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Chronophysiology of High-Producing Ruminants Management: A Global Revelation

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The world ruminant industry moves towards higher efficiency [1,3]. This requires arts and not only science [2,3]. For maximum efficiency, the time of nutrient delivery to the rumen, splanchnic tissues, and the periphery needs to be synchronized with the endogenous rhythms in body metabolism. Diurnal rhythms in body metabolism are reflected in endogenous and exogenous patterns in blood levels of metabolites and hormones. Endogenous rhythms are regulated by the suprachiasmatic nuclei in the hypothalamous and not only by the environmental factors such as photoperiod and feeding time. For example, blood glucose in humans possesses endogenous rhythmicity. In contrast, exogenous rhythms are controlled by external agants. Blood urea is largely responsive to feeding and digestive function, and thus, is exogenously regulated. Chronophysiology of metabolism in humans has received increasing attention [4,5]. This requires determination and clarification in ruminants also.

It is important to determine if and to what extent feeding time can alter such diurnal patterns in the rumen and host metabolism. Such knowledge will indicate the time of day when nutrients can be assimilated more efficiently for both productivity and body energy expenditure. We now know that evening rather than morning feeding improves beef cattle and dairy cow performance. Thus, it is important to study the chronobiological concept of feeding time in high-producing ruminants. The lactating cow is an exceptional mammal with uniquely high levels of feed intake and milk production (as high as 6× maintenance). Any chronobiological mediation of the rumen and intermediary metabolisms will have an enormous impact on milk secretion and tissue deposition.

Ruminants have evolved to ruminate mostly overnight, when the rumen possesses a greater fermentation capacity and volume, compared to day-time. Feeding in the evening, when ruminants have evolved to ruminate, may significantly alter post-feeding fermentation patterns. It is critical to understand how changing the feeding time can alter post-feeding patterns in feed intake. It is known that feeding time can alter post-feeding patterns in rumen fermentation and 24-h patterns in peripheral blood metabolites in lactating cows [6]. Interdisciplinary insight into such post-feeding patterns in ingestive, digestive, and metabolic indices is required to elucidate the mechanisms whereby feed delivery time mediates productive responses in ruminants.

In humans and rats, for example, regulation of glucose metabolism and insulin sensitivity depends on time of day. Humans are unable to metabolize or handle glucose as effectively in the evening as do they in the morning. This is because glucose tolerance and insulin

sensitivity decreases as day progresses and evening begins. Such crucial knowledge leads to the suggestion that large evening meals may be avoided by humans seeking a reduced risk of type-2 diabetes and its consequent cardiovascular abnormalities [4,5]. It is, thus, a global aim to open a new horizon into the chronobiological involvement of ruminant metabolism [6]. Future research needs to be formulated to determine how to optimize ruminant metabolism through manipulation of rumen and intermediary nutrient interactions.

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