ACTION ON ANIMAL HEALTH AND WELFARE

Guide to Alleviation of Thermal Stress in Poultry in Lairage

MAFF

Thermal Stress

It is well recognised within the poultry industry that thermal (heat) stress in birds in transport and lairage* can have the following effects:

- an increase in mortality
- a reduction in product quality
- compromised poultry welfare

While a number of studies have addressed thermal stress in transit, little has been known about the nature of the effects of the lairage environment on welfare and productivity. This guide focuses on the causes and effects of thermal stress in lairage alone, however, any effect on birds will be substantially greater if they are already heat stressed on arrival due to transport conditions.

*For the purposes of this guide, lairage is defined as any building used to hold birds in modular systems of crates or drawers (i.e. 'modules') between end of journey from farm and slaughter.

Effect of thermal stress on birds

Birds are able to regulate their body temperature by controlling heat loss through:

- their skin and feather cover
- evaporation by panting.

This ability to thermoregulate is compromised if the birds are confined in close proximity to one another and unable to move freely (as they are in modules). This reduces their ability to lose heat by radiation, convection and conduction. Additionally, their ability to lose heat by evaporation is reduced if there is a high humidity. If the birds' ability to lose heat is reduced, their body temperature will rise and they will suffer from thermal stress, dehydration and exhaustion. This compromises their welfare and can lead to a reduction in meat quality by causing:

- alteration to the acid-base balance
- alteration to hydration state
- fatigue and depletion of energy reserves including liver and muscle glycogen loss.

Ultimately, if body temperature rises by 4°C or more, the bird will die.

The Facts

Birds in modules in lairage...

- Heat and humidity are generated by birds in modules.
- Holding birds in modules imposes severe constraints on their behaviour and hence their ability to regulate their body temperature.
- Stocking density (including empty or part filled crates or drawers) affects temperature, humidity and ventilation conditions in modules.
- Bird-level ventilation in modules is low, despite airflow around the modules.
- There is a large temperature gradient from top to bottom of the modules due to rising heat.

Poultry held in modules stacked in lairage may be subject to thermal stress which can effect both productivity and welfare

- Heat build-up inside the modules is a problem throughout the year, not just in summer.
- Temperature rise inside the modules occurs primarily in the first hour of lairage, after which time an elevated equilibrium temperature is reached.
- However, conditions *combining* to cause thermal stress in birds in modules (humidity, fatigue etc.) worsen with increasing time in lairage.

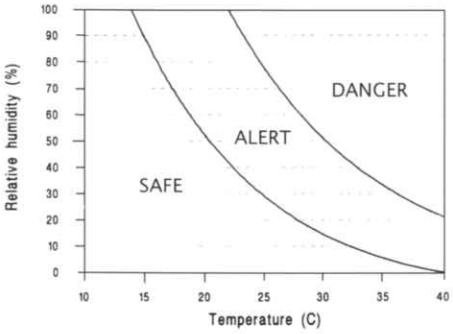


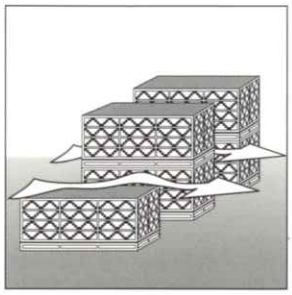
Figure 1. Thermal comfort zones in crates (derived from Apparent Equivalent Temperatures)

Stress in birds in modules...

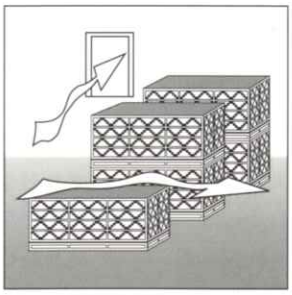
- Thermal stress can result from a combination of elevated temperature and humidity (see Figure 1) and any inability of the birds to regulate their body temperature.
- Dissipation of water vapour and heat from the modules is the key to reducing thermal stress - less than 0.1ms^{-1} air flow through each module is not enough for heat to be dissipated.

Lairage effects...

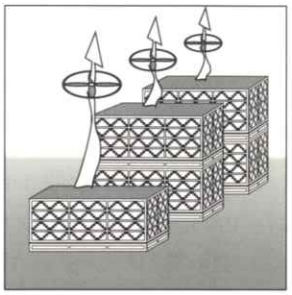
- Base-line conditions in the module are determined by the lairage environment - for example, at an average relative humidity of 70%, temperature in the module should not exceed 26°C if severe heat stress is to be avoided. Since conditions in a full module are *approximately* elevated by 9°C above lairage temperature this indicates that, even without high humidity, there may be a potential heat stress problem for lairage temperatures of 17°C or more.
- Lairage buildings are often big and open, offering no control over air flow - they are expensive or even impossible to air-condition.
- Large heterogeneous buildings with many heat and/or moisture sources cannot be easily controlled, e.g. those with water treatment plants, or where lorries and crates are washed down inside the lairage.



Bird-level ventilation in modules is low, despite air flow around the modules.



Air intended to move through modules can be short-circuited



Extraction of water vapour and heat from the modules is more effective

- There are technical and commercial constraints on how the lairage can be operated and ventilated - e.g. positioning of safety barriers, number and positioning of lanes, existing building structures etc.
- Control strategies, e.g. fans and misting systems, currently in operation are not always helpful.

Fans...

- Fans may reduce the ambient temperature in the lairage by 'importing' external cool air (which has a knock-on effect on the base-line temperature in the crates) but existing fans which provide poor air mixing do not give bird-level ventilation.
- Extraction of water vapour and heat from the modules is more effective at reducing heat stress than attempting to ventilate the entire lairage.
- Air intended to move through modules can be 'short-circuited' e.g. through open doors, walls and windows or by gaps due to safety barriers, drafts caused by passing lorries etc. and air may simply move *around* modules not *through* them.

Misting Systems...

- The use of water sprays or misting systems, while reducing air temperature by 2 or 3°C, raises humidity, saturating the air and inhibiting the birds' heat loss through panting. The efficacy of misting systems is therefore highly questionable due to the relationship between humidity and evaporative heat loss in birds.
- If air entering crates above 20°C is saturated, this leads to severe heat stress in birds, therefore, if misting systems are used to reduce lairage temperature from, say, an ambient temperature of 25°C to 23°C at the expense of saturating the air, the subsequent crate conditions cause severe heat stress.

The Recommendations:

In the lairage...

- Use fans to
  - reduce ambient temperature
  - improve internal air mixing to avoid hot and cold spots
  - extract rather than ventilate
- If fans are used to provide controlled bird-level ventilation:
  - aim to achieve air change at module level with a minimum bird-level air flow of 0.1ms^{-1}
  - increase air flow with rising ambient temperature
  - avoid blasting.
- Consider the entry point and route of air through the lairage and prevent local effects and short-circuiting of air, e.g. from gaps, open doors etc.
- Remove or isolate heat and moisture sources, e.g. misting systems, washing of crates and lorries inside the lairage.
- Worry primarily about the micro-environment in the modules not the lairage.

Focus on removing heat from modules...

- Enhance free natural convection of rising heat by placing modules close to extraction fans where the fans are either over each stack of modules or at the apex of the roof.
- Improve radiated heat loss from the sides of a stack by leaving gaps between modules and lanes of modules.
- Don't put heaters above or on the end of a stack of modules.
- Where possible contain and control the environment within the modules separately by decoupling the micro-environment from the lairage - for example, house each stack of modules in a ventilated tunnel with direct extraction.

MONITORING...

- Monitor birds:

  The minimum requirement should be to inspect birds on arrival at lairage and if panting, distressed or exhausted they should be killed immediately.

  If possible a vet should take rectal temperatures at intervals throughout lairage - moderate heat stress is indicated by a body temperature above 42°C, and in these circumstances steps should be taken to avoid prolonged lairage times.

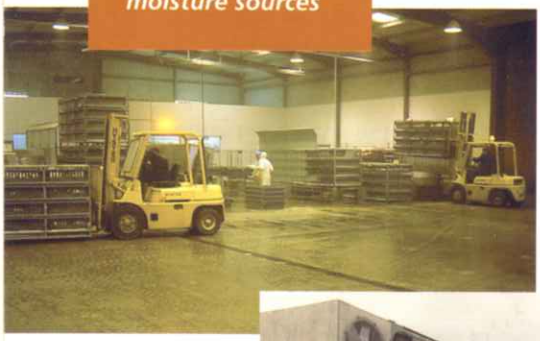
- Monitor the environment in the lairage and the modules using temperature and humidity sensors - refer back to Figure 1.
- Signal a potential threat of heat stress if lairage temperature rises above 17°C or if air is saturated with water vapour.
- Maintain fans and other equipment to the highest standards.

REDUCE THE TIME IN LAIRAGE...

- Keep duration of lairage to a minimum of not more than 1 hour with a MAXIMUM of 2 hours if necessary.
- Ideally kill birds immediately on arrival.
- Regulate and enforce maximum lairage times.
- Plan to avoid hold-ups, e.g. by ensuring delivery of birds of the correct size.

Monitor the environment in the modules using sensors

Remove or isolate moisture sources



Ideally kill birds immediately on arrival

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THE RESEARCH

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CART was formed in 1993 to provide a focus for research. The group promotes multidisciplinary work using the complementary skills and resources available at its various academic and scientific centres throughout the UK and by liaising with commercial communities.

Current members of CART are:

- **Design Research Centre, Brunel University**
- **Division of Food Animal Science, Bristol University**
- **Roslin Institute, Edinburgh**
- **Silsoe Research Institute.**

These organisations provide expertise in a number of areas including animal physiology, behaviour and welfare, meat quality, environmental monitoring, engineering innovation and application, and product design and development.

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CART

Consortium for Animal Research during Transport

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