CHAPTER V

SUMMARY AND CONCLUSION

Ber is found widely grown in the plains and forest areas of Maharashtra with sporadic evidence of its commercial cultivation. It is nutritious and richest source of vitamin C and B. It is said that the nutritive quality of the processed product varies with commodity and its kind. The period and temperature of storage is said to affect the nutritive quality of the stored products. Since early days dried bers, ber powder (borkut) are some of the locally prepared products used by people. These days the Scientists and Technologists are engaged in the development and standardization of the processes for the preparation of different products of ber of commercial level.

In view of this, present study was undertaken to identify the different products those can be prepared from the various varieties of ber and to standardize the process of their preparation as well as to know consumers acceptability and shelf life of these products with their nutritive values. The varieties studied were Gola, Kadaka, Mehrun, Nagpuri, Sanaur and Umran.

5.1. Physicochemical characteristics

The length and diameter of the mature fruits ranged from 2.5 to 4.7 cm respectively in different cultivars under study. The shape of the fruit noted was roundish in Gola, oblong with blunty point in Kadaka, oval in Mehrun, Sanaur and Umran, oblong with apex in Nagpuri. The percentage of pulp content in different varieties ranged from 87.50 to 95.40%, while percentage of stone ranged from 4.60% to 12.5%. The total soluble solids were in the range of 18.0 to 19.5%. The reducing and non reducing sugar ranged between 3.33 to 4.12% and 4.79 to 5.56% respectively. The percent acidity was within the range of 0.22 to 0.38%. The ascorbic acid ranged from 82.7 mg/100 g to 123.0 mg/100 g. Gola and Sanaur fruits were sweet in taste with mild and pleasant flavour and both had greenish
yellow coloured fruits. Mehrun and Umran varieties were very sweet in taste with pleasant flavour, respectively with yellow and golden yellowish colour. Nagpuri and Kadaka were acidic sweet and flat in taste with mild flavour, respectively having greenish yellow and yellowish brown colour.

The panel of six judges was asked to evaluate the colour, taste, flavour and texture of all the products during storage at 0 days (fresh), 120, 240 and 360 days of storage. The ten point hedonic scale was used to score the attributes. Where the score below 4 was considered not acceptable, 4-6 fair, 6-7 good and 7-10 excellent. The fresh and stored samples were also evaluated for sensory acceptability and chemical changes during storage period at an interval of 3 months.

The total soluble solids (T.S.S.) were measured by Hand Refractometer and pH was recorded by pH-meter as per methods described by Raganna (1978). Acidity was determined by the simple titration method of Millar (1960). Ascorbic acid was determined by direct titration with 2,6 Dichlorophenol indophenol dye according to the modified Tillman’s method of Mack and Tressler (1937).

5.2. Ber candy

The data on sensory evaluation for all the four attributes revealed that the candy prepared by slow method had more acceptability than that of quick method. The sensory score recorded at the different intervals of storage period showed the trend i.e. score for almost all varieties and attributes decreases with the increase in storage period but at slow rate. However, ber candy was good and acceptable upto 120 days storage in quick method and upto 240 days storage in slow method. The overall acceptability of ber candy of Sanaur, Umran and Mehrun was better and it was followed by Kadaka, Gola and Nagpuri.

In view of these results the ber candy prepared only from Mehrun and Sanaur was further studied. The ber candy thus prepared was then stored at room temperature and in
domestic freeze for a period of 180 days. The sensory data revealed that ber candy stored at freeze temperature was significantly better than when stored at room temperature. All the attributes i.e. colour, taste, flavour and texture observed to be almost unchanged during the storage at freeze temperature. But in case of room temperature storage the product showed linear but slow decrease in mean score values with the increase in storage period.

The percent acidity of the ber candy prepared using both methods was found to increase with the increase in storage period for all the cultivars ranging between 0.33 to 0.48 in quick method and 0.32 to 0.45 in slow method. The acidity of candy of Nagpuri variety was higher during storage as compared to other varieties.

The ascorbic acid content was observed to be decreasing with the increase in storage period for all the varieties with maximum of 13.49 mg/100 g and minimum of 11.47 mg/100 g in slow method. The ascorbic acid content of candy prepared by slow method was observed to be better as compared to that of quick method.

The percentage of reducing and total sugar was found to increase slightly with the increase in storage period in all the cultivars under study. There were significant differences in reducing sugar content in the ber candy prepared using both the methods.

The reverse trend was noted in case of the non reducing sugar with the increase in storage period the non reducing sugar of the candy showed decreasing trend. The process of preparation of candy did not influence the percentage non reducing sugar.

Candy prepared by slow method and stored at freeze temperature had better retention of all these chemical attributes and consumers acceptability than that of stored at room temperature. The cost of the one kg ber candy is estimated to as Rs. 40 which is less than that of the other fruits candy available in local market.
5.3. Ber preserve

The mean score of six judges for all the four quality attributes revealed that the ber preserved by slow method was more acceptable than that of quick method. The sensory score recorded periodically during storage showed the trend that mean score for almost all the varieties and quality attributes decreases with the increase in storage period. Almost all the attributes of ber preserve prepared by the quick method were found not acceptable after the storage period of 120 days only. More over in case of slow method the preserve observed to be in acceptable condition even upto 360 days of storage. Gola cultivar produced better quality preserve and was followed by Mehrun, Umran, Sanaur, Kadaka and Nagpuri in quick method while in slow method Sanaur, Umran, Kadaka, Mehrun and Nagpuri. Interaction between varieties and storage periods was found statistically significant only for texture of the ber preserve.

The percent acidity of the ber preserve prepared using both methods was found to increase with the increase in storage period while it ranged between 0.31 to 0.44 percent in quick method and 0.29 to 0.39 per cent in slow method. The acidity of the ber preserve of Nagpuri cultivar was significantly higher at 0, 90, 180, 270 and 360 days of storage as compared to other cultivars. In quick method the rate of increase in acidity was observed after 270 days of storage.

The ascorbic acid content of preserve of all the cultivars was observed to be decreasing with the increase in storage period respectively with maximum and minimum of 19.0 mg/100g and 5.78 mg/100g in quick and slow method. The ascorbic acid content of ber preserve prepared by slow method was observed to be comparatively better to that of quick method. The percent ascorbic acid content was found decreased faster after 90 days of storage in quick method. However in slow method, the rate of decrease was almost uniform between 0 to 360 days storage. The ascorbic acid content in ber preserve of
Nagpuri cultivar was significantly lower at 0, 90, 180, 270 and 360 days storage as compared to other cultivars.

The percentage reducing sugar was found to increase with the increase in storage period for all the cultivars under study. No significant differences were observed in percent reducing sugar of the ber preserve from quick method. However reverse trend was observed for the non reducing sugar content. The non reducing sugar of the ber preserve was noticed to be slightly decreasing during the storage period. The process of preparation of ber preserve did not influence the percentage of non reducing sugar content.

Interaction between varieties and storage period for all the chemical attributes of ber preserve prepared using both methods except for reducing sugar of ber preserve prepared by quick method, found statistically significant. However the interaction between varieties and storage period for the consumer index was found non significant. The cost of one kg ber preserve is estimated Rs. 54.00 which is less than that of the other fruit preserves available in local market.

5.4. Ber jam

The sensory scores for all the quality attributes of ber jam reveals that jam prepared by pulping method was significantly better as compared to one prepared by grating method. The decrease in sensory score was found with increase in storage period for all the varieties. The jam of the cultivars Sanaur, Umran and Gola followed by Kadaka prepared by using both the methods was acceptable upto 240 days storage period. The cultivars Nagpuri and Mehrun had less preference for jam preparation probably because of comparatively inferior quality and small size of the fruits of these varieties. The other attributes did not found influenced by varietal differences. The jam of Nagpuri and Kadaka cultivars had high acidity as compared to other cultivars. The percent acidity was found
to increase with increase in storage period ranging from 0.31 to 0.37 in pulping and 0.31 to 0.40 in grating methods of jam preparation.

The ascorbic acid content of jam of all varieties prepared using both methods was found decreased significantly with the increase in storage period. The maximum ascorbic acid content was in the jam of Mehrun, followed by Umran, Sanaur, Kadaka and Gola prepared using both methods. The reducing sugar was observed to increase with the storage period whereas the non reducing sugar decreased with the increase in storage period in all the cases. The cultivars Sanaur and Umran were found suitable varieties for the jam preparation and recorded the highest consumer index. The cost of the one kg ber jam is estimated Rs. 50.00 which is less than that of the other fruit jams available in the local market.

5.5. Mix fruit jam

The attempts were made to prepare the mixed fruit jam of two ber varieties Sanaur and Umran using papaya in different proportions i.e. 100 percent ber alone, 75 percent ber plus 25 percent papaya and 50 percent ber plus 50 percent papaya and storability was studied at room and at refrigerator temperature. Jam prepared with 50 percent ber plus 50 percent papaya had recorded better score for all sensory attributes and was followed by 75 percent ber plus 25 percent papaya and 100 per cent ber alone. The sensory score was observed to decrease very slowly during the storage period upto 180 days. The products stored at refrigerator temperature was found better than those stored at room temperature. Similar trend showing decrease in non reducing sugar and increase in reducing sugar was found for the mixed jam as that of the ber jam.

No marked differences either in increase or decrease in the chemical attributes as well as between mixed fruit jam and ber jam alone was noted upto 180 days of storage. However nutritive evaluation of ber jam revealed that as compared to fresh fruits acidity
was found increased by 3.5 to 4.5%, while decrease in ascorbic acid content of jam was by 91 to 92%.

All the quality as well as chemical attributes were observed to be decreased with increase in storage period. The cost of the one kg mixed fruit jam is estimated Rs. 50.00 which is less than the mixed fruit jam available in local market.

5.6. Canned ber

The score for all the four attributes revealed that the pricked ber canned in 35\(^0\) brix were more acceptable than those canned without pricking. The sensory score of all the varieties and attributes of pricked and non pricked canned ber in 35\(^0\) brix was found decreased with increase in storage period.

The sensory data clearly reveal that for almost all the attributes of pricked and non pricked canned ber did not show acceptability after 120 days of storage. Comparatively overall acceptability of pricked canned ber of Umran and Mehrun was better and was followed by Sanaur, Gola and Kadaka than that of non pricked canned bers. In general, it reveals that Umran and Mehrun are most suitable and acceptable cultivars for pricked canned ber. However, the canned ber were not much preferred by the panel of judges as compared to the other products under the investigations. The canned ber were not acceptable after 120 days storage due to the disintegration of whole fruits in the syrup.

The mean acidity percent for all the cultivars found ranging between 0.28 to 0.51 in pricked and 0.25 to 0.45 in non pricked canned ber. Much decrease in ascorbic acid content in both pricked and non pricked canned ber was observed after 180 days of storage. Interaction between varieties and storage period for acidity, reducing and non reducing sugars were statistically significant.
The cost of 500 g of canned ber (A2, size 1/2 lacquered can) is estimated as Rs. 10.50. This cost is found comparatively very less than that of other canned fruits available in local market (Table 4.72).

5.7. Dried and dehydrated ber

The fresh ber fruits of different cultivars took about 10 to 13 days periods to dry by traditional method of drying (Sundrying). Gola required 10 days to dry while days for others were 11 for Kadaka, 12 for Mehrun and Umran and 13 for Nagpuri and Sanaur. Drying time for ber fruit found to decrease with increase in (drying) air temperature. It took about 84, 68 and 65 hours time for drying the ber fruits at 45, 55 and 65°C temperature respectively. Moisture content in all varieties was found to decrease exponentially with progress of drying time.

In both the method rate of moisture removal was faster during initial period of drying till the removal of free moisture and found decreased later on when only bound water was available.

The quality of dried ber was influenced by the drying methods and drying temperature. The ber fruits dried at 45°C had better taste, colour and appearance than ber dried at 65°C or sundried. The ber dried at 65°C gave bitter taste due to charring and had dark black colour associated with caramel flavour, shrinking in ber size. The cultivars in order viz., Gola, Sanaur, Umran, Kadaka and Mehrun acceptable were considered for dehydrated ber at 45°C. Amongst various methods of dehydration, drying at 45°C was found better and scored high for acceptability of dried product. For all the ber cultivars linear relationships were observed between moisture content and drying time for mechanical as well as Sundrying. The estimated cost of one kg dried ber is Rs. 49.0 which is less than those available in the market (Table 4.72) however the cost of one kg
dehydrated ber is estimated to Rs. 59.0 which is higher because of the requirement of the instrumentation and electricity.

5.8. Ber jelly

An attempts were made to prepare jelly from the ber pulp using artificial pectin and asseed the feasibility of jelly making. It was not possible to make perfect jelly practically as jelly did not set within the ingredients used.

The results of this investigation revealed that products like ber candy, ber preserves, ber jam, dried and dehydrated ber had consumer’s acceptability. These products could easily be prepared at home scale or at cottage industry level and had a very good potential in the surrounding market where they are produced. The simple adoptable and acceptable process technology had been standardized for preparation of these products. If these products prepared on large scale the cost of the product can be reduced than that of prepared at home scale. It has an added advantage for its wider acceptability. Not much sophisticated equipments and machineries are required for the preparation of these products. They can easily be prepared and generate self employment to the educated rural youth and women.

5.9 Conclusions

The various ber products which had good consumers acceptability and prepared easily are candy, preserves, jam, mix fruit jam, dried and dehydrated ber.

In light of the above results and interpretation of the present research, it may be concluded that,

5.9.1 Candy

a) The cultivars Sanaur, Umran and Mehrun are most acceptable for candy preparation.

b) Slow method of candy preparation is better than quick method.
c) Candy can possibly be stored minimum up to 240 days in acceptable form at room temperature.

d) Candy stored at freeze temperature is significantly better than when stored at room temperature and can be safely stored up to 360 days.

e) Nutritional losses are minimum in candy prepared by slow method and are negligible when stored at freeze temperature.

f) On the home scale basis, the estimated per kg cost of the candy is Rs. 40.

5.9.2 Ber preserve

a) Slow method of preparation of ber preserve is better than quick method.

b) The Gola cultivar is most suitable for preserve making followed by Sanaur, Umran, Kadaka and Mehrun.

c) Consumer’s acceptability for ber preserve is only up to 180 days.

d) Nutritional point of view, the preserve made from the variety Mehrun possessed better qualities and was followed by Umran, Sanaur, Gola and Kadaka as compared to Nagpuri.

e) On the home scale basis, the estimated per kg cost of the ber preserve is Rs. 54.

5.9.3 Jam

a) Pulping method of ber jam preparation is better than grating method.

b) Cultivars viz. Sanaur, Umran, Gola and Kadaka were observed suitable for jam preparation by pulping method.

c) Considering all the quality as well as chemical (nutritional point of view) attributes jam can possibly be stored minimum up to 240 days without losing acceptability.

d) Considering all attributes, mixed fruit jam having 50% ber plus 50% papaya is better and economical.
e) On the home scale basis the estimated per kg cost of the ber jam and mixed fruit jam is Rs. 50.

5.9.4 Canned ber

a) Pricked canned ber are more acceptable compared to non pricked.

b) Cultivars, Umran and Mehrun are most suitable for canning.

c) In comparison to other products, canned products are not so acceptable.

d) Canned ber can be stored only upto 120 days considering all attributes.

e) On laboratory scale basis, cost of the A2 size 1/2 lacquered can containing about 500 g canned ber is Rs. 10.50.

5.9.5 Dehydrated and sundried ber

a) Ber dehydrated at 45°C temperature are more acceptable than dehydrated at 55°C and sundried.

b) Ber dehydration at 65°C temperature can not be recommended looking to qualities of prepared product.

c) On home scale basis the estimated per kg cost of the dried and dehydrated ber is Rs. 49 and 59 respectively.

On an average all the ber products prepared are found economical than that of the other fruits products available in the local market.