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The effects of breed cross on performance and meat quality of once-bred gilts in a seasonal outdoor rearing system

Dedicated to Prof. Dr. Dr. h.c. mult. Ernst Kalm on the occasion of his 65th birthday

Abstract

This study investigated the suitability of once-bred gilts of two different breed crosses in an alternative seasonal outdoor rearing system, with slaughter of the once-bred gilts and their progeny at the end of the season. In total 38 once-bred gilts (Large White x Landrace (LW*L) and Large White x Duroc (LW*D) were housed outdoors one month before farrowing until slaughter, 2-3 weeks after weaning. Body weight, backfat thickness and litter size of the once-bred gilts, and pre-weaning mortality and growth of the piglets were recorded. Carcass quality and technological meat quality (pH_u, internal and surface reflectance, water-holding capacity, processing yield and shear-force) of m. longissimus dorsi were measured. Sensory meat quality (taste panel) of oven-baked loin (m. longissimus dorsi) and cured and smoked ham (m. semimembranosus) was investigated. LW*L once-bred gilts had more piglets at weaning, whereas growth rate of LW*D progeny was higher; pre-weaning mortality and litter weight did not differ between the breeds. LW*L had higher lean meat content and lower backfat thickness. Technological meat quality and chemical composition did not considerably differ between the two breed crosses. LW*D had higher quality with regard to meat flavour and stringiness, but tended to have lower quality with regard to juiciness of cured and smoked ham, compared with LW*L.

Key Words: Duroc, Landrace, housing system, outdoor housing, carcass quality, sensory meat quality, technological meat quality

Zusammenfassung

Titel der Arbeit: **Einfluss der Rassenkreuzung auf das Leistungsvermögen und die Fleischqualität bei Jungsauen in einem saisonalen Freilandhaltungssystem**

In dieser Studie wurde die Eignung einer Freilandhaltungsform, bei der belegte Jungsauen ab dem Frühjahr im Freien gehalten und vor dem Winter mit ihren Nachkommen geschlachtet werden, untersucht. 38 Jungsauen der Rassenkreuzungen Large White*Schwedische Landrasse (LW*L) und Large White*Duroc (LW*D) wurden hinsichtlich des mütterlichen Produktions- und Aufzuchtleistungsvermögens sowie der mütterlichen Schlachtkörper- und Fleischqualität verglichen. Gewichts- und Rückenspeckentwicklung sowie Anzahl lebend geborener und abgesetzter Ferkel wurden notiert. Schlachtkörperqualität und technologische Fleischqualität (pH_u, FOP, Farbe (Minolta), Wasserbindevermögen, Prozess-Ausbeute und Scherkraft) des m. longissimus dorsi (LD) wurden gemessen. Sensorische Fleischqualität von im Ofen gebackenem LD und gepökelt/geräuchertem m. semimembranosus (SMA) wurde von ausgebildeten Sensorikern ermittelt. LW*L Jungsauen hatten mehr Ferkel beim Absetzen, wohingegen die täglichen Zuwachsraten bei den LW*D Nachkommen besser waren. Die Ferkelsterblichkeit in der Säugeperiode unterschied sich nicht zwischen den Rassenkreuzungen. Die Schlachtkörper von LW*L wiesen einen höheren Fleischanteil mit geringerer Speckdicke auf. Technologische Fleischqualität und chemische Zusammensetzung zeigten keine nennenswerten Unterschiede. Im Vergleich zu LW*L wurde das Fleisch von LW*D hinsichtlich der Eigenschaften von Fleischgeschmack und Faserigkeit als besser eingestuft, zeigte jedoch verminderte Saftigkeit im SMA.

Schlüsselwörter: Duroc, Landrasse, Haltungssystem, Freilandhaltung, Schlachtkörperqualität, sensorische Fleischqualität, technologische Fleischqualität

Introduction

Seasonal outdoor rearing of once-bred gilts with their progeny and slaughter of all pigs at the end of the warm period might be a worthwhile, alternative rearing form for organic pork production. The advantages of such a rearing system are savings for stable and feeding costs during wintertime and a higher value of the carcass due to larger cutting details from once-bred gilts compared with female slaughter pigs (HÅKANSSON et al., 1982). The seasonal application of this rearing system benefits the natural cover of soil with grass because from late autumn until early spring the meadow has time to recover properly. An ample natural cover is important for nitrogen uptake by the plants and thus reduced nitrogen leak in the ground water. A year-long outdoor rearing of the pigs would require a larger area to dilute and disperse the porcine faeces. However, outdoor rearing of once-bred gilts is a rarely used system. This might be because of a low economic outcome, as the payment for the carcass is reduced due to an assumed decrease in meat quality and processing properties compared with the younger slaughter pigs.

To stimulate the seasonal production of pig meat and improve maternal performance, carcass and meat quality characteristics of the once-bred gilts, an appropriate dam breed has to be used. The Duroc breed and its crosses are common in outdoor production (BLANCHARD et al., 1999) because of its robustness. This breed has advantages in growing performance (ELLIS et al., 1999; GLODEK et al., 2004) and meat quality (BARTON-GADE, 1988; OLIVER et al., 1994). The generally stated higher intramuscular fat content of Duroc meat is often linked with better eating quality and favourable sensory meat quality characteristics (BEJERHOLM and BARTON-GADE, 1986; LAUBE et al., 2000; MLC, 1992). The Landrace breed is known for good maternal performance and high lean meat content with good processing abilities (GAUGLER et al., 1984; CULBERTSON et al., 1997; TUMMARUK et al., 2000).

The objective of this study was to compare two types of breed crosses (Large White x Duroc and Large White x Landrace) in a seasonal outdoor piglet production with once-bred gilts regarding maternal performance, carcass quality, technological and sensory meat quality. A comparison between maiden gilts, slaughtered at a live weight about 145 kg and these once-bred gilts has been published elsewhere (HEYER et al., 2004).

Material and methods

Animals

This study was performed at Funbo-Lövsta, Swedish University of Agricultural Sciences (SLU), outside Uppsala on the 60th latitude. The vegetation period in this region is between May and October. The study comprised 38 once-bred gilts during two years. Of these, 15 were Large White (sow) x Swedish Landrace (boar) crosses, hereafter referred to as LW*L and 23 were Large White (sow) x Duroc (boar) crosses, referred to as LW*D. The gilts were reared indoors and given a rearing diet (Table 1) ad libitum up to a live weight of 90 kg and thereafter restrictedly according to the standard feeding regimen for growing/finishing pigs in Sweden (ANDERSSON et al., 1997). They were inseminated with Hampshire semen at an average age of 251 days (SD 19). After insemination, the gilts received a gestation diet (30 MJ ME/day) and were housed outdoors from approximately one week before farrowing. The gilts farrowed in farrowing huts in individual enclosures in five batches (April, May and

June 1999; April and May 2000). They were moved to one large enclosure approximately 3 weeks after farrowing, where they remained until slaughter. The piglets were weaned at an age of 9 weeks (76 days, SD 4) and were used in a study concerning the effect of growing/finishing raising indoor or outdoor (STERN et al., 2003). A lactation diet (Table 1) was given in a trough according to a norm based on litter size. The ratio was, however, increased, as the piglets started to consume large amounts of feed. No creep feed was used in this study. After weaning, the once-bred gilts in the first year received a rearing diet twice per day according to their voluntary feed intake. The second year, they were fed the lactation diet restrictedly (4 kg/day). The once-bred gilts were slaughtered two to three weeks after weaning (slaughter age 446 days, SD 25; period from weaning to slaughter 17 days, SD 3).
The gilts were weighed, and backfat was measured with ultrasound 30 days after insemination, at start of the outdoor season, 5 weeks after farrowing, at weaning and at slaughter. The once-bred gilts' individual weight and backfat thickness at farrowing were estimated by using linear regression from measurements at 30 days after insemination and from the day they were moved outdoors (9 days before farrowing, SD 5). Backfat was measured at the last rib of both sides, approximately 8 cm from the middle of the back. Litter size was recorded after farrowing by inspection through the hut window. The stable staff judged the causes when piglets were found dead. The piglets were weighed 4 days after birth and at weaning. The animals were monitored daily for health and all signs of disease or injury were recorded.

Table 1
Composition and calculated nutrient content of the diet (Futtermittelzusammensetzung und errechnete Nährwerte)

	Rearing	Gestation	Lactation	Post- weaning 1st year	Post- weaning 2nd year
Ingredients, %					
Barley	67.00	9.24	23.45	17.72	23.45
Wheat	-	5.38	36.00	43.23	36.00
Oats	-	29.57	-	-	-
Wheat bran	-	10.00	-	-	-
Rye wheat	-	32.86	4.69	-	4.69
Rapeseed meal	7.05	8.89	15.00	13.73	15.00
Yellow peas	20.00	-	17.34	21.73	17.34
Feed fat	1.84	-	-	-	-
Limestone	0.51	1.45	0.89	0.92	0.89
NaCl	0.40	0.45	0.45	0.44	0.45
Dicalcium phosphate	1.95	1.16	1.18	1.23	1.18
L-lysine•HCl (78%)	0.16	-	-	-	-
DL-methionine (99%)	0.06	-	-	-	-
Vitamin and mineral premix	1.00	1.00	1.00	1.00	1.00
Calculated nutrient content					
ME, MJ/kg	12.4	11.3	12.0	12.0	12.0
CP, %	16.0	13.6	17.0	17.7	17.0
Lysine, digestible, %	0.72	0.44	0.70	0.72	0.70

Carcass traits, technological and sensory meat quality

All animals were slaughtered at a commercial slaughterhouse, after 10 km transport and at least 2 h of lairage in the abattoir. Cold carcass weight was measured on the bled and eviscerated animal, with head but without tongue, front legs, hooves, genital

organs, flare fat, kidney and diaphragm. Backfat thickness was measured over the m. longissimus dorsi (LD), just behind the last rib. Ham and loin of the right carcass half were weighed with skin and fat then defatted and weighed again as meat and bone. Five ham muscles (m. semimembranosus et aductor (SMA), m. semitendinosus (ST), m. quadriceps (QUA), m. gluteus (GLU) and m. biceps femoris (BF)) were dissected and weighed separately. Lean meat percentage was estimated according to [-49.672 + (1.012* % ham in carcass) + (0.622* % meat and bone in ham) + (0.667* % loin in carcass) + (0.2* % meat and bone in loin)] (I. HANSSON, pers. comm.).
Technological meat quality traits were measured on samples of LD taken at the last rib and backwards approximately 24 h after slaughter. All measurements followed the procedures as described in HEYER et al. (2004). The technological meat quality measurements included ultimate pH (pH_u), internal reflectance (FOP), surface reflectance with the parameters L* (lightness), a* (redness) and b* (yellowness). Water-holding capacity was determined as drip loss on LD and thawing loss as weight difference of frozen and defrosted SMA. For processing yields, brine absorption during immersion of SMA, commercial processing yield (total yield) on SMA and laboratory processing yield (Napole yield) on LD were measured. Maximal shear force and total work of Warner-Bratzler (WB) was determined on cooked LD. Chemical composition of the LD was analysed as intramuscular fat (IMF), crude protein, ash and dry matter, according to the methods as described in HEYER et al. (2004).
Sensory meat quality was determined on oven-baked LD of 20 once-bred gilts (all animals of the first year) and cured and smoked SMA of 18 once-bred gilts (all animals of the second year) by a trained taste panel. The meat (oven-baked LD and cured and smoked SMA) was prepared as described in HEYER el al. (2004). Tenderness, juiciness and fat flavour were determined on both LD and SMA, acidity and meat flavour solely on LD and smoke flavour, stringiness and salinity solely on SMA. The scale for the taste characteristics scored from 1= very low intensity of the character to 100 = very high intensity.

Statistics
Statistical analyses of maternal performance, carcass quality and technological meat quality were performed with the GLM procedure in SAS (SAS Institute Inc., Cary, N.C., USA, versions 8.02). Data given in the tables are least square means and standard errors. The model included breed cross (LW*D or LW*L) and year as fixed factors. No interactions between the fixed effects were found. For litter weight and piglet growth, age of the piglets at weighing was included as a covariate. Pre-weaning mortality (no. weaned/no. live-born) and piglet growth were analysed with and without the fixed effect of litter size (class: ≤6; 7-9; 10-12; ≥13 live-born piglets). Statistical analyses of sensory meat quality were performed with the MIXED procedure in SAS. In addition to the fixed effects described above, taste panel member and individual pig were included in the model as random effects.

Results

Maternal performance
All 38 once-bred gilts were healthy during the whole study; no sign of illness was observed. LW*L had significantly larger litters 4 days after birth (2.0 piglets; p=0.021) compared to LW*D (Table 2). These once-bred gilts also had more piglets at weaning

(1.7 piglets) because pre-weaning mortality did not differ. The main reason for the mortality was crushing. For LW*L, 38.5% of piglet mortality was registered as crushing losses, compared with 48.6 % for the LW*D. No effect of breed cross on litter weight 4 days after birth and at weaning was observed. Litters with LW*D mothers grew faster in the period from day 4 to weaning. When litter size was included in the model, a tendency of higher growth rate could still be seen.

Table 2
Maternal and piglet performance traits for once-bred gilts of Landrace and Duroc breed crosses, least square means (LSM) and standard errors (SE) (Leistungsvermögen von Kreuzungs-Jungsauen und Ferkeln, LS-Mittelwerte und Standardfehler)

	LW*L (n=15)		LW*D (n=23)		
	LSM	SE	LSM	SE	p-value
Litter size					
no. born total	11.9	0.72	10.0	0.57	0.052
no. live-born	11.5	0.73	9.9	0.58	0.092
no. 4 days after birth	10.8	0.62	8.8	0.49	**0.021**
no. at weaning	10.2	0.60	8.5	0.48	**0.034**
Pre-weaning mortality, %	12.1	3.14	13.3	2.51	0.773
Pre-weaning mortality$_{corr}$[1], %	9.5	3.43	13.7	2.35	0.293
Litter weight 4 days after birth, kg	20.8	1.09	18.6	0.87	0.136
Litter weight at weaning, kg	206.9	10.81	193.2	8.65	0.334
Piglet daily weight gain, g					
day 4 to weaning	298	10.6	340	8.4	**0.004**
day 4 to weaning$_{corr}$[2]	323	9.8	344	6.7	0.071

[1] Values corrected for litter size; p=0.017 for effect of litter size.
[2] Values corrected for litter size; p=0.001 for effect of litter size.

From 30 days after service to slaughter, body weight of LW*D was considerably higher than of LW*L (Figure 1). At start of the outdoor period, the difference in weight was 16 kg (p=0.069). Five weeks after farrowing, LW*D was heavier than LW*L (p=0.004). Also when including the effect of litter size in the statistical model a significant difference in weight could be seen (p=0.010). During the first 5 weeks of lactation, LW*D had a lower weight loss, compared with the LW*L. Until weaning, both LW*D and LW*L increased in weight; the LW*D more than the LW*L (9 kg vs. 5 kg; p=0.002). At slaughter, LW*D was 32 kg heavier (p=0.001) and reached the similar weight as at the start of the outdoor period. Backfat of LW*D was initially significantly thicker than that of LW*L, and this difference remained during the whole rearing period. Compared with LW*L, LW*D had thicker backfat after farrowing (p=0.028) (with litter size included in the statistical model: p=0.032). During the first 5 weeks of lactation, LW*D lost significantly less backfat than LW*L. At slaughter, these once-bred gilts were as fat as 30 days after service, whereas backfat of LW*L was 4 mm thinner.

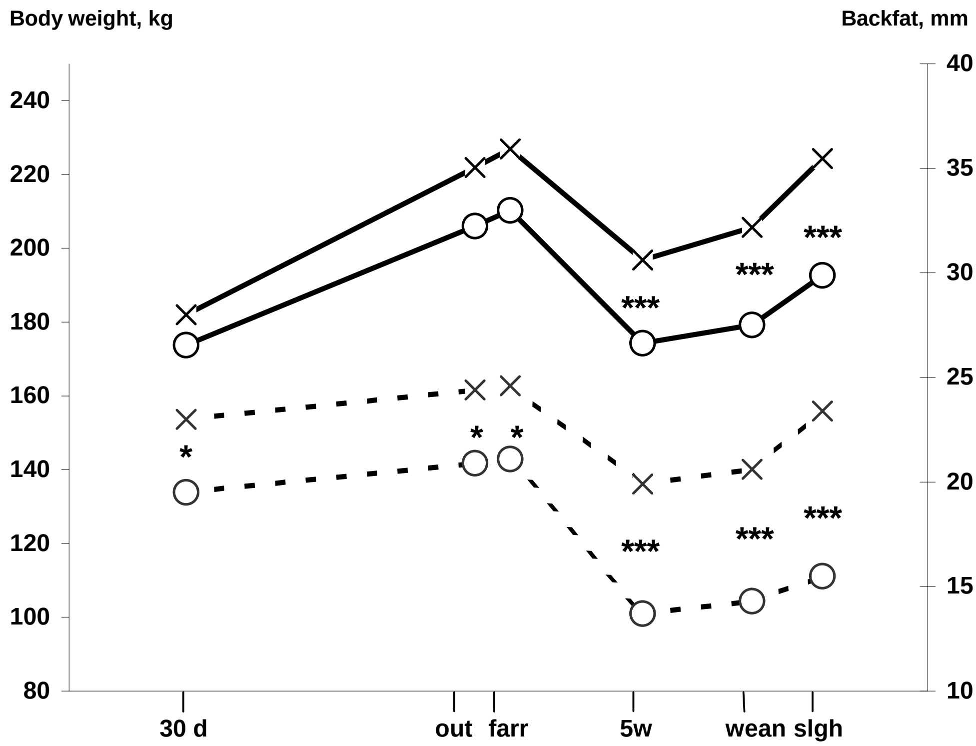

Fig. 1: Body weight and backfat thickness of once-bred gilts from 30 days after service to slaughter. Measurements at time of: 30 d= 30 days after service; out= start of the outdoor period, approximately one week before farrowing; farr = farrowing; 5w = five weeks after farrowing, wean = weaning; slgh = slaughter; X= LW*D cross; ○= LW*L cross; Straight line= body weight; Dashed line= backfat thickness; Levels of significance between breed cross: ***=p<0.001, *=p<0.05 (Entwicklung von Körpergewicht und Rückenspeckdicke bei Jungsauen vom 30. Tage der Trächtigkeit bis Schlachtung)

Feed consumption during the first 10 days of lactation was 91 and 76% of the recommended amount based on litter size for LW*D and LW*L once-bred gilts, respectively. The total consumption of feed from farrowing until slaughter could not be compared between breed crosses because the animals were kept in mixed groups. On average, feed consumption was 681 kg per sow from farrowing to slaughter, including the feed consumed by the piglets (until weaning). The last weeks of lactation, the piglets were often observed to eat sows' feed. The piglets were weaned at a weight of 21.3 (SD 4.25 kg) and 24.3 kg (SD 4.39 kg) for LW*L and LW*D litters, respectively.

Carcass quality traits
The once-bred gilts were slaughtered at an approximate age of 450 days and a carcass weight of 146 kg. LW*D had higher carcass weight and thicker backfat than LW*L (p<0.001; Table 3). Lean meat content and percentage of meat and bone in ham and loin were significantly lower in LW*D than in LW*L. The proportion of loin in carcass was higher in LW*D. However, the proportion of QUA in the ham was lower in LW*D than in LW*L (p=0.007), whereas the proportion of ST was higher in the LW*D (p=0.001).

Table 3
Carcass quality traits and proportion of different ham muscles in once-bred gilts of Landrace and Duroc breed crosses, least square means (LSM) and standard errors (SE) (Schlachtkörperqualität und prozentualer Anteil verschiedener Muskeln im Schinken bei Kreuzungs-Jungsauen; LS-Mittelwerte und Standardfehler)

	LW* L (n=15)		LW*D (n=23)		
	LSM	SE	LSM	SE	p-value
Carcass weight[1], kg	137.3	3.75	153.7	2.92	**0.002**
Lean meat content, %	56.0	0.62	54.0	0.49	**0.017**
Backfat, mm	16.7	1.18	22.1	0.89	**0.001**
Ham in carcass, %	30.0	0.35	30.5	0.27	0.252
Meat and bone in ham, %	79.6	0.65	75.8	0.51	**0.001**
Loin in carcass, %	16.2	0.26	16.8	0.20	**0.036**
Meat and bone in loin, %	75.4	0.97	72.0	0.76	**0.011**
SMA[2] in ham, %	25.5	0.27	25.3	0.21	0.554
ST[3] in ham, %	7.9	0.15	9.0	0.11	**0.001**
QUA[4] in ham, %	21.5	0.24	20.5	0.19	**0.007**
GLU[5] in ham, %	17.3	0.32	17.0	0.25	0.434
BF[6] in ham, %	27.8	0.20	28.2	0.16	0.118

[1]Measured with head and without front legs; [2]SMA= m. semimembranosus et aductor; [3]ST= m. semitendinosus; [4]QUA= m. quadriceps; [5]GLU= m. gluteus; [6]BF= m. biceps femoris.

Table 4
Technological meat quality and chemical composition of muscles in once-bred gilts of Landrace and Duroc breed crosses, least square means (LSM) and standard errors (SE) (Technologische Fleischqualität und chemische Zusammensetzung in Muskeln von Kreuzungs-Jungsauen; LS-Mittelwerte und Standardfehler)

	LW*L (n=15)		LW*D (n=23)		
	LSM	SE	LSM	SE	p-value
$pH_{u\ LD}$	5.45	0.02	5. 48	0.01	0.143
FOP_{LD}	36.0	1.74	37.1	1.37	0.656
Minolta $values_{LD}$					
L* (lightness)	48.1	0.63	47.5	0.49	0.479
a* (redness)	8.4	0.36	8.4	0.28	0.921
b* (yellowness)	3.5	0.29	3.7	0.23	0.709
Water holding $capacity_{LD}$					
Drip loss, %	6.0	0.52	4.7	0.41	0.063
Thawing loss, %	8.7	1.08	7.6	0.58	0.352
Processing yield					
Brine $immersion_{SMA}$, %	15.1	1.75	15.4	0.93	0.879
Total $yield_{SMA}$[1], %	98.1	1.36	99.1	0.72	0.530
Napole $yield_{LD}$[2], %	84.2	0.70	86.4	0.55	**0.023**
WB shear $force_{LD}$					
Max shear force, N	40.7	2.19	38.4	1.71	0.514
Total work, Nmm	201.6	7.77	202.5	6.09	0.926
Chemical $composition_{LD}$					
Intra muscular fat, %	2.2	0.21	2.6	0.17	0.234
Crude protein, %	23.4	0.42	23.2	0.33	0.741
Dry matter, %	24.8	0.21	25.2	0.16	0.108
Ash, %	1.0	0.05	1.0	0.04	0.865

[1]Commercial yield during ham production; [2]Laboratory processing yield.

Technological and sensory meat quality and chemical composition

pH_u, internal and surface reflectance, thawing loss, total yield (commercial processing yield), shear force and chemical composition did not differ between the two types of cross-bred gilts (Table 4). A tendency of lower drip loss (p=0.063) and 2.2 percentage

points higher Napole yield (laboratory processing yield; p=0.023) were found in meat from LW*D than that from LW*L. No difference in chemical composition was found in meat of the two breed crosses.
Oven-baked LD of LW*D and LW*L cross-bred gilts were equally scored in sensory meat quality test, except meat flavour, where LD of LW*D scored higher (p=0.032) (Figure 2). Cured and smoked SMA of LW*L tended to have juicier meat (p=0.084) and had higher stringiness (p=0.005) than of LW*D, according to the test panel.

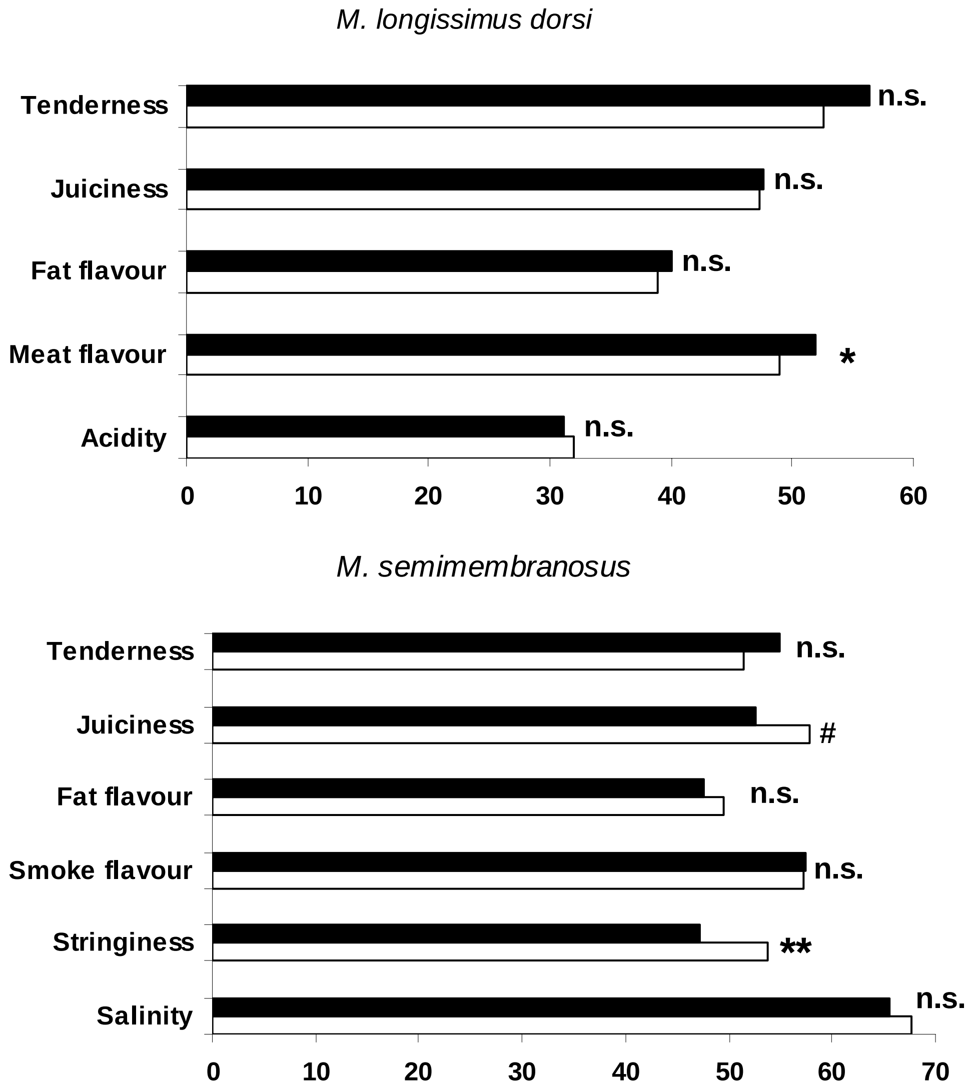

Fig. 2: Sensory meat quality of oven-baked m. *longissimus dorsi* (n=20) and cured and smoked m. *semimembranosus* (n=18) from once-bred gilts ■ LW*D cross, □ LW*L cross; Levels of significance: n.s.= p>0.10, #=p<0.10, *=p<0.05, **=p<0.01 (Sensorische Fleischqualität von gebackenem m. longissimus dorsi und gepökelt/geräuchertem m. semimebranosus bei Kreuzungs-Jungsauen)

Discussion

Maternal performance

In this study once-bred LW*L gilts had larger litters than once-bred LW*D gilts. A higher number of live-born and weaned piglets of the Landrace breed and its crosses are widely described in the literature (CULBERTSON et al., 1997; TUMMARUK et al., 2000). GAUGLER et al. (1984) reported that Landrace females, compared to the

breed of Duroc and Large White, are most productive in terms of litter size and litter weight, but the authors also emphasized that significant heterosis estimates were obtained for litter size, litter weight and piglet mortality. It has to be ‚emphasized' that despite the lack of access to creep feed for the piglets, they grew well and both the piglets and the once-bred gilts were in a good condition at weaning. LW*D had higher growth rate, compared to the LW*L pigs. For these LW*D pigs a higher growth rate was also observed during the growing/finishing period (STERN et al., 2003).
Crushing is reported as a main factor for pre-weaning mortality of piglets, caused by down-laying of the mother (MCGLONE and HICKS, 2000). In the present study, the most important reason was crushing as well. The higher crushing rate for Duroc sows might be because they are larger and heavier and thus less agile in their movements at down-laying before suckling. The LW*L once-bred gilts had the capacity to rear their larger litters and had consequently more piglets at weaning than the LW*D once-bred gilts. A mortality of 12 to 13%, as found in the present study, was on an acceptable level for an outdoor rearing system and no aggressiveness of the sows towards piglets was observed. SPITSCHAK (1997) reported a similar mortality during the summer months, which increased during winter with losses as high as 24%.
LW*L had higher weight loss during lactation, compared to the LW*D. This is in accordance with CASSADY et al. (2002), who found that pure-bred Duroc sows have lower weight loss during lactation, compared to Landrace and Large White pure-breeds. Weight loss during lactation is strongly related to litter size and piglet growth (WÜLBERS-MINDERMANN et al., 2002) because sows mobilise more body reserves with greater number of piglets (NEIL et al., 1996). HARDGE et al. (1999) considered that for pre-weaning growth, the most important factor is maternal milk yield. Thus, the higher weight loss of LW*L might be explained by their larger number of piglets in addition to a lower feed consumption. During the first 10 days of lactation, when individual feed intake was recorded, LW*L once-bred gilts consumed approximately 25% less than the recommended norm, which was based on litter size. Less body reserves are probably mobilised during lactation in LW*D due to higher feed consumption. The high body weight and backfat thickness of the LW*D may indicate that these once-bred gilts are more suitable for outdoor production, especially in colder countries.

Carcass meat quality
Higher backfat thickness and lower lean meat content of LW*D compared to LW*L was in accordance to earlier comparisons (WOOD et al., 1988; ENFÄLT et al., 1997; STERN et al., 2003) between Duroc crosses and other commercial breeds. BLANCHARD et al. (1999) reported that backfat thickness increased with increasing genetic portion of Duroc breed in the growing/finishing pig. Also the progeny of the once-bred gilts in the present study (25% Duroc or Landrace, 25% Large White, 50% Hampshire) showed that Duroc cross breeds had lower lean meat content, compared to the Landrace cross breeds (STERN et al., 2003). Nowadays Duroc has an improved carcass quality, in terms of higher lean meat content and thinner backfat thickness, because this was effectively included in the breeding goals for Duroc boars (NORSVIN, 2004). However, differences in these carcass traits are still present. It has to be emphasized that the lower lean meat content in the present study was found for LW*D once-bred gilts, which have a higher age, higher carcass weight and underwent

a whole cycle of reproduction. In comparison with growing/finishing pigs, the once-bred gilts reach a lower price per kg meat (0.75 vs. 1.20 EUR/kg) because of their higher body weight and backfat thickness. This disadvantage of lower economic value per kg meat has to be taken into account when gilts are slaughtered after their first reproduction cycle. However, the lower payment per kg meat might not be justified, because once-bred gilts produce valuable carcasses of good quality with adequate technological and sensory meat quality when comparing to maiden gilts, raised to a higher slaughter weight (HEYER et al., 2004).

Technological meat quality and chemical composition

The Duroc breed is widely known for its enhanced technological meat quality traits, e.g. decrease of WB shear force and cooking loss compared to white breeds (MLC, 1992) and is therefore often used as terminal sire breed (OLIVER et al., 1994). The breeding company, from which the Duroc sires in the present study originated, has technological meat quality included in the breeding goal (NORSVIN, 2004). In accordance with other studies, pH_u and FOP values did not differ between the two breed crosses in the present study (CAMERON et al., 1990; EDWARDS et al., 1992; ENFÄLT et al., 1997; BLANCHARD et al., 1999). ENFÄLT et al. (1997), who found no differences in pH_u between Duroc and Yorkshire breed crosses, suggested that differences in pH_u of pure breeds might be alleviated by the effect of breed cross. In literature, Duroc meat is often mentioned as darker (OLIVER et al., 1994) and also redder (CAMERON et al., 1990), compared to other breeds, which could be explained by the higher content of haem in the muscle fibres of Duroc pigs (MLC, 1992). However, in the present study, no differences in lightness or redness could be measured, which might be due to the higher age and weight of the once-bred gilts in comparison with the growing/finishing pigs of the cited studies.

The water-holding capacity in terms of drip and cooking losses in meat from pure breeds and breed crosses of Duroc and white breeds are widely studied (OLIVER et al., 1994; ENFÄLT et al., 1997; BLANCHARD et al., 1999) and generally no differences in drip and cooking losses between the breed crosses were found. However, in the present study, drip loss in LW*D tended to be lower, compared to LW*L. Also Napole yield differed between the two breed crosses with a higher yield for LW*D, whereas total yield after commercial ham processing was similar. The discrepancy between Napole and total yield might be due to the preparation of the meat (fresh/thawed) and/or the use of different muscles for yield determination.

Shear force values did not differ between breed crosses. BARTON-GADE (1988) reported that shear force of meat from purebred Duroc pigs was significantly lower than that from white races. BLANCHARD et al. (1999) considered that with increasing portion of Duroc genes in the pig, shear force decreased. ENFÄLT et al. (1997) found similar shear force for breed crosses with Duroc or Large White as sires. In all named cases, the measurements were carried out on growing/finishing pigs and as possible explanation for differences in meat toughness, differences in IMF content and growth rate were discussed. However, in the present study once-bred gilts were used, and differences in WB shear force between breeds might have been alleviated due to their high age and weight.

In contrast to the general perception of higher IMF in Duroc and its breed crosses (BARTON-GADE, 1988; OLIVER et al., 1994; LAUBE et al., 2000), no differences between LW*D and LW*L once-bred gilts in IMF and other chemical components were found. This might be because the once-bred gilts underwent a whole reproduction cycle, including gestation and lactation. During lactation, fat reserves were depleted by the suckling progeny and could not be recovered during the short post-weaning fattening period. Even when the backfat thickness of the Duroc breed cross was higher post-weaning, the IMF content was similar.

Sensory meat quality

The general consistency of sensory meat quality between breed crosses in the present study is contrary to findings from several authors (BARTON-GADE, 1988; CAMERON et al., 1990; BLANCHARD et al., 1999), who found higher tenderness and juiciness of Duroc and its crosses, compared to other breeds. Sensory meat quality characteristics i.e. tenderness and juiciness are, related to IMF, pH value and shear force (WOOD et al., 1986; EIKELENBOOM et al., 1996a, b; ENFÄLT et al., 1997; ELLIS et al., 1999; OLSSON et al., 2003). In the present study, pH_u, IMF and shear force did not differ between the breed crosses and therefore did not affect tenderness and juiciness (in LD) to a greater extent. The tendency of juicier SMA of LW*L pigs might be an effect of the lower water-holding capacity of this breed cross. HULLBERG et al. (2005) described that a lower water-holding capacity, in that study determined as lower processing yield, resulted in higher juiciness. An explanation might be that meat with low water-holding capacity binds the water less strongly and releases water more easy during chewing.

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