ISSN Print: 2664-844X
ISSN Online: 2664-8458
NAAS Rating (2025): 4.97
IJAFS 2025; 7(8): 313-316
www.agriculturaljournals.com
Received: 18-06-2025
Accepted: 22-07-2025

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

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DOI: https://www.doi.org/10.33545/2664844X.2025.v7.i8e.628

Abstract
The Betel (*Piper betle* L.) is a leaf of a vine belonging to the Piperaceae family, which includes Pepper and Kava, is a shade loving perennial root climber. It is valued as a mild stimulant and for its medicinal properties. It has an immense medicinal, social, religious and export value. The study found that the leaves of *Piper betle* (L.) have a higher amount of antioxidant activity**.** Ascorbic acid range vary between 0.71 to 3.11 mg/100ml, total phenolic content ranged from 94.98 to 95.18 mg/100g equivalent to gallic acid, 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 betel* 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 is originated from Malaysia but is distributed extensively in South and Southwest China (Das *et al.* 2016) [2]. This crop is usually cultivated in India, Sri Lanka, Malaysia, Thailand, Taiwan, and other South east Asian countries. The betle leaves are exported to the countries of the world like Bahrain, Canada, Great Britain, Nepal, Pakistan, and Saudi Arabia, UK, USA, Bangladesh, Malaysia, Singapore, Sri Lanka (Guha, 2004) [4].

Materials 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 T_1: Control (with distilled water), T_2: Benzyl Adenine 0.1%, T_3: Sodium Hypoclorite 0.1%, T_4: Ethrel 0.1%, T_5: Thiourea 0.1%, T_6: Alum (g/l) and four storage methods S_1: Bamboo basket covered with cloth, S_2: Polythene Bag, S_3: Gunny Bags, S_4: 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.

Ascorbic acid (mg/100ml)
The data revealed that the effect of chemical on stored betel leaves the highest content of ascorbic acid (2.69 mg/100ml) found in treatment T_6 which is significantly superior to rest of the treatments in the experiment. Whereas the minimum ascorbic acid (1.45 mg/100ml) observed in T_6. The significantly highest ascorbic acid (2.37 mg/100ml) was seen in treatment S_1 on the other hand lowest ascorbic acid (1.69 mg/100ml) reported in treatment S_4. Among aggregates of treatment combinations, T_6S_1 showed maximum content (3.11 mg/100ml). It might be due to alum has properties to inhibits microbial activity that can degrade ascorbic acid, it decreases the rate of enzymatic browning and oxidation which they are indirectly preserving vitamin C. (Guha, 2006) [3].

Table 1: Effect of chemicals and storage method on ascorbic acid (mg/100ml) of betel leaves

Ascorbic acid (mg/100ml)							
Treatment	**T_1**	**T_2**	**T_3**	**T_4**	**T_5**	**T_6**	**Mean**
S_1	2.52	2.72	1.99	2.11	1.82	3.11	2.37
S_2	2.46	2.66	1.94	1.94	1.63	2.89	2.25
S_3	2.11	2.43	1.73	1.58	1.30	2.46	1.94
S_4	1.94	2.22	1.44	1.56	0.71	2.29	1.69
Mean	2.26	2.51	1.50	1.80	1.45	2.69	2.06
		S.E.M. ±		C.D. at 1%		Result	
T		0.04		0.16		SIG	
S		0.02		0.09		SIG	
T X S		0.06		0.23		SIG	

Table 2: Effect of chemicals and storage method on ascorbic acid (mg/100ml) of betel leaves

Ascorbic acid (mg/100ml)							
Treatment	**T_1**	**T_2**	**T_3**	**T_4**	**T_5**	**T_6**	**Mean**
S_1	2.52	2.72	1.99	2.11	1.82	3.11	2.37
S_2	2.46	2.66	1.94	1.94	1.63	2.89	2.25
S_3	2.11	2.43	1.73	1.58	1.30	2.46	1.94
S_4	1.94	2.22	1.44	1.56	0.71	2.29	1.69
Mean	2.26	2.51	1.50	1.80	1.45	2.69	2.06
		S.E.M. ±		C.D. at 1%		Result	
T		0.04		0.16		SIG	
S		0.02		0.09		SIG	
T X S		0.06		0.23		SIG	

3.1.3 Phenol content (mg GAE/g)

From the data it concluded that, treatment T_6 showed maximum content of phenol content (95.80 mg GAE/g), the minimum phenolic content (81.73 mg GAE/g) showed in treatment T_5. Interaction effect between chemicals and storage on phenolic content of betel leaves showed significant effect. T_6S_1 showed maximum content (98.28 mg GAE/g) of phenolic content which was significantly superior to all treatments in the experiment. It is because of bamboo basket prevents anaerobic conditions and microbial build up that can oxidize phenols. Also, less bruising means less oxidative stress and slower phenol breakdown. Better retention of phenol content over 7-8 days compared to other packaging material (Chattopadhyay *et al*., 1984) [1].

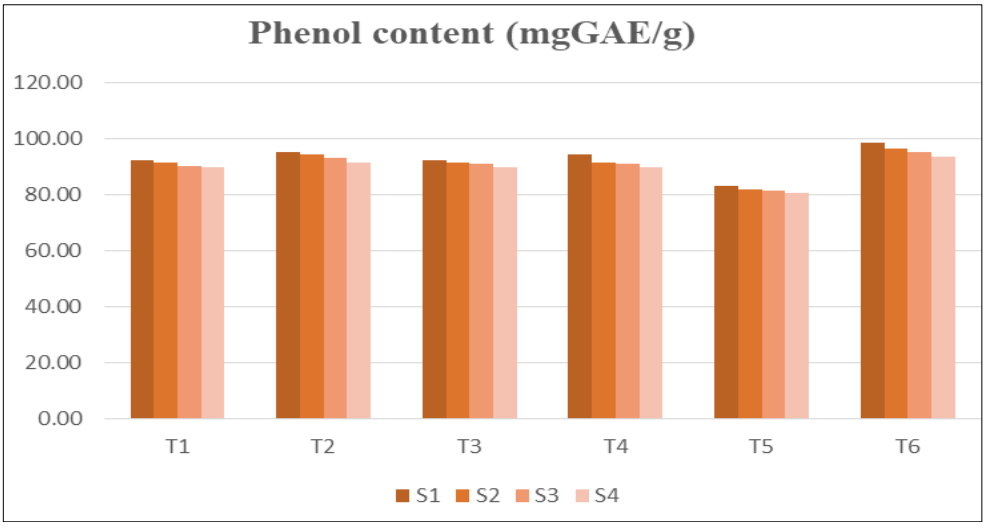

Fig 1: Effect of chemicals and storage on phenol content of betel leaves

Table 3: Effect of chemicals and storage method on phenol content (mg GAE/g) of betel leaves

Phenolic content (mg GAE/g)							
Treatment	**T_1**	**T_2**	**T_3**	**T_4**	**T_5**	**T_6**	**Mean**
S_1	92.16	95.23	92.25	94.47	82.95	98.28	92.56
S_2	91.23	94.37	91.53	91.53	81.98	96.27	91.46
S_3	90.00	92.93	90.77	90.77	81.39	95.23	90.28
S_4	90.73	91.23	89.50	89.50	80.61	93.43	88.98
Mean	90.73	93.44	91.01	92.20	81.73	95.80	90.82
		S.E.M. ±		C.D. at 1%		Result	
T		0.14		0.55		SIG	
S		0.08		0.29		SIG	
T X S		0.20		0.78		SIG	

3.1.6 Rotting (%)

The data revealed that among the chemical treatment T_6 was found significantly superior to all the treatment whereas minimum percentage of rotten leaves (7.42%) were was observed in treatment T_6 (Alum) whereas highest rotten leaves (16.42%) was recorded in treatment T_5. Interaction effect between chemicals and storage on rotting of betel leaves showed significant effect. Treatment combinations, T_5S_4 showed maximum rotting of leaves (21.33%).

Table 6: Effect of chemicals and storage method on Rotting (%) of betel leaves

Rotting (%)							
Treatment	**T_1**	**T_2**	**T_3**	**T_4**	**T_5**	**T_6**	**Mean**
S_1	7.67 (16.07)	5.67 (13.77)	7.67 (16.07)	7.33 (15.71)	12.67 (20.84)	5.33 (13.35)	7.72 (16.13)
S_2	8.00 (16.42)	7.00 (15.34)	8.67 (17.12)	8.67 (17.12)	15.33 (23.05)	6.67 (14.96)	9.06 (17.51)
S_3	9.00 (17.45)	8.67 (17.12)	11.00 (19.36)	11.33 (19.67)	16.33 (23.83)	7.33 (15.71)	10.61 (19.01)
S_4	11.33 (18.75)	11.33 (18.75)	12.33 (20.56)	13.00 (21.13)	21.33 (27.50)	10.33 (18.75)	12.94 (21.08)
Mean	8.75 (17.20)	7.92 (16.34)	9.92 (18.35)	10.08 (18.51)	16.42 (23.90)	7.42 (15.80)	10.08 (18.51)
		S.E.M. ±		C.D. at 1%		Result	
T		0.28		1.08		SIG	
S		0.15		0.58		SIG	
T X S		0.39		1.53		SIG	

3.1.7 Shelf life (days)

The data revealed that among the chemical treatment T_6 was found significantly superior to all the highest shelf life of betel leaves. Betel leaves had higher shelf life of 10.25 days was recorded in treatment T_6 while in treatment T_5 lowest shelf life was observed in 6.75 day. According to the figures, the effect of packaging material showed considerably longer shelf life. It is evident from the data (Table 14) interaction effect between chemicals and storage on shelf life of betel leaves showed significant effect. The combination of aggregates treatment, T_6 S_1 showed maximum content (11.67 days). The chlorophyll content decreased gradually up to 12th day and then showed a steep fall.

When betel leaves stored in bamboo baskets, the leaves got benefit from a naturally ventilated, temperature-moderating, and cushioned environment that reduces heat build-up, moisture imbalance, and mechanical damage. Its antimicrobial and astringent properties further enhance the preservation by inhibiting microbial spoilage and reducing cell permeability and water loss. This increased the leaves shelf life (Singh *et al*., 1990) [5].

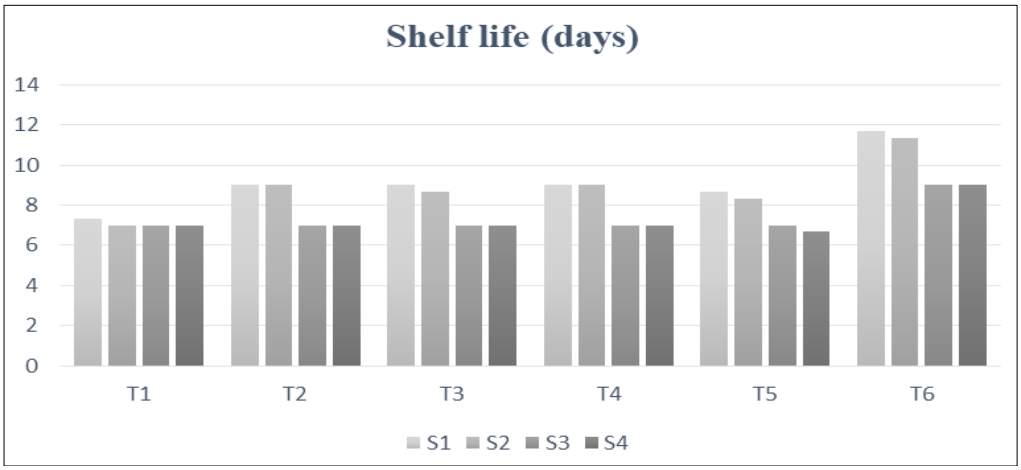

Fig 2: Effect of chemicals and storage on shelf life (Days) of betel leaves

Table 7: Effect of chemicals and storage method on shelf life (days) of betel leaves

Shelf life							
Treatment	**T_1**	**T_2**	**T_3**	**T_4**	**T_5**	**T_6**	**Mean**
S_1	7.33	9.00	9.00	9.00	8.67	11.67	9.00
S_2	7.00	9.00	8.67	9.00	8.33	11.33	8.94
S_3	7.00	7.00	7.00	7.00	7.00	9.00	7.33
S_4	7.00	7.00	7.00	7.00	6.67	9.00	7.33
Mean	7.00	8.00	7.92	8.00	7.75	10.25	8.15
		S.E.M. ±		C.D. at 1%		Result	
T		0.15		0.59		SIG	
S		0.08		0.32		SIG	
T X S		0.22		0.84		SIG	

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 Ascorbic acid, Phenol content, 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).

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