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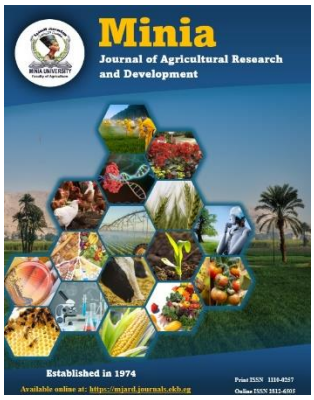

Improving the functional properties of Yoghurt by using Pomegranate (*Punica granatum*) Juice

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ABSTRACT

This study sought to ascertain the effects of adding pomegranate (Punica granatum) juices as natural ingredients on the physio-chemical characteristics, antioxidant, total phenolic, total flavonoid, flavor compounds such as (acetaldehyde, diacetyl, and acetoin)microbiological examination, as well as the sensory evaluation of the set yoghurt. The set yoghurt was made cow's milk, 3% fat, pomegranate juice (10 and 15%), and stabilizer (1% starch and 0.4% gelatin). and, and the the final product were stored at 5°C until the end of the 15-day storage period. The physicochemical properties of the yogurt samples, such as their pH, protein, fat, total solids, and syneresis, were investigated. Furthermore, treatments were subjected to microbiological examination and sensory evaluation both fresh and following seven and fifteen days of cold storage at 5°C. The results showed that there are significant differences in total solids, pH and titratable acidity between control and treated samples. Moreover, antioxidants, total flavonoids and phenolic compounds increased significantly with addition of. Pomegranate juicesl . It was found that all samples' titratable acidity increased during storage. The syneresis levels of yoghurt with 15% pomegranate juice were significant. The sensory evaluations showed that there were notable differences between the control yoghurt samples and treated samples with 10% pomegranate juices received the highest flavor and texture ratings when compared to treated with 15% juices. The obtained results obtained in this study demonstrated that addition of pomegranate juices in yoghurt making significantly improved the yogurt's quality and expanded its health benefits.

Keywords: functional yoghourt , pomegranate, stabilizer , fermented milk.

1. INTRODUCTION

Functional foods has received increased attention (Martínez, etal 2012.Fermentation preserves the milk's essential nutrients since customers are more conscious of the connection between eating well and maintaining excellent health (Goma et al., 2014). yoghurt is The most popular fermented milk made in Egypt.

Yogurt, a nutrient-dense food rich in protein, fatty acids, and minerals such as

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calcium and phosphorus (Sanchez et al., 2000), is easily digestible and a source of probiotics. To enhance its appeal, manufacturers have explored the addition of fruit to yogurt, while preserving the fruit's refreshing flavor. (Ali, etal 2016)

According to Shori (2022) and Rashwan et al. (2023), yoghurt is the most widely consumed fermented milk product in Egypt and the entire world. According to Barkallah et al. (2017), yoghurt is categorized as fermented milk and may contain up to 50% (wt/wt) of nondairy ingredients. Many fruits, like orange, peach, and others are included in yoghurt recipes because of their refreshing flavor, which enhances the dish's deliciousness (Gomah et al., 2014). The fruit known as the pomegranate (*Pumice qranatum* L.) is grown well in Egypt and in other regions over the world like United States, Southeast Asia, and the Mediterranean. About 50–70% of the pomegranate fruit is edible, where the seeds are made up of 80% of the juicy part and 20% is (woody section) (Zaouay et al., 2014).

The advantages of adding pomegranate juice to yogurt were demonstratedand can be added as an antioxidant and antibacterial.

Adding pomegranates to yoghurt milk improved the product's quality and provide naturally derived foods. Pomegranates juices are regarded as functional foods due to their ability to lower the risk of diabetes, atherosclerosis, and cancer (Rahmani et al., 2017).

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The advantages of adding pomegranate juice to yogurt were covered in a number of studies. These results suggested that pomegranate-based yoghurt may offer numerous benefits over regular yoghurt (Rahmani et al., 2017)

In addition to enhancing the quality of the final product, using pomegranates would give the fruit a market outlet during the season of peak production, when prices were drastically reduced (Khanchoufi et al., 2017). Additionally, pomegranates (*Punica granatum L.*) are rich in polyphenols and gallic acid, which offer anti-inflammatory and antioxidant properties that help prevent some metabolic diseases (Gouda et al., 2020). Flavonoids and phenolic compounds are substances found in pomegranates (Seeram et al., 2006) which are used to improve the antioxidant and functional activity of yoghurt due to its possible health advantages. Meanwhile, the physicochemical and nutritional qualities of the yoghurt can be significantly affected by the inclusion of fruits or fruit extracts (Oliveira et al., 2015). It is well known that phenolic compounds can interact with milk proteins to generate protein-polyphenol complexes, which can improve the nutritional value of dairy products. Therefore, adding pomegranate juice to yoghurt can offer extra health benefits, including phenolic components and antioxidant qualities. Additionally, this supplementation may result in the creation of novel functional dairy products that meet customer needs (Axten et al., 2008).

The gel structure is altered when pomegranates juice is added, (poor body and gel separation). Therefore, corn starch and gelatin are added to solve these issues. Starch are low cost, extensive availability, and seems to be a desirable element among hydrocolloids (Macit et al., 2019). When

stabilizers added to yoghurt, the sensory examination of the finished product produced acceptable and adequate results and the resistance of the separated whey and curd decreased (Ali et al. 2022)

The main objective of this research was to evaluate the effect of using different concentrations of pomegranate juices with different stabilizers on the physicochemical , rheological, microbiological and organoleptic characteristics of yoghurt

MATERIAL AND METHODS

Milk supply

cow's milk was obtained from the fresh morning of the animal production department faculty of Agriculture, Minia University.

Pomegranate: was obtained from the Agriculture Administration, Minia Governorate

Starsh and gelatin were obtained from the local market.

Starters culture

Yoghurt starter culture consisted of (*Streptococcus salivarius subsp thermophilus, Lactobacillus delbureckii subsp. Bulgaricus*) were obtained from Cairo Microbiological Resource center (MIRCEN), Faculty of Agriculture Ain Shams University. The organisms were inoculated at (1:1). Preparation

Preparation of Pomegranate juice

Fresh fruits were washed , arils of pomegranate fruits were manually separated from the Peels and piths and their juice was extracted using an electric juicer (bifinett model KH 450) .the pomegranate juice (pJ)was homogenized at 6000 rpm/min for 5min.The insoluble material was removed by using cheese cloth and the juice stored in a deep freezer -18 ^{o}C until used (Nanis et. al 2014)The composition of pomegranate juice is given in Table (1)

Preparation of yoghurt

Fresh cow's milk (3%fat)was heated at 90 ^{o}C for min. then cooled to 40°C, the milk was divided into five parts.

The first part is considered as a control. the second part contain 10% pomegranate juice plus 0.4%gelatin.the third part contain 15% pomegranate juice plus 0.4%gelatin the fourth part contain 10% pomegranate juice plus 1% starch. The last part contain 15% pomegranate juice plus 1% starch. Gelatin or stash was added directly to the milk.The pomegranate juice was heated at 72 ^{o}C for 15 sec then cooled at 40 ^{o}C the pomegranate juice was added immediately after incubation with 2% starter culture) Bacilii-Cocci) to avoid the quick reduction of PH and transfer all yoghurt samples into plastic containers and incubated at 42 ^{0}C until complete curd formation

Chemical analysis :

Yoghurt samples were determind for protein, Total solid ,acidity and PH value were determined according the AOAC(2016)

Diacetyl and acetoine were determined as described by Westerfeleld (1945).

Total phenol (T.P) levels of yoghurt samples were measured using spectrophotometer at 765 nm according to Shiri *et al.*, (2011). method and determined as garlic acid equivalent (GAE)

The total flavonoid The total flavonoid content was determined using catechin as a reference using the aluminum chloride method (Chang *etal*., 2002).

Determination of Total Antioxidant Capacity :

The determination of total antioxidant capacity was done as per the phosphomolybdenum method with some modifications (Kanika *etal.*, 2015)

Acetaldehyde Content was determination according to **(Yılmaz, 2006)**.

Determination of curd firmness The firmness of the formed gel was determined using the penetration method described by **(Ibrahim, 1983**).

Measurement of syneresis:

Yoghurt syneresis (the released of whey) was determined by the centrifugation method described by **Keogh & O'Kennedy, (1998)**.

$$\textbf{Syneresis (\%)} = \frac{\text{Weight of supernatant (g)}}{\text{Weight of yogurt sample (g)}} \times 100$$

Lactic acid bacterial count agar was used for total bacterial count (ISO., 2013). MRS and M17 agar was used for total lactic acid bacterial count (Dave, and Shah, 1996).

Total count of yeasts and molds :The enumeration of yeasts and molds were carried out according to (ISO 2008).

Sensory Evaluation: Yoghurt samples were assessed according to Eman *etal* .,2019) after fresh ,7 days and15 days of storage by staff , members at the Department of Dairy Science, Faculty of Agriculture, Minia University Egypt.

Statistical analysis: The statistical analysis was performed employing the Costat software program. The Duncan's multiple range test using tow-way analysis of variance (ANOVA) at 5% significant level ($P < 0.05$) (Snedecor and Cochran, 1980).

RESULTS AND DISCUSSION

Chemical Composition of Raw Materials (cow's milk and pomegranate):

The chemical composition of cow milk and pomegranate juice (PJ) are presented in Table (1). It was observed that the total solids, protein, fat, acidity and ash contents of the cow's milk were 13.27,3.50 ,3.30, 0.18 and 0.70%, respectively. Also, the results showed that the pomegranate juice had high amounts of total solids, acidity and ash but decreased in protein content. These results are in good agreement with the results obtained by **Ali etal (2016)** and **Amany etal (2019)**

Table(1) Chemical composition of cow milk and Pomegranate Juice (PJ)

	PH	Acidity	Total Solids	Protein	Fat	Ash
cow's milk	6.75±0.02	0.18±.01	13.27±0.25	3.50±0.1	3.30±0.3	0.70±0.1
Pomegranate Juice	3.16±0.01	1.08±0.002	15.47±0.25	3.20±0.2	nd	1.07±0.02

nd: not detected

Chemical Composition of Yoghurt:

Table (2) shows the chemical composition of yoghurt with different ratio of pomegranate juice.Pomegranate juice increa sed the yoghurt's protein, fat, and ash content while slightly lowering its moisture %.Pomegranate juice, which is used to make set yogurt, had a substantial ($p<0.05$) impact on the amount of ash and total solids.

after 15 days of storage at 4ºc±1, the values of all treated samples indicated a significant($P<0.05$).These findings are consi stent with those of (ELNemr et al., 1990 and Ali 2016).

Table(2) :Chemical composition of yoghurt fortified with (10,15%)concentrate Pomegranate juice and starch (S 1%) and gelatin (G0.4%) during storage at 5°c±1 for 15 days

Treatments	stored	Control	T_1	T_2	T_3	T_4
Moisture	fresh	85.463 ^{b} ±0.158	84.54 ^{cde} ±0.603	84.33 ^{def} ±0.30	84.55 ^{cde} ±0.125	83.2 ^{g} ±0.346
	7days	85.867 ^{b} ±0.808	85.103 ^{bcd} ±0.18	85.21 ^{bc} ±0.36	85.24 ^{bc} ±0.398	83.6 ^{fg} ±0.324
	15days	86.75 ^{a} ±0.75	85.283 ^{bc} ±0.77	85.56 ^{b} ±0.428	84.11 ^{ef} ±0.12	83.937 ^{efg} ±0.22
T.S	fresh	14.177 ^{f} ±0.143	15.43 ^{cd} ±0.509	15.24 ^{d} ±0.173	15.42 ^{cd} ±0.31	16.37 ^{a} ±0.075
	7days	14.11 ^{f} ±149	14.3 ^{f} ±0.272	15.21 ^{d} ±0.259	15.297 ^{d} ±0.295	16.08 ^{ab} ±0.106
	15days	13.237 ^{g} ±0.318	14.03 ^{f} ±0.03	14.77 ^{e} ±0.299	14.72 ^{e} ±0.14	15.8 ^{bc} ±0.22
Protein	fresh	3.42 ^{e} ±0.147	3.39 ^{e} ±0.087	3.9 ^{d} ±0.12	3.9 ^{d} ±0.04	4.73 ^{a} ±0.101
	7days	3.45 ^{e} ±0.3	3.4 ^{e} ±0.321	4.013 ^{cd} ±0.186	4.3 ^{bc} ±0.175	3.9 ^{d} ±0.193
	15days	3.49 ^{e} ±0.218	3.82 ^{d} ±0.137	3.707 ^{de} ±0.1	4.6 ^{ab} ±0.141	4.3 ^{bc} ±0.156
Fat	fresh	3.02 ^{b} ±0.02	3.17 ^{ab} ±0.106	3.513 ^{a} ±0.609	3.3 ^{ab} ±0.075	3.25 ^{ab} ±0.151
	7days	3.16 ^{ab} ±0.156	3.19 ^{ab} ±0.09	3.2 ^{ab} ±0.151	3.27 ^{ab} ±0.062	3.27 ^{ab} ±0.139
	15days	3.177 ^{ab} ±0.158	3.07 ^{b} ±0.095	3.22 ^{ab} ±0.117	3.22 ^{ab} ±0.132	3.103 ^{b} ±0.083

Values are expressed as mean± standard deviation (*N*=3). a (significantly different from control group at P < 0. **C=yoghurt without juice** **T_1=**yoghurt with 10% pomegranate juice (PJ)+0.4% Gelatin (G)
T_2=yoghurt with 15% pomegranate juice (PJ)+0.4% Gelatin (G)
T_3=yoghurt with 10% pomegranate juice (PJ)+1%starch (S)
T_4=yoghurt with 15% pomegranate juice (PJ)+1% starch (S)

pH and Titratable Acidity

Data given in Table 3, shown pH of yoghurt samples made with different ratio pomegranate juices during storage at 5°c±1 for 15 days. Different fruit juices had a highly substantial impact on titratable acidity and pH levels. Yogurt's pH decrease when pomegranate juices were added in comparison with the control (Mousavi et al., 2011; Nirmala and Subba, 2011).

Additionally, it was observed that the post-fermentation of lactose with lactic acid caused a substantial ($P \leq 0.05$) drop in pH values for all yoghurt samples when the storage period was extended to 15 days. Moreover, there was usually an inverse relationship between pH and titratable acidity. Titratable acidity rose as the proportion of pomegranate juice in the yoghurt samples increased, as Table 3 illustrates. yoghurt with a 15% pomegranate juice had the lowest pH highest titratable acidity .these results resemble those reported by Debashis et al. (2015) for yoghurt by mixing banana ,papaya and watermelon . Throughout the storage period, the titratable acidity contents of the yoghurt for all treatments increased significantly. This might be explained by the fact that fruit liquids contained more vital ingredients, including vitamins, minerals, and simple sugar, which could promote the development of yoghurt culture (Al-Farsi and Lee, 2008). Moreover, the titratable acidity of treated samples with 1% starch showed the lowest values. The results showed that the the titratable acidity of control samples had the lowest values compared to treated samples)

Table (3): PH and of yoghurt fortified with (10,15%)concentrate Pomegranate juice and starch (S 1%) and gelatin (G0.4%) during storage at 5°c±1 for 15 days

	Storage period	C	T_1	T_2	T_3	T_4
PH	Fresh	4.44 [a] ±0.096	4.2 [d] ±0.02	4.01 [d] ±0.026	4.04 [d] ±0.02	3.68 [f] ±0.03
	7	4.17 [b] ±0.056	4.14 [bc] ±0.061	4.01 [d] ±0.012	3.88 [e] ±0.108	3.507 [g] ±0.03
	15	4.06 [cd] ±0.01	3.98 [d] ±0.029	3.67 [f] ±0.061	3.533±0.058[g]	3.487 [g] ±0.05
Titratable acidity	Fresh	0.64 [i] ±0.036	0.81 [gh] ±0.020	0.98 [ef] ±0.21	0.81 [gh] ±0.01	1.05 [ab] ±0.015
	7	0.783 [h] ±0.021	0.803 [de] ±0.03	0.99 [de] ±0.01	1.013 [bc] ±0.21	1.067 [a] ±0.015
	15	0.837 [fg] ±0.15	0.93±0.026[d]	0.973±0.21[c]	1.043[ab] ± 0.05	1.083 [a] ±0.02

Values are expressed as mean± standard deviation (*N*=3). a (significantly different from control group at P < 0. **C=yoghurt without juice** **T_1=**yoghurt with 10% pomegranate juice (PJ)+0.4% Gelatin (G)

T_2=yoghurt with 15% pomegranate juice (PJ)+0.4% Gelatin (G)

T_3=yoghurt with 10% pomegranate juice (PJ)+1%starch (S) , **T_4**=yoghurt with 15% pomegranate juice (PJ)+1% starch (S)

Syneresis and firmness of yoghurt : Table 4 displayed the yoghurt syneresis. The higher level showed a greater separation of whey from the yogurt. of pomegranate concentrate, Yoghurt syneresis increased over the course of the interval storage periods, according to the treatments. Both the control and all treated samples showed a notable rise in syneresis values while being stored at 4° c ±1. El-Nagar and Shenana (1998) reported similar findings. However, the use of stabilizers such starch and gelatins reduced the vulnerability to syneresis. According to Supavititpatana (2008), syneresis levels reduced as yoghurt's gelatin and starch content increased. Furthermore, gelatin created a twofold network structure in yogurt, which decreased the syneresis values of the yoghurt, according to Fiszman et al. (1999). As indicated in Table 3, the amounts of pomegranate juice employed also had an impact on the firmness of the yogurt. When compared to controls, the addition of PJ to yoghurt resulted in a substantial rise during storage and a decrease with increasing pomegranate concentration. According to Macit and Bakirci (201٩), during the storage period, the yoghurt sample containing gelatin had a sharp decline in protein values and an increase in acidity values(Kumar and Mishra (2004)).

In comparison to the control group without stabilizer, it was found that the addition of gelatin improved adhesiveness, cohesiveness, springiness, and gumminess. Gelatin-casein interactions produced a stronger three-dimensional network (Ares et al., 2007), which could account for this impact (Kumar and Mishra, 2004). When heated, the starch absorbs water and swells, increasing the viscosity of the solution by gelling at a specific temperature. Yogurt's viscosity is thus increased by adding starch (Schmidt et al., 2001; Williams et al., 2003;Mishra and Rai 2006; Ares et al., 2007;). Protein and starch had electrostatic interaction, Schmidt (2001). Positively charged casein molecules can interact with negatively charged starch molecules at pH values below 4.6. Calcium ions from casein dissociate by dissolving from casein and attaching themselves to the starch molecule

as the pH drops. These modifications strengthen the yogurt gel. The other samples' viscosity index values were higher than those of the control group. Coagulum stability (hardness) increased during storage, and the effect of storage was substantial ($p<0.05$), according to Nazan and Gokhan (2016). The curd's rheological characteristics in yoghurt are influenced by a number of variables, including the soluble Ca++ ratio, pH, applied temperature, and the milk's casein and whey protein composition. As the acidity rises, the interaction between serum proteins and casein micelles was enhanced, serum separation is reduced, calcium become more soluble, and viscosity was subsequently was increased (Anema etal 2004).

Tables(4) Syneresis and firmness of yoghurt fortified with (10,15%)concentrate Pomegranate juice and starch (S 1%) and gelatin (G0.4%) during storage at 5°c±1 for 15 days

	Storage Periods	C	T_1	T_2	T_3	T_4
Syneresis	Fresh	12.03^{i} ±0.046	7.43^{j} ±0.125	11.1^{d} ±0.115	8.04^{i} ±0.04	10.7^{f} ±0.125
	7	13.3^{h} ±0.164	9.1^{h} ±0.11	11.5^{e}±0.105	9.7^{g} ±0.098	10.6^{f}±0.229
	15	13.69^{a} ±0.203	11.5^{f} ±0.095	13.72^{b} ±0.244	10.04^{k} ±0.036	11.04^{c} ±0.03
firmness	Fresh	25.23^{m} ±0.076	36.3^{h} ±0.1	36.02^{l} ±0.034	38.01^{f} ±0.01	39.02^{k} ±0.03
	7	36.05^{i} ±0.05	37.71^{g} ±0.25	39.9^{e} ±0.173	42.5^{b} ±0.265	40.2^{d} ±0.117
	15	35^{j} ±0.04	41.3^{c} ±0.173	40.0^{de} ±0.025	43.01^{a} ±0.012	42.04^{de} ±0.04

Values are expressed as mean± standard deviation (N=3). a (significantly different from control group at $P < 0.05$ **T_1**=yoghurt with 10% pomegranate juice (PJ)+0.4% Gelatin (G)

T_2=yoghurt with 15% pomegranate juice (PJ)+0.4% Gelatin (G)

T_3=yoghurt with 10% pomegranate juice (PJ)+1%starch (S)

T_4=yoghurt with 15% pomegranate juice (PJ)+1% starch (S)

Acetaldehyde, diacetyl and acetoin of yoghurt:

Acetaldehyde is major flavor component in yoghurt (Lee and Jago 1978) .It was found in table(5) The amount of acetaldehyde, diacetyl, and acetoin in all treated samples rose as the amount of pomegranate increased. The volatile flavor component content of treated samples gradually increased over 15 days while being stored at 5ºC±1. This could be because the high nutritional value of pomegranate concentrate increased the starting activity. Similarities were noted by Driessen and Puhan (1988), who reported that yoghurt samples of acetaldehyde, diacetyl, and acetoin rose over the course of cold storage.

Tabe(5): Acetaldehyde ,diacetyl and acetoin level of yoghurt fortified with (10,15%)concentrate Pomegranate juice and starch (S 1%) and gelatin (G0.4%) during storage at 5°c±1 for 15 days

	Storage Periods	Control	T_1	T_2	T_3	T_4
Acetaldehyde	Fresh	52.2^{h} ±0.09	65.1^{g} ±0.17	76.2^{f} ±0.1	66.07^{f} ±0.15	77.9^{c} ±0.173
	7	55.1^{g} ±0.1	66.6^{e} ±0.173	77.03^{d} ±0.153	68.1^{c} ±0.1	79.03^{a} ±0.15
	15	56.6^{e} ±0.1	68.1^{c} ±0.173	79.1^{d} ±0.1	68.7^{b} ±0.1	79.6^{b} ±0.1
Diacetyl	Fresh	1.65^{i} ±0.03	2.933^{e}±0.12	3.1^{g} ±0.1	3.597^{f} ±0.02	3.993^{de} ±0.01
	7	2.9^{h} ±0.1	3.533±0.06^{f}	3.9^{e} ±0.1	3.667^{f} ±0.07	4.063^{d} ±0.118
	15	3^{gh} ±0.1	4.153±0.1^{hc}	4.5^{g} ±0.1	4.6^{b} ±0.1	4.903^{a} ±0.100
Acetoin	Fresh	2^{g} ±0.1	3.14±0.052^{fg}	4.5^{e}±0.173	3.9^{cd} ±0.087	4.1^{c} ±0.173
	7	3.033^{fg} ±0.06	4.097^{c} ±0.11	4.867^{d} ±0.153	4.07^{cd} ±0.12	4.8^{b} ±0.173
	15	3.233^{f} ±0.06	5.01^{a} ±0.09	5.6^{e} ±0.1	5.1^{a} ±0.1	5.1^{a} ±0.173

Values are expressed as mean± standard deviation (*N*=3). a (significantly different from control group at P < 0. **C=yoghurt without juice** **T_1=**yoghurt with 10% pomegranate juice (PJ)+0.4% Gelatin (G)
T_2=yoghurt with 15% pomegranate juice (PJ)+0.4% Gelatin (G)
T_3=yoghurt with 10% pomegranate juice (PJ)+1%starch (S)
T_4=yoghurt with 15% pomegranate juice (PJ)+1% starch (S)

Total Phenolic Content , total flavonoid and Antioxidant capacity : According Data in table (6) cleared that total phenolic content of T1,T2,T3and T4 were 182±0.17 ,200.82± 0.76 ,187.7± 0.3 and 213.9 ±0.1 respectively In fresh set yoghurt which the total content of phenolic for control samples 166.3±0.104 in fresh products . total phenolic content of control sample after 15 days posed 60.5 data demonstrated that the addition of pomegranate juice to yoghurt samples resulted in higher total content of phenolic , flavonoid and antioxidant than control and phenolic , flavonoid and antioxidant content decrease in all treatment and control during storage it was possible that moste of the degradation of the total phenolic contents resulted from oxidation reaction .Data obtained in table (6)concluded that when pomegranate juice was added to yoghurt total phenolic , total flavonoid and antioxidant was much higher significant ($p \leq 0.05$)than control. Ashoush et al. (2013) and Ashoush and Gadallah (2011)

Table(6): Total phenol, Flavonoid and Antioxidant of yoghurt fortified with (10,15%)concentrate Pomegranate juice and starch (S 1%) and gelatin (G0.4%) during storage at 5°c±1 for 15 days

	Storage period	Control	T_1	T_2	T_3	T_4
Total phenolic Mg/100g	Fresh	166.3 ^{g} ±0.104	182.9 ^{e} ±0.17	200.82 ^{a} ±0.76	187.7 ^{d} ±0.3	213.9 ^{b} ±0.1
	7	120.4 ^{j} ±0.02	156.5 ^{h} ±0.1	189.87 ^{c} ±0.153	176.9 ^{f} ±0.1	191.17 ^{n} ±0.06
	15	60.5±0.03 ^{l}	118.1 ^{k} ±0.04	140.3 ^{m} ±0.1	118.02 ^{k} ±0.06	156.01 ^{i} ±0.02
Total Flavonoid Mg /100g	Fresh	265.4 ^{a} ±0.1	427.017 ^{b} ±0.029	457.007 ^{b} ±0.04	421.54 ^{c} ±0.08	465.4 ^{e} ±0.17
	7	150 ^{g} ±0.1	350.007 ^{g} ±0.19	396.2 ^{f} ±0.1	354.1 ^{j} ±0.1	376.15 ^{h} ±.0.07
	15	106.207 ^{k} ±0.101	200.3 ^{l} ±0.05	293.1 ^{i} ±0.1	203 ^{m} ±0.17	219.3 ^{d} ±0.056
Antioxidant Capacity Mg/100g	Fresh	250.9 ^{a} ±0.1	330.13 ^{ab} ±1.3	347.6 ^{ab} ±0.2	333.1 ^{ab} ±0.1	345.3 ^{ab} ±0.1
	7	229.57 ^{ab} ±0.981	319.53 ^{abc} ±0.4	326.8 ^{ab} ±0.17	318.1 ^{bc} ±0.1	332.01 ^{ab} ±0.01
	15	159 ^{d} ±0.03	193.8 ^{c} ±0.4	224.5 ^{ab} ±0.1	189 ^{d} ±0.03	221.4 ^{abc} ±0.1

Values are expressed as mean± standard deviation (*N*=3). a (significantly different from control group at P < 0.05 C=yoghurt without juice T_1=yoghurt with 10% pomegranate juice (PJ)+0.4% Gelatin (G)
T_2=yoghurt with 15% pomegranate juice (PJ)+0.4% Gelatin (G)
T_3=yoghurt with 10% pomegranate juice (PJ)+1%starch (S)
T_4=yoghurt with 15% pomegranate juice (PJ)+1% starch (S)

Microbiological Analysis

Total lactic acid bacteria

Table 7 demonstrates the microbial load of sample with use of deferent pomegranate juices ratio .The total bacterial count of yoghurt fortified with pomegranate juices was greater than that of the control samples. the yoghurt samples fortified with pomegranate juice (15%) exhibited the highest overall LAB bacterial count. Additionally, the data in Table 7 demonstrated that at the end of the storage period.

During the first week of storage, the numbers of *Str. thermophilus* and *Lb. delbrueckii* ssp. *Bulgaricus* declined significantly. After that, they decreased gradually until the end of the storage period. These bacteria's sensitivity to acid evolved over the course of the storage period, which is why the lactic acid bacterial populations gradually decreased. these findings are consistent with those of El-Batawy (2012), Paseephol and Sherkat (2009), Oliveira et al. (2009), and Ibrahim et al. (2004). Emine and Ihsan (2017 found that *S. thermophilus* and *L. delbrueckii* subsp. *bulgaricus* counts rose until the fourteenth day and then fell, . This decline may have resulted from a drop in pH values brought on by the development of acidity. According to Ali et al. (2022), control samples had a greater drop in LAB than the stabilizer-treated samples. This could be because the medium's water activity was lower than that of the stabilizer-treated medium.

yeast and molds:

yeast and molds were free in all yoghurt samples. these findings are in consistent with those of Matter et al. (2016) and El-Nagga and Abd El-Tawab (2012).

Table(7) : Effect of concentrated pomegranate on total count lactic acid bacteria , yeast and mold of yoghurt during storage periods of yoghurt fortified with (10,15%)concentrate Pomegranate juice and starch (S 1%) and gelatin (G0.4%) during storage at 5°c±1 for 15 days

Test	Storage Periods	Control	T_1	T_2	T_3	T_4
Total L.A.B	Fresh	$80^{i} \times 10^{7}$	$192^{f} \times 10^{7}$	193×10^{7f}	$232^{b} \times 10^{7}$	$255^{a} \times 10^{7}$
	7	$78^{i} \times 10^{7}$	$184^{h} \times 10^{7}$	190×10^{7g}	$213^{c} \times 10^{7}$	$241^{b} \times 10^{7}$
	15	$72^{k} \times 10^{7}$	$165^{j} \times 10^{7}$	$179^{i} \times 10^{7}$	$197^{e} \times 10^{7}$	$200^{d} \times 10^{7}$
Mold and yeast	Fresh	ND	ND	ND	ND	ND
	7	ND	ND	ND	ND	ND
	15	ND	ND	ND	ND	ND

Values are expressed as mean± standard deviation (*N*=3). a (significantly different from control group at P < 0.05 C=yoghurt without juice T_1=yoghurt with 10% pomegranate juice (PJ)+0.4% Gelatin (G)
T_2=yoghurt with 15% pomegranate juice (PJ)+0.4% Gelatin (G)
T_3=yoghurt with 10% pomegranate juice (PJ)+1%starch (S)
T_4=yoghurt with 15% pomegranate juice (PJ)+1% starch (S)
nd: not detected

Sensory evaluations:

Data in Table 8 incorporation the texture, appearance, flavor, and acidity values. It is evident that adding pomegranate juice at any level significantly (p>0.05) affects all criteria, including freshness scores texture, appearance, flavor, and acidity compared to control and other treatments. The inclusion of pomegranate juice had a 10% positive impact on all parameters and received the highest rating. According to Gomah and Zohri, (2014), adding pomegranate juice to yoghurt improved the resulting yoghurt's sensory assessments.

Table (8) : Sensory evaluation of yoghurt fortified with (10,15%)concentrate Pomegranate juice and starch (S 1%) and gelatin (G0.4%)

treatments		Body and texture (30)	Appearance (15)	Acidity 10	Flavor (45)
Control		25.5 ± 0.5^{d}	11.5 ± 0.5^{b}	$5.5^{d} \pm 0.5$	$29.5^{d} \pm 0.5$
10% PJ	1% ST	$28.5^{b} \pm 0.5$	$14^{a} \pm 0.5$	$9.33^{a} \pm 0.29$	$43.5^{b} \pm 0.5$
	0.4 G	27.5 c ±0.5	$13.6^{a} \pm 0.36$	$9.17^{ab} \pm 0.29$	$44^{ab} \pm 0.5$
15%PJ	1% ST	$29.5^{a} \pm 0.5$	$14.17^{a} \pm 0.29$	$8.75^{bc} \pm 0.07$	$44.5^{a} \pm 0.5$
	0.4 G	$28.17^{bc} \pm 0.289$	$13.67^{a} \pm 0.29$	$8.28^{c} \pm 0.026$	$42.5^{c} \pm 0.5$

Values are expressed as mean± standard deviation (*N*=3). a (significantly different from control group at P < 0.05 C=yoghurt without juice T_1=yoghurt with 10% pomegranate juice (PJ)+0.4% Gelatin (G)
T_2=yoghurt with 15% pomegranate juice (PJ)+0.4% Gelatin (G)
T_3=yoghurt with 10% pomegranate juice (PJ)+1%starch (S)
T_4=yoghurt with 15% pomegranate juice (PJ)+1% starch (S)

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الملخص العربي

تحسين الخواص الوظيفيه للزبادي باستخدام عير الرمان

اسماء رمضان علي - ا.د صباح توني عبد الرازق - مها محمود السيد بخيت
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هذه الدراسه الي التحقق من تأثير اضافة عصير الرمان كمكون طبيعي علي الخصائص الفزيائيه و الكيميائيه و مضادات الاكسده والفينولات و الفلافونويد و مركبات النكهه (الاسيتالدهيد وثنائي الاسيتسل و الاسيتون) والفحص الميكروبيولوجي .التقييم الحسي للزبادي . ينكون من لبن بقري ،٣% دهن،عصير الرمان (١٠و ١٥%) ومثبت (١% نشا و ٠.٤% جيلاتين) تمت إضافة ١٠ و١٥% من العصير، وأضيف ٢% بادئ زبادي إلى كل المعاملات، وتم تخزينها جميعها عند درجة حرارة ١±٥ درجه مئوية حتى نهاية فترة التخز ين البالغة ١٥ يومًا. تم دراسة الخصائص الفيزيائية والكيميائية لعينات الزبادي، مثل الرقم الهيدروجينيو الحموضه والبروتين والدهن والمواد الصلبة الكلية. علاوة على ذلك، تم اجراء تقييم الحسي وفحص الميكروبيولوجي علي جميع المعاملات سواء كانت طازجة أو بعد سبعة ايام وخمسة عشر يومًا من التخزين البارد عند درجة حرارة ١±٥ درجه مئوية. و أظهرت النتائج وجود فروق معنوية في المواد الصلبة الكلية والأس الهيدروجيني والحموضة بين عينات. علاوة على ذلك فإن مضادات الأكسدة والفلافونويدات الكلية والمركبات الفينولية زادت معنوياً مع إضافةعصير الرمان . وقد وجد أن الحموضة لجميع العينات زادت أثناء التخزين. وكانت مستويات التشريش للزبادي مع عصير الرمان ١٥% معنوية. أظهر التقييم الحسي وجود اختلافات ملحوظة بين عينات الزبادي. الكنترول و حصلت العينات المعامله بالعصير بنسبة ١٠% على أعلى درجات النكهة والملمس مقارنة بالعينات المعامله بعصير الرمان بنسبة ١٥%. أظهرت النتائج التي تم الحصول عليها في هذه الدراسة أن إضافة عصيرالرمان الي الزبادي حسنت بشكل كبير من جودة الزبادي وزادت من فوائده الصحية.