(3.7–64.5). Likewise, the cycles/conception rate achieved by theratozoospermic and oligozoospermic bulls was 2.1 (213/102) and 3.1 (203/65) respectively ($p < 0.05$). The parameters studied diverged according to the type of spermiogramme deviation under natural mating in tropical farms. Although, CR at first service and cycles/conception index are likely impaired in deferred compared to sound for breeding bulls.

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Thermographic scrotal pattern in sound for breeding zebu bulls extensively managed in tropical Costa Rica

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Infrared thermography (IR) is relatively a novel procedure in animal andrology for studying bull's scrotal thermal pattern. The accuracy of this technique lies onto camera's performance and operator skills, and although the high cost of the equipment is still a constraint for its broad use, it could assist on diagnosis and prognosis the sire's potential fertility, since bulls with a disrupted testicular thermoregulation are linked with impaired semen quality. This report aims to outline the thermal scrotal pattern in sound for breeding Brahman sires, in order to reference these values when using IR for assisting during bull's breeding soundness examination.

IR files were recorded from the scrotum's posterior surface on thirty-seven Brahman sires (3.5 ± 1.4 years-old) ranked as sound for breeding. The bulls were breeding naturally in beef farms managed under extensive rearing in tropical Costa Rica. IR images were studied individually for left (L) and right (R) side of the scrotum through the software LumaSpec Offline Analyzer® using the tool "temperature point" and "region" on the following areas of interest: Top-Botton Neck Gradient (SNG), Top-Botton Testicular gradient (STG), Average Testicular Temperature (AST) and Average Cauda Epididymis Temperature (AET).

Environmental temperature showed a significant and positive correlation with rectal bull's temperature ($r = 0.26$; $p < 0.01$), (AST) ($r = 0.71$ to 0.72; $p < 0.0001$) and (AET) ($r = 0.74$ to 0.78; $p < 0.0001$). (AST) for (L) and (R) was highly and positively correlated with (AET) (coefficient ranging from 0.86 to 0.91; $p < 0.0001$). Mean temperatures (C°) on left and right side of the scrotum for (SNG), (STG), (AST) and (AET) were respectively: 1.05 ± 0.41 and 1.13 ± 0.43; 1.01 ± 0.52 and 0.96 ± 0.52; 32.12 ± 1.00 and 31.99 ± 1.04; 31.04 ± 1.08 and 31.00 ± 1.19. Minimal dissimilarities on average temperature were observed between (L) and (R) only for (SNG) and (AST) (0.08 ± 0.33 $p < 0.05$, and 0.13 ± 0.27 $p < 0.0001$ respectively). These slight differences are detectable only by IR software analysis using highly accurate cameras. Besides, they are indicative of a symmetrical temperature pattern in different regions of the scrotum from Brahman bulls ranked as sound for breeding.

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Flagella parameters used as descriptors of fish spermatozoa motility

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In many fish species, spermatozoa are immotile in the male reproductive tract but their flagella are activated when delivered into the surrounding medium, where various physico-chemical interactions regulating or influence their motility. Our aim is to describe quantitatively how such interactions affect flagella waves in their form and efficiency.

Optical microscopy (40 or 100×) with high-speed video or stroboscopic illumination with up to 5000 images/sec can be used to observe and record flagella movement of fish sperm. Various physical agents can be used to influence such movement: [1] ionic or sugar solutions to control osmolality combined, e.g. DMSO; [2] the interface of air/water or the egg surface; [3] methylcellulose to adjust viscosity; [4] temperature controlled microscope; and [5] gas effect using a gentle stream of CO_2. Carp, trout, sturgeon, and/or turbot spermatozoa can be studied.

The main signal activating fish sperm motility is osmotic pressure. Osmotic shock leads to serious damage to membranes and shortens motility. Biochemical steps of activation are well understood but the latter occur during cell dispersion in the swimming medium. Using osmotic agents (DMSO), we could delay for several second the appearance of the first waves at the head-tail junction and video-record this step.

Spermatozoa reaching surface vicinity remain swimming but "trapped" very close to it. Detailed waves properties are dependent on surface suppleness. Such accumulation of swimming spermatozoa is clearly of biological importance when approaching the egg surface as we demonstrated complementarily by simulation approach.

Viscosity is important for sperm swimming in the follicular or ovarian fluid. Addition of polymers, e.g. methyl-cellulose, drastically changes wave properties.

Temperature is important, especially for species of fish that reproduce at low temperature, such as trout (4–8 °C), or below 4 °C, for example burbot. Thermodynamic aspects of mechano-chemical properties of flagella are affected differentially by temperature.

In flatfishe, for example turbot, CO_2 can block transiently flagella wave propagation. But such an effect is fully reversible. This allows observing initiation sequence of first bending waves.