

Antioxidant supplementation alleviates DNA damage in boar spermatozoa induced by tropical heat stress

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Seasonal heat stress is known to significantly diminish reproductive performance in pigs, particularly in the tropics, costing the industry millions in annual losses. The boar's reduced capacity to sweat, non-pendulous scrotum, and widespread use of European breeds in the tropics, makes this species particularly vulnerable to heat stress. While traditionally considered a sow problem, recent mouse studies demonstrate that heat stress-induced sperm DNA damage can result in arrested development and loss of early embryos. Our study investigated the impact of tropical summer heat stress on the quality and DNA integrity of boar sperm, and trialled antioxidant supplementation to alleviate the problem. Data, expressed as mean \pm SEM, were analysed by one-way repeated measures ANOVA with pairwise Bonferroni tests.

Motility of sperm obtained from $n = 5$ Large White boars housed in the dry tropics of Townsville, North Queensland, Australia was characterized by Computer-Assisted Sperm Analysis but did not differ between summer, winter or spring (total motility: 71.3 ± 8.1 vs. 90.2 ± 4.2 vs. $70.8 \pm 5.5\%$ respectively, $P > 0.05$; progressive motility: 35.4 ± 7.0 vs. 46.6 ± 4.0 vs. $41.7 \pm 2.8\%$ respectively, $P > 0.05$). Sperm DNA integrity in 20,000 sperm/boar/season, evaluated using TUNEL and flow cytometry, revealed 16-fold more DNA damaged sperm in summer than winter, and nearly 9-fold more than spring (16.1 ± 4.8 vs. 1.0 ± 0.2 vs. $1.9 \pm 0.5\%$ respectively, $P \leq 0.05$). However, boar feed supplemented with 100g/boar/day of proprietary custom-made antioxidants during summer significantly reduced sperm DNA damage to $9.9 \pm 4.5\%$ and $7.2 \pm 1.6\%$ ($P \leq 0.05$) after 42 and 84 days treatment respectively. Total and progressive motility were not altered by the supplement.

In summary, sperm DNA integrity is compromised in boars during summer, suggesting boar factors may contribute to seasonal embryo loss in sows. Moreover, such damage appears undetectable using traditional measures of sperm motility. Antioxidant supplementation during summer appears to mitigate the negative impact of heat stress on sperm DNA integrity.

JCU Research Festival 2018

College Public Health, Medical and Veterinary Sciences

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30/10/2018

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