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Mini Review

Body Fat, Lactation Stage, and Parity Mediation of Feed Intake in Ruminants: Modeling Human Physiology

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Abstract

The objective was to discuss how body fat, parity and lactation stage mediate feed intake regulation in ruminants. This was done with a prospectus perspective as a human physiology model. Feed intake control in ruminants is mediated through physical and metabolic constraints. Body weight and body fat contribute to both physical and metabolic constraints on feed intake. Parity and lactation stage are of importance in regulating feed intake through different physical and metabolic constraints. More in-depth insights are to be gained in elucidating the direct and interactive effects of body fat, parity, and lactation stage on feed intake regulation in high-producing ruminants. These factors will be required to be investigated in-depth in humans.

Keywords: Feed Intake; Metabolism; Constraint; Ruminant

Body Weight and Body Fat

The objective of this review was to discuss how body fat, parity and lactation stage mediate feed intake regulation in ruminants. Nutrient demands rise as body weight (BW) or more accurately metabolic BW increases [1]. Growth affects feed intake [2]. Unlike multiparous cows which have already achieved the adult BW, primiparous cows are still growing [3]. Sustained growth needs a balanced profile of nutrients, notably amino acids (AA) and energy [4]. Growth will, thus, be expected to affect feed intake response to nutritional treatments. Body fat is another factor controlling feed intake. Kennedy [5] proposed that animals control BW by controlling body fat. According to this lipostatic theory, increased body fat can depress feed intake. Such an effect appears to be mediated via leptin secreted by adipocytes and may be involved in feed intake regulation [6]. In a recent study using growing lambs, Tolkamp., *et al.* [7] suggested that body condition score (BCS), as an indicator of body fatness, can improve feed intake prediction models that are based on BW. The findings of Tolkamp., *et al.* [7] support the original lipostatic theory of Kennedy [5]. Earlier [8,9], body fat, particularly in abdominal region, had been thought to limit the rumen capacity and reduce feed intake. Makela [8] found that rumen contents were negatively related to the abdominal fat size in post slaughter cows. These studies, however, were unable to prove if the inhibitory impact of body fat was mediated mainly by the physical rather than metabolic constraints. Orr [10] noticed that even when a highly digestible diet is fed, feed intake was lower in fat animals. These data would suggest that chemical constraints associated with body fat (such as leptin) may in part explain the lipostatic theory [6].

Parity and Lactation Stage

Maintenance nutrient requirements are about 10 - 20% lower in primiparous compared to multiparous cows. The lower maintenance requirement would lower maintenance nutrient intake. Thus, at comparable productivity, primiparous cows would be expected to consume about 20% less feed than would multiparous cows [11].

Lactating cows experience a dip in feed intake during the periparturient phase (3 weeks before until 3 weeks after calving [12] with the minimum dry matter intake (DMI) occurring at calving. The decline in DMI starts even long before the last few weeks of pregnancy [11]. The energy concentration of the diet has a significant impact on DMI response to pregnancy and calving. For instance, the decreased feed intake in late pregnancy is more pronounced at higher compared to lower dietary energy levels [13]. This may be due to stronger metabolic effects of high-energy diets on DMI [14].

Parity may influence post-calving patterns in DMI [3]. Primiparous cows tend to exhibit a slow rise in DMI over about 16 weeks postpartum, compared to multiparous cows. After the peak, DMI in primiparous cows remain almost constant but in multiparous cows DMI declines continuously. The differences in post-calving DMI patterns between parities may stem from the different patterns in milk yield. Multiparous cows face a higher peak in milk yield followed by a more dramatic decrease towards the end of lactation. Primiparous cows, in contrast, have a more consistent milk yield pattern throughout lactation. As a result, DMI curve will change accordingly.

It has been a question whether, and to what extent, feed intake pushes milk production or milk secretion drives feed intake. The latest NRC [3] suggested that milk production drives feed intake. The NRC [3] based its suggestion on the increased feed intake due to increased milk yield by bovine somatotropin. The application of bovine somatotropin in early lactation stimulates the mammary nutrient uptake and milk production in advance of increasing feed intake [15]. Across parities, the peak in milk yield usually occurs at about 4 - 6 weeks postpartum, but the peak in DMI lags to occur at 10 - 14 weeks postpartum [16]. During the negative nutrient balance, the high-producing cows draw from their body reserves (fat, protein, calcium) to meet nutrient requirements [17]. This suggests that the elevated demand for nutrients at production peak drives the cow to increase DMI. However, such a driving force does not become apparent until after several weeks of increased milk yield [18]. Thus, in view of the literature, the author believes that the degree to which the milk yield stimulates feed intake varies across lactation. At higher production levels, DMI response should be more pronounced. The hypothetical positive impact of a given feeding strategy (such as time of feeding) on DMI is expected to be of greater magnitude in early lactation cows.

As an aside, there is a speculation that the high-yielding cows can produce more than the low-yielding cows because they can ruminate longer. The longer rumination enables the high-yielding cows to digest the feed more effectively [19].

Conclusion

Different feed intake regulations in high-producing ruminants were reviewed with respect to varying body fat, parity and lactation stage. Optimal feeding strategies and feeding systems need to be adopted that lead to optimal regulation of feed intake by body fat, parity and lactation stage. Future research is required to elucidate how to optimize feeding strategies and feeding systems to improve feed intake in high-producing ruminants with varying parity and lactation stage. The above factors will need to be in-depth investigated in humans as well.

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Bibliography

1. Rayburn EB and DG Fox. "Variation in neutral detergent fiber intake of Holstein cows". *Journal of Dairy Science* 76.2 (1993): 544-554.
2. Quigley J., *et al*. "Dry matter intake in dairy heifers. 2. Equations to predict intake of heifers under intensive management". *Journal of Dairy Science* 69.11 (1986): 2863- 2867.
3. National Research Council. "Nutrient Requirements of Dairy Cattle: Seventh Revised Edition". Washington, DC: The National Academies Press (2001).
4. Lawrence TLJ and VR Fowler. "Growth of Farm Animals". Second edition. CABI Pub. Wallingford, UK (2002): 347.
5. Kennedy GC. "The role of depot fat in the hypothalamic control of food intake in the rat". *Proceedings of the Royal Society* 140.901 (1953): 578-592.
6. Houseknecht KL., *et al*. "The biology of leptin: a review". *Journal of Animal Science* 76.5 (1998): 1405-1420.
7. Tolkamp BJ., *et al*. "Body fatness affects feed intake of sheep at a given body weight". *Journal of Animal Science* 84.7 (2006): 1778-1789.
8. Makela A. "Studies on the question of bulk in the nutrition of farm animals with special reference to cattle". *Annals of Agricultural Sciences* 85 (1956): 1-130.
9. Tayler JC. "A relationship between weight of internal fat, "fill", and the herbage intake of grazing cattle". *Nature* 184.26 (1959): 2021-2022.
10. Orr RJ., *et al*. "Diurnal patterns of intake rate by sheep grazing monocultures of ryegrass or white clover". *Applied Animal Behaviour Science* 52.1-2 (1997): 65-77.
11. Ingvartsen KL and JB Andersen. "Integration of metabolism and intake regulation: A review focusing on periparturient animals". *Journal of Dairy Science* 83.7 (2000): 1573-1597.
12. Drackley JK. "Biology of dairy cows during the transition period: the final frontier". *Journal of Dairy Science* 82.11 (1999): 2259-2273.
13. Coppock CE., *et al*. "Effect of forage-concentrate ratio in complete feeds fed ad libitum on feed intake prepartum and the occurrence of abomasal displacement in dairy cows". *Journal of Dairy Science* 55.6 (1972): 783-789.
14. Illius AW and NS Jessop. "Metabolic constraints on voluntary intake in ruminants". *Journal of Animal Science* 74 (1996): 3052-3062.
15. Etherton TD and DE Bauman. "Review: Biology of somatotropin in growth and lactation of domestic animals". *Physiological Reviews* 78.3 (1998): 745-761.
16. Schingoethe DJ. "Feeding dairy cows". In Livestock Feeds and Feeding. Eds., R. O. Kellems and D. C. Church. 5th edition. Pearson Edu., Inc., NJ (2002): 313-328.
17. Bauman DE and WB Currie. "Partitioning of nutrients during pregnancy and lactation: A review of mechanisms involving homeostasis and homeorhesis". *Journal of Dairy Science* 63.9 (1980): 1514-1546.
18. Bauman DE. "Bovine somatotropin: review of an emerging animal technology". *Journal of Dairy Science* 75.12 (1992): 3432-3451.
19. Phillips CJC and K Hecheimi. "The effect of forge supplementation, herbage height and season on the ingestive behaviour of dairy cows". 24 (1989): 203-216.

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