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Harshali M Rathod
 M.Sc. Plantation, Spices,
 Medicinal and Aromatic crops,
 College of Horticulture, Dapoli,
 Dr. B.S.K.K.V., Dapoli,
 Maharashtra, India

Dr. Thorat SB
 Assistant Professor, College of
 Horticulture, Dapoli,
 D.B.S.K.K.V., Dapoli,
 Maharashtra, India

Rutuja S Barawkar
 M.Sc. Plantation, Spices,
 Medicinal and Aromatic crops,
 College of Horticulture, Dapoli,
 Dr. B.S.K.K.V., Dapoli,
 Maharashtra, India

Prajakta B Bhakare
 M.Sc. Plantation, Spices,
 Medicinal and Aromatic crops,
 College of Horticulture, Dapoli,
 Dr. B.S.K.K.V., Dapoli,
 Maharashtra, India

Akshaya A Fargade
 M.Sc. Fruit Science, College of
 Horticulture, Dapoli. Dr.
 B.S.K.K.V., Dapoli,
 Maharashtra, India

Corresponding Author:
Harshali M Rathod
 M.Sc. Plantation, Spices,
 Medicinal and Aromatic crops,
 College of Horticulture, Dapoli,
 Dr. B.S.K.K.V., Dapoli,
 Maharashtra, India

Influenced of different methods of storage on betel leaves (*Piper betle* L.)

Harshali M Rathod, Thorat SB, Rutuja S Barawkar, Prajakta B Bhakare and Akshaya A Fargade

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Abstract

"Pan" or Betelvine (*Piper betle* L.) is a perennial dioecious creeper belonging to family Piperaceae and is probably a native of Malaysia but cultivated in India from time immemorial as cash crop for its leaves, used for chewing. Its deep green heart shaped leaf for (15-20) million Indian and 2 billion foreign consumers annually. The assessment of total sugar, ascorbic acid, total phenol content, moisture content, fresh weight, rotting and shelf life of *Piper betle* (L.) leaves has been attempted in this work. The study found that the leaves of *Piper betle* (L.) have a higher amount of antioxidant activity. Total sugar range vary between 0.44 to 0.74%, Ascorbic acid 0.71 to 3.11 mg/100ml, the minimum rotting 5.33% and highest shelf life 11 days are found in Alum with Bamboo basket covered with cloth. Among all the treatment, Alum and bamboo baskets shows the statistically significant superior result in all biochemical and physical observation.

Keywords: *Piper betle* L., chemicals, storage, biochemical analysis, quality

Introduction

Betel vine is the most important and useful asexually propagated cash crop having various cultivars. It belongs to Piperaceae family and is a shed loving plant. It has a perennial creeper and bears leaves that are 4-7-inch long and 2-4 inch broad. It bears both male and female flowers. It is also found to be one of the most important commercial crops which can attract adequate amount of foreign exchange to the country. The objective of this study to minimizes spoilage loss of betel leaves and maintained their biochemical factor for keeping their quality using different chemicals and storage methods (Guha, 2006) ^[4].

Material and Methodology

The field experiment was conducted during the year 2024-2025 at Dapoli, Dist. Ratnagiri (MS). The treatment combinations comprised with six chemical treatment T₁: Control (with distilled water), T₂: Benzyl Adenine 0.1%, T₃: Sodium Hypochlorite 0.1%, T₄: Ethrel 0.1%, T₅: Thiourea 0.1%, T₆: Alum (g/l) and four storage methods S₁: Bamboo basket covered with cloth, S₂: Polythene Bag, S₃: Gunny Bags, S₄: Glass container with silver foil were conducted with Factorial Completely Randomized Design (FCRD).

Results and Discussion

Effect of chemicals and storage method on biochemical analysis of betel leaves. The data gathered after 7 days of chemical treatments and storage of betel leaves by different methods as a result presented in Tables.

β-Carotene (mg/g)

From the data it can be concluded that, the maximum β-Carotene (0.17 mg/g) was recorded in treatment T₆ while the treatment T₅ showed minimum content of β-Carotene (0.11 mg/g). The significantly maximum β-Carotene (0.14 mg/g) reported in treatment S₁. Whereas, the minimum β-Carotene (0.12 mg/g) reported in treatment S₄. Interaction effect between chemicals and storage on β-carotene content of betel leaves showed significant effect. Among aggregates of treatment combinations, T₆S₁ showed maximum content (0.18 mg/100

gm). Akshata and Vijayalaxmi (2019) ^[1] observed that carotenoids continued to form even in detached green leaves after the chlorophyll disappeared ^[4]. Thus, it appears that the increase in temperature inside the packages is only a secondary effect of respiration and it may not directly be responsible for the deterioration of β -Carotene. On the other

hand, bamboo basket has natural material provides thermal insulation and breathability, maintaining a more stable environment. Thereby increasing the enzymatic activity with passage of time which were reduced with the application of benzyl adenine (Singh *et al.* 1990) ^[8].

Table 1: Effect of chemicals and storage method on β -Carotene (mg/g) of betel leaves

β -Carotene (mg/g)							
Treatment	T ₁	T ₂	T ₃	T ₄	T ₅	T ₆	Mean
S ₁	0.14	0.15	0.14	0.13	0.11	0.18	0.14
S ₂	0.12	0.14	0.12	0.13	0.11	0.17	0.13
S ₃	0.12	0.13	0.12	0.13	0.11	0.16	0.13
S ₄	0.12	0.12	0.12	0.12	0.10	0.15	0.12
Mean	0.13	0.13	0.13	0.13	0.11	0.17	0.13
		S.E.M. $\pm$		C.D. at 1%		RESULT	
T		0.002		0.007		SIG	
S		0.001		0.004		SIG	
T X S		0.003		0.010		SIG	

Sugar Content

From the below data the highest content of total sugar (0.73%) was found in treatment T₆ which is significantly superior to all below treatments, whereas the lowest total sugar content (0.51%) showed in treatment T₅. The significantly maximum total sugar (0.65%) was seen in treatment S₁. Interaction effect between chemicals and storage on total sugar of betel leaves showed significant effect. Among aggregates of treatment combinations, T₆S₁

recorded maximum content (0.74%). Also, minimum total sugar content (0.44%) was observed in treatment combination T₅S₄. It might be due to Alum may restrict enzymatic activity mildly, preserving internal biochemicals balance. Also, alum showed enzymatic degradation that can lead to sugar breakdown. Freshly picked produce often has higher levels of sugar than stored produce, and as storage time increases, the amount of total sugar in produce gradually decreases (Iman MN and Pariari (2012).

Table 2: Effect of chemicals and storage method on sugar content (%) of betel leaves

Sugar content (%)							
Treatment	T ₁	T ₂	T ₃	T ₄	T ₅	T ₆	Mean
S ₁	0.59 (4.40)	0.71 (4.82)	0.65 (4.61)	0.65 (4.64)	0.56 (4.30)	0.74 (4.92)	0.65 (4.62)
S ₂	0.57 (4.32)	0.68 (4.72)	0.64 (4.59)	0.64 (4.57)	0.56 (4.30)	0.73 (4.90)	0.64 (4.57)
S ₃	0.56 (4.28)	0.65 (4.61)	0.64 (4.59)	0.61 (4.46)	0.48 (3.98)	0.72 (4.85)	0.61 (4.47)
S ₄	0.53 (4.16)	0.64 (4.58)	0.61 (4.46)	0.59 (4.41)	0.44 (3.81)	0.71 (4.82)	0.59 (4.39)
Mean	0.56 (4.29)	0.67 (4.68)	0.63 (4.56)	0.62 (4.52)	0.51 (4.10)	0.73 (4.87)	0.62 (4.51)
		S.E.M. $\pm$		C.D. at 1%		RESULT	
T		0.003		0.01		SIG	
S		0.002		0.01		SIG	
T X S		0.005		0.02		SIG	

3.1.3 TSS (°Brix)

From the data it can be concluded that, treatment T₅ showed minimum TSS (0.48°Brix) which is significantly superior and the maximum TSS (1.13°Brix) showed in treatment T₆ (Alum). The significantly the maximum TSS (0.99°Brix) was found in treatment S₁. Whereas, lowest TSS (0.55°Brix)

was observed in treatment S₄. Interaction effect between chemicals and storage on TSS of betel leaves showed significant effect. Among aggregates of treatment combinations, T₆ S₁ showed maximum content of TSS (1.33°Brix). Whereas the minimum TSS (0.37°Brix) of betel leaves was recorded in treatment combination T₅S₄.

Table 3: Effect of chemicals and storage method on TSS (°Brix) of betel leaves

TSS (°Brix)							
Treatment	T ₁	T ₂	T ₃	T ₄	T ₅	T ₆	Mean
S ₁	1.03	1.13	1.07	0.83	0.57	1.33	0.99
S ₂	0.93	0.87	1.03	0.57	0.50	1.13	0.84
S ₃	0.80	0.63	0.53	0.47	0.50	1.07	0.67
S ₄	0.50	0.53	0.40	0.40	0.37	1.00	0.55
Mean	0.82	0.79	0.76	0.59	0.48	1.13	0.76
		S.E. m. $\pm$		C.D. at 1%		Result	
T		0.04		0.14		SIG	
S		0.02		0.07		SIG	

T X S	0.05	0.19	SIG
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3.1.4 Essential oil%

From the data it can be concluded that, treatment T₆ showed highest percentage of essential oil (0.44%). However, in betle leaves the lowest percentage of essential oil (0.40%) showed in treatment T₅. The significantly maximum percentage of shelf life (0.43%) was observed in treatment S₁. Whereas, minimum percentage of shelf life (0.41%) showed in treatment S₄. Interaction between chemicals and storage on essential oil of betel leaves showed significant

effect. T₆S₁ showed maximum content (0.46%) whereas minimum percentage of oil (0.40%) reflects in treatment combination T₅S₄.

Alum has astringent and antimicrobial property which reduces enzymatic activity and microbial spoilage that can degrade essential oil compounds. Also, stabilizes cell membranes where they prevent rupture of oil glands and loss of volatile compounds (Bidisha Mondal 2022) [2].

Table 4: Effect of chemicals and storage methods on essential oil (%) of betel leaves

Essential oil%							
Treatment	T ₁	T ₂	T ₃	T ₄	T ₅	T ₆	Mean
S ₁	0.42 (3.73)	0.44 (3.80)	0.42 (3.71)	0.42 (3.71)	0.41 (3.67)	0.46 (3.87)	0.43 (3.75)
S ₂	0.41 (3.68)	0.44 (3.80)	0.41 (3.67)	0.41 (3.67)	0.40 (3.62)	0.45 (3.84)	0.42 (3.71)
S ₃	0.41 (3.68)	0.43 (3.77)	0.41 (3.67)	0.41 (3.67)	0.40 (3.62)	0.45 (3.84)	0.42 (3.71)
S ₄	0.41 (3.68)	0.42 (3.70)	0.41 (3.67)	0.41 (3.67)	0.40 (3.64)	0.41 (3.67)	0.41 (3.67)
Mean	0.42 (3.69)	0.43 (3.77)	0.41 (3.68)	0.41 (3.68)	0.40 (3.64)	0.44 (3.81)	0.42 (3.71)
		S.E.M. ±		C.D. at 1%		Result	
T		0.001		0.005		SIG	
S		0.000		0.003		SIG	
T X S		0.001		0.007		SIG	

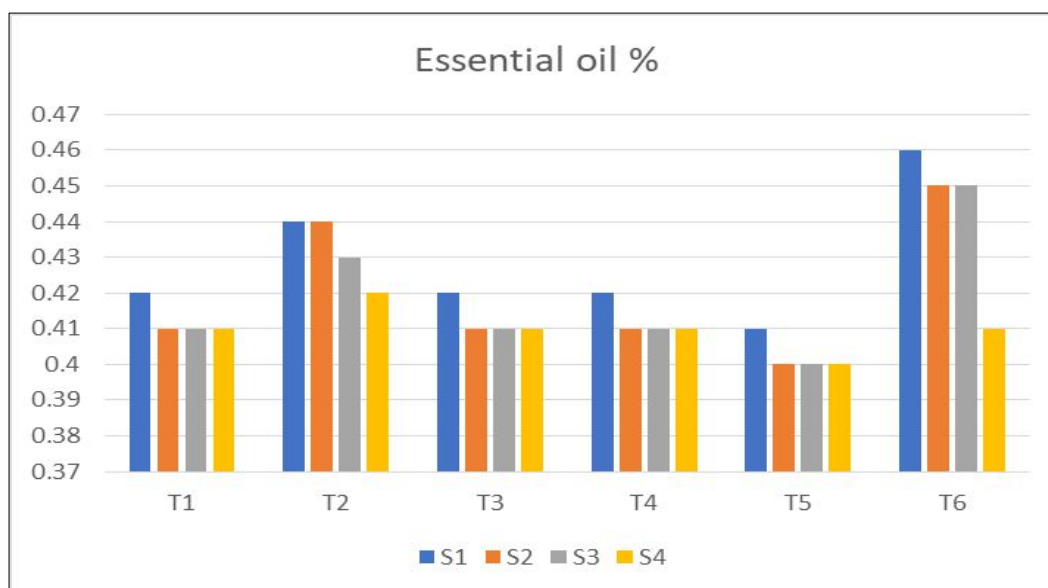


Fig 1: Effect of chemicals and storage on essential oil% of betel leaves

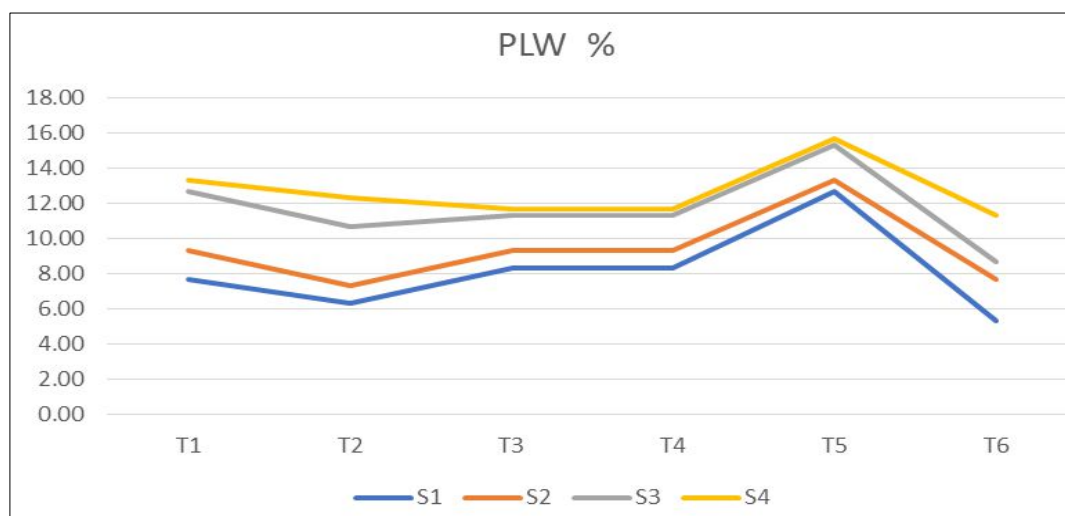
Physiological Loss in Weight (%)

Treatment T₆ recorded significantly lower percentage of PLW (8.25%). The higher PLW percentage (14.25%) was recorded with treatment T₅. The different storage method also showed a significant effect on PLW. The highest PLW (12.67%) was recorded with treatment S₄. The highest PLW (15.67%) was recorded with treatment combination T₅S₄ whereas lowest PLW percentage (5.33%) was recorded with treatment combination T₆S₁ having a comparable value reported in T₂S₁ which was significantly superior to all over combination.

The physiological loss in weight of betel leaves was found increased when stored for 15 days at room temperature. The reason might be due to their lack of respiration and presence of vents has failed to decrease oxygen concentration and increase carbon dioxide concentration, thus leading to higher amount of Periodical loss in weight. Mathur *et al.* (1956) [7] also found that, this is mainly attributed to the continuous moisture and other nutrient loss as leaves are actively involved in the physiological processes like respiration and transpiration and these processes is influenced by temperature.

Table 5: Effect of chemicals and storage method on Physiological Loss in Weight (%) of leaves

Physiological Loss in Weight (%)							
Treatment	T ₁	T ₂	T ₃	T ₄	T ₅	T ₆	Mean
S ₁	7.67 (16.07)	6.33 (14.57)	8.33 (16.77)	8.33 (16.77)	12.67 (20.84)	5.33 (13.35)	8.11 (16.54)
S ₂	9.33 (17.78)	7.33 (15.71)	9.33 (17.78)	9.33 (17.78)	13.33 (21.41)	7.67 (16.07)	9.39 (17.84)
S ₃	12.67 (20.84)	10.67 (19.06)	11.33 (19.67)	11.33 (19.67)	15.33 (23.05)	8.67 (17.12)	11.67 (19.97)
S ₄	13.33 (21.41)	12.33 (20.56)	11.67 (19.97)	11.67 (19.97)	15.67 (23.31)	11.33 (19.67)	12.67 (20.84)
Mean	10.75 (19.13)	9.17 (17.62)	10.17 (18.59)	10.17 (18.59)	14.25 (22.17)	8.25 (16.69)	10.46 (18.84)
		S.E.M. ±		C.D. at 1%		Result	
T		0.24		0.92		SIG	
S		0.13		0.49		SIG	
T X S		0.33		1.30		SIG	

**Fig 2:** Effect of chemicals and storage on physiological loss in weight% of betel leaves**Rotting (%)**

The data revealed that among the chemical treatment T₆ was found significantly superior to all the treatment whereas minimum percentage of rotten leaves (7.42%) were observed in treatment T₆ whereas highest rotten leaves (16.42%) was recorded in treatment T₅. The lowest percentage of rotten leaves (7.72%) was observed in treatment S₁ while the highest percentage of rotten leaves (12.94%) was observed in treatment S₄. Interaction effect between chemicals and storage on rotting of betel leaves showed significant effect. Gather of treatment combinations, T₅S₄ showed maximum rotting of leaves (21.33%) Whereas, the lowest percentage (5.33%) of rotten leaves reported in treatment combination T₆S₁.

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It reduces cell permeability and delays microbial colonization, especially under ambient conditions. Glass container had the maximum humidity and no temperature fluctuations, which limit respiration rate and as a result, reduce vegetable decay toward the end of storage life. It may be because of the lack of respiration and the rise in CO₂ levels in the glass container and the lowest decay rate among the storage conditions. (Garande *et al.* 2019) [3].

Conclusion

The effect of chemical treatment, storage, and their combined effect on leaves treated with alum and stored bamboo basket covered with cloth can be considered as the best treatment. However, based on differences in overall acceptance like Total sugar, Ascorbic acid, Phenol content, Moisture, Fresh Weight, rotting of leaves values scored lower as well as the shelf life of betel leaves treated with alum was higher (12 Days) compared to other treatments, leaves were treated with Thiourea was lower (6 Days).

Reference

1. Vernekar A, Vijayalaxmi. Nutritional composition of fresh and dehydrated betel leaves. *Pharma Innov J.* 2019;8(4):602-605.
2. Mondal B. Extraction of betel leaf essential oil for the sustainable solution to betel business in West Bengal

- for effective economic gain: A review. *Mysore J Agric Sci.* 2022;56(2):1-13.
3. Garande VK, Raut PD, Dhumal SS, Sonawane PN, Sarvade SA. Studies on storage behavior of primary processed leafy vegetables under different storage conditions. *Int J Curr Microbiol Appl Sci.* 2019;8(6):2249-2272. Available from: <https://doi.org/10.20546/ijcmas.2019.806.268>
 4. Hency Thacker and Vijay Ram. Theoretical evaluation of corrosion inhibitor potential of phytoconstituents of male and female *Phoenix dactylifera* L. extracts. *Int. J. Adv. Chem. Res.* 2024;6(1):58-62.
 5. Guha P. Development of technology for enhancing shelf life of betel leaves (*Piper betle* L.). In: Annual report of all India coordinated research project on post-harvest technology (ICAR). Kharagpur: Food and Agricultural Engineering Department, IIT Kharagpur; 2004, p. 39-56.
 6. Iman MN, Pariari A. Keeping quality of betel leaves (*Piper betle* L.) as influenced by different methods and seasons. *J Spices Aromat Crops.* 2012;21(2):106-12. Available from: <https://www.indianspicesociety.in/josac/index.php/josac>
 7. Mathur PB, Iyengar NVR, Srinivasa NVR, Date WB. Studies in packaging and cold storage of betel leaves. *Bull C.F.T.R.I. Mysore.* 1956;5:307-310.
 8. Singh KK, Balasubrahmanyam VR, Kochhar VK. Effect of different packing methods, temperature conditions, treatment with chemicals on the senescence and storage behaviour of betel (*Piper betle* L.) leaves. *J Plants Crops.* 1990;18(1):23-28.
 9. Guha P. Betel leaf: The neglected green gold of India. *J Hum Ecol.* 2006;19(2):87-93.