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EFFECT OF PERSIMMON (*Diospyros Kaki*) PULP ON THE PHYSICO-CHEMICAL AND SENSORIAL CHARACTERISTIC OF YOGHURT DURING STORAGE

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Abstract

Persimmon (Diospyros kaki) is an edible fruit contained a lot of secondary metabolites that carry out diverse biological and antioxidant action. The fruit is particularly nutritious and therapeutic. The study was conducted to evaluate the physico-chemical and sensory properties of the persimmon based yogurt during the storage period. The persimmon based yogurt was prepared with various percentages of persimmon pulp including 0 %, 5 %, 10 %,15 %, 20, %. A different yoghurt samples were evaluated for pH, titratable acidity, syneresis, fat, protein, total phenol and antioxidant activity was also checked from 5-25 days of storage period. A significant variations at (P<0.05) were observed among different treatment for physicochemical, functional and organoleptic evaluation. By increasing the concentration of persimmon pulp, fat and protein decreased in all pH treatments, but acidity tannin, syneresis, total phenolic and antioxidant activity increased. Similarly with the passage of time the pH, total phenols, antioxidant, fat, protein and tannin content dropped while acidity and syneresis increased. Significant variation was also observed for organoleptic evaluation. The inclusion of persimmon pulp improved the flavor, taste and overall acceptability up to 10 % concentration however yogurt samples with higher concentrations had an unpleasant taste and flavor. During storage acidity and syneresis increased but pH, fat, protein, phenolic content, and antioxidant activity and organoleptic decreased. Persimmon yoghurt samples with 10% yogurt content were found to be acceptable for 15 days. It was concluded that persimmon-based yoghurt made with various combinations may kept for 15 days at 4°C to reduce the post-harvest loses and increase the nutritional contents.

INTRODUCTION

Persimmon *(Diospyros kaki)* is an edible fruit that is a member of the family Ebenaceae, which is native to China and Japan (Baltacıoglu and Artık, 2013). Persimmon is cultivated and known as "Trabzon hurması" in Turkey (Doymaz, 2012). The colour of its fruits varies from light yellow orange to dark red-orange. It can be consumed fresh or dried (Ergun and Ergun, 2010). Traditionally it is used as an herbal medicine in China (Gu *et al.*, 2008). A persimmon is generally consumed as a fresh fruit in Europe and has a positive impact on human health (Karaman *et al.*, 2014); it is an abundant source of vitamin C, vitamin A, calcium and iron. It contains many bioactive

compounds, especially ascorbic acid, condensed tannins and carotenoids. Bioactive compounds contribute to human health mainly through their antioxidant properties (Karaman *et al.*, 2014). In addition, some bioactive compounds can influence sensory characteristics. Fresh fruits have a short shelf life. There are many methods for extending shelf life, such as drying and making fruit juice (Benedetti *et al.*, 2011).The use of a honey dip solution prolonged the storage life of fresh persimmon based on the delay of off-aroma development (Ergun and Ergun, 2010). Recently, different properties of persimmon and preservation methods have been studied (Gu *et al.*, 2008).

Yogurt is one of the oldest and popular fermented foods because of its nutritive and therapeutic value (Mahmood *et al.*, 2008). It is derived from Turkish Word ''Jugurt'' showing any fermented food with acidic taste. It is known by different name in different countries of world, like Jugurt/Eyran in Turkey, Zabady in Egypt and Dahi/dadhi/dahee in India, Pakistan, Bangladesh and Nepal. Yogurt is rich in nutrients such as potassium, calcium, protein, vitamin B and probiotics that is good for digestion, cholesterol reduction and in prevention of diarrhea. Consumer acceptance of yogurts is based on physical attributes like lack of Syneresis, perceived viscosity, lack of acidity and aroma perceptions and the textural properties. Flavor and consistency are important parameters in yogurt quality (Vercet *et al.*, 2002). Yogurt has non-Newtonian flow properties with strong time dependence on both the thixotropic and viscous elastic types (De-Lorenzi *et al.*, 1995).

Beside the nutritional aspect yogurt also has some health benefits or physiological function. It is a rich source of bio-active peptide like casomorphins, casokinins, immunopeptides, lactoferricin and phosphopeptides (Raut *et al.*, 2015).

It is used for antimicrobial activity, gastrointestinal infection and also used for the treatment of cancer. It also helps in the reduction of serum cholesterol. It improves the immunity of a body by rapid stimulation. Yogurt bacteria reduce the activity of nitrate reductase which produces the carcinogenic compound (Amerinasab *et al.*, 2015). Consumption of yogurt also helps for the treatment of cardiovascular system diseases, musculoskeletal system diseases and urogenital system disease (Gahruie *et al.*, 2015). It is used for treatment of diarrheal disease and lactose intolerance (Adam *et al.*, 2004). It alleviates bone problems and a good form of pre-digested food. It is also used for the treatment of dysentery and dyspepsia (Gandhi, 2010: (Kumruzzaman *et al.*, 2013).

In developed countries yogurt is fortified with different types of fruit pulp, to reduce the post-harvest loses and increase the nutritional contents for the benefit of human being (Arteuro *et al.*, 2012). In order to add to its nutrition and therapeutic characteristics, some other edibles like fruit pulp is added (Adam *et al.*, 2004). As making the yogurt 'functional' the trend has been found increasing considerably by users as well as manufacturers because of its additional health and nutritional benefits (Sengul *et al.*, 2012). Yogurt with addition of seasonal fruits are very nutritious and attractive. Addition of fruits makes the yogurt most tasteful. The product made by the addition of fruit having both nutritive as well as refreshing effects of fruits. Fruit yogurt is a popular type functional food which is also liked by children who disliked the sour taste of plain yogurt. This change made the yogurt tastier and delightful which has both nutritious as well as the additional benefits depending upon the fruits is used (Mahmood *et al.*, 2008).

Persimmon fruit is highly produced in different areas of Azad Kashmir. Although it is a rich source of vitamin C and bioactive compounds, but due to lake of awareness of people it is not properly utilized and mostly wasted. To avoid the wastage Persimmon fruits can be more efficiently utilized by its value addition or by adding into different food products. Yogurt is one of the products for the addition of persimmon fruit as it is the most common dairy product which is liked by all age groups, especially children. In this research, an alternative use for persimmon is provided by developing its product, following will be the objective of this study. To investigate the physico-chemical and sensory properties of the Persimmon based yogurt samples during the

storage period. To developed persimmon based yogurt product.

MATERIAL AND METHODS

Collection of milk and Persimmon fruit

The raw buffalo milk and persimmon fruits were collected from local market of Rawalakot city, Azad Kashmir and transferred to the Laboratory of Food Science and Technology Department. The milk was stored at 4°C until used.

A persimmon pulp were prepared

Preparation of yogurt

Yogurt was prepared by the method of Robinson and Tamime (1999). Milk was heated to 90°C for 10 minutes and then rapidly cooled to 42°C. The milk was then inoculated with starter culture (20 g /100 per L) containing *S. thermophilus and L. bulgaricus* and incubated at 42 °C until pH reached to 4.6, and then, the yogurt was stored in a refrigerator at 4°C. Then yogurt addition of persimmon pulp was in following manner.

Table 1. Different Concentrations of persimmon pulp

Treatment	Persimmon Pulp Concentration (%)
T_0	0 (Control)
T_1	5
T_2	10
T_3	15
T_4	20

The yogurt sample was stored in pre-sterilised plastic jars and stored at low temperature. Each treatment was consist of 6 jars and separate jar sample was used for analysis during each storage interval. In this way total numbers of 30 jars were used for the study. These yogurt samples were analysed for different physico-chemical and sensory parameters at 0, 5, 10, 15, 20 and 25 days of storage. The experiment was laid out in two factor factorial in completely randomized design with three replications.

Physico-chemical analysis of Persimmon-based yogurt

pH

The pH of Yogurt samples were measured by pH meter according to method as reported in AOAC (2006). After calibration the Yogurt sample was taken in a beaker. The reading was noted by dipping electrode in sample.

Titratable acidity

Titratable acidity was analyzed by the method described in procedure AOAC method no. 942.15 (2006). Titratable Acidity in percentage was measured by given formula. For this purpose 10% Data was recorded on three replications and percent titratable acidity was calculated in terms of malic acid by using the following formula:

$$T.A(\%) = \frac{\text{mL of NaOH used} \times \text{Normality of NaOH} \times \text{Eq.Wt. of malic acid}}{\text{Wt. of sample} \times \text{Vol. of aliquot taken}}$$

Total phenols

The total phenolic content as Gallic acid equivalent (GAE) was determined by using the method of (Singleton *et al.*, 1999). The mean of three readings were used and the total phenol content was expressed as milligrams of Gallic acid equivalents/g extract.

$$\text{Total Phenols (mg)} = \frac{1.13 \times (\text{absorbance})}{\text{weight of sample}} \times 100$$

Antioxidant

Antioxidant activity of the yogurt sample was determined by DPPH method as described by (Williams *et al*,. 1995).The antioxidant activity was calculated by using following formula:

DPPH scavenging activity (%) = (Ao -As/Ao) × 100

Syneresis
Syneresis of yogurt was determined (Khan and Haque, 1992), by putting filter paper on the top of a funnel, after that 100g of yogurt sample was spread on the paper. The drainage time and temperature degree was 2h at 4°C. The percentage of syneresis calculated as,
Syneresis (%) = Liquid weight/initial sample weight) x 100

Fat content
The Gerber method analysis was used to determine the fat content in yogurtt (AOAC, 1984).

Protein content
Total protein percent of yogurt sample was estimated through kjeldhal apparatus. The Kjeldahl method was performed according to method 981.10 of the AOAC International.
The Kjeldahl method was performed according to method 981.10 of the AOAC (2000).

Tannin content
Soluble tannins were measured according to the method of Khasnabis *et al*,. (2015).
Tannin (%)= (a-b) × normality of KMnO4 × 4.16 ÷ weight of sample.

Organoleptic Evaluation
Organoleptic tests were carried out on preserved samples using a panel of five judges. The judges were asked to rate the samples on the colour, taste, flavour and overall acceptability based on the 9-point Hedonic scale ranging from liked extremely (9) to disliked extremely (1) (Larmond, 1977).

Statistical analysis
The data obtained was statistically analysed by using two factor factorial in completely randomized designed at 5% level of significance while the means were compared by using LSD value (Steel *et al*., 1997).

Results and Discussion
The Persimmon based yogurt was evaluated for physico-chemical characteristics (pH, Titratable Acidity, Fat, Protein, Synersis), Functionals are (Total Phenols, Anti-oxidant Activity) and Sensory characteristics are (Colour, flavour, taste and overall acceptability) during storage.

pH
Storage intervals were significantly different while their interaction have non-significant effect (Table 1). The LSD test displays that all treatments had decreasing trend. It is obvious from the results that pH of the persimmon based yogurt samples decrease with increasing the Concentration of persimmon pulp. Top most value of (4.91) was observed in T_0 (without persimmon pulp), while minimum pH value (4.40) was recorded in T_4 (with 20 % persimmon pulp). This decrease in pH with increasing the concentration of persimmon pulp in yogurt samples might be due to the presence of organic acids such as tartaric acid followed by malic acid, citric acid and fumaric acid in persimmon fruit (Chen *et al*., 2016). Results reported in this study were consistent with the result of previous studies conducted by (Ertürk and Demirkol, 2014).
The results regarding pH of yogurt samples as affected by different storage intervals are showed in Table 1. These results highlighted decreasing trend of pH during storage. The highest pH value noted at 0 day while lowest value was observed at 25 days. The decreasing trend of pH in all treatments during storage was due to conversion of lactose into lactic acid by the action of lactic acid bacteria. The results regarding decrease in pH during storage were in line with the finding of (Temiz *et al*,. 2014) who also observed decreasing trend of pH during storage in addition of Cherry laurel marmalade to yogurt in the same way (Bingle *et al*,. 2016) also reported decreasing pH during storage by the addition Persimmon marmalade and puree in yogurt.

Table 1. Effect of treatment and storage intervals on pH of Persimmon based yogurt Samples

Treatments	Days of storage						Means
	0	5	10	15	20	25	
T_0	4.91±0.17	4.82±0.16	4.70±0.16	4.55±0.15	4.42±0.15	4.40±0.15	**4.63A**

T_1	4.83±0.15	4.75±0.14	4.63±0.14	4.48±0.14	4.38±0.13	4.34±0.13	**4.56A**
T_2	4.73±0.19	4.65±0.19	4.50±0.18	4.33±0.17	4.20±0.17	4.16±0.17	**4.42B**
T_3	4.42±0.13	4.34±0.13	4.35±0.22	4.18±0.21	4.02±0.20	4.0±0.20	**4.17C**
T_4	4.40±0.11	4.29±0.10	4.12±0.10	4.00±0.10	3.84±0.09	3.77±0.10	**4.07C**
Means	**4.65A**	**4.57A**	**4.46B**	**4.29C**	**4.15D**	**3.10D**	

Titratable acidity (%)

The results related to analysis of variance shown that all the treatments, storage intervals and their interactions were significantly different from each other (Table 2). Results having significant difference were tested LSD test at 5% level of significance. It is obvious from the results that TA of the persimmon based yogurt samples increased with increasing the concentration of persimmon pulp. Highest value of TA (0.99) was observed in T_4 (with 20% persimmon pulp), while minimum TA value (0.48) was recorded in T_0 (0% persimmon pulp). This increased in TA with increasing the concentration of persimmon pulp in yogurt samples might be due to lowering of pH and the presence of organic acids such as tartaric acid followed by malic acid, citric acid and fumaric acid in persimmon fruit. Results reported in this study were consistent with the result of previous studies conducted by (Chen *et al.*, 2016).

The results related TA of yogurt samples as affected by different storage intervals are showed in Table 2. These results depict the increasing trend of TA during storage. The highest TA value noted at 25 days while lowest value was observed at 0 day of storage. The decreasing trend of TA in all treatments during storage was due to conversion of lactose into lactic acid by the action of lactic acid bacteria as a result of this various acids produced which increased the acidity of yogurt. The results regarding increase the TA during storage were in line with the finding of (Barkallah *et al*,. 2017) who observed increasing trend of TA during storage in addition of Spirulinaplatensis marmalade to yogurt in the same way (Joung *et al*., 2016) also reported increasing TA during storage by the Korean herb in yogurt.

Table 2. Effect of treatment and storage intervals on Titratable Acidity (%) of Persimmon based yogurt Samples

Treatments	Days of storage						Means
	0	5	10	15	20	25	
T_0	0.30±0.01	0.35±0.01	0.41±0.02	0.68±0.02	0.85±0.03	0.91±0.03	**0.48E**
T_1	0.40±0.01	0.45±0.02	0.60±0.02	0.78±0.02	0.94±0.03	1.00±0.03	**0.69D**
T_2	0.4±0.02	0.5±0.01	0.75±0.03	0.88±0.04	1.00±0.04	1.06±0.04	**0.78C**
T_3	0.57±0.02	0.66±0.02	0.83±0.04	0.92±0.05	1.07±0.05	1.17±0.06	**0.86B**
T_4	0.72±0.02	0.76±0.02	0.97±0.02	1.09±0.03	1.16±0.03	1.24±0.03	**0.99A**
Means	**0.49F**	**0.54E**	**0.71D**	**0.86C**	**1.0B**	**1.07A**	

Fat Content (%).

Analysis of variance of yogurt samples were statistically analyzed and their finding are given in table (Table 3) It is analyzed from the results that treatments and storage means have significant while their interaction have non-significant effect on fat level. Results showing significant difference were subjected to LSD test at 5% level of significance.

Results regarding mean values related to fat content of persimmon based yogurt samples are given in Table 3. The results clearly showed that highest value (3.77%) of fat content was observed in T_0 (control without persimmon pulp) followed by (3.19%) T_1 (yogurt with 5% persimmon pulp) and lowest fat content (2.84%) was observed in T_4 (yogurt with 20 % persimmon pulp). It is showed that fat percentage decreased by increasing mulberry pulp concentration into yogurt samples. This decreasing trend may be due to the fact that persimmon fruit have lower percentage of fat that is why when the fruit percentage increased the fat level became lower. Similar results were found (Sengul *et al,*. 2012), study showed decreasing fat level by the addition of sour cherry into yogurt and (Roy *et al,*. 2016) concluded that addition of fruits pulp in yogurt decreased the fat level.

During the storage the highest value (3.30%) of fat content was observed at 0 days, while the lowest value (3.22 %) of fat percentage at 25 days of storage given in Table 3, showing that as the storage period increase the fat level of yogurt samples decreased although the percentage of decreasing trend is smaller. Same trend were showed by (Kauser *et al,*. 2011) who concluded the decreasing trend of fat in apricot yogurt during 22 days of storage. It is concluded that fat% decreased non-significantly during the storage.

Table 3. Effect of treatment and storage intervals on Fat (%) of Persimmon based yogurt Samples

Treatments	Days of storage						Means
	0	5	10	15	20	25	
T_0	3.82±0.13	3.81±0.13	3.79±0.09	3.76±0.07	3.74±0.13	3.71±0.08	**3.77A**
T_1	3.58±0.11	3.57±0.16	3.55±0.08	3.53±0.05	3.48±0.10	3.45±0.01	**3.52B**
T_2	3.25±0.13	3.25±0.16	3.22±0.01	3.20±0.08	3.18±0.13	3.17±0.06	**3.21C**
T_3	3.14±0.09	3.12±0.08	3.10±0.07	3.08±0.05	3.05±0.05	3.02±0.04	**3.04D**
T_4	2.84±0.08	2.82±0.07	2.80±0.03	2.78±0.06	2.77±0.14	2.73±0.08	**2.84E**
Means	**3.30A**	**3.30A**	**3.29A**	**3.27AB**	**3.25AB**	**3.22B**	

Proteins Content (%)

Proteins are essential nutrients for the human body. They are one of the building blocks of body tissue and can also serve as a fuel source.

The results regarding analysis of variance of yogurt samples under various treatments during storage were shown in Table 4. Statistical analysis of protein highlighted that significant effect were observed for different yogurt treatments and storage interval but non-significant effect was found in case of interaction. It is cleared that increasing the concentration of persimmon pulp in yogurt samples resulted decrease of protein content. Higher value (3.21%) recorded in T_0 (yogurt with 0% persimmon pulp) while minimum value (3.05%) recorded in T_4 (yogurt with 20% persimmon pulp). The decreasing trend of protein in yogurt samples with higher concentration of persimmon pulp might be due to lower content of protein in persimmon pulp and suppress the protein values in yogurt samples. The results of present study are in line with the finding of (Khan, 2000) who also observed lower protein content in yogurt added with banana based yogurt.

Protein in all yogurt treatments gradually decreased significantly during the storage, means are reported in Table 4. It is clear from the results that greatest decreased in protein was observed with the passage of time. This decreased trend is due to the breakdown of peptide. Similar findings were noted by (Arslan and Özel, 2012).

Table 4. Effect of treatment and storage intervals on Protein content (%) of Persimmon based yogurt Sample

Treatments	Days of storage						Means
	0	5	10	15	20	25	

T_0	3.25±0.11	3.22±0.11	3.22±0.12	3.21±0.07	3.20±0.13	3.18±0.08	**3.21BC**
T_1	3.22±0.10	3.21±0.10	3.21±0.11	3.20±0.05	3.19±0.10	3.17±0.01	**3.18CD**
T_2	3.18±0.13	3.15±0.13	3.15±012	3.13±0.11	3.11±0.13	3.09±0.06	**3.13D**
T_3	3.04±0.09	3.01±0.09	3.12±0.08	3.11±0.07	3.09±0.05	3.04±0.04	**3.11B**
T_4	3.09±0.09	3.05±0.08	3.05±0.08	3.04±0.06	3.03±0.14	3.00±0.08	**3.05A**
Means	**3.31A**	**3.29A**	**3.29AB**	**3.28B**	**3.24B**	**3.23B**	

Syneresis (%)

Syneresis is the removal of water from the surface of yogurt. It is one of the quality defects of yogurt. Lower syneresis improves the quality and also the acceptability of yogurt.

The results regarding analysis of variance of yogurt samples under various treatments during storage were shown in Table 5. Statistical analysis of syneresis highlighted that significant effect were observed for different yogurt treatments and storage interval but non-significant effect was found in case of interaction. It is cleared that increasing the concentration of persimmon pulp in yogurt samples resulted an increase of syneresis. Higher value (41.40%) recorded in T_4 (yogurt with 20% persimmon pulp) while minimum value (25.81%) recorded in control T_0 (control without persimmon pulp). The increasing trend of syneresis in yogurt samples with higher concentration of persimmon pulp might be due to high acidity resulting lower the water holding capacity of protein present in yogurt thus allowing water to release. The result of present study are in agreement with the finding of (Fox *et al.*, 2000) who also observed high syneresis in yogurt added with lime based yogurt, similarly addition of carrot juice also resulted in higher syneresis values as reported by (Emun *et al*, 2016). Syneresis in all yogurt treatments gradually increased significantly during the storage, means are reported in Table 5. It is cleared from the results that greatest increase in syneresis was observed on 25 days (53.24%) while minimum was noted on zero days (16.64%), which means syneresis increase with the passage of time. This increment is due to the production of acidity in yogurts which decreases the water holding capacity and removes water from gel network. Similar findings was observed by (Kauser *et al,*. 2013) and (Temiz *et al,*. 2013).

Table 5. Effect of treatment and storage intervals on Synersis (%) of Persimmon based yogurt Samples

Treatments	Days of storage						Means
	0	5	10	15	20	25	
T_0	10.0±0.34	14.3±0.49	19.0±0.85	28.5±0.65	37.0±1.29	45.1±1.57	**25.81E**
T_1	13.0±0.39	17.2±0.52	22.1±0.79	32.7±0.66	40.0±1.20	47.8±1.43	**28.80D**
T_2	16.2±0.65	19.1±0.76	24.2±1.18	35.8±0.97	43.4±1.74	51.0±2.04	**31.61C**
T_3	20.3±0.59	25.2±0.77	28.3±1.76	42.2±1.42	51.3±2.57	59.3±2.97	**37.51B**
T_4	24.2±0.59	29.0±0.76	32.0±0.97	46.5±1.44	54.5±1.31	62.0±1.49	**41.40A**
Means	**16.64A**	**20.79B**	**25.12C**	**37.14D**	**25.24E**	**53.24F**	

Total Phenols

Persimmon fruits contain many phenolic compounds such as flavonoid (gallic acid and cinnamic acid), catechin, epicatechine, rutin, procyanidin B1 and luteolin. The results related to analysis of variance of various yogurt samples were statistically analysed and results are given in Table 6.

The mean values of phenolic contents of different treatments are showed in Table 6. It is cleared from results that phenolic content increasing by the addition of persimmon concentration. As increasing persimmon pulp concentration, phenolic content also increased. Highest value (63.1mg/gallic acids) was noted in T_4 (yogurt with 20% Persimmon pulp) while Lowest value (15.8mg/gallic acids) of antioxidant activity in T_0 (control without persimmon pulp). This increased in phenolic content by the addition of persimmon pulp due to the fact that persimmon fruit have higher phenolic compounds (Sengul *et al.*, 2012) who also found the increasing trend of phenols by the addition of sour cherry pulp into yogurt, similarly (Yadav *et al*,. 2015) also observed the increasing values of phenolic content in grape peel extract based yogurt. It is obvious from results that antioxidant activity in all sample decreased with the passage of time. Results illustrated that top most value of phenolic contents (51.33%) was observed at 0 day of storage while lowest value (17.3%) was reported at 25 days of storage. The decreasing trend is due to lowering of phenolic content during storage because antioxidant activity is directly proportion to phenolic contents. This decreasing trend is due to the loss of most important single group of phenolics which are flavonoids which involves mostly catechins, proanthocyanins, anthocyanidins, quercetin, and their glycoside into monomeric anthocyanins might have been distorted into polymeric compounds this is the reason for lowering of total phenolic. The result of this research concord (Klimczak *et al.*, 2007), who reported that decreasing the total phenols during storage in orange based yogurt. In the same way persimmon based yogurt also showed decreasing trend during storage as reported by (Arslan and Bayrakci, 2015).

Table 6. Effect of treatment and storage intervals on Total Phenols (mg) of Persimmon based yogurt Samples

Treatments	Days of storage						Means
	0	5	10	15	20	25	
T_0	24.5±0.83	21.5±0.73	17±0.58	14±0.48	10.7±0.36	7.3±0.25	**15.8E**
T_1	35.7±1.07	33.2±1.0	31.4±0.94	28.2±0.85	26.5±0.80	24.3±0.73	**29.8D**
T_2	47.3±1.89	44.5±1.78	42.6±1.70	40.1±1.60	37.3±1.49	35.5±1.42	**41.2C**
T_3	59±1.76	56.1±1.67	55.8±2.79	52.3±2.62	50.2±2.51	47.2±2.36	**52.7B**
T_4	74.9±1.80	66.2±1.59	64±1.54	60.5±1.45	58.1±1.39	55.3±1.33	**63.1A**
Means	**47.8A**	**43.9B**	**42.1C**	**39.0D**	**36.5E**	**33.9 F**	

Antioxidant Activity (%)

The results related to analysis of variance of various yogurt samples were statistically analysed and results are given in Table 7. It is concluded from results that antioxidant activity was significantly affected by different treatments and storage intervals while their interaction have non-significant effect. Results showing significant effect were subjected to LSD test at 5% level of significance. It is cleared from results that antioxidant activity increasing by the addition of persimmon concentration. As increasing persimmon pulp concentration, antioxidant activity also increases. Highest value (51.33%) was noted in T_4 (yogurt with 20% Persimmon pulp) followed by (37.56%) T_3

(yogurt with 15% persimmon pulp), while lowest value (17.22%) of antioxidant activity in T_0 (control without persimmon pulp). This increase in antioxidant activity by the addition of persimmon pulp might be due to the fact that persimmon fruit have higher antioxidant include vitamin C, lycopene, flavones and hydroxybenzoic acids (Butkhup *et al*,. 2013) because of these compounds in persimmon results increased antioxidant activity when added it into yogurt. These results are in line with the research of (Zainoldin and Baba, 2009) that added Hylocereuspolyrhizus and Hylocereusundatus (white and red dragon fruit) into yogurt and reported similar increasing trend. Similarly, antioxidant activity increased by the addition of pomegranate seed extract in yogurt as reported by (Ersoz *et al*,. 2011). The results regarding effect of different storage interval on antioxidant activity of yogurt samples were presented in Table 7. It is obvious from results that antioxidant activity in all sample decreased with the passage of time. Results illustrated that top most value of antioxidant activity (51.33%) was observed at 0 day of storage while lowest value (17.3%) was reported at 25 days of storage. The decreasing trend is due to lowering of phenolic content during storage because antioxidant activity is directly proportion to phenolic contents (Butkhup *et al*,. 2013).

Another reason for decreasing the antioxidant activity is due to lower content of vitamin C that directly influence on antioxidant activity. Previously (Oliveira *et al*,. 2015) also reported the decrease in antioxidant activity during storage in strawberry based. Similarly yogurt with aronia juice also showed decreasing trend of antioxidant activity during storage as reported (Nguyen and Hwang, 2016).

Table 7.Effect of treatment and storage intervals on Antioxidant Activity (%) of Persimmon based yogurt Samples

Treatments	Days of storage						Means
	0	5	10	15	20	25	
T_0	25.0±0.82	21±0.75	19±0.65	16.2±0.56	12.1±0.42	10.0±0.34	**17.22E**
T_1	29±0.87	26±0.78	22±0.66	19±0.57	17±0.51	15.3±0.46	**21.38D**
T_2	37±1.48	33±1.32	30±1.20	28.5±1.14	26.0±1.04	23.3±0.93	**29.63C**
T_3	45.4±1.36	40.6±1.2	40±2.00	37.2±1.86	34±1.70	31.0±1.55	**37.56B**
T_4	59±1.42	56±1.34	52±1.25	50±1.20	47±1.13	44±1.06	**51.33A**
Means	**38.77A**	**35.05B**	**32.60C**	**30.18D**	**27.22E**	**24.72F**	

Tannin Content (%)

Mean values of tannin content in stored samples presented increasing trend from 0.56, 0.47, 0.42, 0.36, 0.30 and 0.22 at first to last day of storage respectively (Table 8). Present results related to tannin content depict significant difference from first to 5th to 25th day of storage. Increased tannin content during storage might be due to the reaction of fruit with yogurt. Above results with increasing trend in tannin content of persimmon samples during storage are in accordance with (Arslan and Bayrakçi, 2015).

The Analysis of Variance shown that all the treatments, storage intervals and their interactions were significantly different from each other (Table 8). The LSD test shows that all treatments had increasing trend were observed in different treatments and also significant difference were observed among all treatments. Mean values of tannin were observed by T_4 (0.80%) followed by T_3 (0.67%), T_2 (0.36%), T_1 (0.11 %) and T_0 (0.00%). In present study the different concentrations of pulp responsible to increase the tannin content in yogurt as compared to control sample which depict maximum mean value of the samples was similar to that reported by Arslan and Özel, 2012).

Table 8. Effect of treatment and storage intervals on Tannin content (%) of Persimmon based yogurt Samples

Treatments	Days of storage						Means
	0	5	10	15	20	25	
T_1	0.22±0.01	0.18±0.01	0.14±0.02	0.10±0.1	0.05±0.05	0.01±0.01	**0.11D**
T_2	0.52±.0.02	0.48±0.03	0.40±0.04	0.34±0.03	0.28±0.03	0.18±0.2	**0.36C**
T_3	0.92±0.05	0.82±0.05	0.73±0.02	0.63±0.06	0.55±0.6	0.45±0.5	**0.67B**
T_4	1.2±1.5	0.93±0.09	0.84±0.05	0.75±0.7	0.63±0.6	0.48±0.41	**0.80A**
Means	**0.56A**	**0.47B**	**0.42C**	**0.36D**	**0.30E**	**0.22F**	

Colour (Scores)

Mean values of colour content in stored samples shown decreasing trend from 7.08, 6.78, 6.52, 6.28, 5.92 and 5.58 at 0 first to last day of storage respectively (Table 9). Present results related to colour content depict significant difference from first to 5th to 25th day of storage. Decrease in mean values of colour during storage might be due to the activity of enzymes and low pH of medium. Above results with decreasing trend in colour of persimmon samples during storage are in accordance with (Cinbas and Yazici, 2008), who reported that colour scores decreased in stored sample.

The Analysis of Variance showed that all the treatments and their storage intervals were significantly different for each other while their interaction has non-significant interaction. The LSD test shows that all treatments had decreasing trend were observed in different treatments. Mean values of colour content were observed by T_4 (7.2) followed by T_3 (6.7), T_2 (6.4), T_1 (5.7) and T_0 (5.5). In present study the colour of all sample showed maximum retention but T_4 is best as compared to control sample which depict maximum mean value of colour of the samples was similar to that reported by (Won-Young *et al*, 2017).

Table 9. Effect of treatment and storage intervals on Colour (Scores) of Persimmon based yogurt Sample

Treatments	Days of storage						Means
	0	5	10	15	20	25	
T_0	6.4±0.22	5.8±0.20	5.7±0.19	5.5±0.18	5.0±0.23	4.8±0.16	**5.53E**
T_1	6.6±0.23	6.3±0.19	5.8±0.17	5.5±0.17	5.4±0.21	5.0±0.15	**5.7D**
T_2	7.2±0.36	7.0±0.28	6.6±0.26	6.4±0.23	6.0±0.30	5.6±0.23	**6.4C**
T_3	7.3±0.22	7.0±0.26	7.0±0.35	6.9±0.35	6.4±0.31	6.0±0.30	**6.7B**
T_4	7.9±0.19	7.8±0.19	7.5±0.18	7.1±0.16	6.8±0.14	6.5±0.16	**7.2A**
Means	**7.08A**	**6.78B**	**6.52C**	**6.28D**	**5.92E**	**5.58F**	

Flavour (Score)

Mean values of flavour in stored samples shown decreasing trend from 7.23, 6.85, 6.66, 6.30, 6.62 and 5.52 at 0 first to last day of storage respectively (Table 10). Present results related to flavour score depict significant difference from first to 5th to 25th day of storage. Decrease in mean values of flavour during storage due to increasing of storage period because storage intervals inversely affect the flavour. Another possibility of change in flavour is the large amount of carbon dioxide depicted in anaerobic respiration which cause to formation of ethanol and bad smelling aldehydes. Above results with decreasing trend in flavour of persimmon samples during storage are in accordance with (Cinbas and Yazici, 2008), who reported that flavour scores decreased in stored sample.

The Analysis of Variance showed that all the treatments and storage intervals were significantly different from each other and their

interactions were non-significant interactions. The LSD test shows that all treatments had decreasing trend were observed in different treatments and also significant difference were observed among all treatments. Mean values of flavour were observed by T_4 (6.68) followed by T_3 (6.98), T_2 (7.5), T_1 (5.02) and T_0 (5.7). In present study the flavour of all sample showed maximum retention but T_2 is best as compared to control sample which depict maximum mean value of flavour of the samples was similar to that reported by (Won-Young *et al*,. 2017).

Table 10. Effect of treatment and storage intervals on Flavour (Score) of Persimmon based yogurt Samples

Treatments	Days of storage						Means
	0	5	10	15	20	25	
T_0	7.5±0.26	7.2±0.24	7.0±0.24	6.6±0.22	6.4±0.22	6.1±0.21	**6.68A**
T_1	7.8±0.23	7.4±0.22	7.3±0.22	6.9±0.21	6.8±0.20	6.3±0.19	**6.98A**
T_2	8.1±0.32	7.7±0.31	7.5±0.30	7.0±0.28	6.9±0.28	6.5±0.26	**7.5B**
T_3	6.9±0.20	6.3±0.19	6.2±0.31	6.6±0.33	6.2±0.31	6.0±0.30	**6.02C**
T_4	5.9±0.14	6.5±0.13	5.3±0.13	6.0±0.14	5.8±0.14	5.5±0.13	**5.7D**
Means	**7.23A**	**6.85 B**	**6.66 C**	**6.30D**	**6.00 E**	**5.52 F**	

Taste (Score)

Mean values of taste in stored samples shown decreasing trend from 7.08, 6.78, 6.52, 6.28, 5.92 and 5.58 at 0 first to last day of storage respectively (Table 11). Present results related to Taste score depict significant difference from first to 5th to 25th day of storage. Decrease in mean values of taste during storage due to degradation of carbohydrate into simpler compounds or might be the phenolic compounds. Above results with decreasing trend in taste of persimmon samples during storage are in accordance with Cinbas and Yazici (2008), who reported that taste scores decreased in stored sample.

The Analysis of Variance shown that all the treatments, storage intervals and their interactions were significantly different from each other (Table 11). The LSD test shows that all treatments had decreasing trend were observed in different treatments and also significant difference were observed among all treatments. Mean values of taste (Table 11) were observed by T_4 (7.16) followed by T_3 (6.9), T_2 (7.16), T_1 (6.38) and T_0 (5.9). In present study the taste of all sample showed maximum retention but T_2 is best as compared to control sample which depict maximum mean value of taste of the samples was similar to that reported by (Won-Young *et al*,. 2017).

Table 11. Effect of treatment and storage intervals on Taste (Score) of Persimmon based yogurt Samples

Treatments	Days of storage						Means
	0	5	10	15	20	25	
T_0	7.6±0.26	7.0±0.25	6.7±0.23	6.4±0.22	6.2±0.21	5.4±0.19	**7.16A**
T_1	7.8±0.24	7.3±0.23	7.1±0.21	6.9±0.20	6.6±0.19	5.7±0.18	**6.9B**
T_2	8.4±0.34	7.5±0.32	7.3±0.31	7.0±0.29	6.9±0.28	5.9±0.26	**7.16A**
T_3	6.9±0.23	6.8±0.21	6.9±0.35	6.7±0.33	6.4±0.30	4.5±0.29	**6.38D**
T_4	6.8±0.17	6.6±0.16	6.4±0.15	6.2±0.13	5.8±0.12	4.0±0.12	**5.9E**
Means	**7.23A**	**6.85 B**	**6.66 C**	**6.30D**	**6.00 E**	**5.52 F**	

Overall acceptability (Score)

Mean values of overall acceptability in stored samples shown decreasing trend from 7.23, 6.85, 6.66, 6.30, 6.00 and 5.52 at 0 first to last day of storage respectively (Table 12). Present results related to Overall acceptability score depict significant difference from first to 5th to 25th day of storage. Decrease in mean values of overall acceptability during storage due to degradation of carbohydrate into simpler compounds or might be due to the phenolic compounds. Above results with decreasing trend in overall acceptability of persimmon samples during storage are in accordance with (Cinbas and Yazici, 2008), who reported that overall acceptability scores decreased in stored sample.

The Analysis of Variance showed that all the treatments and storage intervals were significantly different from each other and their interactions were non-significant interactions. The LSD test shows that all treatments had decreasing trend were observed in different treatments and also significant difference were observed among all treatments. Mean values of overall acceptability (Table 12) were observed by T_4 (4.07) followed by T_3 (5.67), T_2 (8.13), T_1 (7.46) and T_0 (7.18). In present study the overall acceptability of all samples showed maximum retention was similar to that reported by (Won-Young *et al*,. 2017).

Table 12. Effect of treatment and storage intervals on Overall Acceptability (Score) of Persimmon based yogurt Samples

Treatments	Days of storage						Means
	0	5	10	15	20	25	
T_0	7.4±0.27	7.2±0.26	6.9±0.25	6.7±0.24	6.5±0.23	6.2±0.22	**6.81A**
T_1	8.2±0.25	7.9±0.24	7.6±0.23	7.3±0.22	7.0±0.21	6.8±0.20	**7.46B**
T_2	8.8±0.35	8.5±0.34	8.3±0.32	8.0±0.32	7.7±0.31	7.5±0.30	**8.13C**
T_3	7.1±0.21	6.8±0.20	6.0±0.34	5.7±0.33	5.2±0.31	5.0±0.30	**5.69D**
T_4	6.9±0.17	6.6±0.16	5.9±0.15	5.4±0.15	4.7±0.14	4.2±0.13	**4.70E**
Means	**7.23 A**	**6.85 B**	**6.66 C**	**6.30 D**	**6.00 E**	**5.52F**	

CONCLUSION AND RECOMMENDATIONS

From current research following conclusion have been concluded, nutritious yogurt can be prepared by the addition of persimmon up to 8-10% level, while higher concentration of persimmon pulp (>10 %) resulted in synersis as well as decline organoleptic scores. The persimmon based yogurt can be stored (4 °C) and acceptable for 10 days.

Some recommendations for future work on fruit yogurt are utilization of different stabilizer to increase the storage stability of persimmon based yogurt. Utilization of some other indigenous fruits for the development of value added yogurt.

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