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Effect of microclimatic variables in different flooring systems of pig sty

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Abstract
The influence of the flooring pattern on the thermal comfort of Large White Yorkshire weaned pigs was investigated in three different flooring systems. Three different flooring systems in conventional pig farming viz., solid concrete floor (T_1), raised slatted concrete floor (T_2) and raised slatted polypropylene floor (T_3) formed the experimental housing design and three sty of equal sizes measuring 3.50 m x 2.90 m were taken. Pigs in the different housing systems are maintained in standard floor space of 0.8-1.0 m^2 with similar feeding practices and management conditions. Under each treatment, 10 numbers (5 males and 5 females in each treatment) of weaned large white Yorkshire pigs are allotted with average body weight of 16.50±0.50 kg respectively. Microclimatic variables include air temperature, relative humidity, air velocity were recorded daily and statistically there was significantly (P<0.01) higher difference observed between the treatment groups in the morning and afternoon hour recording.

Keywords: weaned pigs, grower pigs, flooring pattern, temperature, relative humidity and welfare

Introduction
The human population has grown faster and larger enough, intensive animal production has developed simultaneously to satisfy the demand for meat [1]. Intensive pig production in confinement provides an increasingly large source of income and jobs for the rural communities and also possible to adopt the technological advancements in nutrition, genetics, management and environmental control. The challenge for any swine production was made to meet the demand of environmental sustainability while providing the animals the quality physical environment for enhanced well-being and thus productivity [10]. The thermally comfortable environment makes the animal capable of maintaining its performance, consume and absorb nutrients properly [12]. At the same time, the reduction in performance, heat and social stress can depress the pig's health [3]. The primary purpose of pig farming all over the world is the production of pork. Secondary considerations are the production of pig skin, bristles, manure and gainful employment round the year. Pigs are efficient converter of agricultural by-products and waste material in to high quality protein with 65-80 per cent dressed carcass weight. Porcine dung is used for maintaining the soil fertility.

The important factor affecting welfare of animals throughout the stages of breeding, growth and maturity is the environment [9]. Pigs farming in tropical conditions are always under stress, where the environmental temperatures are frequently above the zones of thermo neutrality (comfort zone) which causes reduced growth in pigs and behavioural modification leads to economic losses to pig farmers [8].

Hence the studies on different flooring system of pigs on microclimatic variables will help to improve the welfare of animals. The successful management of pig rearing requires provision of suitable environmental conditions with conducive microclimate for better growth performance. Therefore, a study in microclimatic variables under different flooring systems of pig sty is chosen and the result will help farmers for adoption.

Materials and Methods
Experimental design
Thirty numbers of homogenous stocks of weaned Large White Yorkshire piglets of both sexes were taken for the study.

The piglets were weaned at the age of 30 days with the average body weight around 7.5 kg. Three different flooring systems of pig rearing viz., Solid concrete floor (T_1), Raised slatted concrete floor (T_2) and Raised slatted polypropylene floor (T_3) were constructed as an experimental housing designs and 10 animals were allotted in each flooring system. Pigs are provided with a floor space of 1 sq.m per animal. Each pen had feeding trough and nipple drinker.

The piglets used for the study were housed from weaning to market age in pig fattener sty. The buildings were located in East – West orientation. Three pens of equal sizes measuring 3.50 m x 2.90 m were taken for the treatment T_1, T_2 and T_3 respectively within roofed area.

Microclimatic variables measurements

Air temperature (°C) and Relative humidity (%) were measured with wet and dry bulb thermometer (GM 907 BR) and Digital Hygrometer (IBS HTC-1) and Air velocity (m/sec) was measured with Digital Anemometer (Generic GM816). The microclimatic variables were recorded at 8.00 hours and 14.00 hours throughout the experimental period [15]. The overall average maximum temperature, average minimum temperature, relative humidity and wind velocity were calculated to study the effect of micro environmental influence on the growth of pigs in different floor patterns [14].

Statistical analysis

The collected data were statistically analysed by One Way ANOVA by using IBM SPSS® Version 20.0 for Windows®. The significance was tested using Duncan's multiple range test and Post Hoc technique to compare the experimental groups.

Result and Discussions

Air temperature

Air temperature recorded in the morning and afternoon hours of three different flooring systems T_1, T_2 and T_3 during the experimental trial was presented in Table 1 and 2. Statistical analysis revealed that significantly (P<0.01) higher temperature was observed in raised slatted polypropylene and solid concrete flooring systems when compared with raised slatted concrete floor during afternoon hours though no significant difference was observed. The mean ± SE maximum and minimum temperature recorded in the morning and afternoon hours of three different flooring systems T_1, T_2 and T_3 during the experimental trial was presented in Table 1 and 2 whereas significantly (P<0.01) higher maximum and minimum temperature recorded in T_1 (30.07±0.53 and 28.92±0.07 ºC) followed by T_3 (29.96±0.06 and 28.80±0.08 ºC) and T_2 (28.85±0.08 and 26.92±0.08 ºC) respectively in the afternoon maximum and minimum temperature in three different flooring system during the entire experimental trial. The mean ± SE of morning hours dry bulb and wet bulb temperature during the entire period of experiment for the groups T_1, T_2 and T_3 were presented in Table 1 and 2. Statistical analysis revealed that there is no significant difference between the treatment groups in morning hours wet bulb temperature and afternoon hours dry bulb temperature. Significantly (P<0.05) higher temperature in T_1 followed by T_2 and T_3 higher temperature in T_1 followed by T_2 and T_3 of morning dry bulb and afternoon the highest wet bulb temperature was observed in T_3 (26.78±0.03 ºC) followed by T_1 (26.76±0.06 ºC) and T_2 (26.67±0.06 ºC) during the experiment. Significantly (P<0.01) higher air temperature in the afternoon when compared to morning and this might due to due to the phenomenon of atmosphere [15]. However, the higher ambient temperature indicates lower the performance of animals in different flooring conditions [6, 7, 19]. This coincides well with the findings of [11, 13], the microclimate differed significantly between different types of animal shelter and system of management.

Table 1: Microclimatic variables (mean ± SE) in three different flooring systems and its analysis of variance (morning hours)

Parameters	Solid concrete floor (T1)	Raised slatted concrete floor (T2)	Raised slatted polypropylene floor (T3)	F value
Air temperature (°C)	30.28±0.07	30.03±0.08	30.49±0.07	10.639 NS
Dry bulb temperature (°C)	30.18±0.05	30.12±0.05	29.96±0.06	4.141*
Wet bulb temperature (°C)	27.02±0.05	26.74±0.07	27.14±0.07	9.096 NS
Maximum temperature (°C)	30.01±0.75	28.66±0.08	29.83±0.08	80.297 NS
Minimum temperature(°C)	28.37±0.12	26.43±0.15	28.65±0.10	85.177 NS
Wind velocity (m/sec)	0.10±0.01	0.08±0.01	0.16±0.01	18.482 NS
Relative humidity (%)	71.61±0.34	72.13±0.39	72.72±0.41	2.081 NS

Table 2: Microclimatic variables (mean ± SE) in three different flooring systems and its analysis of variance (afternoon hours)

Parameters	Solid concrete floor (T1)	Raised slatted concrete floor (T2)	Raised slatted polypropylene floor (T3)	F value
Air temperature (°C)	30.30±0.06	30.30±0.07	30.57±0.07	5.241**
Dry bulb temperature (°C)	30.25±0.04	30.10±0.06	30.29±0.06	2.726 NS
Wet bulb temperature (°C)	26.76±0.06	26.67±0.06	26.78±0.03	3.911*
Maximum temperature (°C)	30.07±0.53	28.85±0.08	29.96±0.06	95.316**
Minimum temperature(°C)	28.92±0.07	26.92±0.08	28.80±0.08	180.366**
Wind velocity (m/sec)	0.11±0.01	0.08±0.01	0.17±0.01	18.571**
Relative humidity (%)	70.90±0.41	71.33±0.34	71.11±0.34	0.346 NS

NS-Not Significant (P>0.05)
* Significant at five percent level (P<0.05)
** Significant at one percent level (P<0.01)

Relative humidity

The mean micro environmental relative humidity recorded in the morning hours during the entire experimental trial in the treatment groups T_1, T_2 and T_3 were 71.61±0.34, 72.13 and 72.72±0.41 per cent respectively but in the afternoon hours relative humidity recorded in the treatment groups T_1, T_2 and

T_3 were 70.90±0.41, 71.33±0.33 and 71.11±0.33 respectively, No significant difference was observed between the treatment groups (Table 1 and 2). Similarly [2, 4] found out no effect of relative humidity in accordance with floor types. However [17], also observed no significant influence on the floor type. The result also revealed that higher range of ambient temperature also increasing the relative humidity which helps to ameliorating the effect of heat stress condition in animals.

Wind velocity

The mean± SE wind velocity of pigs reared in three treatment groups T_1, T_2 and T_3 were 0.104±0.007, 0.0815±0.006 and 0.161±0.011 (m/sec) respectively (Table 1 and 2). A range of lower wind speed in all three treatment groups was sufficient for grower pigs as found [7]. Significantly lower wind velocity in the morning when compared with afternoon due to lower air temperature in the animal shed [18].

Summary and Conclusions

The study was conducted to assess the thermal comfort of Large White Yorkshire grower pigs maintained in three different flooring systems. Environmental parameters such as atmospheric temperature, relative humidity and air velocity were recorded to find out variations on the performance of different treatment groups. The mean maximum temperature (ºC) and minimum temperature (ºC) ranged between 28.70 and 30.60, and 26.40 and 28.70 in all the three treatment groups during the study. Statistically, there was no significant difference in morning hour recorded air temperature in the pigsty whereas significantly (P<0.01) higher difference observed in afternoon hours. Relative humidity was higher at 8.00 hours compared to 14.00 hours in three treatment groups which indicate the significant difference between the morning and afternoon hour measured relative humidity. Microclimatic variables did not differ significantly between treatments but statistically (P<0.01) higher values observed in afternoon hour recordings.

Based on the above study, the following conclusions were made and which can be advised to farmers,

Air temperature, relative humidity and wind velocity are compared to access the microclimatic conditions of pig sty where the performance of pigs were evaluated. All the observed microclimatic variables were under the normal values of animal housing conditions.

Air temperature and relative humidity are used to access the thermal comfort zone of animals in the different housing systems by using the temperature and relative humidity of the animal house though comparatively lower range of temperature, temperature humidity index was observed in T_2 (raised slatted concrete floor) then T_1 and T_3.

It is concluded that raised slatted concrete floor can be advised for animal comfort and to maintain the productivity and health status of animals.

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