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Professors Kyobin Lee and Jae Gwan Kim's research team develops a rapid measurement method to determine freshness of beef by using artificial intelligence optical technology

- Food freshness, which is directly related to quality as well as the taste of food, is the most important factor in making a purchase decision by consumers. Korean researchers have proposed a new way to measure the freshness of beef by utilizing artificial intelligence optical technology.
- GIST (Gwangju Institute of Science and Technology, President Kiseon Kim) School of Integrated Technology Professor Kyobin Lee and Department of Biomedical Science & Engineering Professor Jae Gwan Kim's research team developed a deep-learning-based technology that can measure the freshness of meat quickly and without damage by extracting myoglobin* information.

* myoglobin: a protein found in mammalian muscle tissue that turns red when combined with oxygen

- The research team confirmed through diffuse reflectance spectroscopy* that the freshness decreases when meat is stored for a long time along with changes to the spectral and myoglobin information, which were successfully learned and classified by deep learning models.



- * diffuse reflectance spectroscopy: a technique in which white light is irradiated onto a sample and then a spectroscope analyzes the reflected scattered light to determine the composition of the sample
- There are methods, such as chemical analysis methods or microbiological analysis, to measure the decrease in meat freshness, but both methods take a long time and the meat is damaged during the measurement process. Another disadvantage is that the accuracy of the measurement results can vary greatly depending on the skill level of the experimenter.
 - To overcome these limitations, recent studies have been conducted to quickly measure freshness while minimizing damage to the meat as much as possible. Most require expensive equipment that have complex systems along with the limitation of only being used in environments where the temperature and humidity can be controlled due to the sensitivity of the measurements.
- The research team succeeded in solving these problems by applying diffuse reflectance spectroscopy, which is widely applied in the field of biomedical engineering, in combination with deep-learning, which is widely applied in various fields.
 - Diffuse reflectance spectroscopy systems have the advantage of being relatively simple to configure with spectrometers, white light, and optical fiber along with having relatively low cost for the overall system. In addition, unlike previous studies, it was proved through experiments that it was robust to surrounding environments such as temperature and humidity by selectively using a wavelength band that has little influence from water.
- Professor Kyoobin Lee and Professor Jae Gwan Kim said, "The techniques developed in this study address limitations of existing meat freshness measurement methods, such as long measurement times, damage to the beef in the measurement process, and errors in the results due to an experimenter's lack of proficiency. Because it can be used in a normal environment at a relatively low



price, we expect it to have a wide range of applications in the food safety sector in the future."

- This research was led by GIST Professor Kyoobin Lee and Professor Jae Gwan Kim and was conducted by Ph.D. student Sungho Shin (co-first author, School of Integrated Technology) and Yongjoo Lee (co-first author, Department of Biomedical Science & Engineering) with support from the GIST Research Institute (GRI), the National Research Foundation of Korea, and the Technology Innovation Program funded by the Ministry of Trade, Industry & Energy and was published online on February 23, 2021, in *Food Chemistry*, a prominent international journal in the field of food science and technology.

