Effect of adding some medicinal and aromatic plant extracts on physiochemical, Microbiological and sensory properties of drinking yogurt

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Abstract

This study aimed to produce drinking yogurt using a lactic acid bacteria starter (Streptococcus thermophilus and Lactobacillus bulgaricus) with different concentrations of aqueous aromatic medicinal plant extracts garlic: **(**0.2%, 0.5% and 0.8%) and mint: **(**1%, 2.5% and 4%) . The treatments were stored up to 21 days at 4 ± 1 ° C . The physicochemical properties were studied, which included the measurement of (pH, total acidity, and viscosity) and microbiological examinations represented by counting the (starter bacteria, coliform, Staphylococcus aureus, as well as yeasts and molds) and sensory characteristics were measured after manufacturing on the first day , 7, 14 and 21 days of storage. The results showed that there were no significant differences in pH values immediately after manufacturing for all treatments. As for the percentage of total acidity (TTA), it was close to immediately after manufacturing for all the different drinking yogurt treatments, while during storage, a clear increase in their values was observed for all transactions. As for the viscosity values, significant differences were found in their values immediately after manufacturing and during cold storage and for all treatments. The results showed that the addition of aqueous extracts to the drinking yogurt did not affect the numbers of starter bacteria and their activity throughout the storage period compared to the control sample. Also, the results showed that the superiority of concentrations (2.5%) for mint and (0.2%) for garlic in the sensory evaluation of the characteristics of taste, flavor, texture and general acceptance.

Keywords: Plant extract - Aqueous mint extract - Microbiological - Drinking yogurt.

تأثير إضافة بعض مستخلصات النباتات الطبية والعطرية على الخصائص الفيزيوكيمياوية والمايكروبايولوجية والحسية لمشروب اللبن الرائب (الشنينة)

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المستخلص

تهدف هذه الدراسة إلى إنتاج مشروب اللبن الرائب (الشنينة) باستخدام بادئ بكتريا حامض اللاكتيك (*Streptococcus thermophilus* و *Lactobacillus bulgaricus*) وتراكيز مختلفة من المستخلصات المائية للنباتات الطبية والعطرية الثوم: (0.2 %، 0.5% و 0.8%) والنعناع:(1 %و 2.5% و 4%). خَزنت المعاملات لمدة 21 يوماً على درجة حرارة (4± 1)° م . تمت دراسة الخواص الفيزيوكيميائية والتي تضمنت قياس (الأس الهيدروجيني Ph ، الحموضة الكلية ، واللزوجة) والفحوصات المايكروبايولوجية المتمثلة في عد (بكتريا البادئ، وبكتريا القولون ، وبكتريا المكورات العنقودية الذهبية ، وكذلك الخمائر والأعفان) فضلاً عن التقويم الحسي في اليوم الاول من التصنيع وبعد 7 و14 و21 يوماً من الخزن . اوضحت نتائج الدراسة فيما يخص الأس الهيدروجيني عدم وجود فروق معنوية في قيمها بعد التصنيع مباشرة لجميع المعاملات، أمّا النسبة المئوية للحموضة الكلية (TTA) فقد كانت متقاربة بعد التصنيع مباشرة لجميع معاملات مشروب اللّبن الرائب المختلفة ، أمّا اثناء الخزن فقد لوحظ ارتفاع واضح في قيمها لجميع المعاملات . أما بالنسبة لقيم اللزوجة فقد وجدت فروقاً معنوية في قيمها بعد التصنيع مباشرة واثناء الخزن المبرد ولكل المعاملات . اوضحت النتائج أن إضافة المستخلصات المائية إلى مشروب اللبن الرائب لم تؤثر على أعداد بكتريا البادئ ونشاطها طوال فترة التخزين مقارنة بعينة السيطرة ، ونلاحظ من نتائج التقويم الحسي تفوق التراكيز (2.5%) من النعناع و (0.2%) من الثوم لصفات الطعم والنكهة والنسجة والقبول العام .

كلمات مفتاحية : مستخلص نباتي ، المستخلص المائي للنعناع ، مايكروبايولوجي ، مشروب اللبن الرائب

Introduction

Since ancient times, milk and dairy products constitute a major part of human diet and play a prominent role in the diet (Pal, 2014). Milk and dairy products contain many nutrients, such as proteins, vitamins, calcium, phosphorous, magnesium, zinc, etc., which are essential for a healthy life for humans and for all age groups (Das *et al*., 2015).The drinking yogurt is one of the traditional fermented milk drinks known in Iraq and is produced and consumed all over the world with different names, production techniques and flavors. It is classified as a low-viscosity yogurt drink, as there is a growing interest in this field due to its convenience, portability, and ability to provide all the health and nutritional benefits of Set and Stirred yogurt (Eder, 2003;Thompson *et al*., 2007). Recent years have witnessed a wide trend to develop dairy products, and produce foods with new flavors. Consumer demands in the field of food production have changed greatly. Consumers are becoming more and more aware of foods that directly affect their health (Mocanu *et al*., 2010). There is growing

concern about the use of chemical preservatives and synthetic antimicro to prevent or inhibit the growth of disease-causing and spoilage microorganisms, and as a result, natural antimicrobials receive a greater much attention has been paid to its many benefits, including reducing the need for antibiotics, controlling microbial contamination in food, improving shelf life techniques by eliminating pathogens and delaying microbial spoilage, and avoiding the development of antibiotic resistance by pathogenic microorganisms or strengthening immune cells in humans (Tajkarimi *et al*., 2010). Plants are rich in natural substances with antimicrobial properties, and act as antioxidants and flavor and color enhancing agents that can increase sensory acceptability, extend food shelf life, and inhibit growth of foodborne pathogens (Razavi Rohani et al., 2011). In general, most plant-derived extracts are considered safe (Generally Recognized as Safe :GRAS) (21 (CFR) 182, 184) (Burt, 2004). Mint is an aromatic plant that grows widely in the temperate regions of the Northern Hemisphere (Soilhi *et al*., 2019).It has been used traditionally in folk medicine, and is a rich source of iron and magnesium, which play an important role in human nutrition (Pramila *et al*., 2012).It has been used for various ailments such as allergies, upset stomach, indigestion, muscle and nerve pain, flatulence, anxiety related to depression and colds (Abdelrazzq-Al et al.,2013) Garlic is an herbal plant belonging to the family (Liliaceae), and it is one of the most widely cultivated herbs used as a food ingredient and for medicinal purposes. In addition to containing essential nutritional vitamins and minerals with therapeutic effects (Zhu *et al*., 2018).Consumption of garlic and its products is associated with cold and flu prevention, prevention and treatment of cardiovascular disease, hypertension, thrombosis, atherosclerosis, hyperlipidemia and diabetes (Hosseini and Hosseinzadeh, 2015). The study aimed to:

1- Producing a therapeutic milk product (drinking yogurt) using a lactic acid bacteria starter with two types of aromatic medicinal plant extracts (garlic and mint) added.
2- Studying the effect of adding aqueous extract of the plant (garlic and mint) on the physicochemical, Rheological and sensory properties of drinking yogurt.
3- Studying the effect of adding aqueous extract of the plant (garlic and mint) on prolonging the shelf life of this product.

Materials and Methods

Materials:

Full-fat powdered cow's milk was used, Purchased from local market and used in manufacturing of drinking yogurt, and the strains of *Streptococcus Salivarius Subsp thermophiles* and *Lactobacillus delbrueckii Subsp bulgaricus* (type Yo / 446 produced by the Italian company) biochem were used by direct addition to the milk mixtures prepared for the manufacture of drinking yogurt. Fresh mint and garlic were purchased from the local markets in the province of Babylon. Fresh garlic cloves were used to prepare the aqueous extract of garlic. As for the mint leaves, their stems were removed and carefully cleaned manually to remove dirt and damaged, then dried in a drying oven, and turned into a fine powder, and the resulting powder is used to prepare the aqueous extract of mint .

Preparation of plant extracts:

The aqueous extract of garlic was prepared according to the method followed by (Matthew, 2009 & Ilić *et al*., 2017), 50 g of fresh garlic was weighed, then the volume was completed to 100 ml with distilled water, mixed well with an electric mixer, then packed in opaque containers and left for 24 hours at a temperature 4 °C. Then it was repeatedly filtered by sterile gauze to get rid of large particles, then the filtrate was centrifuged at 5000 rpm for 10 minutes at laboratory temperature, then filtered through filter paper by a Buechner funnel under vacuum. While the aqueous extract of mint was prepared according to the method of (Farhan *et al*., 2020) where 5 gram of mint powder was weighed and 50 ml of distilled water was added to it in a ratio of (1:10, solids: solvent) and then the solution was stirred using a hot plate (magnetic stirrer) at 100 °C, after which the extract was filtered through a Whatman No. 1، then the filtrate was subjected to centrifugation for 10 minutes to obtain a clear aqueous extract, Finally, the extracts were collected in dark colored bottles and kept in cold storage at 4 °C until use.

Drinking yogurt manufacture:

The drinking yogurt in this study was made according to (Say *et al*., 2018). The aqueous extract of (mint and garlic) is added to the milk after adding the starter as follows : Full cream cow's milk powder reconstituted (7%) was used, and 4 liters was prepared. After that, the homogenization process was carried out and the milk was subjected to heat treatment at a temperature of 90 °C for 5 minutes, then the samples were cooled to a temperature of (46 ±1) °C. Then they were inoculated with the starter consisting of *Streptococcus Salivarius subsp thermophilus* and *Lactobacillus delbrueckii subsp bulgaricus* by direct addition and with the quantity indicated by the manufacturer at the rate of 0.01 gram per liter. The prepared quantity was divided into four sections, the first section

was left without addition and used in the manufacture of drinking yogurt for the control S, as for the other three sections, aqueous mint extract was added to each liter, at concentrations of 1%, 2.5% and 4% (v/v). Then they were mixed well and filled into plastic containers with a capacity of 1000 ml and incubated at a temperature of (44±1)°C until the coagulation was complete, about 4-6 hours, and until the pH decreased to 4.6 - 4.7 . Then it is taken out of the incubator and transferred to the refrigerator for cooling, then salt is added at the rate of 1 gram per liter and mixed thoroughly for 15-30 minutes. They were packaged in plastic containers with a capacity of 250 ml and transferred to the refrigerator for cooling and keep it at a temperature of (4±1) °C until the necessary tests are performed after 1, 7, 14 and 21 days after manufacture. This process was repeated in the manufacture of drinking yogurt samples with aqueous garlic extract added at concentrations of 0.2%, 0.5% and 0.8% for each liter of milk, and each separately.

Physicochemical Analysis

Estimation of pH and total acidity(TTA):

The pH of the drinking yogurt samples was estimated after 1, 7, 14 and 21 days of manufacture by placing the sensor of the pH meter directly into the drinking yogurt sample. A total acidity (TTA) test was carried out according to Saady (2014), By taking 10 ml of the sample in a beaker and adding to it a few drops of phenol-phthalein indicator at a concentration of 1%, then it is titrated with sodium hydroxide at a concentration of (0.1 N) NaOH, until the appearance of the pink color. and the percentage of total acidity was calculated according to the following equation and estimated on the basis of lactic acid:

$$\textbf{Total acidity \%} = \frac{\text{Consumed volume of NaOH x 0.1 x 0.09}}{\textbf{\textit{sample weight}}} \text{ x } 100$$

Viscosity value:

The apparent viscosity of drinking yogurt samples was estimated at a constant temperature (4±1) °C after 1, 7, 14 and 21 days of refrigerated storage according to the method of Gursoy *et al*., (2016) . using a Brookfield DVII+ viscometer (Brookfield Engineering Lab Inc., Stoughton, Mass.).It used axial spindle(No. 2) with a number of cycles between 30-120 revolutions / min with a volume of (0.8 liters) of the sample in a 1 liter beaker where the sample was shaken well, Then the spindle was left to rotate inside the sample for 10 seconds. The reading was taken three times.

Microbiological examinations of drinking yogurt:

Microbiological were carried out to study the effect of adding aqueous extract of (mint and garlic) on preserving drinking yogurt and prolonging the shelf life of drinking yogurt samples from day 1, 7, 14 and up to 21days of cold storage at a temperature of (4 ± 1) ° C . 1 ml of the drinking yogurt sample was transferred to a test tube containing 9 ml of sterile peptone water to obtain a dilution of 10^1. Then the contents were mixed with the (Vortex electrophoresis) and then the necessary decimal dilutions were performed by transferring 1 ml of the first dilution to several test tubes containing 9 ml of sterile peptone water until the desired dilution was reached, 0.1 ml of the dilution was transferred to Petri dishes and then poured on to the appropriate media according to the required essay.

Estimation the total number of starter bacteria

M17 agar was used to estimate *Streptococcus salivarius subsp thermophilus* and De Man, Rogosa and Sharpe agar (MRS agar) was used to estimate *Lactobacillus delbrueckii ssp.bulgaricus* , then the dishes were incubated in anaerobic conditions at a temperature ranging between (42-45)°C for (48-72) hours.

Estimation the total number of coliform bacteria:

MacConkey agar medium was used to estimate total coliform bacteria by the pour plate method, then the dishes were incubated at 37°C for (24-48) hours (APHA, 1989).

Calculating of the numbers of Staphylococcus aureus bacteria:

Mannitol Salt Agar culture media was used to estimate the number of Staphylococcus aureus according to the method mentioned by Harrigan & McCance (1976), then the dishes were incubated at 37°C for 24 hours.

Calculating the numbers of yeasts and molds:

Potato dextrose agar was used to estimate the numbers of molds and yeasts. The dishes were incubated at 22 °C for five days (APHA, 1989), then the numbers of yeasts and molds were calculated using a colony counting microbiological device.

Sensory evaluation for drinking yogurt:

Sensory evaluation of drinking yogurt supplemented with mint and garlic extract was performed after 1, 7, 14 and 21 days of storage; the samples were presented in small cups (250 ml) and were evaluated by a number of specialized professors in the College of Food Sciences / Al-Qasim Green University.

The samples were evaluated in terms of flavor, texture, appearance and acidity, according to the sensory evaluation created by Mohammed *et al*.,(2019).

Statistical analysis:

The Statistical Analysis System -SAS (2012), was used when analyzing the data to study the effect of different factors on the studied traits according to the Complete Random Design (CRD), and the significant differences between the means were compared through the Least Significant Difference-LSD test.

Results and discussion:

Effect of adding some medicinal and aromatic plant extracts on the physicochemical and rheological properties of the drinking yogurt:

Studying the physicochemical and rheological properties of drinking yogurt after adding medicinal and aromatic plant extracts and for two treatments, is the SN that represents the addition of the aqueous extract of mint, and ST which represents the addition of aqueous extract of garlic .These extracts were added to milk with different concentrations(1%, 2.5% and 4%) mint, and (0.2%, 0.5% and 0.8%) garlic, and the properties of the resulting drinking yogurt were studied.

pH:

Table (1). show pH values of the drinking yogurt for SN and ST treatments, as the pH of the drinking yogurt samples ranged between (4.48 and 3.90),with different percentage of addition, and the type of extract. In general, Tamucay-Özünlü and Kocak,(2010) and Sanli *et al*.,(2011), indicated that the pH values of the yogurt beverage ranged between (4.52 and 3.96) on the first day of production.

The results in the Table (1). indicated that the pH value of the drinking yogurt after storage for one day at a temperature of (4±1) °C for the SN treatment was (4.45) for the control .This result is close to what was found by Srimali *et al*.,(2019), and this result is less than what was found by Ayar and Burucu (2013), where the found that pH was for control 4.59, the pH values of SN1, SN2 and SN3 treatments were 4.48, 4.46 and 4.47, respectively. The results of the statistical analysis of treatment N showed that there were no significant differences ($P<0.05$) between the pH values of the control and the samples to which mint extract was added, these results show that adding aqueous mint extract has no effect on the pH of the drinking yogurt compared to the control as it does not affect the starter bacteria. As the storage period progresses, we notice a gradual decrease in the pH values of all samples and the pH values of the control after 21 days reached 3.94, And for SN1, SN2 and SN3 treatments reached to 3.97, 3.96 and 3.98, respectively, the reason for this decrease is probably due

to the glycolysis of lactose and the persistence of the starter bacteria to produce lactic acid after the fermentation time and during cold storage until the temperature of the yogurt treatments reached (4 ± 1)° C (Bakry *et al*., 2019). These results agree with Azizkhani and Tooryan, (2016), where they indicated that the pH values of yogurt supplemented with mint oil, basil and thyme were not significantly different from the control treatment after one day of processing, and they indicated that the pH continued to gradually decrease after storage for 28 days for all treatments as a result of the continuation of the activity of the starter bacteria by converting the residues of lactose sugar into lactic acid.

Table (1). shows the results of pH values for different drinking yoghurt treatments, immediately after manufacturing and during storage at (5 ± 1) °C for 21 days.

SN Treatments	Shelf life of drinking yogurt (day)	pH	ST Treatments	Shelf life of drinking yogurt (day)	pH
S	1 day	4.45	S	1 day	4.39
	7 day	4.24		7 day	4.29
	14 day	4.11		14 day	4.12
	21 day	3.94		21 day	3.93
SN1	1 day	4.48	ST1	1 day	4.37
	7 day	4.29		7 day	4.28
	14 day	4.17		14 day	4.10
	21 day	3.97		21 day	3.92
SN2	1 day	4.46	ST2	1 day	4.35
	7 day	4.28		7 day	4.26
	14 day	4.15		14 day	4.09
	21 day	3.96		21 day	3.90
SN3	1 day	4.47	ST3	1 day	4.34
	7 day	4.25		7 day	4.27
	14 day	4.16		14 day	4.11
	21 day	3.98		21 day	3.90
LSD	---	0.403 NS	LSD	---	0.416 NS

- **S: control , SN1 : 1% Mint , SN2 : 2.5 % Mint , SN3: 4% Mint , ST1 : 0.2% Garlic , ST2 : 0.5 % Garlic , ST3: 0.8% Garlic .**

The results in the Table (1). shows the pH values of drinking yogurt immediately after manufacturing for ST treatment. The value of the control was 4.39, and this result is close to what was found by Yilmaz *et al*., (2014) where the indicated that pH values for control was 4.38 , as for the pH values of ST1, ST2 and ST3 treatments they were 4.37, 4.35 and 4.34, respectively. The results of the statistical analysis of T treatment showed that there were no significant differences ($P<0.05$) between the pH values of the control and the treatments to which aqueous garlic extract was added. Where we note that the addition of garlic extract to drinking yogurt has no effect on the pH compared to the control as it did not affect the activity of the starter bacteria and this is consistent with Sanchez-

Vega, (2013). Also, these results do not agree with Gündoğdu *et al*, (2009), where the indicated that there were significant differences (P<0.05) between the pH values of the stirred yogurt compared to the control , and they noted that the higher the amount of garlic added, the pH decreased. As for storage for 21 days, it is noted that the pH values of all treatments gradually decreased with the progression of the storage period, as the pH values of the control reached 3.93, and for T1, T2 and T3 treatments were 3.92, 3.90 and 3.90, respectively. This is due to the biochemical changes that occur in the milk and the continuation of the activity of the starter bacteria by converting the lactose sugar and producing lactic acid and the lack of effect of garlic, this is consistent with Oladipo *et al*., (2014).

Total Acidity:

Fig.(1),(2). show the total acidity values for the SN and ST treatments after storage for 21 days at (4±1)° C. Fig. (1). A shows the values of the total acidity of the drinking yogurt for the SN treatment, as the values of the total acidity after storage for one day at (4±1)° C for the control was 0.63%, this result less than what was found by Colakoglu and Gursoy, (2011), amounting to 0.72%, while the total acidity values for SN1, SN2 and SN3 treatments were 0.59, 0.60 and 0.62, respectively. The results of the statistical analysis of treatment SN showed that there were no significant differences (P<0.05) between the values of the total acidity of the control and the treatments to which mint extract was added during the storage period, as a result of the lack of effect of adding mint on the total acidity of the drinking yogurt, and this is due to its lack of effect on the activity of the starter bacteria responsible for Lactic acid production (Amirdivani and Hj Baba, 2011). After storing for 21 days, it was noticed that the values of the total acidity increased, which was 0.73% for the control ,and for SN1, SN2 and SN3 treatments they were 0.72, 0.74 and 0.75%, respectively. These results are consistents with Thabet *et al*.,(2014) , where they indicated that the total acidity values of the labneh supplemented with oil of mint, cinnamon and cumin after storage , as a result of the increase in the activity of the starter bacteria and their continuation in producing lactic acid, and the lack of influence of the oils of mint, cinnamon and cumin on the starter bacteria.

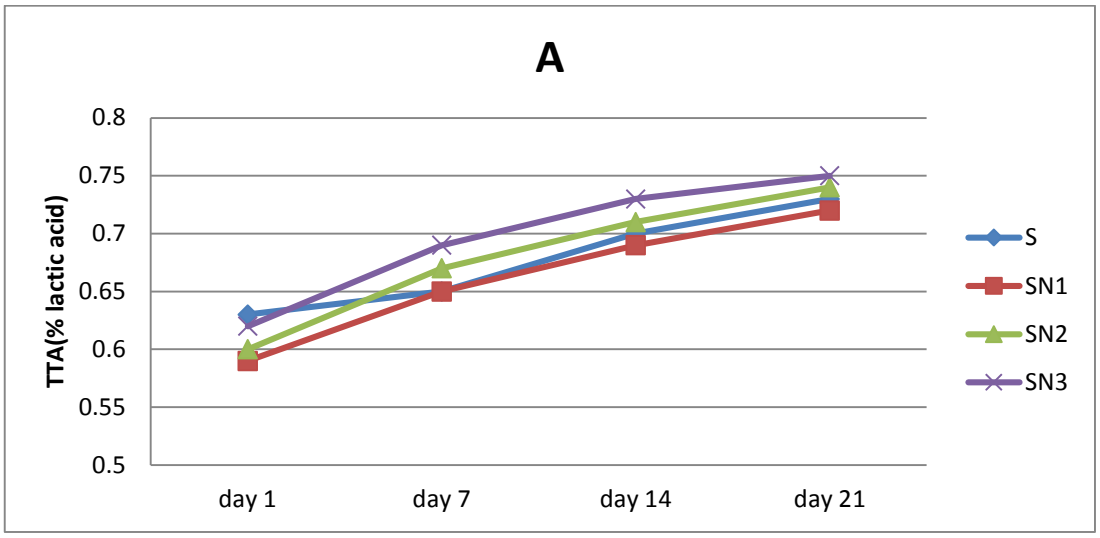

Fig 1: TTA values of yogurt prepared with different concentrations of aqueous mint extract (SN) and stored for 21 days at (4±1) °C. Where, S: control , SN1 : 1% Mint , SN2 : 2.5 % Mint , SN3: 4% Mint.

Fig.(2). shows that the values of the acidity values of drinking yogurt for the ST treatment immediately after manufacturing where were 0.60% for the control , and this result is close to Yilmaz *et al*., (2014) where the found that acidity for control was 0.58%. while the total acidity values for ST1, ST2 and ST3 treatments where were 0.59, 0.61 and 0.63%, respectively. The results of the statistical analysis of the ST treatment showed that there were no significant differences ($P<0.05$) between the values of the total acidity of the control and the treatments to which aqueous garlic extract was added. After storing at (4±1) °C for 21 days, we notice a continuation of the increase in the values of the total acidity, which was (0.70)% for control , and for ST1, ST2 and ST3 treatments they were 0.72, 0.74 and 0.75%, respectively. These results are consistent with Gündoğdu *et al*. (2009), where they mentioned that there were no significant differences in the acidity of set and stirred yogurt between control and treatments supplemented with garlic at the rate of 1% and 0.5 % after manufacture and throughout the storage period. Also, these results do not agree with Dinpajhooh *et al*.,(2019), where they mentioned the presence of significant differences in the acidity of the doogh (Iranian fermented drink) between the control and the treatments to which garlic and dill were added after processing, They also indicated that the acidity increased after 48 days of storage as a result of the accumulation of lactic acid produced by the starter bacteria. They noticed that increasing the amount of garlic and dill extracts in the doogh yogurt drink formula leads to a decrease in acidity and an increase in the storage period. This is consistent with the study of Degirmenci *et al*., (2021) who added purslane and hot pepper to the yogurt drink ayran.

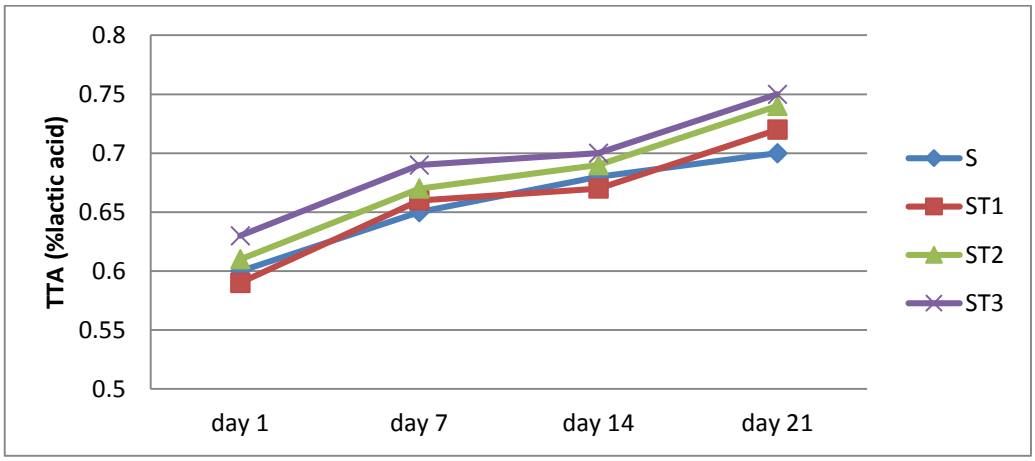

Fig 2: TTA values of yogurt prepared with different concentrations of aqueous garlic extract (ST) and stored for 21 days at (4±1) °C. Where, S: control , ST1 : 0.2% Garlic , ST2 : 0.5 % Garlic , ST3: 0.8% Garlic .

Viscosity Value:

The viscosity of dairy products, such as a drinking yogurt, is one of the most important quality criteria. The viscosity of fermented milk is directly related to the physical interactions of proteins with each other and the retention of fat and whey globules in the protein complex (Mohammed *et al*.,2019). Fig.(3). shows the viscosity values of the drinking yogurt immediately after manufacturing for treatment SN where were for the control 200 centipoise, and this result is close to Saady, (2014) where were for control 199.63 centipoise. while the viscosity values for SN1, SN2 and SN3 treatments were 220, 213, and 190 centipoise respectively. We note that the addition of aqueous mint extract to treatments SN1 and SN2 improved the viscosity property, and its values were higher than those of the control . The reason for this may be due to the presence of some compounds that have the ability to interact with milk proteins such as polyphenols (Ozdal *et al*., 2013), As for the high concentration, which it had a negative effect as the SN3 treatment led to a decrease in the viscosity values compared to the control . This may be due to the presence of some compounds in high concentrations of mint extract that lead to the instability of the protein structure, and then the formation of a weak gel network. These results may be in line with the conclusion reached by Akkoyun and Arslan, (2020), they pointed out that adding quinoa flour to the yogurt drink ayran negatively affects its viscosity, he pointed out that high concentrations of quinoa flour lead to a decrease in viscosity and stated that the reason for this may be due to the accumulation of part of the casein; because adding quinoa flour may cause damage to the structure of gel proteins and reduce the bonding between molecules. After storage for 21 days, we notice an increase in the viscosity values for all treatments. The control was 245 centipoise, and the SN1, SN2 and SN3 treatments were 251, 247 and 239 centipoise, respectively. This is consistent with Mohammed *et al*.,(2019) who indicated that the viscosity of the drinking yogurt treatment increased from (152± 6.08) centipoise

immediately after processing to (193 ± 2.88) centipoise during storage for 12 days, the reason for this may be due to the low pH of less than 4.6, and this agrees with Akbulut Çakır and Bozkurt (2020), who studied the effect of pH on the viscosity of a drinking yogurt , they found that the drinking yogurt treatments at pH 4.2 and 4.4 had a higher viscosity than the other treatments at 4.6 during storage for 20 days, they pointed out that the viscosity values of the drinking yogurt increase as the pH decreases. The results of the statistical analysis showed that there were significant differences ($P < 0.05$) in the viscosity values after 21 days of storage between the control and SN1, SN2 and SN3 treatments to which mint extract was added.

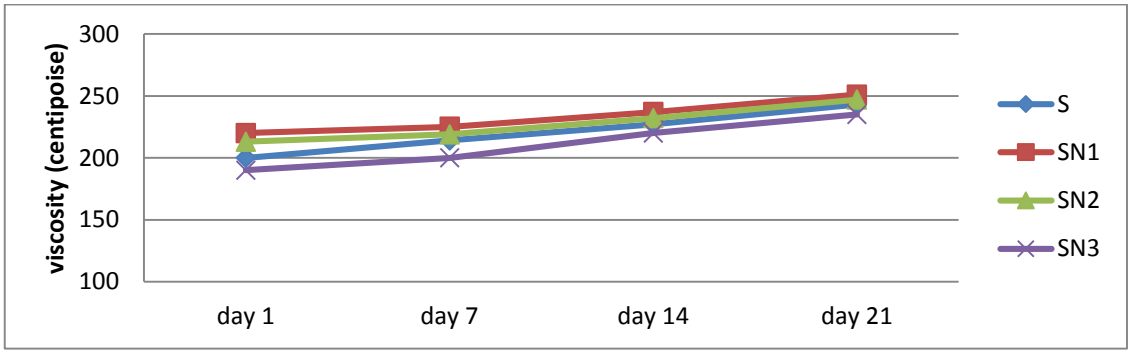

Fig 3: Viscosity values of yogurt prepared with different concentrations of aqueous mint extract (SN) and stored for 21 days at (4±1) °C. Where, S: control , SN1 : 1% Mint , SN2 : 2.5 % Mint , SN3: 4% Mint.

Fig. (4). shows the viscosity values of the drinking yogurt immediately after manufacturing for the ST treatment, as the control was 173 centipoise, and this result is close to what was found by Gursoy *et al*.,(2016) for the control of 174 centipoise and higher than Mohammed *et al*., (2019) where were the found the viscosity for control was 152± 6.08 centipoise, as for the viscosity values for ST1, ST2 and ST3 treatments, they were 178, 182 and 170 centipoise, respectively. The above results show that the ST1 and ST2 treatments improved the viscosity, these results are consistent with Sanchez-Vega (2013), which indicated that adding garlic juice to the yogurt improved the viscosity compared to the control during the storage period of 35 days, while the viscosity values decreased in the ST3 treatment compared to the control .This may be due to changes in the interactions of protein with the exogenous polysaccharides (EPS) during the fermentation process of yogurt and yogurt drink, which depends on the final EPS structure, production levels as well as the chemical composition of the final product, which can be affected by the type of starter bacteria, incubation temperature and time. But after 21 days of storage, We note a rise in the viscosity values for all treatments, the control was 240 centipoise, and for ST1, ST2 and ST3 treatments, they were 246, 250 and 237 centipoise, respectively. This increase in viscosity could be due to the stability of the structure of casein particles and the increase of intra-casein binding during storage (Ziena and Nasser, 2019), the reason for this may also be due to the activity of the starter bacteria and the production of exogenous polysaccharides that

interfere with the protein content of milk, raise its viscosity and improve its quality characteristics (Yilmaz *et al*., 2014). We note from the statistical analysis that there are significant differences ($P < 0.05$) in the viscosity values between the control , and the ST1, ST2 and ST3 treatments, immediately after manufacturing and during storage for 21 days.

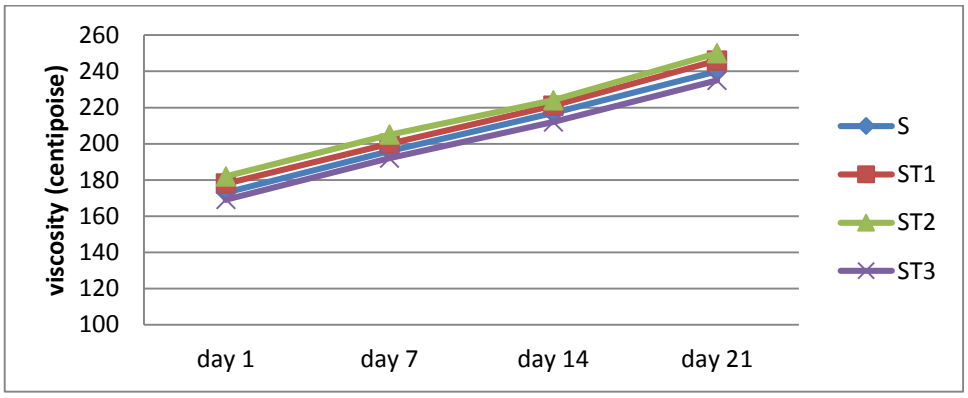

Fig 4: Viscosity values of yogurt prepared with different concentrations of aqueous garlic extract (ST) and stored for 21 days at (4±1) °C. Where, S: control , ST1 : 0.2% Garlic , ST2 : 0.5 % Garlic , ST3: 0.8% Garlic .

Microbiological Tests Of Drinking Yogurt:

Through the results shown in table (2). for the drinking yogurt treatments, the total microorganisms were estimated to investigate the microbiological quality for the product by counting the starter culture bacteria, coliform bacteria , Staphylococcus aureus bacteria, as well as yeasts and molds immediately after manufacturing and during storage at a temperature of (4 ± 1) °C for a period of 21 days. The results of microbiological tests in Table (2).showed that there were significant differences in numbers of the starter culture bacteria immediately after manufacturing and for all treatments. Its values for the drinking yogurt manufactured for SN treatments (S , SN, SN2, SN3), were 59×10^6, 56×10^6, 58×10^6 and 61×10^6 CFU/ml and for ST treatments (S ,ST1, ST2, ST3) , were 57×10^6, 55×10^6, 59×10^6 and 61×10^6 CFU/ml, respectively . As for during storage for 21 days , a gradual decrease in the numbers starter bacteria was observed for all treatments, where values for the SN treatments (S, SN1, SN2 ,SN3), were 7.3×10^5, 7.5×10^5, 7.8×10^5 and 7.9×10^5 CFU/ml, while for ST treatments (S , ST1, ST2, ST3), were 5.1×10^5, 5.0×10^5, 5.3×10^5 CFU/ml, respectively. The reason for this decrease is most likely due to the development of acidity during storage. We found that the number of bacteria increases with the increase in the concentration of plant extracts, the reason may be attributed to the phenolic compounds found in herbal extracts that play a stimulating role and promote the growth of yogurt starter bacteria (Oh *et al*., 2016) and probiotic bacteria (Marhamatizadeh *et al*., (2013). and this indicates that the addition of these extracts improves the proteolytic activity of the starter bacteria in the yoghurt drink as it does not affect this bacteria. And we note from the results that the numbers of starter bacteria in all the treatments increased until the

second week and after that it began to decline significantly, This is consistent with Akbari-Adergani *et al*.,(2020); they studied the vitality of the probiotic bacteria *Lactobacilus Acidophilus* and *Bifidobacterium* in doogh yogurt drink during storage period. They noticed a significant difference between the number of bacteria in the second and third week, as the number of bacteria increased until the second week and after that began to decline significantly. In addition, The low pH and high acidity of the fermented products are among the most important factors affecting the viability of the starter bacteria (Ahmadi *et al*., 2013). As for the numbers of coliform bacteria and Staphylococcus aureus bacteria, we note from Table (2). the results were close for all treatments where no numbers appeared indicating contamination immediately after manufacturing and during storage for a period of 21 days for all samples. This may be due to the high pasteurization temperature, good manufacturing conditions, and good production. This is consistent with Hatamikia *et al*.,(2016) who did not observe any growth of coliform bacteria and Staphylococcus aureus bacteria in all samples of doogh yogurt drink, they pointed out that the reason for this is due to good manufacturing and production conditions, and adherence to the necessary health conditions. As we notice from Table (2). the total number of yeasts and molds in relation to the SN treatment were mostly absent during in the first days, this is consistent with the findings of Srimali *et al*.,(2019) who did not notice any growth of yeasts and molds in the drinking yogurt until after a week of storage. The numbers of yeasts and molds at the end of the storage period for the control were 6 CFU/g, while the N1, N2, and N3 treatments, were 4, 3 and 3 CFU/g , respectively. these numbers are within the permissible limits in the standard specification set by Codex for milk fermented during storage for a period of 21 days (Codex, 2010).We note from the results that the numbers of yeasts and molds were lower in the treatments containing mint extract compared to the control, and this is consistent with Bakry *et al*., (2019). As for yeasts and molds for ST treatment, There no numbers appeared indicating contamination during the early days, and this is consistent with the findings of Sawant *et al*., (2015) who did not notice any growth of yeasts and molds in the drinking yogurt until after a week of storage. The numbers of yeasts and molds at the end of the storage period for the control were 7 CFU/ml and for the T1 sample was 5 CFU/ml, It should be noted that these numbers are within the limits allowed in the specifications set by the Codex Alimentarius Commission for fermented milk (Codex, 2010). As for samples T2 and T3, no presence of yeasts and molds was recorded. This is consistent with Dinpajhooh *et al*., (2019), who indicated that the treatments of doogh supplemented with garlic and dill extract did not show any growth of yeasts and molds during the storage period of 42 days compared to the control .

Table (2). shows the results of microbiological tests for different drinking yoghurt treatments, immediately after manufacturing and during storage at (5 ± 1) °C for 21 days.

SN Treatments	Shelf life of drinking yogurt (day)	yeasts and molds (CFU /ml)	starter bacteria (CFU /ml)	E.Coli (CFU /ml	ST Treatments	Shelf life of drinking yogurt (day)	yeasts and molds (CFU /ml)	starter bacteria (CFU /ml)	E.Coli (CFU /ml
S	1 day	0	59 ×10^6	-	S	1 day	0	57 ×10^6	-
	7 day	2	67 ×10^6	-		7 day	3	69 ×10^6	-
	14 day	3	19 ×10^6	-		14 day	4	25 ×10^6	-
	21 day	6	7.3 ×10^5	-		21 day	7	4.8 ×10^5	-
SN1	1 day	0	56 ×10^6	-	ST1	1 day	0	55 ×10^6	-
	7 day	0	65 ×10^6	-		7 day	0	68 ×10^6	-
	14 day	2	18 ×10^6	-		14 day	0	27 ×10^6	-
	21 day	4	7.5 ×10^5	-		21 day	5	5.1 ×10^5	-
SN2	1 day	0	58 ×10^6	-	ST2	1 day	0	59 ×10^6	-
	7 day	0	69 ×10^6	-		7 day	0	70 ×10^6	-
	14 day	2	21 ×10^6	-		14 day	0	29 ×10^6	-
	21 day	3	7.8 ×10^5	-		21 day	0	5.0 ×10^5	-
SN3	1 day	0	61 ×10^6	-	ST3	1 day	0	61 ×10^6	-
	7 day	0	72 ×10^6	-		7 day	0	72 ×10^6	-
	14 day	0	23 ×10^6	-		14 day	0	28 ×10^6	-
	21 day	3	7.9 ×10^5	-		21 day	0	5.3 ×10^5	-
LSD	---	NS	31.84 *	NS	LSD	---	6.035 *	37.92 *	NS

•Reading is an average of three repetitions.

Sensory Evaluation Of Drinking Yogurt:

the results of sensory evaluation of the drinking yogurt treatments prepared by adding different concentrations of aqueous extract of the (garlic and mint) showed a difference in taste, flavor, texture, and the total acceptance degree of each of the control and the drinking yogurt treatments to which plant extracts are added for immediately after manufacturing and during storage at (4 ± 1) °C for 14 days. Table (3). shows the total sensory evaluation scores of the drinking yogurt immediately after manufacturing for the SN treatment, as the control was 91.52 and for the SN1, SN2 and SN3 treatments were 93.22, 92.88 and 92.66, respectively. As for the sensory evaluation scores given to the treatments after storage for 14 days at (4 ± 1)°C, it was 85.20 for the control , and for SN1, SN2 and SN3 treatments they were 89.36, 91.55 and 87.50, respectively. Of the evaluation scores above, SN1 and SN2 treatments obtained the highest evaluation scores of 89.36 and 91.55, respectively, followed by SN3 treatment and control.

Table (3). shows the Sensory evaluation of the drinking yogurt supplemented with aqueous mint extract immediately after manufacturing and during storage at (4 ± 1) °C for 21 days

Treatment	Storage period (day)	flavor 45˚	Texture 35˚	Acidity 10˚	Appearance 10˚	Total 100˚
S	0 day	41.43	32.09	9	9	91.52
	5 day	40.30	31.79	9	9	90.09
	9 day	40.0	31.5	9	9	89.50
	14 day	39.2	30.0	8	8	85.20
SN1	0 day	42.52	33.7	8	9	93.22
	5 day	41.6	32.67	9	9	92.27
	9 day	41.10	31.94	9	9	91.04
	14 day	40.5	30.86	9	9	89.36
SN2	0 day	43.10	32.78	8	9	92.88
	5 day	42.00	32.4	9	9	92.40
	9 day	41.70	32.15	9	9	91.85
	14 day	40.45	31.1	10	10	91.55
SN3	0 day	42.00	32.66	8	10	92.66
	5 day	41.73	31.5	9	9	91.23
	9 day	41.00	30.42	9	9	89.42
	14 day	39.5	30.0	10	8	87.50
LSD	---	3.02 *	2.23 *	1.72 *	1.74 *	5.45 *
*(P≤0.05).						

S: control , SN1 : 1% Mint , SN2 : 2.5% Mint , SN3: 4% Mint .

As the lower concentrations got higher scores compared to the control .This is consistent with Tomar, (2020), who stated that adding low concentrations of mint and hibiscus improved the sensory properties of yogurt compared to high concentrations. He pointed out that adding plant extracts such as mint and hibiscus positively affected the sensory and functional properties of yogurt, the plant extracts increased the antioxidant activity of yogurt. Table (4). shows the total sensory evaluation scores of the drinking yogurt immediately after manufacturing for the ST treatment, as the control was 93.70, and for ST1, ST2 and ST3 treatments supplemented with aqueous garlic extract they were 96.75, 93.7, and 92.4, respectively. As for the sensory evaluation scores granted to the treatments during storage for 14 days at (4 ±1) °C, for control was 86.10 and for ST1, ST2 and ST3 treatments, were 89.80, 89.00 and 85.7, respectively. Of the evaluation scores above, the ST1 treatment got the highest evaluation scores of 89.23, followed by the of ST2 treatment and the control .The lower concentrations obtained higher scores compared to the control .This is consistent with Dinpajhooh *et al*., (2019), which indicated the superiority of sensory evaluation scores for doogh supplemented with garlic extract compared to the control .

Table (4). shows the Sensory evaluation of the drinking yogurt supplemented with aqueous garlic extract immediately after manufacturing and during storage at (4 ± 1) °C for 21 days

Treatment	Storage period (day)	flavor 45˚	Texture 35˚	Acidity 10˚	Appearance 10˚	Total 100˚
S	0 day	41.7	32.00	10	10	93.70
	5 day	41.3	31.8	9	10	92.10
	9 day	40.9	31.4	9	9	90.30
	14 day	39.6	30.5	8	8	86.10
ST1	0 day	42.9	33.85	10	10	96.75
	5 day	42.0	32.4	10	10	94.4
	9 day	41.9	31.7	9	9	91.60
	14 day	40.7	31.1	9	9	89.80
ST2	0 day	41.9	32.8	9	10	93.7
	5 day	41.5	32.0	9	9	91.50
	9 day	40.6	31.2	9	9	89.80
	14 day	40.0	31.0	9	9	89.00
ST3	0 day	40.0	32.4	10	10	92.4
	5 day	39.5	31.6	9	10	90.1
	9 day	38.9	31.0	9	9	87.9
	14 day	37.6	30.1	9	9	85.7
LSD	---	2.97 *	1.961 *	1.73 *	1.68 *	5.51 *
*(P≤0.05).						

S: control , ST1 : 0.2% garlic , ST2 : 0.5% garlic , ST3: 0.8% garlic .

Conclusion

The possibility of manufacturing a drinking yogurt supplemented with certain concentrations of mint and garlic extracts without changing the composition compared to the control treatments. Whereas, the process of adding these extracts to drinking yoghurt and it did not have a significant differences in the values of pH and acidity compared with the control . Treatments of a drinking yoghurt containing aqueous extracts showed high activity against pathogenic microorganisms compared to the control group. The panellists recorded the highest scores for flavor, aroma and overall acceptability to the drinking yoghurt containing (mint and garlic) aqueous extracts . Therefore, it can be concluded that aqueous extracts can be used in manufacturing a drinking yoghurt with good antioxidant properties, Antimicrobial properties, and sensory attributes during the storage.

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