ISSN 0258-7122
Bangladesh J. Agril. Res. 37(4): 729-736, December 2012

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

MOHAMMAD MIZANUR RAHMAN[1], MD. MIARUDDIN[2]
MD. GOLAM FERDOUS CHOWDHURY[3],
MD. HAFIZUL HAQUE KHAN[4] AND M.A. MATIN[5]

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/shriveling. These treatment combinations also considerably retained vitamin C, ß-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, shelft 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^{O}C but they do not maintain the humidity. As a result, the quality of green chilies

[1]Senior Scientific Officer, [2]Principal Scientific Officer, [3&4]Senior Scientific Officer, Postharvest Technology Division, Bangladesh Agricultural Research Institute (BARI), [5]Principal Scientific Officer, Agricultural Economics Division, BARI, Gazipur, Bangladesh.

deteriorates quickly. 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.

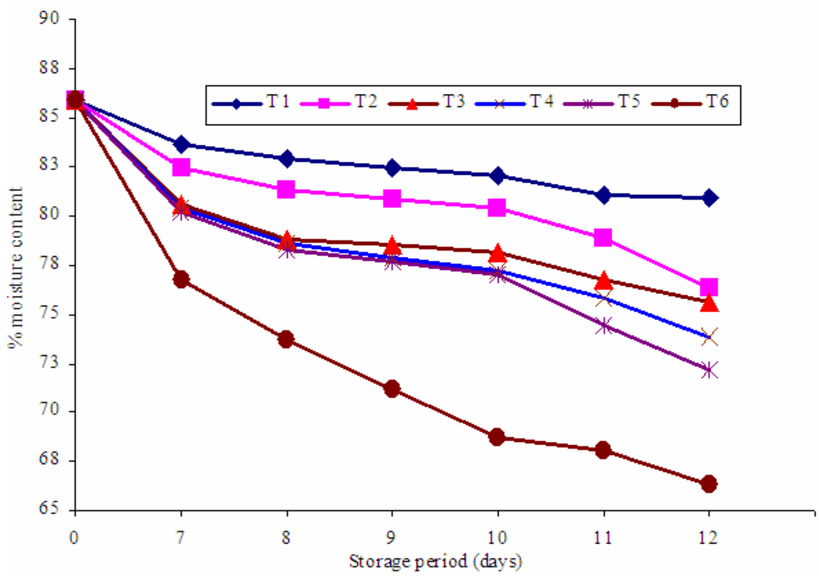
Decay/Rotting (%): It is the percentage of the damaged chilies. It was also determined by the quality parameters of the chilies like rotting, shriveling, incidence of disease, etc.

Physico-chemical analysis: Vitamin C, ß-carotene and moisture content were determined for the fresh chilies at 7^{th} to 12^{th} 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

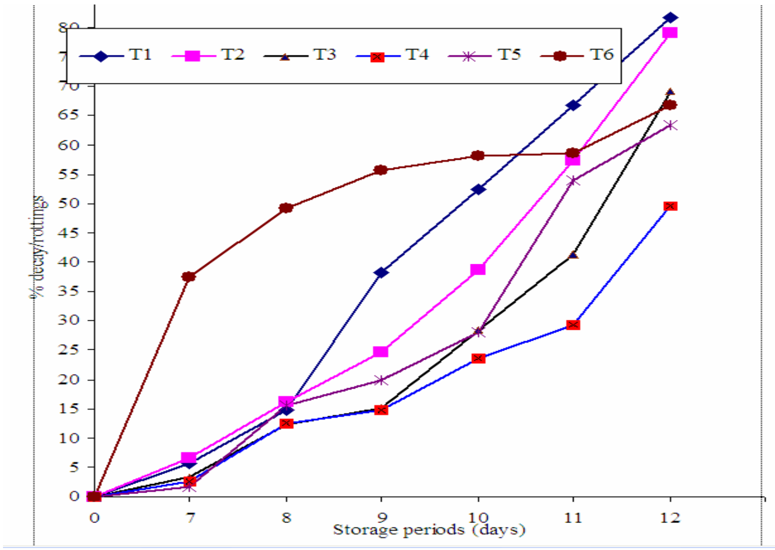
Data on physico-chemical parameters (moisture content, vitamin C, and ß-carotene) and rotting/decay as well as marketability of green chilies were analyzed at 7^{th}, 8^{th}, 9^{th} , 10^{th}, 11^{th}, and 12^{th} days of storage at ambient temperature. Temperature was recorded during the experiment as 28^0 – 32^0C (max.) and 20^0 – 25^0C (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 (T_4) retained optimum moisture content (77.18%), minimum rotting/decay (23.56%) and thus highest marketability (70%) followed by packet with 0.4% perforation (T_5) 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 T_1 (sealed polypropylene) followed by treatment T_2 (0.1% perforation) and T_3 (0.2% perforation), respectively, through the storage periods (Fig. 1 & 2). Conservation of excessive moisture content resulted more condensed water in the T_1 packet thus enhanced the rotting. Chilies kept in bulk without packaging (treatment T_6) 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 (T_4) 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 O_2 (1–5%) and high in CO_2 (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 O_2 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 O_2 and high CO_2 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 O_2 levels (Alejandra Rojas-Grau *et al.*, 2009).



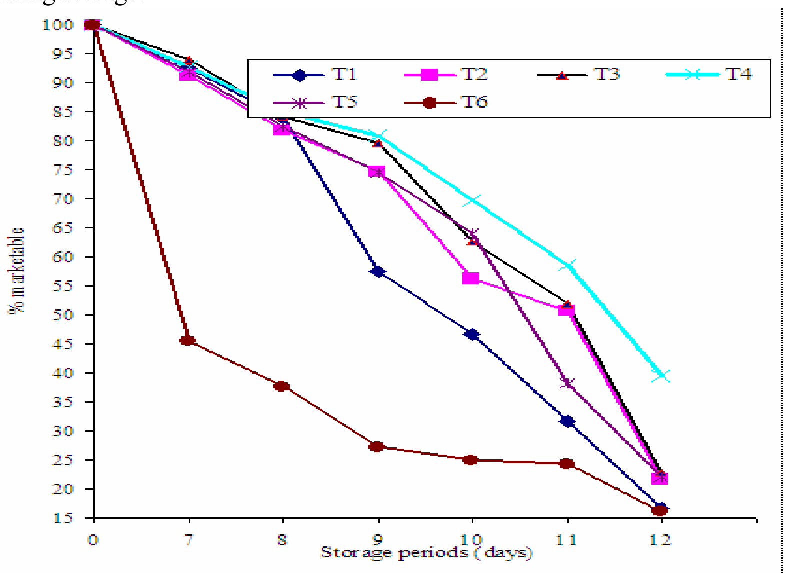
T_1 = Zero perforation packet, T_2 = 0.1% perforation packet, T_3 = 0.2% perforation packet, T_4 = 0.3% perforation packet, T_5 = 0.4% perforation packet, T_6 = Control (without packet)

Fig.1. Effect of different packaging systems on the moisture content 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.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 ß-carotene retention was highest (83.67 mg/100 gm, 54.287 µgm/gm) in treatment T_4 followed by T_3, and T_5, 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.

a) Vitamin C (mg/100g)

Treatments	Vitamin-C content (mg/100g) during storage						
	Initial	7 days	8 days	9 days	10 days	11 days	12 days
T_1	144.90	136.87a	95.84c	91.66d	89.23b	73.23e	66.33c
T_2		137.70a	95.77c	93.17b	89.74b	78.14c	61.08d
T_3		135.58b	95.70c	92.19c	87.56d	86.19b	75.11b
T_4		137.89a	104.37a	99.60a	92.59a	92.07a	83.67a
T_5		135.75b	97.44b	92.41c	88.36c	77.66d	61.67d
T_6		126.86c	80.28d	77.61e	74.15e	56.30f	51.23e
CV (%)		2.04	3.34	2.46	1.20	1.63	1.69
Level of significance		*	*	*	*	*	*

b) β- carotene (µg/g)

Treat-ment	β- carotene content (µgm/g) during Storage						
	Initial	7 days	8 days	9 days	10 days	11 days	12days
T_1	78.75	54.013e	50.010f	49.257f	49.170e	48.157e	45.123d
T_2		60.227a	55.247d	54.110c	52.073c	51.230d	51.053c
T_3		59.173b	58.287a	57.017a	54.103b	53.057b	52.013b
T_4		57.137c	57.030b	56.260b	56.017a	55.060a	54.287a
T_5		57.083c	56.197c	53.190d	52.217c	52.027c	51.243c
T_6		55.290d	54.257e	52.140e	51.277d	51.080d	51.007c
CV (%)		1.83	1.92	1.96	1.98	1.98	2.05
Level of significance		*	*	*	*	*	*

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)
*= 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

Amiruzzaman M. 2000. Postharvest Technology/Management (vegetables). A consultancy report. AVRDC-USAID Bangladesh Project. Pp. 193.

Alejandra Rojas-Grau¨ M, Gemma Oms-Oliu, Robert Soliva-Fortuny and Olga Martı´n-Belloso 2009. The use of packaging techniques to maintain freshness in fresh-cut fruits and vegetables: a review. International Journal of Food Science and Technology 2009, 44, 875–889

AOAC 1984. Official Methods of Analysis. 14th edn. Association of Official Analytical Chemists, Arlington.

Badgujar, C.D., K.E. Lawande and P.N. Kale. 1987. Polythene packaging for increasing shelf life in brinjal fruits. Current Research Reporter. *Mahatma Phule Agril. Univ.* **3**:2, 22-25; 2 ref.

BBS, 2009. Statistical Year Book of Bangladesh, Bangladesh Bureau of Statistics, Ministry of planning, Government of the Peoples Republic of Bangladesh.

Eskin, N.A.M. 1979. Plant pigments, flavours and textures. The Chemistry and Biochemistry of Selected Compounds. Academic Press, London.

Giraldo LF, Forero RA, Salazar CR and Torres R. 1977. The Effect of Packaging and Potassium Permanganate on the Storage of Tomatoes under Room Conditions. Ravista Inst. Collanbiano Agropecuario, 12 (4): 393-405. (Hort, Abstr. 49:4289)

Kader, A.A., D. Zagory and E.L. Kervel. 1989. Modified atmosphere packaging of fruits and vegetables. *Critical Review in Food Science and Nutrition* **28**: 1-30.

Land, D.G. 1962. Stability of plant pigments. *Advanced Food Research* **2**:50-56.

Ranganna S. 1986. Hand Book of Analysis and Quality Control for Fruits and Vegetables Products. Tata McGraw-Hill Publishing Company Limited.

Salunkhe DK, Bolin HR and Reddy NR. 1991. Storage, processing and nutritional quality of fruits and vegetables (2nd edition), CRC Press, Boston, USA.

Yang, S.F. and Hoffman, N.E. 1984. Ethylene biosynthesis and its regulation in higher plants. *Annual Review of Plant Physiology* **35**:155–189.