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EFFECT OF HEAT STRESS ON BIOCHEMICAL PARAMETERS OF HENS

WPLYW STRESU CIEPLNEGO NA PARAMETRY BIOCHEMICZNE BADANYCH KUR

Abstract: The objective of this paper was to evaluate the effects of high temperatures on biochemical parameters of hens. Heat stress generally causes a decrease in feed intake. The hypothesis that feed intake, egg production, egg quality measures, acid-base status (pH, pCO₂, HCO₃⁻) of hens would be influenced by the high temperature period was tested. Twenty four Isa Brown hens at 60 weeks of age were used in this experiment and hens were randomly separated into 2 equal groups. Each group contains 12 hens. First control group was housed at 20.1÷21.2°C and 60÷65% relative humidity. Experimental group was housed for 2 weeks at 20.5°C and 60÷65% relative humidity in experimental box, and then exposed to 27°C and 60% for 4 week, and then allowed to recover for 2 week at 20.5°C and 60% relative humidity. All production parameters and egg quality were significantly affected by heat stress. Feed intake during first week heat period was significantly reduced (18%). In three next weeks, feed intake was increasing with reduction 14.5%, 8% and 9.5%, respectively. Blood pH values were significantly lower from 3rd week of exposure. Blood pH had these values: 1st week 7.372, 2nd week 7.371, 3rd week 7.380 and 4th week 7.289.

Keywords: heat stress, temperature, hen, acid-base, pH

High ambient temperature is of great concern in all types of poultry operations. Heat loss in poultry is limited due to feathering and the absence of sweat glands. When the temperature and relative humidity exceed the comfort level of a bird, it loses the ability to efficiently dissipate heat. High ambient temperatures compromise performance and productivity through reducing feed intake and decreasing nutrient utilization, growth rate and egg quality, which lead to economic losses in poultry [1]. Heat stress is well known to reduce the reproductive performance of laying hens by interrupting egg production, an effect caused by a reduction in feed intake [2]. In addition, heat stress negatively affects the strength, weight, thickness and ash content of eggshell [3], as responses involve various aspect of calcium metabolism, including a reduction in free ionized calcium in the blood [4]. Hens exhibit a variety of panting patterns to lose heat as water vapor [5]. The increase in respiration rate leads to a reduction in blood partial pressure of CO₂, HCO₃⁻ and an increase in blood pH, resulting in respiratory alkalosis [6, 7].

Materials and methods

Twenty four Isa Brown hens at 60 weeks of age were used in this experiment and hens were randomly separated into 2 equal groups. Each group contains 12 hens. First control group was housed at 20.1÷21.2°C and 60÷65% relative humidity. Experimental group was housed for 2 weeks at 20.5°C and 60÷65% relative humidity in experimental box, and then exposed to 27°C and 60% for 4 week, and then allowed to recover for 2 week at 20.5°C and 60% relative humidity.

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Blood (4 cm^3) was drawn from the brachial vein into a syringe containing lithium heparin. All samples were stored in ice until analysed. The partial pressure of CO (pCO_2), concentration of bicarbonate ions and pH of blood and shell-gland fluid, corrected to body temperature of 41°C , were measured within 1.5 h using an acid-base laboratory OPTI Critical Care Analyzer.

The sampling intervals and measured parameters in this study are summarized in Table 1.

Table 1

Summary of measurements taken, sampling intervals used	
Collection interval	Parameter
Daily	Egg production [%]
	Feed intake [g]
Once a 5 day	Acid-base status
	pH
	pCO_2
	HCO_3^-

Results and discussion

The effects of heat stress are presented in Figures 1 and 2. The statistical analysis of the present study revealed that chronic high temperature 27°C significantly ($p < 0.05$) decreased feed intake during the first seven days of the heat stress (18%). In two next weeks, feed intake was increasing with reduction 14.5, 8 and 9.5%, respectively. These results are supported by the findings of Sahin et al [1].

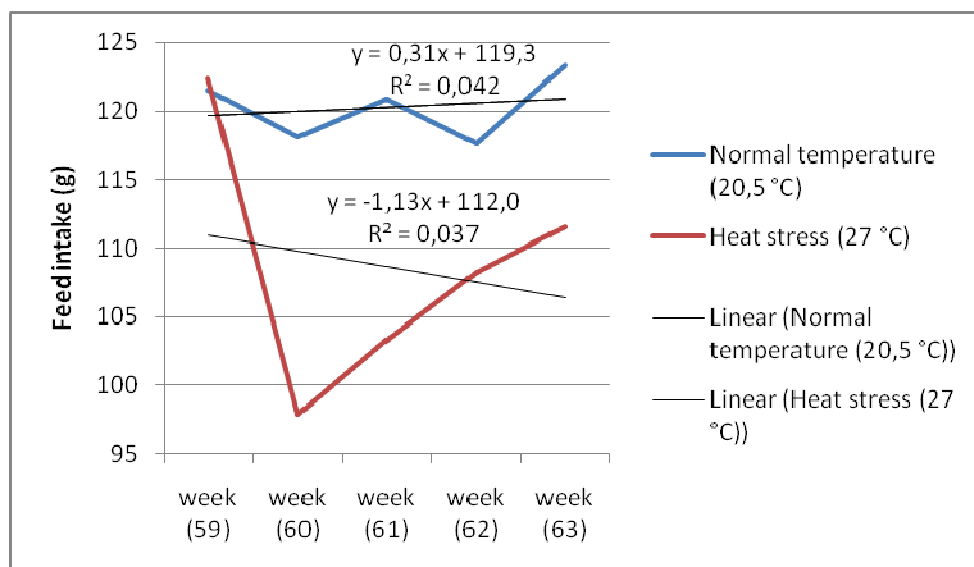


Fig. 1. Effect of heat stress on feed intake

Effect of high temperature on production is shown in Table 2. A significantly lower egg-laying was detected in the second and fourth week of heat stress exposure ($p < 0.01$). Significantly lower ($p < 0.05$) production was observed in the third week of high temperature. The highest decrease was recorded in the third week of high temperature.

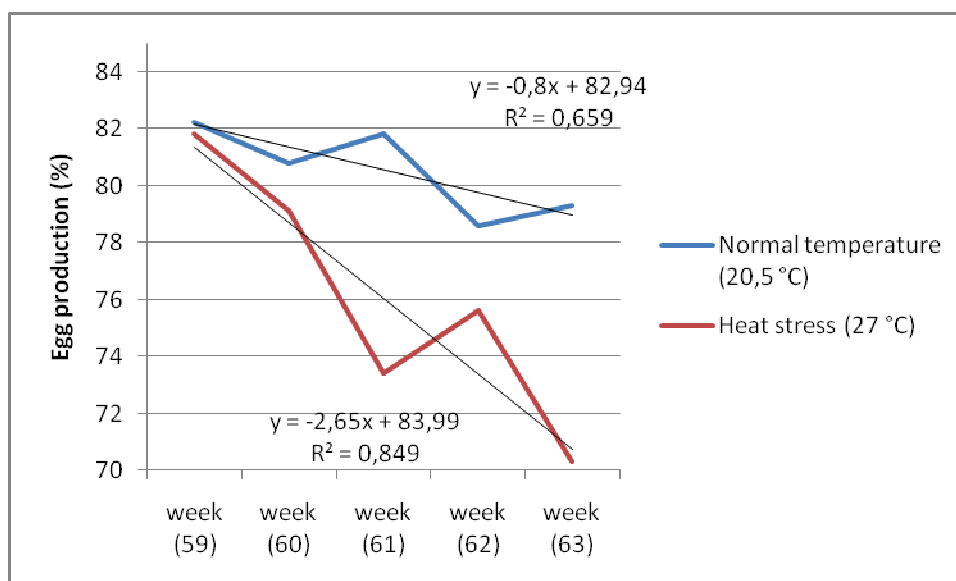


Fig. 2. Production parameters of laying hens as affected by heat stress

Parameters of acid-base balance are presented in Table 2. Acid-base parameters of laying hens were affected by heat stress. Highly significant differences were found for the parameters $p\text{CO}_2$ and st.HCO_3 . Blood pH values were not altered in the first 2 weeks of heat stress exposure. Changed values of $p\text{CO}_2$ and st.HCO_3 can be regarded as the state compensated respiratory alkalosis. Although, the next period the heat stress expected alkalosis, the effect was not confirmed.

Table 2

Parameters of acid-base balance

	week	60		61		62		63	
		Mean	SE	Mean	SE	Mean	SE	Mean	SE
pH	20.5°C	7.371	0.0032	7.372	0.0015	7.383	0.0021	7.378	0.0014
	27°C	7.372	0.0029	7.371	0.0011	7.380	0.0018	7.289	0.0008
$p\text{CO}_2$	20.5°C	37.23	0.081	36.84	0.095	37.12	0.084	37.20	0.094
	27°C	27.53	0.064	25.18	0.097	26.72	0.077	25.91	0.068
st.HCO_3	20.5°C	27.21	0.042	27.43	0.122	27.61	0.075	26.83	0.066
	27°C	22.41	0.033	21.83	0.093	22.01	0.052	25.76	0.071
BE	20.5°C	0.35	0.775	3.28	0.680	2.16	0.543	-2.81	0.449
	27°C	-3.83	0.341	-4.31	0.337	-6.25	0.447	-1.16	0.326

Conclusion

Heat loss in poultry is limited due to feathering and the absence of sweat glands. When the temperature and relative humidity exceed the comfort level, it loses the ability to efficiently dissipate heat. Biochemical parameters of internal environment of hens are suitable indicator to evaluate comfort level of animals. Therefore, our study was focused on the effect of heat stress on biochemical parameters of hens.

Acid-base parameters of laying hens were affected by heat stress. Significant differences were found in $p\text{CO}_2$ and st.HCO_3 . Blood pH values were not altered in the first 2 weeks of heat stress exposure. Changed values of $p\text{CO}_2$ and st.HCO_3 can be regarded as the state compensated respiratory alkalosis.

To confirm these data, there is necessary next exploration to reveal detail effects of heat stress on biochemical and production parameters of laying hens.

Acknowledgments

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