



RESEARCH ARTICLE

Evaluation of mycelium foam packaging for quality preservation of *Jasminum sambac* (L.) Aiton during long-distance transport

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Abstract

The floriculture industry faces increasing pressure to adopt sustainable packaging solutions while maintaining product quality during long-distance transportation. This study evaluated 4 packaging materials-expanded polystyrene (EPS), mycelium foam, coir-lined carton and aluminium foil-lined carton-for preserving *Jasminum sambac* (L.) Aiton flowers under ice gel conditions (4-6 °C) over 48 hr. Visual, physiological and biochemical parameters were assessed using a completely randomized design (CRD) with 5 replications. Mycelium foam packaging demonstrated consistently higher performance across all quality metrics: highest freshness retention (71.54 % at 48 hr vs. 63.43 % for EPS), colour preservation (77.82 % vs. 68.71 %), extended shelf life (4.12 vs. 3.83 days) and superior moisture retention (49.91 % vs. 40.43 %). Physiological parameters confirmed mycelium superiority with minimum physiological loss in weight (3.59 % vs. 4.65 % for EPS). Biochemical analysis revealed maximum total carbohydrate retention (63.50 mg/g vs. 58.54 mg/g in EPS) and phenolic content (39.94 mg/g vs. 28.26 mg/g in EPS) at 48 hr, indicating suppressed respiration and enhanced antioxidant capacity. The porous hygroscopic structure of mycelium foam provided optimal humidity regulation and thermal buffering (0.04 W/m·K) while offering complete biodegradability within 30-45 days. This study demonstrates that mycelium foam can serve as an effective bio-based alternative to conventional EPS packaging for jasmine flower export, simultaneously enhancing post-harvest quality and environmental sustainability.

Keywords: biodegradable packaging; floriculture; jasmine export; mycelium foam; sustainable packaging

Introduction

Jasminum sambac (L.) Aiton, commonly known as Arabian jasmine, is a floriculture crop of immense cultural and economic significance, particularly in India where it plays an integral role in religious ceremonies, garland manufacturing, perfumery industries and essential oil extraction (1). India's jasmine cultivation occupies approximately 27000 ha, yielding 272000 MT annually, with Tamil Nadu leading national production at 172000 MT from 17000 ha (2). The global jasmine trade, valued at approximately USD 500 million annually, depends critically on maintaining flower quality during long-distance transportation (3).

Despite its commercial importance, jasmine cultivation and marketing face significant post-harvest challenges that threaten long-term sustainability and profitability. The inherently perishable nature of jasmine flowers results in rapid quality deterioration, with shelf-life ranging from 2.7 days under conventional storage to 4.16

days with advanced packaging technologies (such as chitosan-based biodegradable films and optimised cold chain systems) (4). The broader horticultural sector experiences post-harvest losses of 20-30 % due to inadequate handling practices, highlighting substantial post-harvest risk for perishable ornamental crops (3). Traditional packaging systems predominantly rely on non-biodegradable materials, particularly expanded polystyrene (EPS), which contribute to environmental degradation while failing to provide optimal preservation conditions (5).

The environmental crisis associated with conventional plastics has become increasingly severe, with European markets alone producing 25 million tonnes of plastic waste annually while achieving only 30 % recycling rates (6). Nearly 99 % of conventional plastics originate from non-renewable petrochemical sources, contributing to persistent pollution, greenhouse gas emissions and resource depletion throughout extended product lifecycles (7). Increasingly stringent regulatory frameworks now restrict single-

use plastic applications across international markets, while consumer purchasing preferences demonstrate clear shifts toward environmentally responsible products (8). These converging pressures-regulatory mandates, consumer demand and corporate sustainability imperatives-create urgent imperatives for the floriculture sector to transition toward biodegradable packaging alternatives.

Jasminum sambac presents particularly complex post-harvest challenges, as its delicate white flowers and intense fragrance are accompanied by exceptionally demanding preservation requirements. The flowers exhibit extraordinarily rapid senescence processes characterised by immediate moisture loss, accelerated enzymatic browning and deterioration of essential oil content that directly impacts market value (9). Conventional storage methods demonstrate severe limitations, restricting shelf life to approximately 24–48 hr under ambient storage conditions without cold chain support, while international export markets routinely require 48–72 hr transportation periods with stringent quality maintenance standards throughout the cold chain (10).

Recent advances in biodegradable packaging materials have opened new possibilities for sustainable floriculture. Mycelium-based bio composites, manufactured through controlled fungal cultivation on agricultural waste substrates, achieve thermal conductivity values of 0.038–0.05 W/m·K, approaching EPS performance benchmarks while offering complete biodegradability and carbon sequestration benefits (11). Coir pith-based materials utilize abundant coconut processing waste to create naturally structured packaging with inherent cushioning properties and humidity regulation capabilities (12). Aluminium foil-lined carton systems represent transitional approaches combining renewable cellulose-based substrates with metallic barrier properties for enhanced thermal performance (13).

Research on jasmine post-harvest management has demonstrated potential for significant improvements through technological interventions. Chitosan-glycerol based biodegradable packaging extended *J. sambac* shelf life to 4.16 days compared to 2.7 days in untreated controls (4). Export-oriented packaging systems combining boric acid treatment with aluminium-foil lined containers and gel-ice achieved 42.88 hr shelf life with improved freshness and colour retention (14). However, the development of biodegradable packaging specifically optimised for the Ramanathapuram Gundumalli variety for long-distance market transportation remains an urgent priority.

This study evaluated the efficacy of three eco-friendly packaging materials-mycelium foam, coir-lined carton and aluminium foil-lined carton-as sustainable alternatives to conventional expanded polystyrene (EPS) packaging for jasmine string flowers under gel-ice cold conditions, assessing their performance across visual, physiological and biochemical parameters to establish viable solutions for the international flower export industry.

Materials and Methods

Plant material and experimental location

The experiment was conducted at the Department of Floriculture and Landscape Architecture, Horticultural College and Research Institute, Tamil Nadu Agricultural University, Coimbatore

(11°00'57.3" N, 76°55'52.3" E, 457 m above mean sea level) during June 2025. Fresh *J. sambac* cv. Ramanathapuram Gundumalli flowers were harvested during morning hr (05:00–06:00 hr) from field-grown plants following optimised microbial inoculant treatments (*Methylobacterium radiotolerans* JSM15 + potassium-solubilising bacteria). Only uniform, unopened flowers with consistent bud size were selected, with flowers exhibiting physical damage, pest infestation, or over-maturity rigorously excluded. Each experimental unit contained 100 g of freshly harvested jasmine string flowers.

Experimental design and treatments

The experiment employed a completely randomized design (CRD) with 4 packaging treatments and 5 replications, with 2 experimental units per replication (total $n=40$ packages). The treatments comprised: T_1 - Expanded polystyrene (EPS) packaging (control); T_2 - Mycelium foam packaging; T_3 - Coir pith-lined carton packaging; T_4 - Aluminium foil-lined carton packaging. All packaging materials maintained standardised dimensions (20 cm × 15 cm × 8 cm) to ensure comparable conditions.

Packaging material specifications

EPS packaging (T_1): Conventional expanded polystyrene with 2.5 cm thickness, density 0.02 g/cm³, thermal conductivity 0.033 W/m·K, sourced from commercial packaging supplier, Coimbatore.

Mycelium foam (T_2): Bio-fabricated mycelium foam derived from agricultural waste substrates (*Pleurotus ostreatus* cultivated on rice straw), 2.5cm thickness, density 0.15g/cm³, thermal conductivity 0.04W/m·K, laboratory-grown following the protocol of Sivaprasad et al. (15). Briefly, rice straw substrate was sterilised by autoclaving (121°C, 30min), then inoculated with *P. ostreatus* oyster mushroom spawn under sterile laminar-flow conditions and packed into acrylic moulds (20cm × 15cm × 8cm) sealed with perforated cling wrap. Moulds were incubated at 28 °C and 70–80 % relative humidity for 7–10 days until complete mycelial colonisation was confirmed visually. Growth was arrested by oven-drying at 80–100 °C for 2–3hr. Finished panels were demoulded, inspected for structural integrity and trimmed to final packaging dimensions (Fig. 1 and Plate 1A–C).

Coir-lined carton (T_3): Processed coir pith with natural binding agents, 1.5 cm thickness, density 0.18 g/cm³, thermal conductivity 0.05 W/m·K, sourced from Coconut Development Board, Tamil Nadu.

Aluminium foil-lined carton (T_4): Corrugated cardboard (3 mm, 3-ply) with aluminium foil inner lining (0.01 mm thickness), sourced from packaging materials supplier, Coimbatore.

Pre-treatment and packaging protocol

Fresh jasmine flower buds were sorted for uniformity, with damaged or over-mature buds removed. Pre-cooling was performed by soaking flower buds for 10–15 min in cold water (4–6 °C) containing 4 % boric acid a concentration established as optimal for jasmine post-harvest quality preservation by Jawaharlal et al. (14). The flower buds were strung with gentle handling to avoid mechanical injury. Exactly 100 g of pre-cooled jasmine strings were weighed using digital balance (± 0.01 g accuracy) and packed in small boxes (14 × 7 × 4 cm dimension) lined with food-grade butter paper. Flower boxes were placed in respective packaging materials with gel-ice packs (ThermaFreeze™, New Jersey, USA) layered between flower boxes, with aluminium foil and butter paper preventing direct gel-ice contact. Gel-ice to product ratio was maintained at 1:2 (w/w). Each

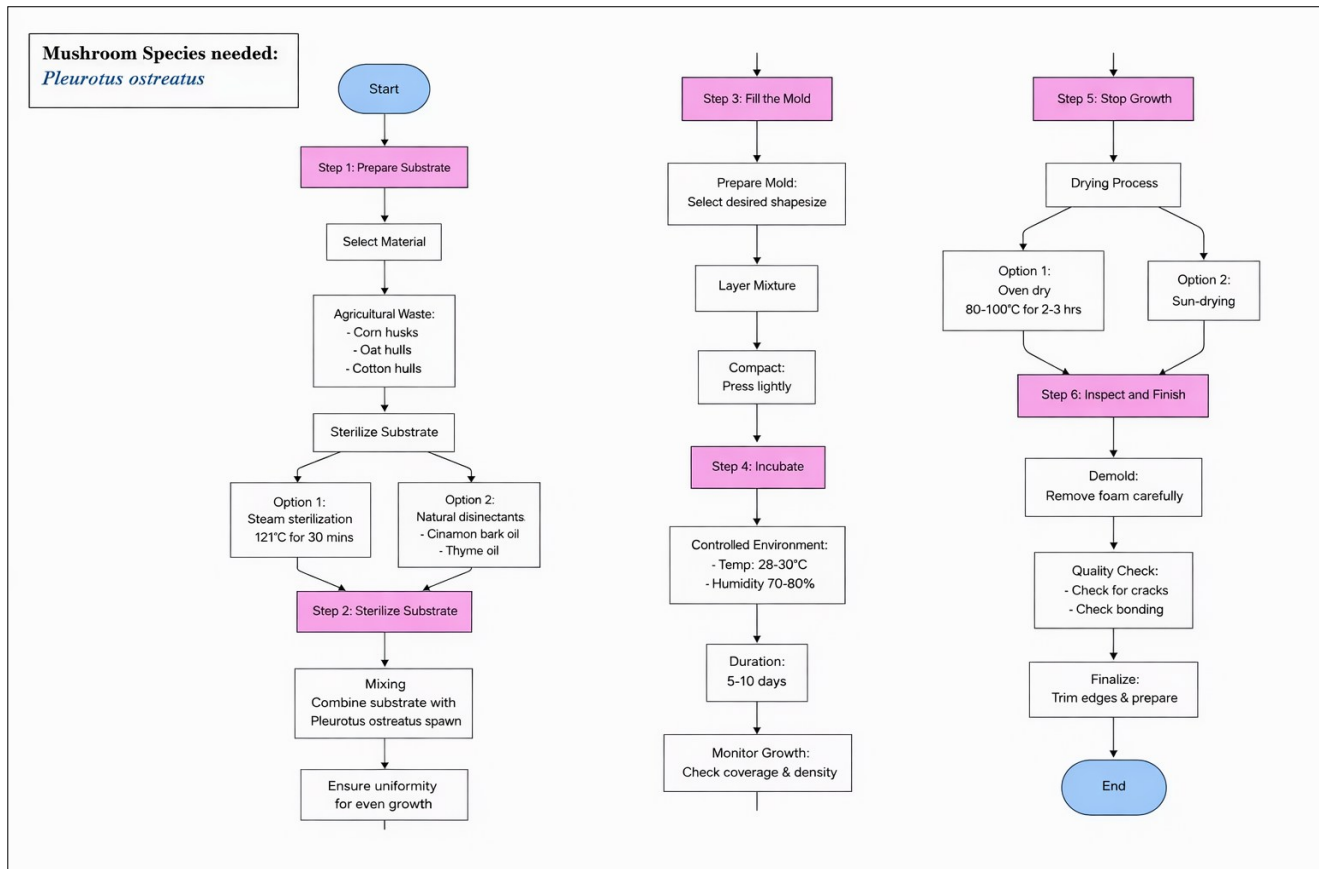


Fig. 1. Step-by-step fabrication workflow for mycelium foam packaging.

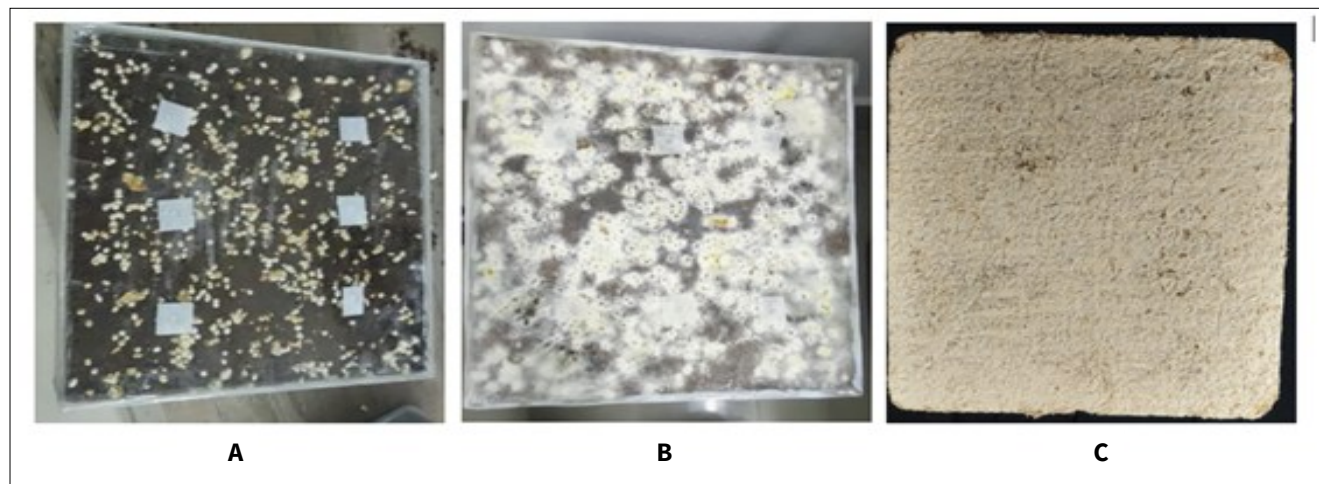


Plate 1. Mycelium foam panel development stages: (A) Initial substrate inoculation; (B) Mycelial colonisation at day 7; (C) Final demoulded mycelium foam panel.

package was sealed using food-grade adhesive tape and stored under ambient conditions (temperature 28–32 °C, relative humidity 60–70 %) for 48 hr to simulate long-distance export conditions.

Visual parameter assessment

Freshness index (FI): Flowers were scored based on turgidity, petal necrosis, wilting and browning using a 7-point scale (7 = all buds turgid, 1 = fully wilted). FI was calculated as: $FI = [(7 \times X_1) + (6 \times X_2) + (5 \times X_3) + (4 \times X_4) + (3 \times X_5) + (2 \times X_6) + (1 \times X_7)] / [(X_1 + X_2 + X_3 + X_4 + X_5 + X_6 + X_7) \times 7] \times 100$, where X_1 – X_7 represent flower counts in each score category (16).

Colour retention index (CRI): Flower colour development scored using 9-point scale (9 = bright white, 1 = completely brown). $CRI = [(9 \times X_1) + (8 \times X_2) + \dots + (1 \times X_9)] / [(X_1 + X_2 + \dots + X_9) \times 9] \times 100$ (16).

Shelf life: Number of days until 50 % freshness retention threshold

(16).

Physiological parameter measurements

Moisture content: Fresh and dry weights (70 °C oven-drying) were recorded. Moisture content (%) = $[(\text{Fresh weight} - \text{Dry weight}) / \text{Fresh weight}] \times 100$ (17).

Physiological loss in weight (PLW): $PLW (\%) = [(\text{Fresh weight Day 1} - \text{Weight Day 2}) / \text{Fresh weight Day 1}] \times 100$.

Biochemical parameter estimation

Total carbohydrates: Estimated using anthrone method (18). Approximately 100mg fresh weight of petal tissue per sample was hydrolysed with HCl, neutralised with sodium carbonate and colour development by anthrone reagent measured at 630 nm, expressed as mg glucose/g sample.

Total phenol content: Phenols extracted using 80 % ethanol, evaporated and blue colour development by Folin-Ciocalteu reagent measured at 690 nm (the optimal absorbance wavelength for the Folin-Ciocalteu blue chromophore, which shows peak response in the 650–750nm range, per Malick and Singh (19)), expressed as mg pyrocatechol equivalent/g sample.

Statistical analysis

Data were subjected to analysis of variance (ANOVA) following a CRD with AGRES statistical software (Pascal Rousset, CIRAD, France) (20). Treatment means were compared using Duncan's multiple range test (DMRT) at $p \leq 0.05$ significance level. Results are presented as means $\pm$ SE based on 5 replications.

Results

Visual quality

Mycelium foam packaging (T_2) maintained the highest freshness index at 48 hr (71.54 %), exceeding EPS control (63.43 %) by 12.8 %. Colour retention was superior in mycelium packaging (77.82 %) compared to EPS (68.71 %), representing a 13.3 % improvement. Shelf life extended to 4.12 days with mycelium foam versus 3.83 days for EPS-a 7.6 % increase. Coir-lined and aluminium foil-lined cartons showed substantially poorer performance (Table 1).

Physiological parameter

Mycelium foam maintained the highest moisture content at both 24 and 48 hr, with a progressive decline observed across all treatments. At 48 hr, mycelium foam recorded 49.91 % compared

to EPS (40.43 %), coir-lined (29.85 %) and aluminium foil-lined cartons (26.24 %). Physiological weight loss was minimised in mycelium packaging (3.59 %) versus EPS (4.65 %), representing a 22.8 % reduction (Table 2).

Biochemical parameters

Total carbohydrate content declined progressively in all treatments from 24 to 48 hr. Mycelium foam (T_2) showed the slowest rate of decline, retaining 8.5 % more carbohydrate than EPS at 48 hr. The T_3 and T_4 exhibited substantially greater losses (Table 3).

Total phenolic content followed a similar declining pattern. Mycelium foam (T_2) retained 41.3 % more phenolics than EPS at 48 hr, while T_3 and T_4 showed the steepest declines, indicating greater oxidative stress under those packaging conditions (Table 3) (Fig. 2 and 3).

Discussion

Mycelium foam superiority

The exceptional performance of mycelium foam packaging stems from its distinctive porous hygroscopic architecture that enables optimal humidity regulation while maintaining gas exchange. The fungal mycelium network creates interconnected micro-pores (15–50 μ m diameter) that facilitate controlled water vapour diffusion, preventing desiccation while avoiding condensation-induced microbial proliferation (21). This directly accounts for the 23.5 % higher moisture retention and 22.8 % lower physiological weight loss compared to EPS at 48 hr.

Table 1. Visual quality parameters of *Jasminum sambac* flowers at 48 hr storage

Treatment	Freshness index (%)		Colour retention index (%)		Shelf life (days)
	24 hr	48 hr	24 hr	48 hr	
T_1 (EPS control)	81.72 $\pm$ 1.23 ^b	63.43 $\pm$ 1.45 ^b	79.42 $\pm$ 1.56 ^b	68.71 $\pm$ 1.78 ^b	3.83 $\pm$ 0.12 ^b
T_2 (Mycelium foam)	84.55 $\pm$ 1.12 ^a	71.54 $\pm$ 1.34 ^a	88.90 $\pm$ 1.34 ^a	77.82 $\pm$ 1.45 ^a	4.12 $\pm$ 0.09 ^a
T_3 (Coir-lined carton)	74.68 $\pm$ 1.45 ^c	58.15 $\pm$ 1.67 ^c	67.23 $\pm$ 1.89 ^c	47.65 $\pm$ 2.01 ^c	2.48 $\pm$ 0.15 ^c
T_4 (Aluminium foil carton)	71.67 $\pm$ 1.56 ^d	52.51 $\pm$ 1.89 ^d	62.95 $\pm$ 2.12 ^d	40.73 $\pm$ 2.34 ^d	2.17 $\pm$ 0.18 ^d
Mean	78.16	61.41	74.63	58.73	3.15
CD ($p \leq 0.05$)	2.87	3.12	3.45	3.67	0.28

Values represent mean $\pm$ SE (n=5). Different superscript letters indicate significant differences at $p \leq 0.05$.

Table 2. Physiological parameters of *Jasminum sambac* flowers at 48 hr storage

Treatment	Moisture content (%)		Physiological loss in weight (%)	
	24 hr	48 hr	24 hr	48 hr
T_1 (EPS control)	52.65 $\pm$ 1.23 ^b	40.43 $\pm$ 1.56 ^b	2.17 $\pm$ 0.12 ^b	4.65 $\pm$ 0.23 ^b
T_2 (Mycelium foam)	57.01 $\pm$ 1.12 ^a	49.91 $\pm$ 1.34 ^a	1.93 $\pm$ 0.09 ^d	3.59 $\pm$ 0.19 ^d
T_3 (Coir-lined carton)	51.23 $\pm$ 1.45 ^c	29.85 $\pm$ 1.78 ^c	2.64 $\pm$ 0.15 ^c	5.96 $\pm$ 0.28 ^c
T_4 (Aluminium foil carton)	48.62 $\pm$ 1.67 ^d	26.24 $\pm$ 2.01 ^d	2.85 $\pm$ 0.18 ^a	6.53 $\pm$ 0.32 ^a
Mean	52.38	36.61	2.40	5.18
CD ($p \leq 0.05$)	2.56	3.12	0.28	0.45

Values represent mean $\pm$ SE (n=5). Different superscript letters indicate significant differences at $p \leq 0.05$.

Table 3. Biochemical parameters of *Jasminum sambac* flowers during storage

Treatment	Total carbohydrates (mg/g)		Total phenols (mg/g)	
	24 hr	48 hr	24 hr	48 hr
T_1 (EPS control)	66.75 $\pm$ 1.45 ^b	58.54 $\pm$ 1.67 ^b	41.61 $\pm$ 1.23 ^b	28.26 $\pm$ 1.45 ^b
T_2 (Mycelium foam)	72.31 $\pm$ 1.23 ^a	63.50 $\pm$ 1.45 ^a	44.22 $\pm$ 1.12 ^a	39.94 $\pm$ 1.34 ^a
T_3 (Coir-lined carton)	64.92 $\pm$ 1.67 ^c	44.13 $\pm$ 2.01 ^c	40.77 $\pm$ 1.45 ^c	26.10 $\pm$ 1.67 ^c
T_4 (Aluminium foil carton)	64.23 $\pm$ 1.89 ^c	33.36 $\pm$ 2.34 ^d	40.35 $\pm$ 1.67 ^c	25.75 $\pm$ 1.89 ^c
Mean	67.05	49.88	41.74	30.01
CD ($p \leq 0.05$)	2.89	3.45	2.67	2.98

Values represent mean $\pm$ SE (n=5). Different superscript letters indicate significant differences at $p \leq 0.05$.

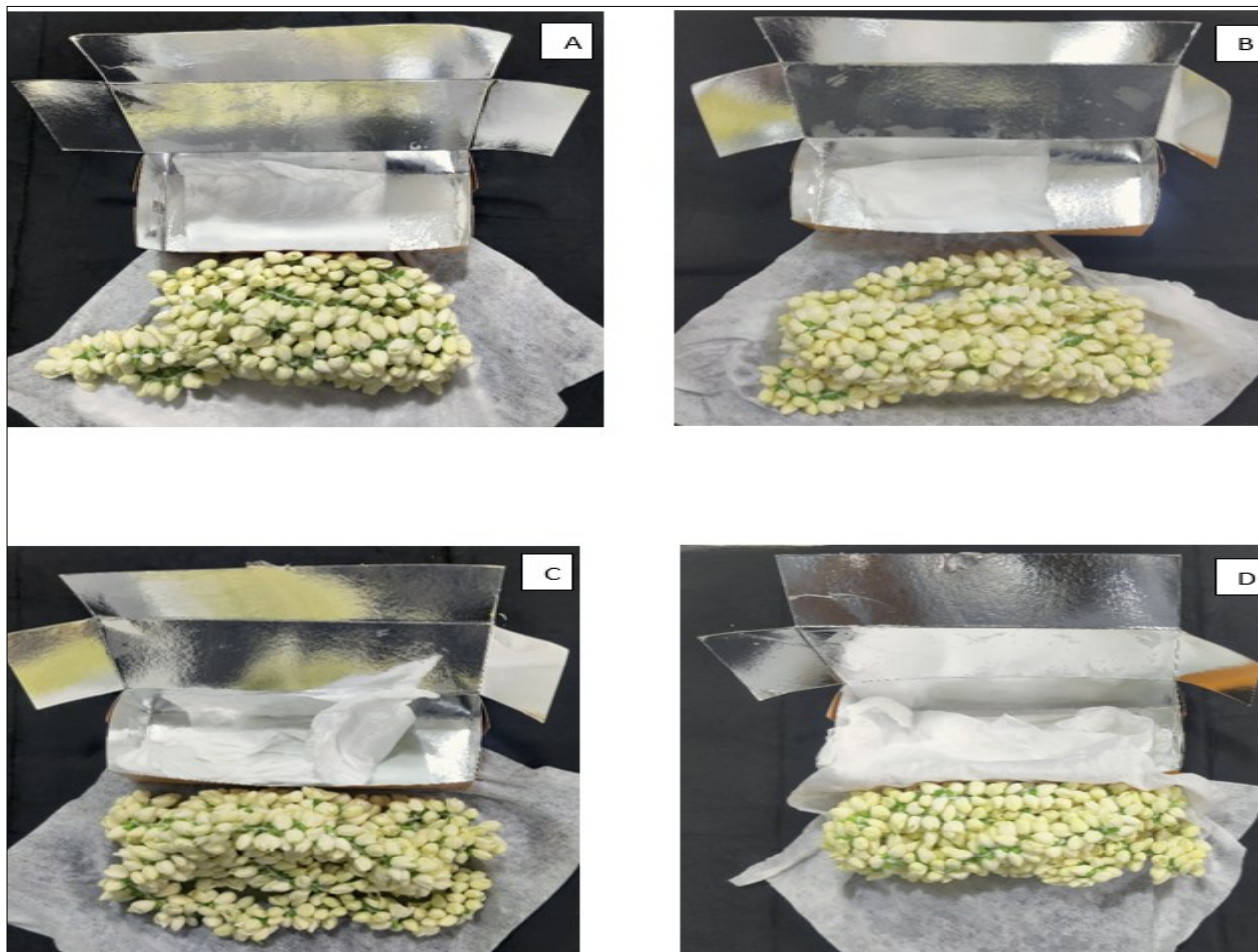


Fig. 2. Initial fresh flower images kept in different packaging boxes. (A) Flowers kept in EPS box; (B) Flowers kept in mycelium box; (C) Flowers kept in coir pith lined box; (D) Flowers kept in aluminium foil lined carton box.

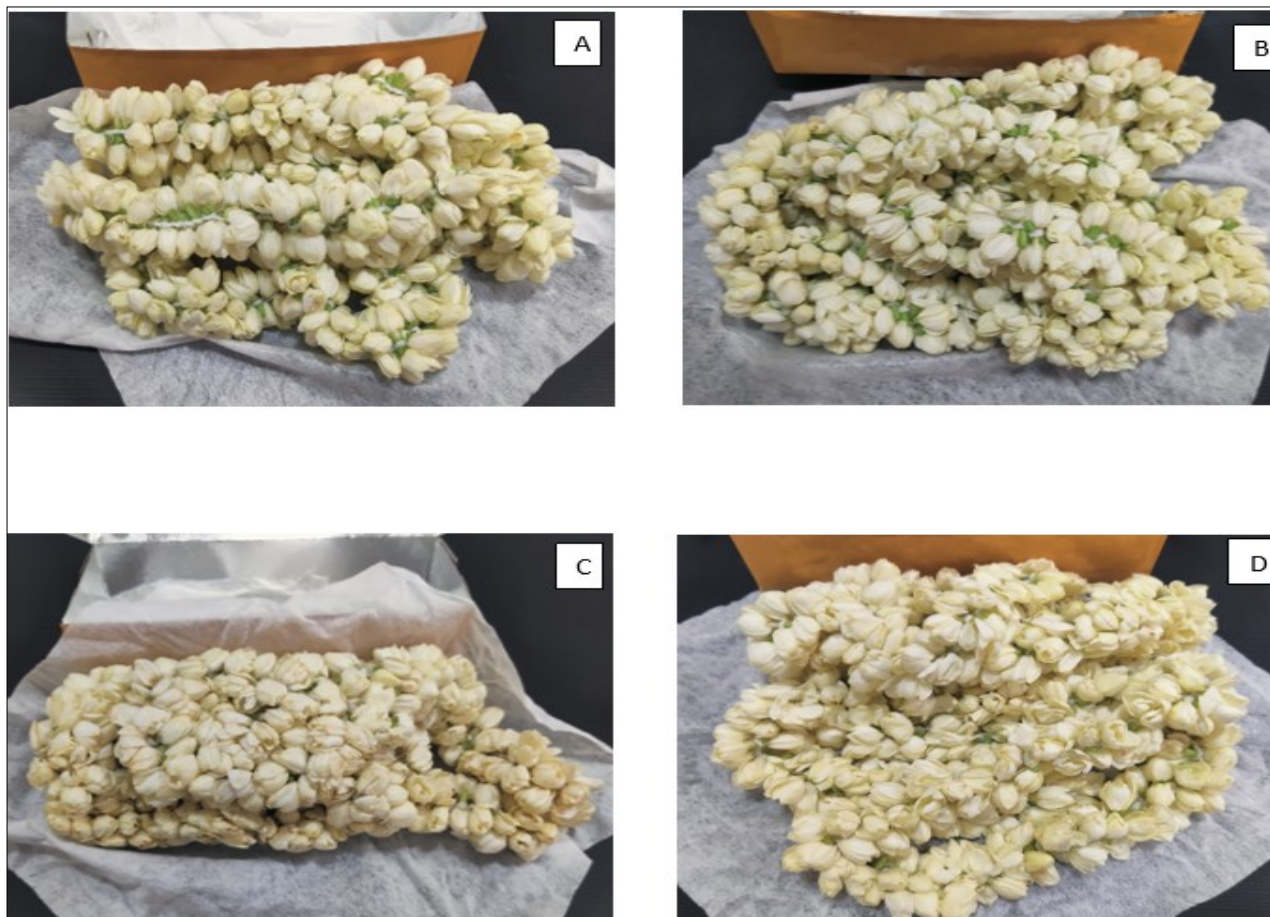


Fig. 3. Flower images kept in different packaging boxes after 48 hr. (A) Flowers kept in EPS box; (B) Flowers kept in mycelium box; (C) Flowers kept in coir pith lined box; (D) Flowers kept in aluminium foil lined carton box.

The thermal properties of mycelium composites (thermal conductivity 0.04 W/m·K) provide effective insulation approaching EPS performance (0.033 W/m·K) while offering superior breathability (22). The controlled gas permeability prevents accumulation of CO₂ and ethylene while ensuring adequate O₂ supply, thereby suppressing fermentative pathways that accelerate deterioration (23). This mechanism explains the 8.5 % higher carbohydrate retention and 41.3 % higher phenolic content observed in mycelium-packaged flowers, indicating suppressed respiratory substrate depletion and enhanced antioxidant capacity.

Comparison with alternative materials

While EPS provides thermal insulation, its hydrophobic closed-cell structure prevents moisture regulation, leading to quality loss (24). The lack of breathability causes ethylene accumulation, accelerating senescence. Coir-lined carton showed intermediate performance with natural cushioning and humidity regulation, but lower density and higher thermal conductivity resulted in inadequate temperature buffering and accelerated moisture loss (25). Aluminium foil-lined carton performed poorest across all parameters. The impermeable metallic barrier trapped heat and moisture, creating anaerobic conditions conducive to fermentative metabolism and microbial proliferation (26).

Physiological and biochemical implications

The significantly higher carbohydrate retention in mycelium-packaged flowers (63.50 mg/g vs. 58.54 mg/g in EPS at 48 hr) indicates suppressed respiratory metabolism, as carbohydrates serve as primary energy substrates during post-harvest senescence (27). The moderated oxygen availability through mycelium pore structure likely shifts metabolism toward more efficient aerobic pathways while preventing excessive respiration rates that deplete energy reserves (23).

The enhanced phenolic content in mycelium packaging (39.94 mg/g vs. 28.26 mg/g in EPS) suggests that the packaging microenvironment supports antioxidant defence mechanisms. The exceptional colour retention in mycelium packaging (77.82 % vs. 68.71 % in EPS at 48 hr) directly correlates with reduced enzymatic browning and oxidative pigment degradation. Polyphenol oxidase and peroxidase activities, which catalyse browning reactions upon cellular breakdown, are suppressed under the stable microenvironment conditions maintained by mycelium foam (28). The stable humidity prevents desiccation-induced cellular collapse while the breathable structure minimises oxidative stress, collectively preserving petal chromatic quality.

Environmental and commercial implications

Mycelium foam offers compelling environmental benefits. The material achieves complete biodegradability within 30–45 days under composting conditions, contrasting with centuries-long EPS persistence (29). Production utilises agricultural waste substrates, achieving carbon sequestration while valorising waste streams (30).

Life cycle assessments of mycelium-based packaging demonstrate substantially lower environmental impacts across global warming potential, eutrophication and fossil fuel depletion categories compared to petroleum-based plastics (31). The 7.6 % shelf-life extension enables expanded market access for jasmine exports to more distant international markets without quality compromise.

Implementation considerations

Commercial adoption requires addressing several considerations. Current production costs exceed EPS by approximately 40–60 %, though economies of scale and increasing EPS regulatory restrictions are narrowing this differential. The 7–14-day production timeframe for mycelium cultivation necessitates production planning aligned with jasmine harvest schedules.

Quality standardisation represents another challenge, as mycelium composite properties vary with substrate composition and cultivation parameters (32). However, ongoing advances in mycelium manufacturing are progressively improving process control and product consistency (33).

Conclusion

Mycelium foam packaging demonstrated clear superiority over conventional expanded polystyrene and other eco-friendly alternatives for preserving *Jasminum sambac* during long-distance transport, achieving 12.8 % higher freshness retention, 13.3 % better colour stability, 7.6 % extended shelf life, 23.5 % improved moisture retention and markedly higher preservation of carbohydrates and phenolics at 48 hr. Its porous hygroscopic structure provides effective humidity regulation, gas exchange control and thermal buffering (0.04W/m·K), while offering complete biodegradation within 30–45 days—simultaneously addressing product quality and environmental sustainability objectives. These findings support adoption of mycelium foam as a viable bio-based replacement for expanded polystyrene in floriculture export packaging. Future research should focus on scale-up economics, substrate optimisation and performance validation across diverse export route durations and temperature profiles.

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Authors' contributions

MMA prepared the manuscript. CSRK, RR, PIV, US, RJ and MD provided guidance in manuscript preparation, ensured proper formatting and approved the final version. All authors read and approved the final manuscript.

Compliance with ethical standards

Conflict of interest: Authors do not have any conflict of interests to declare.

Ethical issues: None

AI Declaration Statement

The authors declare that the AI tool Claude (Anthropic) was used only for language editing to improve clarity, coherence and grammar. The AI did not contribute to the study design, data analysis, interpretation, or conclusions. All scientific content is

the responsibility of the authors, who reviewed and approved the final manuscript.

References

1. Silalahi M. Jasmine (*Jasminum sambac* (L.) Aiton): potential utilization and bioactivity. *Asian Journal of Research in Agriculture and Forestry*. 2023;9(2):28–36.
2. Welfare MoAaF. Horticulture statistics at a glance 2024–2025. Statistical report. New Delhi: Government of India; 2025. <https://doi.org/10.9734/ajraf/2023/v9i2198>
3. Nirmala L, Brindha I. Global perspectives on socio-economic dynamics, marketing practices and challenges in jasmine trade: evidence from a prominent Indian flower market. 2025. <https://doi.org/10.14719/pst.6262>
4. Ffadhilah A, Chitra R, Ganga M, Prasanthrajan M, Djanaguiraman M. Chitosan-based biodegradable packaging: enhancing the shelf life and quality of *Jasminum sambac* L. flowers. *Plant Science*. 2024;11. <https://doi.org/10.14719/pst.5438>
5. D'Almeida AP, de Albuquerque TL. Innovations in food packaging: from bio-based materials to smart packaging systems. *Processes*. 2024;12(10):2085. <https://doi.org/10.3390/pr12102085>
6. Silva G, Oliveira M, Rangel B, Lino J. A brief review on sustainable packaging materials. *Wastes: Solutions, Treatments and Opportunities III*. 2019:463–9. <https://doi.org/10.1201/9780429289798-73>
7. Sinha S. An overview of biopolymer-derived packaging material. *Polymers from Renewable Resources*. 2024;15(2):193–209. <https://doi.org/10.1177/20412479241226884>
8. Kumar M, Kumar R, Motla R, Sharma M, Shukla D, Kaushik K, et al. Innovative eco-friendly approaches to enhance the vase life of cut flowers: a comprehensive review. *Journal of Advances in Biology & Biotechnology*. 2024;27(12):36–45. <https://doi.org/10.9734/jabb/2024/v27i121753>
9. van Doorn WG, Stead AD. Abscission of flowers and floral parts. *Journal of Experimental Botany*. 1997;48(4):821–37. <https://doi.org/10.1093/jxb/48.4.821>
10. Choudhary S, Das JN, Mohanty CR, Das AK, Mishra A. Packaging technology for extending shelf-life of jasmine (*Jasminum sambac* cv. Gundumulli) flowers. *International Journal of Current Microbiology and Applied Sciences*. 2019;8(9):1724–32. <https://doi.org/10.20546/ijcmas.2019.809.199>
11. Luksta I, Vamža I, Blumberga D, editors. Mycelium thermal insulation material. CONECT International Scientific Conference of Environmental and Climate Technologies; 2025. <https://doi.org/10.7250/CONECT.2025.032>
12. Kitirojapn P, Teeravarunyou S, Kamolwit K, Pattanachan P. Development of sustainable packaging cushions from coconut waste using 3D printing techniques. *Environment and Natural Resources Journal*. 2025;23(2):132–41. <https://doi.org/10.32526/enrj/23/20240224>
13. Čekon M, Struhala K, Slávik R. Cardboard-based packaging materials as renewable thermal insulation of buildings: thermal and life-cycle performance. *Journal of Renewable Materials*. 2017;5(1):84–93. <https://doi.org/10.7569/JRM.2017.634135>
14. Jawaharlal M, Thamaraiselvi S, Ganga M. Packaging technology for export of jasmine (*Jasminum sambac* Ait.) flowers. *Journal of Horticultural Science*. 2012;7(2):180–9. <https://doi.org/10.24154/jhs.v7i2.372>
15. Sivaprasad S, Byju SK, Prajith C, Shaju J, Rejeesh CR. Development of a novel mycelium bio-composite material to substitute for polystyrene in packaging applications. *Materials Today Proceedings*. 2021;47:5038–44. <https://doi.org/10.1016/j.matpr.2021.04.622>
16. Madhu G. Studies on the effect of different packaging materials and chemicals on the post-harvest life of jasmine flowers. M Sc (Ag) thesis. Annamalai University, Annamalinagar, Tamil Nadu; 1999.
17. Barrs H, Weatherley P. A re-examination of the relative turgidity technique for estimating water deficits in leaves. *Australian Journal of Biological Sciences*. 1962;15(3):413–28. <https://doi.org/10.1071/B19620413>
18. Je H. Determination of reducing sugars and carbohydrates. *Methods of Carbohydrate Chemistry*. 1962;1:380–94.
19. Malick CC, Singh MB. Estimation of phenol content. In: *Plant enzymology and histoenzymology*. New Delhi: Kalyani Publishers; 1980. p. 286.
20. Sukhatme P. Statistical methods for agricultural workers. New Delhi: Indian Council of Agricultural Research; 1957.
21. Jose J, Uvais K, Sreenadh T, Deepak AV, Rejeesh C. Investigations into the development of a mycelium biocomposite to substitute polystyrene in packaging applications. *Arabian Journal for Science and Engineering*. 2021;46(3):2975–84. <https://doi.org/10.1007/s13369-020-05247-2>
22. Alemu D, Tafesse M, Mondal AK. Mycelium-based composite: the future sustainable biomaterial. *International Journal of Biomaterials*. 2022;2022:8401528. <https://doi.org/10.1155/2022/8401528>
23. Pohan JN, Kusumawati YA, Radhitanti A. Mushroom mycelium-based biodegradable packaging material: a promising sustainable solution for food industry. *E3S Web of Conferences*. 2023;426:02128. <https://doi.org/10.1051/e3sconf/202342602128>
24. Serrano M, Amorós A, Pretel MT, Martínez-Madrid MC, Romojaro F. Preservative solutions containing boric acid delay senescence of carnation flowers. *Postharvest Biology and Technology*. 2001;23(2):133–42. [https://doi.org/10.1016/S0925-5214\(01\)00108-9](https://doi.org/10.1016/S0925-5214(01)00108-9)
25. Chand N, Hashmi SA. Mechanical properties of sisal fibre at elevated temperatures. *Journal of Materials Science*. 1993;28(24):6724–8. <https://doi.org/10.1007/BF00356422>
26. Enarevba DR, Haapala KR. A comparative life cycle assessment of expanded polystyrene and mycelium packaging box inserts. *Procedia CIRP*. 2023;116:654–9. <https://doi.org/10.1016/j.procir.2023.02.110>
27. Sharma V. Biochemical changes accompanying petal development in *Rosa damascena*. MSc thesis.1981.
28. Mishra SD, Gaur BK, Bhattacharya VW, Bhattacharya BB. Isolation, identification and significance of free radical in senescing leaves. *Plant Cell Physiology*. 1976;17(4):725–30.
29. Abhijith R, Ashok A, Rejeesh C. Sustainable packaging applications from mycelium to substitute polystyrene: a review. *Materials today: proceedings*. 2018;5(1):2139–45. <https://doi.org/10.1016/j.matpr.2017.09.211>
30. Appels FV, Camere S, Montalti M, Karana E, Jansen KM, Dijksterhuis J, et al. Fabrication factors influencing mechanical, moisture- and water-related properties of mycelium-based composites. *Materials & Design*. 2019;161:64–71. <https://doi.org/10.1016/j.matdes.2018.11.027>
31. Holt GA, McIntyre G, Flagg D, Bayer E, Wanjura JD, Pelletier MG. Fungal mycelium and cotton plant materials in the manufacture of biodegradable molded packaging material: evaluation study of select blends of cotton byproducts. *Journal of Biobased Materials and Bioenergy*. 2012;6(4):431–9. <https://doi.org/10.1166/jbmb.2012.1241>
32. Joshi K, Meher MK, Poluri KM. Fabrication and characterization of bioblocks from agricultural waste using fungal mycelium for renewable and sustainable applications. *ACS Applied Bio Materials*. 2020;3(4):1884–92. <https://doi.org/10.1021/acsabm.9b01047>
33. JL S, Gopalsamy S, N B, Sundarapandian M, Balasubramanian S. Harnessing mycelium bio-composite panels for improved acoustic and flame-retardant properties for architectural applications: a comprehensive review. *Frontiers in Advanced Materials Research*. 2025.

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