

EFFECT OF CALCIUM CHLORIDE SOLUTIONS ON MARKETING QUALITY OF FRESHBARHI (C.V.) DATE

KHALED A. M. AHMED, AHMED ATIA & ABDULLAH M. ALHAMDAN

Chair of Dates Industry & Technology, King Saud University, Riyadh, Saudi Arabia

ABSTRACT

In order to maintain favorites quality of Barhi dates to the consumers at the khalal stage with its yellow color and crunchiness firmness. Controlled atmospheric storage has the ability to keep Barhi fruits for three months. But the main problem remains to maintain the same quality fruits in the markets. So the aim of the current study is the application of immersion Barhi fruits after CA storage in calcium chloride solution at concentrations (1%, 2%) for (3-5 minutes) and then left to dry at room temperature and then save them in cooled stores (5 °C) for a period of two weeks and in room temperature (23±2 °C) for a week and also develop a set without treatment to study the effect of different solutions on the product. Samples were taken each week for measurements and sensory evaluation tests. The best result was to use calcium chloride concentration (2%) after storage in a controlled atmosphere in terms of maintaining the texture, color, taste, and loss rate in fruits

KEYWORDS: Calcium Chloride; Controlled Atmospheric; Barhi Fruits; Quality Parameters

INTRODUCTION

Dates palm (*Phoenix dactylifera* L.) is the oldest fruit tree that rich in sugars (fructose, glucose, and sucrose), minerals, and vitamins (Kader et al., 2009). In 2013 world production of dates was about 7627624 tons, the top five producing countries were Egypt, Saudi Arabia, Iran, United Arab Emirates and Pakistan, they produce 19.7%, 13.94%, 14.2%, 4.2 and 7% respectively, with a total of 44.8 % world production. (FAOSTAT, 2013). Based on the geographical location, in Saudi Arabia, the harvesting season of Barhi cultivar started from mid of July till mid of September, two or three weeks of harvesting season is for harvest the fresh fruits at maturity stage named Khalal (Alhamdan et al., 2008). Fresh Barhi at Khalal maturity stage is preferable to consumers for its crunches, sweetness, and appearances. Up to 23.87% of fresh date, fruits are accounted as losses in farms, because of the huge production at a short season and no commercial method available to preserve these fruits at their Khalal stage of maturity. As a result, a problem of low price appears. However, at the end of the season, the prices reach ten times that at peak season (Al-Mashhad et al., 2003; Alhamdan et al., 2008).

Controlled Atmosphere (CA) is used to extend the storage period when refrigeration is not sufficient. In (CA) storage, the percentage of Oxygen (O₂) can be reduced by replacing it with Nitrogen (N₂), adding carbon dioxide (CO₂) to reduce the aerobic organism's growth and respiration rate. Although CA storage plays a relevant role to preserve the quality of Barhi dates long period at Khalal stage of maturity, its shelf life after storage is short (Al-Redhaiman, 2004; Alhamdan et al., 2008).

Postharvest pretreatments of fruits prior to storage have a significant effect on quality preservation for many

fruits. (Torres et al., 2009; Al-Qurashi., 2012). These pretreatments include hot air, hot water, methyljasmonate, methylcyclopropene, salicylic acid, waxing, calcium chloride, Nicin, Low doses of fungicides, Growth regulators, silicon, and ethanol (Wojciech et al., 2010). Calcium Chloride solution applications as postharvest treatments are applied to a wide variety of fruits and vegetables; this application achieves good results in quality preservation (Hafez, 2012). Solutions of Calcium Chloride (1%-2%) approved delay softening of Kiwi, Persimmon, Apple, Dates, Pomegranate, Watermelon and many other fruits (Kazemi, 2013; Torres et al,2009; Wali et al, 2013).

This research work aims to apply two Calcium Chloride solutions as post storage in CA treatment in order to extend shelf-life of Barhi cultivar at its Khalal maturity stage.

MATERIALS AND METHODS

Barhi dates Cultivate Purchased from known farms of their superior date's quality at Khalal stage of maturity. A cold storage truck transported the fruits from the farms to the College of Food and Agricultural Sciences at a campus where the CA cold stores are located. After three months of storage, samples for post-storage treatments were randomly chosen.

CALCIUM CHLORIDE SOLUTIONS TREATMENTS

Two solutions of Calcium Chloride (1 g.L^{-1} and 2g.L^{-1}) were prepared, and then the fruits were dipped for three minutes at room temperature (Antunesa et al., 2009). After dipping nine batches of fruit were packaged in carton boxes (3 kg. weight) for every batch. To evaluate the effect of treatments under study on marketing shelf life, all batches sorted at 5°C for 21 days.

Measurements were performed each seven days at room temperature (23 ± 1). The peppers were removed without cooling, placed in plastic bags and submerged in a water bath at a constant temperature of 65°C for various holding times (0, 15, 30, and 45 min) to foster the action of PME and Ca^{2+} ion bonds.

PHYSICAL PROPERTIES MEASUREMENTS

Physical properties (mass, density, moisture content, water activity and CIE color component) were measured. Mass of individual dates (100 sample/batch) was measured using a sensitive balance (0.01g). The Mettler-Toledo PG-203 sensitive balance provided with density kit was used to determine 100 individual densities. Ten replicates of moisture content wet base were measured using an electrical oven according to ASTM. Like moisture content, ten replicates of water activity were measured utilizing Aqua Lab instrument Series 3 /3TE.

MECHANICAL PROPERTIES MEASUREMENTS

A texture analyzer (TA-HDi, Model HD3128, Stable Micro systems, Surrey, England), together with 75-mm-diameter disk plunger, was used to conduct TPA test for 50 individual fruits per batch.

COLOR MEASUREMENTS

Hunter Lab Scan XE was used to measure CIE color component in order to calculate total color differences. Measurements were performed for 50 individual fruits per batch.

DECAY MEASUREMENTS

Individual fruit accounted as ripening ones if the brown color cover more than 25% of the fruit (Alhamdan et al., 2008). The Decay percentage is calculated as: -

$$\text{Decay \%} = (\text{Number of ripe fruits}) / (\text{Total number of fruits}) * 100$$

SENSORY EVALUATION

Sensory analysis was carried out by trained panel of ten judges using hedonic scale test for visual quality (color), texture, taste, and overall acceptance. Every panel member was presented with three samples, control, 1% treatment and 2% treatment (two individual fruit each) with a unique random code. For each attribute, the panel recorded the code for the sample and the score.

STATISTICAL ANALYSIS

SAS Version 9.2 (SAS Institute, Cary, NC) was used for factorial analysis of data. Comparison between means was evaluated by Duncan's Multiple Range Test at 5% level of significance.

Data on the above parameters was taken in triplicate and analyzed statistically by using Randomized Complete Block Design (RCBD) while means were separated by Least Significant Difference (LSD) test at 5% level of significance as described by Steel and Torrie (1997).

RESULTS AND DISSECTIONS

EFFECT OF CALCIUM CHLORIDE TREATMENTS ON PHYSICAL AND MECHANICAL PROPERTIES

No significant differences in fruit water activity between the both CaCl_2 treatments and the control treatment regardless the storage time, while the storage time has significant differences regardless CaCl_2 treatments as shown in Figure (1). On another hand, both CaCl_2 treatments and storage time have a significant effect compared with control treatment on either moisture content or mass of Barhi fruits as presented in Figure (2) and Figure (3) respectively. The storage time is significantly different regardless CaCl_2 treatments as. The same behavior was observed for fruit moisture content, density and mass as shown in Figures (2) through Figure (4) respectively.

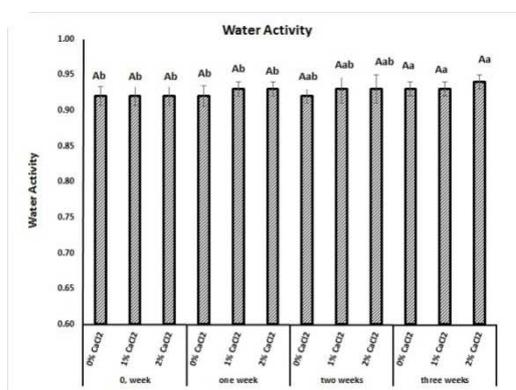


Figure 1: Water Activity (Dimensionless) of Barhi Fruits at Khalal Maturity Stage Treated and Untreated with CaCl_2 . Columns with the Same Uppercase Letter are Not Significantly Different as Treatment ($p < 0.05$) While these has Same Lowercase Letter are Not Significantly Different as Storage Time ($p < 0.05$)

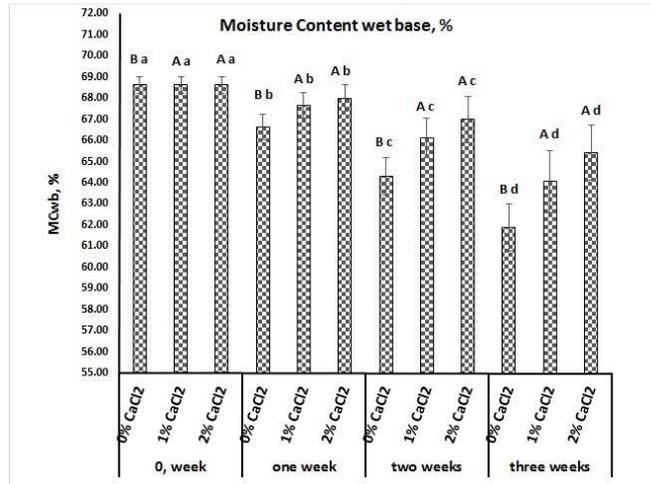


Figure 2: Moisture Content Wet Base (%) of Barhi Fruits at Khalal Maturity Stage Treated And Untreated with CaCl₂ Columns with the Same Uppercase Letter are Not Significantly Different as Treatment ($p < 0.05$) While These has Same Lowercase Letter are Not Significantly Different as Storage Time ($p < 0.05$)

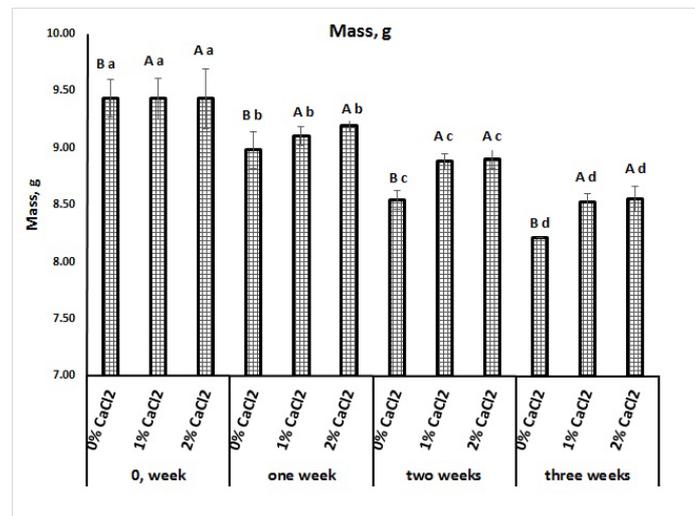


Figure 3: Mass (g) of Barhi Fruits at Khalal Maturity Stage Treated and Untreated With CaCl₂ Columns with the Same Uppercase Letter are Not Significantly Different as Treatment ($p < 0.05$) While These has Same Lowercase Letter are Not Significantly Different as Storage Time ($p < 0.05$)

Addition to CaCl₂ treatments and storage time effect on density and total color difference of Barhi fruits, the level of CaCl₂ treatments is significantly affecting on these properties. The existing results are shown in Figure (4) and Figure (5) respectively.

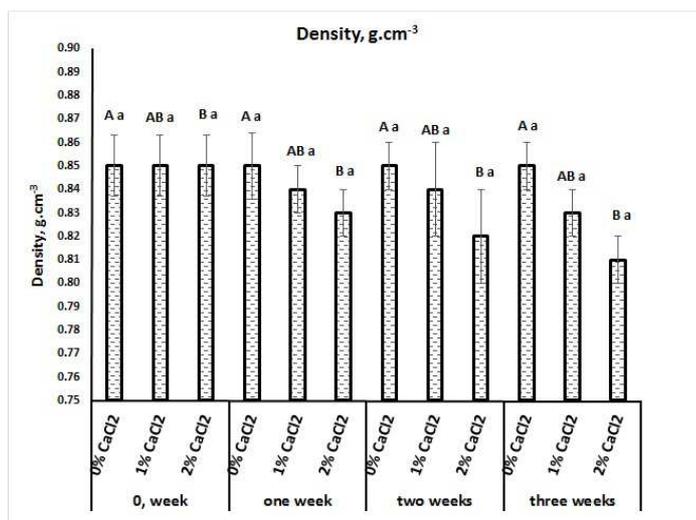


Figure 4: Density (g.cm⁻³) of Barhi Fruits at Khalal Maturity Stage Treated and Untreated with CaCl₂. Columns with the Same Uppercase Letter are Not Significantly Different as Treatment ($p < 0.05$) While These has Same Lowercase Letter are Not Significantly Different as Storage Time ($p < 0.05$)

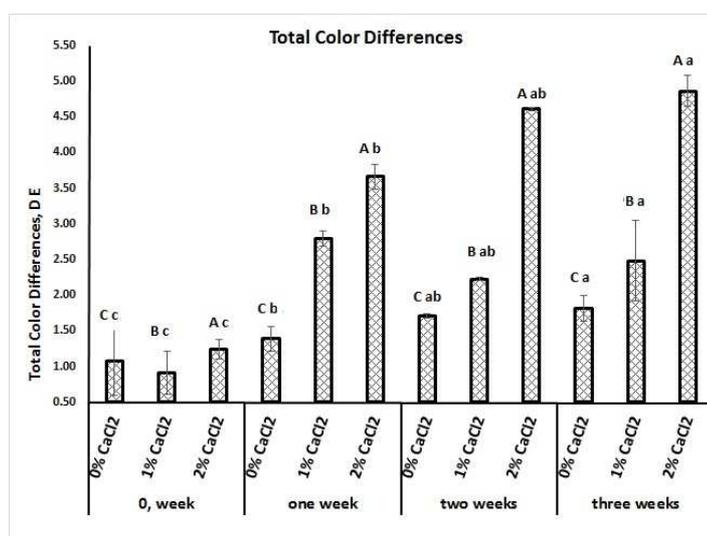


Figure 5: The Total Color Difference (Dimensionless) of Barhi Fruits at Khalal Maturity Stage Treated and Untreated with CaCl₂. Columns with the Same Uppercase Letter are Not Significantly Different as Treatment ($p < 0.05$) While these has Same Lowercase Letter are Not Significantly Different as Storage Time ($p < 0.05$)

For mechanical properties under study Figure (6) through Figure (8) illustrated the effect of CaCl₂ treatments and storage time on Hardiness, Springiness and Chewiness respectively.

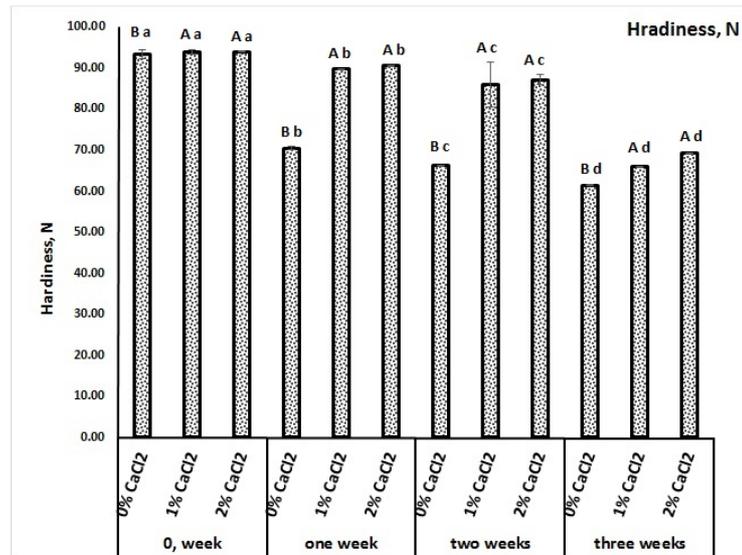


Figure 6: Hardness (N) of Barhi Fruits at Khalal Maturity Stage Treated and Untreated with CaCl₂. Columns with the Same Uppercase Letter are Not Significantly Different as Treatment ($p < 0.05$) While These has Same Lowercase Letter are Not Significantly Different as Storage Time ($p < 0.05$)

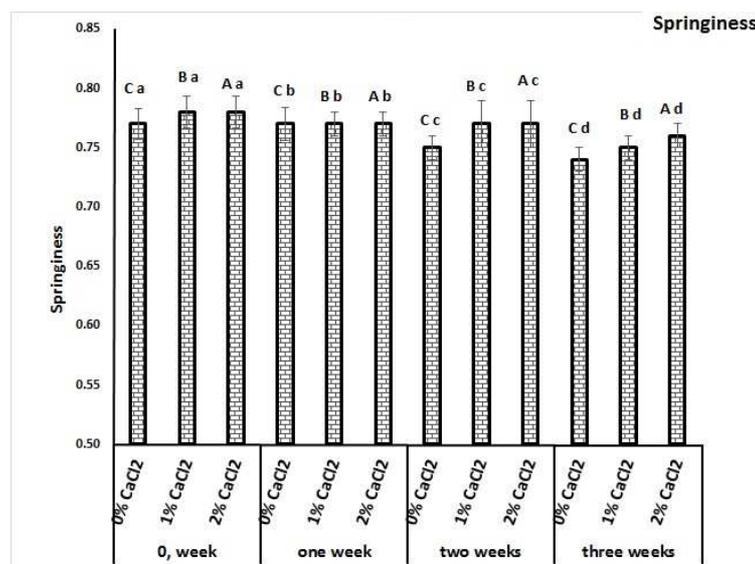


Figure 7: Springiness (Dimensionless) of Barhi Fruits at Khalal Maturity Stage Treated and Untreated with CaCl₂. Columns with the Same Uppercase Letter are Not Significantly Different as Treatment ($p < 0.05$) While These has Same Lowercase Letter are Not Significantly Different as Storage Time ($p < 0.05$)

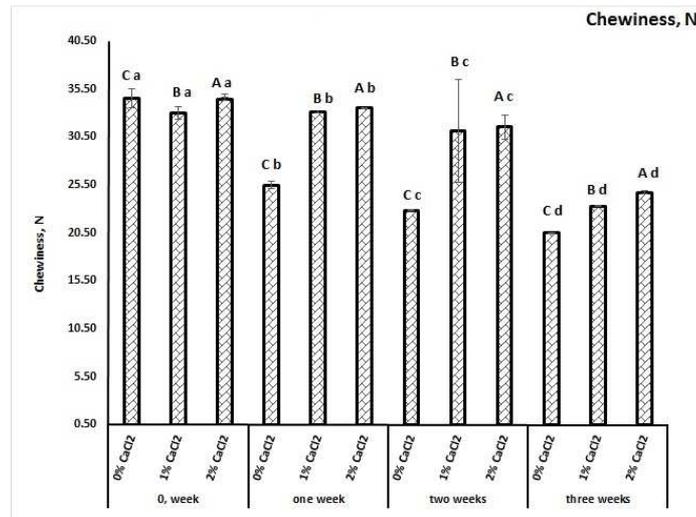


Figure 8: Chewiness (N) of Barhi Fruits at Khalal Maturity Stage Treated and Untreated with CaCl₂. Columns with the Same Uppercase Letter are Not Significantly Different as Treatment ($p < 0.05$) While These has Same Lowercase Letter are Not Significantly Different as Storage Time ($p < 0.05$)

These all differences in physical and mechanical properties under study could be owing to that the application of calcium chloride acts as a barrier, by this means limiting water transfer and thus delaying dehydration of the fruits (Sohail et al. 2015).

EFFECT OF CALCIUM CHLORIDE TREATMENTS ON BOTH DECAY AND WEIGHT LOSSES PERSONAGE

After seven days, the decay of fruits in zero CaCl₂ treatment (control treatment) was 12.4%±1.2 while the treated fruits were lower than ten percentages. Dramatically, the decay index was doubled in the next seven days and tripled at the end of the experiment as illustrated in Figure (6). Analysis of variance showed significant differences either in treatments vector or storage time vector as in Table (1). For weight loss percentage, the same behavior was found and shown in Fig (9) and Table (10).

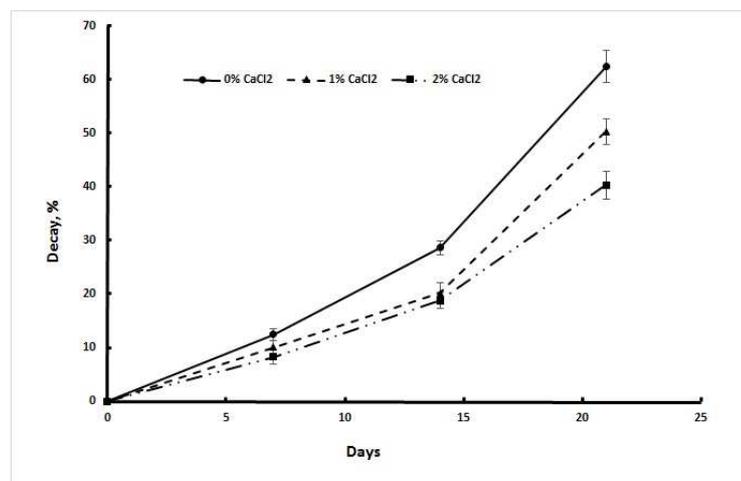


Figure 9: Effect of Calcium Chloride Treatments and Storage Time on Decay Index

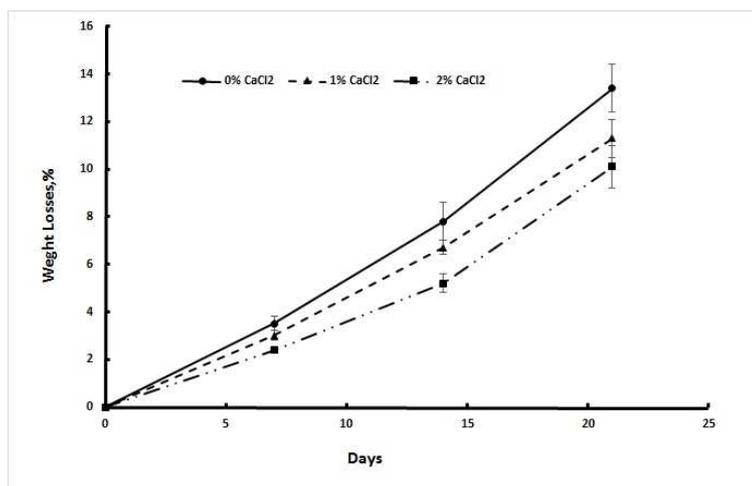


Figure 10: Effect of Calcium Chloride Treatments and Storage Time on Weight Losses, %

Table 1: Calcium Chloride Treatments and Storage Time on Decay Index and Weight Losses, %

Storage Time (Day)	Decay Index, %			Weight Losses, %		
	0% CaCl ₂	1% CaCl ₂	2% CaCl ₂	0% CaCl ₂	1% CaCl ₂	2% CaCl ₂
7	12.4 ^{Ca} ±1.1	10.1 ^{Cb} ±1.3	8.3 ^{Cc} ±1.4	7 ^{Ca} ±0.3	3.5 ^{Cb} ±0.5	2.4 ^{Cc} ±0.5
14	28.6 ^{Ba} ±1.3	20.1 ^{Bb} ±2.0	18.7 ^{Bc} ±1.5	14 ^{Ba} ±1.2	7.8 ^{Bb} ±0.8	5.2 ^{Bc} ±0.9
21	62.4 ^{Aa} ±3.1	50.3 ^{Ab} ±2.4	40.3 ^{Ac} ±1.6	20 ^{Aa} ±1.5	11.3 ^{Ab} ±1.1	10.1 ^{Ac} ±1.2

* For each property, values are expressed as means standard deviation. Values in the same row having the same uppercase letter (A, B, or C) are not significantly different by pairwise LSD tests at $p < 0.05$, and values in the same column having the same lowercase letter (a, b, c, or d) are not significantly different at $p < 0.05$.

SENSORY EVALUATION

The sensory profiles of all treatment are presented in Figure (11). These profiles showed attributes of Barhi date fruits along the storage time.

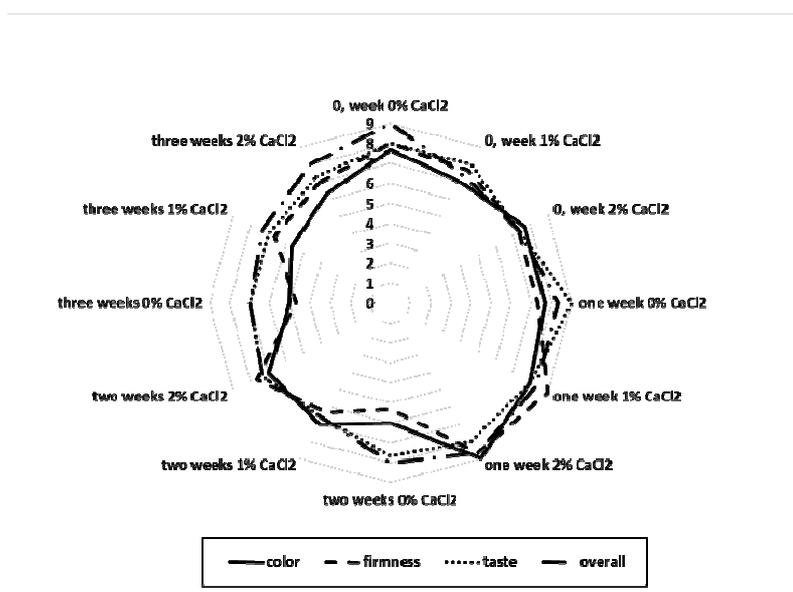


Figure 11: Sensory Profiles for Calcium Chloride Treatments and Storage Time

CONCLUSIONS

The obtained results showed that there is no significant differences between one percent calcium chloride treated fruits and two present on the quality attribute. Furthermore, studies a chemical analysis is needed to conclude precise results.

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