

Overripeness in pears transported
from Everett, USA to Rotterdam by
m.v. "Shikishima Reefer" in Dec./Jan.
1989/1990

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ATO AGROTECHNOLOGIE

OVERRIPENESS IN PEARS TRANSPORTED FROM EVERETT, U.S.A. TO ROTTERDAM BY
M.V. "SHIKISHIMA REEFER" IN DEC/JAN 1989/1990.

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Introduction

In January 1990 a transport of apples and pears arrived in Rotterdam by m.v. "Shikishima Reefer". It was pointed out, that a number of consignments of pears were in an overripe condition. Ruys en Co bv asked the Marine Survey Bureau

H.A. van Ameyde to inspect the ship and the pears in order to explain the overripeness. This bureau came to the conclusion, that the cause of the overripeness should be sought not in the conditions during transport but in the conditions before it.

On the other hand BV Marine Surveyor "MS-74" in Barendrecht reported to Harmsen & de Groot in Rotterdam, that the cause of overripeness of the pears was due to the stowage of the apples and pears together. Ethylene from the apples should have had an adverse effect on the pears, resulting in an overripe condition upon arrival in Rotterdam.

ATO Agrotechnology in Wageningen was asked by Ruys & Co bv in August 1991 to give a scientific opinion on the cause of the overripeness of the pears. ATO did not inspect the fruits or the ship. Information given here on the voyage and the condition of the fruits is derived from the files placed at ATO's disposal by Ruys en Co bv.

The apples and pears (varieties d'Anjou, Bosc and Doyenne du Comice) were transported as refrigerated cargo on board the m.v. "SHIKISHIMA REEFER". The vessel was loaded between 11th and 15th December 1989 at Everett, U.S.A.. Pulp temperatures upon loading ranged between +1.5 and +2.5°C. The vessel left Everett on 15th December 1989 and arrived in Rotterdam on 15 January 1990. During the voyage pulp temperatures ranged between 0.3°C and 0.8°C.

Several consignments of pears appeared to be overripe upon arrival in Rotterdam. These fruits appeared to be soft, yellowish and eating ripe. In some cases brown core was also discovered.

In this report keepability of pears will be discussed in general terms as well as ethylene production and ethylene sensitivity of pears. After that this knowledge will be applied to the pears of the "SHIKISHIMA Reefer".

Keepability of pears

Most important limiting criteria for the storage life of pears are: softness, shrivelling, yellowing, physiological disorders for example hollow hearts and brown core and decay.

The period pears can be safely stored at -1.1°C are according to Lutz and Hardenburg (1968):

Comice:	2.5 to 3 months
Bosc:	3 to 3.5 months
Anjou:	4 to 6 months

The same authors mention the great susceptibility of pears to temperature. Storage life of Anjou pears may be longer at -1.1°C than at 0°C. They also draw attention to factors, which cause brown core. Delayed storage, slow cooling and high carbon dioxide favour the development of brown core. In our own research with Conference pears we saw, that development of brown was stimulated by exactly the same factors (Schouten et al 1985).

Conclusion: Storage life of pears is limited and is greatly influenced by picking date, cooling delays, temperature and storage atmosphere.

Ripening and ethylene production

Apples and pears both are climacteric fruits. This means, that on the onset of ripening an increase in respiration activity can be observed. At the same time a sudden increase in ethylene production can be watched. Both increases in respiration and ethylene production can be induced by treating climacteric fruit with ethylene. The ripening process amongst others accompanied by changes in composition and texture is irreversible (McGlasson 1985).

Ethylene is produced by almost all tissues of harvested living plant organs. However this ethylene production occurs on very different levels. For example apples and pears may produce very much ethylene (> 100 ul.kg.hr) whereas grapes and citrus show a much lower production of < 0.1 ul.kg.hr (Kader 1985).

Ethylene production is suppressed by low temperature, excess of carbon dioxide and low oxygen concentrations (Sherman 1985). Despite this inhibition high concentrations may be found in commercial (CA) rooms.

Fidler & North (1969) saw that Conference and Comice pears stored at 0-1°C reached peaks in ethylene production of 175 and 240 mg C.ton.day after 75 and 100 days respectively.

In 8% CO₂ the production was considerably lower. Bosc pears showed the same pattern as Comice and Conference.

Ryall and Pentzer (1984) mention the start of ethylene production of apples and pears stored at 3°C and 1°C respectively to peak concentrations of 100 - 150 ppm which was maintained for many months.

Blanpied, Cadun & Tamura (1972) held Bosc pears at 0°C and in 2.2%CO₂ and 3.1%O₂ and they observed ethylene concentrations in december and january of 235 and 635 ppm if they scrubbed their storage cabinets with dry lime.

Truter & Combrink (1989) found concentrations of ethylene concentrations of 160 ppm as an average for Packham's Triumph pears in commercial CA rooms.

Conclusion: Under practical circumstances in commercial rooms high ethylene concentrations must be expected after some time even when very low temperatures and CA conditions are applied.

Ethylene Sensitivity

It is believed that accumulation of ethylene in the fruit precedes the rise in respiration. It triggers the climacteric of unripe fruits and results in more ethylene being produced. A very small quantity of ethylene within the tissue of the fruit (lower than 1 ppm) is required to bring about the ripening response (Ryall & Pentzer 1984).

The ripening response of climacteric fruits (accompanied by changes in composition and texture) can be promoted by exogenous ethylene. This response is brought about by very low concentrations of ethylene and is irreversible (Ryall and Pentzer 1984).

At higher temperatures pears react well on exogenous ethylene. A recent review (Meheriuk & Sholberg 1990) indicates many authors who published results on the effect of ethylene on ripening of pears including the varieties Anjou, Bosc and Comice. They all concluded that ethylene treatments initiated the onset of the climacteric rise in respiration in pears.

However there is evidence for the statement that at low temperatures the ripening response is very weak or absent.

Burg (1962): ethylene is ineffective if it is applied at too low a temperature, or in the presence of too little oxygen or an excess of carbon dioxide.

Lutz and Hardenburg (1968): ripening effect in fruits by ethylene is negligible at 0°C.

Already Gerhardt & Siegelman (1953) saw that Anjou pears were not affected at 0.5°C and 7.3°C if they were exposed to the vapours of preripened fruits.

Flesh firmness loss and respiration of 'Anjou' pears held in air was increased by ethylene (500 ppm) at 21.1, 15.6°C but not at 10, 4.4 and 0°C (Blanpied and Hansen 1969 mentioned by Blanpied et al 1972).

A practical consequence of these facts is found in the literature. Lipton (1977) produced compatibility tables, which represent groups of commodities, which can be transported together. In these tables a number of factors are involved including temperature, relative humidity, modified

atmosphere, protection from odors or from physiologically active gasses such as ethylene. According to Table 1 pears and apples may be combined.

Conclusion: Although pears show a ripening response on exogenous ethylene this response is strongly inhibited at low temperatures.

The pears of the "SHIKISHIMA REEFER"

It is not mentioned in the reports, where the pears were grown and when they were picked from the trees. Also the conditions after harvest and during storage until 11th december 1989 are not known. The storage lives of the involved pears are limited to 3 to 4 months (Comice and Bosc) and 6 months respectively at -1.1°C according to Lutz and Hardenburg (1968). Let us assume, that the pears were grown in the U.S.A. and that they were picked on the right dates and finally that they were stored on the right conditions. In that case much of the storage lives have been used, as the pears may have been picked in the U.S.A. between the middle and the end of september 1989. Before loading the pears on board the "SHIKISHIMA REEFER" much of the maximal keepability had already been used. However it is surprising that the major part of overripeness occurred in the Anjou pears, which is the best keepable variety among the varieties involved.

As the pears were stored already some months before loading on board the ship it is highly probable that they already produced ethylene. So during the voyage they did not need the ethylene produced by the apples to receive stimuli for ripening. During the voyage the temperature was near to 0°C . As stated above: pears are sensitive to ethylene but at low temperatures the ripening response is minimal.

Conclusion: The cause of the overripeness of Anjou, Bosc and Comice pears after a voyage of a month at about 0°C between 15th december 1989 and 15th january 1990 on board the "SHIKISHIMA REEFER" must not be sought in the storage conditions on the vessel including ethylene from apples, which were stored together with the pears.

Literature

Blanpied G.D. O. Cadun and T. Tamura Ethylene in Apple and Pear experimental Chambers. J. Am. Soc. Hort. Sci. 97(2): 207-209 (1972).

Burg S.P. The Physiology of Ethylene Formation. Ann. Rev. Pl. Physiol. 13, 265-302 (1962).

Fidler J.C and C.J. North. production of volatile organic compounds by pears. J. Sci. Fd. Agric. vol 20, 518-520 (1969).

Gerhardt F.& H.W. Siegelman Storage of Apples and Pears in the Presence of ripe Fruit. J. Agr. Food. Chem. 3, 428-433 (1953).

Kader A.A., R.F. Kasmire, F.G. Mitchell. M.S. Reid, N.F. Sommer and J.F. Thompson. Postharvest Technology of Horticultural Crops. Coop. Ext. Univ. of Calif. Special Publication 3311, 3-7 (1985).

Lipton W.J. Compatibility of Fruits and Vegetables during Transport in mixed Loads. USDA Marketing Res. Rpt. No 1070, Washington D.C. (1972).

Lutz J.M. and R.E. Hardenburg The Commercial storage of Fruits, Vegetables, and Florist and Nursery Stocks. USDA Agriculture Handbook No 66, 34-36 (1968).

McGlasson W.B. Ethylene and Fruit Ripening. Hortscience, vol 20(1), 51-54 (1985).

Meheriuk M. & P. Sholberg Postharvest Treatments of Pears. Postharvest News and Information Vol. 1, No 6 441-446 (1990).

Ryall A.L. and W.T. Pentzer. In: Handling, Transportation and Storage of Fruits and Vegetables. Vol.2. AVI. Co.: Westport, CT (1984).

Schouten S.P. A.C.R. van Schaik and G. Spruit CA-bewaring Conference. Groenten en Fruit 41(7): 56 (1985).

Sherman M. Control of Ethylene in the Postharvest Environment. Hortscience. Vol 20(1), 57-60 (1985).

Truter A.B. & J.C. Combrink Ethylene Levels in commercial Stores and Low-Ethylene CA Storage of 'Golden Delicious', 'Starking' and 'Granny Smith' Apples and 'Packham's Triumph' Pears. Int. Contr.Atm. Conf. 5th Proc., Vol. 1, 333-338 (1989).