



Mass Spectrometric Evidence of Aldehyde Adduction in Beef and Pork Carboxymyoglobins

S. Li, M. N. Nair*, C. M. Beach, and S. P. Suman

University of Kentucky, Lexington, Kentucky, KY, USA

Keywords: carboxymyoglobin, lipid oxidation, meat color stability
Meat and Muscle Biology 1(2):153

doi:10.221751/rmc2016.146

Objectives

Modified atmosphere packaging (MAP) containing carbon monoxide (CO) is employed to stabilize and improve color of fresh red meats. CO binds with myoglobin to form carboxymyoglobin (COMb), which provides consumer-desirable bright cherry-red color to fresh meats. Although lipid oxidation-induced discoloration in COMb has been documented, the molecular basis for interactions between lipid oxidation products (i.e., reactive aldehydes) and red meat COMb has not been investigated. Therefore, our objective was to characterize the adduction of 4-hydroxy-2-nonenal (HNE), a model aldehyde, in beef COMb and pork COMb at typical meat storage condition.

Materials and Methods

Myoglobin was purified from beef and pork cardiac muscle tissue. Deoxymyoglobin was prepared by sodium hydrosulfite-mediated reduction of myoglobin in 50 mM sodium citrate buffer (pH 5.6). COMb was prepared by bubbling deoxymyoglobin with a gas mixture containing 0.4% CO, 30% CO₂, and 69.6% N₂ for 40 min. Beef COMb (0.15 mM) and pork COMb (0.075

mM) were incubated with 1.0 mM HNE at pH 5.6 and 4°C (typical meat storage condition) for 8 d. Controls consisted of COMb plus an equivalent volume of ethanol used to deliver HNE. At the end of the storage, the samples were digested with trypsin, and the peptides were analyzed using liquid chromatography tandem-mass spectrometry (LC-MS/MS) for HNE adducts

Results

LC-MS/MS spectra revealed that HNE adducted seven histidines (at positions 24, 48, 64, 88, 93, 119, and 152) in beef COMb, whereas only five histidines (at positions 24, 36, 48, 64, and 119) were adducted in pork COMb.

Conclusion

These findings suggested that the molecular interactions between reactive lipid oxidation products and COMb are species-specific, and beef COMb is more susceptible to nucleophilic adduction by aldehydes than pork COMb. Additionally, the results indicated that lipid oxidation is more critical to color in fresh beef than in pork when retailing red meats in CO MAP.