

## Pomegranate Seed (*Punica granatum L*): A Study on Nutrient and Quality Characteristics of Bread as Modified by Partial Addition of PSF

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Punica granatum is popularly known as pomegranate (Anar). The edible part of the fruit (seeds) contains a considerable amount of sugars, vitamins, polysaccharides, minerals. These compounds are able to reduce the formation of free radical compounds that cause oxidation reactions associated with biological complications such as ageing, cardiovascular disease and carcinogenesis. So the aim of the study was to assess nutrients and evaluate the quality characteristics of bread as modified by partial addition of pomegranate seed flour. Proximate analysis (moisture, protein, fat, fiber, ash and carbohydrates) as well as mineral components (calcium, iron, magnesium and zinc) were assessed. Protein, fat and carbohydrate were assessed using Micro-Kjeldahl, Soxhlet and difference method respectively whereas calcium was analyzed by titrimetric method and iron by Wong's method. The sensory evaluation was conducted to assess the sensory attributes (appearance, color, crumb appearance, texture, flavour and overall acceptability) of pomegranate fruit bread by 15 semi-trained panel members using 9-point hedonic rating scale. Results of the study revealed that the seeds had the highest crude fiber (35.2g/100g) among all the proximate components whereas calcium (58.1mg/100g) and iron (14.4mg/100g) were found to be higher among minerals analyzed. The results of sensory evaluation revealed that on the basis of overall acceptability, sample 'A' (10% incorporation of PSF to wheat flour) was significantly different ( $p < 0.05$ ) when compared with other variants and have pleasant organoleptic properties. The results obtained from the present study suggested that byproducts could be considered as an excellent source of vitamins and minerals thus it can improve the quality characteristics of the bread which can be beneficial for the health of the humans and other added value products could be made from those wastes.

### 25 Introduction

The pomegranate (*Punica granatum L*) belongs to the **Punicaceae** family. It is widely considered native to Iran and its surrounding areas, including some parts of the Mediterranean area [1]. Others suggest that its origin comes from the area lying from Iran to Himalaya in northern India and had been cultivated and naturalized over the whole Mediterranean region since ancient times [2, 3]. The studies have proven the existence of the wild pomegranate in many countries. In Iran it is found even in house gardens of the locals [4]. It is mainly cultivated in Iran, Afghanistan, India, Mediterranean countries, and to some extent in the USA, China, Japan, and Russia [5, 6]. Spain is the greatest European producer [7], and its production is mainly located in the southeastern provinces, mainly Alicante [8].

Pomegranate is used in several systems of medicine for a variety of ailments. In Ayurvedic medicine the pomegranate is considered a *pharmacy unto itself* and to heal apathae, diarrhoea and ulcer. Pomegranate also serves as a remedy for diabetes in the Middle East and India. The potential therapeutic properties of pomegranate are wide-ranging and include treatment and prevention of cancer, cardiovascular diseases, diabetes, dental conditions, erectile dysfunctions and protection from ultraviolet radiation. Other potential applications include infant brain ischemia, Alzheimer's disease, male infertility, arthritis and

obesity [9]. The pomegranate is reported to have several health benefits due to the presence of various tannins, flavonoids, alkaloids and organic acids. Gallagylidilaction, gallic acid, granatin B have showed anti-inflammatory activity. Apart from that, various flavonoids like catechin, epicatechin, epigallocatechin-3-gallate, flavan-3-o-glucoside, kaempferol-3-o-rhammoglucoside, luteolin, luteolin 7-o-glucoside, naringin, pelargonidin, prodelpindin, quercetin and rutin have been also found in peel extracts of pomegranate which shows antibacterial, antiviral, antioxidant, anti-inflammatory and antineoplastic bioactivities. [10]. Pomegranate is reported for treating the infection of male or female sexual organs, mastitis, acne, folliculitis, pile, allergic dermatitis, lympanitis and scald for curing diarrhoea and dysentery and as part of medicine for the treatment of oral diseases [11].

### Methodology

This section contains relevant information pertaining to material and techniques used and other methodological aspects of study. The methodological aspects of the study have been discussed as under:

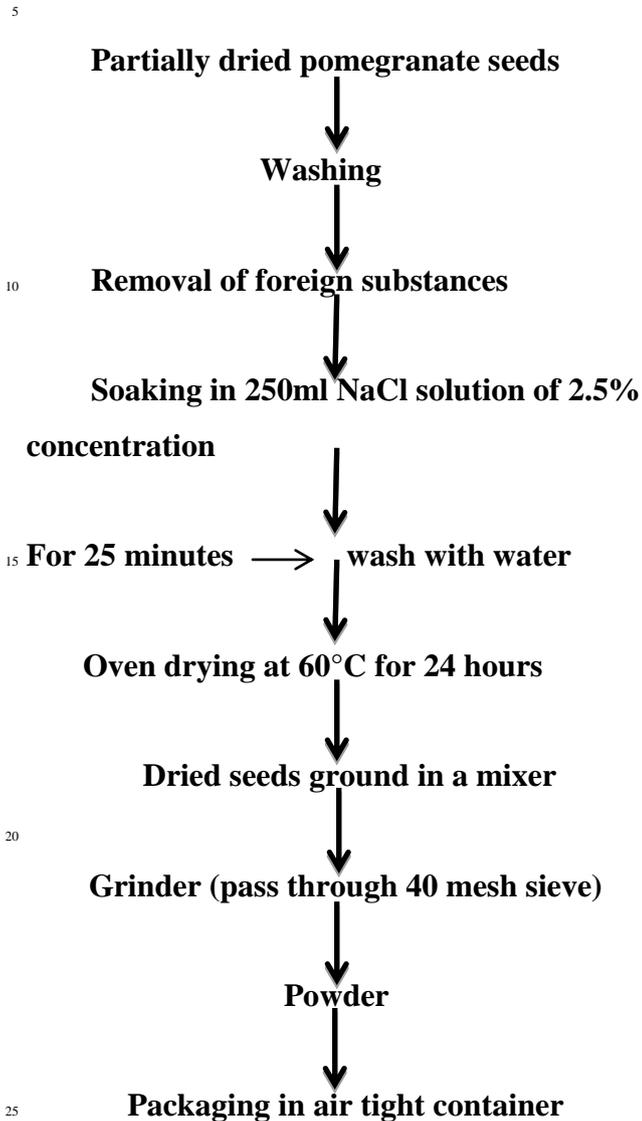
#### Procurement of Pomegranate Seeds

Pomegranate seeds of species *Punica granatum L*. were purchased from the local market of Jaipur (Rajasthan) and

identified from Krashi Vigyan Kendra in Banasthali University, Newai (Tonk), Jaipur (Rajasthan).

### Sample Preparation

#### Oven Drying and Formation of Powder



### Chemical Analysis

#### Moisture Content [12]

##### Procedure:

10 gm of well mixed sample was taken in an already weighted Petridis and Sample was dried in an oven at 100°C for 3 to 4 hours. Cooling was done in a desiccator and drying, cooling and weighted was repeated until the weight was constant.

##### Calculation:

$$\text{Initial weight (g)} - \text{final weight (g)}$$

$$35 \text{ Moisture content (g/100g)} = \frac{\text{Initial weight (g)} - \text{final weight (g)}}{\text{Weight of the sample}} \times 100$$

#### Ash Content [13]

##### Procedure:

10 gm sample was taken in a crucible and weighed crucible and charred over a burner. The sample was then ignited in a muffle furnace at 600°C for 5-6 hours and a light grey ash marked the completion of ashing process. The sample was weighed after cooling in a desiccator and the process of heating for half an hour, followed by cooling in a desiccator and weighing was repeated until two concomitant readings were obtained.

##### Calculation:

$$\text{Weight of ash (g)}$$

$$50 \text{ Ash content (g/100g sample)} = \frac{\text{Weight of ash (g)}}{\text{Weight of sample}} \times 100$$

#### Protein by Micro – Kjeldahl method [12]

##### Procedure:

55 Clean all 6 test tubes, oven dry them and cool them down in desiccator. Prepare 15% NaOH – 1.5 L, 40%NaOH – 1L, 4% Boric acid – 200 ml. Prepare Copper sulphate: Potassium sulphate mixture in the ratio of 1:5 – for 24g mixture (CuSO<sub>4</sub>:K<sub>2</sub>SO<sub>4</sub>), take separately 4g copper sulfate and 20g potassium sulfate. Mix them after weighing. Now weigh 3g mixture in 6 lots (each for 6 tubes of digestion).

##### Digestion:

Preheat the digestion unit to 350°C for 25 minutes. After 25 minutes, put 6-tube stand, having 0.2g sample + 3g copper sulphate : Potassium sulphate + 10ml conc. H<sub>2</sub>SO<sub>4</sub>, into preheated digestion rack, switch on the KELVAC system, increase the temperature of digestion unit to 420°C and cover 6 – tubes with sealed lids. Digestion will take approximately one to one and a half hours or until green color appears in the sample.

70 After the digestion, switch off both digestion unit and Kelvac system. Place the digestion tubes in other supporting system and let them cool. Add 50ml distilled water in each 6 tubes to prevent solidification of the contents.

##### Distillation:

75 Switch on the distillation system. Put one by one digested tube and fill it with 20 ml alkali two times. After alkali filling, start process time to 12 minutes and turn on the water tap. At the receiver end, place 25ml of 4% boric acid in conical flask with 5 – 6 drops of bromocresol green. End of process time denotes the end of distillation phase.

##### Titration:

Fill burette with 0.1 HCl and titrate it against the solution obtained from the receiver from the receiver end of distillation system.

$$85 \quad 14.01 \times 0.1 (TV-BV) \times 100$$

$$N \text{ Value} = \frac{14.01 \times 0.1 (TV-BV) \times 100}{\text{Sample weight} \times 1000}$$

Where, TV = Test Value and BV = Blank Value.

#### Fat Content [12]

Generally the fat content is estimated in a dry sample following the removal of moisture.

##### Procedure:

The procedure involved a 15 hours extraction fat accurately

weighed dry sample (8-10) in soxhlet apparatus. Solvent ether of the fat extract obtained is evaporated to dryness and residue. Further dried in the oven at 70-80°C cooled in a desiccator and finally weighed accurately. The fat content (g/100g) of fresh sample and the conversion of dry weight of the sample to weight is made from the extracts of decrease in weight of the given sample on its completely dry out.

Calculation:

Fat (g/100g) =

Weight of dried sample – weight of the sample after extraction

$$\frac{\text{Weight of dried sample} - \text{Weight of the sample after extraction}}{\text{Weight of the sample}} \times 100$$

Weight of the sample

### Fiber Content [12]

Procedure:

About 3-5 g of moisture and fat free sample was weighed into a 500ml graduated beaker. Very dilute 0.255 N (1.25% w/v) boiling sulphuric acid was added make the total volume reach 200ml mark. Contents were boiled for 30 minutes. Water was added frequently to keep volume constant at 200 ml mark. After 30 minutes, the contents were cooled filtered through muslin cloth. The beaker was washed thoroughly and kept inverted on a piece of filter paper. The residue was washed free of alkali with hot water and finally the residue was washed with alcohol ether mixture (1:1v/v). The contents were transferred to a platinum crucible and dried out in an oven at 100°C for 10-12 hour. Weight (W<sub>1</sub>) was taken after cooling in desiccator and weighed again (W<sub>2</sub>). Crucible was heated in muffle furnace at 600°C for 3-4 hours. It was cooled in desiccator and weighed again (W<sub>2</sub>). Difference in two weights (W<sub>1</sub>-W<sub>2</sub>) was the weight of crude fiber in the sample.

Calculation:

$$W_1 - W_2$$

$$\text{Crude fiber (g/100g)} = \frac{W_1 - W_2}{W} \times 100$$

W (weight of sample)

### Carbohydrate

Subtract from 100, a sum of value (g/100g) for moisture, protein, fat, ash, and crude fiber to get the carbohydrate content (g/100g) of sample.

### Iron Content (Wong's Method) [13]

Method of Preparation of Aliquots:

The ash was washed with a small amount of glass distilled water (0.5 to 1.0ml) and 5 ml dilute HCl was added to it. The mixture was evaporated to dryness in a boiling water bath. Another 5 ml of HCl was added again and solution evaporated to dryness as before. 4 ml of HCl and few ml of H<sub>2</sub>O were then added and the solution was washed over a boiling water bath and was filtered into 100 ml volumetric flask using Whatman no. 40, make the volume to 100 ml. Suitable aliquots were used for the estimation of iron.

Procedure:

6.5ml of aliquot of the mineral ash solution was taken in a test tube followed by addition of 1 ml of 30% conc. H<sub>2</sub>SO<sub>4</sub>. 1 ml of potassium persulphate solution was added just before taking the reading. The red color developed was measured within 20 minutes at 540 nm.

Calculation:

Iron (mg/100g) =

Optical density of test

$$\frac{\text{Optical density of test}}{\text{Optical density of standard}} \times \text{conc. Factor} \times \text{conc. of standard}$$

Optical density of standard

### Calcium by Titrimetric Method [12]

Procedure:

Aliquot of the sample (40-50 ml) was boiled in a beaker. 10 ml of 4% ammonium oxalate solution was added to it. Two drops of methyl red indicator were added followed by dilute ammonia till the attainment of the faint pink color. It was boiled for 5-10 minutes so as to make precipitate thick and granular. Then it was allowed to stand for 6-8 hours. It was filtered using Whatman No. 40 filter paper and washed with hot distilled water to make the precipitate free of soluble chlorides and oxalates. Now precipitate as dissolved in 5 ml of 1N H<sub>2</sub>SO<sub>4</sub> by washing the filter paper completely. Then it was titrated against 0.01N KMnO<sub>4</sub> to the persistence of faint pink color.

Calculation:

S - B

$$\text{Ca content (mg/100ml)} = \frac{S - B}{X} \times 0.2004 \times 100$$

X

S = volume (ml) KMnO<sub>4</sub> used for sample titration.

B = volume (ml) KMnO<sub>4</sub> used for a blank titration.

X = volume (ml) of an aliquot of sample.

### Vitamin C [12]

Vitamin C (L- ascorbic acid) gets oxidized to its dehydro form by especially at alkaline ph. However it remains stable in acid solution. It is, therefore, necessary to stabilize vitamin C by extracting it in metaphosphoric acid, or in a mixture of metaphosphoric and dilute acetic acid, before its estimation. The estimation is carried out by titrating vitamin C with 2, 6, dichlorophenol indophenol solution. Oxidized form of this dye has a blue color in alkaline medium and red color in acidic medium. Reduced form, on the other hand, has no color and is termed as leuco form.

Burette was filled up with the dye solution (Dissolve 52 mg of sodium salt of the dye and 42 mg of sodium bicarbonate in water. Make up the final volume to 500 ml). 20 ml of standard vitamin C solution (Dissolve 10 mg of vitamin C in 6% metaphosphoric acid and make up the final volume to 1 liter with metaphosphoric acid) was transferred into a titration flask. It was titrated against the dye solution to the appearance of a light pink color and the volume was noted. Similarly, 20 ml of test solution was titrated against the dye solution.

Calculation:

Y

$$\text{Vitamin C} = \frac{Y}{X} \times 10 \text{ mg} / 100 \text{ ml}$$

X

### Zinc by Complexation Titration

Procedure:

Prepare an ammonia-ammonium chloride buffer solution (pH 10)

by adding 142 ml conc. ammonia solution (specific gravity 0.88-0.90) to 17.5 g ammonium chloride to 250 ml with deionized water. Prepare the magnesium complex of EDTA and magnesium NaMgY, by mixing equal volumes of 0.2 M solutions of EDTA and magnesium sulphate, neutralize with sodium hydroxide solution to a pH between 8-9 phenolphthalein just reddened. Take a portion of the solution; add a few drops of the buffer solution (pH10), and a few milligrams of the solochrome black- potassium nitrate indicator mixture. A violet color should be produced which turns blue on the addition of a single drop of 0.01 M magnesium sulphate solution; this confirms the equimolarity of zinc or EDTA. If the solution does not pass this test, it may be treated with more EDTA or with more magnesium sulphate solution until the required conditions of equimolarity is attained; this gives an approximately 0.1M solution.

Calculation:

$$N1V1 = N2V2$$

Where, N1 = normality of the EDTA

V1 = volume of the EDTA

N2 = normality of the sample

V2 = volume of the sample used

Zinc = molecular weight × N

### Magnesium Content [13]

Magnesium is converted to magnesium pyrophosphate, which is estimated gravimetrically.

Procedure:

To the calcium free filtrate (obtained from the filtrate after precipitation of calcium as oxalate) are added 30 ml of conc. HCl and 100 ml of distilled water and solution stirred well with a glass rod. It is followed by the addition of 10 ml of 10% ammonium phosphate solution and the mixture stirred. After adding 2 or 3 drops of methyl red indicator, the solution is neutralized with the addition of 1:4 dilute ammonia. Strong ammonia (25ml) is then added, stirred vigorously and the mixture left to stand overnight, filtered through Whatman No. 40 or 44 filter paper and washed free from chloride using 1:10 dilute ammonia (tested with HNO<sub>3</sub> + silver nitrate solution). The funnel with the precipitate on the filter paper is dried in an oven. The filter paper is then transferred to a weighed crucible and ashed slowly over burner. It is then kept in a muffle furnace at 900°C for 2 hours. The crucible and the contents are cooled in a desiccator and weighed to get magnesium as its pyrophosphate.

Calculation:

Magnesium (mg/100g) =

$$\frac{\text{Weight of ash} \times 48.64 \times 100}{\text{Weight of sample}} \times 1000$$

$$222.6 \times \text{ash solution for estimation} \times \text{weight of sample}$$

### Product Development

The central aim of product development is to fulfill the nutritional needs of the community within the constraints of time, energy and money available. Product development is the process of making new or modified food products. Following steps were undertaken to formulate and standardize pomegranate fruit bread-

### Standardization and Formulation of Fruit Bread by Incorporating Pomegranate Seed Flour to Wheat Flour

Stage of Innovation

Idea generation was carried out with a thorough literature review and discussion with key informants. The various techniques of bread preparation were recorded and screened. This stage led to taking up of trial to prepare pomegranate fruit bread. The possibilities to be explored were-

- Percentage of addition of pomegranate seed flour to wheat flour
- Proportion of pomegranate seed flour to be added
- Form in which pomegranate seeds were to be added (flour)
- Percentage of sugar to be added
- Household method of dough texture improvement

Table 2.4.1 Pomegranate Fruit Bread

Sample	PSF (%)	WF (gm)	Sugar (%)	Butter (%)
A	10	100	50	10
B	20	100	50	10
C	30	100	50	10
D	40	100	50	10
E	50	100	50	10

<sup>a</sup> PSF; pomegranate seed flour, WF; wheat flour

Standardization of Recipe

Preparation of Pomegranate Fruit Bread

### Sensory Evaluation

Sensory evaluation is made by the senses of taste, smell, touch and hearing when food is eaten. The complex sensation that results from the interaction of our senses is used to measure food quality at different stage of the development process. Sensory evaluation is conducted in a formal manner by laboratory and consumer panels. Trained assessors comment on the appearance, color, texture, taste and flavour of the product being developed. The assessors are able to do this with great accuracy.

The sensory testing requires human judge who were selected by using triangle difference test.

### Selection of Panel Members by Triangle Difference Test

Triangle difference test was conducted to screen 30 PG students of Home Science faculty who were apparently healthy, with no habit of smoking and tobacco chewing and also had some basic information about sensory testing.

In this, three cups of tea were prepared.

Out of three, two had same percentage of sugar and one had lesser percentage.

These were coded as A, B, C and randomly presented to the tasters.

The panel members were asked to pick out in each triangle set, the odd sample of tea.

A well prepared performa (appendix VII) for triangle test was provided to the students. After the evaluation, the performa was collected from each member and evaluation was done on the basis of discrimination ability, to select panel members, for carrying out the analysis of other products.

Nineteen students could discriminate the odd sample correctly. Fifteen of them identified the right reason of difference and they were selected to constitute the semi-trained panel of judge. They were then given the required instructions regarding conduction of

sensory evaluation.

### Sensory Evaluation by the Panelists

The 15 judges selected by triangle test evaluated the test products. The evaluation was done using:

#### 5 Nine point hedonic rating scale

In this test, the panelists were asked to measure the degree of pleasurable and unpleasurable experience of the food products on a 9 point hedonic rating scale ranging from “like extremely” to “dislike extremely”. The former carried a score of 9 while latter was scored as 1. Performa has been attached in appendix VIII.

### Conduction of Sensory Test

When people are used as a measuring instrument, it is necessary to rigidly control all testing by psychological factors (all kinds of extraneous influences).

15 Sensory evaluation was conducted in a laboratory, free of noise and odour during morning between 10-11 am, as this is considered the best time for testing. The samples were introduced one at a time to each of the panel members and water was provided after testing of each sample. It was a quiet area, free from any disturbance. Natural light source was used during the test as it would not influence the appearance of the product to be tested. No communication between panelists was allowed so that they can make their independent judgment. Judges suffering from cold or ill health were not allowed to evaluate. Use of odouriferous substance (cosmetics) was avoided.

### Statistical Analysis

Statistics is concerned with scientific methods for collecting, organizing, summarizing, presenting and analyzing data as well as withdrawing valid conclusion and making reasonable decisions on the basis of such analysis. The statistical methods used in analysis of data regarding the present investigation were:

- Mean
- Standard deviation
- T-test
- 35 Diagrammatic presentation

#### Mean (X)

The mean of a distribution is commonly understood as the arithmetic average. It is perhaps the familiar, most frequently used statistics.

$$x = \frac{\sum X}{N}$$

Where,

- x = Mean
- 45 X = value of variable
- N = total number of panel members
- Σ = Summation

#### Standard Deviation (σ)

It is most important and widely used measure of studying dispersion. It is defined as a positive square root of the arithmetic mean of the squared deviation of the scores from the mean. It is denoted by the small Greek letter σ (read as sigma)

$$\sigma = \sqrt{\frac{\sum d^2}{N}}$$

### 55 Student’s T-Test

Theoretical work on t- distribution was done by W.S. Gusset (1876-1937) in early 1999. Gusset was employed by the Guinness and Son’s Dublin brewery Ireland, who did not permit employees to publish research findings under their own names. So Gusset adopted the name “student” and published his findings under his own name.

60 Thereafter, the distribution is commonly called student’s t-distribution is generally used to test significance various results obtained from small samples.

$$65 t = \frac{x_1 - x_2}{s} \times \sqrt{\frac{n_1 n_2}{n_1 + n_2}}$$

Where,

- X<sub>1</sub> = mean of first sample
- X<sub>2</sub> = mean of second sample
- N<sub>1</sub> = no. of observations in first sample
- 70 N<sub>2</sub> = no. of observations in second sample
- S = combine standard deviation

### Diagrammatic Presentation

One of the most convincing and appealing ways in which statistical result may presented is through diagrams. Diagrams are extremely useful because of the following reasons:

- 75 They give a bird’s eye view and therefore, the information presented is easily understood.
- They are attractive to eye.
- They have a great memorizing effect.
- 80 They facilitate comparison of data.

### Results and discussion

Data were collected with the help of various methods in order to accomplish the study. It needed to be put into some definite form because raw data is in a most jumbled form with which one cannot draw any conclusion.

This chapter presents the findings of the study, wherein the unintelligible mass of data has been given some significant and understandable form and then thoroughly analyzed. Analysis is hardly complete without interpretation coming into play and, therefore, all the figures and facts have been explained in the context of theory on which the study was based.

This project was an attempt to develop fruit bread (though household methods) by incorporating pomegranate seed flour to wheat flour so as to improve nutritional and sensory attributes.

95 The products were subjected to sensory evaluation to check their overall acceptability. Chemical analysis of the sample was also conducted. This chapter presents the findings of study along with relevant discussion. The results have been discussed under the three main heads:

#### 100 Proximate Analysis

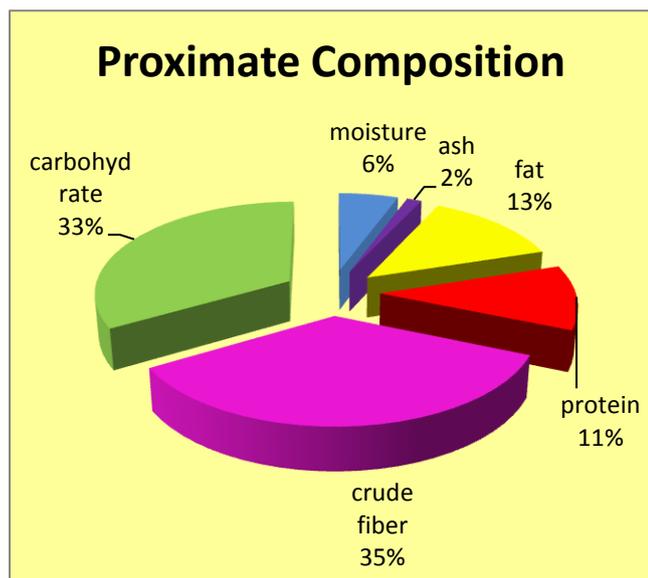
Pomegranate fruit bread made as a part of this endeavor were analyzed for proximate (moisture, protein, ash, fat, fiber, carbohydrates, vitamin C, calcium, iron, magnesium and zinc) content.

**Table 3.1.1** Result of Proximate Composition of Pomegranate Seed (dry basis)

Nutrients	Pomegranate Seed
Moisture (g/100g)	5.6±0.16
Ash (g/100g)	1.4±0.07
Fat (g/100g)	13±0.16
Protein (g/100g)	11.2±0.01
Crude fiber (g/100g)	35.2±0.01
Carbohydrates (g/100g)	33.3±0.01
Vitamin C (mg/100g)	7.9±0.01
Iron (mg/100g)	14.4±0.01
Calcium (mg/100g)	58.1±0.01
Magnesium (mg/100g)	13.2±.16
Zinc (mg/100g)	0.7±0.01

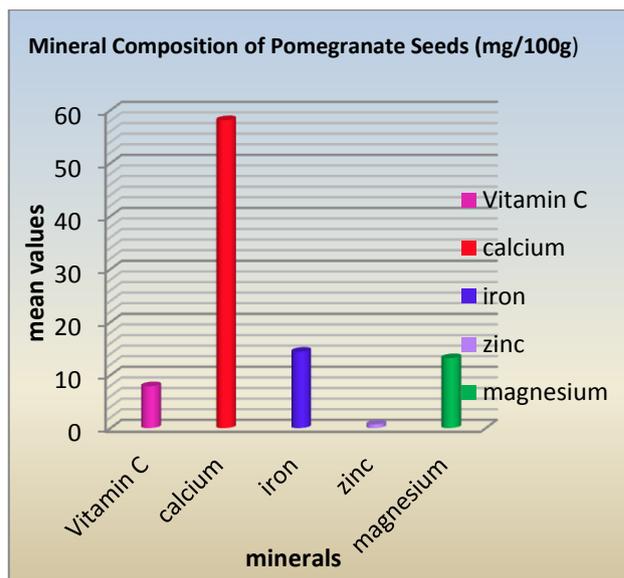
<sup>a</sup> Values are expressed in Mean ± SD (Duplicate reading)\*calculated by difference

5



**Fig 3.1.1** proximate composition of pomegranate seed (dry basis)

Results indicate that moisture content of pomegranate seeds was 5.6±0.16 g/100g and ash content was 1.4±0.07 g/100g in seeds. Study carried out by [14] indicated the approximate results. The crude fiber content in seeds was 35.2±0.01 g/100g. The results were in accordance with the results of [14]. The protein content of pomegranate seeds was 11.2±0.01 g/100g. However the study by [14] showed the similar results. Fat content in seeds was 13±0.16 g/100g. Similar results were reported by [15] indicating the higher content of fat in seeds.



**Fig 3.1.2** Minerals composition of pomegranate seeds (dry basis)

Vitamin C content in pomegranate seeds flour was 7.9±0.01 mg/100g which was higher than the study reported by [15]. The calcium content in seeds was 58.1±0.01mg/00g but the similar result was higher in the study reported by [15]. Pomegranate seeds contain 14.4±0.01 mg/100g iron. The iron content of seeds was found to be higher than the result was reported by [15]. Magnesium and zinc content were 13.2±.16 mg/100g and 0.7±0.01 mg/100g in seeds respectively. Study carried out by [15] indicated the lower value of magnesium while higher value of zinc.

**Discussion**

Pomegranate seeds powder is considered a good source of crude protein, crude fat, carbohydrates, and crude fibers. It should be utilized in fortification of foodstuffs. These results are nearly in accordance with those found by [16] [17]. In this concern, pomegranate fruits seeds can be used as functional ingredient as a good source of crude fibers which provide numerous health benefits such as their ability to decrease serum LDL-Cholesterol level, improve glucose tolerance and the insulin response, reduce hyperlipidemia and hypertension, contribute to gastrointestinal health and the prevention of certain cancers such as colon cancer [18, 19]. On the other hand, fruits' fibers can be considered as potential ingredients of foods; especially of meat products because of their ability to reduce the residual nitrite level, thus avoiding the possible formation of nitrosamines and nitrosamides [19] and they have been used in meat products processing as fat replacer, reducing agent of fat absorption during frying, volume enhancer, binder, bulking agent and stabilizer [20]. The nutritional quality of pomegranate seeds powder (PSP) with regards their minerals content was evaluated and the obtained results are documented in Table (4.1). From the obtained data (Table 4.1), it could be showed that the pomegranate seeds powder (PSP) contained all tested minerals. The PSP contained a considerable content of calcium, iron, magnesium and zinc at level of 58.1, 14.4, 13.2 and 0.7 mg/100g dry matter respectively. In general, it could be concluded that

pomegranate fruits seed powders was characterized with their richness with the most determined nutritious minerals and they are considered a good source of macro and micro elements. Therefore, they should be utilized in food fortification.

### Product Development and Sensory Evaluation

#### Results of Sensory Evaluation

**Table 3.2.1** Acceptability Evaluation of Food Product of (pomegranate fruit bread) *pomegranate seeds* powder in terms of Sensory Attributes

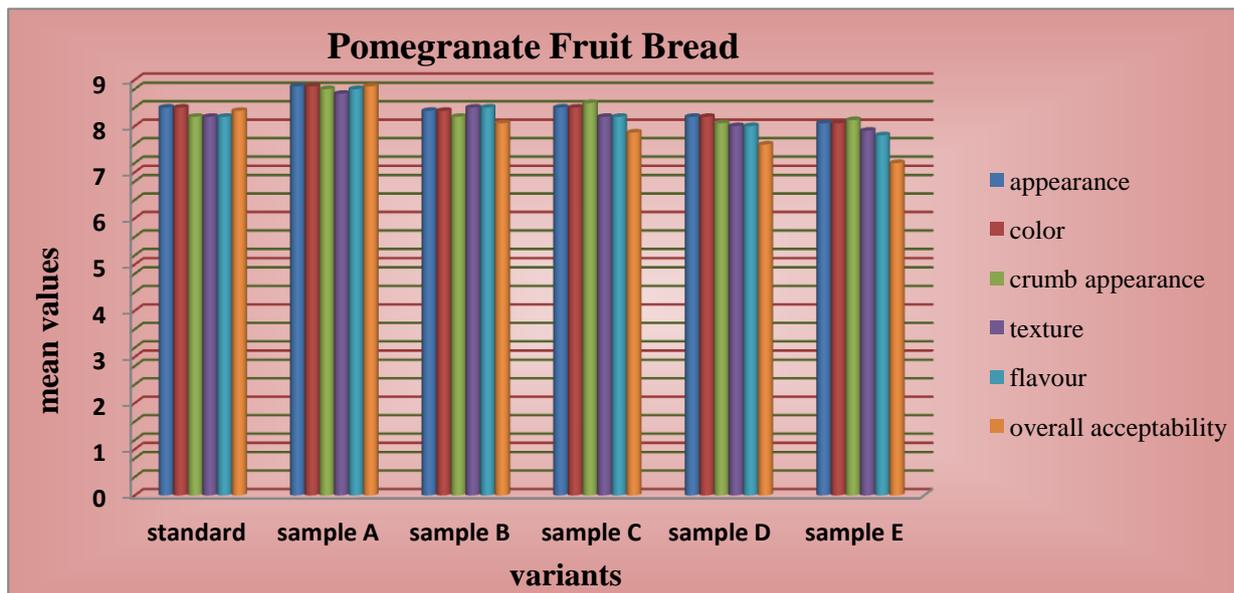
Attributes	Standard	Sample A	Sample B	Sample C	Sample D	Sample E
Appearance	8.4±0.48	8.86±0.33*	8.33±0.59 <sup>ns</sup>	8.4±0.8 <sup>ns</sup>	8.2±0.74 <sup>ns</sup>	8.06±0.77 <sup>ns</sup>
color	8.2±0.54	8.80±0.4*	8.26±0.57 <sup>ns</sup>	8.53±0.6 <sup>ns</sup>	8.06±0.67 <sup>ns</sup>	8.13±0.80 <sup>ns</sup>
crumb Appearance	8.2±0.65	8.73±0.44*	8.4±0.48 <sup>ns</sup>	8.2±0.65 <sup>ns</sup>	8.0±0.63 <sup>ns</sup>	7.93±0.67 <sup>ns</sup>
texture	8.26±0.67	8.86±0.33*	8.46±0.49 <sup>ns</sup>	8.26±0.67 <sup>ns</sup>	8.0±0.73 <sup>ns</sup>	7.86±0.80 <sup>ns</sup>
flavour	8.33±0.69	8.86±0.33*	8.06±0.67 <sup>ns</sup>	7.86±0.71 <sup>ns</sup>	7.6±0.61*	7.2±0.54*
overall Acceptability	8.33±0.47	8.8±0.4*	8.2±0.4 <sup>ns</sup>	8.06±0.57 <sup>ns</sup>	7.8±0.65*	7.33±0.69 <sup>ns</sup>

(\*) = significance difference (p<0.05), ns = no significance difference (p>0.05)

Data is reported as Mean±SD group of fifteen panels each. All test recipes groups (sample A, sample B, sample C, sample D and sample E) compared to standard recipe. The product was made from pomegranate seeds flour. Pomegranate fruit bread was made with five concentrations i.e. 10%, 20%, 30%, 40% and 50% proportion and was compared with the standard. Table 3.2.1 revealed that Mean±SD for all the attributes (appearance, color, crumb appearance, texture, flavour and overall acceptability) lies between (7.2±0.54 to 8.86±0.33). The product showed good results as compare to standard. For variant A, it can be seen that all the attributes of pomegranate seed flour were most acceptable when compared with other variants. On the basis of overall acceptability variant A was highly acceptable as shown in figure 3.2.1.

Statistical analysis revealed that on the basis of overall acceptability sample A and sample D were significantly (p<0.05) different where B, C, D and E were non-significant (p>0.05) as compared to standard.

In the present study, pomegranate fruit bread was prepared by incorporating pomegranate seed powder in 5 different proportions i.e. 10%, 20%, 30%, 40% and 50%. The formulated bread samples were evaluated for their organoleptic quality by 15 semi trained panel members through 9-point hedonic rating test. The results of the evaluation are presenting bellow:



**Fig. 3.2.1** Acceptability Evaluation of Food Product of pomegranate seeds powder in terms of Sensory Attributes

S: Standard  
 A: 10% Incorporation with pomegranate seed powder  
 B: 20% Incorporation with pomegranate seed powder

C: 30% Incorporation with pomegranate seed powder  
 D: 40% Incorporation with pomegranate seed powder  
 E: 50% Incorporation with pomegranate seed powder

## Conclusion

The observations made in this study reveal that the pomegranate seeds are rich in macro (protein, fat and carbohydrates) and micronutrients (vitamin C, calcium, iron and magnesium). It is essential that compositional studies in pomegranate fruits be carried out to take into account various factors such as cultivars, seasons and pre and post-harvest condition that may affect chemical composition of pomegranate seeds. Pomegranate seeds are byproducts of the food industry. Added value products could be made from these wastes. Sensory attributes of pomegranate seeds were significantly affected by their drying. Drying of seeds could be a good option to reduce the amount of wastes and create extra value in fruits with inappropriate appearance. Dried pomegranate seeds were a delicious, sweet, sour product with intense pomegranate aroma due to proper and equilibrated amounts of sugars and organic acid contents.

## Notes and References

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