

Understanding Heat Stress

By Joshua A. Jendza, PhD – Sr Research and Technical Services Manager, QualiTech, LLC



Heat Increment

The classical partitioning of feed energy involves allocating the gross energy (all chemical energy in a feedstuff) into sub-fractions based on how the energy is either used or lost from the animal (Figure 1). The heat increment is the portion of energy that is lost as heat as a by-product of all metabolic activity. A portion of this heat must be lost to the environment to prevent over-heating.

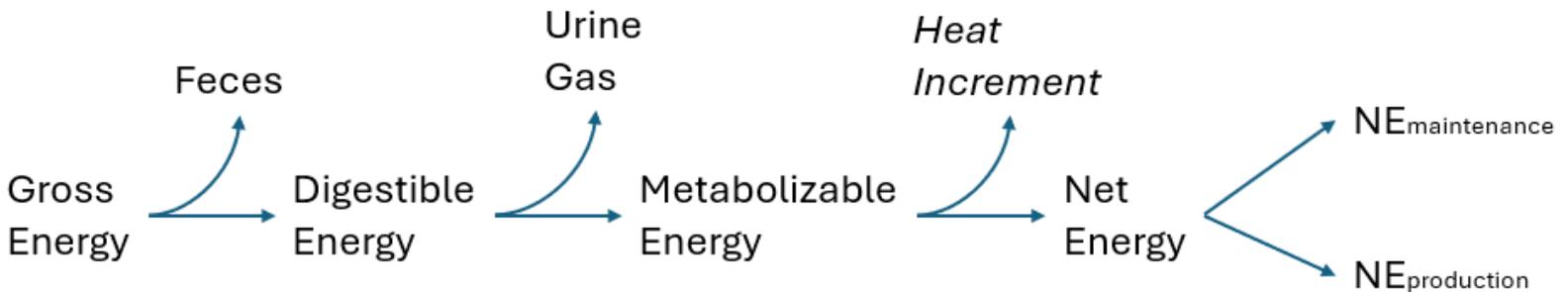
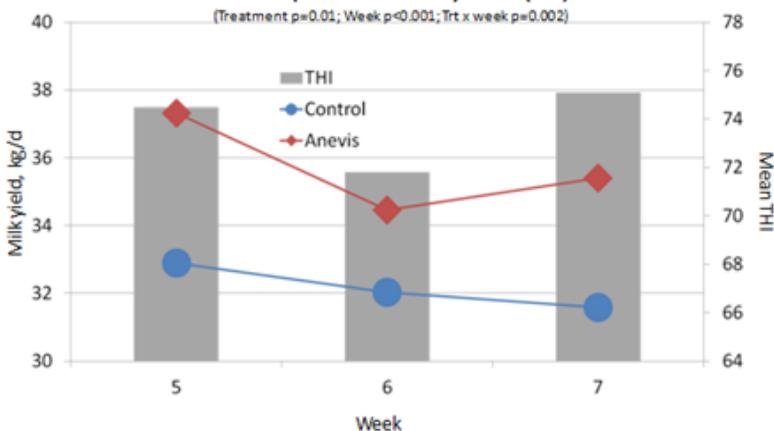


Figure 1. Classical energy partitioning of feedstuffs.

Mitigation of Heat Stress

Rumen protected niacin (ANEVIS®) has been shown to improve heat dissipation by increasing blood flow to the skin, thus enhancing the rate of heat dissipation, and improving overall animal performance when fed immediately before and during acute heat-stress events¹ (Figure 2). However, use of niacin in this way requires the knowledge that a heat-stress event is imminent, and the ability to add it to the feed on short-notice.

Figure 2. Milk yield of cows fed Control or Anevis supplemented diet during weeks with temperature humidity index (THI) >72.



Heat Stress

During periods of high heat and/or humidity the animal's ability to shed this heat becomes impaired, triggering adaptations that both increase the rate of heat loss to the environment, and decrease the amount of heat produced. Unfortunately, these adaptations ultimately reduce animal performance, efficiency, and immune competence.

Capsicum is commonly believed to have a similar effect, due to its ability to increase blood flow to the skin as well. However, the few studies available on capsicum indicate that this increased blood flow is paired with a much larger increase in metabolic heat production² (Figure 3), which can actually worsen the experience for the animal, as they struggle to shed even more heat into their already hot environment.

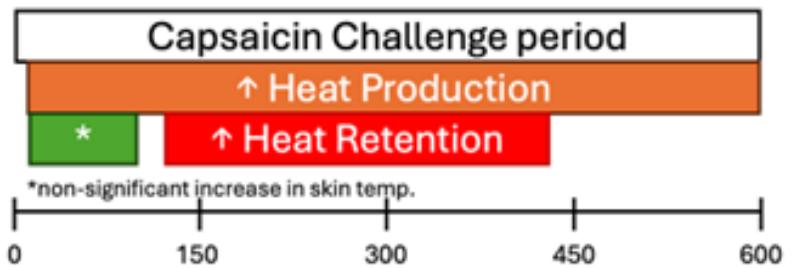


Figure 3. Anesthetized rats injected with capsaicin (5 mg/kg) experienced prolonged period of increased heat production (O₂ consumption) and heat retention (colon temperature) and heat dissipation (skin temp, non-significant)²

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In contrast, Fennel has been shown repeatedly to reduce the impact of heat stress on animal performance and metabolic heat production (Figure 4). Fennel does not achieve this heat stress relief through vasodilation of the capillaries under the skin. Instead, it acts to reduce metabolic heat production through modulation of the immune system.

Immune Function and Heat Production

Heat stress is often associated with an impairment of immune function in response to increased cortisol secretion. Specifically reduced phagocytic activity of macrophages, which are the first line of defense against infection, and an exhaustion of the normal anti-oxidant reserves as fewer macrophages struggle to handle the increase in immune challenges.

Fennel has been shown to enhance the functioning of the innate immune system based on various metrics:

- 20% increase in phagocyte number⁶
- 25% increase in phagocyte index (bacteria ingested per cell)⁶
- Restoration of anti-oxidant markers to normal levels in spite of heat stress⁷

Fennel's documented ability to improve performance under heat stress conditions, is linked to an ability to support proper immune function and anti-oxidant status. By improving innate immune competence, metabolic heat production is reduced (less fever), thus lessening the severity of heat stress as experienced by the animal, and ensuring more normal levels of performance.

Conclusions

Fennel offers a unique approach to combating heat stress in animals. One that works by reducing infection-driven metabolic heat production and is complementary to other approaches that are based on increasing the efficiency of heat dissipation (see ANEVIS®).

■ No Fennel ■ Low Fennel ■ High Fennel

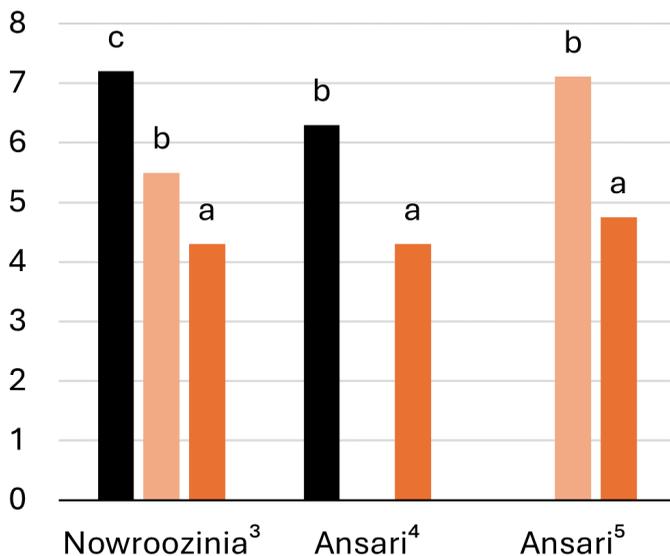


Figure 4. Days of elevated rectal temperature in calves consuming fennel seed powder, and experiencing heat stress.

BioEdge™ Defend combines Fennel with Garlic to create a flavor-based additive that helps defend your beef cattle from flies, ticks, lice, worms and from environmental stressors like heat and humidity.

References

1. DOI: 10.1016/j.livsci.2016.02.004
2. DOI: 10.1152/ajpregu.1998.275.1.R92.
3. DOI: 10.3168/jds.2021-20221
4. DOI: 10.3168/jds.2022-21776
5. DOI: 10.1016/j.anifeedsci.2023.115861
6. DOI: 10.1007/978-981-99-4165-0_16
7. DOI: 10.1016/j.livsci.2022.105082

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