BREEDING FOR IMPROVED WELFARE OF PIGS, IS IT TECHNICALLY ACHIEVABLE IN PRACTICE?

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INTRODUCTION

During the process of domestication pigs have been gradually adapted to man and to the environmental conditions man provides. This resulted in clear differences between the wild boar and the various modern pig breeds that are currently used for pork production, not only for exterior and production related traits, but also for behavioural traits. Domesticated pigs are, for example, generally calmer and less sensitive to changes in their environment (e.g. Špinka *et al.*, 2000; Price, 1999). It is usually assumed that domestication has resulted in pigs that are better able to cope with pig husbandry systems and, therefore, have a better welfare than wild pigs would have under the same conditions (Price, 1999).

Nevertheless, there is increasing concern about welfare of pigs kept in modern production systems. Possible reasons are: 1) increased (costs) efficiency of pig production which often has led to intensive husbandry conditions that cause extra stress to the pigs, 2) decreased capabilities of pigs to cope with their environment, which might be related to a strong genetic selection for production, 3) an increased ethical consciousness in our society regarding pig welfare and 4) an increased availability of information about pig welfare. With respect to the first two reasons we may argue that at present the process of domestication and adaptation is not fast and not purposive enough to keep pace with the intensification of the production process. The question to be addressed in this paper is, therefore, how in practice we could select purposively for a better welfare.

FROM WELFARE TO WELL-DEFINED TRAITS

According to Wiepkema (1987) we assume that welfare is a matter of feelings resulting from the differences between the animal's needs and the extent to which those needs are currently satisfied. Bracke *et al.* (1999) defined the following needs of pigs: ingestion (including the need for food and water), rest, social contact, reproduction-related needs (sex, nest building and maternal care), kinesis, exploration (including exploration of novelty, foraging and play), body care, evacuation, thermal comfort, respiration, health (including no injuries or pain) and safety (including no danger and no aggression). The degree to which a need can be satisfied, and thus contributes to total welfare, depends on its level, on the husbandry conditions and on the coping abilities of the pigs. In order to derive well-defined welfare traits, a conceptual framework has been developed that describes welfare with regard to each need as a curvilinear function of the respective husbandry conditions (De Greef *et al.*, 2002). Because feelings, and thus welfare, can not be recorded directly it is assumed that welfare can be deduced from

behavioural and physiological responses of pigs to changing husbandry conditions. Briefly, the basic idea of the conceptual framework is that a zone of environmental conditions can be identified in which pigs show "normal" behavioural or physiological reactions to cope with variation in the environment (called zone C1 to C4; within this zone C2 and C3 represent the boundaries of the optimum zone), and two adjacent zones which lead to "abnormal" behavioural or physiological reactions (zones C0 to C1 and C4 to C5). Examples of such abnormal, but often functional, reactions are an increased respiration and heart rate, shivering, fever, stereotypic behaviour, high levels of aggression, low feed intake, hyper-activity, apathy, etc. The positions of the transition points between those welfare zones (C-values) represent animal characteristics that probably show genetic variation. C-values are proposed here as traits to be used in breeding programmes addressing welfare.

DEFINING THE BREEDING GOAL

Total welfare of a pig can be defined as the sum of the feelings resulting from the degree of satisfaction of each need. Because such feelings cannot be measured directly, it is not possible to obtain the phenotypic and genetic parameters which are necessary for breeding goal traits. We, therefore, propose to use C-values as breeding goal traits. If, by genetic selection, the zone C1-C4 could be extended by moving C1 and/or C4, pigs are better able to cope in a normal way with unfavourable (or unfamiliar) conditions and are, therefore, assumed to have a better welfare. Measuring C-values is not an easy task either since it theoretically requires recording behavioural and physiological responses to changing environmental conditions for all needs. However, occasional data collection, starting with those needs that have the highest priority, may be sufficient for the estimation of phenotypic and genetic parameters.

If C-values cannot be measured, the breeding goal for pig welfare has to be defined at a level closer to traits we can readily observe. For that purpose we classify the animal characteristics relevant for welfare into three main groups:

1) Temperament, which includes traits like aggressiveness, activity, curiosity and docility,
2) Stress resistance, including fearfulness, nervousness and flexibility,
3) Robustness, including bodily soundness and fitness, and disease resistance.

Each of these three groups should still be defined more precisely in order to estimate the required genetic parameters and to implement them in a breeding goal. Nevertheless, intuitively we know quite well what is meant with temperament, stress resistance and robustness, and several possibilities are available to test or measure various aspects of each of these three groups of welfare characteristics.

INFORMATION TO BASE SELECTION ON

To select the best animals, relevant information should be obtained routinely from each potential breeding animal and/or its relatives. Theoretically, it would be possible to measure C-values routinely, but this seems not feasible for a breeding organisation. Thus, relevant behavioural tests or correlated traits that can be performed relatively easily or measured routinely should be searched for. Assessing motivation of animals to change their situation is an entry that is closely related to the applied welfare definition and breeding goal. In test stations operant conditioning tests (OCTs) could be an interesting option to obtain information regarding the satisfaction of certain needs. Potential breeding pigs could thus be tested for their motivation to exchange a certain (bad or common) environmental condition for another (better)

one (see e.g. Bergeron *et al.*, 2000). Pigs with the lowest motivation to change environment feel apparently best and those pigs should then be selected for breeding purposes. Examples of some other traits, correlated with C-values, that can be obtained with simple behavioural tests were recently published by Van Erp-van der Kooij *et al.* (2002). They suggested that they could measure fear, activity and exploration or dominance in piglets by combining results from a 'backtest', a 'human approach test', an 'open door test' and a 'novel object test'. They found consistencies in behaviour of piglets over time and across situations.
There might, however, be various reasons or situations in which OCTs or other behavioural tests are not possible or useful. For example, pigs probably cannot notice a difference between areas with high and low densities of harmful micro-organisms because the possible negative feelings (of fever, sickness) emerge only after some (incubation) time. Then, under normal conditions, coping problems (like incidences of stereotypies, diseases, leg problems and injuries) and/or other relevant traits (e.g. saliva cortisol levels, longevity and even production traits) could be recorded routinely (also in on-the-farm tests) and used as selection index information. In current pig breeding programs there might be already selection on some of these traits, but mainly for economic reasons.

DISCUSSION

Genetic selection for improved welfare of pigs seems technically achievable. There is evidence that various aspects of welfare are heritable, not only in pigs (Hemsworth *et al.* 1990), but also in e.g. White Leghorns (Kjaer *et al.*, 2001) and mice (Schwaibold and Pillay, 2001). The main challenge is probably to obtain well-defined and easily measurable welfare traits. By defining the breeding goal traits as the positions of the transition points between welfare zones, pigs can be bred which are better able to cope with more extreme (or unfamiliar) conditions in a normal way. This way of adaptation resembles the domestication process and can, therefore, probably be interpreted as an accelerated way of domestication. Thanks to increasing ethological research, various relatively simple and potentially valuable tests are and become available, of which the results can probably be used in a breeding program for pig welfare.
For various reasons more research is recommended before the proposed selection for a better pig welfare should be applied in practice. First, the presented concept and the various tests have to be validated under practical conditions, and priorities have to be set among the many pig needs, and between those needs and the (re)production traits. Second, possible consequences of selection for better welfare have to be considered. Because there is evidence that production traits are slightly negatively correlated genetically with some welfare traits (e.g. Rauw *et al.*, 1998), a possible genetic gain in welfare may result in a reduced or negative genetic gain in (re)production traits. It could be imagined, for example, that selection for sows that don't show nest-building behaviour under conditions with no nest-building material available, leads to reduced oestrus signs, which is undesired for economic reasons. Also other economic aspects, such as costs of testing, should be investigated. If there are no or just small economic benefits of selection for a better welfare of pigs, pig breeding organisations will only consider selection for welfare if selection costs are low or if it improves their public image a lot.
Further, selection for pigs which are better able to cope with extreme environments regarding their needs, should not lead to a reduced attention for optimising pig husbandry conditions. It is, however, inevitable that pigs encounter situations in their lives that affect their welfare (e.g.

moving to another pen, transport, infectious diseases). Pigs that are genetically better able to cope with such situations then have less troubles compared to their unselected congeners. This should also be an important ethical argument in favour of genetic selection for welfare in pigs.

CONCLUSIONS

Several aspects of welfare of pigs are genetically determined and could, therefore, be changed by genetic selection. To find well-defined welfare traits that could be implemented in a breeding program, a conceptual framework has been used, identifying a zone of environmental conditions in which pigs show normal behavioural or physiological reactions to cope with their environment, and two adjacent zones which lead to abnormal reactions. The positions of the transition points between those zones are proposed as breeding goal traits in order to breed for pigs which are better able to cope with unfavourable (or unfamiliar) conditions in a normal way. Operant conditioning tests and some simple behavioural tests are proposed to be carried out routinely in test stations to obtain selection information. On the farm, routinely collected information on incidences of stereotypies and veterinary treatments, aggression, certain hormone levels, etc. could be combined in a selection index.

Breeding for improved welfare of pigs seems technically achievable, but more research is necessary to test the usefulness of the concept and the various behavioural tests, to predict possible undesired side effects in practice and to study the economic aspects.

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