



REGULAR ARTICLE

ENHANCEMENT OF SHELF-LIFE OF TOMATOES USING HERBAL EXTRACTS

C. Surekha¹, K.V. Chethan Kumar^{1*}, R. Lakshmipathy²

¹Department of Microbiology MSRCASC, Bangalore-560054, India

²Agricultural Research Station, ANGRAU, Amadalavalasa-532185, Bangalore, India

SUMMARY

A study was taken up to enhance the shelf life of tomatoes by using Garlic (*Allium sativum* Linn) and Ginger (*Zingiber officinale* Rose) extracts at different concentrations viz, 1%, 5% and 10%. Tomatoes keeping quality was improved by spraying 10% garlic and ginger extracts, which reduced the spoilage, physiological loss and microbial load on the surface of the fruits. Among these, 10% garlic extract was more efficient in controlling spoilage microorganisms, enhancing shelf life and reducing physiological weight loss. This study revealed the possibility of utilization of Garlic (*Allium sativum* Linn) and Ginger (*Zingiber officinale* Rose) extracts to enhance the keeping quality of tomatoes.

Keywords: Shelf life, *Allium sativum*, *Zingiber officinale*.

C. Sureka et al. Enhancement of Shelf-Life of Tomatoes Using Herbal Extracts. J Phytol 1 (2010) 013-017

*Corresponding Author, Email: cvkumarchethan@rediffmail.com

1. Introduction

Many fruits and vegetables are perishable especially in tropical and subtropical regions without adequate refrigeration (Coursey, 1983). The magnitude of post harvest losses in fresh fruits and vegetables is estimated to be 25.80 % (Thirupathi, 2006). Tomatoes are cultivated throughout tropical and subtropical regions (Slunkhe and Desai, 1984). Most of the product is lost after the harvest because of inadequate handling and preservation methods (Wills *et al.*, 1981; Liu and Ma, 1983) and also it is extremely difficult to harvest fresh tomatoes and vegetables without causing injury (Pantastico *et al.*, 1975). The people in developing countries often cannot afford use the cold storage facilities (Liu and Ma, 1983) that may be because of lack of capital or lack of technical knowledge to small scale growers and retailers in these areas (Pantastico and

Bautista, 1976).

Simple post harvest treatments are required for the preservation of tomatoes especially in the developing countries. Inaba and Crandall (1986) recommended the use of simple cold shock treatment to increase the shelf life of tomatoes without using cold storage. The extracts of many herbal plants showed antimicrobial activity (Sheik and Agnihothri, 1972). Kappo (1997) tested antifungal activity of fresh juice and aqueous extracts of turmeric and ginger against the fungi *Aspergillus niger* and *Penicillium digitatum*. There are some reports of using plant extracts as bio-preservatives to enhance the shelf life of tomatoes during storage. Hasabins and D'Souza (1988) showed the effect of natural plant products on storage rot of tomatoes,

where the fruits dipped in the plant extracts had reduction in the diseases incidence. Ayala-Zavala *et al* (2008) showed that antimicrobial treatments enhanced quality and bioactive compounds of fresh cut tomatoes. Hence, this study was taken up to evaluate the Garlic and Ginger extracts to enhance the shelf life of tomato during storage.

2. Materials and Methods

Ripened tomatoes were obtained from Yeshwanthpur vegetable market, retail shop from Mathikere and Sanjaynagar of Bangalore. The collected sample were placed in sterile polythene bags and made air tight. The tomatoes were subjected to microbiological analysis

The whole tomato was squeezed under aseptic condition and 10 gm of the sample was suspended in 90 ml of sterile physiological saline and serially diluted. The microbial load of the raw tomatoes was estimated by standard dilution method by using Nutrient Agar (For bacteria) and MRBA (For fungi) and the dominant microbial isolates were characterized up to genus level.

Plant extract preparation

Aqueous extracts of garlic (*Allium sativum* Linn) and ginger (*Zingiber officinale* Rose) were prepared by blending and squeezing of bulbs and rhizomes respectively by following the method described by Singh and Majumdar (2001). The bulbs of garlic and Rhizomes of ginger were cleaned and washed. The samples were blended by adding sterile in 1:1 (w/v) proportion to get fine texture. The blended material was then squeezed by using sterile muslin cloth to get extract. Further it was filtered through whatmann filter paper to have a clear solution this served as 100% concentration and then filter sterilized.

Screening of the plant extracts for their antimicrobial properties

The antimicrobial activity of the extracts on the microbial isolates from the tomato was

studied by following modified media method. The extracts in different concentration were mixed with the Nutrient Agar and MRBA and were poured to sterile plates. Bacterial and fungal isolates inoculated onto NA and MRBA plates by streaking and point inoculation methods respectively. NA plates were incubated at 37 C for Two days and MRBA plates were incubated for Six days at room temperature. The observations were recorded in terms of resistance of growth in centimeters by measuring the colony diameter by taking average reading from four directions.

Shelf life studies on tomato

Matured, uniform sized, undamaged healthy ripened tomatoes were randomly selected and subjected to various treatments. The tomatoes were sprayed with the extract and then air dried. The untreated and treated tomatoes were bagged in a perforated polythene cover and kept at room temperature. Observations were recorded on the 1st, 3rd, 6th and 10th day. The spoilage percentage was calculated by following equation

Spoilage percentage = $\frac{\text{Number of tomatoes spoiled}}{\text{Total number of tomatoes}} \times 100$

Total number of tomatoes

Physiological loss of weight (PLW) was calculated as percent loss of weight

Loss of weight of spoiled tomato $\times 100$

PLW = $\frac{\text{Initial weight of tomato}}$

3. Results

The dominant bacteria isolated from tomato samples were *Bacillus*, *E.coli*, *Micrococcus*, *Staphylococcus*, *Erwinia*, *Pseudomonas*. *Rhizopus*, *Penicillium* and fungi were *Fusarium*. *Trichoderma*. *Aspergillus*, *Cladosporium* and *Alternaria*. The microbial isolates when treated with ginger and garlic extracts at different concentrations, the growth of these isolates was suppressed. The ginger extract at 1% concentration did not have much effect on both bacterial and fungal isolates but at 5% and 10% concentration the growth was suppressed. Garlic extracts comparatively

showed a good antimicrobial activity even at 1% concentration. At 10% concentration the microbial growth was completely inhibited.

Table 1: Antimicrobial activity of ginger extract on fungi

Organisms	Fungal growth at different concentration of ginger extract (Diameter of the colony in cms)			
	0%	1%	5%	10%
<i>Rhizopus</i>	9.0	9.0	9.0	9.0
<i>Penicillium</i>	6.0	4.0	3.6	3.3
<i>Fusarium</i>	7.2	6.7	5.0	3.2
<i>Trichoderma</i>	9.0	9.0	9.0	7.0
<i>Aspergillus</i>	9.0	9.0	6.3	5.0
<i>Cladosporium</i>	2.0	1.6	1.2	1.0
<i>Alternaria</i>	3.6	3.4	2.5	2.3

Note: Values are average diameter of colonies on three plates.

Table 2: Antimicrobial activity of garlic extract on fungal growth (diameter of colony in cm)

Organisms	Fungal growth at different concentration of garlic extract (Diameter of the colony in cms)			
	0%	1%	5%	10%
<i>Rhizopus</i>	9.0	9.0	4.0	2.0
<i>Penicillium</i>	5.0	3.2	2.6	2.2
<i>Fusarium</i>	6.2	4.0	0.0	0.0
<i>Trichoderma</i>	6.0	5.5	4.3	0.2
<i>Aspergillus</i>	9.0	9.0	6.3	5.0
<i>Cladosporium</i>	3.0	2.5	1.6	1.0
<i>Alternaria</i>	3.0	2.3	2.3	1.6

Note: Values are average diameter of colonies on three plates.

Table 3: Antimicrobial activity of ginger extract on bacterial growth

Organisms	Bacterial growth at different concentration of ginger extract (Diameter of the colony in cms)			
	Control (0%)	1%	5%	10%
<i>Bacillus</i>	+++	+++	++	++
<i>E.coli</i>	+++	+++	++	+
<i>Micrococcus</i>	+++	+++	++	++
<i>Staphylococcus</i>	+++	+++	++	++
<i>Erwinia</i>	+++	+++	+	+
<i>Pseudomonas</i>	+++	+++	++	++
Unidentified	+++	+++	++	++

Note: +++: Good growth; ++: Moderate growth; +: Less growth; 0: No growth

The spoilage percent of the tomatoes treated with 10% extract after 10 days was 26.60 whereas, spoilage percent of the tomatoes treated with 1% and 5% was 53.00 and 33.33 respectively. Tomatoes treated with 10% ginger extract the spoil percent was 33.33 after 10 days of storage whereas, with 5% ginger extract the spoilage percent was 60 but 1% ginger extract did not show any significant affect. Physiological loss of weight (PLW) of 0.63% observed in the tomatoes treated with 10% Garlic extract after 10 days of storage followed by 0.95% PLW of tomatoes treated with 10% ginger extract, 1.01% PLW of tomatoes treated with 5% garlic extract, 1.3% PLW of tomatoes treated with 1% garlic extract, 2% PLW of tomatoes treated with 5% ginger extract, 3.9% PLW of tomatoes treated with 1% ginger extract and 4.2% was recorded in the untreated tomatoes.

4. Discussion

The fruits normally exposed to large number of microorganisms of soil born, air

born or may be introduced from the surface of plant (Andrews and Hirano, 1992). The spoilage of the fruits during post-harvest storage is due to infection by these microorganisms which gain entry through stomatal openings, lenticels, growth cracks or surface injuries (Wills et al, 1981).

Table 4: Antimicrobial activity of garlic extract on bacteria

Organisms	Bacterial growth at different concentration of garlic extract (Diameter of the colony in cms)			
	Control (0%)	1%	5%	10%
<i>Bacillus</i>	+++	+++	++	0
<i>E.coli</i>	+++	+++	++	0
<i>Micrococcus</i>	+++	+	+	0
<i>Staphylococcus</i>	+++	+++	++	+
<i>Erwinia</i>	+++	+	+	0
<i>Pseudomonas</i>	+++	++	+	0
Unidentified	+++	+	+	0

Note: +++: Good growth; ++: Moderate growth; +: Less growth; 0: No growth

Table 5: Shelf life studies of tomatoes treated with garlic extract and ginger extract

Treatment	Spoilage %			
	1 st day	3 rd day	6 th day	10 th day
Control	00	25	60	100
1 % garlic extract	00	00	46	53
5 % garlic extract	00	00	20	33.33
10 % garlic extract	00	00	13.3	26.6
1 % ginger extract	00	25	60	100
5 % ginger extract	00	20	53.33	60
10 % ginger extract	00	6.66	20	33.33

Table 6: Physiological weight loss (PLW) percentage in tomatoes treated with garlic and ginger extract

Treatment	PLW %			
	1 st day	3 days	6 days	10 days
Control	00	01	2.3	4.2
1 % garlic extract	00	00	0.7	1.3
5 % garlic extract	00	00	0.7	1.01
10 % garlic extract	00	00	0.3	0.63
1 % ginger extract	00	1.0	2.0	3.9
5 % ginger extract	00	0.8	1.2	2.0
10 % ginger extract	00	0.2	0.5	0.95

Note: Weight loss is expressed as % weight loss

Several plant extracts or plant products have broad spectrum antimicrobial properties. They can be recognized as bio-preservatives having no harmful effects on human health. Therefore herbal extracts are promising for use with fruits to enhance the shelf life. They are safe and non-toxic, their application is simple and do not lose their efficacy at normal storage temperature. The use of herbal extracts has opened a new avenue for the control of spoilage (Shivpuri et al 1977). The extracts of garlic and ginger in 10 % concentration were inhibitory for most of bacterial and fungal isolates except for *Rhizopus* and *Aspergillus* in the present study. It is also noticed that as concentration of the extract increases, the effectiveness of extracts also increased. This type of results was observed by Sharma and Bohora (2003) with leaf extracts of *Barehaevia diffusa*, *Salvadora*

persica. Dubey and Dwivedi (1991) reported the antifungal properties of garlic extracts on *Macrophoma phaseolina*. The extracts of *Azadirachta indica*, *Oscimum sanctum* and *Ricinus communis* were most effective in controlling banana rot (Singh *et al*, 1993). The extracts of turmeric and ginger were effective in arresting growth of *Aspergillus niger* and *Penicillium digitatum* (Kappo, 1997).

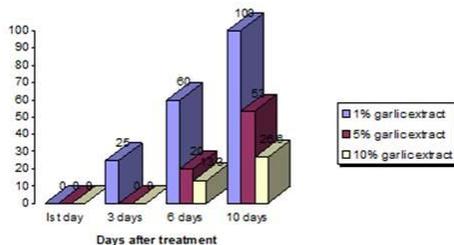


Fig 1: Shelf life studies of tomatoes treated with garlic extract given in spoilage percent

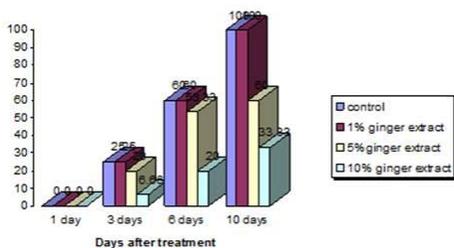


Fig 2: Shelf life studies of tomatoes treated with ginger extract given in spoilage percent

The Tulsi leaf extracts contain polyamine biosynthesis inhibitor which block ornithine decarboxylase pathway which could be exploited to control fruit rots (Patil *et al*, 1992). Spraying of tomato fruits with 10% garlic and ginger extract showed lesser spoil percentage. This significantly reduced the extent of spoilage. These results were on par with the observations of Hasabnis and D'Souza (1998) they recorded a spoil percent of 23 in alphonso fruits dipped in 10 % garlic extract. Significantly lower PLW percentage was recorded in the tomato fruits sprayed with 10% garlic extract followed by 10% ginger extract. There was a direct relationship was observed between the cumulative physiological weight loss and spoilage i.e. a high rate of PLW attributed to the spoilage of fruits (Gupta and

Mukherjee, 1990).By the use of natural antimicrobials like herbal extracts can enhance the shelf-life and bioactive compounds of fresh-cut tomatoes, maintaining or increasing the contents of lycopene, ascorbic acid and total phenolic compounds (Ayala-Zavala, 2008).Application of garlic and ginger extracts can enhanced the helf life of tomato and this low cost technology can be better utilized for preservation of raw tomatoes

5. Acknowledgements

We are indebted to Directors, CEO, Principal and HOD Department of Microbiology MSRCASC, Bangalore for their constant support and encouragement.

References

- Andrews, H.J and Hirano, S.S. 1992. Microbial ecology of leaves. Brock Springer series in contemporary bioscience, New York, pp. 1-499.
- Ayala-Zavala, J.F., Oms-Oliu, G., Odriozola-Serrano, I., Gonzalez-Aguilar, G.A., Alvarez-Parrilla, E and Martin-Belloso, O. 2008. Biopreservation of fresh-cut tomatoes using natural antimicrobials. *Eur. Food Res. Technol.* **226**: 1047-1055.
- Coursey, D.G. 1983. Postharvest losses in perishable foods of the developing world, p. 485-515. **In:** M. Liberman (ed.). Postharvest physiology and crop preservation. Plenum Press, NY.
- Dubey, D.R.C and Dwivedi, R.S. 1991. Fungi toxic properties of some plant extracts against vegetative growth and sclerotial viability of *Macrophoma phaseolina*. *Indian Phytopath.* **44**: 411-413.
- Gohil, V.P and Vala, D.G.1996. Effects of extracts of some Medicinal plants on the growth of *Fusarium moniliforme*. *Indian Mycol. Pl. Pathol.* **26**(1): 110-111.
- Hasabnis, S.N and 'Souza, T.F. 1988. Use of natural Plant products in the control of the storage rot of Alphonso Mango fruits. *J. Maharashtra Agric. Univ.* **12** (1): 105-106

- Inaba, M and Crandall, P.G .1986. Cold Shock treatment of mature green tomatoes to delay color development and increase shelf-life during room temperature storage. *Proc. Fla. State Hort. Soc.* **99**: 143-145.
- Kapoor, A. 1997. Antifungal activities of fresh juice and aqueous extracts of turmeric and ginger. *J. Phtological Res.* **10**: 59-62.
- Liu, M.S and P.C. Ma. 1983. Post harvest problems of vegetables and fruits in the tropics and subtropics. Asian Vegetable Research and Development Center.10th anniversary Monograph Series. Taiwan, China.
- Pantastico, Er.B. and Bautista, O.K. 1976. Postharvest handling of tropical vegetable crops. *Hort Science.* **11** (2): 122-124.
- Patil, R.K., Patel, K.D., Sharma, A and Pathak, V.N. 1992b. Inhibition effect of *Ocimum sanctum* extract on fruit rot fungi. *Indian J. Mycol. Pl. Pathol.* **22** (2) 199-200.
- Salunkhe, P.K and Desai. 1984. Postharvest biotechnology of vegetables. CRC Press, Boca Raton, FL.
- Sharma, S and Bohra, A. 2003. Effect of extracts of some medicinal plants on *Fusarium oxysporum* var.cumini. *Indian J. Mycol. Pl. Pathol.* **33** (2): 323-324.
- Sheik, A and Agnihotri, J.P. 1972. Antifungal properties of some plant extracts. *Indian J Mycol and Pl. Pathol.* **2**: 142-146.
- Shivpuri, A., Sharma, O.P and Jhamaria, S.L. 1997. Fungitoxic property of plant extracts against pathogenic fungi. *J. Mycol. Pl. Pathol.* **27** (1): 29-31.
- Singh, J and Majumdar, V.L. 2001. Efficacy of plant extracts against *Alternaria alternata* the incitant of fruit rots of pomegranate. *J Mycol. Pl. Pathol.* **31**(3): 346-349.
- Sundaraj, I.V., Kurucheve and Jayaraj, J. 1996. Screening of higher plants and animal faeces for the fungal toxicity against *Rhizoctonia solani*. *Indian Phytopath.* **49** (4): 398-403.
- Singh, H.N.P., Prasad, M.M and Sinha, K.K. 1993. Evaluation of Medicinal Plant extracts against banana rot. *J. Ind. Bot. Soc.* **72**: 163-164.
- Thirupathi, V., Sasikala, S and John Kennedy, Z. 2006. Preservation of fruits and vegetables by wax coating. In: Science Tech Entrepreneur (Eds. Mittal, H. K et al), NSTEDB, DST. Delhi pp1-10.
- Wills, R.H., Lee, T.H., Graham, D., Mcglassom, W.B and Hall, E.G. 1981. An introduction to the physiology and handling of fruits and vegetables. London. NY pp 1-162.