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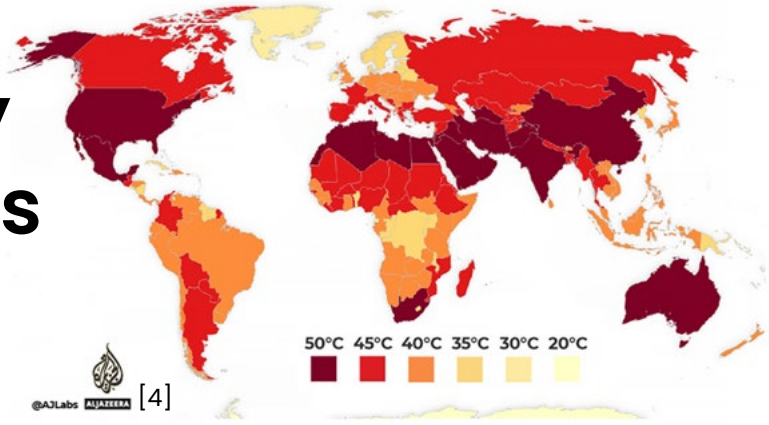
DYNESCAN

New Insights

Semen longevity under heat stress conditions



[4]

Can we identify semen ideal for using in hot regions?

J. Kidd, T. A. Wood and V. A. Martinez

Heat Stress

Can we use Dynescan to identify batches of semen that will be more suitable for cows in hot regions?

The rectal temperature inside a cow can climb as high as 41.5 °C when experiencing heat stress [1]. Poor conception rates are often blamed on a cow's reduced feed intake, negative energy balance and endocrine disruptions [2] but little consideration has been given to the ability of semen to tolerate elevated temperatures. In order to fertilise, spermatozoa must maintain sufficient motility while experiencing high temperatures in an oxygen deficient environment in the reproductive tract.

The Sustained Motility Lifetime at elevated temperatures

Dynescan allows for precise, automated measurements of the speed and % progressive motility (PM) of spermatozoa over time as a semen sample passes from high to low oxygen conditions. The Sustained Motility Lifetime (SML) is defined as the time (t) at which the initial % progressive motility (PM_0) falls to one half of its original value ($PM_0/2$).

To explore the effects of elevated temperatures the Dynescan sample chamber was held at specific temperatures (±0.3°C) between 35°C to 45°C while the PM was measured over time. An example, shown in Figure 1, show that the % progressive motility declines at sooner at elevated temperatures, resulting in a shorter SML.

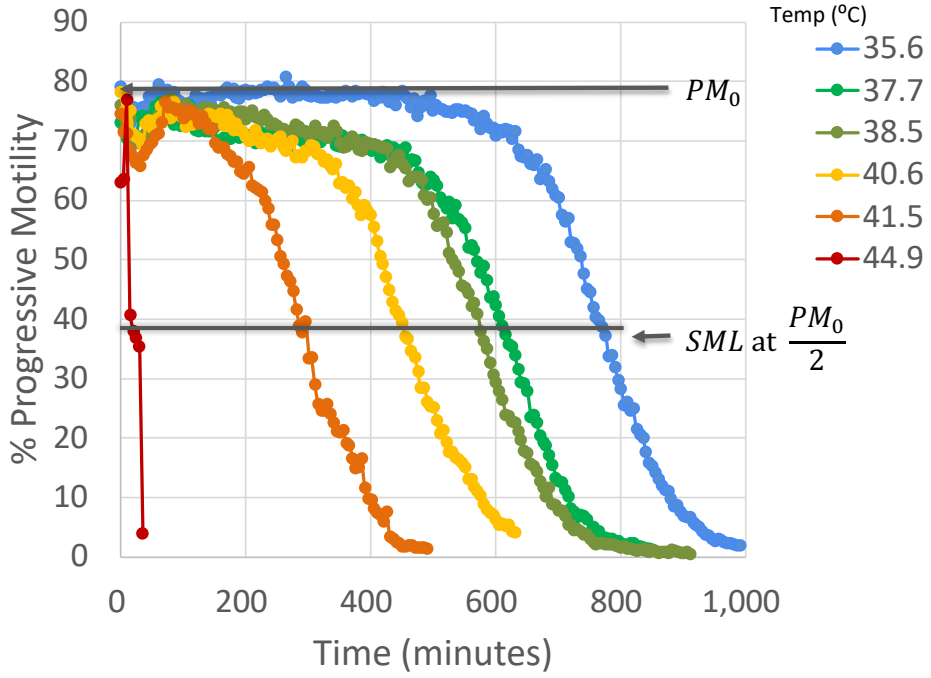


Fig 1. a) % Progressive Motility over time for a batch of conventional thawed bull semen (bull 1 2020) held at temperatures between 35.6°C to 44.9°C. The sustained motility lifetime (SML) is the time at which the initial % progressive motility (PM_0) falls to one half (PM_0/2).

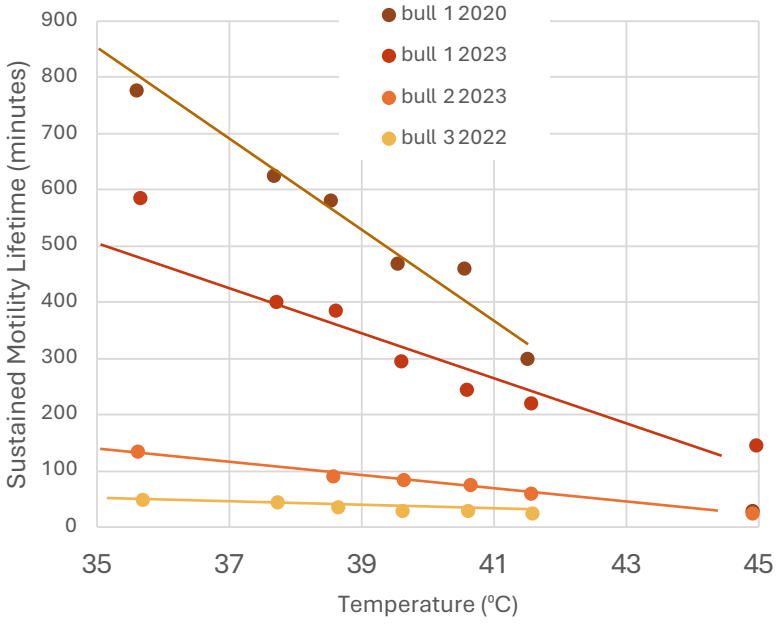
Do some batches decline more rapidly with temperature than others?

To explore variation of temperature on SML between bulls and batches, 25 Jersey bulls collected indoors in a cool climate (UK) were measured. Considerable differences in SML were observed between batches at the different temperatures varying from less than an hour to over ten hours, as shown in figure 2a. This led to the question, do some samples decline more rapidly with temperature than others? Further data analysis indicated that, if we normalise the SML values in figure 2 any temperature by the SML at 37.5 °C, the reduction in the SML as a function of temperature declines linearly with a gradient of -0.12 ± 0.02 for all batches. Since the rate of decline of normalised SML is independent of the batch, we are able to predict the likely SML at elevated temperatures based on the SML measured at body temperature.

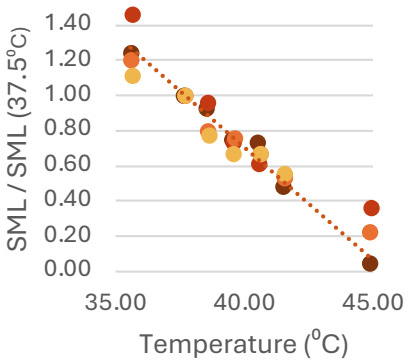
As a rule of thumb, the SML at 41.5 °C will be half that measured at 37.5°C

Note: It is standard to incubate semen straws for 2-3 hours as part of a quality control checks [3]. For cells that become non-motile due to shut down of their metabolic activity, motility can be re-activated once exposed to oxygen [3]. Automated measurements using Dynescan ensure motility can be measured through the transition from high to low oxygen conditions to understand truly the metabolic pathways.

Cows experiencing heat stress are more likely to conceive if inseminated with batches of semen having a long Sustained Motility Lifetime.



a)



b)

Gradient: -0.12 +/- 0.02

Fig 2a) Sustained Motility Lifetime (SML)) measured for conventional semen taken from three different bulls as a function of temperature. 2b) The SML, normalised by the SML at body temperature (37.5°C), decreases linearly with a gradient of -0.12±0.02 for all samples.

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Accelerated test protocols

At high concentrations, the SML is shorter because available nutrients are consumed more quickly. Therefore, tests can be accelerated by performing measurements with fresh semen. Talk to our team to learn more: contact@dyneval.com

REFERENCES

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