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Effect of Different Packaging on Broccoli Quality in Room Conditions

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ABSTRACT

A research work was carried out to discuss the effect of different packaging materials on the quality of broccoli stored in room condition. In Horticultural Research Station, Mondouri, the crop was grown which was harvested at tight and compact stage of broccoli for storage studies in room conditions. Broccoli were kept without any packaging material (T1), packaging with 0.5% perforation polypropylene bag (T2), 1% perforation polypropylene (PP) bag (T3) and polypropylene bag without any perforation (T4) and stored in room condition. During the storage period, the change in physico-chemical characteristics based on physiological loss in weight (PLW), marketability, yellowing %, ascorbic acid, total soluble solids and chlorophyll content were studied at regular intervals in order to identify the changes in quality during the room storage. The maximum weight loss (17.97%) occurred in broccoli without any packaging material while the minimum weight loss (2.49%) was recorded in broccoli without any perforation. Maximum TSS was recorded in broccoli heads packed with 1% perforation PP bag (T3) while the minimum was recorded in unpacked broccoli heads (T1). The maximum ascorbic acid content in non perforated packaging (T4) was 93.67 while minimum content in unpacked broccoli was 54% on the 3rd day. The highest value of chlorophyll content of 293 µg/g on the day of storage declined to 271.33 µg/g on the 3rd day of storage in non-perforated package (T4). Unpacked broccoli showed maximum yellowing which increased to 97.67% on while broccoli packed with no perforation (T4) resulted with least yellowing of 2% on the 3rd day of storage. So, the best packaging method in broccoli for room storage is T4 during the 3 days storage in room condition.

Key Words: Ascorbic acid, Broccoli, Chlorophyll, Shelf life, Yellowing.

INTRODUCTION

Broccoli (*Brassica oleracea var italica*) is a cool season crop belonging to the family Brassicaceae and grows in temperature range of 18-23°C maturing in about 75 to 95d after planting depending upon the cultivar, season and planting date. Broccoli can grow well during winter season in India so there is good scope for export during this period to the Gulf and other developed countries where the climatic conditions are unfavourable (Thanburaj and Singh, 2003). The main sugars present in broccoli includes glucose, fructose, sucrose, maltose and lactose. Broccoli is a good source of ascorbic acid among vegetables containing on an average of 34-185mg/100g fresh weight, while broccoli leaves and stalk contain on average 93.2mg ascorbic acid/100g fresh weight. Broccoli consists of glucosinolate compounds, which shows characteristic flavour of this vegetable. An average amount 1.20-6.24µmol of glucosinolates/g of fresh weight of broccoli is present (Song and Thornalley, 2007). Consumer prefers broccoli with sweet,crisp with characteristic flavour instead of intense bitter broccoli. It has been found that lower bitter pungent flavours was related with 30-35mg/100g fresh weight or less of glucosinolate content in broccoli (Bruckner *et al*, 2005). Kundu *et al* (2018) have demonstrated that this high value crop has a good scope to grow in the prevailing climatic condition of the West Bengal with potential for export.

Inspite of the rich nutritional value of broccoli, the high respiration rate of broccoli is responsible for the short shelf life of broccoli. Packaging to give proper protection against mechanical damage and moisture is necessary. The most important external factor that affects post harvest deterioration of crops is temperature (Wills *et al*, 2007). The main aim of the work was to enhance the shelf life of this perishable crop by using packaging of different perforations and reduce the post harvest loss to increase the benefit of the broccoli growers.

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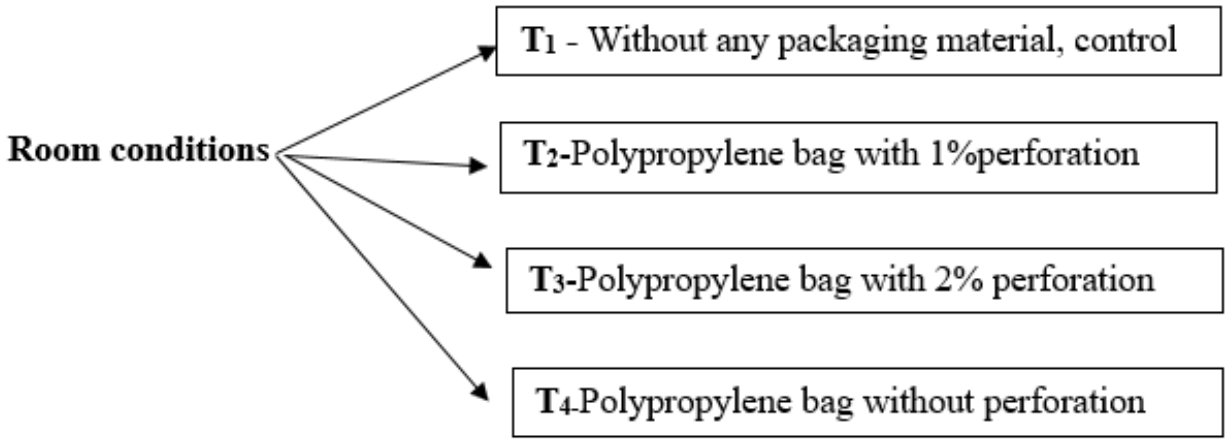

MATERIALS AND METHODS

The study was carried in Bidhan Chandra Krishi Viswavidyalaya in the department of Post Harvest Technology of Horticultural Crops in Mohanpur, West Bengal. Broccoli was cultivated in the Horticultural Research Station, Mondouri, West Bengal which falls under sub tropical humid (Indo-Gangetic) agro climatic zone with 9.75m above mean sea level, 23.5^{0}N latitude and 89^{0}E longitude where the soil type is sandy loam and sufficiently deep soil with pH 6.0 to 6.8. Harvested broccoli heads were precooled in room condition followed by removing the leaves and packed with polypropylene bags with different level of perforations while the unpacked heads were kept as control for comparison. Storage was done at four different conditions as stated below:

Completely randomised design was used to analyse the data with three replications for each treatment. Analysis in data recorded on PLW%, ascorbic acid content, Total soluble solids, content of chlorophyll (µg/g), yellowing (%). These data were recorded daily basis for the entire storage period.

Analysis of Physico-chemical parameters:

Physiological loss in weight (PLW)%

PLW is calculated based on the initial weight (before storage) and loss in weight recorded at the time of sampling during storage (Nath *et al*, 2011).

$$PLW = \frac{\text{initial weight} - \text{finalweight}}{\text{initial weight}} \times 100$$

Ascorbic acid (mg/100g)

It is calculated by titration method using 2, 6-dichlorophenol indophenols (blue colour) where the a pink colour appearance denotes the end point since the blue dye is pink coloured in acid medium. Ascorbic acid (mg/100 g)

$$= \frac{\text{Titre value} \times \text{Dye factor} \times \text{Volume made up}}{\text{Aliquot of extract taken for estimation} \times \text{Wt: or vol: of the sample taken for estimation}} \times 100$$

Chlorophyll

Spectrophotometric method is used to determine the chlorophyll content. The supernatant volume is made up with acetone 80% and value of optical density value is measured against blank through wavelength 660nm and 642.5nm in a colorimeter. The total chlorophyll content is calculated by the formula:

Total chlorophyll (a+b), µg/ ml = (7.12 × OD at 660nm) + (16.8 × OD at 642.5nm)

(TSS) Total soluble solids in °Brix

Broccoli juice sample was used to determine the TSS in degree brix (°B). For this purpose (Erma Hand Refractrometer I.S.O 2173)

is used where thebroccoli juice is placed on face of the prism and the reading in °Brix will be noted.

Yellowing %

The broccoli head can be imaginarily divided into four parts out of 100 per cent. The area which becomes yellow are will be recorded as per the division of the whole head.

RESULTS AND DISCUSSION

The storage studies in room condition was done for 3days. The highest PLW was 4.90 to 17.97% in unpacked broccoli while the lowest PLW was recorded in broccoli packed without perforation (0.79 to 2.49%) throughout the storage period. Loss in weight increased during broccoli storage in the room condition.

Table 1. Change in physiological loss in weight (%) of broccoli during storage.

Treatment	Days in storage		
	Day 1	Day 2	Day 3
T1(no packaging)	4.90(12.78)	11.77(20.05)	17.97(25.07)
T2(PP+0.5%perforation)	0.43(3.74)	2.72(9.49)	4.58(12.36)
T3(PP+1% perforation	1.14(6.13)	3.33(10.52)	4.67(12.48)
T4(PP+ no perforation)	0.79(5.11)	1.58(7.22)	2.49(9.07)
SEm±	0.03	0.08	0.07
CD(P=0.05)	0.10	0.27	0.24

Note: Values in bracket denote angular transformed data

Regarding TSS (Table 2), it increased gradually in all the broccoli with different level of packagings. Broccoli in non perforated packaging showed the highest TTS content while minimum content was recorded in non packed broccoli heads which may be due to the varying rate of respiration in the packed and non packed broccoli.

Table 2. Change in TSS (^{o}B) of broccoli during storage.

Treatment	Days in storage			
	At harvest	Day 1	Day 2	Day 3
T1(no packaging)	7.13	7.77	7.80	7.43
T2(PP+0.5%perforation)	7.20	7.43	7.70	7.93
T3(PP+1% perforation	7.13	7.53	8.00	8.17
T4(PP+ no perforation)	7.20	7.57	7.99	8.00
SEm±	0.13	0.12	0.08	0.05
CD(P=0.05)	NS	NS	NS	0.16

Note: NS= non significance

The highest ascorbic acid content was found in non perforated packaging followed by packaging with 0.5% perforation while the least effective treatment was in the unpacked broccoli with minimum ascorbic acid content. This occurred due to change in atmosphere in package leading to vitamin C retention due to the increase in CO_2 with the reduction in O_2 amount (Barth and Zhuang, 1996).

Table 3. Change in ascorbic acid (mg/g) of broccoli during storage.

Treatment	Days in storage			
	At harvest	Day 1	Day 2	Day 3
T1(no packaging)	129.67	82.33	69.00	54.00
T2(PP+0.5%perforation)	127.00	102.67	82.33	69.00
T3(PP+1% perforation	127.67	106.67	79.67	60.67
T4(PP+ no perforation)	128.00	116.67	103.00	93.67
SEm±	2.63	1.42	1.31	1.62
CD(P=0.05)	NS	4.72	4.35	5.38

Broccoli packed with no perforation showed the highest chlorophyll content which reduced from 287.33 to 271.33 µg/g during the storage followed by those packed with 0.5% perforation PP bag while the minimum chlorophyll content was recorded in unpacked broccoli which decreased from 267 to 121 µg/g during the storage study. The total chlorophyll a+b content followed decreasing trend for all the cases where the rate of decrease was slower in lower temperature along with no perforation. This was in line with finding of Serrano *et al* (2006) where the total chlorophyll content reduced drastically control floral part of broccoli with similar reduction in macro perforated packaged broccoli.

Table 4. Change in chlorophyll (µg/g) of broccoli during storage.

Treatment	Days in storage			
	At harvest	Day 1	Day 2	Day 3
T1(no packaging)	296.00	267.00	170.00	121.400
T2(PP+0.5%perforation)	294.67	271.33	183.33	176.67
T3(PP+1% perforation	296.67	278.33	243.33	117.67
T4(PP+ no perforation)	293.33	287.33	281.00	271.33
SEm±	3.09	2.86	13.25	8.55
CD(P=0.05)	NS	9.46	43.87	28.33

Note: NS= non significance

Yellowing started from day 2 with maximum yellowing (91.67%) in unpacked broccoli followed by 88.33% in broccoli packed with 0.5% perforation while minimum yellowing occurred in broccoli packed with no perforation with 1.33 and 2.00% on 2 and 3 days after storage respectively.

Table 5. Change in yellowing (%) of broccoli during storage.

Treatment	Days in storage	
	Day 2	Day 3
T1(no packaging)	91.67(73.37)	97.67(82.96)
T2(PP+0.5%perforation)	88.33(70.08)	98.33(82.63)
T3(PP+1% perforation	80.33(63.65)	90.00(71.53)
T4(PP+ no perforation)	1.33 (6.53)	2.00(8.13)
SEm±	1.24	1.93
CD(P=0.05)	4.11	6.39

Note: Values in bracket denote angular transformed data

CONCLUSION

The least physiological loss in weight was shown by polypropylene (PP) packed broccoli with no perforation which was responsible to maintain the texture of fresh broccoli along with high retention of ascorbic acid (93.67%) and the highest chlorophyll retention during the three days storage period while the unpacked one is not desirable due to wilting problem. Though there was only slight yellow part in the broccoli (T4) packed with no perforation. So it can be concluded that among the various packaging, broccoli in (T4) which is packed in PP without any perforation resulted in maximum desirable character whereas broccoli in (T1) without any packaging started yellowing and wilting fast during the 3 days study in the room condition.

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