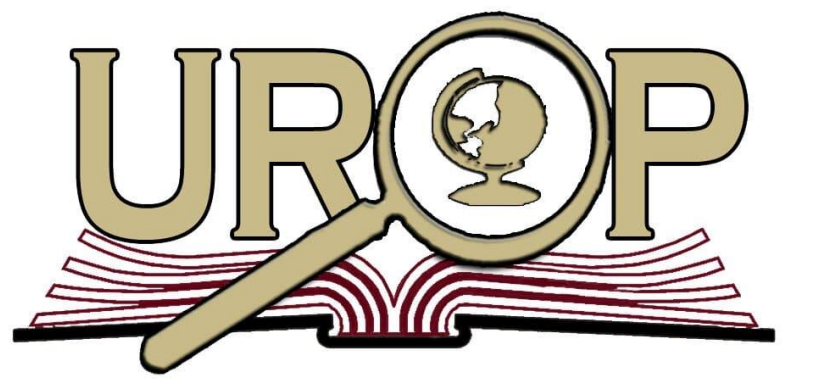# Determining Produce Freshness Using Smartphone Imaging and Machine Learning

Samuel Willert, In-Hwan Lee, Ojasvini Sharman, Zhengao Li, Luyao Ma*

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Background

In America alone, it is estimated that **30-40% of our entire food supply is wasted**, including 50 percent of all produce, fruits, and vegetables grown. This could be because there is a significant lack of awareness of how to store fruits and vegetables correctly, to ensure lasting freshness and preservation of color, firmness, and taste. The focus of this project is to develop a machine learning tool that can be used by consumers as well as commercial kitchens, that can help foster a greater understanding of shelf life and factors affecting the freshness of various produce items and it begins with the avocado. Avocados are ideal for this type of experimentation, as they gradually develop a distinct color change, loss of firmness, and difference in taste with ripening. The database collected during the experimentation phase of this project will serve as a strong basis for future endeavors into artificial intelligence (AI)-assisted food science.

Methods

- As the avocado ripens, the green and yellow colors deteriorate, and the firmness decreases.

- **Smartphone-based imaging technique** was developed to determine freshness. A smartphone camera was used to capture images of the surfaces of the avocados over time, which an AI model for similar specifications will analyze. Based on the image database, the AI model will be developed to recognize patterns in color values of images and associate these with a label of freshness level on a scale from 1 to 5.

- The results were **validated** by a conventional colorimeter and texture analyzer. The colorimeter and texture analyzer provide information on the physical aspects of the fruit.
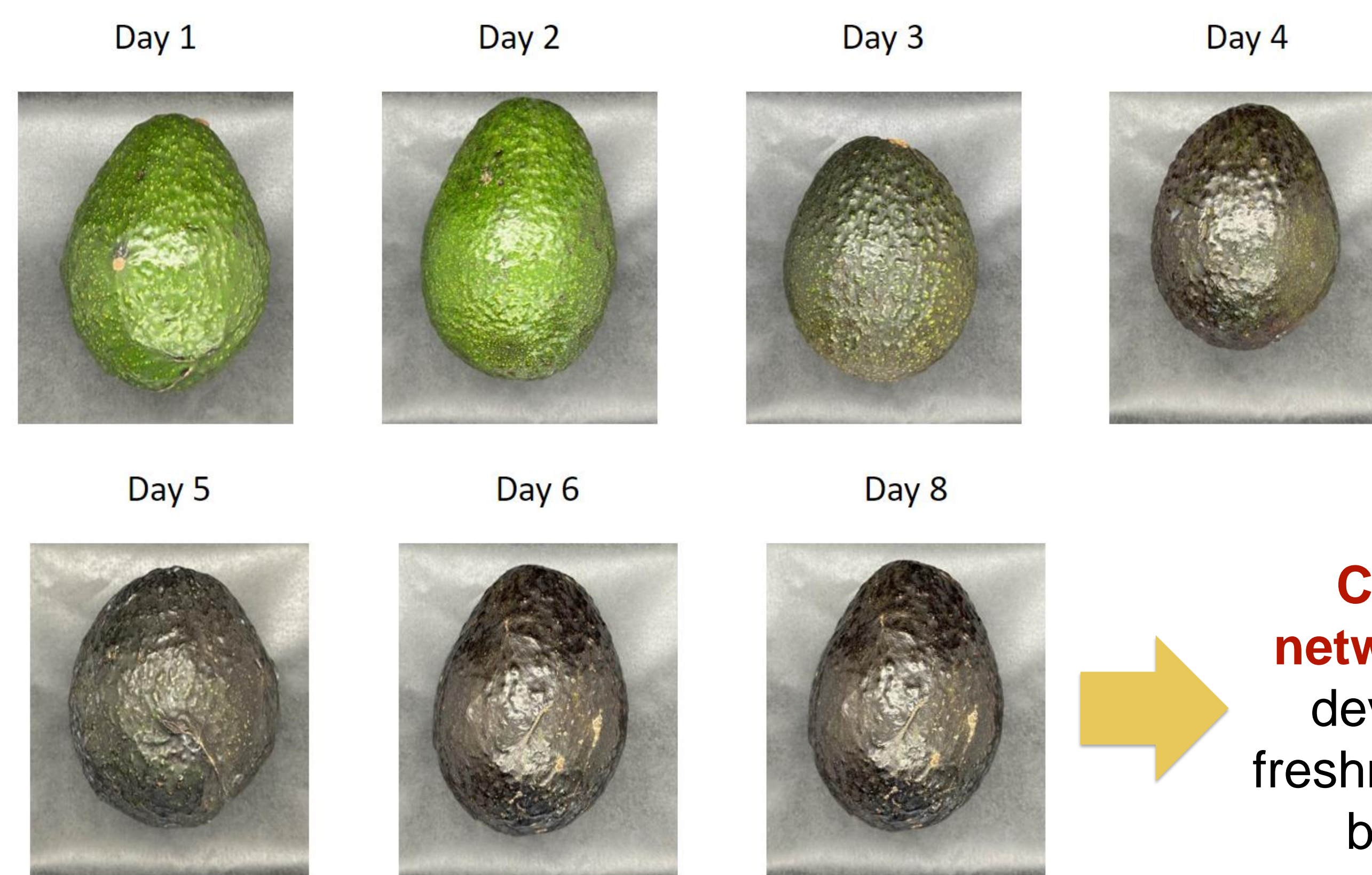
Results

Figure 1. Representative images of avocados were obtained using a smartphone.

Convolutional neural network ResNet50 is being developed to classify the freshness stages of avocados based on the images.
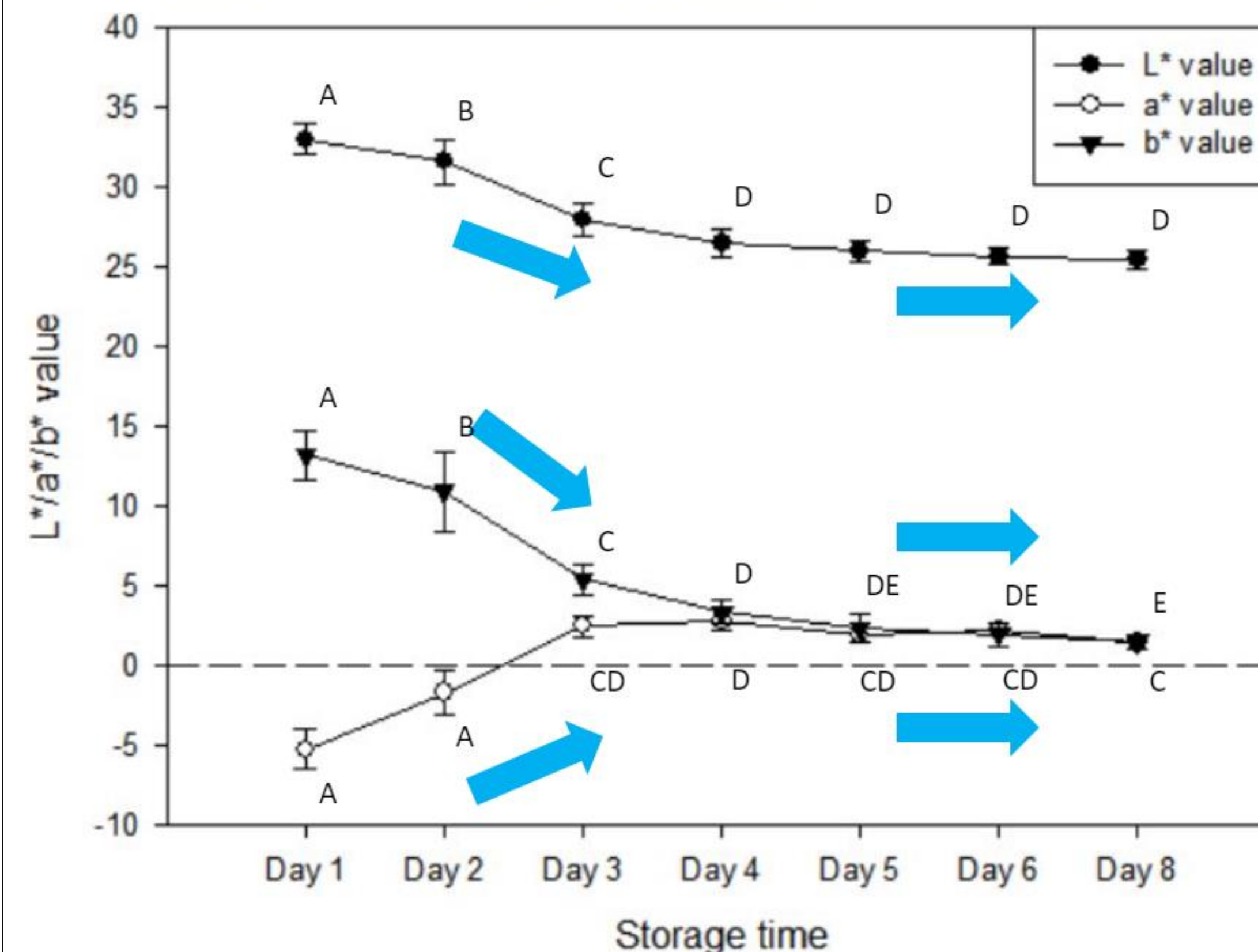

Figure 2 depicts the colorimeter results for an 8-day period. The L* value represents lightness, the a* value represents the green/red spectrum, and the b* value represents the yellow/blue spectrum. There was an increase in the red value and a decrease in the lightness.

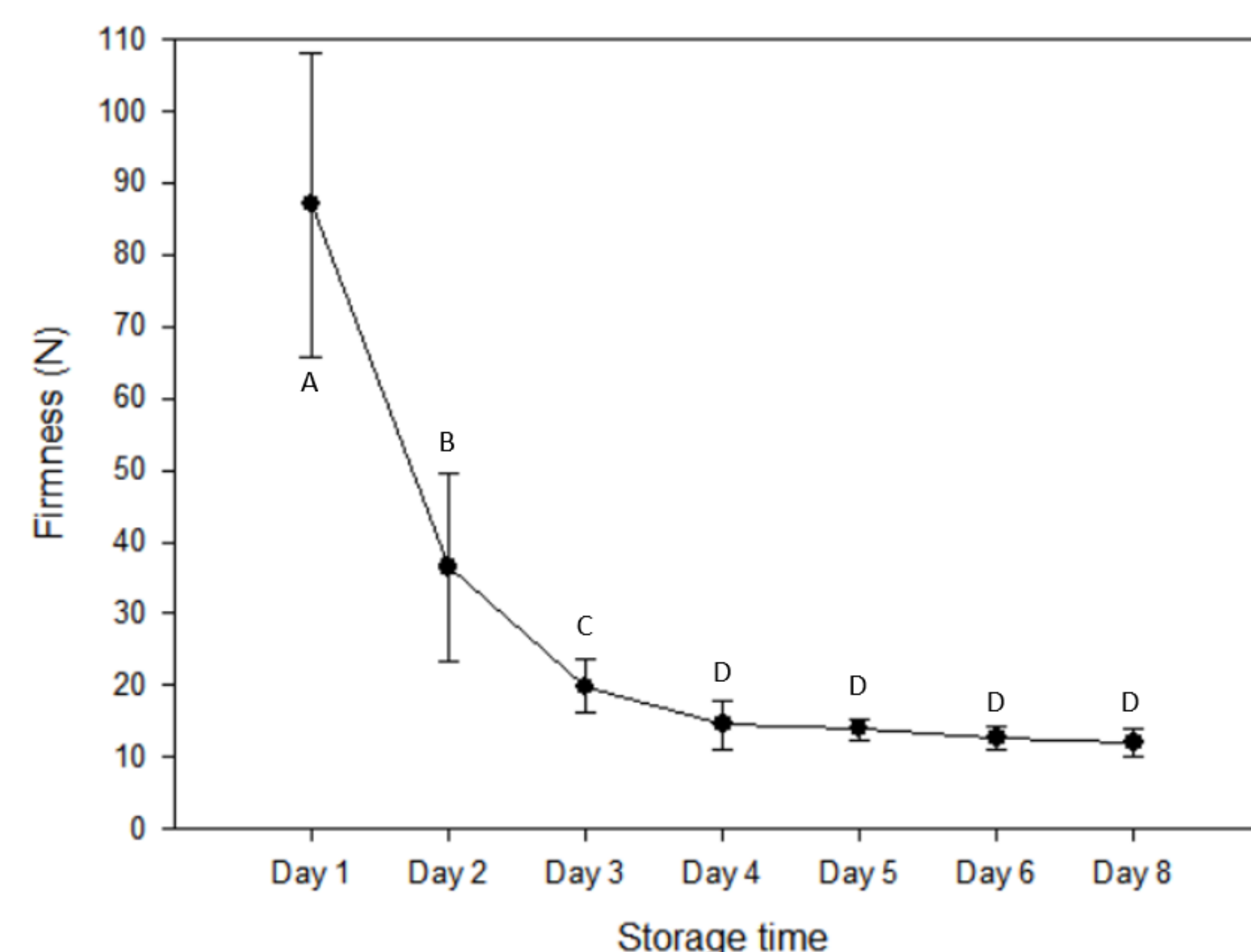**Figure 2.** Kinetic color changes of avocados during room-temperature storage.

In **Figure 3**, the firmness results of avocados stored at room temperature are shown. As shown in the figure, the firmness of the avocados decreased with seemingly logarithmic decay, where the firmness decreased sharply over the first few days, and at a slower rate later in the week.

Figure 3. Firmness trend of avocados during room-temperature storage.

Discussion

We will continue this project by creating an application that can use our machine learning model to predict the freshness and/or ripeness of different types of produce.

The first step is calibrating the AI to test the color values of avocados, and then we may work on other fruits and vegetables.

Applying our work with machine learning and freshness determination to a smartphone application could give the public access to a helpful tool encouraging observation of shelf life and earth-friendly practices to help eliminate food waste.

Acknowledgements

References

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