ICR0160

MODELING OF COUPLED HEAT AND MOISTURE TRANSFER IN BEEF CARCASS CHILLING

F.J. Trujillo[1] and Q.T. Pham[2]
School of Chemical Engineering and Industrial Chemistry
University of New South Wales
Sydney 2052, AUSTRALIA

[1] z3017392@student.unsw.edu.au
[2] tuan.pham@unsw.edu.au

ABSTRACT

During the chilling of beef carcasses, both heat and moisture are lost from the product. Several mathematical models have been proposed to predict the heat and mass transfer process based on the calculation of the global heat (HTC) and mass (MTC) transfer coefficients. However, giving the air flow pattern in commercial chillers and the complex geometry of beef carcasses, spatial variable conditions are founded over the surface, leading to local variation of the HTC and MTC. It is also known that moisture and heat movements are strongly coupled at the surface of the meat, each influence the other and have strong effect on the spoiling of bacteria. Thus, a CFD model using finite volumes has been built to model both the heat and mass transfer processes during the chilling of beef.

However, there are many problems that must be overcome to construct the model. For instance, the heat and mass transfer phenomena happens on vastly different scales due to the big difference in heat and mass diffusivity. This scale difference makes it difficult to model the simultaneous heat and mass transfer accurately. On the other hand, the boundary condition between the beef surface and the air is more complex. The meat surface gets dry and then rewet causing a decrease in the water activity reducing the vapor pressure of the air in the interface. At the same time, the temperature of the surface is reduced by effect of the heat transfer and the heat of vaporization of water, which is proportional to the local MTC. To complete the circle, the vapor pressure on the interface, which gives the driving force to the mass transfer, is also function of the temperature. Finally, the low velocity of the air founded in commercial chillers may increase the influence of the natural convection and the radiation on the calculation.

This paper will report on progress in this project approaching separately the major problems on the modeling: geometry, difference on scale between heat and mass transfer, boundary condition on the carcass–air interface, and influence of natural convection and radiation.