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CLIMATE IMPACT ON SUPEROVULATORY RESPONSE, QUALITY, AND STAGE OF EMBRYO DEVELOPMENT IN TROPICAL CATTLE

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Abstract: Large temperature variations (as in cold fronts in the tropics), solar radiation and humidity impact productivity and reproductive activity in tropical cattle. These conditions, together with cattle genotype play a key role in a embryo transfer programs. This paper presents two cases in which temperature extremes (hot and cold) affected the superovulation response, embryo development and the percentage of transferable embryos (TE). In case no. 1, heat stress in Sinaloa resulted in an ET rate of 21.04%, while in case no. 2, a "northern" cold front in Veracruz resulted in an ET rate of 28.12%. It should be noted that in both embryo transfer programs, the mean number of transferable embryos was 1.1 and 2.2, respectively, indicating poor embryo development and a reduced number of oocytes obtained.
Keywords: Embryos, climate, cattle, tropics.

INTRODUCTION

HEAT STRESS AND COLD FRONT" NORTH"

The combination of climatic factors that displace temperatures above or below physiological tolerable conditions is defined as heat stress. These climatic factors affect response to superovulation treatments, as well as embryo quality and development.

The comfort thermal zone for cattle in terms of ambient temperature is between 18 and 25 degrees Celsius (Hopper, 2021). Temperatures above this range cause heat stress, while lower temperatures cause gamete transport failure. High levels of cortisol are secreted under both of these conditions, which can inhibit the frequency of LH pulses by inhibiting pulsatile GnRH secretion in the follicular phase (Arias et al., 2005). However, the mechanisms by which heat stress alters circulating concentrations of reproductive hormones are unclear (Andersen, 2003). It has been suggested that during summer in tropical climates, the dominant bovine follicle develops at low LH concentrations, resulting in low estradiol concentrations. This causes poor sexual in-heat response, leading to low fertility. Alternatively, heat stress can directly affect the ovary, decreasing its sensitivity to gonadotropins. These findings were reported by De Rensis and Scaramuzzi in 2003, and by Hansen in 2004.

Studies in different breeds susceptible to varying temperatures throughout the year have shown that the proportion of morphologically normal oocytes is lower during summer than in winter, as reported by Al-katanani et al. (2002), Barros et al. (2006) and Ferreira et al. (2009). Observations made during the summer months have shown that a lower percentage of *in-vitro* fertilized oocytes develop to the blastocyst stage (Hansen 2007a., 2002). The negative effects of heat-stress on oocyte development may persist even after cows have been exposed to high temperatures, resulting in a decrease in the quality and competitiveness of oocytes obtained in the fall (De Rensis and Scaramuzzi, 2003). Heat stress can also increase the number of abnormal embryos when it occurs around or after fertilization. This should be considered when initiating superovulation programs in tropical cattle. Studies have shown that heat stress can compromise the ability of the oocyte to be fertilized and embryo development to the blastocyst stage (Hansen, 2004, Arias et al., 2008). The susceptibility of the embryo to heat stress occurs in the first three days of life (Al-katanani and Hansen, 2002, Ealy et al., 1993,1995).

In regions where "nortes" or cold fronts occur (Gulf of Mexico), there are sudden drops in temperature that are unusual for Bos Indicus cattle (5 to 15 degrees Celsius). This climate change also affects the reproductive activity of the cow (Putney et al., 1988, Ferreira et al., 2009, Hopper 2021). Also, the sudden change in temperature causes stress in the animal that responds releasing cortisol. Cortisol has implications for corpus luteum viability and gamete transport. There is little information regarding the effects of a sudden drop in temperature on the bovine response to superovulation and embryo development. Here, we describe 2 cases from the states of Veracruz and Sinaloa, Mexico in superovulation programs for embryo production in tropical cattle, where heat or cold were involved.

CASE NUMBER 1

In the state of Sinaloa, nine Gyrolando cows with a body condition score of 2.7 to 3.5 were subjected to superovulation in September 2022. These cows had a history of being cycled, were between 3 and 6 years old and 70 to 150 days postpartum. Cows were synchronized with a CIDR containing 1.9 g progesterone (Zoetis) for 12 days. Superovulation was induced by a 280 mg porcine follicle-stimulating hormone (FSHp Folltropin®) administered intramuscularly in decreasing doses every 12 hours for 4 days prior to withdrawal of CIDR. At CIDR withdrawal, 5 ml prostaglandins (Lutalyse Zoetis) were administered, and the onset of estrus was detected 24 hours later. At the time of the first AI (day 0), 100 µg of GnRH was administered to cows showing estrus. Cows in estrus were inseminated 2 or 3 times at 12-h intervals while they remained in estrus. Cows that did not show estrus were excluded from the superovulation program. After being inseminated cows were exposed to extreme environmental heat temperatures of 40 to 44 degrees Celsius lasting until day 7 when embryos were collected.

RESULTS

On day 7 after insemination, intrauterine lavage was performed on the cows that showed response to the superovulatory treatment (counting the number of corpora lutea present in both ovaries, using a portable ultrasound equipment). Samples from seven cows were collected, 38 structures were recovered, where 21.04% were transferable embryos (morulae and blastocysts), and the remaining 78.96% were non-fertilized oocytes and embryos in different degrees of development. The structures recovered were evaluated according to the classification established by the IETS (International Embryo Transfer Society).

CASE NUMBER 2

In the state of Veracruz, 5 Wagyu cows with a body condition of 3.0 to 3.5 were superovulated in February 2022. These cows were between 90 and 150 days postpartum, cycling, aged between 3 and 5 years. The synchronization and superovulation scheme were similar to that used in case 1, only the FSH dose was changed using 240 mg porcine Follicle Stimulating Hormone (FSHp Folltropin V).

In this embryo production program during the superovulation treatment and insemination of the cows, there were drastic changes in temperature, 6 to 15 degrees Celsius during the day ("north"), this climatic condition lasted for 4 days, post-insemination.

BREEDS	Case 1 Gyrolando	Case 2 Wagyu
Treated cows	9	5
In heat	9	4
Collected cows	7	4
Total corpora lutea	75 (X:10.7)	47 (X.11.7)
Total structures collected	38 (X:5.4)	32 (X: 8.0)
Degenerated oocytes and embryos	30	23
Transferable embryos (viable, morula and blastocyst)	8 (X:1.1)	9 (X: 2.2)

Table 1. Summary of results of superovulation and embryo collection programs in two cases using (Case 1) Gyrolando cows in the state of Sinaloa and (Case 2) Wagyu cows in the state of Veracruz.

RESULTS

The results obtained are shown in Table 1. Nine transferable embryos were obtained (28.12 % morulae and blastocysts), and the rest oocytes and embryos in different stages of development (71.88 %).

In both cases, stress due to temperature changes affected embryo development, and in case 2, estrus presentation was also affected. Production of transferable embryos was very low as compared to the average obtained in cattle from tropical regions, which is 6.

CONCLUSIONS

This paper reports two cases that arose during field work with embryo transfer programs. It was observed that the average number of recovered structures was within reported range. However, remarkably poor embryo development and percentage of transferable embryos were obtained.

Spontaneous temperature changes, which are unpredictable and uncontrollable, are an environmental factor to be considered in embryo transfer programs in certain regions and times of the year.

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