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Assesement of Color Analysis of Longissimus Dorsi Muscle in Aubrac Beef: Surface and Cross-section

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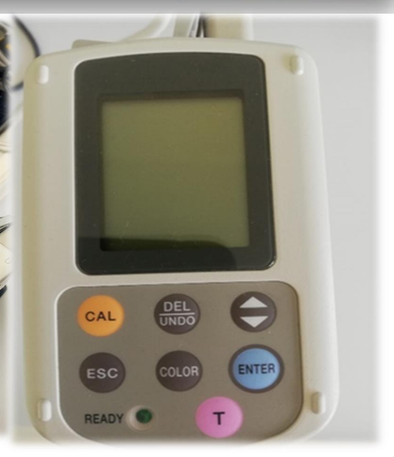
Abstract: The aim of this research was to analyze the color of the longissimus dorsi muscle, both on the surface and in cross-section, obtained from Aubrac cattle. The analysis was conducted over a period of 3 days, starting from day 0 with fresh meat, followed by analysis after 24 and 48 hours to observe color changes that occur over time. Meat color measurements involve two basic methods: human visual appraisal and instrumental analyses. The study was conducted using the Konica Minolta Chroma Meter CR-410, a reflection spectrocolorimeter that functions to measure the color of the sample in colorimetric scales such as L*a* b*. Regarding the luminosity of the meat, a value of 32.02 L*(C) was recorded, indicating a moderate level of brightness. The average value of approximately 10.39 a*(C) on the green-red axis suggests that the meat hue tends towards red. Additionally, the color intensity value on the blue-yellow axis was approximately 3.95 b*(C), leaning towards a yellow color. In summary, the accurate assessment of meat color using advanced instruments enhances our understanding of meat quality, enables product optimization, and facilitates troubleshooting of color-related issues, ultimately ensuring the delivery of high-quality meat products to consumers.

Introduction

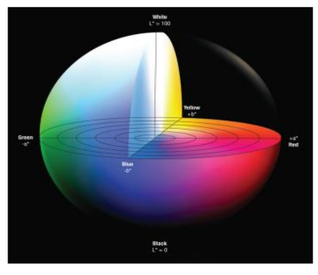
The color of meat is a significant factor in determining its quality for consumers. It is influenced by the concentration and properties of myoglobin and, to a lesser extent, hemoglobin pigments present in the meat. The proportion of myoglobin in muscle, comprising 80-90% of total pigments, varies depending on factors such as species, breed, sex, age, muscle type, and level of physical activity. Fresh meat contains three distinct forms of myoglobin: the reduced form (deoxymyoglobin) appears purplish, the oxygenated form (oxymyoglobin) exhibits a bright red color, and the oxidized form (metmyoglobin) appears brown**.**

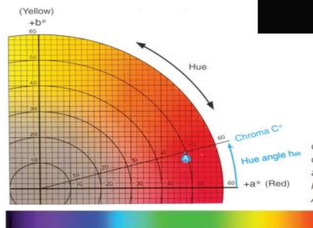
Material and method

The color analysis of beef samples was conducted using the Konica Minolta Chroma Meter CR-410. This device is a reflection spectrocolorimeter designed to measure the color of the sample using colorimetric scales such as XYZ, Lab*. With a measurement area of 50 mm, the Chroma Meter CR-410 is suitable for assessing both reflected color and color differences across a wide range of industrial fields. It can operate independently, displaying the data on its screen and storing it in its memory (with a storage capacity of up to 1000 readings), or it can be connected to a computer for data display and storage through a dedicated software called SpectraMagicTM NX.

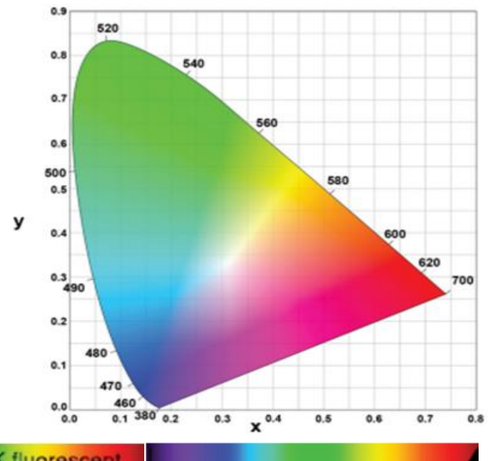


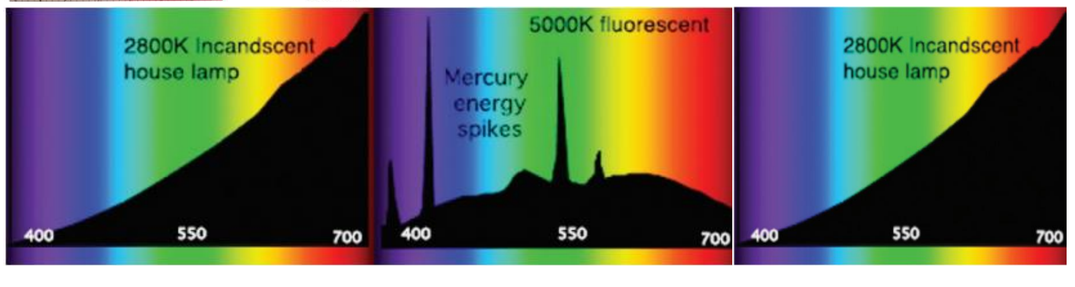
Representation of color solid for CIE L*a*b* color space. *Image courtesy of Konica Minolta Sensing Americas.*





An illustration of hue angle and chroma C* (saturation index) within part of a chromaticity diagram. Point A is the plot of CIE a* (47.63) and CIE b* (14.12). *Image courtesy of Konica Minolta Sensing Americas.*





Results and discussion

The development of the CIE Lab* color space has enabled the expression of colors in a three-dimensional space. Due to the optical response of the human eye to blue, green, and red colors, calculations converted these responses into L*, a*, and b* values. When combined, they establish a three-dimensional color space. In this color space, a* values are represented on the X-axis, b* values on the Y-axis, and L* values on the Z-axis. The center of the color space represents neutral gray. Along the a* axis, positive values indicate red, while negative values indicate green (ranging from +60 for red to -60 for green). Along the Y-axis, positive values represent yellow, while negative values represent blue (ranging from +60 for yellow to -60 for blue). The third dimension, L*, is represented numerically, where 100 represents white and 0 represents black. For this color space, a* and b* values can be graphically plotted to determine the color or hue of a meat sample. Using the L* value, the brightness of the sample can be determined. The color of fresh meat is determined by the relative abundance of these three forms. Antemortem factors can impact meat color through various mechanisms, including changes in muscle pH and the redox chemistry of myoglobin. For instance, an animal's diet can affect its metabolism, glycogen storage, pH levels, cooling rate, and the accumulation of antioxidants, all of which influence meat color. This can be observed when comparing the color of meat from animals raised on grass-fed diets versus grain-fed diets. Carcasses from grain-fed animals cool at a slower rate and have higher muscle temperatures shortly after slaughter. This promotes glycolytic enzyme activity, pH reduction, protein denaturation, and increased brightness in the muscles of grain-fed animals compared to those fed on pasture. Additionally, diets based on forage tend to encourage oxidative metabolism in muscles rather than anaerobic metabolism and affect glycogen storage.

Conclusions

In conclusion, the color of beef is a vital quality indicator for consumers and a key aspect of meat research and product development.