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The Effect of Chromium Propionate on Piglets and Sows in a Commercial Swine Herd

A trial was conducted at a large integrated, confinement sow operation in the western region of the United States. The sows were housed within close proximity to each other in the sow unit in a manner to minimize environmental differences while still allowing for different feeds to be fed. The purpose of the trial was to determine the effect of supplementing highly productive sows with KemTRACE® Chromium Propionate. The sows were supplemented with 200 ppb Cr/ton of feed in the first reproductive cycle at either 14 days prior to farrowing and through lactation or at the beginning of their lactation period and compared to the control group without chromium propionate supplementation. Sows that were fed chromium propionate in this trial had pigs that showed a difference in wean weight over the control ($P < 0.07$). This response was observed again ($P < 0.001$) in the second reproductive cycle. Also during the second reproductive cycle there was a difference in more live born pigs ($P < 0.02$). In this research trial and in previous research trials (Brennan et al., 2011; Hagen, 2000), supplemental chromium has been shown to improve sow and pig performance. The use of chromium propionate as a management tool in commercial swine production to maximize sow unit performance is supported by the trials conducted.

Introduction

Chromium is commercially available to the swine industry in the United States (AAFCO, 2011) in two forms, Chromium Picolinate (CrPic) and Chromium Propionate (CrProp). Chromium supplementation to sow diets has been shown to improve the reproductive performance of sows and their offspring. Supplementation of chromium has also been shown to improve glucose metabolism as demonstrated by insulin sensitivity (Matthews et al., 2001). The chromium present in the chromium propionate (CrProp) molecule is highly soluble (Vincent, 2000). This is supported in growth trials where performance of animals has increased when chromium was supplied by chromium propionate. Greiner et al. (2010) demonstrated that feeding chromium at a rate of 200 ppb improved the growth rate of barrows in the period from 46 days post weaning through slaughter. Hinson et al. (2009) noted that gilts fed chromium during the Paylean® (Eli Lilly and Company) phase (last 4 weeks prior to slaughter) had improved performance over the controls as well. James (2009) reported that chromium fed from weaning through 42 days post weaning increased growth rate when fed either for two weeks or all the way through the time period. However, the effects of supplemental chromium from chromium propionate have not been extensively documented in sows until recently. Brennan et al. (2011) showed in two separate Canadian trials that supplementation with chromium propionate in gestation and lactation feeds resulted in increased sow body condition, increased pigs born alive, decreased pre-weaning mortality, and increased pigs weaned. Many sow units with modern highly productive sow lines indicate that having more pigs born is not a driving factor in determining profitability. Increasing the number of pigs weaned, the weight of weaned pigs, and improving sow breeding performance are key performance criteria for today's commercial swine herd.

The objective of this study was to evaluate the performance of sows and pigs in a large commercial swine herd when chromium from chromium propionate was supplied to the sows through feed either in lactation or in gestation and lactation. The study was also conducted over two reproductive cycles to examine the influence of chromium propionate as the sows respond to longer feeding.

Materials and Methods

A total of 600 LW x LR crossed sows were initially allotted to one of three dietary regimens for this trial in a commercial farrow to wean operation in southern Utah. They were randomly assigned, immediately after breeding, to a control diet (CON) fed throughout the gestation and lactation periods, a CON plus 200 ppb chromium from chromium propionate fed throughout the gestation and lactation periods, or a CON plus 200 ppb chromium from chromium propionate starting in the farrowing room and continuing throughout lactation. Sows were housed in environmentally controlled gestation and in farrowing facilities. Sows were housed in gestation crates with partially slatted concrete floors for the entire gestation and farrowing crates with woven wire flooring throughout the entire lactation period (24d). Sows were allotted to minimize differences in parity within the blocks by having sows of the same parity constitute the block when possible. Sows within the block were also assigned based on their expected farrowing date. The farm followed animal care guidelines set in the company's standard operation procedures.

Sows were placed on test at the beginning of the gestation period. The test was concluded at the end of their second time through the farrowing unit, meaning the sows fed chromium propionate were fed through two entire gestations and lactations. The reason for this is that previous research indicated that the parameters affected by sow intake of chromium can change over time (Brennan et al., 2011). The same parameters were measured for the sows and their offspring throughout both time periods to observe any differences in response.

Body weights and back-fat measurements of sows were collected pre-and post-lactation. The litter birth weight was recorded at birth (within first 24 hours), at cross foster, and at weaning. Cross fostering was done within the same treatment so that pigs born of sows receiving a specific dietary regimen were only transferred to other sows receiving the same dietary regimen. For the lactation period, sows were fed ad libitum at 4 days post-farrow. Daily lactation feed intake was recorded for each sow as daily feed disappearance. Pigs were fed a standard medicated creep feed starting at day 14. The creep feed was available to the piglets twice daily. Pigs were given 1 cc of a mixture of iron and a broad-spectrum antibiotic (Polyflex™, Fort Dodge Animal Health) at day 3 after birth and males were castrated at that time.

Results and Discussion

Overall, the most economically relevant results involved increased pig weaning weights. In the first reproductive cycle (Figure 1), there were differences in pig weight between the control and treatment groups either in lactation or starting 14d prior to lactation. In the second reproductive cycle (Figure 2), the chromium propionate fed sows showed a difference in pig wean weights over the control.

Sow performance was not altered by chromium propionate feeding in the first reproductive cycle. During the second reproductive cycle (Table 1), there were differences in litter birth weight and pigs born alive between the control and treatment groups. These pigs were also much larger at weaning on average. This tends to indicate that this advantage was added by factors that occurred during the lactation in the second reproductive cycle. However, there were also advantages that occurred at birth in the second reproductive cycle.

Overall, there were no significant differences in pig health measures during the lactations in either reproductive cycle. Because there were no differences in sow feed intake and weight loss was not affected by the dietary treatments, sow milk quality was considered to be of great interest to determine why the pigs were heavier.

In the first reproductive cycle, there were differences in lactose, total solids and fat between the control and treatment groups. Dilution of the milk would tend to indicate that there was more milk (volume) produced resulting in a larger pig weaned. During the second reproductive cycle, there were differences in protein, energy and somatic cell counts between the control and treatment groups. The differences in protein, energy and somatic cell counts, along with larger pigs weaned, would tend to imply higher milk volumes.

Figure 1. Wean Weights during First Reproductive Cycle

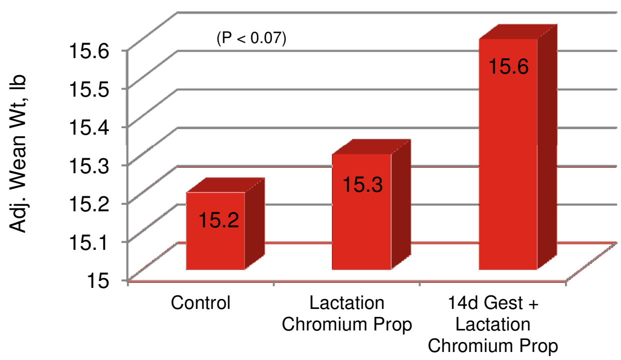

Figure 2. Wean Weights during Second Reproductive Cycle

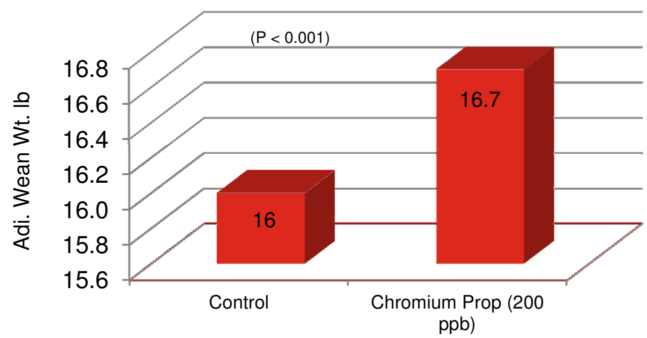

Table 1: Farrowing and Back Fat Analyses during the Second Reproductive Cycle

		Feed Regimen			Treatment		
Performance		**Chromium (200 ppb)**	**Non-Medicated (Control)**	**SE**	**Difference (Cr-Control)**	**(P<)**	**SED**
Farrowing	Litter Birth Weight, lb	45.6	43.9	0.631	1.7	0.05	0.859
	Born Live/ Sow	13.0	12.4	0.221	0.6	0.02	0.295
Back Fat	Back Fat, Pre-farrow, mm	20.2	20.1	0.269	0.1	0.8	0.364
	Back Fat, Post-farrow, mm	19.5	18.6	0.254	0.9	0.01	0.344
	Difference in Back Fat, mm	-0.7	-1.6	0.177	0.92	0.001	0.237

The results of this trial show that the sows were able to produce more milk without affecting the sow body condition as measured by back fat. In fact, after the second reproductive cycle, sows within the treatment group had greater ($P < 0.001$) back fat than those in the control group. The data would tend to indicate that chromium made it possible for more of the energy taken in during the reproductive process to be directed to the production of higher volumes of milk. This is similar to studies that have been conducted in dairy cows (McNamara and Valdez, 2005). In this study, once again, the number of pigs born alive was increased slightly in the second reproductive cycle. This is consistent with previous studies (Brennan et al., 2011; Hagen, 2000).

There have been theories presented in the past implying a needed loading period for chromium to have an effect in sows. The chromium presented to the animal should have the effect of increasing glucose supply to the muscle and/or fat tissues when ingested (Vincent, 2002). The reason for the lag time in seeing the effects in sows is more likely due to several reasons. As sows pass through the first reproductive cycle, the energy supplied to these tissues allows for increases in milk and sow body condition improvements. The pig numbers are not affected because of the hierarchy of needs for that energy supply. As the sow is able to meet the lower level needs, pig numbers are able to be influenced as the sow progresses through the second cycle. If pig numbers are the main criteria being observed, then a loading period is observed and hypothesized. However, as we measure more biological parameters in highly controlled studies, we can observe changes more immediately. So, the term “lag” has not been used in its proper context as the first cycle is used to improve the energy and health status of the sow.

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The sows were able to improve not only born alive, but they were able to produce a larger pig between 0.40 and 0.70 lb. bigger in the different reproductive cycles (Figures 1 & 2). In running chromium trials, the initial body condition and management level are going to have influences as to what is observed in the records of the sow unit. Sows in better body condition and under high level of management are more likely to have more and/or bigger pigs. Sows in poor body condition or where management is sub-optimal will tend to improve themselves prior to improving the productivity in relation to litter size or pig growth. These sows had good feed intake and higher intake was not observed as in previous studies (Brennan et al., 2011). As sows are eating at or near their physical limit, the sow will be able to utilize the energy from the feed to better fuel muscle and fat when they are fed chromium propionate.

Conclusions

Sows that were fed chromium propionate in this trial had pigs that showed a difference in wean weight over the control ($P < 0.07$). This response (weaned weight) was observed again ($P < 0.001$) in the second reproductive cycle. Also during the second reproductive cycle there was a difference in more live born pigs ($P < 0.02$). In this research trial and in previous research trials (Brennan et al., 2011; Hagen, 2000), supplemental chromium has been shown to improve sow and pig performance. The use of chromium propionate as a management tool in commercial swine production to maximize sow unit performance is supported in the research done to date.

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