Effect of Fortifying Goat Milk Yogurt with Taro Corms Paste on the Quality of Yogurt Produced during Cold Storage

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كلية معتمدة

مجلة البحوث في مجالات التربية النوعية

معرف البحث الرقمي DOI: 10.21608/JEDU.2025.368580.2210

المجلد الحادي عشر العدد57 . مارس 2025

الترقيم الدولي

E- ISSN: 2735-3346　　P-ISSN: 1687-3424

موقع المجلة عبر بنك المعرفة المصري https://jedu.journals.ekb.eg/

موقع المجلة http://jrfse.minia.edu.eg/Hom

العنوان: كلية التربية النوعية . جامعة المنيا . جمهورية مصر العربية

Abstract:

The present study aimed to inspect the evaluate of physical, microbiological, sensory properties, nutritional and chemical of goat yogurt after adding different concentrations of taro corms paste (5, 10, 15 and 20%) over 28 days of refrigeration, for production of yogurt as functional food to improve body functions and provide health benefits and nutritional balance as a result of mixing them. The results showed that fortification of goat milk yogurt with taro corms paste improved the nutritional value of fortified yogurt samples due to increasing the contents of total solids, protein, ash and fiber with increasing fortification percentage, in addition to increasing the contents of phenolic substances, vitamin C and antioxidant activity. Throughout the storage period tested, the numbers of probiotics in all formulations ranged from 7 to 8 log CFU mL^{-1}). Fortification with taro corms paste also caused more significant physical changes (improved texture, viscosity and whey separation) in yogurt compared to goat yogurt alone. Taro corms paste also reduced syneresis during storage, thus maintaining the physical quality of yogurt. Consumers preferred yogurt containing 5% and 10% taro corms paste over those containing 15% and 20% because its addition resulted in undesirable high viscosity with the appearance of a vegetal taste. Given the addition of taro corms paste with potential beneficial properties, the manufacture of goat milk yogurt with taro corms paste and *L. acidophilus* LA-05 is one way to produce a new goat milk product with added value. It can be recommended that the necessity of production goat yogurt containing 5% and 10% taro corms paste as function food to improve the healthy condition and prevent diseases

Keywords: Goat milk yogurt, *Colocassia esculenta*, physicochemical, phytochemical, synbiotic.

1. Introduction:

The dairy manufacturing is now one of the top industries in the creation of healthy foods due to the broad range of uses for milk and its high customer acceptance (**Verruck *et al*., 2019**). Because of its great levels of conjugated linoleic acid, vitamin B, and bioactive peptides, as well as its improved calcium bioavailability and protein digestibility, yogurt is a popular and widely consumed dairy product with a high nutritional value that surpasses that of other non-fermented dairy products (**Fardet *et al*., 2019**). These qualities have primarily been evaluated in cow milk-based yogurts, but goat milk can be utilised to improve them because it has lower allergenic qualities and is more digestible due to its high percentage of tiny fat globules (1.5 μm) (**Milani and Wendorff, 2011**). Goat milk has larger concentrations of short-chain fatty acids, antimicrobial chemicals, and mineral components like zinc, iron, and magnesium than cow milk (**Slacanac *et al*., 2010**). Yogurt also contains probiotic-potent useful lactic acid bacteria that may afford health advantages. According to physico-chemical analysis, yogurt is acidic milk coagulate where casein micelles unite to form a linkage that traps serum within. The development of multiplexes between k-caseins and denatured whey proteins on the surface micelles, and fat globules reinforces this network. This progression happens when lactic acid bacteria ferment milk, acidifying it and lowering the negative charge of caseins. At an isoelectric point of 4.6, the acidification of milk is neutralised, resulting in a decrease in electrostatic repulsions (**Durmus *et al*., 2021**). Because goat milk contains more capric, caprylic, and caproic fatty acids than cow milk, it has a stronger flavour and aroma, which is one of the main market barriers for goat milk products (**Slacanac *et al*., 2010**). Furthermore, because goat milk products have lower quantities of α-s1 casein, they frequently have weaker curd formation and lesser viscosity (**Wang *et al*., 2023**). To enhance the rheological characteristics and "goaty" taste of goat's milk yogurt, certain sweeteners, texturizers, colourants, and flavouring compounds have been frequently added. These days, fruit, vegetable, and fruit extracts could be used to address these effects in keeping with the growing demand for more natural foods.

Taro is the ninth most popular food crop in the world, and grown all over Africa, **(Rashmi *et al*., 2018**). Taro tubers are a fundamental food in tropical and subtropical counties and are a vital supply of carbohydrates for energy. It is cultivated mainly as type of underground corms (**Kaushal *et***

***al*., 2015**). Similar numerous tuber crops, taro's corm contains a moderate amount of fat (0.2- 0.8%) and protein (1.5-5.0 %). It is high in fibre (0.8-3.0%), ash (1.0-4.0%), and starch (more than70%) (**Sudhakar *et al*., 2020**). Starch represents about 85% of the dry matter in taro tubers. It is expected that the amylose, starch and dry matter content of taro will positively relate with the quality of its products (**Kaushal *et al*., 2015**). Its commercial potential is further evidenced by the fact that it is an active ingredient in numerous foods and medications. In addition, vitamin C, vitamin B6, thiamine, niacin, riboflavin, manganese, potassium, copper, phosphorus, iron, and zinc are all found in taro (**Rashmi *et al*., 2018**). Taro is rich in easily digestible minerals and carbohydrates. According to **Darkwa and Darkwa (2013),** taro meals are beneficial for people with cereal allergies as well as for infants and kids who are lactose intolerant. Taro's nutritional qualities give it a number of therapeutic benefits, including anti-cancer, anti-inflammatory, anti-hepatotoxic, anti-lipid peroxidative, hypolipidemic and anti-diabetic effects (**Shah *et al*., 2022**).

Because of these promising benefits of goat milk and taro corm paste, the present study was carried out to strengthen of determine the effect of fortifying goat milk with varying concentrations (5, 10, 15, and 20%) of taro corm paste on the nutritional, technical, microbiological, physicochemical, and sensory qualities of yogurt during cold storage to become a functional yogurt high nutrients and other bioactive components, so that the widely consumed and can be effortlessly added to regular meals without altering dietary habits, the taro corm products may enhance the smoothness and consistency of goat yogurt.

2. Materials and methods:

Fresh goat's milk (3% fat) was gotten from a desert research center farm in Cairo, Egypt, and was standardized to 3 % fat by partially removing the cream. High-quality taro corms were sourced from a local market in Zagazig, Egypt. Additionally, the yogurt culture (YF-L903) *including Lactobacillus delbrueckii* subsp. *Bulgaricus*, *Streptococcus* *salivarius* subsp. *thermophilus*, and the probiotic culture of *L. acidophilus LA-05* were acquired from Christian Hansen Laboratory in Copenhagen. All analytical-grade chemicals were acquired from Sigma-Aldrich in Steinheim, Germany.

2.1. Preparation of taro corms paste (TCP):

The taro corms were peeled, washed, cut, and then soaked in a 7.5% NaCl solution for 1 hour to remove oxalate (**Krisnaningsih *et al.*, 2019**). The washed small parts of taro corms were soaked in water (1 kilogramme of taro corms and 200 ml of water), heated for 10 minutes, then minced and mixed to create a paste of very fine particles, which was then frozen until needed.

2.2. Manufacture of goat yogurt:

TCP was added at 5, 10, 15 and 20% (w/w) to four of the five portions (2000 mL) of goat milk (10 L), with the fifth serving as the control sample. After adding TPC to the milk at the prescribed concentrations and homogenising the mix until it attained 42 ± 2 ◦C, the yogurt culture (0.4 g L^{-1}) and probiotic culture (0.1 g L^{-1}) were added in amounts determined by earlier testing to ensure a minimum final count of roughly 7 log CFU mL^{-1} of probiotic culture, and the mixture was homogenised for two minutes. After being divided among 20 sterile 100 g canisters each batch, the samples were put in an incubator set at 42 ± 2 ◦C until their pH fell among 4.65 and 4.60. Lastly, the yogurts were kept for 28 days at 4–6 ◦C in preparation for the ensuing analyses.

2.3. Physicochemical analysis of yogurts:

The physicochemical properties of yogurts were assessed after 1, 14 and 28 days of cold storage. The levels of total solids, total protein, fat, ash and titratable acidity were analysed in the treatments of yogurt-TCP and control according to **AOAC (2016).** The variations in the pH value of samples throughout storage were assessed using a laboratory pH meter (HANNA Instruments, Portugal). The samples' syneresis was ascertained following the procedure outlined by **Jrad *et al*., (2022).** The viscosity of the yogurt was measured using a rotating viscometer, more precisely the Brookfield viscometer (Brookfield, USA), the viscosity is expressed as centi Poise (cP) units (**Chen *et al*., 2018**). A Minolta CM-700d spectrophotocolorimeter was used to measure the colour profiles in accordance with (**Akgün *et al*., 2020**). Every measurement was carried out three times.

2.4. Texture profile analysis (TPA):

Goat yogurts texture is measured in the experiment using the TPA puncture technique. P/5 is the model of the probe. Specify the following: 50%, 5 mm/s before the test rate, 1 mm/s before the test rate, and 1 mm/s after the test rate. The 5 g trigger force and the compression ratio. Hardness, elasticity, cohesion, chewiness and adhesiveness are some of the measurement markers, according to **Muñoz-Tebar *et al*., (2024**) methods.

2.5. Microbiological quality:

Following conventional protocols, the produced yogurts were examined for lactic acid bacteria viable counts and microbiological quality indices (**APHA, 2001**). On the 1, 14, and 28 days of storage, the microbiological quality standards for *Salmonella spp*., moulds, yeasts, and coliforms were evaluated. The samples were tested for thermotolerant coliforms using *Escherichia coli* broth incubated for 1 day at 45°C. *Salmonella spp*. were detected by means of pre-enrichment using Lactose broth incubated for 18–20 hours at 35°C, selective enrichment using Cystine selenite and Tetrathionate broth incubated for 1 day at 43°C, and differential selective plating on Brilliant green agar and *Salmonella* differential agar incubated for 18–24 hours at 35°C. Plate count agar was incubated for 2 days at 35°C. All media were obtained from HiMedia, Mumbai, India, and used Saboraud agar for moulds and yeasts, which were incubated for three to five days at 25 °C. The number of lactic acid bacteria was assessed. The pour-plate inoculation method was used to enumerate *S. thermophilus L. bulgaricus* and *L. acidophilus LA-05*, on M-17 agar, C-MRS agar (MRS agar with 0.5

g L^{-1} cysteine) and LC agar, respectively. *S. thermophilus* was incubated for two days at 37 °C under aerobic circumstances, whereas *L. bulgaricus* and *L. acidophilus* were cultured for three days at 37 °C under anaerobic conditions (AnaeroGen Anaerobic System, Oxoid).4, 24 Log CFU per millilitre of yogurt (log CFU mL^{-1}) was used to express the viable counts.

2.6. Antioxidant activity and phenolic content analyses:

Antioxidant and total phenolic sample extracts were made using the process outlined by **Salehi *et al*., (2023).** The total phenolic concentration was established using the Folin-Ciocalteu reagent and then converted to mg. (GAE)/100 g, and the DPPH method developed by **Wibawanti *et al*., (2018)** was used to calculate radical scavenging activity (%). The **AOAC (2016)** method was utilised to analyse ascorbic acid.

2.7. Sensory analysis:

The **Nurhartadi *et al*., (2017)** approach was used to determine the sensory analysis. The panellists' acceptance of the goat yogurt's scent, color, taste, texture, and general quality was assessed using the hedonic test. Twenty-five semi-trained panellists from Zagazig University's Faculty of Agriculture's Food Science Department analyzed the samples. A 3-digit random number is used to identify the tested samples, which weigh about 10 g. Using a scoring system, the panellists indicated how much they liked each attribute: 1 meant hate, 2 meant somewhat like, 3 meant quite like, and 4 meant like. To prevent a neutral or middle score that would potentially add bias into the data, a scoring range of 1 to 4 was used, with numbers representing hate, somewhat like, quite like, and like.

2.8. Statistical analysis:

IBM SPSS Statistics version 26 was used to undertake the statistical analysis of the data. All data were performed in triplicate, and the results were expressed as mean ± standard deviation (SD). To find out if there was a considerable difference among the control and TCP-containing yogurts over 28 days of storage, a Two-way ANOVA was performed with a 95%

sureness level. The Tukey test was used to identify the variations between the various yogurt formulas and storage durations when there was a significant variance ($P < 0.05$) **(Muñoz-Tebar *et al*., 2024)**.

3. Results and discussion:

3.1. Chemical composition of TCP and goat milk:

The chemical composition means of goat milk and taro corms paste (TCP) are shown in Table (1). The content of total solids, crude protein, fat, and ash in goat milk were 11.70, 3.50 and 3.00, 0.8%, respectively. While, TCP contained 31.80% total solids, 2.90% protein, 0.55% fat, 2.56% crude fibers, and 2.25% ash. Also, TCP exhibited significantly higher phenolic content (74.8 mg GAE/100g), vitamin C (42.80 mg/100g), and antioxidant activity (65.70%) compared to goat milk (5.80 mg GAE/100g, 0.33 mg/100g and 8.14%, respectively). Hence, TCP is nutritionally dense, with high fiber, minerals, vitamin C, and antioxidants, making it a valuable functional food. Goat milk, on the other hand, provides more protein and fat but lacks fiber and bioactive compounds. Combining these two ingredients could yield a balanced product with enhanced nutritional and health-promoting properties. These results are in line with **(Pramono *et al*., 2023)**.

Table (1): Chemical composition (in wet basis), of taro corms paste (TCP) and goat milk

Characteristics (%)	TCP	Goat milk
Moisture	68.20±0.42	88.30±0.55
Total Solids	31.80±0.65	11.70±0.14
Crude Protein	2.90 ±0.18	3.50±0.12
Crude Fat	0.55±0.04	3.00±0.16
Crude fibers	2.56±0.22	0.00±0.00
Ash	2.25±0.25	0.8 ±0.02
Total phenolic content (mg GAE/100 g)	74.8±2.30	5.80±0.33
Ascorbic acid (mg/100gm)	42.80±0.95	0.33±0.002
Total Antioxidant activity (%)	65.70±3.66	8.14±0.96

Each analysis was performed triplicate, each value is the mean ± SD.

3.2. Coagulation time throughout yogurt manufacture:

TCP considerably raised the pH of the yogurt at the time of addition ($P < 0.05$). Yogurts containing TCP had a more rapid and noticeable rise in the pH compared to control yogurt. It took 143, 152, 160, 162 min. for yogurts containing 5, 10, 15 and 20% TCP, respectively compared to 130 min. for the control yogurt, to attain the necessary final pH (Figure 1). Lactic acid bacteria (LAB) digest milk carbohydrates to produce lactic acid during normal yogurt fermentation. This acidification or pH drop causes milk proteins, primarily caseins, to become unstable and gel, giving yogurt its distinctive texture (**Kanauchi, 2019**). The sluggish acidification in these batches may have been caused by the addition of TCP to yogurts, which may have discouraged an early protein network formation.

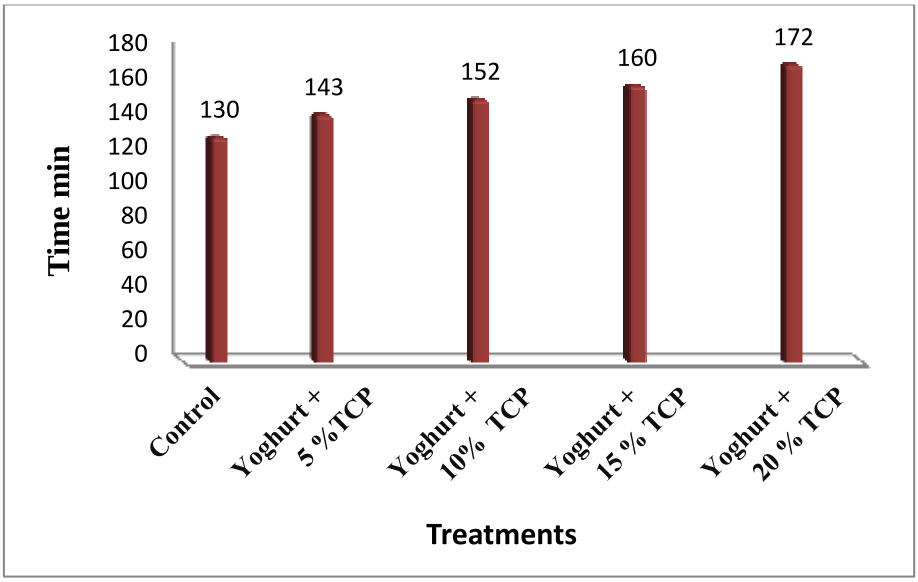

Figure (1): Coagulation time (min) of goat yogurt supplemented with different concentrations of TCP

3.3. Proximate composition of TCP goat yogurts:

Table (2) displays the average values for the chemical limits found in goat milk yogurt samples that contain TCP. The ash, fiber, and protein contents of the yogurt formulation without TCP were lower ($P < 0.05$) than those of the formulations with TCP, with variations ($P > 0.05$) in their concentrations (5 to 20%). The TCP added is the primary cause of the variations in composition between samples. Over the course of the observed storage time, the total solids in yogurt formulations including TCP (12.60– 16.0%) were higher than those in yogurt formulations not comprising TCP (11.72– 12.50%). The results of our current study are consistent with the findings of **Pramono *et al*., (2023)** who observed an increase in the contents of total solids, protein, ash and fiber when they fortified a yogurt drink with taro flour.

Table (2): Effect of cold storage on chemical composition of goat yogurt supplemented with TCP after 1, 14 and 28 days of refrigerated storage

Parameter	Storage period (days)	Treatment				
		Control	Yogurt + 5% TCP	Yogurt + 10% TCP	Yogurt + 15% TCP	Yogurt + 20% TCP
Total solids (%)	1	11.72±0.22^{f,A}	12.60±0.18^{e,B}	13.46±0.12^{d,B}	14.38±0.14^{c,B}	15.24±0.12^{b,B}
	14	12.08±0.36^{e,D}	12.92±0.32^{e,A}	13.88±0.24^{d,A}	14.74±0.26^{c,A}	15.60±0.30^{b,A}
	28	12.50±0.30^{e,C}	13.44±0.24^{d,B}	14.36±0.18^{c,B}	15.12±0.34^{b,C}	16.00±0.22^{a,A}
Fat (%)	1	3.28±0.06^{a,C}	3.16±0.04^{b,A}	3.04±0.05^{b,B}	2.96±0.03^{c,A}	2.85±0.08^{c,A}
	14	3.40±0.04^{a,B}	3.33±0.03^{a,C}	3.24±0.04^{a,C}	3.14±0.04^{b,A}	3.02±0.05^{b,B}
	28	3.55±0.05^{a,A}	3.42±0.06^{a,B}	3.36±0.03^{a,C}	3.28±0.07^{a,C}	3.18±0.03^{b,A}
Total protein (%)	1	3.28 ±0.09^{c,B}	3.36±0.11^{c,A}	3.50±0.07^{b,C}	3.66±0.08^{b,C}	3.82±0.07^{b,B}
	14	3.36±0.07^{c,A}	3.42±0.08^{c,A}	3.65±0.12^{b,C}	4.12±0.06^{a,B}	4.22±0.11^{a,B}
	28	3.80±0.05^{b,B}	3.90±0.07^{b,A}	3.98±0.10^{b,A}	4.36±0.10^{a,A}	4.48±0.12^{a,A}
Ash (%)	1	0.84±0.02^{d,B}	0.96±0.01^{d,A}	1.05±0.03^{c,B}	1.14±0.02^{c,A}	1.28±0.04^{b,A}
	14	0.88±0.04^{d,A}	1.02±0.02^{c,B}	1.12±0.04^{c,A}	1.20±0.05^{b,B}	1.34±0.02^{a,B}
	28	0.94±0.03^{d,A}	1.11±0.05^{c,A}	1.18±0.01^{b,B}	1.26±0.03^{b,A}	1.40±0.03^{a,A}
Fiber (%)	1	0.0±0.00^{f,A}	0.12±0.01^{e,B}	0.20±0.02^{d,B}	0.33±0.02^{c,B}	0.45±0.01^{b,A}
	14	0.0±0.00^{f,A}	0.16±0.01^{e,A}	0.25±0.01^{d,A}	0.38±0.01^{c,A}	0.50±0.02^{a,B}
	28	0.0±0.00^{f,A}	0.20±0.02^{d,B}	0.31±0.02^{c,B}	0.44±0.01^{b,A}	0.55±0.02^{a,A}

Dissimilar lowercase letters in the rows indicate significant differences (P < 0.05) due to the addition of TCP over 28 days of storage, as analyzed by two-way ANOVA. Dissimilar uppercase letters indicate significant variations (P < 0.05) resulting from the Tukey test, when significant differences were detected among yogurt treatments over 28 days of storage.

3.4. Physicochemical properties during cold storage:

3.4.1. pH and titratable acidity:

Overall, during cold storage, the physicochemical properties of yogurt were impacted by the addition of TCP in varying degrees. Both TCP inclusion and storage period had an impact on the yogurts' pH and titratable acidity ($P < 0.05$). Every yogurt sample with TCP added had a higher pH and a lower titratable acidity value than the control group ($P < 0.05$). There were no appreciable changes in this behavior based on the TCP concentration during the course of the storage period. In general, it could be said that the yogurts' titratable acidity increased and their pH decreased with storage time. Although this is correct for acidity in all samples, the pattern varies for pH, which is especially noticeable in yogurts that include TCP as the storage period came to a close and the pH values dropped (Table 3). Over the course of the 28-day storage period, the lactic acid content of the samples increased most significantly in the control yogurts, whereas the largest increase was observed in the yogurts that had TCP added, regardless of concentration. The additional metabolic activities caused by the starter cultures through storage that hydrolyse lactose into lactic acid and dietary fiber (from TCP) into uronic acids may be the cause of the rise in acidity and the reduction in pH of control and TCP-added yogurts through cold storage. This lowers pH values and increases acidity through storage (**Almusallam *et al*., 2021**). Throughout the whole storage period, all yogurt samples had acidity values between 0.70 and 1.16%, falling within the minimum acceptable range of 0.60 to 1.50% that the **Codex Commission (2015)** recommends for fermented dairy products. Yogurts enriched with natural extracts such taro flour (**Pramono *et al*., 2023**) and taro starch (**Ali *et al*., 2023**) showed a comparable pH and acidity behavior. **Riyanto and Nafisah (2022)** claim that oligosaccharides, such as inulin, are the possible prebiotic carbohydrates in TCP. Increased nutrition, particularly carbohydrates, is made possible for LAB by the use of TCP. This is in line with the results of **Cahyanti *et al*., (2021),** who found that the addition of cempedak and jackfruit pulp had no effect on the LAB population since its ability to use sugar as an energy source during fermentation was optimally limited. Because of this restriction, not all nutritional carbohydrates ferment into lactic acid. As a result, the TCP-supported treatment's acidity decreased.

3.4.2. Syneresis:

Since whey separation on the yogurt surface may adversely affect the yogurt's shelf life and consumer acceptability, syneresis is an important physical feature that might affect the yogurt's storage stability and acceptability. Yogurt stability increases with decreasing syneresis (**Kiros *et al*., 2016**). The addition of TCP and storage duration had an impact on the syneresis of fresh yogurt ($p < 0.05$). Over the course of the storage period, yogurts that were added with TCP exhibited the lowest syneresis; these values were lower with increased TCP ($P < 0.05$). These findings imply that TCP can preserve the physical quality characteristics of goat milk yogurts by lowering syneresis alterations that occur during cold storage. Yogurts containing fruit pomace or purée have shown a similar behavior **(Almusallam *et al*., 2021; Rashwan *et al*., 2024).** This is because the polysaccharide molecules in fortified yogurts with fruit or vegetables have a high-water holding capacity (WHC), which increases the rigidity of the protein-gel network by absorbing a lot of water. Furthermore, the electrostatic interaction between polysaccharides and milk proteins may contribute to the reduction of yogurt syneresis and the increase of WHC (**Du *et al*., 2023; Fan *et al*., 2023**). Additionally, the protein coagulation network and, thus syneresis, may be impacted by some phenolic chemicals found in TCP (**Durmus *et al*., 2021**). Furthermore, according to **Rashwan *et al*., (2024),** these contacts suggest that hydroxyl and anionic groups would combine to create a complex with clusters of positively charged proteins and increase hydrogen bonding in the yogurt. Over the course of storage, all yogurts displayed increasing syneresis levels, reaching their peak on day 28 ($P < 0.05$). A frequent occurrence in these dairy products is the rise in syneresis during storage, which is frequently connected to gradually rising acidity. According to **Molaee Parvarei *et al*., (2021),** this rise in acidity causes a decrease in the net negative charges of casein micelles, which impacts their colloidal stability and increases the amount of water that separates from yogurt curds.

3.4.3. Viscosity:

The analysis of variance findings indicated that the viscosity of yogurt changed significantly (P <0.05) when TCP was added. Yogurt's viscosity varied between 1500- 1120 centi Poise in control and 2460- 2930 centi Poise in yogurt fortified with TCP. The treatment without the addition of TCP produced the lowest viscosity value (1500 centi Poise), whereas the treatment with a 20% addition of TCP produced the highest value (2930 centi Poise) (see Table 3). An increasingly acidic pH causes casein to become less soluble, which results in the development of hydrophobic casein micelles that give yogurt its shape and consistency. This causes a change in viscosity. Since 80% of yogurt is carbohydrate-based, TCP makes it more viscous (**Rostianti *et al*., 2018). Dhawi *et al*., (2020)** claim that because carbohydrates may bind water and create a gel, they can improve viscosity. Seventy-six percent of the total starch is found in taro flour. Because starch, which is made up of solid components like amylose and amylopectin, has a great capacity to absorb water, adding TCP can make yogurt more viscous (**Khubber *et al*., 2021**). Starch serves as a thickening agent and binds water. Due to the increased capacity to bind water, the viscosity increases with the amount of starch added (**Sofyan *et al*., 2022**). Yogurt's enhanced viscosity may possibly be caused by the inulin found in TCP. The results of **Handayani *et al*., (2016)** are consistent with this one, showing that yogurt made with modified yam flour (which contains 7.5% inulin) at 2%, 4%, and 6% levels had increased viscosity. The capacity of inulin to bind extracellular polysaccharides and proteins is responsible for the increased viscosity of yogurt and its firm texture. As the storage period went on, the apparent viscosity dropped (P < 0.05) in all treatments. Most likely, the enhanced syneresis (serum separation) during storage was linked to the decrease in the apparent viscosity of goat milk yogurt (**Al Mijan *et al*., 2014**).

Table (3): Mean values of pH, acidity, syneresis, color and apparent viscosity of goat milk yogurts containing TCP after 1, 14 and 28 days of refrigerated storage

Parameter	Storage period (days)	Treatment				
		Control	Yogurt + 5% TCP	Yogurt + 10% TCP	Yogurt + 15% TCP	Yogurt + 20% TCP
pH value	1	4.52±0.04^{c,A}	4.58±0.02^{b,A}	4.62±0.01^{a,C}	4.68±0.03^{a,B}	4.74±0.02^{a,A}
	14	4.44±0.02^{c,B}	4.50±0.01^{c,A}	4.55±0.04^{b,A}	4.60±0.02^{a,C}	4.68±0.03^{a,B}
	28	4.32±0.02^{d,A}	4.43±0.02^{c,B}	4.47±0.03^{c,B}	4.54±0.04^{b,A}	4.60±0.01^{a,C}
Acidity (lactic acid %)	1	0.88±0.03^{b,C}	0.84±0.02^{b,C}	0.80±0.03^{c,A}	0.76±0.01^{c,B}	0.70±0.01^{d,A}
	14	1.06±0.02^{a,B}	0.92±0.03^{b,A}	0.87±0.02^{b,C}	0.82±0.03^{c,A}	0.77±0.03^{c,B}
	28	1.16±0.01^{a,A}	1.00±0.02^{a,C}	0.94±0.01^{b,A}	0.90±0.02^{b,B}	0.85±0.02^{b,C}
Syneresis (mL/100 g)	1	24.50±1.04^{d,A}	22.30±1.02^{d,C}	20.80±0.98^{e,A}	20.20±0.95^{e,A}	19.70±1.01^{e,B}
	14	26.40±0.88^{c,A}	24.80±0.87^{d,A}	23.20±1.02^{d,B}	22.70±0.94^{d,C}	20.90±1.00^{e,A}
	28	30.20±0.94^{a,A}	28.50±0.90^{b,A}	26.70±1.04^{c,A}	24.80±0.85^{d,A}	23.20±0.92^{d,B}
Viscosity (cp)	1	1500±5.2^{e,A}	1820±4.5^{d,B}	2270±3.7^{c,A}	2640±3.2^{a,B}	2930±2.7^{a,A}
	14	1280±4.8^{f,A}	1650±5.4^{d,C}	2150±5.3^{c,B}	2420±5.6^{b,B}	2750±3.8^{a,B}
	28	1120±6.2^{f,B}	1380±5.8^{e,B}	1930±6.2^{d,A}	2180±4.4^{c,B}	2460±5.3^{b,A}
*L**	1	88.41±0.12^{a,C}	87.14±0.09^{b,C}	85.16±0.15^{d,A}	84.12±0.08^{d,C}	82.13±0.02^{f,A}
	14	88.95±0.02^{a,B}	87.84±0.12^{b,B}	86.02±0.12^{c,B}	84.92±0.09^{d,B}	83.14±0.08^{e,B}
	28	89.16±0.02^{a,A}	88.06±0.14^{b,A}	86.54±0.11^{c,A}	85.30±0.12^{d,A}	83.70±0.14^{e,A}
*a**	1	-3.82±0.02^{e,A}	-3.12±0.01^{d,C}	-2.60±0.02^{d,B}	-2.00±0.03^{c,A}	-1.47±0.02^{a,B}
	14	-3.94±0.01^{e,B}	-2.69±0.02^{d,B}	-2.24±0.03^{c,B}	-1.85±0.02^{b,B}	-1.33±0.03^{a,B}
	28	-4.05±0.01^{f,A}	-2.54±0.03^{d,A}	-2.02±0.01^{c,A}	-1.64±0.01^{b,A}	-1.17±0.02^{a,A}
*b**	1	9.27±0.22^{a,B}	9.07±0.20^{b,A}	8.94±0.16^{b,B}	8.77±0.22^{d,B}	8.87±0.15^{d,A}
	14	9.44±0.18^{a,A}	9.25±0.18^{a,B}	9.05±0.14^{b,A}	8.90±0.18^{b,C}	8.99±0.14^{b,B}
	28	9.57±0.14^{a,A}	9.36±0.12^{a,B}	9.24±0.12^{a,B}	9.07±0.20^{b,A}	9.26±0.22^{a,B}

Dissimilar lowercase letters in the rows indicate significant differences ($P < 0.05$) due to the addition of TCP over 28 days of storage, as analyzed by two-way ANOVA. Dissimilar uppercase letters indicate significant variations ($P < 0.05$) resulting from the Tukey test, when significant differences were detected among yogurt treatments over 28 days of storage. *L**: lightness, *a**: redness, *b**: yellowness.

3.4.4. Color:

One of the most crucial quality factors that have a big impact on a food's marketability and consumer acceptance is its color. All of the color parameters examined (*L**, *a**, and *b**) changed statistically significantly when TCP was added to yogurts compared to the control yogurt. Throughout cold storage, TCP-added yogurts displayed higher *a** and lower *b** and *L** values compared to control yogurts ($P < 0.05$). Similar color shifts have been documented in natural extract-fortified yogurts

(**Muñoz-Tebar *et al*., 2024**). According to **Kryzhska and Shang (2022),** these color variations are connected to the areca taro paste's gray-white hue, which causes the yogurt's initial light red hue to gradually dilute. Yogurt's $L*$ and $b*$ values dropped as the percentage of TCP grew, while it's $a*$ value increased. One may argue that TCP-added yogurts displayed greater $L*$ and $b*$ values and lower $b*$ values after 28 days of refrigeration compared to day 1. In any event, these alterations during storage may be connected to the development of acidity and adjustments to the three-dimensional structure of yogurt that facilitate the release of these TCP pigments from the matrix, making it more susceptible to microbial, enzymatic, and chemical breakdowns or transformations (**Muñoz-Tebar *et al*., 2024).**

3.5. Mechanical properties (Texture):

The hardness of the control yogurt, as indicated in Table (4), is 4.9 N, which is significantly higher than that of the goat yogurt supplemented with TCP. In the experiment, the hardness of the goat yogurt was 3.20 N, which was significantly lower than other treatments, when the amount of TCP was 20%. There was no discernible difference between the treatments and the control group in terms of elasticity (springiness). The control sample's stickiness (Gumminess) and masticatory (Chewiness) scores were 2.0 N and 26.21 mj, respectively, which were noticeably higher than those of TCP-supplemented treatments. When the amount of taro paste was 20%, the hardness of the supplemented treatments was the lowest, and the cohesion and elasticity were the best when compared to other supplemented treatments. The test results showed that the chewability of goat yogurt supplemented with 5% TCP were the best, and the hardness was higher than other supplemented treatments. One could argue that the textural changes in yogurts caused by the addition of TCP were more pronounced than those caused by the control.

In addition, the found components like phenolic composites and polysaccharides that may act to help stabilize the yogurt gel (**Rashwan *et al*., 2024**), the total solid content of yogurts has previously been linked to their firmness and consistency, providing a uniform structure (**Wang *et al*., 2023**). The force required removing yogurt that has adhered to the spoon or mouth after consumption is indicated by the cohesiveness of the yogurt (**Wang *et al*., 2019**). In general, the interaction of water with macromolecules like proteins and polysaccharides has been linked to the viscosity of yogurt (**Rashwan *et al*., 2022**). According to several writers, adding fruit extracts to yogurt improves its texture **(Fan *et al*., 2023; Du *et al*., 2023; Rashwan *et al*., 2024)**. Furthermore, **Harper *et al*., (2022)** pointed out that the lactic acid bacteria used to make yogurt may generate exopolysaccharides that can combine with milk caseins to improve the texture of the finished product.

Table (4): Texture profile of goat milk yogurts containing TCP after 7 and 28 days of refrigerated storage

Parameter	Storage period (days)	Treatments				
		Control	Yogurt + 5% TCP	Yogurt + 10% TCP	Yogurt + 15% TCP	Yogurt + 20% TCP
Hardness 1 (N)	7	4.90±0.14^{a,A}	4.00±0.18^{b,A}	3.70±0.22^{b,B}	3.40±0.12^{b,C}	3.20±0.16^{b,C}
	28	4.50±0.12^{a,B}	3.60±0.22^{b,B}	3.30±0.14^{b,C}	2.90±0.16^{c,A}	2.70±0.18^{c,B}
Adhesiveness (mj)	7	0.707±0.02^{d,A}	1.682±0.01^{c,A}	2.198±0.04^{b,C}	2.330±0.06^{b,A}	3.774±0.05^{a,A}
	28	0.662±0.05^{d,B}	1.520±0.04^{c,B}	2.030±0.05^{b,C}	2.120±0.08^{b,B}	3.435±0.02^{a,B}
Cohesiveness (Ratio)	7	0.41±0.01^{a,A}	0.38±0.01^{a,B}	0.33±0.02^{b,A}	0.30±0.02^{b,B}	0.30±0.01^{b,B}
	28	0.37±0.02^{a,B}	0.33±0.02^{b,A}	0.29±0.01^{b,B}	0.25±0.01^{c,A}	0.22±0.02^{c,B}
Springiness (mm)	7	13.00±0.24^{a,A}	13.00±0.30^{a,A}	13.00±0.22^{a,A}	13.00±0.16^{a,A}	13.00±0.12^{a,A}
	28	12.60±0.18^{a,B}	12.58±0.42^{a,B}	12.58±0.33^{a,B}	12.60±0.28^{a,B}	12.62±0.32^{a,B}
Gumminess (N)	7	2.00±0.02^{a,A}	1.70±0.01^{b,A}	1.40±0.02^{c,A}	1.00±0.02^{d,A}	0.96±0.01^{d,B}
	28	1.92±0.01^{a,B}	1.57±0.02^{b,B}	1.28±0.01^{c,B}	0.94±0.02^{d,B}	0.88±0.02^{d,C}
Chewiness (mj)	7	26.21±0.11^{a,A}	20.89±0.15^{b,A}	17.66±0.18^{c,A}	14.45±0.22^{d,A}	13.75±0.16^{d,B}
	28	25.80±0.14^{a,B}	16.30±0.22^{c,B}	16.54±0.12^{c,B}	13.40±0.25^{d,B}	12.55±0.18^{e,A}

Dissimilar lowercase letters in the rows indicate significant differences ($P < 0.05$) due to the addition of TCP over 28 days of storage, as analyzed by two-way ANOVA. Dissimilar uppercase letters indicate significant variations ($P < 0.05$) resulting from the Tukey test, when significant differences were detected among yogurt treatments over 28 days of storage.

3.6. Microbiological properties:

All of the assessed yogurt preparations attained acceptable quality through the course of the 28 days of refrigerated storage, according to the results of the microbiological quality examination. Assuring safety for human consumption, the total coliform, mold, and yeast counts, as well as the lack of *Salmonella* spp., were all within the bounds set by current law (**De- Carvalho Lima *et al*., 2009**). In goat milk yogurt containing TCP, the viable counts of *L. bulgaricus, S. thermophilus,* and *L. acidophilus* LA-05 through refrigeration are shown in Table (5). The minimal bacterial counts of 7 log CFU mL^{-1} required to identify a fermented milk product as yogurt were exceeded by the bacterial counts found in all yogurt formulations during fermentation (first day of storage) (**Béal and Helinck, 2014**). Compared to *L. bulgaricus* (7.05–7.70 and 6.42–6.90 log CFU mL^{-1}, respectively), the initial and final *S. thermophilus* counts (8.02–8.80 and 7.04–7.95 log CFU mL^{-1}, respectively) were higher. Even though *S. thermophilus* and *L. bulgaricus* work well together (**Sumarmono and Sulistyowati, 2015**), previous research has shown that co-culturing these two bacterial species results in reduced numbers of *L. bulgaricus*. Because *L. bulgaricus* produces less acetic acid, this behavior is linked to the traits of commercial co-cultures and results in a lesser sensory impact (**De-Espírito Santo *et al*., 2012**). According to **Venizelou (2000),** adding some fruit juices to yogurt at quantities greater than 15% (v/v) hindered the growth of bacteria, with the effect being more noticeable on the starter *L. bulgaricus* than on *S. thermophilus*. Its higher sensitivity to oxygen in comparison to S. thermophiles may also be the reason for the lower *L. bulgaricus* numbers (**De Brito *et al*., 2007**). So, when the yogurt is being homogenized and TCP is being added, oxygen should be added**.**

Furthermore, the discovery of low *L. bulgaricus* counts may be related to antagonistic interactions between *L. bulgaricus* and *L. acidophilus* LA-05. Certain strains of *L. acidophilus* can create bacteriocins that prevent *L. bulgaricus* from growing, whereas *L. bulgaricus* can generate hydrogen peroxide that stops *L. acidophilus* from growing (**Lourens-Hattingh and Viljoen, 2001**). According to **Salva *et al*., (2011),** a probiotic count of 6–8 log CFU mL^{-1} is recommended at the conclusion of food product preservation in order to provide health advantages. Initial counts for *L. acidophilus* LA-05 in the yogurt formulations examined in this investigation ranged from 8.06 to 8.40 log CFU mL^{-1}, and at the conclusion of the evaluated storage period, counts ranged from 7.90 to 8.25 log CFU mL^{-1} (Table 5).

The total LAB (lactic acid bacteria) was not significantly affected by the addition of TCP to goat yogurt (P >0.05). The treatment that did not include TCP had the greatest total LAB, while the treatment that did include TCP had the lowest result. The incapacity of one of the starting bacteria to degrade the substrate from the TCP is probably the cause of the decreased total LAB in yogurt after TCP was added. This is consistent with the claim made by **Cahyanti *et al*., (2021)** that *L. bulgaricus* is a culture that is unable to ferment specific kinds of substrates, such as inulin. The claim made by **Eris *et al*., (2022)** that taro flour has 12% inulin is supported.

The ingredients used in yogurt provide LAB with their nutritional sources. It is hypothesized that yogurt with TCP will have a lower total LAB due to the decrease in milk concentration, which is replaced by the addition of TCP, and thus the lower available lactose. Where, the primary energy source for LAB cell proliferation in yogurt is the breakdown of lactose into glucose and galactose, which are then transformed into lactic acid (**Harper *et al*., 2022**). Furthermore, surplus nutrients that LAB cannot use are thought to be the cause of the reduced total LAB in yogurt with added TCP when compared to the control treatment. **Riyanto and Nafisah (2022)** claim that oligosaccharides, such as inulin, are the possible prebiotic carbohydrates in TCP. This is in line with the results of **Cahyanti *et al*., (2021),** who found that the addition of jackfruit pulp had no effect on the LAB population since its ability to use sugar as an energy source during fermentation was optimally limited. Because of this restriction, not all nutritional carbohydrates ferment into lactic acid.

Table (5): Lactic acid bacteria count in goat milk yogurts containing TCP after 1, 14 and 28 days of refrigerated storage

Parameter	Storage period (days)	Treatment				
		Control	Yogurt + 5% TCP	Yogurt + 10% TCP	Yogurt + 15% TCP	Yogurt + 20% TCP
***S. thermophiles* (log CFU mL^{-1})**	1	$8.80\pm0.06^{a,A}$	$8.30\pm0.08^{a,B}$	$8.22\pm0.11^{a,C}$	$8.14\pm0.05^{a,C}$	$8.02\pm0.12^{a,D}$
	14	$8.55\pm0.08^{a,B}$	$7.90\pm0.05^{b,A}$	$7.82\pm0.12^{b,B}$	$7.66\pm0.06^{b,C}$	$7.50\pm0.08^{b,C}$
	28	$7.95\pm0.11^{b,A}$	$7.40\pm0.12^{c,A}$	$7.36\pm0.09^{c,B}$	$7.22\pm0.08^{c,B}$	$7.04\pm0.11^{d,A}$
***L. bulgaricus* (log CFU mL^{-1})**	1	$7.70\pm0.07^{a,A}$	$7.50\pm0.05^{a,B}$	$7.20\pm0.04^{b,A}$	$7.12\pm0.05^{b,B}$	$7.05\pm0.08^{b,C}$
	14	$7.20\pm0.09^{b,A}$	$7.04\pm0.08^{b,C}$	$6.98\pm0.09^{c,A}$	$6.77\pm0.08^{c,B}$	$6.64\pm0.05^{c,C}$
	28	$6.90\pm0.05^{c,A}$	$6.64\pm0.11^{c,C}$	$6.84\pm0.07^{c,B}$	$6.53\pm0.06^{c,C}$	$6.42\pm0.11^{d,A}$
***L. acidophilus* (log CFU mL^{-1})**	1	$8.40\pm0.09^{a,B}$	$8.34\pm0.05^{a,B}$	$8.26\pm0.09^{b,A}$	$8.14\pm0.09^{b,B}$	$8.06\pm0.08^{c,A}$
	14	$8.60\pm0.05^{a,A}$	$8.46\pm0.08^{a,B}$	$8.35\pm0.06^{a,B}$	$8.24\pm0.06^{b,A}$	$8.14\pm0.05^{b,B}$
	28	$8.25\pm0.04^{b,A}$	$8.18\pm0.07^{b,B}$	$8.06\pm0.08^{c,A}$	$7.95\pm0.07^{d,A}$	$7.90\pm0.09^{d,B}$

Dissimilar lowercase letters in the rows indicate significant differences ($P < 0.05$) due to the addition of TCP over 28 days of storage, as analyzed by two-way ANOVA. Dissimilar uppercase letters indicate significant variations ($P < 0.05$) resulting from the Tukey test, when significant differences were detected among yogurt treatments over 28 days of storage.

3.7. Phytochemical properties of goat milk yogurt:

As compared to similar samples, yogurt samples added with TCP showed significantly higher levels of ascorbic acid, phenolic compounds (PC), and antioxidant activity (AOA); this difference was widened by raising the TCP level. The findings showed that after 1, 14, and 28 days of cold storage, the yogurt treated with 20% TCP had the greatest levels of PC (16.60, 14.50, and 11.40 mg/100 g), AOA (15.50, 13.30, and 11.40 %), and ascorbic acid (8.26, 7.14, and 6.70 mg/100 g) (Table 6). According to earlier research, taro corms have high levels of ascorbic acid, PC, and AOA, which is in line with **Wudali *et al.*, (2023)** findings. All treatments' phenolic components and AOA significantly decreased ($P < 0.05$) with increasing storage time, which can be attributed to a decline in PC stability and chemical-enzyme interactions. Additionally, the formation of lactic acid bacteria during storage was accelerated by the degradation of polymeric phenolic chemicals **(Qu *et al.*, 2021).** It has also been noted that the antioxidant activity of yogurt decreases with storage **(Dimitrellou *et***

al**., 2020).** The previous results are consistent with those of **Narváez Cadena *et al*., (2025),** who discovered comparable increases in AOA and total phenol levels when taro flour was added to high-protein and gluten-free diets. Following storage, ascorbic acid, total phenols, and AOA progressively dropped for all yogurt treatments. They also discovered that yogurt samples' AOA levels dropped over time. The breakdown of certain PC into aromatic acids including benzoic, phenylacetic, and phenyl propionic acids may help to explain this. Phenolic acids, flavonoids, and tannins are subgroups of PC (**Elkot *et al*., 2023**).

Table (6): Phytochemical properties of goat milk yogurts containing TCP after 1, 14 and 28 days of refrigerated storage

Parameter	Storage period (days)	Treatment				
		Control	Yogurt + 5% TCP	Yogurt + 10% TCP	Yogurt + 15% TCP	Yogurt + 20% TCP
Phenolic compounds (mg/100g)	1	$6.80{\pm}0.35^{e,B}$	$9.70{\pm}0.54^{d,B}$	$12.40{\pm}0.38^{c,A}$	$14.50{\pm}0.45^{b,A}$	$16.60{\pm}0.52^{a,A}$
	14	$5.20{\pm}0.44^{f,A}$	$7.80{\pm}0.60^{e,A}$	$10.30{\pm}0.55^{d,A}$	$11.60{\pm}0.34^{c,B}$	$14.50{\pm}0.40^{b,A}$
	28	$4.70{\pm}0.62^{g,A}$	$6.40{\pm}0.33^{e,B}$	$7.50{\pm}0.42^{e,B}$	$9.20{\pm}0.53^{d,B}$	$11.40{\pm}0.22^{c,B}$
Total Antioxidant activity (%)	1	$4.70{\pm}0.35^{g,A}$	$7.90{\pm}0.40^{e,B}$	$9.20{\pm}0.43^{d,B}$	$13.60{\pm}0.42^{b,A}$	$15.50{\pm}0.52^{a,A}$
	14	$4.00{\pm}0.28^{g,B}$	$7.20{\pm}0.53^{e,C}$	$8.30{\pm}0.52^{e,A}$	$11.70{\pm}0.36^{c,A}$	$13.30{\pm}0.33^{b,B}$
	28	$3.70{\pm}0.33^{g,C}$	$6.60{\pm}0.25^{f,A}$	$7.80{\pm}0.38^{e,B}$	$9.50{\pm}0.50^{d,A}$	$11.40{\pm}0.42^{c,B}$
Ascorbic acid (mg/100g)	1	$0.88{\pm}0.12^{h,A}$	$2.24{\pm}0.14^{f,B}$	$3.66{\pm}0.15^{e,A}$	$5.14{\pm}0.22^{d,A}$	$8.26{\pm}0.16^{a,A}$
	14	$0.72{\pm}0.14^{h,B}$	$1.94{\pm}0.16^{f,B}$	$2.98{\pm}0.18^{e,B}$	$3.64{\pm}0.16^{e,A}$	$7.14{\pm}0.12^{b,A}$
	28	$0.60{\pm}0.18^{h,C}$	$1.68{\pm}0.22^{g,A}$	$2.44{\pm}0.14^{f,A}$	$2.92{\pm}0.14^{e,B}$	$6.70{\pm}0.18^{c,A}$

Dissimilar lowercase letters in the rows indicate significant differences ($P < 0.05$) due to the addition of TCP over 28 days of storage, as analyzed by two-way ANOVA. Dissimilar uppercase letters indicate significant variations ($P < 0.05$) resulting from the Tukey test, when significant differences were detected among yogurt treatments over 28 days of storage.

3.8. Sensory properties of goat yogurts:

Table (7) displays the test findings of the panellists' preferences for the overall acceptance, color, texture, taste, and aroma of yogurt with different TCP addition concentrations. The results of the hedonic parameters indicated that the addition of TCP significantly altered the overall qualities, color, texture, and scent. With the exception of texture, panellists' acceptance of all hedonic qualities decreased when TCP concentration is increased. In general, panellists dislike yogurt that smells strongly of sourness **(Thun *et al*., 2022).** The strength of the aroma increased with increasing the amount of TCP added. In terms of color, panellists like items with more vibrant hues (**Emam and El-Nashar, 2022**). When goat yogurt is mixed with TCP, its color seems darker. The cream-brown color of TCP created by taro corms color and enzymatic reactions during manufacture is what gives goat yogurt its darker hue (**Sofyan *et al*., 2022**). Panellists like yogurt that has a harmonious balance of sweetness and acidity in terms of flavor (**Atwaa *et al*., 2020**). The panellists' preference for goat yogurt's flavour tends to decline when TCP is added. Panellists' ratings of the yogurt's flavour ranged from somewhat like to rather like, with the strong acidic taste also resulting from the lack of sweets in the production process (**Nurhartadi *et al*., 2017**). The preference for goat yogurt's texture increased with the amount of TCP added because it thickened. According to **Selvamuthukumaran and Farhath (2014),** panellists dislike watery textures and choose thick-to-semi-solid textures. Since TCP's primary component is carbohydrates, along with the starch and inulin that bind water, adding TCP can make the yogurt thicker. Goat yogurt with a 10% TCP addition received the highest overall acceptance rating (very like). The aroma, color, and texture of this goat yogurt were rated as quite like, while the taste was rated as somewhat like. In terms of aroma, color, taste, and texture, the panellists gave goat yogurt that contained higher concentrations of TCP the lowest acceptance ratings. Higher taro flour additions reduce the yogurt drink's sensory acceptability, according to **Pramono *et al*., (2023).**

According to this study, people generally dislike yogurt that contains greater levels of TCP. Only yogurt with a TCP addition of up to 10% is accepted by consumers. Yogurt's texture can be improved by adding more TCP, but the yogurt's flavor was not improved. These results are in line with a study by **Kusumasari and Pamela (2019)** that demonstrated that adding taro flour to yogurt increased its acidity compared to control yogurt. Taste is typically regarded by consumers as the most important sensory aspect when deciding which food products, including goat yogurt, they prefer. Therefore, more variety is required to address the taste of TCP yogurt if it is to continue employing TCP to enhance its fiber content. More study can be done to produce synbiotic TCP yogurt with adding sweetening agents.

Table (7): Sensory properties of goat milk yogurts containing TCP after 7 and 28 days of refrigerated storage

Parameter	Storage period (days)	Treatment				
		Control	Yogurt + 5% TCP	Yogurt + 10% TCP	Yogurt + 15% TCP	Yogurt + 20% TCP
Aroma	7	$3.3\pm0.12^{c,A}$	$3.5\pm0.15^{b,A}$	$3.7\pm0.12^{a,A}$	$3.0\pm0.18^{d,A}$	$2.8\pm0.11^{e,A}$
	28	$3.0\pm0.15^{d,A}$	$3.3\pm0.18^{c,A}$	$3.5\pm0.13^{b,A}$	$2.7\pm0.15^{e,B}$	$2.5\pm0.14^{f,A}$
Color	7	$3.2\pm0.11^{c,A}$	$3.6\pm0.11^{a,A}$	$3.4\pm0.08^{b,A}$	$3.0\pm0.11^{c,B}$	$2.7\pm0.08^{d,B}$
	28	$2.8\pm0.12^{d,A}$	$3.2\pm0.08^{c,A}$	$3.0\pm0.11^{c,B}$	$2.7\pm0.14^{d,B}$	$2.5\pm0.15^{e,A}$
Taste	7	$2.5\pm0.16^{c,B}$	$2.8\pm0.16^{b,A}$	$3.0\pm0.15^{a,A}$	$2.6\pm0.18^{c,A}$	$2.4\pm0.18^{d,A}$
	28	$2.3\pm0.18^{d,B}$	$2.5\pm0.18^{c,B}$	$2.8\pm0.12^{b,A}$	$2.3\pm0.16^{b,B}$	$2.2\pm0.16^{e,A}$
Texture	7	$2.4\pm0.15^{e,B}$	$2.8\pm0.15^{d,B}$	$3.2\pm0.18^{c,A}$	$3.5\pm0.11^{b,A}$	$3.8\pm0.13^{a,A}$
	28	$2.2\pm0.12^{f,A}$	$2.5\pm0.12^{e,A}$	$2.9\pm0.16^{d,A}$	$3.2\pm0.14^{c,A}$	$3.5\pm0.17^{b,A}$
Overall acceptance	7	$3.0\pm0.08^{c,A}$	$3.3\pm0.11^{b,A}$	$3.5\pm0.11^{a,A}$	$2.8\pm0.08^{d,A}$	$2.6\pm0.18^{e,A}$
	28	$2.8\pm0.11^{d,A}$	$3.0\pm0.14^{c,A}$	$3.2\pm0.14^{b,B}$	$2.5\pm0.12^{e,B}$	$2.2\pm0.12^{f,A}$

Dissimilar lowercase letters in the rows indicate significant differences ($P < 0.05$) due to the addition of TCP over 28 days of storage, as analyzed by two-way ANOVA. Dissimilar uppercase letters indicate significant variations ($P < 0.05$) resulting from the Tukey test, when significant differences were detected among yogurt treatments over 28 days of storage.

4. Conclusions:

In conclusion, fortifying the goat milk yogurts with the addition of taro corm paste will lead to slow the acidification process considerably. Also, the total LAB and panelists' preferences to fragrance, color, taste, and overall acceptance dropped with increasing the levels of taro corm paste added to yogurt more than 10%. But the content of ascorbic acid, total antioxidants activity, phenolic compounds, total solids, fiber, and panelists' choice for texture increased. The addition of taro corm paste to yogurt causes more noticeable changes in their physicochemical characteristics, such as texture, and viscosity. Also, taro corm paste decreased the goat milk yogurts' syneresis while preserving their physicochemical quality throughout storage. Yogurts with 5 and 10% taro corm paste compared to those with 15 and 20% were favorably received by consumers. We recommend that the Fortifying goat milk yogurts with taro corm paste in diets because have ability to reduced many diseases and improved healthy profiles, more investigation is required to ascertain the ideal doses of goat milk yogurts with taro corm in various food products for best nutritional advantages as well as to examine the long-term impacts of consuming taro corm-enriched other products.

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تأثير تدعيم الزبادي المصنع من حليب الماعز بمعجون درنات القلقاس على جودة الزبادي الناتج خلال التخزين بالتبريد

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الملخص العربي:

هدفت هذه الدراسة إلى تقييم الخصائص الفيزيائية والميكروبيولوجية والحسية والتغذوية والكيميائية للزبادي المصنوع من لبن الماعز بعد إضافة تركيزات مختلفة من معجون درنات القلقاس (5، 10، 15 و20%) على مدار 28 يومًا من التخزين بالتبريد وذلك لإنتاج زبادي يستخدم كغذاء وظيفي لتحسين وظائف الجسم وتوفير فوائد صحية وتوازن غذائي، أظهرت النتائج أن تدعيم زبادي لبن الماعز بمعجون درنات القلقاس قد حسّن القيمة الغذائية لعينات الزبادي المدعم نتيجة لزيادة محتوى المواد الصلبة الكلية والبروتين والرماد والألياف بزيادة نسبة التدعيم، بالإضافة إلى زيادة محتوى المواد الفينولية وفيتامين ج والنشاط المضادات للأكسدة. وخلال فترة التخزين، تراوحت أعداد بكتريا البروبيوتيك في جميع التركيبات من 7 إلى 8 لوغاريتم CFU/ مل. كما أدى تدعيم زبادي الماعز بمعجون درنات القلقاس إلى حدوث تغييرات فيزيائية ذات أهمية مثل تحسين الملمس واللزوجة وانفصال الشرش في الزبادي بالمقارنةً بزبادي الماعز الكنترول كما قلل معجون درنات القلقاس من انفصال الشرش أثناء التخزين، مما حافظ على الجودة الفيزيائية للزبادي، وفضّل المستهلكون الزبادي الذي يحتوي على 5% و10% من معجون درنات القلقاس على الزبادي الذي يحتوي على 15% و20%، حيث زيادة النسب أدت الي لزوجة عالية غير مرغوب فيها مع ظهور طعم نباتي، ونظرًا لخصائص معجون درنات القلقاس المفيدة، يُعدّ تصنيع زبادي حليب الماعز باستخدام معجون درنات القلقاس وبكتيريا L. acidophilus LA-05 إحدى الطرق لإنتاج منتج جديد من حليب الماعز ذي قيمة مضافة. ويُوصى بضرورة إنتاج زبادي الماعز الذي يحتوي على 5% و10% من معجون درنات القلقاس كغذاء وظيفي للحفاظ على الصحة والوقاية من الأمراض.

الكلمات المفتاحية: يوغورت لبن الماعز، القلقاس، الخواص الفيزوكيميائية