

# Development of food products by incorporating beetroot (*Beta vulgaris* L.)

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The study was conducted to formulate beverages by incorporating beetroot juice concentrate. The beverages selected for the study were lime beet juice and amla beet juice. Beetroot juice concentrate was incorporated at 0, 5, 7 and 10 per cent level. Acceptability of the beverages was evaluated using 9 point hedonic rating scale. It was found that 10 per cent level of incorporation of beetroot juice concentrate was more accepted in lime beet juice and amla beet juice. The results of nutrient analysis inferred that protein (g %), fat (g %), fibre (g %), carbohydrates (g %), total minerals (mg %) and zinc (mg %) content of amla beet juice was more than that of content of lime beet juice. On the other hand, moisture (g %), iron (mg %), calcium (mg %), manganese (mg %) and energy (kcal) content were more in lime beet juice. Lime beet juice can be stored upto 3 days in LDPE, HDPE and PET jar at room temperature and at refrigeration temperature in good condition. Whereas amla beet juice can be stored in LDPE for 5 days at room temperature and at refrigeration temperature in PET jar for 3 weeks in good condition.

**Key Words :** Beetroot, Lime beet juice, Amla beet juice, Sensory evaluation, Nutrient content, Storage study

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## INTRODUCTION

Beetroot (*Beta vulgaris* L.) has numerous cultivated varieties, the most well-known which is root vegetable known as the beetroot. Deep red colored beetroots are the most popular for human consumption. Beetroot is used as a vegetable, juice and extracts. Beetroots are rich in valuable, active compounds such as carotenoids, glycine betanin (De Zwart *et al.*, 2003), saponins (Atamanova *et al.*, 2005), betacyanines (Patkai *et al.*, 1997), betanin,

polyphenols and flavonoids (Vali *et al.*, 2007). Colour is one of the important attributes of foods and most sensitive part of any commodity not only for its appeal but also it enhances consumer acceptability (Chattopadhyaya *et al.*, 2008). Recently, dyes derived from natural sources for these applications have emerged as an important alternative to potentially harmful synthetic dyes. The natural colorants are termed as bio colorants. The coloring pigment present in beetroot is collectively known as betalain or betanine. It has been reported that betalain has antioxidant, radical scavenging properties, antimicrobial and antiviral activity (Pedreno and Escibano, 2001).

Fresh beetroots are degraded when exposed to light, heat, oxygen and finally leads to spoilage due to their high moisture content but it can be very well preserved by preparing beetroot juice concentrate. Therefore the present study is planned to extract beetroot juice concentrate and to utilize indifferent beverages such as

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lime beet juice and amla beet juice and to study the acceptability, nutrient content and keeping quality of the selected beverages.

## METHODOLOGY

Beetroot juice concentrate was prepared the various steps followed in preparing the beetroot juice concentrate are given in flow chart (Fig.A) it can be stored for one month. Beetroot juice concentrate was incorporated into the beverages such as lime beet juice and amla beet juice at 0, 5, 7 and 10 per cent level. The organoleptic evaluation was conducted to find out the maximum level of incorporation of beetroot juice concentrate in the selected food products. The developed beverages were evaluated by a 10 semi trained judges. The judges were requested to score the recipes for different sensory characters namely colour, texture, taste, flavour and overall acceptability by using 9 point hedonic rating scale (Srilakshmi, 2014).

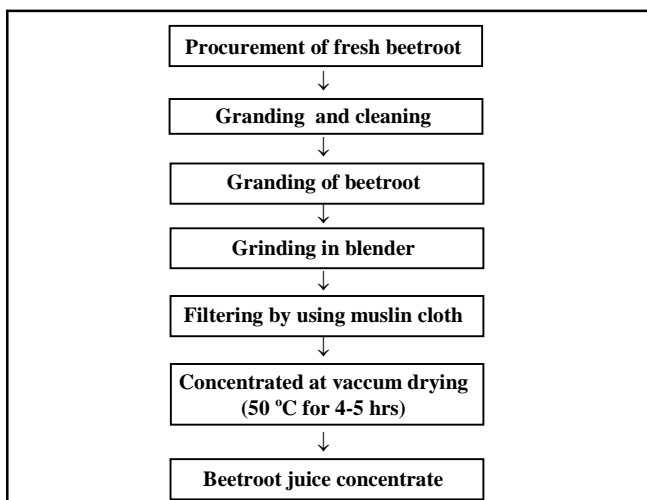


Fig. A : Flow chart of extraction of beetroot juice concentrate

Highly accepted variation of beverage was analyzed for Nutrient content namely moisture, protein, fat, carbohydrate, fibre, calcium, iron, manganese, zinc and energy content was calculated by using nutritive value Table (Gopalan *et al.*, 2010). Further shelf-life of the beverages were studied by packaging beverages in different packaging material such as LDPE, HDPE and PET jar and kept at room temperature and at refrigeration temperature. The collected data was consolidated, tabulated and analyzed statistically (Panse and Sukhatme,

1985).

## OBSERVATIONS AND ASSESSMENT

The mean scores for organoleptic characteristics of lime beet juice with varying levels of incorporation of beetroot juice concentrate are presented in Table 1. The scores obtained for the color of lime beet juice prepared with 0, 5, 7 and 10 per cent level of incorporation of beetroot juice concentrate found highest score of 8.4 was recorded and statistically significant difference was noticed. The maximum score for the texture and for taste 7.9 was secured by the 10 per cent. Statistical analysis showed that the scores obtained for texture and taste of lime beet juice were differed at 5 per cent significantly. In case of flavour and overall acceptability the maximum score were 8.0 at 5 per cent and 8.3 at 10 per cent level was recorded by 5 per cent and 10 per cent level of incorporation of beetroot juice concentrate were differed significantly.

On the whole among the varying level of incorporation of beetroot juice concentrate 10 per cent level was most accepted. Even Vanajakshi *et al.* (2015) reported that fermented drumstick (*Moringa oleifera*) leaves based beetroot beverage was well accepted organoleptically, therefore it can be considered as a refreshing health drink.

The mean values for organoleptic scores for the acceptability of amla beet juice prepared with and without incorporation of different levels of beetroot juice concentrate are given in Table 2. Marked variations were observed in score secured for colour of amla beet juice prepared with 10 per cent level of incorporation of beetroot juice concentrate, showed significant statistically. Amla beet juice prepared with 5 per cent level of incorporation of beetroot juice concentrate secured more score for texture and taste which was significant statistically. The mean scores for flavour and overall acceptability of amla beet juice registered highest score 8.2 and 8.3 at 10 per cent level of incorporation of beetroot juice concentrate. The statistical analysis showed that the flavour and overall acceptability of amla beet juice showed significant statistically.

In conclusion, it was inferred from the results that 10 per cent level of incorporation of beetroot juice concentrate in amla beet juice was considered to be the most accepted level, as it secured highest score. These results are found to be in agreement with those reported

by Kathivaran *et al.* (2015) and Yadav *et al.* (2016). They reported that ready to drink beetroot and passion fruit (*Passiflora edulis* var. *flavicarpa*) juice blend (1:1) dilution had good sensory acceptability.

The data on nutritional composition of highly accepted lime beet juice and amla beet juice are presented are given in Table 3. Moisture content of lime beet juice and amla beet juice prepared with the incorporation of beetroot juice concentrate was 30.74±2.39 and 23.06±6.132. Moisture content of lime beet juice was

significantly more as compared to amla beet juice.

The content of protein (g %), fat (g %), fibre (g %) and carbohydrate (g %) of lime beet juice were 0.83±0.15, 0.166±0.057, 0.5±0.26 and 0.366±0.208, respectively. The respective values for corresponding nutrients of amla beet juice were 1.083±0.144, 0.183±0.076, 0.666±0.152 and 7.44±1. In case of micronutrients such as total minerals (mg %), calcium (mg %), iron (mg %), manganese (mg %) and zinc (mg %) of lime beet juice were 0.73±0.40, 8.56±2.22, 1.68±0.55, 1.01±0.42 and 1.166±0.288,

**Table 1 : Mean values of organoleptic scores for the acceptability of lime beet juice prepared with and without incorporation of different levels of beetroot juice concentrate**

| Variations | Level of beetroot juice concentrate incorporation | Mean value of sensory scores |         |       |         |                       |
|------------|---------------------------------------------------|------------------------------|---------|-------|---------|-----------------------|
|            |                                                   | Colour                       | Texture | Taste | Flavour | Overall acceptability |
| I          | 0 % (Control)                                     | 8.4                          | 7.7     | 7.5   | 7.8     | 7.5                   |
| II         | 5 %                                               | 7.9                          | 8.0     | 7.9   | 8.0     | 8.2                   |
| III        | 7 %                                               | 7.9                          | 8.0     | 7.7   | 7.6     | 8.0                   |
| IV         | 10 %                                              | 8.0                          | 8.1     | 7.9   | 7.6     | 8.3                   |
|            | C.D. (P=0.05)                                     | 0.32                         | 0.2     | 0.31  | 0.30    | 0.29                  |
|            | S.E. ±                                            | 0.11                         | 0.09    | 0.11  | 0.10    | 0.10                  |
|            | F-value                                           | 4.34**                       | 3.50*   | 3.00* | 3.30*   | 12.00**               |

\* and \*\* indicate significance of values at P=0.05 and 0.01, respectively

**Table 2 : Mean values of organoleptic scores for the acceptability of amla beet juice prepared with and without incorporation of different levels of beetroot juice concentrate**

| Variations | Level of beetroot juice concentrate incorporation | Mean value of sensory scores |         |         |         |                       |
|------------|---------------------------------------------------|------------------------------|---------|---------|---------|-----------------------|
|            |                                                   | Colour                       | Texture | Taste   | Flavour | Overall acceptability |
| I          | 0 % (Control)                                     | 8.1                          | 7.2     | 7.3     | 7.8     | 7.3                   |
| II         | 5 %                                               | 8.4                          | 8.4     | 8.2     | 8.0     | 8.1                   |
| III        | 7 %                                               | 8.2                          | 8.2     | 7.6     | 8.1     | 8.0                   |
| IV         | 10 %                                              | 8.6                          | 8.2     | 8.0     | 8.2     | 8.3                   |
|            | C.D. (P=0.05)                                     | 0.33                         | 0.62    | 0.36    | 0.27    | 0.72                  |
|            | S.E. ±                                            | 0.11                         | 0.21    | 0.12    | 0.09    | 0.25                  |
|            | F-value                                           | 3.68*                        | 6.14**  | 10.01** | 3.30*   | 2.94*                 |

\* and \*\* indicate significance of values at P=0.05 and 0.01, respectively

**Table 3 : Nutrient composition of lime beet root juice and amla beet root juice (100/g)**

| Nutrients          | Lime beet juice<br>Mean ± SD | Amla beet juice<br>Mean ± SD | 't' value           |
|--------------------|------------------------------|------------------------------|---------------------|
| Moisture (g)       | 30.74 ± 2.39                 | 23.06±6.132                  | 19.286 **           |
| Protein (g)        | 0.83 ± 0.15                  | 1.083±0.144                  | 1.890 <sup>NS</sup> |
| Fat (g)            | 0.166±0.057                  | 0.183±0.076                  | 0.229 <sup>NS</sup> |
| Fibre (g)          | 0.5±0.26                     | 0.666±0.152                  | 0.326 <sup>NS</sup> |
| Total mineral (mg) | 0.73±0.40                    | 0.893±0.533                  | 1.890 <sup>NS</sup> |
| Carbohydrate (g)   | 0.366±0.208                  | 7.44±1.257                   | 10.695**            |
| Iron (mg)          | 1.68±0.55                    | 1.336±0.574                  | 0.601 <sup>NS</sup> |
| Calcium (mg)       | 8.56±2.22                    | 7.66±0.577                   | 0.527 <sup>NS</sup> |
| Manganese (mg)     | 1.01±0.42                    | 0.9±0.1                      | 0.852 <sup>NS</sup> |
| Zinc (mg)          | 1.166±0.288                  | 1.91±0.15                    | 2.896 <sup>NS</sup> |

NS=Non-significant

\*\* indicates significance of value at P=0.01

respectively. On the other hand, amla beet juice contains total minerals (0.893mg %), iron (1.336 mg %), calcium (7.66 mg %), manganese (0.9 mg %) and zinc (1.91 mg %).

On the whole the results of nutrient analysis inferred that protein, fat, fibre, carbohydrates, total minerals and zinc content of amla beet juice were more than that of contents of lime beet juice. On the other hand, lime beet juice content more amount of moisture, iron, calcium, manganese and energy. However significant difference was noticed only in moisture and carbohydrate content.

The mean scores for overall acceptability of lime beet juice packed in LDPE, HDPE and PET jar kept at room temperature and at refrigeration temperature for three days are given in Table 4. It was found that lime

beet juice can be stored upto three days in good condition. Results indicated that the score obtained for overall acceptability of lime beet juice stored at room temperature was 8.3 at initial which was found to be reduced at third day of storage period upto 5.0 at room temperature and 5.3 at refrigeration temperature was not significant statistically. In conclusion it can be said that the scores obtained for overall acceptability of the lime beet juice in different packaging material and stored at room or at refrigeration temperature was well accepted upto three days of storage.

The mean scores for overall acceptability of amlabeet juice packed in LDPE, HDPE and PET jar stored at room temperature and at refrigeration temperature for varying period are given in Table 5. Sensory evaluation indicated

**Table 4 : Mean sensory scores of lime beet root juice before and after storage**

| Conditions                | Packaging materials | Colour          |                 | Flavour         |                 | Taste           |                 | Texture         |                 | Overall acceptability |                 |
|---------------------------|---------------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------------|-----------------|
|                           |                     | 1 <sup>st</sup> | 3 <sup>rd</sup> | 1 <sup>st</sup> | 3 <sup>rd</sup> | 1 <sup>st</sup> | 3 <sup>rd</sup> | 1 <sup>st</sup> | 3 <sup>rd</sup> | 1 <sup>st</sup>       | 3 <sup>rd</sup> |
| Room temperature          | LDPE                | 8.0             | 5.4             | 7.6             | 4.9             | 7.9             | 4.3             | 8.1             | 4.8             | 8.3                   | 5.0             |
|                           | HDPE                | 8.0             | 5.7             | 7.6             | 5.1             | 7.9             | 4.8             | 8.1             | 5.1             | 8.3                   | 5.0             |
|                           | PET jar             | 8.0             | 5.7             | 7.6             | 5.3             | 7.8             | 4.2             | 8.1             | 5.6             | 8.3                   | 5.1             |
| Refrigeration temperature | LDPE                | 8.0             | 5.6             | 7.6             | 5.4             | 7.8             | 4.4             | 8.1             | 5.2             | 8.3                   | 5.4             |
|                           | HDPE                | 8.0             | 5.7             | 7.6             | 5.4             | 7.9             | 4.8             | 8.1             | 5.1             | 8.3                   | 5.4             |
|                           | PET jar             | 8.0             | 5.5             | 7.6             | 5.4             | 7.9             | 4.8             | 8.1             | 5.1             | 8.3                   | 5.3             |
|                           | Mean                |                 | 0.30            |                 | 0.75            |                 | 0.15            |                 | 0.50            |                       | 0.03            |
|                           | C.D. (P=0.05)       |                 | 0.64            |                 | 0.66            |                 | 0.51            |                 | 0.63            |                       | 0.59            |
|                           | S.E. ±              |                 | 0.23            |                 | 0.24            |                 | 0.18            |                 | 0.23            |                       | 0.21            |
|                           | F- value            |                 | 3.09*           |                 | 3.23*           |                 | 4.01*           |                 | 3.89*           |                       | 4.62*           |

\* indicates significance of value at P=0.05

**Table 5 : Mean sensory scores of amla beet root juice before and after storage**

| Conditions                | Packaging materials | Colour          |                    | Flavour         |                    | Taste           |                 | Texture         |                 | Overall acceptability |                 |
|---------------------------|---------------------|-----------------|--------------------|-----------------|--------------------|-----------------|-----------------|-----------------|-----------------|-----------------------|-----------------|
|                           |                     | 1 <sup>st</sup> | 5 <sup>th</sup>    | 1 <sup>st</sup> | 5 <sup>th</sup>    | 1 <sup>st</sup> | 5 <sup>th</sup> | 1 <sup>st</sup> | 5 <sup>th</sup> | 1 <sup>st</sup>       | 5 <sup>th</sup> |
| Room temperature          | LDPE                | 8.4             | 7.4                | 7.8             | 6.9                | 8.2             | 5.2             | 8.3             | 7.1             | 8.0                   | 6.8             |
|                           | HDPE                | 8.4             | 7.4                | 7.8             | 5.8                | 8.2             | 5.9             | 8.3             | 7.1             | 8.0                   | 6.3             |
|                           | PET jar             | 8.4             | 7.6                | 7.8             | 6.9                | 8.2             | 6.0             | 8.3             | 7.8             | 8.0                   | 6.5             |
|                           | Mean                |                 | 6.0                |                 | 14.01              |                 | 40.8            |                 | 7.61            |                       | 15.61           |
|                           | C.D. (P=0.05)       |                 | 0.51               |                 | 0.77               |                 | 0.57            |                 | 0.60            |                       | 0.73            |
|                           | S.E. ±              |                 | 0.18               |                 | 0.27               |                 | 0.20            |                 | 0.21            |                       | 0.65            |
|                           | F value             |                 | 17.80**            |                 | 17.93**            |                 | 94.5**          |                 | 16.0**          |                       | 22.0**          |
| Refrigeration temperature | LDPE                | 8.4             | 8.0                | 7.8             | 7.2                | 8.2             | 7.5             | 8.3             | 7.3             | 8.0                   | 7.4             |
|                           | HDPE                | 8.4             | 8.0                | 7.8             | 6.9                | 8.2             | 7.5             | 8.3             | 7.1             | 8.0                   | 7.2             |
|                           | PET jar             | 8.4             | 8.1                | 7.8             | 7.5                | 8.2             | 7.8             | 8.3             | 7.9             | 8.0                   | 7.7             |
|                           | Mean                |                 | 0.95               |                 | 3.15               |                 | 2.71            |                 | 6.46            |                       | 2.71            |
|                           | C.D. (P=0.05)       |                 | 0.50               |                 | 0.90               |                 | 0.40            |                 | 0.53            |                       | 0.71            |
|                           | S.E. ±              |                 | 0.18               |                 | 0.32               |                 | 0.14            |                 | 0.19            |                       | 0.25            |
|                           | F value             |                 | 2.83 <sup>NS</sup> |                 | 2.94 <sup>NS</sup> |                 | 12.86**         |                 | 17.28**         |                       | 4.06*           |

NS=Non-significant \* and \*\* indicate significance of value at P=0.05 and 0.01, respectively

that amla beet juice can be stored upto five days at room temperature. Maximum score was recorded by amla beet juice stored in LDPE followed by PET jar, while minimum score was recorded by HDPE. The mean scores of overall acceptability of amla beet juice kept in various packaging material was recorded less score at one week of storage compared to initial score and was significant statistically at one per cent level. The amla beet juice was stored at refrigeration temperature was packed in PET jar recorded more score for overall acceptability at the end of three weeks of storage period than that of initial score was differed significantly.

### Conclusion :

It was found that 10 per cent level of incorporation of beetroot juice concentrate was found to be more accepted level of incorporation in lime beet juice and amla beet juice. The lime beet juice can be stored upto 3 days while amla beet juice for 5 days at room temperature. However amla beet juice can be stored at refrigeration temperature upto 3 weeks in good condition. It demonstrates the potential application of nutritious beetroot juice concentrate as a value added ingredient for functional foods. Which is beneficial for enhancing the consumption of beetroot in the regular diet among the community to get health benefits.

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