

Study on development and shelf life of beetroot storable products

Shikha Srivastava¹, and Dr.Lakshmi Bala*²

¹ Nutrition Consultant, Department of Food and Nutrition, Era's Lucknow Medical College and Hospital.

² Professor and Head, Department of Biochemistry, Babu Banarasi Das University.

Corresponding author - Dr.Lakshmi Bala
Babu Banarasi Das University.

Abstract

Beta Vulgaris is generally known as beetroot. It is a wonderful dietary supplement because it is not only rich in nutrients, minerals, and vitamins but it also has unique phytoconstituents, which have various therapeutic importance such as ant-oxidant, anti-depressant, anti-microbial, anti-inflammatory, diuretic, and expectorant. But beetroots are not liberally available in every season. So there is a requirement to preserve this vegetable. The objective of the present study was to develop some value-added storable (beetroot biscuits, beetroot pickle, and beetroot jam) products from beetroot and to assess their shelf life. All the storable products were kept at room temperature (29-30 0C) for 3 months and analyzed for their shelf life at 0, 15, 30, 45, 60, 75 and 90 days with sensory characteristics by using the Nine-point hedonic scale and microbiological analysis by using Pour Plate Technique. The result showed that beetroot biscuit and beetroot pickle can consume up to 75 days of storage but beetroot jam can be consumed up to 60 days of storage. However, the microbial load of all the storable products was within the acceptance range for 3 months of storage so they can store up to 3 months and also safe for consumption

Keywords : beetroot biscuit, beetroot pickle, beetroot jam, TPC, Nin-point hedonic scale

I. Introduction

It is well-documented that consumption of fruits and vegetables have many health benefits and it has led to growing interest in so-called "functional food" and reduced the risk of many non-communicable and chronic diseases.^{1,2} Beetroot (Beta Vulgaris) is the taproot portion of beet plant. It is one of the original "super food" .³ Beetroots are ranked among ten most powerful vegetables with respect to its antioxidant capacity and total phenolic content of 50-60 μ mole/g dry weight. Beetroot is a potential source of valuable nitrogenous pigments called betalins .⁴

Numerous studies have proven that beetroots have many therapeutic importance such as hepatoprotective, anticancer, anti-inflammatory, antihypertensive, antibacterial, antimicrobial, antidiabetic, cardioprotective, beneficial in dementia and many others.¹ But beetroots are not available in liberal amount in all seasons . So there is a requirement to preserve this vegetable for taking its benefit in all seasons. Keeping this view the present study is planned to carry out this work with following objective.

1. To develop some value added storable (beetroot biscuits, beetroot pickles and beetroot jam) products from beetroot.
2. To assess the shelf life of developed products.

II. Materials and Methods

1.1. Procurement of raw materials

Beetroots which were used in this research were procured from Ghala farm, Hardoi by pass road, Lucknow (U.P). However refined wheat flour, fat, sugar, sugar, baking powder vanilla essence, Curd, spice mixed, salt, vinegar, mustered oil, apples and citric acid were purchased from local market of Aminabad, Lucknow.

1.2. Processing of beetroot powder

Beetroot powder (BRP) which was used for the preparation of beetroot biscuits were prepared by following steps. Firstly fresh beetroots were washed with tap water and chopped into small pieces. After that it was dried in hot air-circulated oven at 60°C for 11-12 hours for complete dryness. Then the dried beetroots were grinded by electric grinder.

1.3. Formulation of Storable Products

The method of formulation of some storable products from beetroots were given in Fig 1.



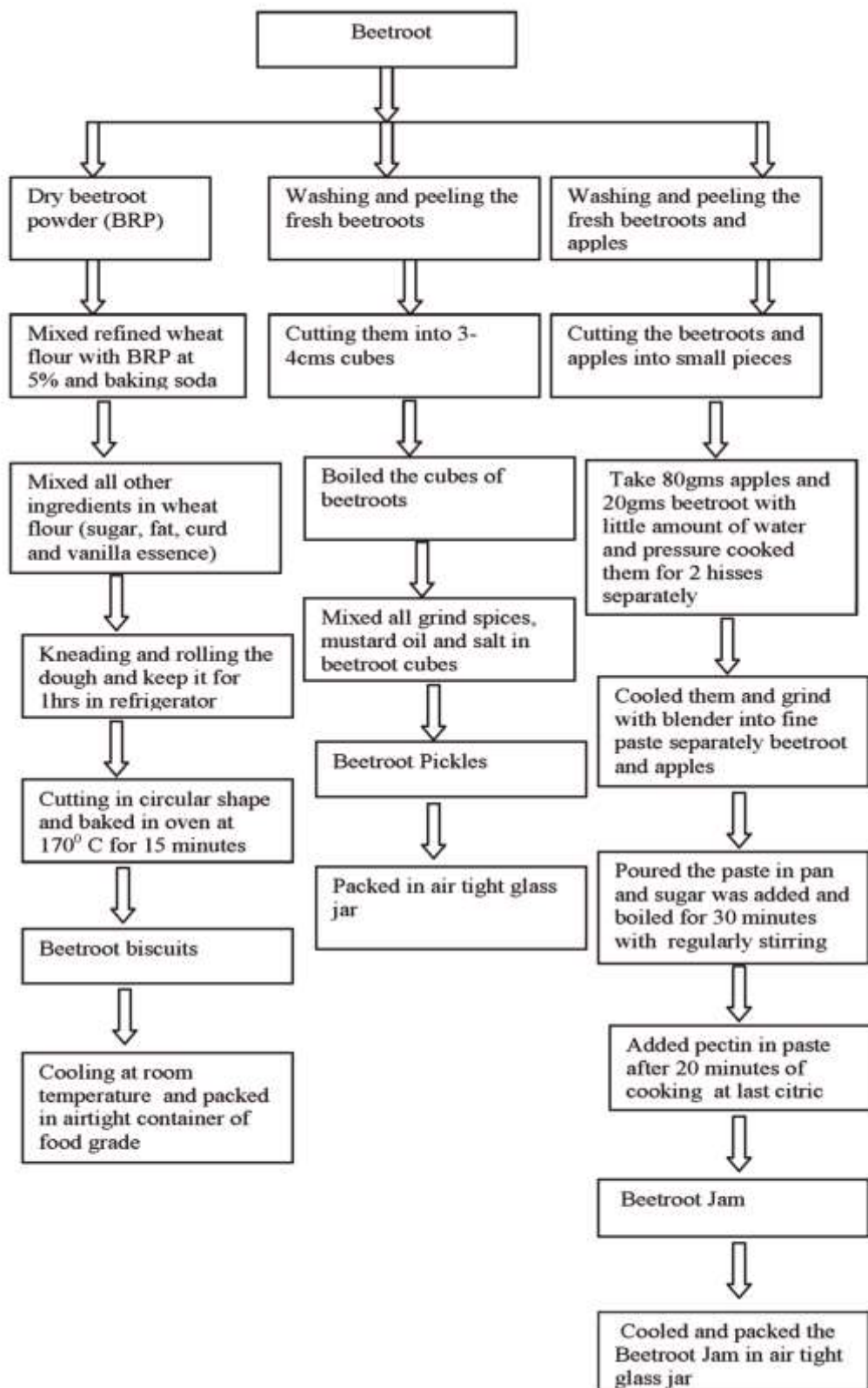


Fig. 1 Formulation of some storable products from beetroots

1.4. Shelf life analysis of storable products

All the samples of storable products of beetroot (beetroot biscuits, beetroot jam and beetroot pickles) were kept room temperature (29-30 °C) for 3 months and they were analyzed for their shelf life in ways i.e. by sensory evaluation and microbiological analysis.

1.5. Shelf life by sensory evaluation

The shelf life of all the storable products were analyzed by sensory characteristics by using Nine-Point hedonic scale with semi-trained panel of ten judges from School of Hotel Management, Babu Banarasi Das University, Lucknow and Era's Lucknow Medical Collage and Hospital at 0, 15, 30, 45, 60, 75 and 90 days of interval .The panelists were asked to evaluate the products for different sensory attributes namely color, appearance, Aroma, Texture, Taste, and overall acceptability.

1.6. Shelf life by microbiological analysis

In microbiological analysis the shelf life of all the storable products were analyzed by using Pour Plate technique at Regional Food Research and Analysis centre, Lucknow at same interval. The TPC (total plate count) and Y& M (yeast and mould) were analyzed by applying following methods.⁵

Reagents

Phosphate Buffer, PDA media and PCA media.

1.7. Procedure

The molten media was cooled and poured into the Petri dish which contained the specified amount of diluted samples after addition of molten media. After that the plate was rotated in circular motion

for achieving the distribution of microorganism. After the solidification of media the plate was kept in incubator for bacterial growth and the result was noted after two days. While for yeast and mould growth the plates were placed in BOD (Bio-oxygen Demand) and maintain a temperature at 25 °C and this result was noted after 5 days. The following formula was applied for calculation of the number of cells per gm.

$$\text{No. of cell per gm} = \text{No. of Colonies} \times \text{Dilution factor}$$

III. Result and Discussion

In present study , three storable value-added products of beetroots were prepared and preserved at room temperature (29-30 °C) for three months and every 15 days of interval these products were evaluated for their sensory attributes for colour, appearance, aroma, texture, taste and overall acceptability scores and the result for their shelf life are given in Table 1. On sensory evaluation of beetroot biscuits the mean score of colour at 0 to 54 days of storage were felt in the category of 'moderately liked'. However at 60 to 75 days of storage it was in the 'slightly liked' category. After that at 90 days of storage it was categorized in 'Neither like nor dislike' category. The significant difference ($p < 0.05$) in the colour of beetroot biscuits were found at 0 to 90 days of storage. It was observed that upto 75 days all the values of colour of beetroot biscuits were within the acceptance range but at 90 days of storage it goes below the acceptance range. However in appearance at 0 to 75 days of storage the mean scores were ranged between 'moderately liked' to 'slightly liked' category.

But at 90 days the mean score was lying in 'neither liked nor disliked' category. So at 0 to 75 days of storage the mean score of appearance of beetroot biscuits were within the acceptable range. Although 90 days of storage it was not in the acceptable range. The aroma, texture and taste of beetroot biscuits at 0 to 60 days of storage the mean were ranged between 'moderately liked' to 'slightly liked' category. However at 75 days to 90 days of storage the values were ranged between 'slightly liked' to 'neither liked nor disliked' category. Therefore the aroma and texture of beetroot biscuits at 0 to 60 days were within the acceptable range but at 75 to 90 days of storage the mean score values were not in the acceptable range. But the taste of beetroot biscuits were

within the acceptable range at 75 days of storage and at 90 days of storage it was in non-acceptable range. The significant difference ($p < 0.05$) was found in all the sensory attributes of beetroot biscuits at 0 to 90 days of storage.

In beetroot pickle on storage all the sensory attributes from 0 to 45 days were lying in 'moderately liked' category. However, the colour and appearance at 60 to 90 days of storage the mean values were lying between 'slightly liked' to 'neither liked nor disliked' category. But the aroma, texture and taste of beetroot pickles at 60 to 90 days of storage the mean values were lying in 'very much liked' category. The significant difference ($p < 0.05$) was found in all the sensory attributes of beetroot pickles at 0 to 90 days of storage. Although, after evaluating the status of shelf life of beetroot pickle for their all sensory factors, it was observed that upto 75 days of storage all mean score values of sensory attributes were within the acceptance range but after that at 90 days of storage the mean score value of colour and appearance were not in the acceptance range.

On storage of beetroot jam the mean scores of all sensory attributes (colour, appearance, aroma, texture and taste) at 0 to 60 days of storage were rated in 'moderately liked' to 'slightly liked' category. However, at 75 to 90 days of storage the mean value of colour and aroma were lying in 'neither liked nor disliked' category. The mean value of appearance and texture at 75 to 90 days of storage were rated in 'liked slightly' to 'neither liked nor disliked' category. The taste of beetroot jam at 75 to 90 days of storage was lying in 'neither liked nor disliked' category. However, the significant differences were found in all the sensory factors at 0 to 90 days of storage. After evaluating the changes in all the sensory attributes it was observed that upto 60 days all the values were within the acceptance range but after that the mean score values of all the sensory attributes were gone below the acceptance range.

Table 1. Shelf Life of Storable products of beetroot by Sensory Evaluation

Beetroot Biscuit					
Days	Colour	Appearance	Aroma	Texture	Taste
0 Days	7.90±0.74	7.80±0.42	7.70±0.67	7.80±0.63	8.10±0.74
15 Days	7.90±0.74	7.80±0.42	7.70±0.67	7.80±0.63	8.10±0.74
30 Days	7.90±0.74	7.80±0.42	7.50±0.85	7.70±0.67	8.00±0.67
45 Days	7.10±0.88	6.90±0.57	6.90±0.74	6.80±0.63	7.30±0.82
60 Days	6.90±0.74	6.80±0.42	6.20±1.03	6.50±0.85	6.70±0.82
75 Days	6.30±0.82	6.10±0.74	5.90±0.88	5.90±0.74	6.10±0.99
90 Days	5.70±0.82	5.40±0.70	5.10±0.88	5.10±0.74	5.40±0.97
P-value	0.001	0.001	0.001	0.001	0.001
Beetroot Pickle					
Days	Colour	Appearance	Aroma	Texture	Taste
0 Days	7.70±0.48	7.70±0.67	7.80±0.79	7.80±0.63	7.90±0.57
15 Days	7.70±0.48	7.70±0.67	7.80±0.79	7.80±0.63	7.90±0.57
30 Days	7.70±0.48	7.70±0.67	7.80±0.79	7.80±0.63	7.90±0.57
45 Days	7.60±0.52	7.50±0.53	7.90±0.74	7.80±0.63	7.90±0.57
60 Days	6.80±0.63	6.90±0.57	8.00±0.67	8.00±0.47	8.00±0.67

75 Days	6.40±0.52	6.40±0.52	8.50±0.71	8.40±0.52	8.00±0.67
90 Days	5.60±0.70	5.70±0.67	8.70±0.48	8.80±0.42	8.80±0.42
P-value	0.001	0.001	0.001	0.001	0.001

Beetroot Jam					
Days	Colour	Appearance	Aroma	Texture	Taste
0 Days	7.50±0.85	7.70±0.67	7.80±0.63	7.70±0.82	7.90±0.74
15 Days	7.50±0.85	7.70±0.67	7.80±0.63	7.70±0.82	7.90±0.74
30 Days	7.40±0.84	7.70±0.67	7.70±0.67	7.70±0.82	7.90±0.74
45 Days	6.60±0.84	7.30±0.82	7.00±0.82	7.50±0.85	7.20±0.63
60 Days	6.30±0.67	6.70±0.67	6.70±0.82	7.10±0.74	6.50±0.53
75 Days	5.70±0.67	6.00±0.82	5.70±0.67	6.30±0.82	5.90±0.74
90 Days	5.20±0.63	5.50±0.71	5.20±0.63	5.70±0.95	4.90±0.74
P-value	0.001	0.001	0.001	0.001	0.001

The microbial count of storable products (beetroot biscuits, beetroot pickles and beetroot jam) which were stored up to 90 days of storage period at room temperature in respect of total plate count (TPC) and yeast and mould count (YMC) were studied and the results are presented in Table 2. The result showed that in beetroot biscuits upto 60 days the growth of TPC was zero. But after that the minimum growth in TPC value was found at 75 days of storage i.e. it was 16.67±5.77 cfu/g. While at 90 days of storage period the TPC value was 33.33±11.55 cfu/g. The result showed that significant differences were observed for TPC at 0 to 90 days of storage period.

In beetroot pickle the TPC growth was found just from 0 to 90 days of storage. On storage the TPC value of beetroot pickle was as follows, it was 1.67±1.53 cfu/g at 0 day, 3.33±2.89 cfu/g at 15 days, 3.33±2.89 cfu/g at 30 days, 6.33±1.16 cfu/g at 45 days, 6.67±5.77 cfu/g at 60 days, 10.00±0.0 cfu/g at 75 days and 9.33±1.16 at 90 days of storage period. So the result shows that the TPC values was increased on increasing the storage period from 0 to 75 days of storage. But at 90 days the value of TPC was decreased. The significant difference ($p < 0.05$) was found at 0 to 90 days of storage.

In beetroot jam there was no growth of TPC was found at 0 to 75 days of storage. But at 90 days of storage the value of TPC was 30.0±10.0 cfu/g and the significant difference was found from 0 to 90 days of storage.

However, the yeast and mould growth were nil in all the storable products in whole storage period. So statistical analysis was not performed for yeast and mould.

Table 2. Shelf Life of Storable products of beetroot by Microbiological Analysis

Days	Beetroot Biscuit		Beetroot Pickles		Beetroot Jam	
	Mean	Median	Mean	Median	Mean	Median
0						
15						
30						
45						
60						
75						
90						
P-value						

0 Day	0.0 ± 0.0	0	1.67 ± 1.53	2.00	0.0 ± 0.0	0
15 Days	0.0 ± 0.0	0	3.33 ± 2.89	5.00	0.0 ± 0.0	0
30 Days	0.0 ± 0.0	0	3.33 ± 2.89	5.00	0.0 ± 0.0	0
45 Days	0.0 ± 0.0	0	6.33 ± 1.16	7.00	0.0 ± 0.0	0
60 Days	0.0 ± 0.0	0	6.67 ± 5.77	10.00	0.0 ± 0.0	0
75 Days	16.67 ± 5.77	20.00	10.00 ± 0.00	10.00	0.0 ± 0.0	0
90 Days	33.33 ± 11.55	40.00	9.33 ± 1.16	10.00	30.0 ± 10.0	0
P- Value	0.001		0.001		0.004	

IV. Discussion

The present study agreed with Saeed et al. (2012) who reported that the gradual decreased in all sensory attributes of sweet potato flour incorporated biscuits during storage for 90 days⁶. Dhumal (2016) also reported that the sensory values of sweet potato flour incorporated biscuit was decreased due to storage and he described that the decreased in colour score during storage of sweet potato biscuits may be due to increased in the non-enzymatic browning reaction during storage period⁷. The present finding of sensory score of beetroot pickle was agreed with Hong et al. (2015) who reported that during storage the sensory attributes of pickles were declined⁸. Ullah et al. (2018) reported that the values of all sensory factor in carrot and apple jam were high at 0 day and lowest at 90 days of storage period and decline in colour score may be due to degradation of ascorbic acid and also enzymatic browning reaction. However, decline in taste score may be due to fluctuations in acids or due to decreased in pH value.⁹

In present study the shelf life study of beetroot biscuits by microbiological study was agreed with Seevaratnam et al. (2012) they noticed the similar trend in potato flour incorporated biscuits that after storage the bacterial count of biscuits were increased but they were lower than acceptable limit and the fungus growth were not observed during storage.¹⁰ However, in present study the shelf life study of beetroot pickle by microbiological study was agreed with Hong et al. (2015) that in pickles total number of colonies were increased with storage time⁸. In this study the shelf life study of beetroot jam by microbial count was agreed with Shakir et al. (2005) they reported that the total microbial count was increased with storage for 90 days in jam prepared with apples and pears.¹¹

Conclusion

Overall the result of the study indicates that the storable products developed (beetroot biscuits, beetroot pickle and beetroot jam) from beetroots can be store and consumed for 90 days of storage time. It was concluded that on sensory evaluation beetroot biscuit and beetroot pickle can be consume upto 75 days of storage but beetroot jam can be consumed up to 60 days of storage time but after that it goes below the acceptance range. However, the microbial load of all the storable products was within the acceptance range for 3 months of storage period and they are safe for consumption.

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