

Performance traits in different generations of imported Danish Landrace pigs

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Abstract

The number of foreign pig breeds imported to Lithuania has increased, especially Landraces. Animals imported from other countries get into different environmental conditions. Decisions about adaptation of Danish Landraces were made when analysing the changes in the data for productivity of imported pigs and their offsprings of F_1 - F_6 generations born in Lithuania. The work was carried out in the years 1998-2006. Because of adaptation to new environmental conditions, litter size, litter weight of piglets at 21 days of age and survival rate percent of piglets for primiparous sows of Danish Landrace breed, born and grown in Lithuania, was improving, in comparison with imported primiparous sows. According to evaluation data analysis of the control fattening and carcass for Danish Landrace progeny born in the country, offspring of sixth generation (F_6) distinguished by the best fattening performance. However, tendency manifested, that with increasing daily gain in many cases meatiness traits of pigs are getting worse. Muscularity of F_6 Landraces was 1.7-2.9% lower than of F_2 - F_5 progeny of this breed ($P<0.05$ - 0.01). Therefore, when striving in the adaptation process to stabilise specific traits of Landrace pigs, especially fattening performance and meatiness, besides balanced feeding and making of good keeping conditions, it is also purposeful regularly to import boars (each 3-4 years) of this breed into breeding centres or to use AI stations services.

Keywords: Pig, Danish Landrace, adaptation, generation, litter performance, fattening performance, carcass quality

Zusammenfassung

Leistungsentwicklung nach mehreren Generationen von importierten Schweinen der Dänische Landrasse

Untersucht wurde die Leistungsentwicklung von nach Litauen importierten Schweinen der Dänischen Landrasse nach mehreren Generationen. Erfasst wurden Leistungen der importierten Tiere sowie deren Nachkommen der Generationen F_1 - F_6 aus den Jahren 1998 bis 2006 mit den Merkmalen Wurfgröße, Wurfgewicht am 21. Tag und Aufzuchttrate bei Jungsaugen. Gegenüber der Importgeneration konnte tendenziell ein positiver Trend der Wurfleistungen beobachtet werden. Im Ergebnis der Nachkommenprüfung auf Mast- und Schlachtleistungen konnten in den Generation F_4 bis F_6 eine positive Leistungsentwicklung beobachtet werden. Die Rückenspeckdicke erhöhte sich bis zu F_6 und die Schlachtkörperqualität zeigte mit

Ausnahme der F_6 Tiere leicht verbesserte Werte. Um das Qualitätsniveau zu halten wird empfohlen alle 3 bis 4 Jahre Eber der Dänischen Landrasse zu importieren.

Schlüsselwörter: Schwein, Dänische Landrasse, Anpassung, Generation, Wurfleistung, Mastleistung, Schlachtkörperqualität

Introduction

At Lithuanian breeding centres about 40 % of all purebred pigs were Landrace, 34 % - Large White (Yorkshire), 21 % - Lithuanian White open population, 4 % - Duroc and Pietrain paternal breeds, 1 % - Lithuanian White old genotype and Lithuanian native gene pool (Rimkevičius *et al.* 2009). Recently, the number of foreign pig breeds imported to Lithuania has increased, especially Landraces. Lithuanian law acts ascribe Landrace breed as intermediate performance breed (Saikevičius 2003). Accordingly to that, possibilities of Landraces use are the biggest of all pigs bred in Lithuania.

Animals imported from other countries get into different environmental conditions (climate, feeding, housing) and strive to survive. It is supposed that reproductive, fattening and meatiness traits (phenotype) of pigs depend on environmental conditions even up to 60 %, and only up to 40 % depend on genotype (Close 1970, Curtis 1983, Verhagen 1987, Cameron 1993, Diekman *et al.* 1994, Verstegen & Close 1994, Lynch & Walsh 1998, Bizelis *et al.* 2000, Röhe *et al.* 2000, Hoste 2003, Köck *et al.* 2009). Therefore, after changing environmental conditions, the productivity of animals often gets worse (Cameron 1993, Lynch & Walsh 1998, Hoste 2003). This is related to the natural resistance of organism against unfavourable influences. If new conditions are very different from the earlier ones, adaptation can last even through several generations. During this period weaker animals die and only those adapted normally to new conditions survive. Adaptation, like reproduction, is directed towards survival. Provided the environmental conditions are favourable, all the processes may even have an improving effect on the animals. However, if more energy has to be spent on survival, performance dramatically falls down, especially that of highly productive animals (Kasprzyk 2007a, 2007b). Besides that, the course of adaptation depends on the breed of animals and on individual features: type of nervous system, stress-resistance and age (Cameron 1993, Hoste 2003, Kriauzienė *et al.* 2005, Klimienė & Klimas 2007, Vostry *et al.* 2009, Klimas & Klimienė 2009, Fördös *et al.* 2010). Thus, adaptation of imported pigs of different breed under new environmental conditions should be investigate.

The aim of this work was to investigate changes of the reproductive traits, fattening performance and meatiness in different generations of Danish Landrace pigs during their adaptation process in Lithuania.

Material and methods

Decisions about the adaptation of Danish Landraces were made when analysing changes in productivity data of the imported pigs and their offsprings born in Lithuania. Various breeding records for the years 1998-2006 have been studied (pedigree certificate of imported progeny, sow farrowing and offspring records, control fattening and slaughter data).

Danish Landrace gilts from 16 families and young boars from three lines were imported from Denmark and located to farmer A. Matusevičius Breeding Centre (Šakiai district) in the year 1998. Imported and born (local) Danish Landrace gilts and sows in this breeding centre were inseminated with Danish Landrace boars. Microclimate in stables was regulated by computerized equipment. During the observation period, the temperature in the lodgements for farrowing sows was constantly 19 °C, for pedigreed progeny –21 °C, for piglets up to 26 °C. The relative air humidity was 70 %. Up to 8-12 farrowing sows and up to 15 pedigreed gilts were kept in stalls. The pigs were kept on grid floor, and the stalls were not littered.

The pigs were fed with a balanced compound feed. Progenies till 20 kg of weight were fed with feed brought from the Netherlands. The piglets from 10 to 20 days of age were received pre-starter feed »Promote WF« containing 18.4 % of proteins, 10 % of fat and 0.5 % of fibre per 1 kg. Later, piglets received starter feed »Porcipart AP« containing 18.5 % of proteins, 6.5 % of fat and 2 % of fibre per 1 kg at 20 to 40 days of age. The progenies till 20 kg of weight (approx. 65 days of age) received compound feed »Proresponce«.

From 20 kg of weight the pigs were already fed with compound feed made in the stock company »Lekėčiai« (Lithuania). One kilogram of feed for the pedigreed gilts of 20-40 kg of weight contained 13.8 MJ of metabolizable energy and 18.5 % of proteins, for pedigreed gilts of over 40 kg of weight 13.5 MJ and 17.5 %, respectively; for farrowing sows 12.3 MJ and 12.5 %, respectively; and for lactating sows 13.2 MJ of metabolizable energy and 17.2 % of proteins. The weaned piglets (approx. 35 days of age) and the lactating sows were fed with dry compound feed, and pigs of other groups (pedigree progenies, farrowing sows) – with mash, served automatically.

Number of investigated pigs

Reproductive performance – litter size (number of piglets born alive), number and litter weight of piglets at 21 days of age, survival rate – of imported ($n=24$) and born and grown in breeding centre F_1 ($n=24$), F_2 ($n=24$), F_3 ($n=24$), F_4 ($n=24$) and F_5 ($n=24$) generations of primiparous sows of Danish Landrace breed were analysed. Additionally, data for the fattening performance and meatiness traits delivered F_1 ($n=16$), F_2 ($n=59$), F_3 ($n=49$), F_4 ($n=70$), F_5 ($n=39$) and F_6 ($n=10$) Landrace breed progenies were recorded, systemised and analysed. According to the accepted methodology (Saikevičius 2003), the fattening performance and meatiness traits of the offspring of 243 F_1 - F_6 generations of Danish Landraces were evaluated in control fattening stables of the State Pig Breeding Station.

Fattening performance

Piglets of Landrace breed were transported from the breeding centre to the fattening performance test station at the age of 77-85 days (24-26 kg). Four piglets (two gilts and two castrates) were selected from the same litter for control fattening, which was proceeded at 30 kg to approximately 100 kg live weight. Housing and feeding conditions were the same for all pigs. The pigs were kept in individual pens. The average air temperature was 18-20 °C and the relative humidity was not higher than 70 %. During the control fattening, the animals were fed special dry compound feed twice a day. The feed was individually weighed for each pig. A kilogram of compound feed contained 13.84 MJ of metabolizable energy and 16.0 % of

proteins. The pigs had free access to water for 24 h. When the pigs were fattened to approx. 100 kg in weight, their age in days, average daily gain and feed conversion (metabolizable energy) per kg gain were estimated.

Phenotypic evaluation of the pig leanness

At the control fattening test station the pigs with about 100 kg live weight were measured with ultrasonic apparatus before delivered to meat-processing plant. The lean meat percentage was determined with Piglog 105 by measuring the backfat thickness (mm) on live pigs at two points and *M. longissimus dorsi* thickness (mm) – at one point (Piglog 105 User's Guide 1991):

- 1) between the 3rd and 4th last lumbar vertebrae and 7 cm sideways from the middle dorsal line (FAT-1);
- 2) 10 cm from the last rib towards the cranial part and 7 cm sideways from the middle dorsal line (FAT-2). The thickness of the loin lean (*M. longissimus dorsi*) was also measured at this point.

The lean meat percentage was calculated according by the in-coded Piglog 105 formula. Age (days) and live weight (kg) of pigs were introduced to the apparatus before testing.

Control slaughter of pigs

The control slaughtering of pigs at about 100 kg and evaluation of the carcasses were carried out at the one meat – processing plant. Carcass length (from cranial edge of first neck vertebra to anterior edge of the pubic bone), backfat thickness (at 6-7 rib and at the last rib), loin lean area (at the last rib) and ham weight of chilled carcasses (at 0...+4 °C in 24 h period) were recalculated according to 100 kg live weight of pigs, using accepted coefficients of regression (Saikevičius 2003).

Statistical analysis

The investigation data were processed using statistical package Statistica for Windows version 6.0 (StatSoft 2001) and according to the basic guide to the statistical analysis of biological data by Tucker (2003). The difference was considered statistically significant when $P < 0.05$.

Results and discussion

The results of reproductive traits of different generations Danish Landrace sows presented in Table 1. After changing an environmental conditions, litter size of imported as well as born in Lithuania primiparous sows was statistically not reliably different. However, due to adaptation to new conditions, litter weight of piglets at 21 days of age was increasing and mortality rate of piglets was decreasing. Number of piglets at 21 days of age of F_1 - F_5 Landrace sows had 0.8-1.5 piglets more, litter weight of F_1 , F_3 - F_5 generations was 4.9-7.0 kg, survival rate of piglets F_1 , F_2 , F_4 and F_5 generations was 6.0-8.1 % higher, to compare with imported sows. It should be noted that litter weight between F_1 - F_5 sows of Landrace breed was not reliably different, except F_2 sows.

Table 1
Reproductive performance of primiparous sows of Danish Landrace breed

Item	Imported pigs		Generations of pigs born in Lithuania			
		F ₁	F ₂	F ₃	F ₄	F ₅
No. of sows	24	24	24	24	24	24
Litter size	11.0±0.2	11.2±0.2	11.2±0.1	11.3±0.1	11.6±0.1	11.2±0.1
At 21 days:						
No. of piglets	9.4±0.2	10.2±0.2 ^a	10.5±0.1 ^b	10.2±0.2 ^a	10.9±0.2 ^c	10.5±0.2 ^b
Litter weight, kg	51.2±1.4	56.1±0.7 ^a	51.8±0.9	56.7±1.2 ^a	58.2±0.7 ^b	58.1±0.5 ^b
Survival rate, %	85.8±1.5	91.8±1.4 ^a	93.8±0.9 ^b	90.4±1.7	93.9±1.3 ^b	93.8±1.3 ^b

Significant effects to compare with imported pigs: ^a $P<0.05$, ^b $P<0.01$, ^c $P<0.001$

According to evaluation of control fattening and carcass data of Danish Landrace progenies born in Lithuania (Table 2) there was indicated, that due to adaptation process in new environmental conditions, only progenies of sixth generation (F₆) showed superiority on fattening performance. To compare with Landraces of other groups (F₁-F₅), F₆ progeny reached 100 kg weight by 10-23 days earlier, gained daily by 52-157 g more (to compare with F₁ differences is not statistically significant) and consumed 0.8-14.6 % of compound feed per kg gain less (to compare with F₁ and F₂ differences are statistically significant). However, agreeably to the data by Kapelanski *et al.* (2000), Michalska *et al.* (2000), Pierzchala *et al.* (2003), Citek *et al.* (2006) and Stupka *et al.* (2006), with increasing daily gain the meatiness traits of pigs in many cases are worsening. Backfat thickness at 6-7 rib of F₆ progeny was 6.1 mm thicker than of F₁ progenies, and muscularity – 1.7-2.9 % lower than of F₂-F₅ progeny. Thus, for pigs of Danish Landrace breed in the course of adaptation were determined more variable changes of fattening and meatiness traits. It should be noted that productivity of investigated Landraces were partially maintained by insemination using semen of new lines of Landrace boars (kept in the AI stations) continuously imported to Lithuania.

Pig breeds in Lithuania are classified into three groups: maternal breed (Lithuanian native, Lithuanian White, Large White/Yorkshire), intermediate breed (Landrace) and paternal breed (Duroc, Pietrain and their hybrids with Landrace pigs). Because Landrace by the trend of productivity are ascribed to intermediary group, use of this breed is much wider compared with all of pigs bred in Lithuania. Therefore it is no coincidence that at breeding centres about 40% pigs are Landraces (Rimkevičius *et al.* 2009). The population of Landrace pigs in Lithuania to be comprised of German, Danish, Finnish, Swedish, Norwegian, Dutch and French Landrace breeds. Striving to preserve specific traits of pigs of imported breeds, it is necessary to investigate influence of adaptation on their reproductive traits and fattening performance, and on meatiness. After analysing productivity traits and tendency changes of imported and locally born (no less than of two – three generations) pigs, it was possible to determine which breed of pigs adapt better or worse to new environmental conditions. Beside Danish Landrace pigs, such researches were made with Finnish Yorkshires (Klimienė 1993), maternal C-line (imported from Poland, nurtured in company »Hypor« by using Large White and Hampshire breeds) and D-line (imported from Poland, nurtured in company »Hypor« by using Dutch and Swedish Landrace breeds) (Kriausienė *et al.* 2005), English Large White, Swedish Yorkshire, Danish Duroc and Dutch Pietrain breeds (Klimienė & Klimas 2007, Klimas & Klimienė 2009). It was shown that the reproductive traits and fattening

performance of Pietrain pigs breed were getting worse in the course of adaptation, whereas leanness, comparing F_1 and F_4 progeny, essentially did not changed. It is likely that Pietrains are most difficultly adapting to a new environmental conditions. However, Pietrain are used in combinations of commercial crossbreeding (hybridization) only as paternal breed.

Consequently, due to adaptation to new environmental conditions the litter size, litter weight of piglets at 21 days of age and percent of survived piglets of primiparous Danish Landrace sows born in Lithuania, were improved compared to the imported primiparous sows. Offspring of sixth generation (F_6) distinguished by the best fattening performance. However, muscularity of F_6 Landraces was 1.7-2.9% less than of F_2 - F_5 progeny of this breed. Adaptation is a complicated process, therefore when striving to stabilise specific traits of Landrace pigs, and especially fattening performance and meatiness, besides balanced feeding and making of good keeping conditions, it is also purposeful regularly to import boars (each 3-4 years) of this breed into breeding centres or to use AI stations services.

Table 2
Control fattening and meatiness traits of Danish Landrace breed offsprings

Item	Generations of pigs born in Lithuania					
	F_1	F_2	F_3	F_4	F_5	F_6
No. of pigs	16	59	49	70	39	10
Age at 100 kg live weight, d.	170±1 ^b	175±1 ^c	183±2 ^c	173±1 ^b	179±2 ^c	160±2
Daily gain, g	932±30	829±12 ^c	827±17 ^b	882±10 ^a	830±13 ^b	984±24
Conversion per kg gain:						
Compound feed, kg	2.98±0.03 ^a	2.95±0.03 ^a	2.89±0.04	2.63±0.03	2.62±0.04	2.60±0.10
Metabolizable energy, MJ	41.24±0.41 ^a	40.83±0.41 ^a	40.00±0.55	36.40±0.41	36.26±0.55	35.98±1.38
Carcass length, cm	99.5±0.3	98.5±0.3	97.2±0.3	96.6±0.3	98.6±0.2	98.5±0.4
Backfat thickness:						
At 6-7 rib, mm	17.7±0.2 ^c	20.0±0.4 ^a	18.8±0.4 ^b	18.9±0.4 ^b	18.4±0.5 ^b	23.8±0.8
At last rib, mm	-*	17.2±0.4	15.5±0.4 ^b	16.0±0.3 ^b	15.3±0.3 ^b	19.2±0.7
Loin lean area, cm ²	39.4±0.1 ^b	38.5±0.7 ^b	38.0±0.3 ^c	38.7±0.3 ^b	42.9±1.0	43.4±0.8
Ham weight, kg	11.9±0.1	11.5±0.1	11.4±0.1	11.4±0.1	11.7±0.1	11.8±0.1
Lean meat % (Piglog 105)	-*	55.9±0.2 ^a	56.5±0.3 ^b	57.0±0.2 ^b	57.1±0.3 ^b	54.2±0.5

Significant effects to compare with F_6 progenies: ^a $P<0.05$, ^b $P<0.01$, ^c $P<0.001$, *Evaluation backfat thickness at last rib and lean meat percentage (Piglog 105) of pigs fattened in control fattening stables of the State Pig Breeding Station was started from 2002, therefore F_1 progenies not having mentioned data.

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