VITESY

Shelfy
Test Report 2022

Odor abatement in refrigerator by use of Shelfy

Product tested → Shelfy
Test conducted by ArcoSolution Srl and INSTM

Test Report 2022 - Rev. 0 - 10.2022

Test in real refrigerator with Shelfy

Product tested → Shelfy

Test conducted by ArcoSolution Srl

Odor abatement in refrigerator

Product tested → Shelfy

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Test in real refrigerator with Shelfy

Abatement of VOCs from natural sources

Test conducted in collaboration with Arco Solution Srl

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PREMISE

The objective of this test is to define the ability of the Vitesy Module to keep the level of VOCs (Volatile Organic Compounds) in the refrigerator low. VOCs are emanated mainly from F&V (Fruits and Vegetables) during the various stages of ripening, and their presence inside the refrigerator **negatively affects the ripening of F&V itself**, accelerating it, and **the organoleptic properties**, i.e. the physical-chemical characteristics of a food perceived by the sense organs (smell, sight, taste).

In this test, **avocados** and **apples** are used to generate VOCs because they are climacteric foods and, as such, continue ripening after being detached from the plant. The ripening phenomenon is induced by **ethylene** ($CH_2=CH_2$), a colorless and odorless gaseous plant hormone that plays a crucial role in fruit growth, development and storage, even when present in small concentrations, such as ppm (parts per million) or even ppb (parts per billion). Climacteric food, as it ripens, produces ethylene; the more ethylene there is in the air, the more the food is stimulated to produce ethylene itself.

Apples and avocados are among the major ethylene emitters.

SETUP

Two refrigerators of the same brand and model were used for the tests. The internal volume is 370 liters, or 0.37 m^3. The refrigerators were set at 4°C.

Unripe avocados (hard to the touch) and three types of apples were purchased. Each food item was placed with the same arrangement in both refrigerators.

By means of Teflon tubes, air sampling points were created outside the refrigerator so that air sampling could be performed without opening the refrigerator doors. The air in each refrigerator is sampled on the shelf.

The Tiger Ion (PID), which measures the tVOC level in the refrigerator in isobutylene equivalent, was used to perform the sampling.
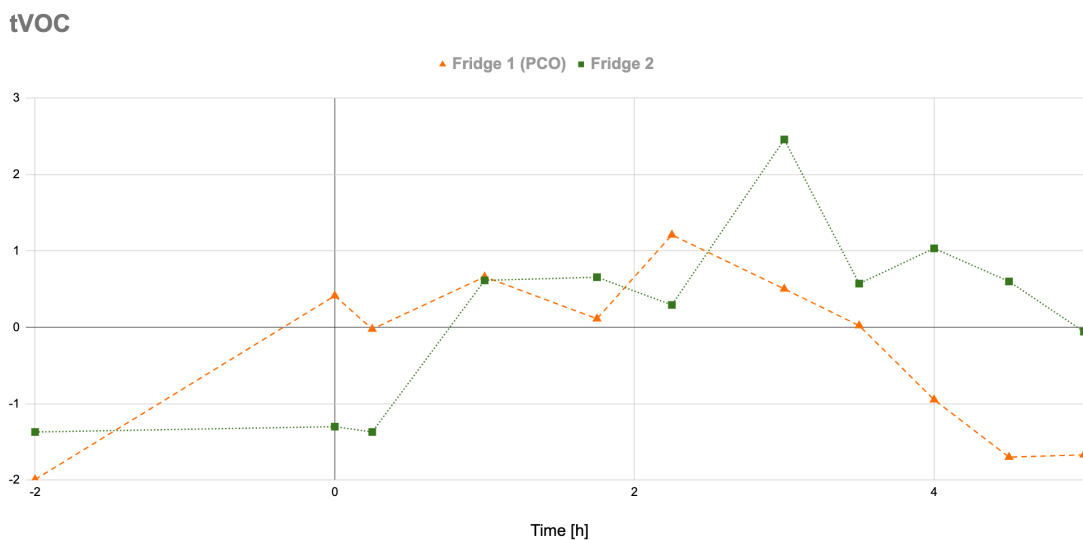
The Vitesy Module is inserted in **refrigerator 1**.

VOC levels were recorded for 7 hours; the contamination occurred about ten minutes before t0.

RESULTS

The collected data were normalized using the Z-score. It can be seen that in refrigerator 1 the tVOC concentration remains constant for the first two hours thanks to the Vitesy Module, after which it begins to decrease and in a little more than 4 hours returns to values comparable to the initial values (t:-2). **5 hours** after the forced increase in VOCs (t:0) with natural source in refrigerator 1 there is an **80%** abatement.

In the refrigerator without the Vitesy Module, however, the concentration tends to increase in the first three hours, after which slowly decreases, without returning to values comparable to those at the beginning of the test.

tVOC

*Figure 1 - tVOC (total Volatile Organic Compound) in the two fridge*

CONCLUSIONS

From the test performed, it is shown that the Vitesy Module is able to keep the level of VOCs inside the refrigerator low; after increasing the tVOC concentration with natural source (avocados and apples) in the refrigerator, in 5 hours there is an 80% abatement.

Odor abatement in refrigerator

Hexanal degradation analysis

Test conducted in collaboration with INSTM
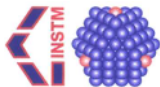
TEST

We measured the concentration of hexanal in the following tests
- Test with 24-hour hexanal with sampling at 0h - 2h - 5h - 24h (white)
- Test with 24-hour hexanal with sampling at 0h - 2h - 5h - 24h (with Vitesy Module in mode 1)
- Test with 24-hour hexanal with sampling at 0h - 2h - 5h - 24h (with Vitesy Module in mode 2)

The modes will be set by Vitesy.

SETUP

The device (Prototype) is placed inside the refrigerator according to the manufacturer's instructions, the refrigerator is closed. The device was set remotely by Vitesy when used for pollutant degradation and in off mode during the saturation of the environment with the pollutant, hexanal aldehyde was selected as the target molecule (pollutant) in high concentrations (equilibrium concentration of the vapor phase with the liquid phase in the refrigerator volume at the average temperature of 4°C and pressure of 1 atm). A sampling point was set up through a Teflon tube closed at the outer end by a tap with luer-lock connection so that ambient air sampling could be performed without opening the refrigerator door.

The refrigerator was contaminated with the tested target substance by leaving an open glass container containing 0.5 mL of the liquid pollutant inside the refrigerator for 16 hours. Then the container inside the refrigerator was closed and sampling was performed at time t=0, the vapor phase collected was placed in a glass vial with a cap for headspace analysis containing 5 uL of internal standard. It was verified that the opening and closing of the door required to perform this operation did not significantly change the initial pollutant concentration. The timing of the initial sampling was arranged with Vitesy in order to allow them to set the timers in the

device to the modes selected by them, then sampling was performed at known times to verify the effectiveness of the system in abating the pollutant.

The samples thus obtained were analyzed in triplicate at GC-MS, the results are related to the area of the internal standard.

In the case of test 1 (white), the device was removed from the refrigerator and the above described procedure was used to determine any pollutant "leakage" in the absence of an abatement device.

Figure 2 shows the results for the degradation of the target molecule.

% residual
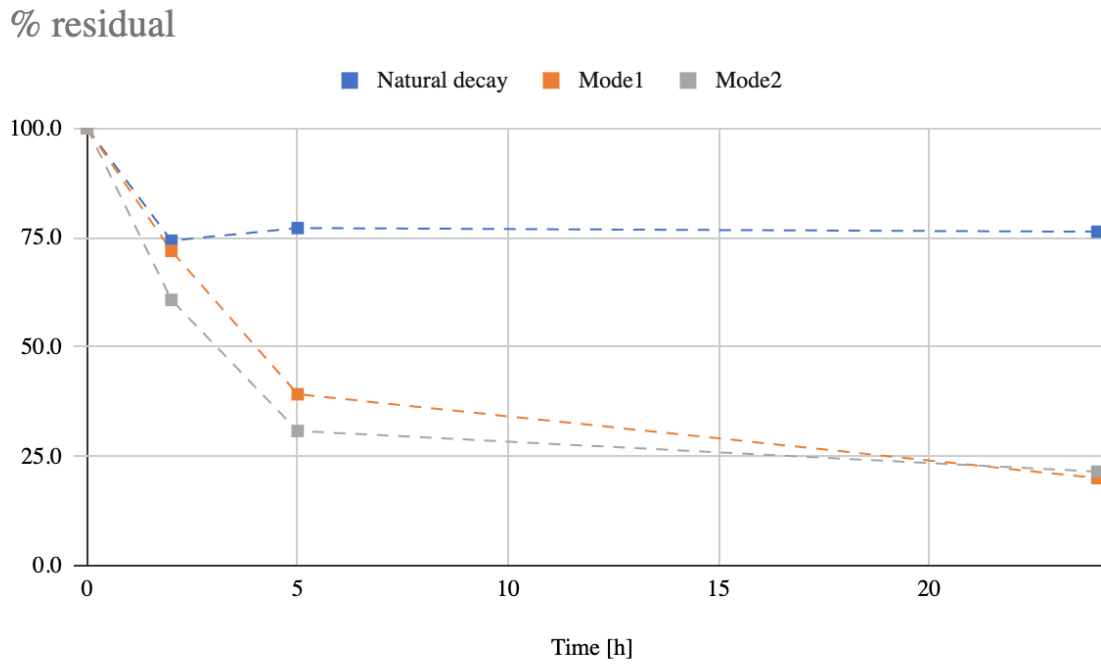
Figure 2 - Abatement of the target molecule (hexanal) on the prototype