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Scientific Research

Textural properties, acceptability and count of starter cultures of low-fat stirred yogurt containing transglutaminase and Persian gum

Morteza Aryamanesh[1], Hossein Jooyandeh*[2], Mohammad Hojjati[2]

1. MSC Student, Department of Food Science and Technology, Agricultural Sciences and Natural Resources University of Khuzestan, Mollasani, Iran.
2. Professor, Department of Food Science and Technology, Agricultural Sciences and Natural Resources University of Khuzestan, Mollasani, Iran

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*Corresponding Author E-

hosjooy@asnrukh.ac.ir

ABSTRACT

Today, the desire to consume healthier foods, including low-fat yogurt, has encouraged manufacturers to use suitable fat substitutes in order to provide a product in the market with an acceptable sensory properties in addition to creating a desirable consistency and texture. In this research, it was aimed to improve the textural and sensory characteristics of low-fat yogurt with the help of microbial transglutaminase (MTG) enzyme treatment and the use of Persian gum (PG) as a native gum. In addition, the effect of the mentioned variables on the number of starter bacteria during 14 days of storage was also investigated. For this purpose, low-fat yogurt samples using levels of 0, 0.1 and 0.2% (w/v) of PG gum and levels of 0 and 0.015% (w/v) of MTG enzyme were produced and kept in the refrigerator until the tests. The results of this research showed that with the increase in gum concentration, the firmness and consistency of the produced yogurt samples decreased significantly, while the enzyme treatment increased the texture parameters ($p<0.01$). In addition, both enzyme and gum variables improved the overall acceptance score, but they had a negative effect on the count of yogurt starter bacteria. Also, with the increase in storage time, the firmness and consistency of yogurt samples increased and the acceptability of the product and the count of yogurt starter bacteria decreased significantly ($p<0.001$). In total, the results of this research showed that by using transglutaminase enzyme treatment (0.015%) and adding Persian gum (especially 0.2%), a low-fat stirred yogurt with desirable textural and sensory properties containing appropriate count of yogurt starter bacteria could be produced.

1.Introduction

Yogurt is one of the most popular dairy products, which is prepared as a result of lactic fermentation of milk by thermophilic lactic acid bacteria, i.e. *Lactobacillus delbrueckii* subsp. *bulgaricus* and *Streptococcus salivarius* subsp. *thermophilus*. The production of yogurt and similar dairy products has always been associated with problems such as defects in texture, structure, consistency, and syneresis [1]. Syneresis is a process that occurs due to casein network rearrangement as a result of increasing the number of interactions or connections between casein micelles. As a result, the network tends to gather and expel the interstitial fluid, and serum (whey) appears on the surface of the gel [2]. Three common ways to improve yogurt texture are: 1) increasing milk dry matter such as adding milk casein powder, 2) controlling fermentation conditions such as the starter used or controlling the temperature and time of warming, and 3) adding thickening compounds or hydrocolloids. In the case of low-fat products and reduction of fat, the problem of yogurt texture reduplicate. This is due to the production of yogurt with a dense casein network, which, in addition to the excessive stiffness of the gel, increases the syneresis of the product during storage [3]. Therefore, considering the importance of consuming low-fat food products, extensive research has been done to produce a low-fat product alike to its high-fat type. In the last decade, the use of microbial transglutaminase (MTG) and gums such as Persian gum (PG) in the production of low-fat dairy products has been considered [4-9].

Gums are one of the most important types of hydrocolloids, which, in addition to thickening properties and producing a suitable gel, sometimes also have emulsifying properties. In addition, gums are important sources of dietary fibers [10]. Mountain almond with the scientific name *Amygdalus scoparia Spach* is a tree or shrub from the rose family. A kind of gum exudations from the trunk and branches of this tree, which is called Persian gum, Zedo or Shirazi gum. This gum is found in white, light yellow to orange and red colors [11]. The results of the researchers have shown that Persian gum can be used in the production of stirred yogurt by improving its physicochemical properties and reducing syneresis and it has no adverse effect on the sensory properties of this product [12].

The transglutaminase enzyme is one of the transferase enzymes that catalyzes the acyl transfer reaction between the gamma-carboxyamide of the amino acid glutamine and the first-type amines in proteins, and as a result, intra- and intermolecular covalent cross-links lead to the formation of polymers with high molecular weight increases [13]. Such bonds can modify the structure and function of proteins. Polymerization and coagulation (gelation) of food protein with microbial transglutaminase (MTG) enzyme may affect the quality of many foods by modifying the physicochemical properties, including the amount of adhesion, coagulation (gelation), emulsification and microstructure [14].

In recent years, the use of appropriate methods to achieve the desired texture in low-fat yogurt has been of great interest. The stability of the three-dimensional network of yogurt gel by establishing the cross-linking between protein chains by the MTG is one of the new and effective methods to prevent the common problems in the production of dairy products. Among milk proteins, sodium caseinate is the best substrate for MTG. Whey proteins, in case of denaturation, are suitable substrates for this enzyme [15]. Transglutaminase is most widely used in the dairy industry in yogurt production, which increases gel strength, viscosity, and reduces syneresis. By establishing cross-linking between protein chains, transglutaminase reduces the size of protein network particles and uniform distribution of proteins in the product and ultimately leads to reduction of syneresis. In yogurt samples treated with MTG, the distribution of proteins is more uniform and regular, and less porosity is observed in the protein network, which is probably related to cross-links catalyzed by MTG between milk proteins, which ultimately reduces syneresis [3]. Studies also show that the increase in strength of yogurt gel treated with MTG is related to the reduction of particle size and the regular distribution of the protein network, which subsequently reduces syneresis [13].

Until now, various researches have been conducted in the field of low-fat yogurt production using various hydrocolloids and MTG enzyme. Gauche et al. [16] evaluated the effect of transglutaminase on the physical properties of yogurt prepared from a mixture of milk and whey and concluded that the consistency of yogurt increases with enzyme treatment. According to textural and rheological results, the researchers found that the physical changes made by the addition of whey to yogurt could be compensated by the enzyme treatment. Moayedzadeh et al [17] investigated the effect of transglutaminase enzyme on proteolysis and rheological properties of nonfat yogurt and concluded that transglutaminase enzyme increases the viscosity and water holding capacity in the yogurt gel network and therefore it can be successfully used in the preparation of nonfat yogurt. Sabooni et al. [18] found that kefir samples containing 150 ppm transglutaminase and 0.2% xanthan gum had the highest number of probiotic bacteria, and with increasing amounts of gum and enzyme, the viscosity of the samples increased and syneresis decreased significantly. Nateghi [19] investigated the possibility of producing low-fat stirred yogurt using Zedu gum and concluded that the use of gum up to 0.4% improves the sensory and quality characteristics of the yogurt. Beirami-Serizkani et al [9] investigated the effect of MTG and Persian gum (PG) on the characteristics of traditional kefir drink and concluded that the use of MTG and PG can improve the qualitative properties of kefir. Torabi et al [20] also reported that a synbiotic cheese (treated with MTG enzyme and containing inulin) had higher textural and sensory properties than the probiotics and non-probiotics control samples. Although few researches have been conducted on the simultaneous use of PG gum and MTG enzyme in dairy products such as kefir, no research has been evaluated the coincident effect of these variables on yogurt. Therefore, this research was conducted in order to investigate the simultaneous effect of MTG and PG on textural, sensory properties and count of starter bacteria in yogurt during 14 days of storage at refrigerator temperature.

2- Materials and methods

2-1- Materials

Low-fat yogurt samples were produced using low-fat pasteurized milk (1.5% fat). Microbial transglutaminase enzyme (MTG) with an average activity of 100 units per gram, produced in the French company Ajintomoto, was purchased. Skim milk powder was purchased from Khorasan Pegah Dairy Company. Yogurt starter culture (YF-L 811) containing *Lactobacillus delbrueckii* subsp. *bulgaricus* and *Streptococcus thermophilus* from DVS type manufactured by Christian Hansen, Denmark was purchased and stored at -18 °C. The water-soluble part of Persian gum (PG) was used to produce yogurt samples. PG was purchased from the local market in Shiraz and after washing, it was finely powdered. Then the powdered gum was sieved with 60 mesh to obtain uniform particles. PG powder was continuously added to distilled water at 50 °C with stirring for 30 min and kept overnight at room temperature to complete hydration. To separate the soluble and insoluble fractions, the suspension was centrifuged for 15 minutes with a force of 14,000 g (HK236, Hermle, Germany), and the supernatant was separated and dried at 50 °C. The dried PG was powdered and then ground and stored in polyethylene bags in the refrigerator until use [9].

2-2- Production of stirred yogurt samples

The stirred yogurt samples were produced in Pegah dairy factory of Khuzestan according to the method of Yademellat et al. [12] with some modifications. In order to produce yogurt samples, first, 2% of skim milk powder was added to the low-fat milk (containing 1.5% fat) to increase the dry matter. Then the milk was subjected to heat treatment at 90 °C for 15 minutes. In the samples containing Persian gum, PG powder was added to the milk in different proportions at three levels: 0, 0.1 and 0.2% (w/v), and was mixed until identical combination. After the thermal process and during cooling the milk, Persian gum was added to it at a temperature of 65 °C and then the temperature of the milk was gradually cooled down to the inoculation temperature (45 °C) while stirring. In the samples containing MTG enzyme, after bringing the milk temperature to 45 °C, the enzyme was added to the milk at two levels of 0 and 0.015% (w/v). In order to enzyme activation, the samples were placed in an incubator at the same temperature for

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1 hour. Then, in order to inactivate the enzyme, the samples were pasteurized at a temperature of 80 °C for 1 minute in a hot water bath (Bain-Marie) [21]. Next, the yogurt starter was added to the milk according to the manufacturer's instructions, and the inoculated milk samples were kept in an incubator at 42 °C for 3 hours. After the pH reached 4.6, the yogurt samples were transferred to the refrigerator with a temperature of 7 °C. On the day after production, the prepared clots were gently stirred and divided into small 90 cc containers with lids. Then, the containers were moved to the refrigerator and kept for testing. All tests were performed 1 and 14 days after production in three replicates. It is worth mentioning that the levels of PG and MTG enzyme were determined based on preliminary tests. The sample without PG and MTG was considered as the control yogurt and compared with other low-fat yogurt samples in terms of textural parameters, sensory characteristics, and the number of yogurt starter bacteria during 14 days of cold storage.

2-3- Analysis

2-3-1- Texture analysis

TA.XT.PLUS texture measuring device (Micro stable system, made in England) was used to investigate the effect of adding enzymes and Persian gum on yogurt texture. The probe used had a diameter of 36 mm and a height of 3.5 mm. The penetration of the probe to the depth of the samples was 10 mm, the speed of the probe before and during the test was 1 mm/s and its speed after the test was 10 mm/s. Texture parameters including hardness (the maximum compression force necessary to plunge the probe into the sample (grams of force)) and consistency (the area under the graph during the phase of the probe's plunging (grams of force per second)) were measured [22].

2-3-2- Sensory evaluation

For sensory evaluation of yogurt samples, 20 panelists were used and the 9-point hedonic (preferential) test method was applied. In this study, the overall acceptability feature of the final product was evaluated after 1 and 14 days of yogurt production [23].

2-3-3- Evaluation of the count of starter cultures

MRS agar culture medium was used to count the number of lactic acid bacteria in the samples. For stepwise dilution, peptone water solution was used. In this way, to prepare 0.1 dilution, one gram of sample was dissolved in 9 ml of peptone water solution and mixed well. In the same way, subsequent dilutions were prepared by transferring one milliliter of each dilution to 9 milliliters of peptone water solution. Different dilutions were cultured on MRS agar culture medium and lactic acid bacteria were counted under aerobic conditions after 72 hours of incubation at 37°C. Plates containing 30-300 colonies were counted and their average was reported as the number of lactic acid bacteria in each treatment [24].

2-4-Statistical analysis

In this study, the effect of PG (at 3 levels) and MTG enzyme (at 2 levels) on the quality of low-fat stirred yogurt samples was investigated. Therefore, in this research, 6 yogurt treatments (3×2) were produced. Each treatment was produced in 3 replications and the studied characteristics were evaluated during the cold storage time after 1 and 14 days of the yogurt production. To investigate the effect of variables (gum, enzyme and storage time), completely random design in factorial format was used and one-way analysis of variance was applied to compare the mean of treatments. Data analysis was done using SPSS version 20 software, and the average of the data was compared with the help of Duncan's multi-range test at the level of 5%.

3-Results and Discussion

3-1- Evaluation of the texture of yogurt samples

Figures 1 and 2 respectively show the hardness and consistency of yogurt samples under the impact of different concentrations of PG and MTG treatments during the cold storage period. As can be seen, with the increase in gum concentration, the firmness and consistency of the produced yogurt samples decreased significantly, while the enzyme treatment increased the firmness and consistency of the samples ($p<0.01$). According to Figures 1 and 2, the hardness and consistency of yogurt without PG gum decreased by increasing its amount to 0.2% from 170.16 g and 1260.1 g.s to 154.69 g and 1198.3 g.s, respectively. On the other hand, the average hardness and consistency values of yogurt without enzyme increased from 154.33 g and 1187.9 g. to 170.91 g and 1273.2 g.s respectively as a result of MTG enzyme treatment.

The firmness of yogurt texture is strongly influenced by its dry matter content, fat content, and especially protein content. By increasing the amount of dry matter and protein, amount of cross-linkages in the gel network of yogurt enhances, therefore it leads to the development of a three-dimensional network and formation of a stronger gel structure. While in yogurt with high fat content, interaction of fat globules with yogurt gel network creates an open gel structure and increase the softness of the tissue [3]. Addition of hydrocolloid to yogurt samples, due to the placement of hydrocolloid-forming polysaccharides among casein micelles, causes interference in the formation of the three-dimensional protein network, which ultimately creates a coarser and more open microscopic structure. and as a result leads to a decrease in the firmness of the resulting texture [4]. In fact, by increasing the concentration of gum and increasing the interaction between hydrocolloid-protein, some changes are made in the arrangement of the gel network, which will lead to the creation of a softer texture. The reduction of yogurt hardness and consistency as a result of adding gum in various food products, especially dairy products, has been reported by other researchers [12, 25].

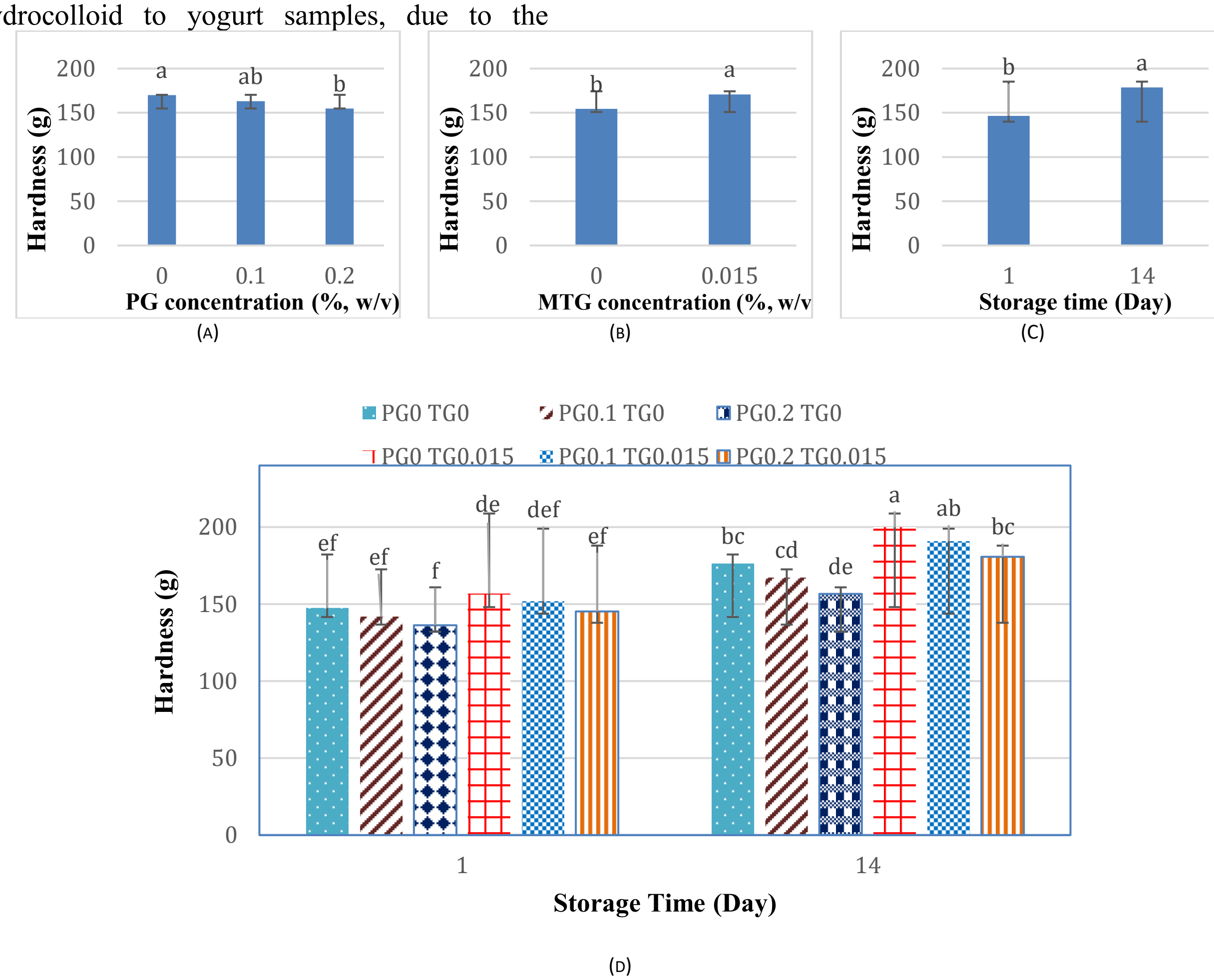

Figure 1- The influence of Persian gum (PG), microbial transglutaminase (MTG) enzyme, storage time, and the interaction effect of PG and MTG (i.e., treatments) on the hardness of low-fat yogurt samples ($p<0.05$) and their standard deviations.

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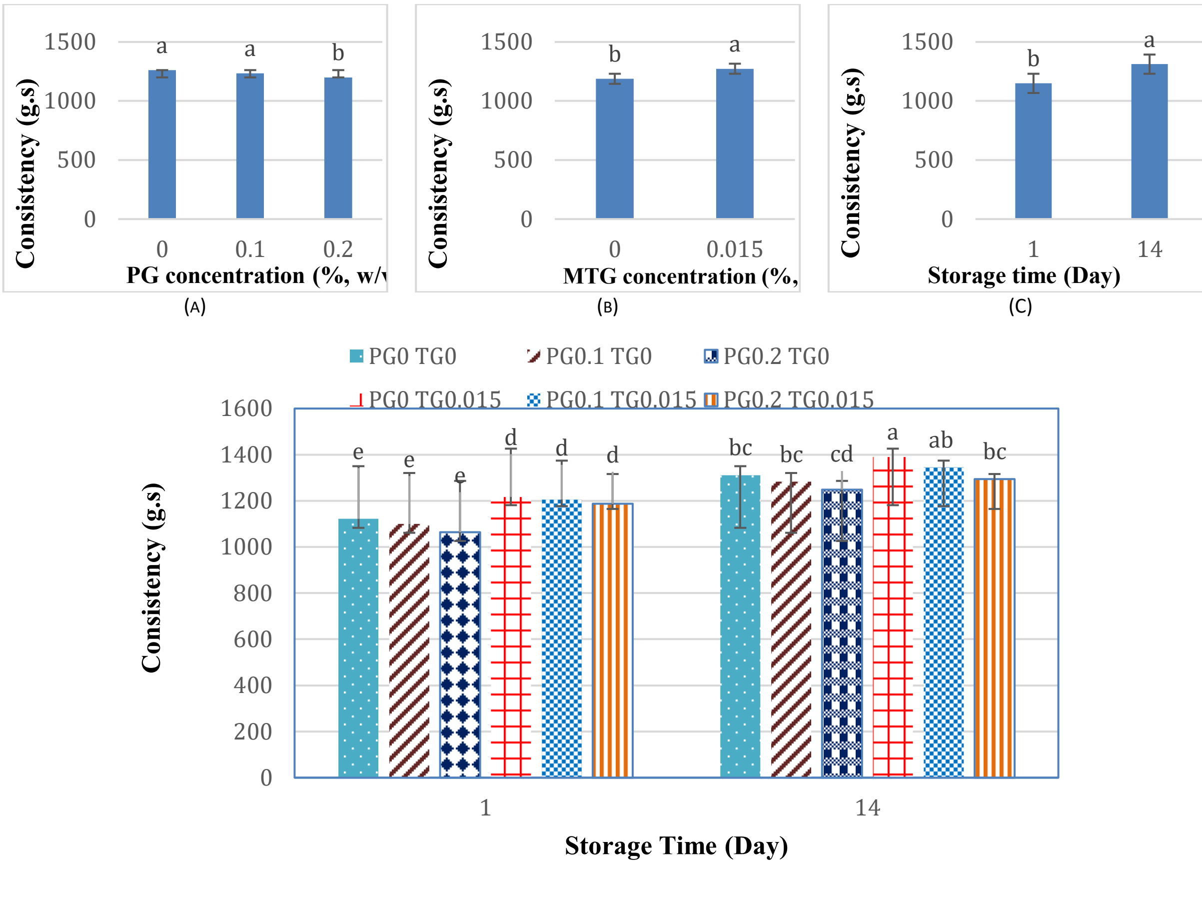


Figure 2- The influence of Persian gum (PG), microbial transglutaminase (MTG) enzyme, storage time, and the interaction effect of PG and MTG (i.e., treatments) on the consistency of low-fat yogurt samples ($p<0.05$) and their standard deviations.

It has been proven that the addition of MTG to protein substrates rich in glutamine, lysine, gelatin and myosin amino acids causes the formation of cross-links and subsequently increases the firmness and consistency of the texture. Based on the research, it has been determined that cold enzymatic treatment with MTG before fermentation [22] or simultaneous enzymatic treatment with milk fermentation and turning it into yogurt [6] increases the firmness and consistency of the product. Increasing the firmness and consistency of the texture under the influence of enzyme treatment in other different dairy products such as strained yogurt [21], traditional white cheese [5], processed cheese [24 and 26], kefir [9] and ice cream [27] and non-dairy products such as soy yogurt [8], soy cheese [28], gluten-free cake [29] and edible films [30] have been reported.

The results of data analysis revealed that with increasing storage time, the firmness and consistency of yogurt increased significantly. The average hardness and consistency values of yogurt at the beginning of the storage period were determined 146.62 g and 1149.2 g.s, respectively, which increased to 178.62 g and 1311.9 g.s at the end of the storage period. The increase in firmness and consistency of yogurt during the storage period has been attributed to changes in the arrangement and binding of proteins [31].

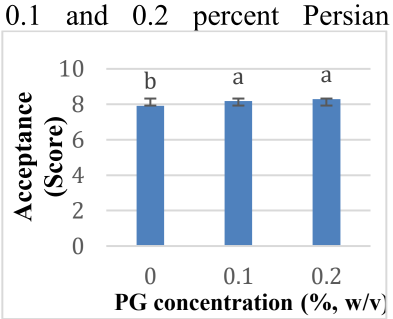
According to the Figures 1-D and 2-D, although in terms of firmness and consistency during the storage period there were no significant differences between the control yogurt sample and the samples containing %0.1 and %0.2 PG, but for samples containing enzyme, these differences were significant. The highest amount of hardness (199/92 g) and consistency (1390/3 g.s) was observed in the low-fat yogurt sample containing enzyme and without gum at the end of storage time. The lowest hardness (136.26 g) and consistency (1064.0 g.s) were also observed in the sample without enzyme and containing the highest amount of gum at the beginning of the storage period.

3-2- Evaluation of the sensory characteristics of yogurt samples

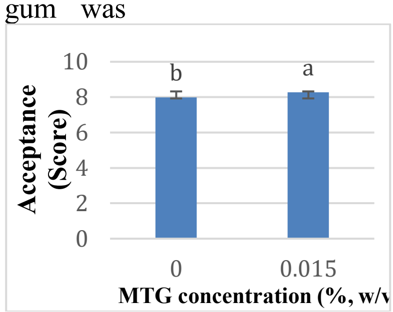
Sensory properties are one of the most important factors influencing the acceptance of food by consumers. Considering the importance of this feature, it is necessary to evaluate it in order to obtain the best formulation or production method [3]. Some researchers who have worked in this field have stated that in the absence or faint presence of fat, the taste quality of dairy products decreases significantly and this is one of the determining factors in reducing the acceptance of this product [12 and 32].

The results of product acceptability by the panelists are shown in Figure 3. According to the graphs presented in this figure, the tested variables had a significant effect on the sensory quality of yogurt samples. According to Figure 3, addition of gum and MTG enzyme treatment increased the sensory quality of yogurt samples, while storage time had a negative effect on the product acceptability ($p<0.001$). The overall acceptability score of yogurt samples containing 0, 0.1 and 0.2 percent Persian gum was determined as 7.91, 8.18 and 8.29 respectively (3-A). Also, the sensory score of yogurt samples without MTG enzyme and containing it was determined as 7.99 and 8.27, respectively (3-B). As mentioned above, among the sensory characteristics, the panelists gave more scores to the color and texture (mouthfeel) of the samples containing PG gum and MTG enzyme, while there was no significant difference in terms of the aroma and taste characteristics of the product (data not shown). It has already been mentioned that by increasing the concentration of PG gum and MTG enzyme, the syneresis decreases and the color of the product increases. Based on these two characteristics of texture (mouthfeel) and color, the panelists gave the highest score to the sample treated with enzyme and containing the highest concentration of gum (Chart 3-D).

It is said that fat reduction in dairy products usually results in a reduction in their consistency and creaminess (Arshia et al., 2011). This causes a decrease in consumer satisfaction with the texture desirability of low-fat desserts. In accordance with the results of this research, Ersia et al. [33] reported the significant improvement of the mentioned two textural parameters due to the use of fat substitute in the formulation of low-fat dairy desserts. Targa and Castel [32] also found similar findings in this field. The improvement of product texture and brightness as a result of enzymatic treatment with MTG has also been reported by other researchers [7, 8, 24].



(A)



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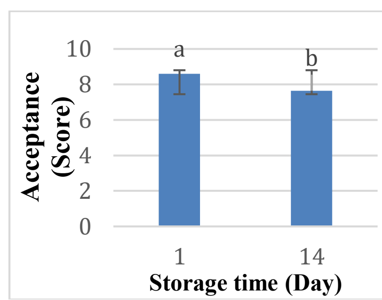

(C)

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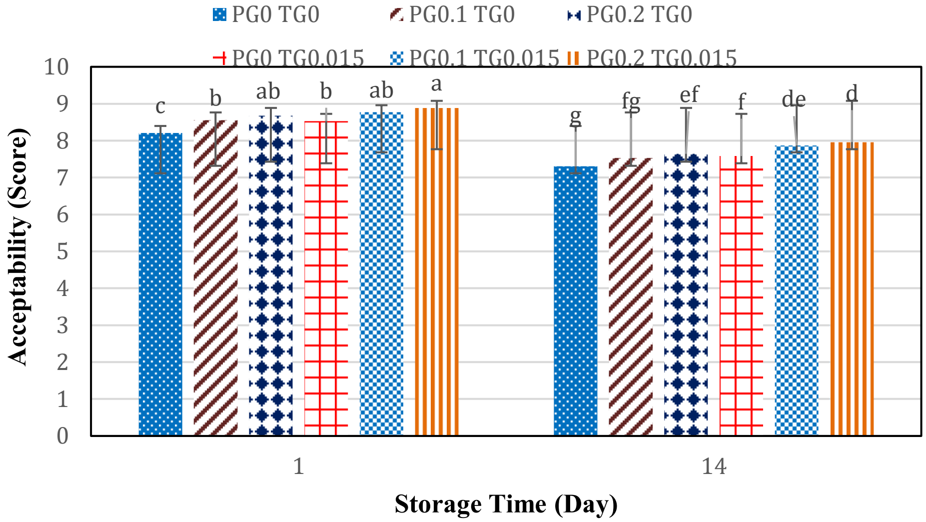

(D)

Figure 3- The influence of Persian gum (PG), microbial transglutaminase (MTG) enzyme, storage time, and the interaction effect of PG and MTG (i.e., treatments) on the acceptability of low-fat yogurt samples ($p<0.05$) and their standard deviations.

The results of data analysis revealed that with the increase of storage time, the total acceptance score of yogurt decreases significantly. The average sensory score of yogurt at the beginning of the storage period was determined as 8.60, which decreased to 7.65 at the end of the storage period. The decrease in sensory quality of yogurt during the storage period is due to the physicochemical changes that occur in the product, especially the increase in acidity, color change and reduction in aroma [3]. A decrease in the overall acceptance of yogurt during the storage period has been reported by many researchers [18, 21, 23].

3-3- Evaluation of the count of starter cultures

Based on the results of statistical analysis, all the variables of this research had a significant negative effect on the survival of the starter bacteria. (Figure 4). The addition of PG gum ($p<0.05$), MTG enzyme ($p<0.01$) and storage time ($p<0.001$) caused a significant decrease in the number of starter bacteria. According to Figure 4-A, the amount of starter bacteria in yogurt samples containing 0, 0.1 and 0.2 percent Persian gum was determined as 7.76, 7.59 and 7.47 Log CFU/g, respectively. Also, the average number of starter bacteria in yogurt samples without enzyme was 7.72 Log CFU/g and in samples containing enzyme Log CFU/g was 7.49 (B-4). The reduction of starter bacteria as a result of enzyme treatment and addition of gum is due to the reduction of water available for the activity of yogurt bacteria [3]. The observed results regarding the decrease in acidity of yogurt as a result of increasing the concentration of Persian gum also confirm this fact that in the presence of PG, the growth rate of yogurt bacteria decreases. Some researchers have stated that the addition of polysaccharide compounds such as inulin increases the survival of lactic acid bacteria (LAB) and attributed the reason to the ability of LAB to use these compounds [8, 34]. Therefore, one of the reasons for the reduction of yogurt bacteria when adding PG can be due to inability of yogurt cultures in PG consumption. In a similar result, Torabi et al [24] reported the reduction of LAB bacteria as a result of MTG enzyme treatment. MTGase enzyme does not have any toxic effect on LAB, but the reason for this decrease may be the delay in the growth of these bacteria. MTG enzyme cross-links peptides with low molecular weight as well as amino acids required for LAB growth and therefore these compounds become unreachable for these bacteria [24].

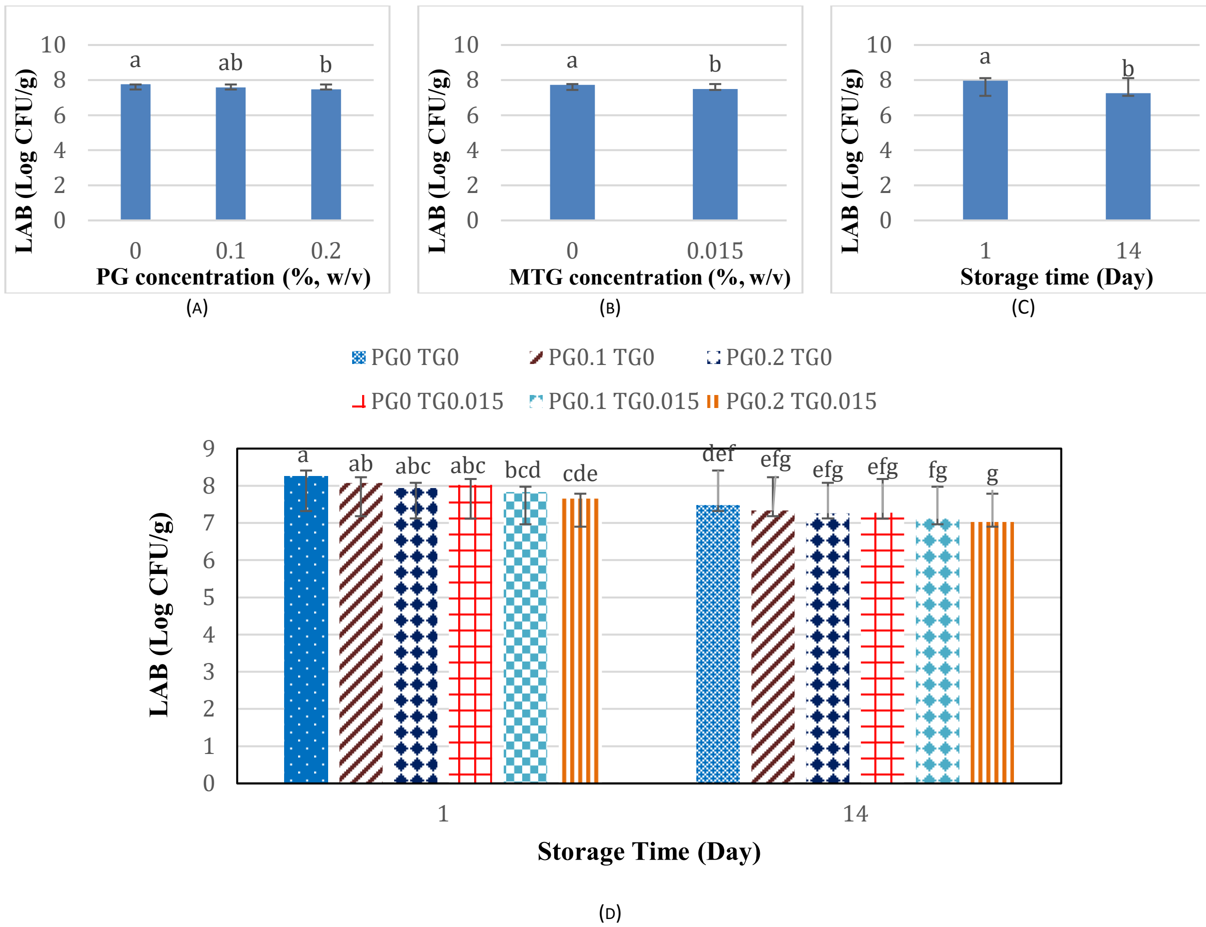

Figure 4- The influence of Persian gum (PG), microbial transglutaminase (MTG) enzyme, storage time, and the interaction effect of PG and MTG (i.e., treatments) on the count of starter bacteria of low-fat yogurt samples ($p<0.05$) and their standard deviations.

As mentioned, storage time had a significant negative effect on the number of LAB bacteria ($p<0.001$) and with the passage of storage time, the number of yogurt starter bacteria decreased significantly (Figure 4-C). A decrease in the number of LAB bacteria during cold storage in yogurt and other dairy products has been reported by many researchers [21, 23, 35]. The reason for this decrease is mainly attributed to the decrease in milk compounds and increase in acidity. The average number of lactic acid bacteria at the beginning of the storage period was determined as 7.96 Log CFU/g, which decreased to 7.25 Log CFU/g after 14 days of storing yogurt samples in the refrigerator. According to Figure 4-D, the highest amount of LAB with 8.25 Log CFU/g in the low-fat control sample was determined on the first day of storage, and the lowest number of acid bacteria was determined with 7.03 Log CFU/g at the end of the storage period.

4-Conclusion

In this research, an attempt was made to change the three-dimensional structure of the casein network by using microbial transglutaminase (MTG) enzyme treatment in such a way that the produced yogurt would have desirable texture and sensory properties. Due to the high efficiency of the reaction and the reduction of the risk of forming toxic compounds, the use of the enzyme method has more advantages compared to physical or chemical methods and can be used as an effective and useful technique. For this purpose, 0.015% (w/v) of MTG enzyme (approximately equivalent to 0.5 units per gram of milk protein) was used to produce low-fat yogurt samples. On the other hand, in this research, the effect of adding Persian gum (PG) on the properties of stirred low-fat yogurt as a native gum was investigated in amounts of 0, 0.1

and 0.2% (w/v). One of the goals of using hydrocolloids such as PG gum is to improve the texture of low-fat products and bring its texture characteristics closer to similar high-fat products. The reasonable price of native hydrocolloids is another influencing factor in their use in the food industry. The price per kilo of Persian gum in the Iranian market is much lower compared to hydrocolloids or commercial gums such as xanthan or guar. The results of this research showed that the addition of gum and enzyme had a different effect on the hardness and consistency of yogurt. The addition of gum caused a significant decrease in these parameters, while the enzyme treatment had the opposite effect and increased the hardness and consistency by about 11% and 7%, respectively. Nevertheless, based on the sensory results, it was found that the panelists gave more marks to the samples containing enzymes and the reason was a more uniform and coherent texture. Although the mechanical analysis showed an increase in hardness as a result of enzyme treatment, due to the uniform confinement of water in the casein network by MTG, these yogurt samples had a more uniform texture and were preferred by the panelists due to a better mouthfeel. The results showed that the MTG enzyme treatment and the use of PG gum improved the texture characteristics of the product, so that the panelists gave the highest texture score to the sample containing the enzyme and the highest amount of gum (0.2%). In addition, although the overall average acceptance score of yogurt samples decreased by more than 10% with the passage of storage time, all low-fat stirred yogurt samples had acceptable scores (above 7, pleasant) at the end of 14 days of storage. Also, among the examined variables, enzyme addition had the least effect and storage time had the greatest effect on reducing the number of lactic acid bacteria. On average, the use of 0.2% of gum (w/v), enzyme treatment (0.015%, w/v) and storage time respectively caused a decrease of approximately 3.7, 3.0, and 9.8% bacteria count. Nevertheless, all yogurt samples had a high count of lactic acid bacteria (Log CFU/g>7), which are beneficial for health. In total, the results of this research showed that by using enzyme treatment (0.015%) and adding gum (especially 0.2%), a low-fat yogurt with appropriate textural properties, sensory characteristics and bacterial count can be produced.

5- Acknowledgement

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مقاله علمی_پژوهشی

ویژگی‌های بافت، قابلیت‌پذیرش و شمارش باکتری‌های آغازگر ماست هم‌زدهٔ کم‌چرب حاوی آنزیم ترانس‌گلوتامیناز و صمغ فارسی

مرتضی آریامنش[1]، حسین جوینده[2]*، محمد حجتی[2]

۱- دانشجوی کارشناسی ارشد، گروه علوم و صنایع غذایی، دانشگاه علوم کشاورزی و منابع طبیعی خوزستان، ملاثانی، ایران.

۲- استاد گروه علوم وصنایع غذایی، دانشگاه علوم کشاورزی و منابع طبیعی خوزستان، ملاثانی، ایران.

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* مسئول مکاتبات:

hosjooy@asnrukh.ac.ir

امروزه تمایل به مصرف مواد غذایی سالم‌تر، از جمله ماست کم‌چرب، تولیدکنندگان را به استفاده از جایگزین‌های مناسب چربی ترغیب نموده است تا علاوه بر ایجاد قوام و بافتی مطلوب، محصولی با خواص حسی قابل قبول به بازار عرضه کنند. در این پژوهش سعی گردید تا با کمک تیمار آنزیمی ترانس‌گلوتامیناز میکروبی (MTG) و استفاده از صمغ فارسی (PG) به عنوان یک صمغ بومی بتوان ویژگی‌های بافتی و حسی ماست هم‌زدهٔ کم‌چرب را بهبود بخشید. به علاوه تأثیر متغیّرهای مذکور بر شمارش باکتری‌های آغازگر طی مدت ١٤ روز نگهداری نیز بررسی شد. برای این منظور، نمونه‌های ماست هم‌زدهٔ کم‌چرب با استفاده از سطوح ۰، ۰/۱ و ۰/۲ درصد (w/v) صمغ PG و سطوح ۰ و ۰/۰۱۵ درصد (w/v) آنزیم MTG تولید شدند و تا زمان انجام آزمون‌ها در یخچال نگهداری شدند. نتایج این تحقیق نشان داد که با افزایش غلظت صمغ، سفتی و قوام نمونه‌های ماست تولیدی به‌طور قابل توجهی کاهش یافت درحالی که تیمار آنزیمی سبب افزایش پارامترهای بافت شد (p< ۰/۰۱). به‌علاوه، هر دو متغیر آنزیم و صمغ هرچند سبب بهبود امتیاز پذیرش کلی شدند، اما تأثیر منفی بر شمارش باکتری‌های آغازگر ماست داشتند. همچنین، با افزایش زمان نگهداری، سفتی و قوام ماست افزایش و قابلیت پذیرش محصول و شمارش باکتری‌های آغازگر ماست کاهش معنی‌داری یافت (p< ۰/۰۰۱). در مجموع نتایج این تحقیق نشان داد که با به‌کارگیری تیمار آنزیمی ترانس‌گلوتامیناز (۰/۰۱۵٪) و افزودن صمغ فارسی (به‌خصوص ۰/۲٪)، می‌توان ماست کم‌چرب هم‌زده‌ای با خصوصیات بافتی و حسی مطلوب حاوی شمارش مناسب باکتری‌های آغازگر ماست تولید نمود.