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Model concept for testing freshness in sensitive horticultural products

Sensitive horticultural products are susceptible to considerable post harvest damage and therefore value loss. Of particular importance in this period, especially from the consumer point of view, is loss of freshness. The basis for freshness evaluation, and design of a horticultural post harvest chain for retention of freshness, was to be created though applying a freshness test model in all aspects of the production chains. First calculations on the basis of a transpiration-dependent freshness loss enabled predetermination of changes in freshness and thus keeping quality under post harvest conditions.

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Keywords

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Sensitive horticultural products are susceptible to high post harvest climatic and mechanical stresses between producer and consumer. Reduction of product freshness is continual, especially through transpiration and respiration of content substances. Even in the developed industrial countries these losses can represent up to 25% of the harvest [1, 2]. Often horticultural products are already reduced in quality on reaching the consumer, which means that fruit and vegetables often (still) do not have the attractive appearance to match their high health status, an appearance to increase turnover and image in the public eye. On the part of the consumer we also now have, through BSE, F&M and the associated crises, a stronger trend in required freshness and quality

With this as background, those involved in post harvest handling often have only a general, rather diffuse, knowledge about quality-retaining treatment of these sensitive products in the individual phases after harvest. There are no practicably applicable instruments to indicate interior processes resulting from different treatments, changes which give no visible exterior alterations, and their influence on keeping quality and freshness at the consumer end of the chain.

Existing models for determining freshness are currently, above all because of their limitations to individual freshness criteria, only of limited practical use. Important product characteristics have not yet been brought together in a way enabling comprehensive findings regarding product condition and procedural changes with associated prognosis as to keeping quality.

With the planned model the important factors influencing product freshness should be applied in a freshness prognostic instrument using the simplest-possible measurement procedure. This model should make it possible for those involved in the post harvest phase to follow the freshness status of a product and calculate keeping quality and storage duration. This would make the post harvest process more transparent, allowing planning and influence. Weak points could be identified and efficient product and situation based measures towards more quality assurance simulated and introduced.

Transpiration process in sensitive products

Product freshness is a very complex factor comprising results from both interior and exterior characteristics. This complicates simple measurement and recording based on a model.

In a first step towards realizing the planned project it was thus assumed that a large proportion of the consumer-recognisable changes in quality post harvest were influenced by water content. As a rule, this involves signs of drying-out and these occur especially rapidly with particularly sensitive products such as radish or carrots. In such cases there is, therefore, a visual measurement of freshness loss.

Based on the definition of transpiration coefficients [3], an ATB-developed measurement principal was used for the determination of transpiration characteristics. Here, the water content and a significant value characterising the air flow in the immediate vicinity of the product could be individually determined [4]. For this, transpiration resistances were used which characterized the water content and could be measured with simple equipment. Tissue resistance is cultivar-specific and additionally dependent on the freshness of the product, pre-harvest

Table 1: Transpiration resistances of selected fruits and vegetables

Product	Resistance of outer in individual products (s/cm)	Initial tissue resistance (s/cm)
Radish root	1.0 1.5	0.25 1.5
Carrot (without shaws)	1.2 2.4	1.0 6.0
Asparagus (white)	1.0 2.0	1.0 2.5
Peppers	3.0 4.5	35.0 80.0
Sweet cherry (with stalks)	1.5 2.5	15.0 25.0
Apple	3.0 4.0	170.0 320.0

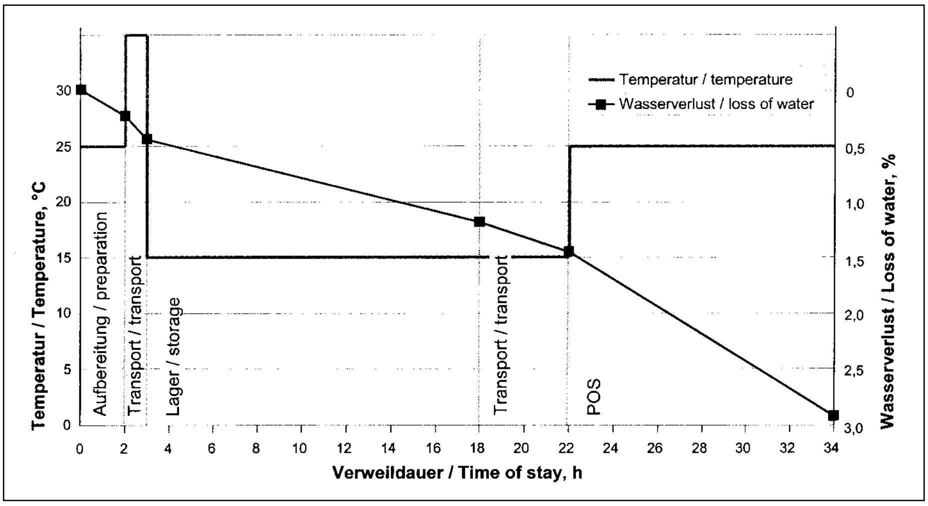

Fig. 1: Exterior loss of freshness with washed carrots, unsuitable ambient surroundings

conditions and post harvest stresses. The outer layer resistance is a measurement of existing airflows onto and around the object. Its resulting size is caused by the overlaying of individual outer layers in the bundle, in layers once again, and/or through the protection of packaging. Thus, increased outer layer resistances act like an increase in relative air moisture on the product (air moisture equivalent). *Table1* gives an oversight of the transpiration resistances of selected fruit and vegetables with free convection on the individual products [5].

With this, changes in transpiration characteristics can be analysed free from surrounding influences, conclusions drawn on pre-harvest conditions and predictions arrived at regarding post harvest reaction. This procedure was first applied for reaching the best cool-cabinet design based on product requirements. Current investigations in this subject are aimed at the evaluation of transport packaging [6].

First calculation with washed carrots as subject

The concept of the future model was evolved and first calculations carried out on the basis of transpiration losses. Here, through comparison of two fictive post harvest product chains the changes in transpiration-dependent loss of freshness with washed carrots could be calculated, graphically presented and thus the effects of post harvest conditions on water content be demonstrated. Through selection of suitable, ambient conditions matching the requirements of the products a substantial lengthening of the keeping quality/sale capacity could be achieved on the basis of water loss *(Fig. 1 and 2)*.

To complete the natural science prognosis basis, additional freshness criteria have to be taken account of – especially the reduction of value-giving contents through respiration. Additionally necessary is the collection of product data for further types of fruit and vegetables. In order to make these as practical and understandable as possible, care will have to be taken in the creation of product groups with similar post harvest behaviour.

Summary and outlook

The solution conceived here should result in a suitable instrument for freshness evaluation and thus a basis for product-matched design of complex horticultural added-value chains. The aim at the end of the day here is a reduction in post harvest quality losses and results of the first calculations presented here indicate that this sort of potential is realistic.

The model to be created can also be used for solving completely different problems. The evaluation of technical equipment and help material (packaging, storage equipment, transport means, presentation furniture) is just as realistic here as is the testing of post harvest procedures to maintain freshness on a practical basis (washing, cooling). Weak links in the post harvest procedure can be identified, effects of planned changes simulated, or locational advantages or disadvantages examined. In connection with an ecological extension, there exists the basis for decision-supports at farm and other procedural levels.

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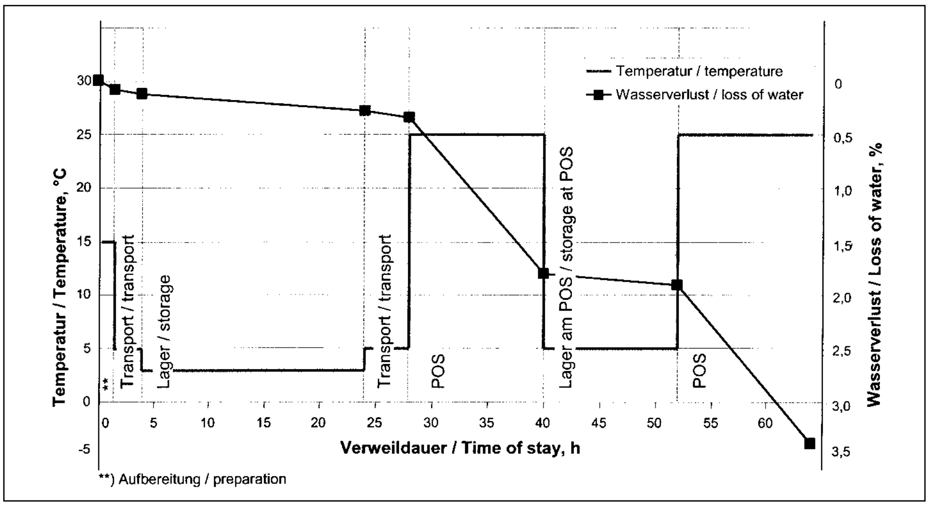

Fig. 2: Exterior loss of freshness with washed carrots, suitable ambient surroundings