ACTA UNIVERSITATIS AGRICULTURAE ET SILVICULTURAE MENDELIANAE BRUNENSIS

Volume 65 14 Number 1, 2017
https://doi.org/10.11118/actaun201765010119

EFFECT OF BIRTH WEIGHT OF PIGLETS ON THEIR GROWTH ABILITY, CARCASS TRAITS AND MEAT QUALITY

Pavel Nevrkla[1], Eva Václavková[2], Zdeněk Hadaš[1], Vendula Kamanová[1]

[1] Department of Animal Breeding, Faculty of AgriSciences, Mendel University in Brno, Zemědělská 1, 613 00 Brno, Czech Republic
[2] Department of Pig Breeding, Institute of Animal Science, Komenského 1239, 517 41 Kostelec nad Orlicí, Czech Republic

Abstract

NEVRKLA PAVEL, VÁCLAVKOVÁ EVA, HADAŠ ZDENĚK, KAMANOVÁ VENDULA. 2017. Effect of Birth Weight of Piglets on Their Growth Ability, Carcass Traits and Meat Quality. *Acta Universitatis Agriculturae et Silviculturae Mendelianae Brunensis,* 65(1): 0119–0123.

The objective of this study was to investigate the effect of birth weight on growth performance and carcass quality. Data were collected from 80 crossbred piglets. Individual body weight was measured at birth, at the age of 21, 28 and 38 days, 4 weeks before slaughter, 2 weeks before slaughter and one day before slaughter. Average daily weight gains in separate intervals were calculated. Fattening period was finished at the same day for all pigs. Lean meat percentage and pH_1 value were measured after slaughter, drip loss and intramuscular fat content were analysed in laboratory. Data were divided into 4 groups according to the birth weight of piglets (I: less than 1000 g, II: 1001–1200 g, III: 1201–1500 g, IV: 1501 g and more). Increased birth weight resulted in increased daily weight gain from birth to weaning (28 days), after weaning and also from birth to slaughter ($P \leq 0.05$, $P \leq 0.01$). The high daily weight gain in group IV enabled pigs to reach the slaughter weight one month earlier than pigs from group II. The lowest lean meat content (52.74 ± 2.82 %) was found in group IV. This is connected with high slaughter weight (132.50 ± 7.27 kg). Intramuscular fat content, pH_1 value and drip loss were not affected by birth weight of piglets.

Keywords: pig, birth weight, carcass value, meat quality

INTRODUCTION

Intensity of fattening is determined as early as by birth weight of a piglet. Improvement of fertility leads to higher ovulation rate and higher survivability of embryos, but without increase in capacity of uterus (Nissen *et al*., 2003). Roehe and Kalm (2000) note that growth rate in uterus has substantial effect on birth weight of piglets, which affects behaviour of piglets in terms of movement to sow's teats and sucking of milk, which is a crucial factor for weight gain before weaning. They also state that an increase of a litter from 9 to 14 piglets led to a decrease of mean birth weight of piglets from 1.60 kg to 1.40 kg. With this decrease they recorded lower gains before weaning by up to 30 g/day and by 90 g/day in rearing. Blood supply to uterus and fetuses is slower than the increase in the number of fetuses, therefore nutritional supply of individual fetuses is slower in large litters. This explains deteriorative prenatal development of piglets in large litters, which is evident mainly on lower birth weights. Deterioration of intrauterine growth between the 30th and the 90th day of gestation negatively influences formation of muscle fibres, which causes impaired formation of muscles and higher fat deposition in postnatal period. Such animals are characterized by a worse meat quality at slaughter. Litter size is in a negative correlation with survivability of piglets from birth to weaning, weight gains before weaning and weaning weight of piglets (Milligan *et al*., 2002; Damgaard *et al*., 2003; Mlynek *et al*., 2013; Horký 2014). Surek *et al*. (2014) also proved that increased birth weight is associated with higher weaning weight of piglets with statistical

significance ($P \leq 0.05$). Similar conclusions were published by Kabalin *et al.* (2012), who confirm the importance of higher birth weight and add the information that piglets with birth weight over 1.40 kg had higher growth intensity in the period between birth and weaning, than piglets with lower birth weight. The more numerous the litter is, the higher is the variability of birth weight of piglets. In these litters the piglets compete for the sow's teats, heavier piglets push lighter piglets away from the teats with higher milk production. Thus the heavier piglets get more nutrients and also other milk compounds. On the contrary, the weaker piglets suffer from hunger and higher risk of overlying from the sow. A crucial period for further growth and development of piglets is up to 3 weeks of age, when 65 % of losses happen (Alonso-Spilsbury *et al.*, 2007).

The aim of the study was to evaluate the effect of birth weight of piglets on their further growth ability, selected carcass traits and meat quality.

MATERIALS AND METHODS

Growth ability of piglets, carcass value and meat quality were analysed in 80 selected piglets with different birth weight regardless to sex. The animals were of hybrid combination (Czech Large White x Czech Landrace) x Duroc. The piglets were divided into weight intervals: I: less than 1000 g, II: 1001–1200 g, III: 1201–1500 g, IV: 1501 g and more. The piglets were labeled by ear notching. After weaning, the piglets were fed with standard commercial feed mixtures used in pre-rearing and rearing of pigs. The feed was administered twice a day during the whole rearing period. At first, the feed mixture was moisturized and then dosed by mobile feeding device. Water intake was *ad libitum*. The experimental animals were stabled in groups. Piglets after weaning were stabled in groups of 20 animals in a pen. In pre-rearing and rearing in groups of 10 animals. The pens were partly slatted and fencing was of plastic.

The following traits were analysed: mean weight of piglets at birth, at the age of 21 days, 28 days (weaning) and 38 days. Afterwards the mean weight of pigs 4 weeks before slaughter, 2 weaks before slaughter and 1 day before slaughter. Recorded weights were used for calculation of mean daily gain in idividual weight intervals. After the slaughter, the carcass halves were weighed, the lean meat share was measured with FOM device, the values of pH_1 of leg and loin, drip loss and intramuscular fat content were measured. Statistical analysis of growth ability, carcass value and meat quality was performed with software QC Expert (TriloByte Statistical Software Ltd.). Processed values of analysed parameters are presented as basic statistical characteristics, namely mean and standard deviation. Statistical significance of differences was tested using t-test. Statistical significance of differences between mean values of the analysed parameters was evaluated as follows: a, b, c statistically significant difference ($P \leq 0.05$), A, B, C, D statistically highly significant difference ($P \leq 0.01$).

RESULTS AND DISCUSSION

Tab. I presents mean values of weight and daily gain of animals in different phases of growth (from 21 days to the end of fattening). The results show that a higher mean birth weight is associated with a higher mean daily gain of piglets. Differences in growth ability of piglets in the weight categories are evident even before the weaning, at the time of weaning at the age of 28 days, the difference between the piglets with the lowest and the highest birth weight reaches nearly 2 kg. This corresponds to mean daily gain from birth to 21 days of age, or mean daily gain before weaning, where the difference between individual weight categories was nearly 80 g/day. The same trend was recorded also in piglets 10 days after weaning. The differences between individual groups are statistically significant ($P \leq 0.05$; $P \leq 0.01$). Fattening of all the experimental animals was initiated on the same day and also terminated on the same day. The length of fattening was planned based on weight gains of piglets with birth weight of 1000–1200 g. During fattening, the weight of pigs was assessed 4 weeks and 2 weeks before the planned slaughter. Mean age at the time of slaughter was 175 days. The pigs with birth weight under 1000 g did not reach required slaughter weight at this age. The pigs with birth weight of 1201–1500 g would achieve required slaughter weight 14 days earlier and the pigs with birth weight over 1501 g one month earlier. This corresponds also to mean daily gains in individual categories of birth weight, when the difference between the pigs with the lowest and the highest mean birth weight was nearly 200 g. The differences between the individual groups are statistically significant ($P \leq 0.05$; $P \leq 0.01$). These results confirm that piglets with higher birth weight finnish fattening to required slaughter weight earlier, which leads to a decrease of feed consumption. The pigs with lower birth weight (or lower weaning weight) grow more slowly and have worse carcass value after reaching the same slaughter weight. The pigs with higher birth weight (weaning weight) reach higher gains and better meat quality. For breeders, the traits with substantial economical importance are number of piglets per litter, their weight and viability. If sows give large litters of piglets with higher birth weight and good viability, the losses of piglets decrase and due to faster growth the time necessary for fattening is shortened and profitability increases (Fix *et al.*, 2010; Pardo *et al.*, 2011). Beaulieu *et al.* (2010) studied the effect of birth weight of piglets on their growth. The authors found out that piglets with lower birth weight reach lower live weight at the time of weaning, 5 and 7 days after weaning and their fattening up to slaughter weight lasts longer. Pardo *et al.* (2011) state that piglets with birth weight higher

by 0.5 kg had weaning weight higher by 1.4 kg and slaughter weight by 12.2 kg on average. Rehfeldt *et al.* (2008) say that growth intensity of piglets increases with higher birth weight of piglets. In terms of meat quality, the authors recommend piglets with average birth weight. Balanced litters are a prerequisite. Also Gondred *et al.* (2005) described relation between birth weight and later growth of piglets. In their experiment, they observed that piglets which weighed 1.91 kg at birth reached weaning weight 9.99 kg, 32.0 kg at the age of 67 days and 103.0 kg at the time of slaughter. They recorded mean daily gain (birth-slaughter) 658 kg. In piglets with birth weight 0.97 kg they found weaning weight 6.45 kg, 23.0 kg at the age of 67 days and 101.5 kg at the time of slaughter. Daily gain counted 605 g. Similar results were published by Rehfeldt *et al.* (2008).

Also meat quality was analysed in the observed group of animals (Tab. II). The highest lean meat content was reached by pigs with the lowest mean birth weight and the pigs with birth weight under 1200 g. The differences were statistically significant ($P \leq 0.01$), in the other weight categories the lean meat content was influenced by high slaughter weight of the pigs. Intramuscular fat content was on the recommended level of 2.5 % in all the observed animals. Also the values of pH_1 measured in leg and loin were not influenced by mean birth weight or slaughter weight. Drip loss value was the highest in the group of pigs with the highest birth weight and slaughter weight, neverthless the differences between the values in individual groups were not statistically significant. Gondret *et al.* (2006) compared growth in groups of piglets with low birth weight (mean 1.05 kg) and high birth weight (mean 1.89 kg). After termination of fattening, the animals with low birth weight were 12 days older. Lean meat content was lower in this group of piglets. Drip loss value was not influenced by birth weight of piglets as same as in our experiment. On the contrary, Rehfeldt *et al.* (2008) described statistically significant effect ($P < 0.05$) of birth weight of piglets on drip loss value. The pigs with lower birth weight showed higher values of drip loss. These authors also found a relation between birth weight and intramuscular fat content. The pigs with lower birth weight had more intramuscular fat in meat than the pigs with higher birth weight. However, the authors did not find the relation between the birth weight and lean meat content. Also Bérad *et al.* (2008) did not find an effect of birth weight on lean meat content and pH_1 value. Nissen and Oksbjerg (2011) reported pH_1 6.22 in meat of pigs with low birth weight and pH_1 6.12 in pigs with higher birth weight. Drip loss value was 8.7 % in pigs with lower birth weight and 9.5 % in pigs with higher birth weight.

I: *Basic statistical characteristics of growth and carcass value in relation to birth weight of piglets*

Parameter	Birth weight (g)			
	< 1000	1001 – 1200	1201 – 1500	1501 <
Mean weight at the age of 21 days (kg)	6.57 ± 0.41^{A}	6.84 ± 0.42^{B}	7.02 ± 0.44^{C}	8.12 ± 0.78^{ABC}
Mean weight at the age of 28 days (kg)	6.77 ± 0.74^{AB}	7.40 ± 0.81^{C}	8.01 ± 0.78^{A}	8.67 ± 1.12^{BC}
Mean weight at the age of 38 days (kg)	8.62 ± 1.17^{AB}	9.51 ± 1.62^{c}	10.78 ± 1.71^{A}	11.50 ± 1.92^{Bc}
Mean weight 4 weeks before slaughter (kg)	74.17 ± 3.76^{aAB}	83.67 ± 11.10^{aCD}	94.76 ± 7.75^{AC}	102.67 ± 6.55^{BD}
Mean weight 2 weeks before slaughter (kg)	86.33 ± 4.99^{AB}	95.17 ± 12.18^{CD}	109.47 ± 8.32^{AC}	116.33 ± 7.23^{BD}
Mean weight at the end of fattening (kg)	98.83 ± 6.41^{aAB}	108.58 ± 12.18^{aCD}	122.06 ± 7.35^{bAC}	132.50 ± 7.27^{bBD}
Mean weight of carcass (kg)	76.68 ± 4.15^{AB}	83.72 ± 13.09^{CD}	97.14 ± 8.33^{AC}	101.90 ± 8.10^{BD}
Mean daily gain from birth to 21 days (g)	274.60 ± 14.59^{A}	270.24 ± 19.55^{B}	271.51 ± 19.74^{C}	307.70 ± 33.33^{ABC}
Mean daily gain from birth to weaning (g)	241.67 ± 26.30^{AB}	264.29 ± 28.79^{C}	286.13 ± 27.96^{A}	309.52 ± 39.86^{BC}
Mean daily gain from birth to 38 days (g)	205.70 ± 30.33^{ab}	219.52 ± 42.29	249.12 ± 45.01^{a}	259.08 ± 48.43^{b}
Mean daily gain from birth to the end of fattening (g)	546.04 ± 35.44^{aAB}	599.91 ± 67.27^{aCD}	674.36 ± 40.62^{bAC}	732.04 ± 40.19^{bBD}

a, b, c – statistically significant difference ($P \leq 0.05$) and A, B, C, D - highly statistically significant difference ($P \leq 0.01$) of the mean values in the same row

II: *Basic statistical characteristics of meat quality in relation to birth weight of piglets*

Parameter	Birth weight (g)			
	< 1000	1001 – 1200	1201 – 1500	1501 <
Lean meat content (%)	57.07 ± 1.44^{Aa}	55.95 ± 1.89^{b}	52.98 ± 4.09^{Ab}	52.74 ± 2.82^{a}
Intramuscular fat content (%)	2.57 ± 0.73	2.55 ± 0.42	2.55 ± 0.52	2.46 ± 0.16
pH_1 leg	6.03 ± 0.39	5.90 ± 0.41	6.01 ± 0.38	5.68 ± 0.40
pH_1 loin	5.97 ± 0.33	5.99 ± 0.37	6.03 ± 0.40	5.87 ± 0.56
Drip loss (%)	4.67 ± 3.30	5.86 ± 1.91	5.09 ± 2.27	6.40 ± 2.89

a, b – statistically significant difference ($P \leq 0.05$) and A – highly statistically significant difference ($P \leq 0.01$) of the mean values in the same row

CONCLUSION

Birth weight of piglets influences growth intensity before weaning, after weaning and in fattening. A higher weaning weight is positively reflected in values of gain in following period and shortens the length of fattening. The piglets with higher birth weight finish fattening to required slaughter weight earlier, which is reflected in a decrease of feed consumtion and other fattening expenses. Birth weight of piglets in the experimental group of pigs did not statistically influence parameters of meat quality (pH_1, intramuscular fat content and drip loss).

Acknowledgements

This study was supported by the project of MENDELU internal grant agency, Faculty of AgriSciences No. TP 1/2016 and the NAZV Project No. QJ1210253 of the Ministry of Agriculture of the Czech Republic.

REFERENCES

ALONSO-SPILSBURY, M., RAMIREZ-NECOECHEA, R., GONZALEZ-LOZANO, M., MOTA-ROJAS, D. and TRUJILLO-ORTEGA M. E. 2007. Piglet survival in early lactation: a review. *J. Anim. Vet. Adv.*, 6(1): 76–86.

BEAULIEU, A. D., AALHUS, J. L., WILLIAMS, N. H. and PATIENCE J. F. 2010. Impact of piglet birth weight, birth order, and litter size on subsequent growth performance, carcass quality, muscle composition, and eating quality of pork. *J. Anim. Sci.*, 88(8): 2767–2778.

BÉRARD, J., KREUZER, M. and BEE, G. 2008. Effect of litter size and birth weight on growth, carcass and pork quality, and their relationship to postmortem proteolysis. *J. Anim. Sci.*, 86(9): 2357–2368.

DAMGAARD, L. H., RYDHMER, L., LOVENDAHL, P. and GRANDINSON K. 2003. Genetic parameters for within-litter variation in piglet birth weigh tand change in within-litter variation during suckling. *J. Anim. Sci.*, 81(3): 604–610.

FIX, J. S., CASSADY, J. P., HOLL, J. W., HERRING, W. O., CULBERTSON, M. S. and SEE M. T. 2010. Effect of piglet birth weight on body weight, growth, backfat, and longissimus muscle area of commercial market swine. *Livest. Sci.*, 127(1): 51–59.

GONDRET, F., LEFAUCHEUR, L., JUIN, H., LOUVEAU, I. and LEBRET, B. 2006. Low birth weight is associated with enlarged muscle fiber area and impaired meat tenderness of the longissimus muscle in pigs. *J. Anim. Sci.*, 84(1): 93–103.

GONDRET, F., LEFAUCHEUR, L., LOUVEAU, I., LEBRET, B., PICHODO, X. and LE COZLER, Y. 2005. Influence of piglet birth weight on postnatal growth performance, tissue lipogenic capacity and muscle histological traits at market weight. *Livest. Prod. Sci.*, 93(2): 137–146.

HORKÝ, P. 2014. Influence of increased dietary selenium on glutathione peroxidase activity and glutathione concentration in erythrocytes of lactating sows. *Ann. Anim. Scie.*, 14(4): 869–882.

KABALIN, A. E., BALENOVIĆ, T., MENČIK, S., SUŠIĆ, V., PAVIČIĆ, Ž., ŠTOKOVIĆ, I. and OSTOVIĆ M. 2012. Influence of birth mass on losses and weight gain of Large Yorkshire piglets during preweaning period. *Maced. J. Anim. Scie.*, 2(3): 273–276.

MILLIGAN, B. N., FRASER, D. and KRAMER D. L. 2002. Within-litter birth weight variation in the domestic pig and its relation to pre-weaning survival, weight gain, and variation in weaning weights. *Livest. Prod. Sci.*, 76(1–2): 181–191.

MLYNEK, J., IMRICH, I., KAPELAŃSKI, W. and MLYNEKOVÁ, E. 2013. Effect of transport, rest period and temperature on pork quality from different countries. *J. Cent. Eur. Agric.*, 14(2): 751–757.
NISSEN, P. M., and OKSBJERG, N. 2011. Birth weight and postnatal dietary protein level affect performance, muscle metabolism and meat quality in pigs. *Animal*, 5(9): 1382–1389.
NISSEN, P. M., DANIELSEN, V. O., JORGENSEN, P. F. and OKSBJERG, N. 2003. Increased maternal nutrition of sows has no beneficial effects on muscle fiber number or postnatal growth and has no impact on the meat quality of the offspring. *J. Anim. Sci.* 81(12): 3018–3027.
PARDO, C. E., MÜLLER, S., BÉRARD, J., KREUZER, M. and BEE G. 2011. Importance of average litter weight and individual birth weight for early postnatal performance and myofiber characteristics of progeny. *Livest. Sci.*, 157(1): 330–338.
REHFELDT, C., TUCHSHERER, A., HARTUNG, M. and KUHN G. 2008. A second look at the influence of birth weight on carcass and meat duality in pigs. *Meat Sci.*, 78(3): 170–175.
ROEHE, R. and KALM, E. 2000. Estimation of genetic and environmental risk factors associated with pre-weaning mortality in piglets using generalized linear mixed models. *Anim. Scie.*, 70(2): 227–240.
SUREK, D., BARRILLI, L. N. E., BUENO, I. J. M., KRABBE, E. L., ALBERTON, G. C. and MAJORKA, A., 2014: Growth of suckling piglets in litters standardized by weight. *J. Anim. Sci.*, 92(1): 177–181.

Contact information

Pavel Nevrkla: pavel.nevrkla.uchhz@mendelu.cz
Eva Václavková: vaclavkova.eva@vuzv.cz
Zdeněk Hadaš: zdenek.hadas@mendelu.cz
Vendula Kamanová: xkamano1@node.mendelu.cz