Original Research

Effect of Body Cooling on Reproductive Performance of Hampshire Sow

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Abstract

Pregnant Hampshire sows (20 nos.) of second and third parity of 30-Sow Teaching Unit, College of Veterinary Science, AAU, Khanapara were selected and randomly divided into control and treatment group to find out the effect of body cooling on reproductive performance during summer. Treatment group was sprinkled with water during the hotter part of the day. The mean indoor and outdoor environmental temperature, relative humidity and THI were recorded. There was significantly higher litter weight (p < 0.01) and litter size at birth (p < 0.05). The farrowing time was found to be 2.4 ± 0.20 and 2.06 ± 0.24 hours for control and treatment groups respectively which was statistically not significant. No significant difference was observed in number of stillborn piglets and service period between the treatment and the control groups. There was significantly (p < 0.01) lower rectal temperature and respiration rate in the sprinkled animals than in control. It can be concluded that sprinkling of water in pregnant sows reduces heat stress and ultimately improved reproduction.

Key words: Cooling, Hampshire, Litter, Sow, Size, Weight

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Introduction

Heat stress has direct and indirect impact on livestock production, growth and reproduction and welfare of animals. The environmental temperatures above the thermo neutrality (comfort) zone for swine are frequently seen in tropical and subtropical regions. The thermal discomfort is almost permanent in pigs under the hot humid climatic condition and is one of the major problems affecting pig production. When exposed to heat stress, pigs either decrease heat production or increase the rate of heat loss to maintain core body temperature (Nichols *et al*., 1982). Pigs are especially sensitive to high environmental temperatures as compared to other species of farm animals, because they have limited physiological mechanisms for evaporative cooling. The optimum temperature range for finishing pigs is between 10 and

23.9 ^{0}C (Mayer and Bucklin, 2001), and temperature above 23.9 ^{0}C decrease voluntary feed intake and pig growth (Kouba *et al*., 2001). For reducing the heat stress an amelioration measurement is of utmost importance in pig farm especially in Assam. Water is an effective cooling agent either through wetting of the animal's body surface as the water evaporates or through indirect evaporative cooling of the air. There was no study on the cooling effect on reproduction in pregnant sow. Thus, the present study was undertaken to study the effect of body cooling on reproductive performance of Hampshire pigs during summer.

Materials and Methods

Twenty pregnant Hampshire sows of second and third parity were randomly selected and divided into two groups of ten each. The study was undertaken at 30-Sow Teaching Unit, College of Veterinary Science, AAU, Khanapara during summer (May to August, 2014). The animals were provided with standard feeding and the daily allowance was divided into two equal halves and offered in the morning at 10.00 am and afternoon at 3.30 pm. Fortnightly feed intake (kg) per sow during gestation period was recorded up to 98 days as to prevent the sow from unnecessary stress. Same feed and feeding schedule was followed for both the groups of animal. The treatment group (T1) water was sprinkled on the body of the sow at a stretch for two to three minutes during hotter part of the day once daily. Water was sprinkled only during gestation period. It was practiced from the date of successful conception to the date of farrowing. The rectal temperatures (^{o}F) and respiration rate per minute of the animals were recorded before and after 30 minutes of post sprinkling. Respiration rate was calculated by counting the number of flank movement per minutes (Renaudeau and Noblet, 2001) and recorded in number per minute. Daily data on climatic variables of indoor and outdoor, *viz.* environmental temperature, relative humidity and THI were recorded. Temperature Humidity Index (THI) was calculated as per U.S Weather Bureau, by using dry and wet bulb Thermometer readings using following equation-

$$THI = 0.72 \text{ (Dry bulb temperature } ^{o}C + \text{Wet bulb temperature } ^{o}C) + 40.6$$

Number of piglets in a litter alive at a particular age was the litter size at that very age. In case of litter size at birth was considered as the number of piglets in a litter born alive. The service period was calculated from the difference between the date of farrowing and subsequent date of fertile service and expressed in days. The time taken for the duration of farrowing was recorded for each animal in minutes and the average was calculated for each group. The total numbers of live piglet and stillborn piglet if any was recorded at the time of farrowing from each sow.

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Statistical Analysis

Baseline information was presented with descriptive statistic like mean and Standard Error (SE) and significance of group differences tested using student t-test and large sample Z-test as per requirement. Data were analyzed using statistical software SAS version 9.3.

Results and Discussion

THE average rectal temperature (°F) was 101.56 ± 0.01 and 101.23 ± 0.009 for the animals before and after cooling (Table 1). Statistical analysis showed significantly lower rectal temperature ($p < 0.01$) in the treated group. This might be due to sprinkling of water when the animals were in heat stress. This is logical, because vasodilatation of epidermal blood vessels allows deep body heat load to be dissipated more easily to the cooler environment (Yousef, 1985).

Table 1: Average rectal temperature (°F) and respiration rate (min-1) of the sows before and after cooling

Parameters	Before cooling	After cooling	IZI- value
Rectal temperature (°F)	101.56 ±0.01 (100.6 – 102.4)	101.23± 0.009 (100.2 – 101.8)	23.07**
Respiration rate(Min^{-1})	49.15 ±0.07 (46 – 54)	46.38 ± 0.05 (45 – 50)	31.88**

** *Highly significant at ($p < 0.01$)*

The present findings are in close agreement with the findings of Bull *et al.* (1997) who reported that cooling system in mature gilts had a significant effect on rectal temperature during heat stress period. Jeon *et al*. (2014) also reported that rectal temperature was lower in sows in the CW group (Chilled drinking water) than in control group ($p < 0.01$). But in contrary to the present findings, Sailo (2005) and Huynh *et al*. (2006) observed non-significant difference in rectal temperature between the treatment groups. The mean value of respiration rate was found to be 49.15 ± 0.07 and 46.38 ± 0.05 per minutes before and after cooling of sows under two treatment groups, respectively with significantly lower ($p < 0.01$) respiration rate of the animals after cooling (Table 1). This might be due to increased evaporative heat loss from the skin and lungs in relation to body cooling during hotter part of the day to maintain towards the thermoneutral zone of body temperature.

The mean relative humidity (%) in the morning, noon and the evening in the month of May, 2014 were 79.79 ± 1.71, 71.49 ± 1.77 and 80.54 ± 1.48 and 87.42 ± 1.07, 85.42 ± 1.28 and 92.54 ± 0.78 in the indoor and outdoor environment respectively. In the month of June, 2014 the mean relative humidity (%) on three occasion of the day were recorded to be 83.41 ± 1.07, 77.02 ± 1.56 and 79.60 ± 1.18 and 89.53 ± 1.15, 88.30 ± 1.01 and 93.82 ± 1.04 in the indoor and outdoor environment respectively. The mean relative humidity (%) in the morning, noon and the evening in the month of July, 2014 were 80.69 ± 0.93, 73.60 ± 1.56 and 79.38 ± 0.90 and 91.12 ± 0.70, 89.34 ± 1.12 and 95.12 ± 0.41 in the indoor and outdoor

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environment respectively. In the month of August, 2014 the mean relative humidity of the outdoor environment was recorded to be on the higher side as compared to the months of May, June and July, 2014. The mean relative humidity (%) in the morning, noon and the evening in the month of August, 2014 were 83.88 ± 1.09, 75.29 ± 1.57 and 81.62 ± 0.93 and 91.37 ± 0.97, 91.14 ± 0.88 and 95.58 ± 0.71 in the indoor and outdoor environment respectively. The mean THI in the morning, noon and the evening in the month of May, 2014 were 78.49 ± 0.53, 84.04 ± 0.73 and 82.02 ± 0.63 and 82.48 ± 0.80, 86.61 ± 0.83 and 82.97 ± 0.64 in the indoor and the outdoor environment respectively. However, the mean THI in the morning, noon and the evening in the month of June, 2014 were 79.66 ± 0.45, 83.95 ± 0.54 and 82.17 ± 0.46 and 83.17 ± 0.66, 86.74 ± 0.63 and 83.50 ± 0.47 in the indoor and the outdoor environment respectively. The mean THI were found to be highest during the months of July, 2014 on all three occasion of the day. The mean THI in the morning, noon and the evening in the month of July, 2014 were 81.01 ± 0.29, 85.30 ± 0.46 and 83.37 ± 0.25 and 84.23 ± 0.45, 88.37 ± 0.49 and 84.43 ± 0.28 in the indoor and the outdoor environment respectively. Moreover the mean THI in the morning, noon and the evening in the month of August, 2014 were 79.19 ± 0.37, 83.38 ± 0.57 and 81.49 ± 0.40 and 82.64 ± 0.64, 86.40 ± 0.63 and 82.86 ± 0.40 in the indoor and the outdoor environment respectively.

The litter weight at birth (kg) in control and treatment group was 7.89 ± 0.53 and 12.61 ± 0.92 kg respectively. Litter weight in treatment group was found to be significantly higher than in control group. Likewise the average litter size at birth was 8.3 ± 0.47 and 9.6 ± 0.4 for control and treatment groups, respectively which was statistically significant. This might be due to the impact on enrichments in the form of sprinklers and health status of the sows. Sprinkling of water on the body helps to reduce the heat stress during summer. Because of reduced heat stress the sow got a comfort zone and consumes normal feed which ultimately helped in increasing productivity and reproductivity of the sow. Health status of the sow is also one of the prime factors for the above mentioned parameter. In the experiment the pregnant sows were selected randomly without considering the history of the health record. The present findings was in agreement with Ramesh *et al.* (2001) and Jeon *et al*. (2014) who reported significant difference on litter weight and litter size at birth on conventional house with sprinklers than that of control group in Yorkshire sow. The fortnightly feed consumption of the sows was recorded to be 32.22 ± 0.07 and 34.51 ± 0.09 kg for control and treatment groups respectively (Table 2). Statistical analysis revealed significant difference ($P < 0.01$) for feed intake of sows between the control and the experimental groups. The service period of treatment and control group was 116.7 ± 11.37 and 123 ± 4.87 days. The service period of treatment group was lower in comparison to the control but did not differ significantly. It could be due to poor performance history of sows and suffered heat stress for which ovulation was not properly occurred. The service period of the animals in control group was in close conformity with the findings of Kalita *et al.*, 2000.

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Table 2: Fortnightly feed intake(kg) per sow during gestation period

Fortnight	Feed Intake	
	Control (Mean ± SE)	Treatment (Mean ± SE)
1	32.16±0.18	33.93±0.22
2	31.94±0.18	34.56±0.29
3	32.04±0.23	34.39±0.25
4	31.75±0.13	34.78±0.20
5	32.78±0.13	34.67±0.17
6	32.08±0.24	34.46±0.30
7	32.77±0.12	34.75±0.26
Overall	32.22 ± 0.07	34.51 ± 0.09

However, Ying and Chen (2002) and Suriyasomboon *et al.* (2006) reported that heat stress and seasons has a negative impact on the service period of sow.

Statistically, no significant difference was observed for farrowing time between the control and treatment groups (Table 3). It might be due to the fact that most of the farrowing took place in the later part of night or early morning when the ambient temperature was comparatively lower. The present observation with regards to the farrowing time of Hampshire sow was similar with the findings of Bazar and First (1983), Goswami *et al.* (1999) and Deka *et al.* (2012). The number of stillborn piglets was 0.5 ± 0.30 and 0.3 ± 0.21 for control and treatment groups, respectively with significant difference among the group.

Table 3: Reproductive parameter of sow in average

Parameters	Control	Treatment	(t) value	P value
Litter weight(kg) at birth	7.89 ± 0.53	12.61 ± 0.92	4.45^{**}	0.0003
Litter size at birth	8.3 ± 0.47	9.6 ± 0.4	2.10^{*}	0.05
Service period (days)	123.0 ± 4.87	116.7 ± 11.37	0.51^{NS}	0.61
Farrowing time(hrs)	2.4 ± 0.20	2.06 ± 0.24	1.05^{NS}	0.30
Stillborn piglet	0.5 ± 0.30	0.3 ± 0.21	0.53^{NS}	0.59

*** Highly significant at (p < 0.01; * Significant at (p < 0.05; NS, non significant*

These finding contradict with the observation of Shobamani *et al.* (1999) and Shankar *et al.* (2009). The finding of Singh and Singh (2003) was in concomitant with the present findings but they observed significantly higher percentage of still birth in summer than during rainy and winter. This difference might be possibly due to numbers of parity, management practices less number of experimental animals.

Conclusion

Heat stress is one of the chief economic issues in the pig farming. It affects the reproductive performance through physiological changes. The present findings indicate that sprinkling of water in the body of pregnant sow reduced the heat stress by lowering the respiration rate, rectal temperature. Thus, improved

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the reproductive performance during the summer months, which is one of the most important managemental tools in the pig farm. Strategies to reduce negative impact of heat stress by cooling with water sprinkling will improve the reproductive performance and ultimately increase the economic status.

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References

1. Bazar FW and First NL. 1983. Journal of Animal Science. (Supple 2): (c.f. Swine Production, 1st edn., Published by ICAR, 2005, New Delhi. pp. 425 -60.).
2. Bull RP, Harrison PC, Riskowski GL and Gonyou HW. 1997. Preference among cooling system by gilt under heat stress. Journal of Animal Science**.** 75: 2078 -2083.
3. Deka D, Nath DR and Bora MC. 2012. Effect of Dams' weight at mating or productive traits and pre-weaning mortality in Hampshire pigs. Indian Veterinary Journal. 89: 33-35.
4. Goswami BK, Miachieo V, Borgohain BN and Barua P M. 1999 . Gestation length, duration of farrowing, litter size at birth and weaning in Hampshire, Indigenous pigs and their crosses. Indian Veterinary Journal. 76: 65- 66.
5. Huynh T T T, Aarnink A J A, Truong CT, Kemp B and Verstegen M W A. 2006. Effect of tropical climate and water cooling methods on growing pig's responses. Livestock Science. 104: 278-291.
6. Jeon JH and Kim D H. 2014. Method to supply chilled drinking water for lactating sows during high ambient temperature. Italian Journal of Animal Science**.** 13: 3431.
7. Kalita G, Roychoudhury R, Goswami RN, Aziz A and Brahma ML. 2000. Studies on reproductive traits in Hampshire pigs in Assam. Journal of Assam Veterinary Council. 7-8: 32-34.
8. Kouba M, Hermier D and Le Dividich J. 2001. Journal of Anim. Science. 79:87 (c.f. Indian Veterinary Journal. 2014. 91: 93-95.
9. Mayer R and Bucklin R. 2001. Influence of hot-humid environment on growth performance and reproduction of swine. http://edis.ifas.ufl.edu/AN107 Accessed May 30, 2007.
10. Nichols DA, Ames DR and Hines RH. 1982. Effect of temperature on performance and efficiency of finishing swine. Livestock Environment II, Proceedings of the 2nd International Livestock Environment Symposium. ASAE Publication 3-82. St-Joseph, ASAE, 376- 379.
11. Ramesh V, Saseendran PC and Thomas CK. 2001. Effect of housing system on reproductive performance of sow. Indian Journal of Animal Science**.** 71: 378-380.
12. Renaudeau D and Noblet J. 2001. Effect of exposure to high ambient temperature and dietary protein level on sow milk production and performance of piglet**.** Journal of Animal Science. 1540-1548.
13. Sailo RN. 2005. Effect of body cooling and dietary energy levels on the growth performance and carcass characteristics of pigs, M.V.Sc. Thesis. Assam Agricultural University, Guwahati.
14. Shankar BP, Madhusudhan HS and Harish DB. 2009. Pre-weaning mortality in pig - causes and management. Veterinary World. 2: 236-239.
15. Shobamani B and Reddy KK. 1999. Causes of preweaning mortality in swine. Indian Veterinary Journal. 76: 257-258.
16. Singh BK and Singh RK. 2003. Study on stillbirths in exotic pigs under tropical climate. Indian Veterinary Journal. 80: 949- 951
17. Statistical Analyzing System-9.3 (SAS).
18. Suriyasomboon A, Lundehein N, Kunavongkrit A and Einarsson S. 2006. Effect of temperature and humidity on reproductive performance of crossbred sows in Thailand. Theriogenology. 65: 608- 628.

 DOI 10.5455/ijlr.20170828124802

19. Ying Z and Chen H. 2002. Relationship between climatic factors and wannanhua sow's reproductivity. Tai Xue. 13:1311-1314.
20. Yousef M K. 1985. Stress Physiology: Definition and Terminology. In: Stress Physiology in Livestock, CRS Press, pp. 1: 205.

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