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Marcjanna Wrzecińska

Wpływ stresu i wybranych czynników środowiskowych na wskaźniki reprodukcyjne i produkcyjne bydła

The impact of stress and selected environmental factors on the reproductive and production indicators of cattle

Rozprawa doktorska

Promotor: Prof. dr hab. inż. Ewa Czerniawska-Piątkowska
Promotor pomocnicza: Dr hab. inż. Alicja Kowalczyk, Prof. UPWr

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Abstract

The fertility of dairy cows directly impacts the profitability of dairy farms. Selection of cows for increased milk yield has led a reduction in reproductive functions by inhibiting ovarian follicles development and the secretion of steroid hormones. Factors such as improper maintenance conditions and various forms of stress (metabolic, heat, oxidative, and chronic) further negatively affect fertility. A routine examination used to assess the physiological condition of cows is the testing of the hematological profile, which can reveal the cattle's ability to adapt to environmental conditions, as well as to pregnancy or stress. Polish Holstein-Friesian cows are highly sensitive to heat stress, which disturbs the developmental competence of oocytes, adversely affecting mitochondrial functions.

The aim of the conducted studies was to analyze the hematological parameters of pregnant dairy cows of the Polish Holstein-Friesian black-and-white variety up to the 50th day of pregnancy *(Experiment I)* and to investigate the effect of heat stress on the *in vitro* fertilization process and its effect on mitochondria and cytoplasmic processes in oocytes were investigated *(Experiment II)*.

The first part of the study involved 101 cows of the Polish Holstein-Friesian black-and-white variety, divided into groups according to pregnancy duration. Blood samples were collected from the animals and subjected to hematological analysis. Statistically significant differences ($P \leq 0.01$) in hematological parameters were observed between the groups, including the number of granulocytes, white and red blood cells, and the percentage of lymphocytes, which may indicate stress in the animals. No significant differences in mean platelet volume or other hematological parameters were observed between the animal groups *(Experiment I)*. In the second part of the study, to better understand the impact of heat stress on cow reproduction, slaughterhouse material in the form of ovaries was obtained from 21 cows of the same variety. Bovine cumulus – oocyte complexes were then matured *in vitro* at 38.3°C and under thermal stress conditions (39.8°C, 41.0°C). Analyses after 24 hours of maturation included measuring reactive oxygen species, ATP content, and analyzing the expression of SIRT1 and LC3 proteins, assessing the impact of temperature on mitochondrial and cytoplasmic processes as well as autophagy regulation. The study demonstrated that heat stress adversely affects the development of cattle embryos, decreasing the percentage of embryos that cleaved and transformed into blastocysts, especially at 41.0°C. High

temperatures significantly increased the levels of cytoplasmic and mitochondrial reactive oxygen species and decreased ATP content in oocytes, indicating increased oxidative stress. Additionally, a decrease in the expression of LC3 and SIRT1 proteins, markers of autophagy, suggested disturbances in autophagic processes under elevated temperature conditions *(Experiment I)*.

Thermal stress negatively affects the developmental functions of bovine oocytes, and regular hematological profiling enables the rapid identification of disorders, including stress.

Keywords

Reproduction, dairy cattle, stress, hematological profile