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Meat Quality of Crossbred (Hampshire × Assam Local) Pigs Reared in Deep Litter Housing System: A Comparison with Pigs Reared in Conventional Concrete Floor

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ABSTRACT

Present study was planned to compare meat quality characteristics of crossbred Hampshire pigs under two different housing systems. Forty crossbred Hampshire pigs of 2 to 3 months of age and with an average body weight of 10 kg were selected and kept under two housing system *viz.,* deep litter and conventional concrete floor. 5 males and 5 females of each group were slaughtered at the age of 32 weeks for study of meat quality. The proximate composition, physico-chemical properties (pH and water holding capacity), colour characteristics, shear force and organoleptic evaluation data were recorded. From the study on meat quality, it was revealed that crude protein% of *Longissimus dorsi* muscle of pigs in deep litter floor (Group II) was higher than conventional concrete floor housing system (Group I) while the % total ash content was higher in Group I than Group II. The mean pH value of *L. dorsi* muscle of pigs in deep litter was found to be significantly higher. The WHC of *L. dorsi* muscle of the pigs of Group II was found to be better as compared to Group I. The colour component had significantly higher b*components in Group I. Sensory ratings of the cooked *L. dorsi* muscle, it is seen that Group II were rated better for taste, juiciness and overall acceptability.

HIGHLIGHTS

- The crude protein % of *Longissimus dorsi* muscle of pigs in deep litter floor was higher than conventional concrete floor housing system.
- The % total ash content in meat was higher in conventional concrete floor system.
- The mean pH value of *L. dorsi* muscle of pigs in deep litter was found to be significantly higher.

Keywords: Conventional concrete floor, crossbred pig, deep litter, *Longissimus dorsi*, meat quality

Pork quality is determined by the rate and extent of postmortem muscle metabolism. Stress in the period around slaughter is known to influence the physiological and biochemical processes in pigs, which will affect

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the perimortem muscle metabolism and thereby meat quality (Xing *et al*., 2018). Confinement housing of pigs increases stress susceptibility of animals (Van de Perre, 2011). Consumers all over the world now-a-days prefer their pork to be produced from pigs maintained on animal welfare friendly systems. Therefore, research approaches have been directed towards developing pig production systems meeting the requirements of animal health and welfare paradigms without affecting the intensity of production and pork quality. When compared to the conventional housing system, many scientists agree that there is a cost benefit of deep litter housing system as it is 40% cheaper. (Kralik *et al*., 2004) and more favorable for animal welfare and environment protection (Margeta *et al*., 2005). While considering health and disease state, pigs reared on deep litter housing system have found more tolerance to disease development as it is less stressful and eco-friendly. Moreover, because of the bedding materials in deep litter housing, the pigs were less prone to injury in comparison to conventional housing system.

Studies on effects of housing system on meat quality of pigs have yielded widely differing results. The conventional system is generally considered to be associated with a negative environmental impact and poor animal welfare due to high animal densities and hard floor conditions, and is perceived to result in reduced meat quality (Terlouw *et al*., 2009). Muscle fiber type percentages are influence by environmental factors (Street and Gonyou, 2008), genetics (Salas and Mingala, 2017), exercise (Lebret, 2008), age, sex, and slaughter weight (Borah *et al*., 2016). The relationship between muscle fiber types and meat quality is not fully understood in pigs and muscle fiber type composition is highly variable (Lee *et al*., 2010). Hence, the present study has been carried out to determine the effect of deep litter and conventional concrete floor housing systems on meat quality of crossbred (Hampshire x Local) pigs under the agro-climatic condition of Assam**.**

MATERIALS AND METHODS

For the present study, 40 crossbred (Hampshire × Assam Local) weaned piglets (females and castrated males) of 6-8 weeks of age and with an average body weight of 10 kg were selected from the National Agricultural Innovation Project (Component-2) pig farm located at the Assam Agricultural University, Khanapara Campus, Guwahati. The animals were divided into two equal groups and were housed in two different housing systems. One group was kept in a conventional concrete floor (Group - I) house while the other group was kept on deep litter floor (Group - II). The deep litter composed of 60 per cent paddy husk, 20 per cent sawdust and 20 per cent dry soil as bedding materials. The animals of both the groups were provided with identical floor space of 1.3 m^2 per pig (Sastry and Thomas, 2000). Pigs were fed with a compound ration containing 17.50 % crude protein up to 50 kg body weight and thereafter, with a ration containing 15.31 % crude protein as per (NRC, 1998) till 32 weeks of age as detailed in Table 1.

Table 1: Composition of experimental rations (%)

Ingredients	Ration	
	Grower	Finisher
Maize	50	55
Wheat Bran	22	22
Groundnut cake (Decorticated)	15	10
Soya bean meal	10	10
Mineral mixture	2.5	2.5
Common salt	0.5	0.5
Total	100	100
Vitamin (g)	10	10
Lysine (g)	30	30
Methionine (g)	15	15
Calculated analysis		
Crude Protein (%)	17.50	15.31
Crude Fibre (%)	2.37	2.80

For the study of meat quality, 5 males and 5 females of each group were slaughtered at the age of 32 weeks. The slaughtering and fabrication were done as per standard procedure (Ziegler, 1968). Meat quality was determined by studying the proximate composition, pH, water holding capacity, colour components, shear force and sensory properties using the *Longissimus dorsi* as the representative muscle sample.

The proximate composition of meat was determined as described by (AOAC, 2005). pH of the determined following the method described by (Pippen *et al*., 1965). The water holding capacity of the muscle samples were determined as per (Grau and Hamm, 1953). The colour component was studied by using a Spectrophotometer equipped with solid sample holder and colour software at 380 to 800 nm. The texture of the meat samples was determined by using texture analyzer (equipped with Warner-Bratzler shear apparatus. Sensory evaluation of the cooked meat samples was determined as described by (Bratzler, 1971). Data were analyzed for randomized block design with interaction using SAS (Enterprise Guide 4.2.).

RESULTS AND DISCUSSION

The proximate composition of *Longissimus dorsi* muscle of pigs (Table 2) in deep litter floor (Group II) had higher % of crude protein content (22.39 ± 0.06 *vs.* 20.75 ± 0.10, P<0.01) than the pigs of conventional concrete floor housing system while the % total ash content was higher in Group I (1.37 ± 0.02 *vs.* 1.18 ± 0.02, P<0.01) than Group II. However, % moisture (74.07 ± 0.11 and 74.09 ± 0.09) and ether extract (2.00 ± 0.03 and 2.06 ± 0.05) were similar in pigs reared in deep litter housing systems than those housed on the conventional concrete floor. These findings are in close proximity to the results reported by various researchers (Grzeskowiak *et al*., 2009; Kim *et al*., 2009) who reported that the pigs reared in outdoor with bedding contain significantly higher percentage of crude protein than conventionally housed pigs. However, other worker (Miaorano *et al*., 2012) did not find any significant influence of the type of housing system on meat quality.

The mean pH value of *L. dorsi* muscle of pigs (Table 3) in deep litter was found to be significantly higher (5.91 ± 0.03 *vs.* 5.71 ± 0.01, P<0.01) than conventional concrete floor housing system. Data obtained from the present study in respect of pH corroborate to the report of various researchers (Lebret, 2008; Prevolnik *et al*., 2011; Sirtori *et al*., 2011) who also reported that pigs reared outdoor had higher pH value than those of indoor reared pigs. From the present findings and report of various researchers, it is revealed that pigs housed in a conventional environment might be more susceptible to stress, which may affect the quality of pork (Xing *et al*., 2018). Some other researchers opined that floor space provided to pigs and environmental enrichment to encourage increased levels of spontaneous activity, compared to low activity levels in confinement building resulted in minimal differences in pH of pork (Gentry *et al*., 2002).

Table 2: Proximate Composition of *Longissimus dorsi* Muscle

Group		Proximate Composition (%)			
		Moisture	**Crude Protein**	**Ether Extract**	**Total Ash**
Group I	Male	74.06 ± 0.17	20.67 ± 0.13	2.07 ± 0.04	1.40 ± 0.02**
	Female	74.09 ± 0.15	20.83 ± 0.16	1.94 ±0.02	1.34 ± 0.03**
Group II	Male	74.03 ± 0.13^{NS}	22.44 ± 0.10**	2.07 ±0.07^{NS}	1.14 ± 0.03
	Female	74.15 ± 0.15^{NS}	22.35 ± 0.08**	2.05 ± 0.07^{NS}	1.21 ± 0.02
Overall	Group I	74.07 ± 0.11	20.75 ± 0.10	2.00 ± 0.03	1.37 ± 0.02**
	Group II	74.09 ± 0.09^{NS}	22.39 ± 0.06**	2.06 ± 0.05^{NS}	1.18 ±0.02

Values are the Mean ± S.E for six replicates; **P<0.01; NS (Nonsignificant) as compared to conventional concrete floor housed group.

Table 3: Physico-chemical Properties of *L. dorsi* Muscle

Group		pH	Water Holding Capacity (cm^2)
Group I	Male	5.71 ± 0.01	2.10 ± 0.22
	Female	5.71 ± 0.01	3.43 ± 0.50
Group II	Male	5.94 ± 0.05**	2.07 ± 0.20^{NS}
	Female	5.88 ± 0.04**	1.91 ± 0.14**
Overall	Group I	5.71 ± 0.01	2.76 ± 0.31
	Group II	5.91 ± 0.03**	1.99 ± 0.12**

Values are the Mean ± S.E for six replicates; **P<0.01; NS (Nonsignificant) as compared to conventional concrete floor housed group.

The WHC of *L. dorsi* muscle of the pigs (Table 3) of Group II (1.99 ± 0.12 *vs.* 2.76 ± 0.31, P<0.01 cm^2) was found to be better as compared to Group I as indicated by smaller area of impression in the filter paper resulting from the exudation of the meat juice upon application of pressure. Better WHC in muscle tissue may be explained because of pig's intensive movement during fattening, which affected firmness and better structure of muscular tissue. Data obtained from the present study in respect of loin eye area corroborate well to the report of researchers (Lambooij *et al*., 2004). However, some workers (Bridi *et al*., 2003) noted that rearing system did not affect the water holding capacity of pork.

The colour component (Table 4) had significantly higher b*components in Group I (0.41 ± 0.04 *vs.* -0.03 ± 0.06, P<0.01) than in Group II. No significance difference was found in L* and a*component. Data obtained from the present study in respect of colour components corroborate well to the report of some workers (Lebret *et al*., 2011) who reported that housing system had no significant effect on L* and a* colour component. The textural properties were measured as shear force value of the *L. dorsi* muscle was found to be statistically non-significant.

From the sensory ratings of the cooked *L. dorsi* of pigs (Table 5), it is seen that the samples from Group II were rated better for taste (6.64 ± 0.12 *vs.* 6.21 ± 0.09, P<0.01), juiciness (6.64 ± 0.14 *vs.* 6.32 ± 0.24, P<0.05) and overall acceptability (6.86 ± 0.10 *vs.* 6.36 ± 0.14, P<0.01) over Group I. However, the panelists preferred the meat samples of Group I for colour (6.07 ± 0.09 *vs.* 5.79 ± 0.12, P<0.01) characteristics than Group II. These findings correspond well with the results reported by various workers (Lebret *et al*., 2011) who reported that pig finished outdoor (bedding) had higher taste juiciness and overall acceptability than conventional housing system.

Table 4: Colour and Texture of *L. dorsi* Muscle

Group		Colour Component			Texture (kg)
		L*	a*	b*	
Group I	Male	4.84±0.04	-0.43±0.03	0.48±0.07**	0.006±0.001
	Female	4.74±0.14	-0.24±0.10	0.34±0.04**	0.006±0.001
Group II	Male	4.94±0.04NS	-0.35±0.06NS	-0.02±0.08	0.008±0.001
	Female	5.01±0.04NS	-0.48±0.02NS	-0.04±0.08	0.006±0.001
Overall	Group I	4.79±0.07	-0.33±0.05	0.41±0.04**	0.006±0.001
	Group II	4.98±0.03NS	-0.41±0.03NS	-0.03±0.06	0.007±0.001

Values are the Mean ± S.E for six replicates; **P<0.01; NS (Nonsignificant) as compared to conventional concrete floor housed group.

Table 5: Taste Panel Evaluation of *Longissimus dorsi* Muscle

Group		Taste Panel Evaluation						
		Appearance	Taste	Flavour	Colour	Tenderness	Juiciness	Overall Acceptability
Group I	Male	5.50±0.07	6.07±0.07	5.79±0.07	5.93±0.07	6.00±0.14	5.93±0.07	6.14±0.02
	Female	5.86±0.14	6.36±0.07	6.43±0.14	6.21±0.07	6.57±0.08	6.71±0.14	6.57±0.14
Group II	Male	5.57±0.14	6.43±0.05**	6.14±0.14	5.57±0.03	6.14±0.14	6.43±0.14*	6.71±0.14**
	Female	5.64±0.07	6.86±0.03**	6.29±0.14	6.00±0.07	6.64±0.21	6.86±0.08*	7.27±0.08**
Overall	Group I	5.68±0.12	6.21±0.09	6.11±0.02	6.07±0.09	6.29±0.17	6.32±0.24	6.36±0.14
	Group II	5.61±0.07	6.64±0.12**	6.21±0.09	5.79±0.12	6.39±0.18	6.64±0.14*	6.86±0.10**

Values are the Mean ± S.E for six replicates; *P<0.05; **P<0.01 as compared to conventional concrete floor housed group.

CONCLUSION

The current data demonstrate that the deep litter floor housing system significantly influence meat quality traits of crossbred Hampshire pigs. The deep litter system resulted in significantly higher crude protein content, pH, water holding capacity and sensory eating quality of the deep litter housed pigs than the conventional ones. Therefore, the benefit of the deep litter housing system for pig production in terms of meat quality appears to be better than conventionally reared pigs on the concrete floor.

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