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Calf Note #141 – Further thoughts on colostrum variation

Introduction

Variation in colostrum immunoglobulin concentration is well documented. In Calf Note #133 (http://www.calfnotes.com/pdffiles/CN133.pdf), I summarized the results of research conducted at Penn State University and published in the Journal of Dairy Science (Kehoe et al., 2007). In this Calf Note, I'll give further consideration to variation in nutrient concentration of colostrum.

Variation in energy content of colostrum

Nutrient specifications reported by Kehoe et al. (2007) are in Table 1. Using the formula for calculating ME of milk from the NRC (2001), I calculated the expected ME for colostrum using the average, minimum and maximum values reported by Kehoe et al. Note that these calculated values may be incorrect, as the sample with the lowest protein may not have the lowest fat or lactose. However, they do allow us to see the maximum potential variation in the data set.

Table 1. Composition of colostrum from dairy cows in Pennsylvania. Adapted from Kehoe et al., 2007.

Item	N	Avg.	SE	Min	Max
Fat, %	54	6.7	4.16	2.0	26.5
Protein, %	55	14.92	3.32	7.1	22.6
Lactose, %	55	2.49	0.65	1.2	5.2
Total solids, %	55	27.64	5.84	18.3	43.3
Ash, %	55	0.05	0.01	0.02	0.07
Calculated ME, Mcal/kg		5.73	…	3.40	8.32
Calculated ME, MJ/kg		23.97	…	14.21	34.79

Metabolizable energy values calculated from average, minimum and maximum values and based on ME calculation of milk (NRC, 2001).

Calculated ME averaged 24.0 MJ/kg of dry matter and ranged from 14.2 to 34.8 MJ/kg. This variation is amazing to consider. Let's assume that a calf consumes a total of 4 L of colostrum in the first 24 hours of life. If the colostrum is average composition (based on the Penn State study), then the calf will consume 4 × 0.2764 = 1.11 kg of solids and 1.11 × 24.0 MJ/kg DM = 26.6 MJ of ME. However, comparing the extremes of the data, the potential minimum and maximum ME intake would range from 10.4 to 60.3 MJ in the first 24 hours of life. This is a six-fold difference in the amount of energy available to the calf.

The average ME calculated for colostrum is about 24.0 MJ/kg of DM. This compares to an average ME of 22.3 MJ/kg in whole milk or about 20.3 MJ/kg of DM in a 20% CP, 20% fat milk replacer.

According to the NRC, the maintenance ME requirement for a 40 kg calf is about 6.7 MJ per day. Thus, feeding 6.7 MJ needed / 24.0 MJ/kg of DM = 0.279 kg of DM as colostrum, or about 1 kg of colostrum on an as fed basis would meet the animal's ME needs.

Clearly, the additional ME in colostrum is designed to be used for thermogenesis (heat production) to allow the calf to stay warm. Calves have a special amount of fat called brown adipose tissue

(**BAT**) that is designed specifically to produce heat. These supplies are approximately 2% of BW at birth but the actual amount may depend on the cow's prepartum diet. This BAT is then used by the calf to generate heat during the first days of life. As the calf ages, the amount of BAT decreases so that by about 4-5 weeks, all fat in the animal is "typical" white (not brown) fat.

Brown fat allows calves to generate heat and stay warm. However, energy and protein from colostrum can also be used by the calf to generate heat. As seen in Table 1, the amount of energy available to the calf from colostrum is remarkably variable.

Klimeš et al. (1986) as well as others have shown that the nutrient composition of colostrum varies with time after calving. But, what factors affect the huge variation from cow to cow reported by Kehoe et al. (2007) and others? This, unfortunately, is not well understood. There are some data to suggest that the composition of colostrum can be affected by changing the diet of the dry cow (for a review, see Quigley and Drewry, 1998; also Hadjipanayiotou, 1995). The amount of variation reported by Kehoe et al. is much greater than what would be predicted in the literature (e.g., Hadjipanayiotou, 1995) and may be related to diet, management, day of gestation at calving and many other factors.

Summary

The nutrient content of maternal colostrum as reported by Kehoe et al. (2007) is remarkably variable and colostrum with low amounts of protein and ME may provide insufficient nutrients for calves to thermoregulate, particularly in cold environments. Currently, the reasons for the magnitude of this variation is unclear. It's recommended that dairy producers should evaluate colostrum not only for IgG content (using a colostrometer) but be aware of colostrum with insufficient energy and protein. These samples would be thin and watery, whereas colostrum with large amounts of fat and protein would be thicker with clear fat layer.

References

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