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Interactive Effects of Wrapping Materials and Cold Storage Durations on Firmness of Nectarine

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Abstract: Three wrapping materials (news paper + straw, kraft paper and kraft paper + straw) and five cold storage durations (0, 8, 16, 24 and 32-day) were investigated for firmness of nectarine (cv. Moghan) during cold storage at -1°C temperature and 98% relative humidity. The experiment was laid out in Factorial Completely Randomized Design (FCRD) with four replications for each one of factors. The data collected were subjected to Analysis of Variance (ANOVA) and Duncan's Multiple Range Test (DMRT) at 1% probability was performed to compare the means of different treatments. The statistical results of the study indicated that although wrapping material had no significant effect ($P \leq 0.01$) on firmness, cold storage duration significantly ($P \leq 0.01$) affected it. Results of the study also indicated that firmness decreased by increasing cold storage duration. In addition, kraft paper + straw was the best wrapping materials for keeping firmness.

Key words: Nectarine · Wrapping material · Cold storage duration · Firmness

INTRODUCTION

Currently, world production of peaches and nectarines stands at 11 million tones, with the three major producing countries being China, Italy and the United States in the Northern hemisphere and Chile, South Africa and Australia in the Southern hemisphere. Different combinations of fruit types, i.e. peach or nectarine, clingstone or freestone, yellow or white flesh, low, medium or high acidity, are available as freshly harvested fruit from April through September in the Northern Hemisphere and from November to March in the Southern Hemisphere [1].

Methods that are being used to preserve whole fruits and vegetables during storage and marketing are generally based on refrigeration with or without control of composition of the atmosphere [2, 3]. However, temperature, atmosphere, relative humidity and sanitation must be regulated to maintain quality of them [4, 5]. In this direction, several methods that have been used are refrigeration, controlled atmosphere packaging, modified atmosphere packaging and chemical preservatives [6-8]. The most prevalent method is rapid cooling at a low temperature with high relative humidity [9]. However, low temperature storage is not economically feasible in most developing countries [3, 10].

Fungicides control postharvest decay of whole fruits, but they leave residues that are potential risks to humans and the environment [10]. In addition, many consumers are suspicious of chemicals in their foods, especially in fruits and vegetables [7]. Sulfites were effective chemical preservative as they were both inhibitors of enzymatic browning and antimicrobial. But their use has been banned due to adverse reaction in consumers [7, 11]. Moreover, chemical preservatives affect the flavor of fruits and vegetables [12].

Coatings, films and wrapping materials are also effective in reducing desiccation (moisture loss), but are subject to microbial growth and disposal problems [8, 13]. Many years of research are conducted to develop a material that would cover fruit so that an internal modified atmosphere would develop [14, 15].

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Fig 1: Handheld fruit penetrometer or fruit firmness tester

In this paper, the effect of wrapping material and cold storage duration on firmness of nectarine (cv. Moghan) during cold storage at -1°C temperature and 98% relative humidity is reported.

MATERIALS AND METHODS

Plant Materials: Nectarines (cv. Moghan) were purchased from a local market in Karaj, Iran. They were visually inspected for freedom of defects and blemishes. Nectarines were then wrapped in different wrapping materials (news paper + straw, kraft paper and kraft paper + straw), placed in plastic boxes and stored in cold storage at -1°C temperature and 98% relative humidity for 0, 8, 16, 24 and 32 days.

Firmness: The firmness of nectarines was measured using a handheld fruit penetrometer or fruit firmness tester (Fig. 1). The penetrometer had a diameter of 8.0 mm and the maximum pressure measured during each test based on kg cm^{-2} was considered as stiffness.

Statistical Analysis: The experiment was laid out in Factorial Completely Randomized Design (FCRD) with three wrapping materials (news paper + straw, kraft paper and kraft paper + straw) and five cold storage durations (0, 8, 16, 24 and 32-day) at -1°C temperature and 98% relative humidity with four replications for each one of factors. The effect of the factors on firmness was determined by analysis of variance (ANOVA) using SPSS 12.0 (Version, 2003). Also, Duncan's Multiple Range Test (DMRT) at 1% probability was performed to compare the means of different treatments.

RESULTS AND DISCUSSION

Although wrapping material had no significant effect ($P \leq 0.01$) on firmness of nectarine, cold storage duration significantly ($P \leq 0.01$) affected it (Table 1). Anyhow, the highest firmness of 19.47 kg/cm^2 was observed in kraft paper + straw and lowest (16.82 kg/cm^2) in news paper + straw and wrapping material affected firmness in the order of kraft paper + straw > kraft paper > news paper + straw. Also, the highest firmness of 25.45 kg/cm^2 was observed in 0-day and lowest (12.08 kg/cm^2) in 32-day and firmness decreased with increased cold storage duration (Table 2). Moreover, interaction of wrapping material × cold storage duration had no significant effect ($P \leq 0.01$) on firmness (Table 1). The study of wrapping material and cold storage duration combinations on firmness indicated that in news paper + straw, firmness had the highest value (25.45 kg/cm^2) in 0-day and the lowest value (9.378 kg/cm^2) in 32-day. Also, in kraft paper, firmness had the highest value (25.45 kg/cm^2) in 0-day and the lowest value (13.53 kg/cm^2) in 32-day. Besides, in kraft paper + straw, firmness had the highest value (25.45 kg/cm^2) in 0-day and the lowest value (11.55 kg/cm^2) in 24-day. In addition, the maximum mean value for firmness (25.45 kg/cm^2) was observed in 0-day of three wrapping materials and the minimum mean value for firmness (9.378 kg/cm^2) was observed in 32-day of news paper + straw (Table 3).

Table 1: Analysis of variance for firmness of nectarine (cv. Moghan)

Source of variation	Degree of freedom	Mean square
Wrapping material	2	46.27 ^{ns}
Cold storage duration	4	15848.4 **
Wrapping material × Cold storage duration	8	22.10 ^{ns}
Error	45	17.14
C.V. (%)	---	12.55

** = Significant at 0.01 probability level

ns = Non-significant

Table 2: Means comparison for firmness of nectarine (cv. Moghan) for different studied treatments using DMRT at 1% probability

Treatment		Firmness (kg/cm^2)
Wrapping material	News paper + straw	16.82 a
	Kraft paper	19.44 a
	Kraft paper + straw	19.47 a
Cold storage duration	0-day	25.45 a
	8-day	23.69 a
	16-day	18.11 b
	24-day	13.54 c
	32-day	12.08 c

Means in the same column with different letters differ significantly at 0.01 probability level according to DMRT

Table 3: Means comparison for firmness of nectarine (cv. Moghan) for combinations of wrapping material and cold storage duration using DMRT at 1% probability

Wrapping material × Cold storage duration		Firmness (kg/cm^2)
News paper + straw	0-day	25.45 a
	8-day	19.95 abc
	16-day	17.47 bcd
	24-day	11.84 de
	32-day	9.378 e
Kraft paper	0-day	25.45 a
	8-day	25.17 a
	16-day	15.79 bcde
	24-day	17.25 bcd
	32-day	13.53 cde
Kraft paper + straw	0-day	25.45 a
	8-day	25.94 a
	16-day	21.06 ab
	24-day	11.55 de
	32-day	13.33 cde

Means in the same column with different letters differ significantly at 0.01 probability level according to DMRT

These results are in agreement with those of Lerdthanangkul and Krochta [13] and Rashidi *et al*. [16] who concluded that coatings, films and wrapping materials significantly affected firmness. These results are also in line with the results reported by Mostofi and Toivonen [5] and Rashidi *et al*. [16] that firmness significantly decreased by increasing cold storage duration.

CONCLUSION

Although wrapping material had no significant effect ($P \leq 0.01$) on firmness of nectarine, cold storage duration significantly ($P \leq 0.01$) affected it. Also, firmness decreased by increasing cold storage duration. In addition, kraft paper + straw was the best wrapping materials for keeping firmness.

REFERENCES

1. Lurie, S. and C.H. Crisosto, 2005. Chilling injury in peach and nectarine. Postharvest Biology and Technology, 37: 195-208.
2. Smith, S.M. and J.R. Stow, 1984. The potential of a sucrose ester coating material for improving the storage and shelf-life qualities of Cox's Orange Pippin apples. Annals of Applied Biology, 104: 383-391.
3. Smith, S.M., J. Geeson and J.R. Stow, 1987. Production of modified atmospheres in deciduous fruits by the use of films ad coatings. Horticultural Science, 22(5): 772-776.
4. Watada, A.E., N.P. Ko and D.A. Minott, 1996. Factors affecting quality of fresh-cut horticultural products. Postharvest Biology and Technology, 9: 115-125.
5. Mostofi, Y. and P.M.A. Toivonen, 2006. Effects of storage conditions and 1-methylcyclopropene on some qualitative characteristics of tomato fruits. International Journal of Agriculture & Biology, 8(1): 93-96.
6. Ahmad, M. and I. Khan, 1987. Effects of waxing and cellophane lining on chemical quality indices of citrus fruits. Plant Foods for Human Nutrition, 37: 47-57.
7. Baldwin, E.A., M.O. Nisperos-Carriedo, X. Chen and R.D. Hagenmaier, 1996. Improving storage life of cut apple and potato with edible coating. Postharvest Biology and Technology, 9(2): 151-163.
8. Zhang, D. and P.C. Quantick, 1997. Effects of chitosan coating on enzymatic browning and decay during postharvest storage of litchi (Litchi chinensis Sonn.) fruit. Postharvest Biology and Technology, 12: 195-202.
9. El Ghaouth, A., J. Arul, R. Ponnampalam and M. Boulet, 1991. Chitosan coating effect on storability and quality of fresh strawberries. Journal of Food Science, 56(6): 1618-1620.
10. Li, H. and T. Yu, 2000. Effect of chitosan on incidence of brown rot, quality and physiological attributes of postharvest peach fruit. Journal of the Science of Food and Agriculture, 81: 269-274.
11. Kim, D.M., N.L. Smith and C.Y. Lee, 1993. Quality of minimally processed apple slices from selected cultivars. Journal of Food Science, 58(5): 1115-1117.
12. Rocha, A.M.C.N., C.M. Brochado and A.M.M.B. Morais, 1998. Influence of chemical treatment on quality of cut apple (cv. Jonagored). Journal of Food Quality, 21(1): 13-28.
13. Lerdthanangkul, S. and J.M. Krochta, 1996. Edible coating effects on post harvest quality of green bell peppers. Journal of Food Science, 61(1): 176-179.
14. Park, H.J., M.S. Chinnan and R.L. Shewfelt, 1994. Edible coating effects on storage life and quality of tomatoes. Journal of Food Science, 59(3): 568-570.
15. Park, H.J., M.S. Chinnan and R.L. Shewfelt, 1994. Edible corn-zein film coatings to extend storage life of tomatoes. Journal of Food Processing and Preservation, 18: 317-331.
16. Rashidi, M., M.H. Bahri and S. Abbassi, 2009. Effects of relative humidity, coating methods and storage periods on some qualitative characteristics of carrot during cold storage. American-Eurasian J. Agric. & Environ. Sci., 5(3): 359-367.