NATIONAL AGRICULTURAL AND FOOD CENTRE
RESEARCH INSTITUTE FOR ANIMAL PRODUCTION NITRA

Slovak J. Anim. Sci., 48, 2015 (1): 16–22
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ISSN 1337-9984

GROWTH PERFORMANCE, CARCASS YIELD AND ORGAN WEIGHT OF GROWING PIGS FED DIFFERENT LEVELS OF FEED

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ABSTRACT

A total of forty eight Large White weaner male pigs of 8 weeks old with average initial weight of 9.67±0.26 were used in a 150-day trial to determine the effect of feed quantity offered (1.5, 2.0 or 2.5 kg) on performance, carcass yield and organ weights of growing pigs. Final weight, daily feed intake and daily weight gain increased (P <0.05) significantly with increase in feed quantity offered. Feed conversion ratio, daily water intake and frequency of faecal excretion decreased significantly (P <0.05) with increasing feed quantity offered. Carcass weight and dressing percentage were significantly (P <0.05) influenced by feed quantity offered. The backfat depth increased significantly (P <0.05) with increase in feed quantity offered. Pigs fed 2.5 kg feed daily had higher (P <0.05) head, ham and shoulder compared to the values recorded for pigs fed 1.5 kg feed daily. Liver weights of pigs fed 2.0 and 2.5 kg feed daily had comparably similar values which differed significantly from those fed 1.5 kg feed daily. These results showed that quantity of feed offered greatly influenced feed intake, weight, carcass yield, liver and heart of growing pigs, hence, it could be used as a management tool to improve performance and carcass yield of pigs.

Keywords: feed quantity; performance; carcass yield; organs; growing pigs

INTRODUCTION

Profitability of pig enterprise depends on efficient use of feed for lean tissue growth and the rate of growth. Growth rate and nutritional requirement of pigs are two essential factors necessary for maximum pork productivity. An ideal nutritional programme should provide adequate nutrients to maximize pig productivity while minimizing excreted nutrients and feed costs. Since 75 % of total feed used in a farrow-finish operation is consumed in the grower-finisher phase (Edwards, 2010), nutritional accuracy in this phase has a substantial economic impact. Insufficient feed intake (quantitative and qualitative) has negative impact on the performance of pigs, hence, leading to higher maintenance cost. Fat deposition occurs when feed intake exceeds the rate at which maximum lean growth is achieved.

The meat industry requires animals to be as lean as possible since pork with low fat content reduces human caloric intake and intramuscular fat is related to lower sensory quality traits (Fernandez *et al.*, 1999). High level of carcass fat is therefore unacceptable because of the associated health problems. Under tropical conditions, it is therefore logical to adopt a system of feeding that promotes feed intake and lean tissue growth. High temperature leads to decrease in voluntary feed intake, and hence a reduction in growth rate. The *ad libitum* feeding, particularly, if involves feeds of high energy density, tends to promote synthesis of body fat which is inefficient in terms of feed conversion. Restricted feed allowance reduces back fat thickness and intramuscular fat content (Gondret and Lebret, 2002) resulting to acceptable carcass grading. Although progress has been made in swine nutrition in the last 30 years, there is still a need for more information relative to the various methods of feed management practices in swine production. The present study therefore seeks to completely define the levels of feeding necessary for

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Received: July 18, 2014
Accepted: February 13, 2015

lean meat productivity and for minimizing feed waste especially in a humid tropical environment.

MATERIALS AND METHODS

Experimental Site

The experiment was carried out at the Piggery Unit of the Teaching and Research Farms Directorate (TREFAD), Federal University of Agriculture, Abeokuta, Ogun State, Nigeria. The farm lies within latitude 7° 10′ N, longitude 3° 2′ E and altitude 76 mm. It is located in the derived savannah zone of South-Western Nigeria. It has a humid climate with mean annual rainfall of about 1037 mm and temperature of about 34.7 °C. The relative humidity ranges from 63 to 96 % in the rainy season (late March to October) and from 55 to 82 % in the dry season (November to early March) with an annual average of 82 %. The seasonal distribution of annual rainfall is approximately 44.96 mm in the late dry season (January–March); 212.4 mm in the early wet season (April–June); 259.3 mm in the late wet season (July–September) and 48.1 mm in the early dry season (October–December) as documented by Federal University of Agriculture, Abeokuta Meteorological Station, respectively.

Experimental Animals and Their Management

Forty eight weaner Large White male pigs of eight weeks old with mean body weight of 9.67 ± 0.26 kg were randomly assigned to three experimental groups in a completely randomized design. The pigs were grouped based on weight equalization to three groups (group 1 consisting of pigs fed 2.5 kg feed daily, while pigs in groups 2 and 3 were offered 2.0 and 1.5 kg feed daily, respectively) of sixteen pigs each. Each group was replicated four times with 4 pigs per replicate. Each replicate consisting of four pigs were fed and housed together in naturally ventilated pen with floor size dimension of 3 × 2 m. Fresh and clean water was supplied *ad libitum* throughout the duration of the experiment.

Experimental Design

The pigs were randomly assigned to 3 experimental groups in a Completely Randomized Design of 16 pigs per group. The experimental groups consisted of the daily amount of dietary portion fed to each of the pigs. Pigs were offered 2.5, 2.0 or 1.5 kg feed daily for duration of 150 days. Each pig received halves of their daily ration at 08:00 hr and the remaining portion at 14:00 hr. Diets were formulated to meet the body requirements of growing pigs. The ration contained 18 % crude protein and metabolizable energy of 12.16 MJ kg^{-1} as depicted in Table 1.

Table 1: Composition of Experimental Diet (%)

Ingredients	Grower ration
Maize	45.00
Groundnut cake	20.00
Wheat offal	20.00
Palm kernel cake	12.50
Bone meal	2.00
Premix*	0.35
Common salt	0.30
Lysine	0.05
Methionine	0.05
Total	**100.00**
Calculated Analysis	
Crude protein (%)	18.06
Crude fibre (%)	5.84
Calcium (%)	0.72
Phosphorus (%)	0.34
ME (MJ kg^{-1})	12.16

*Composition of diet per kg: Vit. A 12 600 IU; Vit. D_3 2 800 IU; Vit. E 49 IU; Vit.K_3 2.8 mg; Vit. B_1 1.4 mg; Vit. B_2 5.6 mg; Vit. B_6 1.4 mg; Vit. B_{12} 0.014 mcg; Niacin 21 mg; Pantothenic Acid 14 mg; Folic Acid 1.4 mg; Biotin 0.028 mcg; Choline Chloride 70 mg; Manganese 70 mg; Zinc 140 mg; Iron 140 mg; Copper 140 mg; Iodine 1.4 mg; Selenium 0.28 mg; Cobalt 0.7 mg; Antioxidant 168 mg

Data Collection

Feed and water intakes were determined daily by subtracting the feed and water left-over from those supplied. Initial body weight of weaner pigs were taken using weighing scale with a 0.05 g precision and documented when the pigs arrived at the experimental site and weekly records of change in body weight were subsequently taken and documented. The feed conversion ratio was calculated as ratio of feed/gain. Quantity of faecal excreted by pig was measured with the aid of measuring scale while the frequency of faecal excretion was determined by observing the number of times a pig defecates daily.

Carcass Characteristics

Twenty four pigs consisting of 8 pigs per treatment were randomly selected, slaughtered and analyzed for carcass yield, cut-up parts and fat composition at the end of the experiment. The pigs were weighed and fasted for 16 hours, and the fasted weight of each pig meant for slaughtering was taken before they were stunned by percussion method and bled by incision using a sharp knife cutting through the jugular vein between the skull and the atlas. Complete bleeding and dehairing were done. The stomach of the pigs was opened along the greater curvature and emptied. After the removal of the visceral organs, the remaining part was measured as carcass weight and later expressed as percentage of the live weight to get the dressing percentage. The head was removed by section at the occipito-atlas joint and the feet by sawing through the hock joint at a right angle to the long axis of the leg. The carcass was divided longitudinally. The left half of the carcass was dissected as described by Barca *et al.* (2006). Ham was separated by locating the division between the 2nd and 3rd sacral vertebrae and saw perpendicularly along axis of the ham. Shoulder of the pig was separated from the loin and belly by a straight cut between the second and third ribs and a straight cut 2.5 centimetre ventral to the ventral edge of the scapula. The parts were weighed and recorded. Back-fat depth was taken at the last rib using vernier calliper. The fat-free index was estimated using the formulae postulated by National Pork Producers Council (1994).

Fat-free index = 50.767 + (0.035 × hot carcass weight in kilogram) – (8.979 × last rib midline back-fat on hot carcass in centimetre).

Statistical Analysis

Data were processed by one-way analysis of variance using Statistical Analyst Software (SAS Institute, 2000) package. Significantly (P <0.05) different means among variables were separated using New Duncan's Multiple Range Test as contained in the same package.

RESULTS AND DISCUSSION

The response of pigs to quantity of feed offered is shown in Table 2. There was no significant (P >0.05) difference in the initial body weights of pigs fed at different levels. This implied that the experimental pigs were equalized before the commencement of the experiment. The final body weight, daily weight gain and daily feed intake increased significantly (P <0.05) with increase in feed quantity offered. Pigs fed 2.5 kg feed daily had higher final body weight of 53.67 kg compared to 48.42 and 45.50 kg obtained for those fed 2.0 and 1.5 kg feed daily, respectively. Daily weight gain followed the same trend with the highest mean value of 296.13 g found among pigs on 2.5 kg feed daily while the least value of 238.33 g was recorded for pigs fed 1.5 kg feed daily. Pigs fed 2.5 kg feed daily had highest feed intake (1.05 kg), followed by those on 2.0 and then 1.5 kg feed daily. These significant differences attested to the fact that pigs on higher nutritional plane (2.5 kg feed) obtained adequate intake of nutrients required to sustain rapid growth and development (Njoku *et al.*, 2013). Sufficient offering of feed to pigs is vital in optimizing overall growth performance. Garcia-Valverde *et al.* (2008) reported that pigs on high level of nutrition deposited both lean and fat at a faster rate than those fed moderate level of nutrition on both age- and weight-constant bases. This is in line with the observations noted in this study where weight gain and feed intake were significantly influenced by feed quantity offered. Quantity of feed offered significantly (P<0.05) influenced feed conversion ratio of growing pigs. Feed conversion ratio decreased significantly (P <0.05) with increase in feed quantity offered. The pigs on daily ration of 2.5 kg feed required less feed (3.01 kg) to gain one kg weight.

Table 2: Effect of feed quantity offered on performance of growing pigs

	Quantity offered			
Parameters/Treatments (kg)	1.5	2.0	2.5	SEM
Initial weight (kg)	9.75	10.00	9.25	0.58
Final weight (kg)	45.50^{b}	48.42^{ab}	53.67^{a}	2.10
Daily weight gain (g)	238.33^{b}	256.13^{ab}	296.13^{a}	12.05
Daily feed intake (kg)	0.81^{c}	0.95^{b}	1.05^{a}	0.12
Feed conversion ratio	4.13^{a}	3.56^{ab}	3.01^{b}	0.27
Daily water intake (l)	4.80^{a}	3.97^{b}	3.59^{b}	0.34
Excreted faecal weight (g/day)	665.17	591.98	575.27	29.55
Frequency of faecal excretion (times)	3.18^{a}	2.89^{b}	2.96^{b}	0.11

^{abc} – means within rows followed by different superscripts are significantly different (P <0.05)

The increase in growth rate with increasing feed offered indicates that protein deposition had larger effect on growth rate than fat deposition. The extra feed consumed by the pigs on 2.5 kg feeding regimen could have resulted to increase in protein deposition which mainly determines the growth rate of growing pigs. The extra gain in growth rate could be hypothesized to be proportionately higher than the increase in feed intake resulting in a reduced and therefore improved feed conversion ratio. Affentranger *et al.* (1996) reported better feed intake and feed efficiency in pigs fed under different feeding regimes. Feeding level, feed composition and feeding patterns have been used as tools to manipulate growth rate, weight gain, fat deposition and pork quality (Wood *et al.*, 2004). So, feeding level have been applied to increase/decrease growth rate and thereby decrease/increase age at slaughter at a given body weight (Garcia-Valverde *et al.*, 2008; Lebret, 2008a). Daily water intake of pigs fed 2.0 and 2.5 kg feed daily were statistically similar (3.97 and 3.59 litres, respectively) but differed significantly (P <0.05) from those on 1.5 kg feed daily (4.80 litres). The water intake decreased significantly with increase in feed quantity offered. The decrease in water intake with increasing feed quantity offered could be linked to level of satiety attained among the pigs on higher nutritional plane, since they had more access to feed than those on limited nutritional plane. Pigs fed limited amount of feed might have increased their water in order to compensate for low abdominal fill. This corroborates the findings of Silanikove and Brosh (1989) that reported 6-fold increase in water intake of pigs whose total daily ration was halved or completely withheld for a period. Under limited-feeding conditions, pigs consume excessive and highly variable quantities of water (Yang *et al.*, 1981). Excess water intake often referred to as hunger-induced polydypsia could be reduced by *ad libitum* feeding (Shaw *et al.*, 2006). There was no significant (P >0.05) difference in excreted faecal weight, although numerical differences were recorded among treatments. Pigs on 1.5 kg feed quantity offered had the highest faecal weight (665.17 g day^{-1}) while those on 2.5 kg feed daily had the least value (575.27 g day^{-1}). The numerical differences could be attributed to the level of water intake which was higher among the pigs fed 1.5 kg feed daily. Hosseini-Assal and Hosseini (2000) reported that faecal weights of human subjects depend on amount of water intake and fibre content of diet. Pigs on 1.5 kg feed offered drank more water in order to compensate for low abdominal fill; this must have increased the level of unabsorbed water in the large intestine, leading to increase in faecal weight. Frequency of faecal excretion is defined as the number of times an animal passes out faeces per day. The significant difference noted in the frequency of faecal excretion could be associated with the rate of water intake. Water aids digestion and promotes the rate of passage of digesta in the gastrointestinal tract. The quicker the rate of passage through the gastrointestinal tract, the earlier it reaches the rectum and therefore excretion occurs more frequently.

Carcass yield, cut-up parts and organ weight of growing pigs fed different quantity of feed is shown in Table 3. The fasted weight, bled weight, carcass weight and dressed percentage of the experimental pigs increased significantly (P <0.05) with increasing level of feed offered. The values for fasted weight ranged from 42.17 kg (pigs fed 1.5 kg feed daily) to 51.83 kg (pigs fed 2.5 kg daily). Bled weights of pigs on 1.5 and 2.0 kg daily ration were statistically similar (37.53 and 41.00 kg) which differed significantly (P <0.05) from 48.33 kg recorded for those on 2.5 kg daily ration. Pigs on 2.5 kg daily ration had the highest carcass weight (36.83 kg) and dressed percentage (81.86 %), while those on 1.5 kg daily ration had the least values (26.17 kg and 72.09 %, respectively). The significant differences observed in these parameters could be attributed to the level of feed offered to the individual pigs in each treatment group. The pigs on higher nutritional plane must have obtained sufficient amount of nutrients from the dry matter intake to compensate the energy requirement for body maintenance and tissue growth. Adequate quantity of energy intake is critical to optimize lean growth rate and efficiency (Augenstein *et al.*, 1997). The feeding level, pattern and protein: energy ratio of the diet, together with the genetic growth potential of pigs determine the growth rate and composition of weight gain at both whole-body and muscle level (Lebret, 2008a; Merck, 2008). There was a reduction in the rate and efficiency of gain as limited-feeding intensifies, though a better carcass quality was obtained. Many research findings had shown that the level of feed offered greatly influenced the back fat deposition of pigs. Feed restriction affects more fat tissue than lean tissue deposition when applied during the finishing stage of pigs. Therefore, restricted feeding leads to leaner carcasses compared with *ad libitum* feeding (Lebret *et al.*, 2001). Decrease in back fat thickness, adipocyte volume and lipogenic capacity in pigs are some of the effect of restricted feeding (Gondret and Lebret, 2002). The least back fat deposition as observed from the pigs on 1.5 kg per day feeding regime must have resulted from restriction of feed intake. Hence, the importance of feed restriction on production indices over the growth period and meat quality cannot be over-emphasized and this depends very much on feeding pattern, degree and duration (Critser *et al.*, 1995). The amount of feed offered per day played vital role in the growth performance which therefore had direct bearing on the quality of carcass produced. Limited-feeding leads to depletion of apparent rate of glycogen as measured by muscle acidity (McPhee and Trout, 1995) resulting to

Table 3: Effect of feed quantity offered on carcass yield, cut-up parts and organ weight of growing pigs

	Quantity offered			
Parameters/treatments	1.5	2.0	2.5	SEM
	Carcass yield			
Fasted weight (kg)	42.17[c]	47.67[b]	51.83[a]	2.93
Bled weight (kg)	37.53[b]	41.00[b]	48.33[a]	2.29
Carcass weight (kg)	26.17[c]	30.33[b]	36.83[a]	2.23
Dressed percentage (%)	72.09[c]	74.43[b]	81.86[a]	2.47
Backfat depth (cm)	0.56[ab]	0.62[b]	0.71[a]	0.09
Fat free index	49.20	49.10	48.83	0.30
	Cut-up parts[1]			
Head weight	10.17[b]	10.97[a]	10.84[a]	0.35
Ham weight	13.47[c]	13.95[b]	14.80[a]	0.54
Shoulder weight	12.07[b]	11.94[b]	12.60[a]	0.38
Feet weight	2.51[a]	2.45[ab]	2.37[b]	0.05
Tail weight	0.31	0.23	0.25	0.01
	Organ weight[2]			
Empty Stomach weight	2.06	1.80	2.06	0.07
Lung weight	1.00	1.03	0.93	0.03
Liver weight	2.21b	2.36a	2.42a	0.04
Spleen weight	0.40	0.31	0.31	0.01
Heart weight	0.43c	0.52b	0.62a	0.02

[abc] – means within rows followed by different superscripts are significantly different ($P < 0.05$); [1, 2] – values are expressed as percentage of fasted weight

reduction in back fat depth and increase in rate of lean growth (McPhee *et al.*, 1988). Pigs raised on restricted feeding was reported by Nguyen and Cam (2001) to have high growth rate, low back fat and high lean percentage in the carcass of their descendants. Hence, the advantage of restricted feeding transcend generations.

The head, ham and shoulder weights increased significantly with increase in feed quantity offered. Head weight of the pigs on 2.0 and 2.5 kg feed daily had statistically similar values (10.97 and 10.84 %) but differed ($P < 0.05$) from that of pigs on 1.5 kg daily feed. The ham weights (13.47, 13.95 and 14.80 %) increased significantly ($P < 0.05$) with increase in feed quantity offered. The shoulder weight of pigs on 1.5 and 2.0 kg feed daily had comparable values which differed significantly ($P < 0.05$) from those fed 2.5 kg feed daily (12.60 %). Feet weight decreased significantly ($P < 0.05$) with increase in feed quantity offered. The significant differences noted in these parameters might have resulted from better conformation of pigs' carcass in relation to the final body weight (body mass) of the pigs' slaughtered. Pigs with larger body weight had higher head, ham, shoulder and feet weights. This is in line with the findings of Latorre *et al.* (2008) who observed that the weight of ham, shoulder and loin increased with weight at slaughter, which is also close to the result of Lo Fiego *et al.* (2005). However, the observation contradicted the findings of Virgili *et al.* (2003) who suggested that primal cut proportion decreases with increasing body weight because the growth rate of primal cuts was lower with age than the growth rate of the whole body. Liver was also observed to increase with increasing feed quantity. This might have resulted from the numerous chemical changes taking place in the liver whenever feed is consumed. De Lange *et al.* (2003) reported that feed intake stimulates visceral organ growth and it also alters the distribution of whole-body protein. Liver weight of pigs on 2.0 and

2.5 kg feeding regime had comparable mean values (2.36 and 2.42 %) which were higher than the value (2.21 %) obtained among pigs on 1.5 kg feeding regime. Heart weight mean values (0.43, 0.52 and 0.62 %) increased significantly (*P* <0.05) with increase in feed quantity offered. Variability in carcass weight may have contributed to variation in some visceral organ mass (liver and heart). Some factors known to influence visceral organ size are body weight, feeding level, diet composition and pig genotype (Nyachoti, 1998). The relationship between visceral organ mass and body weight appears to reflect both changes in feed intake and maintenance energy requirements with increasing body weight (van Milgen and Noblet, 2003). Lebret (2008b) reported that feeding level and pattern of feeding are tools used to manipulate growth rate, composition of weight gain and intramuscular fat deposition.

CONCLUSION

Growth indices (final body weight, daily weight gain, daily feed intake), carcass cut parts (head, ham, shoulder) and some visceral organs (liver and heart) were influenced by higher feed quantity offered. Hence, 2.0 kg daily feed offered can be used as management tool in order to improve the performance, carcass parameters and some visceral organs of growing pigs.

REFERENCES

AFFENTRANGER, P. – GERWIG, C. – SEEWER, G. J. F. – SCHWORER, D. – KUNZI, N. 1996. Growth and carcass characteristics as well as meat and fat quality of three types of pigs under different feeding regimes. *Livestock Production Science*, vol. 45, 1996, p. 187–196.

AUGENSTEIN, M.L. – JOHNSTON, L.J. – SHURSON, G.C. – HAWTON, J.D. – PETTIGREW, J.E. 1997. Formulating farm-specific swine diets. Minnessota Extension Publication FO-5639. Minnessota Extension Service, St. Paul, MN, 1997.

BARCA, R. – NIETO, R. – LARA, L. – GARCIA, M.A. – VILCHEZ, M.A. – AQUILERA, J.F. 2006. Effects of dietary protein content and feeding level on carcass characteristics and organ weights of Iberian pigs growing between 50 and 100 kg liveweight. *Animal Science*, vol. 82, 2006, p. 405–413.

CRITSER, D.J. – MILLER, P.S. – LEWIS, A.J. 1995. The effects of dietary protein concentration on compensatory growth in barrows and gilts. *Journal of Animal Science*, vol. 73, 1995, p. 3376–3383.

DE LANGE, C.F.M. – FAN, M.Z. – SWIDERSKY, A. 2003. Optimum dietary levels for grower finisher pigs. Proceedings of the Centralia Swine Research Update, January 29, 2003, p. 25–27.

EDWARDS, S. 2010. Practical approaches to improving the efficiency of finishing pigs. Proceedings of the 1st Nigerian International Pig Summit, Institute of Agricultural Research and Training, Moor Plantation, Ibadan, 22nd – 25th November, 2010, p 69–77.

FERNANDEZ, X. – MONIN, G. – TALMANT, A. – MOUROT, J. – LEBRET, B. 1999. Influence of intramuscular fat content on the quality of pig meat. *Meat Science,* vol. 53, 1999, p. 59–72.

GARCIA-VALVERDE, R. – BAREA, R. – LARA, L. – NIETO, R. – AGUILERA, J.F. 2008. The effects of feeding level upon protein and fat deposition in Iberian heavy pigs. *Livestock Science*, vol. 114, 2008, p. 263–273.

GONDRET, F. – LEBRET, B. 2002. Feeding intensity and dietary protein level affect adipocyte cellularity and lipogenic capacity of muscle homogenates in growing pigs, without modification of the expression of sterol regulatory element binding protein. *Journal of Animal Science*, vol. 80, 2002, p. 3184–3193.

HOSSEINI-ASSAL, S.M.K. – HOSSEINI, S.D. 2000. Determination of the mean daily stool weight, frequency of defecation and bowel transit time: Assessment of 1000 healthy subjects. *Archives of Iranian Medicine*, vol. 3 (4), 2000, p. 1–5.

LATORRE, M.A. – GARCÍA-BELENGUER, E. – ARIÑO, L. 2008. The effects of gender and slaughter weight on growth performance and carcass traits of pigs intended for dry red ham from Teruel (Spain). *Journal of Animal Science*, vol. 86, 2008, p. 1933–1942.

LEBRET, B. – JUIN, H. – NOBLET, J. – BONNEAU M. 2001. The effects of two methods of increasing age at slaughter weight on carcass and muscle traits and meat sensory quality in pigs. *Animal Science*, vol. 72, 2001, p. 87–94.

LEBRET, B. 2008a. The response of various muscle types to a restriction realimentation feeding strategy in growing pigs. *Journal of Animal Science*, vol. 2, 2008, p. 849–857.

LEBRET, B. 2008b. Effects of feeding and rearing systems on growth, carcass traits and meat quality in pigs. *Journal of Animal Science*, vol. 2, 2008, p. 1548–1558.

LO FIEGO, D.P. – SANTERO, P. – MACCHIONI, P. – DE LEONIBUS, E. 2005. Influence of genetic type, live weight at slaughter and carcass fatness on fatty acid composition of subcutaneous adipose tissue of raw ham in the heavy pig. *Meat Science*, vol. 69, 2005, p. 107–114.

McPHEE, C.P. – TROUT, G.R. 1995. The effects of selection for lean growth and the halothane allele on carcass and meat quality of pigs transported long and short distances to slaughter. *Livestock Production Science*, vol. 42 (1), 1995, p. 55–62.

McPHEE, C.P. – RATHMELL, G.A. – DANIELS, L.J. – CAMERON N.D. 1988. Selection for pigs for increased lean growth rate on a time-based feeding scale. *Animal Production*, vol. 47, 1988, p. 149–156.

MERCK & CO., INC. 2008. Whitehouse Station, NJ USA. Published in educational partnership with Merial Ltd.

NATIONAL PORK PRODUCERS COUNCIL. 1994. *"Procedures to evaluate market hogs."* National Pork Producers Council, Des Moines, Iowa.

NJOKU, C.P. – AINA, A.B.J. – SOGUNLE, O.M. – ODUGUWA, O.O. – ADEYEMI, O.A. – EKUNSEITAN, D.A. 2013. Influence of feed quantity offered on linear body measurements, nutrient digestibility and backfat composition of finishing pigs. *The Pacific Journal of Science and Technology,* vol. 14 (1), 2013, p. 387–396.

NGUYEN, H.N. – CAM, P.M. 2001: Selection for efficient lean growth on restricted feeding in large white pigs. Breeding and feeding pigs in Australia and Vietnam – ACIAR 9423.

NYACHOTI, C.M. 1998. Significance of endogenous gut protein losses in growing pigs. Ph.D. thesis. Department of Animal and Poultry Science, University of Guelph, Guelph, ON, Canada.

SAS. 2000. SAS/STAT® User's guide (Version 8, 4th edition), SAS Institute Inc. Cary NC.

SHAW, M.I. – BEAULIEU, A.D. – PATIENCE, J.F. 2006. Effect of diet composition on water consumption in growing pigs. *Journal of Animal Science*, vol. 84, 2006, p. 3123–3132.

SILANIKOVE, N. – BROSH, A. 1989. Lignocellulose degradation and subsequent metabolism of lignin fermentation products by the desert black Bedouin goat fed on wheat straw as a single-component diet. *British Journal of Nutrition*, vol. 62, 1989, p. 509–520.

VAN MILGEN, J. – NOBLET, J. 2003. Partitioning of energy intake to heat, protein, and fat in growing pigs. *Journal of Animal Science*, vol. 81 (2), 2003, p. 86–93.

VIRGILI, R. – DEGNI, M. – SCHIVAZAPANA, C. – FAETI, V. – POLETTI, E. – MARCHETTO, G. – CCHIOLI, M.T. – MORDENTI, A. 2003. Effect of age at slaughter on carcass traits and meat quality of Italian heavy pigs. *Journal of Animal Science*, vol. 81, 2003, p. 2448–2456.

WOOD, J.D. – NUTE, G.R. – RICHARDSON, R.I. – WHITTINGTON, F.M. – SOUTHWOOD, O. – PLASTOW, G. – MANSBRIDGE, R. – DA COSTA, N. – CHANG, K.C. 2004. Effects of breed, diet and muscle on fat deposition and eating quality in pigs. *Meat Science*, vol. 67, 2004, p. 651–667.

YANG, T.S. – HOWARD, B.E. – MCFARLANE, W.V. 1981. Effects of food on drinking behaviour of growing pigs. *Applied Animal Ethnology*, vol. 7, 1981, p. 256–270.