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Production of a healthy yoghurt drink fortified with persimmon fruits

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ABSTRACT

The present study aimed to produce yoghurt drink as a functional food fortified with persimmon fruits at the concentrations of 5, 10, 15 and 20%, w/w. The chemical composition, antioxidant capacity, microbiological evaluation and sensory properties of the prepared yoghurts were established at fresh and after 14 days as storage period. The result indicated that the pH and titraTable acidity values of the samples were altered slowly during the storage period. Also, there was an increasing in the total phenols, total flavonoids, antioxidant capacity, total solids, fiber, ash, carbohydrates and energy, with increasing of percentage persimmon fruit. Yoghurt sample containing 20% persimmon fruit had the highest value of Fe and Zn contents at fresh and after storage period. Microbial population decreased with the increasing of persimmon fruit levels at fresh and after storage period. Sensorial investigation indicated that the greatest accepTable persimmon stirred yoghurt was linked to 20% persimmon fruits. Making a healthy flavored yogurt drink can be of accepTable taste, consistency and consistency by using the right amount of persimmon fruits. Because of its high content of nutrients, including phenols, dietary fiber, vitamins, antioxidants, and other ingredients, this drink can help promote health, especially in childhood.

Keywords: persimmon fruits, yogurt, chemical properties, antioxidant activity, sensory properties.

INTRODUCTION

The creation of augmented dairy products as food function improved human health. It has attracted increasing interest over the past few decades (Bimbo *et al*., 2017; Dimitrellou *et al*., 2020). Dairy products are the most popular functional food among consumers, making them ideal for enrichment with functional constituents. These stimulated dairy products to have undergone extensive research (Swelam *et al*., 2021; Atwaa *et al*., 2022; Shahein *et al*. 2022). Due to several linked health issues such lactose intolerance, a cow's milk allergy, and hypercholesterolemia, there is a growing tendency towards avoiding dairy products, thus this should be taken into consideration (Szilagyi and Ishayek, 2018; Munekata *et al*. 2020). Also, its multiple health advantages, yoghurt is among the most popular dairy products (Swelam *et al*., 2021; Atwaa *et al*., 2022; Aryana and Olson, 2017).Consumer approval of functional fermented yoghurt is still quite high, especially among women of all ages and older consumers, who have demonstrated a readiness to include such food in their diets (Bimbo *et al*., 2017). Consumer demand for yoghurt drinks has grown as a result of their distinct qualities and several health advantages. Protein, B vitamins, calcium, and potassium in yoghurt

drinks are abundant and help to maintain a healthy immune system (Rahimzadeh *et al*. 2020). The natural compounds from comestible and remedial plants have potent antioxidant properties, therefore, could be preventing hepatotoxicity (Othman *et al*. 2014; Khan *et al*., 2020).

Diospyros kaki L., also known as the persimmon, that contains significant amounts of carotenoids, dietary fibers, pectin substances, vitamins (A, B, and C), minerals (Mg and P), condensed tannins and high sugar contents (Altuntas *et al*., 2011;Hernández-Carrión *et al*., 2014; Lee *et al*., 2010). Persimmon fruits are richness of dietary fiber, bioactive components, particularly phenolics (ferulic, p-coumaric, and gallic acids) and carotenoids (β-cryptoxanthin, lycopene, -carotene, and lutein). These bioactive compounds promote the antioxidant properties which prevented and treated many wide of illnesses, including cancer, diabetes, and hypercholesterolemia (Cortellino *et al*., 2009; Karaman *et al*., 2014; Yaqub *et al*., 2016).

The mature persimmon has a very short shelf life (almost 4 weeks). So, it could be transformed into tasty new products (such as fruit desserts, smoothies, or beverages with dairy flavors), which show a possible way to improve consumer health through intakes of carotenoids and other bioactive compounds. This can help flavored milks' nutritive, physicochemical, and textural qualities (Hernández-Carrión *et al*., 2014; Cortellino *et al*. 2009; Garcia-Cayuela *et al*., 2018). Moreover, persimmon has a high phenols content that might be added to yoghurt as a supplement, to produce the health advantages of fermented milk products.

A number of investigations showed the possible advantages of adding vegeTable or fruit juices to the planning of functional fruit yoghurt. It could be increasing the acceptability of the flavor, phenols content, and free radical scavenging activity of yoghurt (Dimitrellou *et al*., 2020; Ismail *et al*., 2020). However, combining yoghurt with phenolic-rich food like persimmon can increase the health advantages of fermented milk products with an extreme phenolic compound intake. The impact of persimmon on certain features of fermented milk products, such as fermentation time, acidification degree, starter bacterial development, and primary physicochemical properties, has to be clarified (Dimitrellou *et al*., 2020).

The current study aimed to develop a new type of yoghurt drink by adding persimmon to increase its nutritional and functional properties. The chemical, microbiological, antioxidant capacity and sensory properties of the yogurt drink were examined at zero time and after 14 days of storage period.

MATERIALS AND METHODS

1. Materials

Persimmon fruits were obtained from local market (Zagazig, Egypt). Fresh cow uniform milk (3% fat) was found from Dairy Technology Unit, Food Science Department, Faculty Agric., Zagazig .Univ. Yoghurt culture comprising *Streptococcus salivarius* subsp., *Thermophilus* EMCC104 and *Lactobacillus delbruekii subsp*. bulgaricus EMCC1102 were obtained from the Microbiological Resources Center (MIRCEN), Faculty of Agric., Ain Shams Univ., Egypt.

2. Methods

2.1 Preparation of persimmon fruits

Persimmon fruits (PF) were washed, cleaned, cut to slices and pasteurized. Consequently, the fruits were pulped by a high-speed electric mixer.

2.2 Manufacture of yoghurt drink.

Different treatments of yoghurt drink (YD) were manufactured according to the procedure of Thomas and Wansapala (2017) with some alterations as follows: standardized Egyptian cow milk (3% fat) was heated at 85ºC for 10 min, then cooled

to 42±1ºC, before adding the yoghurt culture comprising *Streptococcus salivarius subsp., Thermophilus* and *Lactobacillus delbruekii subsp. bulgaricus* (1:1) as percent 3% and incubated at 42±ºC until the pH reached 4.65. The developed yoghurt samples were cooled overnight at 5±1ºC. Then, 6% sugar was added to the pain yogurt. Yogurt samples were distributed into 5 parts. The first part was earmarked as a control yogurt without adding of persimmon (C). The samples T1, T2, T3 and T4 were manufactured by addition 5%, 10%, 15% and 20% (w/w) Persimmon fruits, respectively as shown in Table (1). The drinking yoghurt mixtures were located in100-g plastic cups and then stored at 6±1ºC in refrigerator for 14 days and sampled for analysis at fresh and after 14 days. This experiment was triplicate.

Table 1. The percentages of materials in prepared yoghurt drink.

Treatments	Yoghurt drink %	Sugar %	Persimmon %
C	94	6	-
T1	89	6	5
T2	84	6	10
T3	79	6	15
T4	74	6	20

2.3 Chemical analysis

Moisture, fat, protein, ash, titraTable acidity (T.A.), and fiber contents for raw and prepared samples were determined as described by AOAC (2000). pH value was calculated by using pH meter type HANNA pH meter (Italy) (8417). The carbohydrates intended by difference as follows; Carbohydrates = (100 – (fat + protein + ash + fiber).

Approach calorific value was designed by the suiTable factor as described by Livesey and Elia (1985). The mineral insides were determined by using the Atomic Absorption Spectrophotometer as described in AOAC (2000). The total phenols and flavonoids were determined using the method described by Batista *et al*. (2011). The total antioxidant activity was regulated by the 1,1-diphenyl-2-picryl-hydrazyl (DPPH) method of Maksimovi *et al*. (2005).

2.4 Microbiological investigates

Microbiological investigation was performed to the prepared yoghurt drink with persimmon fruit at fresh and after 14 days of storage. The total bacterial count (T.B.C) was determined using plate count agar according to Houghtby *et al*. (1992). Coliform bacteria, yeasts and molds were enumerated according to IDF (1985a,b), respectively.

2.5 Sensory evaluation:

YD treatments were assessed for their sensory qualities by ten professional panelists from the Faculty of Agriculture, Zagazig University. The panelists were asked to judge the samples for appearance (out of 10 points), flavor (out of 50 points), body and texture (out of 30 points) and color (out of 10 points) as described by El-Etriby *et al*. (1997).

3. Statistical analysis:

Statistical calculations were carried out by SPSS (software version 19.0) as according by SPSS (1998). One way of variance analysis was applied for determining differences between results of samples. Duncan test was taken to compare the data. Values of $P \leq 0.05$ were considered as significantly different.

RESULTS AND DISCUSSION

Proximate composition of persimmon fruits

The proximate composition contents of PF were illustrated in Table (2). Moisture, protein, fat, crude fiber, ash carbohydrates (g/100g) and energy (kcal/100g) contents of PF were (80.40±2.22, 0.60±0.05, 0.25±0.03, 3.82±0.14, 0.96±0.08, 14.97±0.07g/100g and 65 kcal\100g) respectively. These results were in agreement with Barea-Álvarez *et al*. (2016) who found that PF contained 80.86 % water, 0.64 % protein, 0.25 % total lipids, 17.3 % total carbohydrates, in addition, 2.6 % total crude fiber on fresh weight. Results indicated that, PF has a low fat, protein and ash. Mapama (2016) showed almost similar data where PF has a low protein, fat content and about 16% of carbohydrates. It was obvious from data in the Table (1) that PF contain 7.25±.05, 0.76±.01 and 0.16±.002 mg/100g of Ca, Fe and Zn, respectively. These results were in accordance with those mentioned by Pérez-Burillo *et al*. (2018) who found the content of Ca, Iron and Zinc were (8 , 0.31 , 0.11 mg/100g, respectively. Also, Mapama (2016) found that PF had important quantities of potassium but rather low amounts of other minerals such as phosphorus and magnesium. As well as; Mg, Fe, Zn, Cu and Mn were found in PF as reported by Őzen *et al*. (2004) and Ercisli *et al*. (2007).

Table (2) reveled that the TPC, TFC and antioxidant activity by DPPH for PF were 264.20±5.60mg/100g, 52.60±1.05 mg/100g and 86.70± 3.40%, respectively. Sakanaka *et al*., (2005) and Butt *et al*., (2015) found that the total polyphenols was 1.45 mg/100g in fresh PF. Flavonoids exhibit antioxidant potential as free radical scavenger.

Table 2. Chemical, minerals and phytochemicals composition of persimmon fruits

Parameters	Persimmon fruit	Parameters	Persimmon fruit
Moisture (g/100g)	80.40±2.22	Ca (mg/100g)	7.25±.05
Protein (g/100g)	0.60±0.05	Fe (mg/100g)	0.76±.01
Fat (g/100g)	0.25±0.03	Zn (mg/100g)	0.16±.002
Cured fiber (g/100g)	3.82±0.14	Total phenol (mg GAE/100 mL)	264.20±5.60
Ash (g/100g)	0.96±0.08	Total flavonoid (mg Q/100 mL)	52.60±1.05
Carbohydrates (g/100g)	14.97±0.07	DPPH Inhibition%	86.70±3.40
Energy (kcal/100g)	65±00[a]		

Chemical composition of yoghurt drink supplemented with persimmon fruit

Results in Table (3) show the chemical composition of YD supplemented with different percentages of PF (5, 10, 15 and 20 %) at zero time and after 14 days storage. Generally, the addition of PF caused increasing in the total solids (TS), fiber, ash, carbohydrates and energy with the increase of percentage PF. So, T4 which contained (20%) of PF had the highest levels of TS, fiber, ash, carbohydrates and energy at zero time and after 14 days storage, while it had the lowest protein and fat contents. These results agreed with those given by Arslan and Bayrakci (2016) who found that fortification of YD with fruits increased the TS, but it did not affect the contents of fat, protein and ash of resulting YD. Also, El-Sayed *et al*. (2017) found that enrichment of yoghurt with persimmon juice increased the TS, but it did not affect the contents of fat, protein and ash of the resulting yoghurt.

Table 3.Chemical composition of yoghurt drink supplemented with persimmon fruit after 14 days storage.

Parameters	Storage period (Day)	Treatments				
		C	T_1	T_2	T_3	T_4
TS (g/100g)	Fresh	19.37±0.20^{e}	20.32±0.15^{d}	21.33±0.20^{c}	22.36±0.29^{b}	23.35±0.29^{a}
	14	22.17±0.26^{e}	23.50±0.12^{d}	24.37±0.20^{c}	25.33±0.15^{b}	26.10±0.26^{a}
Protein (g/100g)	Fresh	3.78±0.22^{a}	3.52±0.41^{a}	3.36±0.32^{a}	3.22±0.51^{a}	3.07±0.35^{a}
	14	4.36±0.24^{a}	4.34±0.02^{a}	4.07±0.33^{a}	3.83±0.23^{a}	3.71±0.21^{a}
Fat (g/100g)	Fresh	3.09±0.01^{a}	2.93±0.05^{b}	2.80±0.07^{c}	2.76±0.09^{d}	2.50±0.04^{e}
	14	3.61±0.04^{a}	3.45±0.01^{b}	3.31±0.02^{c}	3.25±0.01^{d}	3.10±0.03^{e}
Crude fiber (g/100g)	Fresh	0.00	0.14±0.01^{d}	0.30±0.01^{c}	0.41±0.01^{b}	0.54±0.01^{a}
	14	0.00	0.18±0.01^{d}	0.34±0.01^{c}	0.45±0.01^{b}	0.56±0.09^{a}
Ash (g/100g)	Fresh	0.62±0.02^{e}	0.65±0.02^{d}	0.72±0.00^{c}	0.76±0.04^{b}	0.81±0.09^{a}
	14	0.79±0.06e	0.82±0.07^{d}	0.88±0.02^{c}	0.95±0.04^{b}	1.04±0.01^{a}
Carbohydrates (g/100g)	Fresh	6.88±0.49^{b}	8.08±0.02^{b}	9.15±0.52^{b}	10.21±0.08^{b}	11.43±0.38^{a}
	14	8.41±0.26^{a}	9.71±0.16^{d}	10.77±0.25^{bc}	11.85±0.09^{b}	12.69±0.09^{cd}
Energy (kcal/100g)	Fresh	70±2^{c}	73±1^{b}	75±1^{b}	79±1^{ab}	81±2^{a}
	14	84±1^{c}	87±1^{b}	89±1^{b}	92±0.00^{b}	94±1^{a}

* Values (means ±SD) with different superscript letters are statistically significantly different ($P \leq 0.05$).
C: control yoghurt. T1: yoghurt treated with 5% Persimmon. T2: yoghurt treated with 10% Persimmon.
T3: yoghurt treated with 15% persimmon. T4: yoghurt treated with 20% persimmon.
a,b,c…. etc: means within the same row with different superscripts are significantly different (P<0.05).

Minerals contents of yoghurt drink supplemented with persimmon fruit

The results in Table (4) showed that the control sample had the highest value of calcium at zero time and after storage period (17± 1.12 and 12.14±.08 mg /100g FW, respectively) and T4 had the lowest level of Ca. On the other hand, T4 at zero time had the highest value of Fe and Zn contents (0.69±.01 and 1.02±.001mg/100g FW, respectively). While after storage period T4 had 0.65±.01 and 0.78±.02 mg /100g FW for Fe and Zn, respectively. Statistical analysis of the data showed that there were high significant differences ($P \leq 0.05$) between samples. The obtained results showed that mineral contents of all YD samples were decreased as storage period progressed. These were agreed with El-Sayed *et al* (2017) who found that fortification of yoghurt with persimmon juice increased the Fe and Zn contents of yogurt.

Table (4). Minerals contents of yoghurt drink supplemented with persimmon fruit after 14 days storage.

Minerals (mg / 100g FW)	Storage period (Day)	Treatments					
		C	T_1	T_2	T_3	T_3	T_4
Ca	Fresh	17± 1.12^{a}	16.38±.08^{b}	15.64±.05^{c}	13.87±.06^{d}	13.87±.06^{d}	12.14±.08^{e}
	14	15±1.30^{a}	13.52±.28^{b}	12.73±.15^{c}	11.09±.08^{d}	11.09±.08^{d}	10.38±.15^{e}
Fe	Fresh	0.49±2.02^{e}	0.52±.01^{d}	0.57±.02b^{c}	0.65±.02^{b}	0.65±.02^{b}	0.69±.01^{a}
	14	0.40±1.62^{e}	0.50±.02^{d}	0.54±.02^{c}	0.61±.01^{b}	0.61±.01^{b}	0.65±.01^{a}
Zn	Fresh	0.82±0.014^{e}	0.88±.001^{d}	0.94±.001^{c}	0.98±.001^{b}	0.98±.001^{b}	1.02±.001^{a}
	14	0.54±0. 04^{e}	0.61±.28^{d}	0.66±.01^{c}	0.70±.02^{b}	0.70±.02^{b}	0.78±.02^{a}

* Values (means ±SD) with different superscript letters are statistically significantly different ($P \leq 0.05$).
C: control yoghurt. T1: yoghurt treated with 5% Persimmon. T2: yoghurt treated with 10% Persimmon. T3: yoghurt treated with 15% persimmon. T4: yoghurt treated with 20% persimmon.
a,b,c…. etc: means within the same row with different superscripts are significantly different (P<0.05).

Physicochemical and phytochemicals properties of yoghurt drink supplemented with persimmon fruit

Table (5) indicated that titraTable acidity (TA) and the pH value were significantly affected by the storage period ($P \leq 0.05$). The TA and pH value (lactic acid %) varied between (0.80±0.06 % and 1.12±0.01%) and between (4.33±0.02 and 4.67±0.04), respectively. TA in all samples was increased, while, pH value of all samples were decreased as storage period passed. These results could be connected to the growth of lactic acid bacteria in the yoghurt. The growth of lactic acid bacteria may be affected by the antimicrobial activity of the PF (Matheus *et al*. (2021). Birollo *et al*. (2000) found that the viability of lactic acid bacteria in yoghurt was negatively affected by a high sugar concentration in yoghurt.

The current results clearly indicated the development of antioxidant activity (AA %) in all samples (Table 5). This result was due to the addition of PF to YD. Haida and Hakiman (2019) indicated that PF possesses multi-faced biological activities such as antioxidant. PF are renowned as phenolic compound and rich sources of carotenoids and it has been widely used as important remedies because of potential beneficial effects on various chronic diseases (George and Redpath, 2008).

It was evident from results that total flavonoids (TF) content of YD supplemented with PF, ranged between 0.75±0.12 and 12.01±0.39mg/100g. The results indicated that, control YD sample had the lowest level of TF (0.75±0.12mg/100g), while, sample (T4) which contained 20% PF had the highest level of TF (12.01±0.39mg/100g). The same trending was watched after storage period (14 days in refrigerator) (Table 5). There were significant changes ($P \leq 0.05$) between samples concerning TP, in fresh and after storage period.

Moreover, the antioxidant activity (AA%) for YD samples was increased with increasing of concentration of PF (Table 5). Sample (T4) had the highest inhibition for both zero time (60.17±2.34%) and after storage period (46.76±1.74%). There were significant changes ($P \leq 0.05$) between samples for DPPH in fresh and after storage period. TP, TF and AA% for all YD samples were decreased as storage period progressed (Table 5). These are agreed with El-Sayed *et al*. (2017) who found that fortification of yoghurt with persimmon juice increased the TP, TF and AA% of yoghurt.

Table 5. Physicochemical and phytochemicals properties of yoghurt drink supplemented with Persimmon fruit after 14 days storage.

Parameters	Storage period (Day)	Treatments				
		C	T_1	T_2	T_3	T_4
Acidity%	Fresh	0.80±0.06^{e}	0.87±0.02^{d}	0.98±0.01^{c}	1.04±0.03^{b}	1.12±0.01^{a}
	14	1.02±0.10^{e}	1.08±0.01^{d}	1.14±0.04^{c}	1.23±0.02^{b}	1.40±0.03^{a}
PH meter%	Fresh	4.67±0.04^{a}	4.62±0.02^{b}	4.53±0.04^{c}	4.49±0.01^{d}	4.33±0.02^{e}
	14	3.92±0.06^{a}	3.87±0.05^{b}	3.78±0.02^{c}	3.70±0.03^{d}	3.66±0.04^{e}
TP (mg /100g)	Fresh	58.74±2.40^{e}	65.30±2.40^{d}	72.20±3.50^{c}	78.80±2.24^{b}	85.50±3.44^{a}
	14	18.6±1.20^{e}	26.70±1.50^{d}	38.60±2.42^{c}	55.40±2.34^{b}	71.30±1.54^{a}
TF (mg /100g)	Fresh	0.75±0.12^{e}	3.62±0.43^{d}	6.54±0.48^{c}	9.61±0.48^{b}	12.01±0.39^{a}
	14	0.38±0.002^{e}	2.40±0.67^{d}	4.43±0.54^{c}	6.05±1.10^{b}	7.68±0.75^{a}
DPPH %	Fresh	27.50±1.14^{e}	36.06±1.10^{d}	41.40±2.24^{c}	54.28±3.35^{b}	60.17±2.34^{a}
	14	16.40±0.92^{e}	22.36±1.64^{d}	33.87±2.72^{c}	37.56±2.61^{b}	46.76±1.74^{a}

* Values (means ±SD) with different superscript letters are statistically significantly different ($P \leq 0.05$).
C: control yoghurt. T1: yoghurt treated with 5% Persimmon. T2: yoghurt treated with 10% Persimmon. T3: yoghurt treated with 15% persimmon. T4: yoghurt treated with 20% persimmon.
a,b,c…. etc: means within the same row with different superscripts are significantly different ($P<0.05$).

Microbiological evaluation of yoghurt drink supplemented with persimmon fruit

Microbiological examination of YD was considering one of the most important studies, which could take during and after processed yoghurt. Control sample recorded the highest TBC at zero time and after storage period, while, sample (T4) had the lowest number of TBC (Table 6). The microbial population decreased with the increase of PF levels at zero time and after storage period, which may be due to an antioxidant which has antibacterial effect in YD samples by increasing PF. During storage, TBC of all YD samples were declined regularly as the extended of storage time. TBC of samples were extended from (78 x 105 to 50 x 108cfu/g) at fresh and it was declined regularly as the storage time until reached between (90 x 104 and 32 x 107 cfu/g) at the end of storage period (Table 6). The obtained results revealed that all YD samples had an adverse reasonable test for the presence of coliform bacteria. These results may be partially due to the effect of heat treatments during the preparation. The obtained results are in agreement with the recommendation of Egyptian Organization Standard EOS (1998). Matter *et al*. (2016) did not detect coliform counts in yoghurt samples. It was evident from results that all yoghurt samples had a negative probable test for the presence of yeasts and molds at fresh. It is worthy to mention that these microorganisms grew during the storage period, T2 was recorded the highest value (8 x 102 cfu/ g). While, T1 sample had the lowest count of yeasts and molds (2 x 102 cfu/ g) (Table 6). These are agreed with El-Sayed *et al*. (2017) who found that enrichment of yoghurt with persimmon juice decreased the TBC, yeasts and molds of yoghurt.

Table 6. Microbiological evaluation of yoghurt drink supplemented with persimmon fruit after 14 days storage.

Items	Treatments	Storage period (days)	
		Fresh	14 days storage
T.B.C cfu/10^7 g	C	50 x 0^8	32 x 10^7
	T_1	4 x 10^7	95 x 10^5
	T_2	80 x 10^6	82 x 10^5
	T_3	6 x 10^6	7 x 10^5
	T_4	78 x 10^5	90 x 10^4
Coliform cfu/ g	C	ND	ND
	T_1	ND	ND
	T_2	ND	ND
	T_3	ND	ND
	T_4	ND	ND
Yeasts & Molds cfu/ g	C	ND	4 x 10^2
	T_1	ND	2 x 10^2
	T_2	ND	8 x 10^2
	T_3	ND	5 x 10^2
	T_4	ND	3 x 10^2

C: control yoghurt. T1: yoghurt treated with 5% Persimmon. T2: yoghurt treated with 10% Persimmon. T3: yoghurt treated with 15% persimmon. T4: yoghurt treated with 20% persimmon

Sensory evaluation of yoghurt drink supplemented with Persimmon fruit

Sensory evaluation of appearance of YD supplement with PF is illustrated in Table (7). It was clear that the control sample recorded the highest score at zero time (9.10±0.23) and during storage period (7.90±0.28) by the panelists which may be

related to the addition of PF. Meanwhile, sample (T4) which contained (20%) persimmon had the lowest score at zero time and after storage period (8.60±.16 and 6.20±0.36), respectively. Statistical analysis of sensory evaluation of appearance showed that there was significant difference at ($p \leq 0.05$) between samples.

Concerning sensory evaluation for flavor, the results showed that all prepared samples were highly accepTable of general flavor. T4 had recorded the highest score of flavor and at zero time (47.50±0.70) and after storage (46.90±0.44). Meanwhile, control sample had the lowest score (42.00±.81 and 45.60±0.50) at zero time and after storage, respectively. Statistical analysis of sensory evaluation for flavor of yoghurt indicated that there was significant difference among samples at ($p \leq 0.05$).

T4 recorded the highest score of body and texture (27.90±0.60 and 27.20±0.42) at zero time and after storage, respectively as shown in Table (7). Moreover, control sample had the lowest score of body and texture at zero time and after storage ((23.20±1.65 and 25.80±0.34, respectively). This result may be due to addition of PF. Statistical analysis of sensory evaluation for body and texture showed that, there was significant difference ($p \leq 0.05$) among samples.

The color score of YD ranged from 7.9±0.23 to 9.30±0.32 at zero time. Control sample recorded the best color score, but T4 had the lowest color score at zero time and after storage period. Statistical analysis of the numbers presented that there were significant changes ($P \leq 0.05$) of color score among samples.

Generally, it could mention that the overall acceptability score for all YD were consider as high accepTable scores from the sensory evaluation point of view. T4 recorded the highest score of overall acceptability (93.7±2.26) as compared with other investigated samples at zero time. On the other hand, the control sample was the lowest (86.8±1.36) after storage period. Statistical analysis of sensory evaluation of overall acceptability showed that, there was significant change ($p \leq 0.05$) among samples. These are agreed with Jokar and Azizi (2022) who found that fortification of YD with PF enhancement the Sensory attributes of YD.

Table 7. Sensory evaluation of yoghurt drink supplemented with persimmon fruit after 14 days storage.

Properties	Storage period (Day)	Treatments				
		C	T_1	T_2	T_3	T_4
Appearance (10)	Fresh	9.10±0.23^{a}	8.90±0.14^{b}	8.70±0.29^{c}	8.30±.18^{d}	8.00±.16^{e}
	14	7.90±0.28^{a}	7.20±0.50^{b}	6.90±0.15^{c}	6.60±0.28^{d}	6.20±0.36^{e}
Flavors (50)	Fresh	47.50±0.40^{e}	47.70±0.44^{d}	48.00±0.32^{c}	48.30±0.26^{b}	48.60±.41^{a}
	14	45.60±0.50e	46.20±0.42^{d}	46.40±0.30^{c}	46.50±0.23^{b}	46.90±0.44^{a}
Body and texture (30)	Fresh	27.90±0.40^{e}	28.10±0.33^{d}	28.40±0.35^{c}	28.90±0.45^{b}	29.20±0.35^{a}
	14	25.80±0.34^{e}	26.10±0.28^{d}	26.50±0.35^{c}	26.90±0.38^{b}	27.20±0.42^{a}
Colour (10)	Fresh	9±0.36^{a}	8.70±0.32^{b}	8.50±0.32^{c}	8.20±0.16^{d}	7.90±0.23^{e}
	14	7.50±0.22^{a}	7.00±0.28^{b}	6.80±0.37^{c}	6.50±0.41^{d}	6.0±0.50^{e}
overall acceptability (100)	Fresh	93.5 ±1.36^{b}	93.4±2.11^{b}	93.6±2.62^{b}	93.7±2.19^{b}	93.7±2.26^{a}
	14	86.8±1.36^{b}	86.5±2.44^{ab}	86.6±2.87^{ab}	86.5±4.71^{a}	86.3±2.01^{a}

* Values (means ±SD) with different superscript letters are statistically significantly different ($P \leq 0.05$).
C: control yoghurt. T1: yoghurt treated with 5% Persimmon. T2: yoghurt treated with 10% Persimmon. T3: yoghurt treated with 15% persimmon. T4: yoghurt treated with 20% persimmon.
a,b,c…. etc: means within the same row with different superscripts are significantly different ($P<0.05$).

Conclusion

Using persimmon fruits up to 20 % in the making of yoghurt drink did not affect the contents of fat, protein and ash, while greatly affected the acidity values, total sensorial preference, antioxidant activity, total phenolic content and adding health advantages to yoghurt drink based on its high antimicrobial activity.

Recommendation:

Persimmon fruits can be recommended as a nature additive in the production of functional yoghurt drink.

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REFERENCES

Altuntas, E., Cangi, R., & Kaya, C. (2011). Physical and chemical properties of persimmon fruit. International Agrophysics, 25(1), 89–92.

AOAC. (2000). Official Method of Analysis of the Association of the Analytical Chemsits. 17ed Published by the Assoication of Official Analytical Chemists.PO Box 540. Benjamin Franklin Station Washington DC. 20044.

Arslan, S. and Bayrakci, S. (2016). Physicochemical, functional, and sensory properties of yogurts containing persimmon. Turkish J. Agric. Forestry, 40(1). https://doi.org/ 10.3906/tar-1406-150.

Aryana, K.J. and Olson, D.W. (2017). A 100-Year Review: Yogurt and other cultured dairy products. J. Dairy Sci., 100:9987–10013.

Atwaa, E.S.H.; Shahein, M.R.; El-Sattar, E.S.A.; Hijazy, H.H.A.; Albrakati, A. and Elmahallawy, E.K. (2022). Bioactivity, Physicochemical and Sensory Properties of Probiotic Yoghurt Made from Whole Milk Powder Reconstituted in Aqueous Fennel Extract. Fermentation, 8:52.

Barea-Álvarez, M.; Delgado-Andrade, C.; Haro, A.; Olalla, M.; Seiquer, I. and Rufián-Henares, J.Á. (2016). Subtropical fruits grown in Spain and elsewhere: A comparison of mineral profiles. J. Food Compos. Anal. 48:34–40.

Batista, C., Barros, L., Carvalho, AM & Ferrira, ICFR. (2011): Nutritional and nutraceutical potential of rape (Brassica napus L. vor napus) and "tronchuda" cabbage (*Brassica oleraceae* L. var. Costata) inflorescences. Food Chemical Toxicol., 49;1208-1214.

Bimbo, F.; Bonanno, A.; Nocella, G.; Viscecchia, R.; Nardone, G.; De Devitiis, B. and Carlucci, D. (2017). Consumers' acceptance and preferences for nutrition-modified and functional dairy products: A systematic review. Appetite, 113:141–154.

Birollo, G.; Reinhemer, J. and Vinderola, C. (2000). Viability of lactic acid microflora in different types of yoghurt. Food Res. Int., 33: 799–805.

Butt, M.S.; Sultan, M.T.; Aziz, M.; Naz, A.; Ahmed, W.; Kumar, N. and Imran, M. (2015). Persimmon (*Diospyros kaki*) fruit: Hidden phytochemicals and health claims. EXCLI J., 14:542.

Cortellino, G., Lo Scalzo, R., Testoni, A., Bertolo, G., & Maestrelli, A. (2009). Persimmon puree: a new ingredient to improve technological and health benefits in sherbets. Acta Horticulturae, 833(833), 77–82.

Dimitrellou, D.; Solomakou, N.; Kokkinomagoulos, E. and Kandylis,

P. (2020).Yogurts supplemented with juices from grapes and berries. Foods, 9:1158.

El-Etriby, H.M.; EL-Darouty, R.T. and Zaghloul, A.H. (1997). Physicochemical and bacteriological studies on mango yoghurt manufacture from ultrafiltrated milk retentat using glucodeltalactone (GDL). Egyptian J. Dairy Sci., 25: 349.

El-Sayed, H.A. (2017). Production of Healthy Yoghurt Fortified With Kaki Juice (Persimmon). Egypt. J. Food Sci., 45:179-190.

EOS, (1998). Egyptian Organization for Standard, No. 135."Cereal Based and/ or legumes Baby Food", Egyption Organization for Standardization and Quality Control. Ministry of Industry, Cairo, Egypt.

Ercisli, S.; Akbulut, M.; Ozdemir, O.; Sengul, M. and Orhan, E. (2007). Phenolic and antioxidant diversity among persimmon (*Diospyrus kaki* L.) genotypes in Turkey. Int. J. Food Sci. Nutr., 59:477-82.

Garcia-Cayuela, T., Nuno-Escobar, B., Welti-Chanes, J., & Cano, M. P. (2018). In vitro bioaccessibility of individual carotenoids from persimmon (Diospyros kaki, cv. Rojo Brillante) used as an ingredient in a model dairy food. Journal of the Science of Food and Agriculture, 98(9), 3246–3254.

George, A.P. and Redpath, S. (2008). Health and medicinal benefits of persimmon fruit: A review. Adv. Hortic. Sci., 22: 244-249.

Haida, Z and Hakiman, M. (2019). A comprehensive review on the determination of enzymatic assay and nonenzymatic antioxidant activities. Food Sci. Nutr., 7(5):1555–1563. https://doi.org/10.1002/ fsn3.1012.

Hernández-Carrión, M., Tárrega, A., Hernando, I., Fiszman, S. M., & Quiles, A. (2014). High hydrostatic pressure treatment provides persimmon good characteristics to formulate milk-based beverages with enhanced functionality. Food and Function, 5(6), 1250–1260.

Houghtby A.G., Maturin L. J. & Koenig K.E. 1992. Microbiological count methods. In: Marshal, R.T. (Ed.). Standard methods for the examination of dairy products. 16th Edn. American Public Health Association, Washington, D C, USA. 213-246.

IDF (1985a), Milk and milk products, Enumeration of coliforms- colony counts technique and most probable number technique at 30 ºC, Standard73A, International Dairy Federation, Brussels, Belgium.

IDF (1985b), Milk and milk products, Detection and enumeration of yeasts and moulds, Standard 94A, International Dairy Federation, Brussels, Belgium.

Ismail, E.; Shenana, M.; Elalfy, M.; Essawy, E.; Abdelhahim, S. Novel Probiotic Adjunct Cultures for the Production of Fruit-Flavoured Drinkable Yoghurt. Egypt. J. Food Sci. 2020, 48, 213–228.

Jokar, A. and Azizi, M.H. (2022). Formulation and production of persimmon milk drink and evaluation of its physicochemical, rheological, and sensorial properties. Food Sci. Nutr., 10:1126–1134.

Karaman, S., Toker, T. S., Yüksel, F., Çam, M., Kayacier, A., & Dogan, M. (2014). Physicochemical, bioactive, and sensory properties of persimmon-based ice cream: Technique for order preference by similarity to ideal solution to determine optimum concentration. Journal of Dairy Science, 97(1), 97–110.

Khan, M.Z.; Shabbir, M.I.; Saqib, Z.; Gilani, S.A.; Jogezai, N.U.; Kiyani, M.M.; Malik, M.A. Investigation of polyphenol profile,antioxidant activity and hepatoprotective potential of

Aconogonon alpinum (All.) Schur roots. Open Chem. 2020, 18, 516–536.

Lee, S. J., Ryu, J. H., Kim, R. J., Lee, H. J., & Sung, N. J. (2010). Effect of removed peel from sweet persimmon on nutritional ingredients and antioxidant activities. Journal of the Korean Society of Food Science and Nutrition, 39(10), 1495–1502.

Livesey, G., & Elia, M. (1985). Food energy values of artificial feeds for man. Clinical Nutrition, 4(2), 99-111.

Maksimovi´c, Z.; Malenˇci´c, Đ.; Kovaˇcevi´c, N. Polyphenol contents and antioxidant activity of Maydis stigma extracts. Bioresour. Technol. 2005, 96, 873–877.

Mapama (2016). Spanish Ministry of Agriculture, Fisheries, Nutrition and Environment. Available at: http://www.mapama.gob.es/ministerio/pags/plataforma_conocimiento/alimentos/fichas%20de%20alimentos/frutas/CAQUI.pdf.

Matheus, J.R.V.; Nogueira, T.B.D.B.; Pereira, A.P.A.; Correia, T.R.; de Sousa, A.M.F.; Pastore, G. M., ... & Fai, A.E.C. (2021). Antibacterial films made with persimmon (*Diospyros kaki* L.), pectin, and glycerol: An experimental design approach. J. Food Sci.,, 86(10):4539-4553

Matter, A.A.; Mahmoud, E.A.M. and Zidan, N.S. (2016). Fruit flavored yoghurt: Chemical, functional and rheological properties. IJOEAR, 2(5):57-66.

Munekata, P.E.; Domínguez, R.; Budaraju, S.; Roselló-Soto, E.; Barba, F.J.; Mallikarjunan, K.; Roohinejad, S. and Lorenzo, J.M. (2020). Effect of innovative food processing technologies on the physicochemical and nutritional properties and quality of non-dairy plant-based beverages. Foods, 9, 288.

Othman, M.S.; Nada, A.; Zaki, H.S. and Moneim, A.E.A. (2014). Effect of Physalis peruviana L. on cadmium-induced testicular toxicity in rats. Biol. Trace Elem. Res., 159: 278–287.

Őzen, A.; Colack, A.; Dincer, B. and Gűner, S. (2004). A diphenolase from persimmon fruits (Diospyros kaki L. Ebenaceae). Food Chem., 85: 431-437..

Pérez-Burillo, S.; Oliveras, M.J.; Quesada, J.; Rufián-Henares, J.A, and Pastoriza S. (2018). Relationship between composition and bioactivity of persimmon and kiwifruit. Food. Res. Int., 105: 461-472..

Rahimzadeh, G.; Tay, A.; Mac Regenstein, J.; Rokhzadi, A. and Dabiri, H. (2020). Evaluation of microbial and sensory properties of flavored yogurt drink produced by Noaea mucronata and liquid smoke treatment. Infect. Dis. Herb. Med., 77: 5–10.

Sakanaka, S.; Tachibana, Y. and Okada, Y. (2005). Preparation and antioxidant properties of extracts of Japanese persimmon leaf tea (kakinoha-cha). Food Chem.; 89:569–75.

Shahein, M.R.; Atwaa, E.S.H.; El-Zahar, K.M.; Elmaadawy, A.A.; Hijazy, H.H.A.; Sitohy, M.Z.; Albrakati, A. and Elmahallawy, E.K. (2018). Remedial Action of Yoghurt Enriched with Watermelon Seed Milk on Renal Injured Hyperuricemic Rats. Fermentation, 8: 41.

SPSS, (1998): Statistical package for Science Computer Software, Ver, SPSS Company London UK..

Swelam, S.; Zommara, M.A.; Abd El-Aziz, A.E.-A.M.; Elgammal, N.A.; Baty, R.S. and Elmahallawy, E.K. (2021). Insights into Chufa Milk Frozen Yoghurt as Cheap Functional Frozen Yoghurt with High Nutritional Value. Fermentation, 7: 255.

Szilagyi, A. and Ishayek, N. (2018). Lactose intolerance, dairy avoidance, and treatment options. Nutrients, 10:1994.

Thomas. N and Wansapala. MAJ. (2017). Utilization of green tea (Camellia

sinensis) extract for the production of antioxidant rich functional drinking yoghurt. International Journal of Food Science and Nutrition 2, 188-195.

Yaqub, S., Farooq, U., Shafi, A., Akram, K., Murtaza, M. A., Kausar, T., and Siddique, F. (2016). Chemistry and functionality of bioactive compounds present in persimmon. Journal of Chemistry, 2016, 3424025.

انتاج مشروب الزبادي الصحي المدعم بثمار البرسيمون (الكاكا)

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المستخلص

هدفت الدراسة الحالية إلى إنتاج مشروب الزبادي المدعم بثمار البرسيمون كغذاء وظيفي بتركيزات ٥ ،١٠،١٥، ٢٠٪ وزن / وزن. تم تحديد التركيب الكيميائي والقدرة المضادة للأكسدة والتقييم الميكروبيولوجي والخصائص الحسية للزبادي المدعم بثمار البرسيمون والمحضر طازجًا وبعد ١٤ يومًا كفترة تخزين. تم تغيير قيم الأس الهيدروجيني والحموضة القابلة للمعايرة ببطء خلال فترة التخزين. أوضحت النتائج ان إضافة ثمار البرسيمون قد أدى إلى زيادة إجمالي الفينولات وإجمالي مركبات الفلافونويد والقدرة المضادة للأكسدة والمواد الصلبة الكلية والألياف والرماد والكربوهيدرات والطاقة وقد كانت الزيادة تتناسب مع زيادة نسبة ثمار البرسيمون. سجلت عينة الزبادي المحتوية على ٢٠٪ من ثمار البرسيمون أعلى قيمة لمحتويات الحديد والزنك في فترة التخزين الطازجة وبعد فترة التخزين. كما انخفض عدد الميكروبات مع زيادة مستويات ثمار الكاكا الطازجة في فترة التخزين وبعد فترة التخزين. كشف التحقيق الحسي أن أكبر كمية مقبولة من الزبادي المخلوط من البرسيمون كانت مرتبطة بنسبة ٢٠٪ من ثمار البرسيمون. يمكن أن يكون صنع مشروب الزبادي الصحي المنكه مذاقًا وثباتًا واتساقًا مقبولًا باستخدام الكمية المناسبة من ثمار البرسيمون. بسبب احتوائه على نسبة عالية من العناصر الغذائية ، بما في ذلك الفينول والألياف الغذائية والفيتامينات ومضادات الأكسدة والمكونات الأخرى يمكن أن يساعد هذا المشروب في تعزيز الصحة ، خاصة في مرحلة الطفولة.