Detecting ethylene, the fruit ripening hormone

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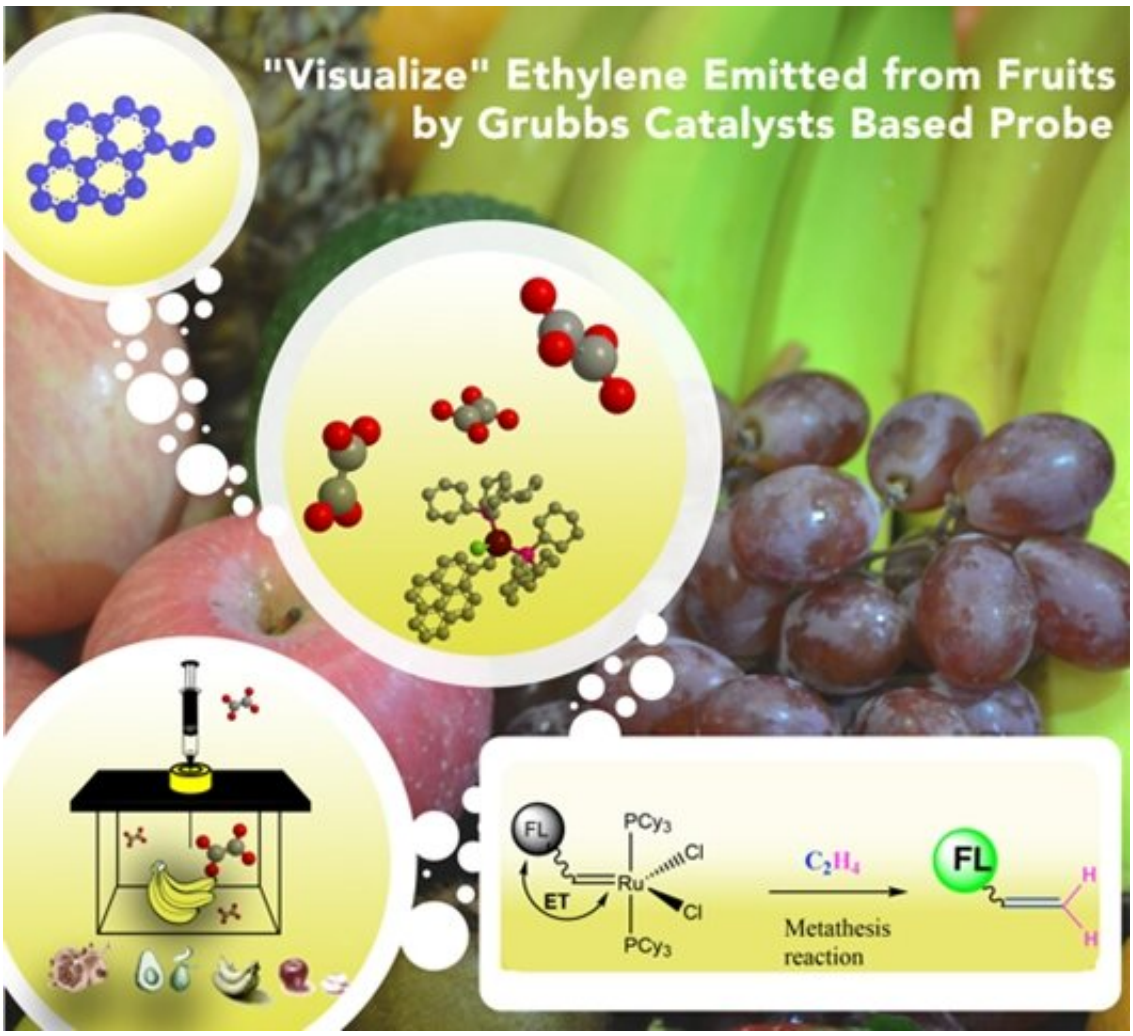

Figure shows the potential application of using the fluorescent probe for the detection of ethylene gas during the ripening processes of fruits. In the presence of ethylene gas, the fluorophores in the probes are activated and give an increased signal.

Ethylene is a gaseous plant hormone which regulates a wide range of biological processes in plants. It is associated with the ripening processes in a number of fruits such as apples and pears. Better understanding of the effects of ethylene concentration on the ripening process can lead to improved management of fruit harvesting, storage and transportation. However, current methods used to measure ethylene gas are time-consuming and rely on sophisticated instrumental methods. These methods include gas chromatography and photoacoustic spectrometry.

A research team led by Prof Huang Dejian from the Food Science and Technology Programme at the Department of Chemistry, NUS has developed fluorescent probes which provide a convenient way to visually detect the presence of ethylene gas released from the fruit ripening process through a simple fluorescence microscope. The probes are developed from a class of transition metal carbene complexes known as Grubbs catalysts and can detect ethylene up to a level of 0.9 ppm (parts per million) in air. In the presence of other possible gaseous species which may also be emitted by ripening fruits (e.g. carbon dioxide, sulphur dioxide and hydrogen sulphide), the research team found that the effectiveness of the probe in detecting ethylene gas is not affected, showing that the probe is selective. This probe could be used to determine the ethylene formation during fruit ripening to determine the fruit maturity levels for harvesting and storage.

The probe contains weakly fluorescent molecules which are activated when exposed to ethylene gas. The colour intensity increases when more ethylene gas is detected. The research team used the probe to monitor the ethylene gas emitted by four different types of fruits (passion fruit, avocado, banana and apple) and found that the ethylene release rate increases linearly with storage time. Their results are consistent with previous studies using other detection methods, showing the application potential of the probes.

Prof Huang said, "This research opens up a new avenue for the application of Grubbs catalysts in the bioanalytical chemistry of ethylene, which is important for plant biology, agriculture and the food industry."

More information: Mingtai Sun et al. Rapid and Visual Detection and Quantitation of Ethylene Released from Ripening Fruits: The New Use of Grubbs Catalyst, *Journal of Agricultural and Food Chemistry* (2018). DOI: 10.1021/acs.jafc.8b05874

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