Effect of Different Floor Types on Growth Performance of Pigs and Carcass Back-Fat Thickness

K. Kidega, T. Aliro, B. Mugonola, E. K. Ndyomugyenyi & I. Okello-Uma

ABSTRACT

Pig production (Sus scrofa domesticus) amongst smallholder farmers is constrained by poor growth performances in terms of feed intake (FI), weight gain (WG) and feed conversion ratio (FCR) and, high proportion of carcass back-fat thickness to lean meat. This study investigated the effect of floor types on growth performance of pigs and carcass back-fat thickness of pigs raised on IMO treated deep litter floor, untreated deep litter floor and concrete floor.Three-month old pigs (Large White x Landrace) were raised on a deep litter floor and concrete floor (control); one type of deep litter floor was treated with IMO solution and one type not treated. No significant ($P \geq 0.05$) difference were observed in feed conversion ratio (FCR), carcass back-fat thickness at the back from the 15th rib to the last Lumbar vertebrae, at gluteus medius muscle and the thigh of pigs raised on both concrete floor, IMO treated and untreated deep litter floor.

Keywords: feed intake; feed conversion ratio; weight gain; back-fat thickness.

Classification: FOR CODE: 070799

Language: English

London Journals Press

LJP Copyright ID: 925652
Print ISSN: 2631-8490
Online ISSN: 2631-8504

London Journal of Research in Science: Natural and Formal

Volume 21 | Issue 2 | Compilation 1.0

Effect of Different Floor Types on Growth Performance of Pigs and Carcass Back-Fat Thickness

K. Kidega[α], T. Aliro[σ], B. Mugonola[ρ], E. K. Ndyomugyenyi[Ѡ] & I. Okello-Uma[¥]

ABSTRACT

Pig production (Sus scrofa domesticus) amongst smallholder farmers is constrained by poor growth performances in terms of feed intake (FI), weight gain (WG) and feed conversion ratio (FCR) and, high proportion of carcass back-fat thickness to lean meat. This study investigated the effect of floor types on growth performance of pigs and carcass back-fat thickness of pigs raised on IMO treated deep litter floor, untreated deep litter floor and concrete floor. Three-month old pigs (Large White x Landrace) were raised on a deep litter floor and concrete floor (control); one type of deep litter floor was treated with IMO solution and one type not treated. No significant (P≥0.05) difference were observed in feed conversion ratio (FCR), carcass back-fat thickness at the back from the 15th rib to the last Lumbar vertebrae, at gluteus medius muscle and the thigh of pigs raised on both concrete floor, IMO treated and untreated deep litter floor. However, significant (P≤0.05) difference were observed in feed intake (FI), weight gain (WG), carcass back-fat thickness in the neck at 1st cervical vertebrae, over the shoulder and at the back from the 6th to the 14th rib of pigs raised on concrete floor, IMO treated and untreated deep litter floor. Therefore, IMO treatment of deep litter floors does not affect feed conversion ratio rather enhance weight gain and reduce back-fat thickness in pigs.

Keywords: feed intake; feed conversion ratio; weight gain; back-fat thickness.

Author α ¥: Department of Food Science and Post-harvest Technology, Gulu University, P. O. Box 166 Gulu, Uganda.

σ Ѡ: Department of Animal Production and Range Management, Gulu University, P. O. Box 166 Gulu, Uganda.

ρ: Department of Rural Development and Agribusiness, Gulu University, P. O. Box 166, Gulu, Uganda.

I. INTRODUCTION

Worldwide, pig (Sus scrofa domesticus) production is the fourth among livestock with a population of 977 million pigs of which 36 million are in Africa (Gennari et al., 2015). Pig rearing is one of the fastest growing livestock enterprises in Uganda that has become attractive and has made Uganda to be the largest pork consumers in East Africa (Lagu et al., 2017). Per capita pork consumption in Uganda was estimated to be increasing at the rate of 3.4 kg/person/year and the demand is still rising amongst urban and peri-urban population (Tatwangire, 2013).

Smallholder farmers in Uganda produce nearly 3 million pigs yearly of which more than 80% are concentrated in rural areas (MAAIF, 2008). Pigs do not only provide people with pork which is a source of good quality protein but also a source of reliable income for smallholder farmers (Ikwap *et al.,* 2014). There is high potential of economic gain from pig production given its high feed conversion efficiency, prolificacy and rapid growth rate compared to other livestock which makes pigs to generate income for farmers within a short period of time and ensure food security (FAO, 2011). Regardless of the benefits and opportunities pigs offer for better livelihood of rural smallholder farmers, pig production is still hindered by poor growth performance in terms of feed conversion ratio, weight gain and high back-fat content to lean meat (Corrêa *et al.*, 2009).

Generally, conventional systems of pig production under smallholder farmer systems are associated with poor animal performance and welfare that results in deterioration of pork quality (Ngapo *et al.*, 2004). However, environmental enrichment of piggery house floor with substrates (litter) has been found to be effective in improving performance and welfare of pigs by providing more comfortable resting surfaces (Morrison *et al.,* 2007). Deep litter floor bedding materials provides pigs with adequate sources of manipulatable objects to exhibit rooting and other natural behaviours (Gentry et al., 2004).

Daily application of indigenous micro-organism (IMO) solution on deep litter floors of pig houses have been suggested to improve growth performance of pigs and reduce back-fat thickness and, it is increasingly being practiced in Uganda by smallholder pig farmers (Nistor et al., 2012; Ndyomugyenyi and Kyasimire, 2015). Implementation of pig production systems that lower environmental impact, improve animal performances, welfare and reduce carcass back-fat content is very important for smallholder farmers therefore, this study aimed to assess the growth performance and carcass back-fat thickness of pigs raised on IMO treated deep litter floor.

II. MATERIALS AND METHODS

Study area

The study was carried out in Paicho and Koro sub-counties in Gulu and Omoro Districts of Northern Uganda for a duration of three months (90 days). These districts were selected because they have the highest population of pig farmers in the region (MAAIF, 2008). The districts are located between longitudes 30° 21' east to longitude 32° east and latitude 2° north to latitude 4° north. The districts receive an average rainfall of 1,500 mm per annum with a monthly average ranging between 14 mm in January and 230 mm in August. The wet season normally extends to October with the highest rainfall in May, August and October (Nabukenya *et al.,* 2014).

2.1 Experimental treatments and design

Concrete floors and deep litter floors were used in the study where three deep litter floor units with IMO treatment as experimental units; three deep litter floor units without IMO treatment and three concrete floor units as control units. A completely randomised block design (CRBD) was used, whereby thirty six (36) three months old healthy crosses of Large White and Landrace pigs of mixed sex were purchased from the existing pig farmers within the two districts. The pigs were randomly distributed into nine piggery units within the treatments, the beddings in all deep litter floor units were laid systematically in 1 metre deep hole measuring 3x3m on bare soil ground with, charcoal as the first layer, followed by tree shoots, maize stalks, dry red soil mixed with lime and wood shavings. The IMO solution was applied on a daily basis in all the experimental units. Restricted feeding method was used and all pigs were fed on growers' mash consisting of maize bran (74 kg), fishmeal (5 kg), soybean meal (10 kg), sunflower cake (5 kg), lake shells (4 kg), bone ash (1 kg), salt (0.5 kg) and premix (0.05 kg). In general, the nutrient composition of the feed contained; energy (2971 kcal kg-1), crude protein (13.6%), lysine (0.957%), methionine + cysteine (0.685%), fats (5.1%), crude fibre (6.3%), calcium (1.97%) and phosphorus (0.74%).

2.2 Growth performance of pigs

Growth performance of pigs raised on both concrete, IMO treated and untreated deep litter floors was determined by measuring their feed intake (FI), feed conversion ratio (FCR) and weight gain (WG). To determine WG, pigs were weighed at the beginning of the experiment and after every one week for 12 weeks using a spring balance weighing scale. The FI was determined by subtracting the total feed left (refused) by pigs from the total feed given to the pigs in a week and, the ratio of FI to WG was used to calculate the FCR. Pigs in all units were fed and watered daily two times (in the morning and evening) and application of IMO solution on the deep litter floor was also done on a daily basis.

2.3 Carcass back-fat thickness determination

Carcass back-fat thickness was measured (cm) at 6 points on one of the half carcasses using a vernier caliper; in the neck at 1st cervical vertebrae, over the shoulder at the thickest point, at the beginning of the back from the 6th rib to the 14th rib, at the centre of the back from the 15th rib to the last Lumbar vertebrae, at the centre of Gluteus medius muscle and on the thigh. The average back-fat thickness of the 6 measurements was then calculated to determine the total back-fat (Duzinski *et al.,* 2015).

2.4 Data analysis

All data obtained were analysed using Statistical Package for the Social Sciences (SPSS) version 20.0 and One-way ANOVA was generated. Means were separated by Least Significant Difference (LSD) Tests at 5 % significance level ($P \leq 0.05$).

III. RESULTS

3.1 Growth performance of pigs raised on different floor types

Feed conversion ratio (FCR) of pigs raised on both concrete, IMO treated and untreated deep litter floor houses had no significant ($P \geq 0.05$) difference (Table1). However, significant ($P \leq 0.05$) differences were observed in feed intake (FI) and weight gain (WG) of pigs raised on concrete, IMO treated and untreated deep litter floors. The FI of pigs raised on concrete floor was higher by 2.4kg than those raised on IMO treated deep litter floor and 3.4kg than those raised on untreated deep litter floor. The WG of pigs raised on concrete floor was higher by 2.4kg compared to pigs raised on IMO treated deep litter floor and 9.4kg than pigs raised on untreated deep litter floor.

Table 1: Effect of floor types on growth performance of pigs

Variable	Concrete floor (Control)	Litter floor without IMO	Litter floor with IMO	LSD	*P-value*
Initial weight (kg)	17.50±13.00	15.10±3.82	19.50±5.40	0.45	0.428
Feed intake (kg)	12.10±0.46^{c}	8.73±1.78^{b}	9.72±1.18^{a}	0.150	0.031
Weight gain (kg)	23.80±4.23^{c}	14.40±3.46^{b}	21.40±3.52^{a}	0.183	0.051
Feed conversion ratio	0.52±0.09	0.62±0.14	0.46±0.08	0.27	0.248

Means within a row with different superscripts differ significantly ($P \leq 0.05$)

3.2 Carcass back-fat thickness of pigs raised on different floor types

Carcass back-fat thickness of pigs raised on concrete floor, IMO treated and untreated deep litter floor significantly ($P \leq 0.05$) differed over the shoulder, in the neck at the 1st cervical vertebra and, at the back from the 6th to the 14th rib. However, no significant ($P \geq 0.05$) difference was observed in carcass back-fat fat thickness at the centre of the back from the 15th rib to the last Lumbar vertebrae, at gluteus medius muscle and thigh of pigs raised on both concrete floor, IMO treated and untreated deep litter floor. Carcass back-fat thickness of pigs raised on concrete floor was higher in the neck at the 1st cervical vertebrae by 1.7cm than of pigs raised on IMO treated deep litter floor and, by 0.9cm compared to pigs raised on untreated deep litter floor. Over the shoulder, it was higher by 1.8cm compared to pigs raised on IMO treated deep litter floors and, by 1cm than pigs raised on untreated deep litter floors. At the back from the 6th rib to the 14th rib, carcass back-fat thickness of pigs raised on concrete floor was higher by 1.6cm than of pigs raised on IMO treated deep litter floor and, by 1cm compared to pigs raised on untreated deep litter floors.

London Journal of Research in Science: Natural and Formal

Table 2: Effects of floor types on carcass back-fat thickness

Variables (cm)	Concrete floor	Litter floor without IMO	Litter floor with IMO	LSD	*P-value*
Neck 1st cervical vertebra	3.63 ± 0.61^{c}	2.70 ± 0.46^{b}	1.93 ± 0.29^{a}	0.031	0.004
Over the shoulder	3.63 ± 0.35^{c}	2.60 ± 0.46^{b}	1.87 ± 0.32^{a}	0.016	0.001
Beginning of the back (6th rib to the 14th rib)	2.67 ± 0.64^{c}	1.70 ± 0.53^{b}	1.10 ± 0.00^{a}	0.045	0.005
Centre of the back (15th rib to the last Lumbar vertebrae)	1.67± 0.65	0.97± 0.55	0.90± 0.26	0.349	0.202
Gluteus medius muscle	2.10± 1.31	1.17± 0.86	1.17± 0.21	0.459	0.430
Thigh	1.93± 0.83	1.23± 0.74	1.10± 0.36	0.376	0.346

Means within a row with different superscripts differ significantly ($P \leq 0.05$)

IV. DISCUSSION

4.1 Effect of different floor types on growth performance of pigs

The significant difference ($P \leq 0.05$) in FI and WG of pigs raised on concrete, IMO treated and untreated deep litter floor (Table 1) suggests that it is worth for smallholder farmers to adopt the IMO technology for pig production putting its costs and value under consideration as compared to conventional system (concrete floor). The costs and labour involved in making IMO solution included; boiling a carbohydrates source food, cooling and burying it in the soil for five days to trap the micro-organisms, making the IMO solution and applying it daily on the deep litter floor to achieve its better results. The increased FI of pigs raised on concrete floors could be due to increased energy requirements because they were more susceptible to heat (higher temperatures) stress and much of their energy were used in body temperature regulation and manipulative behaviour in stress conditions than pigs raised on deep litter floors. The more the FI, the higher the WG and this explains why pigs raised on concrete floors had higher WG compared to those raised on deep litter floors.

This suggestion concurs with Morrison *et al.* (2007) who reported that, weight gain in pigs was not influenced by housing treatment for pigs raised on deep litter (straw bedding) floor and conventional (slatted concrete floor) housing system. In addition, Correa *et al.* (2009) and Sheen et al. (2005) also reported that weight gain and feed conversion ratio of pigs raised on deep litter floor housing systems to be equal to those raised in conventional concrete floor pig houses.

However, our findings disagree with Corrêa et al. (2009) who reported no significant difference in weight gain of pigs raised on solid concrete floor and deep litter (rice husk) floor. In addition, Zhou *et al.* (2011) and Peeters et al. (2006) also reported that pigs raised on fermented bedding (sawdust, paddy husk, dry soil, charcoal, dried tree leaves, extract of fermented bamboo shoot, black salt, water, and active culture of (Lactobacillus brevis) had higher weight gain of 8.49% than those raised conventionally on cemented concrete floor which justify that deep litter bed had obvious effect on improving growth performance in pigs. In a similar study, Gentry *et al.* (2002); Johnston and Morrison (2004) also reported that pigs raised on deep-litter (Wheat straw) floor, large group systems are fatter and consumed more feed than conventionally housed pigs on concrete-slatted floor and this increased in feed intake was partly attributed to the cooler ambient temperatures experienced. Furthermore, Lebret *et al.* (2006a) reported that pigs reared on an enriched environment (sawdust bedding) floor exhibited higher feed consumption and increased growth rate than those raised conventionally on fully slatted floor and the increase could be due to the lower ambient temperature. Our findings also disagree with Honeyman and Harmon (2003) who found out that there was an increase in feed intake of 2.54kg/day and weight gain of 834g/day for pigs reared on straw beddings (cornstalks) compared to those kept on slatted floor.

4.2 Carcass back-fat thickness of pigs raised on different floor types

Reduced carcass back-fat thickness of pigs raised on IMO treated deep litter in comparison with pigs raised on concrete floor and untreated deep litter floor (Table 2) suggests that, there was a high proportion of lean meat in pork of pigs raised on IMO treated deep litter floor. This could be due to the fact that, the daily application of IMO solution on the deep litter floors on which pigs were resting most of the time cooled down their body temperature and this could have facilitated the assimilation of back-fat into the muscle to form Intramuscular fats (IMF). This suggestion concurs with Dooremalen and Ellers (2010), who reported that when temperature increases, the composition of membrane lipids (phospholipid fatty acids) become more saturated to be able to maintain homeo viscosity.

In addition, Kidega et al. 2020 also reported a high composition of saturated fatty acids in the back-fat of pigs raised on deep litter floors without IMO treatment where temperature was slightly higher than IMO treated deep litter floored. Furthermore, Lu et al., 2007 also reported that, improved external fat deposition is probably an adaptive regulation under hot conditions; the more dietary energy stored as fat, the lower heat produced thus, less heat needed to be dispersed. In addition, Kouba et al. (2001) also reported that exposure to high ambient temperature increased back-fat deposition in pigs and increased amounts of external fat in pigs could increase thermal insulation which is useful to adapt to high ambient temperature.

However, our study disagrees with Morrison *et al.* (2007) who reported no significant difference in back-fat depth of 23.7 (mm) and 23.4 (mm) of pigs raised on deep litter (straw bedding) floor and conventional (totally slatted concrete floor) housing system. In addition, Millet et al., (2004) also reported a lower muscle thickness and higher back-fat thickness in the carcass of pigs raised on organic stable (straw bedding) than those reared on conventional stable (concrete floor). In a similar study, Olsson et al. (2003) reported that organic pigs reared outdoors on free range land had lower lean meat percentages and higher carcass back-fat thickness than conventionally raised pigs indoor on concrete floor.

V. CONCLUSIONS

Daily application of IMO solution on deep litter floors (wood shavings) neither reduces feed intake nor enhance weight gain of pigs but rather reduces back-fat thickness.

VI. RECOMMENDATIONS

Further research should be conducted to compare back-fat thickness of pigs raised on different deep litter floor bedding materials treated with IMO solution.

ACKNOWLEDGEMENT

The authors acknowledge the support of MASTERCARD foundation (MCF) through the Regional Universities Forum for Capacity Building in Agriculture (RUFORUM) for funding the study. Further regards go to Dr. Solomon Olum, Mr. Samuel Elolu, Mr. Junior Kasima Senyonga and Asso Prof. Duncan Ongeng whose outstanding comments contributed in stimulating suggestions and encouragement that motivated me to coordinate this study effectively.

Conflicts of Interest

The authors declare no conflicts of interest concerning the publication of this paper.

REFERENCES

1. Corrêa, E. K., Bianchi, I., Ulguim, R. R., Corrêa, M. N., Gil-Turnes, C. and Júnior, T. L. (2009). Effects of different litter depths on enviro- nmental parameters and growth performance of growing finishing pigs. Ciência Rural, Santa Maria , 39 (3) 838-843.
2. Dooremalen, C.V. and Ellers, J. 2010. A moderate change in temperature induces changes in fatty acid composition of storage

and membrane lipids in a soil arthropod. Journal of Insect Physiology 56:178-184.
3. Duzinski, K., Lisiak, D., Knecht, D. and Srodon, S. (2015). The estimation of pork carcass primal cuts value based on backfat thickness. Journal of Central European Agriculture, 16 (1): 112-121.
4. FAO. (2011). World Livestock 2011-Livestock in food security. Rome, Italy. FAO.
5. Gennari, P., Heyman, A. and Kainu, M. (2015). FAO Statistical pocket book. World Food and Agriculture, Food and Agricultural Organization of United nations, Rome, Italy.
6. Gentry, J. G., McGlone, J. J., Blanton, J. R. and Miller, M. F. (2002). Alternative housing systems for pigs: Influence on growth, composition and pork quality. Journal of Animal of Sciences., 80:1781-1790.
7. Gentry, J.G., McGlone, J.J., Miller, M.F. and Blanton, Jr., J.R. (2004), Environmental effects on pig performance, meat quality, and muscle characteristics. Journal of Animal Sciences.82: 209-217.
8. Honeyman, M. S. and Harmon, J. D. (2003). Performance of finishing pigs in hoop structures and confinement during winter and summer. Journal of Animal Science, 8:1663–1670.
9. Ikwap, K., Jacobson, M., Lundeheim, N., Owiny, D. O., Nasinyama, G. W., Fellstrom, C. and Erume, J. (2014). Characterization of pig production in Gulu and Soroti districts in northern and eastern Uganda. Livestock Research for Rural Development , 26(4):8-24.
10. Johnson, L. J. and Morrison, R. S. (2004). Growth performance and carcass quality of pigs housed in deep-litter barns fed diets containing alternative ingredients. Minnesota: Final report to Minnesota Pork Producers. Minnesota Pork Producers, MN, USA.
11. Kidega, K., Ndyomugyenyi, E.K. and Okello -Uma, I. (2020). Effect of indigenous microorganism treatment of deep litter floor on nutrient content of pork. African Crop Science Journal, Vol. 28 Issue Supplement, s1 pp. 247 - 254
12. Kouba, M., Hermier, D. and Le Dividich, J. (2001). Influence of a high ambient temperature on lipid metabolism in the growing pig. Journal of Animal Science. 79:81–87.
13. Lagu, C., Andama, M., Lee, S., Park, M., Ainomugisha, A., Ariho, A., Weisheit, A. and Tusingwire, S. (2017). Prevalence and intensity of internal parasites in pigs under indigenous micro-organism (IMO) and conventional piggery farms, greater Mbarara, Uganda. Livestock Research for Rural Development, 29 (6).
14. Lebret, B., Meunier-Salaun, M.C., Foury, A., Mormede, P., Dransfield, E. and Dourmad, J.Y. (2006) Influence of rearing conditions on performance, behavioural, and physiological responses of pigs to pre slaughter handling, carcass traits, and meat quality. Journal of Animal Sciences, 84: 2436-2447.
15. Lu, Q., Wen, J. and Zhang, H. (2007). Effect of Chronic Heat Exposure on Fat Deposition and Meat Quality in Two Genetic Types of Chicken. Poultry Science, 86: 1059-1064
16. MAAIF. (2008). The National Livestock Census Report 2008. UBOS, Uganda Bureau of Statistics. Ministry of Finance, Planning and Economic Development, Kampala, Uganda.
17. Millet, S., Hestaa, M., Seynaeveb, M., Ongenae, E., DeSmet, S., Debraekeleer, J. and Janssens, G. P. J. (2004). Performance, meat and carcass traits of fattening pigs with organic versus conventional housing and nutrition. Livestock Production Science, 87;109 – 119 .
18. Morrison, S. R., Johnston, J. L. and Hilbrands, A. M. (2007). The behaviour, welfare, growth performance and meat quality of pigs housed in deep litter, large group housing system compared to a conventional confined housing system.Applied Animal Behaviour Science , 103:12-24.
19. Nabukenya, I., Akiiki, C.R., Olila, D., Ikwap, K., and Höglund, J. (2014). Ethnopharmacological practices by livestock farmers in Uganda: Survey experiences from Mpigi and Gulu districts. Journal of Ethnobiology and Ethnomedicine, 10:1-14.
20. Ndyomugyenyi, E. K. and Kyasimire, J.(2015). Pig production in Kichwamba Sub-county,

Rubirizi district, Uganda . Livestock Research for Rural Development 27(10):1-13.

21. Ngapo, T.M., Dransfield, E., Martin, Magnusson, M., Bredahl, L. and Nute, G.R. (2004) Consumer perceptions: Pork and pig production. Insights from France, England, Sweden, and Denmark. Meat Science, 66:125-134.
22. Nistor, E., Bampidis, V., Pentea, M., Prundeanu, H. and Ciolac, V. (2012). Nutritional Quality of Pork Produced by Mangalitsa Breed. Scientific Papers: Animal Science and Biotechnologies 45 (2):386-389.
23. Olsson, V., Andersson, K., Hansson, I. and Lundström, K. (2003). Differences in meat quality between organically and conventionally produced pigs. Meat Science, 64 (3) : 287–297.
24. Peeters, E., Driessen, B., Moons, C. P. H., Ödberg, F. O. and Geers, R. (2006). Effect of temporary straw bedding on pigs' behaviour, performance, cortisol and meat quality. Applied Animal Behaviour Science, 98 : 234–248.
25. Sheen, S.Y., Su, C.C., Lee, M.S., Chang, H.L. and Hong, C.M. (2005). Study on the management model of litter bedded pig houses. Livestock Research, 34(2): 69-78.
26. Tatwangire, A. (2013). Successes and failures of institutional innovations to improve access to services, input and output markets for smallholder pig production systems and value chains in Uganda. CGIAR.
27. Zhou, Y. G., Wen, A. Y., Ning, K. J. N., Xu, B. N., Xie, J. L., Tang, H. and Liu, S. Q. (2011). Effects of biological fermentation bed on growth performance and pork quality of growing-finishing pigs. Journal of Anhui Science Technology University 25(1), 9-12.

This page is intentionally left blank