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Original Article

# Effect of Ventilation and Atmospheric Ammonia on the Health and Performance of Broiler Chickens in Summer

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**ABSTRACT**

This study was carried out during summer season on two broiler buildings with a capacity of 10000 each one. The first building with natural ventilation while the second was recently renovated with dynamic ventilation system composed of 10 ventilators with a capacity of 5000 $m^3$/hour/unit. The results of this experiment showed that ammonia concentration was higher in the building with natural ventilation during various breeding phases. The average concentration of ammonia in the building with natural ventilation was already higher than standard levels from the third week of breeding (16.5 ppm) and reached higher and alarming levels at the seventh week (31.5ppm). Dynamic ventilation in the second building made possible decrease in this concentration that reach 19.5 ppm at the fourth week and 13.50 ppm at the end of breeding (week7). The variation of the ammonia levels in the building with dynamic ventilation is in close relationship to the ventilation flow and working time of the extractor fans. Mortality in the building with natural ventilation was twice higher than that with dynamic ventilation (10.5 vs. 4.5%). The presence of dynamic ventilation has also positively influenced the performance parameters of chicken. The day56, live weight of broiler chickens in the poultry house of dynamic ventilation was superior to that of broiler chickens in building of natural ventilation (1870 vs.1682 gr). This is confirmed by better feed conversion (1.98 vs. 2.66). In the building with natural ventilation, examination of 50 chickens shows the presence of conjunctivitis in animals (20%).

**Key words:** Atmospheric ammonia, broilers, production performances, health, ventilation

## INTRODUCTION

Poultry production develops itself quickly in Algeria. However, the hygienic and sanitary problems drag some consequent economic losses in poultry farms (Alloui et al., 2001). The poultry house atmospheric pollution (dusts, ammonia and others gas) are a factor that can influence on production performances and the health of the chicken. Ammonia produced of decomposition and fermentation of the litter and excrements in broiler houses can influence on the growth of chickens and can especially encourage respiratory diseases (Tahseen, 2010). Beker et al. (2004) found that $NH_3$ in poultry houses lowers performance and may increase disease susceptibility. It has been suggested that $NH_3$ should not exceed 25 ppm in poultry houses (Carlile, 1984). In Algeria, almost the total parts of buildings are not endowing mechanical ventilation system permitting the optimisation of the temperature and extraction of the toxic gas which is ammonia ($NH_3$). The goal of our work is to value the effect of ventilation on the concentration of ammonia in two broiler houses in summer. The first is endowed of a dynamic ventilation system whereas the second only possesses natural ventilation. Performances of production and the death rate in every building will also be recorded.

## MATERIALS AND METHODS

The experimental work was conducted in two broiler houses in the Center of poultry Tazoult (District of Batna) in the summer. The capacities of each poultry house were 10000 chickens; the density was 10 birds/$m^2$ at the end of broiler breeding (day 49).

The first poultry house (P1) had only natural ventilation, composed of four windows (60 x 80 cm) on each lateral side and a large gate (180 x 210 cm). The second building (P2) was upgraded by installing 10 extractors on a side wall.

The capacity of each fan was 5000 $m^3$ of air / hour with a flow rate of 4 $m^3$ air / h / kg live weight in summer. Broiler chickens were raised on straw (3 kg / $m^2$). Feed diets were compound of a starter (3050 Kcal /kg), growth (3050 Kcal / kg) and finishing feed (2900 Kcal /kg).

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To evaluate the temperature (T) inside the building, we used a manual weather station (Oregon Scientific Bar 938 HG-Model). To measure the concentration of ammonia ($NH_3$), we used the Gas Sensor (TG-501TOX multi-gas monitor sensor Direct Sense, Gray wolf Sensing solution, 12 Cambridge Drive, Trumbull, CT, 06611 USA).

The air velocity (V) in the buildings was removed by Manometer type digital Testo 415 GmbH Germany.

These parameters were recorded every day until the end of breeding, according to the method of Rokicki and Kolbuszewski (1996). The ventilation flow in broiler house (P2) was calculated to determine the working time of extractors and ventilation rate for each rearing phase. In parallel, we recorded the performance parameters (feed intake, weight gain, feed conversion and mortality). The statistical analysis was performed using ANOVA and MS Excel file, 2009.

## RESULTS and DISCUSSIONS

The microclimatic conditions in the two broilers houses (P1, P2), are indicated in table 1. The variations of the internal temperature were due to the ventilation system applied in the buildings during various phase of breeding.

Mechanical ventilation influenced the ammonia rate positively in the P2 building. During the first three weeks, the ammonia rate in the two buildings was in conformity with the standards norms (Le Menec, 1984; Rokicki and Kolbusewski, 1996, Ritz et al., 2004). The maximum value ammonia was 16.65 and 10.25 ppm respectively in the two buildings. By the end of the fourth week of breeding, this rate increased in the P1 building. It varied between 22.15 and 31.20 ppm, until the end of breeding.

In the P2 building, mechanical ventilation involved a reduction in this toxic gas, from 19.45 to 13.50 ppm at the end of the breeding. These results agree with several works (Reece et al., 1980; Miles et al., 2002; Redwine et al., 2002).

Contrary to the building P1, the mechanical system ventilation in the P2 building, influenced the internal temperature positively. Between the fourth and the seventh week of breeding, the internal temperatures in the P2 building were largely lower than these of the P1 building in which an inappropriate ventilation in this last poultry house, was characterized by a low air velocity.

The flow of ventilation in the P2 building increased according to the breeding phases which induced a consequent increase air velocity. The work of Demmers et al., (1999) confirms the effectiveness of mechanical ventilation in the optimization of the temperature and toxic gases ($NH_3$ and $CO_2$).

The evolution of the ammonia rate in the two buildings is represented by figure 1. In the P1 building, the curve is ascending according to the duration of breeding (7 week). However in the P2 building, the curve began with an ascending phase up to the value from 19.5 ppm of ammonia then is declined to a point where the rate of ammonia is 12.50 ppm.

The production performances in J49 are summarized in table 2. The final weight of chickens in the P2 building was higher than those of the P1 building (1870 vs. 1682 gr.). The quantity of feed consumed by chicken in the P1 building was higher 780 gr. than that consumed in the P2 building This is reflected in a lower feed conversion in broiler house P2 (2.66 vs 1.98). Current results are in agreement with the previous research work of Charles and Payne (1966), Reece et al., (1980) and Beker et al. (2004).

The death rates in the building with natural ventilation were twice higher than that of the building with mechanical ventilation. Several authors (Kristensen et al., 2000; Al Homidani et al., 2003) confirm this hypothesis. In the building with natural ventilation, examination of 50 chickens shows the presence of conjunctivitis in animals (20%).

**Table 1.** Ventilation conditions, temperature and ammonia ($NH_3$) in broiler houses

| | Broiler house (P1) | | | | Broiler house (P2) | | | |
|---|---|---|---|---|---|---|---|---|
| **Week** | **Ammonia (ppm)** | **Air velocity (m/s)** | **Ventilation ($m^3$/h)** | **Temperature (°C)** | **Ammonia (ppm)** | **Air velocity (m/s)** | **Ventilation ($m^3$/h)** | **Temperature (°C)** |
| 1 | 7.10±0.4 | 0.11±0.06 | - | 33.30±.2.25 | 6.80±0,08 | 0.62±0.05 | 4160 | 31.50±5.15 |
| 2 | 13.20±1.6 | 0.41±0.03 | - | 31.90±3.75 | 8.50±0,06 | 0.45±0.07 | 7400 | 28.50±2.75 |
| 3 | 16.65±2.2 | 0.24±0.05 | - | 30.25±2.70 | 10.25±0,06 | 0.32±0.09 | 15200 | 28.75±3.50 |
| 4 | 22.15±0.15 | 0.48±0.07 | - | 29.65±4.50 | 19.45±1,02 | 0.70±0.06 | 29200 | 27.50±4.50 |
| 5 | 19.90±2.25 | 0.22±0.02 | - | 30.00±2.50 | 18.50±0,09 | 0.57±0.08 | 35200 | 27.00±.2.25 |
| 6 | 28.10±3.25 | 0.49±0.03 | - | 28.50±3.45 | 15.75±2,06 | 0.85±0.04 | 48400 | 25.50±3.75 |
| 7 | 31.20±2.5 | 0.25±0.04 | - | 30.00±5.10 | 13.50±1,26 | 0.75±0.09 | 74800 | 23.50±2.50 |

**Table 2.** Performance of production and mortality in broiler houses (day 49)

| **Broiler house** | **Capacity (birds)** | **Bird/$m^2$** | **Feed intake (gr)** | **Live weight (gr)** | **Feed conversion** | **Mortality (%)** |
|---|---|---|---|---|---|---|
| P1 | 10 000 | 10 | 4480±132 | 1682±79 | 2.66 | 10.5 |
| P2 | 10 000 | 10 | 3700±104 | 1870±56 | 1.98 | 4.8 |

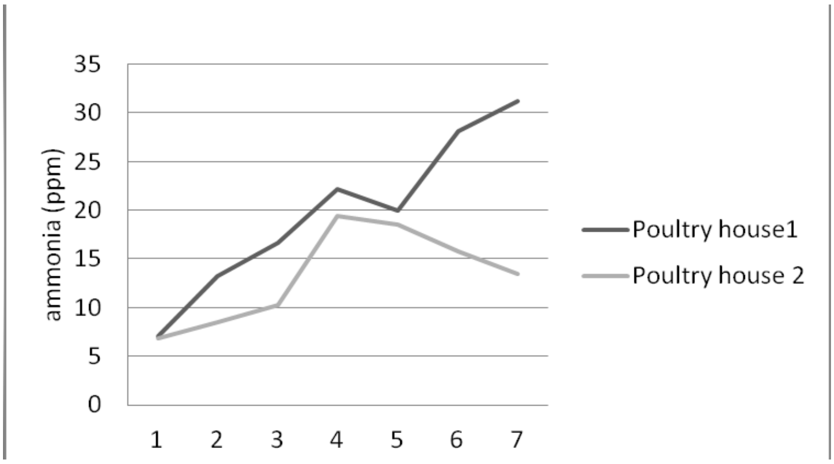


**Figure 1.** Ammonia levels in broiler houses for seven weeks

## CONCLUSION

Mechanical ventilation is a process which it is necessary to install in all the broiler houses because it involves an improvement of the internal environment parameters of the building in summer:

- An increase in the air flow and its velocity
- A decrease in high temperatures in poultry houses
- A reduction of the concentration of ammonia
- An improvement of production performances
- A reduction of the death rate

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