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Effect of Phytosanitary Irradiation on the Quality of Chandler Pummelo (*Citrus maxima* (Burm.) Merr.)

Akanksha Jain

Chapman University, jain118@mail.chapman.edu

J.J. Ornelas-Paz

Chapman University, paz@chapman.edu

Karina Rodriguez

Chapman University, rodri332@mail.chapman.edu

Anuradha Prakash

Chapman University, prakash@chapman.edu

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Effect of phytosanitary irradiation on the quality of Chandler Pummelo (*Citrus maxima* (Burm.) Merr.)



Jain, A. Paz, J. Rodriguez. Prakash, A.

Food Science and Nutrition Program, Schmid College of Science and Technology, Chapman University, Orange, CA

Abstract

Gamma Irradiation is increasingly being considered as an alternative to chemical phytosanitary treatments, such as methyl bromide. In this study, the chemical and physiological effect of low-dose gamma irradiation on the post-harvest quality of Chandler Pummelos (*Citrus maxima* (Burm.) Merr.), an emerging crop of interest in the U.S. was evaluated. Chandler pummelos from a local grower in California were irradiated at target doses of 150 Gy and 1000 Gy. Irradiated and untreated pummelos were stored at 12° C for 3 weeks and at 20° C for the 4th week to reflect temperature conditions during three weeks of sea shipment and an additional week of retail under ambient conditions. Color, titratable acidity, total sugars, juice content, weight loss and concentrations of organic acids were not different for the irradiated fruit in comparison to the untreated pummelos. Irradiation reduced hardness of the pummelo peel and firmness of the flesh. The external appearance of pummelos was negatively impacted by higher irradiation dose, longer storage time and higher temperatures as pitting and mold growth were evident on pummelos treated at 1000 Gy and following storage at 20° C. The results suggest that Chandler pummelo quality is compromised at 20° C and 1000 Gy treatment but irradiation with 150 Gy can serve as a potential phytosanitary treatment for Chandler pummelos.

Introduction

Pummelos (*Citrus maxima* or *Citrus grandis*) are popular in Asia for their desirable taste, flavor and juicy texture. Pummelo is one of the largest citrus fruits and is becoming commercially important in the U.S due to emerging consumer interest. USDA-APHIS is considering importing Pummelos from China. However, a phytosanitary treatment is needed to destroy insect pests such as moths, thrips, fruit flies, etc.

Approved phytosanitary treatments include chemical control (fumigation), irradiation, cold and hot treatments (McDonald and others 2013), of which Methyl bromide (MeBr) fumigation is most commonly used in the U.S. However, due to its harmful effects on the ozone layer MeBr has been banned under the 1987 Montreal protocol and continuous efforts are being made to phase out MeBr completely (EPA 2014). Methyl Bromide Technical Options Committee under The United Environmental Programme has recognized irradiation as one of the potential phytosanitary alternatives to MeBr fumigation (Patil and others 2004).



Previous studies performed by Bustos and Mindeta (1988), Miller and others (2000) and Nagai and Moy (1985), on gamma irradiation of citrus fruits such as Navel oranges, Valencia oranges and Grapefruit suggest that the effect of irradiation on a fruit differs based on the type of cultivar used, dose levels of gamma irradiation used, age/maturity of the fruit, time of harvesting of the fruit, and post-treatment storage conditions of fruit such as temperature. Although research has been conducted on other citrus fruits, no studies highlighting the effect of low-dose gamma irradiation on post harvest quality of Pummelos has been documented. Therefore, the objective of the research was to observe the effects of low-dose gamma irradiation (150 Gy and 1000 Gy) on the post harvest quality of Chandler pummelos during storage at 12° C for 3 weeks and at 20° C for the 4th week to simulate 3 weeks of shipment from Asian countries and one week of storage at retail.

Key Findings (Cont'd)

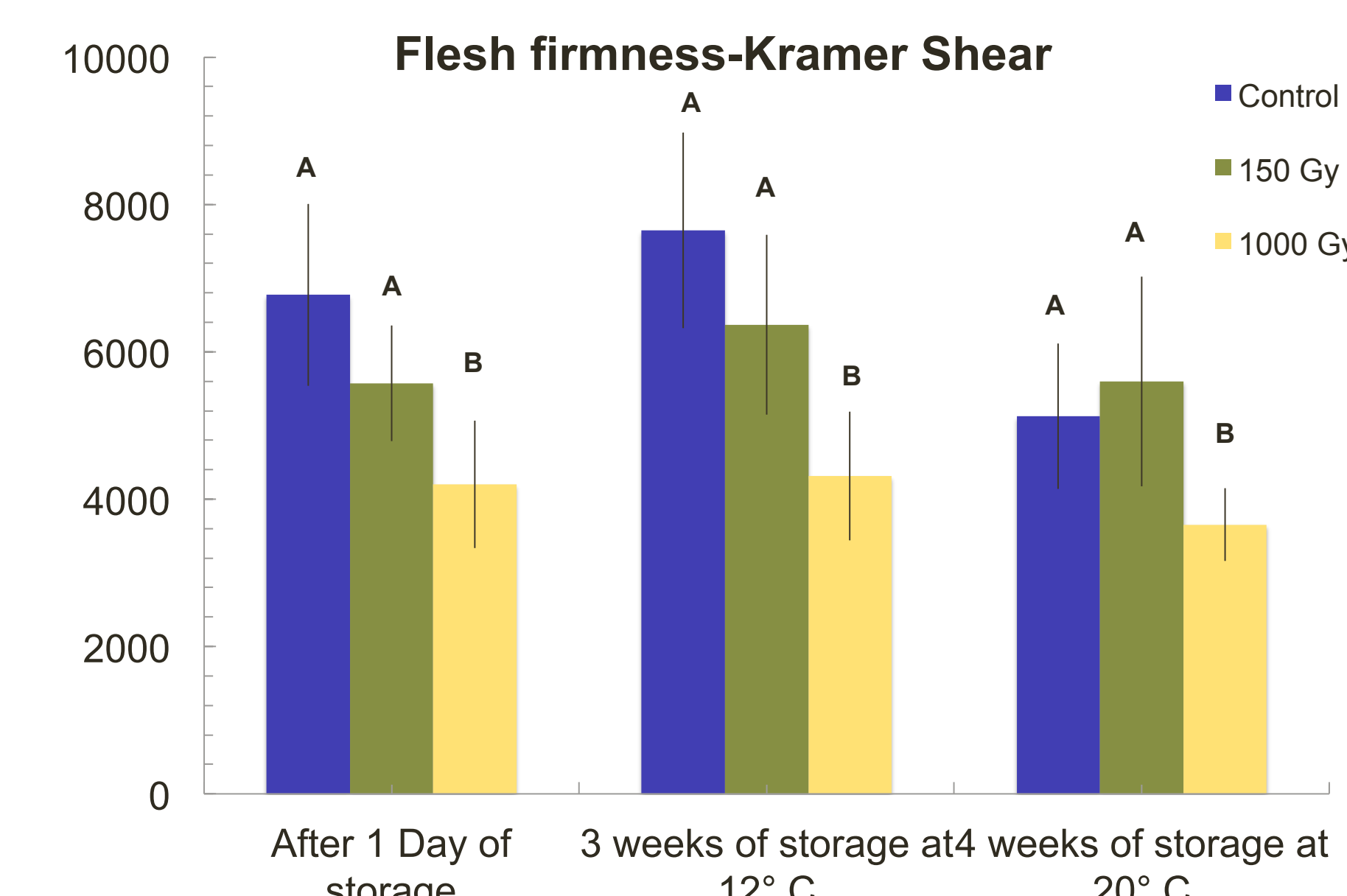
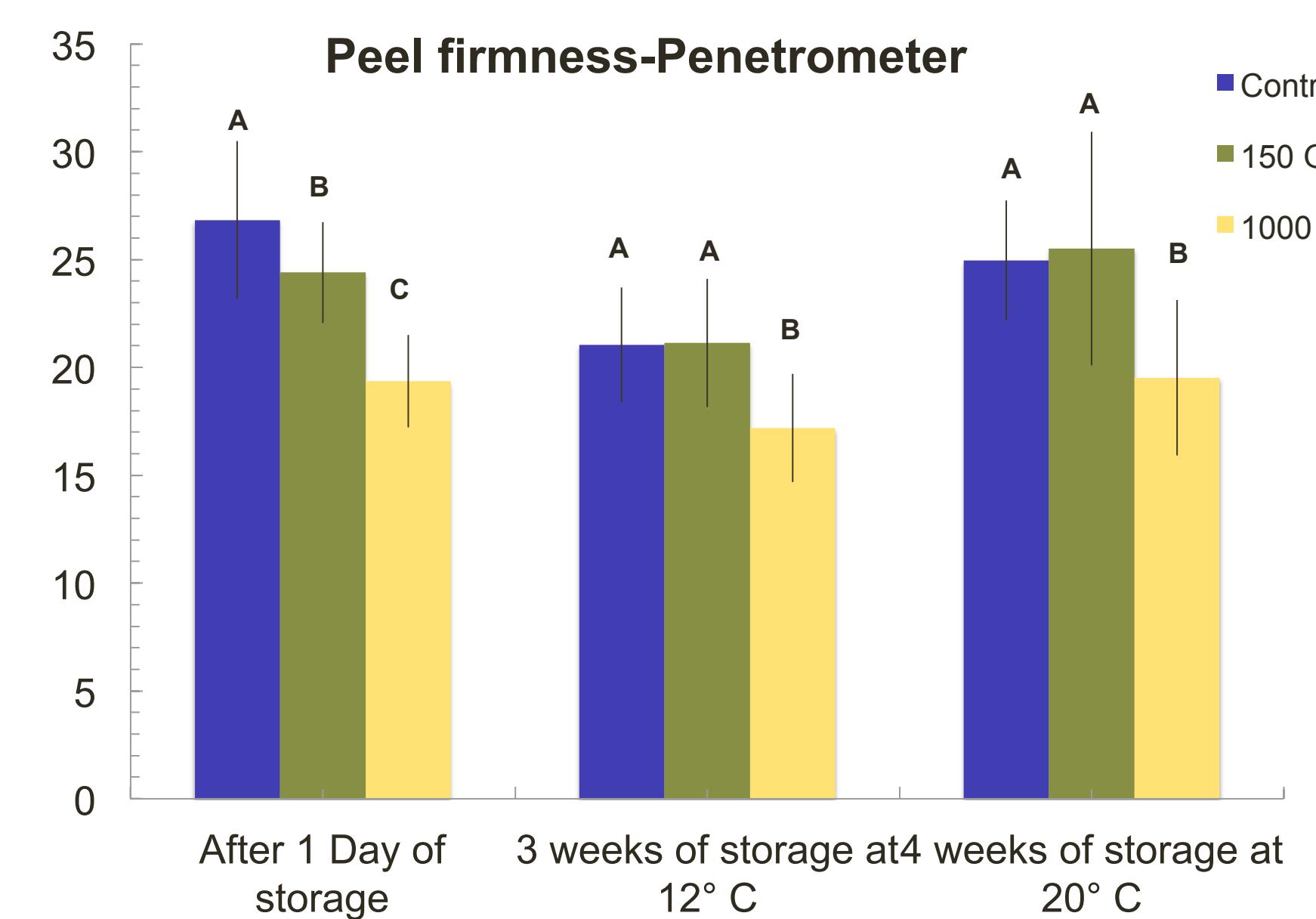
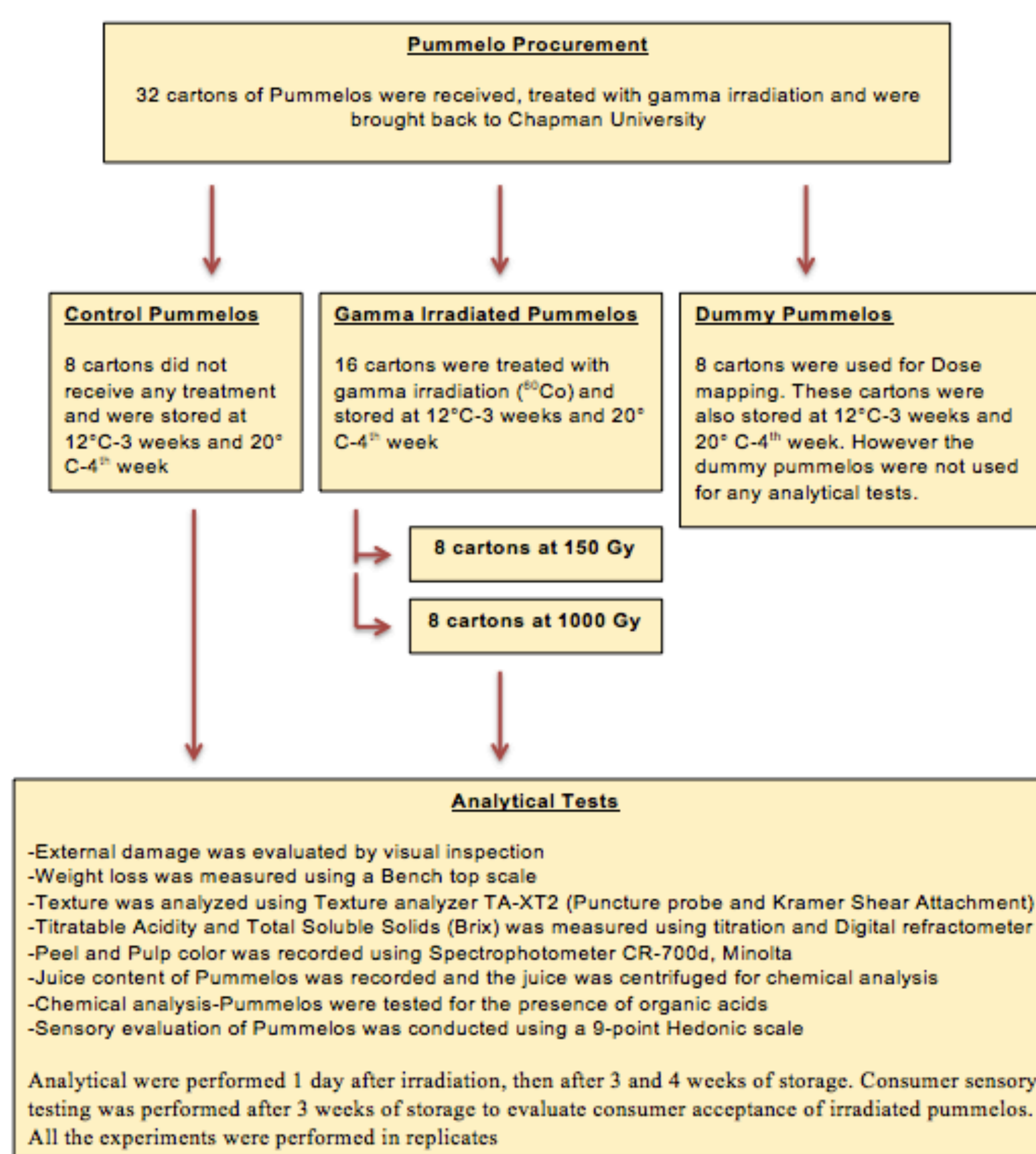


Figure 2. Force required to shear through a whole pummelo using a penetrometer. Means with the same letter are not significantly different (p>0.05)

Figure 3. Force required to shear through 150 g of pummelo segments using a Kramer Shear. Means with the same letter are not significantly different (p>0.05)

- Gamma irradiation resulted in softening of the peel and flesh. After 3 weeks, the control fruit and 150 Gy pummelos had similar peel and flesh texture, whereas the 1000 Gy pummelos were significantly softer. After 1 week at 20° C, the peel became firmer most likely due to dehydration.
- Significant differences in total soluble sugars and titratable acidity were observed among irradiated and untreated pummelos. However, due to lack of a pattern, it was concluded that the differences might be due to fruit variability and not as a result of irradiation.
- Citric acid content decreased significantly for the irradiated fruit
- Juice content, weight of the fruit, color of the peel and the flesh was not significantly different for the irradiated and untreated pummelos. Weight of the fruit decreased over storage period of 4 weeks, the loss can be attributed to fruit respiration and dehydration during storage.

Experimental Design



Key Findings



Figure 1. Control, 150 Gy and 1000 Gy pummelos after 4 weeks of storage; 3 weeks at 12° C and 4th week at 20° C. 1000 Gy pummelos had maximum damage

- External appearance of the fruit was negatively impacted when treated with 1000 Gy; resulting in greater peel injury, pitting and mold growth. Pummelos treated with 150 Gy showed similar effects, however the damage was not as intense as in the case of 1000 Gy fruit.
- However, consumers rated the pummelos similarly, suggesting that no perceivable differences were present between treatments.

Conclusion

Gamma irradiation at 1000 Gy negatively impacted the quality of Chandler pummelos. However, pummelos irradiated at 150 Gy can maintain almost similar quality as untreated pummelos when stored at appropriate storage conditions and thus can serve as a potential phytosanitary treatment for Chandler pummelos

Acknowledgement



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