

Blood biochemical and physical parameters of crossbred barrows reared with different floor space allowances

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ABSTRACT

To compare the effect of different floor space allowances on physiological status of pigs, 36 crossbred (Landrace x *Desi*) barrows were reared with 3 different floor space allowances {n = 4(group size) x 3(replications) = 12 each}. Group T_{IS} (control) had floor space allowance (0.9, 1.35 and 1.8 m²/pig during weaner, grower and finisher stage) as per Indian Standards (IS: 3916-1966), while T_{2/3} and T_{1/2} treatment groups had 33% and 50% reduced floor space allocation with fixed small (n=4) group size throughout the experiment. Skin lesion score, blood parameters and back fat thickness (BFT) of pigs were estimated. Mean skin lesion score of head and ears (weaner, P<0.05) was lower in T_{IS} group than other groups, and body regions (finisher, P<0.05) was lower in T_{IS} than T_{1/2} group, whereas, lesion score for other body parts and growth stages did not differ among the groups. Plasma cortisol concentration was higher (P<0.05) in T_{1/2} group than other groups (grower) and T_{IS} group (finisher). BFT of pigs did not differ statistically among the groups. It is concluded that suitable floor space allowance in Indian conditions should lie between T_{2/3} and T_{1/2} group for crossbred pigs.

Key words: Back fat thickness, Crossbred barrow, Floor space, Lesions, Welfare

Pig farming has become a profitable enterprise since it possesses many favourable economic traits e.g. high prolificacy, faster growth rate, shorter generation interval, low cost of rearing and high dressing percentage with better feed conversion efficiency¹⁵. Rearing of pigs in India is predominantly occupied by marginal (52.36%), small (20.9%) and semi-medium (15.42%) farmers² who are already constrained by availability of little land. Efficient

utilization of floor space without adversely affecting the quality of pigs and products is an important aspect for profitable pork production. Efficient use of indoor floor space enhances economic and management benefits^{18,19}. Some studies indicate that there is scope of reduction of floor space for pigs through environment enrichment^{4,5,13}. Hence, this investigation was carried out to assess the effect of reduction in floor space allowance on welfare indicators of pigs.

MATERIALS AND METHODS

Animals, Facilities and Management Conditions

A total of 36 crossbred {Landrace x *Desi* (local Indian)} male piglets, from 14 litters of unrelated sows farrowed contemporarily, were selected randomly taking body weight and age into consideration at ICAR - Indian Veterinary Research Institute (IVRI), India. These piglets were castrated at one month of age, weaned at 6 weeks of age and subsequently

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distributed randomly in to three equal groups {n=12 each (group size=4, replications=3)} on the basis of 3 different floor space allowances. T_{IS} (control) group provided floor space as per Indian Standards¹¹ specification, while T_{2/3} and T_{1/2} treatment groups with 33% and 50% reduced floor space allocation per pig in comparison to IS. Indian Standards suggests

covered floor area of 0.9 and 1.8 m²/pig for weaner and finisher pigs, respectively. During weaner (6-14 weeks), grower (15-22 weeks) and finisher (23-29 weeks) stages, 3 different floor spaces {T_{IS} group (0.9, 1.35 and 1.8 m²/pig), T_{2/3} group (0.6, 0.9 and 1.2 m²/pig) and T_{1/2} group (0.45, 0.68 and 0.9 m²/pig)} were provided (Table 1).

Table 1. Floor space allowance (m²/pig) for different treatment groups

Stages	Groups		
	T _{IS}	T _{2/3}	T _{1/2}
Weaner (6-14 weeks)	0.9	0.6	0.45
Grower (15-22 weeks)	1.35	0.9	0.68
Finisher (23-28 weeks)	1.8	1.2	0.9

Each pen had 2.5 m width and specified floor space was provided by fixing length of the pen using metallic grill gates. Floor was made of concrete with serrations. Animals were fed twice daily in linear feeders with provision of potable water round the clock. Pigs were provided with corn-barley-soybean meal-wheat bran based diet based on formula as per growth stage (Table 2). Management practices related to health and hygiene were followed as

per farm's guidelines. Experiment coincided with summer and monsoon months (May-November, 2012). During weaner, grower and finisher stage micro climatic temperature and relative humidity (RH) ranged between 29-41°C, 48.6-75.3%; 24.5-37°C, 79-94.9%; and 22-34.5°C, 75.3-90.3%. Permission of Institutional animal ethics committee was taken before conduct of experiment.

Table 2. Physical composition of ration for pigs

Ingredients	Weaner (Parts/100 kg)	Grower and Finisher (Parts/100 kg)
Crushed Maize	35	35
Barley	-	15
Deoiled Soybean Meal	10	15
Wheat Bran	47	33
Fish Meal	06	-
Mineral Mixture	1.5	1.5
Common Salt	0.5	0.5

Skin Lesion Score and Physiological Parameters

All the experimental animals were examined daily for any incidence of health problem. Each animal was carefully examined for skin lesions at weekly interval. Skin lesions were examined in four body zones i.e. Head & ears, body, legs and tail. Lesions (scratches and wounds) were scored on a 4 point scale of 0-3 i.e. 0 (No apparent lesion or injury), 1 (up to 5 scratches), 2 (5-10 scratches or 1

Abrasion) and 3 (>10 scratches or >1 abrasions or cut) as per modified technique¹.

Blood samples were collected randomly from 5 barrows of each group during grower (18th week) and finisher (24th week) stages for estimation of plasma cortisol, albumin and total protein. Blood samples were collected aseptically from the anterior venacava in sterilized disposable syringes (24 gauge needle) after restraining pigs in dorsal recumbency. Collected blood samples were transferred to heparin coated centrifuge tubes and centrifuged at 3000 rpm for 10

minutes for separation of plasma. Plasma was stored at -20°C till the estimation of different biochemical parameters. Plasma cortisol concentration was determined by standard technique using commercial radio-immunoassay (RIA) kit (Beckman Coulter) at Nuclear Research Laboratory, IVRI, Izatnagar, India. Total protein in plasma was estimated using biuret method and albumin was estimated using bromocresol green (BCG) method⁷.

Back Fat Thickness

Back fat thickness (BFT) of pigs were recorded using ultrasound scanner (Lean-meater series 11, S/N: 40001, Renco Corporation, 8830 7th Avenue North Golden Valley, MN 55427 USA) once during each stage (weaner, grower and finisher) i.e. at 8th, 16th and 28th week of age. Skin was saturated with light mineral oil and good contact between skin and probe was made. Readings were taken at 3 points i.e. first rib, last rib and last lumbar vertebrae at 2.5 inch off the mid line. Average of these 3 readings (mm) was used as mean BFT value.

Statistical Analysis

The data, thus collected during the experimental period, was subjected to the statistical analysis as per the procedures¹⁷ using the Statistical Analysis System (SAS institute Inc., Cary, NC; USA). The mean and standard error values have been presented and data collected for three treatment

groups was compared using ANOVA. P value of ≤ 0.05 was considered significant in the analyses.

RESULTS AND DISCUSSION

Skin Lesion Score

Skin lesion scores were measured at weekly interval for body parts i.e. head & ear, body, legs, tail and total lesion score was derived as sum of all. Mean skin lesion score as per stage of the barrows is presented in Table 3. Lesion scores for different parts and total lesion score did not differ for most of the trial period in barrows of different groups. However, mean lesion score of head & ears was significantly ($P < 0.05$) higher in $T_{2/3}$ and $T_{1/2}$ groups during weaner stage than T_{1S} group while during finisher stage lesion score of body part was higher ($P < 0.05$) in $T_{1/2}$ group than other groups. The adverse health effects with decreasing floor space are of concern from both animal welfare and economic perspectives, and require confirmation⁶. Skin lesion score differed only for head & ear and body region during weaner and finisher stages, respectively and did not differ for rest of the body categories during various stages. It could be due to the fact that animals in $T_{2/3}$ and $T_{1/2}$ groups had lesser free space when compared to T_{1S} group to escape themselves from face to face interactions of their dominant pen mates especially during feeding and group frolicking at weaner stage. During finisher stage too similar results were noted for body region.

Table 3. Mean skin lesion score of barrows with different floor space allowances

Stage	Groups	Head & Ear	Body	Legs	Tail	Total score
Weaner	T_{1S}	0.083±0.043 ^a	0.176±0.046	0.157±0.039	0.102±0.027	0.454±0.063
	$T_{2/3}$	0.222±0.043 ^b	0.306±0.046	0.176±0.039	0.019±0.027	0.630±0.063
	$T_{1/2}$	0.231±0.043 ^b	0.213±0.046	0.185±0.039	0.028±0.027	0.546±0.063
Grower	T_{1S}	0.292±0.049	0.448±0.052	0.177±0.037	0.021±0.018	0.750±0.050
	$T_{2/3}$	0.260±0.049	0.406±0.052	0.167±0.037	0.042±0.018	0.677±0.050
	$T_{1/2}$	0.312±0.049	0.542±0.052	0.125±0.037	0.031±0.018	0.760±0.050
Finisher	T_{1S}	0.306±0.057	0.514±0.060 ^a	0.278±0.047	0.000±0.008	0.861±0.049
	$T_{2/3}$	0.222±0.057	0.556±0.060 ^{ab}	0.222±0.047	0.014±0.008	0.861±0.049
	$T_{1/2}$	0.333±0.057	0.722±0.060 ^b	0.139±0.047	0.000±0.008	0.889±0.049

Values (Mean ± SE) bearing different superscripts column wise are significantly ($p < 0.05$) different stage-wise

Reduced space allowances lead to increased aggression-related skin lesion scores^{1,19&20}. Pigs (75 kg) housed at 0.8 m² per animal had more lesions on the ears ($p<0.01$), front ($p<0.01$), middle ($p<0.01$) and hind-quarters ($p<0.01$) regions than those housed at 1.6 and 1.2 m² and total scores of lesions on the body were gradually increased ($p<0.01$) with the increasing stocking density⁹. Lower joint swelling scores and lesions associated with fighting or biting were observed in pens with lesser space¹⁶. Low floor space allowance also increased the rate of removal of pigs from pens due to injury, poor health, or death²². Since agonistic interactions did not differ between the groups for most of the time, skin lesion scores too did not vary much during majority of the period. As space allowance (minimum $k\approx 0.05$) in this study was not as low as discussed above, overall lesion scores for most of the body parts did not differ significantly among different treatment groups. The values of lesion score were under acceptable limits for reduced floor space groups as compared with other studies^{1&19}.

Blood Parameters

Blood parameters were determined only for grower and finisher stages (Table 4). Plasma cortisol concentration was significantly ($p<0.05$) higher in $T_{1/2}$ group than other groups during both grower and finisher stages while albumin and total protein level did not differ among the groups. For the pigs circadian rhythm is characterized by peak amounts of circulating cortisol expressed in the morning with reduced levels during the afternoon and early evening²¹. The study¹² reported plasma cortisol concentration in pigs in the range of 27 to 355 nM/L. Values of plasma cortisol obtained were lower than earlier report available¹⁴ and falls under normal range. However, another study¹⁸ suggested that breed specific variations exist in basal plasma cortisol levels. These results indicate relatively more stress among pigs of $T_{1/2}$ group than T_{IS} group. Plasma concentration of total protein and albumin did not differ significantly between the groups. Total protein and albumin levels were within normal range as per earlier report⁸ in pigs.

Table 4. Plasma concentration of physiological parameters in barrows reared with different floor space allowances

Parameter	Groups	Grower (18 th week)	Finisher (24 th week)
Cortisol (nM/L)	T_{IS}	100.52 ± 15.15 ^a	68.66 ± 14.07 ^a
	$T_{2/3}$	101.32 ± 21.78 ^a	93.66 ± 25.17 ^{ab}
	$T_{1/2}$	157.78 ± 18.28 ^{b,A}	101.69 ± 20.62 ^{b,B}
Total Protein (g/dl)	T_{IS}	6.88 ± 0.66	6.64 ± 0.64
	$T_{2/3}$	5.67 ± 0.62	5.48 ± 0.55
	$T_{1/2}$	6.37 ± 0.38	6.54 ± 0.50
Albumin (g/dl)	T_{IS}	3.73 ± 0.27	4.27 ± 0.37
	$T_{2/3}$	3.08 ± 0.44	4.01 ± 0.22
	$T_{1/2}$	3.72 ± 0.36	3.72 ± 0.31

Values (Mean±SE) with different superscripts column (a,b) & row (A,B) wise are significantly ($p<0.05$) different

Back Fat Thickness

Back fat thickness of live barrows did not differ ($p>0.05$) among the groups throughout the experiment (Table 5). In³ finishing pigs (120 kg LW), back fat increased from 19.4 to 21.4 mm when available space increased as per floor space

coefficient from $k = 0.023$ to $k = 0.030$. Whereas, increasing⁴ space allowance was related to a decrease in fat depth, which is a highly desirable characteristic for the producer and the abattoir. In contrast, no¹⁰ differences in fat depth in pigs slaughtered at 120 kg LW and reared in restricted or unrestricted conditions ($k = 0.022$ versus $k = 0.038$)

was also reported. Similarly, in present study BFT did not vary for different floor space allowances which could be due to the fact that stocking density

(minimum $k \approx 0.05$) was not high enough even in lowest space allowance group ($T_{1/2}$) to affect BFT.

Table 5. Back fat thickness (mm) of barrows with different floor space allowances

Groups	Weaner (8 th week)	Grower (16 th week)	Finisher (28 th week)	SEM
T_{1s}	13.78	18.11	19.89	1.01
$T_{2/3}$	12.03	19.31	21.56	1.01
$T_{1/2}$	13.64	17.53	20.78	1.01

CONCLUSION

It can be concluded that 33% reduced floor space to IS in pigs didn't affect welfare indicators while 50% reduction led to relatively higher plasma cortisol level and skin lesion score of few body parts unaffacting major ones though values were under acceptable limits.

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