EFFECT OF DIFFERENT PACKAGING SYSTEMS AND CHLORINATION ON THE QUALITY AND SHELF LIFE OF GREEN CHILI

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Abstract

The experiment was conducted to evaluate the effect of packaging materials on the quality and shelf life of green chili (Capsicum annuum) using passive modification of modified atmosphere packaging system. The modified atmosphere was created by making perforation in the polypropylene packets. Green chili pre-treated with chlorine water and then packaging in 0.3% perforated polypropylene packet resulted substantial reduction of weight loss and rotting/shrivelng. These treatment combinations also considerably retained vitamin C, β-carotene, moisture content, etc. Under this condition the retention of quality and shelf life of green chili could be extended up to 10 days at ambient condition as compared to non-treated and without packaging.

Keywords: Packaging systems, chlorinations, shelf life, green chili.

Introduction

The total spices and condiments production in Bangladesh is about 1370 thousand metric tons from 729 thousand acres of land in 2007-2008 in which the production of chili is 118 thousand metric tons from 231 thousand acres of land (BBS, 2008). A large quantity of these spices is lost due to lack of proper postharvest handling, transportation, packaging, and storage facilities. The postharvest loss of vegetables in the developing countries is 20-50% and 5-25% in the developed countries (Amiruzzaman, 2000). Since green chili is highly perishable like other green vegetables, these are also subject to huge losses during the peak production season mainly during transportation, storage, and marketing.

In the super market, the shelf life of green chili has been found to be very short. The suppliers generally use gunny bags, big cartoons or boxes for carrying of green chili. The super market authority stored the collected chilies in different chambers of their cold room. They maintain the temperature at around 20°C but they do not maintain the humidity. As a result, the quality of green chilies

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Modified atmosphere packaging is used in storage of fresh fruits and vegetables; the term refers to their storage in plastic films, which restrict the transmission of respiratory gases. This results in the accumulation of carbon dioxide and depletion of oxygen around the crop, which may increase their storage life (Kader et al., 1989). Badgujar et al. (1987) reported that packing of brinjal in perforated polyethylene bags (1% holes) prolonged shelf life and maintained quality compared to unpacked ones. The storage of green chili in small packet with or without some pretreatments and controlling its humidity may extend the shelf life. Pretreatments of vegetables with potassium permanganate water or chlorine water before packaging exhibit better shelf life in room temperature (Giraldo et al., 1977). Pretreatment is done in order to reduce micro flora, especially bacteria from the produce. Again, the demand of the consumers is only half to one kilogram of fruits and vegetables. However, there is no standard packet of such quantity. Standardization of packages will extend the shelf life of chilies as well as reduce the postharvest losses.

Materials and Method

Freshly harvested green chili (*Capsicum annuum*) was collected from the producers’ field. The green chilies were sorted out to remove the pest affected, over matured and damaged ones in the laboratory of Postharvest Technology Division, BARI, Gazipur. Then, the green chilies were washed with chlorine water. Chlorine water is achieved by adding 200 ppm sodium hypochlorite (or 2 Halotab tablets/litre water) in clean water (Amiruzzaman, 2000). Polypropylene of thickness 33 micron was used as packaging material and the packages were modified with different perforations (0.1%, 0.2%, 0.3%, and 0.4% perforation) to restrict the respiration of the chilies.

Treatments

- $T_1$ = Polypropylene packet with zero perforation,
- $T_2$ = Polypropylene packet with 0.1% perforation,
- $T_3$ = Polypropylene packet with 0.2% perforation,
- $T_4$ = Polypropylene packet with 0.3% perforation,
- $T_5$ = Polypropylene packet with 0.4% perforation,
- $T_6$ = Control (without packet),

The experiment was laid out in CRD with three replications. Each replication of the treatments consisted of 500 grams of green chilies. After packing, the chilies were stored in ambient temperature. Temperature and humidity were recorded and close observations were made to record the physicochemical parameters like moisture content, rotting/decay, marketability, vitamin C and ß-carotene of the green chili.
Package perforation (%): The perforations on the packets were made by using a puncher machine. The number of perforations on each packet was determined using the following calculation:
Area of each packet = 28 cm x 26 cm = 728 sq cm
Diameter of each hole (dia. of puncher rod) = 0.4 cm
From these data numbers of perforations were calculated to be 5, 10, 15 and 20 for 0.1, 0.2, 0.3 and 0.4% perforation, respectively.

Shelf life (day): Shelf life of the green chilies was determined by observing and judging the quality parameters like rotting, shriveling, incidence of disease, etc. with respect to storage days. It was detected when most of the chilies of a treatment were still marketable.

Decay/Rotting (%): It is the percentage of the damaged chilies. It was also determined by the quality parameters of the chilies like rotting, shriveling, incidence of disease, etc.

Physico-chemical analysis: Vitamin C, ß-carotene and moisture content were determined for the fresh chilies at 7th to 12th days of storage. Vitamin C (ascorbic acid) was determined by 2,6 – Dichlorophenol – Indophenol Visual Titration method, ß-carotene by AOAC (Association of Official Analytical Chemists) method and moisture content by Oven Drying method. These methods were conducted according to Ranganna (1986).

Results and Discussion

Data on physico-chemical parameters (moisture content, vitamin C, and ß-carotene) and rotting/decay as well as marketability of green chilies were analyzed at 7th, 8th, 9th, 10th, 11th, and 12th days of storage at ambient temperature. Temperature was recorded during the experiment as 28°C – 32°C (max.) and 20°C – 25°C (min.). Again, humidity was recorded as 65% - 85% (at 9:00 am) and 68% - 92% (at 4:30 pm).

The results showed that green chili packed in 0.3% perforated packets (T4) retained optimum moisture content (77.18%), minimum rotting/decay (23.56%) and thus highest marketability (70%) followed by packet with 0.4% perforation (T5) after 10 days of storage period (Fig. 1, 2, and 3). Retention of maximum moisture content (80.94%) and maximum rotting/decay (81.76%) occurred in the treatment T1 (sealed polypropylene) followed by treatment T2 (0.1% perforation) and T3 (0.2% perforation), respectively, through the storage periods (Fig. 1 & 2). Conservation of excessive moisture content resulted more condensed water in the T1 packet thus enhanced the rotting. Chilies kept in bulk without packaging (treatment T6) lost moisture drastically and shriveled rapidly thus lost marketable quality as turned into red and lost freshness. After 10 days of storage, the green
chilies stored in 0.3% perforated packets (T₄) showed best acceptance as compared to other treatments in terms of freshness, rotting/decay and turning into red that ultimately led its highest marketability. The storage of the chilies in the polypropylene packets conserved the moisture hence prevented shrinkage and reduced the weight loss. Chilies in the perforated packets lost moisture with respect to perforated openings but slower than the bulk and open storage. Respiration involves the oxidative breakdown of complex substrate molecules, normally present in plant cells such as starch, sugars and organic acids to simpler molecules, in the course of which energy, carbon dioxide and water are given out. Atmospheres low in O₂ (1–5%) and high in CO₂ (5–10%) have been used to extend the shelf-life of fresh-cut fruits and vegetables by reducing respiration, product transpiration and ethylene production, as O₂ is involved in the conversion of 1-amino-cycloprane-1-carboxylic acid to ethylene (Yang and Hoffman, 1984).

In general, an inverse relationship has been shown between respiration rates of fruits and vegetables and their postharvest shelf-life. Reduced O₂ and high CO₂ levels have also been proved to effectively control enzymatic browning, firmness and decay of fresh-cut fruits and vegetables. Besides, the proliferation of aerobic spoilage microorganisms can be substantially delayed with reduced O₂ levels (Alejandra Rojas-Grau et al., 2009).

\[ T₁ = \text{Zero perforation packet}, \quad T₂ = 0.1\% \text{ perforation packet}, \quad T₃ = 0.2\% \text{ perforation packet}, \quad T₄ = 0.3\% \text{ perforation packet}, \quad T₅ = 0.4\% \text{ perforation packet}, \quad T₆ = \text{Control (without packet)} \]

Fig.1. Effect of different packaging systems on the moisture content of green chili during storage.
EFFECT OF DIFFERENT PACKAGING SYSTEMS

$T_1 =$ Zero perforation packet, $T_2 =$ 0.1% perforation packet, $T_3 =$ 0.2% perforation packet, $T_4 =$ 0.3% perforation packet, $T_5 =$ 0.4% perforation packet, $T_6 =$ Control (without packet)

Fig. 2. Effect of different packaging systems on the decay/rotting percent of green chili during storage.

$T_1 =$ Zero perforation packet, $T_2 =$ 0.1% perforation packet, $T_3 =$ 0.2% perforation packet, $T_4 =$ 0.3% perforation packet, $T_5 =$ 0.4% perforation packet, $T_6 =$ Control (without packet)

Fig. 3. Effect of different packaging systems on the marketable quality of green chili during storage.
A substantial reduction was noted in ascorbic acid (vitamin C) and β-carotene (vitamin A) contents of the chilies during storage. The reduction could be due to both oxidative and non-oxidative changes as described by Eskin (1979) and Land (1962). Such changes altered the colour of the chilies and lowered the nutritive value. Vitamin C and β-carotene retention was highest (83.67 mg/100 gm, 54.287 µgm/gm) in treatment T4 followed by T3, and T5, respectively, over the storage periods (Table 1 & 2). These chemical and nutritional compositions and changing behaviors of the stored chilies support to those found by Salunkhe (1991).

Table 1. Effect of packaging techniques on physico-chemical parameters of green chili during storage.

<table>
<thead>
<tr>
<th>Treatments</th>
<th>Vitamin-C content (mg/100g) during storage</th>
<th>β- carotene content (µgm/g)</th>
<th>Level of significance</th>
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<tbody>
<tr>
<td></td>
<td>Initial 7 days 8 days 9 days 10 days 11 days 12 days</td>
<td>Initial 7 days 8 days 9 days 10 days 11 days 12 days</td>
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<tr>
<td>T1</td>
<td>136.87a 95.84c 91.66d 89.23b 73.23e 66.33c</td>
<td>54.013e 50.010f 49.257f 49.170e 48.157e 45.123d</td>
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<tr>
<td>T2</td>
<td>137.70a 95.77c 93.17b 89.74b 78.14c 61.08d</td>
<td>60.227a 55.247d 54.110e 52.073c 51.230d 50.53c</td>
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<tr>
<td>T3</td>
<td>135.58b 95.70c 92.19c 87.56d 86.19b 75.11b</td>
<td>59.173b 58.287a 57.017a 54.103b 53.057b 52.013b</td>
<td></td>
</tr>
<tr>
<td>T4</td>
<td>137.89a 104.37a 99.60a 92.59a 92.07a 83.67a</td>
<td>57.137c 57.030b 56.260b 56.017a 55.060a 54.287a</td>
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<tr>
<td>T5</td>
<td>135.75b 97.44b 92.41c 88.36c 77.66d 61.67d</td>
<td>57.083c 56.197c 53.190d 52.217c 52.027c 51.243c</td>
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<tr>
<td>T6</td>
<td>126.86c 80.28d 77.61e 74.15e 56.30f 51.23e</td>
<td>55.290d 54.257e 52.140e 51.277d 51.080d 51.007c</td>
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CV (%) = 2.04 3.34 2.46 1.20 1.63 1.69

T1 = Zero perforation packet, T2 = 0.1% perforation packet, T3 = 0.2% perforation packet, T4 = 0.3% perforation packet, T5 = 0.4% perforation packet, T6 = Control (without packet)

*= Significant at 5% level of probability
Conclusion

Green chili pre-treated with chlorine water and then packaging in 0.3% perforated polypropylene is the best for quality and shelf life for 10 days of storage at ambient temperature considering its physical appearance, marketable quality and change of physico-chemical parameters. Beyond this storage period, rotting and decay of the spices occurs rapidly, turn into red and shriveled and hence lose marketable quality.

References


