Effects of Sodium and Chloride on Nursery Pigs Growth Performance

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Background

Sodium and chloride provide assistance in regulating osmotic pressure within cells. Chloride is necessary for proper hydrochloric acid production in the stomach and therefore its concentration can affect nutrient digestibility (Mahan et al., 1996, National Swine Nutrition Guide, 2010). Sodium is involved in the absorption of essential dietary nutrients in the small intestine. If either sodium or chloride are deficient in the diet, appetite and growth performance will be decreased. Mahan et al. (1996) found that supplemental sodium and chloride in the form of salt added to the diet improved weight gain and feed efficiency during the 14-day post weaning period. The NRC (2012) recommends that there must be at least 0.35% sodium and 0.45% chloride in diets for nursery pigs weighing 15 to 25 lb. Dried whey which is frequently added to diets for weaned pigs, also contributes salt. Because dried whey contains approximately 3 to 4% salt, typical practice among swine nutritionists is to add 7 lb/ton of additional salt to the diet. Previously, Shawk et al. (2016) observed that adding 12 lb/ton of additional salt in a diet already containing 10% dried whey maximized growth performance. The typical practice of adding 7 lb/ton of salt (0.18% sodium) to the diet proves to be deficient according to NRC standards (0.35% sodium). However, when 12 lb/ton of salt is added to a diet already containing 10% dried whey, NRC (2012) recommendations are met. Because the main focus of Shawk et al. (2016) was to determine the effects of salt on growth performance, our study was designed to evaluate the individual influence of sodium and chloride on growth performance of phase 2 nursery pigs.

Experimental Procedures

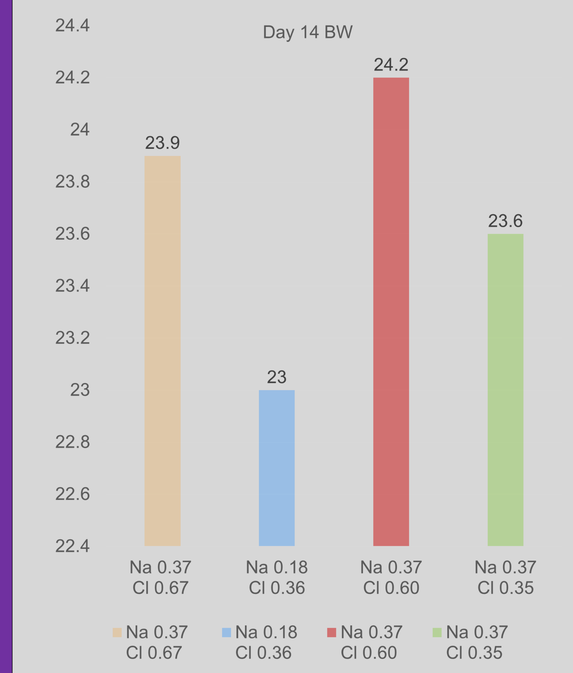
A total of 360 pigs (DNA 200 × 400, Columbus, NE) were used in a 14-day trial at the Kansas State University Swine Teaching and Research Center. After 7-days post-weaning, each pig was weighed and allotted to pens according to body weight. Each pen contained 6 pigs with an average initial weight of 15 lb. A total of 4 treatments were randomly distributed with a total of 15 replications per treatment. A sample of each diet was taken and analyzed at Ward Labs in Kearney, NE. The positive control diet contained 200 lb/ton of dried whey with 12 lb/ton of added salt (0.37% sodium and 0.67% chloride; Table 1). This diet showed the best growth performance of the previous study conducted by Shawk et al. (2016). The negative control diet contained 144 lb/ton of lactose with 7 lb/ton of added salt (0.18% sodium and 0.35% chloride). The two additional diets were the negative control plus either 15.5 lb/ton of salt (0.37% sodium and 0.60% chloride) or 23 lb/ton of sodium bicarbonate and 8 lb/ton of potassium chloride (0.37% sodium and 0.35% chloride). The negative control diet with 15.5 lb/ton of added salt was used to meet the sodium requirement but exceeded chloride requirement. The last diet was formulated with sodium bicarbonate and potassium chloride to perfectly met NRC recommendations for sodium and chloride. Each pen started off with approximately 25 lb of feed and feed additions were added throughout the week as needed. Each pig and feeder was weighed and recorded on d 0, 7, and 14 in order to calculate ADG, ADFI, and F/G.

Average Daily Gain

Feed to Gain

Average Daily Feed Intake

Day 14 Body Weights



Results

Chemical analysis of the diets was similar to formulated values with the exception that chloride concentration in the negative control diet with potassium chloride and sodium bicarbonate was slightly lower than formulated (Table 2).

Pigs fed the positive control diet or the negative control diet with 15.5 lb of added salt had similar ADG which was greater ($P < 0.05$) than the pigs fed the negative control diet with 7 lb of added salt. Pigs fed the negative control diet with potassium chloride and sodium bicarbonate were intermediate.

Pigs fed the positive control diet had the greatest ($P < 0.05$) ADFI, while pigs fed the negative control diet with 7 lb had the lowest ADFI. Pigs fed the negative control diet with 15.5 lb of added salt and the negative control with potassium chloride and sodium bicarbonate were intermediate.

Pigs fed the negative control diet with 15.5 lb of added salt had the best feed efficiency ($P < 0.09$), while pigs fed the positive control diet had the poorest feed efficiency. Pigs fed the negative control diet with 7 lb of added salt and the negative control diet with potassium chloride and sodium bicarbonate were intermediate.

Day 14 body weight of pigs fed the negative control diet with 15.5 lb of added salt was greater ($P < 0.08$) than pigs fed the negative control diet with 7 lb of added salt. Pigs fed the positive control and the negative control with potassium chloride and sodium bicarbonate were intermediate.

Discussion

Overall, pigs fed the positive control diet or the negative control diet with 15.5 lb of added salt showed similar ADG. Pigs fed the negative control diet with 7 lb of added salt showed the poorest results. Because both the positive control and the negative control with 15.5 lb of added salt met the NRC (2012) standards of 0.35 for sodium, while the negative control with 7 lb of added salt was deficient (0.18), sodium concentrations must be met in accordance with NRC (2012) standards. If standards are met than ADG and ADFI will be improved. If a nutritionist is designing a diet for nursery pigs from 15 to 25 lb with dried whey, at least 12 lb/ton of salt must be added to meet NRC (2012) standards. If a nutritionist is designing a diet for nursery pigs from 15 to 25 lb with lactose, at least 15.5 lb/ton of salt must be added because there is no salt in lactose. Our results coincide with Mahan et al, 1996 and Shawk et al, 2016 findings that sodium levels must meet 0.35% in order to maximize ADG and ADFI.

Because pigs fed the negative control diet with potassium chloride and sodium bicarbonate had intermediate growth performance compared with other treatments, the chloride concentration (analyzing at 0.35% Cl) which was deficient according to NRC (2012) standards may have limited performance of these pigs. Therefore, future research should be directed towards determining the chloride requirement for 15 to 25 lb pigs.

References

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