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## **Opinion of the Scientific Panel on Animal Health and Welfare on a request from the Commission related to**

**"The welfare aspects of the main systems of stunning and killing applied to commercially farmed deer, goats, rabbits, ostriches, ducks, geese and quail"**

**EFSA-Q-2005-005**

**Adopted by the AHAW panel on 13<sup>th</sup> of February 2006**

**Chapter 9 on food safety aspects, as adopted by Biohazard panel on 17<sup>th</sup> -18<sup>th</sup> January 2006**

## SUMMARY

It is a legal obligation in the EU to stun animals before killing them so that the animal is unconscious and does not feel pain. Few exemptions are granted to this rule and then only in some Member States to allow for religious slaughter requirements. EU legislation aims to ensure that appropriate measures are applied across the EU to maximise animal welfare conditions for farm animals. Stunning is therefore required under that legislation, so that slaughter can be carried out without causing unnecessary fear, anxiety, pain, suffering or distress to the animal.

To ensure that the best methods of stunning are applied and to gain a better understanding of the process, the European Commission asked the EFSA Panel on Animal Health and Welfare (AHAW) to make a full evaluation of and give its opinion on the main systems of stunning and killing as they apply to deer, goats, rabbits, ostriches, ducks, geese and quail, looking in particular at aspects of animal welfare, biosecurity and the microbiological safety of the carcass. The chapter on the food safety aspects of stunning was adopted jointly by the AHAW Panel and the Panel on Biological Hazards (BIOHAZ).

AHAW panel found in its conclusions that published scientific information on slaughter and killing issues for the species under consideration was very scarce. It identifies an urgent need for further detailed investigation of the methods, mechanisms and effects of the different stunning methods and of their technical and organisational performance in practice. The Panel recommends improved and continuing education of staff to ensure good animal welfare. The opinion also advises industry and those who apply stunning and killing, to develop and implement quality control programs which can be audited and which will ensure that poor stun quality will be detected and corrective measures provided.

As there are no ideal methods of stunning and killing appropriate to all types of farm animals for commercial slaughter or disease control purposes, the Panel considers it necessary to select procedures, that with proper application, will have the greatest advantages in terms of animal welfare, biosecurity and microbiological safety of the carcass.

Stunning and killing methods induce unconsciousness and death either simultaneously or sequentially. Stunning induces temporary loss of consciousness and relies solely on prompt and accurate sticking procedures to facilitate bleeding and to cause death. Sticking involves the severing of major blood vessels e.g. neck cutting or chest sticking. If sticking is not promptly carried out, the adequately stunned animal has the potential to regain brain and body functions. As the duration of unconsciousness and insensibility varies between methods, species and animals, the procedures most appropriate to deer, goats, rabbits, ostriches, ducks, geese and quail should be applied. Some stunning and killing methods do not rely on bleeding to cause death and are a better option when available and proven to be effective.

The opinion makes recommendations for some methods over others, specifying which species are best served by each one. For example, red and fallow deer that are not used to humans will be at risk of poor welfare if subjected to handling and restraining as well as transport. For them, the recommendation is not to transport them but to shoot them in situ using free bullet. The Panel warns however that effectivity of this method depends on the training and skill of the personal involved. For geese in contrast, the only effective and proven method is to use the percussive stunning method.

Gas and electrical stunning methods are both seen to be highly effective for most species. However both are very demanding in terms of the technical equipment needed and require skilled people and effective monitoring of the processes.

All of the methods described depend for their proper implementation on good practices. It is important that all operators involved with stunning and slaughter should be competent, properly trained and that they should have a positive attitude towards the welfare of the animals. In addition,

all the equipment used for stunning or stunning and killing should be maintained in good working condition, evidence of the parameters applied should be recorded as well as maintenance and rectified defects records.

The BIOHAZ Panel affirms that there are indeed food safety concerns associated with some methods used for the animal species dealt with in this opinion. According to the Panel, the knowledge and data currently available are insufficient to quantify the food safety risks associated with these stunning methods; that nevertheless, such risks cannot be excluded.

The main concern relates to penetrating captive bolt (Pcb) stunning of goats and the potential dissemination of central nervous system (CNS) emboli into edible tissues with consequent exposure of humans to the bovine spongiform encephalopathy (BSE) agent. Caution is recommended in this area and further research is needed.

Another concern addressed by the BIOHAZ Panel points to the current lack of knowledge on the extent of microbial contamination of water used in stunning baths for ducks, geese and quail. This according to the Panel, means the fate of foodborne pathogens that may be present in such water is unknown; although it can be assumed that there is a risk of contamination of the lungs of those species with such pathogens in the course of stunning. It is also advised that such risks may be addressed through appropriate Good Hygiene Practice measures and recommends further research to determine the extent of any such risk.

This opinion follows on from an earlier AHAW Panel opinion and report of June 2004, that investigated the welfare aspects of the main systems of stunning and killing techniques as they apply to cattle, sheep, pigs, chickens and turkeys, horses and farmed fish, including methods applied in slaughterhouses and on the farm in disease control situations.

These two opinions and accompanying reports from the AHAW Panel, taken together, address stunning and killing of most species kept for farming purposes within the EU.

Key words : deer, goats, rabbits, ostriches, ducks, geese, quail,, animal welfare, stunning, killing, slaughterhouses, disease control, consciousness, mechanical stunning methods, mechanical stun / killing methods, electrical stunning methods, electrical stun / killing methods, gas stunning methods, gas stun / killing methods, controlled atmospheres, needle bolts, percussive stunning, asphyxia, decapitation, exsanguinations, anaesthesia, shooting, biosecurity, food safety, microbiological safety.

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## BACKGROUND

In response to a request from the Commission, the EFSA Panel on Animal Health and Welfare adopted on 15 June 2004 a scientific report and opinion related to welfare aspects of the main systems of stunning and killing the main commercial species of animals. This scientific report and opinion considered stunning and killing techniques applied to cattle, sheep, pigs, poultry (chickens and turkeys), horses and farmed fish, including methods applied in slaughterhouses and on-farm in disease control situations.

The outcome of this work will assist the Commission with regard to possible future revisions of Community legislation<sup>1</sup> on the protection of animals at the time of slaughter or killing. However, Community legislation in this field also encompasses other species kept for farming purposes and therefore the Commission requested that an additional EFSA scientific opinion be prepared covering stunning and killing techniques applied to deer, goats, rabbits, ostriches, ducks, geese and quail. This scientific opinion should consider, in particular, the welfare aspects of the main systems of stunning and killing these commercially farmed species of animals, either in slaughterhouses or on-farm in disease control situations. Where relevant, the impact of the stunning/killing method used on the microbiological safety of the carcass as well as biosecurity considerations concerning methods used in disease control situations should also be considered.

## TERMS OF REFERENCE

The Commission requested EFSA to issue a scientific opinion on the main systems of stunning and killing commercially farmed species of deer, goats, rabbits, ostriches, ducks, geese and quail, including systems used either in slaughterhouses or on-farm in disease control situations.

The scientific opinion should consider for each method described:

- the minimal conditions by which the method is likely to be efficient from the animal welfare point of view
- the criteria or procedures that could be used to check that the stunning or killing method has been effectively carried out
- the advantages and disadvantages of the method used in terms of animal welfare, taking into account the use of the method either in slaughterhouses or on-farm for disease control purposes
- where relevant, the impact of the stunning/killing method used on the microbiological safety of the carcass as well as biosecurity considerations concerning methods used in disease control situations

## ASSESSMENT

In general it appeared that published scientific information on slaughter and killing issues related to deer, goats, rabbits, ostriches, ducks, geese and quail was very scarce. Where specific scientific data are lacking, current practical applications are described in order to provide some relevant information. In that case assessment was done on the basis of analogy with related species and expert opinion. The assessment can be found in the Scientific Report published in the EFSA web site [www.efsa.eu.int](http://www.efsa.eu.int), which was drafted by a Working Group set up by the AHAW Panel. For basis background and general information on existing methods, the Scientific Report refers to the chapters '*Scientific basis of consciousness and stunning*' and '*Available stunning and stun/killing methods and their use*' in an earlier scientific report (EFSA, 2004c) and considers these as integral part of the present report. The Scientific Report is considered as the basis for the discussion to establish the conclusions and recommendations by the AHAW Panel, as expressed in this opinion.

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<sup>1</sup> Council Directive 93/119/EC OJ L340 p.21-34

## **CONCLUSIONS AND RECOMMENDATIONS**

The conclusions and recommendations in this opinion related to welfare aspects and biosecurity were developed under the responsibility of the EFSA Scientific Panel on Animal Health and Welfare. Conclusions and recommendations related to the effects of methods on the microbiological safety of the carcass were developed under the responsibility of the EFSA Scientific Panel on Biohazards.

Together the two Panels conclude on the main systems of stunning and killing techniques applied to deer, goats, rabbits, ostriches, ducks, geese and quail as follows:

### **1. GENERAL**

#### **1.1. CONCLUSIONS**

In general, stunning methods induce temporary loss of consciousness and rely on prompt and accurate sticking procedures (bleeding out) to cause death. The duration of unconsciousness and insensibility varies between methods, species and animals.

Effective stun/kill methods on the other hand, which induce unconsciousness and death either simultaneously or sequentially, do not rely on bleeding to cause death.

Restraint of animals, needed to ensure proper application of mechanical or electrical stunning or stun/killing methods, can be one of the most stressful and painful stages of the slaughtering process. Therefore, the ability to move animals in groups with less handling and restraint is an advantage on welfare grounds of all gas stunning or stun/killing systems as compared with mechanical or electrical methods.

While carbon dioxide (CO<sub>2</sub>) has many advantages, aversion (a tendency to show behaviour to avoid or withdraw from a situation which is associated with a noxious stimulus) to this gas at some level is clearly established in several species (other than the ones under consideration here). Based on the evidence in other species a welfare problem may be expected with some of the species considered in this report as well.

#### **1.2. RECOMMENDATIONS**

In all the stunning and stun/killing methods, animals should be restrained appropriately and heads properly presented to the operator for effective application of procedure(s) (excluding free bullet in the field and gas mixtures).

The stun-stick interval should be sufficiently short to induce death through blood loss before the animal recovers from the stun.

Sticking procedures vary between species. However, supply of oxygenated blood to the brain should be stopped as rapidly as possible.

No carcass processing or electrical stimulation to improve meat quality should commence until the animal is dead.

All operators involved with stunning and slaughter should be properly trained, their skills and knowledge examined, in particular in the field of welfare, and the person should be certified to be competent and should have a positive attitude towards improving animal welfare. They should also attend retraining courses and their ability to implement new knowledge and acquire new skills should be assessed as new technologies evolve.

All the equipment used for stunning or stun/killing should be maintained in good working conditions. Recorded evidence of maintenance and rectified defects should be kept.

##### **1.2.1. Mechanical methods**

When using captive bolt guns, colour codes indicating cartridge strength should be harmonised across manufacturers. Colour codes should be the same for the same species and age group.

Open cartridges should not be used as they can easily absorb moisture and lose their function. All captive bolt equipment, including cartridges, should be stored in appropriate conditions in abattoirs.

Bolt velocity should be measured regularly according to the manufacturers' specifications and appropriate field devices made available to ensure proper use in the field.

### 1.2.2. Electrical methods

All stunning and stun/kill electrical parameters should be based on sound science.

Electrical stunning tongs should be placed on the head such that they span the brain. Electrical stun/killing tongs (one cycle method) should be placed on the head and body such that they span the brain and the heart.

Electrical stunning and stun/killing devices should supply constant currents and should also be fitted with an acoustic or optic signal to indicate: (a) an interrupted stun, (b) excessively short stun duration or (c) increase in total electrical resistance in the pathway (due to dirt, fleece or carbonisation), which could lead to failure. This would facilitate effective monitoring of electrical stunning and stun/killing methods under commercial conditions. Electrical stunning and stun/kill devices should indicate that the recommended voltage and current have been delivered during the stun or signal if this is not the case.

The voltage and current measuring

devices should be appropriate to the waveform and frequency of the current used in the stunner.

A calibrated volt and/or current meter appropriate to the waveform and frequency of the current should be used to verify the output of the stunner. The sampling rate of the meter needs to be fast enough and appropriate to the electrical parameters.

The details of electrical stunning parameters, such as waveform, frequency and the output voltage and current in appropriate units (average or root mean square) need to be recorded and readily available for internal or external audit and to verify that correct parameters are applied, thus ensuring that a current of sufficient magnitude beyond that recommended to induce generalised epilepsy is applied. Systems with heart electrodes should be operated in a way that generalised epilepsy is effective before the heart electrode is applied.

Monitoring of electrical stunning and stun/killing efficiency should be improved by evaluating the stunners in designated laboratories, using established neurophysiological criteria, prior to installation and delivery of a certificate (kite mark).

### 1.2.3. Gas methods

Gas concentrations and exposure times need to be monitored and records kept. They should be readily available for internal or external audit and to verify that the recommended methods are used.

### 1.2.4. Backup stunning methods

As a general rule, each method should be applied only once, i.e. animals should be rendered unconscious and insensible by a stunning or stun / killing method or device applied for the first time. In the event of a failure (unsuccessful stun), the animal should be killed immediately by an appropriate backup killing method. Two consecutive failures to stun with any specific device should warrant immediate investigation and the fault should be rectified before starting stunning procedures again.

## **2. METHODS FOR STUNNING AND STUN / KILLING DEER**

### **2.1. Conclusions**

- Handling, transport and the pre-slaughter environment in conventional slaughterhouses may cause poor welfare for many red and fallow deer. Although a few animals are intensively farmed and therefore adapted to human contact to the extent that transport and pre-slaughter

handling are possible without inducing severe stress, many animals do not have this degree of tameness. The use of firearms as a killing method on unrestrained deer/reindeer have welfare advantages over captive bolt or electrical stunning methods, that require restraint, particularly when the animals are not used to handling. Shooting free-standing deer in the field can also be used as an on-farm slaughter method for disease control.

- Penetrative captive bolt is suitable for on-farm stunning (followed by bleeding), as well as a method for disease control in red and fallow deer and reindeer when followed by pithing. Adequate animal restraint is crucial to ensure proper placement of the shot.
- Electrical head-only stunning proved to be effective for red and fallow deer. Adequate animal restraint is crucial to ensure proper placement and maintenance of the captive bolt or the head-electrodes.

## 2.2. Recommendations

Different recommendations will be given for stunning red and fallow deer or reindeer. Reindeer are considered separately and treated the same as other domestic species, whereas guidelines for red and fallow deer differ according to the animals' degree of adaptation to human handling.

In the absence of any evidence that use of carbon dioxide to stun deer is humane, high concentrations of carbon dioxide should not be used for any species of deer.

### RED and FALLOW DEER

- Deer are classified in relation to their farming system, as described in the scientific report. Red and fallow deer under very extensive management (low animal density, 3<sup>rd</sup> Category Deer Farms) are considered to be at very high welfare risk if subjected to handling and restraint, and transport. Hence the best method of killing these animals that are not adapted to human contact is to shoot them *in situ*, i.e. in a field where they are kept or in a collecting area, with minimal handling.
- The use of firearms always requires a high level of skill and specific training. Particular care should be taken to kill each animal with the first shot, without causing panic and flight reactions to the rest of the herd. The use of telescopic sights and silencers should be considered. The use of any form of restraint prior to shooting should be avoided.
- If the animals are adapted to some human contact (semi-extensive management, 2<sup>nd</sup> Category Deer Farms as described in the scientific report), they may be also handled on farm and moved into on farm slaughter facilities or into mobile slaughter plants where pre and post slaughter meat hygiene inspection can be carried out.
- Red and fallow deer reared in intensive farms (1<sup>st</sup> Category Deer Farms as described in the scientific report) should be transported to a slaughterhouse only if they have been carefully accustomed to routine handling in proper deer facilities. Animals thus adapted to humans should be transported and slaughtered in specialised deer abattoirs, equipped with specific lairaging and restraining/handling facilities. The appropriate stunning and killing methods are mechanical (penetrative captive bolt) and electrical (head-only) stunning methods. Particular care and expertise are always needed for deer.
- Mechanical (penetrative captive bolt) or electrical (head-only) stunning methods must be used before slaughtering red and fallow deer kept in 1<sup>st</sup> and 2<sup>nd</sup> Category Deer Farms. The use of penetrative captive bolt and electrical stunning should always be carried out with animals restrained within a drop-floor crate (stunning-box) to firmly but calmly handle them. The box should be located in an area of reduced light intensity as an additional calming effect.
- When mechanical stunning methods are used, particular care should be taken to ensure that the animals are rendered unconscious by a single shot to the head and that trauma to and bleeding of the brain results.

- When electrical stunning methods are used, adequate animal restraint is crucial to ensure proper placement of the electrodes on the head in a position that spans the brain.
- The minimum recommended current for effective electrical head-only stunning deer is 1.3 A for red deer and of 1.0 A for fallow deer.
- In summary, red and fallow deer should be killed on farm by shooting *in situ* unless they are well adapted to human contact and hence not significantly disturbed by human proximity.

#### REINDEER

- Reindeer, similarly to intensively farmed red and fallow deer, should be transported and slaughtered in specialised deer abattoirs, which have to be equipped with specific lairage handling and restraint facilities. However, particular care and expertise are always required.
- The use of penetrative captive bolt guns should always be carried out with animals properly restrained, either in a stunning-box or included manually restrained by an operator. When mechanical stunning methods are used, particular care should be taken to ensure that the animals are rendered unconscious by a single shot to the head and that trauma to and bleeding of the brain results.

### 2.3. Future research

- Research is recommended to improve knowledge on the methods used for stunning and killing deer.

#### *Electrical methods*

- Very little research has been carried out in this field. There is an urgent need to review and evaluate the electrical methods in use, and to determine specific electrical parameters to be used according to different deer species, sex and age.

## 3. METHODS FOR STUNNING AND STUN / KILLING GOATS

### 3.1. Conclusions

- Captive bolt and electrical stunning methods are used in goats. It is assumed that they are effective by analogy to research findings with sheep and other species.

### 3.2. Recommendations

- When mechanical stunning is used it must be followed by bleeding.
- In the absence of any evidence that use of carbon dioxide to stun goats is humane, high concentrations of carbon dioxide should not be used.

### 3.3. Future research

- Research should be undertaken to underpin the use of captive bolt and electrical stunning methods with goats.

## 4. METHODS FOR STUNNING AND STUN / KILLING RABBITS

### 4.1. Conclusions

- Penetrative captive bolt stunning is effective in rabbits. Adequate animal restraint is crucial to ensure proper placement of the bolt. Rabbits may likewise be stun/killed by the shot but this effect cannot be guaranteed.
- Penetrative captive bolt is also suitable for on-farm disease control culling.
- Electrical stunning is the method of choice in commercial slaughter plants. However, due to

insufficient data, no recommendations can be given with regard to the magnitude, type and duration of the current required to ensure that all rabbits are adequately stunned and remain unconscious until death from bleeding supervenes.

- With existing electrical stunning devices for rabbits (V-shaped electrodes) there is a conflict between using high voltages to overcome the isolating properties of the fur to achieve an instantaneous stun and the requirement to protect workers' safety.
- Gaseous stunning would remove the stress of handling the animals while they are still conscious and would therefore be the method of choice. However, it has not been scientifically investigated whether the induction phase might cause distress and even pain for the animal and in addition the gas concentrations and exposure needed to achieve a reliable stun are unknown. Therefore, the method can not be recommended at this time.

#### **4.2. Recommendations**

- Penetrative captive bolt is the preferred method for small numbers of rabbits.
- Until further research has been carried out, the minimum recommended current for head-only stunning of rabbits is 400 mA.
- When mechanical stunning is used it must be followed by bleeding or in the event of casualty slaughter, by pithing.
- In the absence of any evidence that use of carbon dioxide to stun rabbits is humane, high concentrations of carbon dioxide should not be used.

#### **4.3. Future research**

- Research is recommended to create more knowledge of the humane methods for stunning rabbits. In view of the fact that electrical stunning is already widely used in commercial slaughter plants it is suggested that the European Commission should prioritise research in this area.
- The use of gaseous methods for stunning rabbits needs further research.
- Spring operated captive bolt guns have to be manually cocked between shots while cartridge operated guns have to be reloaded. Both actions will slow down throughput and therefore this effective method may be overlooked. An air operated stunner, if properly designed, would probably overcome this problem and therefore should be researched.
- For mass culling purposes methods should be developed which will quickly and painlessly kill the animals while still in their husbandry units.

### **5. METHODS FOR STUNNING AND STUN / KILLING OSTRICHES**

#### **5.1. Conclusions**

- Ostriches can be effectively stunned by mechanical and electrical methods.
- The mechanism of mechanical stunning is not completely understood with ostriches.
- Ostriches may show panic responses when handled if they have not been carefully adapted to handling.
- A major problem with all stunning methods is the post-stun convulsions which can delay the shackling, hoisting and bleeding of the animals and therefore prolong the time to brain death and increase the chance of recovery.

#### **5.2. Recommendations**

- Until further research has been carried out the minimum recommended current for the head-

only stunning is 500mA.

- When mechanical stunning is used it must be followed by bleeding.
- When animals are stunned they should be restrained to enable them to be bled as quickly as possible.
- Ostriches should be carefully adapted to humans during rearing so that they are not severely disturbed by transport and pre-slaughter handling.
- For casualty slaughter or disease control, penetrative captive bolt followed by pithing or bleeding or head-only electrical stunning followed by the induction of the cardiac arrest is recommended.

### **5.3. Future research**

- Research is required to either kill the birds at the point of stun, to reduce post-stun convulsions, to reduce the time between stunning and bleeding and also promote operator safety.
- The mechanism for stunning and killing ostriches by mechanical means requires further investigation to differentiate between physical destruction and concussion.
- Head-only electrical stunning of ostriches can result in their death. The mechanism for this effect requires investigation.

## **6. METHODS FOR STUNNING AND STUN / KILLING DUCKS**

### **6.1. Conclusions**

- The penetrative captive bolt may be effective for killing ducks, but its use has not been investigated.
- Non-penetrative captive bolt killing has been demonstrated to give an effective stun/kill in ducks if applied correctly. Due to individual handling of the birds the method is mainly suitable for smaller slaughter numbers, especially with on-farm and emergency slaughter.
- Electrical stunning in a water bath stunner, is an effective method for stunning ducks and is also suitable for large numbers. A stun/killing operation has welfare advantages over a mere stunning operation, however, it is vital that the heads of the birds are fully immersed in the water.
- Killing ducks in a water bath stunner requires currents of at least 130 mA per bird (sinusoidal AC at 50 Hz). A reversible stun can be achieved by raising the frequency, however, no current/frequency combination above 50Hz which will result in an effective stun has been shown to date.
- Head-only-stunning using tongs may be an acceptable method with currents of not less than 600 mA (sinusoidal AC at 50 Hz).
- Gas can be used to kill ducks. Exposure to an inert gas or to <30% Carbon Dioxide and 60% inert gas is likely to result in humane stunning and killing. However, due to lack of data some concerns remain as to whether the induction phase is acceptable on welfare grounds.
- Cervical dislocation and decapitation should only be used to kill stunned ducks.

### **6.2. Recommendations**

- Electrical stunning in a water bath stunner should aim to kill the ducks. This requires currents of at least 130 mA (sinusoidal AC at 50 Hz) per bird.
- If water bath stunners are used, the heads of the ducks must be fully immersed in the water.

- If head-only stunning is carried out, currents of at least 600 mA (sinusoidal AC at 50 Hz) are recommended.
- When mechanical stunning is used it must be followed by bleeding.
- In the absence of any evidence that use of carbon dioxide to stun ducks is humane, high concentrations of carbon dioxide should not be used.

### **6.3. Future research**

- There is need for research to evaluate the use of penetrative captive bolt killing for ducks.
- The use of current/frequency combinations at higher frequencies in electrical water baths stunning requires investigation.
- Further investigation into the effects of induction on the welfare of ducks during gas stunning is required.
- Also research is recommended to develop quick, efficient and painless methods for mass culling of ducks in their holdings.

## **7. METHODS FOR STUNNING AND STUN / KILLING GEESE**

### **7.1. Conclusions**

- There is little information on the stunning and slaughter of geese.
- Percussive stunning is the only proven method for the effective stun/killing of geese. There is a commercial device (Cash Poultry Killer) that will deliver a percussive blow that will result in immediate unconsciousness and death when carried out correctly.
- It is likely that electrical waterbath stunning would be effective with geese however; the minimum current to stun has not been demonstrated.
- Electrical waterbath stunning with at least 130 mA per bird at 50 HZ sinusoidal AC will result in 90% of birds being killed in the stunner.
- Gas can be used to kill geese. Exposure to an inert gas or to some gas mixtures is likely to result in humane stunning and killing, however it is not known whether or not the induction phase is acceptable on welfare grounds.

### **7.2. Recommendations**

- Special emphasis should be given to establish whether the induction phase of gas stunning and killing geese would be acceptable from the view of animal welfare.
- When mechanical stunning is used it must be followed by bleeding.
- In the absence of any evidence that use of carbon dioxide to stun geese is humane, high concentrations of carbon dioxide should not be used.

### **7.3. Future research**

- There is a need for more scientific investigations on stunning and slaughter of geese.
- Further investigation into the effects on the welfare of geese during gas stunning is necessary.

## **8. METHODS FOR STUNNING AND STUN / KILLING QUAIL**

### **8.1. Conclusions**

- There is not much information on stunning and slaughter of quail.

- Electrical methods are considered to be effective for stun/killing quail.
- Gas stunning seems to be less stressful when birds are exposed to the gas mixture while restrained in their transport crates. Gas mixtures with 90% argon (or inert gas), or mixtures of up to 30% carbon dioxide and 60% argon (or inert gas), with less than 2% oxygen, are effective to kill the birds.

## 8.2. Recommendations

- Electrical stunning should be designed to induce an effective stun and cardiac arrest.
- Gas stunning should be performed with either 90 % argon, or mixtures of up to 30 % carbon dioxide, and 60 % argon, with less than 2% oxygen. In the absence of any evidence that use of carbon dioxide to stun quail is humane, high concentrations of carbon dioxide should not be used.
- Gas stunning should be carried out in transport containers to avoid stress of unloading.
- Stunning methods should kill the bird but it is necessary to make sure that the birds are dead before they are skinned.
- When mechanical stunning is used it must be followed by bleeding.

## 8.3. Future research

- There is a need for more scientific investigations on stunning and slaughter of quail.

## 9. CONCLUSIONS AND RECOMMENDATIONS ON THE FOOD SAFETY IMPLICATIONS (BIOHAZ PANEL)

1. Present knowledge on the food safety risks associated with use of penetrative captive bolt (Pcb) stunning of goats, with respect to potential dissemination of CNS emboli into edible tissues and consequent exposure of humans to BSE agent, is insufficient to quantify the risks.

However, based on expected similarities between goats and sheep with respect to Pcb stunning-induced CNS embolism, such risks may exist. Therefore, as with cattle and sheep, use of stunning methods for goats that do not cause CNS embolism (*e.g.* electrical) would be preferred. Further research in this area is urgently needed.

2. Present knowledge on the food safety risks associated with use of Pcb stunning of deer, with respect to potential dissemination of CNS emboli into edible tissues and consequent exposure of humans to CWD agent, is insufficient to quantify the risks.

Because CNS emboli dissemination has been demonstrated in other ruminants (cattle, sheep), it might also occur in deer. Potential food safety risks associated with Pcb stunning of deer may be lower than in goats, because BSE has not been reported in deer and CWD has not been reported in Europe. Therefore, a caution would be advisable, in terms of preferred use of non-CNS emboli-causing stunning methods for deer (*e.g.* electrical). Further research in this area is needed.

3. Present knowledge on the food safety risks associated with use of Pcb stunning of deer, goats, ostriches and rabbits with respect to potential contamination of their brains with pathogenic bacteria from head skin and subsequent spread to edible tissues, is insufficient.

Nevertheless, because such a possibility was experimentally demonstrated with marker bacteria in other species, further research is needed to evaluate whether such a risk exist with actual pathogens under commercial conditions.

4. Current knowledge on the extent of microbial contamination of water used in stunning baths for ducks, geese and quail is inadequate, as is the case for other poultry species (broilers, turkeys).

The fate of foodborne pathogens that may be present in such water is unknown; however, it can be assumed that there is a risk of contamination of the lungs of those species with such pathogens in the course of stunning.

As the evidence of such contamination has come from studies conducted in poultry other than duck, geese or quail, extrapolation to the latter species should be made worst case. Such risks require to be addressed through appropriate Good Hygiene Practice measures. Should such measures be found to be ineffective, alternative approaches would need to be considered. Meanwhile further research on this issue is required to determine the extent of any such risk.

## **10. DOCUMENTATION PROVIDED TO EFSA**

Letter sent on the 11/01/2005 with ref. SANCO/E2/RH/gp (04) D/522469r1, from Mr. Jaana Husu-Kallio, Deputy Director General, Health and Consumer Protection Directorate-General.

## **11. REFERENCES**

All references are available in the Scientific Report on the welfare aspects of the main systems of stunning and killing applied to commercially farmed deer, goats, rabbits, ostriches, ducks, geese and quail.

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