Effect of hot weather on microclimate in tunnel-ventilated pig fattening house

Ľubomír Botto[1], Jana Lendelová[2]

[1]*Animal Production Research Centre Nitra, Hlohovecká 2, 951 41 Lužianky, Slovak Republic*

[2]*Slovak University of Agricultural in Nitra, Trieda A. Hlinku 2, 949 76 Nitra, Slovak Republic*

Introduction

Pigs are relatively sensitive to high environmental temperatures when compared to other species of farm animals (Curtis, 1985). A lot of research has been done on the factors affecting heat production in pigs (Brown-Brandl et al, 2001). Animals reduce feed intake progressively with increased temperature (Kemp, Verstegen, 1987), as response to heat stress that leads to increased rectal temperature (Huynh, 2005). Pigs modify their posture in relation to ambient conditions (Mount, 1979). Evaporative heat loss might occur either via respiratory evaporation or by evaporation from the wet body surface of pigs (Nienaber et al., 1999). Fattening pigs preferred to lie on slatted floor at high ambient temperature. Air temperature as cardinal environmental factor is influenced by relative humidity and air flow velocity. Air humidity level is very important in cooling process (Myer, Bucklin, 2001). Utilization of enhanced air flow is one possible method of cooling during high ambient temperatures.

Aim

The objective of this work was to evaluate effect of hot summer weather on microclimate in tunnel-ventilated pig fattening house. This system of tunnel ventilation made use of combined air inlet for summer and winter period.

Material and methods

The stable was longitudinal divided into two sections with total capacity 500 housed pigs in 6 pens from 30 to 100 kg (Fig. 1). In the summer period air exchange in each section was provided by 5 fans situated at backside of stable (2 front, 2 side fans and 1 fan for under-slatted exhaust). External air input was through openings with adjustable size situated in front wall. Inlet openings by their area nearly covered whole internal vertical front wall intersection and their immediate largeness was adaptable by means of folded curtain.

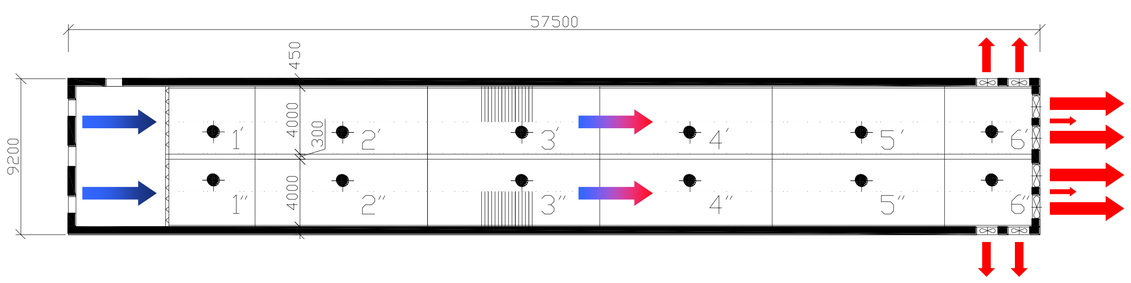

Fig. 1. Ground layout, measurement places (1´-6´, 1˝-6˝) and air movement in stable

Experiment was carried out when both front fans were operating. Basic microclimatic parameters were noticed in each section in pens in animal zone and in zone of stock-keeper (0.5 m and 1.8 m above the floor). Temperature, relative humidity and air flow were measured in each section in all pens (measurement places 1´-6´, 1˝-6˝) by ALMEMO 2290-4 device during the day with hot weather.

External air parameters were registered in time measurement, too, at the beginning and at the end of measurement of indoor parameters. At evaluation of measured data the average values in pens (M1-M6) were expressed for both sections. The data were analyzed using the statistical package STATISTIX 9.0. Values are expressed as means ± SD.

Results

The average external air temperature during evaluated hot summer day was 37.5 ± 0.15 °C and air relative humidity was 24.4 ± 0.44 % (Tab. 1). Average velocity of external air was 1.6 ± 0.86 m.s^{-1}.

Table 1. Average outdoor values (± SD) of the microclimatic parameters

Parameter	Air temperature, °C	Relative humidity, %	Air velocity, m.s^{-1}
Start of measuring	37.7 ± 0.05	24.1 ± 0.46	1.75 ± 0.70
End of measuring	37.4 ± 0.02	24.6 ± 0.14	1.77 ± 0.69
Together	37.5 ± 0.15	24.4 ± 0.44	1.76 ± 0.68

In fattening house were registered lower average temperatures in zones 0.5 and 1.8 m above the floor (36.6 ± 0.45°C and 36.9 ± 0.60°C) than external air temperature (Tab. 2). Average internal air relative humidity in both zones was higher than external air humidity (28.8 ± 2.25 % and 27.4 ± 1.59 %).

Table 2. Average indoor values (± SD) of the microclimatic parameters

Zone of measurement	Places of measuring	Air temperature °C	Relative humidity %	Air velocity m.s^{-1}
Animal zone (0.5 m above the floor)	M1	36.7	27.8	0.64
	M2	36.2	27.2	1.05
	M3	37.1	25.7	2.14
	M4	36.7	29.5	1.88
	M5	36.9	30.9	1.28
	M6	35.9	31.5	0.20
	Average ± SD	**36.6 ± 0.45**	**28.8 ± 2.25**	**1.20 ± 0.73**
Zone of swineherd (1.8 m above the floor)	M1	37.7	25.0	4.94
	M2	36.3	26.8	0.72
	M3	36.8	28.7	1.72
	M4	37.6	29.5	1.69
	M5	36.7	26.8	3.10
	M6	36.4	27.3	3.16
	Average ± SD	**36.9 ± 0.60**	**27.4 ± 1.59**	**2.56 ± 1.49**
Together	Average ± SD	36.75 ± 0.53	28.06 ± 2.00	1.88 ± 1.33

Comment: M1 (1´+1´´), M2 (2´+2´´), M3 (3´+3´´), M4 (4´+4´´), M5 (5´+5´´), M6 (6´+6´´)

Air humidification or another system of adiabatic cooling was not used in the stable. Average internal velocity of air was 1.20 ± 0.73 m.s^{-1} in animal zone (0.5 m above the floor) and 2.56 ± 1.49 m.s^{-1} in zone of stock-keeper (1.8 m above the floor). The highest average value in animal zone has exceeded the maximum value 2.0 m.s^{-1} according to the required parameters in Slovakia in third pens (M3) by 0.14 m.s^{-1}. The highest average value in zone of stock-keeper was in the first pens M1 (4.94 m.s^{-1}) and the lowest value was in the second pens M2 (0.72 m.s^{-1}). In this zone, air velocity is not limited.

Conclusion

In the pig fattening house with tunnel ventilation (without humidification) we noticed lower average internal temperatures by 0.9 in animal zone and by 0.6 °C in zone of stock-keeper than external temperature (37.5 °C) during hot summer day. Enhanced air flow velocity in both zones (on average 1.20 and 2.56 m.s^{-1}) ensured evaporative cooling of housed pigs; consequently sensational decreasing ambient temperature occurred. Pigs tolerated better higher temperatures under interoperation with low relative humidity of air (28.8 %). Behaviour of pigs did not indicate deflection in standard manifestations at lying, movement, urination and appetite.

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Contact e-mail address: Ľubomír Botto, botto@cvzv.sk