Using Ginger Extract to Prolong the Shelf Life of Soft Cheese

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Abstract
Ginger is considered to have a high nutritional value, in addition to containing many beneficial nutrients and having multiple important biological applications, especially its effective role in treating many diseases, including infections, antioxidants, bacteria, and others. For this reason, the current research was conducted and aimed to fortify the milk prepared for making cheese with high concentrations. Different types of aqueous extract of ginger in order to raise its level in the manufactured product. The study included the following: - Production of cheese from whole milk fortified with two concentrations of the aqueous extract: 3% and 6% of milk, in addition to a control experiment in which cheese was made from whole milk without adding the aqueous extract. The cheese treatments fortified with the aqueous extract maintained a moisture content similar to the moisture content of the control treatment immediately after manufacturing. When monitoring the humidity values when stored at a temperature of (5±1) °C for a period of 15 days, it was noted that there was a slight decrease in their values for all treatments. The percentage of total acidity was also similar for all cheese treatments immediately after manufacturing. When stored, a clear increase in their values was observed for all transactions. The pH values of the cheese produced were similar for all treatments immediately after manufacturing, but during storage, a clear, slight decrease in its values was observed. The aqueous extract added to the cheese improved the test values, which included testing protein, fat, and moisture, compared to control cheese. The results of the sensory evaluation indicated the superiority of the cheese treatments fortified with aqueous extract, especially the T2 treatment with a concentration of 3%, as it obtained the highest scores and excelled in all sensory attributes compared to the control treatment C.

Keywords: Ginger extract, Probiotics, Soft cheese, Shelf life(

Introduction

Medicinal plants still play important roles in the daily lives of developing countries, as they are an important source of many medicinal drugs and medicinal preparations and serve as supplements to modern medical treatments that often enhance human health. The medical benefit lies in their ability to produce chemical compounds with pharmaceutical properties

that are used as active substances. Primary or as auxiliary agents in the manufacture of drugs. In past years, plants were used for therapeutic purposes and were used on the basis of experience or previous experience. However, at the present time, when the components with effective medicinal components of each plant are carefully identified, diagnosed, isolated, and their effectiveness and effects are evaluated. Then scientific rules have been developed for their use. For the purpose of treatment [1.[

Ginger (Zingiber officinale Rose) is a perennial aromatic herbaceous plant from the Zingiberaceae family. It reaches a height of 90 cm. The roots are a storehouse of food with a pungent taste and grow horizontally. They have thick aromatic lobes that are pale yellow in color. They are thick, from which lateral shoots branch out that look like the fingers of a hand and have pulp. It is white or yellow in color [2.[

The plant has long, filamentous or rectangular leaves with lance-shaped bases, with a smooth texture and pale green color, reaching a length of between (10 - 20) cm and a width of between (3 - 8) cm. The stem is upright and slanting, growing from the base of the ground rhizomes, appearing in the form of a group of aerial stems reaching the height of the stem's ranges between 50 - 90 cm, while the ginger flowers are small and yellowish-green in color, mixed with a layer of violet [5.[

subtropical and tropical conditions. The The inflorescences are single and pointed, the calyx is located at the top and the corolla consists of three equal leaves. Ginger cultivation flourishes on the western coast of India, and ginger flowers bloom in the middle of the month of February and at the beginning of the month.

March when winds are moderate [6]. It is preferable to grow ginger in humid tropical areas and in ideal, fragile soil rich in humus, such as sandy clay soil or red clay soil that is susceptible to friability, with a pH between (6.0 - 6.5), and

The appropriate temperature for ginger production ranges between (19-28°C) and humidity ranges between (70-90.% (

Ginger reaches maturity between 210 and 240 days after planting [7.[

Ginger consists of many secondary metabolic compounds that depend on the origin and physical condition of the plant. The presence of chemical compounds in fresh ginger differs significantly from that in dry ginger [3]. There are many active components in ginger that include terpenes and the resinous substance oleoresin, which reaches a percentage of (4 - 10%) and is characterized by a pungent taste. The essential oils, which consist mainly of terpenes, are either volatile oil with a ratio of of 1–3% or non-volatile oils [4.[

There are two main types of secondary metabolic compounds characterized as ideal products: terpenes, such as sesquiterpene hydrocarbons, and phenolic compounds, which mainly include gingerol and shogaol, as well as other compounds represented by flavonoids, proteins, carbohydrates, glycosides, alkaloids, saponins, steroids, and tannins. [8.[

Most of the therapeutic microorganisms belong to the group of lactic acid bacteria (LAB), such as Lactobacillus sp., Bifidobacterium sp., Enterococcus sp. [9] in addition to Saccharomyces boulardii [10].

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Bifidobacterium species have received great attention through many studies for their various therapeutic abilities, which has led to hopes of helping and treating many diseases, especially since the dominant organisms in the digestive tract of children who depend on breast milk constitute 95% of the natural flora, and the dominance of these bacteria is due to (Selective agent) in the meconium (a sterile fluid found in the digestive tract of newborns), the mother's colostrum (the first milk after birth), and breast milk. These selective factors are known as bifidus growth factors.

Research has focused on cheeses carrying microorganisms, and in 1994 in Denmark it was proposed to include Bifi. bifidum in hard cheese in addition to the starter culture (hard cheese was chosen because it provides a suitable environment for preserving therapeutic bacteria and keeping them in high and appropriate numbers). After six months of ripening, their numbers were about 2 x 107 t/g. [11.[

[12] When manufacturing a curative cheese similar to curd, the cream was inoculated with Bifidobacterium infantis bacteria at numbers of 8 x 106 cfu/g, and the therapeutic bacteria showed good viability during the storage period of 12 weeks, and their numbers became 3 x 106 cfu/g. [13] pointed out the effectiveness of the therapeutic isolate Lactobacillus paracasei in maintaining high vitality and in numbers that make it within the therapeutic effect. The bacterial numbers of the Enterococcus faecium isolate remained high and reached 4×108 cfu/g when manufacturing therapeutic hard cheese, while the Lb isolate failed. salivarius to survive during the ripening period of 15 months at a temperature of 8°C.

There is a possibility that cheese is a good carrier of some types of therapeutic bacteria that promote health. This is certainly a great advantage for carrier cheese and its preference over cheese and fermented milk. He pointed out that his study and other studies led to the development of therapeutic cheeses containing therapeutic isolates such as Lactobacilli, Bifidobacteria and Enterococci. [14.[

produced semi-dry therapeutic cheese using the therapeutic isolate Lactobacillus gasseri k7 and L. gasseri LF221 (it was not used alone as a starter culture for cheese production because it grows slowly in milk) with the starter culture Streptococcus thermophilus TH-4, where it was inoculated with the milk was 107 cfu/ml for both isolates, and after 6 weeks of ripening, the number of therapeutic bacteria for the cheese was still 108 cfu/g. [15.[

demonstrated the therapeutic potential of L. acidophilus LA-5 and Bifi. bifidium BB-02, added to white cheese pickled in brine, maintains a concentration of 106 t/g, which makes it within the therapeutic effect after 90 days of ripening, as the cheese was inoculated at a rate of 2.5 and 5% corresponding volume/weight (1.3-1.0) x 109 cfu/g and (2.1 - 2.0) x 109 cfu/g for each [16.[

VFF indicated that a number of countries have launched new products with therapeutic bacteria LGG, including cheese products of various types. [17] indicated the production of fresh cheese containing therapeutic bacteria LGG (Lactobacillus rhamnosus GG) found in Croatia. Fresh cheese containing therapeutic bacteria LGG, natural vitamins and a variety of fruits was produced in Switzerland. [17] indicated the production of low-fat cheese containing the therapeutic bacteria LGG in Belgium.

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The current study aims to find the best formula for a therapeutic cheese that includes adding concentrations of ginger to achieve multiple benefits, including nutritional ones by enriching the cheese with some concentrations of ginger that may be present in it, and another therapeutic formula using certain types of therapeutic lactic acid bacteria. To increase the shelf life of these cheeses and the extent to which the Iraqi consumer accepts them.

Material and Methods

Lactobacillus acidophilus

I used the Lactobacillus acidophilus obtained from the laboratories of Al-Amin Center / Ataba Al-Alawia.

It was activated as follows:

.1A portion of the obtained bacterial culture was transferred to MRS broth and incubated at a temperature of 37°C for 24 hours. This step was repeated two additional times for the purpose of activation.

.2Inoculate the reconstituted sorted milk (12% weight/volume), sterilized with an autoclave, with 10% of the activated culture and incubate it at a temperature of 37°C until coagulation. The previous process was repeated three times in a row for the purpose of activation. [16.[

Manufacture of therapeutic cheese

Milk used in manufacturing

Use full-fat powdered milk (Modhesh), which was obtained from local markets, and the proportions of ingredients for this milk are as mentioned: (approximate analysis per 100 grams), fat 28%, protein 26%, lactose 37%, minerals 6%. Humidity 3%, Vitamin A 3000-2000 IU, Vitamin D 400-300 IU(international unit.(

Preparation of aqueous extract of ginger

The aqueous extract was prepared by taking 50 grams of ginger in a liter of water, then filtering with filter paper. The resulting concentration was 100%, from which the final concentrations were made.

Preparing milk for manufacturing

-1Use recovered whole milk powder at a ratio of 12% w/v in distilled water .

-2Distribute it in tightly sealed sterile glass bottles in an amount of 75 cm3 / bottle .

-3Sterilize the milk using a freezer (121°C for 5 minutes) and cool it to the appropriate temperature.

-4Add the activated initiator at a rate of 2.5% after conducting a microscopic examination to confirm the numbers of initiator bacteria. [15.[

Where the transactions were as follows

-1Control sample: cheese rennet

-2T1: Adding cheese rennet + ginger 3%

-3T2: Adding cheese rennet + probiotic bacteria + ginger 3%

-4T3: Adding cheese rennet + ginger 6%

-5T4: Adding cheese rennet + probiotic bacteria + ginger 6%

Working methods for cheese testing [15.[

Chemical tests for cheese

Estimation of the percentage of moisture. Moisture was estimated according to the method of [18] by weighing 2 grams of cheese that was dried in an electric oven at a temperature of 105°C until the weight stabilized.

Estimation of the percentage of fat Fat % The percentage of fat in milk was estimated by the Soxhlet method, according to what was mentioned by [18.[

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Estimation of pH. The pH was estimated using a Chinese-origin pH meter Crison with an accuracy of up to ±0.05 units directly into the milk after mixing it well. [19.[

Estimating the acidity percentage. The acidity was estimated according to the method mentioned in [19] by withdrawing 9 milliliters of milk and placing it in a flask, adding a few drops of phenophthalein reagent to it, then scouring with 0.1 metric of sodium hydroxide solution (NaOH .(

Estimation of total nitrogen

Total nitrogen was estimated according to what was stated in [19] by weighing 2 grams of cheese sample and transferring it to the digestion bottle of the microcalcium device, to which 25 milliliters of concentrated sulfuric acid H2SO4 was added, with the addition of the digestion powder consisting of hydrated copper sulphate CuSO4 5H2O with a substance that raises the boiling temperature. Potassium sulfate K2SO4 and hydrogen peroxide (H2O2% 30) are often used. During the digestion process, all proteins and organic materials are oxidized and ammonia is released, which in turn is combined with concentrated sulfuric acid.

Then ammonia is liberated from the ammonium sulfate formed by making the reaction medium basic and receiving the liberated ammonia in a container containing boric acid. The solution is then purified with 0.1 M hydrochloric acid in the presence of Tashiro's reagent consisting of 0.2 g of methyl red and 0.1 g of methyl blue dissolved together in 100 cm3. Of ethyl alcohol with a concentration of 96%, the digestion and distillation process were completed using a Behr analysis system, model S2, of German origin.

%protein = % N × 6.38

Sensory evaluation of products

The sensory evaluation of the products was conducted according to what was stated in the form provided by [20], and they were evaluated by specialists, including professors in the Department of Food Science, as well as by consumers.

Results and Discussion

Chemical composition and physical properties of cheese fortified with ginger

Chemical composition of soft cheese

Humidity percentage

The results shown in Figure (4-1) indicate that the average moisture content in the control cheese according to the treatments T1, T2, T3, and T4 is 59.52%, 59.00%, 58.7%, 58.65, and 57.00, respectively.

These results are consistent with what [5], found that the moisture percentage of the soft cheese produced is 56.45% and within the acceptable limits of the Iraqi Standard Specification (2000) No. (3725)/5, which indicates that the moisture percentage in soft cheeses should not be less than 50%.

The same table showed that adding ginger led to a slight decrease in the average moisture content of the resulting cheeses compared to the control treatment. This result is consistent with what was stated by [21] that the average moisture content of the soft cheese reached 59.50%, while for the control treatment it was (57.20-59.0) % after a day of storage when adding the starter

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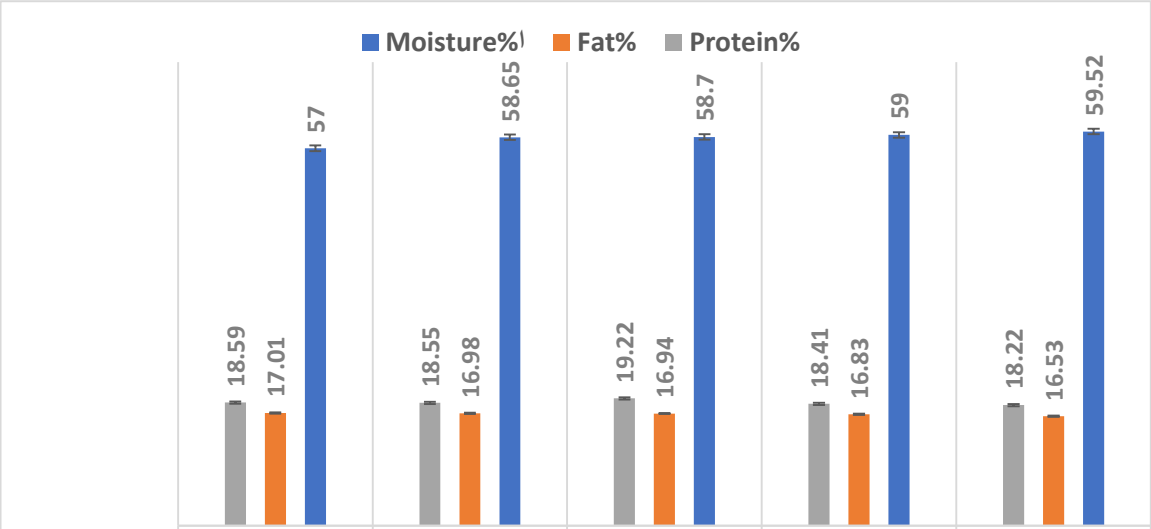

	T4	T3	T2	T1	Control
Moisture%	57	58.65	58.7	59	59.52
Fat%	17.01	16.98	16.94	16.83	16.53
Protein%	18.59	18.55	19.22	18.41	18.22

Fig (4-1) Chemical composition of soft cheese before and after adding ginger and its treatments at one day

Fat percentage

Figure (4-1) shows the average fat percentages in the cheese samples under study (control and treatment percentages T1, T2, T3, and T4) after one day of storage were (16.53, 16.83, 16.94, 17,00, and 16.98) %, respectively. It is noted that the treatments to which the primer was added gave slightly higher percentages compared to the control treatment.

This result is lower than what was stated by [22], which is 19.5%, and [5], as it was 23.24% for the control sample and 23.05% for the addition sample. The reason for the increase in the average fat percentage may be due to the effect of humidity, and this was confirmed by [23] that the differences in the average fat percentage are due to the difference in moisture content in different treatments.

Protein percentage

It is noted from Figure (4-1) that the percentage of protein in the control treatment was 18.22%, in the treatment including T1 was 18.41%, and in the treatment including adding a bacterial starter T2 was 19.22%. The table also shows that the difference in the moisture percentage when adding the starter led to a slight increase in the percentage Protein. These results were similar to what was found by [5], [23] in soft cheeses, in which the percentage of protein was: 16.25%, (18.06-18.5) %, and (20.6-20.10) %, respectively, and what [24] in soft cheese,

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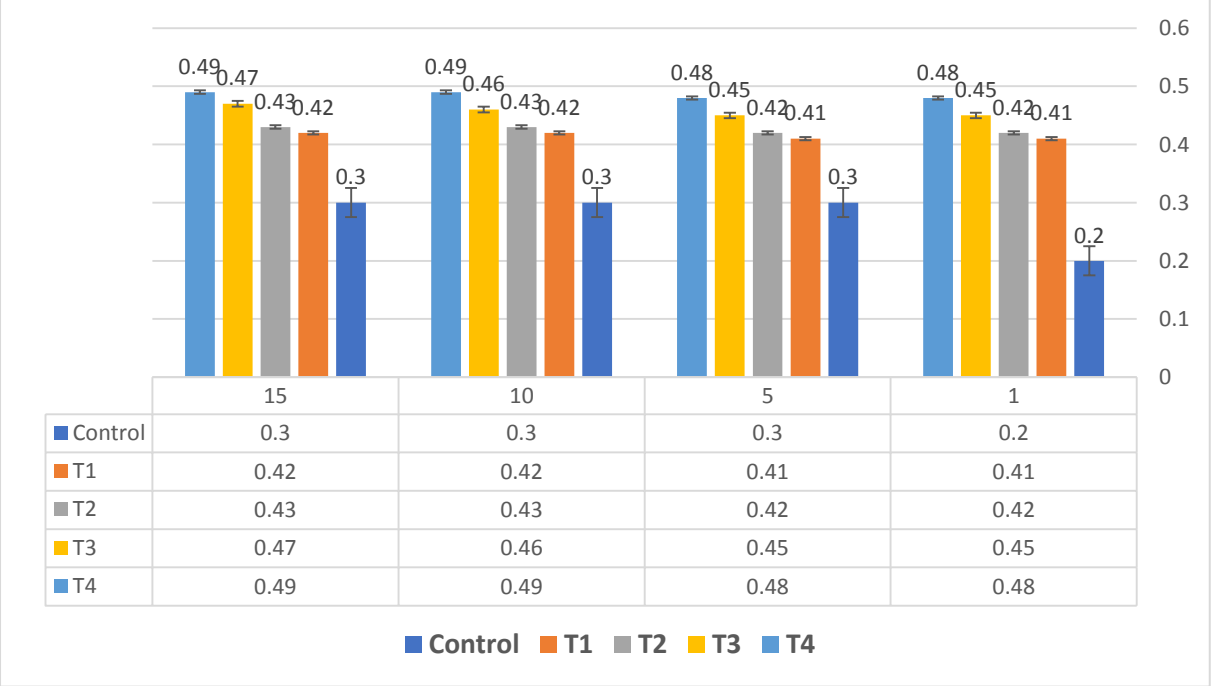
where the protein percentage was 17.72% for the control treatment and 17.80% for the addition treatment.

Acidity test results

It is noted from Figure (4-2) that the salt acidity of the cheese was 0.20 and 0.30 for storage periode 1 and 5 days of storage, respectively. These values increase in relation to the control treatment due to the activity of microorganisms, and this increase continues until the end of the sample's spoilage at the age of 10 days. As for the cheese to which T1 was added, the values were 0.41, 0.41, 0.42, 0.42 for storage periode 1, 5, 10, and 15 days of storage, respectively, and the leachate acidity of cheese to which T4 was added was 0.48, 0.48, 0.49, 0.49 and for storage periode 1, 5, 10, and 1 5 One day of storage, respectively.

t is observed that the acidity increases in the cheeses produced with different treatments due to the addition of the starter culture. We notice a relative stability of the acidity due to the inability of the bacteria to grow and carry out vital activities at refrigerator temperatures (4±1°C). This is consistent with what was mentioned by [25 .[



	15	10	5	1
Control	0.3	0.3	0.3	0.2
T1	0.42	0.42	0.41	0.41
T2	0.43	0.43	0.42	0.42
T3	0.47	0.46	0.45	0.45
T4	0.49	0.49	0.48	0.48

Figure (4-2) Alkaline acidity of soft cheese samples with different treatments and pH

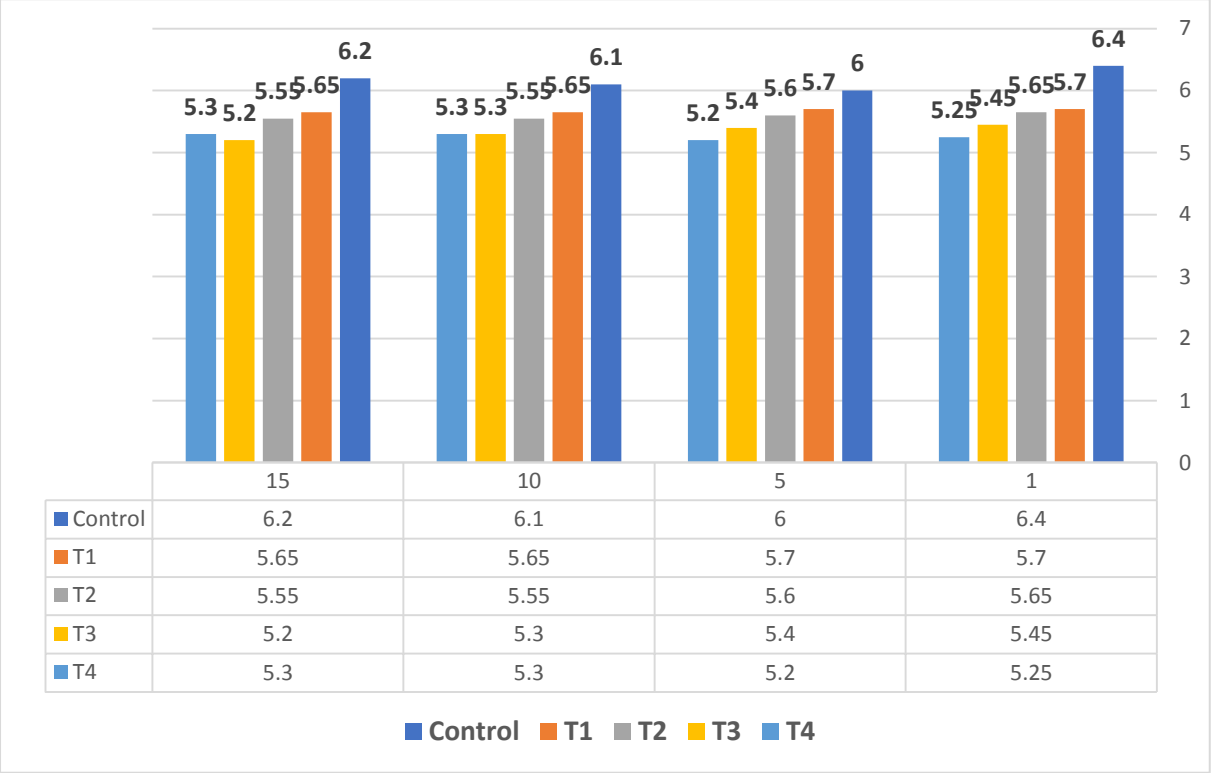
It is noted from Figure (4-3) that the pH values for the control treatment of soft cheese were 6.40 and 6 for storage periode 1 and 5 days, respectively. During refrigerated storage, a gradual decrease in the pH value of the control sample was observed .

Our results agree with what was stated by that the pH applicable in Iraq is approximately 6.4, and [26] that the pH of soft cheese was 6.44 at one day old.

The same figure shows that the pH values of the cheeses added to the Lactobacillus acidophilus starter were lower compared to the control treatment, as the pH values of the T1 addition treatment ranged from 5.70, 5.70, 5.65, and 5.65 for storage periode 1, 5, 10, and 15 days of storage, respectively. It is noted that there is no change in the pH of the cheese throughout the storage period.

Increasing the addition ratio to the treatments led to an increase in the decrease in pH. The pH values for the T4 addition treatment ranged from 5.2, 5.2, 5.3, and 5.3 for storage periode 1, 5, 10, and 15 days of storage, respectively.

A decrease in the pH of the cheeses is observed throughout the storage period due to the addition of the starter culture, and a relative stability of the pH values is observed due to the cessation of bacteria from growing and carrying out biological activities at refrigerator temperatures (4±1°C). This is consistent with what was mentioned by [25.[



	15	10	5	1
Control	6.2	6.1	6	6.4
T1	5.65	5.65	5.7	5.7
T2	5.55	5.55	5.6	5.65
T3	5.2	5.3	5.4	5.45
T4	5.3	5.3	5.2	5.25

Figure (4-3) pH values of Iraqi soft cheese at different storage periode

Sensory evaluation

Figure (4-4 A, B, C, D) shows the results of the sensory evaluation of the above-mentioned treatment models. It is clear from the results that the cheese treatments with added ginger were superior to the control treatment. The results showed the important and effective role

of the protein (ginger) in maintaining the good colour, taste, flavor and texture, as it has (Ginger) has the ability to stop damage caused by a number of microorganisms. The results also indicated that it has a clear role in preserving the sensory characteristics of cheese, in a way that is directly proportional to the increase in the percentage of (ginger) added, as the control treatment C obtained total scores of 91.50 and 90. .00 immediately after manufacturing, while treatments T1, T2, T3, and T4 obtained total scores of 91.00, 92.00, 88.50, and 92.00, respectively.

As for the results of the sensory evaluation of the treatments after 7 days of storage , they were 78.00, 89.00, 92.00, and 90.00 for the previous treatments, respectively. The results indicate that all of the treatments added to it (ginger) were superior to Treatment C in preserving the sensory characteristics of the cheese. Treatment T4 was superior to all Treatments: The cheese maintained excellent sensory qualities throughout the 7-day storage period.

cheese fortified with concentrations of ginger as well as the addition of probiotic bacteria, and no negative effect on taste, flavor and texture was observed

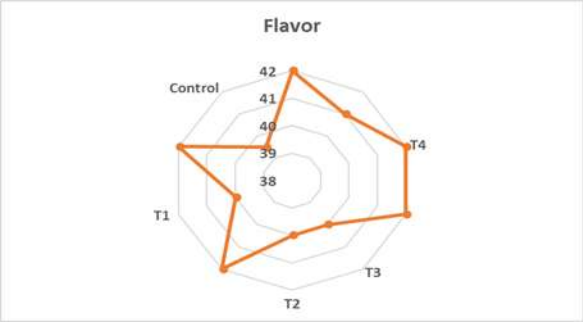


Figure (4-4 A) sensory evaluation of flavour

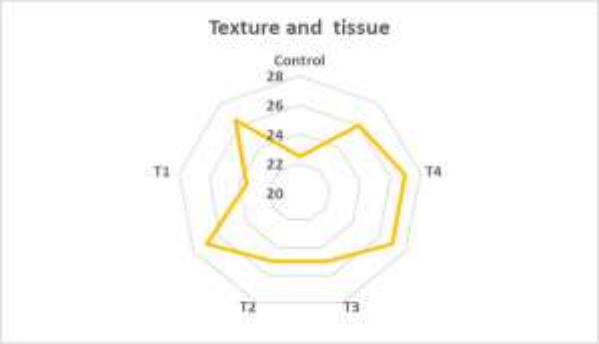


Figure (4-4 B) sensory evaluation of textur and tissue

Figure (4-4 D) sensory evaluation of package

Figure (4-4 C) sensory evaluation of acidity

Conclusion

Ginger plays a role in prolonging shelf life and preserving the chemical composition of cheese because of its nutritional and therapeutic benefits.

Ginger extract has good effectiveness in terms of improving qualitative chemical and sensory characteristics.

The results of the sensory evaluation showed the acceptability of consuming cheese fortified with concentrations of ginger as well as the addition of probiotic bacteria, and no negative effect on taste, flavor and texture was observed.

References

[1] Agidew, M. G. 2022. Phytochemical analysis of some selected traditional medicinal plants in Ethiopia. *Bulletin of the National Research Centre*. 46:87.

[2] Sharifi-Rad, M., Lankatillake, C., Dias, D. A., Docea, A. O., Mahomoodally, M. F., Lobine, D. 2020. Impact of natural compounds on neurodegenerative disorders: from preclinical to pharmacotherapeutics. J. Clin. Med. 9:1061.

[3] Evans, W. C. 2009. "Trease and Evans' pharmacognosy," Elsevier Health Sciences, 16th Edition, Saunders, Elsevier limited.

[4] Zick, S.M.; Djuric, Z.; Ruffin, M.T.; Litzinger, A.J.; Normolle, D.P.; Alrawi, S.; Feng, M.R.and Brenner, D.E. 2008. Pharmacokinetics of 6-gingerol, 8-gingerol, 10-gingerol, and 6-shogaol and conjugate metabolites in healthy human subjects. Cancer Epidemiol Biomarkers Prev; 17: 1930-1936.

ISSN 2072-3857

[5] Ateteallah, A. H., Elkot, W. F., & Abd-Alla, A. E. A. 2022. Physicochemical, antioxidant, microstructure, textural, and organoleptic characteristics of soft cheese incorporated corn milk. *Journal of Food Processing and Preservation*, *46*(7), e16694.

[6] Gupta, S.K. and A. Sharma. 2014. Medicinal properties of Zingiber officinale Roscoe- A Review. Journal of Pharmacy and Biological Sciences (IOSR-JPBS), 9(5): 124-129.

[7] Jayashree, E.; Kandiannan, K.; Prasath, D.; Rashid, P.; Sasikumar, B.; Senthil Kumar, C.M.; Srinivasan, V.; Suseela Bhai, R.; Thankamani, C.K. 2015. Ginger. ICAR-Indian Institute of Spices Research Kozhikode-673 012, Kerala; ICAR-Indian Institute of Spices Research: Kerala, India**.**

[8] Hasan, H.A.; Rasheed Raauf, A.M.; Abd Razik, B.M.and Rasool Hassan, BA. 2012. Pharmaceut Chemical Composition and Antimicrobial Activity of the Crude ExtractsIsolated from Zingiber Officinale by Different Solvents. Pharmaceute Anat Acta; 3: 184.

[9] Alneamah, S. J.; Haider I. A. and Al-Shawi S. G. 2023. Probiotics: Benefits Against the Risks. Euphrates Journal of Agricultural Science, Volume 15, Issue 2, Pages 150-163

[10] Elmer, G. W; Martin, A.W.; Horner, K. L.; Mcfarland, L. V. and Levy, R. H. 1999. Survival of *Saccharomyces boulardii* in the rat gastrointestinal tract and effects of dietary fiber. Microb. Ecol. Health Dis. 11: 29-34.

[11] Gardiner, G.; Ross, R.P.; Collins, J.K; Fitzgerald, G. and Standon, C. 1998. Development of a probiotic Cheddar cheese containing Human. Derived *Lactobacillus paracasei* strains. Appl. Environ Microbiol. 64(6):2192-2199.

[12] Daigle, A.; Roy, D.; Belanger, G.and Vuillemard, J.C. 1999. Production of protiotic cheese (cheddar- like cheese using Enriched Cream fermented by *Bifidotacterium infantis*.J. Dairy sci .82:1081-1091.

[13] Stanton, C.; Ross, P.; Fitzgerald, G.; Collins, K. and Gardiner, G. 2000. New Probiotic Cheddar cheese. Bioscience. 48(8):664.

[14] Ross, R.P.; Fitzgerald, G.; Collins, K. and Stanton C. 2002. Cheese delivering biocultures – protiotic cheese. Aust. J. Dairy Technol .57: 71-78**.**

[15] Perko.B.; Matijasic, B.B. and RogeLJ, I. 2002. Production of probiotic cheese with addition of *Lactobacillus gasseri* LE 221(Rif^{r}) and kz (Rif $^{r),\ zt}$. Bioteh.Fak. Univ.Ljubl., kmet. Zooteh.80(1):61.

[16] Yilmaztekin, M.; Zer, B.H. and Atasoy, F. 2004. Survival of *Lactobcillus acidophilus* LA-5 and *Bifidobacterium bifidum* BB-02 in white-brined cheese. International Journal of Food Sciences and Nutrition.55(1):53-60(8).

[17] VFF, Valio Foods and Functionals. 2004.1:1-18. **www.Valio.com .**

[18] Ling, E.R. 2008. "A textbook of dairy chemistry". Vol. II practical, Chapman and Hall. LTD, (London).

[19] Association of Official Agricultural Chemists – AOAC. 2008\. Official Methods of Analysis of AOAC International, 18th ed. Maryland: AOAC International.

[20] Nelson, J.A. and Trout, G.M. 1964. Judging dairy product. The Olsen Publishing Co., Milwaukee, Wis. 53212, USA.

ISSN 2072-3857

[21] Mohamed, O. A. E., and El Zubeir, I. E. Y. M. 2018. Comparative study on chemical and microbiological properties of white cheese produced by traditional and **modern factories.** ***Annals: Food Science & Technology*****, *19*(1).**

[22] Effat, B. A., Mabrouk, A. M., Sadek, Z. I., Hussein, G. A., & Magdoub, M. N. 2012. Production of novel functional white soft cheese. *Journal of microbiology, biotechnology and food sciences*, *1*(5), 1259-1278.

[23] Zalazar, C. A., Zalazar, C. S., Bernal, S., Bertola, N., Bevilacqua, A., & Zaritzky, N. 2002. Effect of moisture level and fat replacer on physicochemical, rheological and sensory properties of low-fat soft cheeses. *International Dairy Journal*, *12*(1), 45-50.

[24] Zareie, Z., Moayedi, A., Garavand, F., Tabar-Heydar, K., Khomeiri, M., & Maghsoudlou, Y. 2023. Probiotic properties, safety assessment, and aroma-generating attributes of some lactic acid bacteria isolated from Iranian traditional cheese. *Fermentation*, *9*(4), 338**.**

[25] Holt, J.C; Krieg, N.R; Staley, J.T. and Williams, S.T. 1994. Bergey's Manual of Determinative Bacteriology .9th Williams and wilkins. Baltimove maryland, U.S.A.

[26] El-Aziz, M. A., Mohamed, S. H., & Seleet, F. L. (2012). Production and evaluation of soft cheese fortified with ginger extract as a functional dairy food. *Polish journal of food and nutrition sciences*, *62*(2).

ISSN 2072-3857