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Calf Note 169 – What you do to mom…

Introduction

We understand that the development and future productivity of the newborn calf is affected by the genetics of both the sire and dam. Our entire breeding industry is established on selecting those genetically superior animals and using them to further improve the productivity of our herd. Less well understood, perhaps, is the role that fetal development plays in future productivity. Once the egg is fertilized, the genetic composition of the calf is established. However, the expression of that genetic potential may depend on how the cow is fed and managed during gestation.

An increasing amount of data suggests that prepartum management of the cow can affect growth of the fetus and even its ability to grow and produce later in life. An interesting study from China is an excellent case in point.

The research

The study was conducted with Holstein dairy cows (n = 30) assigned to one of three diets during the last 21 days prior to calving. Cows were assigned to a low energy group (net energy of lactation (NEL) = 5.25 MJ/kg of DM); medium energy group (NEL = 5.88 MJ/kg of DM); and high energy group (NEL = 6.48 MJ/kg of DM). The diets consisted of a combination of straw, hay and grains to attain a CP of 13% of DM and increasing amounts of net energy (Table 1).

Ingredient, % of DM	Low	Medium	High
Straw	36.5	17.0	0.0
Corn silage	0.0	19.9	36.5
Chinese wild rye	26.9	24.9	22.9
Alfalfa hay	16.1	7.5	0.0
Corn	8.4	15.7	23.2
Wheat gluten	2.2	2.4	2.8
Proteins[1]	8.7	11.3	13.2
Premix	1.2	1.3	1.4
Nutrients, % of DM			
Protein	13.0	13.1	13.1
NDF	56.3	49.9	43.5
NEl, MJ/kg of DM	5.25	5.88	6.48

Table 1. Composition of diets fed to cows on different level of energy (NEL)

[1]Proteins = soybean meal, cottonseed meal, rapeseed meal, DDGS and extruded full fat soy.

Unfortunately, the authors did not report how much each cow was fed, so it's impossible to say exactly the differences among treatments in energy intake.

Effects on the cow

Feeding lower energy diets to cows during the last three weeks prepartum had several significant effects on the cow.

Cow BW (Table 2) was not significantly affected by differences in prepartum diet though cows on the high energy diet numerically gained BW whereas cows on the lower energy diets did not.

Item	Low	Medium	High
BW, kg			
21 d pp	693	695	685
7 d pp	689	689	700
Change	-4	-6	15
Blood glucose, mM/L			
21 d pp	3.58[a]	3.53[a]	3.52[a]
7 d pp	3.50[a]	3.65[ab]	3.86[b]
Change	-0.08	0.12	0.34
Blood NEFA, mM/L			
21 d pp	136.4[a]	137.6[a]	133.1[a]
7 d pp	366.5[a]	183.7[b]	146.1[b]
Change	230.1	46.1	13.0

Table 2. Effects of diet energy content on cow BW and blood metabolites.

[a,b]Means in rows with different superscripts are different ($P < 0.05$).

Concentrations of glucose and non-esterified fatty acids varied with differences in diet. Cows fed the low energy diet had lower concentrations of glucose and the content of glucose in the blood declined from 21 to 7 days prepartum. In addition, there was a large increase in the NEFA concentration from 21 to 7 days prepartum. This suggests that these cows were in negative energy balance during the immediate prepartum period. Other assays conducted by the researchers supported these observations.

Effects on the calf

The interesting concept of the study was whether prepartum diets affected the calf at birth (and, potentially, throughout life). Results shown in Table 3 suggest that the calf was profoundly affected by the prepartum diet.

Item	Low	Medium	High
Birth BW, kg	39.2[a]	42.1[ab]	43.9[b]
Birth height, cm	74.7[a]	76.6[b]	78.0[b]
Birth length, cm	72.6[a]	73.6[ab]	74.2[b]
Lymphocyte markers, %			
CD4	5.39[a]	8.92[a]	14.21[b]
CD8	11.45[a]	10.98[a]	9.91[a]
CD21	10.26[a]	10.63[a]	9.87[a]
Plasma IL, ng/ml[1]			
IL-2	4.47[a]	5.23[ab]	6.46[b]
IL-4	0.77[a]	0.81[a]	1.20[b]
IL-6	0.23[a]	0.20[a]	0.25[a]
SOD, U/ml[2]			

Table 3. Effects of diet energy content on calf BW and blood metabolites.

[a,b]Means in rows with different superscripts are different ($P < 0.05$).

[1]Plasma interleukin concentration.

Birth weight, body height, body length, abdominal circumference, thoracic girth, umbilical girth, and levels of CD4, CD4:CD8, IL-2, IL-4, and superoxide dismutase were decreased in calves of the L group compared with those of the H group.

Taken together, these results suggest that maternal energy density during

the last 21 d prepartum negatively affected growth, development, immunity, and antioxidant capability of neonatal calves.

The implications of the study are significant. What affects the cow during the dry period appears to affect the calf in many ways. These data support an increasing amount of research that tells us that we need to give special consideration to the prepartum period. Although this research focused on the last 21 days of gestation, other studies also suggest that the fetus can be affected early in gestation.

It's time to remember how to feed and manage our dry cows!

Reference

Gao, F., Y.-C. Liu, Z.-H. Zhang, C.-Z. Zhang, H.-W. Su, and S.-L. Li. 2012. Effect of prepartum maternal energy density on the growth performance, immunity, and antioxidation capability of neonatal calves. J. Dairy Sci. 95:4510–4518.