A quick and accurate estimation of heat losses from a cow

Abstract

The mathematical model available in the literature to calculate the skin temperature required to determine the heat loss from the body of an average cow under different environmental and skin-wetness conditions is complex and iterative. This paper presents a simplified methodology, which can be used for quick and accurate estimation of the skin temperature as well as heat loss without a detailed understanding of heat and mass transfer and fluid flow concepts. Multiple linear regression (MLR) is first used to predict the skin temperature which can subsequently be used to compute various forms of heat losses from the body of the cow. It is found that the skin temperature predicted by the correlation obtained from MLR is accurate except for a few combinations of environmental and skin-wetness conditions where in the maximum error is found to be 8·9%. However, skin temperature of a cow can be more accurately calculated using a set of simple linear relationships proposed in this paper. In addition to this, simple correlations are also presented for the calculation of convective heat and mass transfer coefficients, boundary layer thickness, and latent heat of vapourisation. The use of the proposed correlations for calculating skin temperature is illustrated through an example. It is found that the skin temperatures, and total heat losses under different environmental and skin-wetness conditions predicted by the proposed methodology agree very closely with those available in the literature.