

## DEVELOPMENT AND SHELF LIFE ASSESSMENT OF A CARBONATED RTS BEVERAGE FROM BER FRUIT (*Ziziphus mauritiana*)

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**Abstract:** The research was conducted with the objective of utilizing ber fruit in the production of carbonated ready to drink beverage that can serve two purposes- firstly, value addition & optimum utilization of ber fruit; and secondly, it can be relished by young generation. The clear fruit juice was extracted by following hot process extraction method. Percent recovery of ber fruit was 35 percent. The juice was preserved by adding sugar and citric acid to it so as to prepare syrup. The syrup was filled in PET bottles at the rate of 80 ml, followed by carbonation process leaving 2-3 cm head space and sealed. The prepared drink kept under refrigeration (4<sup>o</sup> C) for a period of 45 days. It was free of any artificial preservative. The developed drink was analyzed for the physio-chemical properties such as titratable acidity, TSS and pH value, ascorbic acid and sugar content as well as for sensory parameters on 0<sup>th</sup> day, 15<sup>th</sup> day, 30<sup>th</sup> day and 45<sup>th</sup> day. Microbial analysis showed absence of Coliform throughout the storage period and yeast and moulds were not found upto 30<sup>th</sup> day of storage.

**Keywords:** Carbonated, RTS, drink, ber fruit, *Ziziphus mauritiana*.

### Introduction

*Ziziphus mauritiana*, also known as Ber, is a tropical fruit tree which is grown widely throughout the Indian subcontinent. *Ziziphus mauritiana* belongs to the family Rhamnaceae. *Z. mauritiana* is a spiny, evergreen shrub or small tree up to 15 m high, with trunk 40 cm or more in diameter; spreading crown; stipular spines and many drooping branches. Bark is dark grey or dull black, irregularly fissured. Where climatic conditions are severe, it is commonly a compact shrub only 3-4 m tall. Its fruit is drupe, globose to ovoid, up to 6 x 4 cm in cultivation, usually much smaller when wild; skin smooth or rough, glossy, thin but tough, yellowish to reddish or blackish; flesh white, crisp, juicy, subacid to sweet, becoming mealy in fully ripe fruits. It grows in neutral or slightly alkaline deep, sandy loam soil, though it can tolerate a range of soil types including those exhibiting moderate arid salinity. Among the fruit trees, ber cultivation requires perhaps the least inputs and care. It gives good production even without irrigation and can be grown as rain fed crop in semi arid and arid regions. The trees can therefore, give assured income even under marginal growing conditions and provide nutritious food at very low cost. It is rich in ascorbic acid and contain fairly good amount of

vitamin A and B, minerals like calcium, phosphorus and iron. The ascorbic acid content of ber fruit is higher than the orange (Kavitha, 2011). Thus, no exaggeration if it is known as 'poor man's apple'.

In India, there are 90 or more cultivars of *Ziziphus mauritiana* are produced and commercially cultivated. Among the important cultivars, eleven are described in the encyclopaedic *Wealth of India*: 'Banarasi (or Banarsi) Pewandi', 'Dandan', 'Kaithli' ('Patham'), 'Muria Mahrara', 'Narikelee', 'Nazuk', 'Sanauri 1', 'Sanauri 5', 'Thornless' and 'Umran' ('Umri'). The skin of most is smooth and greenish-yellow to yellow (Pawar *et al.*, 2012).

The production of ber is confined to a particular season leading to surplus production and glut in the market. The shelf-life of ber is extremely short, hardly 2 to 4 days at ambient temperature conditions, thus early perishability of the fruit possesses a problem and thus needs quick disposal or converted into food products with keeping quality. The development of various value added products greatly helps to minimize the post-harvest losses as well as make it available throughout the year for its nutritive value. Development of preserved products based on ber fruit will increase nutritional value of the regular Indian diet as well as can contribute to food security among the people of the region.

Carbonation is the process of mixing carbon-di-oxide (CO<sub>2</sub>) under pressure with water or beverage. The water or beverages are mixed with certain additives including sweetner, acid, flavour, preservatives, etc. The drink when served gives off gas in fine bubbles has a characteristic pungent taste of the desired beverages. It adds to the life of the product and contributes in some way to its tang. Carbonated beverages are generally bottled with CO<sub>2</sub> content varying from 1 to 8 g per litre. It provides anaerobic condition and reduces the oxidation of ascorbic acid (Nale, 2004). Non-alcoholic beverages are best to serve hydration purpose as well as preferable social drink. There are various types of non-alcoholic drinks, such as fruit based drinks, synthetic drinks, sweetened aerated water or carbonated drinks and sometimes non alcoholic beer, wine, etc. mostly the carbonated drinks contain flavouring components and colouring agents which can be suspected to be allergenic. Inclusion of fruit juices instead of artificial flavours in these drinks not only imparts characteristic colour and flavour but also provides some nutrients. The demand for soft drinks is increasing every year. This trend can be exploited by developing nutrient enriched carbonated fruit based beverages. These beverages can be well marketed at recreational places such as college canteens, cinema hall, cafeterias, public places or food court of malls. The growing health consciousness of

consumers has made the industry to introduce a variety of beverages. The fruit based carbonated beverages can replace the promiscuous consumption of artificial soft drinks.

Bright and Potter (1970) reported the overall acceptability of Carbonated versus non-carbonated apple juice. Their findings included overall preferences for the carbonated apple juice. Khuridya (1989) reported that the CO<sub>2</sub> in the carbonated beverage not only gives a distinctive tingling sensation but also provides anaerobic conditions for oxidation of ascorbic acid. Further, in 1999, Juneja and Checker suggested that because of the carbonation process the beverage stays fresh for long as either the incorporated CO<sub>2</sub> either inhibits or destroys the harmful bacteria.

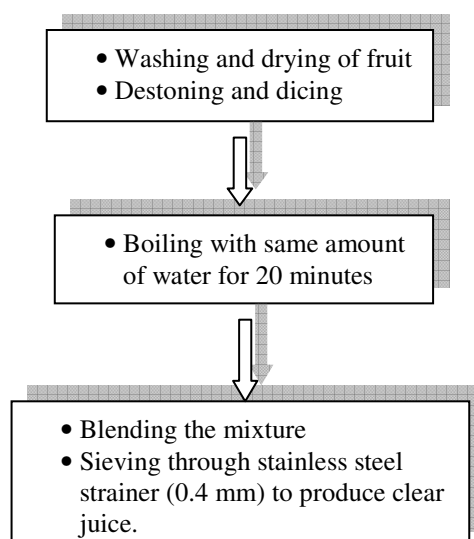
In 1986, Lal *et al.* suggested that without addition of any preservatives the carbonated beverages can be kept fresh for a week at ambient conditions. But if the beverage is to be kept for longer duration it is necessary to add 0.005 percent of sodium benzoate to the final product. A study done by Jadhav *et al.* (2002). Reported that the carbonated beverage prepared from the tamarind juice stored at cold temperature showed the maximum storability of 35 days without affecting any taste and flavour.

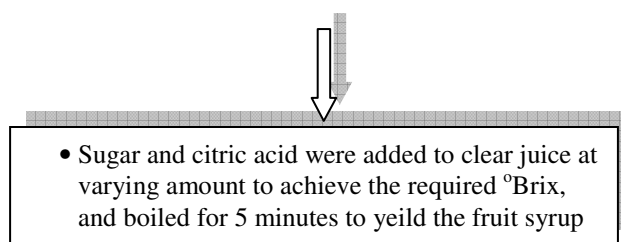
Keeping this in the scrutiny, the present study was carried out with the following objectives:

1. Standardization of protocol for development of carbonated RTS beverage from ber fruit.
2. Physico-chemical analysis and sensory evaluation of the developed RTS beverage.
3. Studies on storage behaviour of carbonated RTS beverage at 4<sup>0</sup> C temperature for 45 days.

#### Methodology:

- **Development and standardization of carbonated RTS beverage from ber fruit**





**Diagram 1: Flow chart of extraction of ber fruit juice and preparation of syrup**

- **Bottling, carbonation and sealing:** pre sterilized PET bottles were filled with 80 ml of fruit syrup. The chilled carbonated water was filled in each bottle at the rate of 170 ml and simultaneously crown corking was done with head space of 2-3 cm. Carbonation was done in the local factory of soda making. An automatic machine named carbonator-cum-crowner (Soda Stream) was used in this process. Carbonation was done by incorporating carbon dioxide gas through a cylinder containing carbon dioxide under high pressure (60 psi, 3.5 volumes). To increase the solubility of CO<sub>2</sub> in water, the water in the storage tank was chilled before the start of bottling operation. At 60 pounds per square inch and 40<sup>0</sup> F approximately 3.50 volume of CO<sub>2</sub> gas was dissolved by one volume of water.
- **Parameters studied:** Total soluble solids, titratable acidity, pH value, ascorbic acid, total sugars, reducing sugars, non-reducing sugars, organoleptic evaluation, shelf life assessment and microbial count.

### Results:

- Developed and standardized ber fruit based carbonated drink:

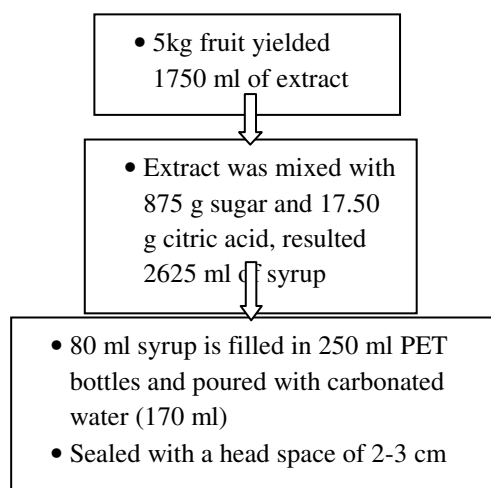


Diagram 2: flow chart of development and standardization of RTS beverage

- **Physico-chemical analysis of developed carbonated beverage and changes during storage period:**

1. **Titratable acidity (TA):** The TA of the freshly developed beverage was recorded as 0.38. during the storage period of 45 days the TA value declined and the effect of storage

period on the TA value of sample was calculated as significant. The TSS values of the developed samples were in agreement with the standards prescribed by FSSAI (2015) for the RTS beverage. At the end of storage period mean acidity was recorded as 0.36.

2. **Total soluble solids:** hand refractometer was used to measure the total soluble solids. TSS of freshly prepared sample was calculated as 12.9 °Brix. During storage period the TSS value was increased from 12.9 to 14.1, SD 0.532. A significant difference was found between the TSS and storage period at 0.1% confidence level. The study conducted by Sandhan *et al.* (2009) also suggested the increase in the TSS of carbonated pomegranate juice with the storage period, as during storage the TSS increased from 15 °Brix to 16.20 °Brix, in the 60 days time interval.

3. **pH value:** pH of beverage was measured just after final preparation and then it was measured fortnightly during the storage period of 45 days. Initially, the pH was recorded as 3.3, which was slightly declined as the storage period increases. The change in the pH value was not found to be significant.

**Table 1:** TA, TSS and pH value of developed carbonated RTS beverage and changes during the storage period.

Time (days)	Titrateable acidity (TA)	TSS (° Brix)	pH value
0	0.38	12.9	3.3
15	0.38	13.8	3.3
30	0.37	13.9	3.2
45	0.36	14.1	3.19
Mean	0.37	13.67	3.2

- Nutritional analysis**

1. **Ascorbic acid content:** The vitamin C content of the freshly prepared beverage was calculated as 1.34 mg/100 ml.

2. **Sugar content:** Freshly prepared sample was tested for the reducing sugar, non-reducing sugar and total sugar content. The enumerated values are given in the table below.

**Table 2:** the nutritional analysis o the developed carbonated RTS beverage from ber fruit

Vitamin C content (mg/100 ml)	Non- reducing sugar (%)	Reducing sugar (%)	Total sugar (%)
1.33	7.88	2.68	10.56

- **Sensory evaluation:** Consumer judges juice quality on the basis of its sensory parameters such as color, taste and flavour etc. Sensory evaluation was carried out to evaluate fresh as well as stored sample after 0, 15, 30 and 45 days.

1. **Appearance:** the developed carbonated product score 8.9 rating on the scale of 9 for the appearance characteristic. During storage period the changes among the given ratings was also found significant as shown in table below. Till 30<sup>th</sup> day the mean values were same but as the 45<sup>th</sup> day approached, significant change was calculated at  $p < 0.001$ . Although, it was clear that there is significant difference between the appearance of beverage and various treatment as well as appearance rating and shelf life, but in both cases the mean rating is almost or more than 8.5.

2. **Colour:** Sensory scores obtained on the basis of colour attribute for the freshly prepared carbonated beverage, were satisfactory and acceptable from consumer's point of view. As the interaction between storage period and colour attribute were evaluated again the changes were found out to be significant ( $p < 0.001$ ) with the highest mean value given to the freshly prepared beverage samples. Thus, it was found that though there was gradual deterioration in the colour attribute of samples as shelf life proceeded, yet the mean value colour scores was above eight and very much liked by the consumers.

3. **Flavour:** Flavour of drink is described as a combination of aroma and taste. The scores obtained for the flavor attribute were shown in the given table. Now if we see the interaction of flavour attribute and refrigeration period a gradual decline is surely observed from 0<sup>th</sup> day to 45<sup>th</sup> day. There is clear deterioration as storage period proceeded, yet the scores are above 6 for 30 days and for the last 15 days still above 5 rating. This shows that the consumers have given positive response.

4. **Taste:** Freshly prepared beverage scored the highest mean rating on the basis of taste attribute  $8.23 \pm 0.91$  and then a gradual decline in the taste scores can be seen as on 15<sup>th</sup> day it was recorded as mean value 7.69, on 30<sup>th</sup> day 6.72, and on 45<sup>th</sup> day. The variation among taste scores were analyzed as significant at 0.1% of confidence level. Though, it was clear that during storage in refrigerator deterioration in taste was observe, yet the scores were at higher side of the scale and showed the positive preference of judges.

5. **Mouthfeel:** investigation on the interaction between storage period and mouth feel suggested that the mean values are varied significantly as the storage time increased ( $p < 0.001$ ) from 7.99 on 0<sup>th</sup> day, 7.50 on 15<sup>th</sup> day, 7.00 on 30<sup>th</sup> day and the least on the 45<sup>th</sup> day as 5.58. Although there is significant decline in the mouth feel scores, yet the scores were almost 8.00 for 0<sup>th</sup> day and more than 7.00 for 15<sup>th</sup> and 30<sup>th</sup> day respectively; which speculated a promisingly positive response of judges towards the samples tested.

6. **Overall acceptability:** it is based on the consumer's acceptability. The rating for overall acceptability of the product on 0<sup>th</sup> day was 8.54. The observed variation in the overall acceptability with the advance in the storage period was found out significantly different ( $p < 0.001$ ). through out the storage period overall acceptability was declined and on the 45<sup>th</sup> day it was recorded as 6.07. yet, the ratings showed the positive response of consumer.

**Table 3:** sensory evaluation of the developed carbonated RTS beverage through out the storage period

days	Sensory attributes					
	Appearance	colour	Flavour	Taste	Mouthfeel	Overall acceptability
0 <sup>th</sup>	8.9	8.93	8.15	8.23	7.99	8.54
15 <sup>th</sup>	8.9	8.88	7.38	7.69	7.50	7.53
30 <sup>th</sup>	8.9	8.65	6.39	6.72	7.00	6.57
45 <sup>th</sup>	8.45	8.20	5.77	5.96	5.58	6.07

- **Microbial analysis of carbonated RTS beverage:** Initially, the yeast count was found to be zero up to the 30<sup>th</sup> day of storage. At last day of storage yeast presence was identified. The result from the Table 3 also exhibited that the developed carbonated RTS was free from *Coliform* throughout the storage period of 45 days at refrigerator temperature as result of good hygienic and sanitary conditions, during the preparation of the beverage.

**Conclusion:** the carbonated RTS from ber fruit has all the goodness of fruit as well as the widely relished fizz to it. Moreover, the developed RTS beverage does not have any sort of chemical or artificial preservative which makes it as an organic drink devoid of any harmful and synthetic ingredient. It is advantageous in the form of natural health drink which can also serve as healthy appetizer.

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