Can chromium help

Supplemental chromium increases the sensitivity of body tissues to insulin, which can improve dry matter intake and milk production of transition cows.

By MARY BETH DE ONDARZA

LACTATION performance is dependent on the success of the transition period from three weeks before to three weeks after calving (Dewey, 1999). Much progress has been made with dry cow and fresh cow nutrition and management to reduce metabolic diseases during this time.

On many commercial dairies, the incidence of clinical disease during the transition period is low, but there are still ample opportunities to reduce subclinical issues and improve performance.

Negative energy balance

Most transition cows experience some degree of negative energy balance due to their high energy demands and insufficient dry matter intake.

To meet these needs, body fat reserves are mobilized and converted to non-esterified fatty acids (NEFAs) to be used as an energy source. Blood NEFA concentrations are about 0.2 millimoles per liter (mg/L) per day for a dry cow and rise three weeks before calving to more than 0.6 mg/L per liter on calving day.

High plasma NEFA levels are typically associated with metabolic problems during the transition period (Dyk et al., 1995; Chandel, 1997). Capitan et al. (2010) sampled blood from 15 apparently healthy prepartum cows (from 1 to 2 days prepartum) and 15 apparently healthy postpartum cows (0 to 14 days postpartum) from 91 Northeast dairies. Blood NEFA and butyrate concentrations were correlated with reproduction and productivity.

This work provides targets for optimum milk production, with NEFA concentrations for prepartum cows to be less than 0.33 mEq per liter and for postpartum cows to be less than 0.72 mg/L per liter with BHI of less than 10 mg/L.

Targets for optimum reproduction were 0.13 mg/L (35 liters) NEFA concentrations of less than 0.73 mg/L per liter and BHI of less than 10 mg/L for postpartum cows.

Insulin sensitivity

Insulin binds to receptors on the cell's surface, initiating a process that causes glucose to enter the cell and be used as an energy source. The amount of glucose made in the liver.

According to the hepatic oxidation theory, the breakdown of NEFAs in the liver reduces blood levels and causes NEFA levels to be low, causing NGA levels to remain elevated.

Several weeks after calving, insulin levels and insulin sensitivity continue to be low, causing additional body fat mobilization, accumulation of liver fat and further inhibition of gluconeogenesis (Overton and Walton, 2004; Reynolds and Overton, 2009).

Calving stress and the risk of infections are high during the transition period. When immune cells are activated, often due to trauma or subclinical infections that occur during the transition period, inflammation occurs (Bradford, 2009). In addition, dietary changes and ruminal acidosis challenges during the transition period can increase blood NEFA concentrations (Khalifeur et al., 2009), which will also affect the inflammatory response.

Cytokines produced in response to inflammation generate more body fat mobilization and reduce insulin action (Kushibiki et al., 2001; 2003) as well as reduce insulin sensitivity (Kushibiki et al., 2001).

Cows with excessive body condition are more likely to have excessive body composition problems during the transition period. The excessive body composition produces inflammatory cytokines like tumor necrosis factor-alpha (TNF-α) (Hotamisljac et al., 2003), which can cause insulin resistance and reduce insulin sensitivity.

Fedding strategies that can reduce excessive body reserve mobilization, increase dry matter intake and positively affect insulin sensitivity and gluconeogenesis will control NEFA and ketone levels.

Allen and Bradford (2009) suggested that it is preferable to increase insulin sensitivity rather than increase body insulin levels in the transition cow since the latter will also affect the amount of glucose made in the liver. chromium increases insulin sensitivity of the cow's tissues, reducing body fat mobilization and reducing NEFA production. Chromium can generate Insulin resistance, the normal amount of glucose made in the liver.

Insulin resistance of the cow's tissues is reduced, further increasing fat mobilization (Gann et al., 1992). Without more glucose to stimulate insulin action, additional body fat mobilization is reduced.

At the liver, NEFAs are first oxidized and converted to energy and, when reaching a limit, are fully oxidized into ketones (acetone, acetoacetic acid and BHEA). Some tissues can use ketones for energy to help reduce overall glucose usage, but high levels of blood ketones can cause a cow to reduce intake, likely, causing additional body fat mobilization, accumulation of liver fat and further inhibition of gluconeogenesis (Overton and Walton, 2004; Reynolds and Overton, 2009).

Researchers have long speculated that chromium improves insulin sensitivity of the cow's tissues, reducing body fat mobilization and reducing NEFA production. Chromium can generate Insulin resistance, the normal amount of glucose made in the liver.

Allen and Bradford (2009) suggested that it is preferable to increase insulin sensitivity rather than increase body insulin levels in the transition cow since the latter will also affect the amount of glucose made in the liver. Chromium increases insulin sensitivity of the cow's tissues, reducing body fat mobilization and reducing NEFA production.

Allen and Bradford (2009) suggested that it is preferable to increase insulin sensitivity rather than increase body insulin levels in the transition cow since the latter will also affect the amount of glucose made in the liver. Chromium increases insulin sensitivity of the cow's tissues, reducing body fat mobilization and reducing NEFA production.

Chromium has been identified as an essential trace element for people and laboratory animals (National Research Council, 1997; Anderson, 1992). Chromium is primarily involved in enhancing glucose uptake by cells (Davie and Vincent, 1993). Research in people and rodents suggests that stress increases the need for chromium (Luea et al., 2010). Stress increases cortisol secretion, which reduces insulin sensitivity of cells (Gustav, 1999; Moon-Lase-Shager and Mohaw, 1993).

Chromium propionate is a bioactive molecular complex of 1000 molecules marketed by Kenilworth Agri-Foods North America Inc. as part of the Ken Trace product line.

McNamara and Valey (2005) supplemented either calcium propionate (0.125% per day) or chromium propionate (10 mg of chromium per day) to 12 multiparous Holstein cows for 21 days before calving to 35 days after calving. All cows were switched to the control diet from 36 to 90 days in milk (DIM). Both groups of supplemented cows showed less stress during the first week of lactation (Bradford, 2009). Furthermore, it has been found that more lipid peroxides are produced when liver NEFAs levels rise, especially in transition cows with excessive body condition.

These lipid peroxides produce an inflammatory response (Bradford, 2009), which reduces glucose uptake by cells. Chromium propionate produces more milk (Table) from one to 90 DIM than those fed the control diet (23.1 and 23.7 kg per day versus 20.1 kg per day for controls). However, only those cows supplemented with chromium propionate produced more milk (Table) from one to 90 DIM (46.5 kg per day for chromium propionate versus 43.7 kg per day for control per day for controls).

Chromium propionate is a bioactive molecular complex of 1000 molecules marketed by Kenilworth Agri-Foods North America Inc. as part of the Ken Trace product line.

McNamara and Valey (2005) supplemented either calcium propionate (0.125% per day) or chromium propionate (10 mg of chromium per day) to 12 multiparous Holstein cows for 21 days before calving to 35 days after calving. All cows were switched to the control diet from 36 to 90 days in milk (DIM). Both groups of supplemented cows showed less stress during the first week of lactation (Bradford, 2009). Furthermore, it has been found that more lipid peroxides are produced when liver NEFAs levels rise, especially in transition cows with excessive body condition.

These lipid peroxides produce an inflammatory response (Bradford, 2009), which reduces glucose uptake by cells. Chromium propionate produces more milk (Table) from one to 90 DIM than those fed the control diet (23.1 and 23.7 kg per day versus 20.1 kg per day for controls). However, only those cows supplemented with chromium propionate produced more milk (Table) from one to 90 DIM (46.5 kg per day for chromium propionate versus 43.7 kg per day for control per day for controls).

It was concluded that chromium treatment had the potential to decrease the rate of lipolysis, likely by increasing insulin sensitivity and enhancing glucose transport, thus facilitating higher dry matter intake and milk production.

Following this study, the goal of McNamara's research group was to further investigate the mechanism of action of chromium in the cow. They looked at the effect of different levels of chromium propionate — 0, 5, 10 or 15 mg of chromium per day — on an intravenous glucose tolerance test in growing Holstein heifers (Sunnier et al., 2007).

Glucose solution was infused intravenously, and the concentrations of glucose and insulin in the blood were measured regularly until they returned to original baseline levels. Chromium raised serum glucose and reduced serum insulin and NEFA concentrations. Chromium increased glucose clearance rates (Figure). More glucose went from the blood into the tissues with supplemental chromium.
insulin sensitivity?

In a similar study, Spears et al. (2010) supplemented 0, 0.3, 0.6, 0.9, 1.2 mg of supplemental chromium per kilogram of diet dry matter to growing beef bulls. Chromium reduced serum insulin and insulin/glucose ratio for 15 minutes after glucose infusion, indicating greater insulin sensitivity.

Intake, milk production
Spears et al. (2010) reviewed the literature and concluded that most studies indicate that supplemental chromium significantly increased or tended to increase milk production and intake. Chromium supplementation in an oral drench once per day for 8 weeks prepartum in a grain-based diet decreased serum NEFA in an oral drench once per day for 8 weeks prepartum in a grain-based diet. Chromium decreased serum NEFA in an oral drench once per day for 8 weeks prepartum in a grain-based diet. Chromium consumption overall, chromium supplementation intake of cows fed a corn-based diet did not affect postpartum dry matter intake in cows of periparum dry matter intake) from 21 body weight (approximately 0.87 mg/kg chromium-L-methionine at 0 or 0.08 mg/kg concentrations (Smith et al., 2008). Chromium supplementation had no effect on however, in this study, chromium supplementation had no effect on periparum dietary carbohydrate source and supplementation with chromium throughout the periparum period. Chromium supplementation had no effect on periparum dietary carbohydrate source and supplementation with chromium throughout the periparum period.

Significance
Daily feeders and their nutritionists know that a great transition period from 21 days before calving to 21 days after calving equates to great lactation for a cow (Bruckmaler, 1999). Although progress has been made in improving diets and management of transition cows, it remains a challenge to quickly increase dry matter intake to provide the nutrients needed for milk production. Chromium supplement increases the sensitivity of body tissues to insulin, enhancing glucose uptake. Chromium reduces mobilization of body fat, consequently lowering blood NEFA levels. These mechanisms, in conjunction, could improve dry matter intake and milk production in the early-lactation cow.

References
Chandler, P. 1997. Insulin is factor for transition cows, more information is needed. Feedstuff, June 18, p. 12.
Dyk PB, R.S. Henny, J.L. Lerman, H.F. Bouchard and M.J. Varsa-Hanz. 1995. Prepartum under-nutrition in dairy cows is associated with increased serum NEFA and insulin concentrations, especially one week prepartum, and tended to improve pregnancy rates, but no difference in milk response was observed.

Significance
Daily feeders and their nutritionists know that a great transition period from 21 days before calving to 21 days after calving equates to great lactation for a cow (Bruckmaler, 1999). Although progress has been made in improving diets and management of transition cows, it remains a challenge to quickly increase dry matter intake to provide the nutrients needed for milk production. Chromium supplement increases the sensitivity of body tissues to insulin, enhancing glucose uptake. Chromium reduces mobilization of body fat, consequently lowering blood NEFA levels. By these mechanisms, supplemental Chromium can improve dry matter intake and milk production in the early-lactation cow.

Significance
Daily feeders and their nutritionists know that a great transition period from 21 days before calving to 21 days after calving equates to great lactation for a cow (Bruckmaler, 1999). Although progress has been made in improving diets and management of transition cows, it remains a challenge to quickly increase dry matter intake to provide the nutrients needed for milk production. Chromium supplement increases the sensitivity of body tissues to insulin, enhancing glucose uptake. Chromium reduces mobilization of body fat, consequently lowering blood NEFA levels. By these mechanisms, supplemental Chromium can improve dry matter intake and milk production in the early-lactation cow.

References
Chandler, P. 1997. Insulin is factor for transition cows, more information is needed. Feedstuff, June 18, p. 12.
Dyk PB, R.S. Henny, J.L. Lerman, H.F. Bouchard and M.J. Varsa-Hanz. 1995. Prepartum under-nutrition in dairy cows is associated with increased serum NEFA and insulin concentrations, especially one week prepartum, and tended to improve pregnancy rates, but no difference in milk response was observed.

Significance
Daily feeders and their nutritionists know that a great transition period from 21 days before calving to 21 days after calving equates to great lactation for a cow (Bruckmaler, 1999). Although progress has been made in improving diets and management of transition cows, it remains a challenge to quickly increase dry matter intake to provide the nutrients needed for milk production. Chromium supplement increases the sensitivity of body tissues to insulin, enhancing glucose uptake. Chromium reduces mobilization of body fat, consequently lowering blood NEFA levels. By these mechanisms, supplemental Chromium can improve dry matter intake and milk production in the early-lactation cow.

Significance
Daily feeders and their nutritionists know that a great transition period from 21 days before calving to 21 days after calving equates to great lactation for a cow (Bruckmaler, 1999). Although progress has been made in improving diets and management of transition cows, it remains a challenge to quickly increase dry matter intake to provide the nutrients needed for milk production. Chromium supplement increases the sensitivity of body tissues to insulin, enhancing glucose uptake. Chromium reduces mobilization of body fat, consequently lowering blood NEFA levels. By these mechanisms, supplemental Chromium can improve dry matter intake and milk production in the early-lactation cow.