



Development of pomegranate based fortified ice cream

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Abstract

Pomegranate (*3XQLFDJUDQDWP L.*) is an important fruit which is highly valued for its health benefits. Pomegranate is rich source of sugars, vitamins, minerals, phenolic components and bioactive compounds, which proved benefits in combating various high risk diseases. Therefore, pomegranate could be good source of functional nutrients and can be used as natural additives or substituted material for production of many foods like ice cream. Ice cream is a delicious and nutritious frozen confectionary dairy product, made from milk and cream combined with flavouring agents and sweeteners. The nutritious components of ice cream depend on the type of ice cream as well as ingredients that are used in preparation of ice cream. Therefore, the primary aim of current study is to fortify ice cream with pomegranate juice at different concentration level and evaluate its biochemical and sensory effects.

Keywords: pomegranate (*Rwpkec"itcpcvwo L.*), ice cream, fortification, sensory analysis, antioxidants

Introduction

Pomegranate (*Rwpkec"itcpcvwo L.*) is important horticultural crop of India. The Maharashtra is the largest producer of pomegranate followed by Karnataka, Gujarat, Andhra Pradesh, and Rajasthan. The processing of pomegranate in to value added products will provide sustained demand of fruits in market and thus will improve the profit of pomegranate producers. The edible part (arils) of the pomegranate fruit consists of 40% arils and 10% seeds. The arils are comprised of approximately 80% juice and 20% seed. The juice of arils contain 85% water, 10% total sugars (glucose, sucrose, and fructose) and 1.5% pectin, organic acids (citric, malic, tartaric, succinic, fumaric, ascorbic acid), fatty acids (i.e. conjugated linoleic acid, linoleic acid, punicic acid and eleostearic acid), and amino acids (i.e. proline, valin, and methionine), and bioactive compounds (phenolics and flavonoids) (Bayazit *et al.*, 2012) ^[4]. Pomegranate is excellent source of vitamin C. Pomegranate juice represents one of the foods recently promoted for its health benefits since a glass of pomegranate juice contains about 40% of the Recommended Daily Allowance (RDA) of Vitamin C (Singh & Singh, 2004). Vitamin C helps the body develop resistance against infectious agents by boosting immunity. Pomegranate is good source of fiber, potassium, thiamin, folate, manganese and copper. Many of the phytochemicals in pomegranate act as antioxidants. Antioxidants neutralize free radicals to prevent cell damage. Fruits not only improve the sensory quality of the product but also improve its nutritive value which varies with the type of fruit used. Therefore, incorporation of fruits, which is also accepted by regulation in India, such as mango, pineapple, strawberry, orange, etc. in the form of juices, pulp or pieces is a common practice. (C.M. Yadav *et al.*, 2010) ^[17]. Ice-cream is a delicious and nutritious frozen desert made from dairy products such as milk and cream combined with

flavoring and sweeteners such as sugar. In some cases, artificial flavorings and colorings are added instead of natural ingredients. It is considered to be a junk food that children love to eat. Mostly they eat this kind of food which is high in sugar and fats, the less they like fresh and natural foods like fruits and vegetables. Ice cream is a very popular frozen confectionary dairy product consumed in India and other countries as well. Ice cream industry has developed a variety of ice creams, for mitigating some of the health concerns. The changes of texture and flavor profile of such ice cream can provide the satisfaction to the consumers (Patel and Amin 2015) ^[11]. The nutrient component of the ice cream depends on the type of ice cream as well as the ingredients that are used in the preparation of ice-cream. On an average, the ice cream contains three times more fat and slightly more protein than the milk. It is a rich source of calcium, phosphorous and other minerals important for bodybuilding (Patel and Amin 2015) ^[11]. Ice-cream is rich in carbohydrates, proteins, fats, and some micronutrients, such as vitamin A, D, E, calcium and minerals. However the Ice-cream currently available commercially is generally poor in natural antioxidants like vitamin C, colors and phenolic. There is a strong drive these days focusing on health and there is a definite consumer trend towards the purchase of healthier products. However in our current era of nutritional excess, the focus of enrichment has shifted from the pursuit of optimal health and dietary intake. Ice cream is an important desert food consumed especially by children and other age groups. Ice-cream could be made more nutritious, health beneficial and tastier by adding pomegranate juice. It will provide attractive natural colour and will improve nutrition. Keeping above points in mind the research has been planned to fortify the ice cream with pomegranate juice and evaluate the use of pomegranate juice at different concentration level in ice cream.

Materials and Methods

Collection of Pomegranate Fruit

Pomegranate Fruits were collected from local market of Ahmednagar. The fruits of uniform size, colour, maturity and free of apparent pest and diseases were randomly selected by visual observation and used as experimental material. Fruits were used freshly or immediately transported to the cold room in the laboratory and stored at 5°C until further use.

Extraction and Clarification of Fruit Juice

The freshly/ cold stored pomegranates were further processed for extraction of juice (being used for ice cream fortification) using the method suggested by Ismail *et al.*, (2014) [8]. The fruits were washed with tap water to remove the dust and wiped completely dry, the fruits were cut in two halves and the juice was immediately extracted using a hand operated juice extractor/mechanical press. The extracted juice was filtered through two to three layers of muslin cloth. The juice was immediately stored at 4°C until further use. The filtered pomegranate juice was further clarified using a commercially available fining agent bentonite according to Priyanka P. *et al.*, (2014). Firstly, the juice was filtered through muslin cloth. To this juice bentonite at 0.5% of juice was added and juice was held for 4 hrs. Then the treated juice was filtered through muslin cloth. This juice was pasteurized at 82°C for 15 min. to get clarified juice.

Physico-chemical Analysis of Fruit Juice

Clarified pomegranate juice were analyzed for its chemical quality, pH, acidity, total sugar, reducing sugar, non-reducing sugar, fat, total soluble solids, ascorbic acid, phenol, anthocyanin, antioxidant capacity by standard methods.

Preparation of Pomegranate based Fortified Ice cream

The standardization of ice-cream with Pomegranate (*Punicagranatum L.*) was carried out according to the method described by Samahy *et al.*, (2009) [15]. Fresh cow's milk (3.5% fat), Skim milk powder, sodium alginate, fresh cream (25% fat) and sugar were procured from the local market. Different compositions on trial basis were worked out to standardize the pomegranate based fortified ice-cream composition as shown in Table 1.

Table 1: Composition of Pomegranate Based Fortified Ice Cream

| Sr. No. | Ingredients | Control | A | B | C |
|---------|--------------------------|---------|-----|-----|-----|
| 1 | Milk (ml) | 100 | 100 | 100 | 100 |
| 2 | Cream (gm) | 50 | 75 | 50 | 25 |
| 3 | Skimmed milk powder (gm) | 15 | 15 | 15 | 15 |
| 4 | Sugar (gm) | 35 | 35 | 35 | 35 |
| 5 | Sodium Alginate (gm) | 1.5 | 1.5 | 1.5 | 1.5 |
| 6 | Pomegranate Juice (gm) | ---- | 25 | 50 | 75 |

The required amounts of skim milk powder were mixed with sodium alginate and sugar, and then added slowly to the liquid ingredients (milk and cream) at 45°C under vigorous agitation. The basic mixes were pasteurized at 80°C for 10 minutes in a water bath and then cooled to 4°C in ice bath. The required amounts of pomegranate juice, which already pasteurized before, were blended with the cooled basic mixes in a blender for 2 minutes. After that, all mixes were aged for 24 hours at 4°C before frozen in an ice cream machine (Kitchenif 222, India). The

produced ice cream was packaged in cups (100cc) and placed in a freezing cabinet at -18°C for 24 hours at least before evaluation.

Physico –chemical Evaluation of Pomegranate based Fortified Ice cream

The pomegranate based fortified ice cream was analysed for overrun, pH, acidity, moisture contents, total solid, total sugar, reducing sugar, non-reducing sugar, fat, total soluble solids, ascorbic acid, phenol, anthocyanin, antioxidant capacity, ash contents according to the methods described by Abdullah *et al.*, (2003) [1], A. O.A.C (1990), Khater Z. K. (2002), Ranganna (1995) and Hashim and Shamsi (2016) [7] and AOAC (922.06).

Sensory Analysis

The pomegranate based ice cream was evaluated for its sensory quality by a panel of 10 judges using 9 points Hedonic scale as described by Pawar *et al.*, (2010). The chilled ice cream was garnished with fresh pomegranate arils while serving to the panel.

Cost Analysis

The cost of development of pomegranate based fortified ice cream was worked out by the method described by Priyanka *et al.*, (2013) [14] and Yadav *et al.*, (2010) [17] considering the prevailing market prices of all the ingredients used and processing cost of the product.

Result and Discussion

Three blends of pomegranate based ice cream (A, B, and C) and of ice cream without pomegranate juice (plain ice cream) as a control were tried in the ice cream formulation.

Physico – chemical Evaluation of Juice and Pomegranate based Fortified Ice cream

The physico – chemical analysis of pomegranate based ice cream are shown in table 2.

Table 2: Physicochemical Analysis of Pomegranate Based Fortified Ice Cream

| Parameters | Juice | Control | Sample A | Sample B | Sample C |
|-------------------------------------|-------|---------|----------|----------|----------|
| Overrun (%) | ----- | 45.60 | 47.619 | 45.61 | 43.60 |
| pH | 3.1 | 6.71 | 6.64 | 6.61 | 6.59 |
| Acidity (%) | 0.3 | 0.157 | 0.184 | 0.198 | 0.216 |
| Moisture content (%) | ----- | 57.63 | 60.03 | 62.91 | 64.13 |
| Total solid (%) | ----- | 42.36 | 39.96 | 37.08 | 35.86 |
| Total sugar (%) | 13.4 | 14.60 | 15.60 | 17.60 | 23.60 |
| Reducing sugar (%) | 12.2 | 0.285 | 0.286 | 0.285 | 0.284 |
| Non reducing sugar (%) | 1.3 | 14.30 | 15.30 | 17.30 | 23.30 |
| Fat (%) | ----- | 7.38 | 10.48 | 8.37 | 7.31 |
| TSS (°B) | 14.5 | 33.65 | 35.78 | 37.43 | 39.75 |
| Ascorbic acid (mg/100g) | 9.0 | 95.41 | 98.75 | 100.41 | 102.08 |
| Phenol (mg/L GAE) | 1285 | 2007 | 2654 | 2860 | 2960 |
| Anthocyanin (mg/100 ml cyanidine) | 5.55 | 0.484 | 1.335 | 3.907 | 5.510 |
| Antioxidant capacity (mg/100 g AAE) | 37.2 | 9.98 | 23.18 | 31.88 | 43.68 |
| Ash content (%) | ----- | 0.50 | 0.70 | 0.59 | 0.50 |

The overrun value of pomegranate based ice-cream (A, B, and C) ranged from 43.60 – 47.61 percent, while an overrun value of control ice cream is 45.60%, this indicates that Sample A is

superior among others with highest value 47.61 which may be due to increased concentration of cream because increased overrun raises the creaminess of ice cream, the similar results were reported by Hashim and Shamsi (2016) [7]. The pH of control ice cream is 6.71 which is slightly higher compared to pH of pomegranate based ice cream samples ranged from 6.59-6.64. Pomegranate based ice cream (Sample C) with high concentration of juice (75ml) has lower pH (6.59) compared to control and other pomegranate based ice cream (Sample A and B). Increasing pomegranate juice concentration decreases pH, the similar results were reported by Cam *et al.*, (2013) [5] and Hashim and Shamsi (2016) [7]. Progressive increase in the titrable acidity is found in the pomegranate based ice cream ranged from 0.18 – 0.21%, as compared to control 0.15%, this is may be due to increase in concentration of pomegranate juice, these result correlates with the previous reports of Pandiyan *et al.*, (2012) and Hashim and Shamsi (2016) [7]. The moisture contents of pomegranate based ice cream ranged from 60.03 – 64.13%, which are higher than control ice cream (57.63%) this indicates that increased concentration of pomegranate juice raises the moisture content of ice cream. These results are similar to the results reported by Abdullah *et al.*, (2003) [1]. Maximum total solids have ranged from 35.86 – 42.36%, including a control sample which indicates that, increase in pomegranate juice decreases total solid, the results are in agreement with Amiri *et al.*, (2014) [2]. The increasing pattern of sugar content was observed ranged from 14.60 – 23.60%, including control ice cream, which may be due to increasing concentration of pomegranate juice. Increasing the sugar content of ice cream causes a smooth texture, because it lowers the freezing point, the amount of unfrozen material is increased, increased viscosity and free water contents declined. The fat content of pomegranate based ice cream including control ice cream ranged from 7.31 – 10.48%, Sample A has a high fat content among others this may be due to rise in cream content increases fat percentage, in present study slight differences are found compared to reports of Abdullah *et al.*, (2003) [1]. The increasing pattern of TSS (°B) of the ice cream samples was observed as 35.78, 37.43, 39.75 for sample A, sample B, and sample C respectively and control sample has lower values of TSS i. e. 33.65%, which might be due to increasing concentration of pomegranate juice. Ascorbic acid (mg/100ml) was founded in increasing order ranged from 98.75 to 102.08 for pomegranate based ice cream while control has 95.41 this might be due to rise in pomegranate juice concentration. Total phenol content (mg/L GAE) values for pomegranate based ice cream are in the range of 2654 – 2960 which observed in an increasing pattern with increasing concentration of juice this might be due to the phenolic contents of pomegranate while the control sample has the lowest value for phenol (2007.33). The anthocyanin contents in pomegranate based ice cream ranged in increasing pattern from 1.33 – 5.51 (mg/100ml cyanidine) as while the control has the lowest value of anthocyanin (0.48) which indicates that the rise in pomegranate juice concentration increases the anthocyanin contents. Antioxidant capacity (mg/100ml AAE) was found to be 9.98, 23.18, 31.88, percent of sample A, sample B, and sample C respectively, and 43.68 mg/100 ml in control, this indicates that improvement in antioxidant capacity with increasing addition of pomegranate juice concentration. Sample A has the highest percentage of Ash (0.70%) among others which indicate higher

mineral content in Sample A as suggested by Bisla *et al.*, (2012) [4].

Sensory Analysis

Sensory attributes of the pomegranate based fortified ice cream prepared from different combinations of blends (A, B and C) along with control ice cream are represented in table 3 as below,

Table 3: Sensory Analysis of Pomegranate Based Fortified Ice Cream

| Treatment | Colour & Appearance | Texture | Taste | Flavour | Mouth Feel | Overall Acceptability |
|-----------|---------------------|---------|-------|---------|------------|-----------------------|
| Control | 6.55 | 7.14 | 6.67 | 7.36 | 6.65 | 6.84 |
| Sample A | 7.87 | 7.72 | 7.76 | 8.07 | 7.00 | 7.68 |
| Sample B | 9.02 | 8.99 | 9.04 | 9.05 | 8.70 | 8.96 |
| Sample C | 6.59 | 6.94 | 6.58 | 7.40 | 7.45 | 6.85 |

Colour and Appearance

Highest colour and appearance score 9.02 was observed that for pomegranate based fortified ice cream with 50ml pomegranate juice (Sample B) whereas, 6.59, 7.87 and 6.55 scores for Sample C, Sample A and Control, respectively, this indicates that, in terms of the colour and appearance Sample B is superior among other samples including control ice cream.

Texture

It was observed from the result that the pomegranate based fortified ice cream prepared with various pomegranate juice combinations exhibited wide differences with regards to texture ranged from 6.94 (Sample C) to 8.99 (Sample B). Sample B scored highest at 8.99 followed by Sample A (7.72) and both were rated in between like very much to like extremely, Control (7.14) valued at like moderately and Sample C (6.94) scored lowest.

Taste

The average score for the taste differed much by the addition of different level of concentration of pomegranate juice of developed pomegranate based fortified ice cream samples as the score varied from 9.04 – 6.58. The best taste was observed in case of Sample B ice-cream samples valued at 9.04, followed by Sample A (7.76) and Control (6.67) rated in between like very much to like extremely and Sample C (6.58) rated in between like slightly to like moderately.

Flavour

It was observed that flavour score was highest in Sample B (9.05) for pomegranate based fortified ice cream followed by Sample A (8.07) ranged in between like a very much to like extremely, Control (7.36) and Sample C (7.40) rated equally in between like moderately to like very much.

Mouth feel

The observed score for mouth fee ranged from 6.65 – 8.70, the highest score was observed for Sample B (8.70) followed by sample C (7.45), Sample A (7.00) and control (6.65).

Overall Acceptability

The mean score for overall acceptability for treatment Control, Sample A, Sample B and Sample C was 6.84, 7.68, 8.96 and 6.85, respectively. It was observed that much variations were found in

overall acceptability score and ranged 6.85 (Sample C) to 8.96 (Sample B). Sample B received top score (8.96) for overall acceptability followed by Sample A (7.68) rated in between like very much to like extremely and Control (6.84).

Cost Analysis

The record of the cost of development of most acceptable pomegranate based fortified ice cream (Sample B) is presented in table

Table 4: Cost Analysis of Pomegranate Based Fortified Ice Cream

| Sr. No. | Particular | Price Per Unit (Rs) | Quantity Used for Control | Cost for Control | Quantity Used for Sample A | Cost for Sample A | Quantity Used for Sample B | Cost for Sample B | Quantity Used for Sample C | Cost for Sample C |
|---|------------------------|---------------------|---------------------------|------------------|----------------------------|-------------------|----------------------------|-------------------|----------------------------|-------------------|
| 1 | Milk (ml) | 22 Rs. / 500ml | 100 | 4.40/- | 100 | 4.40/- | 100 | 4.40/- | 100 | 4.40/- |
| 2 | Milk Cream (ml) | 46 Rs. /200 ml | 50 | 11.50/- | 75 | 17.25/- | 50 | 11.50/- | 25 | 5.75/- |
| 3 | Pomegranate Juice (ml) | 100 Rs. /400 ml | ----- | ----- | 25 | 6.25/- | 50 | 12.5/- | 75 | 18.75/- |
| 4 | Sugar (g) | 20 Rs. / 500g | 35 | 1.4/- | 35 | 1.4/- | 35 | 1.4/- | 35 | 1.4/- |
| 5 | SMP (g) | 36 Rs./100 g | 15 | 0.54/- | 15 | 0.54/- | 1.5 | 0.54/- | 15 | 0.54/- |
| 6 | Alginate (g) | 144 Rs./100 g | 1.5 | 2.16/- | 1.5 | 2.16/- | 1.5 | 2.16/- | 1.5 | 2.16/- |
| Total quantity of raw material used for making ice cream | | | 202ml | | 252ml | | 252ml | | 252ml | |
| Quantity of ice cream obtained after processing of raw material | | | 294ml | | 372ml | | 367 ml | | 362ml | |
| Total cost of ingredient / raw material | | | | | Rs. 20 | | 32 | | Rs. 32.50 = 33.00 | Rs. 33 |
| Processing and Packaging cost @ 10% of raw material cost | | | | | Rs. 2 | | 3.20 | | Rs. 3.30 | Rs. 3.30 |
| Production cost for 367 ml of pomegranate juice fortified ice cream | | | | | Rs. 22 | | 35.20 | | Rs. 36.30 | Rs.36.30 |
| Production cost for 1 L of pomegranate based fortified ice cream | | | | | Rs.74.82= Rs. 75.00 | | Rs. 94.62 = Rs. 95.00 | | Rs.98.91= Rs.99.00 | Rs. 99.00 |

The cost of development of 1 ltr. Ice cream without pomegranate juice control was Rs. 75.00 which increased to Rs. 95.00, Rs. 98.91=Rs.99.00, and Rs. 99.00 for combinations, sample A, B and C respectively. When pomegranate concentration increased there was also increase in cost of ice cream. Ice cream prepared with incorporation of pomegranate juice at rate of 50 ml (Sample B) was with all desired characters with cost of production Rs. Rs.98.91=Rs.99.00/lit.

Conclusions

The primary aim of this investigation was to evaluate the use of pomegranate juice at different concentration level in ice cream. Three blends of pomegranate based ice cream (A, B, and C) and of ice cream without pomegranate juice (plain ice cream) as control were tried in the ice cream formulation. The present study shows potential value of pomegranate fruit as a natural source of energy and nutritive components. The physico chemical and sensory analysis indicated that incorporation of pomegranate juice improved the sensory and functional properties of ice cream including antioxidant, phenolic content. Pomegranate fruit may be a suitable source of natural additive or substituted material for production of many foods like ice cream.

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