Crush-side semen analysis

Collecting and assessing semen from bulls is a profession that involves years of practical experience and theoretical knowledge.

According to the Australian Cattle Veterinary (ACV) Bull Breeding Soundness Evaluation book, experience in the USA and Australia suggests that an acceptable minimum threshold for bulls for natural mating is more than 30% progressively motile sperm. However, because bulls may be required to provide semen for freezing or single mating situations, ACV has adopted a semen standard (a tick) of a 60% threshold for progressively motile, though bulls which achieve at least 30% progressive motility will rate as a Q (qualified).

Without a computer assisted sperm analysing machine (CASA) and based on environmental factors mentioned below, in my experience, the highest semen percentage alive and motile (on-farm) rate is 85%.

Factors affecting semen quality in bull testing:

- Thermal stress – sperm are sensitive to both heat and cold e.g. semen straight from the bull at 37 degrees Celsius would require collection equipment to be at the exact temperature as the bull semen. Exposure to temperatures just a few degrees above or below body temperature will kill large numbers of sperm, making it impossible to give a bull 100% just in temperature variances. This is why a warm stage set at 37 degrees celsius, connected to your microscope, is a vital piece of equipment to evaluate semen.

- Exposure to unhygienic environments - collecting a bull on farm and not in an artificial breeding centre where hygiene is paramount allows a certain amount of contamination (dust and dirt). Contamination will also decrease the percentage of semen alive.

(Paul Kenny – Bull Testing)

Sperm Abnormalities

Proximal Droplets (PD):
The retention of the proximal or distal droplet on a sperm indicates immaturity of the sperm membrane system. It is quite common to see some sperm in the ejaculate with retained droplets.

Pyriform Heads (PH):
Are fairly common abnormalities, usually observed with other head abnormalities such as diadem/crater and vacuole defects. Abnormal spermiogenisis due to disturbances of either heat regulation in testis of endocrine control of testicular function.

Vacuoles/Teratoid (VT):
The term teratoid means significant malformation, in this case of the sperm head region. If a significant number of sperm are affected, this usually reflects a severe spermatogenic insult. Gross deformation of the head region interferes with the fluid dynamics of sperm movement within the female reproductive tract, thus sperm cannot reach the fertilization site (compensable defect), at least in a timely manner.

Heads and Tails: loose/detached heads and abnormal tails (HT):
Loose or detached sperm heads are commonly observed in bull ejaculates and can result from abnormal spermiogenisis or aging of the sperm in the reproductive tract. Environmental factors causing detached sperm heads embrace a wide spectrum which includes heat stress, fever as well as spermiostasis and sperm accumulation within the male tract.

Most defects of the sperm tail, including both reflex and coil tails, are considered to be due to environmental effects, either pre or post ejaculate.

Swollen Acrosomes (SA):
The term swollen acrosomes refer to an evident ballooning of the acrosomal membrane, which is a common occurrence in aging sperm.

Midpiece abnormalities (MP):
Midpiece defects are the most common semen defects in beef bulls. The sperm midpiece region is susceptible to both environmental (eg. temperature and osmolality) and physical damage. Reported defects in bulls include abaxial attachment, broken necks, distal midpiece reflex, dag defect, stump tails and multiple tails as well as various re-arrangements of the mitochondria (eg. gaps, niches, lumps, filform). They are generally considered to be compensable traits, as sperm with midpiece problems usually cannot reach the fertilization site.

Distal Midpiece Reflex (DMR):
The DMR is one of the most common defects encountered in bull sperm. It is differentiated from the bent tail defect by the fact that part of the midpiece is included in the bend.

DMRs can be caused by problems in the post-ejaculation environment (eg. cold shock, hypo-osmolality) or by dysfunctions in the extra-gonadal transport system (often associated with external environmental stressors).

In the latter case, a retained distal cytoplasmic droplet is often associated with the defect. In fact, it can be useful to use the presence or absence of the retained DD as an indirect indicator of the possible site of damage. Because of its association with environmental factors, both internal and external, some individuals are more susceptible than others.

Knobbed Acrosomes (KA):
Abnormal pathogenesis due to disturbances in testis heat regulation eg. Systemic illness, toxicity, nutritional deficiencies, fat deposition around scrotum. Sperm containing KA are either unable to attach to ova (*Buttle & Hancock 1965*) or this capability is much reduced (*Thundathil et al. 2000b*)

Conclusion:

There are many genetic influences on male fertility and infertility and our knowledge and awareness of these is increasing rapidly in step with the development /use of modern technologies. The challenge, as always, is to differentiate between true genetic problems and those that are due to environmental causes – a task made more difficult by interactions between the two. Categorisation as a proof that has rigorous rules of application (*Chenoweth, 2005*) and thus the term "genetic" should not be used lightly. This is particularly relevant in the context of the livestock pure-bred breeding industries, where genetics and marketability are often synonymous. (*Animal Andrology, Theories and Applications, PJ Chenoweth & FJ McPherson, Genetic Aspects of Male Reproduction, pg 162 retrieved 25 September 2017*).