EFFECT OF ORGANIC RAISING AND BREED CROSS ON CARCASS AND TECHNOLOGICAL MEAT QUALITY OF GROWING/FINISHING PIGS

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Background

The promotion of organic pig production is an EU-wide political goal. However, expansion of organic pig production is slow, possibly due to insufficient certitude about final product quality, such as carcass and meat quality. Carcass and technological meat quality traits of outdoor raised pigs are widely discussed in literature. Further, the breed cross may affect carcass and meat quality traits and therefore interact differently in indoor and outdoor housing systems.

Objectives

The aim of this study was to compare organic and conventional production systems of growing/finishing pigs with regard to their carcass and technological meat quality. Further, the influence of two different types of breed crosses on these quality traits was investigated.

Materials and methods

During two years, 280 growing/finishing pigs were raised to approximately 107 kg live weight in four different production systems; they were equally distributed to housing system (outdoor/indoor), breed cross (D*LW/L*LW) and gender (castrates/females). Outdoor pigs were fed *ad libitum*, with either an organic diet diluted with 20% alfalfa roughage throughout (org.dil.) or with first the diluted diet and thereafter this organic diet undiluted (org. dil./org. undil.). In two indoor treatments, pigs were fed restrictively with either the undiluted organic diet (org. undil.) or a conventional diet (conv.).

Hot carcass weight and back fat thickness over the middle of *M. longissimus dorsi* (LD) were recorded. Lean meat content was estimated as [lean meat percentage = -49.781 + (0.899* ham in carcass) + (0.612* meat and bone in ham) + (0.651*loin in carcass) + (0.252*meat and bone in loin) + 0.249 (for females)] (Hansson, pers. comm.). Ultimate pH (portable pH-meter equipped with a combination gel electrode SE104, Knick, Berlin, Germany, calibrated to chilling room temperature), internal reflectance (FOP, 900 nm; TBL Fibre Optics Group Ltd., Leeds, UK) and surface reflectance (Minolta Chroma Meter CR 300, DP-301, Osaka, Japan) were measured on LD. Drip loss was determined on a 2-cm-thick slice, taken from LD directly in front of the last rib towards the forepart, stored in a plastic bag and hanging on a thread at 4°C for 48 h. Thawing loss was determined as the difference between the weight of fresh and thawed 300-g piece of LD after frozen storage at -20°C. On the same piece of meat, cooking loss was determined as the weight difference before and after cooking in a water bath at 70°C during 90 min. Maximal Warner-Bratzler (WB) shear force and total WB-work were measured on 8 strings (10x10x50 mm), sheared across the fibre direction of cooked LD (speed: 55 mm/min, TA-HDI texture Analyser; Stable Micro Systems, Surrey, UK).

Statistical analyses were performed with the MIXED procedure in SAS (SAS Institute Inc., Cary, N.C., USA, version 8.02) with treatment, breed cross and gender as fixed factors. Sire within breed cross and dam within breed cross and sire were treated as random.

Results and discussion

Carcass quality

From both years, average carcass weight of indoor raised pigs was higher compared with outdoor raised pigs (Table 1). The lower dressing percentage of outdoor pigs might depend on the higher gut filling, because the diluted diet contained more indigestible fibre than the undiluted diet; moreover, the outdoor pigs had access to pasture. Lean meat content is often reported to be higher in outdoor raised pigs, compared with indoor pigs, when receiving identical diets (Stern et al., 2003). In our study, outdoor pigs fed the diluted organic diet had significantly higher lean meat content (year 2), probably due to the lower energy content of the diet, and consequently lower daily weight gain. The higher energy requirement of outdoor pigs due to their higher agility could not be covered by the diluted diet, even when given *ad libitum*. The uniformity between indoor raised pigs in dressing percentage, lean meat content and back fat thickness indicates that an organic diet can give carcass quality results comparable with those from a conventional diet.

Between breed crosses, no differences in carcass quality could be observed (Table 2). This is not in accordance with other studies, where higher back fat in Duroc breed crosses compared with Large White breed crosses have been reported (Enfält et al., 1997).

Technological meat quality

Technological meat quality traits, such as pH, internal and surface reflectance, WB shear forces and water-holding capacity, in terms of drip, thawing and cooking losses, differed only in some cases between the production systems (Table 1). However, pH values of both muscles did not differ between the treatments, whereas FOP_{BF} values were higher in outdoor pigs, compared with indoor pigs. The pH and FOP values seemed not to be related to each other, which might indicate that these values depend less on production system than on e.g. slaughter conditions. Meat in LD was paler (higher L* values) in indoor raised pigs (year 1), which could be a consequence of the higher FOP values in that muscle. However, Lindahl et al. (2001) stated, that L* values depended mostly on pigment content and myoglobin forms than on internal reflectance. In our study, water-holding capacity was not affected by production system, which might partly be explained by the consistent pH_{LD}. Shear forces in meat from indoor and outdoor raised pigs are widely investigated with various results. Olsson et al. (2003) found significantly higher, whereas Stern et al. (2003) found lower WB shear forces for outdoor pigs. In our study, WB shear forces were mostly unaffected; solely year 2, outdoor raised pigs had lower maximal shear force, compared with indoor raised pigs, given the organic diet.

Generally, pH, FOP and colour values did not differ between Duroc and Landrace breed crosses, whereas water-holding capacity was higher and WB shear force values were lower (year 1) for the Duroc breed crosses (Table 2). This is in accordance with Blanchard et al. (1999), who reported a decrease in shear force with increasing proportion of Duroc in the final breed cross.

Conclusions

It can be concluded that the production system influenced mainly carcass composition and, to a lesser extent, technological meat quality. Indoor raised pigs fed either organic or conventional diet did not differ in carcass and meat quality traits. Breed cross did not influence carcass traits and colour, pH and FOP values. Indications of higher water-holding capacity and lower WB shear force for D*LW pigs could be found.

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Table 1. Carcass and technological meat quality traits (LS-means and pooled standard error) of growing/finishing pigs raised outdoors and indoors with different diets

	Year 1					Year 2					
	Outdoor		Indoor			Outdoor		Indoor			
	org. dil.	org. dil./ org. undil.	org. undil.	SE	P-value	org. dil.	org. dil./ org. undil.	org. undil.	conv.	SE	P-value
No. of animals	40	37	40			40	39	39	40		
Hot carcass weight, kg	81.7^{b}	82.5^{ab}	83.5^{a}	0.44	**0.0187**	79.3^{b}	80.1^{b}	84.6^{a}	83.3^{c}	0.46	**0.0001**
Dressing percentage	75.8^{b}	76.6^{c}	77.5^{a}	0.35	**0.0001**	74.2^{b}	75.4^{c}	78.5^{a}	77.6^{a}	0.47	**0.0001**
Estm. lean meat, %	58.3	57.5	57.6	1.19	0.2005	60.3^{b}	58.6^{a}	58.8^{a}	59.5^{ab}	0.40	**0.0044**
Back fat[1], mm	13.2^{b}	14.5^{a}	15.0^{a}	1.47	**0.0055**	12.4^{b}	13.9^{a}	14.2^{a}	14.0^{a}	0.65	**0.0068**
pH value											
LD	5.52	5.53	5.49	0.019	0.1575	5.55	5.52	5.53	5.51	0.022	0.5235
BF	5.65	5.67	5.65	0.022	0.7769	5.65	5.60	5.66	5.65	0.028	0.1557
FOP value											
LD	28.8^{a}	26.2^{b}	29.6^{a}	1.04	**0.0035**	29.0	29.4	27.9	27.9	1.10	0.4985
BF	34.4^{b}	33.2^{ab}	31.7^{a}	0.07	**0.0190**	32.2^{b}	35.6^{c}	27.7^{a}	29.3^{a}	0.79	**0.0001**
Minolta value$_{LD}$											
L* (lightness)	47.8^{b}	46.9^{b}	49.1^{a}	0.60	**0.0001**	47.1	47.5	47.8	47.9	0.44	0.1917
a* (redness)	5.9	5.9	5.7	0.15	0.3361	6.1	6.3	6.1	6.1	0.18	0.8613
b* (yellowness)	2.2	1.8	1.8	0.16	0.0737	2.0^{bc}	2.1^{b}	1.5^{a}	1.7^{ac}	0.12	**0.0009**
Drip loss$_{LD}$, %	4.6	4.0	3.9	0.03	0.1134	4.2	4.9	4.1	4.9	0.35	0.1041
Thawing loss$_{LD}$, %	7.2	7.0	7.3	0.59	0.9521	9.8	10.4	10.7	11.6	0.48	0.0912
Cooking loss$_{LD}$, %	21.4	21.1	22.1	0.57	0.5576	18.8	17.8	18.4	19.2	0.44	0.1359
Warner-Bratzler											
max. shear force$_{LD}$, N	30.5	28.9	30.6	1.39	0.5056	28.1^{b}	27.6^{b}	33.8^{a}	31.7^{ab}	1.83	**0.0064**
total work$_{LD}$, Nmm	175.2	161.9	167.8	5.58	0.2426	150.8	144.6	163.1	155.8	6.01	0.1428

[1]Over the middle of *M. longissimus dorsi* at the cut behind the last rib.
Means with different superscript within row and year differ significantly ($p<0.05$).

Table 2. Carcass and technological meat quality traits (LS-means and pooled standard error) of D*LW and L*LW crossbred pigs

	Year 1				Year 2			
	D*LW	L*LW	SE	P-value	D*LW	L*LW	SE	P-value
No. of animals	57	60			79	79		
Hot carcass weight, kg	82.5	82.6	0.35	0.8683	82.0	81.7	0.32	0.6061
Dressing percentage	77.0	76.3	0.41	0.2564	76.3	76.6	0.23	0.3881
Estm. lean meat, %	57.8	57.4	1.18	0.8573	59.3	58.9	0.32	0.4923
Back fat[1], mm	14.6	13.9	2.01	0.7972	13.6	13.7	0.76	0.8790
pH value								
LD	5.52	5.50	0.018	0.5067	5.56	5.50	0.021	0.0791
BF	5.65	5.66	0.021	0.9639	5.65	5.63	0.032	0.6340
FOP value								
LD	28.7	27.7	0.20	0.5654	27.9	29.0	0.10	0.2442
BF	34.5	31.7	0.53	**0.0069**	32.1	30.3	0.55	0.0505
Minolta value$_{LD}$								
L* (lightness)	47.4	48.5	0.78	0.3978	46.9	48.2	0.50	0.0990
a* (redness)	6.1	5.6	0.16	0.3361	6.1	6.2	0.19	0.5781
b* (yellowness)	2.0	1.8	0.20	0.4666	1.8	1.9	0.11	0.6009
Drip loss$_{LD}$, %	3.6	4.8	0.39	0.0643	3.7	5.3	0.34	**0.0091**
Thawing loss$_{LD}$, %	6.7	7.6	0.47	0.2316	10.0	11.2	0.33	**0.0314**
Cooking loss$_{LD}$, %	20.3	22.7	0.64	**0.0451**	18.1	19.1	0.31	0.0513
WB shear force								
total work$_{LD}$, Nmm	156.5	180.1	4.47	**0.0136**	152.5	154.6	5.21	0.7870
max. shear force$_{LD}$, N	27.8	32.2	1.21	**0.0482**	28.9	31.6	1.93	0.3602

[1]Over the middle of *M. longissimus dorsi* at the cut behind the last rib.
Means with different superscript within row and year differ significantly ($p<0.05$).