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Evaluation of the thermal efficiency of housing systems for dairy cows

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INTRODUCTION

Heat stress occurs in dairy cows when THI (Temperature Humidity Index) is higher than 72.
In high yielding dairy cows, heat stress is responsible for reduced milk production and reproductive efficiency, and for impairment of health.
In confined dairy cows, barn structures and cooling systems may mediate the effects of climate on animal performances and health.

OBJECTIVE

The aim of this preliminary work was to study at which extent two housing systems affect THI values inside cow buildings in relation to external THI.

MATERIALS AND METHODS

Two dairy cow farms were considered: A, N-S oriented, no cooling system, concrete roofing; B, NE-SW oriented, cooling system, and metal roof.
Meteorological data were collected outside the buildings (figure 1) and in 3 different areas inside the buildings (figure 2) of the two farms.

Figure 1. Weather station Vantage-Pro 2 Plus

Figure 2. Thermohygrometric data-logger (Testo instruments)

To compare the housing systems performances, it was necessary to introduce indices which measure THI differences (TD) between inside (TDI) and outside (TDO) the buildings.
THI was calculated using the formula: THI = (1.8 * dbT + 32) - (0.55 – 0.55 * RH/100) * [(1.8 * dbT + 32) - 58] were dbT is the dry bulb temperature and RH is the relative humidity.
Different TD were tested and among them the ratio between the sum of the values differences (THI>72), inside (SDI) and outside (SDO) the buildings was chosen.
When the index is higher than 1, it indicates a low microclimatic efficiency of the structure.

RESULTS

Analysis of data show that THI values recorded inside the buildings were always higher than those outside (Table 1).
The ratio of SDI/SDO was 1.33 and 1.47 for farm A and B, respectively (Table 1).
Results show that farm A (N-S oriented, no cooling system, concrete roofing) presented a better thermal efficiency respect to farm B (NE-SW oriented, cooling system present, metal roof).

	Farm "A"		Farm "B"	
	Inside	Outside	Inside	Outside
Total observations every 30'	4208	4208	4208	4208
Number of observations with THI > 72 (*)	748 (TDI)	588 (TDO)	991 (TDI)	778 (TDO)
Percentage of total observations with THI>72	17.8	14	23.6	18.5
Sum of the values differences THI > 72 (**)	2473 (SDI)	1853 (SDO)	4086 (SDI)	2782 (SDO)
Average of SDI and SDO (***)	3.31	3.15	4.12	3.58
Ratio SDI/SDO	**1.33**		**1.47**	

Table 1. Climatic and microclimatic condition recorded in two dairy farms from June to August 2007;
(*) THI differences were calculated as: TDI, (THI_{inside}>72) -72;
TDO, ($THI_{outside}$>72) -72;
(**) SDI and SDO were calculated as ? TDI and ? TDO;
(***) Were calculated as ? TDI/n observations; ? TDO/n observations.

CONCLUSIONS

The present study indicates that the orientation and/or the roof characteristics may affect thermal efficiency of housing systems for dairy cows, and that the presence of a cooling system, whose efficiency is likely to be negatively influenced by the structure type, does not necessarily improve the microclimatic conditions.

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