

Assessment of Ice cream with Pomegranate peel extract properties

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Abstract

Ice cream is a valuable accompaniment to the normal diet for all people especially for children. Ice cream has a great nutritional avail, for example; it contains calcium, vitamins, fats, carbohydrates and proteins. The aim of this study to manufacture an ice cream enriched with pomegranate peel extract as naturally flavoring agents (naturally additives), It has been characterized in order to assess the most common quality indices. The indices examined are; melting properties, protein, sensory properties and overrun, pH, acidity, firmness, microbiological counts. To determine how much are the challenges during manufacturing process effect on them in storage times. Ice cream was first prepared then the extract of pomegranate peel (1.5 & 4.5%) was added at aging stage. Then the samples were stored at -20° C for four weeks. Physicochemical, sensory and microbiological properties of ice cream were evaluated on the 0, 1, 2 and 4 weeks. PH values, overrun, melting resistance are decreased when the amount of (PPE) increased in the ice cream at storage, while; an increase in total acidity, firmness and protein values observed compared to the control. There was a slight decrease in the microorganism counts (bacilli, yeasts and molds) during storage. Considering the above-mentioned points, the sample containing 1.5% pomegranate peel extract was selected as the best sample. It can be concluded that it is possible to produce the ice cream with naturally flavoring agents with desirable physicochemical and sensory properties.

Keywords: Ice cream; firmness; melting resistance; Physicochemical; pomegranate.

1. Introduction

Nowadays, it's well established that there is a clear relation between diet and health. Diet may modulate various functions in the body. Certain foods have been associated with health benefits beyond its nutritional value, there is an increased demand for such products by consumers (Shah, 2007). Ice cream is a valuable accompaniment to the normal diet for all people especially for children. Ice cream has a great nutritional avail, for example; ice cream contains calcium, vitamins, fats, carbohydrates and proteins.

Recently researches have been concerned on healthy foods that have functional and therapeutic values and properties and high in nutraceuticals (Bhat & Bhat, 2012). Ice cream is a frozen mixture, it composed from ingredients such as milk, sweeteners, stabilizers, and etc....., the ingredients of ice cream are divided into two dairy; dairy and non- dairy groups. Dairy ingredients include milk and its products as the major part of ice cream. Non-dairy ingredients include sweeteners, emulsifiers, stabilizers and flavors (Goff and Hartel, 2013).

In general, peels of some fruit contain rich sources of bioactive compound and dietary fibers (Negi *et al.*, 2003). pomegranate fruits peel was


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characterized with their richness with the determined nutritious minerals and considered a good source of major and minor elements. It should be utilized in food fortification. Pomegranate (*Punica granatum* L.) has a great therapeutic effect, for example; antioxidant and antitumor capacity (Zhang *et al.*, 2011). It is one of the most fruit rich in phytochemical compounds like polyphenols (Miguel *et al.*, 2010) as well as protein, vitamins, carbohydrates, amino acids, pectin and fatty acids (Li *et al.*, 2006).

Pomegranate peels wastes represent 78% which use as animal feed (Cam *et al.*, 2013). It's containing high level of polyphenols, enzymes, vitamins and dietary fibers that are considered as bioactive compounds (Negi *et al.*, 2003), and healthy nutrients such as minerals, fiber, and antioxidant potentially protect from diet related diseases (Hesham *et al.*, 2020).

Considering the above mentioned, study of the use pomegranate peel extract as a health product and development of its application in the food industry, especially dairy industry, is very important. The aim of this study was to investigate the effect of adding pomegranate peel extract on physicochemical and sensory properties of ice cream.

2. Materials and methods

2.1. Chemicals

All chemicals used in this study were of analytical grade supplied by Alfa Aesar \A Johnson Matthey, El. Nasr Pharmaceutical, El. Goumhouria and Pio Chem. Alfa Chemicals companies. Distilled water was used for the preparation of all solutions, Pyrex glassware were used throughout.

2.1.1. Aqueous plant extract of pomegranate peel

Preparation of aqueous plant extract of the peels of the pomegranate plant according to (Riose *et al.*, 1987).

2.1.2. Preparation of aqueous plant extract

Prepare the aqueous extract of the peels of the pomegranate plant by mixing (40) gm of the crushed peels well and using the Blender device

with 60 cm of D.W at a ratio of 1-4 by volume. Stir the mixture for an hour by means of the electromagnetic stirrer for the plant cell walls, then leave the mixture in the refrigerator for 24 hours, the mixture was then filtered through layers of gauze to get rid of the non-pulverized parts and fiber residue, according to (Riose *et al.*, 1987).

2.1.3. Procedure for manufacturing ice cream with pomegranate peel extract

- Ice cream mix formula was prepared as described by Hekmat & McMahon (1992) and Hesham *et al.*, (2020).
- Ice cream was first prepared then the extract of pomegranate peel (1.5 & 4.5%) was added at aging stage. Then the samples were stored at -20° C for four weeks. physicochemical and sensory properties of ice cream were evaluated on the 0,1,2 and 4 weeks.

2.2. Physicochemical and bacteriological analysis

2.2.1. PH

PH value of ice cream with PPE was measured using a pH meter 1030 AD (ADWA Instruments Laboratory, Szeged, Hungary, Romania, Europe).

2.2.2. Acidity

Acidity was determined by titration with 0.1N NaOH, using phenolphthalein as an indicator (Alamprese *et al.*, 2002; Akalin and Erisir, 2008).

2.2.3. Overrun

Ice cream overrun was determined on samples as methods reported by Arbuckle (1986) and by Alamprese *et al.* (2002) by the following equation $\text{Overrun \%} = 100 \times (\text{mix weight} - \text{weight of the same ice cream volume}) \times (\text{weight of the same ice cream volume})^{-1}$.

2.2.4. Protein

protein was determined according to the recommended method of Pyne (1932).

2.2.5. Melting behavior

Melting behavior, expressed as melting starting rate, and was evaluated on 70 mL of ice cream samples stored for 4 weeks at -20° C. Melting test was performed at 30° C. the weight of melted ice cream (g) was recorded as a function of time, Alamprese *et al.* (2002).

2.2.6. Firmness of ice cream

The hardness (N) of ice cream was determined by dynamical force measurement. A force gauge (IIAXIS, Model FB 200 S/N 344, Poland) with an internal sensor was used to measure the hardness of ice cream. Force =5.0 N, penetration depth =15 mm, probe speed penetration = 1.0 mm\ s. hardness was determined as the maximum compression force (g) during the testing process of the sample, and adhesiveness as the negative peak force (g) during withdrawal. Measurements were performed for ice cream samples that were tempered to room temperature for 5 min before analysis.

2.2.7. microbiological analysis

Samples of ice cream (1g) were serially diluted (w/w) with 9 mL peptone water 0.1%, and total plate counts, bacilli, yeasts and molds were determined, according to (Heenan *et al.*, 2004).

2.2.8. Sensory evaluation

Samples of ice cream examined by semi-trained panelists of the Dairy Science Department, Faculty of Agriculture, South Valley University in Egypt. The samples were scored for flavour (45 points), body, texture and melting properties (45 points), and color (10 points)

3. Results and discussion

3.1. Acidity and pH

Acidity and pH of ice cream were monitored during the period up to 4 weeks (one month), the effect of flavoring agents on acidity and pH was studied. Results in Table (1) revealed that the changes in pH and acidity up to the end of storage period are negligible. PH values decreased when the amount of (PPE) increased in the ice cream after storage, the decrease of pH values in parallel with the increase in total acidity values its might be due to mildly acidic characteristics of the added PPE, these values described by many investigators (Ullah *et al.*, 2012; El-Deeb *et al.*, 2017; Gastaldi *et al.*, 1996). According to results in tables (1&2) adding pomegranate peel extract doesn't have a significant effect on the acidity of the product (ice cream), during storage the acidity of samples increased and the pH is reduced, reducing at pH due to the presence of acids such as ascorbic acid and other compounds in comparison with the control sample, where the control had the lowest value in acidity. changes in acidity and pH during storage were studied by (Sun-Waterhouse *et al.*, 2011; Ghazizadeh *et al.*, 2021).

Table 1. PH & Acidity of ice cream during different storage times, extract as a lactic acid of ice cream during different storage times.

Analysis	Control	ice cream with 1.5% of PPE	ice cream with 4.5% of PPE	Time of storage (week)
PH	6.27	6.33	6.28	Zero time
Acidity	0.055	0.110	.07	
PH	6.47	6.22	6.28	One week
Acidity	0.011	0.08	0.13	
PH	6.26	6.22	5.94	Two weeks
Acidity	0.09	0.13	0.12	
PH	6.29	6.03	5.35	four weeks
Acidity	0.13	0.14	0.14	

3.2. Overrun

plain ice cream (control sample) overrun is 33.9%
ice cream with 1,5% overrun is 32.01%.
ice cream with 4,5% overrun is 21.1%.

Depending on the results, increasing of PEE, it was followed by decreasing of the overrun values,

this decreasing probably due to decreasing in air bubbles stability, which is been confirmed by Erkaya *et al.* (2012). And these results are accordance with (Abd El-Rashid and Hassan, 2005; El-Kholy, 2015). Temiz and Yesilsu (2010), showed that addition of PEE raises the amounts of

organic acids causing the poor foaming capacity of ice cream. According of the results, increasing the amount of PEE decreased the melting resistance. A great association was observed with the overrun and melting properties of ice cream fortified with PEE. This according to (Hesham. Ismail *et al.*, 2020).

3.3. Protein (%) in ice cream

From results illustrated in table (2), it is obvious that there was slightly higher in protein of samples that enriched with PEE compared with control this due to increase content of protein in pomegranate peel, this accordance with Temiz & Yesilsu (2010).

Table 2. effect of PPE in ice cream on protein in different storage times:

Storage time	Fresh	One week	Two weeks	Four weeks
plain	3.4	3.57	3.5	3.59
1.5% PEE	4.59	4.59	5.4	6.29
4.5% PEE	5.57	6.29	6.29	7

3.4. Melting properties of Ice cream with Pomegranate peel extract

Meltdown is one of the major properties of ice cream which play important role in sensory quality and it's affected by its constituents and the amount of air commingled. According to tables 3,4 and 5, adding pomegranate peel extract decreased melting resistance of ice cream than the plain(control) ice cream, this may be due to

consequence weakening of the network of the structural this results accordance with (El-Samahy *et al.*, 2009; Crizel *et al.*, 2014; El-Kholy, 2005). The lower melting rate relates to the withstanding of the ice cream shape. Melting properties can be attendant with the volume of air implicated during the manufacturing process, its accordance with Cruz *et al.* (2009).

Table 3. The melting behavior of ice cream after one week of storage

Time (min)	The weight of melted plain ice cream (%)	The weight of melted ice cream with 1,5% PPE (%)	The weight of melted ice cream with 4,5% PPE (%)
10	--	--	--
15	6.3	1.03	1.9
20	12.4	8.3	7
25	29.9	21.6	14.1
30	55.9	29.7	20.7
35	64	34.9	31.6
40	82	59.2	52.6
45	84.2	65.6	63.3

Table 4. The melting behavior of ice cream after two weeks of storage

Time (min)	The weight of melted plain ice cream (%)	The weight of melted ice cream with 1.5% PPE (%)	The weight of melted ice cream with 4.5% PPE (%)
10	2.1	--	--
15	3.96	1.9	0.4
20	9.2	6.14	4.7
25	19.41	18.3	17.6
30	32.1	28.01	27.5
35	45.5	42	35.3
40	52.9	48.7	47.4
45	72.1	54	49.4

Table 5. The melting behavior of ice cream after four weeks of storage

Time (min)	The weight of melted plain ice cream (%)	The weight of melted ice cream with (1.5% PPE) (%)	The weight of melted ice cream with (4.5% PPE) (%)
10	---	--	--
15	3	1.7	--
20	6	4.2	3.2
25	9.7	7.7	6.5
30	27.9	19.03	15.3
35	44.7	27.7	26.5
40	50.3	32.4	31.5
45	62.3	42.8	40.8

3.5. Effect of adding of peel extract on texture properties (firmness) of ice cream

As can be seen in table (6), the hardness of samples were increased by increasing the amount of extract of pomegranate peel in comparison with the control treatment, different factors could change the hardness of the ice cream such as fat

globulin net, overrun, ice crystal size and rheology in the ice cream mix. From the results a high-water content of PEE, the number and size of ice crystals increased in ice cream samples, these changes lead to the increased of hardness (firmness) of ice cream containing PEE compared to control, this accordance with Muse and Hartel (2004).

Table 6. The Firmness properties of ice cream

Storage time	Firmness (g) of control	Firmness (g) of ice cream with 1.5% of (PEE)	Firmness (g) of ice cream with 4.5% of (PEE)
One week	170	200	270
Two weeks	175	300	350
Four weeks	300	380	400

3.6. Sensory evaluation of ice cream

Sensory panel test is one of indicator of potential consumer preferences and most closely linked to the choice of food products. Flavor, body texture, melting and color properties of ice cream enriched with PEE were evaluated as sensory characteristics. From results showing in table (7) the highest total score recorded for ice cream until

four weeks of storage was for ice cream enriched with 1.5% of PEE. Incorporation of PEE into ice cream had characterized by creamy color, acceptable flavour and described with soft body and texture and higher scores of sensory parameters. This accordance with Hesham.Ismail *et al.* (2020).

Table 7. sensory evaluation of ice cream enriched with pomegranate peel extract.

	Fresh	One week	Two weeks	Four weeks
Sensory	plain -1.5%- 4.5%	plain -1.5% -4.5%	plain-1.5%-4.5%	plain -1.5% - 4.5%
Aroma	40.9-35.7-41.8	41.8-33.8-36.3	30.8 – 40.7 –29.6	33.2 -39.2 -27.7
Color	8.08-8.09-8.06	8.7-4.5-8.4	6.2-5.2 -3.5	8.6 -5.3 -7.5
Texture & Melting	40.8-38.3-41.6	42.5-43.4-41.1	29.5- 44.2-32.2	39- 39 – 35.6

3.7. Effect of manufacturing and storage conditions on the cell's viability

Total plate count shouldn't be high than 150000 cfu/g .in this study the data were in agreement with this regulation. These results are according to those found by Abd El-Rahim (1999). Singh *et al.*

(2014) and Ali *et al.* (2016). The viable bacteria contents were determined during manufacturing and frozen storage at -20° C shown in tables (8,9&10). According to the results, the count of bacteria, yeasts and molds is changeable, there was a slight decrease in the microorganism counts

(bacilli, yeasts and molds) during storage, it is similar to Acu *et al.* (2021). Viability level of Total count of bacteria, bacilli, yeasts and molds is preserved during storage and steps of

manufacturing process of ice cream enriched with PPE may be due to pH of products, this according to (Cruz *et al.*, 2009; Kemsawasd and Chaikham, 2020).

Table 8. Average value of standard plate count in ice cream at different times of storage $\times 10^3$ cfu/g

Time	control	ice cream with 1,5% of (PX)	ice cream with 4,5% of (PX)
Pre aging	14.9	4.9	1
After aging	11	1	0.9
After freezing	45	7	2.9
After 1 week	11	6	2
After 2 weeks	13	10	9
After 4 weeks	67	30	20

Table 9. Average value of Bacilli in ice cream at different times of storage $\times 10^3$ cfu/g

Time	control	ice cream with 1,5% of (PX)	ice cream with 4,5% of (PX)
Pre aging	0.1	1	0.2
After aging	0.1	1	0.6
After freezing	0.1	1	1
After 1 week	0.3	1	.5
After 2 weeks	0.6	0.1	2.9
After 4 weeks	1	0.1	1

Table 10. Average value of yeast & mould in ice cream at different times of storage $\times 10^3$ cfu/g

Time	control	ice cream with 1,5% of (PX)	ice cream with 4,5% of (PX)
Pre aging	-	-	-
After aging	-	-	-
After freezing	-	-	-
After 1 week	0.5	0.4	1.2
After 2 weeks	2	0.6	0.7
After 4 weeks	0.5	0.9	1

4. Cost analysis

The cost wise pomegranate ice cream treatment combinations were more economical as compared to the ice cream available in present day markets. Because pomegranate peel doesn't cost.

5. Conclusion

This study was performed to throw the light on the ability of incorporation pomegranate peel extract as a natural additive in ice cream processing which having a lot of nutritional avails include: fat, protein, fiber, ash, antioxidant activity and antitumor capacity. And isn't cost anything for

producer. The treatment containing 1.5% PEE had desirable acidity and gainly rate of microbiology, soft body and desirable acceptable flavour, so it could be selected as the best treatment.

Authors' Contributions

All authors are contributed in this research.

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Institutional Review Board Statement

All Institutional Review Board Statements are confirmed and approved.

Data Availability Statement

Data presented in this study are available on fair request from the respective author.

Ethics Approval and Consent to Participate

Not applicable

Consent for Publication

Not applicable.

Conflicts of Interest

The authors disclosed no conflict of interest starting from the conduct of the study, data analysis, and writing until the publication of this research work.

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