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 O_2, higher CO_2 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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Wattana Pongjaruvat **July, 2007**

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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	
$P^f_{H_2O}$	the partial pressure of water vapour in the fruit	Pa
$P^e_{H_2O}$	the partial pressure of water vapour of the environment	Pa
$P^{sat}_{H_2O}(T_w)$	the saturated water vapour pressure at the wet bulb temperature	Pa

P'_{H_2O}	the fruit skin permeance to water vapour	mol s^{-1} m^{-2} 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	mol m s^{-1} m^{-2} 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)	Pa m^3 mol^{-1} K^{-1}
RH	relative humidity	%
RQ	the respiratory quotient	
r_{CO_2}	the respiration rate at storage or room temperature	mol g^{-1} s^{-1}
r'_{H_2O}	the rate of water loss	mol s^{-1}
r_i	the specific rate of exchange of gas *i*	mol kg^{-1} 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	mol s^{-1} m^{-2} Pa^{-1}
γ	the psychometric constant (67)	Pa °C^{-1}
ρ_w	the density of water at 20°C (998.20)	kg m^{-3}