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Breeding against osteochondrosis in swine – the Swedish experience

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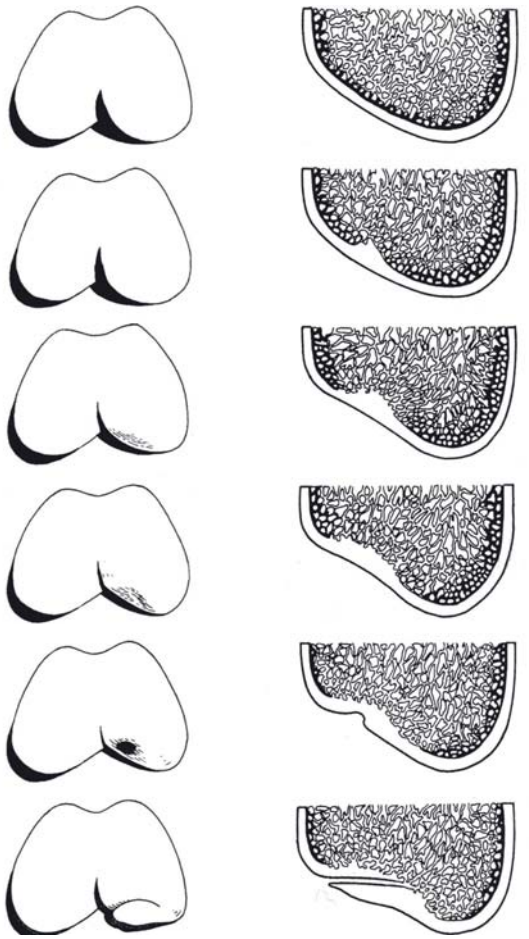
Osteochondrosis is defined as a disturbance of cell differentiation in metaphyseal growth plates and joint cartilage, and is regarded to cause leg weakness symptoms and pain. Studies in the 1970'ies, mainly in Norway and Sweden (e.g. Gröndalen, 1974; Reiland, 1978), identified and described this disorder. The hereditary background was analysed by Reiland et al (1978), presenting estimates of heritability in the range 0.2 to 0.3. See also a review by Fukawa & Kusuhara (2001).

Already in 1982, recording of the presence and severity of osteochondrosis started within the national Swedish pig progeny-/sib-testing scheme. In this testing, slaughter took place at approx. 104 kg live weight. The medial condyle of one elbow joint and one knee joint from all pigs from testing stations were scored after slaughter. This was done in connection with the partial dissection of the carcass, and took only few minutes extra per pig. A six-point scoring was used, see figure below (modified from Reiland et al, 1978): 0=no lesions (top), 5=severe lesions (bottom).



Data from this scoring in the period 1982 to 1984 was genetically analysed (Lundeheim, 1987), and unfavourable genetic correlations between osteochondrosis and production were found. The estimated heritabilities for the osteochondrosis scores were in the range 0.2 to 0.35. In this study, a higher proportion of pigs with clinical leg weakness was found among pigs with joint scores 4 and 5.

The information on osteochondrosis has since 1988 been included in the Swedish pig breeding evaluation, with the primary intention to balance the unfavourable genetic correlations between osteochondrosis and production (growth rate and carcass leanness). The traditional Swedish pig progeny-/sib-testing at testing stations ended in year 2000. However, osteochondrosis is still included in the Swedish pig breeding goal.

The primary aim of this study was to analyse genetic (co)variances for osteochondrosis scores, growth rate (birth to 100 kg) and carcass leanness, on the basis of a well-sized data-set from the Swedish station testing of pigs

Material & methods

Data was extracted from the database of the Swedish pig breeding organisation Quality Genetics, which in the beginning of the 1990'ies 'took over' the Swedish national pig breeding activities. During the 1980'ies the test groups constituted of two full-sibs, one castrated male and one female. Since the beginning of the 1990'ies, entire males were tested instead of the castrated ones. The genetic analyses were restricted to female pigs of Landrace (n=7526) and Yorkshire (n=7470), entering testing station in the period 1987 to 2000.

The analyses were restricted to 4 traits:
Elbow joint score
Knee joint score
Growth rate between birth and slaughter
Lean meat percentage in carcass (% of carcass without head; estimated from partial dissection)

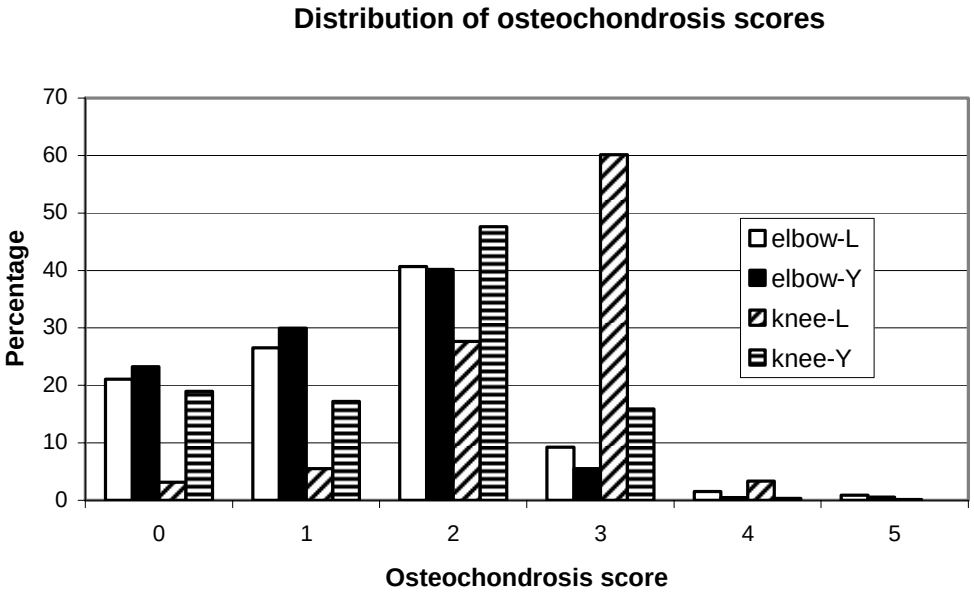
Multiple-trait animal-model genetic analyses were performed within breed, using the DMU package (Madsen & Jensen, 2000). The statistical models included, besides the random genetic effect (pedigree: parents and grand-parents of the tested pigs), the fixed effect of the combination of testing station-year and 3 months period of arrival to testing station. The model for growth rate included also the random effect of the combination of nucleus herd – two-year period of birth of the pig. Pre-correction of growth rate to 100 kg live weight was performed according to Lundeheim (2002).

Results

Landrace had a higher average osteochondrosis score (table 1), compared with Yorkshire, which is in agreement with earlier studies of this scoring system (Lundeheim, 1987) and with earlier studies based on radiological examination of live pigs (Jörgensen & Andersen, 2000). The histogram below shows the distribution of the scores, within breed. Very low proportion of the tested pigs had severe joint lesions (scores 4 and 5, which means more or less open cracks in the cartilage). The marked difference between the two breeds for knee joint score, almost one score unit, is caused by the lower proportion of Landrace pigs with scores 0 and 1, and the higher proportion of Landrace pigs with score 3, compared with Yorkshire.

Table 1. Means, by breed, for the analysed traits

	Landrace (n=7526)	Yorkshire (n=7470)
Elbow joint score	1.46	1.31
Knee joint score	2.56	1.61
Growth rate (g/day)	578	573
Lean meat percentage	63.5	64.0



The results from the genetic analyses are presented in table 2. The estimated heritabilities are consistent with previous studies (Lundeheim, 1987; Jörgensen & Andersen, 2000). The estimated genetic correlations between elbow and knee joint score were +0.5 in both breeds, which is somewhat higher than previous Swedish estimates (+0.4; Lundeheim, 1987). Jörgensen & Andersen (2000) estimated, on the basis of Danish station-tested boars that were radiologically examined, this correlation to +0.5 for Yorkshire and -0.2 for Landrace. The unfavourable genetic correlations between osteochondrosis scores and growth rate found are consistent with earlier estimates (growth rate during fattening period) (Lundeheim, 1987; Jörgensen & Andersen, 2000). Significant positive residual correlations were found between the two osteochondrosis scores.

Table 2. Estimated heritabilities (on the diagonal), genetic correlations (±SE, above diagonal) and residual correlations (±SE, below diagonal)

	Breed	1. Elbow	2. Knee	3. Growth	4. Lean
1. Elbow joint score	Landrace	**h^2=0.16**	+0.52±0.09	+0.25±0.09	+0.06±0.08
	Yorkshire	**h^2=0.21**	+0.46±0.09	+0.17±0.09	+0.03±0.09
2. Knee joint score	Landrace	+0.08±0.03	**h^2=0.28**	+0.39±0.07	+0.13±0.06
	Yorkshire	+0.19±0.03	**h^2=0.22**	+0.26±0.08	+0.04±0.07
3. Growth rate	Landrace	+0.03±0.03	-0.08±0.04	**h^2=0.39**	+0.23±0.06
	Yorkshire	+0.02±0.03	-0.02±0.03	**h^2=0.35**	-0.09±0.06
4. Lean meat percentage	Landrace	+0.03±0.04	-0.08±0.05	-0.35±0.07	**h^2=0.70**
	Yorkshire	0.00±0.04	-0.02±0.04	-0.31±0.05	**h^2=0.64**

Selection perspectives

Leg weakness syndrome involves both ethical aspects (pain and discomfort), as well as economical aspects (e.g. reduced production due to discomfort; too early culling of sows). Culling for, and selection against, inferior exterior of the pig is carried out at many stages in pig breeding schemes. Natural selection acts towards good constitution of the animals. Also the selection performed by the herdsmen in

the nucleus herds, based on their overall impression of the breeding animals, acts in the same direction. In most breeding programmes, information on constitution and leg weakness, recorded either in nucleus herds or at testing station is included in the breeding evaluation.

Leg weakness syndrome includes a number of sub-traits, of which osteochondrosis is one. The unfavourable genetic correlations between osteochondrosis and growth rate, found in a number of studies, explicitly says that osteochondrosis must be regarded in one or another way (=direct or indirect) in the breeding evaluation of pigs. In breeding programmes including carcass evaluation of tested pigs, scoring of osteochondrosis can easy be performed at very low extra cost. Radiological examination of live pigs would be a better alternative than post-mortem examination, but this technique needs higher input of labour. Anyhow, since the leg weakness syndrome involves a number of other component traits, exterior appraisal of the live pigs should also be included in the breeding evaluation.

To my knowledge, only Quality Genetics (Sweden) and Norsvin (Norway) are today including information on osteochondrosis, scored at the carcass evaluation, in their breeding evaluation.

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