



## LETTUCE: A GREEN SUPERFOOD FOR ENHANCED HEALTH AND WELLNESS

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### Review Paper

Received: 30.10.2025

Revised: 15.11.2025

Accepted: 27.11.2025

### ABSTRACT

**Aims:** This study aimed to determine the efficacy of different levels of Fermented Plant Juice (FPJ) on the storage life, sensory, vitamin C and postharvest quality of romaine lettuce (*Lactuca sativa*). By enhancing the quality of lettuce, this can promote the consumption of lettuce with added benefits for healthier food. This makes great foods available with enhanced qualities.

**Study design:** The study was laid out in Completely Block Design (CRD) with seven treatments replicated three times. Each plant was composed of 10 samples per replication.

**Place of Duration:** To evaluate the influence of postharvest application of fermented plant juice on storage life and postharvest quality of romaine lettuce, laboratory experiments were conducted at the postharvest laboratory at CJFI, Davao City.

**Methodology:** Concentrations of Fermented Plant Juice (FPJ) were sprayed on the lettuce roots overnight, and were cut the next morning. The experiment was laid out in a Complete Randomized Design (CRD) with three replications in seven treatments: T1 sprayed - 50 ml FPJ with 950ml of water, T2 sprayed - 60ml FPJ with 940ml of water, T3 sprayed - 70ml FPJ with 930ml of water, T4 sprayed - 80ml FPJ with 920ml of water, T5 sprayed - 90ml FPJ with 910ml of water, T6 sprayed pure water, T7 sprayed 6 tablets of ascorbic + 1 liter of water. It was packed individually in polyethylene bags (14 x18 inches) and placed in boxes with 10 samples per treatment replicated three times. It was stored in a cool room with 16 C and 95% RH and observed for quality parameters daily. Data on storage life, sensory, vitamin C and postharvest quality were analyzed using ANOVA and HSD tests.

**Results:** Based on the results of the study, the spraying of different levels of fermented plant juice (FPJ) and ascorbic acid into the lettuce during a 10-day storage period has no significant effect on the wilting incidence, leaf discoloration, and chilling injury of lettuce. However, application of different levels of fermented plant juice (FPJ) and ascorbic acid significantly affected the weight loss and the visual quality of lettuce during the storage period. Statistical results implied that using 9% FPJ enhanced the visual quality, as well as hinder excessive weight loss during storage. The lettuce sprayed with FPJ and ascorbic acid exhibits more vitamin C content and better sensory acceptability.

**Conclusion:** The use of fermented plant juice (FPJ) as postharvest application has enhanced the postharvest quality, sensory qualities, Vitamin C as well as delayed weight loss during storage as much as 10 days under cool room with 16C and 95% RH.

No. of Pages: 6

References: 08

**Keywords:** Fermented Plant Juice (FPJ), Postharvest, Storage Life, Visual Quality, Romaine Lettuce (*Lactuca sativa* Linn.), Vitamin C.

**Rationale:**

Lettuce (*Lactuca sativa* Linn.) is a widely consumed leafy vegetable known for its high nutritional value, including vitamins A, C, and K, as well as folate and dietary fiber. Despite its health benefits and popularity, lettuce remains a highly perishable commodity. Its postharvest quality rapidly deteriorates due to physiological and microbial factors, leading to flavor loss, discoloration, decay, softening, shrinkage, and significant vitamin depletion (Jideani, 2017). These quality issues not only reduce consumer appeal but also contribute to food waste and economic losses in the supply chain. Therefore, innovative and sustainable approaches to prolong shelf-life and maintain quality are essential.

One promising strategy involves the use of Fermented Plant Juice (FPJ), a type of organic input derived from the fermentation of plant materials rich in nutrients and beneficial microorganisms. FPJ has gained attention for its dual role in crop nutrition and protection, offering a natural alternative to synthetic fertilizers and pesticides. Various plant sources have been explored for FPJ production, including Madre de cacao (*Gliricidia sepium*), Moringa oleifera, Psidium guajava (guava), and *Leucaena leucocephala* (ipil-ipil). Studies have demonstrated the efficacy of FPJ from these plants in enhancing soil fertility, promoting plant growth, and suppressing pathogens (Liamngee *et al.*, 2020; Singh *et al.*, 1999; Banate *et al.*, 2020).

Moringa oleifera, in particular, is recognized for its high antioxidant content and bioactive compounds, which can contribute to improved plant resilience and nutritional quality. Similarly, Madre de cacao and ipil-ipil are known for their nitrogen-fixing properties and antimicrobial effects, making them suitable candidates for FPJ formulations. The integration of FPJ into lettuce cultivation presents a sustainable approach to improving crop quality while reducing reliance on chemical inputs.

The potential use of FPJ in enhancing the postharvest quality of lettuce is especially relevant in the context of promoting healthier food systems. By improving flavor retention, texture, and nutrient content, FPJ-treated lettuce may offer consumers a more appealing and nutritious product. Moreover, the natural origin of FPJ aligns with the growing demand for organic and eco-friendly agricultural practices. This approach not only supports environmental sustainability but also contributes to food security by extending the usability of fresh produce.

Hence, the application of FPJ derived from nutrient-rich plants holds significant promise in improving the quality and shelf-life of lettuce. Further research and field validation are needed to optimize formulations and assess long-term benefits. Nonetheless, FPJ represents a valuable tool in advancing sustainable agriculture and enhancing the nutritional value of fresh vegetables.

**Objective:**

This study aimed to determine the efficacy of different levels of Fermented Plant Juice (FPJ) on the storage life, sensory, vitamin C and postharvest quality of romaine lettuce (*Lactuca sativa* L.).

**Methodology:**

Concentrations of Fermented Plant Juice (FPJ) were sprayed on the lettuce roots overnight for 12 hours, and were cut the next morning. The experiment was laid out in a Completely Randomized Design (CRD) with seven treatments: T1 sprayed - 50 ml FPJ with 950ml of water, T2 sprayed - 60ml FPJ with 940ml of water, T3 sprayed - 70ml FPJ with 930ml of water, T4 sprayed - 80ml FPJ with 920ml of water, T5 sprayed - 90ml FPJ with 910ml of water, T6 sprayed pure water, T7 sprayed 6 tablets of ascorbic + one liter of water. It was packed individually in polyethylene bags (14 x 18 inches) and placed in boxes with 10 samples per treatment replicated three times. It was stored in a cold room with 16C and 95% RH and observed for quality parameters daily for 10 days. Data on storage life, sensory, vitamin C and postharvest quality were analyzed using ANOVA and HSD tests.



**Fig. 1: Preparation of the Fermented Plant Juice. FPJ juice was extracted from a ratio of 1:1 Moringa, Gliricidia and Leucaena to molasses mixture fermented for two weeks.**



**Fig. 2: Treatment application.** Five FPJ rates (5%, 6%, 7%, 8%, 9%) were sprayed on the roots of freshly harvested lettuce from AMCG farm, Toril, Davao City and cut after 12 hours for storage.



**Fig. 5: Data Gathering.** The postharvest quality traits such as wilting incidence, leaf discoloration, chilling injury, weight loss and visual quality of lettuce were taken daily for 10 days.



**Fig. 3: Storage of lettuce.** Lettuce were packed and stored at 16C & 95% RH for 10 days at post-harvest Laboratory of CJFI, Indangan, Davao City.



**Fig. 6: Vitamin C Titration.** The titration was performed using iodine solution in buret. The final amount of titrant used on the standard vit. C and lettuce samples were titrated to blue black color end point to calculate the vitamin C content of lettuce.



**Fig. 4. Sensory evaluation.** After 24 hours from FPJ spray the lettuce leaf salad was served for sensory tests using nine hedonic rating scale. There were ten random panelists, both male and female aged 16-50 years old who are expert in lettuce tasting.

#### Results:

Based on the results of the study, the application of varying concentrations of Fermented Plant Juice (FPJ) and ascorbic acid during a 10-day storage period of lettuce (*Lactuca sativa* Linn.) revealed insightful findings regarding postharvest quality preservation. While the treatments did not significantly influence certain physiological parameters such as wilting incidence, leaf discoloration, and chilling injury, they did have a notable impact on other critical quality indicators specifically weight loss and visual quality (Figures 7-8).

Lettuce is a highly perishable leafy vegetable, and its postharvest deterioration is often rapid due to

moisture loss, enzymatic activity, and microbial growth. Among the parameters evaluated, weight loss is a key indicator of freshness and marketability. Excessive weight loss during storage is typically associated with dehydration and tissue breakdown, which can compromise both texture and nutritional value. In this study, the application of FPJ and ascorbic acid significantly mitigated weight loss, with the 9% FPJ treatment emerging as the most effective. Lettuce treated with 9% FPJ retained more moisture and exhibited less shrinkage, suggesting that FPJ may help maintain cellular integrity and reduce transpiration rates during storage.

Visual quality, another essential attribute for consumer acceptance, was also positively influenced by FPJ application. Lettuce treated with FPJ, particularly at the 9% concentration, maintained a more vibrant green coloration and crisp texture compared to untreated samples. This enhancement in visual appeal is crucial, as consumers often rely on appearance as a primary indicator of freshness and quality. The presence of bioactive compounds and antioxidants in FPJ especially those derived from plants like *Moringa oleifera*, *Gliricidia sepium*, and *Psidium guajava* may contribute to delayed senescence and reduced oxidative stress in stored lettuce.

Moreover, the combination of FPJ and ascorbic acid appeared to have synergistic effects on the nutritional profile of the lettuce. Ascorbic acid, commonly known as vitamin C, is a potent antioxidant that plays a vital role in maintaining cellular health and delaying spoilage. Lettuce samples treated with FPJ and ascorbic acid showed higher vitamin C content, which not only enhances the nutritional value of the produce but also contributes to better resistance against oxidative degradation. This is particularly important for health-conscious consumers seeking fresh produce with retained micronutrient levels.

In addition to objective quality parameters, sensory acceptability was also evaluated. Sensory analysis revealed that lettuce treated with FPJ and ascorbic acid was more favorably received in terms of taste, texture, and overall acceptability. The treated samples were described as fresher, crisper, and more flavorful, indicating that the treatments did not negatively affect palatability in fact, they may have enhanced it. This finding supports the potential of FPJ as a natural postharvest treatment that not only preserves but also improves the sensory attributes of lettuce.

The implications of these findings are significant for both producers and consumers. For growers and distributors, the use of FPJ and ascorbic acid offers a cost-effective and environmentally friendly method to extend the shelf-life of lettuce without relying on synthetic preservatives. For consumers, it means access to fresher, more nutritious, and more appealing produce. Furthermore, the use of FPJ aligns with sustainable agricultural practices, promoting the utilization of locally available plant materials and reducing chemical input in postharvest handling.

Several studies have explored the effects of fermented plant juice (FPJ) and ascorbic acid on the postharvest quality of lettuce. Mambuay *et al.* (2024) demonstrated that FPJ derived from *Moringa oleifera* and *Leucaena leucocephala* significantly improved lettuce growth and yield, suggesting its potential as a foliar supplement. Similarly, Uy *et al.* (2021) found that natural farming inputs, including FPJ, enhanced the nutritional quality and biomass of hydroponically grown lettuce. While these studies focused on growth parameters, postharvest effects were also examined. Esparza-Rivera *et al.* (2006) reported that ascorbic acid treatments, particularly via immersion, increased total ascorbate content and helped maintain water retention in lettuce during cold storage. Moreover, Putnik-Delić *et al.* (2014) emphasized that storage conditions significantly affect vitamin C retention in lettuce, with cooler environments preserving more nutrients. These findings align with the current study's results, where 9% FPJ and ascorbic acid improved visual quality and reduced weight loss, while enhancing vitamin C content and sensory acceptability. Collectively, these studies support the use of FPJ and ascorbic acid as sustainable postharvest treatments to maintain lettuce quality and nutritional value during storage.

In conclusion, while FPJ and ascorbic acid did not significantly affect all physiological parameters during lettuce storage, their impact on weight loss, visual quality, vitamin C content, and sensory acceptability underscores their potential as effective postharvest treatments. The 9% FPJ concentration, in particular, demonstrated superior performance, suggesting that it may be an optimal formulation for maintaining lettuce quality during storage. Future research may explore the mechanisms behind FPJ's efficacy, its interaction with other natural compounds, and its application across different vegetable crops to further validate its role in sustainable postharvest management.



Fig. 7: Efficacy of different levels of Fermented Plant Juice (FPJ) after 24 hours on the storage life, sensory, vitamin C and postharvest quality of romaine lettuce (*Lactuca sativa L.*).



Fig. 8: Efficacy of different levels of Fermented Plant Juice (FPJ) after 10 days on the storage life, sensory, vitamin C and postharvest quality of romaine lettuce (*Lactuca sativa L.*).

#### Recommendation:

The use of fermented plant juice (FPJ) as postharvest application has enhanced the postharvest quality, sensory qualities, Vitamin C as well as delayed weight loss during storage as much as 10 days under cold room with 16C and 95% RH.

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