

EFFECT OF MODIFIED ATMOSPHERE ON STORAGE LIFE OF PURPLE PASSIONFRUIT AND RED TAMARILLO

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ABSTRACT

This study investigates methods to improve storage life of purple passionfruit (*Passiflora edulis* Sims) and tamarillo (*Cyphomandra betacea* (Cav.) Sendt). For passionfruit, the main problem for export and storage is shrivelling whereas for tamarillo the quality of the stem is a key factor in export standards.

Eating quality of passionfruit was best described by the titratable acidity (TA) and the soluble solids content (SSC) with the optimal eating flavour found at an SSC/TA ratio between 10-11. Wax coating, ethylene scavenging, and modified atmosphere packaging (MAP) were assessed as tools to improve storage life. MAP with varying oxygen transmission rates (OTR at 5°C; 854, 1437, 2347 and 3089 ml m⁻² day⁻¹) were compared to the standard packaging in a cardboard box during storage at the commercial temperature of 8°C. Fruit quality was measured after 20, 28, and 42 days of storage with and without seven days of shelf life at 20°C in the same packaging as during storage. Waxing did not improve the quality of the fruit. MAP prevented shrivelling but in the packaging with lower OTR (854 - 1437 ml m⁻² day⁻¹) unacceptable external defects developed. Fruit quality in the packaging with the higher OTR (2347 - 3089 ml m⁻² day⁻¹) was similar except for the development of off-flavours in the packaging with an OTR of 2347 ml m⁻² day⁻¹ during shelf life possibly due to the high ethylene accumulation since the addition of an ethylene scavenger in a second trial eliminated the off-flavour development. The highest OTR MAP is the best option for long term storage. The second highest OTR MAP could be used providing an ethylene scavenger is added.

To extend the storage life of tamarillo, two MAP options (OTR at 5°C; 1437 and 3089 ml m⁻² day⁻¹) were compared to the standard packaging in a cardboard box with polyliner as well as the effect of adding clove oil releasing sachets. All fruit were stored at 4°C for 56 days and fruit and stem quality was measured fortnightly with and without three days of shelf life at 20°C. MAP delayed the development of stem yellowing, which was related to chlorophyll degradation, but did not improve fruit quality and increased stem blackening and bleeding in the locule, especially when clove oil was added. Blackening was related to

polyphenol oxidase activity and was aggravated by clove oil or by injury (e.g. disruption of cellular membranes) due to lower O₂, higher CO₂ and higher ethylene concentrations. Thus, for the two films tested, MAP with or without the addition of clove oil offered no advantages over conventional air storage.

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TABLE OF CONTENTS

ABSTRACT	i
ACKNOWLEDGEMENTS	iii
TABLE OF CONTENTS	v
LIST OF FIGURES.....	ix
LIST OF TABLES.....	xv
LIST OF SYMBOLS AND ABBREVIATIONS	xix
CHAPTER 1	
INTRODUCTION	1
1.1. Passionfruit and tamarillo in New Zealand	1
1.2. Modified atmosphere packaging	3
1.3. Research structure and objective of the thesis.....	4
CHAPTER 2	
LITERATURE REVIEW	7
2.1. Introduction	7
2.2. Postharvest physiology	7
2.3. Deterioration of fruit stem	23
2.4. Postharvest technologies	29

CHAPTER 3

MATERIALS AND METHODS	35
3.1. Introduction.....	35
3.2. Fruit source	35
3.3. Experimental design	36
3.4. Active packaging	38
3.5. Measurements	39
3.6. Statistical methods.....	48

CHAPTER 4

PHYSIOLOGICAL AND CHEMICAL CHARACTERISTICS OF PURPLE PASSIONFRUIT.....	49
4.1. Introduction.....	49
4.2. Results of the first trial	50
4.3. Results of the second trial.....	69
4.4. Discussion.....	77
4.5. Conclusion	89

CHAPTER 5

PHYSIOLOGICAL AND CHEMICAL CHARACTERISTICS OF ‘MULLIGAN RED’ TAMARILLO FRUIT AND STEM.....	93
5.1. Introduction.....	93
5.2. Observations of disorders and resulting changes in the experiment.....	93

5.3. Results	95
5.4. Discussion.....	121
5.5. Conclusion.....	136
CHAPTER 6	
CONCLUSION	139
6.1. Passionfruit.....	139
6.2. Tamarillo	141
6.3. Recommendations and future work.....	143
REFERENCES	145
APPENDICES.....	157
Appendix A: The preparation of saturated silica gel with clove oil.....	157
Appendix B: Calculation of water vapour permeance	158
Appendix C: Calculation of rates of CO ₂ production, O ₂ consumption, and C ₂ H ₄ production.....	160
Appendix D: Calculation of eugenol concentration	161
Appendix E: The appearance scales developed by HortResearch.....	162
Appendix F: The measurement and calculation of the plastic packaging film permeability to water vapour	168
Appendix G: Analyses of ethylene production of passionfruit	170
Appendix H: Summary of analyses of postharvest quality attributes of tamarillo provided in Table A- 3 to Table A- 16	171

LIST OF FIGURES

Figure 2-1. Pathway of ethylene biosynthesis (Saltveit, 1999).....	15
Figure 3-1. Measurement of water vapour permeance with wet/dry bulb probe, data logger, and fruit skin temperature measurement	40
Figure 4-1. Fruit in Bag 1 (A) development of red spots and bleeding after 20 days of storage at 8°C, (B) development of red spots and white fungus after 20 days of storage with 7 days of shelf life at room temperature (20°C).....	50
Figure 4-2. Weight loss of the control, waxed fruit, fruit in Bags 2, 3, and 4 during storage at 8°C without shelf life (—), and with 7 days of shelf life at 20°C (---). (s.e. = 1.1, n = 20 fruit).....	52
Figure 4-3. CO ₂ production rate of the control and waxed fruit during storage at 8°C without shelf life (—), and with 7 days of shelf life at 20°C (---). (s.e. = 0.05, n = 20 fruit).....	53
Figure 4-4. The respiratory quotient of the control and waxed fruit during storage at 8°C without shelf life (—), and with 7 days of shelf life at 20°C (---). (s.e. = 0.23, n = 20 fruit).....	54
Figure 4-5. O ₂ concentration in Bags 2, 3, and 4 during storage at 8°C without shelf life (—), and with 7 days of shelf life at 20°C (---). (s.e. = 0.68, n = 2-5 bags)	55
Figure 4-6. CO ₂ concentration in Bags 2, 3, and 4 during storage at 8°C without shelf life (—), and with 7 days of shelf life at 20°C (---). (s.e. = 0.79, n = 2-5 bags).	55
Figure 4-7. Ethylene production of the control and waxed fruit during storage at 8°C without shelf life (—), and with 7 days of shelf life at 20°C (---). (s.e. = 0.17, n = 20 fruit).....	56
Figure 4-8. Ethylene concentration in Bags 2, 3, and 4 during storage at 8°C without shelf life (—), and with 7 days of shelf life at 20°C (---). (s.e. = 43.13, n = 2-5 bags)	57
Figure 4-9. Lightness of the control, waxed fruit, and fruit in Bags 2, 3, and 4 during storage at 8°C without shelf life (—), and with 7 days of shelf life at 20°C (---). (s.e. = 0.88, n = 20 fruit).....	59
Figure 4-10. The hue angle of the control, waxed fruit, and fruit in Bags 2, 3, and 4 during storage at 8°C without shelf life (—), and with 7 days of shelf life at 20°C (---). (s.e. = 2.70, n = 20 fruit).....	60

Figure 4-11. Stiffness of the control, waxed fruit, and fruit in Bags 2, 3, and 4 during storage at 8°C without shelf life (—), and with 7 days of shelf life at 20°C (---). (s.e. = 0.94, n = 20 fruit).....	61
Figure 4-12. Compression firmness of the control, waxed fruit, and fruit in Bags 2, 3, and 4 during storage at 8°C without shelf life (—), and with 7 days of shelf life at 20°C (---). (s.e. = 1.45, n = 20 fruit)	62
Figure 4-13. pH of the control, waxed fruit, and fruit in Bags 2, 3, and 4 during storage at 8°C without shelf life (—), and with 7 days of shelf life at 20°C (---). (s.e. = 0.002, n = 20 fruit).....	65
Figure 4-14. Titratable acidity of the control, waxed fruit, and fruit in Bags 2, 3, and 4 during storage at 8°C without shelf life (—), and with 7 days of shelf life at 20°C (---). (s.e. = 0.04, n = 20 fruit)	66
Figure 4-15. The SSC/TA ratio of the control, waxed fruit, and fruit in Bags 2, 3, and 4 during storage at 8°C without shelf life (—), and with 7 days of shelf life at 20°C (---). (s.e. = 3.0, n = 20 fruit)	67
Figure 4-16. Sweetness score of the control, waxed fruit, and fruit in Bags 2, 3, and 4 during storage at 8°C without shelf life (—), and with 7 days of shelf life at 20°C (---). (s.e. = 0.11, n = 20 fruit)	68
Figure 4-17. Sourness score of the control, waxed fruit, and fruit in Bags 2, 3, and 4 during storage at 8°C without shelf life (—), and with 7 days of shelf life at 20°C (---). (s.e. = 0.15, n = 20 fruit).....	69
Figure 4-18. Fruit in Bag 3 after 49 days of cold storage at 8°C	70
Figure 4-19. Fruit in Bag 2 after 70 days of storage at 8°C with 4 days of shelf life at 20°C	71
Figure 4-20. Fruit in Bag 4 with KMnO ₄ after 70 days of cold storage at 8°C with 7 days of shelf life at 20°C (left) fruit with bleeding, large indentations, and white powder-like substance in 2 bags and (right) healthy fruit in 3 bags.....	71
Figure 5-1. Discoloration on the surface of fruit in Bag 2 (A) and Bag 3 (B) with the addition of clove oil after 28 days of cold storage at 4°C (left) and during 3 days of shelf life at 20°C (right).....	94
Figure 5-2. Comparison of the locule of the control fruit (left) and fruit in Bag 3 without the addition of clove oil (right) after 28 days of cold storage	95
Figure 5-3. Discoloration at fruit base (left) and disrupted locule (right) of fruit in Bag 3 without the addition of clove oil during 3 days of shelf life after 28 days of cold storage.....	95

- Figure 5-4. Weight loss of the control fruit and fruit in Bags 2 and 3 with or without the addition of clove oil during storage at 4°C (days) without shelf life (—), and with 3 days of shelf life at 20°C (---). (s.e. = 0.007, n = 16 fruit)..... 96
- Figure 5-5. CO₂ production rate of the control fruit and fruit in Bags 2 and 3 with or without clove oil during storage at 4°C without shelf life (—), and with 3 days of shelf life at 20°C (---). (s.e. = 0.004, n = 8 fruit) 97
- Figure 5-6. O₂ consumption rate of the control fruit and fruit in Bags 2 and 3 with or without clove oil during storage at 4°C without shelf life (—), and with 3 days of shelf life at 20°C (---). (s.e. = 0.02, n = 8 fruit). Data for control and Bag 2 after 14 days are missing due to equipment failure..... 98
- Figure 5-7. O₂ concentration in Bags 2 and 3 with or without clove oil during storage at 4°C without shelf life (—), and with 3 days of shelf life at 20°C (---). (s.e. = 0.52, n = 4 bags) 100
- Figure 5-8. CO₂ concentrations in Bags 2 and 3 with or without clove oil during storage at 4°C without shelf life (—), and with 3 days of shelf life at 20°C (---). (s.e. = 0.23, n = 4 bags) 101
- Figure 5-9. Ethylene production rate of the control fruit and fruit in Bags 2 and 3 with or without clove oil during storage at 4°C without shelf life (—), and with 3 days of shelf life at 20°C (---). (s.e. = 7×10^{-4} , n = 8 fruit)..... 102
- Figure 5-10. Ethylene concentration in Bags 2 and 3 with or without clove oil during storage at 4°C without shelf life (—), and with 3 days of shelf life at 20°C (---). (s.e. = 5.79, n = 4 bags) 103
- Figure 5-11. Eugenol concentration in Bags 2 and 3 during storage at 4°C (above) and with 3 days of shelf life at 20°C (below). Vertical bars indicate standard deviations surrounding the mean. 104
- Figure 5-12. Lightness of the control fruit and fruit in Bags 2 and 3 with or without clove oil during storage at 4°C without shelf life (—), and with 3 days of shelf life at 20°C (---). (s.e. = 0.48, n = 16 fruit)..... 105
- Figure 5-13. Redness (a*), yellowness (b*), and chroma (C*) of the control fruit and fruit in Bags 2 and 3 with or without clove oil during storage at 4°C without shelf life (—), and with 3 days of shelf life at 20°C (---). (s.e. of a*, b*, and C* = 2.02, 0.59, and 2.45, respectively, n = 16 fruit)..... 106
- Figure 5-14. Hue angle of the control fruit and fruit in Bags 2 and 3 with or without clove oil during storage at 4°C without shelf life (—), and with 3 days of shelf life at 20°C (---). (s.e. = 1.15, n = 16 fruit)..... 107
-

Figure 5-15. Stiffness of the control fruit and fruit in Bags 2 and 3 with or without clove oil during storage at 4°C without shelf life (—), and with 3 days of shelf life at 20°C (---). (s.e. = 0.83, n = 16 fruit).....	108
Figure 5-16. Compression firmness of the control fruit and fruit in Bags 2 and 3 with or without clove oil during storage at 4°C without shelf life (—), and with 3 days of shelf life at 20°C (---). (s.e. = 2.64, n = 16 fruit).....	109
Figure 5-17. pH of the control fruit and fruit in Bags 2 and 3 with or without clove oil during storage at 4°C without shelf life (—), and with 3 days of shelf life at 20°C (---). (s.e. = 0.003, n = 16 fruit).....	111
Figure 5-18. Titratable acidity of the control fruit and fruit in Bags 2 and 3 with or without clove oil during storage at 4°C without shelf life (—), and with 3 days of shelf life at 20°C (---). (s.e. = 0.02, n = 16 fruit).....	112
Figure 5-19. The SSC/TA ratio of the control fruit and fruit in Bags 2 and 3 with or without clove oil during storage at 4°C without shelf life (—), and with 3 days of shelf life at 20°C (---). (s.e. = 0.45, n = 16 fruit).....	113
Figure 5-20. Moisture content in the stems of the control and fruit in Bags 2 and 3 with or without clove oil during storage at 4°C without shelf life (—), and with 3 days of shelf life at 20°C (---). (s.e. = 3.45, n = 5 stems).....	114
Figure 5-21. Chlorophyll content of the control fruit and fruit in Bags 2 and 3 with or without clove oil during storage at 4°C without shelf life (—), and with 3 days of shelf life at 20°C (---). (s.e. = 14.97, n = 5 stems).....	115
Figure 5-22. Polyphenol oxidase activity in the stem of the control fruit and fruit in Bags 2 and 3 with or without clove oil during storage at 4°C without shelf life (—), and with 3 days of shelf life at 20°C (---). (s.e. = 615.49, n = 5 stems).....	116
Figure 5-23. The score of discoloration on the fruit surface of the control fruit and fruit in Bags 2 and 3 with or without clove oil during storage at 4°C without shelf life (—), and with 3 days of shelf life at 20°C (---). (s.e. = 0.14, n = 16 fruit).....	117
Figure 5-24. Calyx lifting and blackening scores of the control fruit and fruit in Bags 2 and 3 with or without clove oil during storage at 4°C without shelf life (—), and with 3 days of shelf life at 20°C (---). (s.e. of calyx lifting and blackening = 0.05 and 0.1, respectively, n = 16 fruit).....	118
Figure 5-25. Stem blackening and yellowing score of the control fruit and fruit in Bags 2 and 3 with or without clove oil during storage at 4°C without shelf life (—), and with 3 days of shelf life at 20°C (---). (s.e. of stem blackening and yellowing = 0.11 and 0.09, respectively, n = 16 fruit).....	120
Figure A- 1. Standard curve of eugenol.....	161

Figure A- 2. Calyx lifting	162
Figure A- 3. Calyx blackening	163
Figure A- 4. Body disorders and discoloration	164
Figure A- 5. Stem end rots	165
Figure A- 6. Stem yellowing	166
Figure A- 7. Stem blackening.....	167
Figure A- 8. Aluminium moisture can	168
Figure A- 9. The measurement of the permeability of the plastic packaging film to water vapour	168

LIST OF TABLES

Table 1-1. Features of New Zealand passionfruit and tamarillos (* from Janet (2005), ** from MAF (2006)).....	1
Table 2-1. Respiration rates of passionfruit and tamarillo under normal atmosphere	14
Table 2-2. Ethylene production (C ₂ H ₄) of purple passionfruit and red tamarillo	16
Table 3-1. Application of control, waxing, and packaging treatments in passionfruit project.....	36
Table 3-2. Application of packaging treatments in the second trial of passionfruit.....	37
Table 3-3. Treatments applied in tamarillo project	38
Table 4-1. Influence of waxing, cold storage at 8°C (days), and shelf life at 20°C (days) on water vapour permeance (WVP)	51
Table 4-2. Influence of waxing, cold storage at 8°C (days), and shelf life at 20°C (days) on the O ₂ consumption rate (rO ₂)	53
Table 4-3. Influence of waxing, packaging (Bags 2, 3, and 4), cold storage at 8°C (days), and shelf life at 20°C (days) on lightness (L*), redness (a*), yellowness (b*), chroma (C*), and hue angle (h°)	58
Table 4-4. Influence of waxing, packaging (Bags 2, 3, and 4), cold storage at 8°C (days), and shelf life at 20°C (days) on pulp yield and absolute pulp weight	63
Table 4-5. Influence of waxing, packaging (Bags 2, 3, and 4), cold storage at 8°C (days), and shelf life at 20°C (days) on soluble solids content (SSC).....	64
Table 4-6. Quality of the passionfruit at harvest for the first and second trials	70
Table 4-7. The weight loss of fruit in Bag 2 and Bag 4 with KMnO ₄ during storage at 8°C for 42 days and for 70 days with or without 7 days of shelf life at 20°C	72
Table 4-8. O ₂ , CO ₂ , and C ₂ H ₄ content in Bag 2 and Bag 4 with KMnO ₄ during storage at 8°C for 42 days and for 70 days with or without 7 days of shelf life at 20°C ...	72
Table 4-9. The values of lightness (L*), redness (a*), and yellowness (b*) of fruit in Bag 2 and Bag 4 with KMnO ₄ during storage at 8°C for 42 days and for 70 days with or without 7 days of shelf life at 20°C	73
Table 4-10. The values of chroma (C*) and hue angle (h°) of fruit in Bag 2 and Bag 4 with KMnO ₄ during storage at 8°C for 42 days and for 70 days with or without 7 days of shelf life at 20°C.....	73

Table 4-11. Stiffness of fruit in Bag 2 and Bag 4 with KMnO ₄ during storage at 8°C for 42 days and for 70 days with or without 7 days of shelf life at 20°C	74
Table 4-12. Compression firmness of fruit in Bag 2 and Bag 4 with KMnO ₄ during storage at 8°C for 42 days and for 70 days with or without 7 days of shelf life at 20°C	74
Table 4-13. Pulp yield of fruit in Bag 2 and Bag 4 with KMnO ₄ during storage at 8°C for 42 days and for 70 days with or without 7 days of shelf life at 20°C	75
Table 4-14. Soluble solids content (SSC) of fruit in Bag 2 and Bag 4 with KMnO ₄ during storage at 8°C for 42 days and for 70 days with or without 7 days of shelf life at 20°C	75
Table 4-15. pH and titratable acidity (TA) of fruit in Bag 2 and Bag 4 with KMnO ₄ during storage at 8°C for 42 days and for 70 days with or without 7 days of shelf life at 20°C	76
Table 4-16. The SSC/TA ratio of fruit in Bag 2 and Bag 4 with KMnO ₄ during storage at 8°C for 42 days and for 70 days with or without 7 days of shelf life at 20°C ...	76
Table 4-17. The scores of sweetness and sourness of fruit in Bag 2 and Bag 4 with KMnO ₄ during storage at 8°C for 42 days and for 70 days with or without 7 days of shelf life at 20°C	77
Table 5-1. The respiratory quotient of the control fruit and fruit in the bags with or without clove oil during cold storage at 4°C without and with 3 days of shelf life at 20°C. (s.e. = 0.34, n = 8 fruit).....	99
Table 5-2. Influence of packaging, cold storage at 4°C (days), shelf life at 20°C (days), and clove oil on soluble solids content (SSC)	110
Table A- 1. Influence of waxing, cold storage at 8°C (days), and shelf life at 20°C (days) on ethylene production rate (C ₂ H ₄).....	170
Table A- 2. Influence of packaging (Bags 2, 3, and 4), cold storage at 8°C (days), and shelf life at 20°C (days) on ethylene concentration (C ₂ H ₄) in packaging	170
Table A- 3. Influence of packaging, cold storage at 4°C (days), shelf life at of 20°C (days), and clove oil on weight loss.....	171
Table A- 4. Influence of packaging, cold storage at 4°C (days), shelf life at 20°C (days), and clove oil on CO ₂ production rate (rCO ₂).....	172
Table A- 5. Influence of packaging, cold storage at 4°C (days), shelf life at 20°C (days), and clove oil on O ₂ , CO ₂ , and ethylene (C ₂ H ₄) concentrations in packaging .	173
Table A- 6. Influence of packaging, cold storage at 4°C (days), shelf life at 20°C (days), and clove oil on ethylene production rate (C ₂ H ₄).....	174

Table A- 7. Influence of packaging, cold storage at 4°C (days), and shelf life at 20°C (days) on eugenol concentration in packaging	174
Table A- 8. Influence of packaging, cold storage at 4°C (days), shelf life at 20°C (days), and clove oil on lightness (L^*), redness (a^*), yellowness (b^*), chroma (C^*), and hue angle (h°)	175
Table A- 9. Influence of packaging, cold storage at 4°C (days), shelf life at 20°C (days), and clove oil on stiffness and compression firmness	176
Table A- 10. Influence of packaging, cold storage at 4°C (days), shelf life at 20°C (days), and clove oil on the moisture content of the fruit stem	177
Table A- 11. Influence of packaging, cold storage at 4°C (days), shelf life at 20°C (days), and clove oil on chlorophyll content of the fruit stem.....	178
Table A- 12. Influence of packaging, cold storage at 4°C (days), shelf life at 20°C (days), and clove oil on the activity of polyphenol oxidase (PPO)	179
Table A- 13. The score of stem-end rots of the control fruit and fruit in Bags 2 and 3 with or without clove oil during storage at 4°C (days) with and without 3 days of shelf life at 20°C	179
Table A- 14. Influence of packaging, cold storage at 4°C (days), shelf life at 20°C (days), and clove oil on fruit discoloration score	180
Table A- 15. Influence of packaging, cold storage at 4°C (days), shelf life at 20°C (days), and clove oil on the scores of calyx lifting and blackening	181
Table A- 16. Influence of packaging, cold storage at 4°C (days), shelf life at 20°C (days), and clove oil on the scores of stem yellowing and blackening	182

LIST OF SYMBOLS AND ABBREVIATIONS

a^*	redness/greenness	
A	the surface area of the fruit	m^2
A_{GC}	area of gas chromatogram according to injected volume of sample (area)	
A_{film}	the surface area of the plastic packaging film	m^2
b^*	yellowness/blueness	
C^*	colour intensity/chroma	
C	chlorophyll a or b	
C^{Eug}	eugenol concentration	$mol\ m^{-3}$
CA	controlled atmosphere	
Cl	clove oil	
h°	hue angle	
K_{GC}	detector response or slope of eugenol standard curve	
L^*	lightness	
L_{film}	the thickness of the plastic packaging film	m
MAP	modified atmosphere packaging	
$M_{initial}$	the initial weight of the fruit	g
M_{final}	the final weight of the fruit	g
M_f	the fruit mass	kg
NS	not significant	
OTR	oxygen transmission rate	
P	packaging	
PE	polyethylene	
ppm	parts per million	
PPO	polyphenol oxidase	
$P_{H_2O}^f$	the partial pressure of water vapour in the fruit	Pa
$P_{H_2O}^e$	the partial pressure of water vapour of the environment	Pa
$P_{H_2O}^{sat}(T_w)$	the saturated water vapour pressure at the wet bulb temperature	Pa

P'_{H_2O}	the fruit skin permeance to water vapour	$\text{mol s}^{-1} \text{m}^{-2} \text{Pa}^{-1}$
P_{net}	net partial pressure of gas i as the difference between the partial pressure quantified when the fruit was placed in the jar and a certain period after placing the fruit in the sealed jar	Pa
P'_{H_2O}	the film permeability to water vapour	$\text{mol m s}^{-1} \text{m}^{-2} \text{Pa}^{-1}$
ΔP_{H_2O}	the difference in partial pressure between the fruit and the environment/ the difference in partial pressure between the inside of the aluminium can and the environment	Pa
R	the universal gas constant (8.3145)	$\text{Pa m}^3 \text{mol}^{-1} \text{K}^{-1}$
RH	relative humidity	%
RQ	the respiratory quotient	
r_{CO_2}	the respiration rate at storage or room temperature	$\text{mol g}^{-1} \text{s}^{-1}$
r'_{H_2O}	the rate of water loss	mol s^{-1}
r_i	the specific rate of exchange of gas i	$\text{mol kg}^{-1} \text{s}^{-1}$
Sd	Storage duration	
Sl	Shelf life	
SSC	soluble solids content	°brix
t	time	s
T	temperature	K
TA	titratable acidity	
T_e	the air (dry bulb) temperature	°C
T_f	the fruit temperature directly under the skin of the fruit	°C
T_w	the wet bulb temperature	°C
V	the volume of 80% acetone	ml
V_{net}	the free volume in the jar calculated as the difference in volume between the fruit and the jar	m^3
V_f	the volume of the fruit	m^3
Vol_{inj}	Injected volume of sample	m^3
W	the weight of sample	g
W_w	the weight of displaced water	kg

WVP	water vapour permeance	$\text{mol s}^{-1} \text{m}^{-2} \text{Pa}^{-1}$
γ	the psychometric constant (67)	$\text{Pa } ^\circ\text{C}^{-1}$
ρ_w	the density of water at 20°C (998.20)	kg m^{-3}
