Effect of change in laboratory temperature on incubator performance

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Abstract

Introduction

To determine the effect of change in laboratory temperature on incubator temperature and the impact of different culture temperatures on embryo development.

Materials and methods

The experiments were done in a new IVF lab that is yet to provide treatment. The thermometer was programmed to measure the laboratory room temperature and incubator temperature at intervals of 1 minute with an accuracy of 0.1^{o}C; in a box incubator and a bench top incubator that has temperature control for the top culture chamber lids and the base of the culture chambers. The laboratory room temperature was set at 21^{o}C ±0.5^{o}C, then increased by 4 degrees for 1 hour, and then reduced back by 4oC degrees.

Results

After temperature increased by 4^{o}C, the box incubator temperature increased gradually by 0.6^{o}C, plateaued for 15 minutes and then went down to 37.0^{o}C. The lid temperature of the bench top incubator increased by 0.5^{o}C and the base temperature increased by 0.4^{o}C. Both the lid and base remained at high temperature for around 15 minutes and then gradually returned back to normal. After temperature decreased by 4^{o}C, the temperature inside the box incubator decreased by 0.5^{o}C, plateaued for 19 minutes then increased gradually to 37.0^{o}C. The temperature of the lid of the bench top incubator decreased by 0.4^{o}C degrees followed by the base of chamber by 0.3^{o}C degrees then increased gradually after 10 minutes to normal. During these events, the displayed temperature showed 37.0^{o}C at all times.

Conclusion

Changes in laboratory room temperature were reciprocated inside the incubators but this did not alter the display temperature giving a false impression of temperature stability which is misleading and could have negative influence on the quality of embryos generated and pregnancy rate.

Disclaimer: The authors have no conflicts of interest.
J Reprod Biotechnol Fertil 13:35-40
Correspondence: Yousef Alhelou; email: alhelou@yahoo.com
Compliance acknowledgement: This article was edited by the Australian Editorial Services (www.nativeenglisheditor.com)
Keywords: Display, incubator, misleading, reciprocate, temperature

Introduction

It is well recognized the physical conditions of temperature, pH, humidity, and incubation gas mixtures are some of the factors that are set to mimic the in-vivo environment with the goal of obtaining a high number of good-quality embryos for each patient (Gardner and Kelley, 2017). It is still unclear how certain fundamental physical characteristics of the incubator used to produce human in vitro embryos work. One of these is the temperature stability of several incubator types during the culture of embryos. The main function of the incubators in ART laboratory is to act as an artificial uterus and provide the optimal temperature, pH and aseptic

environment for the gametes and embryos. The response of the incubator to temperature fluctuations in the external environment was investigated. In assisted reproductive technology, the preimplantation development of human embryos, and their subsequent viability and ability to implant, depends on the quality of the gametes and the physical in-vitro culture conditions.

The objective of this study is to determine the effect of change in laboratory room temperature on incubator temperature.

Materials and methods

The experiments were done in a new IVF lab that does not have any patients. The objective of so is to assure accurate outcome data.
Thermo button thermometer from PROGES PLUS model 22L was programed to measure the laboratory temperature and incubator temperature at interval of 15 minutes and accuracy of 0.1^{o}C. The accuracy appropriated from the Thermo Bouton is accurate due to being a reliable perfect data recorder for all temperature controls, HACCP, product monitoring, and transportation under controlled temperature. (Temperature Data Logger for Cold Chain Monitoring, 2024). The temperature outcome is retrieved through its programmed special software and adaptor which appears while simultaneously using a laptop.

The measurement was done in a box incubator and in bench top incubator that has temperature control for the top and the bottom of the chambers.

Precisely 8 thermo buttons were positioned inside the box incubator as the temperature was calculated. Simultaneously, 2 buttons exactly were placed inside each chamber of the bench top incubator. One was placed at the bottom of the chamber as the other was at the lid of the chamber.

The lab temperature was set at 21+0.5^{o}C , then increased by 4 degrees for 1 hour then reduced again by 4^{o}C.

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The lab temperature was set at 21 + 0.5^{o}C , then increased by 4 degrees for 1 hour then reduced again by 4^{o}C.

Results

Response of Box incubator after temperature was increased by 4^{o}C.

The box incubator showed gradual temperature increase by 0.6^{o}C, plateaued for 15 minutes then went down gradually to 37.0^{o}C. The displayed temperature showed 37.0^{o}C at all times.

The temperature of the lid of the bench top incubator increased by 0.5^{o}C and the bottom increased by 0.4^{o}C. Both lid and bottom remained at high temperature for around 15 minutes then gradually returned back to normal. The displayed temperature showed 37.0^{o}C at all times.

After temperature decrease by 4^{o}C

The temperature inside the box incubator decreased by 0.5^{o}C, plateaued for 19 minutes then increased gradually to 37.0^{o}C. displayed temperate remained at 37.0^{o}C. The temperature

of the lid of the bench top incubator decreased by 0.4ºC followed by the bottom by 0.3ºC then increased gradually after 10 minutes to normal, displayed temperature remained at 37.0ºC.

Fig. 1. Increasing temperature in the box incubator.

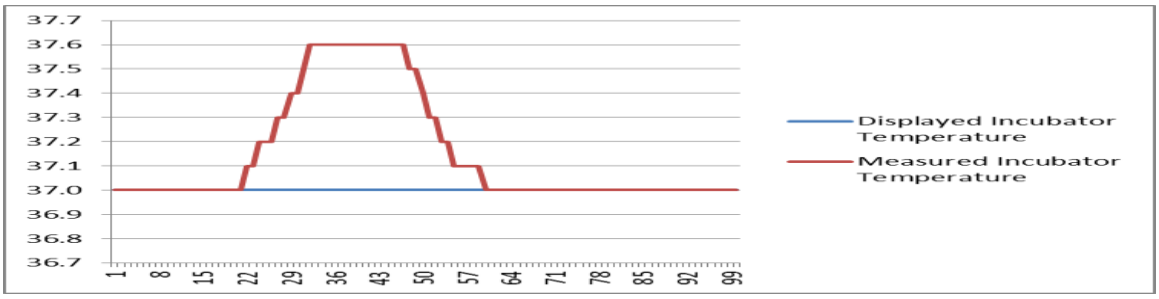

Fig 2: Laboratory Temperature when temperature was increased

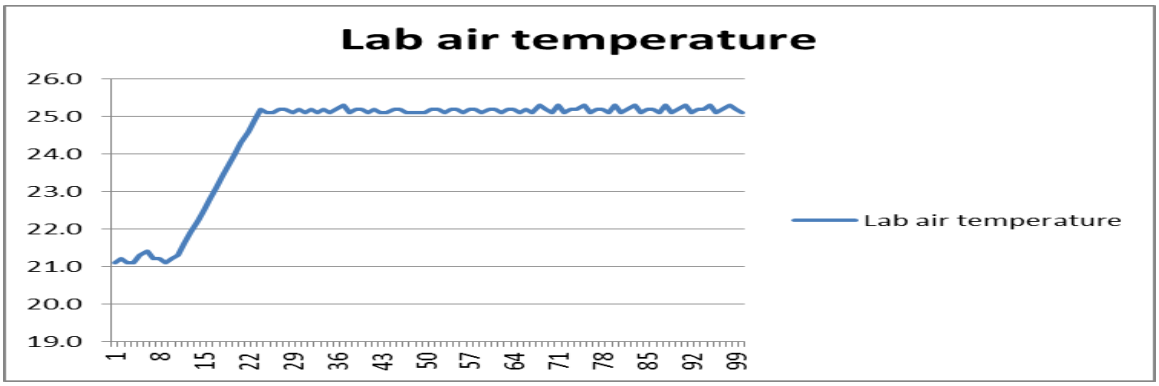

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Fig. 3. Increasing temperature in the bench top incubator

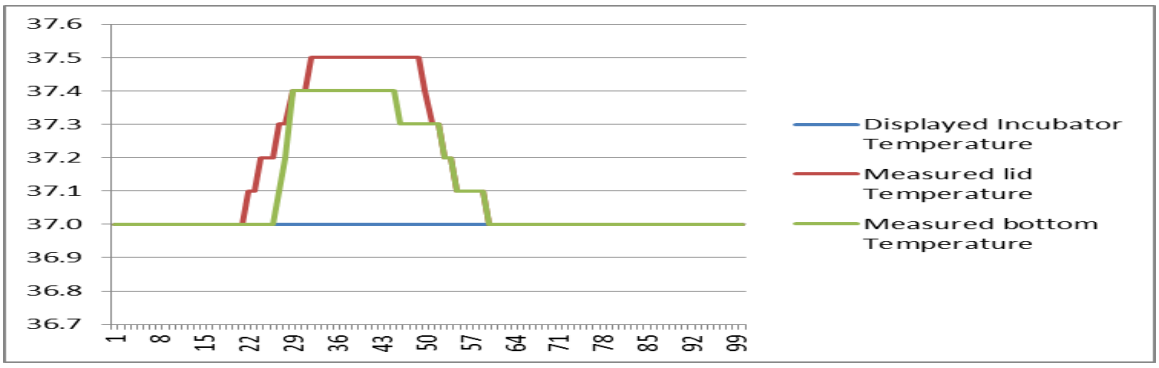


Fig. 4. Laboratory temperature when temperature was increased

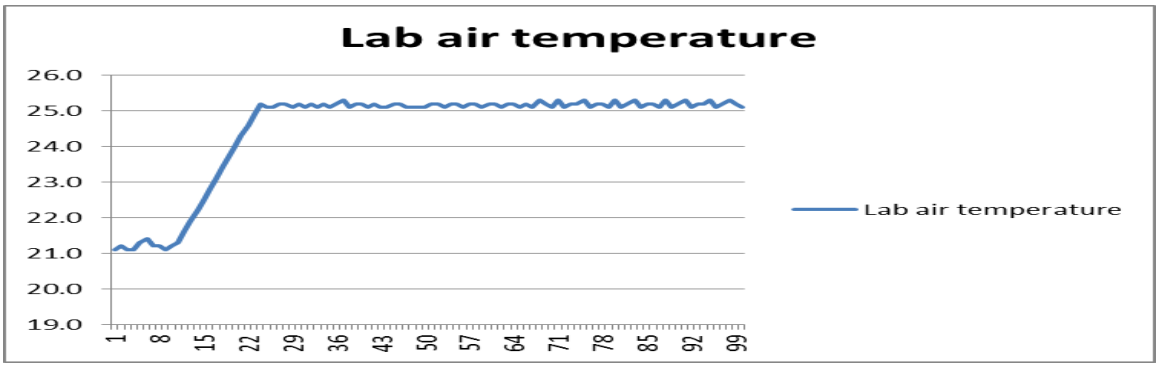


Fig 5. Results decreasing temperature, box incubator

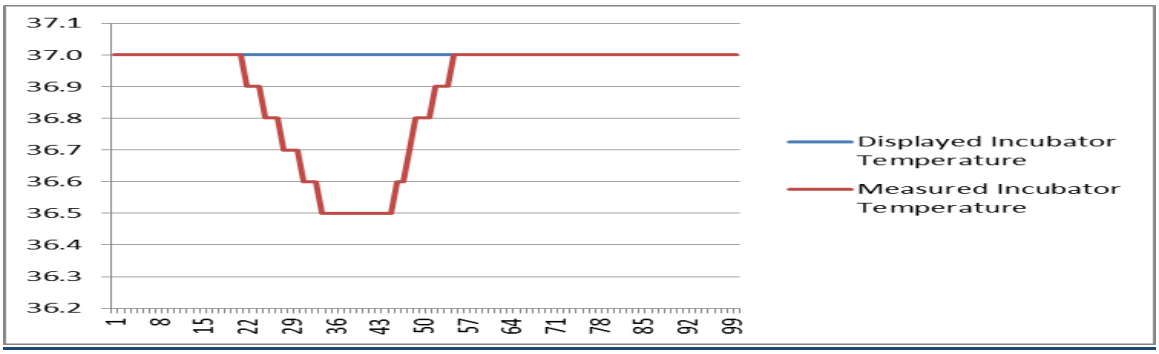


Fig 6. Laboratory temperature

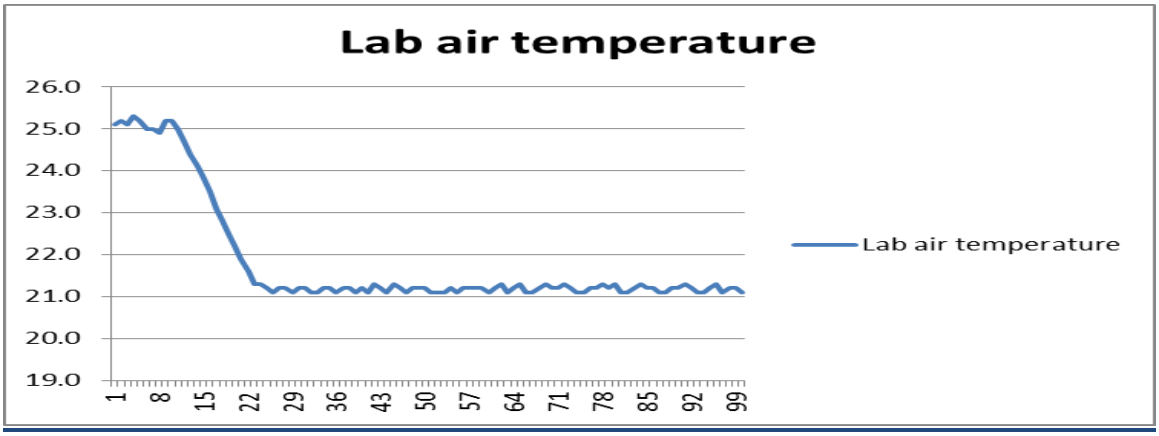


Fig 7: Decreasing temperature of the bench top incubator

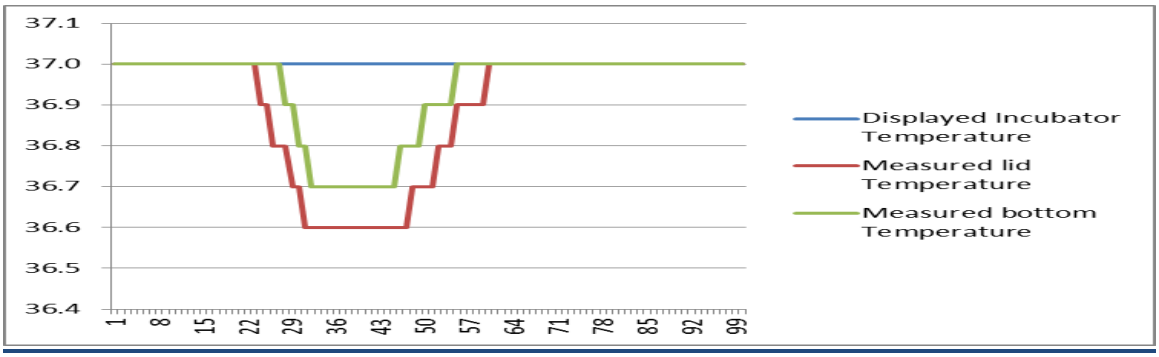
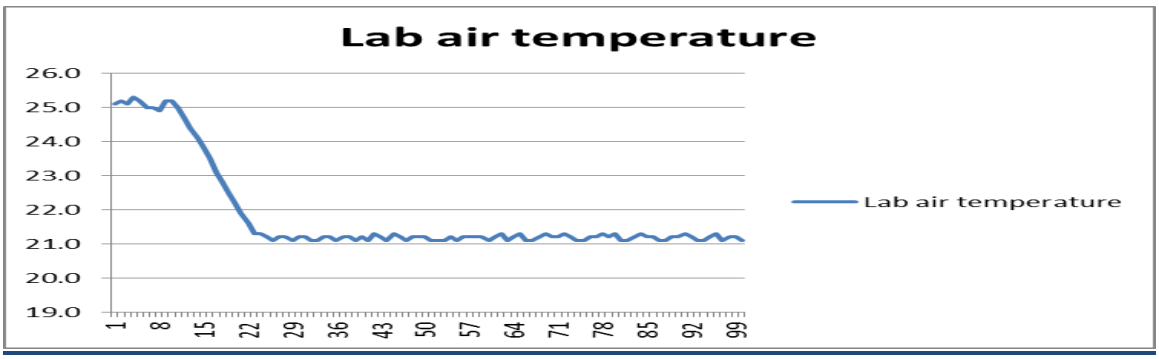


Fig. 8: Laoratory temperature



As shown in the figures 1-6, the temperature was decreased by 4.0^{o}C in 15 minutes exactly. As per the result displayed, the temperature inside the box incubator had decreased by 0.5^{o}C. It remained stable for 19 minutes straight at 37.0^{o}C.

Discussion

The main objective of an incubator used in in vitro fertilization (IVF) is to maintain the optimal microenvironment (humidity, temperature, and gas composition) for gamete activity and embryo development (Swain, 2015). Temperature can affect meiotic spindle stability, gametes, and embryos (Wang et al., 2002). Although the developmental plasticity of embryos allows them to develop throughout a limited range of temperatures, from 36.0 to 37.0°C, it is widely acknowledged that the ability of incubators to maintain a stable micro-environment has a significant impact on embryo quality (Hong et al., 2014; Fujiwara et al., 2007).

The present finding has demonstrated that the change in laboratory temperature is reciprocated inside the incubator but this is not displayed by the incubator in its digital display. Under these conditions the temperature displayed by the incubator is inaccurate and therefore misleading. This situation provides a false sense of satisfactoriness when in actual fact it was not. The IVF laboratory worker must be mindful of this defect prevalent in the incubator.

Fluctuations in temperature are detrimental to the developing embryo. To avoid damage to the embryos in culture, the actual temperature must be made visual and monitored on a continuous basis by installing appropriate sensitive electronic temperature measuring device inside the incubator with an external display unit, or the readings could be transmitted directly to a remote device such as the mobile phone or computer. The temperature readings must be recorded so that it may be possible for laboratory workers to refer to it when the need to trouble shoot arises.

Conclusion

Change in air temperature of ART laboratory can influence the temperature inside incubators in a reciprocal manner but this response change is not displayed by the incubator digital readout display which can mislead laboratory workers, and has potential detrimental effects on embryo development.

References

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