COOLING PANEL TYPE AND LOCATION INFLUENCE NEST TEMPERATURE, GROWTH AND SANITARY STATUS OF RABBITS DURING THE COLD SEASON IN HUNGARY

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ABSTRACT

Evaporative cooling panels fitted to the wall of rabbit houses can have adverse effect on the nearby nests and newborn rabbits, especially in the cold season of continental climate as in Hungary. Changing the way of installation could prevent that. This study was performed at winter in two buildings of a commercial rabbit farm in Hungary which were different only in the way of installation of the evaporative cooling panels. In building A the panel was fitted immediately onto the wall as a single sheet, whereas in the Building B a small room was joined and the panel was fitted onto the wall of that in the form of three smaller sheets but with the same total surface. Air temperature (7.5°C vs. 14.1°C), nestbox wall temperature (14.8°C vs. 18°C), nest temperature (27.2°C vs. 28.8°C) and newborn skin temperature (35.4°C vs. 36.2°C) were significantly (P<0.001) different in building A when measured at the panel or at the end of this building (30-40 m far from the panel). This difference was not present in building B. Temperature gradients between the newborn skin and the nest, as well as between the nest and the nest box wall were high, what means that the heat flow was small and the insulation provided by the nest material was good. Installation type did not affect litter performance, even if higher probability that a kit is dying before 21 days of age was found in each building in the nest boxes placed near to the panel (0.21 vs. 0.13 in A and 0.27 vs. 0.16 in B, P<0.005). The frequency of the *P. multocida* carrier does at day 7 post partum was higher at the end (0.35) of the two buildings than in front of the panel (0.23), but the difference was not significant. In summary, fitting of cooling panel could decrease inside air, nest box wall, nest and newborns skin temperature during the cold season in Hungary. However, insulation provided by the nest material ensures a near normal body temperature even in front of the panel. Installation type of cooling panels thus could influence only inside air and nest box wall temperatures.

Key words: Rabbit, Evaporative cooling, Nest box, Temperature, Performance.

INTRODUCTION

Only few studies have been published about the microclimate inside intensively managed rabbit husbandry and its effect on performance and health of rabbits (Papp *et al*., 1987; Fier, 1994; Lenarduzzi and Da Borso, 1996). To protect rabbits from the dangerous effects of high environmental temperature, evaporative cooling panels are installed. This is a relatively cheap way of cooling the air which allows a plenty flow of filtered fresh air into the building when paired with a depressive ventilation. Hungary has a continental climate with high summer and freezing winter temperatures. Therefore, cooling the air during summer is necessary, but consequently cold air enters across the evaporative panels during winter what can cool the animals in adjacent cages. Adult rabbits having insulating fur will not suffer from this situation, but their newborns could be adversely affected. Temperature in the nest was scarcely observed as quality parameter and optimal values have been determined long ago based on minimal rate of oxygen consumption. This latter was achieved at 37°C environmental temperature for a single newborn rabbit (Hull *et al*., 1986) and at 35°C for a litter including six newborns (Papp *et al*., 1981). Recently, it was shown that the nest temperature is more dependent of the breeder who program and continuously control it. This study aimed to analyze, in field conditions, the effect of evaporative cooling panel system on nest temperature, suckling pups growth, and sanitary status of does and sucklings located at various distance of the panel.

MATERIALS AND METHODS

Buildings and experimental design

Two rabbit houses were involved in this study each different from the other only by the installation and size of the evaporative cooling panels (Figure 1).

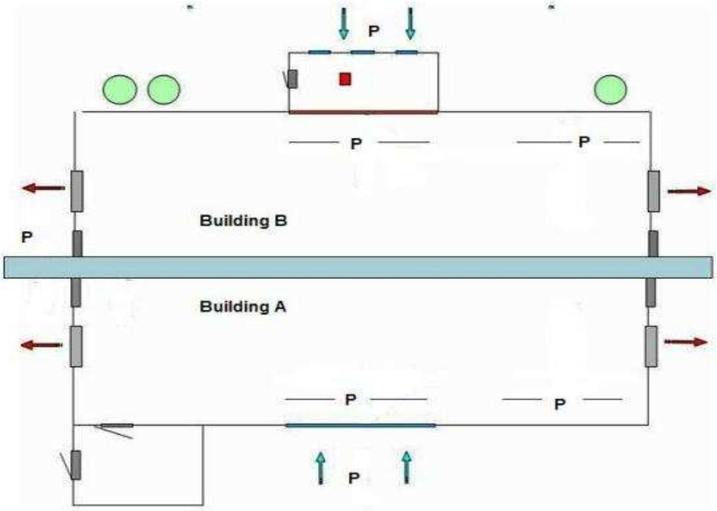

Figure 1: Not scaled scheme of building A and B (cut in half) with different installation and size of the evaporative panels. Each of the buildings has the same installation on its left and right sides. Panels are pointed by vertical arrows. Locations of vents are indicated by horizontal arrows. Arrow heads show the direction of airflow. P means control point

Both building long walls fitted with cooling panels looked to northeast and southwest direction. Length, width and height of the buildings were 90 m, 13 m and 7 m respectively. The cooling panels were 6 m long on building A, 3×2 m divided within 21 m on building B and fitted at halfway on each. Rabbits were in 8 rows of flat deck metal cages with an inner nestbox what was fenced off with a metal sheet. The between doe separators extending to the nest box area were from plastic. The nest box was prepared 2 days before the expected kindling by getting a plastic tray into and than filling it with timber shavings. Litters were equalized at 9 to 10 pups, on the day of parturition and controlled suckling was employed by the stockmen from birth to the 10th day of lactation.

Animals, performance control, temperature measurements and *P. multocida* isolation

Hycole hybrid does were reproduced in 42 day cycles. Ambient temperature inspection points were in front of the panels and at the end of the breeding unit (to 25-35 m of the panel), on left and right parts, and inside and outside of the building as shown in Figure 1. Nest temperatures and rabbit's performance were measured for cages located at the temperature inspection points, 10 for each, 2×40 in total. All measurements were performed on weeks 8th and 9th in building A, and on weeks 11th and twelfth in B because of the shift in reproduction cycle. Size and weight of the equalized litter were measured and sanitary status of individual newborns was first observed at 2 days of age after suckling. On day 7 post partum the signs of disease such as rhinitis, mucous exudates in the eye's corner or on the foreleg's fur, subcutaneous abscess, mastitis, head tilt and pododermatitis were rigorously searched on the does. Same signs completed with skin lesions and emaciation were detected on sucklings. Does nostrils were sampled for *P. multocida* isolation. *P. multocida* was isolated from cotton tipped tampons inserted 1 cm deep into the nostrils and identified as described earlier (Virág *et al*., 2004). At 21 days of age litter size was counted and litters were weighed. Mortality rate was calculated as the difference between the 2 and 21 days age litter size. Litter weight gain was calculated between days 2 and 21. Nest box and body temperatures were measured with testo 905-T1 and 905-T2 thermometers (Testo Ltd, Alton, UK). For body temperature measurement newborns were gently lifted up and held on back in the palm of the operator and the abdomen's skin was touched with the sensor. Ambient temperatures and humidity were measured with Innovalley SMSFHC04 meteorolgical station (Saint-Ouen-l'Aumone, French). Wind speed was measured by testo 405-V1 velocity measuring stick. Temperature gradients (Δ°C) were calculated as differences between temperatures measured at two points.

Statistical Analysis

All statistical evaluations were performed by GenStat software (Lawes Agricultural Trust, 1983). Temperature, size and weight data were analyzed with ANOVA procedure, using building (Bld) and location relative to the panel (LRP) as fixed effects. Side was included as block. Frequency of *P. multocida* carriage and occurrence of any disease sing at does were analyzed by GLM process and Bernoulli distribution. Probability that a newborn is becoming ill to 7 days age or dead to 21 days age were calculated with a binomial proportions model and by the same treatments defined previously.

RESULTS AND DISCUSSION

On the 8th week, outside temperature was -5°C and wind speed was 0.45 m/s. Respective data on 11th week were -1°C and 1.23 m/s (from northwest). Inside air temperature (Figure 2) in building A was lower in front of the panel (7.5°C) compared to that at the end of breeding unit (14.1°C). In building B respective temperatures were almost the same (12°C and 12.8°C). Metal and plastic nest box walls temperature (Table 1) mostly reflected the inside air temperatures measured at the control points only shifted with 2-3 °C and 4-5 °C higher respectively.

Table 1: Temperatures measured on 2 days old rabbits, in nest material and on cage walls

	Building A		Building B		SEM	Probability		
	Panel	End	Panel	End		Bld	LRP	Bld x LRP
Body temperature (°C)[1]	35.41^{a}	36.23^{b}	35.91^{ab}	36.16^{b}	0.13	n.s.	<0.001	<0.05
Nest temperature (°C)	27.24^{a}	28.8^{b}	27.77^{a}	28.70^{b}	0.30	n.s.	<0.001	n.s.
Plastic temperature (°C)	14.79^{a}	17.99^{c}	17.10^{b}	17.31^{b}	0.21	<0.001	<0.001	<0.001
Metal temperature (°C)	13.62^{a}	16.08^{c}	15.44^{b}	15.91^{b}	0.16	<0.001	<0.001	<0.001
Δ°C body and nest[2]	7.96	6.78	7.57	7.16	0.46	n.s.	n.s.	n.s.
Δ°C nest and plastic[2]	12.44^{b}	10.27^{a}	10.69^{a}	10.75^{a}	0.55	n.s.	<0.05	<0.05

[1]Measured on the skin of the abdomen near to the umbilicus. [2] Temperature difference between two surfaces (direction of heat flow is not signed)

Sole exception was at the panel of Bld A where the difference was higher (6°C for metal and 7.2°C for plastic). Metal and plastic temperature measured in front of the panel (13.62°C and 14.8°C, respectively) or at the end of the breeding unit (16.1°C and 18°C, respectively) were significantly different (P<0.001) in Bld A, but similar in building B (what explains the significant interaction). Temperature of nest material was lower in front of the panel in the two buildings (P<0.001) than at the end of the breeding unit (27.2°C and 27.8°C vs. 28.8°C and 28.7°C). These values were lower at each position than the optimal ambient temperatures for 1-5 days old rabbits (35 to 30°C) defined by Papp *et al.* (1981) in presence of siblings but above the 25°C which can cause cold stress.

In Bld A, skin temperature differed in newborns located in front of the panel or at the end of the breeding unit (35.4°C vs. 36.2°C; P<0.001). These values show good agreement with those measured by Borka and Ádám (1990) at higher (20°C) room temperatures and are close to 36.5°C considered as the lower limit (Löliger, 1984).

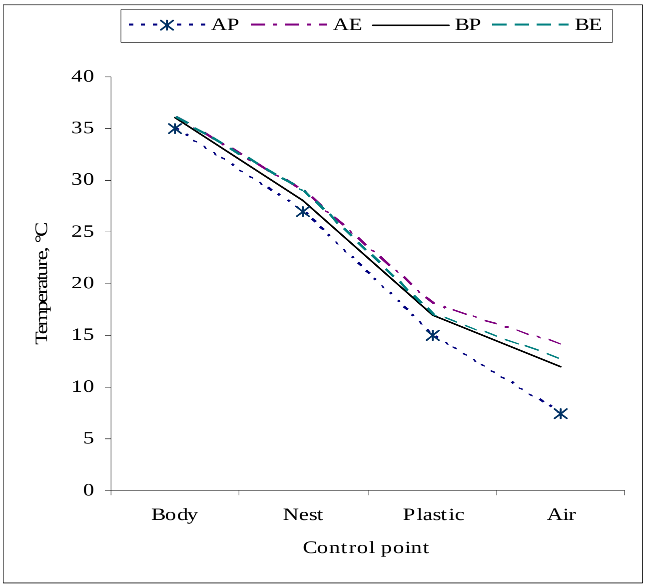

Figure 2: Temperature gradients between body, nest, plastic wall and inside air. AP: Bld A in front of the panel, AE: Bld A at the end of the breeding unit, BP: Bld B in front of the panel, BE: Bld B at the end of the breeding unit

In 4 weeks old rabbits the temperature gradient between the inside (rectal) body and the hair coat surface is between 3°C and 5°C (Löliger, 1984). In case of newborn rabbits the nest material takes the role of insulation and the gradient was larger at each position and paired with normal body temperature (Figure 2) what means that the nest material was sufficiently loose and well insulated by the high amount of air it contained. Still higher gradient between nest and plastic wall temperature indicated the very good insulation provided by the nest. Slight difference (P<0.05) between positions comes because the very low temperature of the plastic wall in Bld A in front of the panel and means good insulation even in these nest boxes. The less temperature difference between plastic and inside air denotes fast heat flow between them.

Average body weight of does and suckling rabbits, litter size, weight and gain are presented in Table 2. Doe body weight at day 7 post partum range between 4.23 and 4.58 kg, characteristic to the medium sized Hycol hybrid and similar in each building group .

Table 2: Litter performance traits as affected by the building and distance to the panel

	Building A		Building B		SEM	Probability		
	Panel	End	Panel	End		Bld	LRP	Bld x LRP
Litter size at age 21 days (n)	8.33	8.27	9.67	8.95	0.24	<0.001	n.s.	n.s.
Litter weight at age 21 (kg)	3.14	3.28	3.50	3.48	0.13	<0.05	n.s.	n.s.
Litter gain day 1-day 21 (kg)	2.66	2.55	2.83	2.83	0.02	n.s.	n.s.	n.s.
Body weight 21 days age (kg)	0.38	0.40	0.36	0.39	0.02	n.s.	n.s.	n.s.

Following equalization the litter size (9.4 and 10.2) and weight (0.65 and 0.67 kg) were similar (P>0.05) in the two buildings. The individual body weight of pups was 68±1.4 g ensuring a good viability and was similar between building group. At 21 days of age litter size differed (P<0.001) in building A (8.3) and B (9.3). Litter weight was slightly different in building A and B (3.2 and 3.5 kg respectively, P<0.05).

The probability that a newborn rabbit cannot survive until 21 days of age was different by the nests' location within the building (Table 3). The mortality rate was higher (P<0.005) for newborns in nests at the proximity of the panel (B=0.27 and A=0.21) compared to those in the nests far from the panel (B=0.16 and A=0.13). Occurrence of *P. multocida* carrier state at day 7 post partum tended to be higher for does caged at the end of the building than those caged in front of the panel, but this difference was not significant. On the contrary, morbidity rate of does tended to be higher near to than far from the panel, but this was not significant too.

Table 3: Sanitary status of the sucklings and does as affected by the building and the position

	Building A		Building B		Probability		
	Panel	End	Panel	End	Bld	LRP	Interact
Kits mortality rate[1]	0.21±0.03[b]	0.13±0.02[a]	0.27±0.04[b]	0.16±0.03[a]	n.s.	<0.005	n.s.
Kits morbidity rate[2]	0.25±0.03[b]	0.33±0.04[b]	0.13±0.03[a]	0.18±0.03[a]	<0.001	n.s.	n.s.
Doe P.m. carrier rate[3]	0.22±0.10	0.33±0.10	0.24±0.11	0.36±0.11	n.s.	n.s.	n.s.
Doe morbidity rate[4]	0.43±0.12	0.39±0.11	0.40±0.13	0.37±0.11	n.s.	n.s.	n.s.

[1]Probability of a kit dying before 21 days of age. [2]Probability of kits displaying disease signs at 21 days of age. [3]Probability of a doe being detected as *P. multocida* nasal carrier at day 7 post partum. [4]Probability of a doe presenting disease signs at day 7 post partum

CONCLUSIONS

The installation of an evaporative air cooling panel could decrease the temperature of air inside the breeding unit, of the nestbox wall, into the nest and of the newborns skin during the cold season in Hungary. Good insulation of high quality nests can decrease this effect on newborn's skin temperature. The lower body temperature of newborn rabbits caged near the panel can lead to higher probability of dying until 21 days of age. Installation type does influence only the inside air and nestbox wall temperatures. Careful nest management has a very important role in intensive rabbit production.

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