# The Role of Natural Plant Extracts in Enhancing Shelf Life and Quality of Fruits: A Novel Therapeutic Approach

**Kavita N. Joshi, Ramesh P. Sharma and Sneha A. Patil***
*Department of Microbiology, S.S.E.S.A's Science College, Congress Nagar, Nagpur-440012, Maharashtra

## ABSTRACT

Fruits provide adequate supplies of vitamins, minerals and fibers to human health. Fruits harvested for human consumption are susceptible for microbial spoilage. Post-harvest loss of fruits poses a serious issue across the globe. Therefore, there is an urgent need to have a natural preservative that will improve the shelf life and quality of fresh fruits. Hence the present investigation was aimed to evaluate the efficacy of natural plant extracts (edible coating solution) like Neem oil, Guar gum, Aloe vera gel and Marigold extract as potential fruit preservatives against 5 different types of fruits such as Apple, Banana, Chikoo, Papaya and Tomato. It was found that except Apple and Chikoo other selected fruits lost their weight even after treatment with the edible coating solution. The study revealed that two types of organisms were found on fruit surface such as *Staphylococcus* spp. and *Pseudomonas* spp. Skin colour analysis showed that Apple was found to be excellent in skin colour while Tomato was good, Papaya and Chikoo were slightly dull whereas banana was <50% brownish in colour. Pulp colour analysis showed that Apple and Tomato were 100% Good, Papaya 75% Good, Chikoo 50% Good while Banana 25% Good.

**KEYWORDS**: Fruit Preservation, Natural Plant Extracts.

## I. INTRODUCTION

Consumers around the globe are demanding for inflated quality food which is devoid of chemical preservatives and having extended shelf life (Lin and Zhao, 2007). A budding awareness among the consumers regarding their health has elevated their interest in use of natural products and natural plant extracts as natural preservatives (Bhat et al., 2011). Post-harvest loss of fruits and vegetables is an alarming threat because of speedy and brisk deterioration during handling, transport and storage (Yahia, 1998). There are distinct preservation methodologies available for the post harvest management of fruits. One such natural method of extending post harvest shelf life of fruits is the use of the formulated edible coatings of natural plant extracts (Baldwin et al., 1995). In post-harvest technology, biopreservation aims at extending storage/shelf life of fruits and vegetables by utilizing natural plant-based products. Edible coatings have encountered considerable attention in recent years because of their advantages including use as edible packaging materials over synthetic films.

Edible coating is defined as a thin layer of material which can be eaten and provides a barrier to moisture, oxygen and solute movement for the fruit (Avena-Bustillos et al., 1997; Mchugh and Senesi, 2000). *Aloe vera* is a plant species of the genus *Aloe*. It is found in many consumer products including beverages, skin lotion, cosmetics, or ointments for minor burns and sunburns (Perkins, 2016). *Aloe vera* is a plant with turgid green leaves joined at the stem in a rosette pattern. The parenchyma cells contain a transparent mucilaginous jelly which is referred to as *Aloe vera* gel (Tripathi and Dubey, 2004). Processed *Aloe vera* gel holds a decent industrial application worldwide in the food industry. The mucilaginous gel of *Aloe vera* plant, holds a potential medicinal properties.

Neem oil is a vegetable oil pressed from the fruits and seeds of the neem (*Azadirachta indica*). It is the most important of the commercially available products of neem for organic farming and medicines (Puri, 1999). Guar gum is a substance made from guar beans (*Cyamopsis tetragonoloba*) which has thickening and stabilizing properties useful in food industry (Whistler and Hymowitz, 1979). Marigolds (*Tagetes erecta*) are very versatile flowers. Pigments of Marigolds are sometimes exracted and used as a food colouring.
Thus, edible coating is generally used for preservation of fruits. Its advantageous properties such as its edibility, non-toxic nature and cost effective as compared to other synthetic coating enable its use in fruit preservation. Hence the present investigation was aimed to evaluate the efficacy of natural plant extracts like Neem oil, Guar gum, *Aloe vera* gel and Marigold extract as a potential fruit preservative against 5 different types of fruits such as Apple, Banana, Chikoo, Papaya and Tomato.

## II. MATERIALS AND METHODS

**a) Collection of fruits:**

Fresh healthy fruits i.e. Apple (*Malus domestica*), Papaya (*Carica papaya*), Banana (*Musa acuminata*), Tomato (*Solanum lycopersicum*) and Chikoo (*Manilkara zapota*) were purchased from local market of Nagpur region in Maharashtra (India) and transferred to laboratory under sterile conditions. The fruits were then washed with sterile distilled water to remove the dirt followed by air drying. The fruits were purchased and analyzed on the basis of size, colour and absence of external injuries.

**b) Preparation of Edible Coating Solution from Natural plant Extracts:**

**Marigold flower extract**: The marigold flowers were collected from a nearby nursery situated in Nagpur region of Maharashtra (India). The petals were removed and were kept under shade till they were completely dried with no moisture content. The petals were then grounded to a fine powder by blender. Aqueous solution of marigold was prepared by soaking a known weight of the powdered material in an equal quantity of water and was kept overnight.

**Guar gum**: Guar was purchased from a local market of Nagpur region. The guar extract was prepared by cutting the guar and keeping it in shade for complete removal of moisture. The dried guar was then blended to a fine powder. A 2% guar powder i.e. guar gum was added to make a coating solution.

**Neem oil**: Neem oil bottle was purchased from a local medical shop situated in Nagpur region. The solution of neem oil was prepared by mixing of oil with distilled water, emulsifying with guar gum on a percentage weight basis (2 ml oil per 100 ml of distilled water with 2% guar gum).

***Aloe vera* Gel:** Matured leaves of *Aloe vera* plant were harvested from a nearby botanical garden in Nagpur region. The leaves were then washed with a mild chlorine solution (25%). The leaf skins were peeled to obtain the pulp. The resulting mixture was filtered to remove the fibers. The liquid obtained constituted the fresh *Aloe vera* gel. It was then pasteurized at 70°C for 30-40 minutes. To stabilize the gel it was cooled immediately to an ambient temperature. The fresh *Aloe vera* gel was later stored in Amber bottle.

**c) Treatment of Fruits with Edible Coating Solution:**

Edible coating solution of natural extracts was prepared by adding 10% *Aloe vera* gel, 20% Marigold flower extract 2% each Neem oil and Guar gum. The fruits used in this experiment were divided into two batches viz., Control and Experimental. Control fruits were not treated with any of the prepared solution and were stored uncovered in a refrigerator basket for 45 days. Experimental fruits were dipped in the prepared edible coating solution for 5 minutes. The fruits were then stored uncovered in a refrigerator basket for 45 days.

**d) Evaluation of Fruits:** Evaluation of fruits was carried out on the basis of weight, bacterial contamination, skin colour quality and pulp colour (Table 1) (Chauhan et al., 2014).

## III. RESULTS AND DISCUSSION

In the present investigation, total 5 different types of fruits were collected from the local fruit market of Nagpur region in Maharashtra (India) such as Apple, Banana, Chikoo, Papaya and Tomato. After weighing, the fruits were further processed for experimentation in Microbiology laboratory. Fruits were divided into 2 groups i.e. Control and Experimental. The experimental fruits were processed for edible coating solution. After that both the groups of fruits were kept in refrigerator for 45 days. It was found that the weight of experimental fruits such as Banana (100gm), Papaya (620gm), and Tomato (55gm) was found to be somewhat decreased to Banana (90 gm), Papaya (580 gm) and Tomato (50 gm) while the weight of Apple (110 gm) and Chikoo (60 gm) was constant after the treatment of edible coating solution (Table 2). The weight loss of fruits may also be due to respiratory process, transference of humidity and oxidation process that occurred during the storage (Ayranci and Tunc, 2003). The weight loss rate constant was affected by the storage temperature and coating treatments. As a result, the fruits became shriveled and wrinkled. The weight loss in some fruits during storage may be attributed to substrate loss by respiration and to loss of water through various mechanisms. This gel treatment was effective as a physical barrier and thus reduced the weight loss during post-harvest storage.

Fruits were also evaluated against bacterial contamination on its surface. The study revealed that two types of organisms were found on fruit surface such as *Staphylococcus* spp. and *Pseudomonas* spp. (Table 3). Before treatment *Staphylococcus* spp. was found only on Apple, Banana and Papaya while *Pseudomonas* spp. was found only on the surface of Papaya. After treatment *Staphylococcus* spp. was found only on Apple, Banana, Chikoo and Papaya while *Pseudomonas* spp. found on only Papaya.

Quality parameters of fruits were also assessed according to evaluation in which skin colour and pulp colour of fruits was observed before and after treatment of prepared edible coating solution (Table 1). Skin colour analysis

showed that Apple was found to be excellent in skin colour while Tomato was good, Papaya and Chikoo were slightly dull whereas banana was <50% brownish in colour. Pulp colour analysis showed that Apple and Tomato were 100% Good, Papaya 75% Good, Chikoo 50% Good while Banana 25% Good (Table 4) (Figure 1-22).

It was observed that the control fruits started to deteriorate before 45 days with higher weight loss, colour changes, accelerated softening and ripening, browning, and high incidence of decay. Whereas, shelf life extended to 45 days for majority of edible solution coated fruits. This could be attributed to the delayed ripening process. The treated samples significantly delayed these parameters after post harvesting. This may be due to the semi-permeability created by coatings on the surface of the fruits, which might have modified the internal atmosphere i.e. $O_2$ and $CO_2$ concentrations in the fruit and retards ripening (Lowings and Cutts, 1982; Bai et al., 1998).

## IV. CONCLUSION

Post harvest loss of fruits is a matter of concern for all those nations whose economy is based on agriculture. Fruits face tremendous loss due to old-fashioned preservation practice and ignorance about the preservation strategies. To effectively extend the shelf life of postharvest fruits, edible coating solution as a relatively convenient and safe measure, is more and more concerned in food industry in recent years. Another advantage of this coating is that it is totally harmless to the environment. In fact it can be considered as a green alternative to synthetic coatings and other postharvest chemical treatments.

***Table 1: Quality Parameters of Fruits***

| **Quality Parameters** | **Methods of evaluation** |
|---|---|
| **Skin Colour** | Visual index for fruits:<br>1 = Excellent, 2 = Good, 3 = slightly dull, 4 = <50% brownish,<br>5 = >50% brownish. |
| **Pulp Colour** | Visual index for fruits:<br>1 = 100% good (faint) 2 = 75% good (pale), 3 = 50% good (light brown), 4 = 25% good (brown), 5 = poor quality (dark brown and black). |

***Table 2: Weight of Fruits***

| **Name of Fruit** | **Weight (grams)** | |
|---|---|---|
| | **Control** | **Experimental** |
| Apple | 110 | 110 |
| Banana | 100 | 90 |
| Chikoo | 60 | 60 |
| Papaya | 620 | 580 |
| Tomato | 55 | 50 |

***Table 3: Bacteriological Contamination on Fruit Surface***

| **Name of Fruit** | **Before Treatment** | | **After Treatment** | |
|---|---|---|---|---|
| | ***Staphylococcus* spp.** | ***Pseudomonas* spp.** | ***Staphylococcus* spp.** | ***Pseudomonas* spp.** |
| Apple | + | - | + | - |
| Banana | + | - | + | - |
| Chikoo | - | - | + | - |
| Papaya | + | + | + | + |
| Tomato | - | - | - | - |

'+' → indicates presence of Bacterial Contamination

'-' → indicates absence of Bacterial Contamination

***Table 4: Evaluation of Fruits***

| | Skin Colour | | Pulp Colour | |
|---|---|---|---|---|
| **Fruits** | **Control (C)** | **Experimental (E)** | **Control (C)** | **Experimental (E)** |
| Apple | 1 | 1 | 1 | 1 |
| Banana | 1 | 4 | 1 | 4 |
| Chikoo | 1 | 3 | 1 | 3 |
| Papaya | 1 | 3 | 1 | 2 |
| Tomato | 1 | 2 | 1 | 1 |

***Figure 1: Apple (C)***

***Figure 2: Apple (E)***

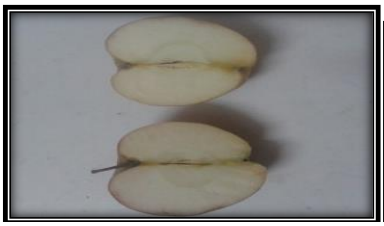

***Figure 3: Apple (C) Sliced***

***Figure 4: Apple (E) Sliced***

***Figure 5: Banana (C)***

***Figure 6: Banana (E)***

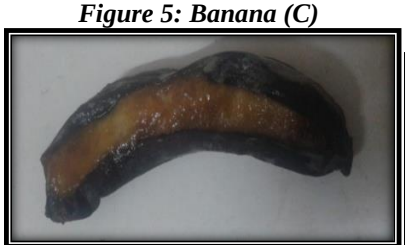

***Figure 7: Banana (C) Sliced***

***Figure 8: Banana (E) Sliced***

***Figure 9: Chikoo (C)***

***Figure 10: Chikoo (E)***

*Figure 11: Chikoo Sliced (C)*

*Figure 12: Chikoo Sliced (E)*

*Figure 13: Papaya (C)*

*Figure 14: Papaya (E)*

*Figure 15: Papaya (C) Sliced*

*Figure 16: Papaya (E) Sliced*

*Figure 17: Tomato (C)*

*Figure 18: Tomato (E)*

*Figure 19: Tomato (C) Sliced*

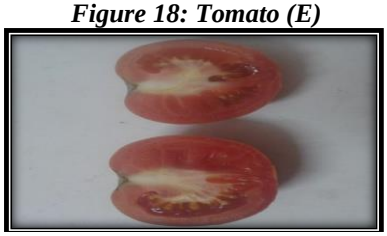

*Figure 20: Tomato (E) Sliced*

*Figure 21: Fruits (C)*

*Figure 22: Fruits (E)*

## V. REFERENCES

[1] Avena- Bustillos, R.J., Krochta, J.M., Saltveit, M.E., "Water vapor resistance of red delicious apples and celery sticks coated with edible caseinate- acetylated monoglyceride films", Journal of Food Science, Vol. 62, pp. 351-354, 1997.

[2] Ayranci, E., Tunc, S., "A method for the measurement of oxygen permeability and the development of edible films to reduce the rate of oxidative reactions in fresh foods"' Food Chem., Vol. 80, pp. 423-431, 2003.

[3] Bai, R.K., Huang, M.Y., Jiang, Y.Y., "Selective permeabilities of chitosanacetica acid complex membrane for oxygen and carbon dioxide"' Polym. Bull., Vol. 20, pp. 83-88, 1998.

[4] Baldwin, E.A., Nisperos- Carriedo, M.O., Baker, R.A. “Use of edible coatings to preserve quality of lightly (and slightly) processed products. Critical Reviews in Food Science and Nutrition”, Vol. 35, pp. 509-524, 1995.
[5] Bhat, R., Alias, A.K., Paliyath, G. “Essential Oils and Other Plant Extracts as Food Preservatives”, Progress in Food Preservation. New Jersey, John Wiley & Sons. pp. 539-580, 2011.
[6] Chauhan, S., Gupta, K.C., Agrawal, M., “Efficacy of natural extracts on the storage quality of Apple”, International Journal of Current Microbiology and Applied Sciences, Vol. 3 Issue 3, pp. 1-6, 2014.
[7] Lin, D., Zhao, Y. 2007. “Innovations in the development and application of edible coatings for fresh and minimally processed fruits and vegetables”, Comprehensive Reviews in Food Science and Food Safety, Vol.6 Issue 3, pp. 60-75, 2007.
[8] Lowings, P.H., Cutts, D.F. “The preservation of fresh fruits and vegetables”, in: Proc. Inst. Food Sci. Technol., Annual Symposium, Nottingham, UK, 1982.
[9] Mchugh, T.H., Senesi, E. “Apple wrap: A novel method to improve the quality and extend shelf life of fresh-cut apples”, Journal of Food Science, Vol. 65 Issue 3, pp. 480-485, 2000.
[10] Perkins, Cyndi. "Is Aloe a Tropical Plant?", SFgate.com. Retrieved 13 February 2016.
[11] Puri, H. S. “Neem: The Divine Tree. Azadirachta indica”, Amsterdam: Harwood Academic Publications. ISBN 90-5702-348-2., 1999.
[12] Tripathi, P., Dubey, N. “Exploitation of natural products as an alternative strategy to control postharvest fungal rotting of fruit and vegetables”, Postharvest Biology and Technology, Vol. 32 Issue 3, pp. 235-245, 2004.
[13] Whistler R.L., Hymowitz T., “Guar: agronomy, production, industrial use and nutrition”, Purdue University Press, West Lafayette, 1979.
[14] Yahia, E. “Modified and controlled atmospheres for tropical fruits”, Horticultural Reviews, Vol. 22, pp. 123-183, 1998.