High value fermented nutraceutical product from pomegranate aril and rind blends

Karan, M., Sreenivas, K.N., Manjula, G.S., Chirag, R.M. and Mohamad Tayeeb Ulla, H.

Received: 03.04.2019 Revised: 24.07.2019 Accepted: 19.08.2019

Abstract

Nutraceutical enriched blended beverages were prepared by using different fruit combination of pomegranate, jamun, kokum and pomegranate rind powder, where the TSS (14 °B) was maintained by using raisin syrup. Fermentation was carried out for 72 hours using *Saccharomyces cerevisiae* var. *ellipsoideus* (MTCC 552) and left for ageing. Among different blending, combination Pomegranate aril (50%) + Pomegranate rind powder (1%) + Jamun pulp (20%) + Kokum (5%) recorded 28.80 mg 100-1 ascorbic acid, 4.4 % reducing sugars, 7.59 % total sugars, 414.72 mg GAE 100 ml⁻¹ phenolic content, 255.78 mg GAE 100 ml⁻¹ antioxidant content, 5.24 mg 100 ml⁻¹ anthocyanin content, 3.80 % alcohol and rated superior by sensory panel.

Key Words: Pomegranate, Fermented beverage, Reducing sugars, Total sugars, Total phenols, Total antioxidants and Sensory evaluation.

Introduction

The term “Nutraceutical”, coined from two words “Nutrition” and “Pharmaceutical” in 1989 by Dr. Stephen de Felice, is defined as ‘food or part of a food that provides medical or health benefits’. Nutraceuticals also refer to natural functional/medical foods or bioactive phytochemicals that have health promoting, disease preventing or medicinal properties. These nutraceuticals normally contain the required amount of vitamins, lipids, proteins, minerals etc. depending on their emphases (Zeisel, 1999). Nutraceuticals provide nutrients and they also contain health promoting ingredients or natural components that have a potential health benefit for the body. Pomegranate (*Punica granatum* L.) belongs to the family Punicaceae. It is native to the Iranian Plateau and has been cultivated in the Caucasus since ancient times. It is widely cultivated throughout Armenia, Azerbaijan, Iran, Afghanistan, Pakistan, Turkey, India, the drier parts of Southeast Asia, Indonesia, peninsular Malaysia, the Mediterranean and Southern Europe and Tropical Africa (La-Rue and James, 1980). It has been extensively used as a source of traditional remedy for thousands of years. The rind of the fruit and the bark of the tree are used as a traditional remedy against diarrhea, dysentery and intestinal parasites. The seeds and juice are considered a tonic for the heart and throat, and classified as a bitter-astringent (pitta or fire), it is considered a healthful counter balance to a diet high in sweet-fatty (kapha or earth) components. The astringent qualities of the flower juice, rind and tree bark are considered valuable for a variety of purposes, such as stopping nose bleeds and gum bleeds, toning skin, (after blending with mustard oil) firming-up sagging breasts and treating hemorrhoids. Its juice (of specific fruit strains) is also used as eye drops. Pomegranate peels are characterized by an interior network of membranes comprising almost 26–30 per cent of total fruit weight and are characterized by substantial amounts of phenolic compounds, including flavonoids (anthocyanins, catechins and other complex flavonoids) and hydrolyzable tannins (punicalin, pedunculagin, punicalagin, gallicand ellagic acid). The technology of manufacturing wine from grapes is advanced. However, limited information is available on the production of nutraceuticals from other fruits particularly from pomegranate, jamun and kokum. It was therefore, proposed to study the preparation of blended nutraceutical beverage from
pomegranate with raisin paste, with the above background the present study was carried out with the following objectives.

1. Standardization and development of pomegranate based fermented nutraceutical product
2. Storage stability, bio-chemical changes and organoleptic quality of prepared blended product

Materials and Method
Fully matured, disease free, pomegranate fruits, jamun, dried Kokum rind were obtained from the market and pomegranate rind powder is prepared in lab by peeling, cutting into small pieces and drying followed by grinding for the experiment. Fruits were washed thoroughly in clean water and pomegranate is peeled and fruits were extracted. Jamun fruit is mashed, dried kokum rind is rehydrated and then used for the experiment. Fruits were blended into different combination viz., T1= Pomegranate aril (50%) + Pomegranate rind powder (1%) + Jamun pulp (20%) + Kokum (5%); T2= Pomegranate aril (50%) + Pomegranate rind powder (1%) + Jamun pulp (20%) + Kokum (10%); T3= Pomegranate aril (50%) + Pomegranate rind powder (1%) + Jamun pulp (30%) + Kokum (5%); T4= Pomegranate aril (50%) + Pomegranate rind powder (1%) + Jamun pulp (30%) + Kokum (10%); T5= Pomegranate aril (50%) + Pomegranate rind powder (2%) + Jamun pulp (20%) + Kokum (5%); T6: Pomegranate aril (50%) + Pomegranate rind powder (2%) + Jamun pulp (20%) + Kokum (10%); T7= Pomegranate aril (50%) + Pomegranate rind powder (2%) + Jamun pulp (30%) + Kokum (5%); T8: Pomegranate aril (50%) + Pomegranate rind powder (2%) + Jamun pulp (30%) + Kokum (10%); T9=Pomegranate- 14 °B (Control) (Fig. 1). The TSS of must was maintained at 14 °B for all treatments using raisin juice. These treatments were evaluated for their bio-chemical composition during storage period and sensory qualities after three months of storage.

Fig.1 Flow chart of preparation of nutritionally enriched pomegranate (*Punica granatum* L.) fermented product
experiment was carried out with nine different treatments and five replications, using completely randomized design. Pomegranate blended nutraceutical beverage was analyzed for ascorbic acid, total phenols, reducing sugars, total sugars, total antioxidants, total anthocyanins and sensory evaluation for three months of storage at regular intervals. Various physico-chemical characteristics of the blended beverage were analyzed as per the standard methods.

Results and Discussion

Ascorbic acid (mg/100 ml)

The decrease in the ascorbic acid content was observed in all the treatments of pomegranate blends during the storage period of 90 days. The higher ascorbic acid content was observed in T₄ \{Pomegranate aril (50%) + Pomegranate rind powder (1%) + Jamun pulp (30%) + Kokum (10%)}\}, whereas, the lowest ascorbic acid content was recorded in T₉ (Pomegranate – 14 °B). Decrease in ascorbic acid due to increase in the temperature and as the pH goes towards acidic it will depletes the ascorbic acid content. Similar results obtained by Kalra and Tandon (1984) were they reported decrease in TSS and ascorbic acid in storage of mango and guava juice. A study conducted by Brock et al. (1998) revealed that, ascorbic acid is very sensitive to thermal and pressure temperatures (Table 4).

Reducing Sugars (%)

Reducing sugars was found to decrease during the storage period. Fermented nutraceutical of Pomegranate aril (50%) + Pomegranate rind powder (1%) + Jamun pulp (20%) + Kokum (5%) - T₃ was found to be significant with higher reducing sugar content of 4.40 per cent. The lowest reducing sugar content of 3.23 per cent was observed in T₉ - Pomegranate - 14°B. As the storage period advanced the reducing sugar content decreased, these results are in agreement with the results of Matapathi (2002) who studied the screening of wine yeasts and pomegranate cultivars for wine production and found reduction in per cent residual sugars content of pomegranate wine during 60 days of storage. Subba Rao (1973) with cashew apple wine, Bardiya et al. (1974) in Guava wine and Kerni and Shant (1984) in Kashmir apple wine.

Total Sugars (%)

Bravo and Inigo (1989) who reported to notice that during ageing total sugars decreased and also Olasupo and Obayori (2003) monitored the process for changes in sugar content for 24 hr interval during the 5 days of fermentation and the sugar content was decreased significantly during all stage of storage. Similar results were reported and they were in similarity with the earlier workers. A decreasing trend of total sugars was observed in the blended beverages. Treatment T₃ \{Pomegranate aril (50%) + Pomegranate rind powder (1%) + Jamun pulp (20%) + Kokum (5%)}\} was found to be significant with higher sugars of 7.59 per cent. The lowest was observed in T₅ - Pomegranate - 14°B (Control) of 6.28 per cent.

Phenols (mg GAE 100 ml⁻¹)

The decreasing trend in the phenolic content was observed during the storage time. The phenolic content (414.72 mg GAE 100 ml⁻¹) was recorded highest in the treatment T₇ \{Pomegranate aril (50%) + Pomegranate rind powder (2%) + Jamun pulp (30%) + Kokum (5%)}\}. There was significant difference between the treatments with respect to phenols. The lowest level of phenols (159.85 mg GAE 100 ml⁻¹) was observed in the treatment T₉ – (Pomegranate 14 °B), this might be due to high rate of fermentation releasing higher amounts of phenols and tannins. The results are on par with the results of Augustin (1987) where he found higher phenolic content in cashew apple wine. Various proteins including yeast cells become coated with tannin making such aggregates to settled down and give clarity to the wine. This result were supported by the study of Atri et al. (2009), they estimated the total phenols content in cashew apple wine was 152.08 mg 1 after 10 days after fermentations.

Antioxidants (mg GAE 100 g⁻¹)

Kapoor and Ranote (2015) in their study of antioxidant potentials and quality of blended pear and jamun juice revealed that jamun pulp supplementation enhanced the bioactive composition of pear juice in terms of increased ascorbic acid, anthocyanins, total phenols and antioxidant activity decreased by 20.52 per cent, during storage period of six months resulted in reduction of bioactive components and had a
Table 1: Proximate estimation of fruits

| Sl. No. | Parameters               | Average values |          |          |          |
|---------|--------------------------|----------------|----------|----------|----------|
|         |                          | Pomegranate    | Jamun    | Kokum    |
| 1       | TSS (°B)                 | 14.50          | 12.00    | 9.50     |
| 2       | pH                       | 3.11           | 3.70     | 2.54     |
| 3       | Acidity (%)              | 0.60           | 0.40     | 0.85     |
| 4       | Ascorbic acid (mg 100g⁻¹)| 4.20           | 18.00    | 12.32    |
| 5       | Reducing sugars (%)      | 8.65           | 8.01     | 1.32     |
| 6       | Total sugars (%)         | 12.80          | 11.80    | 5.08     |
| 7       | Total phenols (mg 100ml⁻¹)| 745.0         | 196      | 31.5     |

Table 2. Effect of different treatments on ascorbic acid (mg 100 ml⁻¹) content of nutraceutical enriched blended beverages during storage

| Treatments | 0 Days | 15 Days | 30 Days | 45 Days | 60 Days | 75 Days | 90 Days |
|------------|--------|---------|---------|---------|---------|---------|---------|
| T₁         | 57.60  | 51.20   | 46.40   | 40.00   | 35.20   | 30.40   | 27.20   |
| T₂         | 62.40  | 56.00   | 49.60   | 43.20   | 38.40   | 35.20   | 32.00   |
| T₃         | 59.20  | 52.80   | 48.00   | 41.60   | 36.80   | 32.00   | 28.80   |
| T₄         | 65.60  | 59.20   | 52.80   | 46.40   | 40.00   | 36.80   | 33.60   |
| T₅         | 46.40  | 40.00   | 33.60   | 28.80   | 25.60   | 22.40   | 19.20   |
| T₆         | 52.80  | 48.00   | 43.20   | 36.80   | 32.00   | 28.80   | 24.00   |
| T₇         | 49.60  | 43.20   | 36.80   | 30.40   | 27.20   | 24.00   | 20.80   |
| T₈         | 56.00  | 49.60   | 44.80   | 40.00   | 33.60   | 28.80   | 25.60   |
| T₉         | 40.00  | 33.60   | 27.20   | 22.40   | 17.60   | 14.40   | 11.20   |
| CD         | 16.600 | 15.281  | 13.054  | 15.350  | 14.648  | 14.720  | 14.791  |
| SEm ±      | 4.316  | 3.973   | 3.394   | 3.991   | 3.827   | 3.846   |
| F test     | **     | **      | **      | **      | **      | **      |

** Significant at 1% level                  NS - Non Significant

Table 3. Effect of different treatments on reducing sugars (%) content of nutraceutical enriched blended beverages during storage

| Treatments | 0 Days | 15 Days | 30 Days | 45 Days | 60 Days | 75 Days | 90 Days |
|------------|--------|---------|---------|---------|---------|---------|---------|
| T₁         | 4.28   | 4.25    | 4.20    | 4.14    | 4.11    | 4.08    | 4.03    |
| T₂         | 4.11   | 4.07    | 4.01    | 3.97    | 3.94    | 3.91    | 3.88    |
| T₃         | 4.66   | 4.61    | 4.57    | 4.52    | 4.49    | 4.44    | 4.40    |
| T₄         | 4.45   | 4.40    | 4.34    | 4.29    | 4.25    | 4.21    | 4.17    |
| T₅         | 3.73   | 3.69    | 3.65    | 3.61    | 3.57    | 3.54    | 3.50    |
| T₆         | 3.59   | 3.55    | 3.51    | 3.47    | 3.44    | 3.40    | 3.37    |
| T₇         | 3.97   | 3.93    | 3.89    | 3.85    | 3.81    | 3.77    | 3.72    |
| T₈         | 3.81   | 3.78    | 3.74    | 3.70    | 3.66    | 3.61    | 3.57    |
| T₉         | 3.47   | 3.43    | 3.39    | 3.35    | 3.31    | 3.27    | 3.23    |
| CD         | 0.060  | 0.031   | 0.037   | 0.036   | 0.025   | 0.037   | 0.026   |
| SEm ±      | 0.016  | 0.008   | 0.010   | 0.009   | 0.006   | 0.010   | 0.007   |
| F test     | **     | **      | **      | **      | **      | **      |

** Significant at 1% level                  NS - Non Significant
Table 4. Effect of different treatments on total sugars (%) content of nutraceutical enriched blended beverages during storage

| Treatments | 0 Days | 15 Days | 30 Days | 45 Days | 60 Days | 75 Days | 90 Days |
|------------|--------|---------|---------|---------|---------|---------|---------|
| T<sub>1</sub> | 7.54   | 7.49    | 7.44    | 7.35    | 7.30    | 7.24    | 7.19    |
| T<sub>2</sub> | 7.34   | 7.27    | 7.20    | 7.14    | 7.10    | 7.06    | 7.01    |
| T<sub>3</sub> | 7.92   | 7.87    | 7.81    | 7.75    | 7.70    | 7.64    | 7.59    |
| T<sub>4</sub> | 7.71   | 7.65    | 7.57    | 7.50    | 7.45    | 7.40    | 7.34    |
| T<sub>5</sub> | 6.97   | 6.89    | 6.83    | 6.75    | 6.69    | 6.64    | 6.59    |
| T<sub>6</sub> | 6.89   | 6.80    | 6.74    | 6.67    | 6.60    | 6.52    | 6.44    |
| T<sub>7</sub> | 7.20   | 7.11    | 7.03    | 6.98    | 6.92    | 6.87    | 6.83    |
| T<sub>8</sub> | 7.10   | 7.01    | 6.94    | 6.86    | 6.79    | 6.72    | 6.67    |
| T<sub>9</sub> | 6.79   | 6.70    | 6.61    | 6.53    | 6.44    | 6.35    | 6.28    |
| CD | 0.034  | 0.041   | 0.025   | 0.030   | 0.027   | 0.036   | 0.115   |
| SEm ± | 0.009  | 0.011   | 0.006   | 0.008   | 0.007   | 0.009   | 0.030   |

F test **  **  **  **  **  **  **

** Significant at 1% level                  NS - Non Significant

Table 5. Effect of different treatments on phenols (mg gallic acid equivalents 100 ml<sup>-1</sup>) content of nutraceutical enriched blended beverages during storage

| Treatments | 0 Days | 15 Days | 30 Days | 45 Days | 60 Days | 75 Days | 90 Days |
|------------|--------|---------|---------|---------|---------|---------|---------|
| T<sub>1</sub> | 748.54 | 645.84  | 448.82  | 380.11  | 323.48  | 282.52  | 224.26  |
| T<sub>2</sub> | 741.38 | 590.44  | 504.22  | 398.34  | 363.52  | 343.04  | 288.36  |
| T<sub>3</sub> | 632.01 | 507.90  | 450.56  | 414.82  | 405.09  | 312.73  | 277.91  |
| T<sub>4</sub> | 577.74 | 479.03  | 446.36  | 384.82  | 358.50  | 343.14  | 304.64  |
| T<sub>5</sub> | 774.35 | 651.26  | 466.02  | 437.25  | 405.71  | 382.26  | 359.53  |
| T<sub>6</sub> | 816.84 | 654.64  | 650.24  | 507.60  | 418.71  | 400.08  | 381.85  |
| T<sub>7</sub> | 942.28 | 753.66  | 631.60  | 612.86  | 512.41  | 466.53  | 414.72  |
| T<sub>8</sub> | 879.41 | 804.86  | 637.95  | 538.21  | 505.14  | 414.82  | 395.26  |
| T<sub>9</sub> | 363.01 | 17.534  | 67.628  | 1.079   | 0.851   | 1.203   | 1.661   |
| CD | 51.791 | 17.534  | 67.628  | 1.079   | 0.851   | 1.203   | 1.661   |
| SEm ± | 13.466 | 4.559   | 17.584  | 0.280   | 0.221   | 0.313   | 0.432   |

F test **  **  **  **  **  **  **

** Significant at 1% level                  NS - Non Significant

Table 6. Effect of different treatments on antioxidants (mg AAE 100 ml<sup>-1</sup>) content of nutraceutical enriched blended beverages during storage.

| Treatments | 0 Days | 15 Days | 30 Days | 45 Days | 60 Days | 75 Days | 90 Days |
|------------|--------|---------|---------|---------|---------|---------|---------|
| T<sub>1</sub> | 398.87 | 385.93  | 340.60  | 307.28  | 261.99  | 246.37  | 232.60  |
| T<sub>2</sub> | 398.24 | 374.28  | 340.88  | 313.45  | 284.85  | 263.84  | 246.69  |
| T<sub>3</sub> | 472.88 | 432.98  | 387.62  | 336.35  | 299.25  | 270.18  | 245.03  |
| T<sub>4</sub> | 444.78 | 409.53  | 365.11  | 328.84  | 303.62  | 277.49  | 255.78  |
| T<sub>5</sub> | 419.80 | 394.49  | 374.08  | 352.36  | 298.27  | 235.20  | 201.09  |
| T<sub>6</sub> | 412.01 | 378.45  | 346.70  | 303.07  | 281.94  | 255.81  | 224.42  |
| T<sub>7</sub> | 414.73 | 382.42  | 342.76  | 301.38  | 258.14  | 231.03  | 210.10  |
| T<sub>8</sub> | 399.50 | 383.92  | 346.78  | 315.46  | 280.21  | 257.78  | 229.06  |
| T<sub>9</sub> | 386.99 | 336.47  | 305.47  | 268.99  | 211.20  | 207.74  | 200.58  |
| CD | 0.257  | 0.305   | 0.431   | 0.355   | 0.484   | 4.596   | 0.353   |
| SEm ± | 0.067  | 0.079   | 0.112   | 0.092   | 0.126   | 1.195   | 0.092   |

F test **  **  **  **  **  **  **

** Significant at 1% level                  NS - Non Significant

High value fermented nutraceutical product from pomegranate
Table 7. Effect of different treatments on anthocyanin (mg 100 ml⁻¹) content of nutraceutical enriched blended beverages during storage

| Treatments | 0 Days | 15 Days | 30 Days | 45 Days | 60 Days | 75 Days | 90 Days |
|------------|--------|---------|---------|---------|---------|---------|---------|
| T₁         | 10.61  | 9.52    | 8.49    | 6.14    | 5.12    | 4.31    | 3.84    |
| T₂         | 10.04  | 8.71    | 7.91    | 5.92    | 4.88    | 4.07    | 3.62    |
| T₃         | 11.52  | 10.89   | 8.73    | 7.80    | 7.05    | 6.02    | 5.11    |
| T₄         | 12.50  | 11.15   | 8.77    | 8.03    | 6.78    | 6.00    | 5.24    |
| T₅         | 9.31   | 8.80    | 7.02    | 6.37    | 5.68    | 3.86    | 3.33    |
| T₆         | 8.54   | 7.28    | 6.67    | 6.19    | 5.57    | 4.51    | 2.87    |
| T₇         | 9.87   | 7.41    | 6.62    | 5.97    | 5.28    | 4.70    | 4.23    |
| T₈         | 10.10  | 8.94    | 7.11    | 6.55    | 6.19    | 5.59    | 4.53    |
| T₉         | 5.68   | 4.34    | 3.82    | 3.16    | 2.53    | 1.59    | 1.25    |
| CD         | 0.012  | 0.010   | 0.010   | 0.013   | 0.043   | 0.009   | 0.011   |
| SEm ±      | 0.003  | 0.003   | 0.002   | 0.003   | 0.011   | 0.002   | 0.003   |
| F test     | **     | **      | **      | **      | **      | **      | **      |

** Significant at 1% level  
NS - Non Significant

Table 8. Effect of different treatments on alcohol (%) content of nutraceutical enriched blended beverages during storage

| Treatments | 0 Days | 15 Days | 30 Days | 45 Days | 60 Days | 75 Days | 90 Days |
|------------|--------|---------|---------|---------|---------|---------|---------|
| T₁         | 3.41   | 3.54    | 3.68    | 3.80    | 3.88    | 3.96    | 4.04    |
| T₂         | 3.47   | 3.60    | 3.66    | 3.74    | 3.86    | 3.94    | 4.06    |
| T₃         | 3.16   | 3.28    | 3.40    | 3.51    | 3.60    | 3.68    | 3.80    |
| T₄         | 3.29   | 3.43    | 3.54    | 3.60    | 3.71    | 3.82    | 3.88    |
| T₅         | 3.62   | 3.71    | 3.78    | 3.86    | 3.98    | 4.06    | 4.12    |
| T₆         | 3.68   | 3.80    | 3.94    | 4.02    | 4.10    | 4.16    | 4.22    |
| T₇         | 3.51   | 3.62    | 3.74    | 3.82    | 3.94    | 4.00    | 4.08    |
| T₈         | 3.55   | 3.64    | 3.76    | 3.84    | 3.92    | 4.02    | 4.10    |
| T₉         | 3.76   | 3.84    | 3.92    | 4.00    | 4.10    | 4.18    | 4.26    |
| CD         | 0.029  | 0.021   | 0.031   | 0.021   | 0.031   | 0.027   | 0.028   |
| SEm ±      | 0.007  | 0.006   | 0.008   | 0.005   | 0.008   | 0.007   | 0.007   |
| F test     | **     | **      | **      | **      | **      | **      | **      |

** Significant at 1% level  
NS - Non Significant

Treatment details

T₁: Pomegranate aril (50%) + Pomegranate rind powder (1%) + Jamun pulp (20%) + Kokum (5%)
T₂: Pomegranate aril (50%) + Pomegranate rind powder (1%) + Jamun pulp (20%) + Kokum (10%)
T₃: Pomegranate aril (50%) + Pomegranate rind powder (1%) + Jamun pulp (30%) + Kokum (5%)
T₄: Pomegranate aril (50%) + Pomegranate rind powder (1%) + Jamun pulp (30%) + Kokum (10%)
T₅: Pomegranate aril (50%) + Pomegranate rind powder (2%) + Jamun pulp (20%) + Kokum (5%)
T₆: Pomegranate aril (50%) + Pomegranate rind powder (2%) + Jamun pulp (20%) + Kokum (10%)
T₇: Pomegranate aril (50%) + Pomegranate rind powder (2%) + Jamun pulp (30%) + Kokum (5%)
T₈: Pomegranate aril (50%) + Pomegranate rind powder (2%) + Jamun pulp (30%) + Kokum (10%)
T₉: Pomegranate- 14° B (Control)
variable effect on physico-chemical characteristics of the blended pear-jamun juice. Similarly in the present investigation the decreasing trend in the antioxidant content was observed during storage period. The antioxidant content of 255.78 mg GAE 100 ml\(^{-1}\) was found highest in the treatment T\(_4\) \{Pomegranate aril (50%) + Pomegranate rind powder (1%) + Jamun pulp (30%) + Kokum (10%)\}. The lowest level of antioxidant of 200.58 mg GAE 100 ml\(^{-1}\) was observed in the treatment T\(_9\) (Pomegranate – 14°B). Vitamin - C is directly correlated with antioxidant content during the storage period Vitamin - C starts decreasing which is directly proportional to the antioxidant content of the fermented nutraceutical.

**Anthocyanin (mg 100 ml\(^{-1}\))**
The decreasing trend in the anthocyanin content was observed in storage period. The anthocyanin content of 5.24 mg 100 ml\(^{-1}\) was found highest in the treatment T\(_4\) \{Pomegranate aril (50%) + Pomegranate rind powder (1%) + Jamun pulp (30%) + Kokum (10%)\}, Whereas the lowest level of anthocyanin content of 1.25 mg 100 ml\(^{-1}\) was observed in the treatment T\(_9\) \{Pomegranate - 14°B (Control)\}. Decrease in the anthocyanin is due to the oxidation to brown pigments caused by Poly Phenyl Oxidase and it is directly correlated with the ascorbic acid.

Similarly Rommel et al., 1990 reported that during fermentation, anthocyanin pigment is partially degraded with a total loss of at least 50 per cent after storage. Cyanidin-3-glucoside was the most unstable anthocyanin which disappearing completely during fermentation while cyanidine 3-sorphoroside was the most stable pigment.

**Alcohol (%)**
Chikkasubbanna et al. (1990) reported that the alcohol percent of the grape wine increased due to a decrease in total soluble sugars due to the activity of yeast during fermentation, Adsule et al. (1992) estimated the alcohol content in pomegranate wine and reported that upon incubation alcohol content increased which was observed to be 6.6 per cent and Sapna et al. (2002) obtained an alcohol content of 6.57 to 6.75 per cent in Japanese wine, coriander wine had 7.05 to 7.37 per cent in the thirds and after nine weeks of storage. The increase in alcohol content was due to the complete conversion of sugars to alcohol.

In the present investigation similar results were obtained which were in agreement with the results of previous workers. The increasing trend in the alcohol content was observed in storage period. The alcohol content of 4.26 per cent was found to be significantly highest in the treatment T\(_9\) (Pomegranate – 14°B). The lowest alcohol percentage of 3.80 was observed in the treatment T\(_3\) - \{Pomegranate aril (50%) + Pomegranate rind powder (1%) + Jamun pulp (20%) + Kokum (5%)\}.

**Organoleptic Evaluation**
The quality of pomegranate nutraceutical samples were assessed by organoleptic or sensory evaluation using hedonic scale. It was wine was evaluated based on the appearance, colour, body, taste, flavour for its overall quality and the score obtained by sensory evaluation are discussed here under.

**Taste**
The highest taste score (8.3) was recorded in the treatment T\(_3\) - \{Pomegranate aril (50%) + Pomegranate rind powder (1%) + Jamun pulp (20%) + Kokum (5%)\} having good attractive colour, taste and it was acceptable when compared to all other treatment and it was found superior with respect to taste and also these results are also agreed with the findings of Sahu et al. (2006), Kotecha et al. (1995).

**Colour**
The fermented nutraceutical was attractive and acceptable in treatment T\(_3\) - \{Pomegranate aril (50%) + Pomegranate rind powder (1%) + Jamun pulp (20%) + Kokum (5%)\} was recorded highest sensory score (8.5) with respect to colour. These results are similar to the findings of Patil (1994).

**Sweetness**
Maximum score (8.6) for sweetness was recorded in the Treatment T\(_3\) - \{Pomegranate aril (50%) + Pomegranate rind powder (1%) + Jamun pulp (20%) + Kokum (5%)\} and this may be due to higher sugar concentration in the treatment and these results are on par with the results of Kulkarni et al. (1980). Higher levels of sugar may be due to abrupt arresting of fermentation.

**Astringency**
Moderate astringency was found in Treatment T\(_3\) - \{Pomegranate aril (50%) + Pomegranate rind powder (1%) + Jamun pulp (20%) + Kokum (5%)\}, this might be due to higher sugar concentration would have reduced the astringency of fermented
Fig.2 Sensory evaluation of nutraceutical enriched blended beverages

**T1:** Pomegranate aril (50%) + Pomegranate rind powder (1%) + Jamun pulp (20%) + Kokum (5%)

**T2:** Pomegranate aril (50%) + Pomegranate rind powder (1%) + Jamun pulp (20%) + Kokum (10%)

**T3:** Pomegranate aril (50%) + Pomegranate rind powder (1%) + Jamun pulp (30%) + Kokum (5%)

**T4:** Pomegranate aril (50%) + Pomegranate rind powder (1%) + Jamun pulp (30%) + Kokum (10%)

**T5:** Pomegranate aril (50%) + Pomegranate rind powder (2%) + Jamun pulp (20%) + Kokum (5%)

**T6:** Pomegranate aril (50%) + Pomegranate rind powder (2%) + Jamun pulp (20%) + Kokum (10%)

**T7:** Pomegranate aril (50%) + Pomegranate rind powder (2%) + Jamun pulp (30%) + Kokum (5%)

**T8:** Pomegranate aril (50%) + Pomegranate rind powder (2%) + Jamun pulp (30%) + Kokum (10%)

**T9:** Pomegranate- 140 B (Control)
High value fermented nutraceutical product from pomegranate

nutraceutical and similar results were also obtained by Gautam and Chundawat (1998).

Overall Acceptability

Overall acceptability was good in Treatment T₃ - {Pomegranate aril (50%) + Pomegranate rind powder (1%) + Jamun pulp (20%) + Kokum (5%)}. This may be due to the presence of correct sweetness, moderate astringency, colour and appearance and these results were on par with the findings of Gautam and Chundawat (1998), Kulkarni et al. (1980), Sahu et al. (2006), Kotecha et al. (1995) and Patil (1994).

Conclusion

Overall from the present investigation, the fermented nutraceutical with the combination of {Pomegranate aril (50%) + Pomegranate rind powder (1%) + Jamun pulp (20%) + Kokum (5%)} was found to be the best with highest anthocyanin, antioxidants, ascorbic acid, TSS, reducing sugars, non-reducing sugars, total sugars and phenols with lower alcohol and titrable acidity level and it was highly accepted by the sensory panel.

References

Adsule, R.N., Kotecha, P.M. and Kadam, S.S. 1992. Preparation of wine from pomegranate. Beverage and Food World, 19(4): 113-114.

Attri, B.L., Lal, B.B., Joshi, V.K. 1998. Physico-chemical characteristics, sensory quality and storage behavior of sand pear juice blended with temperate fruit juices/ pulps. Indian Food Packer, 52 (6): 36-38.

Augustin, A. 1987. Fermented product of cashew apple, Cashew bulletin, 24(7): 12-17.

Bardiya, M.C., Kundu, B.S. and Tauro, P. 1974. Studies of fruit wine-4. Guava wine. Haryana Journal. Of Horticulture Scences, 3: 140-146.

Bravo, A.F. and Inigo, L.B. 1989. Biochemical and technological aspects of the biological ageing of Extremadura white wine. Acta Alimentaria, 204: 43-46.

Brock, V.D., Ludikhuyze, L., Weemaes, C., Van, L.A. and Hendrickx, M. 1998. Kinetics for isobaric isothermal degradation of L-Ascorbic acid. Journal of Agricultural and Food Chemistry, 46(5): 2001-2006.

Chikkasubbanna, V., Chadha, K.L. and Ethiraj, S. 1990. Influence of maturity of Thomson Seedless grapes on the wine composition and quality. Indian Journal of Horticulture, 47: 12-17.