The Productive Response of Hens Exposed to Heat Stress

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Abstract

The environmental stress has been implicated in adverse marked effects on egg production and eggshell quality of hens. The effect of heat stress was studied on three hen breeders (White Leghorn, Rhode Island, and White Plymouth Rock). The experiments were conducted on 4210 hens aged 31 weeks for each breed. The experimental period was 4 weeks. At age 32 weeks, the environmental temperature was 34.4–36.4°C, into the hall. There were monitored the following productive parameters: feed intake, laying rate, egg weight, and shell thickness. After one week of heat stress the feed intake decreased with 32.4% at White Leghorn females stock, 21.8% at Rhode Island and 27.3% at Plymouth Rock. After three weeks of heat exposure, the laying rate decreased with 10.4% at White Leghorn, 6.1% at Rhode Island, and 5.8% at White Plymouth Rock ($p \leq 0.05$). The egg weight decreased with 3-3.2 g to all groups. The shell thickness was lower with 0.07 mm at White Leghorn, 0.04 mm at Rhode Island and 0.03 mm at White Plymouth Rock. The lower egg quality established a decrease of eggs for incubation. White Leghorn breed was more affected by the heat exposure, because the productive parameters production had a drastic decline. In this breed, mortality was determined by cannibalism and internal haemorrhages.

Keywords: *heat stress, hens, parent stock*

INTRODUCTION

The environmental stress has been implicated in adverse marked effects on egg production and eggshell quality of hens. Reports have conclusively indicated that poor performance (egg production and poor eggshell quality) of layers reared in thermally-stressed environments could be adduced to a complex interplay of low feed intake, malfunctioning of the endocrine system, acid-base imbalance and poor physiological functioning of organs and mechanisms connected with the entire egg production process, via follicular recruitment and growth, ovulation, egg formation, shell formation, egg development, oviposition and oviposition interval (Oguntunji and Alabi, 2019). The action of environmental factors is different varying with the breeds or hybrids. At Albo hybrid, the egg production decreased by 9.2%, comparative with Roso hybrid production (Andronie *et al.*, 2009).

Starting from these considerations, our investigation monitored the influence of heat on the

productive capacity of three hen breeders (White Leghorn, Rhode Island and White Plymouth Rock) widely used in Romania to obtain the commercial hybrids used for egg and meat production.

MATERIALS AND METHODS

The experiments were conducted on three groups (White Leghorn, Rhode Island and White Plymouth Rock). Each group has 4210 hens aged 31 weeks (peak egg production). The experimental period was 4 weeks. The hens were breeding on the floor. Starting at age 32 weeks, the environmental temperature was 34.4–36.4°C, into the hall.

The diets used in our trials were isocaloric and isoprotein, providing the requirement of nutrients according to the feeding norms. The lighting programs were specifically for each breed. The monitored parameters were feed intake, laying rate, egg weight, and shell thickness. The feed intake was recorded daily. The laying rate was determined weekly, based on the daily egg

production. The egg weight and egg shell thickness were measured weekly.

The performance data were processed statistically by ANOVA.

RESULTS AND DISCUSSION

The data concerning the feed intake are presented in *Table 1*. Comparing with the results at 31 weeks, after one week of heat stress the feed intake decreased with 32.4% at White Leghorn females stock, 21.8% at Rhode Island, and 27.3% at White Plymouth Rock (*Fig. 1*). It was observed that the heat temperature had influenced the feed intake; the differences were significant ($p \leq 0.05$). The different results between the breeds were explained because of the genetic particularities.

In the literature, it was mentioned that at Albo hybrid exposed at 35°C the feed decreased with 21.2%. At Roso hybrid exposed in same conditions, the feed intake was lower with 15.5% (Andronie *et al.*, 2009). The response of the layers to overheating due to high environmental temperatures is the

Fig.1. Feed intake

depression of the nutrient intake. After 7 days of exposition to 31°C, the feed intake of Hy-Line

Brown laying hens decreased with 47.6% (Song *et al.*, 2012).

In *Table 2* it shows the experimental results concerning the laying rate. It was observed that the laying rate decreased (in 3 weeks of heat) with 10.4% at White Leghorn, 6.1% at Rhode Island and 5.8% at White Plymouth Rock (*Fig. 2*). The differences were significant ($p \leq 0.05$).

Those results are in agreement with the data presented in literature [4], that both laying rate and egg quality are decreased by the heat.

The literature shows that the laying rate decreased with 6.5% after 7 days of heat exposure (Song *et al.*, 2012). As temperatures rise above 32-35°C, egg production levels may also decline; as total nutrient intake is insufficient to support normal rates of lay (Bird *et al.*, 1988).

In our experiment, it was observed that the decrease of laying rate was more drastic in the first week of heat stress, with 4.4% at Leghorn hens, 3.2% at Rhode Island hens and in the third week of heat, the decrease was less drastic, because the organism of birds adapted (in some limits) to the high temperature. The egg weight decreased with 3-3.2 g to all groups. As feed intake declines, the first production trait to respond is egg weight, increasing the percent of medium and small eggs (Bird *et al.* 1988). The literature noticed that only 40-50% of the adverse effects of the heat (i.e. lower egg weight and lower laying percentage) can be attributed to the lower feed intake, the balance being on the account of the hen's capacity to acclimatize (Nyoya, 1995).

The shell thickness was influenced by the heat exposure, too (*Tab. 3*). It was observed that the shell thickness decreased significantly during those three breeds. Also, the percentage of eggs with haemorrhage and eggs without shell

Tab. 1. Feed intake (g/day)

Age (weeks)	White Leghorn	Rhode Island	Plymouth Rock
31	108.05 ± 6.73	119.38 ± 5.91	172.58 ± 8.26
32	73.33 ± 3.26 a	93.67 ± 5.42 a	125.43 ± 6.22 a
33	68.15 ± 4.77 a	85.73 ± 6.34 a	119.97 ± 7.35 a
34	64.52 ± 5.08 a	82.26 ± 4.96 a	116.24 ± 5.86 a

Tab. 2. Laying rate (%)

Age (weeks)	White Leghorn	Rhode Island	Plymouth Rock
31	91.6 ± 3.2	93.3 ± 2.6	87.1 ± 1.3
32	87.2 ± 1.7	90.1 ± 1.8	84.2 ± 1.7
33	83.7 ± 2.1	88.4 ± 2.2	82.0 ± 2.1
34	81.2 ± 1.3 a	87.6 ± 1.9 a	81.3 ± 1.8 a

Fig. 2. Laying rate (%)

Tab. 3. Eggshell thickness

Shell thickness (mm)	White Leghorn	Rhode Island	Plymouth Rock
Before heat stress	0.31 ± 0.022	0.37 ± 0.016	0.36 ± 0.014
Heat stress	0.24 ± 0.012	0.32 ± 0.019	0.33 ± 0.117

were bigger at heat exposure. The results can be explained by the haemorrhages in the oviduct and by the perturbation of calcium metabolism.

The literature shows that the most frequent result of heat stress is a decrease in egg shell quality (Bird *et al.*, 1988). The high percentage of shell-less eggs produced by hens under heat stress is explained by the fact that the high temperatures and higher breathing intensity, the partial pressure of CO₂ and of the blood bicarbonates (HCO₃ ions) decrease. In consequence, without the supply of these ions, the shell of eggs becomes thin and frail (Yahav, 1998).

Particularly at White Leghorn hens, it was observed the apparition of cannibalism, like effect of the heat stress. In this cause, the mortality increased with 10.3%, the differences being significant ($p \leq 0.05$).

CONCLUSION

White Leghorn breed was more affected by the heat exposure, because the zootechnical production had a drastic decline.

The egg quality was affected equally by the heat exposure on all breeds.

The heat stress established the appearance mortality by cannibalism internal haemorrhages on white leghorn hens.

The lower egg quality (egg weight, shell thickness and egg without shell) established a decrease of the eggs for incubation.

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