of bacteria and cold-loving bacteria of ice cream mixes made from goat's milk yogurt

| Treatment | Total number bacteria VFU/gm | Total number of cold-loving bacteria |
|---|---|---|
| Control (100% ice cream) | $11 \times 10^3$c | $4\times 10^3$a |
| 0:100(ice cream:yogurt) | $18 \times 10^3$a | $2\times10^3$b |
| 25:75(ice cream:yogurt) | $15 \times 10^3$b | $2.4 \times10^3$b |
| 50:50(ice cream:yogurt) | $13 \times 10^3$bc | $3 \times 10^3$ab |
| 75:25(ice cream:yogurt) | $11 \times 10^3$c | $4 \times 10^3$a |

**Sensory evaluation**

From Table 4, the results of the sensory evaluation of milk ice cream with different proportions of yogurt (0:100, 25:75, 50:50, 75:25) are noted. The sensory evaluation values of the mixtures were similar when compared to the control sample, except for the 0:100 mixture, which exhibited a significant difference in character. The appearance, texture, and taste affected the general acceptance of this mixture. The other mixtures received scores of 92.0, 87.8, and 85.7, respectively. The 75:25 mixture received the highest evaluation score of 92.0 among all the mixtures.

**Table 4:** The sensory evaluation degrees of ice cream mixes made from goat's milk yogurt

| Type of milk ice cream The mixture | Color and appearance 15 | Textures 35 | Taste and flavor 15 | Oral feeling 20 | Public acceptance 15 | Total 100 |
|---|---|---|---|---|---|---|
| Control (100% ice cream) | 14.0a | 31.0a | 15.0a | 19.0a | 14.0a | 93.0a |
| 0:100(ice cream:yogurt) | 12b | 28b | 10c | 16.3b | 11.3c | 77.6c |
| 25:75(ice cream:yogurt) | 13.2ab | 29ab | 13.7b | 17ab | 12.8b | 85.7b |
| 50:50(ice cream:yogurt) | 14a | 29.2ab | 13.8b | 17.3ab | 13.5ab | 87.8b |
| 75:25(ice cream:yogurt) | 14.6a | 30.4a | 14.2a | 19a | 13.8a | 92a |

## DISCUSSION

Table 1 refers to the values of pH and acidity for the ice cream treatments. Guner *et al.* (2007) mentioned that reflux acidity is lower in yogurt milk ice cream. The pH is higher in yogurt milk ice cream compared to yogurt milk, with pH values ranging from 6.61 to 4.54. The reflux acidity measured 0.58% and 0.09%, and the high acidity is attributed to the production of lactic acid during the coagulation of milk when making yogurt. These results align with findings by Da Silva *et al*. (2015), who reported a pH value of 6.62 for goat milk yogurt ice cream. This change in acidity in goat ice cream occurs

due to the higher acidity of goat milk compared to cow's milk (Salem *et al*., 2017).

Table 2 indicates the melting rate of ice cream parameters. The results align with findings by Guner *et al*. (2007), which show that the melting rate increased with the acidity of the yogurt. When acidity increased from 0.7% to 0.82%, the melting rate rose to 2.07% after 20 minutes and reached 33.80% after 50 minutes. Factors such as the formation of ice crystals, fat content, non-fat solids in the ice cream, and the amount of air trapped in the ice cream mix all contribute to the increased dryness of the ice cream as the storage period progresses (Salem *et al*., 2017; Mulakhudair *et al*., 2023). Additionally, the increased density of ice cream due to the presence of stabilizers enhances its ability to absorb water and prevents the growth of ice crystals (Marshall *et al*., 2003).

Table 3 indicates the total number of cold-loving bacteria in the milk ice cream model. It shows a decrease in the number of cold-loving bacteria due to the inability of harmful bacteria to grow within the milk ice cream (Ranjbar *et al*., 2022). Kumar and Patyal (2024) also noted a decrease in cold-loving bacteria, as mentioned above. This is supported by Tomar and Akarca (2019), who concluded that the lowest logarithm for photophilic bacteria is 4.01, while the highest for cold-loving bacteria is 4.94 colony-forming units per gram (CFU/g). Additionally, it was found that the number of cold-loving bacteria in milk ice cream made from yogurt ranged from 2.24 to 2.50 CFU/g (Ozdemir, 2019).

From Table 4, we observe the sensory evaluation results of the milk ice cream. Szkolnicka *et al*. (2020) noted that the sensory qualities of milk ice cream decrease due to increased milk fermentation and rising pH levels. Similarly, Akın *et al*. (2007) reported that the organoleptic properties of ice cream were not evident due to the high acidity of the product.

## CONCLUSION

In conclusion, it is possible to make ice cream from goat's milk and combine it with yogurt made from goat's milk to enhance the product's health properties, thanks to the high nutritional value of goat's milk and the health benefits of yogurt resulting from fermentation. The 75:25 mixture yielded the best results for physical properties, including pH, acidity, lowest melting rate, and improved sensory acceptance in terms of flavor and strength.

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# تقييم بعض خصائص آيس كريم زبادي حليب الماعز

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صنع آيس كريم زبادي حليب الماعز عن طريق تخمير حليب الماعز باستخدام مقبلات MIX 495 -YO لتحضير الزبادي وخلطه مع الآيس كريم المصنوع من حليب الماعز بأربع نسب استبدال: 0:100، 25:75، 75:25، و50:50٪ من الآيس كريم إلى الزبادي بالإضافة إلى عينة التحكم المكونة من آيس كريم 100٪ لتقييم الخصائص الفيزيائية والقبول الحسي لعلاجات الآيس كريم المدروسة، كما لوحظ أن الخليط 75:25٪ أعطى أعلى درجة حموضة 5.5 وأقل حموضة بنسبة 0.32٪ مقارنة بالعلاجات الأخرى كما أنه أعطى أقل معدل انصهار وصل إلى 23.7٪ وهو قريب من العينة الضابطة البالغة 20.1٪ بعد 50 دقيقة. كانت قيم النكهة والملمس لهذا الخليط على التوالي 8.5 و5.5 وهي قريبة من عينة التحكم بينما أعطى الخليط 0: 100٪ كانت أقل قيمة للنكهة وأعلى قيمة للقوام 4.3 و8.6 على التوالي مقارنة بالعلاجات الأخرى.

**الكلمات المفتاحية:** - ايس كريم، الزبادي، حليب الماعز