

EFFECT OF HEAT STRESS ON AGE IN CONCEPTION OF HOLSTEIN HEIFERS

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Abstract

The aim of the study was to evaluate the effect of heat stress on conception of Holstein cattle heifers. The experiment was carried out at the Mendel University farm in Žabčice. The data was collected between May 2017 and August 2017. 48 heifers of Holstein cattle weighing 400–450 kg and ages 16 to 18 months were included in the experiment. The results of our study showed that heifers at 17 months of age (88 %) and 18 months of age (100 %) conceived best in the temperature range of 15–19.9 °C. Heifers at the age of 16 months (100 %) conceived best in the temperature range of 10–14.9 °C, with a moderately lower success rate (71 %) in the temperature range of 15–19.9 °C. At elevated ambient temperatures (range 15–19.9 °C), a 29 % drop in the level of conception was recorded in the heifers in this age category.

Keywords: Holstein cattle, reproduction, first insemination, heat stress

INTRODUCTION

An important point in the turnover of the herd is proper breeding of heifers. Our aim is to obtain healthy, sturdy and powerful breeders for the sake of herd variety (Vacek *et al.*, 2012). An important milestone in rearing heifers is to estimate the right time for the first insemination. At the time of insemination, the heifers should be well developed with an optimal body frame and harmonious body structure (Illek and Kudrna, 2014). It is important to monitor their growth and development (Urban, 1997). The age at attainment of sexual maturity in Holstein heifers ranges from 9 to 11 months, breeding age is reached at 14 to 16 months of age, weighing between 400 and 430 kg (Coufalík, 2013). The heifers should have 60 % of total body weight

at the time of sexual maturity and 90 % at calving. (Burdych *et al.*, 2004).

Fertility has a low heritability ($h^2 = 0,05–0,2$), indicating that it is largely influenced by outside factors such as ambient temperature, housing, nutrition etc. (Louda *et al.*, 2008; Stupka *et al.*, 2013). In the summer months, both heifers and dairy cows may suffer from heat stress, which may cause problems with conception. Heat stress is defined as the sum of the external forces influencing the animal, resulting in an increase in body temperature and induction of a corresponding physiological response (Dikmen and Hansen, 2009; García-Ispuerto *et al.*, 2007). Cattle tolerates high temperatures worse than lower temperatures (Illek *et al.*, 2007). The most comfortable temperature for cows and heifers is

up to 20 °C (Koukal, 2001; Zejdová *et al.*, 2014). Heat stress worsens the health and reproductive performance of individuals (Polsky and von Keyserlingk, 2017) and negatively affects the ability of the breed to conceive (Lucy, 2002). Al-Katanani *et al.*, (1999) came to the same conclusion. Increasing the ambient temperature negatively affects the ability of cows to exhibit natural reproductive behavior as they reduce both the intensity and duration of the oesterus (Orihuela, 2000). The same was published by De Rensis and Scaramuzzi (2003).

MATERIALS AND METHODS

The experiment was carried out at the Mendel University farm in Žabčice. The effect of heat stress in the first conception of heifers was monitored. The monitored group consisted of 48 heifers of the Holstein breed weighing between 400 and 450 kg and the age range of 16–18 months. The heifers were monitored from May 2017 to August 2017. Heifers for insemination were selected using age and weight criteria. Detection of the oesterus was performed using visual detection and ultrasound examination of the uterus and ovaries. Insemination was performed by the rectal method and by the same insemination technician. Conception was checked ultrasonographically at 30 days of gestation. Temperature data were obtained from the weather station in Žabčice.

RESULTS AND DISCUSSION

Tab. I shows the minimum, maximum and average temperature values in the monitored months. It is noticeable that the average values already exceed the optimum comfort temperature.

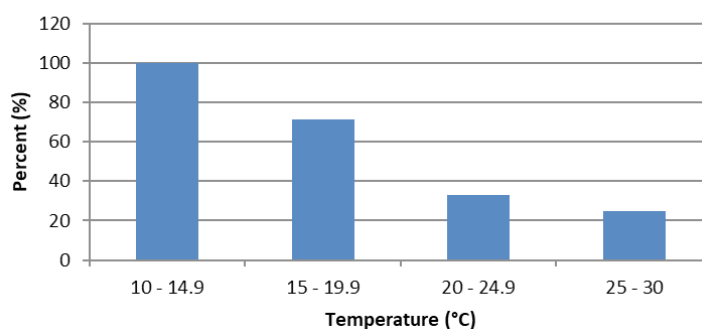
According to Koukala (2001) and Zejdová *et al.* (2014), this value is up to 20 °C, Doležal and Staněk (2015), however, indicate values only up to 16 °C. When comparing these limits with the average value in Tab. I, we can state that with the exception of May, all average temperatures exceeded the comfort zone for cattle. Exceeding the upper limit of the optimum air temperature means a lesser willingness to feed, the gain of heifers is therefore negatively affected, as well as their health status (Pospíšilová, 2013).

Figs. 1, 2 and 3 show the effect of the temperature on conception in each age category (16, 17 and 18 months of age). We divided the temperature criterion into 4 temperature ranges: 10–14.9 °C (temperature range A), 15–19.9 °C (temperature range B), 20–24.9 °C (temperature range C) and 25–30 °C (temperature range D). Graph I shows a decreasing tendency of conception. The heifers at 16 months of age conceived best in the temperature range A (100 %), in the temperature range B the conception rate was lower (71 %) and the worst results were achieved in the temperature range C (33 %) and temperature range D (25 %).

I: Minimum, maximum and average temperatures in individual months

Month	Minimum (°C)	Maximum (°C)	Average (°C)
May	-2.8	32.8	15.8
June	4.3	34.1	20.8
July	6.6	34.5	21.1
August	5.1	37.5	21.7

The effect of temperature on conception of heifers at 16 months of age



1: The effect of temperature on conception of heifers at 16 months of age

Fig. 2 describes the effect of temperature on conception of heifers at 17 months of age. A similar decreasing trend in conception can be observed here. No heifers were inseminated in the temperature range A. In the temperature range B the heifers had the best conception rate (88 %), slight decrease was noticeable in the temperature range C (83 %) and the lowest conception rate was in the temperature range D (50 %).

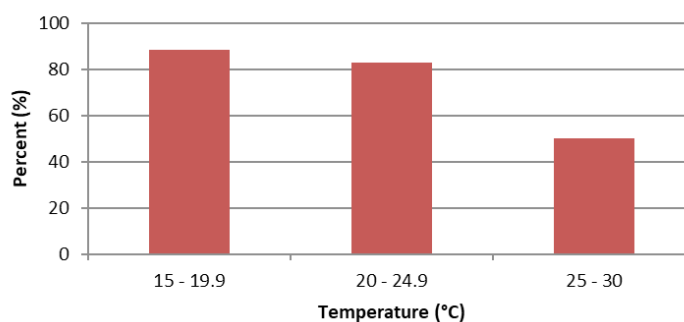
In Fig. 3, no effect of temperature on the conception of heifers at 18 months of age is noticeable. The heifers in the B and C temperature ranges conceived identically (100 %). No heifers were inseminated in temperature ranges A and D.

The above graphs clearly show that the heifers conceived best in the temperature range B (71 %, 88 %, 100 %). The only exception was represented by the heifers covered at 16 months of age, since the highest conception rate can be observed in the temperature range A (100 %). No other age group of heifers was covered in temperature range A.

The results of the experiment confirm the theory of Koukal (2001) and Zejdová *et al.* (2014), that the optimal temperature for cattle is up to 20 °C. Once the temperature exceeds the optimal comfort, body temperature increases, affecting ovarian function and embryo development (Lucy, 2002). Thermal stress can negatively affect the course of the estrous cycle and thus also conception (De Rensis and Scaramuzzi, 2003).

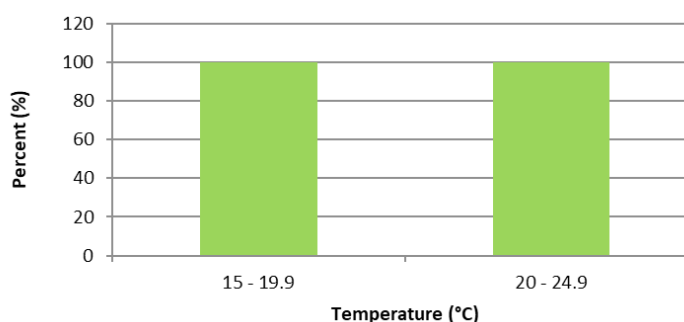
Fig. 4 describes the conception percentage of heifers in individual months. The graph shows that the heifers were most unsuccessful at conception in May, when only 66.7 % of the observed heifers conceived. The highest number of successful conceptions of heifers was achieved in June (100 %). Al-Katanani *et al.* (1999) argues that heat stress is the main factor in low conception rate. De Rensis and Scaramuzzi (2003) came to the same conclusion. Klementová *et al.* (2017), however, points out that the effect of heat stress on conception in cattle occurs with a delay of 3–4 months. Our results are in agreement with this theory.

The effect of temperature on conception of heifers at 17 months of age

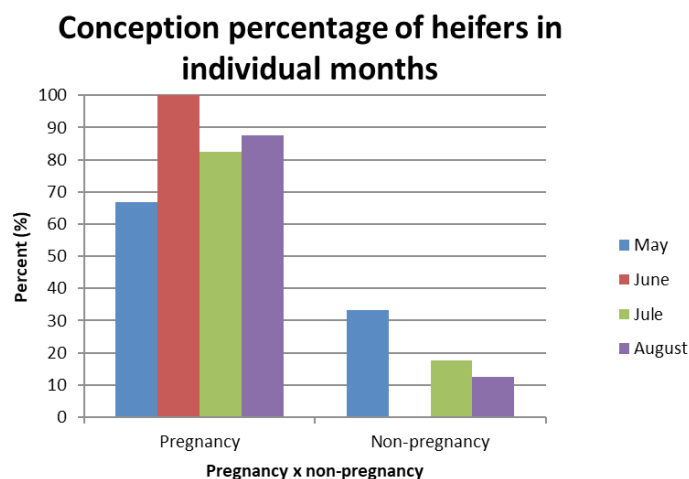


2: The effect of temperature on conception of heifers at 17 months of age

The effect of temperature on conception of heifers at 18 months of age



3: The effect of temperature on conception of heifers at 18 months of age



4: Conception percentage of heifers in individual months

CONCLUSION

Based on the results of our experiment, it is possible to state that the ambient temperature should affect the conception in heifers. Optimal temperature for cattle is up to 20 °C, which we confirmed in this study, when most heifers conceived in the temperature range of 15–19.9 °C (71 %, 88 %, 100 %). In the temperature range of 10–14.9 °C, only heifers at the age of 16 months were inseminated. In this group, the percentage of conception reached the best results (100 %). On the other hand, the worst conception was confirmed in the temperature range of 25–30 °C, when heifers at 16 months of age conceived with success rate of 25 % success and heifers at 17 months of age with success rate of 50 %. Our study shows that temperatures exceeding the critical limit had an effect on the conception of heifers. However, we are talking about the temperature range of 25–30 °C. From a general point of view, we can not confirm that thermal stress should have an effect on conception already in the month when it occurs.

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REFERENCES

- AL-KATANANI, Y. M., WEBB, D. W. and HANSEN P. J. 1999. Factors affecting seasonal variation in 90-day nonreturn rate to first service in lactating Holstein cows in a hot climate. *J. Dairy Sci.*, 82(12): 2611–2616.
- BURDYCH, V., VŠETEČKA, J., DIVOKÝ, L. *et al.* 2004. *Reproduction in cattle herds* [in Czech: *Reprodukce ve stádech skotu*]. 1st Edition. Hradec Králové: CHOVSERVIS a.s.
- COUFALÍK, V. 2013. *Current problems in cattle reproduction* [in Czech: *Současné problémy v reprodukci skotu*]. 1st Edition. Olomouc: Agriprint
- DE RENSIS, F. and SCARAMUZZI, J. R. 2003. Heat stress and seasonal effects on reproduction in the dairy cow – a review. *Theriogenology*, 60(6): 1139–1151.
- DIKMEN, S. and HANSEN, J. P. 2009. Is the temperature-humidity index the best indicator of heat stress in lactating dairy cows in a subtropical environment?. *J. Dairy Sci.*, 92: 109–116.
- DOLEŽAL, O. and STANĚK, S. 2015. *Breeding of dairy cattle* [in Czech: *Chov dojeného skotu*]. Praha: Profipress.
- GARCÍA-ISPIERTO, I., LÓPEZ-GATIUS, F., BECH-SABAT, G., SANTOLARIA, P., YÁÑIZ, J. L., NOGAREDA, C., DE RENSIS, F. and LÓPEZ-BÉJAR, M. 2007. Climate factors affecting conception rate of high producing dairy cows in northeastern Spain. *Theriogenology*, 67(8): 1379–1385.
- ILLEK, J. and KUDRNA, V. 2014. Correct calfs and heifers breeding [in Czech: *Správný odchov telat a jalovic*]. *Farmář*, 20: 58–59.

- ILLEK, J., KUDRNA, V., MATĚJČEK, M., NOVÁK, P. and SLAVÍK, P. 2007. Heat stress of dairy cows – health, production and reproduction. [In Czech: Tepelný stress dojnic – zdraví, produkce a reprodukce]. *Náš chov*, 67(6): 63–65
- KLEMENTOVÁ, K., FILIPČÍK, R. and HOŠEK, M. 2017. The effect of ambient temperature on conception and milk performance in breeding Holstein cows. *Acta Univ. Agric. Silvic. Mendelianae Brun.* 65(5): 1515–1520.
- KOUKAL, P. 2001. Nutrition of dairy cows in warm weather according to experience from the summer of 2000 [in Czech: Výživa dojnic v teplém počasí podle zkušenosti z léta 2000]. *Farmář*, 9: 75–76.
- LUCY, M. C. 2002. Reproductive loss in farm animals during heat stress. In: *15th Conf. on Biometeorology/ Aerobiology and 16th International Congress of Biometeorology*. University of Missouri, Columbia.
- LOUDA, F., VANĚK, D., JEŽKOVÁ, A. et al. 2008. *The application of biological principles in the management of reproduction of cows* [in Czech: Uplatnění biologických zásad při řízení reprodukce plemenic]. 1st Edition. Rapotín: Výzkumný ústav pro chov skotu, s.r.o.
- ORIHUELA, A. 2000. Some factors affecting the behavioural manifestation of oestrus in cattle: a review. *Appl. Anim. Behav. Sci.*, 70(1): 1–16.
- POLSKY, L. and VON KEYSERLINGK, M. A. G. 2017. Invited review: Effects of heat stress on dairy cattle welfare. *J. Dairy Sci.*, 100(11): 8645–8657.
- POSPÍŠILOVÁ, D., HRUŠKA, D., HAVLÍČEK, Z., SLÁMA, P., MARADA, P., SKLÁDANKA, J. and PAVLÍK, A. 2013. *Stable environment* [in Czech: Stájové prostředí]. Brno: Mendelova univerzita v Brně.
- STUPKA, R. 2013. *Animal breeding* [in Czech: Chov zvířat]. 2nd Edition. Praha: Powerprint.
- URBAN, F. 1997. *Breeding of dairy cattle: [reproduction, breeding, management, technology, nutrition]* [in Czech: Chov dojeného skotu: [reprodukce, odchov, management, technologie, výživa]]. Praha: Apros.
- VACEK, M., KRPÁLKOVÁ, L., ZINK, V. and JANECKÁ, M. 2012. *Methodology for the management of breeding and reproduction of holstein heifers in terms of the overall profitability of dairy cows* [in Czech: Metodika řízení odchovu a reprodukce jalovic holštýnského plemene z hlediska celkové rentability chovu dojnic]. Praha-Uhřetíněves: Výzkumný ústav živočišné výroby.
- ZEJDOVÁ, P., CHLÁDEK, G. and FALTA, D. 2014. *The influence of the stable environment on the behavior and milk performance of dairy cows* [in Czech: Vliv stájového prostředí na chování a mléčnou užitkovost dojnic]. Brno: Mendelova univerzita v Brně.

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