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THE INFLUENCE OF MODIFIED ATMOSPHERE STORAGE ON THE QUALITY OF FUERTE AVOCADO FRUIT

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OPSOMMING

Fuerte avokados is behandel met CO_2 teen konsentrasies van 10%, 15% en 20% elk vir 2, 3 en 4 dae tydens 'n opbergingsperiode van 28 dae by 5,5 °C tot 6,5 °C. Raklewe is statisties betekenisvol verleng alhoewel dit nie van groot waarde was nie. Die voorkoms van skilverkleuring en gryspulp net slegs betekenisvol verskil tussen verskillende eksperimente.

SUMMARY

Fuerte avocados were treated with CO_2, at concentrations of 10%, 15% and 20% for 2,3 and 4 days each. This treatment was done at the start of a *28 day storing period at a temperature of 5,5 °C to 6,5 °C. The shelf life was extended significantly although this difference is of little commercial importance. The incidence of skin discolouration and grey pulp only showed significant differences between the different experiments.*

INTRODUCTION

The South African avocado industry is a long way from the main export markets causing a lot of post-harvest problems. Exporting of fruit by air is more expensive than sea freight. The aim is to export avocados successfully by sea but in order to do this specific treatments of fruit are necessary during the long sea freight. In the apple industry controlled atmosphere storage is generally used to store apples for extended periods, but ca is not yet used commercially in the avocado industry.

This report is an extension and a follow-up of the research by Truter and Eksteen (1982).

MATERIALS AND METHODS

Avocados for the experiments were obtained from commercial orchards on Westfalia Estates.

The fruit was picked from the shadow side of the trees (south-eastern) and only from specific orchards where all the trees received the same treatment. Only fruit of the size count 14 were used in all the experiments. After the avocados were picked they were placed in the shade and transported to the packhouse within 2 hours. On arrival at the packhouse the fruit was pre-cooled overnight at 16°C and packed the following morning. The fruit was not treated with wax. The following treatments were used in all experiments.

1.Untreated control.

2.10% CO_2 for2 days.

3.10% CO_2 for 3 days.

4.10% CO_2 for 4 days.

5.15% CO_2 for 2 days.

6.15% CO_2 for 3 days.

7.15% CO_2 for 4 days.

8.20% CO_2 for 2 days.

9.20% CO_2 for 3 days. 10. 20% CO_2 for 4 days.

Every treatment included 10 cartons of count 14 fruit totaling 100 cartons per experiment. After the fruit was packed the cartons were placed in polyethylene bags of 150 micron thickness and sealed off after which the CO_2 gas was released in the bag until the required level was reached. The CO_2% and O_2% was measured by Dráger tubes.

The CO_2 and O_2 levels were again measured when the period of treatment terminated. The periods under CO_2 are stated with the different treatments. After this period the cartons were removed from the polyethylene bags. After filling the bags with CO_2 they were placed under refrigeration at 5,5 °C - 6,5 °C as well as after removal from the bags. Total time under refrigeration was 28 days after which the cartons were placed at ambient temperature (± 17 °C 19 °C) to ripen. The fruit was rated for disease on a scale of 0 to 10 (0 completely healthy 10 being totally affected) when the eat ripe stage was reached each carton of fruit was taken as a replicate and figures given are the average rating per fruit per carton.

RESULTS

In Table 1 buildup of CO_2 concentration in the polyethylene bags is given. The results as given were analyzed statistically through the computer of the University of Pretoria. Duncan's multiple range test was used and all the experiments were analyzed collectively, taking into consideration alt the possible causes of variance. Tables 8 and 9 represent the statistical data and although all the different disease factors were analyzed only those factors being statistically significant are presented.

TABLE 8. The PR>F value for all the sources of variance in the 5 experiments analysed collectively. (* Statistically significant at the 95% level, ** statistically significant at the 99% level).

Treatments	External	Internal	
	Skin discolouration	Grey pulp	Days shelf life
Time under CO_2	0,3402	0,2908	0,0007**
CO_2 concentration	0,5382	0,1633	0,5253
Experiment	0,0001**	0,0001**	0,0001**

TABLE 9. Average disease rating (0 to 10) for the 5 experiments collectively (figures followed by different letters differ statistically significant at the 95% level).

Treatments	External	Internal	
	Skin discolouration	Grey pulp	Days shelf life
Untreated control	0,235 A	0,034 A	6,376 A
CO_2 2 Days	0,191 A	0,031 A	6,539 B
CO_2 3 Days	0,241 A	0,036 A	6,690 B
CO_2 4 Days	0,236 A	0,025 A	6,657 B
Untreated control	0,235 A	0,034 A	6,376 A
10% CO_2	0,221 A	0,028 A	6,651 B
15% CO_2	0,213 A	0,037 A	6,646 B
20% CO_2	0,234 A	0,027 A	6,589 B
Experiment 1	0,444 A	0,079 A	6,560 A
Experiment 2	0,396 B	0,043 B	6,887 B
Experiment 3	0,092 CD	0,001 C	7,195 C
Experiment 4	0,066 D	0,013 CD	6,172 D
Experiment 5	0,122 C	0,020 D	6,202 D

TABEL 1. The increase of CO_2 concentration in poly-ethelyne bags filled with ± 8 kg fruit (two cartons).

CO_2 concentration at start	CO_2 concentration after:		
	2 days	3 days	4 days
10%	17%	25%	24%
15%	20%	25%	25%
20%	24%	25%	25%

TABLE 2. The concentration of O_2 in polyethelyne bags filled with ± 8 kg fruit (two cartons.)

O_2 concentration at start	O_2 concentration after:		
	2 days	3 days	4 days
10%	7%	5%	6%
15%	8%	5%	1%
20%	6%	4%	2%

The results of experiments no 1 to 5 are given in Table 3 to 7. Each treatment consisted of 10 cartons, count 14 Fuerte fruit.

TABLE 3. The average disease rating (0 to 10) for Fuerte fruit treated with different CO_2 concentration and different durations. (Experiment no 1 packed on 13 April 1983).

Treatments	External				Internal					
	Skin dis-colouration	Cold damage	Anthrac-nose	Stem-end rot	Anthrac-nose	Stem-end rot	Pulp spot	Vascular browning	Grey pulp	Days shelf life
Control	0,52	0	0	0,014	0	0,021	0	0,126	0,126	6,338
2 Days 10% CO_2	0,424	0	0,007	0	0,007	0,014	0	0,098	0,056	6,681
2 Days 15% CO_2	0,423	0	0	0,014	0	0,014	0,007	0,084	0,098	6,93
2 Days 20% CO_2	0,402	0	0	0,007	0	0,014	0	0,105	0,091	5,96
3 Days 10% CO_2	0,361	0	0	0,007	0	0,014	0	0,105	0,063	6,680
3 Days 15% CO_2	0,395	0	0	0,007	0	0,007	0	0,098	0,098	7,253
3 Days 20% CO_2	0,481	0	0	0	0	0	0	0,063	0,063	6,703
4 Days 10% CO_2	0,446	0	0,007	0,007	0,007	0,007	0	0,084	0,091	6,553
4 Days 15% CO_2	0,482	0	0	0	0	0,007	0	0,133	0,077	6,489
4 Days 20% CO_2	0,518	0	0	0	0	0,007	0	0,112	0,035	6,552

TABLE 4. The average disease rating (0 to 10) for Fuerte fruit treated with different CO_2 concentrations and different durations. (Experiment no 2 packed on 18 April 1983)

Treatments	External				Internal					
	Skin Dis-colouration	Cold damage	Anthrac-nose	Stem-end rot	Anthrac-nose	Stem-end rot	Pulp spot	Vascular browning	Grey pulp	Days shelf life
Control	0,325	0	0	0,007	0	0,007	0	0,049	0,028	6,611
2 Days 10% CO_2	0,302	0	0,007	0	0,007	0	0	0,035	0,042	6,818
2 Days 15% CO_2	0,225	0	0	0,007	0	0,007	0	0,014	0,028	6,639
2 Days 20% CO_2	0,418	0	0	0	0	0	0	0,049	0,049	6,552
3 Days 10% CO_2	0,475	0,014	0	0	0	0	0	0,007	0,049	6,944
3 Days 15% CO_2	0,626	0	0	0	0,007	0	0	0,021	0,105	6,774
3 Days 20% CO_2	0,447	0	0	0	0	0	0	0,042	0,035	7,233
4 Days 10% CO_2	0,438	0,049	0	0	0	0	0	0,042	0,035	7,189
4 Days 15% CO_2	0,347	0	0	0,007	0	0,007	0	0,007	0,014	6,990
4 Days 20% CO_2	0,382	0,014	0	0,007	0	0,007	0	0,014	0,035	7,017

TABLE 5. The average disease rating (0 to 10) for Fuerte fruit treated with different CO_2 concentrations and different durations. (Experiment no 3 packed on 26 April 1983)

Treatments	External				Internal					
	Skin Dis-colouration	Cold damage	Anthrac-nose	Stem-end rot	Anthrac-nose	Stem-end rot	Pulp spot	Vascular browning	Grey pulp	Days shelf life
Control	0,147	0,028	0	0	0	0	0,007	0	0	6,968
2 Days 10% CO_2	0,042	0	0	0	0	0	0	0,007	0,007	7,417
2 Days 15% CO_2	0,028	0	0	0	0	0	0	0	0	7,088
2 Days 20% CO_2	0,105	0	0	0	0	0	0	0	0	7,266
3 Days 10% CO_2	0,098	0	0	0	0	0	0	0	0	6,962
3 Days 15% CO_2	0,112	0	0	0	0	0	0	0	0	7,445
3 Days 20% CO_2	0,091	0	0	0	0	0	0	0	0	6,995
4 Days 10% CO_2	0,14	0	0	0	0	0	0	0	0	7,367
4 Days 15% CO_2	0,056	0	0	0	0	0	0	0	0	7,28
4 Days 20% CO_2	0,098	0	0	0	0	0	0	0	0	7,166

TABLE 6. The average disease rating (0 to 10) for Fuerte fruit treated with different CO_2 concentrations and different durations. (Experiment no 4 packed on 2 May 1983).

Treatments	External				Internal					
	Skin Dis-colouration	Cold damage	Anthrac-nose	Stem-end rot	Anthrac-nose	Stem-end rot	Pulp spot	Vascular browning	Grey pulp	Days shelf life
Control	0,091	0	0	0	0	0	0,007	0	0	5,774
2 Days 10% CO_2	0,021	0	0	0	0	0	0	0	0,007	6,159
2 Days 15% CO_2	0,042	0,007	0	0	0	0	0	0,014	0,021	6,431
2 Days 20% CO_2	0,021	0	0	0	0	0	0	0	0,014	6,346
3 Days 10% CO_2	0,063	0	0	0	0	0	0	0,014	0,014	5,667
3 Days 15% CO_2	0,933	0,007	0	0	0	0	0,035	0,028	0,042	6,53
3 Days 20% CO_2	0,084	0	0	0	0	0	0,007	0,028	0,007	6,539
4 Days 10% CO_2	0,084	0,007	0	0	0	0	0	0,014	0	6,354
4 Days 15% CO_2	0,112	0	0	0	0	0	0	0,007	0,007	6,026
4 Days 20% CO_2	0,063	0	0	0	0	0	0,028	0	0,014	5,895

TABLE 7. The average disease rating (0 to 10) for Fuerte fruit treated with different CO_2 concentrations and different durations. (Experiment no 5 packed on 9 May 1983.)

Treatments	External				Internal					
	Skin Dis-colouration	Cold damage	Anthrac-nose	Stem end rot	Anthrac-nose	Stem-end rot	Pulp spot	Vascular browning	Grey pulp	Days shelf life
Control	0,091	0,041	0	0	0	0	0	0,007	0,014	6,189
2 Days 10% CO_2	0,241	0,007	0	0,007	0	0,007	0	0	0,014	5,969
2 Days 15% CO_2	0,077	0	0,007	0	0,007	0	0,007	0	0,014	6,162
2 Days 20% CO_2	0,091	0,007	0	0	0	0	0	0	0,021	6,11
3 Days 10% CO_2	0,049	0	0	0	0	0	0	0	0	6,268
3 Days 15% CO_2	0,147	0	0	0	0	0	0	0	0,028	6,182
3 Days 20% CO_2	0,133	0	0,014	0	0,014	0	0	0	0,035	6,174
4 Days 10% CO_2	0,133	0,021	0	0	0	0	0	0,007	0,035	6,731
4 Days 15% CO_2	0,077	0,007	0	0	0	0	0	0,007	0,021	6,009
4 Days 20% CO_2	0,177	0	0	0,007	0	0,007	0	0,007	0,014	6,23

DISCUSSION

From Tables 8 and 9 it can be seen that the severity of skin discolouration only differed statistically between the different experiments decreasing from experiment 1 to 3 and increasing again in experiment 4 and 5. As the post-harvest treatments were the same in all the different experiments the cause for this variance is possibly due to pre-harvest orchard conditions.

Grey pulp exhibited a similar pattern as skin discolouration and the cause for this possibly originated in the orchard.

In Table 9 it can be seen that treatment with CO_2 extended the shelf life of the fruit. Although this is a statistically significant difference it is of no commercial significance other than the knowledge that it did not decrease it. Between' the different experiments shelf life increased from experiment 1 to 3 and suddenly decreased in experiment no 4 and 5. It needs to be noted that although the shelf life increased the severity of grey pulp and skin discolouration decreased.

During the 1983 season the incidence and severity of pulp spot and vascular browning were found to be at a very low level. The low incidence of these physiological diseases caused the beneficial effect of CO_2 treatment to not be apparent reported by B Truter and GJ Eksteen (1982). It does however show that the fruit quality will not be adversely affected during a season with a low pulp spot incidence.

It appears as if factors and conditions in the orchard play a major role in the predisposing of fruit to post-harvest physiological problems. Research needs to be extended on the post-harvest causes of the problem as well as a prediction system to predict the predisposing potential. In the packhouse more research needs to be done to find optimal handling procedures.

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REFERENCE

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