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Improving short-term storage of cherries

Cherries are very susceptible to spoiling and have a short keeping life. Normally they are quickly sold on the fresh market. But for various reasons short-term storage, e.g. over two to three weeks, may be desired. Discussed in the following paper are the effects on cherry keepability of rapid pre-cooling with air and variants of warming and surface drying after the cool phase. Further investigations into direct effects of surface drying and on the behaviour of microorganisms are required.

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Keywords

Forced-air cooling, quality maintenance, short-term storage, sweet cherries

In the mid-European climate freshly harvested sweet cherries are only available over six to eight weeks. Heat, as well as fruit surface condensate, has a decisive influence on the fresh lifetime of cherries, a matter of a few days under normal conditions. Rapid post-harvest cooling admittedly improves keepability [1, 2, 3], but long-term storage is still not possible. However, there are situations where medium-term storage of cherries is necessary.

Warming after cooling results in a condensate [4] problem and this leads to the cooling capacities of plants often not being fully exploited. Especially in this season, the continuous damp weather has caused considerable problems in the coordinating of harvest capacities and regular deliveries of quality product to market. Further investigations into quality retention post-harvest are therefore urgently necessary.

At the Institute for Agricultural Engineering Bornim (ATB) investigations with cherries have been carried out over two years seeking technical solutions for the above problems. This article is mainly aimed at outlining the influence of technical/technological processes on cherry quality and offering advice on necessary actions.

Precooling effects

Without precooling, cherries can be refrigerated from 23° to 5 °C in 18 hours within a ventilated coolhouse representing an average cooling speed of 1K/h. But ambient airflow conditions in storage can often lead to reductions in this performance. Where, however, a precooling plant is used with airflow velocity of only 1.75 m/s the fruit (50 • 6 kg cartons) can be taken from 27° to 10 °C at a cooling speed of 4.7K/h. Naturally, higher airflow means more heat transfer values and therefore increased cooling speeds.

Considered in experiments for quantitative evaluation of precooling efficacy was, among other aspects, transpiration rate, an indirect value for the reduction of the taste-determining sugars and fruit acids, as well as their temperature dependency. In a parallel experiment the fruit firmness measured as an exterior measurable parameter of a cherry spoilage threshold at 20 °C was determined, as was the CO_2 amount emitted through transpiration up to this point. This gave sufficient information to enable a first rough modelling of the precooling effect.

Cherries spoiled in four days of storage at room temperatures (~ 20 °C). Around 13 days keepability was possible with cooling to 5 °C without additional precooling. Moderate precooling (1K/h) increased keepability by one day. Even more intensive and rapid precooling offered no particular keepability improvement. However, a further reduction of storage temperature to 1°C increased keepability to a total 20 days and this variant allowed another two days keepability where cherries were precooled; i.e. the influence of precooling on keepability increased

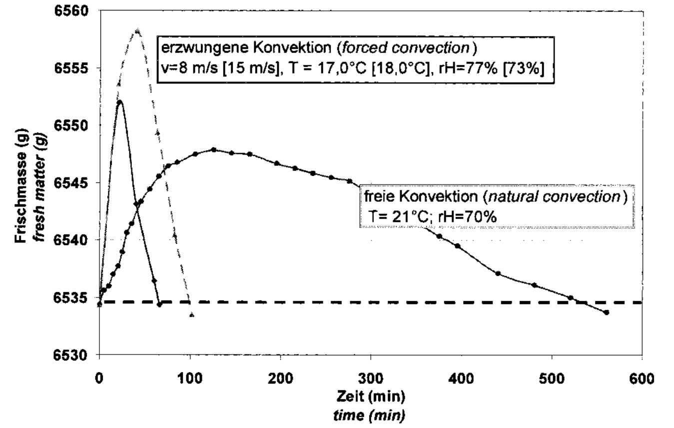

Fig 1: The effects of different airflow conditions at the product on vapour condensation represented through alterations in fresh material

in-line with lower storage temperatures. However, the extent to which precooling is economically viable has to be first resolved under consideration of all relevant parameters (energy input for storage, the market situation, weather, labour....).

Warming after cooling

When a coolroom is being emptied, vapour very often condenses on the cold fruit surface. This moisture can have a negative effect on the further keepability and is therefore not wished by producers and dealers [1, 4]. This negative effect is reduced through a rapid reduction of the condensate through applying warm air to the cherries.

Fig. 2: Sweet cherries being stored in the newly developed conditioner for an experiment

To enable precise information on the optimum handling of the product after cooling, different trials featured the storage of in each case 6 kg cherries under laboratory conditions in commercial waxed cardboard cartons in a cool-cell under controlled climate conditions (3 °C, ~ 90% r.h.). After removal from storage the cherries were subject to various air temperatures, air humidity and airflow conditions and the timed alterations in condensed water amounts on the cherries and the transport packing determined.

With free convection, depending on ambient air conditions, up to 15 g condensate settled on the 6 kg of initially cold cherries. The amount at first increased and then very slowly decreased over a period of up to 10 hours. Water could also be found in the packaging over the total time but especially in the lower layers (*fig. 1*). Under practical conditions (80 cartons in 10 layers on a compact stack upon a Europallet) in free convection conditions with comparable air humidity, much longer times were required for drying-off cartons inside the stack.

Where convention was forced under defined conditions within a wind tunnel (heat and material transfer) up to 100 g water per carton (!) was realised in the packaging which, however, quickly re-evaporated – and was transported by the airflow. Here, better results were achieved with throughflow of air in the cherries compared with air being directed over the fruit.

Under practical conditions single stacks each of 48 • 6 kg cherry cartons were removed from the coolroom (2 °C) into a compact conditioner (*fig. 2*) developed at ATB with fans and air directional equipment and, during partly extreme surrounding air conditions (77% r.h.), they were then warmed and tried. The results from two stacks in which the cherries had reached 95% of the surrounding temperature after the ventilation are shown in figure 1. It was clear that with high airflow speed over the cherries there was a short-term collection of up to 25 g water in the packaging. The amount of water was reduced with rising airflow velocity and also the ventilation period up to the point of initial weight being attained (product + carton). The less humid the outside air, the shorter the warming and drying periods. It was also observed in this trial that the relative air humidity was extremely high. In the observation period this is usually around 50% in Potsdam.

Even when, as often-practiced in direct marketing for avoiding the annoying condensation [1], cherries are only cooled down to 10 °C over a very short storage period, an avoidance of dew point cannot be guaranteed. In *figure 3* are shown the limitations for relative air humidity in the surrounding air in association with the store temperature. It is clear that with higher levels of relative air humidity, some condensation will always take place. Warming the cherries after cool storage should therefore always be done in conjunction with forced ventilation.

Summary

A short storage period at moderately cool temperatures (~ 10 °C) improves keepability of cherries. A rapid precooling with air increases this positive effect. However, greater efficacy is achieved with lower storage temperatures (1 to 0 °C).

Rapid warming and surface drying of condensate at the same time through forced ventilation is to be recommended under all conditions. The higher the ambient air humidity, the greater the air velocity on the product should be. The measuring of the factors involved (air mass flow, coefficient of resistance) has to be done with great care because, depending on the surrounding conditions, high amounts of condensate can occur short-term in the packaging.

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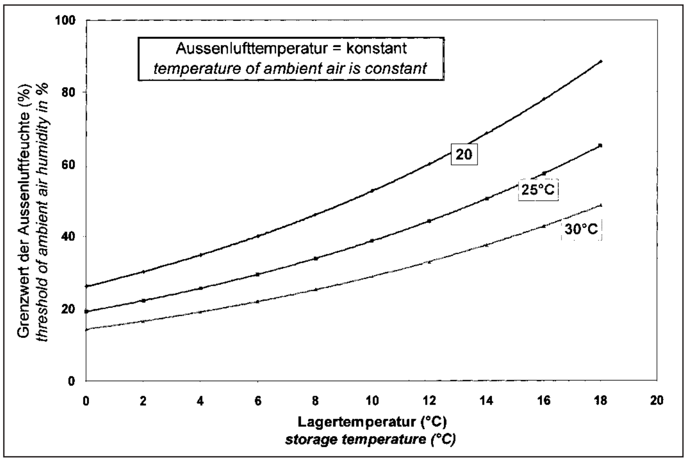

Fig. 3:Thresholds of ambient air relative humidity as function of storage temperature