



# EFFECT OF DIFFERENT SPICE SOLUTIONS ON THE SHELF LIFE EXTENSION OF RED BANANA STORED AT ROOM TEMPERATURE

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## Abstract

The present investigation was carried out in the Department of Horticulture, Faculty of Agriculture, Annamalai University. The experiment was conducted in a Completely Randomized Design with 13 treatments which were replicated thrice. The treatments consisted of cinnamon and clove essential oil at 0.5, 1 and 1.5 percent and their extracts at 2.5, 5 and 7.5 percent and a control was maintained. The results of the study revealed that the red banana fruits dipped in clove extract at 5 percent ( $T_{11}$ ) significantly increased the shelf life, reduced the physiological loss in weight and fruit spoilage percentage when compared to the control and other spice solution treatments during the fruits stored under room temperature.

**Key Words:** Clove extract, Clove oil, Cinnamon extract, Cinnamon oil, Red banana & shelf life

## Introduction

Banana is one of the oldest fruits known to mankind and also an important food for man. It is otherwise called "Apple of Paradise". Each and every part of banana is effectively utilized, so that it is referred as *kalpatharu* or *kalpakaviruksham*. Among the different bananas, red banana is known for its characteristic flavour and taste and it belongs to Musa AAA group. The plant is robust and tall with a characteristic deep red coloured pseudostem. Red Banana is geographically distributed in southern parts of Kerala and Tamil Nadu.

Since red in colour, the red banana has a high content of anthocyanin which acts like an antioxidant. It also contains B6 vitamin and vitamin D which helps in the metabolism of red blood cells and proteins. One red banana contains 4 grams of fibre, which meets 16 per cent of the daily prerequisite of fibre, it is also a good source of potassium, calcium and iron and are good for children suffering with malnutrition.

Banana is a highly perishable fruit with high post harvest losses. It is estimated that 18 to 22 percent of banana produced, accounting to more than 3 million tonnes lost every year (Narayana and Sathiamoorthy, 2002). Therefore it is imperative to find out ways to reduce

the spoilage during postharvest period.

Bananas are generally treated with the fungicides like Prochloraz and Imazalil to control post harvest pathogens (Khan *et al.*, 2001). Recently increased concerns about the fungicides by many countries have demanded a fresh produce without treatment of any chemicals, particularly fungicides applied after harvest. Additionally, due to continuous use of these fungicides *Colletotrichum musae* has developed resistance and reduced the effectiveness of these synthetic chemicals (Mari *et al.*, 2003).

Due to the continuous use of fungicides *Colletotrichum musae* has developed resistance and reduced the effectiveness of these synthetic chemicals (Mari *et al.*, 2003). Moreover, most of the synthetic preservatives produce several side-effects as carcinogenicity, teratogenicity and residual toxicity (Basilico and Basilico, 1999). The industry is under pressure to minimize the use of these synthetic fungicides employed post harvest to control *Colletotrichum musae* of bananas. To avoid the use of these fungicides, some alternative and efficient methods for the control of this disease are required. In ancient days, spices were used in the preservation of mummies and meat. Considering these facts, spice solutions are used in the preservation of fruits and vegetables in the post harvest studies.

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Essential oils are designated as Generally Regarded as Safe (GRAS) and are regarded as alternatives to chemical preservatives and their use in foods to meet the safety demands of consumers for mildly processed natural products, as reviewed by Burt (2004). Essential oils, also called volatile or ethereal oils; are aromatic oily liquids obtained from plant material (flowers, buds, seeds, leaves, twigs, bark, herbs, wood, fruits and roots). They also possess anti-microbial, antiviral, antifungal, antiparasitic, antioxidant and insecticidal properties.

Many researchers have reported cinnamon and clove oils as a good source of antifungal compounds. A previous study by Ranasinghe *et al.*, (2002) to control the crown rot disease of bananas also confirmed the effectiveness of cinnamon oil. This oil contains compound such as cinnamaldehyde, which has been tested on many fresh fruits such as mandarin, kiwi and rambutan to control postharvest diseases (Arras,1988; Sivakumar *et al.*, 2002). Also, clove oils presented inhibitory effects on the fungi. Zeng *et al.*, (2012) suggested that clove extract might be a viable alternative to synthetic fungicides to extend the post harvest storage period and maintain fruits quality. With this background the present study was carried out to find out the effect of different spice solutions on the shelf life extension of red banana stored at room temperature.

## Materials and Methods

The present investigation was carried out in the Department of Horticulture, Faculty of Agriculture, Annamalai University. The experiment was conducted in a Completely Randomized Design with 13 treatments

**Table 1:** Effect of spice solution on physiological loss in weight (%) of red banana.

Treatments	Physiological loss in weight (%)				
	3 <sup>rd</sup> day	5 <sup>th</sup> day	7 <sup>th</sup> day	9 <sup>th</sup> day	11 <sup>th</sup> day
T <sub>1</sub> Cinnamon oil 0.5%	8.97	10.49	11.60	8.47	7.76
T <sub>2</sub> Cinnamon oil 1.0%	8.97	10.43	11.54	8.45	7.75
T <sub>3</sub> Cinnamon oil 1.5%	9.14	10.98	12.65	8.96	8.05
T <sub>4</sub> Clove oil 0.5%	8.79	9.82	10.59	7.95	7.50
T <sub>5</sub> Clove oil 1.0%	8.43	8.59	9.09	7.15	6.97
T <sub>6</sub> Clove oil 1.5%	8.98	10.53	11.64	8.48	7.76
T <sub>7</sub> Cinnamon extract 2.5%	9.15	11.08	12.77	9.01	8.06
T <sub>8</sub> Cinnamon extract 5%	9.15	11.01	12.72	8.99	8.06
T <sub>9</sub> Cinnamon extract 7.5%	9.16	11.11	12.84	9.06	8.07
T <sub>10</sub> Clove extract 2.5%	8.61	9.19	9.86	7.63	7.22
T <sub>11</sub> Clove extract 5%	8.25	7.97	8.27	6.84	6.48
T <sub>12</sub> Clove extract 7.5%	9.17	11.16	12.87	9.09	8.07
T <sub>13</sub> Control	9.33	11.59	13.49	9.40	8.33
S.Ed	0.08	0.17	0.21	1.04	0.12
CD (P=0.05)	0.15	0.34	0.42	2.07	0.23

which were replicated thrice. The treatments consisted of cinnamon and clove essential oil at 0.5, 1 and 1.5 percent and their extracts at 2.5, 5 and 7.5 percent and a control was maintained. Fully mature but unripe fruits were washed and immersed in spice oil solutions and extracts for 3 minutes and then the fruits were surface dried at room temperature (28±2°C). The initial fruit weight was measured and kept under room conditions for recording observations. The details of the treatment are, T1 - Cinnamon oil 0.5%, T2- Cinnamon oil 1.0%, T3- Cinnamon oil 1.5%, T4- Clove oil 0.5%, T5- Clove oil 1.0%, T6- Clove oil 1.5%, T7- Cinnamon extract 2.5%, T8- Cinnamon extract 5%, T9- Cinnamon extract 7.5%, T10- Clove extract 2.5%, T11- Clove extract 5%, T12- Clove extract 7.5%, T13- Control. The effect of different treatments were evaluated based on their influence on the physical traits *viz.*, shelf life, physiological loss in weight and fruit spoilage percentage and the results were analyzed statistically (Panse and Sukhatme 1978). The different methods followed to estimate various physical parameters are given below.

### Physiological loss in weight

The initial weight of fruits was recorded at the beginning of the experiment and the final weight was recorded on 3<sup>rd</sup>, 5<sup>th</sup>, 7<sup>th</sup>, 9<sup>th</sup> and 11<sup>th</sup> day of storage. Physiological loss in weight was calculated using the following formula and expressed in percentage.

Physiological loss in weight (%) =

$$\frac{\text{initial fruit weight} - \text{fruit weight}}{\text{Initial fruit weight}} \times 100$$

### Fruit spoilage percentage

The number of spoiled fruits was recorded at three days interval after imposing the treatments and calculated as percentage of the total number of fruits using the following formula.

Spoilage percentage =

$$\frac{\text{Number of rotten fruits}}{\text{Total number of fruits}} \times 100$$

### Shelf life

When 60-70 per cent of the stored fruits under each treatment become unfit for consumption, that stage was considered as the end of shelf life period of the concerned treatment and was expressed in days.

## Results and Discussion

The data on the effect of spice solutions on physiological loss in weight (%) of fruits on 3<sup>rd</sup>, 5<sup>th</sup>

**Table 2:** Effect of spice solution on fruit spoilage percentage in red banana

Treatments	Fruit spoilage percentage (%)			
	5 <sup>th</sup> day	7 <sup>th</sup> day	9 <sup>th</sup> day	11 <sup>th</sup> day
T <sub>1</sub> Cinnamon oil 0.5%	---	8.56	30.79	58.71
T <sub>2</sub> Cinnamon oil 1.0%	---	8.38	30.19	58.01
T <sub>3</sub> Cinnamon oil 1.5%	---	10.52	35.52	64.48
T <sub>4</sub> Clove oil 0.5%	---	7.17	25.89	51.79
T <sub>5</sub> Clove oil 1.0%	---	4.95	17.76	42.37
T <sub>6</sub> Clove oil 1.5%	---	8.71	31.29	59.61
T <sub>7</sub> Cinnamon extract 2.5%	---	10.85	36.52	66.28
T <sub>8</sub> Cinnamon extract 5%	---	10.69	36.22	65.58
T <sub>9</sub> Cinnamon extract 7.5%	---	11.04	37.12	67.48
T <sub>10</sub> Clove extract 2.5%	---	6.17	22.18	46.58
T <sub>11</sub> Clove extract 5%	---	3.72	13.75	36.16
T <sub>12</sub> Clove extract 7.5%	---	11.19	37.52	68.28
T <sub>13</sub> Control	---	13.11	43.11	73.51
S.Ed		0.40	1.16	1.47
CD (P=0.05)	---	0.79	2.32	2.94

7<sup>th</sup>, 9<sup>th</sup> and 11<sup>th</sup> day after treatments are presented in the Table 1. Significant differences on physiological loss in weight was observed due to the influence of different spice solution treatments. Among the treatments the minimum percentage of physiological loss in weight was recorded in the fruits dipped in clove extract at 5 per cent (T<sub>11</sub>) which registered the values of 8.25, 7.97, 8.27, 6.84 and 6.48 percent at 3<sup>rd</sup>, 5<sup>th</sup>, 7<sup>th</sup>, 9<sup>th</sup> and 11<sup>th</sup> day after treatments respectively. The next best treatment was T<sub>5</sub> (clove oil at 1.0 per cent) which registered the physiological loss in weight of 8.43, 8.59, 9.09, 7.15 and 6.97 at 3<sup>rd</sup>, 5<sup>th</sup>, 7<sup>th</sup>, 9<sup>th</sup> and 11<sup>th</sup> day after treatments per cent respectively. The maximum physiological loss in

**Table 3:** Effect of spice solution on shelf life (days) of red banana.

Treatments	Shelf life (days)	% Over Control
T <sub>1</sub> Cinnamon oil 0.5%	9.64	36.93
T <sub>2</sub> Cinnamon oil 1.0%	9.79	39.06
T <sub>3</sub> Cinnamon oil 1.5%	8.88	26.14
T <sub>4</sub> Clove oil 0.5%	9.96	41.48
T <sub>5</sub> Clove oil 1.0%	11.11	57.81
T <sub>6</sub> Clove oil 1.5%	9.07	28.84
T <sub>7</sub> Cinnamon extract 2.5%	8.52	21.02
T <sub>8</sub> Cinnamon extract 5%	8.72	23.86
T <sub>9</sub> Cinnamon extract 7.5%	8.34	18.47
T <sub>10</sub> Clove extract 2.5%	10.56	50.00
T <sub>11</sub> Clove extract 5%	11.73	66.62
T <sub>12</sub> Clove extract 7.5%	7.68	9.09
T <sub>13</sub> Control	7.04	0.00
S.Ed	0.20	---
CD (P=0.05)	0.41	---

weight of 9.33, 11.59, 13.49, 9.40 and 8.33 per cent respectively were recorded in the control (T<sub>13</sub>). Among the treatments T<sub>4</sub>; T<sub>2</sub>; T<sub>1</sub>; T<sub>6</sub>; T<sub>3</sub>; T<sub>8</sub> and T<sub>7</sub>; T<sub>9</sub> lied on par with each other.

From the results presented in the Table 2 it is observed that the effect of spice solutions on the fruit spoilage percentage at 7<sup>th</sup>, 9<sup>th</sup> and 11<sup>th</sup> day after treatment was found to be significant. A progressive reduction in the fruit spoilage was observed in all the spice solution treatments. Among the various treatments the clove extract at 5 percent (T<sub>11</sub>) registered the least spoilage percentage of 3.72, 13.75 and 36.16 respectively at 7<sup>th</sup>, 9<sup>th</sup> and 11<sup>th</sup> day after treatment followed by T<sub>5</sub> (clove oil at 1.0 per cent) which recorded 4.95, 17.76 and 42.37 per cent respectively. The maximum spoilage percentage of 13.11, 43.11 and 73.51 per cent at 7<sup>th</sup>, 9<sup>th</sup> and 11<sup>th</sup> day after treatment respectively were observed in the control (T<sub>13</sub>). Among the treatments T<sub>4</sub>; T<sub>2</sub>; T<sub>1</sub>; T<sub>6</sub>; T<sub>3</sub>; T<sub>8</sub> and T<sub>7</sub>; T<sub>9</sub> lied on par with each other.

It can be inferred from the data given in the Table.3 that the shelf life (days) varied significantly among the various treatments. The shelf life was maximum (11.73 days) in the fruits dipped in clove extract at 5 percent (T<sub>11</sub>) which recorded an increase of 66.62 percent over the control. The next best treatment was T<sub>5</sub> (clove oil at 1.0 %) which extended the shelf life up to (11.11 days) which was 57.81 percent higher over the control. The shelf life of fruit was least (7.04 days) in the control (T<sub>13</sub>).

The reduction in weight loss and extension of shelf life was probably due to the effect of clove extract in reducing the water vapour exchange or oxidation process was clear. Further, weight loss of the fruit is mainly related with respiration and moisture transfer through their surface. Evaporation of water activated by a gradient of vapour pressure at different locations in fruit is contributing to weight loss (Zhou *et al.*, 2008). These results are in accordance with the findings of Sanchez-Gonzalez *et al.*, (2011) in grapes, Joshi *et al.*, (2017) in papaya and Fatma *et al.*, (2017) in guava.

The decrease in spoilage percent might be due to the effect of clove extract that suppressed spoilage in fruits not only with their antimicrobial properties but also with their promotion of decay resistance in the fruit tissues through increasing the amounts of phenolic compounds, anthocyanins, flavonoids and antioxidant capacities (Wang *et al.*, 2007). The results of the present study are in conformity with the findings of Ranasinghe *et al.*, (2005) in banana, Rong Zeng *et al.*, (2012) in navel orange and Vesaltalab *et al.*, (2012) in grapes.

## Conclusion

From the results of the present study it is clear that the fruits dipped in clove extract at 5 per cent can be recommended for extending the shelf life, improving the physical parameters of red banana fruits stored at room temperature.

## References

- Arras, G. (1988). Antimicrobial activity of various essential oils and their isolates for blue mould decay control in *Citrus reticulata* Blanco. *J. Food Sci. Technol.*, **14**: 14–16.
- Basilico, M.Z and J.C. Basilico (1999). Inhibitory effects of some spice essential oils on *Aspergillus ochraceus* NRRL 3174 growth and ochratoxin A production. *Letters in Appl. Microbiol.*, **29**: 238-241.
- Burt, S. (2004). Essential oils: their antibacterial properties and potential applications in foods- a review. *Int. J. food Microbiol.*, **94**: 223-253.
- Joshi, A.V., N.S. Baraiya, P.B. Vyas and T.R. Rao (2017). Gum Ghatti Based Edible Coating Emulsion with an Additive of Clove Oil Improves the Storage Life and Maintains the Quality of Papaya (*Carica papaya* L., cv. Madhubindu). *Int. J. Curr. Microbiol. Appl. Sci.*, **6(5)**: 160-174.
- Khan, S.H., J. Aked and N. Magan (2001). Control of the anthracnose pathogen of banana (*Colletotrichum musae*) using antioxidants alone and in combination with thiabendazole or imazalil. *Pl. Pathol.*, **50(5)**: 601-608.
- Mari M., P. Bertolini and G.C. Pratella (2003). Non conventional methods for the control of post-harvest pear diseases. *J. Appl. Microbiol.*, **94**: 761-766.
- Narayana, C.K. and S. Sathiamoorthy (2002). Value addition and product 31 October. 2002. Association of the Improvement in Production and Utilization of Banana, Bangalore. Abstract 223.
- Panase, V.G. and P.V. Sukhatme (1963). Statistical methods for agricultural workers. I.C.A.R. Publication, New Delhi.
- Ranasinghe, L., B. Jayawardena and K. Abeywickrama (2005). An integrated strategy to control post harvest decay of Embul banana by combining essential oils with modified atmosphere packaging. *Int.J.food Sci. Technol.*, **40(1)**: 97-103.
- Ranasinghe, L., B. Jayawardena and K. Abeywickrama (2002). Fungicidal activity of essential oils of *Cinnamomum zeylanicum* L. and *Syzygium aromaticum* L. Merret LM Perry against crown rot and anthracnose pathogens isolated from banana. *Letters in Appl. Microbiol.*, **35(3)**: 208-211.
- Rong Zeng, Ashan Zhang, Jinyin Chen. and Fu. Yongqi (2012). Postharvest quality and physiological responses of clove bud extract dip on 'Newhall' navel orange. *Scientia Hort.*, **138**: 253-258.
- Sánchez-González, L., C. Pastor, M. Vargas, A. Chiralt, C. González-Martínez and C. Cháfer (2011). Effect of hydroxypropylmethyl cellulose and chitosan coatings with and without bergamot essential oil on quality and safety of cold stored grapes. *Postharvest Biol. Technol.*, **60**: 57–63.
- Sivakumar, D., R.W. Wijeratnam, R.L.C. Wijesundera and M. Abeysekere (2002). Control of postharvest diseases of rambutan using cinnamaldehyde. *Crop Prot.*, **21(9)**: 847-852.
- Vesaltalab, Z., M. Gholami and D. Zafari (2012). Clove buds (*Eugenia caryophyllata*) and Rosemary (*Rosmarinus officinalis*) essential oils effects on control of grapes gray mould in-vitro. *Ann. Biol. Res.*, **3**: 2447-2453.
- Wang, C.Y., S.Y. Wang, J.J. Yin, J. Parry and L.L. Yu (2007). Enhancing antioxidant, antiproliferation, and free radical scavenging activities in strawberries with essential oils. *J. Agric. food chem.*, **55(16)**: 6527-6532.
- Zeng, R., A. Zhang, J. Chen and Y. Fu (2012). Postharvest quality and physiological responses of clove bud extract dip on 'Newhall' navel orange. *Scientia Hort.*, **138**: 253-258.
- Zhou, R., M. Yun, Y. Li, Z. Yanyun, G. Zhang and H. Yunsheng (2008). Quality and internal characteristics of Huanghua pears (*Pyrus pyrifolia* Nakai, cv. Huanghua) treated with different kinds of coatings during storage. *Postharvest Biol. Technol.*, **49**: 171–179.