Effects of different post-harvest treatments on bio-chemical characters and diseases of litchi in storage

Fakhar Uddin Talukder[1], Md. Sohanur Rahman[2*] and Md. Kamrul Hassan[3]

[1&2] Scientific Officer, Pest Management Division, Bangladesh Jute Research Institute, Dhaka, Bangladesh.

[3]Professor, Department of Horticulture, Bangladesh Agricultural University, Mymensingh, Bangladesh.

Correspondance: (E-mail: sohanbau2010@gmail.com)

Abstract

Objective of the study was to evaluate the effects of different post-harvest treatments on bio-chemical characters and diseases of litchi (*Litchi chinensis* Sonn, var. Bombai). The experiment consisted of two factors. Factor A: Temperature viz. T_1: Ambient temperature, T_2: 4ºC temperature; Factor B: PP bags (Polypropylene bag) viz. P_1: Control (unwrapped), P_2: 50 micro meter (µm) PP bag, P_3: 75µmm PP bag, P_4: 100µm PP bag. The experiment was conducted in completely randomized design (CRD) with three replications. Significant variation was observed in total soluble solid, PH of fruit pulp, vitamin c content, percent disease incidence and disease severity during the storage period. TSS contents increased up to the 6th day of storage and there after declined. pH values were maximum (4.14) in the fruits kept in 100µ polypropylene bag at ambient temperature. Vitamin C continent decreased with the increase of storage period. Disease incidence and severity progress with the storage period. Among the treated and untreated fruits, 75µm pp bag at low temperature (4ºC) treatment exhibited better storage performance. More research should be conducted by using other litchi cultivar like Bedana, China-3 etc. Various technologies have been devised to minimize the post-harvest losses of litchi, one of such technologies is the use of PP bag & low temperature.

Keywords: Litchi, Low temperature, Polypropylene bags, bio-chemical characters and diseases.

1. Introduction

Litchi, a non-climacteric fruit (Wills *et al*., 2004) belongs to the family Sapindaceae. It is one of the most important fruits of tropical and subtropicalworld and is highly prized for its perfectly blended sweet-acidic juicy pulp (Nusrat Perveen and Hidayatullah Mir, 2019). It deteriorates very fast after harvest. It introduced into Australia, South Africa and Hawaii by the end of the 19th century (Menzel and Simpson, 1986). Qu *et al*. (2007) reported that red phosphorus fumigation treatment on litchi delayed the increase in polyphenol oxidase activity, pH value and decreased anthocyanin and phenolies. Semeerbabu *et al*. (2007) conducted an experiment on litchi fruit treated with SO_2 fumigation and followed by 4% HCl dip. Ivi & Dhua (2002) observed that fruits packed in corrugated fiber board with perforated

polythene had the highest total soluble solid (16.80 °Brix), total sugar (13.06%) and titratable acidity (0.65%) than the control fruits after 6 days of storage. Mahajan Goswami (2004) compared the effect of CA (controlled atmosphere 3-5% O_2, 3-5% CO_2, 95% RH and 2°C temp.) and regular atmosphere maintained at 2°C temp. and 92-95% RH. Ghosh *et al.* (2003) performed an experiment by modified atmosphere packaging and samples treated with 50 ppm CuSO4 and Borax. These treated fruits shown the maximum acidity (0.25%), reducing sugar (9.18%), total sugar (15.86%) and total soluble solids (16.10 °Brix) after 15 days of storage. Wu *et al*. (2001) found that during cold storage total ascorbic acids both in the pericarp and in the juice decreased with the increase in pH value. In experiments with litchi cv. 'Huaizhi' fruits, a low temperature hardening treatment (5 days at 5°C) prior to storage for 40 days at 1°C delayed increased in ascorbic acid concentrations after removal from cold storage (Zhang *et al*. (2000).

Mohajan (1997) studied on the bio-chemical changes in litchi fruits during storage. He observed a declining trend in the titratable acidity of litchi fruit during storage. He added that the titratable acidity varied from 0.41 to 0.3% during storage. Mitra *et al. (1996)* found similar trend in change of titratable acid content during storage of litchi fruits. Mitra *et al. (1996)* carried out an experiment with litchi fruits cv. 'Bomabi' subjected to some postharvest treatments, such as fruits wrapped with perforated polyethylene bags and stored at 0 or 4°C and control fruits were dipped in water and stored at ambient temperature and analyzed at 2 days intervals. Similar trend of change in total soluble solid (TSS) during storage of litchi fruit was observed by Nagar (1994).

Liu *et al*. (2006) evaluated the development of main postharvest diseases in litchi. Korsten (2005) reported that combinations with natural plant extract, soft chemicals and modified atmosphere packaging could provide effective control of *Penicillium* infection on litchi. A study was conducted by Jiang *et al.* (2001) to identify the main pathogens of postharvest litchi fruit and evaluate the potential antagonists *in vitro.* Coates *et al.* (2003) reported that if fruits are not handled correctly a wide range of fungi like *Alternaria, Aspergillus, Fusarium, Cladosporium* and *Penicillium* spp. cause postharvest diseases. The effects of latent infection (≥90% infection) of anthracnose fungus *Colletotrichum gloeasporiodes* on the postharvest physiology of litchi cv. 'Huaizhi' fruits were studied by Liu *et al*. (2005).

2. Materials and methods

The experiments were carried out at the laboratories of the Departments of Horticulture ,Bangladesh Agricultural University, Mymensingh during the period from 15 May to 15 September, 2016. The litchi variety, namely 'Bombai' was chosen as experimental materials for the current investigation of the experiment. The experimental litchies were collected from the local growers of Ishwardi, Pabna. The maturity of the fruits was determined by the flatness of tubercles and comparative smoothness of epicarp. The commercially important litchi variety namely 'Bombai' was used for the present experiment. The single factor experiment consists of Eight (8) treatments as T_0= control (Fruits under ordinary conditions without wrapping), T_1= Fruits wrapped in 50µ polypropylene bag at ambient temperature, T_2= Fruits wrapped in 75µ polypropylene bag at ambient temperature, T_3= Fruits wrapped in 100µ polypropylene bag at ambient temperature, T_4= Fruits stored at 4°C temperature, T_5= Fruits wrapped in 50µ polypropylene bag at 4°C temperature, T_6= Fruits wrapped in 75µ polypropylene bag at 4°C temperature and T_7= Fruits wrapped in 100µ polypropylene bag at 4°C temperature.The single factor experiment was laid out in completely randomized design with three replications of 8 fruits. Fruits of more or less similar shape and size and free of visible disease symptoms were randomly selected from the harvested fruits. Among collected fruits in each replication of each treatment 4 fruits were marked to investigate total disease incidence, disease severity, isolation and identification of causal pathogens and the remaining 4 fruits were kept unmarked conditions for destructive sampling to examine TSS, vitamin C and pulp pH. All the marked and unmarked fruits were then subjected to the following treatments as per the experimental design: Fruits were randomly selected from the lot and kept on brown paper placed on the laboratory floor at ambient conditions without imposing any treatment. Polypropylene bag with the thickness of 50µ, 75µ and 100µ (35X24 cm) were used for this treatment. Fruits were kept the Polypropylene bag for each replication. The top of the bag was tied by using thread and then placed on brown paper for observation at ambient condition. Fruits were kept in low temperature (4ºC). Fruits were taken in a petridish and then placed on brown paper for observation at low temperature condition.

The fruits into polypropylene bag were kept into refrigerator at temperature of 4°C. Polypropylene bag with the thickness of 50µ,75µ and 100µ (35X24 cm) were used for this treatment. Fruits were kept the Polypropylene bag for each replication. The top of the bag was tied by using thread and then placed on brown paper for observation at low temperature (4°C) condition. Parameters were studied as per the following methods:

2.1 Total soluble solids

Total soluble solid (TSS) content of litchi pulp was estimated by using Abbe's Refractometer. A drop of litchi juice squeezed from the fruit pulp was placed on the prism of the refractometer. Then TSS was obtained from direct reading of the instrument. Temperature corrections were made by using temperature correction chart that accompanied the instrument.

2.2 Pulp pH

Preparation of standard buffer solution pH -7 and pH-4 buffer tablet BDH (chemicals Ltd., Poole, England) was dissolved in water and made up to the mark of 100 ml with distilled water.

Extraction of fruit juice

For the determination of pulp pH, 5 g of fresh pulp was taken in a conical flask containing 10 ml of distilled water. Then the pulp was crushed thoroughly in a mortar and pestle and extract was filtered through two layers of cloths.

Procedure

The pH meter (Hannan) was standardized by using buffer solution of pH -7 and pH-4 when correction for temperature was also taken into consideration. On completion of calibration the electrode was washed twice with distilled water, rinsed with litchi juice and dipped into the juice. The pH was recorded.

2.3 Vitamin C content

Reagents required for the estimation of vitamin C content of litchi pulp were (i) 3% Metaphosphoric acid (It was prepared by dissolving the sticks of HP03 in distilled water) (ii) Standard ascorbic acid solution and (iii) Dye solution (It was prepared by dissolving 260 mg of sodium salt of 2, 6-dichlorophenol indophenol in 1 litre of distilled water that contained 210 mg/litre of sodium bicarbonate). The following steps were followed for the estimation of vitamin C:

Standardization of dye solution

Five ml of standard ascorbic acid solution was taken in a conical flask and 5 ml of metaphaspharic acid (HPO3) was added to it and shaken. A micro burette was filled with dye solution. Then the mixed solution was titrated with dye using phenolphthalein indicator solution to a pink coloured end point that persisted at least for 15 seconds. Dye factor was calculated using the following formula:

$$\text{Dye factor} = \frac{0.5}{\text{litre}}$$

Preparation of sample

Ten grams of fresh fruit pulp was taken in a 100 ml beaker with 50 ml 3% metaphosphoric acid and then it was transferred to a blender and homogenized with same concentration of metaphosphoric acid. After blending, it was filtered and centrifuged at 2000 rpm for 5 minutes. The homogenized liquid was transferred to a 100 ml volumetric flask and was made up to the mark with 3% metaphosphoric acid.

Titration

Five ml of the aliquot was taken in a conical flask and titrated with 2, 6-dichlorophenol dye. Phenolpthalein was used as indicator to pink coloured end point, which persisted at least 15 seconds. The vitamin C content of the samples was calculated by using the following formula:

$$\text{Vitamin C content (mg/100 g)} = \frac{T \times D \times V_1}{V_2 \times W} \times 100$$

Where,

T = Titre

D = Dye factor

V1 = Volume made up

V2 = Volume of extract

W = Weight of sample

2. 4 Titratable acidity

Titratable acidity of litchi pulp was determined according to the method mentioned by Rangana (1979). The following reagents were used for the determination of titratable acidity.

1. Standard NaOH solution (0.1N)
2. 1% phenolphthalein solution

Extraction of litchi juice

Ten grams of fresh litchi pulp was homogenized with distilled water in a blender. The blended materials were boiled for 1 hr under refluxing. The whole mass was than cooled, filtered and transferred to a 100 ml volumetric flask and the volume was made up to the mark with distilled water.

Procedure

Ten ml pulp solution was taken in a conical flask. Two to three drops of phenolphthalein indicator was added and the flask was shaken vigorously. It was then titrated immediately with 0.1 N NaOH solution from a burette till a permanent pink colour was appeared. The

volume of NaOH solution required for titration was noted and percent titratable acidity was calculated by using the following formula:

$$\text{Percent titratable acidity} = \frac{T \times N \times V_1 \times E}{V_2 \times W \times 1000} \times 100$$

Where,

T=Titre

N=Normality of NaOH

V_1=Volume made up

E= Equivalent weight of acid

V_2= Volume of extract

W= Weight of sample

2.5 Disease incidence

Disease incidence refers to the percentage of fruits infected by disease organisms. The fruits were critically examined every day for the appearance of disease symptoms. The first count was made at the 3rd day of storage. The diseased fruits were identified symptomatically. The disease incidence was calculated as follows:

$$\text{Disease incidence (\%)} = \frac{\text{Number of infected fruits}}{\text{Total number of fruits under study}} \times 100$$

2.6 Disease severity

Disease severity refers to the percentage diseased portion of infected fruit. The infected fruits of each replication of each treatment (varieties) were observed to determine percent fruit area infected and was measured based on eye estimation. The mean values regarding infected fruit area were calculated, presented, and discussed.

2.7 Isolation and identification of causal pathogens

Representative samples of diseased fruits were collected and taken to the laboratory of the Department of Plant Pathology, Bangladesh Agricultural University, Mymensingh for isolation and subsequent identification of causal organisms. Diseased samples with typical symptoms were selected and ten semi-permanent slides were prepared. Scraping method was used to isolate the organisms. The materials included: diseased fruits samples, slide, cover slip, blade, needle, cotton blue, soft cloth and compound microscope. At first, a clean slide was selected and a drop of cotton blue was placed on the slide. Specimen was collected by

scraping with sterilized scalpel blade and was placed on the cotton blue. A cover slip was placed on the specimen. The surrounding area of cover slip was cleaned with soft cloth. A total 10 semi-permanent slide were prepared. The prepared slides were observed under compound microscope for identifying the pathogenic structures. After 24 hours the prepared slides were made permanent by using nail polish.

The images of the pathogens were taken by digital camera (Olympus BX51) from the Field Fertility Clinic of Veterinary Science, Bangladesh Agricultural University, Mymensingh. The pathogens were identified as per the descriptions of Mukherji (1972).

3.7 Observation

Fruits used in the experiment were observed every day. Data were collected on weight loss, physical and chemical changes and rottening of the fruits during storage as influenced by different postharvest treatments.

3.8 Statistical analysis

For the experiment, the collected data were statistically analyzed by Analysis of Variance (ANOVA) test. The means of different parameters were compared by least significant difference (LSD) as described by Gomez and Gomez (1984). For percentage data arcsine transformations were carried out to satisfy the assumption of ANOVA.

4. Result and discussion

4.1 Changes in bio-chemical characters

Bio-chemical changes, namely total soluble solid, pH of fruit pulp and vitamin C content were investigated in the present study. The results are presented and interpreted in the following.

4.1.1 Total soluble solids

The storage treatments involved in the present investigation caused significant variation. At the 3rd day of storage, the maximum TSS (19.60 °Brix) was recorded in T_0 and minimum TSS (18.10 °Brix) was recorded in T_6. Decreases in TSS and TA of litchi are mainly due to respiration that consumes the nutrient substances of fresh litchi (Feng et al., 2011). At day 6, the maximum TSS (21.2 °Brix) was recorded in T_0 and the minimum TSS (18.80 °Brix) was recorded in T_6. At day 9, the maximum TSS (20.40 °Brix) was recorded in T_0 and the minimum TSS (18.20 °Brix) was recorded in T_2 (Fig. 1). The increase in TSS content of

fruit pulp with the advancement of storage period reaching a peak at 6th day of storage and decline thereafter and it was supported by Mohajan (1997) and Nagar (1994). **Similar result found by Elia Nora Aquino Bolaños et.al.2010.**

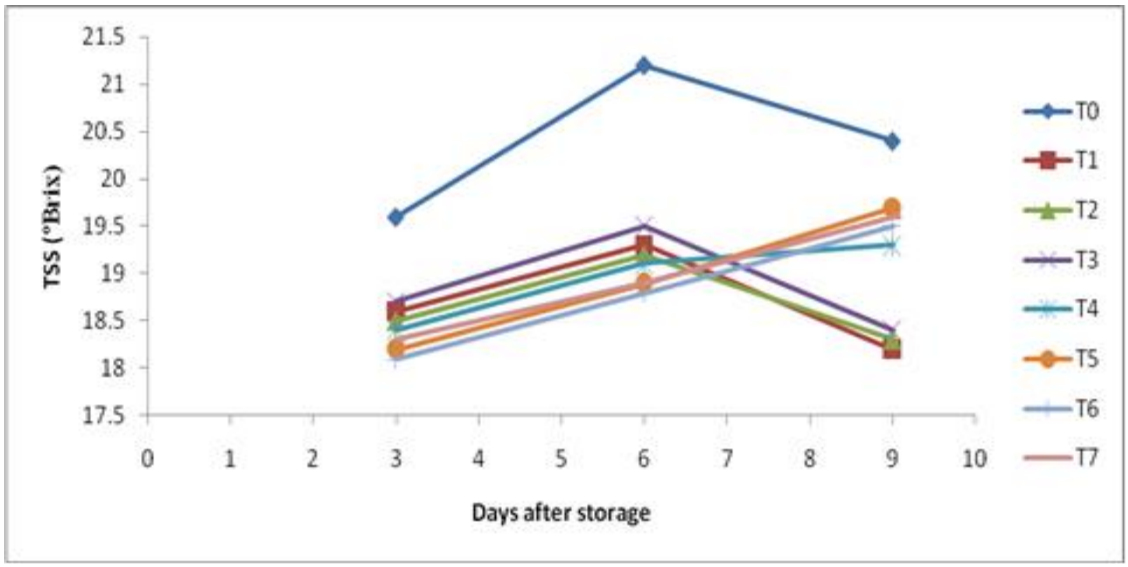

Fig 1. Effect of different postharvest treatments in total soluble solids of litchi during storage. The vertical bar represents LSD at 5% level of probability. T_0= control, T_1= 50µ polypropylene bag at ambient temp, T_2= 75µ polypropylene bag at ambient temp, T_3= 100µ polypropylene bag at ambient temp, T_4= Low temperature (4°C) treatment, T_5= 50µ polypropylene bag at 4°C temp, T_6= 75µ polypropylene bag at 4°C temp, T_7= 100µ polypropylene bag at 4°C temp.

4.1.2 pH of fruit pulp

Variations among the treatments in relation to pH of fruit pulp were significant as influenced by the postharvest treatment by the postharvest treatments. The maximum (3.80) pH of fruit pulp was observed in control (T_0) followed by (T_3)fruits kept in 100µ polypropylene bag at ambient temperature (3.78), T_4 fruits kept in 4°C temperature (3.76), T_7-fruits kept in 100µ polypropylene bag at 4°C temperature (3.74), T1- fruits kept in 50µ polypropylene bag at ambient temperature (3.71), T_2- fruits kept in 75µ polypropylene bag at ambient temperature (3.67), T_5- fruits kept in 50µ polypropylene bag at 4°C temperature (3.66), and minimum pH value was at T_6- fruits kept in 75µ polypropylene bag at 4°C temperature (3.62) at the 3rd day of storage.Further, it was noticed that the pH of fruit pulp was gradually increased during the total storage period (Fig. 2). The increase in pulp pH may be due to continuous falling of acidity during storage. Increased of pulp pH observed in the present study was an agreement

with the findings of Tongdee et al. (1982), who found that pulp pH of litchi, increased with storage duration. Similar result was found by Md. Aklimuzzaman *et al,* 2011.

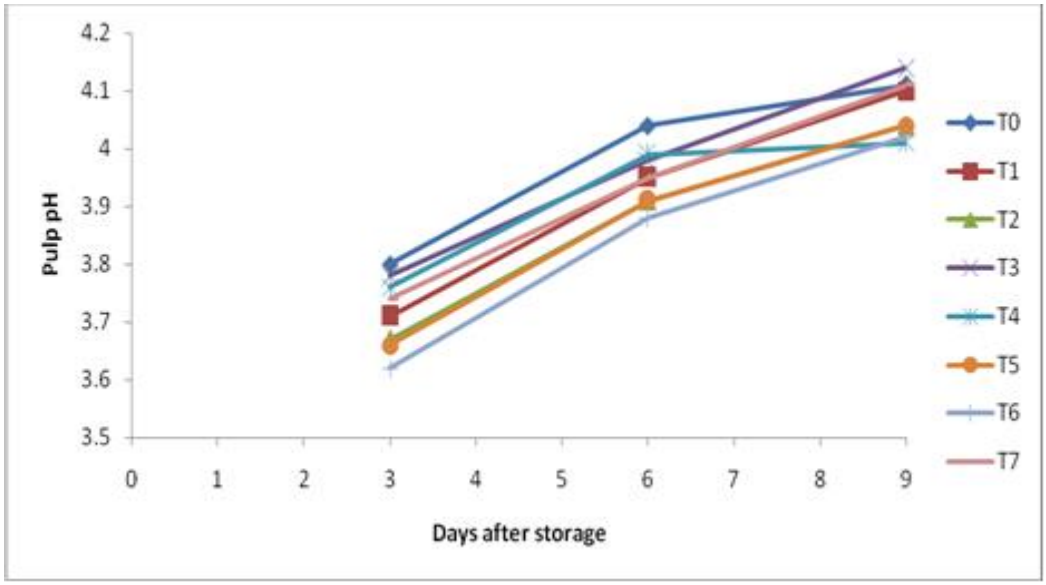

Fig 2. Effect of different postharvest treatments in pulp pH of litchi during storage. The vertical bar represents LSD at 5% level of probability. T_0= control, T_1= 50µ polypropylene bag at ambient temp, T_2= 75µ polypropylene bag at ambient temp, T_3= 100µ polypropylene bag at ambient temp, T_4= Low temperature (4°C) treatment, T_5= 50µ polypropylene bag at 4°C temp, T_6= 75µ polypropylene bag at 4°C temp, T_7= 100µ polypropylene bag at 4°C temp.

4.1.3 Vitamin C content

The postharvest treatments used in the present study in respect of vitamin C content exhibited highly significant variation among the treatments during storage. Vitamin C contents declined with the progress of ripening of fruits and it was observed in all treatments (Table 14). Highest vitamin C content (36.02 mg/100 g) was in fruits kept in 75µ polypropylene bag at 4°C temperature (T_6) followed by fruits kept in 50µ polypropylene bag at 4°C temperature (T_5) (35.73 mg/100 g) at the 3rd day of storage. The lowest vitamin C contents were in order of T_6 (29.40 mg/100g) > T_7 (28.63 mg/100g) > T_5 (28.17 mg/100g) > T_4 (27.47 mg/100g)> T_2 (22.76 mg/100 g)> T_3 (22.20 mg/100g)> T_1 (21.98 mg/100 g)> T_0 (21.34 mg/100 g) at the 9th day of storage as shown in (Table 1). This result is agreement with Xin An Zeng *et. al.* (2008) and Nettra Somboonkaew, Leon A. Terry. (2010): Among the treatments the T_6 (fruits kept in 75µ polypropylene bag at 4°C temperature) treatments was found the most effective in checking the decrease in vitamin C

content of fruit pulp. This result is agreement with Xiaohuang Cao et.al.2019; Lafarga et.al. 2018 and Duan et.al. 2015. Mohajan (1997) stated that vitamin C content decreased during storage period and the present r esult was also a complete agreement with that result. This result was also in complete agreement with the result reported by Mitra *et. al.* (1996) and Thompson (1975).

Table 1. Effects of different postharvest treatments on Vit C of litchi

Postharvest treatments	Vitamin C content (mg/100g) at different days after storage		
	3	**6**	**9**
T_0	31.14	24.14	21.34
T_1	35.22	31.45	21.98
T_2	35.53	31.97	22.76
T_3	35.35	31.02	22.20
T_4	35.18	31.26	27.47
T_5	35.73	32.19	28.17
T_6	36.02	32.94	29.40
T_7	35.50	31.96	28.63
$LSD_{0.05}$	0.681	1.29	0.679
$LSD_{0.01}$	0.939	1.77	0.936
Level of significance	7.369**	23.241**	35.822**

** = Significant at 1% level of probability**,** * = Significant at 5% level of probability, NS = Not significant

4.1.4 Titratable acidity

The varietal difference in terms of titratable acidity was statistically highly significant during storage. Marked reduction was observed in titratable acid content with the advancement of storage period. Titratable acid contents declined up to the 9th day storage for all the treatments. At the 3rd day of storage the maximum acidity was found in those fruits kept in 75µ polypropylene bag at 4°C temperature (0.50), whereas, it was minimum (0.43) in control fruits. At the 6th day of storage the maximum acidity was found in those fruits kept in 75µ polypropylene bag at 4°C temperature (0.39), whereas, it was minimum (0.25) in control fruits. At the 9th day of storage the maximum acidity was found in those fruits kept in 75µ polypropylene bag at 4°C temperature (0.30), whereas, it was minimum (0.19) in control fruits (Table 2). In the present investigation, decrease in percent titratable acidity observed during storage agrees with the results of Mahajan (1997) and Mitra *et al (*1996). The decrease in titratable acidity during storage may be attributed to the utilization of organic acids in respiratory process and other biodegradable reactions (Ulrich, 1974). Decreases in TSS and TA of litchi are mainly due to respiration that consumes the nutrient substances of fresh

litchi (Feng *et al.*, 2011). This result is agreement with Sai Xu, *et.al.* 2019 and Elia Nora Aquino Bolaños et.al.2010.

Table 2. Effects of different postharvest treatments on Titratable acidity of litchi

Postharvest treatments	Titratable acidity at different days after storage		
	3	**6**	**9**
T_0	0.44	0.25	0.19
T_1	0.45	0.35	0.30
T_2	0.45	0.33	0.25
T_3	0.46	0.32	0.28
T_4	0.45	0.31	0.25
T_5	0.49	0.36	0.28
T_6	0.50	0.37	0.29
T_7	0.48	0.35	0.27
$LSD_{0.05}$	0.08	0.05	0.05
$LSD_{0.01}$	0.11	0.08	0.08
Level of significance	0.001NS	0.004*	0.004*

** = Significant at 1% level of probability**,** * = Significant at 5% level of probability, NS = Not significant

4.2 Postharvest disease

4.2.1 Disease incidence

The postharvest storage treatments used in the present study had marked effect on disease incidence of litchi fruits. The variation among the treatments mean in terms of disease incidence were significant except the 2nd day of storage. At the 10th day of storage, maximum (100%) disease incidence was observed in the control (T_0) fruits and also on the fruits kept in 100µ polypropylene bag at ambient temperature. The most of the disease incidence occurs in T_3 (100µ polypropylene bag at ambient temperature) treatment (Table 3). In case of all treatments disease incidence were increased with the storage period. The litchi fruits that were kept in 100µ polypropylene bag at ambient temperature (T_3) and the control fruits (T_I) showed an incidence level of 40.00% and 46.67% at the 4th day of storage, respectively, which sharply increased up to 100% at the 10^{th} day of storage. On the contrary, There is no disease incidence occurs in all the fruits kept in 4ºC temperature (T_4, T_5, T_6,T_7) treatments.

Table 3. Effects of different postharvest treatments on percent disease incidence of litchi

Postharvest treatments	% Disease incidence at different days after storage			
	2	**4**	**6**	**8**
T_0	20.00	46.67	66.67	100.00
T_1	7.33	33.33	53.33	80.00
T_2	0.00	26.67	46.67	66.67
T_3	26.67	40.00	60.00	100.00
T_4	0.00	0.00	0.00	0.00
T_5	0.00	0.00	0.00	0.00
T_6	0.00	0.00	0.00	0.00
T_7	0.00	0.00	0.00	0.00
$LSD_{0.05}$	0.61	12.24	12.24	7.70
$LSD_{0.01}$	0.84	16.86	16.86	10.61
Level of significance	343.079**	1247.619**	2847.619**	6780.952**

** = Significant at 1% level of probability

4.2.2 Disease severity

There was variation in disease severity level during storage. Maximum (51.67%) disease severity was observed in control (T_0) fruits (Table.4), while minimum (0.00%) was observed in the fruits kept in 4ºC temperature (T_4), 50µ polypropylene bag at 4ºC temperature (T_5), 75µ polypropylene bag at 4ºC temperature, 100µ polypropylene at 4ºC temperature(T_7) at the 10^{th} storage period. Disease severity increases with the increase of storage period. All the fruits kept in 4ºC temperature (T_4, T_5, T_6, T_7) showed no disease severity at all the storage period. The fruits remain in ambient condition (T_0) showed a sharp increase in percent severity during the entire storage period but it was slower in the fruits kept in 75µ polypropylene bag at ambient temperature (T_2) treatment and it was 13.33% at the 10^{th} day of the storage period.

Table 4. Effects of different postharvest treatments on percent disease severity of litchi

Postharvest treatments	Disease severity (%) at different days after storage			
	2	**4**	**6**	**8**
T_0	1.00	10.00	25.67	51.67
T_1	0.00	5.06	12.33	19.67
T_2	0.00	1.33	7.04	13.33
T_3	0.00	8.67	17.67	30.67
T_4	0.00	0.00	0.00	0.00
T_5	0.00	0.00	0.00	0.00
T_6	0.00	0.00	0.00	0.00
T_7	0.00	0.00	0.00	0.00
$LSD_{0.05}$	0.87	1.38	1.51	0.87
$LSD_{0.01}$	1.19	1.91	2.08	1.19
Level of significance	53.160**	291.943**	1076.623**	53.160**

** = Significant at 1% level of probability

4.2.3 Isolation and identification of pathogens

Disease starts on fruit skin and gradually expands all over the fruits. Initially small spots were observed, then the spots were enlarged and several spots coalesced together to produce large lesion. Finally, white cottony fungal mycelia developed on the fruit surface in case of serious infection. A wide range of fungi can cause decay of litchi fruit (Holcroft and Mitcham 1996; Jiang et al. 2003). The main pathogen isolated from litchi was identified as Peronophythora litchi (Jiang et al. 2001).

Infected fruits were picked up from the different treatments and were studied at the laboratory of the Department of Plant Pathology Laboratory of Bangladesh Agricultural University, Mymensingh for identifying the causal organisms. Ten semi-permanent slides were prepared from the diseased fruits. In case of 'Bombai' variety were found infected by *Rhizopus* and *Penicillium* spp. The characteristics of the causal pathogens are as follows:

Rhizopus spp.

From the microscopic observation it appears that this pathogen produced sac like and globosely structure called sporangium (Plate A). 1t bears a dome shaped persistent structure named by columella. A root like structure called rhizoid was also present beneath the sporangipohare. This was also reported by Mukherji (1972).

Penicillium spp.

The pathogen was identified based on the sexual reproductive structures called conidia. Conidia are unicellular, globose to ovoid (Plate B). On the top of the sterigmeta conidia produce a conidial chain and similar structure was also observed by Mukherji (1972) and de Jager et al. 2003. Dharini Sivakumar et al. (2007) also isolated ***Penicillium spp***. of storage litchi. Similar disease was identified by Vinod Kumar (2011).

A B

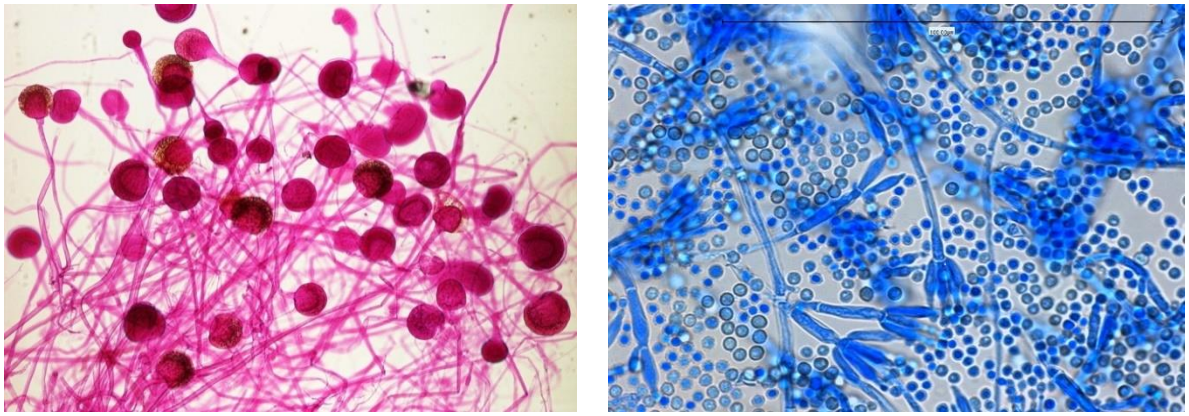

Plate 1. Microscopic view (x80) of isolated pathogens (A: *Rhizopus* sp. and *B: Penicillum* sp) from infected litchi fruits

5. Conclusion

Significant variation was observed in total soluble solid, PH of fruit pulp, vitamin c content, percent disease incidence and disease severity during the storage period. But TSS contents were always higher in the fruits of 100µ polypropylene bag at ambient temperature as compared to the others. pH value increase up to 6th day of storage. Vitamin C continent decreased with the increase of storage period. Minimum (0.00%) disease severity and (0.00%) disease incidence was observed in fruits treated with low temperature with or without polypropylene bag at all the time period of storage.Considering the above discussion it may be concluded that keeping litchi in 75µ polypropylene bag and stored in low temperature (4^{o}C) is the best to extend its storage without affecting the quality.

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Conflict of interest

The authors have no conflict of interest to report.

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