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Improving the quality of bio-yogurt: The impact of gum Arabic and stevia on physicochemical and sensory properties during storage

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Abstract
The aim of this study was to evaluate the effect of 1% gum Arabic and stevia fortification of buffalo milk yogurt on the quality during storage (1, 7, 14 and 21 days). The results show that with the addition of the combination, a significant improvement ($p<0.05$) occurred in the physicochemical properties as compared with the control sample. On day 1 of demonstrated nearly a two fold higher levels of water holding capacity at 82.0% in the combination sample and lower levels of syneresis at 8.0% over 72.5% and 15.5% in control sample respectively. This superiority remained during storage period, indicating a strong improvement in textural stability. Also, the inclusion of the combination contributes to the CE of lactic acid bacteria (LAB), at 21 day, greatly elevated with 9.0 log CFU/g compared to control 6.5 log CFU/g. It is so established that gum Arabic has a prebiotic role and the combination can maintain the viability of bacteria. The fortified sample was found better in flavor, consistent texture, and overall acceptability as revealed by sensory evaluation. Results have shown that 1% gum Arabic and stevia combination is effectively used to produce a functional yogurt with less sweetness, as it improves stability and shelf life of yogurt while retaining the probiotic value and sensory properties.

Keywords: Yogurt, gum Arabic, stevia, physicochemical properties, prebiotic, lactic acid bacteria, storage, sensory evaluation

Introduction
Growing interest in healthy dietary practices has become an integral part of modern lifestyle. Such transformation of lifestyle has led to increase in demand for functional foods which have or are believed to have beneficial health effects. Certain products became important, among these probiotics, computerized important, prevents digestive disorders and maintains gut microbiota balance (Farag *et al.*, 2020) [14]. Furthermore, it is also effective in cholesterol lowering and blood pressure lowering. Yoghurt and other fermented dairy products constitute one of the most essential probiotic sources globally (Bouhadi *et al.*, 2021) [12]. As a result, many studies have tried to increase their functional value by adding bioactive component such as prebiotics and plant extracts (Fazilah *et al.*, 2018) [15]. Studies of yogurt consistently show that changing ingredients alters its characteristics. According to Jaafar *et al.* (2020) [22], for example, changing starter culture can make yogurt different. Similarly, Niamah *et al.* (2024) [29] found that encapsulating probiotics in yogurt alters its organoleptic characteristics. Our study similarly aims to alter yogurt characteristics by supplementing it with prebiotic ingredient that may succeed in changing yogurt characteristics.
Prebiotics are types of food ingredients that cannot be digested but stimulate with benefit the growth and activity of selective bacteria in our colons. (Younis *et al.*, 2015) [40] AG and WPC was seen to promote bifidobacterium growth and stability of probiotic (Ahmed *et al.*, 2020; Shenana, 2021) [3].
Stevia rebaudiana Bertoni is a natural zero-calorie sweetener that is rich in phenolic compounds and flavonoid. It has the power of being an antioxidant and antimicrobial agent, along with a famous role in blood sugar and pressure regulation (Bhasker *et al.* 2015; Tadhani and Subash 2006) [10, 38]. Also, the lactic acid bacteria might enhance the bioactive properties of its extracts by fermenting them (Zhang *et al.*, 2023) [42].
Gum Arabic is a polysaccharide that has produced naturally and is widely used in the food industry due mainly to its functional properties like emulsifying power, water retention, and

film-forming ability. It also works as an effective encapsulating material for bioactive materials (Prasad *et al.*, 2022; Zabot *et al.*, 2022) [31, 41].

The objective of this study is to investigate the effect of Gum Arabic and Stevia rebaudiana extract on specific functional yogurt. Animal feed additives will be taken to assess their influence on growth or stability of probiotics. Also will be taken to check the physical, chemical and functional properties of the product.

2. Materials and Methods

2.1. Preparation of Culture Media

To activate the lactic acid bacteria, De Man, Rogosa, and Sharpe (MRS) Broth was prepared using 54.3 g/L and a pH of 6.8±0.2 as per the instruction of the manufacturers. MRS Agar is the medium used for enumerating lactic acid bacteria using the pour plate method at 67.15 g/L.

For enumeration of coliform bacteria, MacConkey Agar (55.07 g/L) was prepared. Mannitol Salt Agar (MSA) (111.02 g/L) was also prepared as per the manufacturer for isolation and counting of Staphylococci.

All media were sterilized by autoclaving at 121°c for 15 minutes at pressure of 15 psi.

2.2. Preparation of Solutions Used in the Study

0.4 g was dissolved in 100 mL distilled water to prepare a 0.1N NaOH solution. A 0.1N solution of HCl was prepared by taking 0.833 ml of concentrated acid and making it up to 100ml. Both solutions adjusted the pH and determined the titratable acidity.

According to the (A.O.A.C., 2008) [44] method, 1 g of phenolphthalein indicator was dissolved in 50 mL of absolute ethanol, and the volume was made up to 100 mL.

Peptone Water at the concentration of 1g per litre was made and then distributed into test tubes 9 mL per tube and sterilized for preparing serial dilutions for counts.

We took Gum Arabic (AG) from Sigma Aldrich, Germany. It was prepared as a solution 1% (w/v) by dissolving in distilled water.

2.3. Determination of Chemical Content and Physical Properties of Milk

Samples of buffalo milk were taken from breeders at Maysan, Iraq. Analysis of chemical and physical properties was performed using a lacto flash ana lyser as per manufacturer's protocol Titratable acidity according to Nielsen (2010) [46] was performed by taking 9 g of the sample adding a few drops of phenolphthalein (1%) indicator and titrating with 0.1 N NaOH until a pink color appeared. In this study, the titratable acidity was determined as a percentage of lactic acid from the formula.

Titratable Acidity (%) was calculated as (Volume of NaOH (mL) × Normality of NaOH × 0.09 / Weight of sample (g)) × 100. The pH was measured with a pH meter at 25°C by immersing the electrode in the sample (Nielsen 2010) [46].

2.4. Aqueous Extraction of Stevia Leaves

Aqueous extraction was carried out according to the method of Goyal *et al.* (2010) [43] with modifications to suit food matrices. Dried stevia leaves were washed to remove dust. These were dried in a warm oven at 45-50°C for about 24 hours. This was done to preserve active compounds. The leaves were then ground into a fine powder.

A total of hundred mililiter of distilled water was added to 10grams of the powder. The concoction was heated at a temperature of 60-70 °C for a period of 1 h with constant stirring to facilitate the leaching of sweetening agents. The mixture was passed through Whatman No. 1 filter paper after extraction. The filtrate was stored at 4°C until use (Goyal *et al.*, 2010; Lemus-Mondaca *et al.*, 2012) [23, 43].

Stevia leaf extracts in water can be successfully used for fortifying dairy products like yogurt. It enhances the natural flavor and improves sensory acceptability without affecting the functional properties. This is recommended by Giri *et al.* (2017) [18], who does confirm a similar result. Shori (2016) [35] also confirmed the suitability of stevia extract for fermented milk.

2.5. Fortification of Yogurt with Gum Arabic and Stevia

The starter culture made up of Lactobacillus delbrueckii subsp. Our Lactic Strategy RM07 nutritionally activated direct set starter culture containing Lactobacillus bulgaricus and Streptococcus thermophilus (1:1) (Sacco, Italy) was engendered by adding it to sterilized skim milk(110°C for 5 minutes) cooled at 40°C at a rate of 0.2 gm/100 ml. The mixture was kept at 37 degrees Celsius for 24 hours and was repeated three times. Later, 1 g of mother culture was added to 99 mL sterilized milk and incubated at 37 °C till the coagulation occurred. The culture was kept in the refrigerator to make daily use easy.

To make yogurt, buffalo milk was heated for 5 minutes at 90±2 °C and cooled to 42 °C. The starter culture was added at 3% (v/v) (≈ 8 log CFU/g). The milk was poured into 100 mL plastic containers containing gum arabic and control. Further, there were added T_1 With 1% gum Arabic and 1% stevia extract. The vessels were covered and incubated at 37°C until pH was 4.6±0.2. The yogurt samples were stored at a temperature of 4° C for a period of 21 days and analysis were done on 1st, 7th, 14th and 21st days of storage (Shwetnisha and Nongmaithem, 2021) [45].

2.6. Microbiological Analyses

Bacterial counts which would give a viable result were checked with the pour plate method.

- **Lactic Acid Bacteria (LAB):** On MRS Agar, incubated anaerobically at 37°C for 48 hours. After counting the colonies, the results were expressed in log CFU/g (Lima *et al.*, 2009) [25].
- **Total Coliforms:** On MacConkey Agar, incubated at 37°C for 48 hours.
- ***Staphylococcus aureus***: On Mannitol Salt Agar, incubated at 37°C for 24-48 hours. Colonies that were characteristic, golden yellow were enumerated. (Watts *et al.*, 2005) [47].

2.7. Physicochemical Properties

- **Water Holding Capacity (WHC):** According to Shori *et al* (2014) determined. We centrifuged ten (10) grams of yogurt at a force of five thousand times gravity. The supernatant was ascertained. From the weight of the supernatant and sample WHC was calculated. The formula applied was WHC% = [1 - (W_1 / W_2)] × 100 where W_1 is the supernatant and W_2 is the sample.
- **Susceptibility to Syneresis (STS):** Measurement by Niamah *et al.* (2016) [30]. For a duration of 6 hours, Whatman No. 1 filter paper was fixed with 10 mL of

yogurt. The volume of whey that is ejected is calculated and subsequently, the STS is calculated as follows:

$STS\% = [1 - (V_1/V_2)] \times 100$

Where V_1 = volume of whey ejected and V_2 = initial volume of sample.

Titratable Acidity and pH: Testing was done on all yogurt samples as per Nielsen (2010) [46].

2.8. Sensory Evaluation
Using a sensory evaluation form, yogurt samples were assessed by panelists from the Department of Food Science, College of Agriculture, University of Maysan.

2.9. Statistical Analysis
Data were analyzed using SPSS software (Version 12). The application of a Completely Randomized Treatment Design (CRD) and statistical analysis of test results with the Least Significant Difference (LSD) test were conducted at the $P \leq 0.05$ significance level (Dean and Voss, 1999) [48].

3. Results and Discussion
3.1. Physicochemical Composition of Buffalo Milk Used for Probiotic Yogurt Production
Buffalo milk is an important dairy product in many places, especially in the Middle East and Asia. It is known to have superior nutritional characteristics than cow's milk. Table (1) shows the chemical and physical properties of the buffalo milk which used for the study. The buffalo milk used in this study significantly influenced the quality of the final product (yogurt).

The milk contains 8.62% fat while 4.15% protein as per the results of the analysis. These values are much higher than those of cow's milk which contains fat and protein in the region of 3.5-4.5 and 3.2-3.8%, respectively (Fox *et al.* 2015). The rise in cholesterol and fat levels is due to buffalo being designed to produce fat with larger and more stable membranes (Abd El-Salam & El-Shibiny, 2013). The presence of high fat and protein content renders them useful in yogurt manufacture by improving the body and viscosity. Moreover, it will contribute to the formation of a stronger gel network during fermentation. It also improves the nutrition value by enhancing the energy value and levels of fat-soluble vitamins (for example vitamins A and D) (Tamime & Robinson, 2007) [49].

Its lactose content at 5.36% was similar to that of cow's milk. The fermentation of lactose by bacteria such as Lactobacillus delbrueckii subsp. bulgaricus and Streptococcus thermophilus is the primary substrate of these organisms and the main source of lactic acid responsible for coagulation of milk and the final texture (Walstra *et al.*, 2006) [50]. The milk had a recorded pH of 6.74 which falls within the normal pH range of fresh milk (6.6-6.8). This indicates that the milk has good quality at the receiving point. Moreover, no pre-acidification was observed which could hinder the growth of starter culture.

The total solids content was found to be 18.31% with solids-not-fat (SNF) 9.69% These percentages were found to be high as compared to cow's milk, according to Ahmad *et al.* (2013) [1]. The final yield and quality of the product are related to the SNF content. Increasing the SNF content increases the protein and lactose levels. This enhances bacterial fermentation. It also improves the final product's nutritional value. This reduced yogurt syneresis thereby increasing its stability in storage (Tamime & Robinson, 2007) [49].

The milk density of 1.035 g/cm³ refers to a normal density of solid components of milk. Milk being a natural food substance is liable to contamination with water, urea, starch, soft-drinks, detergent, synthetic milk etc by the food processors and other non-authorized hooked dealers. The freezing point of determined milk should not exceed -0.52°C. The water doesn't allow the whole amount to freeze at 0°C. A freezing point that is within a permissible range (-0.512° C to -0.550° C) shows quality of the raw milk and suitability for processing (Bylund, 2015) [51].

The titratable acidity (expressed as lactic acid) of fresh was found to be 0.13% A low ash content of 0.81% indicates that it is rich in mineral salts like calcium, phosphate and magnesium. Milk proteins are stabilized by these minerals. These minerals also help form a gel network during yogurt-making. Calcium ions are specifically able to link together various protein molecules in the gel matrix.

Table 1: Chemical composition of buffalo milk used in yogurt manufacturing.

Milk source	Percentage of contents / 100 gm milk									Total acidity	pH
	Protein	Fat	Lactose	Ash	Moisture	Solid non- fat	Total solids	Density gm/cm3	Freeze point		
Buffalo milk	4.15	8.62	5.36	0.81	84.35	9.69	18.31	1.035	- 0.52	0.13	6.74

3.2. Effect of Adding Gum Arabic and Stevia on the Physicochemical Properties of Yogurt during Storage
The current research showed that the addition of gum Arabic (AG) and aqueous stevia leaf extract (T_1) in yogurt had a considerable ($p<0.05$) effect on the physicochemical properties titratable acidity, pH, syneresis, water holding capacity on various storage days (1, 7, 14, 21 days) (Table 2 and Figures 1 & 2). The interactions between yogurt components with the additives and between these and the starter culture and casein protein network have become complicated owing to these shifts.

All treatments experienced a constant increase in titratable acidity and a constant decrease in pH during the storage time. It is typical and anticipated that during storage lactic acid bacteria (LAB) will continue to convert lactose to lactic acid (Liu, 2025) [26]. The pace at which this increased was different for treatments. Throughout all the storage durations, samples of incubated yogurt reinforced with gum Arabic and stevia had the greatest titratable acidity. Thanks to gum Arabic, which is a fermentation fibre that may have prebiotic potential, acid production is enhanced by simulating the growth and activity of LAB (Al-Musawi *et al.*, 2019) [4].

Gum Arabic and stevia samples experienced more syneresis reduction than the control ones (T_0). The viscosity of the aqueous phase is improved by gum arabic making water molecules not to coalesce (Ahmad *et al.*, 2021) [2]. Gum arabic forms a combined gel network with milk proteins (casein) to improve stability. The high binding capability of water prevents water migration and whey separation on the

surface. The addition of gum Arabic resulted in a more pronounced effect where the final syneresis reduce from 15.5% in the control to 8.0±0.7% in sample T_1 on day 1. The other hand addition of stevia showed no improvement towards stability to the final syneresis as it remains close to the control. The evidence indicates that sweetening on its own, without thickener and stabilizer addition, doesn't improve texture (Ghasempour *et al.*, 2020) [17].

The higher WHC (water-holding capacity) in the newest process caused less syneresis development. The T_1 samples that were fortified with gum Arabic and stevia had the highest water holding capacity (WHC) values and improved during storage. The polymer chains of gum Arabic entrain the water in the yogurt gel structure to reduce its loss and keep the product soft (Saha & Bhattacharya, 2010) [32]. On day 21, the WHC values of control sample reduced to 47.5% while that of T_1 sample maintained at a level of 71.5±1.5%. This important enhancement during prolonged storage increases the shelf life and preserves the sensory quality of yogurt. Once more, adding stevia by itself had not much of an effect on this characteristic, thus showing that gum Arabic mainly does affect properties controlling texture.

The use of gum Arabic along with stevia will have the benefits of both. The acidity values that they show is moderate but analyse met a good improvement on syneresis stability and WHC scope. The addition of stevia did not affect the functional role of gum Arabic in increasing physical stability. Also, the mixture yields a sweet, low-calorie yogurt where a real improvement is perceived in texture and stability, in response to trends towards healthy functional products in the market (Martinez *et al.*, 2022) [28].

Table 2: Physicochemical properties of yoghurt fortified with Gum Arabic and stevia during different storage periods.

Samples	Storage periods	Total acidity % (Mean ±SD)	pH (Mean ±SD)	STS% (Mean ±SD) -	WHC% (Mean ±SD)
T_0	1 Day	0.81±0.06 (d)	4.55±0.04 (a)	15.5±1.2 (d)	72.5±2.5 (a)
	7 Day	0.92±0.07 (c)	4.45±0.04 (b)	25.3±1.8 (c)	65.7±2.8 (b)
	14 Day	1.05±0.08 (b)	4.35±0.04 (c)	38.2±2.5 (b)	58.8±3.0 (c)
	21 Day	1.18±0.09 (a)	4.25±0.04 (d)	52.5±3.2 (a)	47.5±3.2 (d)
T1	1 Day	0.85±0.06 (d)	4.50±0.04 (a)	8.0±0.8 (d)	82.0±2.5 (a)
	7 Day	0.97±0.07(c)	4.42±0.04 (b)	12.5±1.0 (c)	79.5±2.6 (b)
	14 Day	1.13±0.08(b)	4.30±0.04 (c)	18.0±1.5 (b)	77.5±2.8 (c)
	21 Day	1.30±0.09 (a)	4.18±0.04 (d)	25.8±2.0 (a)	71.5±3.0 (d)
L.S.D		0.18	0.13	4.33	4.75

Values are mean ±standard deviation (n=3). Different superscript lowercase letters within the same column for each treatment indicate significant differences ($p<0.05$) over storage time.

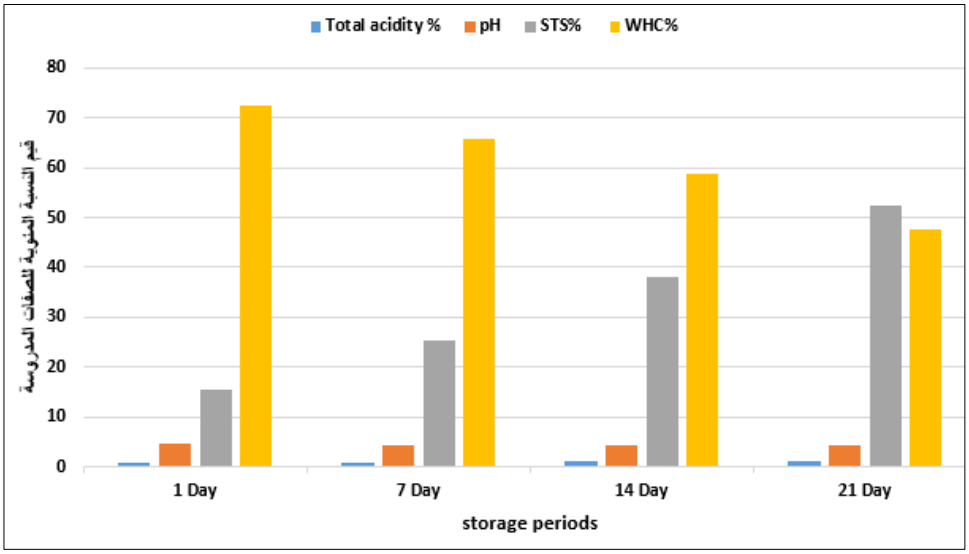

Fig 1: Physiological characteristics of the control sample (T_0) of yogurt produced from buffalo milk

3.3. Effect of Gum Arabic and Stevia Extract on Bacterial Viability in Yogurt

The effectiveness of yogurt as a functional food assembly can be affected by the viability and population density of bacteria especially lactic acid bacteria (LAB) (Küçük *et al.* 2010) [52]. The bacterial count (log CFU/g) of test sample using additives compared to control sample is represented in the Table (3). As the storage period increased, all groups generally and gradually observed a decrease in bacterial counts (Figure 3); probably due to lactic acid, pH, and nutrient deplete in the medium.

The samples with mixed gum Arabic and stevia (T_1) showed stability in bacterial density, especially in the first few weeks. This finding agrees with Srisuvor *et al.* (2013) [37] who stated that the addition of fibers such as inulin and polydextrose (which perform analogy to gum Arabic) acted as prebiotics resulting in the growth of LAB and better survival of in fermented dairy products. This happens because gum Arabic is a substance that can be fermented by specialist bacteria in the gut at a low level, thus encouraging the bacteria to remain alive for longer inside the gut. According to Niamah *et al.* (2016) [30], gum Arabic creates a prebiotic environment that stimulates the activity of probiotics. In fact, gum Arabic exerts a stabilizing effect or stimulates probiotic bacteria. Likewise Hashim *et al.* (2022) [20] who worked on belief on stabilizers like basil seed gum made mention of mechanisms gum Arabic use to enhance texture and offer more suitable environment for bacteria.

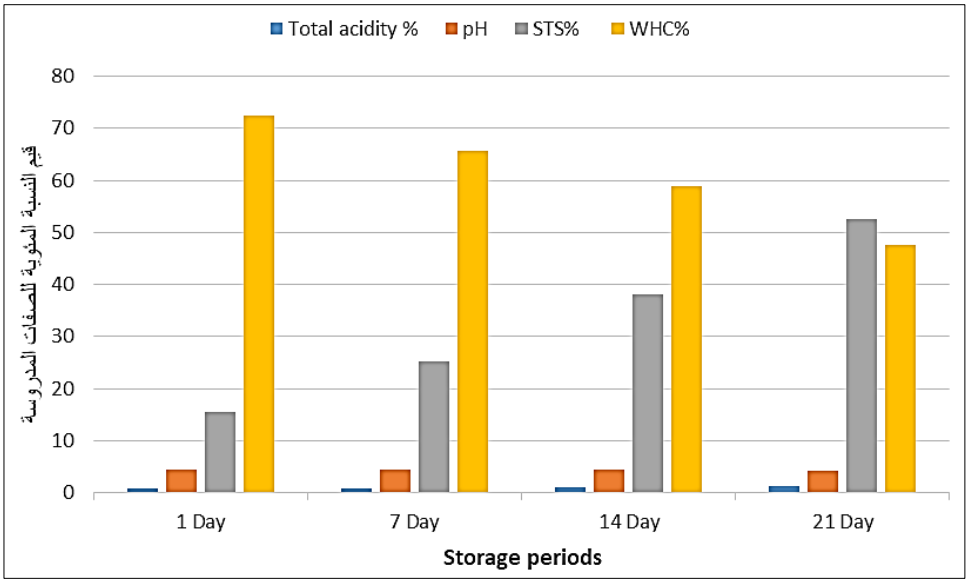

Fig 2: Physiochemical properties of yogurt fortified with the addition of gum Arabic and stevia (T_1) at a concentration of 1%.

On the other hand, the inhibitory effect of samples with stevia alone agrees with the report by Gasmalla *et al.* (2014) [16], which states that the stevia extract contains phenolic and flavonoid compounds that exhibit antimicrobial activity. Therefore, the inhibitory effect show in our experiment may be due to the active compounds in them that may cross-inhibit the growth of useful bacteria at certain concentrations. The fact that the bacterial number was slightly lower in the samples containing stevia may also be justified by the antimicrobial activity of steviol glycosides (Lemus-Mondaca *et al.* 2012) [23]. The study by Tadhani *et al.* (2007) [39] confirmed that "initial" antimicrobial activity exhibited by stevia leave extract offers evidence to support the hypothesis on its effect on the bacteria. The effect would include beneficial bacteria in the yogurt matrix.

The T_1 group who had a mix had intermediate results meaning that gum Arabic partly surpassed the inhibition of the extract from stevia. According to Ma *et al.* (2016) [27], hydrocolloids such as gum Arabic can adsorb or form complexes with the active ingredients in stevia. They do this at the moment of the assay. This reduces the ability of these active ingredients to directly interact with a bacteria. Thus, decreasing their inhibiting effect. As a result, both our findings suggest that the two can be used together in order to incorporate natural sweeteners while not harming probiotic functionality. The effect that gum Arabic and stevia have together could be due to the ability of gum to complex or entrap stevia actives which lowers their availability (Bilgiç, & Seyrekoğlu, 2025; Babeker, 2024) [11]. This could also play a role in how the sweeteners interact with the stabilizers in other studies (Coggins *et al.*, 2010) [13].

Detailed results of their studies on enhanced stability and probiotic viability in yogurt fortified with gum Arabic are in line with some recent findings on probiotic encapsulation technology. Atta *et al.* (2025) [7] proved that encapsulating Limosilactobacillus reuteri enhanced water-holding capacity and reduced syneresis and gave a higher bacterial viability in sheep's milk yogurt for 21 days of storage compared to free bacteria (Atta *et al.*,2025) [7]. Whereas in our study gum Arabic was used as a prebiotic and a stabilizing agent in a synergistic combination with stevia, Atta *et al.* work complimentarily proves that protecting and stabilizing probiotic bacteria by whatever means, and/or whether by encapsulating or by creating a supportive matrix in the yogurt is a very good tool to develop high-quality stable functional yogurts for prolonged shelf-life.

LSD values were calculated for alternative comparisons. Differences in bacterial density between groups, concentrations and days of storage were verified not due to chance, rather true differences. The experimental results are quite repeatable and precise because of the low standard deviation these experiment results show.

Table 3: Viable bacterial counts (log CFU/g) in yoghurt fortified with 1% Gum Arabic and Stevia extract during different storage periods.

Group		Day 1	Day 7	Day 14	Day 21	L.S.D
Total lactic acid bacteria	T_0	9.2 ± 0.1^{a}	$^{***}8.1\pm0.1^{b}$	$^{***}7.3\pm0.1^{b}$	$^{***}6.5\pm0.1^{d}$	0.28
	T1	9.0 ± 0.1^{a}	9.5 ± 0.1^{a}	9.3 ± 0.1^{a}	9.0 ± 0.1^{a}	
Total coliform bacteria		Nil	Nil	Nil	Nil	Nil
Staphylococci aureus		Nil	Nil	Nil	Nil	Nil

Values are mean±standard deviation (n=3). Different superscript letters (a-d) in the same row differ significantly ($p<0.05$) along storage time. *** represents a noteworthy difference ($p<0.001$) as compared to the control group on the same storage day. L.S.D is the least significant difference at P value less than or equal to 0.05 Nil: Not detected.

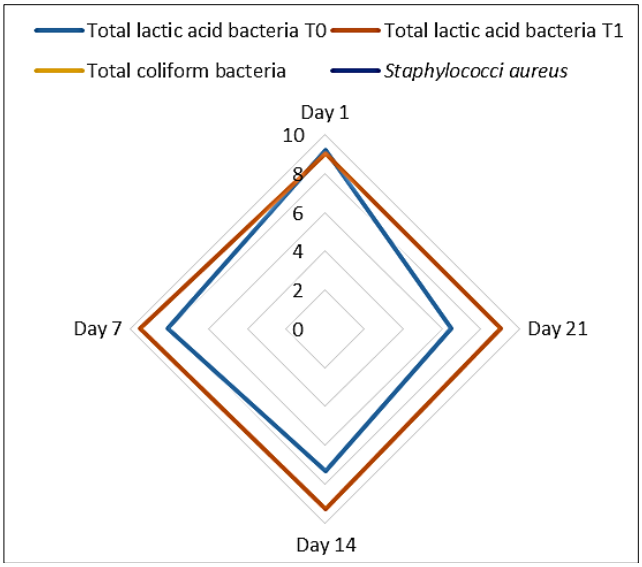

Fig 3: Microbiological content of yoghurt fortified with 1% Gum Arabic and Stevia (T_1), compared to the control sample (T_0).

3.4. Sensory Evaluation of Yogurt Fortified with Gum Arabic and Stevia

Sensory evaluation is a critical determinant for consumer acceptance of probiotic-fortified food products, as sensory attributes play a vital role in consumer preferences. The graph (4) showed a significant increase in the colour attribute with increasing concentration of gum Arabic. The treatment with the combination of gum Arabic and stevia (T_1) at 1% concentration scored maximally (18.0±1.0). On the other hand, the control (T_0) scored 15.0±0.8, and the difference was highly significant (p<0.01). The natural characteristics of gum Arabic can help improve the appearance of the product. The similarity of these results with findings of Sharifi *et al.* (2021) [5] which reported that gum Arabic is capable of enhancing the optical properties of dairy products.

Treatment T_1 (1%) gave the highest score for flavour (27.0±1.3) when compared to control (21.0±1.2) and the difference was highly significant (p<0.001). The natural sweetness of stevia, which does not change the nutritional value of the product, improves the taste. According to Leylak *et al.* (2021) [24], the utilization of natural sweeteners enhances the sensory properties of yogurt surprisingly and significantly better than the control sample, which is confirmed by these results. The consistency attribute of the T_1 treatment (1%) (17.0±1.3) was superior to control (11.0±0.9) with a highly (p<0.001) significant difference. The yogurt's structural matrix improved because of the combined effect of gum Arabic and stevia. The results were similar to Han *et al.* (2020) [19] study which demonstrated an enhancement of textural properties of yogurt with natural materials compared to a control.

All treatments produced a significant improvement in texture attribute over the control (5.0±0.7), where the T_1 treatment (1%) had achieved the highest score (9.0±1.0) with a highly significant difference (p<0.001). This improvement was made because it was shown that gum Arabic improves firmness and cohesiveness. The results show that Awaisheh *et al.* (2013) [8] who had analyzed the effect of natural materials on the textural properties of food products which were better than the control.

All treatments were significantly superior to the control (14.0±0.6) for overall acceptability. The highest value of 19.0±1.0 was scored by treatment T_1 (1%), where the difference was highly significant (p<0.001).

This shows that enhancements in flavor, consistency, and texture work in harmony. These findings are in accordance with those of Anal and Singh (2007) [6], who indicated that sensory properties greatly influenced the acceptability of fortified products over control.

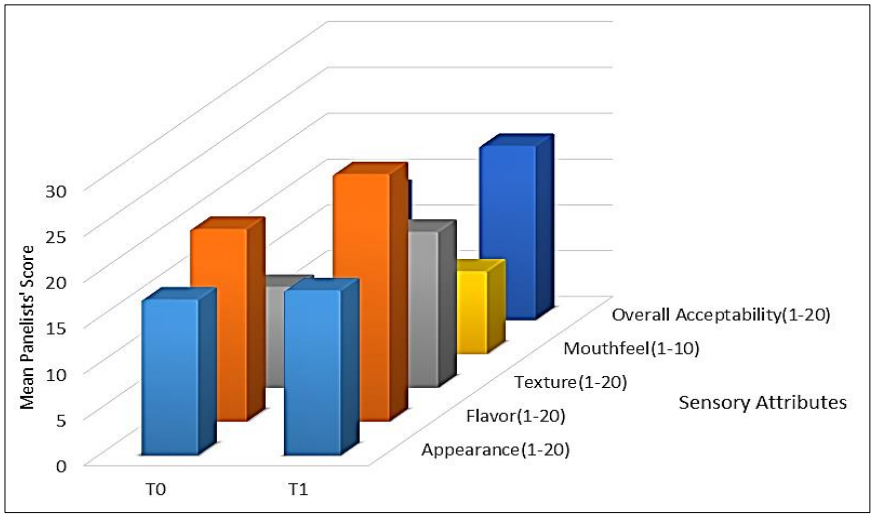

Fig 4: Sensory profile of control (T_0) and gum Arabic-stevia fortified (T_1) yogurt samples during storage.

4. Conclusions

Conclusion obtained from the results of comparing the sample fortified with a mixture of gum Arabic and stevia (1% each) with the control sample.

1. The addition of the gum Arabic and stevia combination (1% each) significantly improved the physical stability of the yogurt, as evidenced by increased Water Holding Capacity (WHC) and a substantial reduction in Susceptibility to Syneresis (STS) throughout the 21-day storage period.
2. The combination effectively contributed to maintaining bacterial viability and stability, registering significantly higher counts of lactic acid bacteria compared to the control at the end of the storage period. A plausible explanation for Prebiotic interaction shows that gum

Arabic and the combination is a suitable candidate for probiotic products.
3. The addition of the combination enhanced the sensory properties of the yogurt, including flavor, consistency, texture, and overall acceptability, thereby increasing its marketability and palatability.
4. The use of a combination of gum Arabic and stevia (at 1% concentration each) is recommended for developing a naturally sweetened functional yogurt with a cohesive and stable body, extended shelf life, preserved probiotic value, and improved sensory characteristics.

Conflict of Interest Statement
The authors declare no competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Author Contributions
- **A.S.A.:** Conceptualization, Methodology, Investigation, Writing - Original Draft.
- **A.S.A.:** Formal analysis, Data Curation, Visualization.
- **A.S.A.:** Validation, Resources, Writing - Review & Editing.
- A.S.A.: Supervision, Project Administration.

Ethical Compliance
I All sensory panelists consented prior to their involvement in the sensory evaluation process.

Data Availability
The corresponding author will provide the data supporting this study's findings upon reasonable request.

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