

Application of fuzzy logic on correlation between piglet's surface temperature and thermal comfort for Piracicaba

Aplicação da lógica fuzzy na correlação entre temperatura superficial de suínos em fase de creche e conforto térmico para região de Piracicaba

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The constant influence of the human-being in animal management activities, besides increasing the cost of production, becomes a source of animal stress; which generates the most important signs of the process, acting as a bio-sensor that needs to be measured in a continuous and direct way. From the many available options to obtain an animal temperature parameter, the measurement of external temperature proves to be a less invasive method. Fuzzy system, based on fuzzy logic, works with inaccurate information and converts them into a mathematical language with easy computational implementation. Therefore, this work aims to use fuzzy logic as a tool for assessing the degree of swine thermal comfort, using variables data entry related to the environment and the animal. For this purpose, a simulation using Microsoft Excel software was performed with the possible environmental conditions of the region of Piracicaba (Dry Bulb Temperature - T_s and Relative Humidity - UR), interacting with the local altitude (z) and potential tympanic piglets temperatures (TiF) using equations 1 and 2 adapted from Mostaço (2014):

$$TR = 41,6 + 0,0213 * (1,006 * T_s + \frac{UR}{719,85 * (1 - 2,22 * 10^{-4} * z)} * 10^{\frac{7,6 * T_s}{1000000}} * (71,28 + 0,052 * T_s)) - 0,0941 * TiF \quad (1)$$

$$FR = 297 + 2,62 * (1,006 * T_s + \frac{UR}{719,85 * (1 - 2,22 * 10^{-4} * z)} * 10^{\frac{7,6 * T_s}{1000000}} * (71,28 + 0,052 * T_s)) - 10,10 * TiF \quad (2)$$

After performing the simulations, Rectal Temperature (TR) and respiratory frequency (FR) data obtained were crossed with FR, TR and critical temperatures for condition of thermal comfort of piglets (5th to 8th week) values, proposed by Mostaço (2014) through the fuzzy logical toolbox of MATLAB software. T_s , UR and TiF were used as variables, the variable output obtained was the Thermal Comfort (TC), rated as good (situation of comfort), bad (stress due to excess or lack of heat) and very bad (death of the animal). Membership functions were generated from data, correlating all the variables that were subdivided into relevant groups; furthermore, a system of rules was generate, whereby it was possible to simulate inputs of environmental and animal characteristics, resulting the probable condition of the animal thermal comfort. The study concluded that the application of fuzzy logic provided a model of easy interpretation and adaptability, on achieving a recognized comfort degree for piglets. It proved to be able to change the rules system and membership functions, to attend other locations and other phases of growth; which indicates the possibility of developing a model that determines the occurrence of heat stress from swine body temperature and environment data, assisting in decision making and therefore improving the welfare quality and reducing production costs.

Keywords: swine, thermal comfort, fuzzy logic.