HOMEOPATHY AS AID IN THE POST-HARVEST CONSERVATION OF STRAWBERRIES

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RESUMO: In addition to medicine, homeopathy has broad applicability in food, serving as a promising alternative. Fresh strawberries undergo rapid deterioration during the time interval between commercialization and consumption. The objective of this study was to evaluate the use of homeopathic preparations in controlling the deterioration of marketable strawberries, focusing on prolonging the shelf life of the fruits. Using a quantitative, exploratory, and experimental approach, homeopathic matrices were selected based on a literature review. Manufactured in a homeopathic pharmacy, the homeopathic preparations were produced at 20CH and 200CH dilutions. Control vehicles were used, including: dynamized homeopathic vehicle, non-dynamized vehicle, sodium hypochlorite solution, and distilled water for comparative analysis. Strawberries, in triplicates, were treated with each solution (25 drops per 500 mL of distilled water), submerged for 1 minute, dried on sieves, and incubated in sterilized containers for 12 days, analyzing mass loss through descriptive statistical techniques. Five homeopathic preparations were selected (*Calendula officinalis, Staphysagria, Thuya occidentalis, Arsenicum album, and Kalium iodatum*). The homeopathic treatments at 20CH and 200CH showed a lower total mass loss compared to the control vehicles, suggesting better effectiveness of homeopathy. These treatments also exhibited lower visual microbial growth.

INTRODUCTION

Food and dietary patterns are diverse, and food choices are made according to each individual's personal taste, the culture in which they are embedded, price, post-harvest quality, preservation, the time available for food preparation, and ethical and political convictions. These factors can contribute to food and nutritional security or represent an obstacle, making it difficult to achieve for certain populations (Ribeiro; Menezes; Rosa, 2019).

Homeopathy, initially restricted to the field of medicine, has expanded its relevance to various social sectors, including its use in food. As technologies strengthen, homeopathy emerges as a valuable tool to promote a viable and safe alternative for use in the food industry (Altieri, 2002). Deterioration is one of the economic problems encountered in the post-harvest of plant-based foods and consequently affects household economies. Thus, homeopathy arises as a supportive tool in the preservation of these foods, preventing deterioration and microbial growth (Queiroz, 2021).

The structural characteristics, handling, and transportation of plant-based foods are important factors that impact the occurrence of damage, which can intensify the proliferation of microorganisms. Pseudofruits like strawberries, due to the aforementioned factors, have a high vulnerability to fungal growth that is directly related to their shelf life. Strawberries exhibit a high rate of softening and mass loss, which can be caused by damage and injuries during post-harvest. The consequences of this process include a shorter shelf life and lower acceptance by consumers (Contigiani et al., 2018).

From this perspective, the study aimed to analyze the feasibility of homeopathic preparations in controlling the post-harvest deterioration of strawberries. The research sought a safe alternative for the conservation, quality, and durability of strawberries, aiming to reduce losses in commercialization, provide economic advantages to consumers, and control the mass loss of treated samples, as well as the impact of the preparations on the growth of surface fungi in the long term. Thus, the goal was to promote a strawberry conservation system that prioritizes the durability of the pseudofruit, linking pharmaceutical practices to the food industry.

MATERIALS AND METHODS

Based on a quantitative approach of an exploratory and experimental nature, the initial stage of this research was based on carrying out a bibliographic survey to define the homeopathic matrices, dynamizations and powers most appropriate to Hahnemann's concepts. Scientific articles were selected from the CAPES and Scielo databases, scoring the homeopathics used in each study. As a time frame, scientific studies were defined between the years 2004 and 2024. The articles chosen were based on the use of homeopathic preparations in the cultivation and post-harvest of strawberries and foods of plant origin. After selecting the studies, 5 homeopathics were chosen from the 20 selected, with exclusion criteria being the availability and production cost of homeopathic laboratories in the region where the study was carried out. Each homeopathic preparation was produced in two different dynamizations, 20CH and 200CH, previously selected through bibliographical research. These preparations were prepared in accordance with

the standards of RDC nº 67/2007 in a qualified laboratory. Controls/comparison were defined, such as 20% potentized homeopathic vehicle, 20% non-potentized homeopathic vehicle, distilled water and 1% sodium hypochlorite solution as a basis of comparison for the groups that received treatment with homeopathic active ingredients.

The strawberries were acquired in the state of Espírito Santo, Brazil, originating from the mountainous region of the state on May 22, 2024, one day prior to the experiment. The samples followed conventional cultivation standards and were purchased at a fresh produce market at room temperature to simulate the standard routine of consumers, with transportation also carried out under the same temperature conditions. After acquisition, the samples were stored in a refrigerator at a temperature of 10ºC until the experiment was conducted and were subsequently transferred to the laboratory in a vehicle with controlled temperature.

A total of 42 samples were selected randomly divided into the 14 treatments, totaling 3 units for each treatment. The samples were cleaned with distilled water and the cup removed from each one. Adapting the method proposed by Capra (2011), the homeopathic preparations, 20% energized and non-dynamized homeopathic vehicle and 1% sodium hypochlorite were diluted at a concentration of 25 drops per 500 mL of distilled water, homogenized with a glass rod. With the help of a beaker, the three units of strawberries were submerged for 1 minute in each solution respectively, followed by resting in sieves for 1 minute at room temperature for drying. After drying the surface of the strawberries, they were transferred to sterilized plastic boxes with lids and stored in temperature-controlled refrigerators, according to a study adapted by Souza (2022). The

temperature was defined according to the availability of refrigerators, as the equipment contained other materials used in the laboratory, restricting the samples from resting to 10ºC.

Within a period of 12 days, the strawberries were evaluated and weighed on an analytical balance with the help of a watch glass sterilized in a laminar flow hood, as well as checking the temperature at 10ºC with the help of a thermometer, at rest intervals. . The first weighing was on day 1 (before undergoing treatment), day 4, day 7 and finally, day 12. The weighing and evaluation days followed routine and laboratory availability. After the 12-day evaluation period, strawberries were visually evaluated for surface fungal growth and apparent spoilage. The visual results were quantified through photographic records, using a smartphone, in adequate lighting.

The data obtained from the weighing were quantified and analyzed using descriptive statistical techniques (measures of central tendency and dispersion) of the average mass losses, conducted through Microsoft Excel using the "data analysis" tool. The results were expressed through photographic records, as well as standard deviation and the coefficient of variation (%CV), key statistical indicators for assessing the relative dispersion of the data around the mean and, consequently, the predictability of responses for each substance, aiming to explore and establish the effectiveness and quality of homeopathic preparations in relation to mass loss during resting intervals and over a total of twelve days.

RESULTS AND DISCUSSION

According to the methodology, articles highlighting 20 homeopathic medicines used in food were selected, as well as the most commonly adopted dilutions in research, utilizing the SciELO and CAPES databases across various journals and periodicals. Of the twenty selected medicines, five were chosen for the study as presented in frame 1.

The table presents a selection of five homeopathic medicines widely used in food homeopathy studies: *Arsenicum Album, Calendula officinalis, Kali iodatum, Staphysagria* and *Thuya occidentalis*. The choice of these homeopathic medicines was based on the availability of inputs and mother tincture, produced in a qualified laboratory.

Frame I - Relationship of results obtained through the search for articles from the SciELO and CAPES platforms

Article title	**Homeopathic**	**Authors**	**Magazine/Newspaper and year**
In vitro effect of homeopathic medicines on Beauveria bassiana (Bals.) Vuill. (Ascomycota: Cordycipitaceae)	*Kali iodatum*	Silvana Damin, *et al.*	Revista Brasileira de Agroecologia, 2015
Organic calendula production: a case study.	*Calendula officialis*	Borba Elder Tschoseck, *et al.*	Ciência Rural, Volume: 55, 2012

Qualitative analysis of beetroot plants (Beta vulgaris) treated with homeopathic Staphysagria solutions	*Staphysagria*	Simone Grisa, *et al.*	Revista Brasileira de Agroecologia, 2007
Antimicrobial activity against Macrophomina phaseolina and control of gray stem rot in soybeans by the homeopathic medicines Sepia and Arsenicum album	*Arsenicum album*	Eloísa Lorenzetti, *et al.*	Arquivos do instituto biológico, volume 84, 2017
Physiological responses and control of Meloidogyne incognita in tomato plants treated with ultra-diluted solutions of Thuya occidentalis	*Thuya occidentalis*	Mioranza, Thaísa Muriel	BDTD - Biblioteca digital de teses e dissertações, 2015

Source: Own elaboration.

MASS LOSS

The statistical analysis conducted on the 20CH and 200CH dilutions of the homeopathic preparations Calendula officinalis, Staphysagria, Thuya occidentalis, Arsenicum album, and Kalium iodatum, as well as the control vehicles such as distilled water, 1% sodium hypochlorite, dynamized homeopathic vehicle, and non-dynamized vehicle, revealed important insights into the consistency and homogeneity of each substance's responses over the different resting periods. The results of the statistical analyses of mass loss from the 3 units of each treatment are presented in Tables I, II, and III, where the average percentage of mass loss was evaluated over three time intervals: from day 1 to day 4 (the first four days of rest), from day 4 to day 7, and from day 7 to day 12.

Table 1 – Descriptive Measures of Mass Losses (%) between D1 and D4

Variables	Average	Standard deviation	Coefficient of Variation (%)
Calendula officinalis 200 CH	1,32	0,42	31,54
Calendula officinalis 20 CH	2,66	0,75	28,37
Staphysagria 200 CH	2,08	0,42	20,24
Staphysagria 20 CH	2,38	1,09	45,67
Thuya occidentalis 200 CH	2,11	0,69	32,86
Thuya occidentalis 20 CH	1,97	0,83	42,08
Arsenicum album 200 CH	1,81	0,96	52,97
Arsenicum album 20 CH	2,15	0,12	5,64
Kalium iodatum 200CH	2,62	1,69	64,37
Kalium iodatum 20CH	2,38	0,46	19,15
20% energized alcohol	2,16	0,48	22,47
20% non-dynamized alcohol	2,70	0,41	15,40
Distilled water	3,87	1,40	36,27
Sodium Hypochlorite 1%	3,68	0,26	7,29

Source: Own elaboration.

In the first resting interval of 4 days, when evaluating the strawberry samples treated with different homeopathics, it is observed that *Calendula officinalis* 200CH stands out among the treatments, showing the lowest average mass loss value (1.32). This value indicates a low mass loss during the first 4 days of testing.

Arsenicum Album 200CH also stands out in this first interval, presenting the second lowest average among the homeopathics. Although its average mass loss value is lower than that of its 20CH counterpart, it exhibits a higher standard deviation and coefficient

of variation compared to the 20CH dilution, which showed good homogeneity regarding the mass loss of the 3 treated samples.

Comparing the treatments with homeopathic active ingredients to the controls/comparisons, it is noted that the good preservation of mass of the homeopathics Kalium and Thuya stands out, with their low average value in the 20CH dilutions. Similarly, Calendula and Staphysagria also stood out in the 200CH dilution. In this first weighing, the initial effectiveness of the homeopathic preparations in conserving the mass of the samples is observed, as the control vehicles showed low conservation, except for the dynamized and non-dynamized homeopathic vehicles.

According to Table II, in the second time interval, compared to the first, the average results indicate that Arsenicum Album 200CH was the homeopathic preparation with the lowest mass loss over the 2-day period. Staphysagria 20CH also showed low mass loss compared to the first interval, while Calendula maintained a good preservation capacity in both dilutions. However, except for Arsenicum, the other homeopathics in the 200CH dilution exhibited greater mass loss than those in the 20CH dilution, suggesting a variation in the conservation effects observed previously and reflected in Table 1.

Table 2 – Descriptive Measures of Mass Loss (%) between D4 and D7

Variables	Average	Standard deviation	Coefficient of Variation (%)
Calendula officinalis 200 CH	1,24	0,57	46,26
Calendula officinalis 20 CH	1,12	0,28	24,75

Staphysagria 200 CH	1,56	0,42	27,22
Staphysagria 20 CH	1,06	0,44	41,21
Thuya occidentalis 200 CH	1,75	0,60	34,09
Thuya occidentalis 20 CH	1,22	0,39	32,21
Arsenicum album 200 CH	0,99	0,66	66,15
Arsenicum album 20 CH	1,31	0,33	25,36
Kalium iodatum 200 CH	1,50	0,01	6,46
Kalium iodatum 20CH	1,45	0,13	8,97
20% energized alcohol	1,17	0,20	17,45
20% non-dynamized alcohol	0,95	0,16	17,65
Distilled water	1,07	0,18	16,70
Sodium Hypochlorite 1%	1,47	0,19	12,92

Source: Own elaboration.

Comparing the control vehicles to the homeopathics, distilled water showed a high mass loss during this interval, while sodium hypochlorite had the highest loss among the controls. Following the trend observed in the first days of rest (described in Table 1), the dynamized homeopathic vehicle continued to show the lowest mass loss compared to the others, suggesting that dynamized preparations may have a superior preservative effect. However, the non-dynamized homeopathic vehicle recorded the lowest loss among the control vehicles.

In the last four days of analysis, Arsenicum 200CH, which demonstrated a reduced mass loss, showed good preservation capacity compared to Calendula 200CH. A good performance was observed in the treatment with Staphysagria 20CH, establishing it as

the homeopathic preparation that best preserved the samples in the final testing periods. Analyzing the other homeopathics, except for Calendula and Arsenicum, there was a greater mass loss in the 200CH dilution compared to 20CH. As shown in Table III, the average mass loss values for the 200CH and 20CH homeopathic preparations increased in the final days. In this case, these results suggest that although some homeopathics may have helped in preservation during the first two resting periods, their performance could be compromised by fungal growth and possible softening over the days. On the other hand, it is important to highlight the coefficient of variation and standard deviation during this period, demonstrating good homogeneity among the 3 units of treated samples.

Table 3 – Descriptive Measures of Mass Loss (%) between D7 and D12

Variables	Average	Standard deviation	Coefficient of Variation (%)
Calendula officinalis 200 CH	3,90	0,94	24,06
Calendula officinalis 20 CH	3,81	1,31	34,47
Staphysagria 200 CH	3,52	0,60	17,14
Staphysagria 20 CH	2,78	0,49	17,63
Thuya occidentalis 200 CH	4,75	0,81	17,09
Thuya occidentalis 20 CH	3,74	0,79	21,17
Arsenium album 200 CH	3,08	1,06	34,46
Arsenium album 20 CH	3,55	0,78	21,96
Kalium iodatum 200CH	4,63	0,69	14,90
Kalium iodatum 20CH	4,25	0,73	17,23
20% energized alcohol	1,17	0,20	17,45

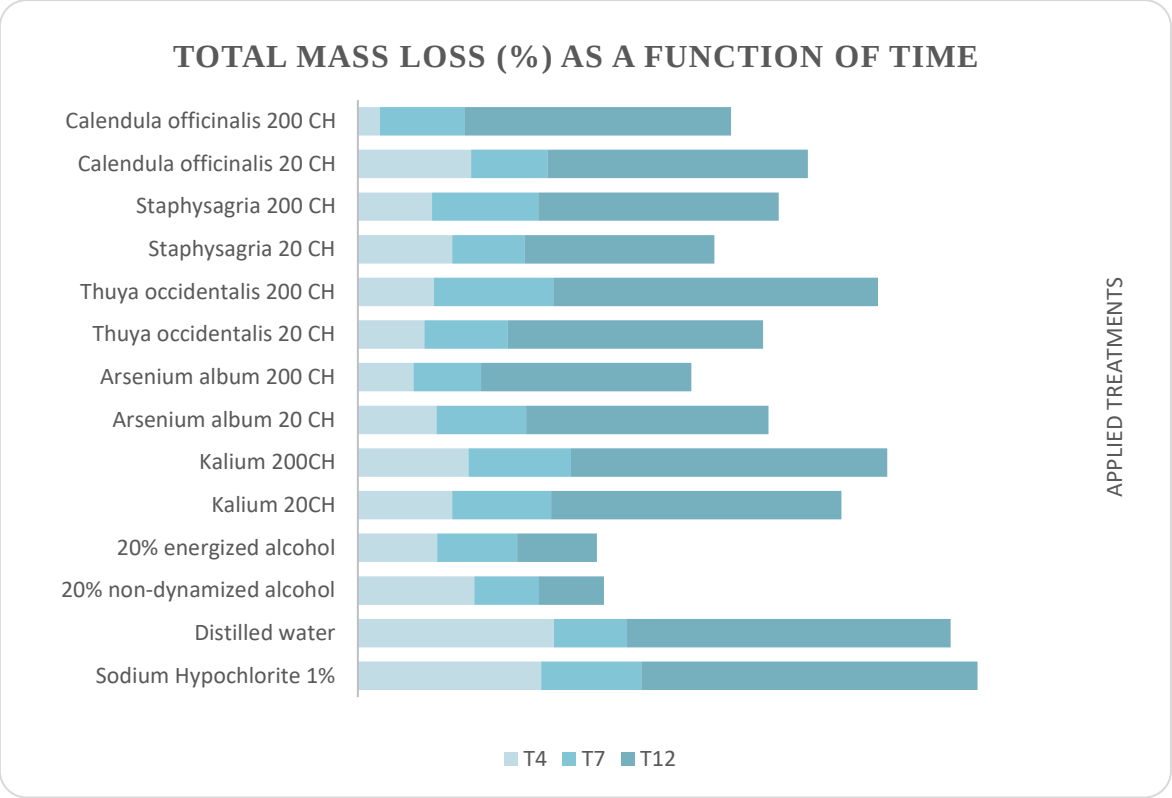
20% non-dynamized alcohol	0,95	0,16	17,65
Distilled water	4,74	0,43	9,08
Sodium Hypochlorite 1%	4,92	0,76	15,53

Source: Own elaboration.

GRAPHIC REPRESENTATION OF THE PERCENTAGE OF MASS LOSS

The performance of homeopaths over the 12 days of the experiment showed statistical variations in each period of analysis, with no homeopath maintaining consistent characteristics of standard deviation, mean and coefficient of variation throughout the study. However, when observing the general percentage of mass loss from dynamizations (Graph 1), there is an emphasis on the conservation of samples treated with dynamized and non-dynamized vehicles, which proved to be more effective in reducing the mass loss of samples. throughout the experiment.

Graph I – Graphical representation of the percentage of mass loss for each treatment



The graph expresses the percentage of mass loss for each group of samples treated with the preparations and comparison vehicles, based on the average of each treated group. It can confirm the previously described results, while generally revealing that among the homeopathics, Arsenicum in 200CH showed the lowest mass loss when analyzing the 12 days of the experiment, taking into consideration the effectiveness of the dynamized alcoholic vehicle, which achieved the best preservation compared to all tested preparations. However, Calendula demonstrated to be the most effective homeopathic in the initial days of analysis, with a lower mass loss than the other groups. When analyzing the last days of observation, Arsenicum in 200CH stood out as the preparation that best

preserved the samples in the long term. It is noteworthy that homeopathics in both 200CH and 20CH dilutions performed equally well.

It is notable that homeopathics in the 200CH and 20CH strengths stood out equally throughout the experiment, demonstrating less mass loss and better conservation of strawberry spoilage in specific periods. Except for distilled water and 1% sodium hypochlorite, the other comparison vehicles showed continuous results, following a pattern since the first time interval. The dynamized and non-dynamized vehicles performed better in relation to the other control/comparison vehicles during the 12 days, especially the 20% alcoholic vehicle dynamized in 20CH, which demonstrated good conservation of the total mass of the three samples treated with the substance.

It is observed that the homeopathics Calendula and Arsenicum in the 200CH dilution showed good preservation compared to the 20CH dilution. However, the other homeopathics demonstrated better preservation in the 20CH dilution, which is a relevant finding, as the homeopathic preparation that best preserved the mass of the samples was Arsenicum in 200CH. It is noteworthy that Calendula in 200CH had the best preservation during the first 4 days of analysis. Considering the better preservation of the dynamized alcoholic vehicle, it is suggested that substances with higher dynamization exhibited lower mass loss, demonstrating greater efficacy.

VISUAL ASPECT OF TREATMENTS WITH BETTER PERFORMANCE

Based on the previously discussed statistical results and photographic records, it is possible to observe the gradual deterioration of the samples over the 12 days of treatment. According to Figure 1 (12-day analysis), sample "B" exhibited fungal growth in the last observation interval, indicating a possible limit to the efficacy of *Arsenicum Album* in 200CH in controlling this type of deterioration, or alternatively, suggesting the possibility of interference from external factors.

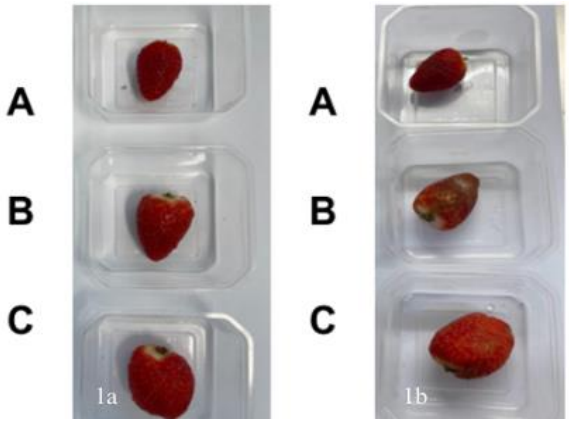


Figure 1: Samples treated with *Arsenicum album* 200CH identified as A, B, and C. Photographic records of the samples on the first and last day of treatment. Superficial fungal growth on sample B (1b).

The treatment with *Arsenicum Album* 200CH stood out by confirming the statistical data, demonstrating superior preservation of the visual and characteristic aspects of the samples throughout the testing period. This efficacy can be observed through the maintenance of color, texture, and overall integrity of the samples, which appeared in visibly better-preserved conditions compared to other treatments.

According to the data presented in Graph 1, the homeopathic treatment applied demonstrated satisfactory results in mass loss during the last testing period. A more detailed analysis of the visual aspects and surface characteristics of the samples reveals some alterations. Noticeable fungal growth and a loss of the original visual characteristics of the fruit, such as color and texture, were observed. This phenomenon raises the hypothesis that sample “B” may have been influenced by external variables not directly related to the treatment itself, such as possible variations in transportation, temperature fluctuations, cultivation conditions, and other environmental factors, since samples A and C remained intact.

Differently from the 200CH dilution, the same homeopathic preparation showed significant results in visual aspects in the 20CH dilution. According to Figure 3, when comparing with the initial state of the samples, it is observed that, in the last incubation period, all samples exhibited initial signs of superficial fungal growth. This suggests that, despite the lower mass preservation compared to the 200CH dilution, the 20CH preparation demonstrated a significant effect in preserving the samples over the 12 days of the experiment, showing only initial superficial damage, which was still barely perceptible, as observed in Figure 2.

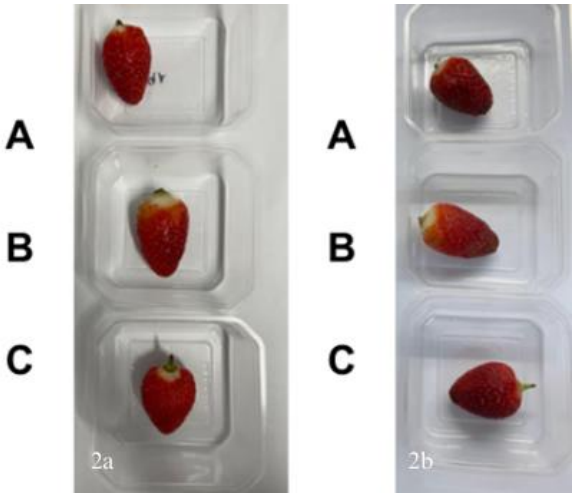


Figure 2: Samples treated with *Arsenicum album* 20CH identified as A, B, and C. Photographic records of the samples on the first and last day of treatment. Preservation of color, texture, and initial characteristics of the samples (2b).

In the records made of the samples treated with *Calendula Officinalis* 200CH, it is observed in Figure 3 that it showed a significant reduction in its ability to preserve the samples during the last incubation interval, with a more pronounced deterioration in visual characteristics such as color and texture compared to previous periods.

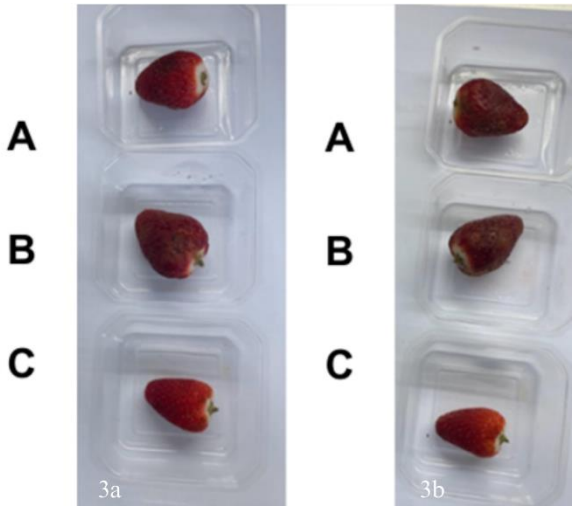


Figure 3: Samples treated with *Calendula officinalis* 200CH identified as A, B, and C. Photographic records of the samples on the first and last day of treatment. Changes in color and texture in the final days of the experiment (3b).

On the seventh day of the experiment, visible changes were observed in the characteristics of samples A and B, confirming the previously obtained results. Initially, the homeopathic preparation stood out for its ability to preserve the mass of the strawberries and maintain the visual appearance of the samples during the early resting intervals.

However, as the experiment progressed into its final phase, a more pronounced deterioration of the samples was noted, particularly concerning texture, color, and consistency. These signs of visual and structural wear corroborate the previous statistical results, indicating that the degradation of the samples tends to intensify with increased incubation time. The trend of more pronounced deterioration in the later phases suggests that the efficacy of the treatment may have diminished over time.

Unlike the other homeopathics tested, *Staphysagria* stood out for its low mass loss in samples treated with 20CH dynamization when compared to 200CH. It can be observed

that samples A and C, despite good initial preservation, there is a progressive loss of the structural characteristics of the strawberries. From the seventh day of incubation, strawberries treated with *Staphysagria* began to suffer visible changes in their characteristics, such as loss of texture and color. Figure 4 illustrates these records, with comparisons between the first and twelfth day of the experiment, showing the evolution of deterioration over time.

Although *Staphysagria* demonstrated good initial performance, like the homeopathic Calendula, the treatment with *Staphysagria* in the 20CH dilution shows failures in visual conservation during the last four days of analysis. These failures indicate that, although the homeopathic was effective for a period, its preservation capacity diminishes as the treatment time progresses, resulting in a more evident deterioration of the samples in the final phases of the experiment.

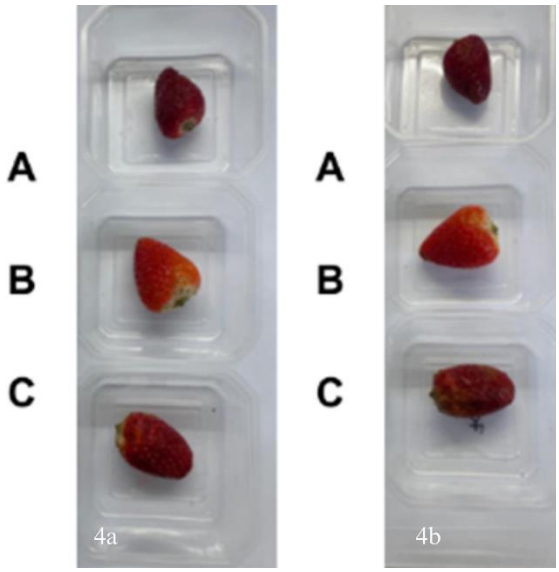


Figure 4: Samples treated with Staphysagria 20CH identified as A, B, and C. Photographic records of the samples on the first and last day of treatment. Loss of coloration (4b) and initial fungal growth in sample C (4b).

AUTHOR CONTRIBUTIONS

The relevance of homeopathy in preserving strawberries is evidenced by the effectiveness of homeopathic preparations, especially *Arsenicum Album, Calendula Offficinalis* and *Staphysagria.* The data obtained demonstrated that these preparations not only presented the lowest mass loss throughout the experiment, but also indicated a good preservation of the visual appearance of the samples. It is important to highlight the effectiveness of the energized homeopathic alcoholic vehicle, which achieved the best preservation of the mass of the samples in relation to all control vehicles. These findings are significant as they offer a viable alternative for use in conjunction with conventional conservation methods, in line with the growing demand for safer and more viable conservation practices.

One of the main contributions of this study is the identification of specific homeopathics that can be used to extend the shelf life of strawberries, along with the rigorous statistical analysis that supported these conclusions. The research shows that, in addition to the potential of homeopathy in agriculture, it also provides insights into the homogeneity of the responses of the preparations at different dilutions within the same potency, highlighting the importance of dynamization in the results obtained.

Through the results, it is feasible to explore combinations of homeopathic preparations and their interactions, as well as the investigation of different types of fruits and vegetables to expand the understanding of the preservative properties of homeopathy. A viable alternative arises from the different profiles of homeopathics that had the best positive effect on the samples, being able to combine them in a formulation, in order to increase the effectiveness of homeopathy in this aspect.

Furthermore, deeper analyses of the mechanisms by which these treatments act in food preservation can enrich existing knowledge and contribute to the development of more viable and effective conservation practices. Continuing this line of research may open new possibilities for the development of products derived from pharmaceutical manipulation, linking the application of homeopathy in the food sector and promoting healthier and safer food production.

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SUBTITLES

Figure 1: Samples treated with *Arsenicum album* 200CH identified as A, B, and C. Photographic records of the samples on the first and last day of treatment. Superficial fungal growth on sample B (1b).

Figure 2: Samples treated with *Arsenicum album* 20CH identified as A, B, and C. Photographic records of the samples on the first and last day of treatment. Preservation of color, texture, and initial characteristics of the samples (2b).

Figure 3: Samples treated with *Calendula officinalis* 200CH identified as A, B, and C. Photographic records of the samples on the first and last day of treatment. Changes in color and texture in the final days of the experiment (3b).

Figure 4: Samples treated with Staphysagria 20CH identified as A, B, and C. Photographic records of the samples on the first and last day of treatment. Loss of coloration (4b) and initial fungal growth in sample C (4b).