

THE INFLUENCE OF PAPER WRAPS ON THE QUALITY AND DISORDERS OF 'D'ANJOU' PEARS AFTER CONTROLLED ATMOSPHERE STORAGE

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SUMMARY

Pears (*Pyrus communis* L. cv. 'd'Anjou') were packed in six commercial paper wraps (dry; 3% oil; 3% oil with copper and ethoxyquin; 6% oil; 6% oil with ethoxyquin; 9% oil). After packing, the pears were placed in 3 different controlled atmosphere (CA) storage conditions in commercial CA rooms: 1) 1.5% O₂ and 1% CO₂; 2) 1.5% O₂ and 3% CO₂; 3) 1.5% O₂ and 1% CO₂ for 60 days, 4% O₂ for 60 more days and finally 6% O₂ for an additional 90 days. Pears were stored in CA for 120 and 210 days, with or without an additional 30 days in regular atmosphere (RA) storage to simulate shipping and handling. Objective quality evaluations were conducted after each storage period and sensory evaluations after 210 days of storage. Paper type influenced both the peel and flesh color of pears before and after ripening, but did not influence firmness, soluble solids or acid content. Subjective ratings of appearance and disorder incidence were unacceptable for pears stored in a variable atmosphere wrapped in dry or paper containing 3% oil. The disorder "black speck" was present only in pears wrapped in paper with 6% oil and stored in an atmosphere of 1.5% O₂ and 1% CO₂. Pears stored in an atmosphere of 1.5% O₂ and 3% CO₂ received acceptable subjective scores regardless of paper type.

BACKGROUND

Atmospheres of 1 % to 2 % O₂ and <1 % CO₂ are normally used for controlled atmosphere (CA) storage of 'd'Anjou' pears. Using 2 % or less O₂ for long-term storage reduced losses of firmness, acidity, greenness and reduced scald severity. Elevated levels of CO₂ (up to 3%) have been used for long-term pear storage, but the quality following storage has been inconsistent.

The standard atmosphere for the CA storage of 'd'Anjou' pears in the State of Washington contains 1.5 % to 2 % O₂ and <1 % CO₂ held at -1 °C. The CA storage law in Washington State requires that winter pears must be stored at <5% O₂ for a minimum of 90 days before they can be certified as CA stored pears.

"Speckled skin" or "black speck" is a superficial disorder that occurs in 'd'Anjou' pears following CA storage. Black speck is not caused by chemicals or pathogens, but is associated with low oxygen (<2%) in storage. It has been postulated that black speck was associated with preharvest environmental stresses. Regardless of the cause, black speck is a frequently observed problem of late CA-stored 'd'Anjou' pears in Washington State.

For decades, pears have been individually wrapped in paper impregnated with low-viscosity petroleum oils, fungicides and/or antioxidants to help control various disorders and reduce

postharvest decay problems. Paper wraps have been used in the Washington State fruit industry since the early 1900's. Initially paper wraps were used to cushion the fruit when in transit and to isolate decay. Use of oil-impregnated paper (15%) to reduce scald was suggested in 1919. In 1931 it was suggested that CuSO₄ be incorporated in the paper wrap to prevent the spread of rot. The oil in paper wraps has been suggested as one possible cause of black speck of 'd'Anjou' pears. This research was conducted to determine the interactions, if any, of CA storage environments and different types of commercially used paper wraps on the quality of 'd'Anjou' pears stored under commercial CA conditions.

CONCLUSIONS

Type of paper wrap had a strong influence on pear quality, but this influence was not present until after extended CA storage. Peel and flesh color, and particularly the amount of scald present, changed during storage depending on paper type. Pears wrapped in dry paper displayed high amounts of scald. There was less dramatic change in both peel and flesh color of pears wrapped in paper containing oil. Subjective scores for general appearance, finish and scald were unacceptable for pears in dry paper or paper with 3% oil stored in a variable atmosphere (CA of 1.5% O₂ and <1% CO₂ for 60 days, then 4% O₂ and <1% CO₂ for 60 days and finally 6% O₂ and <1% CO₂ for 90 days). The disorder "black speck" was present only in pears stored in an atmosphere of 1.5% O₂ and 1.0% CO₂ wrapped in a paper containing 6% oil. Pears stored in an atmosphere of 1.5% O₂ and 3.0% CO₂ received acceptable quality scores regardless of paper type. For the successful long-term storage of 'd'Anjou' pears, the best post-storage fruit quality is obtained using the standard CA atmosphere (1.5% O₂ and 1.0% CO₂) combined with paper wraps containing no more than 3% oil.

Subjective Evaluation of 'd'Anjou' Pear Quality After 210 Days of Controlled Atmosphere Storage As Influenced By the Interaction of Atmosphere and Paper Type.

Atmosphere^x Paper type	General Appearance^z	Finish^z	BlackSpeck^z	Scald^z
1.5 % O₂ & <1.0 % CO₂				
Dry	2.7b	2.2c	1.5c	1.5a
3.0% oil	3.2ab	2.9ab	2.6b	1.2a
3.0% oil + C&E ^x	2.8b	2.8abc	2.7b	1.2a
6.0% oil	3.6a	2.9ab	3.6a	1.2a
6.0% oil + E only ^w	3.3ab	3.0a	3.2ab	1.2a
9.0% oil	2.6b	2.3bc	2.5b	1.2a
Variable (1.5% O₂ and <1% CO₂ for 60 days, then 4% O₂ for 60 days and 6% O₂ for 90 days)				
Dry	3.7a	3.4a	1.6a	3.3a
3.0% oil	3.6a	3.4a	1.4a	3.0a
3.0% oil + C&E ^x	1.7c	1.7c	1.2a	1.1b
6.0% oil	2.2bc	2.2bc	1.2a	1.3b
6.0% oil + E only ^w	2.7b	2.7b	1.2a	1.2b
9.0% oil	2.6b	2.6b	1.5a	1.5b

Atmosphere ^x Paper type	General Appearance ^z	Finish ^z	BlackSpeck ^z	Scald ^z
1.5% O₂ & 3.0% CO₂				
Dry	2.5a	2.4a	1.0a	1.4a
3.0% oil	1.6b	1.5b	1.3a	1.0a
3.0% oil + C&E ^x	2.1ab	2.0ab	1.3a	1.1a
6.0% oil	1.5b	1.5b	1.2a	1.0a
6.0% oil + E only ^w	2.1ab	2.2a	1.4a	1.1a
9.0% oil	2.0ab	2.3a	1.4a	1.3a

^zEvaluated on a scale of 1 to 4 (1 = excellent/none, 2 = good/slight, 3 = fair/moderate, 4 = poor/severe) N = 15.

^yMeans in a column, within atmospheres, not followed by a common letter are significantly different by THSDT (P≤0.05).

^yPaper contains 3% oil with copper and ethoxyquin.

^xPaper contains 6% oil with ethoxyquin only.

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