Swine TECHTALK

Dehydration, Electrolyte Imbalance, and Oxidative Stress: Central Players in Heat Stress

Introduction

As summer temperatures increase and climate patterns grow more unpredictable, heat stress is becoming a pressing issue for swine producers across the U.S. The season is described as one of the most difficult ones to maintain pig performance and profitability (NPB, 2023). Whether inside sow farms, nurseries, grow-finish barns, or during short duration events like transport pigs are especially vulnerable to high temperatures due to their limited ability to dissipate heat. Reduced feed intake, panting pigs, reproductive and productive performance slumps, are obvious signs; but underneath the skin, physiological responses involve hydration status, immune function, nutrient intake disruption, and a "silent killer", oxidative stress that have short-, mid- and long-term repercussions, extending far beyond the hot months.

Understanding how heat stress affects pigs across their lifetime performance is critical to protecting performance and profit.

Heat Stress: How It Happens

Pigs lack functional sweat glands and rely heavily on behavioral and respiratory mechanisms to manage excess heat (Renaudeau et al., 2012). Heat stress occurs when environmental temperature and humidity exceed the pig's thermoneutral zone, pushing it into a state where it can no longer dissipate sufficient heat through convection, conduction, or evaporation (Ross & Hale, 2018) and they try to cool down by panting, eating less, moving less, and redirecting blood flow from core organs towards the skin surface through vasodilation.

Short-Term Consequences

Feed Intake Drop, Dehydration, and Immune Suppression (Hours- Days)

One of the earliest and most consistent effects of heat stress is a drop in voluntary feed intake to minimize metabolic heat production (Renaudeau et al., 2012)—often as much as 10–30% depending on severity—which reduces protein and energy availability during critical growth or reproduction phases (Baumgard & Rhoads, 2013). Compounded by increased water loss through panting and urination, pigs quickly become dehydrated and electrolyte-depleted, especially in potassium and sodium (Sanz Fernandez et al., 2015). Water consumption, while essential, may not be enough to compensate for electrolyte loss and increased maintenance energy demands (Patience et al., 2005).

At the cellular level, heat stress increases reactive oxygen species (ROS) production, tipping the oxidative balance and leading to gut barrier damage, reduced nutrient absorption, and greater susceptibility to pathogens (Liu et al., 2019). The compromised intestinal barrier integrity increases the risk of pathogen translocation and immune activation (Pearce et al., 2013).

Pigs of any age are susceptible to heat stress; though the negative impact of nutrient intake disruption, dehydration, gut damage, and oxidative stress is far more severe in wean pigs as they face additional stressors (immature digestive and immune system, separation from the sow, pre-wean vaccinations, transport, temperature changes, etc.) that have long-lasting negative consequences.

Mid-Term Consequences

Performance lumps (Days-weeks)

As heat stress continues, nutrient partitioning shifts further from reproduction and growth toward basic survival (Lucy & Safranski, 2017). Sows exhibit reduced estrus expression, lower conception rates, and higher early embryonic losses, this is what we deem the "summer dip". In boars, spermatogenesis is impaired, decreasing semen quality (Wettemann et al., 1988).

Growing pigs show sustained reduced feed efficiency and compensatory gain after the heat period often fails to make up for earlier losses (Quiniou et al., 2000). The immune system, already stressed, may become less responsive to vaccination and more susceptible to secondary infections (Huang et al., 2020). Wean pigs show an altered metabolism as well, that may be reflected in a continuous post-wean growth check, immune system depression and reduced average daily gain and feed efficiency (Marchant-Forde et al., 2020; Safranski et al., 2020)

Summer Dips and Fetal Programming Consequences

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Long-Term Consequences

(Weeks-Life)

The most insidious effects of heat stress are long-term and often overlooked. Seasonally bred sows may fail to conceive or farrow fewer piglets. Data consistently shows reduced farrowing rates and litter sizes in sows bred during hot months, even if farrowing occurs later in cooler conditions (Ross et al., 2015). There is also an increased mortality risk in sows, especially in late gestation and lactation due to their increased metabolic load and physiological processes they go through.

What is even non-obvious is that heat stress during late gestation affects fetal development and can alter offspring metabolism and immunity—a phenomenon known as fetal programming (Johnson et al., 2020). These piglets may grow more slowly, exhibit increased morbidity, and respond poorly to immunological challenges (Da Silva et al., 2022), as well as reduced number of piglets weaned in female offspring (Safranski et al., 2015) and compromised sperm quality in male offspring (Lugar et al., 2018).

As heat stressed wean pigs transition into grow-finish stages, the compounded stress effects lead to higher feed conversion ratios (FCR), slower weight gain, and increased days to market weight (Renaudeau et al., 2012). These delays in reaching target weights create bottlenecks in the production cycle, particularly in all-in/all-out systems where barn turnover is critical. Moreover, sustained heat stress elevates systemic inflammation and increases morbidity rates from opportunistic infections, as the immune system remains in a suppressed state (Baumgard & Rhoads, 2013).

Finally, long-term heat stress is associated with reduced carcass quality due to increased fat deposition and reduced lean muscle accretion, largely driven by altered metabolic priorities under thermal stress (Rosero et al., 2016). Importantly, heat-stressed pigs are more prone to pale, soft, exudative (PSE) meat and higher drip loss, both of which reduce meat value (Quiniou et al., 2000). Operationally, heat stress impact finishing periods, disrupting load schedules, and increasing overall production cost per pig. Importantly, mortality rates increase significantly during prolonged heat events, particularly among heavier pigs, exacerbating economic losses and highlighting the need for proactive, integrated heat stress mitigation strategies (Brown-Brandl et al., 2004).

The importance of Electrolytes?

The World Health Organization (WHO) has long recognized that effective rehydration requires more than just water. Without the right electrolyte balance, water alone can be insufficient—or even counterproductive—because it may not be retained or absorbed efficiently. For pigs, as in humans, an optimal electrolyte solution ensures rapid rehydration, supports acid-base balance, and helps maintain cellular function during heat stress.

The value of palatability

One of the most overlooked but critical aspects of any oral rehydration or electrolyte solution is palatability. Pigs (especially newly weaned or heat-stressed animals) are often reluctant to drink, which can rapidly worsen dehydration and electrolyte imbalance. The inclusion of palatability enhancing ingredients (flavor and aroma enhancers) in water enrichment products is a proven strategy to stimulate voluntary water intake.

Key Points:

- Increased Consumption: Studies and commercial experience show that palatable solutions can increase water intake by 15–30% during periods of stress.
- Rapid Correction: Higher intake of enriched water means faster correction of dehydration and electrolyte deficits.
- Better Outcomes: Enhanced palatability is directly linked to improved hydration, reduced morbidity, and faster return to normal growth and feed intake.

Nutrient Resiliency: A consequential factor to fight heat and (other) stress(es)

The TechMix Nutrient Resiliency Concept: Building Better Defenses

TechMix has pioneered the concept of "Nutrient Resiliency" - the ability of an animal to maintain nutrient intake, absorption, and utilization during periods of nutrient disruption - Nutrient disruption is the interruption of normal nutrient intake due to weaning, transport, handling, environmental stress, disease, or other physiological demands.

Nutrient resiliency as a practice focuses on providing targeted, highly available nutrients—including electrolytes, energy sources, vitamins, and functional compounds—at critical moments to support hydration, gut integrity, immune readiness, and metabolic balance.

How Nutrient Resilience Helps Mitigate Heat Stress:

- Rapid Rehydration: delivering a balanced blend of electrolytes and energy, to quickly restore fluid and electrolyte balance.
- Support for Intestinal Integrity: By including functional nutrients and antioxidants, TechMix solutions help maintain gut barrier function and reduce inflammation.
- Metabolic and Immune Support: Added vitamins, trace minerals, and amino acids help pigs better cope with the oxidative and metabolic demands of heat stress.
- Palatability and water intake: TechMix places a strong emphasis on palatability, ensuring pigs are attracted to and consume water-enriched products, which is critical for rapid and effective rehydration.

cont'd on page 3

Practical Takeaways

When and How to Act

- Watch the Weather and Water: Proactively administer hydration or nutrient dense liquids, like Nextein APF® or Blue2®, through the medicator when heat index forecasts exceed their comfort zone (80°F). Ensure all pigs—especially weaned pigs—have access to clean, fresh water.
- Provide Additional Support Beyond Hydration: Use Nextein APF in gruel for pigs in post-weaning transition, during poor appetite phases, or when gut health is visibly compromised.
- Fortify Immune Resilience: Use ImmuFend for pigs in heat stress conditions,, in high-pathogen barns, or during breeding periods in hot months to reduce the negative impact of the summer dip.
- Think the about the "Long Game": Don't wait until heat stress passes to act. Talk to your TechMix representative on options for product combinations to achieve the most benefit. The effects linger—especially in sows bred or gestating during the summer. Supplementing early and consistently reduces the cumulative toll.
- Start Supplementation Early: Begin hydration and antioxidant supplementation at least 1–2 days before a forecasted heat wave. This builds resilience before stress hits.
- Use Proportioners (Medicators) for Continuous Delivery: Water-delivered products like Blue 2, Nextein APF, and ImmuFend are ideal for automated, uniform application.
- Monitor Behavior and Intake: Reduced feed intake and excessive lying are early signs.
- Integrate with Good Husbandry and Environment Management Strategies: Interventions to promote Nutrient Resiliency complement good husbandry practices and barn environment management (fans, misters, cool cells) - not replaces them.

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It's more than just heat

It's Not Just the Heat — It's What Comes After

Heat stress is more than a seasonal inconvenience; it's a silent disruptor with short, mid, and long-term costs. By understanding its cascading impact and responding with targeted, science-backed nutrition, producers can protect health, performance, and profitability. Our team is here to help you plan ahead—not just react—to seasonal stressors, and to support your pigs through every challenge, every season.

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