

Analysis of shelf life, antioxidant and physico-chemical properties on bayberries under different storage conditions. (*Myrica nagi*)

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Article History

Received: 11.12.2023

Accepted: 01.01.2024

Published: 07.01.2024

Abstract: Bayberries are traditionally called as kaphal and they are paramount salient for consumers, scientists and industrialists to understand how different storage temperatures affects their bioactive compounds and properties also helps in ameliorating storage life (Y. Galani et al, 2017). Bayberries (*myrica nagi*) were harvested from the trees during morning hours in Nainital hills of Uttarakhand and placed them at different temperatures for shelf life analysis under 0, 4 and 8 degree C. The novelty of this work were to find the best storable temperature for bayberries, minimize the losses during distant transportations and keep them wholesome until they reaches to the consumers. Also, Analysis were made on various physico-chemical properties and antioxidant properties such as TSS, titrable acidity, phenolic content, flavonoid, ascorbic acid content for every three days after storage to judge the nutritional content at different temperatures. Studies have showed that lower the storage temperature higher will the storage life. (C. Nunes and J. K., Brecht, 2002). Additionally, found that freezing injury was minimum. The antioxidant properties like total phenolic content and ascorbic acid content showed minimum increased and same with total soluble solids, whereas flavonoids content and titrable acidity of fruits were exhibited significant minimum loss under 0⁰ C followed by 4⁰ and 8⁰ C. Colour and appearance remained good till 17th day in case of 0⁰ C stored fruits, followed by 4⁰ C and it was recorded for 9 days. The best result showed in 0⁰ C that is improved shelf life and remain acceptable up to 24 days was seen.

Keywords: Bayberry, shelf life, TSS, antioxidant properties.

1. INTRODUCTION

Bayberry (*Myrica nagi*) is important hilly fruit crop extensively found in northern parts of India and southern parts of Bhutan Also, some parts of Nepal. It belongs to the family Myricaceae. It has good medicinal properties, phytochemicals such as polyphenols, carotenoids and vitamin C (Steinmetz and Potter et al, 1996). Of these phytochemicals, polyphenols are largely recognized as anti-inflammatory, antiviral, antimicrobial and antioxidant agents (Narayana et al, 2001).

The physiological behaviour of fruits and vegetables are more dependent on postharvest handling temperature. Storage of produce at adequate refrigeration temperatures, will also reduce the microbial growth to those that are psychrotrophic; *L. monocytogenes*, *Y. enterocolitica*, non-proteolytic *Cl. botulinum* and *A. hydrophila* being amongst the most notable. Although psychrotrophic organisms, such as *L. monocytogenes*, are capable of growing in low temperatures, reducing the storage temperature ($\leq 4^{\circ}\text{C}$) will significantly reduce the rate of growth (Beuchat and Brackett, 1990a; Carlin et al., 1995).

The use of optimum temperature during handling and storage of horticulture crops is the key factor that determines the quality and storage life fresh product. Manifold studies report the effect of temperature on quality small fruits (Robins and Moore, 1990).

Bayberries are highly perishable, shelf life of which can be greatly abated by storage temperature above 0⁰ C (Salunkhe and Desai, 1984). Although, storage life of bayberries no longer than 2 or 3 days, when they are stored under ambient conditions $20 \pm 2^{\circ}\text{C}$ (Hardenburg et al., 1986). During storage at different temperatures weight loss, phenolic content, ascorbic acid content, total soluble solids and flavonoids increase while titrable acidity decrease (Y. jiang et al, 2013). Berries were stored up to the stage of acceptability with respect to all temperatures and absorbed that fruits start resembling white colour after certain period of time during storage. Also, observed that minimum decreased in titrable acidity and minimum increased in phenolic content, ascorbic content in case of 0⁰ C.

2. Experimental site

Light pink bayberries were harvested from Nainital hills during morning hours. After they were directly brought to laboratory of food technology within one hour transportation. Experiment was carried out during the year 2018 at DIBER, DRDO, Haldwani, Uttar Pradesh, India.

3. Experimental details

Bayberries with uniform maturity, colour, size and free from damages were selected after washing and drying fruits were placed

in open glass plates to maintain a relative humidity level of about 90 to 100%. Fruits were distributed equally among three temperatures controlled rooms at 0^o, 4^o and 8^o C for 24 day storage period. Each parameter was experimented at every three days intervals. Three replication were used and statistical analysis was done by following complete randomized design. Fruits were weighted from day one and at the end of each storage interval. TSS content of fruit was recorded by using digital refractometer H196801. The titrable acidity, ascorbic acid and flavonoid content were estimated following the method of Rangana, 1977. Phenolic content was estimated by the method described by Thimmaiah, 2004.

4. Results and discussions

4.1. Total soluble solids

Observation during the storage of bayberries revealed that the TSS content of bayberry fruits was increased up to a certain period and there after that was abated in all different temperatures(). Consistent minimum decrease in TSS was seen in 0^o C which was followed by 4^o and 8^o C. The reason behind the rose of TSS is due to hydrolysis of starch into simple monomers. No further increase occurs and subsequently decline is predictable as long with other organic acid is primary substrate for respiration (Wills et al., 1980). Decreased respiration rates also slow down the production and use of metabolites resulting in lower TSS (Yaman and Bayoindrili, 2002). Fruits stored under ambient conditions showed least shelf life of about 2 days. The average value for 0^o C was 20.69^o Brix and for 4^o and 8^o C were 20.61^oBrix and 20. 43^oBrix. Best result was seen in 0^oC.

4.2. Titrable acidity

Results revealed that storing bayberries under low temperature such as 0^o C, 4^o C and 8^o C have significant effect on ameliorating shelf life. The response of declining trend during storage is observed due to citric acid content increases with the maturity and stage of ripening (Mathooko, 2003; Bhowmik et al, 1992).More efficient result was seen 0^o C (Mean, 1.64%) followed by 4^o C (Mean 1.66%) and 8^o C (Mean 1.94%). Reducing titratable acidity is due to the biochemical reactions between sugars and organic acids which get galvanised at higher temperatures (Lakhanpal and Vaidya, 2015). Storing under low temperatures showed a significant minimum loss in TSS and titrable acidity as well antioxidant properties and also, improved storage life of fruits (Fawole, 2013).

4.3. Phenol

Efficient result was seen in low temperature that is 0^o C with mean value of 0.96 mg/100g juice followed by 4^o C with value of 0.85mg/100g and 8^o C with the value of 0.82 mg/100g respectively. The phenolic content showed decreased as the storage

period progressed (H. Chen et al, 2013). The rose in phenol content is related with the enhancement of antioxidant capacity (Reyes and Cisneros-Zevallos, 2003). The less amount of total phenol content or a sharp decline at 24th day of storage is probably due to higher rate of respiration subsequently the low phenol content since degradation of certain phenol compounds (Day, 2001). It also, may be due to senescence and breakdown of cell structure during storage (Ali et al., 2010).

4.4. Ascorbic acid

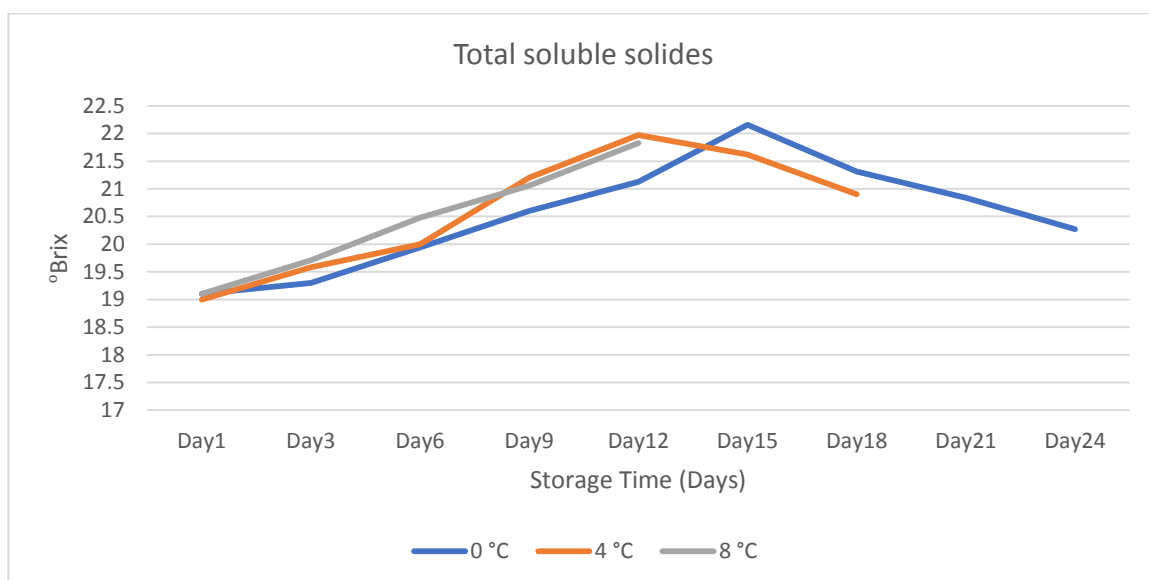
Ascorbic acid content increased of bayberries increased up to 21st days of storage and subsequently declined was seen. But in case of 8^o C steady increase was seen throughout storage period. Results were showed that fruits stored under higher temperature had faster increasing rate of ascorbic content during storage period. The 0^o C (9.83 mg/100ml) temperature showed efficient results when compare to 4^o C (9.39mg/100ml) and 8^o C (9.0 mg/100ml). Ascorbic acid lose at the later stage is because of activities of phenol oxidase and ascorbic acid oxidase enzymes (Salunkeet et al, 1991). The ascorbic acid content increases with maturity and stage of ripening, it will decline once fruit is fully ripen (Mathooko, 2003).

4.5. Flavonoid

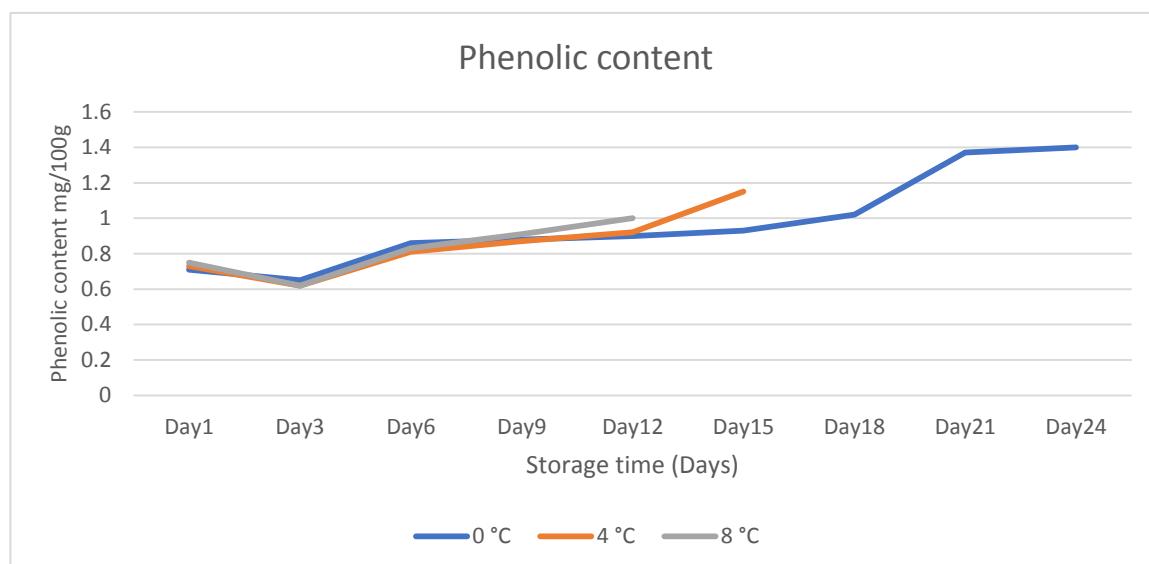
Results revealed that flavonoid content of fruits decreased as storage tenure improved. The best outcome was shown fruits stored under 0^o C (9.75 mg/100ml) which is followed by 4^o C (10.14mg/100ml) and 8^o C (11.68 mg/100ml). Oxidative degradation of flavonoids found to follow first-order reaction kinetics, hence decreasing trend is obtained during the storage (Makris and Rossiter 2000). Flavonoids are polyphenols biosynthesized from the phenylpropanoid pathway and have been reported to be affected by storage temperature (Rapisarda et al., 2008).Fruits when stored under low temperature helps them retain similar or higher level of most the health-promoting compounds by the end of storage tenure while maintaining better quality than the fruits stored under relatively higher temperature or at ambient conditions.

5. Conclusion

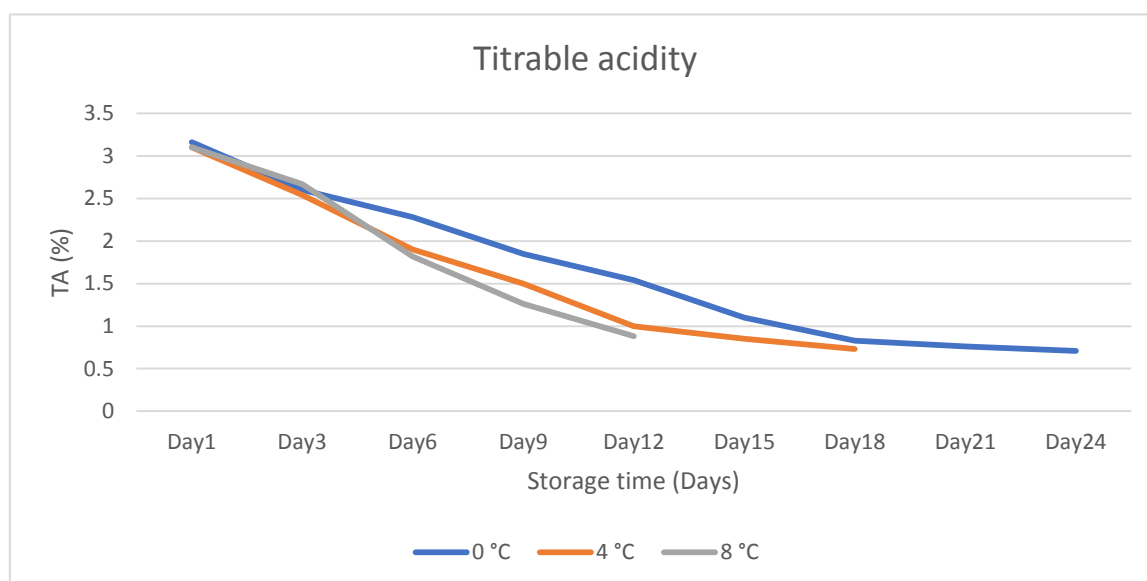
Storing of bayberries (*myrica nagi*) at 0^o C is recommended for maximum storage life. Results on physic-chemical properties and antioxidant properties were more efficient in case of 0^o C. Results also revealed that lower temperatures like 0^o C have higher tendency of maintaining and minimum losses of benefiting compounds such as phenolic content, ascorbic acid content, flavonoids, TSS and titrable acidity than 4^o C and 8^o C. Since bayberries are highly perishable storing under low temperatures especially 0^o C is salient for longer transportation. Under 0^o C fruits remain be acceptable up to 24 days whereas in 4^o C and 8^o C was 18 and 12 days.



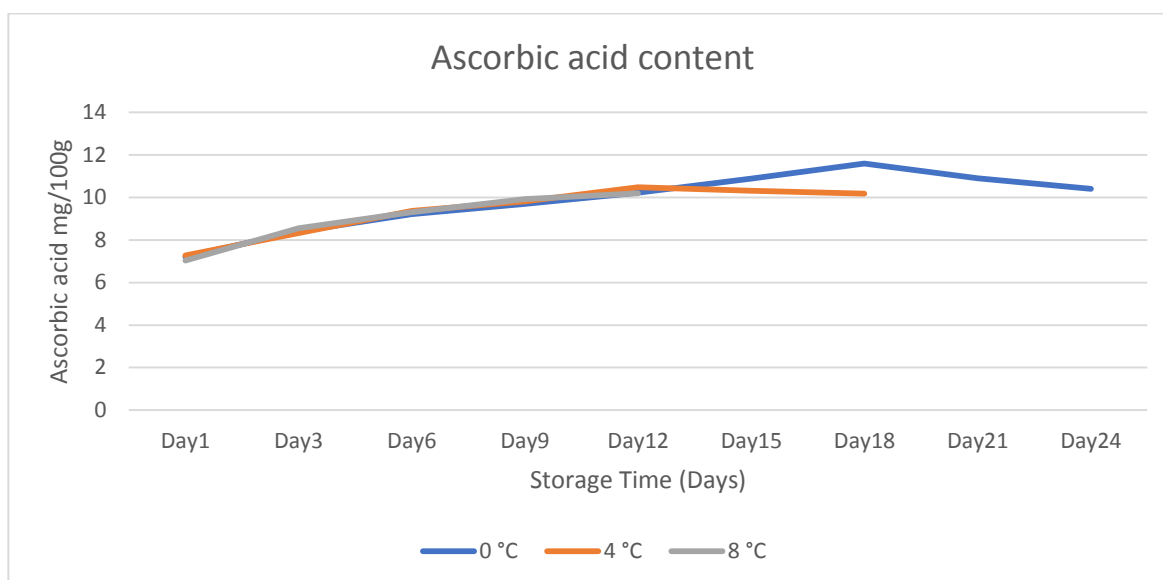
Effect of different temperatures 0° C, 4° C and 8° C on TSS of bayberries (*myrica nagi*) Fig. 1



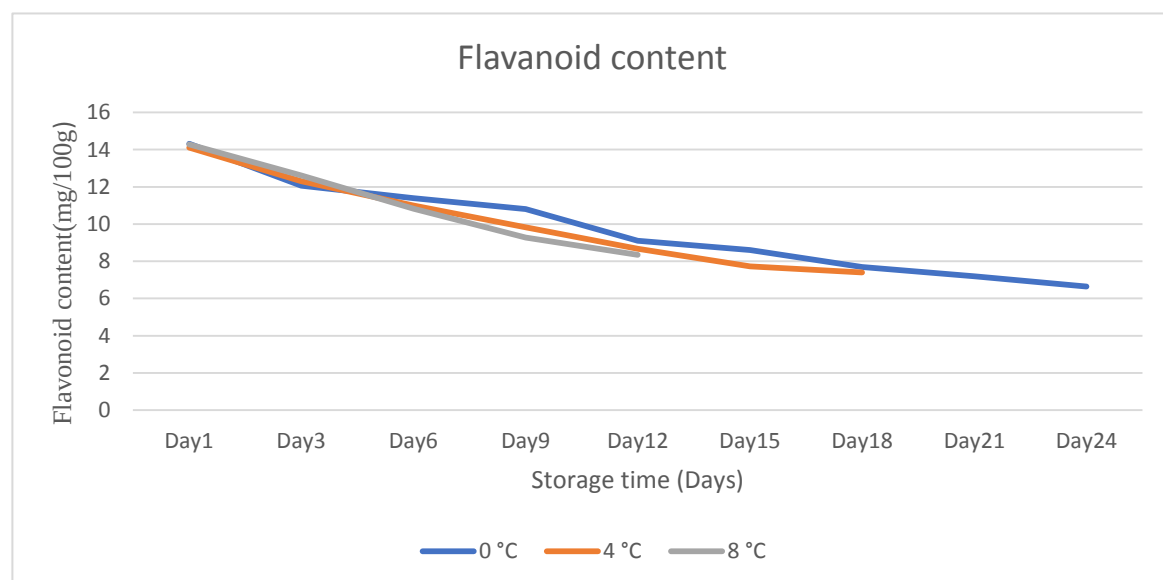
Effect of different temperatures 0° C, 4° C and 8° C on Phenolic content of bayberries (*myrica nagi*) Fig. 2



Effect of different temperatures 0° C, 4° C and 8° C on Titrable acidity of bayberries (*myrica nagi*) Fig. 3



Effect of different temperatures 0⁰ C, 4⁰ C and 8⁰ C on ascorbic acid content of bayberries (*myrica nagi*) Fig. 4



Effect of different temperatures 0⁰ C, 4⁰ C and 8⁰ C on flavanoid content of bayberries (*myrica nagi*) Fig. 5

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