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MODIFIED ATMOSPHERIC STORAGE OF KANDIL BELL-PEPPER CULTIVAR

KANDİL DOLMA BİBER ÇEŞİDİNİN MODİFİYE ATMOSFERDE MUHAFAZASI

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ABSTRACT: Kandil bell pepper cultivar was stored in modified atmospheric conditions at 8 degrees centigrade in 85-90 percent relative humidity, packaged in either perforated or unperforated plastic, which was either polyethylene or polypropylene, and the effects of this treatment on weight loss, total soluble solids, respiration rate and skin cracking were determined. In addition to those effects, visual evidence of infection and chilling injury symptoms were also noted. Untreated (control) pepper lasted only three weeks in storage under these conditions, suffering from severe weight loss as a result. Pepper packaged into polypropylene lasted four weeks in storage while that packaged in perforated polyethylene endured for five weeks. Use of perforated polyethylene packaging appears to be the most suitable for bell pepper based on the data in this study. Weight loss, sking cracking, infections, and chilling injury were the limiting factors affecting bell pepper storage.

ÖZET: Araştırma, Kandil dolma biber çeşidinin farklı ambalaj materyalleri ile sağlanan modifiye atmosferde muhafaza süresini belirlemek amacı ile yürütülmüştür. Bu amaçla 1 kg'lık delikli ve deliksiz polietilen ve polipropilen ambalajlara konulan biberler 8°C sıcaklık ve %85-90 oransal nem içeren depoya yerleştirilmiştir. Depolama süresince haftalık aralıklarla ve her analiz dönemi oda sıcaklığında 48 saat bekletilen örneklerde; ağırlık kaybı, suda eriyebilir toplam kuru madde miktarı, solunum hızı, gevreklik, enfeksiyon ve üşüme zararı belirtisi gösteren meyve oranları belirlenmiştir. Kandil dolma biber çeşidinin muhafaza süresi, ambalajsız örneklerde yüksek ağırlık kaybı nedeni ile 3 hafta ile sınırlanmıştır .Polipropilen ambalajlı biberlerde ise meyve kalitesi, enfeksiyon ve üşüme zararına bağlı olarak 4 hafta korunabilmiştir. Ağırlık kaybı, üşüme zararı, gerveklik kaybı ve mikroorganizma kökenli kayıplar dikkate alındığında Kandil Dolma biber çeşidi için en uygun amablaj materyalinin delikli polietilen olduğu ve bu ambalaj kullanılarak biberlerin önemli bir kalite kaybı olmaksızın 5 hafta süre ile muhafaza edilebileceği belirlenmiştir.

INTRODUCTION

Bell pepper can be stored after harvest for only a brief period unlike most other vegetables. For only certain cultivars and under optimal conditions, a four week storage period is possible (SALUNKHE and DESAI 1984). In general, storage duration can be prolonged by preharvest heat treatment followed by cold storage under controlled or modified atmosphere but only for a limited period.

The packaging of stored product is another widely used technique to maintain postharvest quality for a longer period than possible in the absence of packaging. Poducts subject to a fast resperation rate and a short postharvest life benefit in particular from the use of packaging during storage. Weight loss in pepper as a result of dehydration is minimized with packaging, as a high moisture content has been measured as it accumulates within the packaging (BENYEHOSHUA et. al. 1983). This barrier to dehydration probably also explains why the product also retains its firmness longer, and perhaps why there is no change in color or color loss (MILLER et al. 1987). A downside however is that packaging makes conditions more suitable for supporting infections, and the accumulation of a high moisture content inside packaging has also been given as a reason for increased postharvest losses as well (GORINI et al. 1977). It was shown that long peppers stored better in craft rather polyethylene (PE) bags since, although PE minimized weight loss better, the incidence of infection was a more significant effect (MOHAMMED 1992). The use of perforated PE bags also does little to reduce significant weight losses, color changes, decreases in tissue softening or in infection incidence, according to LOWNDS et al. (1994), who conducted a two week postharvest study at a variety of storage temperatures. Packaging in paper may be more suitable for this product in fact. RISSE (1989) found that weight losses, chilling injury, and color changes could be decreased in pepper, eggplant, and tomato stored at 5°C.

MATERIAL AND METHODS

Changes in the color, brightness, size and shape of fruit shape were considered as harvest criteria for Kandil bell pepper cultivar cultivated in Middle Anatolia. Product was stored in a cold room set at 8°C temperature, with a 85-90% relative humidity (RH). Product was packaged into 1kg-sized perforated and unperforated low-density polyethylene (PPE, PE) and polypropylene (PPP, PP) bags. Pepper product serving as a control (C) for this study was stored in the cold room under the same conditions but without any packaging.

Three experiments were done for every particular treatment conditions, and ten peppers were used in each experiment. Peppers were analyzed at 7-day intervals during the during the storage study. Product obtained for analysis at each interval was analyzed first, then one group transferred to a room temperature environment for 48 hours prior to analysis. Weight loss, total soluble solids (TSS), crispness, the incidence of infection, and symptoms of chilling injury (CI) were determined in these peppers. Respiration rate was evaluated by placing samples into two-liter jars for six hours at the storage temperature, and then determining the amount of carbon dioxide (CO_2) produced in milliliters of gas per kilogram per hour by these peppers using an infrared analyzer (Servomex PA 404, range 0-30% CO_2). TSS content was determined using a hand refractometer to analyze juice squeezed from each pepper. Crispness, incidence of infections, and chilling injury symptoms were visually assesssed.

RESULTS AND DISCUSSION

The effects of different packaging materials on the quality of Kandil bell pepper cv. during cold storage and for all of the parameters studied in these experiments are given in Table 1.

Packaging had the clear advantage of reducing the weight losses and keeping overall quality for a longer period based on comparisons the effects experienced by control product, and this finding is supported in numerous reports (BEN-YEHOSHUA et al. 1983; HARDENBURG et al. 1986; MILLER et al. 1987; MILLER and RISSE 1988; RISSE 1989; MOHAMMED 1992). Overall weight loss in control fruit was 15.14% after 28 days of storage. In contrast packaged samples showed an average weight loss of 0.51% during the same period. One explanation for his reduced weight loss in packaged fruit is that the package minimizes tissue dehydration by maintaining a locally high accumulation of moisture surrounding the tissue confined within the space of the package, and the particular equilibrium conditions favor a slower rate of dehydration (BEN-YESHOSHUE et al. 1983). The results also show that different types of packaging material also result in different rates of weight loss, in agreement with other reports (MENCERELLI et al. 1989; RISSE 1989). Use of PP bags resulted in the least weight loss, with weight losses increasing with the use of PE, perforated PE and perforated PP in that order.

The respiration rate was 69.55 ml CO_2/kg-h at harvest time, and this value declined steadily throughout the storage period. At storage day 28, the respiration rate had declined to the point of analytical detection in all packaged samples except for those samples packaged in PP.. Differences in respiration rate with respect to samples packaged in different types of bags were found to be statistically significant, and these data are supported in other studies (KOZUKUE 1970; KOZUKUE and OGATA 1972). PP bags have a lower gas permeability than the other types of packages, and so the fruit would be subjected to externally higher levels of accumulated CO2 gas within the confined spaces of the package. The biological effect of this accumulation may have the effect of inhibiting the mechanism affecting respiration rate or exerting a mass action effect. Similar results showing a reduced respiration rate were found in samples transferred to the room temperature (Table 1).

TSS values were not changed steadily for all treatments during the storage peroid. There were no significant differences in TSS content in samples with respect to package type. It has been reported that there are no significant differences with respect to the degree of biochemical changes that occur in peppers either unpackaged or packaged in storage (ALIEVA and SHAKHBAZOVA 1994). TSS content is found to increase in all samples trasferred to the room temperature.

Decreases in product crispness are reported to be primarily due to water loss (MILLER et al. 1987; MILLER and RISSE 1988; LOWNDS et al. 1994). Product crispness was retained to a great degrre in packaged samples even lafter 28 days in these experiments whereas control samples clearly lost their crispness within a short period. Although the value assigned for crispness was highest in unperforated PE-packaged samples, followed in order by samples packaged in perforated PE, perforated PP, and then unperforated PP packages, differences in sample crispness with respect to the package type were not found to be significant.

Table 1. Effects of different packing materials on some qualitative and quantitative changes on Kandil bell pepper cv. During cold storage.*

		STORAGE PERIOD (Days)						AFTER TRANSFER TO ROOM TEMPERATURE FOR 48 HOURS					
		0	7	14	21	28	35	0	7	14	21	28	35
Weight Loss (%)	C	-	3.65 a	8.22 a	12.03 a	15.14 a	---						
	PE	-	0.02 c	0.23 bc	0.33 c	0.48 b	0.66 a						
	PPE	-	0.14 bc	0.46 b	0.68 b	0.62 b	1.21 a						
	PP	-	0.05 bc	0.18 c	0.26 c	0.26 c	---						
	PPP	-	0.17 b	0.36 bc	0.62 b	0.65 b	1.20 a						
Respiration Rate ($mlCO_2/kgh$)	C	69.55 a	18.41 c	12.21 b	17.13 b	16.42 bc	---	40.27 a	39.78 a	40.85 ab	54.56 ab	26.9 b	---
	PE	69.55 a	27.30 b	34.29 b	32.72 b	21.64 b	22.61 a	40.27 a	37.37 ab	34.93 ab	40.42 ab	24.35 b	22.61 a
	PPE	69.55 a	16.36 c	17.30 b	16.76 b	16.21 bc	15.60 b	40.27 a	32.76 b	32.68 ab	35.47 b	32.41 b	23.40 a
	PP	69.55 a	63.42 a	87.47 a	70.99 a	54.54 a	---	40.27 a	41.17 a	59.11 a	71.20 a	80.44 a	---
	PPP	69.55 a	19.83 c	13.18 b	17.71 b	12.56 c	13.25 b	40.27 a	38.02 ab	30.30 b	37.25 b	22.94 b	19.87 a
Total Soluble Solid (%)	C	4.30 a	5.13 a	4.53 a	4.56 a	5.57 a	---	4.33 a	5.91 a	4.93 a	5.84 a	7.28 a	---
	PE	4.30 a	4.97 a	3.80 ab	3.89 ab	4.41 b	3.9 a	4.33 a	5.32 ab	4.55 a	5.30 ab	4.80 b	4.33 a
	PPE	4.30 a	4.96 a	4.51 a	3.79 b	3.86 b	3.36 a	4.33 a	4.61 b	3.98 b	5.12 ab	4.66 b	3.65 a
	PP	4.30 a	4.82 a	3.38 b	4.48 ab	4.4 b	---	4.33 a	5.75 a	4.34 ab	5.31 ab	5.17 ab	---
	PPP	4.30 a	4.52 a	3.98 ab	4.48 ab	4.17 b	3.72 a	4.33 a	5.51 a	3.66 b	4.40 b	4.69 b	3.97 a
Cracking	C	5.0 a	4.9 a	4.5 b	4.0 c	3.4 b	---	5.0 a	4.5 b	4.1 c	2.2 b	3.2 c	---
	PE	5.0 a	4.9 a	4.9 a	5.0 a	4.9 a	5.0 a	5.0 a	4.0 ab	4.9 ab	4.1 a	4.8 a	3.8 a
	PPE	5.0 a	5.0 a	4.9 a	5.0 a	4.8 a	5.0 a	5.0 a	4.8 ab	5.0 a	4.2 a	4.7 a	4.3 a
	PP	5.0 a	4.9 a	4.9 a	4.5 b	4.5 a	---	5.0 a	4.8 ab	4.6 b	3.0 a	2.9 c	---
	PPP	5.0 a	5.0 a	5.0 a	5.0 a	4.9 a	5.0 a	5.0 a	4.9 a	4.7 ab	4.1 a	3.9 b	4.4 a
Infection Rate (%)	C	-	-	-	-	4.17 bc	---	-	-	-	4.17 a	0.17 b	---
	PE	-	-	-	-	16.67 ab	-	-	-	-	8.33 a	4.17 ab	4.17 a
	PPE	-	-	-	-	12.50 ab	-	-	-	-	4.17 a	0 b	8.33 a
	PP	-	-	-	-	33.33 a	---	-	-	-	29.17 a	41.67 a	---
	PPP	-	-	-	-	0 c	-	-	-	-	8.33 a	0 b	0 a
Chilling Injury (%)	C	-	-	0 a	4.17 b	0 a	---	-	0 a	4.17 ab	4.17 b	4.17 b	---
	PE	-	-	0 a	4.17 b	8.33 a	12.5 a	-	4.17 a	8.33 ab	12.5 ab	8.33 b	25.0 a
	PPE	-	-	4.17 a	0 b	4.17 a	4.17 a	-	0 a	8.33 ab	8.33 b	16.67 b	20.83 a
	PP	-	-	4.17 a	29.17 b	12.5 a	---	-	4.17 a	33.33 a	41.67 a	70.83 a	---
	PPP	-	-	0 a	0 b	4.17 a	4.17 a	-	0 a	0 b	12.5 b	20.83 b	12.5 a

* Data within a row followed by different letters are significantly different at $P \leq 0.05$ by Duncan's multiple range test.

Infection was present in at least one sample product for all experiments throughout the 28-day storage period except in control samples and those samples packaged in perforated PP. The highest incidence of infection was 33.3%, for samples stored in unperforated PP bags. The range of infection incidence was between 4.17% and 16.67% for the other treatments. It was noted that the incidence of infection increased to 41.67% in the samples packaged in unpeforated PP after transfer to room temperature and re-evaluation after 48 hours.

Symptoms of CI were observed in samples packaged in unpeforated PP and in perforated PE bags as early as the second week of the storage period. The greatest degree of CI symptoms were found in samples packaged into unperforated PP bags, reaching 12.5% on the 28th day., However differences in degree of CI symptoms betweven samples stored in the different bag types were not found to be significant. 70.83% of samples stored in unperforated PP bags and placed at room temperature showed CI symptoms on day 28, and differences between unperforated PP bags and other package types were shown to be statistically significant at room temperature. Similar results were also obtained by HALLORAN et al. (1995).

CONCLUSIONS

Weight loss and the incidence of infection were the most important factors affecting the storage of Kandil bell pepper cultivar for the period of this study. Conktrol samples could be stored only for three weeks, with weights loss being too severe to permit longer storage. With packaging teratments, storage was extended to at least five weeks. Unperforated polypropylene was not found to be a suitable packaging material for Kandil bell pepper cv. as the product suffered from a high incidence of infection and chilling injury symptoms. The other packaging materials, polyethylene, was not found to be a suitable packaging material for Kandil bell pepper cv. as the product suffered from a high incidence of infection and chilling injury symptoms. The other packaging materials, polyethylene, perforated polyethylene, and perforated polypropylene provided better storage quality for the duration of these experiments. Taking into consideration the overall degree of the prevention of weight loss, retention of crispness, and lower incidence of infections and chilling injury symtoms product packaged in perforated PE appeared to offer the best result.

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