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Effects Of Skin Coating Materials, Storage Conditions On P^H,Titratable Acidity And Vitamin C Contents Of Citrus Fruits Stored At Room And Refrigerated Temperatures

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Abstract

An investigation was carried out on fruits of five species of *Citrus namely, Citrus* sinensis, (sweet orange); *C reticulate, (tangerine);* C aurantium, (sour orange); *C auratifolia, (lime);* C paradise (grapefruit).The different citrus fruits were treated by dipping in a mixture of detergent solution and petroleum jelly and wrapping with aluminium foil and stored at room and refrigerated temperatures for 12 weeks.Control fruits which were not treated were also set up. The fruits treated by dipping in a mixture detergent solution and petroleum jelly and refrigerated showed the least changes in p^H, highest changes in titratable acidity and lowest changes in vitamin C content. This was followed by fruits dipped in a mixture of detergent solution and petroleum jelly and refrigerated without wrapping.And the fruits treated by dipping in a mixture of detergent solution and petroleum jelly and stored at room temperature. All the treated fruits performed better when compared to the control with no treatment given and stored at room temperature.Regardless of treatment given to each fruit ,lime has the lowest p^H, highest titratable acidity,this was followed sour orange, grapefruit, tangerine and sweet orange.As for the vitamin C content,sweet orange had the highest value, followed by sour orange, grapefruit,lime and tangerine in that order.

Introduction

Packaging is one of the methods that is commonly employed for control of deterioration and maintenance of fresh appearance of the produce. The use of modified atmosphere packaging for the extension of storage life of fruits and vegetables is of renewed research interest (Hobson and Burton, 1989). Erinle and Karikari (1988) reported the use of waxes and plastic coatings are useful for extending shelf life and retarding respiratory activity of fruits and vegetables, although these techniques are generally only suitable on a large commercial scale. Their use could probably be extended to small scale production, if the value of the crop justified the additional expenses.

Highly gas permeable materials such as polyethylene and carnauba wax control water loss, but do not promote much modification of the internal environment (Hagenmaier and Baker,1994a). This is desirable for control of water loss, without the risk of anaerobic condition, in the case of non – climacteric fruits. Resins which have low permeability to gases can help control ripening, but are more likely to create anaerobic conditions compared to other coating materials especially in case of temperature abuse (Hagenmaier and Shaw, 1991; Hagenmaier and Baker, 1994 a,b, 1996). Carbohydrate and protein coatings are generally hydrophyllic and do not effectively prevent water loss, but they can result in more modification of the vegetable's internal atmosphere for control of ripening compared to resin materials (Baldwin, 1994; Baldwin *et al.*, 1995).

Baldwin (1994) reported polyethylene and carnauba wax micro emulsion are also used on fruits and vegetables to control water loss and shine. Candelilla wax micro-emulsion tested on citrus fruits contributed a glossy appearance especially when combined with gelatin protein (Hagenmaier and Baker, 1996). Chen and Grant (1995), Baldwin *et al.*, (1997) reported coatings can be used to prevent degreening of limes, and lemons especially where consumers assume green colour with freshness, attributed to a delay in chlorophyll synthesis. Inhibition of chlorophyll breakdown may be due to creation of a modified atmosphere, since chlorophyll requires oxygen. This was demonstrated with mineral oil (Baldwin *et al.* 1997). Waks *et al.* (1985) showed that waxing of citrus fruits resulted into less decay, when compared to unwaxed fruits.

This research was designed to test the effectiveness of skin coating materials on the changes in p^H, titratable acidity and vitamin C content.Also to know the effects of period of storage and treatment applied on p^H, titratable acidity and vitamin C content.

Materials and Methods

Physicochemical Analysis

The physico-chemical analyses of different citrus fruits were carried out at interval of 4 weeks throughout the duration of the research

Determination of pH

Ten millilitres juice of each citrus fruit was placed in 100ml distilled water. The pH was determined using Pye-unicam pH meter model 292mv. The electrode of the standardized pH meter was then dipped into the solution and read.

D etermination of titratable acidity

The AOAC (1990) method of was employed. Ten millilitres juice of citrus fruits was placed in 100ml of distilled water. Ten millilitres was centrifuged and titrated against 0.1N NaOH using phenolphthalein indicator until a pale pink end-point was obtained. The acidity was expressed per gram of the sample.

Determination of ascorbic acid

The ascorbic acid content was determined as described by AOAC (1990). Five millilitres of juice was mixed with 15ml of trichloroacetic acid in a 100ml flask. Acetic acid was added as a stabilizing agent. The resultant solution was thoroughly mixed and the volume made up to 40ml using distilled water. The solution was mixed with 1.5ml of acetone and titrated immediately against a solution of 2, 6 dichloroindophenol dye (2% v/v) to a faint pink end point which persisted for 10-15 seconds. The titration was repeated using a standard pure ascorbic acid solution (1mg/ml) in place of the juice sample. The percentage ascorbic acid content per 5ml of sample was calculated with the formula

Ascorbic acid= $\underline{VT}$ X 100W

Where V= volume of dye used for titration of aliquots of diluted sample. T = Ascorbic acid expressed as mg/ml of dye

W= volume of sample in aliquots titrated.

Results

The pH values of different citrus fruits stored at room and refrigerated temperatures .

There were differences in the pH ,titratable acidity and vitamin C content for the different citrus fruits with lime having the lowest p^H,f,ollowed by sour orange, grapefruit, tangerine and sweet orange in that order.Lime also had the highest titratable acidity followed by sour orange, grape fruit,tangerine and sweet orange. As for the vitamin C content,sweet orange had the highest followed by sour orange,grapefruit,lime and finally tangerine.These results are depicted in Figures 1-3

The Titratable acidity of different citrus fruits stored at room and refrigerated temperatures for 12 weeks.

There were differences in the titratable acidity of the different citrus fruits ,with lime having the highest values. This was followed by sour orange ,grapefruit, tangerine and sweet orange.These results are shown in Figure 2.

Discussion

Lime had the lowest value of 2.2 followed by sour orange, grapefruit, tangerine and finally sweet orange. There was a significant difference ($P < 0.05$) for the period of storage in all the citrus fruits, except in sour orange where there was no significant difference between the 8^{th} and 12^{th} weeks of storage. There was no significant difference ($P > 0.05$) between the fruits refrigerated with preservatives, but there was a significant difference between the fruits refrigerated without preservatives (control) and the control. The above observations might be due to the nature of the treatment applied as well as the activities of micro-organisms. The pH increased as the duration of storage increased, regardless of the treatment applied. This agrees with the research work of Sowumi *et al.* (1982), who reported that citrus fruits were found to have an increased pH, lower ascorbic acid concentration and lower total soluble solids and lower titratable acidity with duration of storage.

Lime had the highest titratable acidity; this was followed by sour orange, grapefruits, tangerine and sweet orange. Ben–Yehosa (1997) reported lime to be the most acidic of all the citrus fruits. The titratable acidity decreased significantly ($P < 0.05$) as the storage period increased, while there was variation in the difference observed in the different treatments applied. The differences might be explained on the basis of duration of storage, the treatment applied as well as the activities of micro-organisms which attacked these fruits. The reduction in the titratable acidity concurs with the work of Sowumi *et al.* (1982); and Ladapo (2002) they reported a decrease in the titratable acidity in sweet orange stored in different environments, with different treatment as the duration of storage increased.

As for vitamin C, sweet orange had the highest value of 61.2mg/g, followed by sour orange, grapefruit, lime and tangerine. There was a significant difference ($P < 0.05$) in the period of storage in all the citrus fruits. On the other hand, there was also a significant difference ($P < 0.05$) in the treatment applied, with the fruits refrigerated with preservatives given better result. This was followed by the fruits with preservatives and the fruits refrigerated without preservatives (control) except in lime, where there was no significant difference between the refrigerated fruits without preservatives (control) and the control. This above observation can be explained based on the intrinsic factors, as well as the attack by spoilage microorganisms which utilized the nutrients and the treatment applied. The vitamin C content of the control fruits was not very satisfactory as there was nothing to impede the activities of these spoilage microorganisms, hence the high rate of decrease in the vitamin C content. The decrease in vitamin C content with increasing period of storage agrees with the research findings of Baiyewu and Amosa (1999) who reported a decrease in the vitamin A, vitamin C and total ash contents of pawpaw infected with certain test organisms after 5 days of incubation.

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Appendix

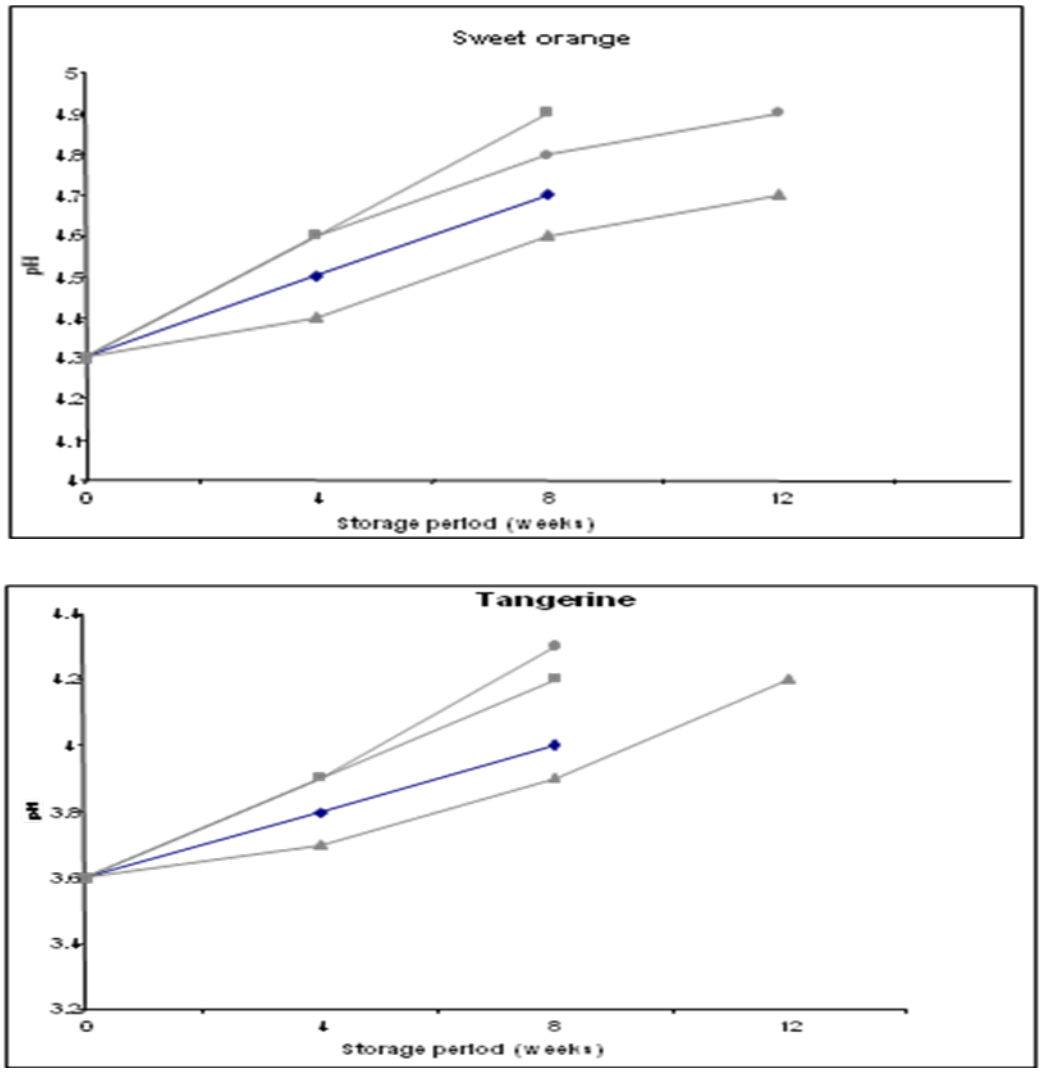
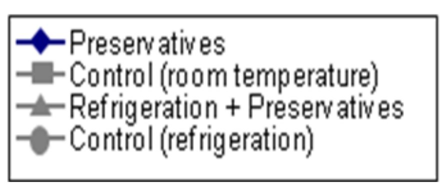
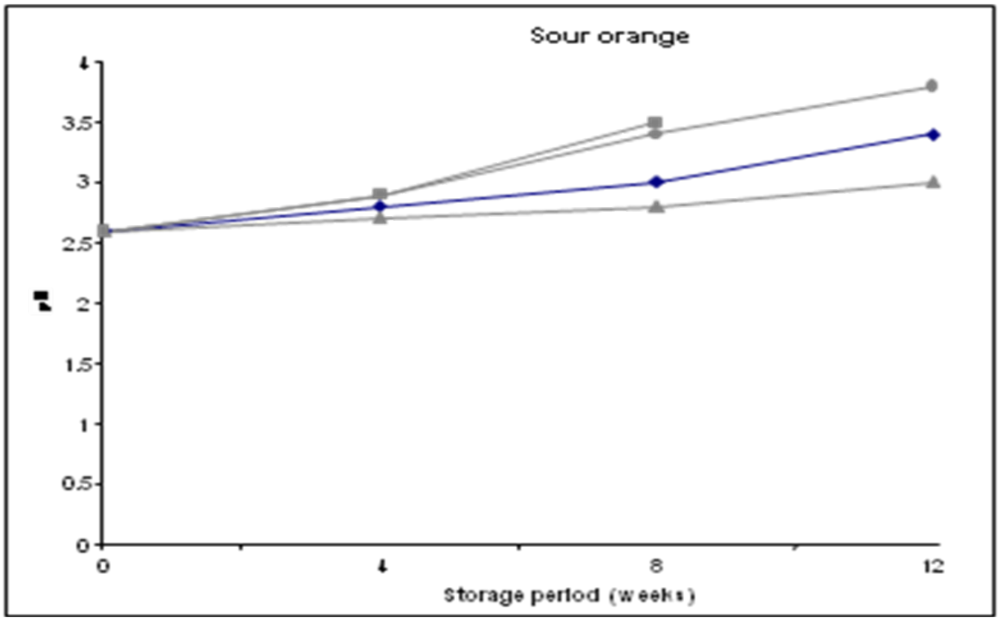
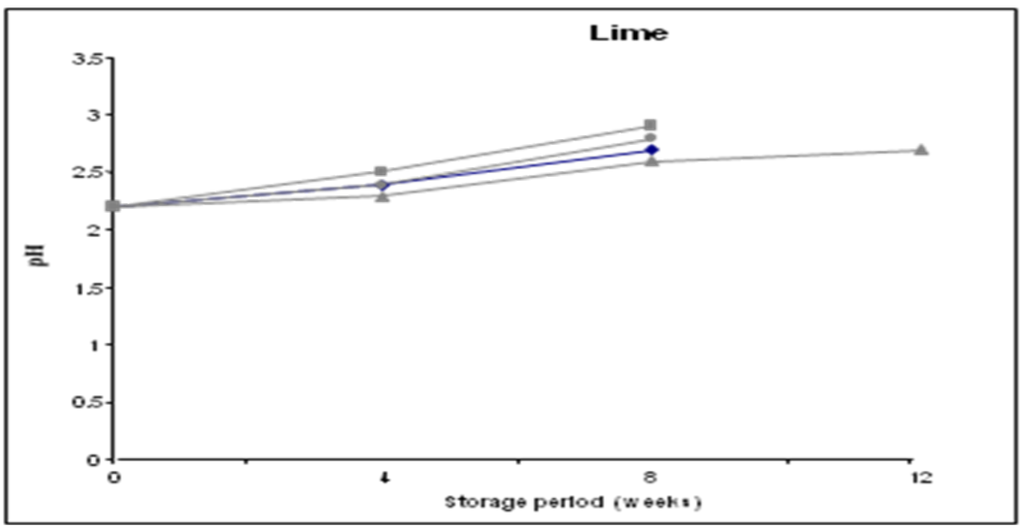


Fig1:Changes in pH of citrus fruits stored at room and refrigerated temperatures for 12 weeks







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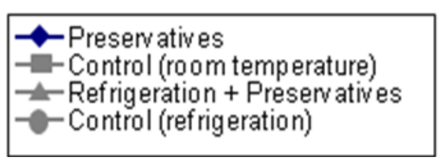


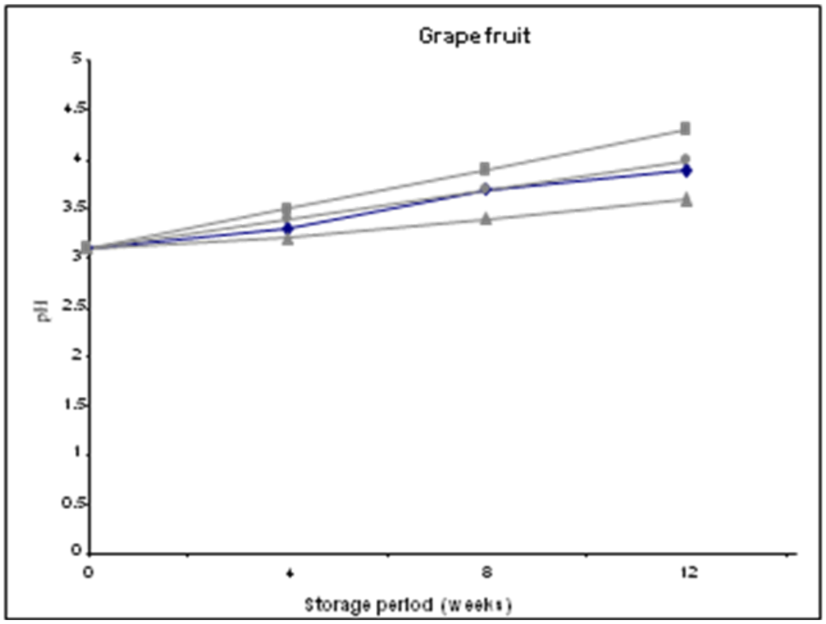
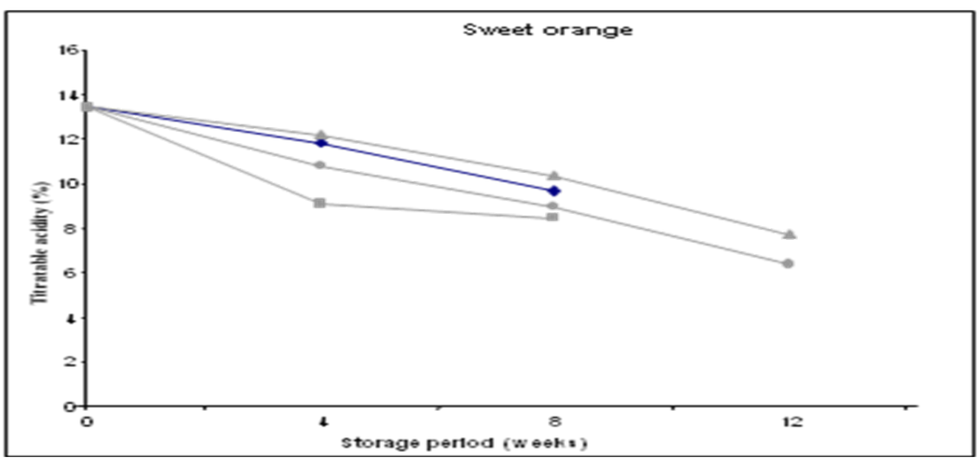


Fig. 1 continued.

The Titratable acidity of different citrus fruits stored at room and refrigerated temperatures for 12 weeks.

There were differences in the titratable acidity of the different citrus fruits ,with lime having the highest values. This was followed by sour orange ,grapefruit, tangerine and sweet orange.These results are shown in Figure 2



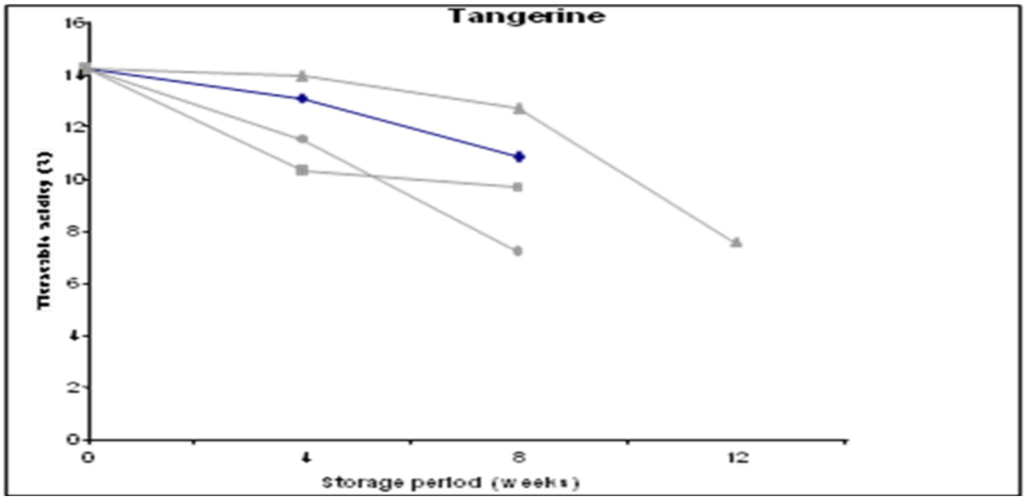
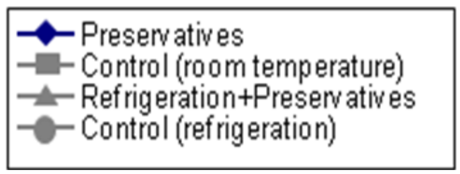
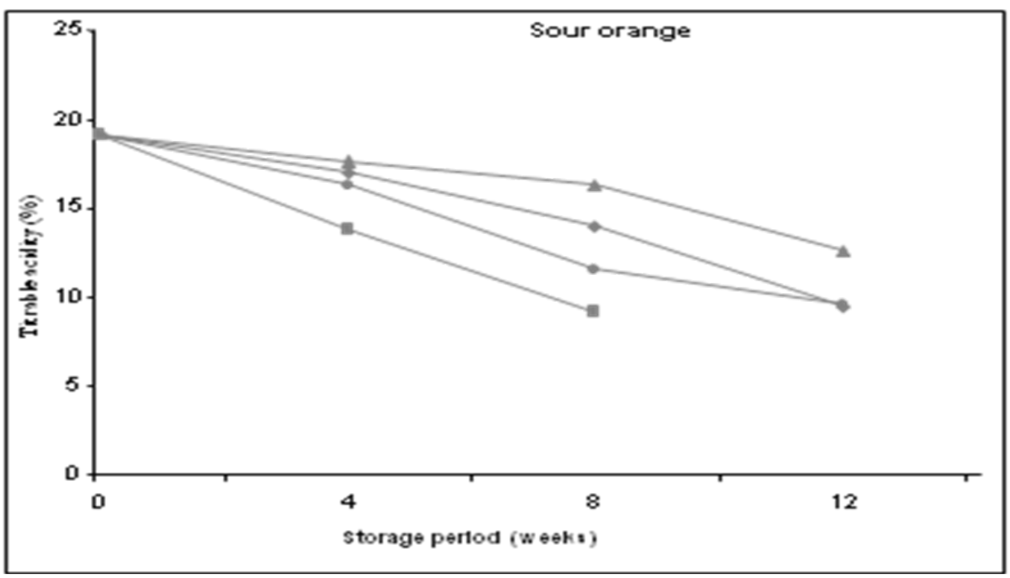
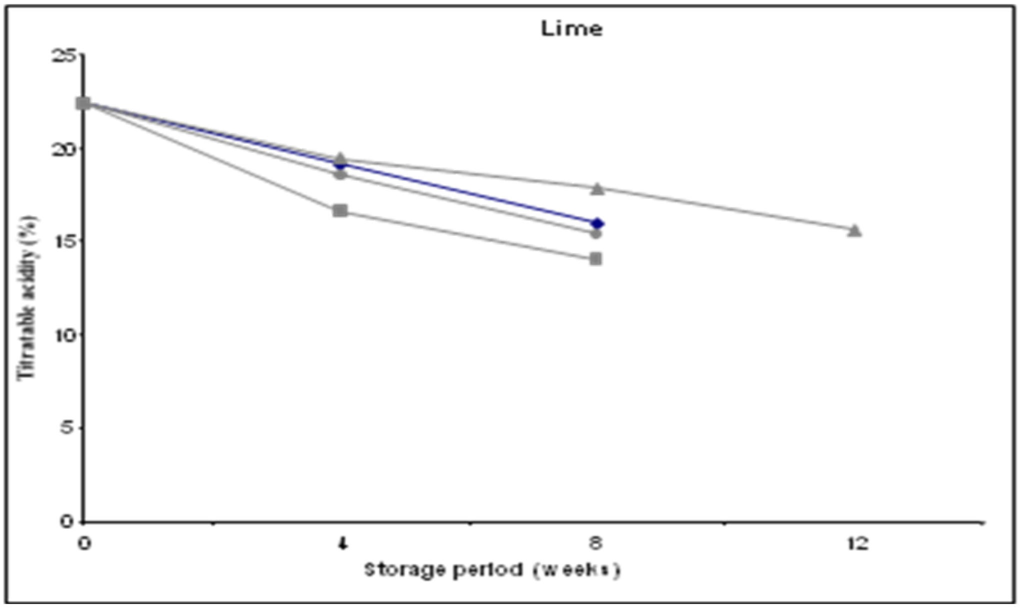


Fig. 2: Changes in the titratable acidity of citrus fruits stored at room and refrigerated temperatures for 12 weeks







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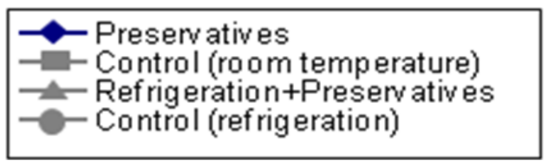

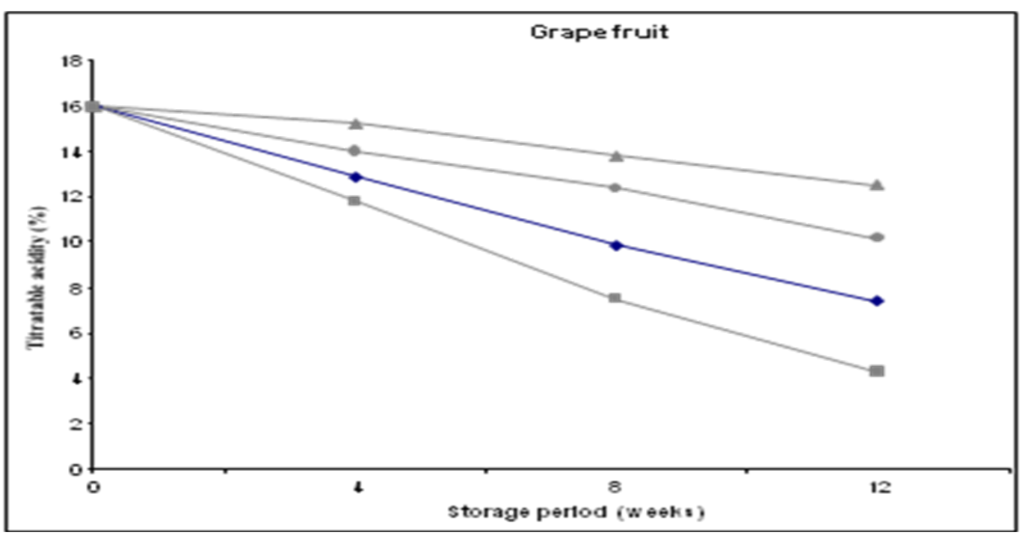

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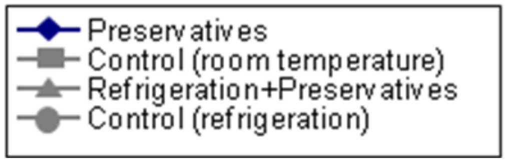
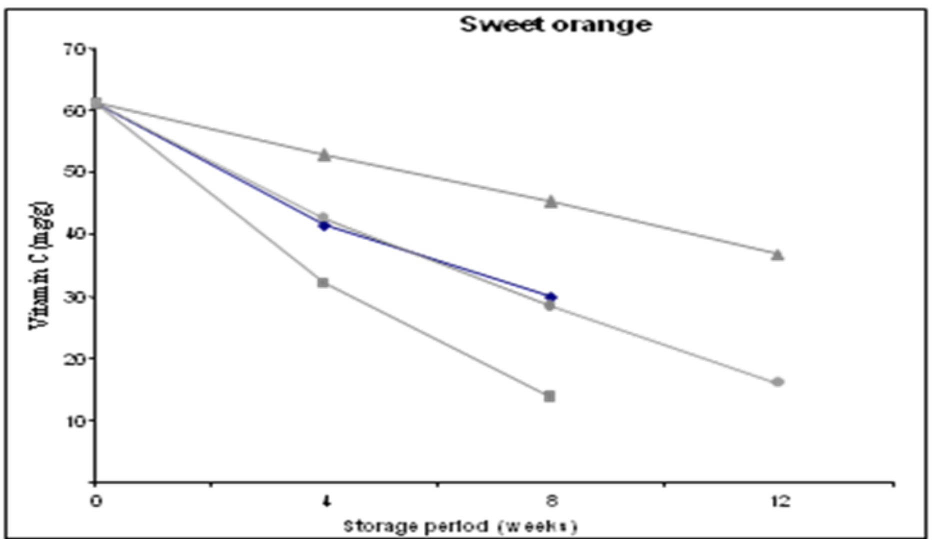


The vitamin C content of different citrus fruits stored at room and refrigerated temperatures for 12 weeks

The vitamin C content showed differences from one fruit to the other .Swwet orange had the highest value,followed by sour orange, grapefruit, lime andtangerine having the least value.These results are shown in Figure 3.



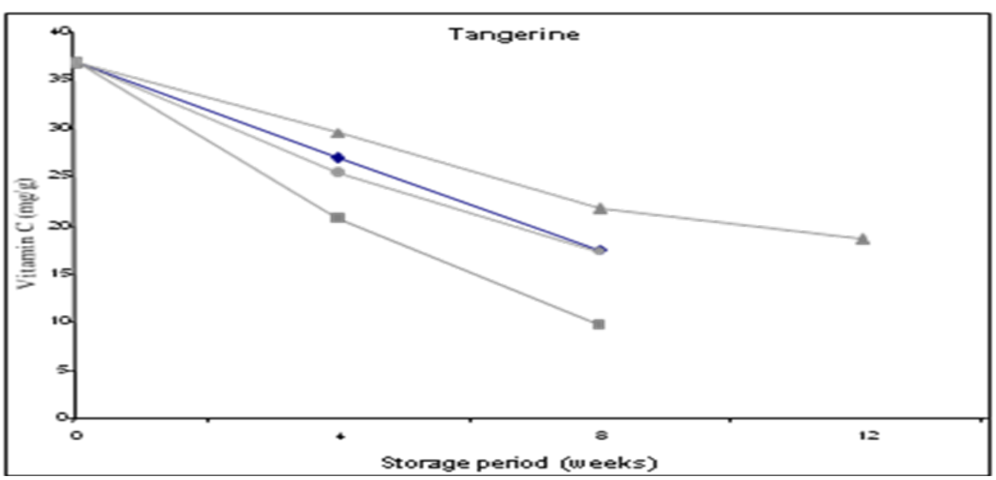
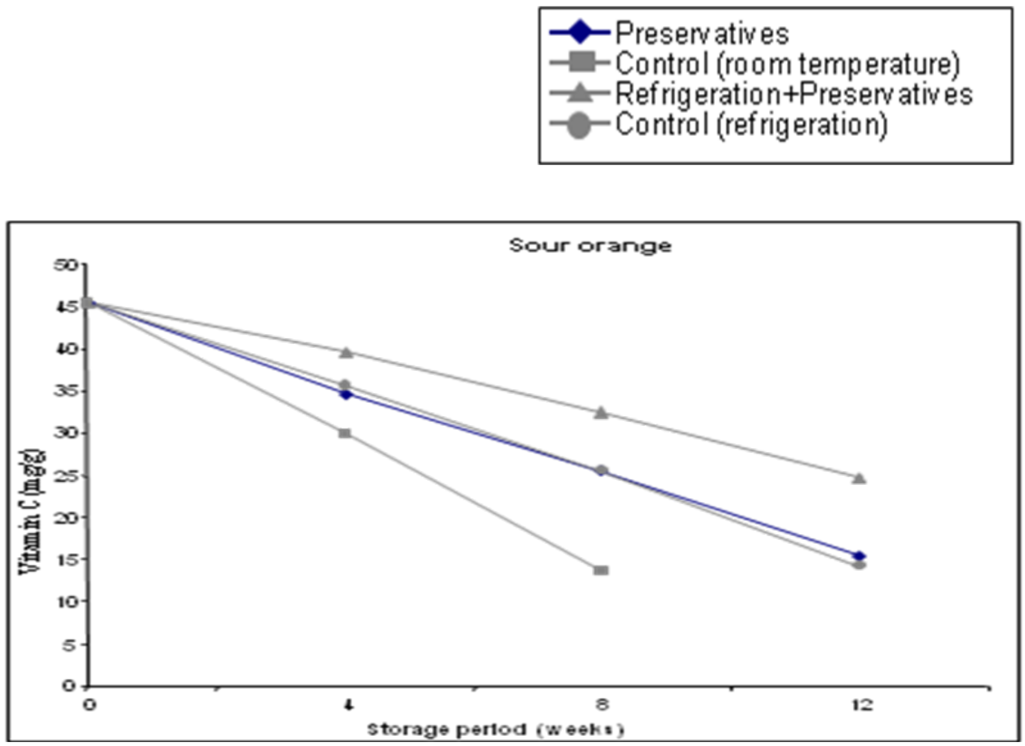
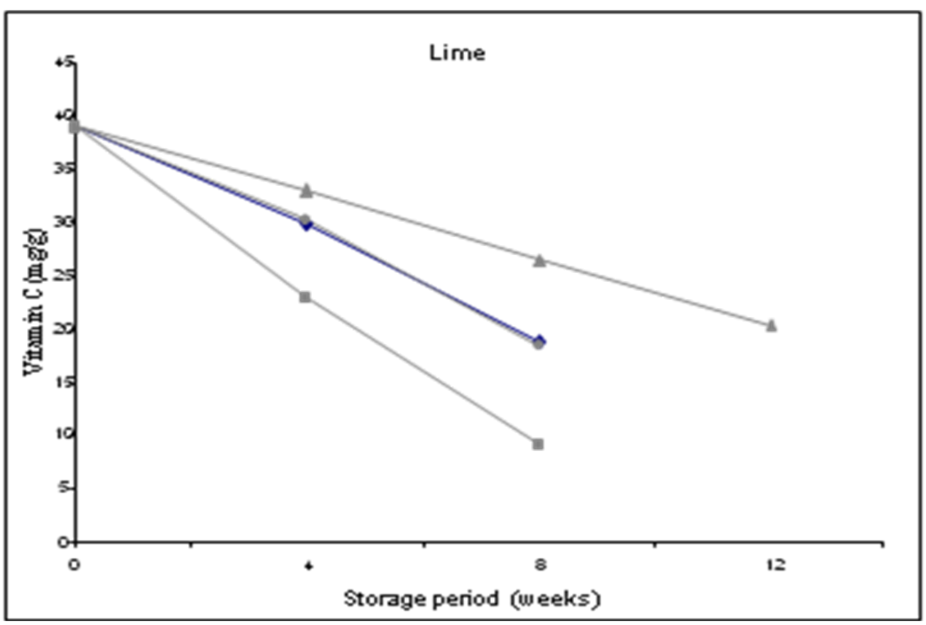


Fig. 3: Changes in vitamin C content of citrus fruits stored at room and refrigerated temperatures for 12 weeks





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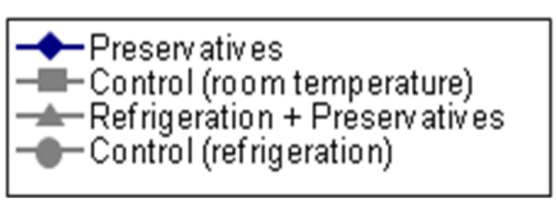

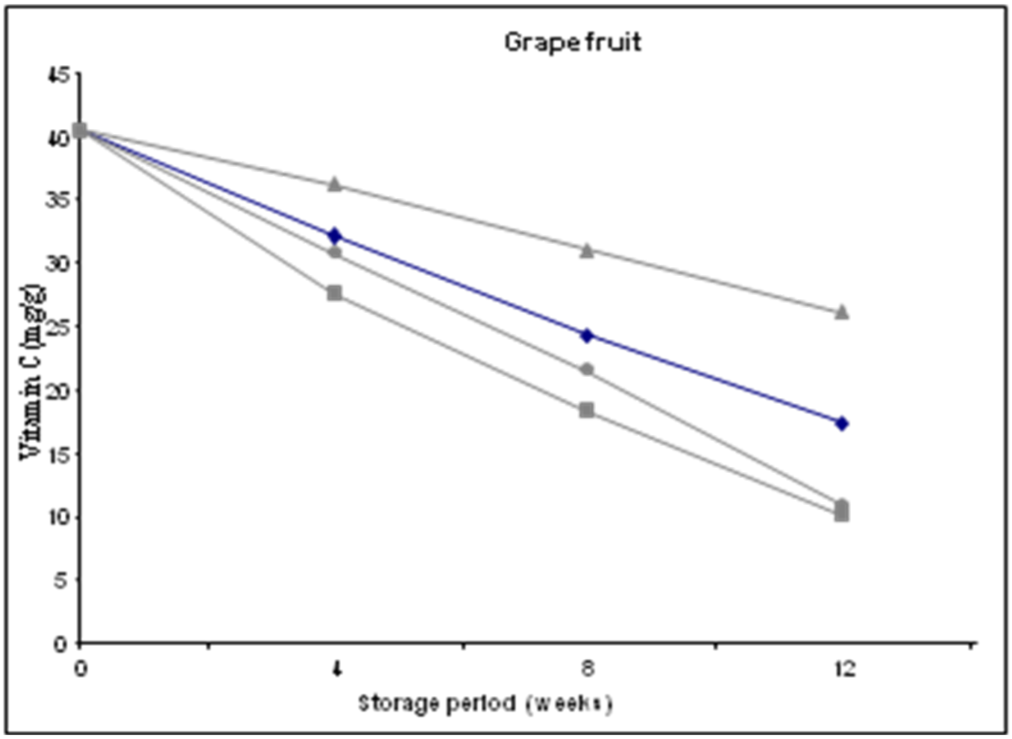

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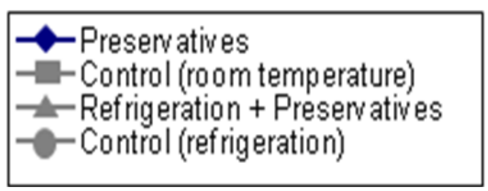

The effects of storage period on p^H ,titratable acidity and vitamin C content of different citrus fruits are presented in Table 1-3.

There was increase in p^H in all the different citrus fruits ,decrease in titratable acidity and decrease in vitamin C in all the citrus fruits as the period of storage increased.as the period of storage increased.

Table-1: Effects of period of storage on pH of different citrus fruits

	Period (weeks)			
Fruit	0	4	8	12
Sweet Orange	3.95^{a}	4.10^{b}	4.29^{c}	4.45^{d}
Tangerine	2.40^{a}	2.55^{b}	2.78^{c}	3.03^{d}
Sour orange	3.70^{a}	3.93^{b}	4.13^{c}	4.2^{c}
Lime	3.10^{a}	3.38^{b}	3.78^{c}	3.83^{d}
Grape fruit	2.65^{a}	2.95^{b}	3.33^{c}	4.2^{d}

Means with different superscripts across a row are significantly different ($P<.05$)

Table-2: Effects of period of storage on titratable acidity of different citrus fruits

	Period (weeks)			
Fruit	1	4	8	12
Sweet orange	11.17^{d}	5.98^{c}	4.5^{b}	3.39^{a}
Tangerine	19.9^{d}	16.4^{c}	8.6^{b}	3.0^{a}
Sour orange	13.7^{c}	9.3^{b}	7.1^{a}	4.9^{a}
Lime	15.4^{d}	11.4^{c}	6.5^{b}	3.8^{a}
Grapefruit	17.7^{d}	13.3^{c}	7.3^{b}	4.6^{a}

Means with different superscripts across a row are significantly different ($p<0.05$)

Table-3: Effects of period of storage on vitamin C of different citrus fruits

	Period (weeks)			
Fruit	1	4	8	12
Sweet Orange	49.0[d]	37.7[c]	36.8[b]	28.7[a]
Tangerine	42.3[d]	34.3[c]	25.8[a]	20.0[a]
Sour orange	50.9[c]	35.5[b]	24.8[b]	19.9[a]
Lime	41.2[d]	27.9[c]	16.5[b]	14.3[a]
Grapefruit	39.8[d]	27.9[c]	16.9[b]	10.5[a]

Means with different superscripts across a row are significantly different (P<0.05)

The effects of treatment on the different citrus fruits are presented in Tables 4-5.

There were marked differences in the treatments applied fo the different citrus fruits.Fruits dipped a mixture of detergent solution and petroleum jelly and wrapping with aluminium foil and stored at refrigerated temperature gave the best performance, this was followed by fruits refrigerated which performed better, while truits treated and stored at room temperature perfomed fairly and the control stoked at room temperature without treatment did noy perfomed satisfactorily..

Table-4 Effects of different treatment of pH of different citrus fruits

	Treatment			
Fruit	1	2	3	4
Sweet Orange	4.5[c]	3.80[a]	4.49[b]	3.85[a]
Tangerine	2.95[c]	2.43[a]	2,77[b]	2.45[a]
Sour orange	4.65[c]	3.50[a]	4.60[b]	3.33[a]
Lime	3.90[c]	3.0[a]	3.80[b]	3.20[a]
Grapefruit	3.7[a]	2.53[a]	3.55[c]	2.46[d]

Means with different superscripts across a row are significantly different (P<0.05)

1, Control; 2, preservatives; 3, control (refrigeration); 4, refrigeration + preservatives

Table-5 : Effects of different treatments on titratable acidity of different citrus fruits

	Treatment			
Fruit	1	2	3	4
Sweet Orange	9.2[d]	9.0[c]	8.9[b]	8.8[a]
Tangerine	17.0[b]	16.8[a]	11.9[b]	10.4[a]
Sour orange	9.3[b]	9.2[a]	11.9[b]	7.2[a]
Lime	14.93[b]	7.89[a]	14.02[b]	7.97[a]
Grapefruit	18.8[c]	13.0[b]	17.7[c]	9.9[a]

Means with different superscript across a row are significantly different (P<0.05)

1, Control; 2, preservatives; 3, control (refrigeration); 4, refrigeration + preservatives