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**Research Article**

# DEVELOPMENT OF SYRUP FROM BOX MYRTLE (*Myrica nagi*) AND ITS QUALITY EVALUATION DURING STORAGE

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**Abstract-** Box myrtle (*Myrica nagi*) belongs to family Myricaceae is a sub-temperate tree found throughout the mid-Himalayas at an elevation of 1,300 to 2,100 meters above mean sea level. Its fruits are known for their ravishing taste and have been reported as rich source of anti-oxidants like phenols and anthocyanins. Therefore, investigations were conducted to develop commercial syrup and its quality evaluation during storage. Different combinations of juice and sugar syrup were tried to standardize proper combination for syrup. The syrup prepared by following the best selected recipe [35 % juice and 65 °B TSS (Total Soluble Solids)] was packed in glass and PET (Polyethylene terephthalate) bottles and stored for six months under ambient and refrigerated temperature conditions. Syrup could be safely stored for a period of six months under both the storage conditions without much change in various quality characteristics. However, the changes in the quality characteristics of the syrup were slower in refrigerated storage conditions as compared to ambient conditions. Both the packaging materials *viz.* PET and glass bottles were found suitable, with comparatively less changes occurring in glass bottles stored under refrigerated conditions.

**Keywords**- Box myrtle, *Myrica nagi*, Syrup, *Kaafal*

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## Introduction

Box myrtle (*Myrica nagi*) is a medium to large woody evergreen tree of genera *Myrica* in family Myricaceae and commonly known as *kaafal* in Himachal Pradesh. Among the various species *Myrica nagi* is a sub-temperate wild tree found throughout the mid-Himalayas between 1,300 to 2,000 meters above the mean sea level. It is found in Khasia, Sylhet and southwards up to Singapore, Malaya Islands, China and Japan. In India, it is widely distributed between 900 to 2,100 meters above mean sea level in Indian Himalaya from Ravi Eastward to Assam, Khasi, Jhantia, Naga and Lushi hills [1].

The fruits of *Myrica nagi* are rich source of anti-oxidants and known for their ravishing taste because of higher sugars, tannins and vitamin C [2, 3]. The small seeded fruits of this species are consumed fresh because of their taste and juiciness in Himachal Pradesh [1]. The juice of this fruit is very attractive, sparkling red in colour and ripe fruits are used as a potential source of formulations for nutraceuticals [4]. No work on processing of this fruit has been reported so far. So, being a rich source of antioxidants specially colour pigments like anthocyanins as well as sugars, this fruit can be exploited for the development of some beverages like syrup. Thus, the present studies were undertaken to develop syrup from this fruit and study its storage life.

## Materials and Methods

The mature fruits of *Myrica nagi* were procured from Dumadevi area of Mandi district of Himachal Pradesh. Fruit syrup was prepared by mixing known quantity of box myrtle juice in sugar syrup of different treatment combinations as given in Table 1. To get the desirable concentration of acid (1.50 %) in syrup, citric acid was added in different combinations. Sodium benzoate (600 ppm) was added at the end of product preparation. The syrup prepared by following the best selected recipe was packed in pre-sterilised glass and PET bottles (700 ml capacity). All the packed products were properly labelled and stored in ambient (20-25 °C) and low temperature (4-7°C) conditions for six months. The physico-chemical and sensory characteristics of all the products were estimated at zero, three and six months of storage. The colour of syrup in terms of different units (Red and Yellow) was observed with Tintometer (Lovibond Tintometer Model-E).TSS, sugars, titratable acidity, ascorbic acid content and anthocyanins of syrup were determined according to Ranganna [5]. pH of syrup was determined by using a digital pH meter (CRISON Instrument, Ltd. Spain). Total phenols content was determined by Folin-Ciocalteu procedure given by Singleton and Rossi [6]. Nine point hedonic rating test was followed for conducting the sensory evaluation of box myrtle syrup. Data on physico-chemical characteristics of syrup were analysed by Completely Randomized Design (CRD) before and during storage, whereas, data pertaining to the sensory evaluation were analyzed by using Randomized Block Design (RBD)as described by Mahony [7]. The experiments on recipe standardization and storage studies were replicated three times.

**Table-1** *Treatment detail of fruit syrup*

| Treatment | $T_1$ | $T_2$ | $T_3$ | $T_4$ | $T_5$ | $T_6$ | $T_7$ | $T_8$ |
|---|---|---|---|---|---|---|---|---|
| Juice (%) | 25 | 30 | 35 | 40 | 25 | 30 | 35 | 40 |
| TSS (°B) | 65 | 65 | 65 | 65 | 70 | 70 | 70 | 70 |

## Results and Discussion

**Standardization of recipe for the preparation of box myrtle syrup:** Data on sensory characteristics of different recipes of box myrtle syrup given in Table 2 indicate that the mean colour score was highest (7.60) in $T_3$ which was statistically at par with $T_4$ and lowest (6.77) in $T_5$ closely followed by $T_1$, $T_2$ and $T_6$. The same recipe ($T_3$) obtained maximum body score of 7.80 which was highest among all the recipes and minimum (6.23) in $T_8$ which was statistically at par with $T_6$. The highest score (7.37) of taste was awarded to $T_3$ while $T_5$ got the lowest score of 5.64 which was statistically at par with $T_1$. The maximum (7.37) score for aroma was recorded in recipe $T_3$ and minimum (5.07) in $T_1$. The highest score (7.55) of overall acceptability was recorded in $T_3$ and lowest score (6.24) in $T_1$ closely followed by $T_5$, $T_6$ and $T_7$.

**Table-2** *Sensory characteristics (score) of different recipes of box myrtle syrup*

| Treatment | Colour | Body | Taste | Aroma | Overall acceptability |
|---|---|---|---|---|---|
| $T_1$ | 7.03 | 7.17 | 5.67 | 5.07 | 6.24 |
| $T_2$ | 7.03 | 7.40 | 5.80 | 5.80 | 6.53 |
| $T_3$ | 7.60 | 7.80 | 7.37 | 7.37 | 7.55 |
| $T_4$ | 7.40 | 7.33 | 7.10 | 6.67 | 7.14 |
| $T_5$ | 6.77 | 6.90 | 5.64 | 5.67 | 6.31 |
| $T_6$ | 6.90 | 6.50 | 5.90 | 6.10 | 6.38 |
| $T_7$ | 7.07 | 6.27 | 6.37 | 6.47 | 6.48 |
| $T_8$ | 7.20 | 6.23 | 6.73 | 6.73 | 6.68 |
| $CD_{0.05}$ | 0.29 | 0.32 | 0.23 | 0.30 | 0.25 |

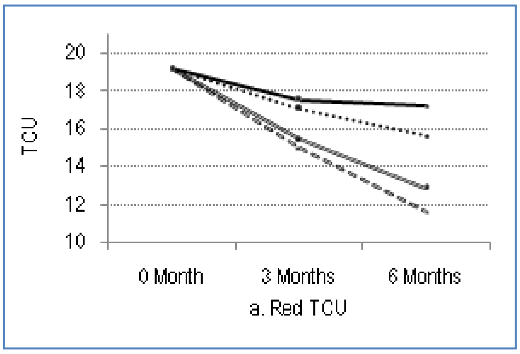
From the [Table-2] it was concluded that the recipe with 35 per cent juice and 65 °B TSS ($T_3$) was the best on the basis of sensory of syrup.

**Storage of box myrtle syrup**

**Physico-chemical characteristics**

**Colour:** There was a decrease in red and yellow TCU (Tintometer Colour Units)of syrup (Fig. 1a and 1b) during storage. However, decrease was significantly lower under refrigerated storage conditions than ambient conditions. The reason for decrease in colour units of syrup during storage might be due to degradation of anthocyanins pigment. However, these pigments degraded at slower rate in low temperature hence less decrease was observed in refrigerated conditions. There was a less decrease in colour units of syrup packed in glass bottle because of slower rate of chemical reactions in this packaging material as a result of difference in their thermal conductance properties. Similar trend of decrease in red and yellow colour units were observed by Waskar and Khurdiya [8] in phalsa beverages.

**TSS:** The TSS content of syrup increased slightly during storage [Fig-1c] and this increase in TSS during storage might be due to hydrolysis of polysaccharides into monosaccharides and soluble disaccharides [9]. The increase in TSS was found more in syrup stored under ambient conditions as compared to refrigerated storage conditions and this might be due to the faster rate of reaction because of high temperature in ambient conditions. However, with respect to the packaging material this increase was found non-significant. The results were similar to the findings of Reddy and Chikkasubbanna [10] in amla syrup.



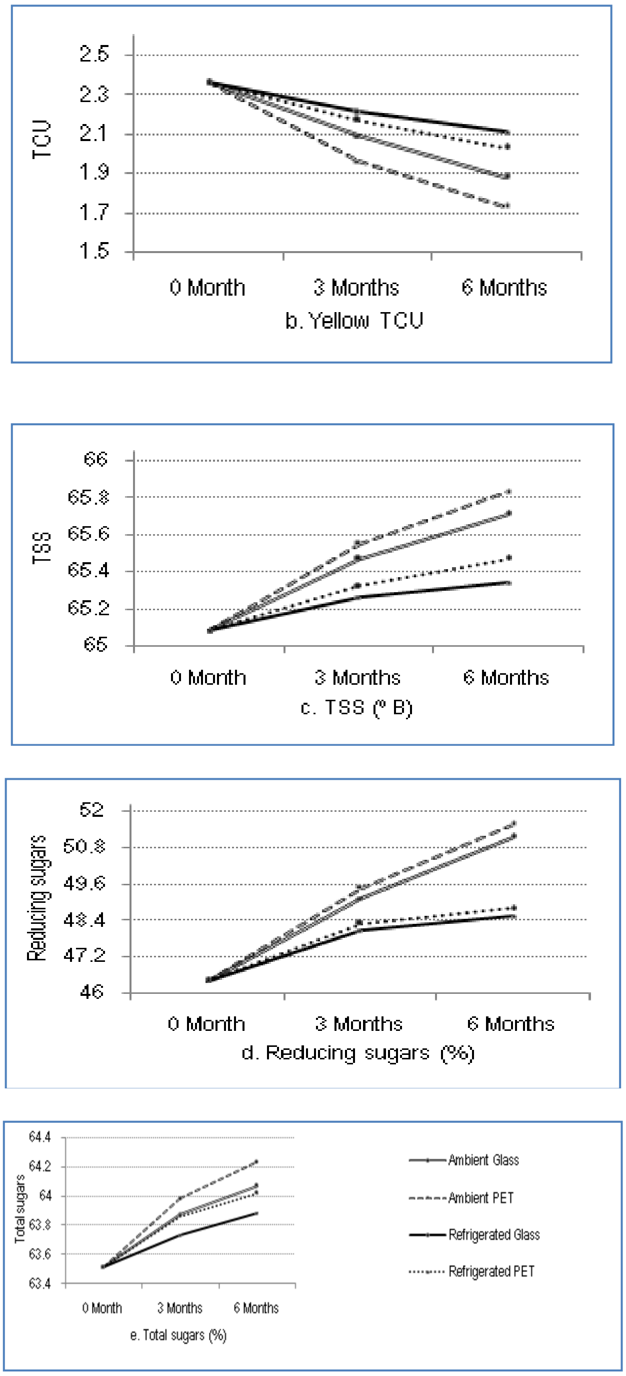




**Fig-1 Effect of storage on physico-chemical characteristics of box myrtle syrup**

**Sugars:** Reducing and total sugars of syrup [Fig-1d and 1e] showed a significant increase during storage which was comparatively less in refrigerated storage conditions than in ambient conditions. This increase might be due to hydrolysis of starch into sugars as well as conversion of complex polysaccharides into simple sugars and conversion of non-reducing to reducing sugars. As far as packaging material is concerned, more increase in sugars was recorded in syrup packed in PET bottle as compared to glass bottle. This might be due to the faster rate of chemical reactions in the product packed in PET bottle because of faster heat absorption of PET packaging material than glass. Similar results have been observed by Choudhary et al [11] in amla syrup.

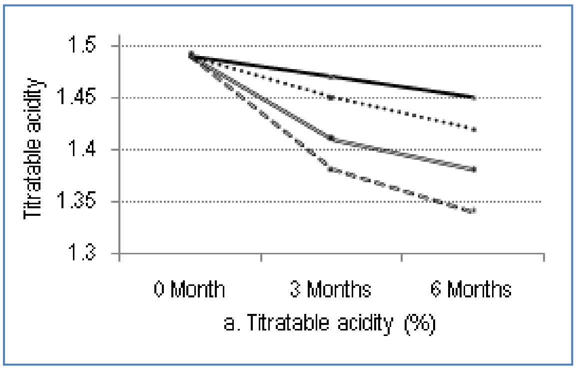
**Titratable acidity:** There was a slight decrease in titratable acidity of syrup during storage [Fig-2a] which was comparatively more under ambient conditions than refrigerated. This might be due to the faster rate of reactions as a result of high temperature in ambient conditions. However, with respect to packaging material this decrease in titratable acidity was non-significant. Decrease in titratable acidity during storage might be due to co-polymerization of organic acids with sugars and amino acids. Similar results were recorded by Reddy and Chikkasubbanna [10] in aonla syrup and Khurdiya and Roy [12] in phalsa syrup.

**pH:** The pH of syrup showed a slight increase during storage [Fig-2b] and this increase was statistically non-significant with respect to storage conditions as well as packaging material. The increase in pH noticed in syrup might be due to the more degradation of acid in the product during storage. Our results were similar with the findings of Reddy and Chikkasubbanna [10] in amla syrup.

**Ascorbic acid:** Ascorbic acid content of syrup decreased significantly during storage; however, the decrease was lower in refrigerated storage conditions than ambient [Fig-2c]. Decrease in ascorbic acid content might be due to its degradation into dehydro-ascorbic acid or furfural during storage. Less decrease of ascorbic acid in refrigerated storage might be due to the slower rate of its degradation in low temperature as compared to ambient storage conditions. Retention of higher ascorbic acid in the product may be due to the slower rate of reactions in glass bottle as it absorbs heat at slower rate as compared to PET bottle during storage. The findings of the present studies were in agreement with the results reported by Jadhav et al [13] in kokum syrup and Das [14] in jamun syrup.

**Anthocyanins:** There was a significant decrease in anthocyanins content of syrup during storage [Fig-2d] and more retention of anthocyanins was observed under refrigerated storage conditions than ambient conditions. Loss of anthocyanins in syrup might be due to their high susceptibility to auto oxidative degradation during storage. More retention of this characteristic in the product in refrigerated conditions as compared to ambient might be due to slower rate of auto oxidation of anthocyanins in refrigerated conditions. Less decrease of anthocyanins in glass bottle may be due to the slower rate of chemical reactions in glass bottle as a result of difference in their thermal conductance properties during storage. Similar findings were recorded by Kannan and Thirumaran [15] in jamun syrup and Thakur et al[16] in wild pomegranate syrup (with arils).

**Total Phenols:** A significant decrease in total phenols content of syrup was recorded during storage [Fig-2e] and this decrease was lower under refrigerated storage conditions than ambient conditions. The decrease in total phenols content in syrup during storage might be due to their involvement in the formation of polymeric compounds by complexing with protein and their subsequent precipitations as observed by Abers and Wrolstad [17]. These reactions may be slower in refrigerated storage conditions and faster in ambient conditions during storage. As far as packaging material is concerned, more retention of total phenols in syrup packed in glass bottle than PET bottle might be due to the difference in their thermal conductance properties which affect internal decomposition reactions. Similar trend of decrease in phenols content have been reported by Reddy and Chikkasubbanna [10] in amla syrup.



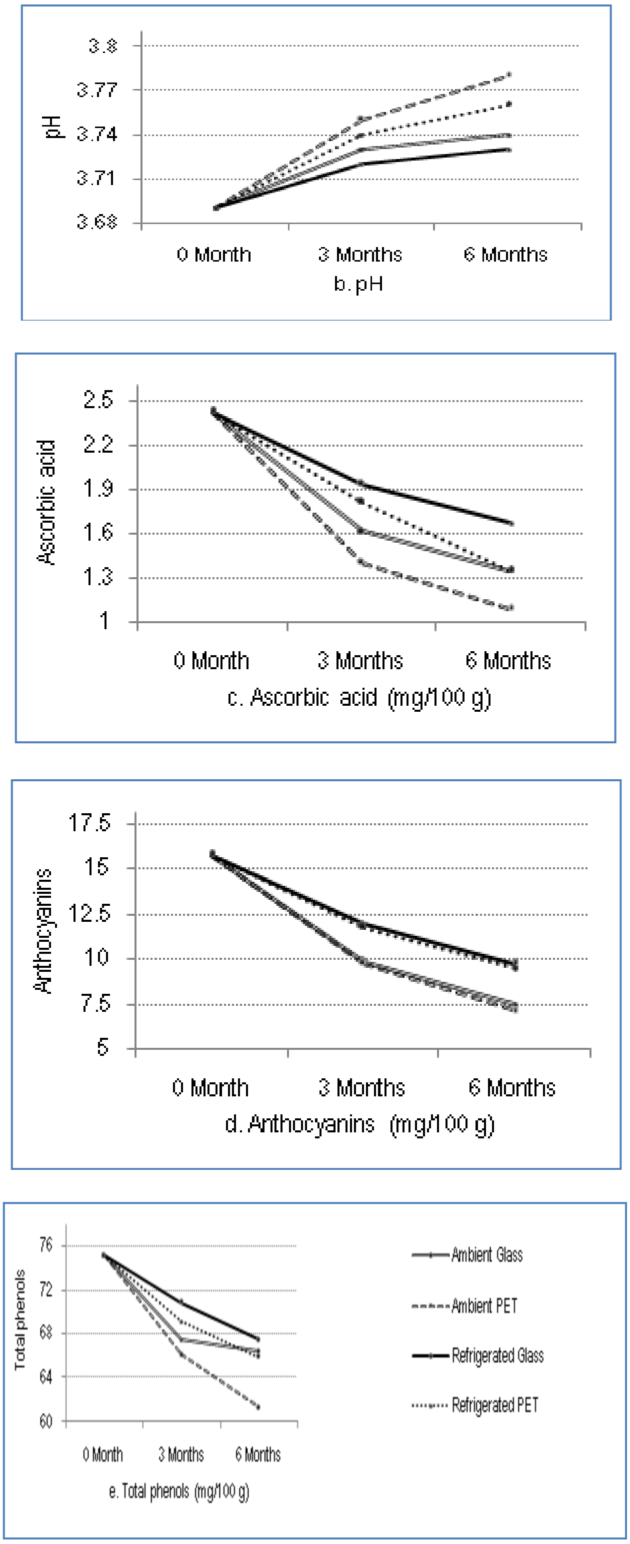




**Fig-2 Effect of storage on physico-chemical characteristics of box myrtle syrup**

**Sensory characteristics of box myrtle syrup during storage:** The colour, body, taste, aroma and overall acceptability scores of syrup decreased significantly during storage [Fig-3-6] and this decrease was more pronounced under ambient storage conditions than refrigerated storage conditions. Retention of higher sensory scores in refrigerated conditions might be due to the better condition of the syrup during storage as a result of slower rate of chemical reactions. Decrease in colour scores during storage might be due to degradation of colour pigment (anthocyanins) and browning caused by copolymerization of organic acids of the product and this might have led the judges to award the lower scores during storage. The possible reason for decrease in body scores might be due to the formation of precipitates in the product as a result of interactions between phenols and protein as well as the formation of cation complexes with phenols during storage. The possible reason for decrease in taste scores might be due to the loss of sugar-acid blend responsible for taste during storage. The decrease in aroma scores during storage might be due to degradation of aromatic compounds in the product. There was a decrease in overall acceptability scores of syrup during storage, which might be due to the loss in appearance, flavour compounds and uniformity of the product. Syrup packed in glass bottles retained more sensory scores than PET bottles. The retention of better overall sensory scores of syrup in glass bottles might be due to the better retention of above given factors as a result of slower reaction rate in glass bottles as compared to PET. The results were in conformity with the finding of Choudhary *et. al.,* [11] in amla syrup, Jadhav *et. al.*, [13] in kokum syrup and Sethi and Maini [18] in phalsa-plum syrup.

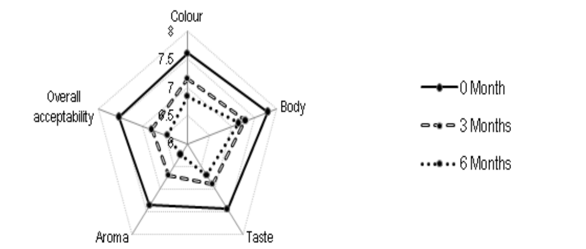



**Fig. 3**-Effect of storage on sensory characteristics of box myrtle syrup packed in PET bottles stored under ambient conditions.

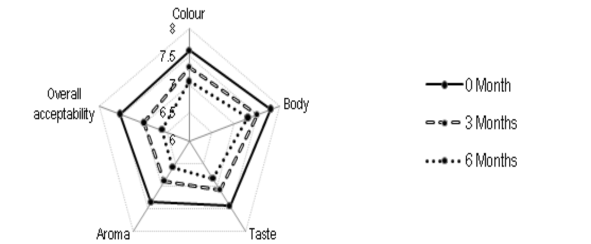



**Fig. 4**-Effect of storage on sensory characteristics of box myrtle syrup packed in glass bottles stored under ambient conditions.

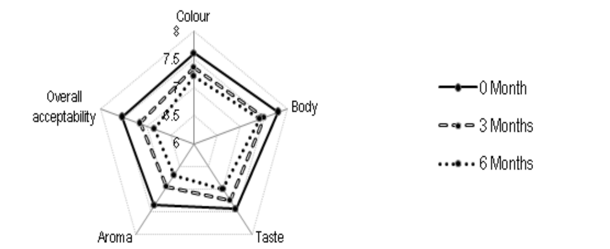



**Fig. 5**-Effect of storage on sensory characteristics of box myrtle syrup packed in PET bottles stored under refrigerated conditions.

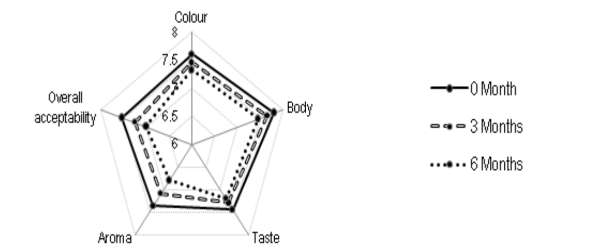



**Fig. 6**-Effect of storage on sensory characteristics of box myrtle syrup packed in glass bottles stored under refrigerated conditions.

## Conclusion

The recipe with 35 per cent juice and 65 $^{o}$B TSS ($T_3$) was the best on the basis of sensory characteristics of the syrup. Syrup could be stored safely for a period of six months under both storage conditions and also in both packaging materials with minimum changes in chemical and sensory attributes. However, comparatively fewer changes in syrup packed in glass bottle and stored under refrigerated storage conditions were observed as compared to PET bottle.

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**Ethical approval:** This article does not contain any studies with human participants or animals performed by any of the authors.

**Conflict of Interest: None declared**

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