

New breeding objectives for the Czech pig population

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The production and economic conditions of pig farmers throughout the world have changed, and additional functional traits and feed efficiency traits seem to play important roles in pig selection schemes (Sørensen 2015). Despite the increased accuracy of the breeding values of traits offered by genomic selection, these traits should be still weighted with “true” weights. The most important traits can be chosen by subjective decisions (Wallenbeck *et al.* 2015) and by objective approaches (Houška *et al.* 2010). The farmers’ preferences have been a useful source of information when comprehensive knowledge of the production system is not available and to evaluate the non-market traits (Biermann *et al.* 2016). The objectives of this study were to provide a survey of the traits that are currently defined as new breeding objectives by Czech pig breeders.

The breeding of pigs involved in the Czech breeding programme is currently based on the desired gain in the

given traits up to the year 2020. The traits were applied to the linear selection schemes of dam and sire breeds by weighting the appropriate traits with points (CPBA 2016). In the breeding program, 2 dam (Czech Large White (CLW) and Czech Landrace) and 3 sire (CLW, Duroc and Pietrein) pig breeds (lines) were included.

Questionnaires were submitted to the authorised breeders as the representatives of the Czech breeding programme. On average, 25 to 40 farms (comprising all from the nucleus to fattening farms and from purebred to crossbred pigs) were under the administration of one authorised organisation. Face-to-face interviews and instructions were conducted prior to questionnaire distribution. The list of potential traits was subdivided into 6 groups as described in Table 1, with the possibility of entering trait(s) not mentioned in any of the given groups of traits. There was no limit in the number of preferred traits they defined, but

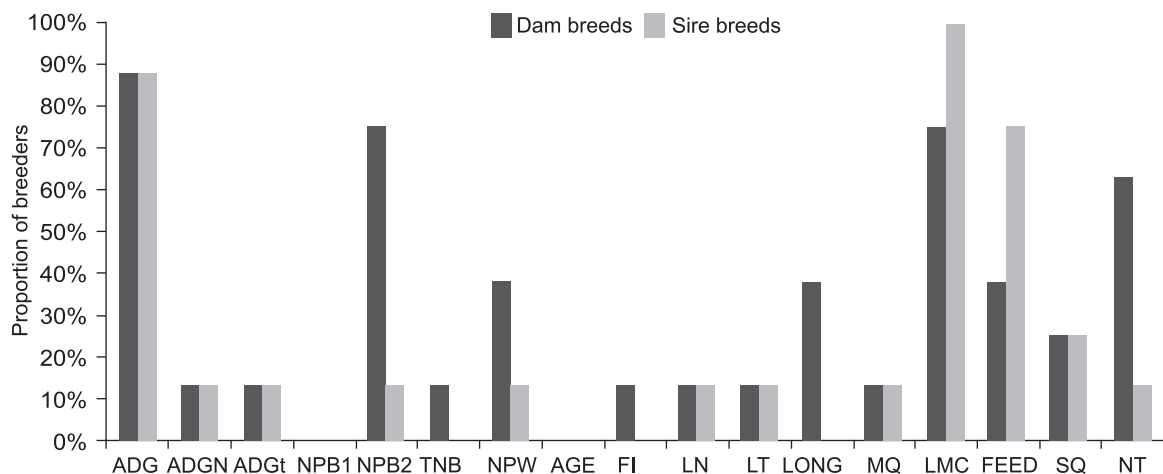


Fig. 1. Proportion of breeders considering the trait important. (Breeders ranked the trait preference points (weights) higher than zero.) Average daily gain (ADG); Average daily gain in nursery (ADGn); Average daily gain in testing (ADGt), Number of piglets born alive 1 (NBA1), Number of piglets born alive 2 (NBA2), Total number of piglets born (TNB), Number of piglets weaned (NPW), Age of sows at the first farrowing (AGE), Farrowing interval (FI), Losses of piglets in nursery (LN), Losses of pigs in testing (LT), Longevity of sows (LONG), Meat quality (MQ), Lean meat content (LMC), Feed conversion (FEED), Sperm quality (SQ), Number of teats (NT).

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the sum of all preference points (weights) was equal to 100 in both the dam and sire breeds. The data were collected anonymously.

All 21 of the sent questionnaires were returned and used for the analysis. The most preferred traits and the preference points (weights) given to the evaluated traits were analysed. The SAS® statistical package (SAS Institute Inc., 2008) was utilised for the descriptive statistics and regression analyses. A normal distribution of the residuals of all

variables (traits) was found using the Shapiro-Wilk test at the 95% level of significance with the exception of non-preferred traits (zero preference was specified by all breeders). The breeding objectives for pigs were calculated based on the average weights given to the group of traits (Table 1).

Table 1. The list of potential traits in dam and sire breeds submitted to breeders

Group of trait	Trait (abbreviation)	Description	Unit
Growth	Average daily gain (ADG)	Growth intensity from birth to end of performance testing (approximately 5 months of age)	g/d
	Average daily gain in nursery (ADGn)	Growth intensity from birth to the beginning of performance testing (at approximately 80 d of age)	g/d
	Average daily gain in testing (ADGt)	Growth intensity during the performance testing	g/d
Reproduction	Number of piglets born alive 1 (NBA1)	Number of piglets born alive at the first farrowing of a sow	piglets/litter/sow
	Number of piglets born alive 2 (NBA2)	Number of piglets born alive at the second and higher farrowing of a sow	piglets/litter/sow
	Total number of piglets born (TNB)	All piglets born as fully developed (alive and died) per litter	piglets/litter/sow
	Number of piglets weaned (NPW)	Number piglets weaned per litter and sow	piglets/litter/sow
	Age of sows at the first farrowing (AGE)	Age of sow at first farrowing	d
	Farrowing interval (FI)	Average time period between two subsequent farrowings of a sow	d
Health	Losses of piglets in nursery (LN)	Proportion of piglets died and culled from birth to the beginning of performance testing	%
	Losses of pigs in testing (LT)	Proportion of piglets died and culled during the performance testing	%
	Longevity of sows (LONG)	Length of a productive lifetime of sows from the first farrowing to culling	d
Carcass	Meat quality (MQ)	Sensory pork quality traits (nutritional, sensory and technological quality) of carcass meat	e.g., pH 1, pH 24, drip losses, colour, marbling
	Lean meat content (LMC)	Proportion of meat in carcass body measured by ultrasound	%
Feed efficiency	Feed conversion (FEED)	Amount of feed consumed per kg of weight gain of a growing pig	kg feed/kg weight
Others	Sperm quality (SQ)	Semen characteristics considering the semen volume, sperm concentration and quality in the ejaculate	e.g., ml of sperm, 10 ³ sperm/mm ³
	Number of teats (NT)	Total number of teats per pig up to 10 d of age	teats/pig

Table 2. Basic statistics for preference points (weights) of traits in dam and sire breeds

Group of trait	Trait ¹	Dam breeds				Sire breeds			
		Current ²	Mean	Modus	v (%) ³	Current ²	Mean	Modus	v (%) ³
Growth	ADG	40.0	26.9 ^a	30	44.4	50.0	38.1	50	44.3
	ADGn	0	1.3	0	168.8	0	2.5	0	148.4
	ADGt	0	2.5	0	184.7	0	5.0	0	183.3
Reproduction	NBA1	0	0.0	0	-	0	0.0	0	-
	NBA2	55.0	32.5 ^a	50	66.8	0	1.3	0	209.9
	TNB	0	5.6	0	255.4	0	0.0	0	-
	NPW	0	12.5	0	169.7	0	1.3	0	165.4
	AGE	0	0.0	0	-	0	0.0	0	-
	FI	0	1.3	0	216.4	0	0.0	0	-
Health	LN	0	0.6	0	254.3	0	0.6	0	141.5
	LT	0	0.6	0	277.8	0	0.6	0	147.2
	LONG	0	1.9	0	138.0	0	0.0	0	-
Carcass	MQ	0	0.6	0	282.8	0	2.5	0	236.6
	LMC	5.0	6.1	5	80.7	50.0	38.1 ^a	40	25.8
Feed efficiency	FEED	0	4.4	0	166.6	0	8.1 ^a	5	98.3
Others	SQ	0	0.9	0	198.4	0	1.3	0	220.0
	NT	0	2.3 ^a	5	102.7	0	0.6	0	262.7

¹The traits are described in Table 1. ²Weighting of the traits in the current Czech pig breeding programme (CPBA 2016). ³Coefficient of variation. ^aPreference points differed from weighting of traits in the current breeding objective at the 95% level of significance ($P < 0.05$).

When considering the general preferences among traits (Fig. 1), all breeders selected from the list of traits, although they were given the possibility of adding additional (not mentioned) traits. Simple descriptive statistics for preference points (weights) of analysed traits and weighting the traits in the current breeding programme (CPBA 2016) are displayed in Table 2. Contentment with the current breeding objectives was evident from their preferences. The Pearson correlations between the trait preferences ranged to a higher extent from high positive (0.996 between LT and LN) and high negative (-0.751 between ADGt and ADG) to almost no correlation (between NT and NPW calculated in sire breeds). Among all potential traits in dam breeds, the highest positive correlations were found for the current breeding objectives (ADG with NBA2 and LMC) and newly preferred traits (SQ with NT, LN with LT, and ADGt with SQ and NT). Logically, the correlations among the alternative traits (ADG with ADGn and ADGt and NBA2 with NPW) were almost negative. Similar characteristics were found when weighting the traits in the sire breeds.

In the pig selection schemes used for dam and sire breeds, the highest weightings are usually given to reproduction and growth traits. This preference was confirmed in our study when 50 and 35 points were specified by most of the breeders for NBA2 and ADG, respectively. Litter size was also highly weighted (42 points) in the Danish sow population (Sørensen 2015). The leading position of reproduction for sow breeding was confirmed by Quinton *et al.* (2006), with litter size represented by 49 to 83 points in a complex of five sow traits. However, when considering sow herds with the integrated fattening system, the importance of reproduction was nearly halved (10 to 38

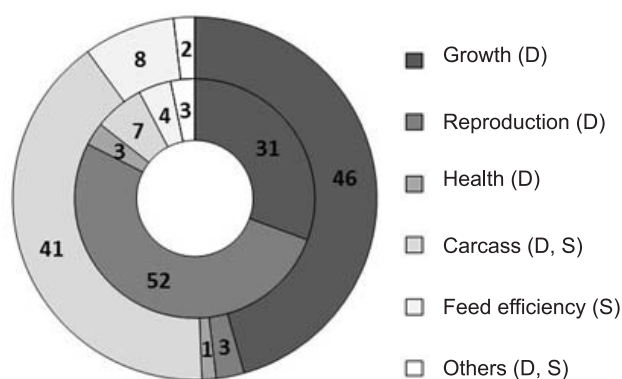


Fig. 2. Preference points for the group of traits in dam (inside) and sire breeds (outside). The group of traits in which actual preference points differed significantly ($P < 0.05$) from the weighting in the current breeding objectives were labelled D (dam breeds) and S (sire breeds).

points; Quinton *et al.* 2006, Houška *et al.* 2010). In this case, the growth traits of pigs (e.g., weaning weight and ADG) became more important (50 to 79 points in Quinton *et al.* 2006), which is closer to the current breeding objectives and the actual preferences of breeders for dam breeds in Czech conditions (Table 2; Fig. 2).

The second option was that breeders give less emphasis to leading traits to make space for sow longevity, feed efficiency (range from 5 to 27 points; Sørensen 2015; Fig. 2 in our study), meat quality (Biermann *et al.* 2016) or maternal and sire ability expressed in the number of teats and sperm quality (Sørensen 2015; our study). For

comparison, the number of teats (NT), which was considered by breeders as the new breeding objective in dam breeds in our study, was not preferred in the sow breeds in Denmark (Sørensen 2015). Only organic farmers expected this trait to be included as the selection criterion in the Danish pig population.

An economically optimal emphasis on the semen quality of boars of dam breeds in AI centres was previously reported by Wolf and Smital (2009). In some studies (e.g., Qunton *et al.* 2006), the age of gilts at puberty was included to measure the importance of the growth intensity of gilts. The ability of gilts to remain pregnant was omitted in this case. The age of gilts at first farrowing (AGE) was considered in our survey to measure these traits jointly. However, breeders probably did not perceive this trait as problematic when providing weightings. Instead, other reproductive traits (NPW and FI; Table 2) seem to be important. Therefore, in dam breeds, genetic parameters for some functional traits (FI, NT, and LONG) were recently evaluated (Krupa *et al.* 2016) to be potentially defined as breeding objectives for the local pig population. Functional and feed efficiency traits as breeding objectives should be evaluated to make space for the genomic data incorporation into the breeding programme in the future. In addition to genetic progress, the overall management conditions (e.g., feeding to improve growth performance and gas emission of pigs; Hossain *et al.* 2015, Lee *et al.* 2016) should be aimed in favour of the efficiency and sustainability of pig farming.

SUMMARY

The survey was carried out to determine whether the general trends in pig selection schemes are reflected by the local authorised breeders. The number of teats and feed efficiency are expected as new breeding objectives in dam and sire breeds, respectively. Alternatively, some functional traits and sperm quality should be considered for the local pig population. The presented methodology can be widely implicated in other pig populations until the detailed production and economic data for the whole integrated production system is available.

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