

Summary Report

The results of this report are the property of the client. The written consent of the Fraunhofer Institute for Process Engineering and Packaging must be obtained for the reproduction of parts of the report or the publication of the results.

Determination of the impact of a natural based coating on selected quality parameters of avocados

Client: Apeel Sciences
71 South Los Carneros Road
Goleta
California

Order number: QL/1057/21

Testing period: 29.07.2021 – 13.08.2021

Date of report: 21.10.2021

The results only relate to the investigated samples and parameters.

1 Objective

The effect of an Apeel coating on selected quality parameters of avocados was investigated in comparative storage tests with uncoated fruits under standardized conditions. The main objective was to quantify the achievable shelf life extension of avocados due to the coating. In addition, the suitability of the normally used measurement methods from Apeel for quality assessment was scientifically evaluated.

2 Main findings and conclusions

Shelf life prolongation of Avocados:

- A comparative storage test with three batches of avocados (coated and uncoated fruits) were carried out at a temperature of **21°C and a relative humidity of 72%**. The avocados were stored in trays under defined exposure to daylight lamps and regularly evaluated with regard to the following parameters: Weight loss (scale), respiration rate (measuring chamber with CO₂ sensor), firmness (durometer), internal and external quality (image evaluation).
- The most important quality factors of avocados from a customer perspective are the **firmness and the optical appearance** of the fruit. Avocados that are too soft or have optical defects such as visible rot are not accepted by the customers. **For firmness, a critical shore value of 40 ° was defined in order to determine the limit of shelf life.**
- **Apeel coated avocados** reached the **critical shore value after an average of 15.9 days**. **Uncoated avocados** stored under the same conditions reached the critical shore value after an **average of 13.1 days**.
Based on the obtained results regarding the firmness measurement, **the shelf life extension due to the Apeel coating was on average 2.8 days (22%) under the considered test conditions.**
- The **internal and external appearance** of the avocados were evaluated regularly (after 8, 12, and 16 days). **Avocados with an Apeel coating showed less rot on the inside and outside of the fruits during storage compared to uncoated avocados under the same conditions.**

Assessment of Apeel test methods:

- The **Apeel coating had direct implications on the respiration rate (CO₂ production), which was significantly reduced by 34% on average**. The used measuring chamber for the CO₂ production rate showed reliable results in just 15 minutes. This experimental setup appears to be well suited for a quick

determination of the respiration activity. The effectiveness of the coating in different steps of the value chain can be demonstrated with this approach.

- **The mass loss of the avocados showed also significant lower values for the Apeel coated samples. The difference was 21% on average.** The measurement of the mass loss takes longer until reliable results are obtained. At least 5 days are needed to obtain a statistically significant result. Using a preferably sensitive scale shortens the period for analysis. A fast measurement, comparable to the respiration rate, is not possible.
- The **measurement of the firmness** was carried out with a handheld durometer. Even though the measurement of the firmness was carried out two times per fruit, the measured values of some fruits showed a strong fluctuation. Such variable results may be caused by the inhomogeneity of individual avocados or also irregularities in the manual measurement. For more precise firmness measurements of avocado fruits, it is recommended to further standardize the method.

3 Signature

Fraunhofer Institute for Process Engineering and Packaging IVV

Freising, October 21, 2021

**Peter
Muranyi**
Digital
unterscriben
von Peter Muranyi
Datum: 2021.10.21
15:50:35 +02'00'

Dr. Peter Muranyi
(Deputy head of the Department Retention of Food Quality)

**Thorsten
Tybussek**
Digital
unterscriben von
Thorsten Tybussek
Datum: 2021.10.22
15:50:54 +02'00'

Thorsten Tybussek
(Department Retention of Food Quality)