Original Research Article

Effect of Chemical Treatment and Wrapping Materials on Physico-Chemical Properties and Storage Life of Litchi Fruits (*Litchi chinensis Sonn*.) Cv. Shahi

ABSTRACT

Litchi fruits have poor shelf life and losses its commercial value within two days after harvest. Several physiological and chemical changes take place which reduces the quality of fruits at room temperature. To overcome these problem, the experiment was conducted at Department of Horticulture, Institute of Agriculture Sciences, BHU, Varanasi to find out the effect of post-harvest application of hot water treatment and dipping in different concentrations of calcium nitrate (1 %, 1.5% and 2 %) for five minutes followed by fruit wrapping in newspaper and perforated polythene on physico-chemical changes and storage life of litchi (*Litchi chinensis* Sonn.) cv. Shahi. Fruits without treatment were considered as control. The experiment was conducted in completely randomized design with three replications and observations were recorded on alternate day up to 13 days of storage. It was observed that fruits treated with 2.0% calcium nitrate in combination of perforated polythene bags recorded minimum losses due to spoilage percentage (12.15%), minimum decrease in fruit size (length- 4.97% and breadth- 5.49%) as compared to control on 11th day of storage. Significantly minimum pH (5.1) change and the best economic life up to 11th day of storage were recorded in perforated polythene wrapping with different concentration of calcium nitrate.Total Sugar Content (17.00%)was recorded significantly highest in polythene wrapping along with 1.5 and 2.0% calcium nitrate. Less loss in volume (17.58%) was recorded in fruits treated with hot water along with polythene wrapping. Based on the above observations, it can be suggested that fruit dipping in calcium nitrate at 2.0 per cent concentration with polythene wrapping (20% vent) gives better result for extending the storage life of litchi fruit at room temperature.

Key words:Litchi, Post-harvest treatments, calcium nitrate, storage life, economic life

1. INTRODUCTION

The litchi (*Litchi chinensis* Sonn.) is an important tropical tosubtropical fruit crop belongs to the family *Sapindaceae*.It is known for itspleasant flavour and juicy pulp (aril) with attractive redcoloured pericarp which enhances its commercial value in national and international market. After harvested fruits loses their bright red skin colour within 1-2 days at ambient temperatures [1]which drastically reduces the commercial value of the fruit [2].Various biochemicals, physiological changes and microbial invasion takes place after harvest. Thesechanges are influenced by the temperature, humidity, ethylene production and presence of microbes inthe place of storage of fruits that deteriorate the quality of fruit.Several approaches like pre-cooling, treating or coating of fruit with different chemicals and packaging materials have been tried for extending the shelf-life of litchi fruit[3],[4],[5].Coatings on litchi creates partial barrier to the movement of moisture on the surfaceof fresh fruit, which minimizing moisture loss duringpostharvest storage. Some chemicals like salicylic acid and 1-methylcyclopropane decrease the activities of enzymeslike ACC synthase, cellulase, polygalacturonase and xylanasethat regulate the ripening process[6]. Suitable packaging materials provides congenial environmentwhich minimizes biochemicalchanges, slows down the rate ofrespiration,reduces the ethylene production and decay of fruitsby microorganismsattack[7], [8], [9].Keeping the above facts, the presentinvestigation was carried out to extend shelf life of litchifruits with the post harvest application of hot water, $CaNO_3$and various packaging materials.

2. MATERIALS AND METHODS

The experiment was conducted in the department of Horticulture, Institute of Agricultural Sciences, Banaras Hindu University,Varanasi.Firm and good looking fruits cv. Shahi of uniform size and maturity and free from pests and diseases, injuries were selected for experiment.Fruits were stored at room temperature in different lots consisting of 200 fruits per treatment, per replication. The experiment was carried out in completely randomiseddesign(CRD) with three three replications.These post-harvest treatments are T_1 – News paper wrapping, T_2 – News paper wrapping + hot water treatments 50 ± 2 ^oC for 5 minutes, T_3 – News paper wrapping + calcium nitrate 1.0 %, T_4 – News paper wrapping + calcium nitrate 1.5 %, T_5 – News paper wrapping + calcium nitrate 2.0 % , T_6– Polythene wrapping (20% vent), T_7 – Polythene wrapping + hot water treatments 50 ± 2 ^oC for 5 minutes, T_8 – Polythene wrapping + calcium nitrate 1.0 %, T_9 – Polythene wrapping + calcium nitrate 1.5 %, T_{10} – Polythene wrapping + calcium nitrate 2.0 %

and T_{11} – Control.Newspaper in size 60 × 30 cmsand 50 gauge thickness of 45 cm x 30 cm in size perforated polythene bag were used as wrapping materials.Different concentrations of calcium nitrate (1.0, 1.5 and 2.0 per cent) were used for dip treatments of fruitsfor 5 minutes. The hot water treatment of litchi fruits was given in an electrically operated bath of 40 gallon capacity and required temperature 50 ± 2^0C for 5 minutes then fruits were taken out and dried under the electric fan. Such treated fruits, either wrapped with newspaper or polythene were kept in bamboo baskets at room temperature.Observation to be recordedwereloss due to spoilage of fruits (%), loss in volume (%), change in size (%), economic life of fruits, total sugar (%) and pH-value.

Loss due to spoilage of fruits - The percentage of spoiled fruits on each day was calculated by using the following formula.

$$\text{Percentage of spoilage} = \frac{\text{No. of spoiled fruits}}{\text{Original number of fruits}} \times 100$$

Economic life of fruits - The economic life of fruits was adjudged by observing the day on which cumulative number of fruits due to spoilage subjected to a particular treatment exceeded 15 percent.

Loss in volume- . The volume of the fruits was recorded by water displacement method [10].The percentage of loss in volume was calculated by using the formula:

$$\text{Percentage loss in volume} = \frac{\text{Loss in volume}}{\text{Original volume}} \times 100$$

Change in size - Length and diameter were measured in centimetre on first and the last day of experiment and average size in terms of length and diameter were calculatedwith the help of slide callipers using following formula.

$$\text{Percentage Change in size} = \frac{\text{Change in size (Length or diameter)}}{\text{Original size (Length or diameter)}} \times 100$$

Total sugar - 10 ml of juice was hydrolysed by adding 3 ml of conc. HCl. It was left for 24 hours. After that it was neutralised by adding sodium hydroxide 4N solution. For complete neutralization blue and red litmus papers were used. This solution was then titrated against Fehling A and B and the percentage of total sugar were worked out.

pH value - p_H in juice was measured directly with the help of systronic pH metre.

3. RESULTS AND DISCUSSION

Spoilage and economic life of fruits: A perusal of the data(Fig.1 and 2)indicated that the minimum spoilage percentage 12.15per cent was recorded in the treatment T_{10} (2.0 per cent calcium nitrate with perforated polythene) which was closely followed by T_9 and T_8 (1.5 and 1.0 per cent calcium nitrate with perforated polythene bags) showing spoilage percentage 12.88 and 13.15 per cent respectivelyon 11^{th} days of storage.The spoilage percentage was found significantly highest in control (T_{11}) fruits with 43.22 per cent on 13^{th} day of storage. Economic shelf life of fruits was maximum (11days) fruits treated with 1.0, 1.5, and 2.0 per cent of calcium nitrate with perforated polythene bags whereas maximum economic life of untreated fruits (control) was 5days. Thus, the economic shelf life of litchi fruits was extended by 6 days with these treatments. It was observed that the spoilage of the fruits in news paper wrapping was as compared to control but more than other respective treatments. These results are in agreement with findings of [1], [11], [12], [13]. Less spoilage under news paper wrapping might be due to barrier from room atmosphere for fungal growth. It was recorded that fruits treated with calcium nitrate and kept in perforated polythene bags were found to spoil less. Similar observation was reported by [5], (14], [15]. in litchi.Moor *et al.* [16] in apple and Xu Ling *et al.*[17] in sweet cheery had reported similar results of reducing fruits loss due to pre harvest treatment of Ca and K. Calcium nitrate under different concentrations might have played the effective role in maintaining the vigour and resistance capacity to fight against the pathogens along with inhibit the activities of polygalactonase enzyme (PG) and peroxidase (POD) slow the accumulation of membranacious peroxide (NDA) in cells [17] resulting less spoilage of fruits under these treatments.

Size of fruits: Data(Fig. 3)indicated that the fruits under all the treatments showed variation in both length and width percentage on the 11^{th} day of observation. Maximum percentage of reduction 14.71 and 13.98 in length and width respectively was observed in untreated fruits (T_{11}) which was followed by 11.42 and 11.88 percent respectively under news paper wrapped (T_1).Minimum reduction in length and width 4.97 and 5.49 per cent respectively was found in the fruits treated with 2.0% calcium nitrate in combination with perforated polythene wrapping (T_{10}). However other treatment with calcium nitrate 1.0, 1.5 per cent with polythene wrapping was very close with 2.0% calcium nitrate with polythene wrapping.

Volume of fruits:.The perusal of data(Fig.4) revealed that polythene wrapping alone or in combination of hot water treatment and calcium nitrate dip have greatly influenced in checking the reduction of volume during storage. It was recorded that minimum reduction 17.58 to 20.35 per cent was observed in treatments T_6, T_7, T_8, T_9 and T_{10} and maximum reduction ranged from 27.14 to 28.43 per cent in rest of the treatments including control from first to eleventh day of storage.It was observed that the fruits packed in perforated polythene bags with combination of different concentration of calcium nitrate showed least change in their size and volume.Kanth *et al.*[15] and Moll *et al*. [5]found similar results in litchiand Rabiei*et al*. [18] in apple fruit using polythene bags. This might be attributed to loss of moisture resulting reduced turgidity and polythene wrapping maintained higher percentage of humidity around the outer layer of the fruits. Wrapping and coating with chemical slowed down metabolism and caused breakdown of insoluble protopectins into soluble pectin thus extending the shelf-life [5].

Total sugar: Total sugar content of fruits gradually increased up to 5^{th} day in all the treatments revealed from data (Fig.5).It was observed that the total sugar percentage was significantly maximum (17.00) in fruits of treatment T_9 (1.5 per cent calcium nitrate + perforated polythene wrapping) and T_{10} (2.0 per cent calcium nitrate + perforated polythene wrapping) on 11^{th} day of storage which was significantly at par to T_7 and T_8 showing 16.70 and 16.85 per cent total sugar respectively. Significantly minimum total sugar percentage (14.85 and 15.05 per cent) were recorded in fruits of T_{11} (control) and T_1 (News paper wrapping) respectively. The result was in close agreement with the findings of [19], [15], [5]. This might be due to slower rate of conversion of starch and polysaccharides into sugar in treated fruits in comparison to untreated ones. After the storage due to senescence the reduction in sugar conversion rate was due to utilization of sugar in the process of respiration [15].

pH content : DatainFig.6 showed that pH gradually increased as the days advanced in storage. Significantly highest pH 5.60 was observed in untreated fruits (T_{11}) in comparison to treated fruits ranged from 5.10 to 5.20 on the same day of storage. Significantly minimum p^H(5.10) was estimated in treatment T_8(Polythene wrapping + calcium nitrate 1.0 %) on 12^{th} day of storage. Similar results were reported by [20] and [5]. The worker [21] had found the results on similar pattern on mandarin. pHwas found to be correlated with the acidity of the fruits. The acidity of the fruits decreased continuously during storage and reverse was true for pH of fruits pulp

[22].The rapid utilization of acids of pulp in the respiratory process might have caused the rapid increase in pH leads to early ripening and senescence in the fruits. The treatment of calcium might have induced some buffer action on hydrogen ion during storage affecting slow rate of pH enhancement.

4. CONCLUSIONS: On the basis of results obtained from the study it can safely be concluded that all concentrations of calcium nitrate (1.0, 1.5 and 2.0 per cent) dip with perforated polythene (20%vent) treatments were equally most effective in enhancing the economic storage life of fruits up to 11th day whereas, under control for 5 days only and were found to maintain the desirable physico-chemical characteristics of litchi fruit cv. Shahi.

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COMPETING INTERESTS

Authors have declared that no competing interest exists.

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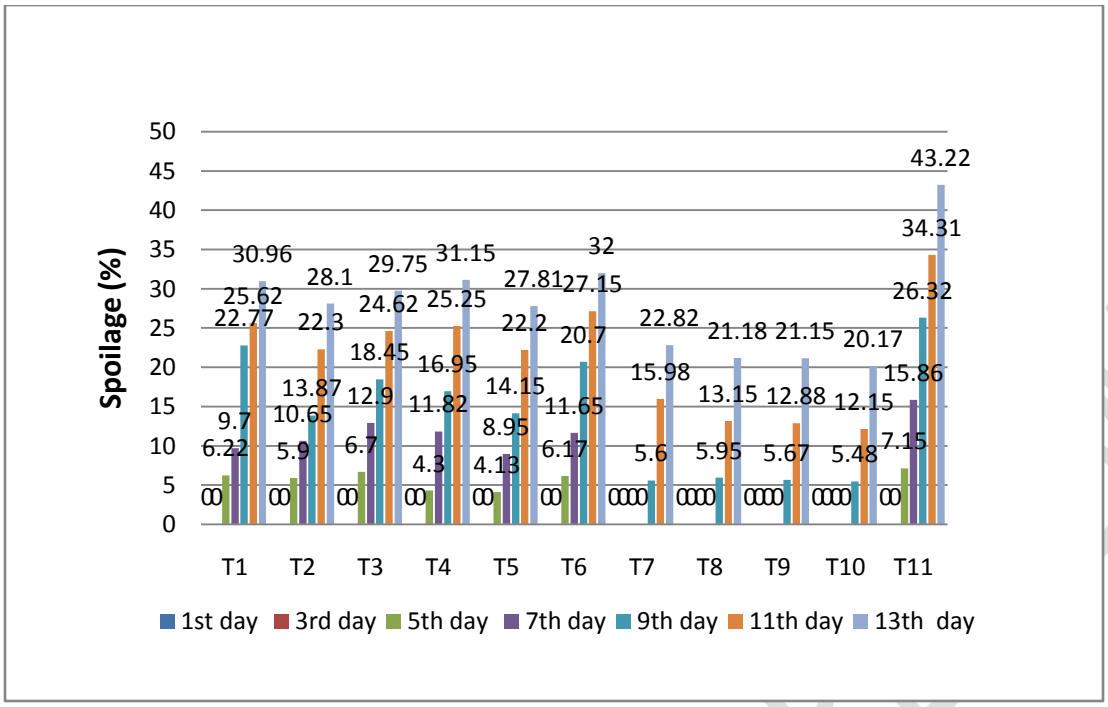

Fig. 1 Spoilage percentage of litchifruits cv. Shahiduring storage

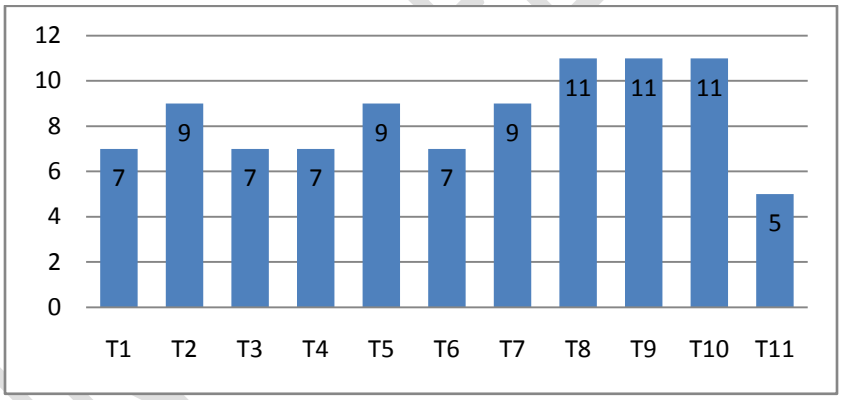

Fig.2 Economic life (days) of litchifruits cv. Shahiduring storage

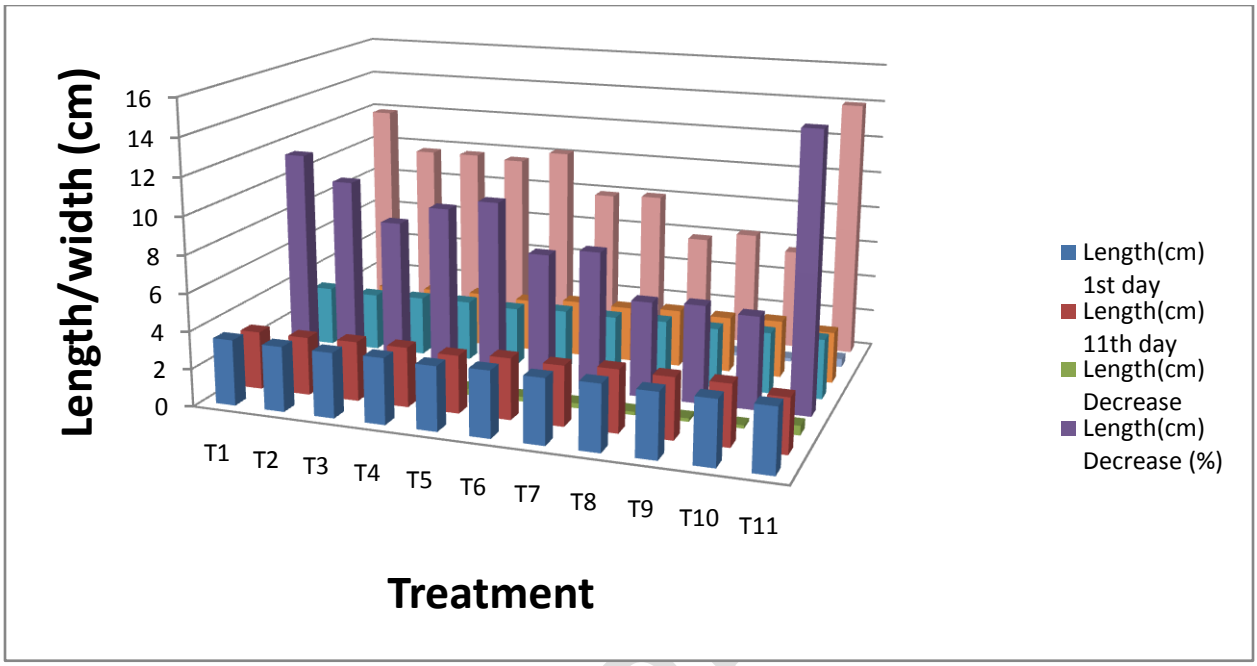

Fig.3: Change in size of litchi fruits cv. Shahi during storage.

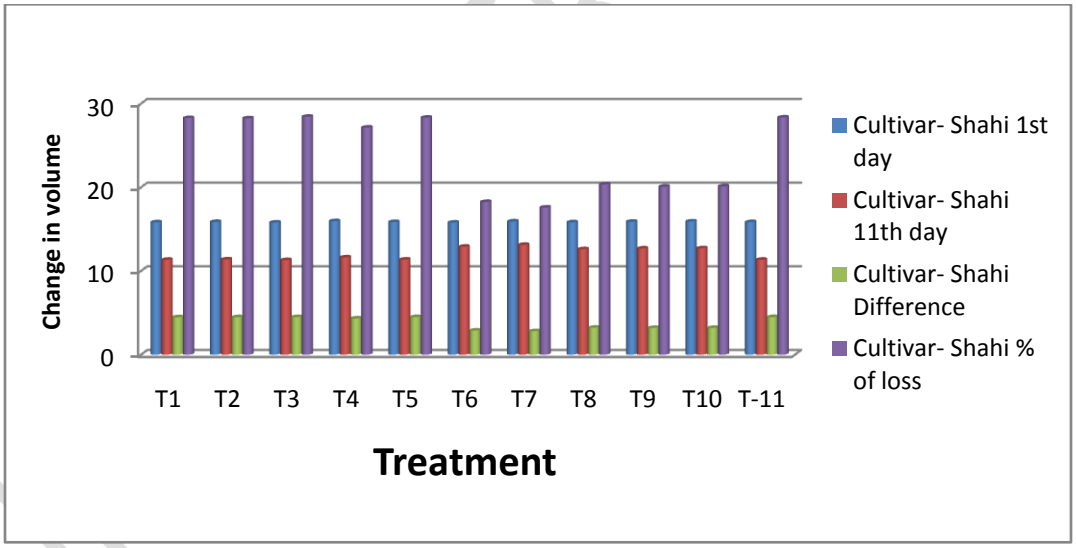

Fig.4: Change in volume of litchi fruits cv. Shahi during storage

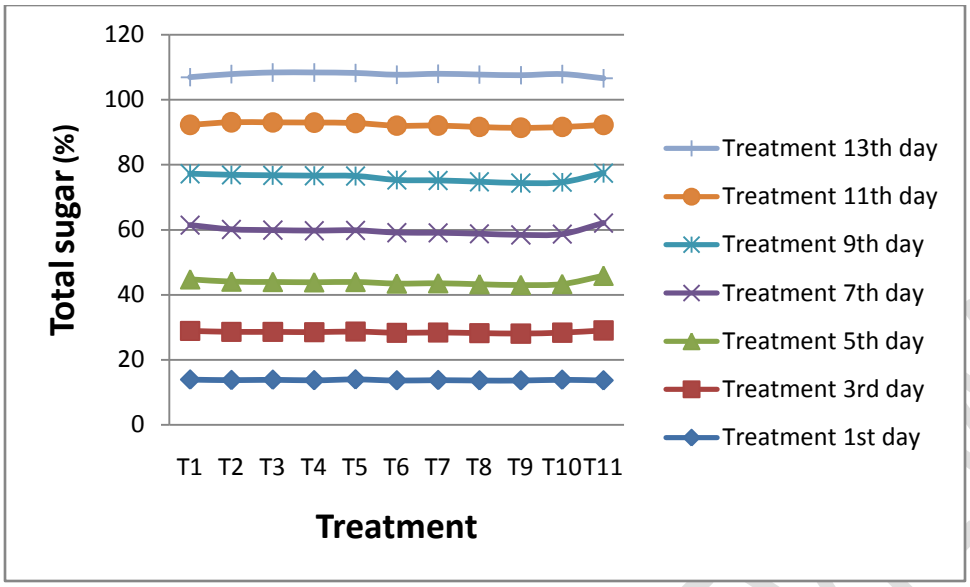

Fig.5: Total sugar (percent) of litchi cv. Shahi fruits during storage

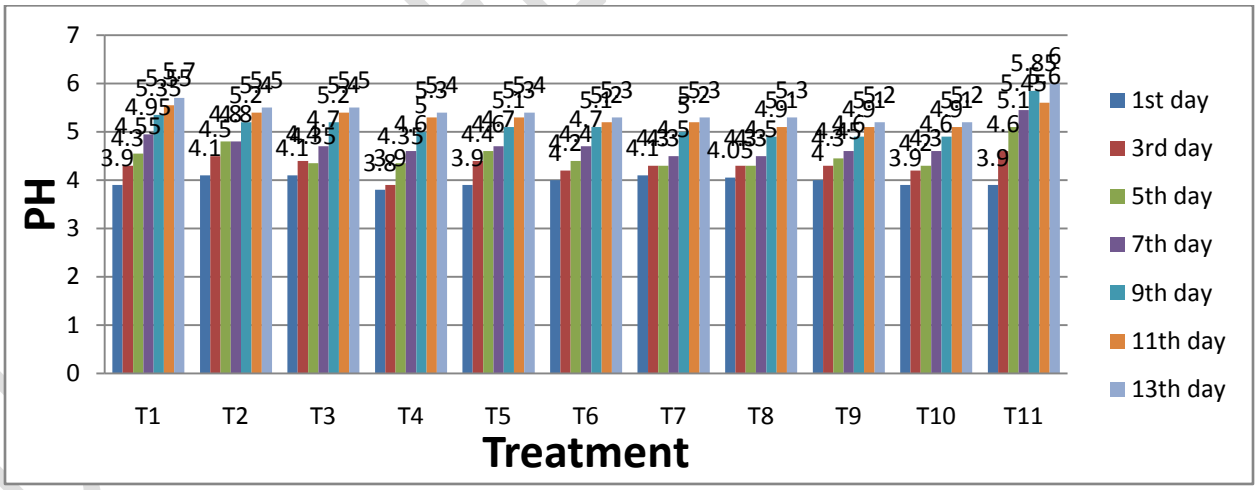

Fig. 6: pH of litchi cv. Shahi fruits during storage