QUICK DETERMINATION OF MEAT COLOR, METMYOGLOBIN FORMATION AND LIPID OXIDATION IN BEEF, PORK AND CHICKEN BY NEAR-INFRARED SPECTROSCOPY

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Meat becomes brown and rancid during storage in the refrigerator and display in the case. Color changes, metmyoglobin formation and lipid oxidation are the important problems in the transportation / distribution of meat and retail display. The freshness of meat is determined by the sense of vision and smell. Since conventional method determining lipid oxidation is time consuming and destructive (it needs to homogenize meat with reagents, filtrate, time for reaction and read optical density using spectroscopy), more rapid and nondestructive technical tools are desired. The objective of this work was to evaluate near-infrared spectroscopy as an analytical tool for determining meat color, metmyoglobin formation and lipid oxidation in beef, pork and chicken.

Semitendinosus and longissimus thoracis muscles from six beef steers, biceps femoris and longissimus thoracis muscles from twelve LWD crossbred pigs, and superficial pectoral muscles from twenty-four broilers were used.

About a 5-cm diameter and 1-cm thick sample (20.0g) was cut from the muscle and placed on plastic foam, over-wrapped with PVC film, and displayed under flourescent lights at 4 degrees C. during 10 days for beef and pork or 4 days for chicken. The spectra was measured by NIRSystems Model 5500 Spectrophotometer using fiber optic scan at range of 400 - 1100 nm. Data were recorded at 2 nm intervals and 10 scans / 10 sec were averaged for every sample. Data obtained were saved as log 1/Re, where Re is the reflectance energy, and then mathematically transformed to second derivatives to reduce effects of differences in particle size. L*, a* and b*, and metmyoglobin formation were determined by conventional spectrophotometer using the integrating sphere unit. 2-Thiobarbituric acid reactive substances (TBARS) were measured for lipid oxidation. A multiple linear regression was used to find the equation which would best fit the data. The number of wavelengths used in the equation was selected based on the fewer number compared to the increasing multiple correlation and Decreasingg standard error.

In beef, the multiple correlation coefficients (R) for a* and metmyoglobin formation were high (R=0.963 and 0.991, respectively), but slightly lower for L* and TBARS (R=0.870 and 0.891, respectively). The first selected wavelengths for a*, metmyoglobin formation and TBARS were in the same region. This could be explained that first selected wavelength for metmyoglobin formation was near the maximum absorption band of metmyoglobin, and that these values highly correlated ($P<0.001$) with each other. In pork, the multiple correlation coefficients for L*, a* and metmyoglobin formation were high (R=0.929 to 0.965), but relatively lower for TBARS (R=0.814). In chicken, the multiple correlation coefficient for metmyoglobin formation was high (R=0.967), but relatively lower for L*, a* and b* (R=0.825 to 0.896). The first selected wavelength for metmyoglobin formation was similar to that in pork. An near-infrared spectroscopy can enable quick determination of meat freshness in points of color changes, metmyoglobin formation and lipid oxidation.