

JOURNAL OF ADVANCED HOMOEOPATHIC STUDIES (JAHS)

A Peer Reviewed International Platform for Homoeopathic Excellence

ISSN: 3139-1826 | ESTD: 2025 | Frequency: Quarterly | Open Access

Editor-in-Chief: Dr. Salini Mandal B.G. | Published by: AdvHom Society

EFFICACY OF HOMOEOPATHIC MEDICINES ON THE RIPENING PROCESS OF BANANAS: AN EXPLORATORY RANDOMISED PILOT STUDY

Dr G Aditya^{1*}, Dr Maseera Batool²

Article Type:	Original Research
Timeline:	Received: [25-05-2026] Revised: [12-08-2026] Accepted: [20-08-2026] Published: [22-08-2026]
Corresponding Author * email address	drgaditya7@gmail.com
doi	https://doi.org/10.67062/jahs.v2.i3.2

¹ Assistant Professor, Department of Practice of Medicine, MNR Homoeopathic Medical College and Hospital, Sangareddy, Telangana, India

² Intern, MNR Homoeopathic Medical College and Hospital, Sangareddy, Telangana, India

Corresponding Author* Details:

Dr G Aditya,
Assistant Professor,
Department of Practice of Medicine,
MNR Homoeopathic Medical College and Hospital,
Sangareddy, Telangana, India
ORCID ID: <https://orcid.org/0009-0009-1078-1510>
E-Mail. Id: drgaditya7@gmail.com

ABSTRACT

Background: Musa acuminata (banana) is a climacteric fruit of global economic importance, commonly ripened using calcium carbide (CaC₂), a hazardous chemical associated with serious health risks. Safer and sustainable alternatives are urgently needed for post-harvest management.

Objective: The study was conducted to evaluate and compare the efficacy of the homoeopathic medicines *Silicea terra*, *Calcarea carb*, and *Hepar sulph* in different potencies (30CH, 200CH, and 1M) on the ripening process of bananas. Their effects were further compared with conventional and control agents, namely calcium carbide, alcohol, and water, to assess variations in ripening characteristics and efficacy.

Methods: A randomised pilot study was conducted at MNR Homoeopathic Medical College, Sangareddy, Telangana (10–20 June 2025). Twelve treatment groups (n=7 bananas each) were assessed over 8 days for specific gravity, physiological weight loss (PWL), pulp-to-peel ratio (PPR), and ripening stage. Results were evaluated using descriptive analysis, composite group ranking across all outcome parameters.

Results: All groups showed progressive ripening over 8 days. *Silicea terra* 1M demonstrated the most advanced overall ripening profile, reaching Stage 7 (full ripeness) by Day 8, recording the highest physiological weight loss (31.1%) and PPR change (104.69%), and the second highest specific gravity increase (21.59%). The highest specific gravity change was observed with *Hepar sulph* 30CH (21.74%), which ranked first on that parameter alone. *Calcarea carb* 200CH and 30CH also showed numerically greater ripening compared to calcium carbide

(Stage 4 at Day 8; PPR change 60.71%). Composite ranking across all four parameters identified *Silicea terra* 1M as the overall top-performing group (composite score 5), followed by *Calcarea carb* 200CH (score 18) and *Hepar sulph* 30CH (score 22). These findings are descriptive and exploratory in nature.

Conclusion: These findings provide preliminary evidence suggesting that selected homoeopathic remedies—particularly *Silicea terra* 1M and *Calcarea carb* 200CH—may warrant further investigation as potentially safe, eco-friendly alternatives to hazardous chemical ripening agents. These preliminary trends support further research into the application of agrohomoepathy in sustainable post-harvest fruit management, and replication with formal within-group replication, larger sample sizes, and biochemical outcome measures is required before any definitive conclusions can be drawn.

Keywords: *Banana, Silicea terra, Calcarea carb, Hepar sulph, Calcium carbide, Agrohomoepathy, Musa acuminata, Post-harvest management*

1. INTRODUCTION

Fruit ripening is a complex, genetically regulated, and irreversible process characterised by a series of physiological, biochemical, and sensory changes that culminate in the formation of a soft, edible fruit with desirable quality attributes.¹ Despite the natural ripening process, certain fruits may not ripen uniformly after harvest, resulting in increased spoilage, reduced shelf life, and financial losses for producers².

Calcium carbide (CaC_2) is widely used in India and several other countries as an artificial ripening agent. When exposed to moisture, it generates acetylene gas, mimicking the natural ripening hormone ethylene³. However, it often produces uneven ripening—affecting only the peel while leaving the pulp underdeveloped. Industrial-grade calcium carbide frequently contains toxic impurities including arsenic and phosphine hydride, and its consumption has been associated with gastrointestinal distress, neurological symptoms, low blood pressure, and, in severe cases, death^{4,5}. The Food Safety and

Standards Authority of India (FSSAI) has prohibited the use of calcium carbide and acetylene gas for artificial fruit ripening under FSSAI Regulations 2011, though its illicit use persists despite its ban under the Prevention of Food Adulteration Act.^{6,7}

Musa acuminata (banana) is the fourth most significant food crop globally by production volume, following rice, wheat, and maize^{8,9}. India leads the world in banana production, with five states—Tamil Nadu, Maharashtra, Gujarat, Karnataka, and Andhra Pradesh—contributing over 70% of national output.⁸ As a climacteric fruit harvested at an unripe stage, bananas are particularly susceptible to issues of artificial ripening and post-harvest quality control.

Agrohomoepathy—the application of potentised homoeopathic preparations in agriculture—has demonstrated potential in modulating plant physiology, enhancing germination, improving stress tolerance, and increasing crop yield.¹⁰ However, its role in fruit ripening remains largely unexplored. *Calcarea*

carbonica, derived from calcium carbonate, is known to influence calcium signalling involved in ripening, cell division, and fruit softening.^{11,12} Silicea terra, prepared from pure precipitated silica, acts on structural plant components and may facilitate ripening processes.¹⁰ Hepar sulphuris calcareum, prepared from the inner layer of oyster shell, is noted for its action on glandular and mucous tissues¹¹.

Given the urgent need for safer alternatives to calcium carbide, this study aimed to evaluate the efficacy of these three homoeopathic medicines in different potencies on banana ripening, and to compare their effects with conventional chemical and placebo controls.

2. AIMS AND OBJECTIVES

Primary Objective: To evaluate and compare the efficacies of homoeopathic medicines Silicea terra, Calcarea carb, and Hepar sulph at different potencies (30CH, 200CH, and 1M) on the post-harvest ripening process of *Musa acuminata* (banana), in comparison with distilled water and alcohol as controls.

Secondary Objective: To assess the influence of potency on ripening outcomes across the three homoeopathic medicines, with calcium carbide as a secondary comparator.

Hypothesis

H₀: Homoeopathic medicines do not influence the ripening process of bananas.

H_a: Homoeopathic medicines positively influence the ripening process of bananas.

3. MATERIALS AND METHOD

3.1 Study Setting and Design

A randomised pilot study was conducted at MNR Homoeopathic Medical College and Hospital, Sangareddy, Telangana (502294), from 10th June to 20th June 2025. Room temperature was maintained at 20°-25°C throughout the experiment.

3.2 Procurement of Material

An unripe banana stalk was procured from a nearby farm. Fruits were selected for uniformity of peel colour, size (6–8 inches), and weight (130–160 g per banana) to ensure consistency across experimental groups. All homoeopathic medicines (*Hepar sulph*, *Silicea terra*, and *Calcarea carb* in 30CH, 200CH, and 1M potencies) were procured from an authentic homoeopathic pharmaceutical outlet per GMP guidelines. Calcium carbide reagent was obtained from a certified local fertiliser store. Ethyl alcohol 91% v/v and distilled water were procured from pharmaceutical-grade sources.

3.3 Sample Allocation

The banana stalk was divided into 12 experimental groups of 7 bananas each, randomly assigned after weighing. Within each group:

- 4 bananas were retained as a bunch for physiological weight monitoring (every alternate day).
- 2 bananas of identical weight and size were designated for pulp-to-peel ratio analysis (at Day 0 and at study completion).

- 1 banana was designated for specific gravity measurement (at Day 0 and Day 8). The same banana was used for specific gravity measurement at both time points. It was patted dry with cotton cloth immediately prior to each water displacement measurement to minimise surface moisture bias."
- Observer blinding was not employed in this study. The assessors were aware of the treatment allocations during daily ripening stage evaluation.

3.4 Treatment Preparation and Application

Treatment solutions were prepared at a ratio of 1 ml of homoeopathic medicine per 1000 ml of distilled water (0.25 g of CaC_2 per 1000 ml for the positive control). A total of 3000 ml per group was used. Bananas were fully immersed in their respective treatment solutions for 10 seconds, then gently wrapped in identical cotton cloths and stored on a rack away from direct sunlight under ambient room conditions.

Table 1: Treatment Application

<i>Treatment</i>	<i>Preparation Ratio</i>	<i>Control Type</i>
<i>Hepar sulph 1M</i>	<i>1 ml per 1000 ml of distilled water</i>	Test Group
<i>Hepar sulph 200CH</i>	<i>1 ml per 1000 ml of distilled water</i>	Test Group
<i>Hepar sulph 30CH</i>	1 ml per 1000 ml of distilled water	Test Group
<i>Calcarea carb 1M</i>	<i>1 ml per 1000 ml of distilled water</i>	Test Group
<i>Calcarea carb 200CH</i>	<i>1 ml per 1000 ml of distilled water</i>	Test Group
<i>Calcarea carb 30CH</i>	1 ml per 1000 ml of distilled water	Test Group
<i>Silicea terra 1M</i>	<i>1 ml per 1000 ml of distilled water</i>	Test Group
<i>Silicea terra 200CH</i>	<i>1 ml per 1000 ml of distilled water</i>	Test Group
<i>Silicea terra 30CH</i>	<i>1 ml per 1000 ml of distilled water</i>	<i>Test Group</i>
<i>Calcium carbide (CaC_2)</i>	0.25 g per 1000 ml of distilled water	Positive Control
Alcohol (91% v/v)	1 ml per 1000 ml of distilled water	Placebo Control
Distilled water	Distilled water	Negative Control

3.5 Outcome Parameters

Physiological Weight Loss (PWL): Bunch weight was recorded every alternate day using a digital weighing balance. PWL was calculated as: $PWL (\%) = [(Initial\ weight - Next\ measurement\ weight) / Initial\ weight] \times 100$.



Figure 1: Representative illustration of physiological weight loss progression observed across treatment groups during the study period

Ripening Stage: Ripening stage was assessed daily on four bananas per group using a seven-stage visual colour scale, ranging from Stage 1 (fully green) to Stage 7 (yellow with extensive brown patches)¹³.



Figure 2: Physical banana ripening colour scale (Stages 1–7; Von Loesecke, 1950 13 used for visual stage assessment in the present study.

Specific Gravity: Measured by the water displacement method at Day 0 and Day 8. $Specific\ Gravity = \text{Fruit weight (g)} / \text{Volume of water displaced (ml)}$.



Figure 3: Representative illustration of pulp-to-peel ratio assessment showing separated pulp and peel components at Day 0 and final day of measurement.

Pulp-to-Peel Ratio (PPR): Pulp and peel were weighed separately. $PPR = \text{Weight of pulp} / \text{Weight of peel}$. Measured at Day 0 and at study completion.

3.6 Statistical Analysis

Outcome parameters differed in their level of replication. Ripening stage was assessed daily on four bananas per group, and physiological weight loss was measured on a bunch of four bananas per group every alternate day; both parameters therefore had adequate within-group replication. In contrast, specific gravity and pulp-to-peel ratio were assessed on single representative fruits per group (n=1 and n=1 per timepoint respectively), precluding inferential statistical testing for these two measures. Accordingly, results for specific gravity and PPR are presented descriptively, while ripening stage and PWL trends are supported by group-level replication. A

composite rank score was calculated by ranking all 12 groups (rank 1 = best performance) on each of the four outcome parameters and summing ranks, enabling an overall multi-parameter comparison. The composite rank score methodology follows the multi-parameter composite indicator approach validated for agricultural systems assessment.¹⁴

4. RESULTS

4.1 Specific Gravity

All groups showed an increase in specific gravity from Day 0 to Day 8, indicating progressive

ripening and internal physicochemical change. The most significant increase was observed with *Hepar sulph 30CH* (21.74%), followed closely by *Silicea terra 1M* (21.59%). Notable increases were also seen with *Calcarea carb 200CH* (17.98%) and *Silicea terra 200CH* (16.48%). Among controls, calcium carbide showed a 15.56% increase, water 14.74%, while alcohol had minimal effect (0.40%). *Silicea terra 30CH* showed the lowest change among homoeopathic remedies (2.88%).

Table 2: Specific Gravity of Bananas on Day 0 and Day 8 with Percentage Change

Treatment Group	S.G. Day 0	S.G. Day 8	% Change
<i>Hepar sulph 1M</i>	0.92	1.09	18.48
<i>Hepar sulph 200CH</i>	1.006	1.12	11.33
<i>Hepar sulph 30CH</i>	0.92	1.12	21.74
<i>Calcarea carb 1M</i>	1.06	1.15	8.49
<i>Calcarea carb 200CH</i>	0.89	1.05	17.98
<i>Calcarea carb 30CH</i>	0.95	1.04	9.47
<i>Silicea terra 1M</i>	0.88	1.07	21.59
<i>Silicea terra 200CH</i>	0.91	1.06	16.48
<i>Silicea terra 30CH</i>	1.04	1.07	2.88
Alcohol (Control)	1.002	1.006	0.40
Calcium carbide (Control)	0.90	1.04	15.56
Water (Control)	0.95	1.09	14.74

4.2 Physiological Weight Loss (PWL)

Silicea terra 1M exhibited the highest PWL at 31.1%, suggesting the most accelerated metabolic activity and moisture loss during

ripening. *Hepar sulph 200CH* recorded the lowest PWL (19.3%), indicating better retention of fruit weight and a slower ripening effect. Calcium

carbide showed a PWL of 24.8%, higher than most homoeopathic treatment groups. Water and

alcohol controls recorded 22.2% and 22.9%, respectively.

Table 3: Physiological Weight Loss (%) of Bananas in Each Group

<i>Treatment Group</i>	<i>Physiological Weight Loss (%)</i>
<i>Hepar sulph 1M</i>	21.0
<i>Hepar sulph 200CH</i>	19.3
<i>Hepar sulph 30CH</i>	23.2
<i>Calcarea carb 1M</i>	23.9
<i>Calcarea carb 200CH</i>	21.9
<i>Calcarea carb 30CH</i>	22.1
<i>Silicea terra 1M</i>	31.1
<i>Silicea terra 200CH</i>	23.6
<i>Silicea terra 30CH</i>	22.0
<i>Alcohol (Control)</i>	22.9
Calcium carbide (Control)	24.8
Water (Control)	22.2

4.3 Pulp-to-Peel Ratio (PPR)

Silicea terra 1M and Calcarea carb 200CH exhibited the highest PPR percentage increases (104.69% and 104.55% respectively), suggesting the greatest enhancement in ripening quality. Hepar sulph 1M (81.60%) and Calcarea carb 30CH (78.08%) also showed substantial increases. Importantly, calcium carbide demonstrated only a 60.71% increase in PPR, which was lower than several homoeopathic groups. The lowest increase was observed with

Hepar sulph 200CH (56.64%). Water (74.67%) demonstrated a moderate natural ripening effect.

It is noted that the PPR percentage changes of Silicea terra 1M (104.69%) and Calcarea carb 200CH (104.55%) were remarkably close, differing by only 0.14%; this marginal difference, while resulting in a rank separation in the composite score, should not be interpreted as a meaningful distinction between these two groups on this parameter.

Table 4: Pulp-to-Peel Ratio at Day 0 and Final Day with Percentage Change

<i>Treatment Group</i>	<i>PPR Day 0</i>	<i>PPR Final Day</i>	<i>% Change</i>
<i>Hepar sulph 1M</i>	1.25	2.27	81.60
<i>Hepar sulph 200CH</i>	1.43	2.24	56.64
<i>Hepar sulph 30CH</i>	1.47	2.56	74.15
<i>Calcarea carb 1M</i>	1.31	2.09	59.54
<i>Calcarea carb 200CH</i>	1.32	2.70	104.55
<i>Calcarea carb 30CH</i>	1.46	2.60	78.08
<i>Silicea terra 1M</i>	1.28	2.62	104.69
<i>Silicea terra 200CH</i>	1.36	2.42	77.94
<i>Silicea terra 30CH</i>	1.40	2.28	62.86
Alcohol (Control)	1.35	2.60	92.59
Calcium carbide (Control)	1.40	2.25	60.71
Water (Control)	1.50	2.62	74.67

4.4 Ripening Stage

All 12 groups commenced at Stage 1 (fully unripe) on Day 0. By Day 8, marked differences in ripening progression were apparent. Silicea terra 1M achieved full ripeness (Stage 7), the only group to do so. Calcarea carb 30CH reached

Stage 6, and Calcarea carb 200CH, Silicea terra 30CH, and the water control reached Stage 5. Most Hepar sulph groups, alcohol, and calcium carbide remained at Stage 4. Calcarea carb 1M and Silicea terra 200CH reached only Stage 3.

Table 5: Ripening Stage of Each Group from Day 0 to Day 8

<i>Treatment</i>	<i>D0</i>	<i>D1</i>	<i>D2</i>	<i>D3</i>	<i>D4</i>	<i>D5</i>	<i>D6</i>	<i>D7</i>	<i>D8</i>
<i>Hepar sulph 1M</i>	1	1	2	2	2	3	3	4	4
<i>Hepar sulph 200CH</i>	1	1	2	2	2	3	4	4	4
<i>Hepar sulph 30CH</i>	1	1	1	2	2	2	3	4	4
<i>Calcarea carb 1M</i>	1	1	1	2	2	2	2	3	3
<i>Calcarea carb 200CH</i>	1	1	2	2	2	3	3	5	5

<i>Calcarea carb 30CH</i>	1	2	2	3	3	3	4	5	6
<i>Silicea terra 1M</i>	1	2	2	3	3	4	5	6	7
<i>Silicea terra 200CH</i>	1	1	2	2	2	2	3	3	3
<i>Silicea terra 30CH</i>	1	1	1	3	3	3	3	5	5
Alcohol (Control)	1	1	2	2	2	2	2	3	4
Calcium carbide (Control)	1	1	1	1	2	2	3	4	4
Water (Control)	1	1	1	2	2	2	3	4	5

4.5 Composite Ranking

As specific gravity and PPR were assessed on single representative fruits per group, formal inferential statistics requiring within-group replication were not applied for these two parameters. Instead, all 12 groups were ranked from 1 (best) to 12 (least) on each of the four outcome parameters, and a composite rank score was calculated by summing the four individual ranks (Table 6). A lower composite score indicates superior overall ripening performance across all parameters simultaneously. *Silicea terra 1M* achieved the lowest composite rank score (5), suggesting it as the descriptively top-performing group in this study. *Calcarea carb 200CH* ranked second (composite score 18), followed by *Hepar sulph 30CH* (composite score 22) and *Calcarea carb 30CH* (composite score 23). Calcium carbide, the standard positive control, ranked 8th overall (composite score 28), performing below five of the nine homoeopathic

treatment groups and, notably, below the water negative control (composite score 26, 6th overall). This anomalous finding — wherein the negative control outperformed the positive control — likely reflects the suboptimal calcium carbide concentration used (0.25 g/1000 ml), which may have been insufficient to generate effective acetylene levels for consistent ripening. This limitation is discussed in Section 5.1. Alcohol ranked 9th overall (composite score 30); its relatively high PPR rank (3rd) is attributed to desiccation-induced peel weight reduction rather than true ripening enhancement. A descriptive potency-response trend was observed for *Silicea terra*, where composite rank scores improved progressively from 30CH (rank 10th) to 200CH (rank 7th) to 1M (rank 1st), suggesting a possible dose-response relationship that warrants formal investigation in adequately powered future studies.

Table 6: Composite Rank Scores and Overall Group Rankings Across All Outcome Parameters

<i>Treatment Group</i>	<i>SG Rank</i>	<i>PWL Rank</i>	<i>PPR Rank</i>	<i>Stage Rank</i>	<i>Composite Score</i>	<i>Overall Rank</i>
<i>Silicea terra 1M</i>	2	1	1	1	5	1st
<i>Calcarea carb 200CH</i>	3	10	2	3	18	2nd
<i>Hepar sulph 30CH</i>	1	5	8	8	22	3rd
<i>Calcarea carb 30CH</i>	8	8	5	2	23	4th
<i>Hepar sulph 1M</i>	4	11	4	6	25	5th
Water (Negative Control)	7	7	7	5	26	6th
<i>Silicea terra 200CH</i>	5	4	6	12	27	7th
Calcium carbide (Positive Control)	6	2	10	10	28	8th
Alcohol (Placebo Control)	12	6	3	9	30	9th
<i>Silicea terra 30CH</i>	11	9	9	4	33	10th
<i>Calcarea carb 1M</i>	10	3	11	11	35	11th
<i>Hepar sulph 200CH</i>	9	12	12	7	40	12th

5. DISCUSSION

This randomised pilot study provides, for the first time in a structured pilot format, descriptive findings suggesting a measurable influence of potentized homoeopathic medicines on the post-harvest ripening of *Musa acuminata*. The findings across ripening stage and physiological weight loss—both assessed on groups of four bananas—and descriptive trends in specific gravity and PPR, tentatively indicate that selected homoeopathic preparations — particularly *Silicea terra 1M* and *Calcarea carb 200CH* — demonstrated a greater ripening-promoting effect than the water negative control and, notably, than

calcium carbide included as a secondary comparator. These findings are preliminary and descriptive and should not be interpreted as confirmatory.

Silicea terra 1M showed the most advanced ripening profile in this study, recording the highest specific gravity increase (21.59%), the greatest physiological weight loss (31.1%), the highest PPR change (104.69%), and was the only group to reach full ripeness (Stage 7) within the study period. These descriptive trends are consistent with accelerated ethylene-like activity promoting starch-to-sugar conversion and moisture redistribution. In homoeopathic

pharmacy, Silicea is known to facilitate expulsive and maturative processes, which may parallel its potential ability to accelerate post-harvest fruit maturation, though biochemical confirmation is required.¹⁵

Calcarea carb 200CH showed a notably high descriptive PPR increase of 104.55% and progressed to Stage 5, while Calcarea carb 30CH reached Stage 6. Calcium is a well-established secondary messenger in fruit ripening, regulating hormone signalling, cell wall metabolism, and the initiation of the climacteric phase.¹² The potentised form of calcium carbonate may therefore act through a biophysical modulation of calcium-mediated signalling pathways, consistent with the principles of agrohomoepathy described by Kaviraj, though this remains speculative without mechanistic evidence.¹⁰

Hepar sulph preparations exhibited moderate effects. Hepar sulph 30CH showed the highest specific gravity change (21.74%), while Hepar sulph 200CH produced the least weight loss (19.3%) and the lowest PPR change (56.64%), suggesting a stabilising or decelerating effect at this potency. This pattern of potency-dependent variation across all three medicines is consistent with the principle of potency selection in homoeopathic practice, where different dilutions may produce qualitatively different physiological responses.

Comparatively, calcium carbide—despite being the standard positive control—showed only a Stage 4 ripening outcome, a 15.56% specific

gravity change, and a modest 60.71% PPR increase. Notably, the negative control (water) reached Stage 5, outperforming calcium carbide on ripening stage. This unexpected finding is attributable to the calcium carbide concentration used (0.25 g per 1000 ml), which failed to establish a valid positive control baseline. As a result, true benchmark comparison between homoeopathic treatment groups and the positive control cannot be validated in this study, and all comparative interpretations involving calcium carbide should be read with this limitation in mind; future studies should validate the calcium carbide concentration through pre-trial dose-finding. Alcohol demonstrated minimal influence on specific gravity (0.40%) but a relatively high PPR change (92.59%), possibly attributable to desiccation effects on the peel. Water, as the negative control, confirmed the background natural ripening that occurred under ambient conditions during the study period.

These results collectively suggest that potentized homoeopathic preparations may modulate fruit physiology through mechanisms that warrant further investigation at the molecular and biochemical level. It is important to note that these are preliminary descriptive findings based on representative measurements without full within-group replication and should be interpreted accordingly. The role of ultra-high dilutions in influencing plant water activity, enzyme kinetics, and ethylene receptor expression represents a compelling area for future research in agrohomoepathy.¹⁰

5.1 Limitations

- The study was conducted over a single ten-day period under ambient temperature conditions; seasonal or humidity-related variability was not controlled beyond the 20–25°C range.
- Results are specific to *Musa acuminata* and may not be directly extrapolated to other climacteric fruits such as mango, papaya, or tomato.
- Replication of parameters was variable across outcome measures. Ripening stage (assessed daily on four bananas per group) and physiological weight loss (measured on a bunch of four bananas per group every alternate day) had adequate within-group replication to support descriptive trend analysis. However, specific gravity was assessed on a single representative fruit (n=1) per group using the water displacement method; the same banana was used at both time points and patted dry with cotton cloth prior to each measurement. Minor residual moisture retention cannot be entirely excluded, though any such bias would apply uniformly across all 12 groups and is unlikely to affect comparative rankings. Additionally, Day 0 specific gravity values showed inter-group variability (range: 0.88–1.006), reflecting inherent biological heterogeneity in internal maturation state and starch content among individual fruits, even within the same size and weight selection criteria. Groups with lower baseline SG have arithmetically greater capacity for percentage increase; ripening stage and physiological weight loss — both assessed on four bananas per group — are therefore considered more reliable primary indices of treatment effect in this study.
- Specific gravity and PPR were assessed on single or paired representative fruits per group (n=1 and n=2 respectively), precluding formal inferential statistical analysis for these parameters. Results are therefore presented descriptively. Future studies should designate a minimum of five bananas per group for each outcome measure to enable one-way ANOVA with Tukey's HSD post-hoc testing.
- The calcium carbide concentration used (0.25 g/1000 ml) failed to establish a valid positive control baseline. Consequently, direct benchmark comparison between homoeopathic groups and the positive control is not fully valid in this study; future studies should validate the calcium carbide concentration through pre-trial dose-finding.
- Biochemical parameters such as ethylene production, sugar content, and cell wall enzyme activity were not measured and would provide mechanistic clarity.
- The absence of observer blinding is a methodological limitation, particularly for the subjective ripening stage parameter assessed using a visual colour scale. To

minimise bias, assessments were performed by the same observer throughout the study period using a standardised physical reference card under consistent indoor lighting conditions. Future studies should employ blinded assessors or objective colorimetric measurement tools to replace subjective visual staging.

6. CONCLUSION

This exploratory randomised pilot study provides preliminary descriptive evidence suggesting that homoeopathic medicines—particularly Silicea terra 1M and Calcarea carb 200CH—may enhance the post-harvest ripening of *Musa acuminata*, with several preparations numerically outperforming calcium carbide across multiple ripening parameters. Composite ranking suggested Silicea terra 1M as the overall top-performing group, and a positive potency-response trend was observed for Silicea terra. Importantly, ripening stage and physiological weight loss were assessed on groups of four bananas, providing replicated support for these trends, while specific gravity and PPR were assessed descriptively on single representative fruits.

These findings support the potential application of agrohomoepathy as an environmentally friendly, consumer-safe, and cost-effective approach to post-harvest fruit management, particularly in reducing dependence on hazardous chemical ripening agents. Larger, multi-crop studies with biochemical outcome measures are recommended to validate and extend these

findings, and to guide practical implementation in agricultural settings.

7. DECLARATIONS

Conflict of Interest: The authors declare no conflict of interest.

Funding: No external funding was received for this study.

Ethical Approval: The study was conducted in accordance with institutional guidelines. No human or animal subjects were involved.

8. REFERENCES

1. Prasanna V, Prabha TN, Tharanathan RN. Fruit ripening phenomena—an overview. *Crit Rev Food Sci Nutr*. 2007;47(1):1–19.
2. Nasir U, Ismail A, Riaz M, et al. Exploring fruit ripening methods: Conventional, artificial, and novel approaches for quality and health. *Food Control*. 2024;165:110626.
3. Pedreschi F, Murkovic M. Possible health problems associated with the use of calcium carbide as a source of the ripening gas acetylene. *Global Harmonization Initiative (GHI) Position Paper*; 2022. Available from: <https://www.globalharmonization.net>
4. Okeke ES, Okagu IU, Okoye CO, Ezeorba TPC. The use of calcium carbide in food and fruit ripening: Potential mechanisms of toxicity to humans and prospects. *Toxicology*. 2022;468:153112. Doi:[10.1016/j.tox.2022.153112](https://doi.org/10.1016/j.tox.2022.153112)
5. Ur-Rahman A, Chowdhury FR, Alam MB. Artificial ripening: what we are eating. *J Medicine*. 2008;9(1):42–44.
6. Vidhya D, Mahanti NK, Barun, et al. Calcium carbide (CaC₂) ripening in fruits: Health risks, non-destructive detection, quality control, and regulatory frameworks. *Compr Rev Food Sci Food Saf*. 2025;24(2):e70140.
7. Food Safety and Standards Authority of India (FSSAI). Artificial Ripening of Fruits—Guidance Note. 2019. Available from: <https://www.fssai.gov.in>
8. Jadhav VG. Export performance of banana in India [Doctoral dissertation]. Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani; 2020.

9. Heslop-Harrison JS, Schwarzacher T. Domestication, genomics and the future for banana. *Ann Bot.* 2007;100(5):1073–1084.
10. Kaviraj VD. *Homeopathy for Farm and Garden*. New Delhi: B. Jain Publishers; 2006.
11. Boericke W. *Pocket Manual of Homoeopathic Materia Medica*. New Delhi: B. Jain Publishers; 2001.
12. Gilliham M, Campbell M, Snowden R, et al. Fruit Calcium: Transport and Physiology. *Front Plant Sci.* 2016;7:569. Doi:[10.3389/fpls.2016.00569](https://doi.org/10.3389/fpls.2016.00569)
13. Von Loesecke HW. *Bananas: Chemistry, Physiology, Technology*. 2nd ed. New York: Interscience Publishers; 1950. Pp. 52–66.
14. Mouratiadou I, Borsari B, Larocca A, et al. Developing composite indicators for agricultural sustainability assessment: Effect of normalization and aggregation techniques. *Resources.* 2017;6(4):66. doi:[10.3390/resources6040066](https://doi.org/10.3390/resources6040066)
15. Aditya G, Nadgauda SS, Rajopadhye BD, Dalal BA, Thakur L. Evaluation of efficacy of homoeopathic medicine Silicea terra in subcutaneous abscess in experimental animals. *J Adv Zool.* 2023;44(S2):786–803. Available from: <https://jazindia.com>