Agronomy Research **14**(1), 228–235, 2016

Effect of broiler chickens living conditions on results of fattening

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Abstract: This work was aimed to monitor outdoor temperature, air humidity and internal microclimate conditions in broilers house during summer days, the temperature and the quality of bedding material as well as bird density. To evaluate the quality of litter we set three-tier system. If the litter dry and hard - value was '1' if it was moist and supple - value was '2', and if it was wet – value was '3'. The measurements were carried out on the 10th and 20th days of chickens age. Air temperature was monitored by (logger Comet R 3120) thermometer and for the measurement of the litter temperature used a non-contact thermometer (Raytek Raynger ST). To find out the birds density a thermocamera (Guide TP8S) for thermal imaging was used and subsequent shots are evaluated the birds stocking density. If the bird density high, value was '1', if the bird density median, value was '2' and if the density low, value was '3'. The hall was divided into 33 rectangular shapes. Results showed that the bedding quality averageed 1.2 on day 10 and 1.3 on day 20 of fattening (dry and hard). By comparing the P values and the significance level α (0.05), the value of 0.651 and 0.820 was found respectively for both age. No significance was detected between the litter temperature and the litter quality, also between bedding temperature and birds density. Intercomparison for bedding temperature and quality on days 10 and 20 a significant difference (0.000 < 0.05) was observed.

Keywords: broiler, litter, temperature, humidity.

INTRODUCTION

Litter quality and suitable climatic conditions are among the key factors in assessing the costs and benefits. In broilers, at the first fattening period (approximately 14 to 21 day) suitable temperature and humidity of the environment must be ensured according to the hybrid. In the second half fattening period, it is important not to exceed a temperature above 25 °C and maintain intensive ventilation and relative humidity below 70%, in the same time not exceeding the permitted levels of harmful gases (Brouček, 2014). Attention should be given to the flock density in the rearing area, which is given either in birds per 1 m^2 surface area of the house, or kilograms of chickens live weight per 1 m^2 at the end of the fattening period. This amendment according to Council Directive 2007/43/EC, which was taken over Slovak Republic and Regulation no. 275/2010 Coll. 9 June 2010 of Slovak Government. Poultry suffering from the summer heat stress from high temperatures. In poultry, neutral zone temperature generally is

between 13 to 24 °C. Feed consumption reduced slightly at temperatures between 24 to 29°C, and decreases at temperatures from 29 to 32 °C, while reduces dramatically when temperature rise more than 35°C, and increasing mortality, especially in broilers (Brouček, 2014). The high moisture content of the litter increases the microbial activity, leading to an increase in the temperature and the concentration of ammonia in the hall, as well as the increase of incidence of dermatitis. On the other hand, dry litter has a lower specific density and better thermal performance which affecting the comfort when birds are lying. Aggressive wet environment creates hygiene risks for animals as well as for people and reduce the life of buildings (Szabóová et al., 2013). The high flock density in the house prevents heat transfer from the surface litter into the atmosphere in the hall. This limits the effectiveness of conventional ventilation systems to alleviate heat stress. Heat produced by the animals is influenced mainly by live weight and activity (Bessei, 2006). If the flock density on the surface is high the temperature can be dangerously increased because they produce more metabolic heat especially the ventilation of the halls has not been prepared for older types or reconstructed halls (Pogran, et al., 2011). This is critical if the ventilation is inadequate or if the existence of non-ventilated places with motionless hot air zone (Karandušovská et al., 2009). According to Knížatová et al. (2009), not only temperature, humidity and pH, but also the time of using of the litter plays an important role. As the Butcher & Miles (2014) stated the optimal moisture of the litter is between 25 and 35% RH. Despite the fact that animals spend their short life in a specified area should not cause suffering to the animal (Webster, 1999). The aim of this study was to monitor microclimate conditions in the selected fattening poultry hall and their influences on the quality of the litter and flock density.

MATERIALS AND METHODS

In this work, we focused on monitoring the external temperature and air relative humidity during the summer days, microclimate conditions in the hall for broilers included the temperature, stocking density and bedding material quality. For the litter quality we have established a three-stage system of subjective evaluation indication (Weaver & Maijerhof, 2015), if the litter dry and hard – value was '1', moist and supple '2', wet '3'. To assess stocking density, we used the same method, by using TIC photo technic assumed for the determination of high stocking density – value was '1', median stocking density '2' and when stocking density was low '3'. This experiment was performed in the selected farm for fattening chickens, which is located in Nitra Region. The main production programme of the poultry farm where measurement was performed is production of 650,000 broiler chickens annually, i.e. approximately 1,300 t of meat. The measurement conducted on the 10^{th} and 20^{th} days of chicken age. Monitored hall, had dimensions of 100 x 10 m, and 17,280 chicks stocked. The hall was established in late sixties of the 20^{th} century. Air inlets were made in the side walls of the hall. Ventilation was provided by 5 ceiling fans with the capacity of 13,800 m^3 h^{-1} and 3 wall fans with capacity of 35,000 m^3 h^{-1}. The litter consisted of 3.5 kg chopped straw on one m^2 of the floor space. For the feeding and watering, the pan feeders and nipple drinkers systems were used. Measurement of external and internal temperatures was achieved by Comet logger R 3120 and for the measure of litter temperature a non-contact thermometer Raytek Raynger ST was used. Deployment of broilers in the hall monitored using thermal imagers Guide TP8S with display range of 8 to 14 μm. Data were

statistically processed in Excel program and statistics and maps of the litter temperature, litter quality and stocking density were processed using the Surfer program.

RESULTS AND DISCUSSION

Even though it was summer, high differences was noted in temperature and humidity during the monitoring period (Table 1 and Fig. 1).

Table 1. Average values of monitored indicators

Hall	10 day age chickens	20 day age chickens
The average outdoor temperature, °C	36.5	14.0
Outside RH%	33.3	75.8
The average inside temperature, °C	32.3	24.3
RH% in the hall	42.8	55.7
The average litter temperature, °C	28.9	26.4
Average litter quality	1.2	1.3
The average stocking density	2.1	1.2
The number of chicks	16,853	16,705

The outside air average temperature at the 20th day of chickens age decreased sharply (from 36.5 °C to 14.0 °C), and the relative humidity is increased rapidly (from 33.3% to 75.8%). This change was also reflected in the microclimate conditions in the rearing hall.

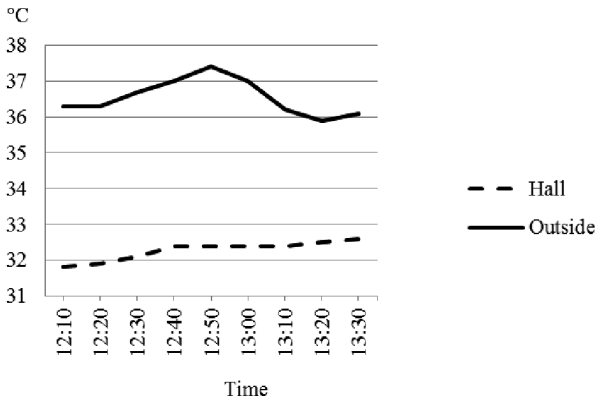

Figure 1. Shows the course of the air temperature on day 10 of chickens' age.

Regression line for the relationship between the outside and inside air temperature on the 10th day of chickens age is presented by the equation $y = 0.5561x + 11.691$ (Fig. 2), when the outside air temperature increased by 1 °C the internal temperature of the air increased by 0.556 °C. The determination coefficient ($R^2 = 0.8955$) indicates that 89% of indoor air temperature variability is explained by the influence of the outside temperature.

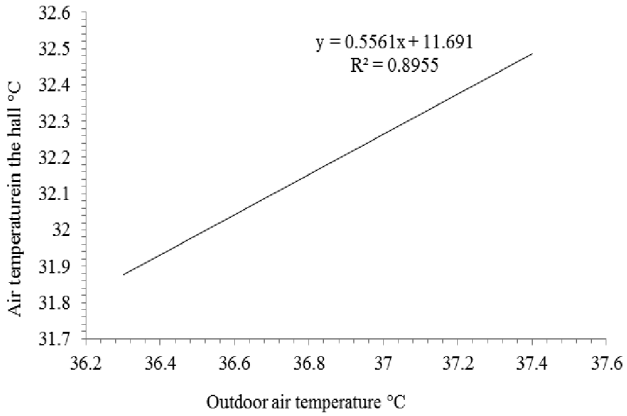

Figure 2. Influence of outdoor temperature on the 10th day of chickens age.

During measurement of litter temperature on the 20th day, the outside air temperature reached the value of 13.5°C and the relative humidity reached 79.1%, while during the day raised up to 86% (Fig. 3), this required minimum ventilation with respect of limited harmful substances in the hall, also continuous reduction of light intensity decreased chickens activity in the rearing hall, after the decreasing of outdoor relative humidity, the ventilation restored again.

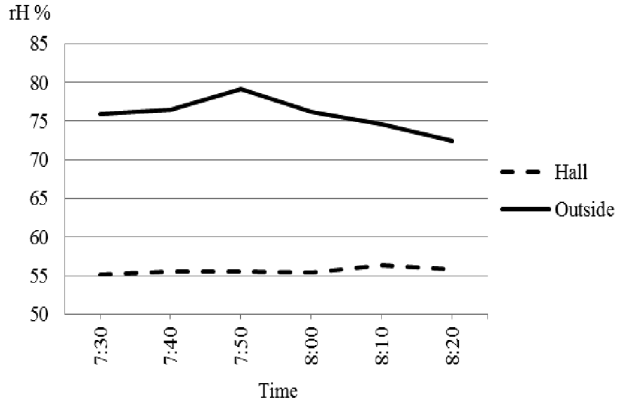

Figure 3. The course of relative humidity on the 20th day of age chickens.

Regression line relationship between external and the hall humidity on the 10th day of chickens age is represented as $y = 0.978x + 10.298$ in Fig. 4. From the regression equation concluded that the increase in outside air humidity by 1%, increase the humidity in the hall by 0.978%. The coefficient of determination R^2 (0.7017) indicates that 70% of the variability of internal relative humidity is explained by the influence of the outside relative humidity.

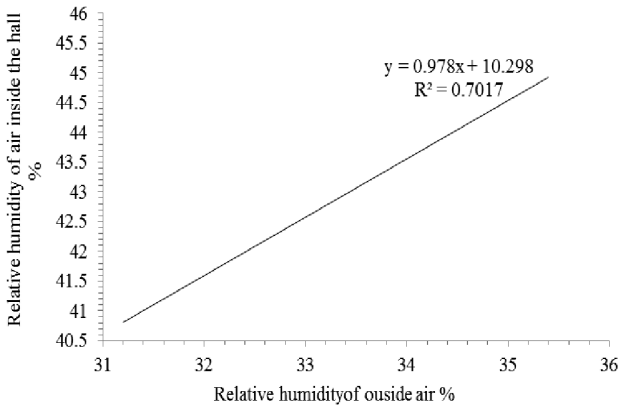

Figure 4. Influence of relative humidity on the 20th day of age chickens.

It showed from the map of the litter temperature in the hall at the 10th and 20th days of chicken's age, that on day 10 some places showed lower litter temperature affected by the high humidity in Figs 5, 6. The same pattern was observed on the 20th day which affected by the high letter moisture in which caused by the water leakage of the drinkers. By comparing the P values and the significance level α (0.05) it found that the value of P is (0.000) < α (0.05) which mean that the values of litter temperature on day 10 and 20 was statistically significant.

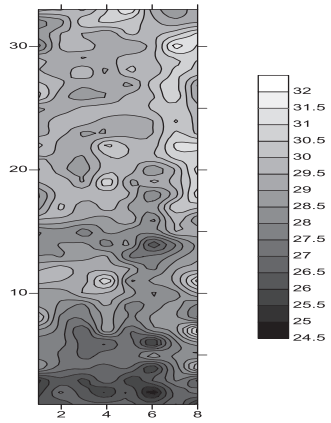

Figure 5. The litter temperature zones map on the 10th day of chickens age.

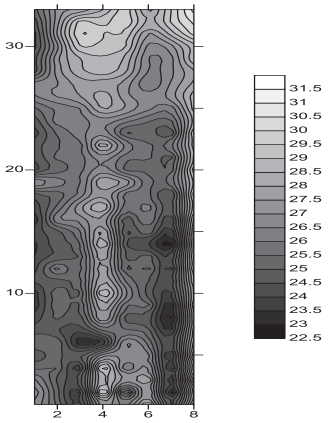

Figure 6. The litter temperature zones map on the20th day of chickens age.

In Figs 7, 8 can be concluded that the value of litter quality on day 10 varied from the value 1 to 2. On the 20th day found places with lower bedding quality caused by the spillage of water from the drinkers where chickens not present on these arias. With the comparison of the 10th and 20th days found significant difference (value of P = 0.000 < α 0.05).

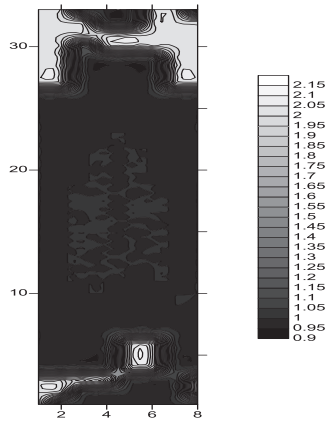

Figure 7. Map of bedding quality on the 10th day of chickens age.

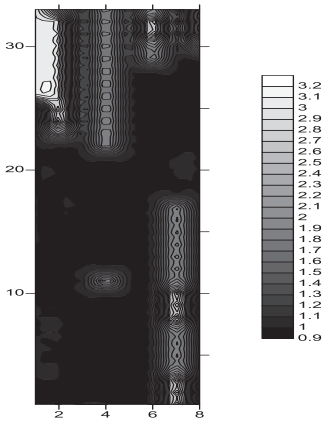

Figure 8. Map quality bedding on the 20th day of chickens age.

On day 10, Figs 9, 10 show the empty places where chickens are not found on moist litter places because enough dry litter places are available. The map of litter quality and density on the 20th day show that chickens occupied the whole area of the hall except for places near the feeders. For the above can be deduced that values at 10 and 20 days are not significant (P = 0.091).

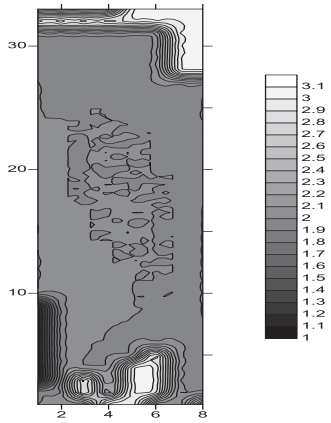

Figure 9. The map of stocking density per m^2 on 10th day of chickens age.

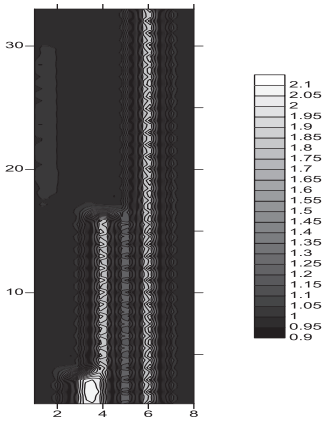

Figure 10. The map of stocking density per m^2 on 20th day of chickens age.

As long as the litter quality deteriorates rapidly due to the seepage of ground water into the bedding material, or due to the drinkers dis-function, therefore chickens search for suit places. Despite it was summer season, the registered data not exceed the reference temperatures according to Brouček (2014). In case of high humidity it requires regulation of the ventilation system. It is important to monitor constantly the air quality in the hall so as not to exceed the levels of harmful substances in the air and minimize of birds activity. In some places litter humidity exceeded the allowable limit which recommended by Butcher & Miles (2014). At the end of fattening period chickens

located on the waterlogged litter also due to lack of space on the appropriate litter. Here it is necessary to pay special attention to proper operation of drinkers.

CONCLUSION

The aim of our study was to monitor the microclimate conditions in the hall for fattening chickens and the results highlighted their impact on the quality of the bedding and the stocking density of chickens. Summer in Slovakia was rainy with fluctuating temperatures, this had effects at the first half of the fattening period which temperature was high and in the second half of the fattening period a low temperature and high relative humidity were registered. The results obtained concluded that:

– The data of litter temperature at the 10^{th} and 20^{th} days of chickens age detected statistical dependence ($P = 0.000 < \alpha = 0.05$);

– The litter quality of 10th and 20th day of chickens age detected statistical dependence ($P = 0.000 < \alpha = 0.05$);

– The stocking density on the 10th and 20th day of chicken age has not been established statistical dependence ($P = 0.091$) < α (0.05);

– In terms of improving the living conditions of chickens recommended to focusing more attention to the drinkers and the structure of the floor and outer wall during the fattening cycle to avoid water seepage through cracks.

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