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The influence of design of group calf hutch on thermal comfort of housed calves

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Abstract The aim of this study was to find out and to compare microclimatic conditions in sheet-metal group calf hutches (MCH) and tarpaulin group calf hutches (TCH) and their influence on rectal temperature housed calves. Three MCH and three TCH were tested. During one year air temperature, relative humidity, air flow velocity were measured in hutches and in exterior. Rectal temperature of calves was measured in parallel. MCH, as well as TCH showed significant different temperature conditions during the spring and summer season and significant different in relative humidity in the winter season ($P<0.05$). The both type of calves hutches significantly ($P<0.05$) eliminated the air flow velocity. The rectal calf temperatures were affected negatively by the determined microclimatic conditions in THC in summer period. Combination of a low air flow velocity and continuation of higher values of the air temperature in the summer period caused a thermal discomfort for the calves housed in TCH.

Key words: *group calf hutches, microclimatic conditions, rectal temperature, thermal comfort*

Introduction

The practice of rearing healthy dairy calves in individual calf hutches has become a common management procedure. These units provide semi-isolation to minimize contact with disease organisms shed by older animals. When management and nutrition are at a high level, calf growth rate is excellent in hutches. Following weaning, at about eight weeks of age, however, calves outgrow hutches, and alternative group housing is necessary. There is generally a lack of suitable housing on dairy farms for calves of this age, and health problems often result from this move. The group calf hutch was developed specifically to provide housing for calves after eight weeks of age (Anderson, Bates, 1993, Doležal et al., 2005). The most common calf hutches are wooden calf hutches and polyethylene calf hutches (Anderson, Bates, 1993, Anonymous, 1993). Three years ago the tarpaulin was used as a new material for group calf hutches (Doležal *et al*., 2004).

Generally, all hutches must provide very good environmental conditions necessary for raising healthy calves (Pace, 2004). Properly designed hutches provide excellent natural ventilation which can further reduce incidence of respiratory diseases (Quigley, 2001).

The aim of this study was to find out and to compare microclimatic conditions in sheet-metal group calf hutches (MCH) and tarpaulin group calf hutches (TCH) and their influence on rectal temperature housed calves.

Methods

Three sheet-metal group calf hutches (MCH) and tarpaulin group calf hutches (TCH) were tested. Six calves after weaning (age from 8 weeks to 12 weeks) were kept in one hutch. Totally 432 calves were measured per year.

During one year air temperature, relative humidity (by digital thermometer TESTO 615) and air flow velocity (by digital anemometer TESTO 415) were measured in hutches (in life zone of animals) and in exterior (E). Rectal temperature of calves was measured by digital medical thermometer in parallel. Data were recorded twice weekly from 0930 to 1030 h. The obtained values were processed by Statistika Complet.cz, StatSoft, USA (ANOVA).

Results and discussion

Results are showed in Tab 1 – 3.

Tab 1 Average air temperature [°C]

	spring period	*summer period*	*autumn period*	*winter period*
MCH	12.31 ± 4.89^{A}	21.08 ± 4.52^{B}	11.23 ± 4.28	$-3{,}00 \pm 4.14$
TCH	$15.01 \pm 5.62^{a,A}$	$24.14 \pm 5.92^{b,B}$	12.21 ± 4.56	-2.19 ± 4.17
Exterior	11.98 ± 4.71^{a}	20.41 ± 4.79^{b}	10.49 ± 3.95	-4.21 ± 4.37

a,b…. between hutches and exterior ($P < 0.05$)
A,B….between hutches ($P < 0.05$)

Tab 2 Average relative humidity [%]

	spring period	*summer period*	*autumn period*	*winter period*
MCH	58.55 ± 9.89	58.91 ± 16.14	69.94 ± 12.14	59.65 ± 10.77^{A}
TCH	58.99 ± 15.32	53.41 ± 18.21	77.37 ± 10.18	73.66 ± 9.77^{aA}
Exterior	56.64 ± 12.08	58.09 ± 16.80	72.65 ± 8.68	59.18 ± 13.64^{a}

a…. between hutches and exterior ($P < 0.05$)
A….between hutches ($P < 0.05$)

Tab 3 Average air flow velocity [$m.s^{-1}$]

	spring period	*summer period*	*autumn period*	*winter period*
MCH	0.12 ± 0.04^{a}	0.17 ± 0.07^{c}	0.10 ± 0.02^{e}	0.10 ± 0.03^{g}
TCH	0.10 ± 0.07^{b}	0.11 ± 0.06^{d}	0.16 ± 0.07^{f}	0.05 ± 0.02^{h}
Exterior	0.37 ± 0.19^{a,b}	0.49 ± 0.54^{c,d}	0.32 ± 0.20^{e,f}	0.26 ± 0.11^{g,h}

a,b,c,d,e,f,g,h…. between hutches and exterior ($P < 0.05$)

Tab 4 Average rectal temperature [°C]

	spring period	*summer period*	*autumn period*	*winter period*
MCH	38. 88 ± 0.20	38.91 ± 0.21^{A}	38.73 ± 0.14	38.89 ± 0.15
TCH	38.91 ± 0.21	39.03 ± 0.25^{A}	38.80 ± 0.21	38.92 ± 0.16

A….between hutches ($P < 0.05$)

The large correlation was found between air temperature in exterior and in MCH ($r = 0.9947$; $y = 0.6016 + 0.9882*x$) and exterior and TCH ($r = 0.9860$; $y = 2.4941 + 1.0524*x$). Outdoor air temperature influenced significantly indoor air temperature in both types of hutches. Statistical differences ($P<0.05$) in air temperature were found between MCH and TCH in spring and summer period. The higher air temperature was maintained in TCH.

The large correlation was found between relative humidity in exterior and in MCH ($r = 0.9253$; $y = 9.6194 + 0.8939*x$) and exterior and TCH ($r = 0.7981$; $y = 6.4447 + 0. 9122*x$). The values of relative humidity in both hutches were influenced by outdoor relative humidity. In winter period significant difference between MCH and TCH was found out ($P < 0.05$). TCH showed the higher value of relative humidity compared with MCH. Further, significant difference between exterior and TCH was found out in winter period ($P < 0.05$).

The medium correlation was found between air flow velocity in exterior and in MCH ($r = 0.4989$; $y = 0.067 + 0.1807*x$) while the small correlation was found out between air flow velocity in exterior and TCH ($r = 0.1864$; $y = 0.0534 + 0.2652*x$). Air flow velocity was significantly ($P < 0.05$) lower in hutches compared with exterior. Both types of hutches eliminated air flow velocity velocity. No differences were found between both hutches.

The difference in rectal temperature was found in summer period. Calves housed in TCH showed significantly higher rectal temperature compared with calves in MCH. This finding are confirmed the calculated correlation between rectal temperature and air temperature. The small correlation was found out between rectal temperature and air temperature in calves housed in MCH ($r = 0.0949$, $y = 38.8508 + 0.0018*x$) while medium correlation was found between rectal temperature and air temperature in calves housed in TCH ($r = 0.2942$, $y = 38.8581 + 0.0058*x$).

The environment of modern housing system has a major influence on animal welfare, health and performance (Wathes *et al*, 1983). In our experiment difference in air temperature of MCH and TCH was evident in spring and summer period. High air temperature can create inadequate rearing environment and can affect thermal comfort of housed calves (Coleman *et al*, 1996). Also lower air flow in both hutches is not suitable and creates thermal discomfort in summer. Holmes et al. (1983), Spain and Spiers (1996) recommend good ventilation in warm climates, which is important to maintaining a comfortable environment for calves. The changes in rectal temperature are allowed to be a response of organism to the changes of climatic parameters. The significant increase of rectal temperature in calves kept in TCH evidences thermal discomfort in summer period. As well maintenance of the higher value of relative humidity in TCH can lead to the significant increase of heat loss from calf organism during the influence of lower air temperatures.

Conclusion

Tarpaulin type of group calf hutch showed worst microclimatic conditions for housed calves, especially in summer period and winter period. The changes in rectal temperature are possible to use for monitoring of thermal comfort.

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