

# Wageningen UR Livestock Research

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Report 532

## A welfare assessment protocol for commercially housed rabbits

First step in the development of the protocol

December 2011



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### Abstract

This report presents the result of a literature  
study and expert meeting as a first step in  
the development of a welfare assessment  
protocol for commercially housed rabbits

### Keywords

Rabbits, Welfare Assessment Protocol

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## A welfare assessment protocol for commercially housed rabbits

Een protocol voor het meten van welzijn bij  
commercieel gehouden konijnen

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December 2011

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## **Preface**

Within the Welfare Quality® project, welfare assessment protocols have been developed for poultry, pigs, dairy cattle and calves but not for commercially housed rabbits. However, the Ministry of Economic Affairs, Agriculture and Innovation expressed its interest in developing a welfare assessment protocol for commercially housed rabbits that is based on the same principles and criteria as used in the Welfare Quality® assessment protocols for other animals. It stressed the importance to discuss this protocol with European researchers, to promote its acceptance at an international level. In this report we describe the first step of the development of such an assessment protocol, i.e. a literature study on possible measures for rabbits housed under commercial conditions. These measures were thoroughly discussed with an international group of experts and their opinions are included in the current document.

Dr. ir. Ingrid de Jong (project leader)



## Summary

Within the Welfare Quality® project protocols have been developed to assess animal welfare on-farm in an objective, science based and practically applicable way. For various species like broilers and laying hens, sows and growing pigs, dairy cattle and veal calves, welfare assessment protocols have been developed, but not for commercially housed rabbits. This report describes the first step that is necessary for the first phase for development of protocols to score and observe rabbits on-farm to assess their welfare. Where possible the welfare of animals is assessed using animal based measures (like health and behavior). Additionally, where no suitable animal based measures were available, resource based measures are included (like house or pen size, climate etc.).

In this project, we made a first step in the development of an assessment protocol for commercially housed rabbits. We did a literature study, describing possible parameters for the different criteria and principles as used in Welfare Quality®. In this first phase we focused on reproductive does (including non-lactating does) and meat rabbits, because it is the majority of the farmed rabbits. The protocol can easily be extended to rearing does and bucks. Where no scientific literature was available, expert opinion was used to find possible parameters. A Workshop in Celle (Germany) was set-up for this purpose with experts in the field of welfare of rabbits from The Netherlands, Belgium, Germany, Austria, Switzerland, Hungary, Italy and Spain. The information of the literature study and expert opinion was brought together in a proposed set of protocols and techniques to measure the parameters on-farm in commercially housed rabbits and is described in this report and summarized in table 2. For some of these parameters as for example body condition score and cleanliness of the floor scoring methods need to be developed before they can finally be included in a definitive set of measures. For some criteria such as appropriate behavior further research is needed to develop tests that also need to be validated before they can be used in the protocols.

A follow-up is necessary for further development of the protocol. After further development of techniques and validation of tests, measures should be tested in practice at commercial rabbit farms. Subsequently, these data will be used to adapt the protocols and define a first version of the welfare assessment protocol for commercially housed rabbits.





## Samenvatting

Welfare Quality® heeft als doel om objectief uitspraken te kunnen doen over het welzijn van dieren. Het welzijn van de dieren wordt gemeten aan de hand van een protocol dat is gebaseerd op dierkenmerken (bijvoorbeeld verwondingen). Indien geen dierkenmerk voorhanden is, wordt gebruik gemaakt van omgevingskenmerken (bijvoorbeeld hokafmetingen). Voor diverse veehouderij sectoren, waaronder pluimvee, varkens en rundvee zijn dergelijke protocollen reeds ontwikkeld en worden ze ook toegepast, echter voor de commerciële konijnenhouderij is nog geen protocol voorhanden. Dit rapport doet verslag van een eerste aanzet om te komen tot een concept protocol voor commercieel gehouden konijnen, dat op praktijkbedrijven kan worden getoetst en verder ontwikkeld moet worden om uiteindelijk te komen tot een definitief protocol waarmee het welzijn van commercieel gehouden konijnen kan worden vastgesteld.

In dit project hebben wij een literatuurstudie verricht naar mogelijke parameters die kunnen worden gebruikt om de verschillende criteria en principes van Welfare Quality® te kunnen meten. In deze fase hebben we ons met name gericht op reproducerende voedsters (inclusief de wachtvoedsters) en vleeskonijnen omdat dit de belangrijkste diergroepen zijn op een konijnenbedrijf. Het protocol kan echter eenvoudig worden uitgebreid naar opfokvoedsters en rammen. Waar geen literatuur voorhanden was, is gebruik gemaakt van de kennis van experts op het gebied van konijnen in binnen- en buitenland. Hiertoe is een workshop georganiseerd in Celle (D) met onderzoekers uit Nederland, België, Duitsland, Oostenrijk, Zwitserland, Hongarije, Italië en Spanje. Op basis van de informatie uit de literatuurstudie en de workshop is een voorstel voor een protocol gemaakt, dat in dit rapport is beschreven en in tabel 2 wordt samengevat. Voor sommige parameters zoals bijvoorbeeld lichaamsconditie en reinheid van de vloeren moeten methodes worden ontwikkeld aan de hand waarvan deze parameters kunnen worden gemeten. Daarnaast is verder onderzoek nodig om testen te ontwikkelen waarmee bijvoorbeeld normaal gedrag bij konijnen kan worden gemeten. Deze testen en technieken zullen vervolgens moeten worden gevalideerd.

Een vervolgstudie is nodig om het protocol verder te ontwikkelen. Eerst zal ontwikkeling en validatie van een aantal testen en technieken plaats moeten vinden en vervolgens dienen deze op commerciële konijnenbedrijven te worden getoetst, waarna een definitief protocol kan worden vastgesteld.



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## 1 Introduction

Within the European Welfare Quality® project, welfare assessment protocols have been developed for various species like broilers and laying hens, sows and growing pigs, dairy cattle and veal calves, but not for commercially housed rabbits. The aim of the current study was to put a first step forwards to a welfare assessment protocol for commercially housed rabbits, that is based on the Welfare Quality® principles and criteria (Table 1) (see [www.welfarequality.net](http://www.welfarequality.net) for more information).

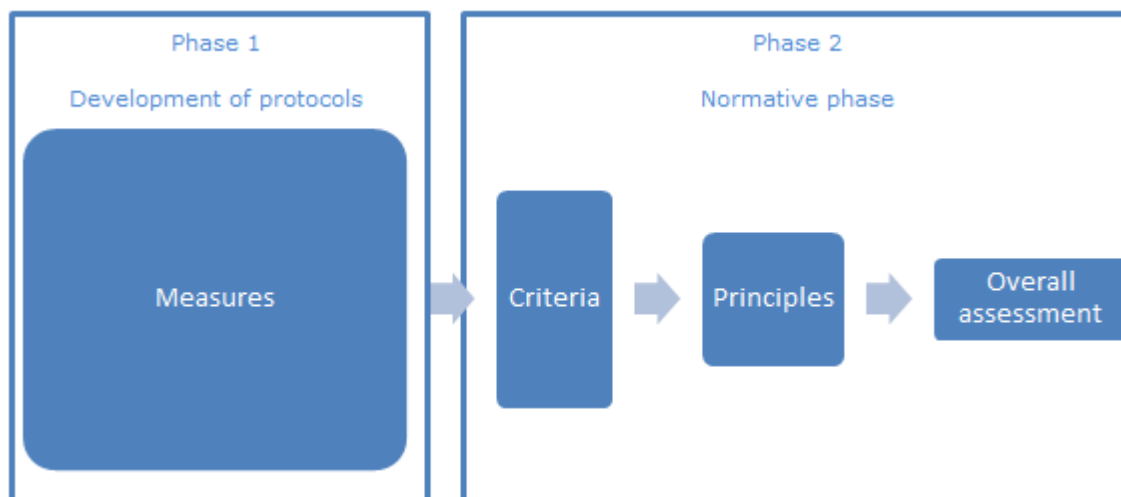
Within the Welfare Quality® project protocols have been developed to assess animal welfare on-farm in an objective, science based and practically applicable way (Blokhuis et al., 2010). Where possible the welfare of animals is assessed using animal based measures (like health and behavior). Additionally also resource based measures are included (like house or pen size, climate, management and equipment) that are possible risk factors for reduced welfare of an individual animal.

**Table 1.** The principles and criteria that are the basis for the Welfare Quality® assessment protocols (Blokhuis et al., 2010).

Welfare Quality Principles	Welfare Quality Criteria
Good feeding	1 Absence of prolonged hunger
	2 Absence of prolonged thirst
Good housing	3 Comfort around resting
	4 Thermal comfort
	5 Ease of movement
Good health	6 Absence of injuries
	7 Absence of disease
	8 Absence of pain induced by management procedures
Appropriate behavior	9 Expression of social behaviors
	10 Expression of other behaviors
	11 Good human-animal relationship
	12 Positive emotional state

The Welfare Quality® approach can be considered as a stepwise process with the ultimate goal the overall judgment of the welfare level of animals on a particular farm. The judgment of the welfare of the animals on a particular farm starts with parameters of behavior and health measured on individual animals at that particular farm ('measures', see figure 1). For this step scientifically based and practical applicable protocols are needed and should be developed (figure 1, phase 1, development of protocols). The next step in the process is the normative phase, where individual measures will be integrated into criteria, principles and at the end an overall assessment of a farm. In this normative phase expert and stakeholder opinions are used to integrate different measures into finally an overall assessment.

The current paper describes a first step that is necessary for the first phase of the above described process, where protocols will be developed to score and observe rabbits on-farm. The development of protocols started with a literature study, describing possible parameters for the different criteria and principles as described in table 1. Where no scientific literature was available, expert opinion was used to find possible parameters. The final result of this literature study is a proposed set of parameters and techniques to measure these parameters on-farm. Some of these parameters need to be validated before they can be included in a definitive set of parameters. In addition, if the literature study or the expert opinion does not reveal parameters for a certain criteria, further research will be needed.



**Figure 1.** Different phases in the development of a welfare assessment protocol, as defined by Welfare Quality®. The current paper describes the first step in phase 1.

#### *Approach applied in the current paper*

In this paper we start with a description of possible parameters for reproductive does (including non-lactating does) and meat rabbits. We chose these two categories as it is the majority of the farmed rabbits. We are aware that there are also many welfare issues in rearing does and bucks. However, the protocol can easily be extended to rearing does and bucks.

As we here start with a first step of the development of an assessment protocol for commercially housed rabbits, it is useful to select a broad range of parameters that may possibly be used. Where possible, we selected animal-based parameters and describe how to assess these. In case resource based measures seem more relevant, or animal based measures are not available, we (also) describe possible resource based measures. For each measure key references are given. Table 2 summarizes the proposed animal and resource based measurements.

The applicability and feasibility of the suggested parameters was discussed in a workshop in Celle (Germany) on May 10<sup>th</sup>, 2011 with experts in rabbit welfare research: Steffen Hoy (Germany), Zsolt Szendro (Hungary), Stephanie Buijs and Luc Maertens (Belgium), Lotty Bigler (Switzerland), Knut Niebuhr (Austria). Marina Lopez (Spain) and Fabio Luzi (Italy) were not able to attend the workshop and commented by e-mail. Based on the discussion and comments parameters were added or altered and this report describes the final result of the literature study with the comments of the discussion session included in the text.

The sections of the current paper refer to the Welfare Quality® principles and criteria as described in table 1.

## 2 When to apply the assessment protocol?

It is important to determine the welfare of commercially housed rabbits at the moment that welfare is most at risk. For meat rabbits, stocking density increases with age. In addition, there is a risk for increasing aggression with age (Lidfors et al., 2007; Szendro, 2009). Therefore, the final weeks before the rabbits are slaughtered may be a suitable time point to assess the welfare of meat type rabbits, i.e. between 10-11 weeks of age.

For does it can be argued that there are two moments to assess the welfare. According to the study of Bonanno et al. (2008), body condition score at artificial insemination (AI) (11 days post partum (PP)) is a reliable indicator. Poor or excessive fatness in rabbit does negative effect fertility and kit mortality during 1-11 days PP. Maternal care and quality of the nest can also be taken into account in the assessment at AI, although they also depend also on the parity of the doe. On the other hand at the end of the lactation period (the week before weaning) aspects of doe and litter can also be observed. Body condition score reflects the entire lactation period and does are palpated for the next gestation. Kits have started individual feeding and kit mortality can be used.

Other parameters as abnormal behavior will be most prevalent around parturition. However, around parturition assessment of the does will cause too much stress. The best time span for welfare assessment in does depends on the parameters that are taken into account; for body condition score and mother care ability the moment of artificial insemination seems appropriate, whereas for abnormal behavior the first week after parturition the assessment can be performed. At the end of lactation, body condition score of the doe, % palpated positive and litter performance can be assessed. Body condition is generally considered as an important welfare criterion, and as kit mortality (of previous parturitions) can also be found in the administration of the farmer, assessment around artificial insemination seems to be the best option.

### 3 Good feeding

#### 3.1 Absence of prolonged hunger

Body condition may be an indicator of rabbits inadequately fed, although diseases also may affect body condition (EFSA, 2005). In Spain a method is being developed to determine body condition of rabbits (Bio-impedance method, A. Garcia Ruiz, Nutreco, personal communication). However, the development of this method has not been completed yet. In addition, it involves the use of an apparatus which makes it difficult to apply at a large scale at different farms in different countries. Alternatively, a body condition scoring system could be developed using example pictures with descriptions. The Welfare Quality® assessment protocol for sows and growing pigs uses such a system, discriminating between pigs having a good body condition and too lean pigs (Welfare Quality®, 2009). For rabbits, a scoring system for body condition was used by Bonanno et al. (2008) and Rosell and de la Fuente Crespo (2008). Bonanno et al. (2008) measured the fatness by feeling by hand loin and rump regions and scored body condition on a scale from 0 to 2. The body was scored 0) if loin was poor, 1) if loin was intermediate and rump was poor and 2) if loin was intermediate or wide and rump was wide. Rosell and de la Fuente Crespo (2008) estimated body condition by weighing and palpating the fullness of muscle and fat of the lumbar, sacral, coxal tuberosity and gluteal regions, in relation to the size of the doe, on a lineal scale of 1 to 9 and added pictures that reflected the different scale numbers. However, these systems need further development and validation before they can be used in an assessment protocol.

Alternatively, body weight may indicate if rabbits are too lean or overfed. Meat rabbits are weighed on a regular basis. However, based on average weight it may be difficult to find individuals that are too lean. Overfeeding in meat rabbits is no problem from welfare point of view, but overfeeding in rabbit does may negatively affect the parturition process and may cause death of kits and doe. However, there are also differences in weight between hybrids. Does are not weighed on a regular basis in practice.

For meat rabbits, the percentage of emaciated rabbits is assessed at the farm by the farmer before they are transported to the slaughter plant (e.g. Spain) or by the slaughter plant (e.g. Belgium). This figure may be a good indicator of hunger. A scoring system for body condition score at slaughter should be developed and validated.

Rabbits eat many times per day and are fed ad libitum. This limits competition around the feeder. Therefore, it is stated that one feeder per 3-4 meat rabbits should be sufficient (EFSA, 2005). But under commercial conditions even 8-10 rabbits can be held per feeder without causing any problems (Lopez, personal comm.), although this depends on the size of the feeder. There are no such data available for group housed does.

##### 3.1.1 Proposed measures

Possible animal based parameters are:

1. body condition score (does and meat rabbits, on-farm);
2. percentage of emaciated rabbits at the slaughter plant (meat rabbits).

Proposed techniques:

1. body condition scoring system comparable as described for pigs;
2. collecting slaughter plant data.

Possible resource based parameter:

1. number of rabbits per feeder (meat rabbits and group-housed does).



### **3.2 Absence of prolonged thirst**

There is no animal based indicator available to measure prolonged thirst. Alternatively, the number of nipples (or drinking points) per rabbit can be measured. Also for other species, no animal based parameters are currently in use for this criterion and alternatively the number of drinking points and sometimes also the cleanliness and functioning of drinkers is assessed (Welfare Quality®, 2009). For individually housed does one nipple per doe is sufficient. For meat rabbits and group housed does, one nipple per 10 rabbits should be a minimum (Verga et al., 2009).

It is important that nipples are clean, e.g. no hairs visible, no green rash (indicator of *Pseudomonas*, Arts, personal communication). In addition to the number of nipples per rabbit, it could be assessed if the nipples are clean and in function. The smallest weaned rabbits should also be able to drink, so the nipples should not be too high. A representative sample of pens should be selected and the nipples should be checked. Water should not be restricted.

#### *3.2.1 Proposed measures*

Possible resource based parameters (does and meat rabbits):

1. number of drinking points per rabbit;
2. functioning of the drinkers;
3. cleanliness of the drinkers;
4. height of drinkers.

## 4 Good housing

### 4.1 Comfort around resting

It is not clear if rabbits prefer a littered floor or a wire floor (EFSA, 2005). For example, it has been shown that rabbits prefer a littered floor above a wire floor for resting except when the environmental temperature is too high (Szendro, 2009). On the other hand, it has also been shown that rabbits prefer wire floor above litter floor at temperatures between 15-20°C (e.g., Morisse et al., 1999; Orova et al., 2004). Preferably, rabbits are provided with a litter floor and a wire floor so that they can choose where to rest on, dependent on environmental conditions (Szendro, 2009). It is important that the floor and the litter, if litter is provided, are clean. A scoring system for cleanliness of litter and cage floor can be developed.

It can be observed that does, when given the choice, rest on a plastic floor instead of a wire floor (Lopez et al, 2002, Rommers, personal communication). However, this observation is not confirmed by others (Buijs, personal observation). Does prefer plastic floors when they suffer from foot injuries which may have played a role in these observations. In addition, limited floor space may also force the does to rest on the plastic floor.

Rabbits prefer to rest in fully stretched body position, preferably against the walls of a pen or pen mates. Between 60-80 cm length is needed for an adult doe (commercially used hybrids) resting in a fully stretched position (EFSA, 2005). In addition, a rabbit should be able to withdraw itself from the group or the kits on an elevated floor, and/or being able to rest in a shelter, protected by a ceiling (Stauffacher, 2000). As animal based parameter it can be scored if the rabbits are able to rest in a fully stretched position. During the light period, rabbits spent a lot of time resting and a practical applicable measure can be to score if there is a rabbit observed resting in a fully stretched position. Alternatively, cage dimensions can be recorded (as at least 60-80 cm is needed for a fully stretched position). As shelter and/or elevated platforms seem to be preferred for resting, scoring the presence of these resources may be a suitable additional parameter, although these are only resource based measurements. If these enrichment structures are present, it could be scored how many rabbits show a fully stretched resting position in these structures.

Meat rabbits show simultaneous resting. Stocking density as well as group size may have an effect on resting behavior, by either disturbing resting or increasing time spent resting in small cages (e.g., Buijs, 2011). If resting space is used as an resource based measurement, the question remains if in group pens it is necessary that all animals can use the resting area at the same time (conclusion from expert discussion, Celle).

At the expert meeting in Celle it was discussed if lying behavior could be scored by direct observations or not. There was no consensus on this topic. Some experts stated that by entering the rabbit house, rabbits will be disturbed and will jump up, so video equipment is needed. However, this will cost too much labour and time to include in an assessment. Other experts experience was that after entering the rabbit house, rabbits will continue with their behavior after a short adaptation period (few minutes). In the discussion at the expert meeting in Celle it was often stressed that a rabbit should have the possibility to choose between different conditions (e.g. resting or hiding place, wire or alternative floor). It was also discussed if all animals should be able to rest at the same moment, but there is not enough knowledge about this to reach consensus between experts.

A natural light-dark pattern enables the rabbit to apply its natural rest-activity rhythm. Meat rabbits show increased activity during dawn and dusk (Buijs et al., 2011)

Good air quality is always necessary for comfort when resting. Dust levels should not be too high. There is no literature showing which dust levels are acceptable or not. For other species, welfare quality applies a dust sheet test which is a simple procedure indicating the amount of dust in the air (Welfare Quality®, 2009). This test can also be applied in rabbit houses. Alternatively, a technique to measure dust in a standardized way should be developed and validated.

It is not clear which is the maximum level of ammonia above which negative effects on rabbit welfare can be found. A maximum of 8 ppm (Peeters, 1989) or 20 ppm (Verga et al., 2009) are published. According to experts opinion it varies among countries. For e.g. in Switzerland and Spain a maximum of 10 ppm is recommended (Bigler, Lopez, personal communication). The mucosa in the nose of rabbits is very sensitive to high concentrations of ammonia. Measuring ammonia levels implicate that

(expensive) techniques should be applied. In addition, it is no animal based measure. In addition, maximum levels of CO<sub>2</sub> are also defined, as well as optimal relative humidity (55-70%), (Lidfors, 1997; Peeters, 1989) and environmental temperature (between 12-27 °C) e.g., (Peeters, 1989), see section on thermal comfort. However, as all these are resource based measures it is preferred to use animal based measures.

#### 4.1.1 Proposed measures

Proposed animal based parameters:

1. fully stretched lying in the pen or at the elevated platform or shelter;
2. simultaneous resting in group housing.

Proposed technique:

1. scoring if fully stretched lying is observed.

Proposed resource based parameters:

1. dust;
2. stocking density and group size;
3. presence of shelter and elevated platform;
4. cage size;
5. size of elevated platform and shelter;
6. light pattern including presence of dawn and dusk phase;
7. floor types and quality of littered floor.

## 4.2 Thermal comfort

Too high environmental temperatures are serious risks for rabbit welfare. Rabbits avoid high temperatures when possible (Lidfors et al., 2007). Rabbits suffering from heat stress show increased respiration frequency and panting and have extremely red ears (Peeters, 1989) and decrease their activity level (Marai and Rashwan, 2004). The number of rabbits showing fully stretched lying may also increase (Rommers, personal observation). In addition, mortality increases (Arts, personal communication). It is indicated that panting means that there are more than 32-60 respirations per minute in does which is probably age dependent (Harcourt-Brown, 2002). This can be a suitable measure for heat stress, although it then should be known what respiration level means heat stress for does and meat rabbits. The respiration level, especially under conditions of heat stress, may also increase with disturbance of the rabbits.

Cold stress can increase mortality in kits (Peeters, 1989). Critical temperature is 12°C or lower for cold stress (can be found in sheds). Meat rabbits may show huddling behavior in response to cold stress; however, in general they prefer lying together. Environmental temperature at visit can be measured. According to the experts (expert meeting Celle) huddling behavior is no good indicator for cold stress in group-housed rabbits, because rabbits like to huddle when resting also at normal temperatures (16-18°C). Therefore, huddling is not included in the proposed measures.

#### 4.2.1 Proposed measures

Possible animal based parameters:

1. respiration rate;
2. red ears.

Proposed techniques:

1. measure these indicators in a representative sample of animals.

Possible resource based parameter:

1. environmental temperature

## 4.3 Ease of movement

Characteristic movements for rabbits are hopping, crawling, jumping and a combination of locomotor play consisting of running, jumping, turning (zigzagging) and head flicking (EFSA, 2005; Lidfors et al., 2007). Hopping is usually performed when rabbits move over longer distances, whereas crawling is performed during feeding on grass, exploring or during social encounters (Lidfors et al., 2007). To facilitate training of the limbs, rabbits should have enough space to be able to make several hops in a

pen (Stauffacher, 2000). An adult rabbit needs at least 70 cm length for a complete hop (EFSA, 2005). For turning adult rabbits need at least 38 cm (EFSA, 2005). Adult rabbits may jump as high as 1 meter (EFSA, 2005). To perform running behavior, rabbits need a considerable pen area. Some of these behaviors are not frequently performed which makes it difficult to observe them as stated by experts in the workshop in Celle. However, it was stressed that rabbits should at least have the possibility to jump and perform their distinctive locomotive behaviors. If animals do not have the possibility for proper movement (e.g. in cages) lameness can be monitored. It was suggested that a hopping test as used by Stauffacher can be used to score if a rabbit still has the ability of proper movement (Bigler, personal communication), but this needs further research and development.

Restrictions of movement lead to skeletal deformities, e.g. deformation of the vertebral column (EFSA, 2005; Lidfors et al., 2007; Stauffacher and Baumans, 2003). To determine if there are any skeletal deformities advanced techniques are necessary, like X-ray photographs or histological research (RDA, 1997), although it is unclear if severe deformities can also be found by manual checking. A deformation of the vertebral column might probably also be visible when the rabbit is forced to walk, but it should be tested if this can be used as animal based indicator for locomotion (Arts, personal communication).

The ability to perform sufficient locomotory behavior leads to a reduction in foot pad dermatitis in rabbits. See absence of injuries for scoring foot pad dermatitis.

There is a large body of literature and regulations with respect to cage dimensions and stocking density, which will not be shown here in detail as we here focus on animal based measures. Stocking density is a resource based measurement, but may indicate if there is enough space for locomotory behavior. Increased stocking density may limit the possibility to express certain behaviors like locomotion. There are several studies with respect to stocking density for meat rabbits. In general, for meat rabbits a maximum stocking density of 16 rabbits/m<sup>2</sup> or 40 kg/m<sup>2</sup> is seen as acceptable in terms of welfare (Szendro, 2009; Verga et al., 2009). According to Bigler (personal communication) this gives the meat rabbits not enough space for movement. In addition to stocking density, small group sizes may also reduce the possibilities to perform locomotory and other behaviors. In larger groups, relatively more free space will be available for locomotion. However, based on experts opinion there is no information about the amount of free space that becomes available.

For does, a minimum stocking density of 4500 cm<sup>2</sup> (cage and nest box) plus 1500 cm<sup>2</sup> for the elevated platform should be available (Hoy and Verga, 2006). However, according to Bigler (personal communication) this gives a doe not enough space for movement. Group housing of does increases the space available for locomotion.

The gait can be scored to identify problems with locomotion and lame rabbits as mentioned above if enough space is available. A locomotion scoring system can be developed. Gait scoring can be done by either taking the rabbit out of the cage and let it run over a certain distance, or by gently pushing the rabbits in the cage with a hand and scoring if any lame rabbits are observed (if the cage is large enough).

#### 4.3.1 Proposed measures

Possible animal based parameters (does and meat rabbits):

1. hopping (number of consecutive hops), jumping, turning, running;
2. number of lame rabbits.

Proposed techniques:

1. observation of behavior in a sample of pens and note if any of above mentioned behaviors is observed;
2. gently force rabbits to move in their home pen and note if any lameness is observed, in a representative sample of pens.

Possible alternative resource based parameters (does and meat rabbits):

1. length of the pen/cage, cage/pen height;
2. stocking density.

## 5 Good health

### 5.1 Absence of injuries

Rabbits should not have any skin damage or wounds. Wounds can be caused by inadequate equipment (e.g., sharp parts of cages), or by mutilative or aggressive behavior of other rabbits. Although aggression is a normal behavior and might cause injuries, bleeding wounds are not acceptable. Meat rabbits may miss toes, either by biting of the doe or an inadequate flooring (Buijs, personal communication), or they may miss part of the ears by biting of the doe when they are in the nest (Rommers, personal communication). In meat rabbits aggression may cause ear wounds (Princz et al., 2009). Rommers and Meijerhof (1998) developed a scoring system skin injuries. For the head and ears, body and limbs, genitals or anus and the tail it was scored if (0) no wounds; (1) superficial wound, area less than 1 cm<sup>2</sup>; (2) superficial wound, area larger than 1 cm<sup>2</sup>; or (3) bleeding wound was observed are present. Meat rabbits can also bite off the hair of each other (trichophagy), which is abnormal behavior. This could also be included in the assessment.

Pododermatitis can be caused by inadequate floor. Pododermatitis is in general not present in meat rabbits (EFSA, 2005) but can be observed in does housed on wire floors. Alternative plastic floors or partially plastic floors (floor pads) may reduce pododermatitis (EFSA, 2005). Rommers and De Jong (2009) developed a scoring method according to Drescher and Schlender-Bobbis (1995), using 5 classes: (0) healthy foot pad; (1) no hairs, callus formed, area smaller than 2,5 cm<sup>2</sup>, (2) no hairs, callus formed, area larger than 2,5 cm<sup>2</sup>, (3) callus open, cracks formed; (4) wounds.

#### 5.1.1 Proposed measures

Possible animal based parameters:

1. skin injuries/wounds (meat rabbits and does);
2. pododermatitis (does);
3. number of toes and ear damage (meat rabbits);
4. trichophagy (meat rabbits).

Proposed techniques:

1. scoring system for skin injuries/wounds and trichophagy, scoring a representative sample of rabbits;
2. scoring system for pododermatitis, scoring a representative sample of does.

### 5.2 Absence of diseases

Mortality gives a general impression of the health status of group of animals. Preferably culling and reason of culling should be registered separately from mortality caused by diseases etc. The lay-out of the nest box affects mortality of kits (Peeters, 1989). Kit mortality (1-11 days PP) is also related to the body condition of the doe at artificial insemination (Bonanno et al., 2008). Dutch welfare regulations state that mortality of meat rabbits should be lower than 10% (PPE, 2006). For does the percentage of replacement may be a good indicator of health. Percentage of replacement of does varies between 70-160% per year (Marai et al., 2010). Management procedures may prevent diseases, like using all-in-all-out (Hoy and Verga, 2007), or housing breeding material separately from production rabbits, using day-old rabbits for breeding instead of older rabbits (EFSA, 2005), vaccinations applied (Arts, personal communication), age at first insemination and the breeding rhythm (intensive, semi-intensive or extensive). Coccidiosis mainly occurs when rabbits get in contact with their droppings. Although it is a resource based measure, the cleanliness of the rabbits and housing system can give an impression of the hygienic status and infection pressure. Therefore, the cleanliness of the housing systems and animals could be scored.

Rabbits may suffer from a number of diseases, which are not listed here. To check if rabbits suffer from diseases they can be checked for a number of clinical signs that are indicative of diseases or health problems, like (1) coughing and sneezing (Peeters, 1989); (2) dirty/wet nose (Peeters, 1989); (3) dirty eyes (Peeters, 1989); (4) diarrhoea (Peeters, 1989) (indicated by a dirty coat); (5) crusts or bold patches on the ears (ear mange, dermatomycosis or mould) (EFSA, 2005; Meek, 2011a); (6) bold patches on the skin (Meek, 2011a); (7) lice or fleas (Meek, 2011a); (8) dermatitis (Meek, 2011b); (9) abscesses (Meek, 2011b) (10) mastitis (Kleyn van Willigen, 2000); (11) teeth abnormalities (Peeters, 1989).

Technical performance is not directly related to welfare. However, a reduced technical performance may indicate welfare problems (Hoy and Verga, 2006). To use this as indicator of health, a good registration by farmers is necessary. Indicators for technical performance are: percentage of does palpated positive, percentage abortion, % kindlings, number of kits born alive or dead, mortality of kits before weaning, mortality from weaning to slaughter.

### 5.2.1 Proposed measures

Proposed animal based measures (does and meat rabbits):

1. percentage mortality and selection;
2. clinical scoring of rabbits, consisting of symptoms listed above;
3. technical performance.

Proposed techniques:

1. scoring system for mortality (meat rabbits, kits) or replacement percentage (does);
2. clinical scoring of a representative sample of rabbits,
3. scoring if sneezing is present and if nasal discharge (snot) is present around the nose or at the forpaws. In the protocol for pigs and sows this is done by observing the pigs for five minutes and noting the number of coughs or sneezes;
4. technical performance as registered by the farmer. In most countries fertility rate, kindling interval, kits born alive and dead, kit mortality before weaning, mortality from weaning until slaughtering, number of litters per year are registered by the farmer.

Proposed resource based measures:

1. management procedures like all-in-all-out, age of breeding material bought, breeding rhythm, age at first insemination, cleanliness of the housing system.

## 5.3 Absence of pain induced by management procedures

In modern production systems artificial insemination is common practice. It involves handling as well as one or two injections of the doe (to stimulate ovulation or for oestrus synchronisation) (EFSA, 2005). An advantage of artificial insemination is that it makes all-in-all-out systems possible (and thus reduces disease risk). A new technique has been developed to avoid intramuscular injection at A.I. to induce ovulation by adding to the seminal dose (Quintela et al., 2004, submitted). This method gives similar results as compared to the intramuscular injection and is already applied in several countries (e.g. Spain) and veterinarian experts in A.I. believe that the injection will not be needed anymore in the near future (Maertens, personal communication).

Different measures can be used to stimulate willingness of the doe (so called bio-stimulation: e.g. lighting regime, closing the nests for 24h, vitamin supplements and feeding regime). These methods are common practice in several countries (e.g. Belgium, Hungary, The Netherlands, Spain) and makes oestrus synchronization by hormone injection unnecessary (Lopez and Maertens, personal communication). However, it is argued that hormonal treatment is not more negative in respect to animal welfare compared to bio-stimulation (Szendro, personal communication).

For identification ear marks (metal or plastic), micro chips or tattoos can be used. They are mainly used for identification of the reproductive rabbits (males and females). There are differences among countries which identifications are allowed. In The Netherlands, ear marks are not allowed. In Spain only tattoos are used, whereas in Switzerland ear marks (metal or plastic) and tattoos are used. When using ear marks it is important that no excessive tissue growth is visible.

### 5.3.1 Proposed measures

Proposed animal based measures:

1. which mutilations are used (for identification);
2. presence of tissue growth when using ear marks.

Proposed technique:

1. inspection of a representative sample of rabbits.

Proposed resource based measures:

1. if artificial insemination is used and how willingness of the doe is stimulated.

## 6 Appropriate behavior

### 6.1 Expression of social behavior

When establishing a hierarchy in a (new) group, aggression can be observed which is part of the normal behavioural repertoire of rabbits. However, (excessive) aggression may lead to wounds and eventually to increased mortality, and has a negative effect on welfare. Age of meat rabbits is an important factor: meat rabbits at the end of the growing period may show aggressive behavior (due to maturation of the rabbits) (Lidfors et al., 2007; Rommers and Meijerhof, 1998; Szendro, 2009). Ear damage, scratches and wounds are indicators of aggressive behavior (see absence of injuries). Group housing is important as rabbits are social animals. Group housing increases alertness, exploration and reduces fear (Stauffacher, 2000). Social contact, like grooming, is part of the normal behavior pattern of rabbits (EFSA, 2005). Other social behaviors are body contact, nose-body contact, sniffing, nose-nose contact (Lehmann, 1991). Solid walls prevent contact between individually housed rabbits (RDA, 1997), although rabbits might be able to establish relationships olfactory (Negretti et al., 2010). Group size of meat rabbits and does may be important and can be scored as well. Large groups promote locomotion and possibilities for social interaction (Szendro, 2009; Verga et al., 2007). However, with increasing group size the risk for ear damage in meat rabbits increases (Princz et al., 2009). Optimal group size in meat rabbits should be all kits from one litter (Szendro and Luzi, 2006). However, also kits from two small litters can be housed together if they are mixed at weaning (Lopez, personal communication).

Body contact when lying may be an indicator of positive social behavior. In addition, grooming might be a suitable indicator.

During the discussion in the workshop in Celle it was stated that social behavior is difficult to observe during an assessment, because this behavior is not performed often and if it is observed it is hard to distinguish positive from negative social behavior, because it can also be a sign of previous aggression. It was concluded that scoring skin injuries is an appropriate method to measure aggression between rabbits.

Another discussion point was the preferred group size for rabbits (does and meat rabbits). It was concluded that there is a lack of knowledge on this topic. Not much is known about group size and recognition of other animals. Based on experience it was stated that it is not appropriate to house two lactating does together, because one becomes dominant over the other. But no further recommendations can be given.

#### 6.1.1 Proposed measures

Proposed animal based measures:

1. scoring of injuries and wounds;
2. scoring social behavior.

Proposed techniques:

1. scoring system for injuries and wounds, see absence of injuries;
2. observation of a sample of rabbits during a certain time span.

Proposed resource based measures:

1. group housing (does), group size (does, meat rabbits);
2. absence of solid cage walls.

### 6.2 Expression of other behaviors

Stereotypies and abnormal behavior are indicators of reduced welfare in rabbits. Individual housing, reduced space and/or barren cages may lead to abnormal behaviors like: head shaking, swaying, wire gnawing, wall pawing, disturbed nesting behavior, disturbed nursing, cannibalism of kits, pacing, aggression, restlessness, freezing, not adopting a fully stretched lying position, over grooming, coat plucking (e.g., Chu et al., 2004; EFSA, 2005; Gunn and Morton, 1995; Lidfors et al., 2007). Boredom can be expressed as apathy, hunched posture, inertia, staring coat and dull eyes (Lidfors et al., 2007). As meat rabbits are group housed, stereotypic behavior might be less in meat rabbits as

compared to does. Observation of rabbits during a certain time period may give information about the presence of stereotypies or abnormal behavior, although it may be difficult to distinguish between abnormal and normal behavior during short observation periods. An example of such observations is found in the protocol for sows, where sows are observed during a certain time span and it is noted if stereotypies are present (Welfare Quality®, 2009). The quality of the coat can be used as indicator of abnormal behavior in meat rabbits (RDA, 1997), although coat quality may also be an indicator of disease. Does show wool plucking as nest building behavior and therefore this indicator is less suitable for does.

Gnawing and digging are important behaviors for rabbits and possibilities to perform these behaviors are often lacking in commercial housing. For gnawing, loose material like straw or hay, or soft wood is preferred (see Rommers and Jong, 2010 for overview). However, according to Swiss standards rabbits need to have straw or hay and soft wood to fulfill their gnawing needs (personal communication, Bigler). The presence of enrichment material can be scored, as well as the use of the material by observations of behavior or inspection of material, and accessibility of the material (only possible for wooden structures). Enrichment may prevent stereotypic behavior. Although it was stressed by experts (expert meeting Celle) that rabbits explore with their teeth and so rabbits will still gnaw on strange objects even if gnawing material is available. It was emphasized that it is not a yes/no indicator, but that the frequency of the behavior displayed is more important.

Digging can only be carried out on littered floors or in outdoor runs. When digging is observed in cages it is considered abnormal (Lidfors et al., 2007). The necessity for a rabbit to dig was discussed in the workshop in Celle. In Switzerland a distinction between digging (nest building) and scratching (exploring) is made. For digging more and deeper substrate is needed. However, in cages it is hard to distinguish scratching from digging, because no substrate is available. Experts had different experiences and it is not clear if a domestic rabbit wants to dig. However this question can be answered with experiments in which the willingness to dig is tested. It was stated that it is important to know what the motivation of the animal is.

Nesting material should be available to promote nest building behavior and to improve survival and growth of the kits. If insufficient nesting material is present the doe cannot perform her natural nest building behavior (Stauffacher and Baumans, 2003). Lack of suitable nesting material is indicated by abnormal behaviors like gnawing and digging on wire (RDA, 1997). Frequent nest inspection without suckling is regarded as disturbed maternal behavior, as well as neglecting kits, infrequent suckling, and a low quality of the nest (EFSA, 2005). A scoring system for nest quality is available (Ross et al., 1956). In Celle it was concluded by the experts (expert meeting, Celle) that nest quality should be part of the assessment protocol. However, it is not clear what a doe needs in order to perform nesting and maternal behavior except from a nest box and nesting material. For instance the shape of the nest (e.g. open or closed at the top) and the distance to the nest remains a question to be solved.

Rabbits in group housing should have possibilities to withdraw themselves from the group. This can be done by providing shelter, closed partitions in the cage or elevated platforms (Stauffacher and Baumans, 2003). An elevated platform enables the doe to withdraw herself from the kits (Verga et al., 2006). Elevated platforms should reduce fear, restlessness, excessive grooming and wire gnawing (Berthelsen and Hansen, 1999). Elevated platforms should have such dimensions that stretched lying is possible (see comfortable resting). The free space above the platform should be enough to allow sitting and comfort behavior and the platform should be easily accessible (Stauffacher, 2000). Kits and does may use the space under the platform to hide (Hoy and Verga, 2006). Elevated platforms also have positive effects on behavior of meat rabbits. They use an elevated platform to rest, to withdraw from a group and it promotes activity (Postollec et al., 2008).

Rabbits inspect their environment by showing 'standing up' behavior (EFSA, 2005). Although the duration of this behavior is in general short and it is not frequently observed, that does not mean it is not important for a rabbit (Martrenchar, 2001).

### 6.2.1 Proposed measures

Proposed animal based measures:

1. abnormal behaviors;
2. coat condition in meat rabbits;
3. kit mortality.



Proposed techniques:

1. observe the behavior during a certain time span (for e.g. 5 minutes or longer per pen or cage; this has to be tested in practice) in a representative sample of cages and score if abnormal behaviors are present;
2. a scoring system for coat quality should be developed.

Proposed resource based measures:

1. individual or group housing (does);
2. group size (meat rabbits);
3. elevated platform present and dimensions of such a platform;
4. cage height;
5. availability of gnawing materials and use of this material (type, amount);
6. availability of nesting material (type, amount);
7. nest quality.

### 6.3 Good human-animal relationship

A good human-animal relationship prevents fear in the rabbit and thus promotes rabbit welfare. Regular handling of rabbits reduces fear of humans (EFSA, 2005). The handling effect is higher if it is applied during a sensitive period in the first week post-partum and near the time of nursing, due to a general increase in arousal that occurs at this time (Bilko and Altbäcker, 1999). Different tests to assess human-animal relationship in rabbits have been described. A handling test was developed for pet animals, where the rabbits was taken out of the cage in a standardized way and the resistance is measured on a scale from 1-4 (Schepers et al., 2009). Verwer et al. (2009) describes a human approach test for group housed rabbits. An unknown person puts his arm during five minutes in a pen, and per rabbit the latency until first approach, latency until first contact and frequency and duration of further contacts are scored. Ducs et al. (2009) describe a human approach test where the rabbit is tested in a test cage outside the stable. The response to a hand against the wire (but outside the cage) is measured after a habituation period of five minutes. This test is not practically applicable as the rabbits have to be taken out of the stable. Schepers et al. (2009) use more or less the same method, called 'contact test', where they put their hand against the cage and score the number of contacts. Rabbits may respond differently to the human approach, either by showing positive behavior (approaching, sniffing) or negative (aggressively). The type of response should also be registered. It should be taken into account that cage size may affect the response of the rabbits (e.g., in small cages rabbits can be more inclined to approach as compared to large cage sizes). At the expert meeting also a human approach test was proposed. In group housing a suitable test would be to go to a pen and see how many animals approach you. However, there is not enough experience to say anything about the variation and such a test should be developed and validated. It was noticed that one should be critical of the significance of these tests, because it is not clear if it is fearfulness for humans what is tested.

Verwer et al. (2009) used also the tonic immobility test as indicator of fear. In this test the animal is held on its back and enters a condition of animal hypnosis (tonic immobility). According to Carli et al., (in Verga et al., 1979) the duration of immobility is positively correlated with fear level, while the number of induction attempts may be negatively correlated with the immobility length. Corticosterone levels were found higher in subjects more susceptible to the test.

For this test, the rabbit should be taken out of the pen or cage and transported outside the stable. This test is practically less suitable as the above described human approach tests. However, experts stated that this test is not the same as in chickens and it was advised not to use it.

#### 6.3.1 Proposed measures

Proposed animal based measure:

1. human approach test (does and meat rabbits).

Proposed technique:

1. one of the above mentioned tests can be used, but the protocol should be tested under commercial conditions and validated.

## 6.4 Positive emotional state

A novel object test can be used to determine fearfulness in general. A novel object test is described in Verwer et al. (2009). The same procedure is applied as the human approach test as described above, but a novel object is placed in the pen instead of the observer's hand. Other experiences with novel objects showed that the individual variability is high (Lopez, personal communication). In cages this method seems also not suitable, because there might be too little space for the animal to have the choice of approaching the novel object or not. At the expert meeting it was stated that rabbits are prey animals and so they get scared when something is approaching from above. This could also be taken into account when developing a new method. However, tests need to be validated.

Open-field tests have been described in different studies (Anderson et al., 1972; Daniewski and Jezierski, 2003; Verwer et al., 2009). As for these test a separate test pen should be available, these are less suitable for an assessment protocol on commercial farms.

It is assumed that elevated platforms reduce fear in rabbits (Berthelsen and Hansen, 1999). Possibly shelter may have the same positive effect.

In other species, Welfare Quality® uses a so-called Qualitative Behavior Assessment (QBA). Qualitative behavior assessment is an integrative methodology that characterizes behavior as a dynamic, expressive body language (e.g. as anxious or content) (Wemelsfelder et al., 2009). Scientific research in poultry has proven that it is a reliable method to score the emotional state of a group of animals. QBA is feasible and easy to learn, but assessors must be experienced in observing poultry and given additional training in recognizing poultry expressions if required (Wemelsfelder et al., 2010). The method can also be useful for characterizing a group of rabbits, but has not been developed yet for rabbits.

At the expert meeting it was discussed that play behavior (especially jumps) is seen quite frequently in young and just weaned fattening rabbits. However, assessors have to stay in the room for quite some time (e.g. an hour) to observe it and it should be validated.

### 6.4.1 Proposed measures

Possible animal based measurement:

1. fear for novel objects (does and meat rabbits);
2. description of behavior of a group;
3. hopping behavior in young rabbits.

Proposed technique:

1. novel object test. Such a test can be adapted to (Verwer et al., 2009) but should first be tested under commercial settings;
2. Qualitative Behavior Assessment (QBA), which should be developed for rabbits.

Possible resource based measurement:

1. elevated platform or shelter present (see comfort around resting).

## 7 Final remarks and conclusions

Table 2 summarizes the measures as proposed in the preceding paragraphs. In Table 3, it is summarized for the specific measures if further development of techniques or validation of a test is needed. Table 3 can be regarded as the basis for further development of the welfare assessment protocol. After further development of techniques and validation of tests, measures should be tested in practice at commercial farms. Subsequently, these data will be used to adapt the protocol and define a first version of the welfare assessment protocol. This needs to be further developed to calculate final scores for farms. Thereafter, a protocol can be published and guidelines for training of assessors can be developed. It is difficult to estimate how much time will be needed to develop the protocol into a final version with guidelines for calculations of scores for farms. This will be dependent on the results of validation studies, development of techniques and the availability of farms to test the protocol. Based on experiences with other farm animals, we estimate that the process (where stakeholders need to be involved) will take at least two years. Currently, a project is running at ILVO Gent where tests to measure fear will be further developed. These tests can be useful for the future protocol.

We discussed possible measures with a group of international experts (researchers). In general, experts showed interest in the development of a welfare assessment protocol for commercially housed rabbits. Except from Belgium, no countries specifically indicated that they were interested in the development of a welfare assessment protocol at this moment. This may however change when further steps in the development will be carried out. Up till now, no stakeholders were involved in the process. Involvement of stakeholders will however be important for increasing the acceptance of a welfare assessment protocol and therefore be important for further development.

**Table 2.** Summary of proposed animal based and resource based measures for meat rabbits and rabbit does.

<b>Welfare Quality Principles</b>	<b>Welfare Quality Criteria</b>	<b>Meat rabbits</b>	<b>Does</b>
Good feeding	1. Absence of prolonged hunger	% emaciated rabbits (slaughter plant), body condition score, number of rabbits per feeder	Body condition score, number of rabbits per feeder (group housing) Number of does per nipple (group housing)
	2. Absence of prolonged thirst	Number of rabbits per nipple Cleanliness, height and functioning of nipples	Cleanliness and functioning of nipples Lying in fully stretched position In case of shelter/elevated platform: lying in fully stretched position in this structure
	3. Comfort around resting	Lying in fully stretched position In case of shelter/elevated platform: lying in fully stretched position in this structure Simultaneously resting Dust, stocking density, group size, presence of shelter and elevated platform, light pattern, floor type, quality of litter	Dust, stocking density, group size, presence of shelter and elevated platform, light pattern, floor type, quality of litter Respiration rate, red ears, huddling
	4 Thermal comfort	Respiration rate, red ears, huddling Environmental temperature	Environmental temperature Locomotory behavior (hopping, jumping, turning, running)
	5 Ease of movement	Locomotory behavior (hopping, jumping, turning, running) Locomotion scoring Cage/pen dimensions, stocking density	Locomotion scoring Cage/pen dimensions, stocking density
Good health	6 Absence of injuries	Skin damage/wounds, damaged ears, toes	Pododermatitis, skin damage/wounds
	7 Absence of disease	Condition of eyes, ears, skin, nose Mortality including selection Coughing and sneezing	Condition of eyes, ears, skin, nose Mortality including selection Coughing and sneezing Number of does palpated positive, percentage abortion, number of kits born alive or dead All-in-all-out, breeding rhythm, age of breeding material bought, age at first insemination
Appropriate behavior	8 Absence of pain induced by management procedures	All-in-all out Mutilations for identification Excessive tissue growth with ear mark	Artificial insemination used, method for stimulation willingness Mutilations for identification Excessive tissue growth with ear mark
	9 Expression of social behaviors	Wound/injury scoring Social behavior	Wound/injury scoring Social behavior
	10 Expression of other behaviors	Coat condition Group size Gnawing material present, accessibility and use of material Elevated platform present and dimensions Shelter present Cage height	Abnormal behavior (stereotypies) Group housing Gnawing material present, accessibility and use of material Elevated platform present and dimensions Shelter present Nesting material Nest quality Kit mortality Cage height
	11 Good human-animal relationship	Human approach test	Human approach test
	12 Positive emotional state, QBA state	Novel object test, QBA Shelter/elevated platform present	Novel object test, QBA Shelter/elevated platform present

**Table 3.** Summary of methods that need to be developed and/or validated for further development of the assessment protocol for meat rabbits and rabbit does.

(MR refers to meat rabbits, D refers to rabbit does, no indication refers to both meat rabbits and rabbit does)

Welfare Quality Principles	WQ Criteria	Animal based	Literature available	Tests to be developed/validated	Resource based	Literature available	Tests to be developed/validated
Good feeding	1 <i>Abs. hunger</i>	MR BCS at slaughter D BCS	- Pictures Rosell, 2008 Scoring Bonnano 2008	Method Further development protocol needed	Animals/feeder	MR 3-4, EFSA, 2005 Max 10, Lopez, pers. Comm. Type feeder, Biggler pers. Comm. Does in groups ?	Validation needed  Does/feeder needs to be tested
	2 <i>Abs. thirst</i>	-	-	-	Animals/nipple	MR 10 (Verga 2009) D ?	Does/nipple needs to be tested
Good housing	3 <i>Comf &amp; resting</i>	No animals fully stretched No animals resting in group	-	Method of observation needs to be developed	Cleanliness nipple Functioning height	Arts pers. comm	
					Floor type	Different opinions (Szendro 2009, Morisse 1999, Orova 2004) Buijs (pers. com)	
					Cleanliness floor		Method of scoring needs development and validation
					Cage dimensions	D 60-80 cm (EFSA 2005) (Stauffacher, 2000, Stauffacher&Baumans, 2003, Berthelsen&Hansen1999, Postollec et al., 2008 Buijs, 2011	
					Shelter or platform		
Stocking density + group size Day-night rhythm	Buijs, 2011  NH3 max 8 ppm Peeters, 1989 Max 20 ppm, Verga 2009 Max 10 ppm pers. com, Bigler&Lopez						
Air quality							

Welfare Quality Principles	WQ Criteria	Animal based	Literature available	Tests to be developed/validated	Resource based	Literature available	Tests to be developed/validated
Good Housing					Airquality	Dust	Max level needs to be determined, research is needed
Good Housing	<b>4 Thermal comfort</b>	Panting > 32-60 respirations/min	Harcourt-Brown, 2002		Temperature (>12°C and < 27°C)	Peeters, 1989	
	<b>5 Ease of movement</b>	Jumping, running Several hop Proper movement/lameness Gait scoring	EFSA, 2005, Lidfors et al., 2007 Stauffacher, 2000 Bigler, pers. Comm.	Scoring system needs to be developed	Ventilation (2 -3 m <sup>3</sup> /kg live weight) Cooling/ heatingsystem	Hoy, personal communication Maertens, pers. communication EFSA, 2005	
Good Health	<b>6 No injuries</b>	Scoring of injuries and wounds Scoring foot injuries	Rommers and Meijerhof, 1998 Rommers and de Jong, 2009		Min length 70 cm Min width for turning around 38 cm Min height 1m	Szendro, 2009, Verga, 2009	
	<b>7 No diseases</b>	Examination of animals	Peeters, 1989, EFSA, 2005, Meek, 2011, Kleyn v. Willigen, 2000		Stocking density Max 16 rabbit/m <sup>2</sup> or 40 kg/m <sup>2</sup> more space than above	Bigler, pers. com.	
	<b>8 Absence of pain by management</b>	Tissue growth around earmarks		Scoring system needs to be developed	<b>D</b> Replacementrate Mortality & morbidity Technical performances	Hoy and Verga, 2006 Hoy and Verga, 2006	
					<b>D</b> Methods used for stimulation receptivity		

Welfare Quality Principles	WQ Criteria	Animal based	Literature available	Tests to be developed/validated	Resource based	Literature available	Tests to be developed/vaildated			
<b>Appropriate behavior</b>	<b>9 Expression of social behavior</b>	Scoring of social Behavior (body-nose contact, allogrooming)	EFSA, 2005, Lehman, 1991	Method of observation needs to be developed	D Group housing Group size  Absence solid cage walls Cage enrichment	Stauffacher, 2000 <b>MR</b> kits from one or two litters Szendro and Luzi, 2006; Lopez, personal Communication RDA, 1997				
		Scoring of skin injuries	Rommers & Meijerhof, 1998							
		<b>10 expression other behavior</b>	Stereotypies	(Chu et al., 2004, EFSA, 2005, Method of observation Gun&Morton, 1995, Lidfors et al., 2007				needs to be developed		Rommers&de Jong, 2009
			Coat quality (trichophagy)	RDA, 1997						
			Standing up	EFSA, 2005, Martrenchar, 2001						
			Digging	Lidfors et al., 2007				Methods of observation needs to be developed		
	Mother caring ability			Nesting material	Stauffacher& Baumans, 2003					
	<b>11 Human-animal relationship</b>	Handling test		Schepers et al., 2009, Verwer et al, 2009, Ducx et al., 2009	Tests needs to be developed and validated	Nest quality Kit mortality	Ross et al., 1956			
	<b>12 positive emotional state</b>	Play behavior in young Rabbits Quality Behavior Assessment		Verwer et al., 2009	Scoring method needs to be developed					
				Wemelsfelder et al., 2009a-b	Method needs to be developed and validated					
				Verwer et al. 2009	Method needs to be developed and validated					
	Novel object test									

## 7.1 Conclusions

- Animal and/or resource based measurements for rabbit does and meat rabbits are proposed in order to judge their overall welfare in commercial housing conditions according to the principles and criteria of Welfare Quality®.
- The assessment should take place at the moment that welfare is most at risk. In meat rabbits this will be at the end of the fattening period (around 10 to 11 weeks of age), because stocking density as well as the risk for aggression increases with age. In rabbit does, one could choose for the moment of artificial insemination, when body condition and mother caring ability of the doe can be scored (nest box quality, condition of the kits) or at the end of the weaning period when body condition of the doe and kit mortality can be measured. As body condition score is regarded as an important welfare criterion, assessment at the moment of artificial insemination seems to be preferred.
- Observations can be done by direct or video-observation. Video-recording is more reliable, but is time-consuming and not always possible.
- For most criteria animal and resource based parameters are given, whereas for some criteria only resource based parameters (e.g. absence of thirst) or animal based parameters (e.g. absence of injuries, good human-animal relationship) are found. However in many cases parameters need further development and validation.
- We therefore advice that the next step in the process of development of a welfare assessment protocol for commercially housed rabbits will be the development of techniques and validation of measures, as indicated in Table 3.

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## 8 Literature

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