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MICROCLIMATE AND BIOSECURITY - KEY ELEMENTS IN THE INTENSIVE REARING OF BROILERS

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Abstract

The study evaluates the role of microclimate control and biosecurity measures in the intensive rearing of broilers under small-farm conditions. A descriptive case study was conducted in a 400 m² production hall populated with approximately 8,000 broiler chicks, mainly Ross 308 and Plymouth Rock Barred hybrids, reared on a slatted floor system during the first 3-4 weeks of life. The assessment included the construction characteristics of the hall, ventilation, temperature, relative humidity, lighting, stocking procedure, manure removal and sanitation measures. The calculated initial stocking density was 20 chicks/m², while the recommended operational microclimate targets were 30-33 °C at chick placement, 50-70% relative humidity, approximately 21% oxygen concentration and 8-10 lux light intensity during the first month. The slatted system reduced direct contact between chicks and manure, facilitated manure evacuation, improved hygiene and shortened the preparation time between production cycles. The results confirm that microclimate stability and strict biosecurity are essential for maintaining chick welfare, limiting disease risk and improving the efficiency of broiler management in small intensive farms.

Keywords: biosecurity, microclimate, broilers, slatted floor, animal welfare.

1. INTRODUCTION

Poultry meat production has become one of the most dynamic sectors of animal production, because chicken meat is relatively affordable, has a short production cycle and responds rapidly to changes in consumer demand. International projections show that poultry meat will continue to account for an important share of the additional meat consumed worldwide, mainly because of its price, nutritional value and lower resource requirements compared with some other animal protein sources [11].

In this context, intensive broiler production requires not only genetic and nutritional management, but also strict control of environmental and sanitary factors. Microclimate parameters such as temperature, relative humidity, air quality, ventilation rate and light intensity directly influence feed intake, growth rate, susceptibility to respiratory disease and welfare status [1,3,8]. Poor control of these parameters may increase ammonia and particulate matter accumulation, reduce litter quality and contribute to footpad dermatitis, respiratory disorders and uneven flock development [3,4,9].

Previous studies have shown that light intensity and lighting programmes influence broiler activity, feed conversion and welfare [1], while litter moisture and ammonia emissions are closely connected with ventilation efficiency, manure management and the physical properties of bedding materials [3,5,6,9]. In addition, farm biosecurity is essential for reducing the introduction and spread of infectious agents, especially in systems where large numbers of chicks are kept in the same air space [7,10].

The present study is positioned as a practical case study focused on a small intensive broiler unit. Its objective was to assess the construction, microclimate and biosecurity elements of a broiler rearing hall using a slatted floor system, to identify the main measurable technological indicators and to evaluate whether the proposed system can support hygienic management and chick welfare during the first weeks of rearing.

2. MATERIALS AND METHODS

The research was conducted as a descriptive farm case study in a production hall intended for intensive broiler rearing. The analysed hall had a built area of 400 m² and an initial stocking capacity of approximately 8,000 chicks, corresponding to a calculated initial density of 20 chicks/m². The biological material consisted mainly of Ross 308 and Plymouth Rock Barred broiler hybrids, followed from placement until 3-4 weeks of age.

The hall was evaluated by direct observation and by analysis of the technological parameters used in farm management. The following components were included in the assessment: construction characteristics of the production hall, type of floor, ventilation equipment, air intake arrangement, lighting regime, temperature and relative humidity targets, stocking procedure, water and feed access, transport conditions, manure removal and biosecurity protocol.

Microclimate evaluation focused on operational indicators relevant for broiler welfare: temperature at chick level, relative humidity, oxygen concentration, air renewal and light intensity. The recommended values used for interpretation were based on poultry production standards and scientific literature: 30-33°C at placement, 50-70% relative humidity, oxygen concentration close to 21%, 8-10 lux during the first month and lower light intensity after the adaptation period [1,3,7].

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The stocking density was interpreted in relation to the European welfare framework for broilers. Directive 2007/43/EC sets a general maximum stocking density of 33 kg live weight/m², with the possibility of higher densities only under additional welfare and monitoring conditions [2]. Because the present assessment covered the early growing period and not final slaughter weight, the density was expressed as chicks/m² and discussed as an initial management indicator.

Biosecurity was assessed by checking the all-in/all-out principle, pre-placement inspection, cleaning and disinfection procedures, staff access rules, protective equipment, vehicle disinfection and the management of feed, drinking water and manure. Since the available farm records did not include repeated numerical measurements for all parameters, statistical analysis was limited to descriptive calculations and comparison with reference ranges. This limitation was considered when interpreting the results.

The case study was carried out in a small intensive broiler production unit with a hall area of 400 m² and an initial flock size of approximately 8,000 chicks, managed according to the all-in/all-out principle. Based on these values, the initial stocking density was approximately 20 chicks/m², a level that must be interpreted in relation to bird age, live weight and the welfare requirements applicable to broiler production systems [10].

The biological material consisted of Ross 308 and Plymouth Rock Barred hybrids, selected because they are commonly used in meat production systems and allow the assessment of practical management requirements under intensive rearing conditions.

The main technological and microclimate indicators considered in the analysis were placement temperature, relative humidity, air quality, lighting, ventilation and floor system.

During placement, the recommended temperature at chick level was 30–33 °C, because day-old chicks do not yet have a fully developed thermoregulation mechanism and are highly dependent on the thermal conditions provided inside the hall [7].

Relative humidity was considered optimal within the range of 50–70%, as excessive humidity favours litter deterioration, microbial development and respiratory problems, while excessively dry air increases dust levels and the risk of eye and respiratory irritation [3,6,9]. The oxygen concentration was considered adequate when it remained close to the atmospheric value of approximately 21%, this being an indirect indicator of proper air renewal and ventilation efficiency [3,8].

Lighting management was also included among the monitored technological factors. In the first growth stage, light intensity was maintained at approximately 8–10 lux, while in the later stage it was reduced to about 5 lux, in order to support feeding, orientation and calmer behaviour of the flock [1].

Ventilation was ensured by two axial fans and air inlets positioned every two metres on the side walls, allowing air renewal, humidity control and the reduction of harmful gases such as ammonia and carbon dioxide [3,8].

The floor system consisted of slatted flooring, which reduced direct contact between birds and manure, facilitated manure removal and contributed to improved hygiene compared with the permanent litter system [4,5,6].

3. RESULTS

The analysed production hall was designed as a light industrial poultry shelter with a reinforced concrete foundation, metal profile structure, sandwich panel closure, PVC joinery and artificial lighting. The foundation had a depth of 60 cm and a height of 40 cm, while the metal support pillars were placed at 4 m intervals. The roof was insulated on the inside with 4 cm polyurethane foam, contributing to the reduction of thermal losses.

The concrete floor was covered with grates, so that the chicks were reared on a slatted surface rather than on permanent litter. This technical solution reduced the direct contact between birds and droppings, favoured the evacuation and drying of manure and limited the accumulation of wet bedding material, which is an important risk factor for ammonia formation and footpad dermatitis [4,5,6,9]. Figure 1 illustrates the slatted floor used in the analysed hall and the alternative permanent bedding system.

Figure 1. Slatted floor used in the analysed hall (left) and permanent bedding system (right).

Ventilation was provided by two axial fans, while air inlets were positioned approximately every two metres on the side walls.

This arrangement is important because air flow affects carbon dioxide removal, ammonia dilution, relative humidity control and the drying capacity of the floor surface [3,8]. Maintaining oxygen concentration close to atmospheric values, approximately 21%, was considered an indicator of adequate air renewal.

Temperature management was identified as a critical technological link during the first days after placement. Because day-old chicks do not have fully functional thermoregulation, the hall must be heated before population so that the floor-level temperature reaches approximately 30-33 °C.

Failure to maintain this range may cause crowding, uneven feeding, dehydration, respiratory stress and increased mortality risk [7].

Relative humidity was interpreted within the recommended interval of 50-70%.

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Values above this range can favour bacterial and fungal development, respiratory problems and manure wetness, while values below the range may increase dust concentration and irritation of the eyes and respiratory tract [3,6,9].
Under the slatted system, manure is separated from the birds more rapidly than in a permanent litter system, reducing the probability of crust formation and excessive moisture accumulation.
The lighting programme was also relevant for chick adaptation. In the first month, the applied light intensity was approximately 8-10 lux, while a lower level of about 5 lux was used during the rest of the growing period. This is consistent with studies showing that light intensity and photoperiod influence activity, feed intake, welfare and feed conversion [1].
Population of the hall was carried out according to the all-in/all-out principle.
The hall was inspected approximately 24 hours before chick placement, including verification of the grates, heating distribution, feeders, drinkers and lighting. Chicks were transported in perforated cardboard boxes, usually containing around 100 chicks per box. Figure 2 shows the transport conditions of day-old chicks before placement.

Figure 2. Transport of day-old chicks before placement in the rearing hall.

After arrival, chicks were distributed evenly in the rearing hall as quickly as possible.
Drinking water was prepared two to three hours before placement so that it could reach ambient temperature and reduce the risk of digestive disorders. Feed was administered fresh immediately after placement. The degree of crop filling was proposed as a practical indicator of adaptation, with checks at approximately 2, 8, 12, 24 and 48 hours after placement.
For each check, 30-40 chicks should be selected from different areas of the hall.
Biosecurity measures included complete cleaning and disinfection after depopulation, mechanical evacuation of manure, removal of feed residues, washing of floors, walls and equipment, inspection of fans and heating systems, staff access through a buffer zone, use of protective clothing and footwear, and disinfection of vehicle tyres.
These measures are particularly important in intensive poultry production, where infectious agents can spread rapidly within a dense flock [7,10].

4. DISCUSSIONS

The results indicate that the slatted floor system can improve several technological and sanitary aspects of broiler rearing under small-farm conditions.
Compared with permanent litter, the separation of birds from manure reduces the persistence of wet organic material in the contact area and can limit the factors associated with footpad dermatitis, plumage soiling and ammonia production [4,5,6].
This confirms the practical relevance of the system, especially in units where rapid cleaning between production cycles is needed.
Ventilation remains the central element that links microclimate quality with biosecurity. Insufficient air exchange favours the accumulation of carbon dioxide, ammonia and suspended particulate matter, while excessive air movement during cold periods can increase heat loss and stress the chicks [3,8].
Therefore, the presence of axial fans and regularly distributed inlets must be accompanied by routine monitoring of temperature, humidity and bird behaviour.
The calculated initial density of 20 chicks/m² must be interpreted with caution, because welfare legislation for broilers is expressed in kg live weight/m² and applies throughout the production cycle [2].
If birds are kept until market age, the farm must calculate final stocking density according to the expected body weight and ensure compliance with the maximum limits allowed by Directive 2007/43/EC. The present case study therefore provides an early-stage density indicator, not a final compliance assessment.
The study also confirms that the first 24-48 hours after placement are decisive for flock uniformity. Water temperature, immediate access to feed, crop filling and even distribution of chicks are practical indicators that can be used by small farms to identify problems before they affect the entire batch.
Similar recommendations are included in poultry housing and farm management standards, which emphasize preparation of the hall before placement and strict control of the adaptation period [7].
The main original contribution of the paper is the integration of construction, microclimate and biosecurity observations into a practical model for a small intensive broiler hall using a slatted floor system.
However, the study has limitations. It was conducted in a single production unit, without a parallel control group reared on litter and without a complete dataset of repeated measurements for temperature, humidity, ammonia, mortality, body weight gain and feed conversion ratio.
For this reason, the results should be interpreted as a technological case study rather than as a full comparative experiment.
Future research should include continuous sensor-based monitoring of temperature, relative humidity, ammonia, carbon dioxide and particulate matter, together with production indicators such as average daily gain, mortality, feed conversion ratio and footpad lesion scores.

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A comparison between slatted floor and permanent litter systems under similar stocking densities would provide stronger evidence regarding the economic and welfare advantages of the proposed system.

5. CONCLUSIONS

• The case study shows that microclimate and biosecurity are key elements in the intensive rearing of broilers, especially during the first weeks of life, when chicks are highly sensitive to temperature, humidity and sanitary conditions.
• The analysed hall had a surface of 400 m² and an initial population of approximately 8,000 chicks, corresponding to 20 chicks/m². The most important management targets were 30-33 °C at placement, 50-70% relative humidity, air quality close to atmospheric oxygen level and adequate light intensity for chick orientation and feeding.
• The slatted floor system reduces direct contact between chicks and manure, facilitates manure evacuation, supports better hygiene and can reduce the time needed to prepare the hall for the next production cycle. These advantages are relevant for small intensive farms, although installation costs may limit its use in larger commercial units.
• Strict biosecurity measures, including all-in/all-out management, pre-placement inspection, complete cleaning and disinfection, protective clothing and vehicle disinfection, are essential for preventing the introduction and spread of infectious agents.
• The main limitation of the study is the absence of a complete experimental dataset and of a control group. Future studies should combine this technological approach with continuous microclimate monitoring and quantitative production data to validate the effectiveness of the slatted system under different farm conditions.

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