Thermal profile of broilers infected by *Eimeria tenella*

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Abstract

In study, infrared thermography (IRT) was assessed as a means of detecting the changes in body temperature in poultry coccidiosis, as well as determining IRT used in imaging and measuring the regional changes in skin temperature that occur in the poultry during this infection. Broilers were inoculated with 5×10^2 or 1×10^3 oocysts of *Eimeria tennella*.The group of control animals remained non-inoculated throughout the study. The study showed that coccidiosis affected temperature homeostasis in animals significantly. Body surface temperature decreases significantly ($p<0.05$). IRT is a promising tool that may provide a more objective an quantitative information about thermal status of animals.

1. Introduction

Coccidiosis is a highly contagious sporozoal infection with a low prognosis for recovery [1]. Symptoms of coccidiosis will depend on the state of the disease at the time of observation as well as on the species of *Eimeria* [2]. In general, coccidiosis affects the intestinal tract, and symptoms are associated with it. In mild cases, only watery diarrhoea may be present, and if blood is present in the faeces, it is in small amounts, and in certain species only [3]. One of the signs of coccidiosis is hypothermia [4 – 6]. That some degree of hypothermia existed during coccidiosis was recognized by [7], who advocated the therapeutic use of heat for flocks during outbreaks of coccidiosis.[8] confirmed that changes in body temperature were slight until a determined point of fatal infection. The body temperature of birds just before death greatly decreased below the control values.

Infrared thermography (IRT) is a non-invasive and safe technique of thermal profile visualisation. The thermographic method also found the use in veterinary medicine and animal science and research [9]. IRT provides both qualitative and quantitative information on the surface temperature of the target tissues. In living organisms, changes in vascular circulation result in an increase or decrease of tissue temperature, which is then used to evaluate the situation in that area [10]. The patterns of a thermogram are affected by activities of the tissues, organs, and vessels inside the animal's body, and may be unique for a particular disease [11]. Thermal imaging has been used successfully for research on thermal physiology and thermal comfort of poultry in particular [12 - 20], but it is applied less frequently in poultry veterinary problems.

In this study, infrared thermography (IRT) was assessed as a means of detecting the changes in body temperature in poultry coccidiosis, as well as determining IRT used in imaging and measuring the regional changes in skin temperature that occur in the poultry during this infection.

2. Materials and methods

A total 42 broilers (from one-day old) were used. They were coccidian-free and reared under controlled conditions. They were divided into two treatment groups (A and B) and one control group (C) each containing 14 broilers. The groups were kept individually in standard conditions and fed a commercial feed.

The pure strain of *Eimeria tenella* (Laboratory of Coccidia, Institute of Parasitology, Biology Centre, ASCR, v.v.i.) was used for the experimental infection, and animals were inoculated *per os*. At day 14 of the experiment, the broilers were inoculated with 5×10^2 (group A) or $1\text{x}10^3$ (group B) oocysts. Uninfected animals served as a control (group C). Each day (days post-infection), faecal samples were collected from all the animals, and oocysts per gram (OPG) were estimated using the modified McMaster technique.

Infrared thermography measurements were at 8 and 15 d after inoculation. All IRT measurements were taken during the time period of 09:00 to 11:00 am. Every broiler was measured individually. The broiler was picked up and placed on a polystyrene board, and the thermograms were taken as fast as possible to reduce stress effects. The broilers were handled by wearing latex gloves to avoid influences of heat and moisture of the human hands on the temperature of their surface. An IRT camera (FLIR SC660, FLIR systems, Inc.) was used for taking images (thermograms) of the broilers (resolutions 640x480, accuracy 1%, 24° lens) at a horizontal distance about 1 m away from the birds. The camera parameters were set to 0.97 for emissivity, 24.3 °C for atmospheric temperature, 25.3 °C for reflected temperature and 37.6 % for relative humidity. FLIR Reporter Professional software (FLIR System Inc., 2010) was used for evaluation of thermograms. Ocular surface temperature (OS), beak surface temperature (BS), shank surface temperature (SB) and body surface temperature (S) were evaluated. The differences in temperature of selected parts of the broiler body surface at 8 and 15 d after inoculation were processed statistically. Statistical analysis of data was conducted by the statistical software program Statistica.cz (StatSoft, USA), ANOVA, POST-HOC Tukey test).

3. Results

The results in the change in temperature are presented in table 1. The significant differences ($p<0.05$) between experimental groups A, B and control group C were recorded at 8 d after inoculation. Temperature of all selected parts of body was found out significantly lower in group A and B when compared with control group C. The difference in changes of temperature between group A and group B did not show statistically significant changes in all selected parts at 8 d.

The significant differences ($p<0.05$) between experimental groups A, B and control group C were also recorded at 15 d after inoculation. Temperature of all selected parts of body was found out again significantly lower in group A and B when compared with control group C. However, group B showed significantly ($p<0.05$) higher decrease in temperature off all selected parts when compared with control group C. The highest difference was recorded in SB (5.03 K) and S (4.59 K). This situation is documented in figure 1 and figure 2. In addition to the significant changes ($p<0.05$) in SB and BS was recorded between group A and B (the differences 3.36 K resp. 2.16 K). No significant responses in temperature of parts OS and S were observed in broilers of groups A and B at 15 d.

Table 1. *Mean values of temperature [°C] in selected parts of broiler body surface at 8 and 15 d after inoculation*

8 d	**OS**	**BS**	**SB**	**S**
Group A	39.61 ± 0.29	33.68 ± 1.91	35.33 ± 0.82	33.15 ± 0.52
Group B	39.36 ± 0.50	33.95 ± 1.38	34.98 ± 1.35	33.47 ± 0.84
Group C	40.69 ± 0.43	36.16 ± 1.12	37.30 ± 0.62	35.70 ± 0.73
15 d				
Group A	39.31 ± 0.65	33.79 ± 2.44	35.39 ± 0.86	31.92 ± 0.56
Group B	39.01 ± 0.50	31.63 ± 1.98	32.03 ± 1.44	31.51 ± 0.35
Group C	40.25 ± 0.29	36.22 ± 0.66	37.06 ± 0.69	33.71 ± 0.67

4. Discussion

The aim of study was carried out to determine the effect on surface body temperature of different parts of the broiler body during patent infection of *E. tenella* using an infrared camera. Study of [1] confirmed by IRT the decrease of body surface temperature as a result of coccidiosis (*E. intestinalis*) in rabbit. Hypothermia was recorded in infected rabbits. Body surface temperature has not yet been investigated by IRT during coccidiosis in poultry. Only [19] showed by other methods of measurement that the temperature of infected chickens (*E.tenella*) was dropped below the control. The decrease of temperature was found out in our study too in 8 d and 15 d. Both infected groups of broilers showed the significant decrease of temperature in all selected parts of body compared with control. In 15 d the significant differences were also recorded between both infected groups, particular in bill area and shank area. These results of our study confirmed the studies [19] and [18]. [20] and [21] consider the bill as an important part of the body for the assessment of bird thermal status. Authors [12] notice, that also shank as un-feathered part of bird body is suitable for evaluation of thermal status of birds. These statements were confirmed in our measurements. The highest temperature differences were found out in the bill and in the shank .Authors [14] refer to a strong positive correlation between body core temperature and surface temperature in chickens. Authors [13] present that thermal comfort is of great importance in chicken to preserve body temperature homeostasis. But the study showed that coccidiosis affected temperature homeostasis in animals significantly, although environmental conditions of rearing, including microclimatic conditions, are according to the standard.

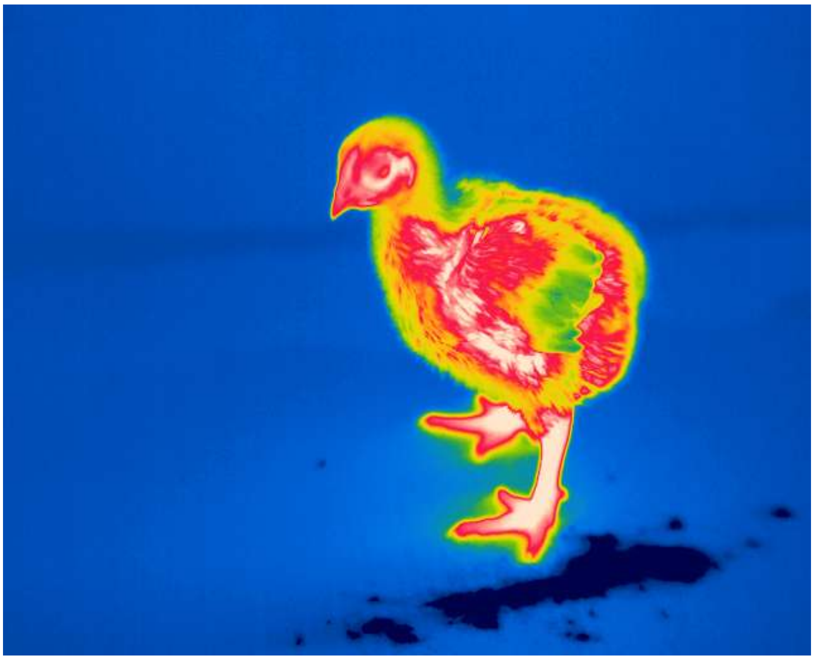

***Fig. 1**. Thermal profile of healthy broiler chicken (group C) at 15 d*

***Fig. 2.** Thermal profile of broiler chicken infected with E.tenella (group B) at 15 d*

5. Conclusion

The best method available to provide information on the temperature of the body surface and, in particular, on the dynamics of its changes, is IRT. IRT facilitates the localization of increased (inflammation, injury) or decreased heat (reduced blood flow vasomotor tone). It was concluded, that IRT is a promising tool that may provide a more objective an quantitative information about thermal status of animals. Generally, infrared thermal measurements can be used very successfully in the prediction and detection of diseases, in research, as well as other applications in animal science.

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