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# Effect of Zein Based Edible Coatings in Litchi Fruits cv Rose Scented

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## ABSTRACT

The present investigation was conducted at Department of Horticulture, GB Pant University of Agriculture and Technology, Pantnagar during the year 2018 on Litchi cv Rose Scented to study the response of different coating treatments on post-harvest life and physico-chemical attributes of litchi fruits. The experiment consisted of 7 treatments and among all treatments, $T_3$ (Zein @ 2.0%) + Glycerol @ 0.75%) was found effective in exhibiting better shelf life of fruits as it retained higher fruit weight and ascorbic acid content, moderate TSS and good anthocyanin content along with less acidity and physiological loss in weight. $T_3$ has recorded highest reducing sugar (10.099%) and total sugar (12.086%) while untreated fruits reported the lowest one. $T_2$ (Zein @ 1.5% + Glycerol @ 0.75%) recorded highest anthocyanin content 13.230 mg/100 g.

**Keywords** Litchi, Zein, Coating, Shelf life, Physico-chemical attributes.

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## INTRODUCTION

Litchi (*Litchi chinensis* Sonn.) belongs to family Sapindaceace. It is an important subtropical fruit crop which is native to Southern China. Litchi was introduced to India in 17$^{th}$ century (Liang 1981). Because of the delicious fruit quality as table purpose and processed products, litchi is a highly demanded fruit. Litchi fruit is highly nutritious as it contains 83.6 g moisture, 0.7g protein, 0.1 g fat, 15.0 g carbohydrates, 4.0 mg calcium, 32.0 mg phosphorus, 0.7 mg iron, 0.02 mg thiamine, 0.07 mg riboflavin, 1.1 mg niacin, 15 mg ascorbic acid and traces of carotene (Deng *et al*. 1999).

India is the second largest producer of litchi in the world next after China. In India, it is mainly grown in Bihar, West Bengal, Uttar Pradesh, Punjab and Uttarakhand. Major litchi producing districts in Uttarakhand are Dehradun, Haridwar, Nainital and US Nagar.

Being a non-climacteric fruit, litchi does not improve its quality after harvesting, but has to ripen on the tree only (Chen *et al*. 2001). Therefore, ripened fruits are harvested and should reach to the consumers

immediately. In order to extend the availability of fruits, storage life of the fruits has to be increased. The harvesting of litchi starts from last week of May and continues till the end of June.

Litchi is very delicate fruit and highly perishable in nature accounting for its low shelf life. The attractive bright red color is lost within 48 hrs of harvest (Underhill and Critchley 1993).

Many techniques have been developed over the years in order to extend the storage life of fruits. One such approach is the use of environment friendly edible coatings which are relatively inexpensive. Edible films and coatings can be potentially used as an elective preservation technique that can provide an additional protective coating that can not only keep fruit plumpness, fresh appearance and hardness but also improve the luster of the fruit surface, thereby increasing the commercial value of fruits (Xu *et al*. 2003). An edible coating is a thin layer which gets deposited on the fruit surface and is co-consumed. It improves handling properties, prevent the moisture loss, increase the shelf-life and reduce the need of packaging material. As the film acts as barrier to moisture/oil or vapor transmission, the shelf-life of fruit gets extended. Edible coatings make good barrier to oxygen and lipid at low to intermediate RH because the polymers can effectively make hydrogen bonds. An edible coating have good eating properties: Acceptable color, odor, taste, texture and flavor.

Proteins and polysaccharides generally have a good barrier to oxygen at low relative humidity due to their tightly packed hydrogen-bonded network structure but have a poor moisture barrier due to their hydrophilic nature (McHugh and Krochta 1994). Zein is a natural storage protein found in corn kernels. Zein coatings have been used to coat nuts and candy for increased gloss, prevention of oxidation and development of off-odors because of their good barrier properties against oxygen and lipids (Bai *et al*. 2003). Zein-based coatings are applied to fresh as well as dried fruits, often as a substitute for shellac coatings because of its high gloss appearance, faster drying rate and increased stability during storage (Gennadios and Weller 1990). Zein have a good barrier to oxygen due to their tightly packed hydrogen-bonded network structure.

Thus, the present study was aimed to investigate the effect of zein based coatings on their ability to extend the shelf life of fresh litchi fruits and their influence on physiological and biochemical changes in fresh fruits.

## MATERIALS AND METHODS

Litchi fruits (cv Rose Scented) were harvested in June, 2018 at fully mature stage from the orchard of Horticultural Research Center, Pattharchatta, Department of Horticulture, Govind Ballabh Pant University of Agriculture and Technology, Pantnagar. The fresh

**Table 1.** Effect of post-harvest application of different coatings on weight (g), physiological loss in weight (%) and anthocyanin content (mg/100 g) of litchi cv Rose Scented.

| Treatments | Weight (g) Storage interval (days) | | | | | | | Physiological loss in weight (%) Storage interval (days) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0 | 3 | 6 | 9 | 12 | 15 | Mean | 0 | 3 | 6 | 9 | 12 | 15 | Mean |
| $T_1$ | 22.233 | 21.730 | 21.167 | 20.777 | 19.897 | 19.707 | 20.918 | 0.000 | 2.267 | 4.797 | 6.550 | 10.507 | 11.360 | 5.913 |
| $T_2$ | 21.800 | 21.337 | 20.833 | 20.460 | 20.067 | 19.007 | 20.584 | 0.000 | 2.127 | 4.430 | 6.147 | 8.497 | 12.803 | 5.667 |
| $T_3$ | 21.267 | 20.903 | 20.520 | 20.147 | 19.987 | 19.843 | 20.444 | 0.000 | 1.707 | 3.510 | 5.267 | 6.017 | 6.690 | 3.865 |
| $T_4$ | 21.550 | 20.590 | 20.157 | 19.473 | 19.310 | 19.107 | 20.031 | 0.000 | 4.453 | 6.463 | 9.633 | 10.393 | 11.337 | 7.047 |
| $T_5$ | 21.353 | 20.907 | 20.530 | 20.217 | 20.013 | 19.830 | 20.475 | 0.000 | 2.093 | 3.853 | 5.320 | 6.273 | 7.137 | 4.113 |
| $T_6$ | 21.310 | 20.810 | 20.413 | 20.200 | 20.003 | 19.880 | 20.436 | 0.000 | 2.343 | 4.203 | 5.207 | 6.130 | 6.710 | 4.099 |
| $T_7$ | 21.103 | 20.670 | 20.140 | 19.600 | 19.100 | 18.407 | 19.837 | 0.000 | 2.053 | 4.553 | 7.120 | 9.490 | 12.790 | 6.001 |
| Mean | 21.517 | 20.993 | 20.537 | 20.125 | 19.768 | 19.397 | | 0.000 | 2.435 | 4.544 | 6.463 | 8.187 | 9.832 | |
| | | CD at 5% | | | SEm ± | | | | CD at 5% | | | SEm ± | | |
| Treatment | | 0.212 | | | 0.075 | | | | 0.236 | | | 0.084 | | |
| Days | | 0.196 | | | 0.070 | | | | 0.219 | | | 0.078 | | |
| Treatment × Days | | 0.518 | | | 0.184 | | | | 0.579 | | | 0.205 | | |

**Table 2.** Effect of post-harvest application of different coatings on anthocyanin content (mg/100 g) and total soluble solids (° Brix) of litchi cv Rose Scented.

| Treatments | Anthocyanin content (mg/100 g) Storage interval (days) | | | | | | | TSS (° Brix) Storage interval (days) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0 | 3 | 6 | 9 | 12 | 15 | Mean | 0 | 3 | 6 | 9 | 12 | 15 | Mean |
| $T_1$ | 19.883 | 18.563 | 15.723 | 11.643 | 4.903 | 3.183 | 12.317 | 18.013 | 18.150 | 18.380 | 18.660 | 19.007 | 19.423 | 18.606 |
| $T_2$ | 20.837 | 19.597 | 16.937 | 11.977 | 5.497 | 4.537 | 13.230 | 17.960 | 18.090 | 18.300 | 18.550 | 18.910 | 19.443 | 18.542 |
| $T_3$ | 20.157 | 18.977 | 16.437 | 11.557 | 5.177 | 4.257 | 12.760 | 18.323 | 18.400 | 18.570 | 18.800 | 19.117 | 19.520 | 18.788 |
| $T_4$ | 19.780 | 18.500 | 15.780 | 10.780 | 4.200 | 3.420 | 12.077 | 17.907 | 18.007 | 18.240 | 18.500 | 18.833 | 19.280 | 18.461 |
| $T_5$ | 19.943 | 18.803 | 16.383 | 11.563 | 5.423 | 4.583 | 12.783 | 18.267 | 18.340 | 18.490 | 18.677 | 18.977 | 19.363 | 18.686 |
| $T_6$ | 19.417 | 18.337 | 16.077 | 11.397 | 5.377 | 4.497 | 12.517 | 18.440 | 18.500 | 18.610 | 18.753 | 19.047 | 19.403 | 18.792 |
| $T_7$ | 20.677 | 19.277 | 16.317 | 11.137 | 4.057 | 2.317 | 12.297 | 17.907 | 18.020 | 18.163 | 18.357 | 18.417 | 18.527 | 18.232 |
| Mean | 20.099 | 18.865 | 16.236 | 11.436 | 4.948 | 3.828 | | 18.117 | 18.215 | 18.393 | 18.614 | 18.901 | 19.280 | |
| | | CD at 5% | | | SEm ± | | | | CD at 5% | | | SEm ± | | |
| Treatment | | 0.029 | | | 0.010 | | | | 0.028 | | | 0.010 | | |
| Days | | 0.027 | | | 0.010 | | | | 0.026 | | | 0.009 | | |
| Treatment × Days | | 0.072 | | | 0.026 | | | | 0.069 | | | 0.025 | | |

fruits of uniform size, shape, color and free from physical injury, diseases and pests were selected for the experiment and randomly distributed into group of 15 fruits in each replication and for each treatment, three replications were used. The fruits were immediately brought to Post-harvest Laboratory of Horticulture Department and firstly pre-cooled in order to remove field heat. After pre-cooling, the fruits were washed thoroughly and dried, following which coatings were applied to the fruits. Different coating treatments of Zein were prepared at different concentrations i.e. 1.0%, 1.5% and 2.0%. The experiment was laid out in Completely Randomized Design consisted of seven treatments viz.,

$T_1$: Zein (1.0%) + Glycerol (0.75%),
$T_2$: Zein (1.5%) + Glycerol (0.75%),
$T_3$: Zein (2.0%) + Glycerol (0.75%),
$T_4$: Zein (1.0%) + Glycerol (0.75%) + Ascorbic acid (1.0%),
$T_5$: Zein (1.5%) + Glycerol (0.75%) + Ascorbic acid (1.0%),
$T_6$: Zein (2.0%) + Glycerol (0.75%) + Ascorbic acid (1.0%) and
$T_7$: Control.

Fruits were dipped for 10 minutes in these coating

**Table 3.** Effect of post-harvest application of different coatings on acidity (%) and ascorbic acid content (mg/ 100 g) of litchi cv Rose Scented.

| Treatments | Acidity (%) Storage interval (days) | | | | | | | Ascorbic acid (mg/100 g) Storage interval (days) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0 | 3 | 6 | 9 | 12 | 15 | Mean | 0 | 3 | 6 | 9 | 12 | 15 | Mean |
| $T_1$ | 0.367 | 0.330 | 0.280 | 0.240 | 0.207 | 0.187 | 0.268 | 27.117 | 26.057 | 24.803 | 23.197 | 21.523 | 19.817 | 23.752 |
| $T_2$ | 0.360 | 0.340 | 0.307 | 0.273 | 0.233 | 0.203 | 0.286 | 27.537 | 26.563 | 25.460 | 24.000 | 22.483 | 20.933 | 24.496 |
| $T_3$ | 0.343 | 0.313 | 0.277 | 0.240 | 0.210 | 0.197 | 0.263 | 27.400 | 26.517 | 25.510 | 24.153 | 22.697 | 22.697 | 24.829 |
| $T_4$ | 0.377 | 0.367 | 0.367 | 0.327 | 0.290 | 0.273 | 0.333 | 26.897 | 26.097 | 25.117 | 23.817 | 23.817 | 20.977 | 24.453 |
| $T_5$ | 0.387 | 0.367 | 0.337 | 0.303 | 0.280 | 0.227 | 0.317 | 27.237 | 26.517 | 25.620 | 24.417 | 23.090 | 21.737 | 24.769 |
| $T_6$ | 0.320 | 0.297 | 0.287 | 0.257 | 0.247 | 0.240 | 0.274 | 27.303 | 26.597 | 25.753 | 24.710 | 23.563 | 22.357 | 25.047 |
| $T_7$ | 0.380 | 0.353 | 0.307 | 0.270 | 0.227 | 0.203 | 0.290 | 27.663 | 26.440 | 24.983 | 23.257 | 21.507 | 18.513 | 23.727 |
| Mean | 0.362 | 0.338 | 0.309 | 0.273 | 0.242 | 0.219 | | 27.308 | 26.398 | 25.321 | 23.936 | 22.669 | 21.004 | |
| | | CD at 5% | | | SEm ± | | | | CD at 5% | | | SEm ± | | |
| Treatment | | 0.011 | | | 0.004 | | | | 0.050 | | | 0.018 | | |
| Days | | 0.010 | | | 0.004 | | | | 0.046 | | | 0.016 | | |
| Treatment × Days | | 0.027 | | | 0.010 | | | | 0.122 | | | 0.043 | | |

**Table 4.** Effect of post-harvest application of different coatings on sugar content (%) of litchi cv Rose Scented.

| Treatments | Reducing sugars (%) Storage interval (days) | | | | | | | Total sugars (%) Storage interval (days) | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 0 | 3 | 6 | 9 | 12 | 15 | Mean | 0 | 3 | 6 |
| $T_1$ | 9.623 | 9.773 | 9.940 | 10.140 | 10.337 | 10.413 | 10.038 | 11.497 | 11.690 | 11.913 |
| $T_2$ | 9.340 | 9.480 | 9.637 | 9.820 | 10.020 | 10.380 | 9.779 | 11.263 | 11.430 | 11.627 |
| $T_3$ | 9.737 | 9.873 | 10.013 | 10.163 | 10.333 | 10.477 | 10.099 | 11.627 | 11.780 | 11.947 |
| $T_4$ | 9.297 | 9.437 | 9.593 | 9.763 | 9.953 | 10.197 | 9.707 | 11.240 | 11.410 | 11.583 |
| $T_5$ | 9.397 | 9.517 | 9.650 | 9.787 | 9.957 | 10.207 | 9.752 | 11.357 | 11.503 | 11.660 |
| $T_6$ | 9.663 | 9.773 | 9.887 | 10.020 | 10.167 | 10.403 | 9.986 | 11.580 | 11.713 | 11.847 |
| $T_7$ | 9.197 | 9.357 | 9.537 | 9.760 | 9.920 | 9.973 | 9.624 | 11.000 | 11.200 | 11.443 |
| Mean | 9.465 | 9.601 | 9.751 | 9.922 | 10.098 | 10.293 | | 11.366 | 11.532 | 11.717 |
| | | CD at 5% | | | SEm ± | | | | CD at 5% | |
| Treatment | | 0.018 | | | 0.006 | | | | 0.017 | |
| Days | | 0.017 | | | 0.006 | | | | 0.016 | |
| Treatment × Days | | 0.044 | | | 0.016 | | | | 0.043 | |

**Table 4.** Continued.

| Treatments | Total sugars (%) Storage interval (days) | | | | Non-reducing sugars (%) Storage interval (days) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 9 | 12 | 15 | Mean | 0 | 3 | 6 | 9 | 12 | 15 | Mean |
| $T_1$ | 12.183 | 12.427 | 12.567 | 12.046 | 1.873 | 1.917 | 1.973 | 2.043 | 2.090 | 2.153 | 2.008 |
| $T_2$ | 11.867 | 12.123 | 12.550 | 11.810 | 1.923 | 1.950 | 1.990 | 2.047 | 2.103 | 2.170 | 2.031 |
| $T_3$ | 12.137 | 12.357 | 12.667 | 12.086 | 1.890 | 1.907 | 1.933 | 1.973 | 2.023 | 2.190 | 1.986 |
| $T_4$ | 11.810 | 12.040 | 12.340 | 11.737 | 1.943 | 1.973 | 1.990 | 2.047 | 2.087 | 2.143 | 2.031 |
| $T_5$ | 11.830 | 12.040 | 12.330 | 11.787 | 1.960 | 1.987 | 2.010 | 2.043 | 2.083 | 2.123 | 2.034 |
| $T_6$ | 12.020 | 12.210 | 12.500 | 11.978 | 1.917 | 1.940 | 1.960 | 2.000 | 2.043 | 2.097 | 1.993 |
| $T_7$ | 11.740 | 11.940 | 11.977 | 11.550 | 1.803 | 1.843 | 1.907 | 1.980 | 2.020 | 2.003 | 1.926 |
| Mean | 11.941 | 12.162 | 12.419 | | 1.901 | 1.931 | 1.966 | 2.019 | 2.064 | 2.126 | |
| | | SEm ± | | | | CD at 5% | | | SEm ± | | |
| Treatment | | 0.006 | | | | 0.012 | | | 0.004 | | |
| Days | | 0.006 | | | | 0.011 | | | 0.004 | | |
| Treatment × Days | | 0.015 | | | | 0.028 | | | 0.010 | | |

solutions and allowed to dry for one hour after dipping. Fruits were placed in a perforated polythene bags providing ventilation by piercing small holes in polythene bag and placed in cold store at 4° C.

All the physico-chemical analysis were conducted at PG Laboratory of Department of Horticulture at 3 days interval i.e., 0, 3rd, 6th, 9th, 12th and 15th day. Observations on fruit weight (g) with digital weighing machine, physiological loss in weight (%), total soluble solids (°Brix) with the help of hand refractometer; titratable acidity (%) and ascorbic acid (mg/100 g) and sugars (%) as per method as described by Ranganna (1986) and anthocyanin content (mg/100 g) according to method of Mazumdar and Majumdar (2003).

## RESULTS AND DISCUSSION

Among all the treatments, weight gradually decreased with the advancement in storage (Table 1). Maximum weight (20.918 g) was found in $T_1$ and minimum in $T_7$ (control) i.e. 19.837g. Physiological loss in weight was recorded lowest in $T_3$ (3.865%) and highest 7.047% and 6.001% in $T_4$ and $T_7$ (control) respectively. Similar result was reported by Baraiya *et al*. (2015), when they used zein 2 % + cystein 0.2 % as a coating material on jamun. The weight loss reduction can be due to the effect of protein-based edible coatings, which prevented the dessication of the fruits that tend to have the walls degraded and the water released, causing tissue wilting (Cipolatti *et al*. 2012).

Anthocyanin content was found highest (13.230 mg/ 100 g) in $T_2$ followed by $T_5$ (12.783 mg/ 100 g) and $T_3$ (12.760 mg/ 100 g). Zein coating significantly reduced the loss of anthocyanin content in storage. Similar result was reported when the application of zein coating delayed color change in tomato fruit (Park *et al*. 1994). The concentration of total soluble solids (TSS) in litchi fruit increased during the storage period (Table 2). Treatment with zein coatings reduced the increase in the concentration of TSS. Maximum TSS was recorded in $T_6$ (18.792°Brix) followed by $T_3$ (18.788°Brix) and minimum in $T_7$ (18.232°Brix).

In Table 3, the titratable acidity was relatively higher at harvest and then it decreased with advancement in storage. The decrease in acid content of fruits with the increase in storage could be attributed to the use of organic acids in respiratory process by the fruit cells and conversion of acids into total sugars (Echeverria and Valich 1989). Acidity was recorded minimum in $T_3$ (0.263%) and maximum in $T_4$ (0.333%). The lower levels of titratable acidity in $T_3$ may be due to higher concentration of zein coating acting as a protective $O_2$ barrier which might inhibited respiration. Ascorbic acid content decreased with increasing storage time in both control and coated samples. $T_3$ was found significantly effective to reduce decreasing trend of ascorbic acid content in pulp of litchi. The coating formulations may reduce $O_2$ diffusion and consequently better preservation of ascorbic acid contents. Gol and Rao (2014) reported that zein coating seemed to have a beneficial impact on delaying the changes in weight loss and titratable acidity of mango.

In Table 4, significantly higher concentration of reducing sugars (10.099%) and total sugars (12.086%) was found in $T_3$ as compared to the untreated fruits. It may be due to conversion of starch into simple sugar or may be due to conversion of certain cell wall material such as hemicelluloses into reducing substance during prolonged storage (Stahi and Camp 1971).

## CONCLUSION

The present investigation concluded that $T_3$ (Zein @ 2.0%) + Glycerol @ 0.75%) was found effective in exhibiting better shelf life of fruits as it retained higher fruit weight and ascorbic acid content, moderate TSS and good anthocyanin content along with less acidity and physiological loss in weight. $T_3$ has recorded highest reducing sugar (10.099%) and total sugar (12.086%) while untreated fruits reported the lowest one.

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