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Mini Review

Over-Feeding and Irregular Delivery of Concentrate Impairs Dairy Cow Normal Endocrinology: A Multidimensional Disorder

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Abstract

The objective of this article was to describe a multidimensional disorder that occurs mainly because of long-term over-feeding of concentrate to dairy cows. To maintain high levels of milk production, dairy farmers usually tend to over-feed concentrate in mixed rations. Concentrate in dairy diets contains mainly high-starch cereal grains as well as high-protein plant and animal meals. Over-supply of nutrient-dense concentrates may alter normal hormonal responses to feeding/eating patterns, thereby contributing to altered circadian and circannual hormonal rhythms. Frequent and arrhythmic insulin surges in response to irregular feeding and eating patterns may lead to impaired insulin action. The impaired insulin action would possibly lead to altered nutrient partitioning towards body tissue accretion, milk secretion, and oxidation. As a consequent, management of body condition score becomes difficult during varying stages of lactation and pregnancy. This multidimensional disorder keeps the high-merit dairy cows from realizing and achieving their optimal potential for fertility and productive life. Education should focus on clarifying the issue to the world dairy industry to prevent major economic losses. Future long-term research will need to illuminate how over-feeding and irregular delivery of high-starch concentrates impairs dairy cow endocrinology involving the intermediary action of insulin, glucagon, IGF-1, leptin and other hormones and metabolites.

Keywords: *Concentrate; Over-Feeding; Dairy Cow; Endocrinology; Insulin; Disorder*

Philosophy and Discussion

The objective of this article was to introduce and describe an endocrinological disorder that occurs mainly due to irregular delivery and over-feeding of high-starch, high-protein concentrates in mixed rations to lactating and pregnant dairy cows. Today's dairy industry is highly dependent on high-energy and high-protein concentrate ingredients to properly meet cow requirements for a variety of nutrients, especially during early- and mid-lactation. As such, dairy farmers tend to over-feed dairy cows with high-starch nutrient-dense concentrates [1,2]. In addition to over-feeding, they also often feed concentrates (in mixed rations) irregularly and without a constant discipline within circadian (i.e. almost 24-h) periods. If feeding and eating diurnal patterns do not fit and are not synchronized with internal circadian rhythms of cow endocrinology, hormones may, most probably, not elicit optimal responses at the right time of the 24-h period, for instance. As a result, nutrient partitioning towards different targets namely body tissue accretion, milk secretion, and splanchnic and peripheral oxidation would substantively change.

The above cascade occurrence in the long-term would cause a multidimensional disorder that would keep high-merit dairy cows from reaching their maximal milk production potential and maintained normal health status. This metabolic phenomenon/disorder would have a multitude of consequences. On one hand, rumen health may be compromised via altered and suboptimal daily, weekly, and monthly rhythms of acidity and VFA dynamics. As a result, asynchronous nutrient release would prevail and energetic efficiency would substantially decrease [3]. On the other hand, because of limited small intestinal capacity for starch assimilation and glucose transport, large amount of undigested or partially digested starch would reach the large intestine where augmented fermentation would increase fecal nutrient loss [4]. From rumen and host animal health perspectives, fluctuated rumen pH could mean elongated subacute ruminal acidosis (SARA), endotoxin release, and inflammation. Other consequences include reduced feed intake and fiber digestion, depressed milk fat, diarrhea, laminitis, liver abscesses, and increased acute phase proteins [5]. As another adverse consequence of the altered cow endocrinological responses, management of body condition score through different phases of lactation and pregnancy becomes more challenging. Such a failure would be due to suboptimal and unpredicted nutrient loss and excretion and oxidation in various splanchnic and peripheral tissues [6]. For example, farmers often complain about excessive body tissue depletion that is usually concurrent with SARA and other health and metabolic disorders.

Future research will be warranted to quantify different hormonal responses to altered eating patterns of high-starch, nutrient-dense concentrates in relation to intermediary metabolites. The impaired dairy cow endocrinology would likely involve altered intermediary actions of insulin, glucagon, IGF-1, leptin and other hormones and metabolites. It is contemplated and postulated that over-feeding and irregular delivery of nutrient-dense concentrates would compromise normal dairy cow endocrinology and would adversely affect rumen and overall cow health.

Conclusion

This article described a multidimensional metabolic and endocrinological disorder that would occur as a consequence of over-feeding and irregular delivery of concentrate in mixed rations to dairy cows. Over-consuming high-starch nutrient-dense concentrates exacerbated by irregular circadian patterns of feed and nutrient delivery would impair normal hormonal responses to feeding management strategies. Other major consequences include erratic eating patterns, SARA, inflammation, diarrhea, laminitis, and depressed milk fat production and body tissue accretion. Finally, major economic losses would occur.

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