Fruits and vegetables, less waste and increased revenues with humidity sensor.

Report from Sensinet AB

Sales of fruits and vegetables varies between 10-15% of business turnover in Sweden. This sector is characterized by a high discard as well as sensitivity to handling and physical environment.

On the purchasing side, scrap can be drastically reduced, here it is possible to reduce the expenses by allowing a larger proportion of goods to be purchased, to pass the cash registers.

On the sales side, revenue for actually sold, not discarded, goods can increase, by weighing more. For each item, for example a tomato that customers buy, it weighs between 0-5% less because it has evaporated some of it liquid both in the coldstore and the during exposure at counter until it has been picked by a customer and bought out through the cash register.

Reduction of waste gives a reduction in overall costs, less goods needs to be purchased for the customers demand sales. Reduction of evaporation gives a pure revenue by weight for example, three-bought tomatoes have not decreased 0-5% before finally bought.

Discarding increases the less the humidity is. Weight loss by evaporation takes place from the arrival of fruit and vegetables, arriving at the fruit and vegetables refrigerator, at an accelerated rate at the exposure, until the undiscarded goods are selected by the customer and weighed in the checkout.

Here's a reality-based account of the size of both discarding and weight loss, related to the moisture and the basis of calculation of the extent to which you can influence your store.

This document, together with the Termosense moisture sensor, are powerful instruments that give you the opportunity to increase your store's profitability, for the benefit of both owners and staff.

Conditions, raw material and controlled circumstances.

We started from the merchants reality, the incoming goods. We have fresh ingredients in the exact condition as they arrive from the wholesaler. When incoming goods are of inferior quality, the circumstances in the coldstore and exposure are even more important, since some of the freshness has already been consumed, and a smaller margin remains before discarding.

We have selected similar products, one group had good conditions with high moisture content (95-100% RH) and the other had low moisture content (0-5% RH), based on these very good and wearing conditions, intermediate values are calculated with interpolation .

Lighting has been off at night and lit during the day, just like in the stores. The temperature has been cool and exactly the same for measuring objects and control groups.

Different types of fruit and vegetables have been tested, in the exact condition as they arrive from the wholesaler, with or without the manufacturer packaging, plastic or the like, and in exactly the condition they are exposed.

In the following, we will account for the "life span" in terms of when the product ceases to be marketable and must be discarded, and the reduction of sales weight due to evaporation.

The formulas below indicate "RH" which means Relative Humidity, 0-100% which can be read out by the Termosense moisture sensor. Insert your average value in the formula and calculate your prerequisites.

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Tomatoes.

These two tomatoes arrived at the store 10 days ago.

- This tomato has been surrounded by low humidity, the weight has dropped 8% by evaporation.
- It is small, shriveled and soft.
- Already four days ago it was in such a condition that it would be discarded. Productive life in the store, 6 days.

- This tomato has been surrounded by high humidity, the weight has only dropped 1% by evaporation.
- It is unchanged, smooth and firm.
- It is still in perfect condition as it arrived. It will be in a salable condition for another 28 days with a productive lifespan of 6.3 times longer.

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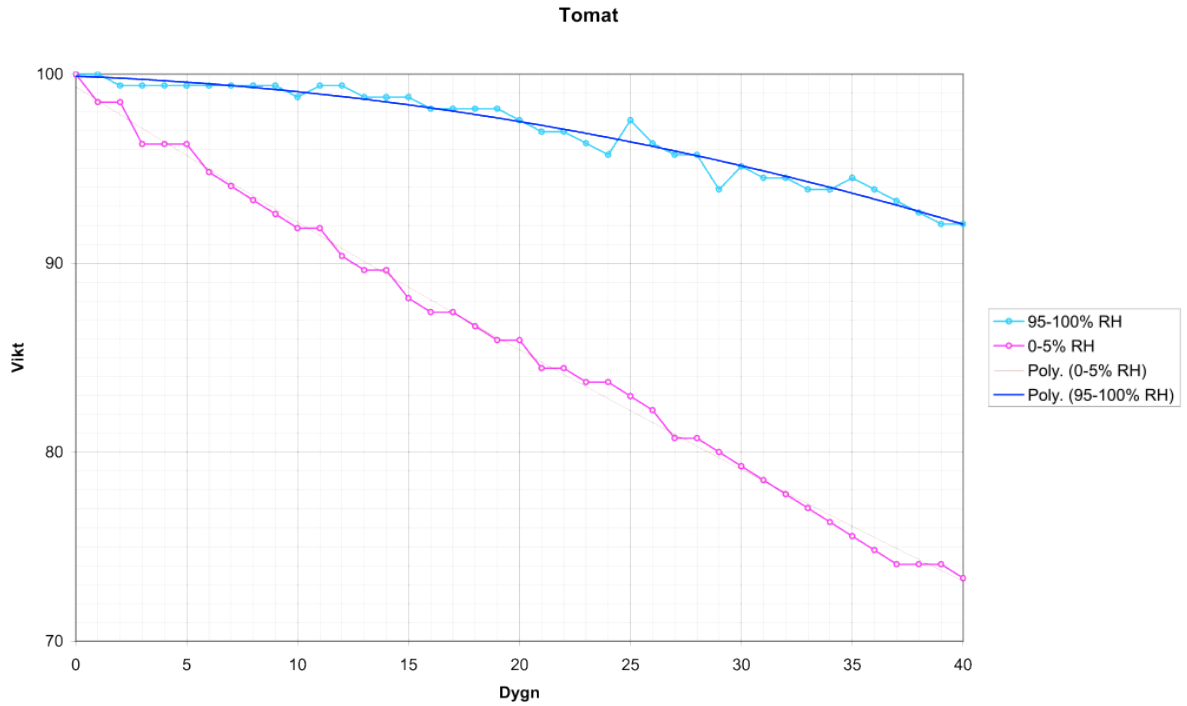
Scientific data and calculation basis for your store;



In the formulas below, you set your average humidity value instead of RH, which means Relative Humidity, and is expressed in% between 0 and 100. Zero percent means absolutely dry air, and 100% means completely saturated air. The relative humidity thus expresses how well the moisture-containing capacity of the air used is, regardless of temperature.

As a curiosum, it can be mentioned that cold air can harbor a smaller amount of water vapor, in grams, and warm air can accommodate a larger amount. It is called absolute humidity and is expressed in grams of water per kilo of air, but in this context it is in fact a useless way of considering the effect of humidity on fruits & vegetables. TermoSense® reports moisture expressed in% RH.

Productive lifespan: 6+ (RH / 100) * 27 days, then discard. The productive lifespan (the time the product is in a salable condition in the store) becomes longer the higher the relative humidity is. At least 6 days and at most 33 days.

Examples, lifespan; A change, an increase of RH by 10% gives an increased productive life of (33-6) * 0.1 = 2.7 days, at 50% RH gives a reduced discarding 2.7 / (6 + 33) / 2 = 12%

Weight loss; Reduction of revenues on the undiscarede tomatoes sold by 0.18% + (0.86-0.18) * (100-RH) / 100 per day.

Example, weight loss; A change, increase of RH by 10% results in a reduced weight loss of 0.68% * 0.1 = 0.068% per day. At a seven-day average turnover, a reduced weight loss of 0.068% * 7 = 0.48% results in a pure revenue increase of 0.48% on the entire product turnover. This results in an unchanged amount of input goods, thus a pure profit increase.

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Iceberg lettuce.

These two salad heads arrived at the store 10 days ago

- This salad has had low humidity, the weight has dropped 8% by evaporation.
- It has incipient decay, started by dried outer leaves.
- Already three days ago it was in such a condition that it would be discarded. Productive life in the store, 7 days.

- This salad has had high humidity, the weight has only dropped 0.7% by evaporation.
- It is unchanged, fresh and nice.
- It is still in perfect condition as it arrived. It will be in a salable condition a total of 19 days with a productive lifespan that is 2.7 times longer

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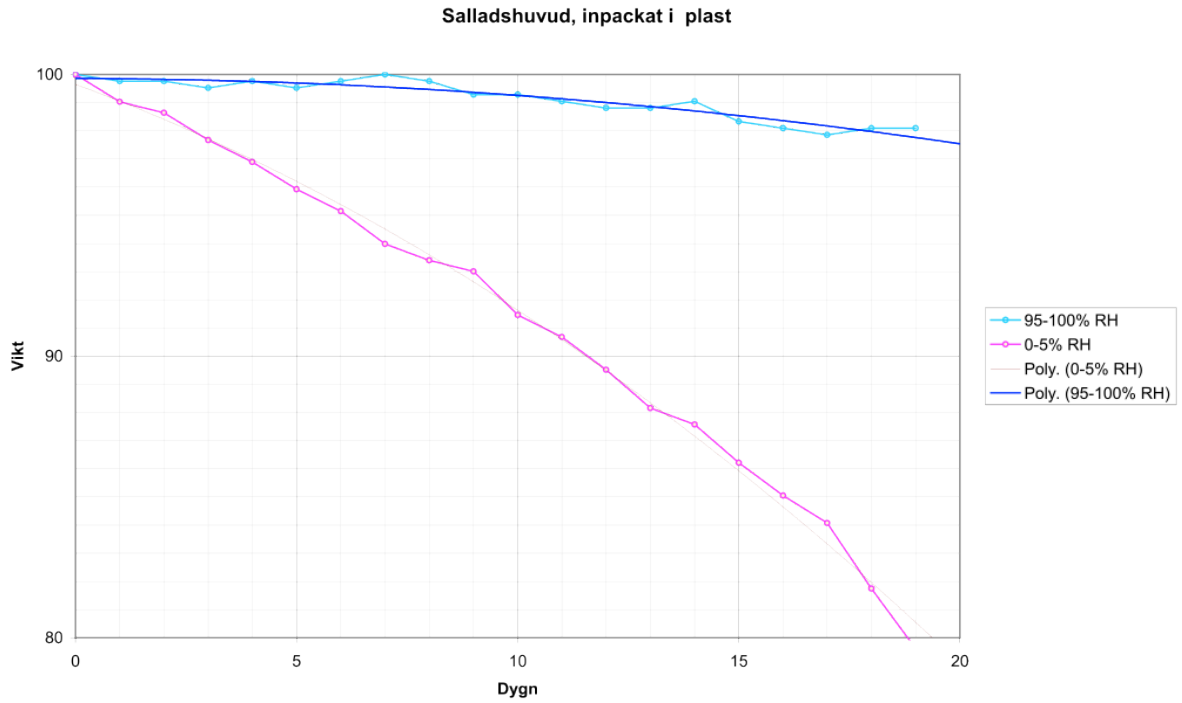
Scientific data and calculation basis for your store;



In the formulas below, you set your average humidity value instead of RH, which means Relative Humidity, and is expressed in% between 0 and 100. Zero percent means absolutely dry air, and 100% means completely saturated air. The relative humidity thus expresses how well the moisture-containing capacity of the air used is, regardless of temperature.

As a curiosum, it can be mentioned that cold air can harbor a smaller amount of water vapor, in grams, and warm air can accommodate a larger amount. It is called absolute humidity and is expressed in grams of water per kilo of air, but in this context it is in fact a useless way of considering the effect of humidity on fruits & vegetables. TermoSense® reports moisture expressed in% RH.

Productive lifespan: 7+ (RH / 100) * 12 days, then discard. The productive lifespan (the time the product is in a salable condition in the store) becomes longer the higher the relative humidity is. At least 7 days and at most 33 days.

Examples, lifespan; A change, an increase of RH by 10% gives an increased productive life of (19-7) * 0.1 = 1.2 days, at 50% RH gives a reduced discarding 1.2/ (7 + 19) / 2 = 9%

Weight loss; Reduction of revenues on the undiscarede tomatoes sold by 0.11% + (0.86-0.11) * (100-RH) / 100 per day.

Example, weight loss; A change, increase of RH by 10% results in a reduced weight loss of 0.75% * 0.1 = 0.075% per day. At a seven-day average turnover, a reduced weight loss of 0.075% * 7 = 0.5% results in a pure revenue increase of 0.5% on the entire product turnover. This results in an unchanged amount of input goods, thus a pure profit increase.

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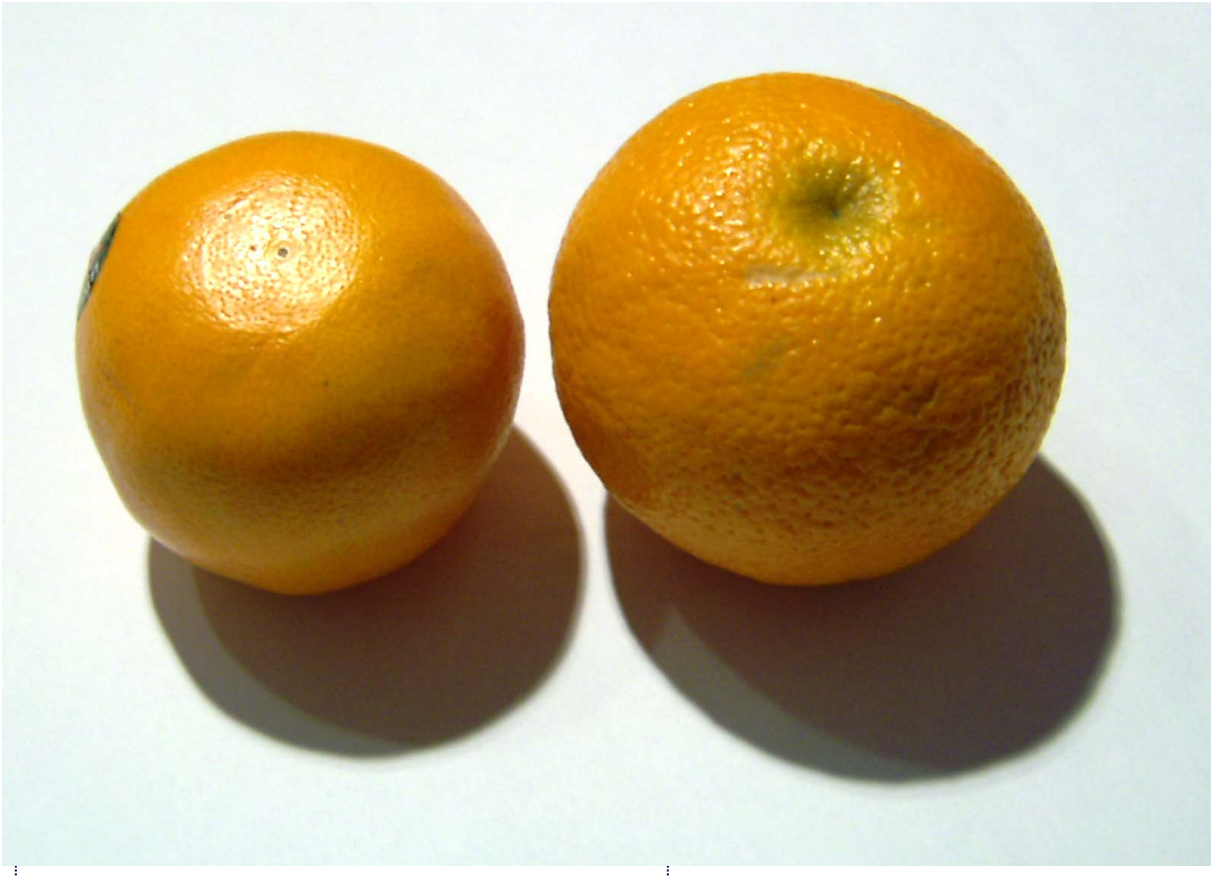
Oranges.

These two oranges arrived at the store 10 days ago.



- This orange has had low humidity, the weight has dropped 9% by evaporation.
- It is soft, smaller, smoother and has an impression of its own weight.
- It was so soft yesterday that it would be discarded. Productive life in the store, 9 days.

- This orange has had high humidity, the weight has only dropped 0.5% by evaporation.
- It is hard, unchanged, fresh and nice.
- It is still in perfect condition as it arrived. It will be in a salable condition for another 50 days with a productive lifespan that's 5.5 times longer.

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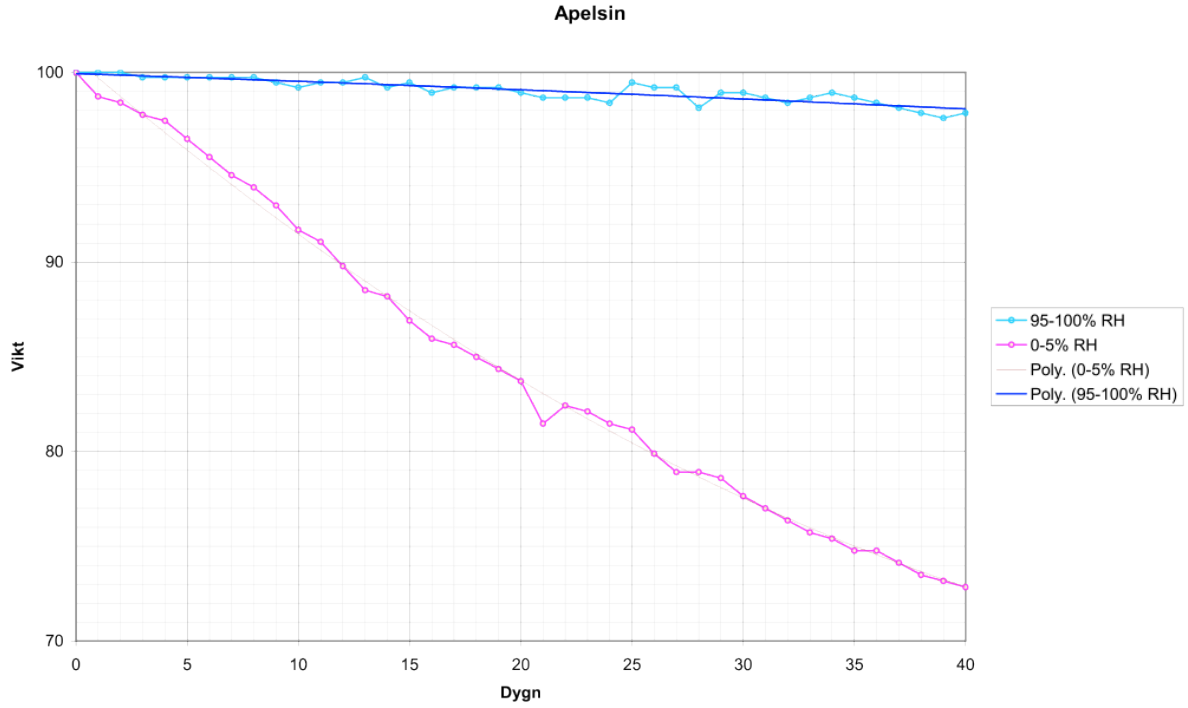
Scientific data and calculation basis for your store;



In the formulas below, you set your average humidity value instead of RH, which means Relative Humidity, and is expressed in% between 0 and 100. Zero percent means absolutely dry air, and 100% means completely saturated air. The relative humidity thus expresses how well the moisture-containing capacity of the air used is, regardless of temperature.

As a curiosum, it can be mentioned that cold air can harbor a smaller amount of water vapor, in grams, and warm air can accommodate a larger amount. It is called absolute humidity and is expressed in grams of water per kilo of air, but in this context it is in fact a useless way of considering the effect of humidity on fruits & vegetables. TermoSense® reports moisture expressed in% RH.

Productive lifespan: 9+ (RH / 100) * 41 days, then discard. The productive lifespan (the time the product is in a salable condition in the store) becomes longer the higher the relative humidity is. At least 9 days and at most 33 days.

Examples, lifespan; A change, an increase of RH by 10% gives an increased productive life of (50-9) * 0.1 = 4.1 days, at 50% RH gives a reduced discarding 4.1/ (9+50) / 2 = 16%

Weight loss; Reduction of revenues on the undiscarede tomatoes sold by 0.05% + (0.81- 0.05) * (100-RH) / 100 per day.

Example, weight loss; A change, increase of RH by 10% results in a reduced weight loss of 0.76% * 0.1 = 0.076% per day. At a seven-day average turnover, a reduced weight loss of 0.076% * 7 = 0.53 % results in a pure revenue increase of 0.53% on the entire product turnover. This results in an unchanged amount of input goods, thus a pure profit increase.

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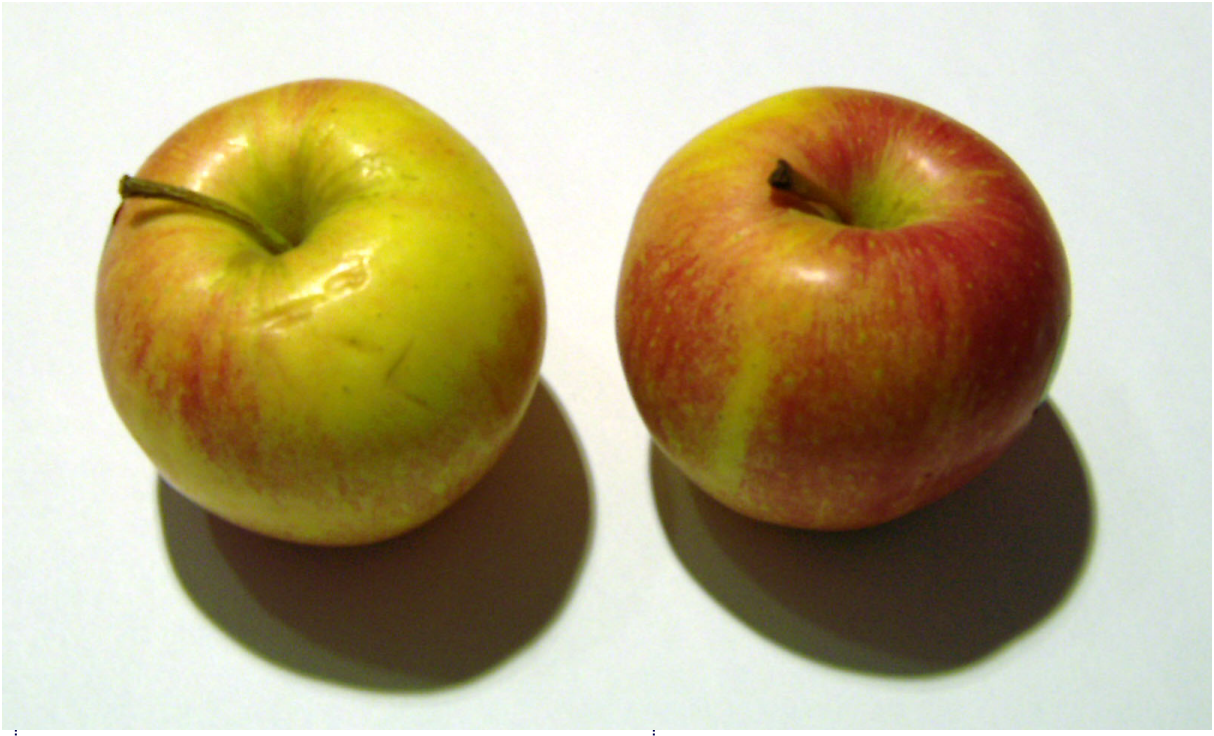
Apples.

These two apples arrived at the store 10 days ago.



- This apple has had low humidity, the weight has dropped 2.5% by evaporation.
- It is almost unchanged, except for all minor injuries that are accentuated.
- It is about seven days to be so soft / limp that it must be discarded. Productive life in the store, 17 days.

- This apple has had high humidity, the weight has only dropped 1% by evaporation.
- It is completely unchanged, fresh and nice.
- It is still in perfect condition as it arrived. It will be in a salable condition for another 40 days with a productive lifespan that's 3 times longer.

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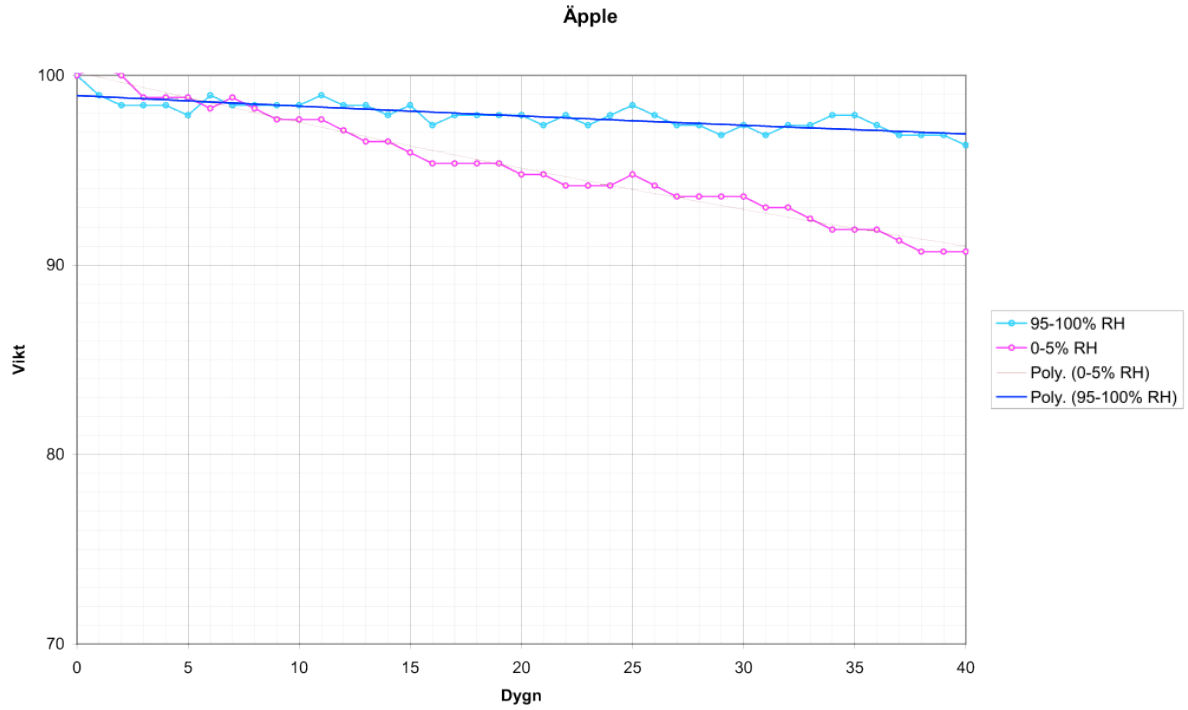

In the formulas below, you set your average humidity value instead of RH, which means Relative Humidity, and is expressed in% between 0 and 100. Zero percent means absolutely dry air, and 100% means completely saturated air. The relative humidity thus expresses how well the moisture-containing capacity of the air used is, regardless of temperature.

As a curiosum, it can be mentioned that cold air can harbor a smaller amount of water vapor, in grams, and warm air can accommodate a larger amount. It is called absolute humidity and is expressed in grams of water per kilo of air, but in this context it is in fact a useless way of considering the effect of humidity on fruits & vegetables. TermoSense® reports moisture expressed in% RH.

Productive lifespan: 17+ (RH / 100) * 33 days, then discard. The productive lifespan (the time the product is in a salable condition in the store) becomes longer the higher the relative humidity is. At least 17 days and at most 50 days.

Examples, lifespan; A change, an increase of RH by 10% gives an increased productive life of (50-17) * 0.1 = 3.3 days, at 50% RH gives a reduced discarding 3.3/ (17+50) / 2 = 8%

Weight loss; Reduction of revenues on the undiscarede apples sold by
0.07% + (0.28-0.07)*(100-RH)/100 per day.
0.05% + (0.81-0.05)*(100-RH)/100 per day.

Example, weight loss; A change, increase of RH by 10% results in a reduced weight loss of 0.21% * 0.1 = 0.021% per day. At a seven-day average turnover, a reduced weight loss of 0.021% * 7 = 0.15 % results in a pure revenue increase of 0.15% on the entire product turnover. This results in an unchanged amount of input goods, thus a pure profit increase.

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Reducing costs, increasing revenues, how to reduce waste and weight loss.

During the 1980s and 1990s, problems were noted with humidification plants, which in extreme cases and incorrect handling created legionella growth, with in some cases subsequent deaths. Many traders therefore chose not to work with moisture addition to avoid this. Thus, it is more important to allow fruit and vegetables to retain the liquid they have when they are delivered. For the traders who invest in both facilities and maintenance of the same, it is even more important to ensure that they are constantly tuned, in order to really provide optimal ROI. The products live, they breathe, they evaporate. It is important to protect the moisture that is evaporated, not to "blow away". Thermosense moisture sensor gives you "eyes" and the knowledge to change the products environment with simple means and thus you can, as shown, save large amounts and also increase revenue.

- Coldstore for fruits and vegetables;

- Set a moisture and temperature sensor, it gives you "eyes" to see the conditions.
- Check the moisture, try to make it as high as possible.
- Minimize unnecessary running in and out of the cold room, each entrance venting the humid air, and the dry air that comes in is moistened with water from the produce. With the sensor you will see every deposit and withdrawal from the cold room as well as the humidification process.

- Check sealing strips and tow bars on the door (s) into the cold room. The slots for vegetable coolers not only emit kilowatts, but also kilos of products in the form of water vapor. A practical example, a trader had an old door to the greenhouse with the result that the relative humidity was "only" 65%. After a practical TermoSense® test, we were able to show that replacement of the door with a new and tight (6 KSEK + assembly, a total of 10 KSEK) would be earned in a couple of months. It turned out to be just right. After replacing the door, a moisture content of 80% was obtained and a reduction of the cooling energy consumption by 35% and a reduction of heating costs of this times three. The increase in moisture content 65% to 80% = 15 percentage points gives a reduction of 17%, the fruit becomes fresher, which leads to increased sales and all vegetables sold weigh 0.6% more, with increased revenue as a result.
- Minimize ventilation.

  Check the temperature variation, the variation should be kept low. Excessive variations can lead to condensation on the mold-driven products.

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Exposure of fruits and vegetables;

- Set a moisture and temperature sensor for each disk, it provides feedback on your actions.
- Check the ventilation of the disks, the circulation, so that it is not unnecessarily high. Fans remove the layer of moist air around the products.
- Check the ventilation in the room at the fruit and vegetable corner. Depending on displacement or mixing ventilation;
    - Displacement = best, with large non-blowing supply air. Make sure that the supply air devices that are close to fruits and vegetables do not have too high flow, throttle down if that is the case.
    - Mixing = whispers around the air volume through blowing means. If possible, switch to displacement ventilation. If you maintain the mixing ventilation, check the supply air diffusers so that they do not blow against the fruit and vegetable surface. Align the devices away from the produce.
- Consider whether the fruit and vegetable corner can be slightly shielded with, for example, a ceiling and/or dividing screen walls. The screen walls can be quite thin board, and can be used as decor or for advertising messages. Their most important task is to prevent/stop the air flow past the products that blow away the moisture that is emitted around them. Before and after changes; Check how your changes affect humidity by reading the mean value from the Humidity Sensor.
- Install shutters that can be pulled down at night, partly to keep cool/cold, and above all to maintain product moisture.
- Switch the lighting from fluorescent or halogen to xenon lights or HID lamps, they provide a cold light that does not heat the products. This reduces evaporation. The light should be both IR-poor to minimize illumination heating and UV-blocked so as not to drive photosynthesis.
- Apples are the most resistant to dehydration, it can be exploited by placing the apples where it is most difficult to maintain high humidity.
- Tomatoes are the most sensitive, followed by lettuce heads for low humidity. These products should be placed where the highest humidity can be maintained.

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