PENETRATION OF SUBSTANCES INTO MUSCLE

B. KILIC and R. G. CASSENS

Dept. Of Meat and Animal Science, University of Wisconsin-Madison,
Madison, WI 53706 U.S.A.

KEYWORDS: diffusion, meat

BACKGROUND: Most previous information about penetration or diffusion of substances into meat is about salt, and the purpose was to learn about preservation. The objective of our work was to study the diffusion of dye substances and gases into meat. The results allowed us to make conclusions about the effect of species, condition of meat, characteristics of diffusate, and temperature on penetration depth and rate.

OBJECTIVE: The rationale for the work was to collect information which could be used eventually to devise procedures to optimize color stability in meat.

METHODS: Meat samples (1 cubic cm.) were placed into dye markers, removed at various time intervals, sectioned and than viewed microscopically to determine depth of penetration. To measure penetration of gases into meat, samples (8 cubic cm.) were placed in modified atmosphere packages which had 80% oxygen and 20% carbon dioxide. Samples were removed at various time intervals and gas penetration depth was measured by cutting the cube and determining the depth of the oxymyoglobin/metmyoglobin boundary. Ten beef, five pork and five lamb samples were used for experimentation.

RESULTS: Results are shown in Figures 1 and 2. Eosin (alcohol soluble) and Hemotoxylin (water soluble) dye penetration is fast initially and after one hour, the rate slows. At 3 hours Hematoxylin had penetrated 3 mm while Eosin had penetrated 4 mm. When temperature is lowered, penetration depth and rate of dye markers decrease. Muscle affects penetration depth (dye penetrates deeper in semimembranosus compared to semitendinosus).
Oxygen penetration rate is similar to dye markers being rapid initially and then slowing. Texture and aging of muscle do not have an effect on oxygen penetration into beef, lamb, and pork. Penetration depth of oxygen is affected by species; at 26 hours, it is 10 mm for beef, 5 mm for pork and 3.5 mm for lamb.

REFERENCES:

FAUSTMAN, C. and CASSENS, R. G. 1989. Strategies for improving fresh meat color. 35 th International Congress of Meat Science and Technology. Copenhagen Denmark. proceedings. Vol.II, 446-453.

KROPF, D. H., HUNT, M. C. and PISKE, D. 1986. Color formation and retention in fresh meat. Meat Ind. Res. Conf. proceedings.pp. 62.

LAUTENSCHLAGER, R. 1995. Diffusion of Sodium Chloride and Sodium Nitrate in Raw Meat Model Systems. 41 th International Congress of Meat Science and Technology. San Antonio U.S.A. proceedings. Vol.II, 507-508.

RAMOS, E. A. P. A., GONZALES-MENDEZ, N. F., CAMOU, J. P., SILVEIRA, M. I., MARTINEZ, J. A. and CUMPLIDO, L. G. 1995. Diffusional Study on Sodium and Potassium Chloride in Fresh Bovine and Porcine Muscle. 41 th International Congress of Meat Science and Technology. San Antonio U.S.A. proceedings. Vol.II, 505-506.

TAYLOR, A. A. 1972. Gases in Fresh Meat Packaging. Meat World 5, 3-5.

VEGA, L. 1993. Effect of Feeding High Level of Vitamin E to Beef Bulls on the Color Stability of Meat

Packaged in Modified Atmospheres. Dissertation, 1-3.

ZARITZKY, N. E. and BEVILACQUA, A. E. 1988. Oxygen Diffusion in Meat Tissues. Int. J. Heat Mass Transfer. Vol.31, 923-930.

ZHAO, Y., WELLS, J. H. and McMILLIN, K. W. 1994. Applications of Dynamic Modified Atmosphere Packaging Systems for Fresh Red Meats: review. J. Muscle Foods. 5, 299-328.

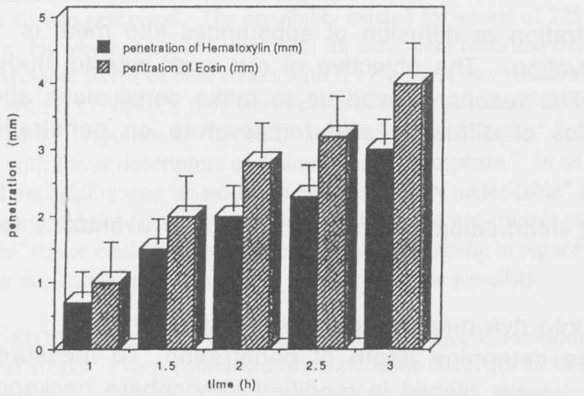

FIG. 1 PENETRATION RATE AND DEPTH OF HEMATOXYLIN AND EOSIN INTO BEEF MUSCLE

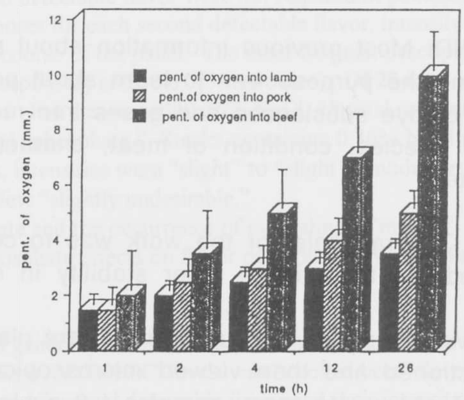

FIG. 2 COMPARISON OF PENETRATION RATE AND DEPTH OF OXYGEN BETWEEN SPECIES