New developments to improve animal welfare during stunning and killing of poultry for disease control purposes

David G Pritchard, Formerly Senior Veterinary Consultant Animal Welfare Defra United Kingdom
New developments in poultry killing - Overview

① Welfare Policy, Ethics, Law, Economics
② Communication - Stakeholders and Public
③ Practical response – preparation, contingency planning, operations, training, people
④ Science of humane killing
⑤ Selection of killing methods
⑥ Conclusions
POLICY QUESTIONS
Choice of killing methods? What should we use?
Challenge 1 – Policy Ethics Law

• Why and when to kill for disease control?
• Does the control of an infectious disease justify killing (large) numbers of wild or domestic animals?
• ....?
Killing animals for disease control is a very complex issue

- Animal welfare
- Quick death
- Workers
- Carcasses, Water, land
- Farmers feelings
- Mass media
- Empty the farm
- Infected animals
- Handling and restraint

- Workers security
- Environment
- Biosecurity
- Social aspects
Large scale depopulation of animals is an emotional issues for all concerned

Large-scale euthanasia or depopulation of animals may apply to;
✓ emergency control or eradication of animal diseases.
✓ Removal animals from a compromised situation (e.g. following flood, storm, re, drought or a feed contamination event),
✓ Welfare depopulation when there is an oversupply due to a dysfunctional or closed marketing channel, or
✓ Depopulation and disposal of animals with minimal handling to decrease the risk of a zoonotic disease infecting humans.
Ethics of disease control

WHY?
Food production
Human disease?
Animal welfare

Questions:

• Does the control of an infectious disease justify killing large numbers of wild or domestic animals?

• Does it matter ethically whether the disease is an animal disease or a zoonosis?

• Do the harms resulting from disease control measures balanced by the benefits to society?
Ethics is different to Science

• Ethics is the systematic study of values, virtues, moral concepts, principles and/or practices as a way to help us determine what we **ought** to do.

• **Ethics questions** are *action-guiding* in nature and take the form of “should.”
  - E.g. , “**Should** we control highly pathogenic avian influenza?”

• **Scientific questions** are *informative* in nature and take the form of “can.”
  - E.g. “**Can** we control highly pathogenic avian influenza?”
The ethics of animal use are the fundamental driver underpinning our interactions with animals and the development of EU welfare policy.

EU's Treaty of Lisbon, 2009. Article 13 states that: 'In formulating and implementing the Union's [...] policies, the Union and the Member States shall, since animals are sentient beings, of animals, while respecting the legislative or administrative provisions and customs of the Member States relating in particular to religious rites, cultural traditions and regional heritage.'
Ethical Principles – Veterinary Paradox of caring and Killing

• How can we reduce the negative effect killing animals can have on people?
• Improve knowledge of killing and ethical basis of personal values
• Improve techniques of euthanasia
• Improve contingency plans and battle rhythms
• Improve efficiency – Do the job well
• Improve CONFIDENCE to organise and manage mass depopulation on farm
• Improve communication and management skills to support staff and each other and take account of views of farmers and local communities
FAWC'S : Basic Principles of slaughter and killing

• pre-slaughter handling facilities which minimise stress;
• use of competent well trained, caring personnel;
• appropriate equipment which is fit for the purpose;
• an effective process which induces immediate unconsciousness and insensibility or an induction to a period of unconsciousness without distress; and
• guarantee of non-recovery from that process until death ensues.
Concept of Notifiable disease

- Evolution of animal disease control for public good - food production - human disease
- Duties on animal keepers
- Duty of monitoring Training skills, competency, licensing
- Duty of reporting
- Duty of biosecurity
- Compensation payments
- Encourage reporting
- Dependant on compliance
- Cost sharing Industry and tax payer
Control by stamping out
Duties of care on Veterinary services
Balance risk, costs and benefits

• Cases
  – Clear definition (OIE)
  – Confirmed cases duty of care
• Clinical signs- training of VOs
• Laboratory test - validation, quality control
• Suspect cases- risk based/ consequence
• Dangerous Contacts
  – Tracing information- duty of truth of informants
  – Epidemiological analysis – factual, risk based

• Contiguous culls - Firewalls
  – Scientific justification
  – Local epidemiological analysis
  – Political activity
Impacts of disease control measures on AW

• Humane killing
  – Technical, Logistics disposal versus welfare
  – Speed, cost, resources

• Disease surveillance veterinary inspection
  – Handling, sampling

• Movement restrictions
  – Animals, fomites, people, recreational activities
  – Risk management tool

• Legal, certainty, confidence, epidemiology hypotheses
  – Impact – scope, scale, duration - Be Proportionate
Impact of disease control measures on AW

• Licensing movements
  — Welfare- safety, food, treatment, facilitate care
  — Economic- slaughter to maintain food supply low risk
  — Economic - Within farm
  — Economic – between farms – local/ long distance
  — Balance benefits of disease control with economic damage

• Economic support due to market failure
  — Welfare disposal schemes
  — Support to farms
  — Support for other affected businesses
Evaluation of vaccination

- **Vaccinate temporary aid to control – to kill**
  - Aid to Eradication
  - Aid to logistic management of epidemic
  - Reduce welfare cost of disease-in infected animals
  - Can reduce economic and welfare impact

- **Vaccinate to live**
  - eradication with DIVA test
  - Reduce economic impact
  - Reduce welfare cost of disease

- **Cons for vaccination**
  - Divert resource from stamping out—two armies
  - Increased animal handling
  - Increased killing rate compared to stamping out
  - Accept endemicity (CSF)
  - Trade impact (consumers)
  - Accept infection for longer period than stamping out
  - Longer term of movement restrictions
  - Indirect welfare impacts due to prolonged movement controls or additional pre testing regimes and market failures.
Vaccination against avian influenza can be an effective tool to supplement disease control measures and to avoid massive killing and destruction of poultry or other captive birds.

Current knowledge suggests that vaccination may be useful not only as a short-term measure in emergencies but also as a long-term measure to prevent disease in situations of higher risk of introduction of avian influenza viruses from wild life or other sources.

Provisions should therefore be established for both emergency and preventive vaccination.

Measures for restricon of vaccinated poultry and their products.
NEW EU REGULATION 1099/2009 (law) TO PROTECT ANIMALS AT TIME OF KILLING

Increased slaughterhouse operator responsibility:
- Standard operating procedures. SOPs.
- Animal based indicators. ABIs
- Animal Welfare Officer. AWOs
- requires manufacturers of stunning equipment to provide instructions.

Training and research on animal welfare:
- staff handling animals in slaughterhouses must have certificate of competence

- provide scientific support and technical assistance
- **Updated standards** - to better define limit stunning or killing and construction of slaughterhouses
NEW Elements required by 1099/2009 to improve accountability

- Training of personnel
- Standard operating procedures
- Maintenance of equipment
- Calibration of equipment
- Depopulation action plans
- Incident reports
- AUDIT Review of procedures and practices
- Member State report to EU Commission
New measures required by 1099/2009 to improve animal welfare by Independent Scientific support.
Contingency Planning, Emergency Response

Horizon Scanning  
Anticipation

Risk Assessment  
Assessment

Disease Prevention  
Prevention

Contingency Planning  
Preparation

Disease Control (killing)  
Response

Recovery  
Learn lessons
NEW EU REGULATION 1099/2009 (law) TO PROTECT ANIMALS AT TIME OF KILLING

• New requirements for killing for disease control purposes
  - Makes the competent authority more accountable for welfare.
  - Better planning, supervision and reporting.

ACTION PLAN ON EACH FARM DEPOPULATED

- Bans welfare unfriendly killing methods but allows exceptions (such as to protect human health or in case of an uncontrollable animal disease).
Regulation 1099/2009 requires an action plan, outlined in Article 18 (1), to be established by CAs.

The plan must include: the stunning and killing methods planned and SOPs formulated on the basis of the scenario established in the disease control contingency plan required under EU laws concerning the size and the location of suspected outbreaks.

Risk assessments and ethical considerations regarding depopulation are expected to be integral considerations in the formulation of such plans, which amongst other issues, allows the most appropriate killing method to be identified for a given scenario.
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Contingency Planning, Emergency Response

Horizon Scanning
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Assessment
Disease Prevention
Prevention
Contingency Planning
Preparation
Disease Control (killing)
Response
Recovery
Learn lessons
**Strategic**

- Civil Contingencies Committee
- (Prime) Minister leadership
- Chief Veterinary Officer
- Other Government depts.
- Expert Science Advice

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**Tactical**

- National Disease Control Centre
- Operational and Policy
- Operational partners
- Stakeholders

---

**Operational**

- Local Disease Control Centre
- Based in outbreak area
- Deliver the response
- Strong local networks
Engagement with stakeholders

• In advance on
  – methods of killing
  – logistics of operations
  – humaneness of killing
• Public documents: available on web
• Training issues
• Communication
Effective preparations

- Preparation to kill animals for disease control
  - Contingency planning includes welfare
  - Engagement with stakeholders in advance
  - Practical Training in advance
  - Decide on skills, knowledge, competences required
- Key people
Key people

• Leadership roles
• Senior experienced
• Trained, confident
• Have practical exposure to methods and situations
• Flexible

*Need strong support*
What do they need to understand?

- Animal behaviour
- Handling livestock
- Weapons
Communication to deal effectively with media coverage
World wide TV images

- FMD 2001
- Negative reaction
- HPAI 2010
Communication about killing on infected premises

• Media handling is key – proactive briefing, factual information and rebuttals
  – The methods of killing you have described in your letter such as birds being drowned, buried or burnt alive or stuffed live into polythene bags or wheelie bins would not be permitted in this country

• Evidence on humaneness and systems
Briefings for media

• Set out what the industry does
  – how it works

• explain key terms
  – stunning, death, a humane kill, stress
  – Provide video material
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6. Conclusions
KILLING OF ANIMALS FOR DISEASE CONTROL PURPOSES

Chapter 7.6.

General principles

These recommendations are based on the premise that a decision to kill the animals has been made, and address the need to ensure the welfare of the animals until they are dead.

1. All personnel involved in the humane killing of animals should have the relevant skills and competencies. Competence may be gained through formal training and/or practical experience.

2. As necessary, operational procedures should be adapted to the specific circumstances operating on the premises and should address, apart from animal welfare, aesthetics of the method of euthanasia, cost of the method, operator safety, biosecurity and environmental aspects, aesthetics of the method of euthanasia and cost of the method.
Management of Critical Points

- Pre-slaughter handling
  - Species specific requirements and throughput rates
- Restraining
  - Appropriate for species and size of animals and stunning methods
  - Keep to minimum and for short duration
- Stunning method
  - Appropriate for species and size of animals
- Killing method
  - Appropriate for species; backup and maintain equipment
Battle rhythm

• Notifiable Disease investigation – suspect or confirmed
• CVO stock take - Telecom to update government players
• Activate LDECCs and NDECC
• Expert group - Animal disease policy group
• Stakeholder Groups
• NDECC holds **Bird Table** three times daily
UK experience and recent developments

- On farm killing – practical methods
- Research on
  - Whole House Gassing (WHG)
  - Foam Delivery of gas
- Containerised Gassing Units (CGUs)
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Effect gases used for depopulation

- Exposure of poultry to inert gases such as nitrogen and argon and the removal of oxygen by low atmosphere pressure stunning LAPS all produce hypoxic hypoxia with similar clinical signs although the time course will vary depending on speed of reduction of oxygen tension.
- Exposure to carbon dioxide produced hypercapnic hypoxia which has a different range of clinical signs as at high concentrations it maybe aversive and also has anesthetic effects due to lowering pH of CSF.
Research Questions on whole house gassing
Humane? Pain? Freezing?

EKG

EEG
Whole house culling of hens for disease purposes using carbon dioxide: behaviour, gas levels and temperature

Deep pit battery house
Lance injection of liquid CO2

- Low temperature of liquid CO\textsubscript{2} (-78 °C)
- Do birds suffer from hypothermia prior to unconsciousness?
- Video the behaviour of hens during while monitoring CO\textsubscript{2} levels and house temperature

Telemetry/logging unit and harness

Victoria Sandilands\textsuperscript{1}, Nicholas Sparks\textsuperscript{1} and Dorothy McKeegan\textsuperscript{2}
\textsuperscript{1}SAC, West Mains Road, Edinburgh, , Scotland
\textsuperscript{2}University of Glasgow, Bearsden Road, Glasgow, Royal Vet college London, Animal Health (IASE 2009)
Temperature measured at 7 locations in a conventional deep pit cage house during injection of CO₂. Time (0) is time of gas entry.

Victoria Sandilands¹, Nicholas Sparks¹ and Dorothy McKeegan²
¹SAC, West Mains Road, Edinburgh, Scotland
²University of Glasgow, Bearsden Road, Glasgow, the Animal Health Office, and included collaboration with RVC London.

(IASE 2009)
Infrared thermography

- Baseline spot temperatures of 37.4 °C (head), 32.2 °C (body) and 22.1 °C (cage)
- Surface temperature of the head or body did not fall below 0 °C, lowest ambient/cage temperature fell to 9 °C
- Gross body movements visible
### Behaviours during hens’ exposure to CO₂ gas and what they indicate.

<table>
<thead>
<tr>
<th>Latency to first:</th>
<th>Indicative of</th>
<th>Mean time ± SD (sec)</th>
<th>Mean CO₂ level (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gasps</td>
<td>Aversion to change of atmosphere, respiratory distress</td>
<td>147 ± 22</td>
<td>0.7 ± 0.8%</td>
</tr>
<tr>
<td>Loss of balance</td>
<td>Losing consciousness</td>
<td>215 ± 18</td>
<td>3.5 ± 3.0%</td>
</tr>
<tr>
<td>Convulsions</td>
<td>Losing consciousness</td>
<td>276 ± 14</td>
<td>6.0 ± 4.6%</td>
</tr>
<tr>
<td>Last visible movement</td>
<td>Death</td>
<td>731 ± 47 sec</td>
<td>27.3 ± 6.8%</td>
</tr>
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Behaviours during hens’ exposure to CO$_2$ gas

CONCLUSION

• The data from video footage indicate that birds died before they suffered from hypothermia while CO$_2$ levels were still relatively low.

• Although CO$_2$ can cause respiratory distress, birds began to lose consciousness (based on behaviour) in ~4 min.

• Whole house gas culling is a relatively quick method of emergency killing.

• In the case of a zoonotic disease outbreak, it is also relatively safe for human operators, because only a small number of staff must come in contact with live diseased birds.

Victoria Sandilands$^1$, Nicholas Sparks$^1$ and Dorothy McKeegan$^2$

$^1$SAC, West Mains Road, Edinburgh, Scotland
$^2$University of Glasgow, Bearsden Road, Glasgow, Royal Vet college London, Animal Health
(IASE 2009)
POLICY QUESTIONS
Operational research
Improve Use of Lethal Gases:
Containerised Gassing units CGUs
Foam delivery of gas

Features

• Development stage
• foam surfactant used to hold gas
• pumped in to fill building
• bird movement breaks bubble and releases inert gas
• death by exposure to anoxic gas mixture, not by physical obstruction of trachea/lungs
• acceptance by birds
Welfare assessment of anoxic gas foam as an agent for emergency killing of poultry

Dorothy McKeegan, Julian Sparrey, John Lowe, Christopher Wathes, Theo Demmers, Frans Withoos, Hatim Alibahti

Marien Gerritzen
Animal Sciences Group of Wageningen
Netherlands

Bruce Webster
University of Georgia USA
## Initial study on CO$_2$ enriched foam

<table>
<thead>
<tr>
<th>Foam expansion rate</th>
<th>Time to fill up house</th>
<th>Time for birds to be immersed in foam</th>
<th>CO$_2$ concentration 10cm. above foam</th>
</tr>
</thead>
<tbody>
<tr>
<td>300:1</td>
<td>30 s. (24-40)</td>
<td>20 s. (12-40)</td>
<td>40-75% 78% in foam</td>
</tr>
</tbody>
</table>

- HR drop = Acute death
- Convulsions in 5 of 6 birds 30-56 sc.
- Minimal fear (great alertness)
- Wing flapping 60s. After foam onset
- Skin Temp. $3^\circ$C↑
- HR 300bmp ↓

Gerritzen & Sparrey - Animal Welfare
2008, 17 : 285 - 288
Hen trials – Electro Cardio Gram responses – CONTROLS Foam with air

Time 0 birds exposed to foam

Hen trials – ECG responses – $N_2$ FOAM

submerged

motionless
Hen trials – Electro Encephalo Gram responses – $N_2$ foam

Timings (seconds) of EEG changes in hens in relation to submersion

Mean ± SD

- **Baseline**
  - **Mean**: 9.8 ± 2.8

- **Transitional**
  - **Mean**: 30.1 ± 6.8

- **Suppressed**
  - **Mean**: 65.7 ± 11.5

Quicker in foam than conventional anoxic nitrogen killing because you are not sucking in air.
Low Atmosphere Pressure Stunning Overview

- Low atmospheric pressure stunning (LAPS) system simulates what happens when you climb to high altitudes.
- During the nearly 5 minute cycle, air is gradually withdrawn from the chamber until the air pressure is roughly 20 percent of what it is outside.
- Because less oxygen is available, the birds lose consciousness, and are unable to feel pain. At the end of the LAPS cycle, birds are irreversibly stunned.
Low atmosphere pressure stunning LAPS

• Developed at Universities of Mississippi and Arkansas in USA with UK and NL Universities
• Approved for commercial slaughter of poultry in USA and Canada
• In use for other killing of poultry in USA Canada.
• Seeking approval for use in Europe
Low Atmosphere Pressure Stunning LAPS
Stun in Transport Coops
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FIGURE 2-3. TIMES OF USEFUL CONSCIOUSNESS VERSUS ALTITUDE

<table>
<thead>
<tr>
<th>ALTITUDE</th>
<th>TUC/EPT</th>
<th>Following Rapid Decompression</th>
</tr>
</thead>
<tbody>
<tr>
<td>18,000</td>
<td>20–30 min</td>
<td>10–15 min</td>
</tr>
<tr>
<td>22,000</td>
<td>10 min</td>
<td>5–6 min</td>
</tr>
<tr>
<td>25,000</td>
<td>3–5 min</td>
<td>1.5–2.5 min</td>
</tr>
<tr>
<td>28,000</td>
<td>2.5–3 min</td>
<td>1–1.5 min</td>
</tr>
<tr>
<td>30,000</td>
<td>1–2 min</td>
<td>30 s–1 min</td>
</tr>
<tr>
<td>35,000</td>
<td>30 s–1 min</td>
<td>15–30 s</td>
</tr>
<tr>
<td>40,000</td>
<td>15–20 s</td>
<td>Nominal</td>
</tr>
<tr>
<td>43,000</td>
<td>9–12 s</td>
<td>Nominal</td>
</tr>
<tr>
<td>50,000</td>
<td>9–12 s</td>
<td>Nominal</td>
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Aviation physiology Hypoxia

Similar to climbing to altitude
Euphoria
Decline in consciousness
Breathing deepens but no gasping
Quick recovery from Loss of Posture but no memory
## Aviation Effects of pressure changes

<table>
<thead>
<tr>
<th>GAS LAW</th>
<th>EXPLANATION</th>
<th>AVIATION APPLICATION</th>
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| Boyle’s Law  
\[
P_1 = \frac{V_2}{V_1}  
P_2 = \frac{V_1}{V_0}  
\] | A volume of a gas is inversely proportional to the pressure to which it is subjected with the temperature remaining constant. | **TRAPPED GAS**  
This law explains how pressure change allows the gas to expand and contract in body cavities (ears, sinuses, and gastrointestinal (GI) tract) with increasing and decreasing altitude. |

Risk of expansion of trapped gas is proportional to rate of pressure change:
- Explosive - High risk
- Rapid - Medium risk
- Slow - low or no risk
AVMA had previously not supported decompression as a method of killing due to concerns over rapid decompression. In 2013 they agreed to low pressure atmosphere stunning when it can be demonstrated that it achieves euthanasia.
Mobile Laps unit for killing for disease control
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1. Competent authority … shall establish an action plan to ensure compliance with the rules .. before the commencement of the operation. Action must specify .. the stunning and killing methods planned and …the standard operating procedures …as may be included ….in the contingency plans required under Community law on animal health, on the basis of the hypothesis established …..concerning the size and the location of suspected outbreaks.
EU1099/2099 – Action plan requirements for depopulation

Art:11

2. (a) ensure that such operations are carried out in accordance with the action plan referred to in paragraph 1;
(b) take any appropriate action to safeguard the welfare of the animals in the best available conditions.

3. ….in exceptional circumstances, the competent authority may grant derogations from one or more of the provisions of this Regulation where it considers that compliance is likely to affect human health or significantly slow down the process of eradication of a disease.
Depopulation Action plan: Establishing the farm situation

Key issue in a action depopulation action plan is to prevent the disease from spreading.

First measure to be taken is to close the farm. Second step is to identify the specific farm conditions based on which you can make decisions on; required staff, killing method, safety measures, services and materials.

Checklist:

- Size of the premise
- Location and access roads
- Location of the farmers house
- Distance to surrounding farms and houses
- Identify farmer family and pets and their preferences
- Number and type of buildings
- Weather conditions.....
Depopulation Action plan: Housing conditions

During an outbreak of a contagious disease you will meet different animal housing conditions. Before you can decide on the best mode of operation you need to collect as much information on the housing conditions as possible.

Checklist:
- Size of the buildings
- Natural or mechanical ventilation
- Access doors
- Animals kept inside or have outdoor access
- Obstructions in the building
- Feeders, drinkers
- Solid walls or (semi)open walls
- Building material (wood, concrete, ...)

During an outbreak of a contagious disease you will meet different animal housing conditions. Before you can decide on the best mode of operation you need to collect as much information on the housing conditions as possible.
Choose the optimum methodology

When you make a choice on the optimum methodology to apply you have to be aware of the limitations of that method regarding housing situation and animal welfare. To help you choose the optimum methodology you can ask yourself a list of questions:

How many animals are on the farm?
What are the housing conditions?
What are the limitations of the methodology?
Which methods are available?
What capacity do I need? (people, equipment,..)
What are the consequences for the rest of the contingency plan (safety, animal welfare, costs, removal of carcasses, biosecurity,..)
Choice of method
Each method has specific working mechanism, capacity and applicability which affects the delivery of humane kill.

Decision on which method(s) are to be used in a particular situation depends strongly on the farm situation, equipment and skills available.

Systems that require handling of live animals
- Electrical killing
- Gas filled containers and culling bags
- Containerised gassing units
- Lethal injection
- Percussion guns
- Cervical dislocation

Methods that do not need handling of live animals.
- Whole house gassing
- Gas-filled foam
- Anaesthetics in water and feed
- Ventilation shut down
Ensuring/Controlling good practice

“A good plan only holds when you are in control”

Have a written plan

Communicate to everybody involved

Be prepared for anything going wrong

Check the during the whole process
Head stun/kill (Single bird Electrocution)

Head electrocution uses stun /kill cycle of head stunner. Birds are caught and killed in house or at station outside.

**Strengths**

- Useful for a small number of birds
- Easy to move
- Head stuner may be available on farm

**Weakness**

- Intensive animal handling
- Large number of personnel
- Very limited capacity
- Shackling pain of live birds
Mobile electrocution lines

Mobile electrocution lines are based on conventional slaughter lines. Birds are caught and walked to the killing unit where they are electrocuted in a water bath.

**Strengths**
- Controllable killing method
- Easy to stop and adjust (meter)
- Applicable in many situations
- Easy to move

**Weakness**
- Intensive animal handling
- Large number of personnel
- Limited capacity
- Shackling pain of live birds
Signs of effective electric Water bath killing

- Neck arched
- Wings folded close to the body
- Rigidly extended legs
- Rapid body tremors
- No response to comb pinch
- No response to touching eye
- No signs of respiration
- Cardiac arrest is induced
Anaesthetic in feed or water

- **Strengths**
  a) Handling is not required until birds are anaesthetised.
  b) There may be biosecurity advantages in the case of large numbers of diseased birds.

- **Weakness**
  a) Non-target animals – accidental ingestion
  b) Dose taken is not regulated and results variable.
  c) Animals may reject adulterated feed or water due to illness or adverse flavour.
  d) The method may need to be followed by killing.
  e) Care is essential in the preparation and provision of treated feed or water, and in the disposal of uneaten treated feed/water and contaminated carcasses.
Neck dislocation

• **Strengths**
  – no equipment
  – field expertise
  – humane at up to 3kg

• **Weakness**
  – small numbers
  – repetitive strain
  – individual birds need to be handled

• **Uses**
  – immediate killing for disease/welfare
Lethal injection

• **Strengths**
  – minimal equipment, already held
  – humane

• **Weakness**
  – requires vet to administer
  – can only deal with small numbers
  – individual animals need to be handled

• **Uses**
  – immediate killing for disease/welfare
  – young animals, hobby and backyard flocks
Controlled atmosphere stunning and Killing - gas mixtures

Council regulation 1099/2009 lists a number of gasses including specific requirements that can be used for depopulation reasons.

**Gasses or gas mixtures**

- Carbon dioxide
- Carbon dioxide mixtures with argon or nitrogen
- Nitrogen
- Argon
- Carbon monoxide

**Requirements**

- Gasses should never create burns, excitement by freezing or lack of humidity.
- Animals remain in the gas concentration until they are dead.
Gas mixtures, making the right choice.

The choice for a gas or gas mixture depends on were and how you want to use it. More important the required conditions should be leading in making the right choice.

**Conditions**

- Inert gasses (Ar, N2) require concentrations resulting in less than 2% residual oxygen closed chambers
- Carbon monoxide is very lethal in low concentrations only in very well controlled situations.
- Carbon dioxide is effective in concentrations > 40% applicable in different situations.
Gas mixtures, making the right choice.

Conditions

- Inert gases (Ar, N2) with <30% Carbon dioxide require concentrations resulting in less than 2% residual oxygen in closed chambers.

Completely relaxed carcasses
Gassing bags

Strengths

• Modest cost
• Proven technique commercially available

Weakness

• Individual birds need to be handled
• H&S associated with use of gas
• Some welfare issues
• Low throughput

Uses

• Small units
Using 100% carbon dioxide in modified skip
Humane death?
Gas filled containers

Gas filled containers or culling bags are placed inside or outside the animal house. The Animals need to be caught and placed by hand into the containers.

**Strengths**

- Easy to move
- Controllable killing method
- Easy to stop and adjust
- Applicable in many situations

**Weakness**

- Intensive handling of live animals
- Large numbers of personnel
- Low capacity per set (operation speed)
- Aversive? High gas concentrations
- Risk of suffocation
Other gas container killing methods

- Danish Chick pulp: mobile slaughter rendering devise

- Hungarian culling tipping trailer
Containerised gassing units CGU

- **Strengths**
  - modest cost
  - proven technique, Robust
  - Humane (low risk of suffocation)
  - Argon/CO2 gas mix (80/20)
  - flexible
- **Weakness**
  - need to handle birds
  - H&S associated with use of gas
  - moderate throughput
Dutch Whole house gassing using 40% Carbon dioxide

Filling the whole house with a gas mixture to kill the animals. The gas is injected from a tanker by one or more injection points into the shed where it distributes.

**Strengths**
No contact with live birds
High capacity

**Weakness**
Difficult to control and to adjust during processing
Needs skilled engineers
Temperature development
Not suitable for all houses
High Expansion Gas filled foam

To apply whole house gassing in non closable buildings the gas filled foam method was developed. The foam is injected in a restricted area or into the shed covering the animals with a layer of foam filled with 99% of nitrogen. Animals will lose consciousness and die due to the lack of oxygen in the breathing air.

**STRENGTHS**

Applicable in open housings  
No drowning. No restriction of airways due to large bubble size  
No recovery, New method, still under development
• Expansion ratio of between 250:1 to 350:1
• **Nitrogen** produced more consistent foam
• Potential for wing flapping to destroy foam
• Height of foam achieved above the bird before wing flapping begins (c. 15-18 sec) is crucial – minimum 60 cm required
Concept

Liquid Nitrogen storage

Vaporiser

Water Storage

Foam Generator Units

Pump, mixing, distribution and control platform
High Pressure Gas Connection

• Gas at 200 bar from pump unit to maintain flow rate.
• Pressure reduced to that required for FGUs
Broiler Trial Shed
Foam loss from shed
Oxygen levels in Laying shed trial

Oxygen Concentration (%) vs. Time (hh:mm)

- Sensor 1 15 m
- Sensor 2 30 m
- Sensor 3 45 m

14:30:00 to 15:10:00
New developments in poultry killing - Overview

① Welfare Policy, Ethics, Law, Economics
② Communication- Stakeholders and Public
③ Science of humane killing
④ Selection of killing methods
⑤ Practical response – preparation, contingency planning, operations, training, people
⑥ Conclusions
Conclusions

• NEW Containerised Gassing Units
• Flexible but birds must be handled
• Robust - Slow throughput
• NEW Low pressure atmosphere
  stunning
• Handle birds - robust system
• Whole house gassing
• Birds to be killed in their production
• No handling; CO$_2$ availability?
• Ventilation Shutdown
• Controversial used only.. last resort
• NEW Foam (in development)
• Use inert gases, no sealing of buildings
Conclusions

• Animal welfare and killing for disease control is a multifaceted challenge
• Preparation is of vital importance
• Key people are essential to success
• Operations can be humane and quick
• Substantial progress has been made
• There is an ongoing implementation challenge
New developments to improve animal welfare during stunning and killing of poultry for disease control purposes

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