VITESY

Shelfy

Test Report 2022

Shelf-life assessment of fresh food (fruits/vegetables) by use of Shelfy

Product tested → Shelfy
Test conducted by CSI SpA

Test Report 2022 - Rev. 0 - 10.2022

Shelfy's effectiveness on fresh product
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Excerpt from CSI Spa Test Report

An experimental study was carried out according to a work plan defined in agreement with CSI Spa. The study was set up during the period 19/07 – 16/08/2022 at the FPM Laboratory - Food Packaging Materials of CSI Spa, at its Bollate (MI) facility.

1. PURPOSE

The purpose of the test is to evaluate the effect of Shelfy in terms of prolonging the shelf life of fresh food products stored in the refrigerator.
Shelfy treats the air inside the refrigerator through photocatalysis, removing odors and microorganisms such as mold and bacteria.
To carry out this evaluation, the test involved storing fresh food products inside the refrigerator.
As requested by Vitesy, the types of products tested are:
- FRUITS
- VEGETABLES.

The products were placed in equal amounts and in equal ways inside two identical refrigerators. The refrigerators are set with temperature + 6°C, in order to create storage conditions similar to domestic storage.
Shelfy was placed inside the first refrigerator.
The module was provided by Vitesy (Prototype - code ZZ-MILSAA00 – ref. DDT 22000062 dated 15/07/2022 Vitesy-Laboratori Fabrici srl).

The module is not present in the second refrigerator.
By monitoring the products over time, in timed steps, and performing microbiological, chemical-physical and sensory determinations on the products, the study aims to evaluate any differences in terms of shelf-life extension between the

product stored in the refrigerator with Shelfy compared to the same products stored in the refrigerator without the module.

2. OPERATING MODES

Taking into account some preliminary empirical tests, the inherent characteristics of the products, the representativeness of broader product families, and also depending on the seasonality and availability at the time of purchase, the test was conducted on the following references:

- Strawberry
- Apricot
- Apple
- Cherry tomato
- Belgian endive
- Zucchini

The Laboratory arranged for the purchase of the samples on behalf of Vitesy.
On the day of purchase, the products were placed inside the two refrigerators, previously set at +6°C and sanitized.
The refrigerators used are two refrigerators provided by the CSI Laboratory that were made available for the conduct of the study.
These were FRIGOTERMOSTATO FOC 225l – VELP Scientifica.

Setup at T0

Refrigerator WITH Module

WITHOUT Module

During the testing period, this equipment was used exclusively for conducting the experiment.
An avocado was placed inside both refrigerators with the aim of emitting ethylene and accelerating the ripening processes of fruit and vegetable products.
No analytical tests are planned on avocado.

Following are the analysis conducted to monitor the storage status of the products over time.
These are the parameters identified as significant in relation to the matrices analyzed and the final purpose of the experiment:

- Total bacterial load
- Mesophilic lactic acid bacteria
- Yeasts
- Molds
- Enterobacteriaceae
- Escherichia coli (on fruit only)
- Staphylococcus aureus (on fruit only)
- Moisture
- Organoleptic evaluations.

The study included sample monitoring with 7 analytical steps, timed as follows:
T0 = upon purchase of samples – in analysis on 19/07;
T3 = +3 days of storage – in analysis on 22/07;
T7 = +7 days of storage – in analysis on 26/07;
T10 = +10 days of storage – in analysis on 29/07;
T14 = +14 days of storage – in analysis on 02/08;
T17 = +17 days of storage – in analysis on 05/08;
T22 = +22 days of storage – in analysis on 10/08.

3. RESULTS

3.1 STRAWBERRY

Strawberry T0

Strawberry T_3days

Strawberry T_7days

Strawberry T_10days

Regarding the microbiological evaluations, the parameters found to be the most significant are **Total bacterial load, Lactic acid bacteria, Molds** and **Yeasts**.
For these, the values found show a growth trend that up to almost T_10days is well defined and shows that **the bacterial and fungal contamination is numerically higher** in the sample kept in the refrigerator without module than in the sample in the refrigerator with module.

The **sensory evaluations are in line with this result**, i.e. up to T_10days the strawberries in the refrigerator with module have significantly better sensory characteristics (appearance / texture / stains / mildew); the strawberries in the refrigerator with module have firmer flesh - no rot and mildew spots; the strawberries in the refrigerator without module: less firm flesh with liquid release - stains and mildew - wilting.

3.2 APRICOT

Apricot T0

Apricot T_3days

Apricot T_7days

Apricot T_10days

Apricot T_14days

Apricot T_17days

Relative to microbiological evaluations, the parameters found to be the most significant are **Total bacterial load, Lactic acid bacteria** and **Yeasts**.

These parameters show that microbial contamination tends to be higher in the sample kept in the refrigerator without module, the differences in these parameters are in the **1-2 order of magnitude**, and the sensory evaluations track a product evolution over time **in line with the analytical results**.

Up to step T_7days the two samples are comparable.

At T_10days in external appearance the products are still similar; on opening, however, it is evident that the sample stored in the refrigerator without module has a less firm texture and pulp. This difference becomes more pronounced at T_14days, accompanied by the appearance of dark and rotten spots (no evidence of mold) on the fruits stored in the refrigerator without module.

Similar situation at T_17days: in the sample stored in the refrigerator with module, the apricot, although no longer characterized by the firmness and turgidity that characterizes the product at T0, does not show mold/rot nor stains with abnormal coloration, elements instead found on sample stored in the refrigerator without module.

3.3 CHERRY TOMATO

Cherry tomato T0

Cherry tomato T_3days

Cherry tomato T_7days

Cherry tomato T_10days

Cherry tomato T_14days

Cherry tomato T_17days

Cherry tomato T_22days

The most significant parameter proves to be the mold trend which, from T_17days, in the sample stored in the refrigerator without module, shows an increase up to 10^3 ufc/g (an order of magnitude higher than the values found in the previous steps, for both samples). The molds, after all, as known in food microbiology are typical alternants of the 'tomato' product.

As far as organoleptic characteristics are concerned, the two samples do not show significant differences until T_7days, after which the wilting defect takes over and becomes progressively more pronounced in intensity and % of spread.
At T_10days it is present on about 20-30% of the units stored in the refrigerator without module (it is absent in the cherry tomatoes stored in the refrigerator with module); at T_14days the percentage increases to about 30-40%; in the sample with module the percentage is 10-20%.

In the refrigerator without module, the increase in mold shown by analytical determinations (T_17days) also corresponds to visible mold on the samples. At T_22days, in fact, the sample stored in the fridge without module shows mold and dark spots, **not present in the product in the refrigerator with module**.

3.4 BELGIAN ENDIVE

Belgian endive T_0

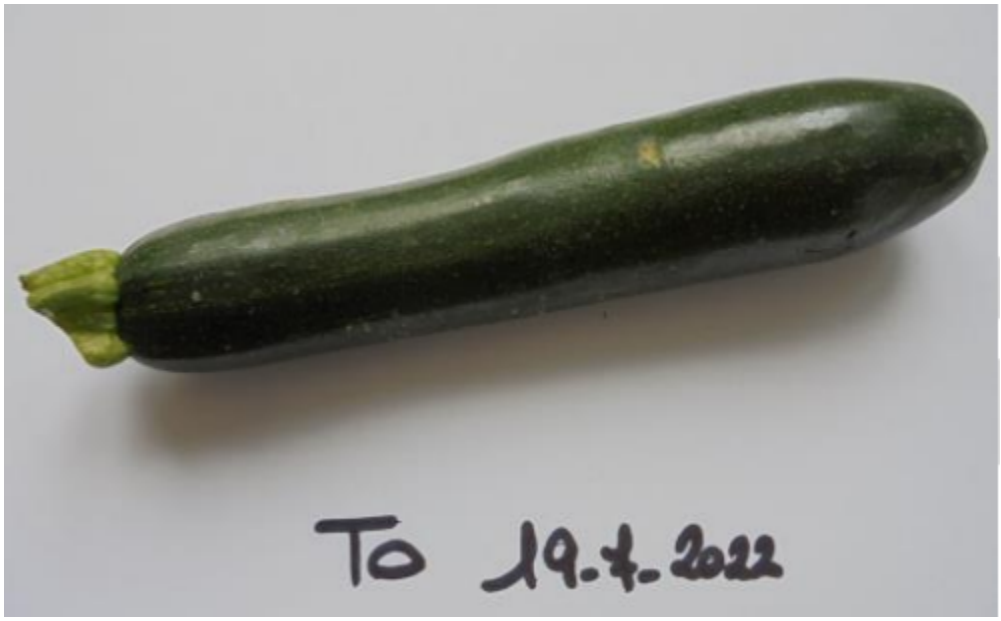
Belgian endive T_3days

Belgian endive T_7days

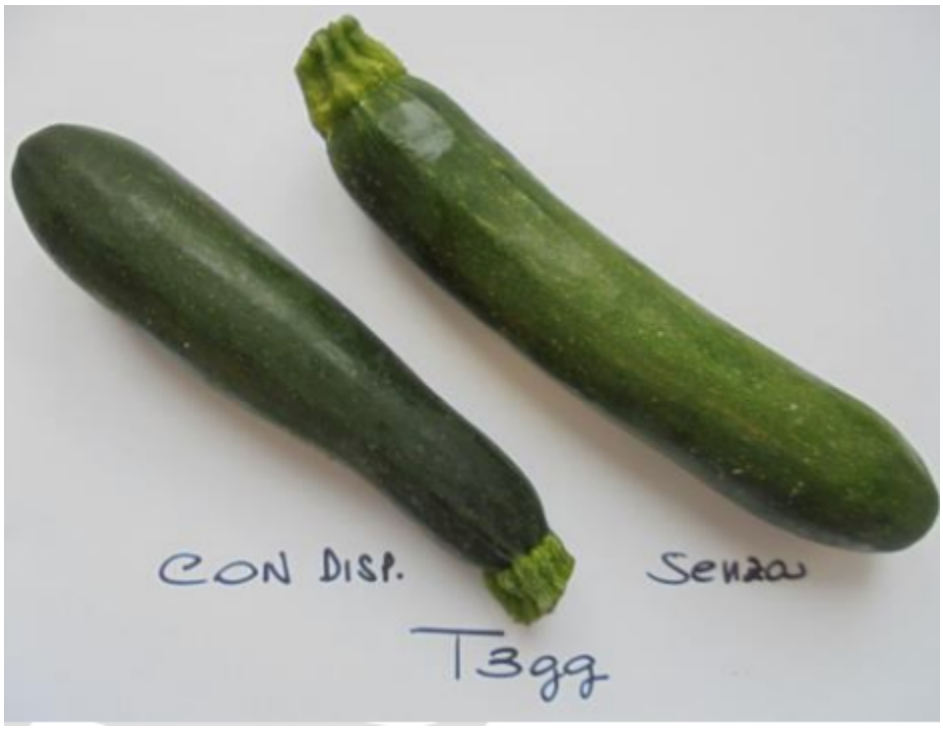
The evidence from the tests on the 'belgian endive' product identifies that bacterial contamination is higher in the sample without module than in the product with.
As far as the organoleptic characteristics are concerned, the evaluations carried out (on whole head and on partially 'flaked' head) at T_7days show that the product in the refrigerator with module was better preserved: the outer leaves are of better appearance, less 'crumpled' and dark at the edges, and at the 'flaking' test the leaves maintain a greater texture and turgidity.

3.5 ZUCCHINI

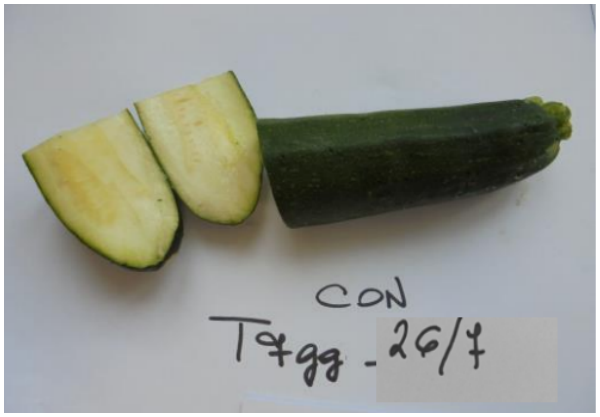
Zucchini T0

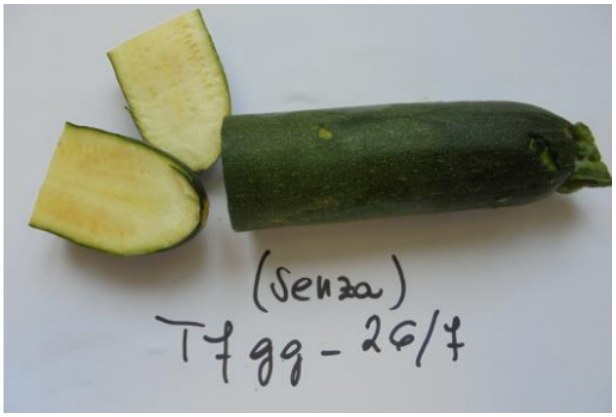


Zucchini T_3days



Zucchini T_7days



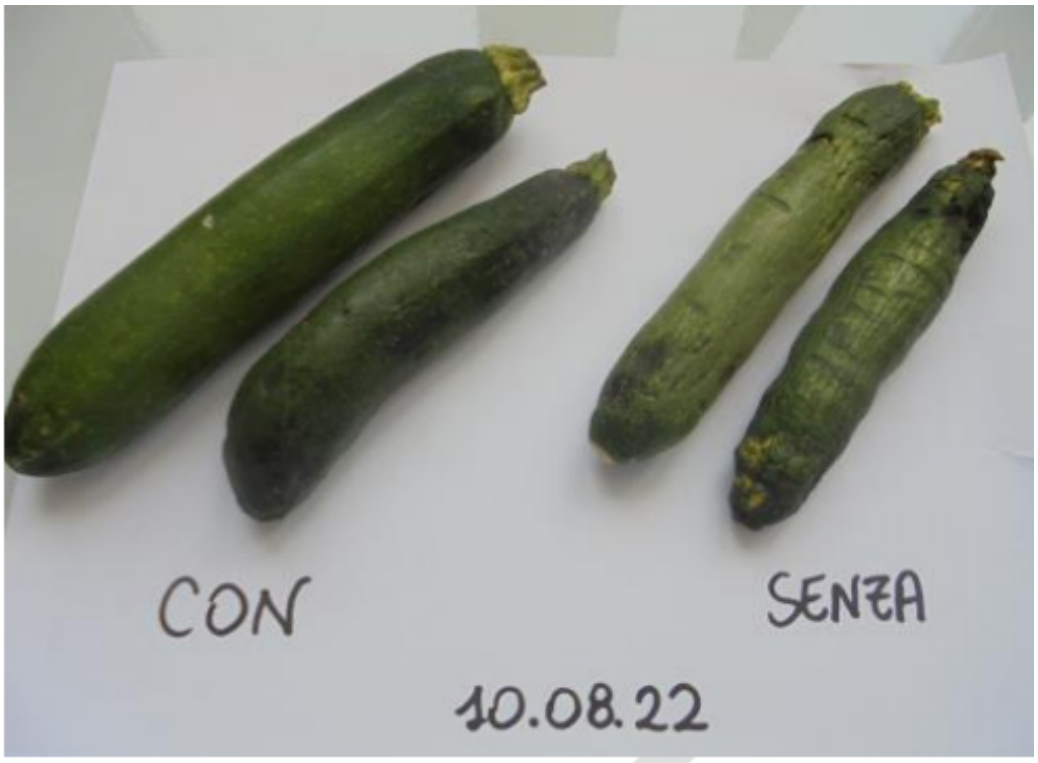


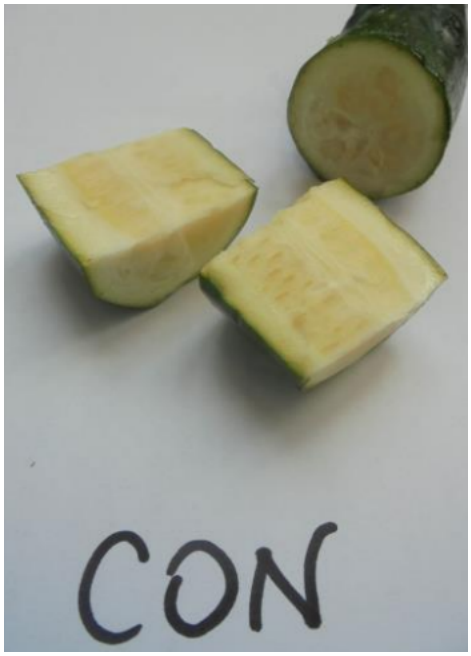
Zucchini T_10days

Zucchini T_14days

Zucchini T_17days

Zucchini T_22days





For the tested product ‘zucchini’ regarding the microbiological analysis, the parameter found to be most significant is the **total bacterial load**. Between sample stored in refrigerator with Shelfy and refrigerator without module in terms of bacterial contamination from T_17days the product stored without module has a higher microbial load by about an order of magnitude than the sample kept in the refrigerator with module.

The evidence emerged from the organoleptic evaluations show that up until T_10days the two samples are comparable, then already from T_14days the loss of turgidity and firmness becomes more pronounced in the sample stored in the refrigerator without module; this difference is already evident in the appearance, but is more noticeable when cut.
In the following steps T_17days and T_22days this difference becomes even more pronounced, as shown in the photos above.

It should be noted that until the end of the study (22 days) both samples show no visible rot / stains or mold. Despite the prolonged storage, this should be attributed to the product’s own characteristics and to the quality and freshness of the raw material used in the study.

4. CONCLUSIONS

The evidence from the present study returns **encouraging results** about Shelfie's ability to extend the shelf life of fresh food products stored in the refrigerator.

In the foods tested in the laboratory and stored in the refrigerator with the Vitesy module, it is observed that **bacterial and fungal contamination tend to be lower** (1-2 orders of magnitude) over the time period monitored than the respective products kept in the refrigerator without module.

The organoleptic evaluations show that the module is **effective in slowing** the aging of the tested products, **postponing the appearance of wilting, softening, staining and rotting**.

By resuming and summarizing the point considerations made for each reference, evaluations for Shelfie's effect on prolonging the product's shelf life, estimated as a % increase in days of shelf life, can be developed:

	Product shelf life up to ACCEPTABLE (*) level in days		
Product	**WITHOUT module**	**WITH module**	**Variation % (**)**
STRAWBERRY	3	10	***70***
APRICOT	10	17	***41***
CHERRY TOMATO	14	22	***36***
BELGIAN ENDIVE	3	7	***57***
ZUCCHINI	10	22	***55***

(*) depending on the sensory characteristics (in particular: color/appearance - texture), 'acceptable' is meant as the product that although no longer presents the typical characteristics of fresh food is still considered edible and usable for normal domestic use by the End Consumer.
(**) Calculated as: [(no. days WITH – no. days WITHOUT)/(no. days WITH)]x100

It is important to emphasize that the reported indications are for the experimental conditions adopted in the study, thus related to the storing temperature and even more to the quality (microbiological and of freshness) of the raw materials used to conduct the study.