BROILERS
REARING
MANUAL
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INTRODUCTION

In order to produce a high quality broiler, there are a range of factors that can limit broiler performance both growth and quality:

1. Health
2. Feed Supply
3. Lighting
4. Ventilation
5. Stocking Density
6. Nutrition
7. Temperature
8. Water Supply
9. Vaccinal Status

The objective of the broiler manager should be to achieve the required flock performance in terms of liveweight, feed conversion, uniformity and meat yield. Development of the vital functions such as the cardiovascular, pulmonary, skeletal and immune systems is crucial to this objective. Critical periods for development of these physiological systems occur during incubation and the first 2 weeks of life. Therefore, particular attention must be given to management during these periods.

NB  No two broiler houses are completely identical
Every flock of broilers will differ subtly in its requirements

The broiler manager MUST understand the bird’s requirements and through responsive management, supply the individual requirements to ensure optimum performance in every flock.
**Section 1**

**HOUSING AND ENVIRONMENT**

**Objective**
To provide an environment that permits the bird to achieve optimum performance in growth rate, uniformity, feed efficiency and meat yield and to ensure that the health and welfare of the bird are not compromised.

**Principles**
The housing and ventilation used will depend upon climate. The housing and equipment should allow responsive control of the environment so that the commercial and bird welfare objectives can be fulfilled.

**Control of Environment**

Local climate is one of the most important factors in the design of housing systems. There are 3 main climates:

1. Temperate climates (usually controlled environment)
2. Hot, dry climates (usually controlled environment with cooling systems)
3. Hot, humid climates (often open-sided housing)

**Temperate Climates – Controlled Environment**

Controlled environment housing should provide:

- **Effective insulation**, U Value 0.4W/m²/°C (i.e. R Value 12-14)
- **Effective light-proofing**. Max light intensity within a darkened house should not exceed 0.4 lux
- **Effective, draught free ventilation** - capable of providing and maintaining and adequate and controlled flow of uniformly good quality air at bird level.
- **Floors**, should be smooth, finished concrete for ease of cleaning with a vapour seal.

*NB Baffles should be fitted to fan housings to prevent draughts and light*

**Hot Climate with Low RH% - Controlled environment with Cooling System**
NB Birds will become stressed and performance will suffer if environmental control is inadequate in extremes of temperature

Insulation, light-proofing and ventilation requirements are similar to those for controlled environments. Due to the higher ambient temperature, a greater ventilation capacity and cooling system is required.

In hot conditions (temp >27°C), evaporative cooling of the air is used to maintain the bird at the optimum temperature 25-32°C

Relative Humidity (RH) influences the effectiveness of evaporative cooling as follows:
  - at 20% RH, reduction in temp can be within 15-20°C
  - at 60-70% RH, reduction in temp is 4-8°C
  - at above 70% RH temp reduction becomes limited, and the bird is progressively stressed at cooling by panting becomes less effective

Additionally convective cooling by directing air over the birds can be utilized and become a significant part of the cooling process at RH rises.

The temp will drop accordingly to the air speed across the birds for each of the following:
  - 1m/sec temp drops by 3°C
  - 2-3m/sec temp drops by 6°C
  - Air speeds greater than 4m/sec will cause stress

In extreme conditions, an air speed of 3m/sec can be used to maximize heat loss by convection. The cooling effect will be greater before birds are fully feathered.

Air flow can be increased by reversing existing fans, so that there is direct flow over the birds. Supplementary fans inside the house can boost air flow.

E.g. in an ambient temp of 36°C, and RH of 50%, evaporative cooling will cause house temps to fall to 28°C. An air speed of 2m/sec would decrease temp by 6°C. Therefore the perceived temp at bird level is 22°C

Evaporative Cooling Systems in Common Use:
  1. Low pressure fogging
    - 100-200psi (7-14 bar), droplet sizes. >30 microns may cause wet litter at high humidity
  2. High pressure fogging
    - 400-600psi (28-41bar), droplet sizes of 10-15 microns minimal residual moisture giving extended humidity range.
3. **Cooling Pads**
   - Air is drawn through a water-soaked filter by tunnel ventilation
   - The dual effect of pad cooling and air speed allows control of environment when house temp is very high i.e. >30°C

**Hot, Humid Climates – open sided housing**

Requirement for Open-Sided Housing
1. Located on well-drained land
2. Plenty of natural air movement
3. Direct sunlight must not fall on the side walls during the hottest part of the day
4. House orientation should be that the long axis of the house is in a line lying east to west
5. The roof should be insulated with a surface finish that reflects solar heat
6. A high pitch roof (i.e. 30-40°) assists natural ventilation by increasing movement of air by convection and reduces radiant heat from the underside of the roof at bird level
7. An effective design is:
   - 12m wide, 2.75m to the eaves, 7m high and the roof should overhang the walls by 1.25m - this limits the heating effect of direct sunlight.
   - The side walls should be 25-30cm in height with wire mesh (mesh diameter 25mm) to the eaves
   - (If severe climatic variations, increase wall height to 60-80cm)
   - End walls can either be similar to side walls or solid depending on climate
   - Side walls must also incorporate an adjustable, reinforced plastic curtain to assist in temp control
   - Vegetation covering the ground around the house will reduce the amount of reflected heat entering the house.
   - Shade from trees is beneficial as long as air circulation is not inhibited
   - Houses must be secure from vermin and wild birds
   - Each house must have a concrete path 1.5m wide surrounding the house followed by a drain

**KEY POINTS**
- Design and construct housing and ventilation systems to incorporate requirements for biosecurity, environmental control and responsive management.
- Ensure that insulation is adequate for effective temp control
- Install cooling systems where air temp exceeds 20 for long periods
- Ensure that tunnel-ventilated houses are completely sealed to maximize air flow through the cooling pads and to ensure constant air temp through the house
- Monitor water quality for mineral content, droplet size and bacterial contamination when using fogging systems

**Stocking Density**

Stocking density has a significant influence on broiler performance and final product in terms of uniformity and quality. Quality of housing and environmental control will influence the stocking density applied. If stocking density is increased, an appropriate increase in feeding space and drinker availability must be made and case must be taken to maintain air quality.

**Overstocking will:**

- Reduce growth, liveability, litter quality and leg health
- Increase carcass downgrading due to breast blisters, hockburn, bruising and scratching

Space required for each broiler will depend on:

- Target liveweight and/or age at slaughter
- Climate and season
- Type and/or system of housing and equipment

According to UK Standards the following stocking densities are required at the differing liveweights

<table>
<thead>
<tr>
<th>Liveweight (kg)</th>
<th>Birds/m²</th>
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<tbody>
<tr>
<td>1.0</td>
<td>34.2</td>
</tr>
<tr>
<td>1.4</td>
<td>24.4</td>
</tr>
<tr>
<td>1.8</td>
<td>19.0</td>
</tr>
<tr>
<td>2.0</td>
<td>17.1</td>
</tr>
<tr>
<td>2.2</td>
<td>15.6</td>
</tr>
<tr>
<td>2.6</td>
<td>13.2</td>
</tr>
<tr>
<td>3.0</td>
<td>11.4</td>
</tr>
<tr>
<td>3.4</td>
<td>10.0</td>
</tr>
<tr>
<td>3.8</td>
<td>9.0</td>
</tr>
</tbody>
</table>
KEY POINTS
- Adjust stocking density to allow for the age and weight at which the flock is to be slaughtered
- Reduce stocking density if target house temps cannot be achieved due to hot climate or season
- Adjust ventilation and feeder and drinker space/bird when stocking density is increased

Ventilation and Air Quality

Ventilation
It is essential to deliver a constant and uniform supply of good quality air at bird level, to allow the bird to remain in good health and fulfil the growth potential.
- Minimum Ventilation Rate: 0.70m$^3$/hour/kg liveweight
- Maximum Ventilation Rate: 7.20m$^3$/hour/kg liveweight

When evaporative cooling is used, the system must be capable of cooling air at the maximum ventilation rate. If the capacity of the cooling system is exceeded, or no evaporative cooling is used, then the birds should be cooled by convective heat loss i.e. moving air over the birds.

Air Quality
As broilers grow they consume oxygen and produce waste gases. The ventilation system must remove these waste gases and deliver good air quality.
The main contaminants of air within the house are dust, ammonia, carbon dioxide, carbon monoxide and excess water vapour. When in excess, they damage the respiratory tract, decreasing the efficiency of respiration and reducing bird performance.

Effects of Common Broiler House Air Contaminants

<table>
<thead>
<tr>
<th>Ammonia</th>
<th>Can be detected by smell at 20ppm or above.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>&gt;10ppm will damage the lung surface</td>
</tr>
<tr>
<td></td>
<td>&gt;20ppm will increase susceptibility to respiratory diseases</td>
</tr>
<tr>
<td></td>
<td>&gt;50ppm will reduce growth rate</td>
</tr>
<tr>
<td>Carbon Dioxide</td>
<td>&gt;0.35% causes Ascites. Fatal at high levels</td>
</tr>
<tr>
<td>Carbon Monoxide</td>
<td>100ppm reduces oxygen binding. Fatal at high levels</td>
</tr>
<tr>
<td>Dust</td>
<td>Damage to respiratory tract lining. Increased susceptibility to disease</td>
</tr>
<tr>
<td>Humidity</td>
<td>Effects vary with temp. At &gt;29 ºC and &gt;70% RH growth will be affected</td>
</tr>
</tbody>
</table>
KEY POINTS

- Use a ventilation system which is capable of achieving the requirements for good air quality (i.e. min ventilation rate) and temp control (i.e. max ventilation rate)
- Maintain ventilation rate at or above the minimum at all times
- Monitor air quality to determine the appropriate adjustment of ventilation rate.

Litter and Litter Management

Litter material should be spread evenly to a depth of 3-10cm, depending on quality of housing and insulation.

Requirements of litter:
- a) good moisture absorption
- b) biodegradability
- c) comfort and cleanliness
- d) low dust level
- e) freedom from taint
- f) constantly available from a biosecure source

Characteristics of Common Litter Material

<table>
<thead>
<tr>
<th>MATERIAL</th>
<th>CHARACTERISTICS</th>
</tr>
</thead>
<tbody>
<tr>
<td>New White Wood Shavings</td>
<td>Good absorption and breakdown Possible contamination by insecticides, which can be toxic and chloramisoles which can cause a musty taint</td>
</tr>
<tr>
<td>Chopped Straw</td>
<td>Wheat straw is best. Possible contamination by agrochemicals, fungi and mycotoxins. Slow to breakdown, best used mixed 50/50 with white wood shavings</td>
</tr>
<tr>
<td>Shredded Paper</td>
<td>Can be difficult to manage in humid conditions. Glossy paper is unsuitable</td>
</tr>
<tr>
<td>Chaff and Hulls</td>
<td>Not very absorbent. Best mixed with other materials. May be ingested</td>
</tr>
<tr>
<td>Sawdust</td>
<td>Not suitable. Dusty and may be ingested</td>
</tr>
<tr>
<td>Chemically Treated Straw Pellets</td>
<td>Use as recommended by the supplier</td>
</tr>
<tr>
<td>Sand</td>
<td>Commonly used in arid/desert areas on concrete floors. Can work well, but birds have difficulty moving about if spread deeply.</td>
</tr>
</tbody>
</table>

Stored litter must be protected from weather and vermin.
Litter must be kept dry throughout the life of the flock. If litter becomes caked or too wet the incidence of Hockburn and breast blisters will increase substantially.

**KEY POINTS**

- Protect broilers from damage and provide a dry, warm covering to the floor by using a good quality litter material.
- Choose litter material that is absorbent, non-dusty and clean. Litter should be readily available at a low cost from a reliable source.
- Use fresh litter for each crop, to prevent reinfection by pathogens.
- Earth floors are a biosecurity hazard as they cannot be cleaned or disinfected effectively.

**Drinking Systems**

*It is essential that water is available 24 hours a day*

Inadequate water supply either in volume or no. of drinking points = reduced growth rate.

To ensure the flock has sufficient water, the ratio of water to feed consumed each day should be monitored. This is correct when the ratio of water volume (ml or l) to feed weight (g or kg) remains close to 1:8:1 (1:6:1 for nipple drinkers).

NB Sudden increases or decreases in demand and/or deviation of the ratio are early indicators of stress, disease or suspect feed quality.

Water requirement increases by approx 6.5% per °C over 21°C

The two main drinking systems are:

**BELL DRINKERS (40cm diameter)**

Day Old: minimum of 6 drinkers/1000 chicks plus 6 mini drinkers or plastic trays/1000 chicks should also be provided

Older: minimum of 8 drinkers/1000 chicks

The drinkers should be placed evenly throughout the house, so no broiler is more than 2m from water

Mini drinkers and trays used at day old must be removed gradually, so by 3-4 days all chicks are drinking from the automatic drinkers.

Drinkers should be checked for height on a daily basis, and adjusted so the base of each drinker is level with the broilers back from 18 days onwards. This minimizes faecal contamination of the water. Water level of the drinkers should be adjusted to prevent spillage and subsequent problems with wet litter.
NIPPLE DRINKERS
Nipple drinkers installed at 12 birds per nipple (83 nipples/1000 birds). Often preferred as less likely to cause spillage and wet litter. Nipple drinkers offer drinking water with lower level of bacterial contamination than conventional open systems. Litter under the drinker system should be level to allow all bird’s equal access to water and to prevent spillage. The height must be monitored closely and on a daily basis.

At initial stages of brooding:
Nipple lines should be placed at a height at which the bird is able to drink. The back of the chick should form an angle of 35-45° with the floor whilst drinking is in progress.

As the bird grows:
Nipple lines should be raised so the back forms an angle of 75-85° with the floor so the birds are stretching slightly for the water.

If water hygiene is suspect, then treatment by ultra-violet (UV) light or chlorination at the point of water entry to the house will reduce bacterial contamination.

KEY POINTS
- Make drinking water available to the birds 24 hours a day
- Provide supplementary drinkers for the first 4 days of the flocks’ life
- Monitor the ratio of water to feed consumption daily, to check that the birds are drinking sufficient water
- Make allowances for an increase in water intake at high temperatures i.e. by 6.5% per degree C over 21°C
- Adjust drinker heights daily
- Provide adequate drinker space, and ensure that the drinkers are easily accessible to the entire flock
- Use fresh, clean drinking water to maintain leg health and reduce carcass downgrading at the processing plant.
Water pressure for Nipple drinker system shown below:

The pressure must be raised from one inch at day 1, to:
- Day 7 - 3 inches
- Day 14 - 6 inches
- Day 21 - 9 inches
- Day 28 - 12 inches
- Day 35 - 15 inches
- Day 42 - 18 inches

It is very important that the water pressure is correct for the age of the bird as too little pressure will cause dehydration and too much can damage the internal organs as well as be a main contributor to wet litter and thus wastage.

**Water Quality**

Depending on the source of the water, the mineral content and bacteria will vary considerably.
The water supply should be tested to check the levels of calcium salts (i.e. hardness), salinity and nitrates. The water should also be tested for bacterial contamination at source, from storage tanks and drinkers.

Maximum acceptable levels of minerals and bacteria in drinking water

<table>
<thead>
<tr>
<th>MINERALS/BACTERIA</th>
<th>ACCEPTABLE CONCENTRATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Dissolved Solids</td>
<td>300-500ppm</td>
</tr>
<tr>
<td>Chloride$^1$</td>
<td>200mg/l</td>
</tr>
<tr>
<td>pH$^2$</td>
<td>6-8</td>
</tr>
<tr>
<td>Nitrates</td>
<td>45ppm</td>
</tr>
<tr>
<td>Sulphates$^3$</td>
<td>200ppm</td>
</tr>
<tr>
<td>Iron</td>
<td>1mg/l</td>
</tr>
<tr>
<td>Calcium</td>
<td>75mg/l</td>
</tr>
<tr>
<td>Copper$^4$</td>
<td>0.05mg/l</td>
</tr>
<tr>
<td>Magnesium$^3$</td>
<td>30mg/l</td>
</tr>
<tr>
<td>Manganese</td>
<td>0.05mg/l</td>
</tr>
<tr>
<td>Zinc</td>
<td>5mg/l</td>
</tr>
<tr>
<td>Lead</td>
<td>0.05mg/l</td>
</tr>
<tr>
<td>Faecal Coliforms</td>
<td>0</td>
</tr>
</tbody>
</table>

Notes:
1. Levels of 14mg/l can impair performance if sodium levels are also high (50mg/l)
2. Acid (pH6) drinking water can affect digestion, corrode drinking equipment, and be incompatible with medicines and vaccines
3. High sulphate levels will cause wet droppings. The effect is exacerbated if sodium or magnesium levels are >50mg/l
4. Excess copper can impart a bitter taste to the water, and cause liver damage.

**KEY POINTS**
- Provide unrestricted access to good quality water at an appropriate delivery temp i.e. 10-12 °C
- Test the water supply regularly for bacteriological and mineral contaminants, and take necessary corrective action
- Flush drinker lines in hot weather to ensure that the water is as cool as possible

**Feeding Systems**

1. Feed should be provided in the form of sieved crumbs for first 2-3 days of life
2. Place on flat trays or on paper sheeting - therefore readily accessible to chicks
3. Change to main feeding system gradually over first 2-3 days of life
4. The main feeding system should provide sufficient space to allow birds to achieve optimum growth

The main automated feeding systems for broilers are:
   a) Flat chain/auger
   b) Pan feeders
   c) Tube feeders

All types of feeders should be adjusted to ensure minimum spillage and optimum access for the birds. I.e. the base of the trough or pans should be level with the birds' back. Uneven distribution of feed can result in lowered performance and increased scratching damage associated with competition at feeders.

**NB Incorrect feeder adjustment can increase feed spillage. When this happens, feed conversion will suffer, and the spilled feed, when eaten is likely to carry a higher risk of bacterial contamination**

Number of Broilers per Feeder

<table>
<thead>
<tr>
<th>TYPE OF FEEDER</th>
<th>NO OF BIRDS PER FEEDER</th>
</tr>
</thead>
</table>
| Pan Feeders    | 1 Pan feeder for 65 birds  
                         Diameter 33cm |
| Tube Feeders   | 1 tube for 70 birds     
                         Diameter 38 cm |
| Chain Feeders  | 2.5cm / bird            
                              i.e. 80 birds/metre of track |

**KEY POINTS**

- Supplement main feeding system using paper and/or trays over the first 3 days
- Supply sufficient feeders for the number of birds in the house
- Increase feeder space per bird when using growth control programmes to allow for increased competition at the feeder
- Adjust feeder height daily, so that the birds' backs are level with base of the feeder
Section 2

CHICK MANAGEMENT

Objective
To establish a healthy flock from day old. To promote early development of feeding and drinking behaviour, this will allow the target bodyweight profile to be achieved with maximum uniformity and good welfare.

Principles
To ensure that chicks receive the best possible start, they must be provided with the correct environment i.e. temp, humidity and house layout, and managed to meet all their requirements.
Deficiencies in the brooding environment will depress final flock performance by preventing the chicks from achieving their potential growth during the first week.

Chick Quality
Final boiler performance and profitability are dependent upon attention to detail throughout production process.
i.e. Healthy parent stock
   Careful hatchery practice
   Efficient delivery of chicks, which are of good quality and uniformity

KEY POINTS
• Plan placements to minimize physiological and immune differences between chicks. Use single donor flocks if possible
• Hold and transport chicks in conditions which prevent dehydration and other types of stress in chicks
• Maintain high standards of hygiene and biosecurity in the hatchery and during transport

Preparation for Chick Arrival
1. All sites should be single age.

NB Recurrent outbreaks of disease due to recycling of pathogens may occur within multi-age sites

2. Houses - the surrounding areas and all equipment must be thoroughly cleaned and disinfected before the arrival of the chicks.

3. Litter material should be spread evenly to a depth of 3-10cm, and then levelled and compacted in the brooding area

NB Uneven litter can restrict access to feed and water and may lead to a loss in flock uniformity

4. Equipment must be assembled in the appropriate configuration. Feeders, drinkers, heaters and fans must be arranged to allow chicks to maintain body temp without dehydration and to find feed and water easily. Chicks should not move more than 1 metre to find feed and water. Supplementary feeders and drinkers should be placed so that the chick makes as association between the supplementary system and the main system.

NB Lack of uniformity and poor growth will result from inadequate provision of heat, feed and water during brooding

5. Houses should be pre-heated and temp and RH stabilised for 24 hours prior to chick arrival

6. The environmental control systems must be capable of supplying air of optimum quality at bird level and removing waste gases produced by chicks and heating systems. Care must be taken to avoid draughts.

NB Failure to remove waste gases from the birds’ environment can lead to heart and lung disease

7. Adequate clean water must be available, so chicks can eat and drink immediately when placed in the house

8. Initially, textured feed should be provided as dust-free, sieved crumbs, on feeder trays or on paper to give a feeding area occupying up to 25% of the brooding area.

KEY POINTS

• Provide chicks with biosecure, clean housing
• Control spread of disease by using single age housing
• Spread litter evenly
• Arrange equipment to enable chicks to reach feed and water easily and associate supplementary feeders and drinkers with the main feeding and drinking system
• Pre-heat the house and stabilise temperature and humidity prior to arrival of chicks
• Ventilate to provide fresh air and remove waste gases
• Make feed and water available to the chicks on arrival

**Chick Placement**

1. Prior to delivery of chicks, a final check of feed and water availability and distribution within the house must be made
2. Establish ETA, so that chicks can be unloaded and correctly placed as quickly as possible
3. Chicks must be tipped quickly, gently and evenly over the brooding area, and empty boxes removed immediately
4. Leave chicks to become accustomed to new environment for 1-2 hours. After this time, check that all chicks have easy access to feed and water and adjust accordingly.
5. From 2-3 days of age, existing feeders and drinkers should be repositioned and adjusted and additional ones introduced as the illuminated area is increased.

**KEY POINTS**

• Unload chicks and place quickly
• Check feed and water availability and distribution
• Leave chicks to settle for 1-2 hours with access to feed and water
• Check feed, water, temp and humidity after 1-2 hours and adjust where necessary

**Environmental Control**

Temp and RH should be monitored frequently and regularly

I.e. twice daily for first 5 days and daily thereafter

Temp and RH measurements should be made as close to chick level as possible

**Brooder Management**

**Spot Brooding**

Heat is provided by conventional canopy brooders. Surrounds may be used but usually, birds are confined by lighting only the brooding area and extinguishing the remaining house lights.
### Brooding Temps

<table>
<thead>
<tr>
<th>Age (days)</th>
<th>Temp °C</th>
<th>Age (days)</th>
<th>Temp °C</th>
</tr>
</thead>
<tbody>
<tr>
<td>D/O</td>
<td>29</td>
<td>D/O</td>
<td>30</td>
</tr>
<tr>
<td>3</td>
<td>28</td>
<td>3</td>
<td>28</td>
</tr>
<tr>
<td>6</td>
<td>27</td>
<td>6</td>
<td>28</td>
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<td>9</td>
<td>26</td>
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<tr>
<td>27</td>
<td>20</td>
<td>27</td>
<td>21</td>
</tr>
</tbody>
</table>

Chick behaviour is the best indicator of correct brooder temp. Correct temp is indicated by chicks being evenly spread throughout the brooding area.

### Bird Distribution under Brooders

**TEMPERATURE TOO LOW**
- Chicks crowd to brooder
- Chicks noisy, distress-calling

**TEMPERATURE CORRECT**
- Chicks evenly spread
- Noise level signifies contentment
TEMP TOO HIGH
Chicks make no noise
Chick’s pant, head and wings droop
Chicks away from brooder

DRAUGHT
this distribution requires investigation
influenced by draught - uneven light
distribution - external noises

The objective is to develop appetite as early as possible. Activity and appetite are stimulated when chicks experience temp at the lower end of their comfort zone. In order to stimulate appetite, temp should be maintained at a level slightly below the figs in the Brooding temps table above.

**Humidity**
Poor performance and loss of uniformity can result from low RH in the first week. RH should be monitored daily within the house. If it falls below 50% in the first week, chicks will begin to dehydrate, causing negative effects on performance. As the chick grows, the ideal RH falls. High RH from 18 days onwards can cause wet litter and its associated problems. As the broiler increase in liveweight, RH levels can be controlled using ventilation and heating systems.

**Interaction between Temperature and Humidity**
All animals will lose heat to the environment by evaporation of moisture from the respiratory tract and through the skin. At high RH, less evaporative loss occurs increasing the animals’ apparent temperature. The optimum RH is 65-70%.

**KEY POINTS**
- Achieve target 7-day liveweight by managing the brooding environment correctly
- Use chick behaviour to determine if temperature is correct
• Use temperature to stimulate activity and appetite
• Expand the brooding area gradually to allow chicks access to all feeders and drinkers
• Monitor temperature and RH frequently and regularly
• Maintain RH above 70% for the first 3 days and above 50% for the remainder of the brooding period
• Adjust temperature settings if RH increases above 80% or falls below 60%, whilst responding to changes in chick behaviour

**Ventilation**

Air quality is critical during the brooding period. Ventilation is required to maintain temp and RH at the correct level, and to allow sufficient air exchange to prevent the accumulation of harmful gases. Accumulation of waste gases can lead to heart and lung disease if not removed effectively.

**KEY POINTS**

• Establish a minimum ventilation programme to supply fresh air and remove waste gases.
• Maintain good air quality within the house using circulation fans

**Lighting**

All lighting programmes should provide for a long day length (e.g. 23 hours light -1 hour dark) in the early stages, to allow chicks to develop a good appetite. Reducing day length too early will reduce feeding activity and depress 7-day liveweight.

Light intensity should be gradually reduced from a minimum of 20 lux at day old, to around 10 lux from 21 days on.

**KEY POINTS**

• Provide chicks with long periods of light for the first week
• Use high intensity of light of (>20 lux) in the first 7 days, then reduce gradually
• Light intensity should be uniform throughout the house.
Section 3

PRE-PROCESSING MANAGEMENT

Objective
To manage the final phase of the production process so that broilers are transferred to the processor in optimum condition, ensuring that the processing requirements are met and high standards of welfare are maintained.

Principles
The maintenance of high quality in broilers during catching and transport requires retailed attention to management of the environment and to welfare of the birds. The planning and organisation of procedures should permit efficient catching and transfer of the birds from the broiler house to the transport system and subsequently into the slaughter house.

Preparation for Catching
A withdrawal ration must be fed for sufficient time prior to slaughter to eliminate the risk of anticoccidial residues in the meat. Feed should be withdrawn 8 to 10 hours before processing. This period should include catching time and the time spent in transit. If feed withdrawal time is prolonged, water absorbed from body tissues accumulates in the digestive tract resulting in deterioration in yield. Unlimited access to water should be available as long as possible.

KEY POINTS
- Use withdrawal feed (i.e. without coccidiostat) as necessary to avoid residues in meat
- Allow 7 days on full light (i.e. 23 hours light and one hour dark) to avoid problems during catching
- Appropriate feed withdrawal will ensure that the digestive systems are empty before catching commences, limiting faecal contamination during transport and processing.
- Delay the removal of drinkers as long as possible

Catching
Most downgrading observed at slaughter will have occurred during the previous 24 hours, when the birds were being caught and handled. Catching therefore must be planned carefully and supervised closely at all times. The handling of the birds and machinery (i.e. forklifts) must be carried out by trained and competent personnel, aiming to avoid unnecessary struggling by the birds and to minimise bruising, scratching or other injuries.

Prior to catching, all feeding equipment should be raised about head height, removed from the house or positioned to avoid obstruction to the birds or personnel. In larger houses, separation of birds into pens will avoid unnecessary crowding, and will allow access to water for birds not immediately due for catching.

Light intensity must be reduced to a minimum within the house, but must be sufficient to allow safe and careful catching. The best results are achieved when birds are allowed to settle after lights have been dimmed and when there is minimum disturbance.

Broilers should be held by the feet and shanks, never by the thighs. They should be caught and held by both legs to minimise distress, damage and injury. The birds should be placed carefully into crates. The crates should never be overfilled, and the quantity per crate must be reduced in high temperatures.

**KEY POINTS**

- Supervise catching and handling methods carefully to minimise trauma injuries to the birds
- Remove or raise obstructions such as feeders of drinkers before beginning the catching operation and use partitions in large houses to avoid injuries cause by crowding
- Reduce light intensity prior to catching to keep the birds calm and minimise damage and subsequent stress.
- Adjust bird numbers in crates to allow for bird weight, and ambient temperature
Section 4

NUTRITION

Objective
To supply a range of balanced diets which satisfy the nutrient requirements of broiler stock at all stages of their development and production, and which optimise efficiency and profitability without compromising bird welfare.

Principles
Feed is a major component of the total cost of broiler production. Every effort should be made, to ensure that the feed is mixed to appropriate specifications and is of good quality.
Broiler rations should be formulated to give the correct balance of energy, protein and amino acids, minerals, vitamins and essential fatty acids, to allow optimum growth and performance. Factors such as stocking density, climate and disease status may depress liveweight gain and increase feed conversion, leading to altered nutrient requirements. A response to improved nutrition will only be achieved in broiler flocks when nutrient supply, rather than other management factors, is limiting performance.

Broiler Diet Specifications
Factors, which will influence optimum broiler diet specification, include the following:
- Supply and price of feed ingredients
- Liveweight at slaughter
- Age at slaughter
- Yield and carcase quality
- Market preferences for skin colour
- Sexed growing

Quality of Feed and Feed Ingredients
It is important that the ingredients used to manufacture feeds for broilers are of high quality and are fresh.
Long term storage of feed ingredients can lead to formation of spoilage products with a negative effect on performance.
Section 5

HEALTH & HYGIENE

Objective
To attain optimum performance and bird welfare. To provide assurance to the consumer on food safety issues. To minimise of prevent the effects of disease or infections.

Principles
The environment in which the broilers are grown should be clean and free from pathogens. Equipment should be maintained so that the broilers can feed and drink, without restriction of damage. The feed should be nutritionally balanced and free of pathogens or other factors likely to cause depression in performance (e.g. mycotoxins)
Management procedures should stimulate performance, minimise physiological problems (e.g. Ascites) and promote leg health.
The consumer requires meat that is free of bacterial contamination (e.g. salmonella, etc) and of residues (e.g. coccidiostats of antibiotics)

Chick Quality
The quality of chicks produced by individual hatcheries can be assessed by monitoring broiler mortality in the first week of each flock. Excessive mortality i.e. >1% in the first week may indicate a problem in the hatchery or in the delivery process or on the farm.

Food Safety Issues
PATHOGENS
Contamination of chicken products with certain salmonella has been associated with outbreaks of food poisoning in humans. Prevention of such outbreaks is ensured when broilers are produced which are free of these pathogens.
The chicks are supplied free of Salmonella. Strict biosecurity can maintain this status through to rearing and on to slaughter.

Feed can be a major source of pathogens. Contamination by salmonella may be found not only in feedstuffs of animal origin, but also for example in Soya beans and derivatives. All raw materials should be monitored routinely for salmonellae. The most reliable programme of control of contamination of feedstuffs by salmonellae involves heat treatment in combination with feed biosecurity. A temperature of 86°C held for 5 min’s will reduce salmonella contamination of feed to negligible levels.

**CHEMICAL RESIDUES**
Chemical residues (e.g. coccidiostats, medicines, pesticides etc) in broiler products can be prevented by auditing the quality and treatments of raw materials (e.g. feedstuffs, water, litter etc) and controlling the use of pesticides. Special care should be taken to observe withdrawal times for health treatments and coccidiostats.

**KEY POINTS**
- Test for salmonellae in quality control of feedstuffs
- Reduce risk of infection with pathogenic bacteria by monitoring and controlling movement of feed, equipment and personnel on to the farm
- Follow manufacturers’ recommended withdrawal periods to avoid drug residues in broiler products

**Bio Security**
Isolation of broilers from all other poultry and livestock is the single most important aspect of biosecurity.

1. Movement of people, feed, equipment or animals on to the boiler site should be controlled to prevent the introduction of pathogens.
2. Single age sites are preferable, so that re-cycling of pathogens is minimised.
3. Sites should be fences and access restricted.
4. There should be a barrier to prevent unauthorised entry and a clearly defined changing area for staff and necessary visitors to the farm, at the farm perimeter.
5. Staff and visitors should be provided with, and should wear appropriate, clean protective clothing on each farm.
6. Hands should be washed and boots should be dipped between visits to each house.
7. If more than one farm visit has to be made in one day, the youngest birds should be visited first.

All points of entry, during the life of a flock, where people, feed, material or equipment are brought onto the farm represent biosecurity risks. Staff education on biosecurity and its implementation will help to ensure its effectiveness.

Water must be of good quality, and should be sourced from holding ponds or dams without subsequent treatment. If water hygiene is suspect, then chlorination at the point of water entry to the house will reduce bacterial contamination. Chlorination to give between 1 and 3ppm at drinker level will reduce the count, especially where drinker systems with open water surfaces are in use.

**KEY POINTS**

- Adopt a single age policy for each site, to limit stock movement and to reduce transfer of disease between stocks of differing age.
- Admit only essential visitors onto the site; they must wear protective clothing
- Wash hands and dip boots between visits to each house
- Keep out wild birds and rodents
- Spray wheels of all vehicles entering the site

**Hygiene**

Broiler house design should incorporate concrete floors, washable walls and ceilings, accessible ventilation ducts and no internal pillars or ledges. An area of concrete or gravel extending to a width of 1-3m surrounding the broiler house can discourage the entry or rodents and provide an area for washing and storing removable items of equipment. Cleaning out should be undertaken after depletion of every flock. It must be carefully planned and the correct procedures followed.

Effective cleaning and length of time between flocks are important in the prevention of transmission of infection from one flock of broilers to the next.

**Health Management**
Vaccination

This is one of the most important procedures in broiler management. It is essential that only experienced poultry men become involved in the administration of these vaccines.

The following guidelines are appropriate for successful vaccination of broilers:

- Follow the recommendations of the vaccine manufacturer in terms of transport, storage of vaccine, dose / bird and route and method of administration.
- Do not allow the vaccine to come into contact with air, thus the bottles must be opened under the surface of the water.
- Vaccinate so that all birds get the same dose of vaccine.
- Ensure that all vaccinated water for Gumboro is worked out so that all the water is consumed within 1 hr 30 minutes. After this time the live vaccine will have died.
- Record vaccine details and check expiry dates. NEVER use vaccines beyond the expiry date.
- When administering live vaccines in water, skimmed milk powder should be added to the water 30 minutes before the vaccine is placed in the same water. This is essential to neutralise chlorine and irons in the water which would inactivate the vaccine.
- Cease chlorine treatments of water during vaccine administration.
- Do not vaccinate sick birds.

Vaccination Program (Breed - Ross)

<table>
<thead>
<tr>
<th>Day</th>
<th>Vaccine</th>
<th>Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>12</td>
<td>Gumboro</td>
<td>Spray</td>
</tr>
<tr>
<td>15</td>
<td>Newcastle</td>
<td>Through drinking system</td>
</tr>
<tr>
<td>18</td>
<td>Gumboro</td>
<td>Through drinking system</td>
</tr>
</tbody>
</table>

Problem solving:
<table>
<thead>
<tr>
<th>Problem</th>
<th>Possible causes</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>High early mortality (&gt;1% in first week)</td>
<td>Poor chick quality</td>
<td>Check hatchery practice. Check chick transport. Re-adjust brooders. Post mortems on dead chicks, take veterinary advice.</td>
</tr>
<tr>
<td></td>
<td>Incorrect brooding</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Disease</td>
<td></td>
</tr>
<tr>
<td>High Mortality</td>
<td>Metabolic diseases. (Ascites, Sudden death syndrome) Leg problems.</td>
<td>Check ventilation practices. Check calcium, phosphorus and Vitamin D3 levels in diet</td>
</tr>
<tr>
<td>Poor Early Growth</td>
<td>Nutrition</td>
<td>Check feed quality and quantity. Check water quality and quantity. Check hatchery hatch &amp; transport time.</td>
</tr>
<tr>
<td></td>
<td>Chick quality</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Environmental conditions</td>
<td>Check temperature and humidity Controls. Check air quality and ventilation. Check poor stimulation of appetite - low number of birds with full crops.</td>
</tr>
<tr>
<td></td>
<td>Appetite</td>
<td></td>
</tr>
<tr>
<td>Poor Late Growth</td>
<td>Low nutrient intake</td>
<td>Check feed nutrition</td>
</tr>
<tr>
<td>Poor Litter Quality</td>
<td>Nutrition</td>
<td>Poor quality fats in diet Excess salts in diet. Excess protein in diet.</td>
</tr>
<tr>
<td>Poor Feed Conversion</td>
<td>Feed wastage</td>
<td>Check adjustments / settings of feeders.</td>
</tr>
<tr>
<td>Poor Feather Cover</td>
<td>Environment</td>
<td>Check house temperatures are Not too high.</td>
</tr>
<tr>
<td>--------------------</td>
<td>-------------</td>
<td>------------------------------------------</td>
</tr>
<tr>
<td></td>
<td>Nutrition</td>
<td>Check ration for methionine and cystine content and balance.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Factory Downgrading</th>
<th>Ascites</th>
<th>See High Mortality.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Blisters and burns</td>
<td>Check stocking density</td>
</tr>
<tr>
<td></td>
<td>Bruises and breaks</td>
<td>Check litter quality.</td>
</tr>
<tr>
<td></td>
<td>Excessive fatness</td>
<td>Check handling procedures at catching and removing from crates.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Check nutritional balance of diet.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Check house temperature is not too high.</td>
</tr>
</tbody>
</table>

We hope this manual will be of good use towards successful broiler production.