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Article

Cooling ventilation at farrowing for sows from first to third parturition

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Abstract

This study aimed to evaluate the thermal comfort considering natural and cooling ventilation on the performance, physiological parameters and thermal comfort indices for sows from first to third parturition. A total of 30 sows from commercial lineage (genetic base Landrace x Large White) initially weighing 252.3±5.7, 280.8±9.5 and 324.5±4.8 kg at first, second and third parturition, respectively, were distributed in a 3x2 factorial arrangement, considering the three parturition orders and the two ventilation methods, with five replicas per treatment. The effect of ventilation methods and times of the day on relative humidity, radiant thermal load, temperature and humidity index and black globe humidity index. There was an interaction among ventilation methods and parturition order for sow weight at weaning and daily feed intake. Regarding the females physiological parameters, with the exception of rectal temperature, there was an interaction between ventilation methods and times of the day. The thermal conditioning using cooling ventilation provides better values for thermal comfort indexes of the sows and promotes an increase in feed intake, mainly in gilts.

Keywords: Adiabatic, Lactation, Pigs, Thermal comfort

Introduction

The viability of intensive swine production is related to the efficiency in the productive and reproductive development of the matrices. For that reason, the selection of sows with greater milk yield capacity, associated to a high nutritional demand in lactation is wanted. During this phase, the energetical needs might be compromised when factors related to the sow, to the environment or to the diet are affecting the voluntary intake (Mellagi et al., 2010), making them more vulnerable to drastic changes in temperature and thermal stress (Martins et al., 2008a), resulting in the reduction of the reproductive rates.

Regarding the factors related to the environment, a dichotomic situation is observed in the nursery phase, where there is the need of providing two distinct microenvironments, so that matrices and piglets may manifest their productive potential. Matrices kept in environments with temperatures over the superior critical temperature might present a decrease in productivity, due to a greater energy demand to trigger thermolysis processes, to the detriment of the utilization for milk production (Rozeboom et al., 2000).

An intake reduction is also observed in sows which are subject to environmental stress through temperature increase, considering

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also that the age at farrowing is a variable of greater attention in primiparous sows, since they present a higher sensibility to increased environmental temperature compared to multiparous sows (Martins et al., 2008c). However, both categories in environments with increased temperature tend to direct energy to trigger thermoregulation mechanisms, like the elevation of respiratory frequency, altering the intake behavior (Renaudeau et al., 2003), reducing the intake mainly during the day (Gourdine et al., 2006), which might result in a compromise in the subsequent estrus (Renaudeau et al., 2003). Another factor to consider is related to the behavior alterations of the matrices subjected to thermal stress, being common to observe a lower number of daily sucklings, thus entailing a reduction in litter size and weight (Spencer et al., 2003).

Aiming to reduce the effects of high temperatures, there is a search for alternatives to mitigate the effects of thermal stress over the matrices development, through environmental modifications which might favor the development of the animals. Among the methods of environment climatization for lactating sows, the localized cooling presents the advantage of reducing air temperature through isenthalpic process, using the cession of sensible heath of the air in contact with the liquid surface (Tolon & Nääs, 2005), triggering the mechanism of thermal change through convection. The efficacy of this ventilation method can be variable in function of the environmental conditions, as well as in function of the parturition order of the sows (Romanini et al., 2008; Barbari & Conti, 2009).

With the exposed, the aim of this work was to evaluate the thermal comfort through natural and cooling ventilation over development, physiological parameters and thermal comfort indexes of lactating sows from first to third parturition.

Material and Methods

The experiment was performed in a piglet farm, located in the municipality of Maranguape-CE. 30 sows of the commercial lineage (Topigs® - Landrace x Large White) of first, second and third parturition were utilized, with an average weight of 252,3±5,7 kg, 280,8±9,5 kg and 324,5±4,8 kg, respectively.

The females from first to third parturition order were distributed into two environments, with natural and localized cooling ventilation. The matrices were kept in the nursery shed of the commercial farm, masonry-built, in east-west orientation, with dimensions of 10m length, 80m width and 3,5m double-height ceiling, covered with clay roof tiles provided with a ridge vent and open laterals with a wall 0,8m high. The facilities had lateral polypropylene curtains, which were opened at 07h30min and closed at 18h00. The sows' individual cages had a partially slatted floor with a conventional masonry feeder and automatic nipple drinker.

For the animals kept in the environment with localized cooling ventilation, an adiabatic air conditioner equipment was utilized, which performed a process of air cooling through the principle of the evaporative adiabatic cooling. The equipment was composed by hive-type adiabatic filter plates, with a broad humid surface, were the washings and the removal of sensible heath were performed. The air escape was directed to the upper part of the matrices head, thus providing a direct cooler air to the animals, with a speed of 10 m/s. This equipment was daily switched on from 06h30 to 17h30. The natural ventilation treatment was not provided of any cooling equipment, only the opening of the shed lateral curtains.

During the 21 experimental days, the data were collected at 07h00, 09h30min, 12h00, 14h30min and 17h00, regarding the physiological parameters of the sows as to respiratory rate, rectal temperature and superficial temperature of the skin at ham and withers. At the same times the data regarding dry-bulb temperatures, air relative humidity, black globe and wind speed were obtained.

Rectal temperature was obtained utilizing a veterinary thermometer (± 0,1°C), measured during 3 minutes (Mueller et al., 2012). The respiratory rate was obtained through observation and counting of flank movements during 15 seconds, performing the correction to one minute. (Martins et al., 2008c). For the surface temperature, an infrared thermometer was also utilized, with digital reading from -32°C to +380°C and resolution of 0,1°C, directed to the withers at a distance of approximately 50 cm.

For the obtaining of the climatological data, two black globe thermometers were installed in the central part of the room, at the height of the sows' withers, one in each row of farrowing cells. Beside these, two HOBO® data loggers were installed, with reading range from -20°C to 70°C for temperature and from 25% to 95% for humidity and resolution of 0,1°C and 0,07% for the respective variables. Furthermore, wind flow velocity was obtained through a digital anemometer with a reading range from 0,3 to 30 m/s, perpendicularly to the incidence of wind direction produced by the localized ventilation equipment. The climatological data were utilized for the calculations of the radiant thermal load (RTL) according to Esmay (1982), Black Globe Temperature and Humidity Index (BGHI), Temperature-Humidity Index (THI - Buffington et al.,1981) and enthalpy (Albright, 1990).

The sows were fed with a specific ration for this lactation phase, according to the energetical and nutritional recommendations of the lineage, being the rations moistened in the proportion 1:1 (weight : weight) at the providing moment, at the times of 06h00 and 10h00. The daily ration consumption of the sows was determined from the second day after parturition until weaning, daily weighing the amount of delivered ration and its remainings. The water was freely provided during the whole experimental period. The providing of pre-initial pelletized ration to the piglets, based in corn and soybean bran, had its start in the seventh day of life of the animals. The daily ration consumption by the piglets was also measured.

The proximal weight (weight, in kg) of the sows was individually obtained at 21 days after parturition with the aid of a body weighing tape for swines, based on the thoracic perimeter (TP, in m) and length (L, in m) of the sow, obtained through the equation: Weight = $TP^2 \times L \times 69,3$. The litters of each matrix were also weighed at birth and at 7, 14 and 21 days with the aid of a digital scale. The estimated milk yield by the sows was estimated through the equation utilized by Martins et al. (2007), considering the weight gain of the piglets during the 21 days and the final weight of the litter. At 21 days after parturition the sows were weighed and the weaning of the piglets was performed. The interval weaning-estrus was measured according to the number of days between the weaning and a new confirmed gestation.

The experimental delimitation was completely random, in a factorial scheme of 3x2, considering the three parturition orders and the ventilation methods, totalizing five repetitions per treatment. The variance analysis of the data was performed according to the proceeding PROC GLM of the statistical software SAS (9.2). The interactions among main factors were evaluated by the F test (5%) and, when significative, the effects of the main factors were studied within each level of another factor, separately, through Tukey's test (5%).

Results and Discussion

According to the temperature averages, relative humidities (RH), radiant thermal load (RTL), temperature-humidity indices (THI), black globe temperature and humidity indices (BGHI) and the enthalpy of the environments with natural or cooled ventilation, in function of the times during the experimental period (Table 1), the effect of the ventilation methods and times of the day over the air relative humidity and radiant thermal load on thermal comfort indices was observed, excepting air temperature, verifying only the effect on different times. Regarding wind flow velocity, an air velocity of 10 m/s was observed for the cooled ventilation system, and absence of wind in the evaluated times.

According to Bortolozzo et al., (2011) the range of thermal comfort for lactating sows spans from 16°C to 22°C, being possible to infer, through the registered temperatures in the experimental period, that the matrices were kept in environments with temperatures over the superior critical temperature. The similarity of air temperature in the environments with natural and cooled ventilation is due to the fact that the directed cooling system does not interfere in the environment temperature, through its action exclusively over sensible thermolysis only in the directed spot.

Table 1. Air temperature, relative humidity, radiant thermal load (RTL), Temperature-Humidity Index (THI), Black globe temperature and humidity index (BHGI) and enthalpy of the environments with natural or cooled ventilation, in function of the times of the day

	Air temperature, (°C)		Relative humidity, %		RTL, W/m²	
Time	Cooled ventilation	Natural ventilation	Cooled ventilation	Natural ventilation	Cooled ventilation	Natural ventilation
07h00	25,82aA	26,26aA	65,89dA	65,58dA	458,65aA	488,02aB
09h30	28,49bA	28,78bA	54,46cA	55,01bA	471,22aA	482,66aB
12h00	31,32cA	31,07dA	43,91aA	47,99aB	486,94dA	498,93cB
14h30	31,63dA	31,00dA	47,52bA	51,53cB	479,74cA	494,16bB
17h00	28,71bA	28,36cA	58,65cA	60,48bB	458,53bA	459,86dB
Média±EPM[1]	29,19±0,61	29,09±0,52	54,09±2,26	56,12±1,81	471,02±3,26	484,73±3,92
CV[2],%	3,09		12,95		5,82	
P value (interaction)	0,0048		0,0003		0,0023	
	THI		BHGI		Enthalpy, kJ/kg dry air	
Time	Cooled ventilation	Natural ventilation	Cooled ventilation	Natural ventilation	Cooled ventilation	Natural ventilation
07h00	74,14aA	74,66aB	74,82aA	75,09aB	79,85aA	80,88aB
09h30	75,59bA	76,99bB	76,86bA	77,09bA	85,91bA	86,71bB
12h00	78,09cA	79,12cA	79,34cA	79,36cA	93,07cA	94,50cB
14h30	78,95dA	79,49dB	79,13cA	79,06dA	94,09dA	94,51cA
17h00	76,31eA	77,01eB	77,11bA	77,06bA	84,64eA	85,85dB
Average±ASE[1]	76,62±0,49	77,45±0,50	77,45±0,48	77,53±0,45	87,51±1,55	88,49±1,53
VC[2], %	1,24		1,27		2,53	
P value (interaction)	0,0001		0,0002		0,0038	

Averages followed by the same letter, lowercase on the column and upper case on the line, do not differ among them at 5% probability by Tukey's test. [1]ASE: average standard error. [2]VC: variation coefficient.

In the same manner, in other studies, Tolon & Nääs (2005), evaluating different ventilation methods (natural, cooled and forced), did not observe effects of fan usage over the environment temperature of the sows' nursery room.

Regarding air relative humidity, there was no effect of the different ventilation methods over this variable; however, there was an effect of the different times of the day. According to Renaudeau et al. (2003), relative humidity values over 85%, when associated with temperatures over the thermal comfort, accentuate the effects of heat stress. In this manner, although the cooled ventilation system utilizes the contact with the humid surface of the plates to the heat change, there is no rise in the humidity level of the environment, which could affect the thermal comfort of the sows due to a high temperature. On the other hand, the advantage of the localized cooling systems usage compared to those whose cooling occurs through increase in the facility humidity, like the fogging system, lies in the maintaining of the absolute humidity in the facility.

The results for radiant thermal load showed that the cooled ventilation system resulted in lower radiant thermal energy on the sow in all times. Corroborating the obtained results, Tolon and Nääs (2005) also observed that in more critical times, regarding the thermal stress for the sows, the cooled ventilation resulted in lower values for the RTL. In the same manner, the values for enthalpy were lower for those sows which received cooled ventilation, except at the time of 14h30, due to the cumulative effect of thermal energy; thus, throughout the day, the contribution in radiant thermal energy originated from radiation contributed to rise the enthalpy value in the period, being over the maximum value of 73,8 KJ/kg recommended by Silva (1999).

Considering that, for the evaluated thermal comfort indices, lower values represent better environment conditions; it was verified for the THI the effect of the adopted ventilation system, observing better indices except for the time of 12h00. However, the BHGI obtained values did not point the highest efficiency of the forced ventilation system in the hotter hours of the day. According to Santos et al. (2012) the limit BHGI value for sows is 72, and therefore the sows subjected to both evaluated ventilation systems were in conditions of thermal discomfort.

An interaction among ventilation methods and parturition order for sow weight and daily ration intake was observed (Table 2).

Table 2. Productive and reproductive development of sows from first to third parturition subjected or not to cooled ventilation

	Parturition order					
	First parturition	Second parturition	Third parturition	Average± ASE¹	VC²,%	P value (interaction)
	Sow weight at weaning, kg					
Cooled ventilation	212,70aA	226,85abA	256,03bA	231,86±5,70	10,01	0,0028
Natural ventilation	197,83aA	219,54abA	252,95bA	223,84±7,17		
Average±ASE¹	205,27±3,32	223,19±1,63	254,49±0,69			
	Daily ration intake, kg					
Cooled ventilation	5,89bA	6,20abA	6,56aA	6,38±0,09	9,67	0,0001
Natural ventilation	5,58bB	5,98bA	6,58aA	6,12±0,13		
Average±ASE¹	5,73±0,07	6,44±0,05	5,57±0,01			
	Estimated milk yield, kg/day					
Cooled ventilation	4,54	5,09	5,06	4,89±0,08A	10,06	0,5612
Natural ventilation	4,18	4,82	4,96	4,65±0,11B		
Average±ASE¹	4,36±0,08	4,95±0,06	5,01±0,02			
	Weaning-estrus interval, days					
Cooled ventilation	17,00	8,40	3,20	9,53±1,79B	19,96	0,3258
Natural ventilation	24,60	9,60	5,20	13,13±2,63A		
Average±ASE¹	20,80±1,70a	9,00±0,27b	4,20±0,45b			

FAverages followed by different letters, lowercase on the line and uppercase on the column, differ among them by Tukey's test at 5% probability. ¹ASE: average standard error. ²VC: variation coefficient.

It was verified that third parturition sows presented a higher weight at weaning compared to first parturition sows, however not differing from the sows in second parturition. Regarding daily ration intake, third parturition sows presented a higher intake compared to first parturition sows. However, second parturition sows subjected to natural ventilation presented a lower consumption compared to third parturition sows, whilst that difference was not observed for the sows under cooled ventilation. The higher ration intake observed in the first parturition sows which received cooled ventilation compared to those which received natural ventilation is beneficial, since it lowers the mobilization of adipose and muscle tissues, being important to avoid further problems like the second parity syndrome (Patterson et al., 2006).

The effect of parturition order and ventilation methods over the interval weaning-estrus was observed, and also only of the ventilation methods over the estimated milk yield. According to the results, the sows which received cooled ventilation presented a higher estimated yield of milk and smaller weaning-estrus interval compared to those under natural ventilation, being also observed a smaller weaning-estrus interval for first parturition sows.

According to Martins et AL. (2008c), thermal stress is more damageable to the primiparous sows, which were shown as more sensible to heath, since they presented a reduced voluntary feeding intake and depended on a greater amount of energy for maintenance, milk production and growth, what might consequently reflect on milk yield and decrease in litter size on second parturition (Prunier & QUesnel, 2000), resulting in decrease of the reproductive indices.

On the other hand, the negative result of thermal stress over the estimated milk yield can also occur in multiparous, such as was observed by Renaudeau & Noblet (2001) when they evaluated sows kept in environments with elevated temperature (29°C) and observed a decline of until 30% on milk yield, compared to those kept under thermal comfort conditions (20°C). This way it is possible to infer that the sow capacity in mobilizing body reserves for milk production is conditioned to the thermal environment in which she is kept, and also the interaction of the factors related to the body weight of the piglets (King et al., 1997), number of sucklings (Audist st al., 2000), parturition order, lactation stage, litter size, diet and metabolic status of the sow (Kim et al., 2001).

The prolongation of the first weaning-estrus interval might be associated to the loss of body condition during the first lactation, seen that the anorectic effect of thermal stress, notably over primiparous sows, results in a lower intake of food to supply the utilizing of nutrients for growth and milk production (Poleze, 2004). In this sense, since the amount of ingested nutrients during lactation is directly related to hormone secretion, which actuates on the reproductive axis, the not attending of nutritional demands potentially influences the metabolic state and, therefore, the reproductive efficiency of the sow during lactation and after weaning, with the increase of the weaning-estrus interval (Bianchi at al., 2006) or the reduction in the number of piglets born in the subsequent parturition (Mellagi at al., 2013). According to Gourdine et al. (2006) this increase in the weaning-estrus interval is due to the amplification of the puerperal hypothalamic inhibition, more pronounced in primiparous sows.

Regarding the physiological parameters of the sows, excepting rectal temperature, there was an interaction among ventilation methods and hours of the day (P<0,05) by the treatments (Table 3).

Table 3. Physiological parameters of sows from first to third parturition kept in ventilated or not ventilated environments, in function of the time the day

Time	First parturition females		Second parturition females		Third parturition females	
	Cooled ventilation	Natural ventilation	Cooled ventilation	Natural ventilation	Cooled ventilation	Natural ventilation
	Respiratory rate (movements/minute)					
07h00	51,961aA	64,490aA	37,981aA	56,226aA	41,009aA	54,523aA
09h30	46,603aA	64,457bA	45,018aA	60,896aA	45,183aA	61,727aA
12h00	57,679aB	94,452bB	65,641aB	88,075bB	63,110aB	92,383bB
14h30	68,059aB	99,961bB	74,568aB	93,862bB	74,000aB	87,499bB
17h00	47,886aA	80,943bB	53,547aA	81,207bB	53,504aA	75,682bB
Average±ASE¹	54,44±2,26	80,86±4,25	55,35±3,84	76,05±4,30	55,36±3,46	74,36±4,19
VC²,%	27,60		28,11		26,58	
P value (interaction)	0,0002		0,0035		0,0096	
	Rectal temperature (°C)					
07h00	38,384	37,872	38,529	38,485	38,114	38,099
09h30	38,408	38,320	38,624	38,570	37,958	38,397
12h00	38,891	38,661	39,183	38,757	38,810	38,900
14h30	39,184	38,746	39,513	39,445	39,310	38,763
17h00	39,029	38,559	39,364	39,378	38,874	38,918
Average±ASE¹	38,78±0,09	38,43±0,09	39,04±0,11	38,93±0,12	38,61±0,14	38,61±0,09
VC²,%	0,99		1,09		1,15	
P value (interaction)	0,2862		0,7526		0,3593	
	Surface temperature (°C)					
07h00	30,144aA	33,376bA	30,528aA	33,657bA	31,178bA	34,134bA
09h30	32,078aB	34,450bB	32,474aB	34,873bB	33,500bB	35,339bB
12h00	34,554aD	35,822bC	35,043aD	36,364bC	35,266aC	36,547bC
14h30	34,693aD	35,644bC	35,078aD	36,366bC	35,302aC	36,261bC
17h00	33,179aC	35,022bBC	33,700aC	35,683bC	33,875aB	35,435bB
Average±ASE¹	32,93±0,49	34,86±0,25	33,36±0,49	35,39±0,29	33,82±0,43	35,54±0,24
VC²,%	5,16		5,32		4,54	
P value (interaction)	0,0026		0,0035		0,0003	

Averages followed by different letters, lowercase on the line and uppercase on the column differ among them by Tukey's test at 5% probability. ¹ASE: average standard error. ²VC: variation coefficient.

For first parturition females, the cooled ventilation system resulted in a lower respiratory rate compared to those which received natural ventilation, in all times, except at 07h00. For second and third parturition females the difference occurred only in the hours after 12h00. Concerning the times of the day, it was observed that the females under cooled ventilation presented a higher respiratory rate at 12h00 e 14h30, independently of the parturition order. For those under natural ventilation the higher rates were observed at 12h00, 14h30 and 17h00.

Considering that in swines the heat dissipation through sweating is practically inexistent (Rodrigues et al., 2010), the increase of the respiratory rate aims the latent thermolysis in animals under thermal stress; the lesser increase of this parameter in sows which received cooled ventilation in higher enthalpy hours is advantageous, due to its negative correlation with ration intake.

In this perspective, the answers verified in sows which did not receive cooled ventilation would be an indicative of higher thermal stress to which these animals were being subjected, since the increment of respiratory rate is an efficient physiological mechanism that actuates in the maintaining of thermoregulation (Manno et al., 2006), increasing heat dissipation for the environment. Renaudeau et al. (2003), observed increases from 8 to 20 breaths/minute/°C in sows subjected to temperatures over 28°C.

In all parturition orders, the respiratory rates of the matrices were higher than those found by Quiniou & Noblet (1999), being between 26 to 27 movements per minute, although near to those observed by Tolon & Naas (2005) and Verussa & Corassa (2013). However, the increase in respiratory rate, for both treatments, was enough for heat dissipation and the maintaining of the rectal temperature of the animals, suggesting that the stress condition through heat was not very severe. The observed values for this variable were revealed to be very near of those found by Lima et al. (2011), with average values of 38,6°C, being an indicative of normothermia. In counterpart, the rectal temperature answers to changes in internal body heat are slow, since in situations of elevated environmental temperature and no acclimatization, after the sow has exhausted heat loss alternatives through increase in respiratory rate and superficial temperature, an increase in rectal temperature occurs, being this an indicative of late heat stress.

Concerning the superficial temperature, it was noted that the animals subjected to cooled ventilation presented lower values compared to those under natural ventilation, independently of the time of the day and parturition order. The obtained results confirm those presented by Carvalho et al. (2004) who also observed lower superficial temperature near to the withers of sows in termination phase subjected to forced ventilation. The highest superficial temperatures on sows which received natural ventilation are attributed to the increases in peripheral blood circulation as a way of dissipating the body heat and returning homeostasis. Directed cooled ventilation to the hypothalamus of the sow aims not only to lower the superficial temperature of the animal, but also to attenuate physiological modifications in the animals subjected to high temperatures, occasioning a possible reduction in respiratory rate, indicating that animals under this treatment had a greater sensation of thermal comfort.

About the zootechnical development indices of piglets originated from sows subjected to the treatments with and without forced ventilation (Table 4) there was no effect of the ventilation methods and parturition order over the average weight of the piglet at 7 days and daily ration consumption.

An interaction of ventilation methods and parturition order of the matrices over the average weight of the piglet at birth was observed, being the piglets of sows in second and third parturition heavier compared to those from first parturition sows. Evaluating the reproductive parameters of sows in different ages, Souza et al. (2004) observed that young matrices (with age between 7 to 8 months) had lighter piglets, affirming that in this age the animals still demand nutrients for their own growth, since they did not reach a complete body development. A similar effect was noted for the average weight of the piglets at 21 days of age. In this sense, although the weight at birth is a result of primarily gestational factors, weight gain in piglets is a consequence of milk production and lactational behavior of the sow in the nursery (Martins et al. 2008b). Weight gain in piglets has been utilized as one of the indicators of the maternal ability for milk production and, furthermore, since milk production is an important reproductive characteristic in the selection of sows, when the thermal stress is low, the sows present adaptative capacity for milk production, such as the mobilization of body reserves (Clowes et al. 2003). However, as consequence, there may be effects over the puerperium and the preparation for a new estrous cycle, reducing the reproductive indices of the sow, particularly with greater effect in first parturition sows. According to the results,

Table 4. Development of piglets from sows from first to third parturition subjected or not to cooled ventilation

	Parturition order					
	First parturition	Second parturition	Third parturition	Average±ASE[1]	VC[2], %	P value (interaction)
	Average piglet weight at birth, kg					
Cooled ventilation	1,31aA	1,41bA	1,49bA	1,40±0,02	7,57	0,0002
Natural ventilation	1,25aA	1,43bA	1,53bA	1,40±0,03		
Average±ASE[1]	1,28±0,01	1,42±0,01	1,51±0,01			
	Average piglet weight at 7 days, kg					
Cooled ventilation	2,18	3,08	2,76	2,67±0,12	18,87	0,5896
Natural ventilation	2,17	3,02	2,83	2,68±0,11		
Average±ASE[1]	2,17±0,01	3,05±0,01	2,79±0,01			
	Average piglet weight at 21 days, kg					
Cooled ventilation	4,79bA	6,16aA	5,78aA	5,58±0,18	10,96	0,0035
Natural ventilation	4,84bA	5,29aA	5,76aA	5,29±0,12		
Average±ASE[1]	4,81±0,01	5,72±0,19	5,77±0,01			
	Daily ration intake, g/animal					
Cooled ventilation	36,16	33,87	33,43	34,48±0,38	14,01	0,1688
Natural ventilation	28,25	34,70	35,86	32,94±1,06		
Average±ASE[1]	32,20±1,77	34,28±0,19	34,64±0,54			

Averages followed by the same uppercase letter on the column and lowercase on the line do not differ among them at 5% probability by Tukey's test. [1]ASE: average standard error. [2]VC variation coefficient.

cooled ventilation, particularly in primiparous, promotes the increase of ration consumption, being favorable for tissue maintenance of the sows and in the reduction of the second parity syndrome.

Conclusions

1. The cooled ventilation climatization system results in reduction of radiant thermal load and in a better index of thermal comfort throughout the day.

2. From 09h30 to 17h00, sows under cooled ventilation presented lower respiratory rate compared to those under natural ventilation.

3. Cooled ventilation results in higher ration consumption in first parturition sows, compared to natural ventilation.

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