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Risk Assessment Methodology and Identification of Animal-based Indicators to Assess Animal Welfare at Farm Level

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Introduction

The Treaty of Amsterdam (EU, 1997), through its Protocol on the Protection and Welfare of Animals, obliges the European Institutions to pay full regard to animal welfare requirements when formulating and implementing European Union (EU) legislation. The key area of action of the Community Action Plan on the Protection and Welfare of Animals (2006-2010) (EC, 2005) is to promote policies for high animal welfare standards in the EU and at international level. The introduction of standardised animal welfare indicators was identified as one of the main areas of action, together with the upgrading of existing minimum standards for animal protection and welfare in line with new scientific evidence and socio-economic assessments. In this context, the future Strategy on Animal Health for 2007-2013 (EC, 2006) will address the promotion of farm practices which comply with animal welfare standards.

The main mission of the European Food Safety Authority (EFSA) is to provide comprehensive scientific and technical support for the Community legislation on the safety and other aspects of the whole food and feed supply chain, including animal health and animal welfare (EC, 2002). In response to questions posed by various European Commission services, the European Parliament, EU Member States or as a result of self-mandates, EFSA provides independent information regarding risks associated with food and feed, plant health, environment, animal health and animal welfare. EFSA follows, whenever possible, a Risk Assessment (RA) approach. Another task of the Authority is to promote and coordinate the development of harmonised risk assessment methodologies in the above-mentioned fields.

Since its creation in 2003, the EFSA Panel on Animal Health and Animal Welfare (AHAW) has adopted a total of 36 Scientific Opinions on animal welfare, dealing with among others laboratory animals, stunning and killing methods, animal transport, the welfare of calves, the welfare risks of the import of captive birds, the welfare of pigs, fish welfare, welfare aspects of fish stunning and killing, dairy cow welfare, genetic selection of broilers and harvesting feathers from live geese (Ribó et al., 2009; 2010).
The use of animal-based measures to assess animal welfare is relatively new (Blokhuis et al., 2003). Several research projects have been working on the development of animal-based measures and such measures are also considered in various assessment schemes. The outcomes of the Welfare Quality® Project provide the methodology for assessing animal welfare and a standardised way to assign farms a welfare grade from poor to excellent (Blokhuis et al., 2010). The welfare assessment protocols (Welfare Quality®, 2009a,b,c) give the procedures and requirements for the assessment of welfare in cattle, pigs and poultry according to this methodology.

This paper reviews the work done by the EFSA Panel on AHAW on the development and use of the risk assessment approach for the formulation of Scientific Opinions on animal welfare. The approach for assessment of animal welfare in the EU-supported project Welfare Quality® is also described. Finally, the EFSA’s current work on the development of animal-based welfare indicators at farm level, as presented in the Welfare Quality® assessment protocols, and in the light of the outcomes of the EFSA Scientific Opinions on animal welfare, is also presented.

**EFSA Approach on Animal Welfare Risk Assessment (AWRA)**

Animal welfare is nowadays a real concern and there is common agreement that standards for animal welfare assessment and a reliable monitoring system need to be established. The main constraint on the development of an overall welfare assessment is that some welfare aspects are not easily assessed in an objective way, either qualitatively or quantitatively (Müller-Graf et al., 2008; Blokhuis et al., 2008).

The Risk Assessment (RA) methodology has been commonly used to describe and quantify the risks of introduction of infections, tox-i-infections or residues of veterinary medicines, or risks resulting from the import of live animals and their products in the animal food chain (Müller-Graf et al., 2008), for which specific international guidelines - produced by the World Health Organization (WHO, 1999) and by the World Organization for Animal Health (OIE, 2004) - have become available. For Animal Welfare-related Risk Assessment (AWRA) purposes, OIE and Codex Alimentarius Commission (CAC, 2001; 2002) definitions have been considered in the EFSA Scientific Opinions on animal welfare (www.efsa.europa.eu).

The Risk Assessment approach applied to animal welfare is a methodology under ongoing development. The major advantage of RA methodology is transparency, since scientific data are provided through documented risk pathways, assumptions are defined, and the associated level of scientific evidence is reported. Due to the limited amount of quantitative data on the adverse effects of hazards on animal welfare, a qualitative or semi-quantitative risk assessment has been developed, mainly based on expert opinion.

The AWRA approach followed by EFSA has evolved consistently since the first EFSA Scientific Opinions (EFSA, 2004a, b), when the RA was limited to the listing of hazards which may compromise animal welfare and the definition of risk pathways. Further developments in the AWRA methodology included estimation of the magnitude of adverse effects (depending on their severity and duration) associated with the presence of the hazard and the probability of its occurrence in a specific animal population, which allowed the calculation of a risk estimate. Table 51.1 shows the animal welfare scientific opinions adopted since 2003 and the evolution in RA methodology. In the recently adopted scientific opinions on dairy cow welfare (EFSA, 2009b, c, d, e, f), conclusions and recommendations were based on both the data presented in the scientific report and the outcomes of the semi-quantitative RA approach (Ribó and Serratosa, 2009).

The current AWRA approach used to rank the risk estimates and hazard magnitudes does not give a precise numerical estimate of the risk attributed to certain hazards. It helps to identify major risks affecting each of the animal categories and may be used to rank risk factors within a certain animal population (Figure 51.1). This allows the identification of priority areas of intervention (risk management) and issues that need to be further clarified through future research (recommendations for future research) (Müller-Graf, et al., 2008; Ribó et al., 2008; Candiani et al., 2009).

Mandates requesting scientific assessments on animal welfare received by the EFSA included very broad ques-

<table>
<thead>
<tr>
<th>AHAW Opinion on Animal welfare</th>
<th>Year</th>
<th>RA</th>
<th>HI</th>
<th>Qual. RA</th>
<th>Semi-Qt RA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Welfare of animals during transport</td>
<td>2004</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Welfare aspects of various systems of keeping laying hens</td>
<td>2004</td>
<td>-</td>
<td>X</td>
<td>X</td>
<td>-</td>
</tr>
<tr>
<td>Impact of the current housing and husbandry systems on the health and welfare of farmed domestic rabbits</td>
<td>2005</td>
<td>-</td>
<td>X</td>
<td>X</td>
<td>-</td>
</tr>
<tr>
<td>Welfare of weaners and rearing pigs: effects of different space allowances and floor types</td>
<td>2005</td>
<td>-</td>
<td>X</td>
<td>X</td>
<td>-</td>
</tr>
<tr>
<td>Biology and welfare of animals used for experimental and other scientific purposes</td>
<td>2005</td>
<td>-</td>
<td>X</td>
<td>X</td>
<td>-</td>
</tr>
<tr>
<td>Welfare aspects of the main systems of stunning and killing applied to commercially farmed deer, goats, rabbits, ostriches, ducks, geese and quail</td>
<td>2006</td>
<td>-</td>
<td>X</td>
<td>X</td>
<td>-</td>
</tr>
<tr>
<td>The risks of poor welfare in intensive calf farming systems</td>
<td>2006</td>
<td>X</td>
<td>X</td>
<td>-</td>
<td>X</td>
</tr>
<tr>
<td>Animal health and welfare risks associated with the import of wild birds other than poultry into the European Union</td>
<td>2006</td>
<td>X</td>
<td>X</td>
<td>-</td>
<td>X</td>
</tr>
<tr>
<td>Welfare of pigs (Sows and boars, Fattening pigs and Tail biting) (3 scientific opinions)</td>
<td>2007</td>
<td>X</td>
<td>X</td>
<td>-</td>
<td>X</td>
</tr>
<tr>
<td>Stunning and killing methods for seals</td>
<td>2007</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>-</td>
</tr>
<tr>
<td>Welfare of fish (Salmon, Trout, Eel, Sea Bass-Sea Bream, Carp) (5 scientific opinions)</td>
<td>2008</td>
<td>X</td>
<td>X</td>
<td>-</td>
<td>X</td>
</tr>
<tr>
<td>Stunning and killing methods of fish (Salmon, Trout, Eel, Sea Bass-Sea Bream, Carp, Turbot and Tuna) (7 scientific opinions)</td>
<td>2009</td>
<td>X</td>
<td>X</td>
<td>-</td>
<td>X</td>
</tr>
<tr>
<td>Assessment of Dairy Cow Welfare (Leg and locomotion, udder, metabolic and reproductive and behaviour) (5 SOs)</td>
<td>2009</td>
<td>X</td>
<td>X</td>
<td>-</td>
<td>X</td>
</tr>
</tbody>
</table>

HI = hazard identification; Qual RA: qualitative RA; Semi-Qt RA: semi-quantitative RA;

Figure 51.1. Risk estimate and magnitude of the adverse effect of hazards affecting dairy cows (EFSA, 2009b).
tions (i.e. welfare of pigs, welfare of fish, welfare of dairy cows). The quantitative assessment of welfare is therefore a problem, as quantitative data are only available for certain animal categories and hazards and not for all. Future mandates on animal welfare should include narrow and precise risk questions in terms of the welfare components to be considered and animal categories, life stages and husbandry systems, in order to allow more precise and concise AWRA to be carried out (Algers, 2009).

In December 2005, the EFSA Scientific Colloquium ‘Principles of Risk Assessment of Food Producing Animals: Current and Future Approaches’ was held in Parma to discuss the state of the art regarding risk assessment in food-producing animals (EFSA, 2006). The main objectives of this Scientific Colloquium were to have an open scientific debate on how to conduct risk assessments (i.e. on essential components of RA for animal health and welfare) and to explore options for making guidelines in these areas. The risk assessment methodology, the need for reliable data, the need for setting up data collection systems, ways to identify the necessary expertise and other resource requirements and the best options to communicate the results of a risk assessment were discussed.

Methodological aspects of animal welfare risk assessment were also debated, notably: i) how to include in such RA exercises the different aspects of animal welfare (including health); ii) how the concept ‘hazard’ should be interpreted in this context, and iii) the need to identify parameters (‘indicators’) for measuring animal welfare that are specific for animal species, breed, age, physiological state and production system. In relation to the data needs, it was agreed that to assess animal welfare appropriately, it should be measured directly in a quantitative way on the animals (EFSA, 2006).

One of the main conclusions of the Colloquium was that although different approaches exist for risk assessment related to food microbiology (WHO, 1999) and animal health issues (OIE, 2004 a,b), “no specific standardized methodology exists in the field of the Animal Welfare Risk Assessment”. The Colloquium recommended that the EFSA consider developing guidelines in this area and pointed out that it would be worthwhile setting up a working group to further investigate methodologies for risk assessment of animal welfare (EFSA, 2006).

Following this recommendation, an EFSA workshop on ‘RA methodology in Animal Welfare’ was held in Vienna in June 2007, during which past and current experiences in the development of risk assessments in animal welfare were reviewed, with the final objective of identifying gaps in the current AWRA methodology and options for its further improvement and development. Main issues discussed during the workshop were i) the use and validation of expert opinion, ii) the interaction between hazards and their cumulative adverse effect on the animal, and iii) possible consideration of the positive effects of factors (welfare promoters) on animal welfare. The workshop concluded that the use of the risk assessment approach for the purposes of formulating scientific opinions on animal welfare should be considered wherever appropriate, and that a systematic AWRA methodology would increase the validity and reliability of animal welfare assessments.

In September 2007, EFSA launched a self-mandate for the development of an EFSA Guidance document on risk assessment for animal welfare. This Guidance should define a comprehensive harmonised methodology to evaluate risks in animal welfare, taking into consideration the various procedures, management and housing systems and the different animal welfare issues, with reference to the methodologies followed in the previous EFSA Scientific Opinions on various species. The methodology should include terminology for the assessment of risks, defined strictly in terms of animal welfare. The defined methodology for assessing risks in animal welfare should take into account and adapt current risk assessment methodologies, for example those for animal diseases and food safety, and also the complex range of measurable welfare outcomes. The guidance document should concisely define the generic approach for working groups addressing specific areas of assessment of risks in AW. The development of a Risk Assessment methodology applied to animal welfare may support the scientific prioritisation of welfare issues for the further implementation of animal welfare standards. The EFSA Guidance on risk assessment for animal welfare is foreseen to be released by 2011.
Animal Welfare Assessment Protocols

Quantification of how animal production processes affect animal welfare is essential to provide transparency to all stakeholders (public, industry, government, etc.) and to implement and evaluate appropriate improvement strategies. It is also crucial to provide quantitative input to AWRA processes. This requires on-farm standardised assessment systems to determine the welfare status of the animals, as well as a standard way of converting science-based, welfare-related measures into information that is applicable and easily understood by stakeholders (Blokhuis et al., 2003, 2008, 2010).

The EU-funded Welfare Quality® project aimed to deliver such on-farm welfare assessment and information systems for several species. In the Welfare Quality® system, the welfare assessment related to a specific animal unit is based on the calculation of welfare scores from the information collected on that unit. The published assessment protocols (Welfare Quality®, 2009a,b,c) contain standardised descriptions of the measures relevant for the species and an explanation of what data should be collected, and in what way. The protocols address animals at different stages of their lives and/or in various housing systems. It can cover rearing, production, or the end of life of the animal. At the moment, there are no measures that are carried out during the actual transport process (Welfare Quality®, 2009).

The focus within the Welfare Quality® project was to measure parameters at the animal level that reflect the actual welfare state of the animals. Such animal-based measures (e.g. related to health and behaviour) include the effects of variation in farm management systems as well as the effects of specific system-animal interactions. Obviously, the set of measures to assess welfare must address all important welfare criteria. Welfare Quality® scientists identified four main welfare principles, divided into 12 independent welfare criteria (see Table 51.2) (Keeling and Veissier, 2005; Veissier and Evans, 2007; Blokhuis et al., 2010). In general, the principles and criteria chosen are relevant for different species and throughout an animal’s entire lifespan.

Whenever possible, the final Welfare Quality® assessment measures have been evaluated with respect to their validity (does the measure reflect some aspect of the actual welfare of animals), reliability (acceptable inter- and intra-observer repeatability and robustness to external factors, e.g. time of day or weather conditions) and their practical feasibility. A further important aspect of this data collection is that value judgements are mini-

<table>
<thead>
<tr>
<th>Welfare principle</th>
<th>Welfare criteria</th>
<th>Meaning</th>
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<tbody>
<tr>
<td>Good feeding</td>
<td>1. Absence of prolonged hunger</td>
<td>Animals should not suffer from prolonged hunger</td>
</tr>
<tr>
<td></td>
<td>2. Absence of prolonged thirst</td>
<td>Animals should not suffer from prolonged thirst</td>
</tr>
<tr>
<td>Good housing</td>
<td>3. Comfort around resting</td>
<td>Animals should be comfortable, especially within their lying areas</td>
</tr>
<tr>
<td></td>
<td>4. Thermal comfort</td>
<td>Animals should be in a good thermal environment</td>
</tr>
<tr>
<td></td>
<td>5. Ease of movement</td>
<td>Animals should be able to move around freely</td>
</tr>
<tr>
<td>Good health</td>
<td>6. Absence of injuries</td>
<td>Animals should not be physically injured</td>
</tr>
<tr>
<td></td>
<td>7. Absence of disease</td>
<td>Animals should be free of disease</td>
</tr>
<tr>
<td></td>
<td>8. Absence of pain induced by management procedures</td>
<td>Animals should not suffer from pain induced by inappropriate management</td>
</tr>
<tr>
<td>Appropriate behaviour</td>
<td>9. Expression of social behaviours</td>
<td>Animals should be allowed to express natural, non-harmful, social behaviour</td>
</tr>
<tr>
<td></td>
<td>10. Expression of other behaviours</td>
<td>Animals should have the possibility of expressing other intuitively desirable natural behaviours, such as exploration and play</td>
</tr>
<tr>
<td></td>
<td>11. Good humane animal relationship</td>
<td>Good humane animal relationships are beneficial to the welfare of animals</td>
</tr>
<tr>
<td></td>
<td>12. Positive emotional state</td>
<td>Animals should not experience negative emotions such as fear, distress, frustration or apathy</td>
</tr>
</tbody>
</table>
mised through appropriate training of assessors. For some criteria, it has been necessary to include resource-based measures (e.g. details of water provision) or management-based measures (e.g. breeding strategies and health plans) because no animal-based measure was available or sufficiently sensitive or satisfactory in terms of validity, reliability, or feasibility.

Once all the measures have been performed on an animal unit, a standardised procedure is followed to produce an overall assessment of animal welfare on that particular unit: First, the data collected (i.e. values obtained for the different measures on the animal unit) are combined to calculate criterion scores; then criterion scores are combined to calculate principle scores; and finally the animal unit is assigned to one welfare category according to the principle scores it obtained. Four welfare categories have been defined:

- **Excellent:** The welfare of the animals is of the highest level.
- **Enhanced:** The welfare of the animals is good.
- **Acceptable:** The welfare of the animals is above or meets minimal requirements.
- **Not classified:** The welfare of the animals is low and considered unacceptable.

Welfare assessment protocols are structured to present: 1) the measures collected on farms, 2) the measures collected at slaughter that apply to welfare assessment on-farm, 3) the calculation of scores needed for overall assessment, and 4) the measures collected at slaughter that apply to assessment of the welfare of the animals during transport and slaughter.

It should be emphasised that scientific research continues to refine measures and assessment methodologies. It is therefore essential to exchange knowledge between ongoing research projects in order to prevent duplication of work and to update the Welfare Quality® protocols in the light of new knowledge. To facilitate this, former partners in the Welfare Quality® project have established the Welfare Quality Network (www.welfarequalitynetwork.net). The collaboration agreement underlying this Network defines the following main areas of activity:

- Management of the system and support instruments (including training in their use by Network partners)
- Maintenance of the system
- Upgrading the system
- Promoting stakeholder involvement
- Prioritising and facilitating research

### Evaluation of Animal-based Measures to Assess the Welfare of Animals

EFSA has been explicitly requested by the European Commission to include measurable welfare indicators, whenever possible, in the conclusions and recommendations of the future EFSA Scientific Opinions on animal welfare. Within this context, EFSA has been recently requested to identify how animal-based measures could be used to ensure the fulfilment of the recommendations of the EFSA Scientific Opinions on animal welfare and how the assessment protocols suggested by the Welfare Quality® project cover the main hazards identified in EFSA scientific Opinions and vice-versa. In addition, possible relevant animal welfare issues that cannot be assessed using animal-based measures and the main factors in the various husbandry systems which have been scientifically proven to have negative effects on the welfare of animals should be identified and listed.

This work will be based on, and linked to, the risk assessments of the previous EFSA Scientific Opinions on animal welfare. In 2009, the Animal Health and Welfare Panel of EFSA released a Scientific Report on the effects of farming systems on dairy cow welfare and disease (EFSA, 2009a), and a Scientific Opinion on an overall assessment of the effects of farming systems on dairy cow welfare and disease (EFSA, 2009b). Therefore, EFSA has been requested to start evaluation of the welfare indicators for dairy cows, which should be followed by an evaluation of indicators for pigs and poultry, as these species have also been considered by the Welfare Quality® assessment protocols. The Scientific Opinion on the use of animal-based indicators for the welfare of dairy cows should be released by summer 2011.

The outcomes of the risk assessment methodology together with the identification of scientific indicators for
welfare will be useful for the establishment and implementation of welfare control and monitoring plans at farm level, detection of poor welfare situations and application of improvement measures. Harmonised reliable indicators for the welfare of food-producing animals could also be used by the European Commission for possible future legislation establishing surveillance systems at Member State level.

In Conclusion

Welfare research provides the scientific basis for reliable and feasible welfare assessment systems and standardised tools for the conversion of welfare measures into accessible and understandable information. EU legislation based on scientific evidence and systematic risk assessment is important to support the further improvement of animal welfare in Europe.

There is an important role for the foreseen European Network of Centres of Excellence on Animal Welfare, to harmonise, update, manage and implement standardised systems for welfare assessment. The results of the implementation of the assessment systems should be used to take appropriate measures to improve welfare.

These results should also provide crucial quantitative data to be used in future animal welfare risk assessments developed by EFSA, which is in charge of providing scientific advice for the Community’s legislation on animal health and welfare. The results of the EFSA’s risk assessment will support the further development of animal-based welfare indicators for welfare assessment at farm level.

Legislative provisions based on appropriate scientific evidence should include animal-based welfare indicators or assessment systems for the control and monitoring of animal welfare at farm level.
Chapter 50


Chapter 51


References


Chapter 52


