Serum Response after Oral Supplementation of Different Zinc Compounds in Horses

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EXPANDED ABSTRACT

KEY WORDS: ● zinc ● horses ● serum response ● zinc compounds

Zinc has been discussed as a feed additive to improve hoof horn quality and skin diseases. Hooves of good quality contain more zinc than hooves of poor quality (1). Because zinc supplementation seems to increase the zinc content of the hoof (1), the bioavailability of different zinc compounds became potentially important. In the present investigation the serum response after oral supplementation of different zinc compounds was investigated.

MATERIALS AND METHODS

Four ponies with a body weight (BW) between 200 and 350 kg were fed with a low zinc diet (hay and oats, zinc content: 27 mg/kg dry matter). They received the hay and half of the oats portion in the mornings after the zinc dose and the remaining portion of oats about 6 h later. The following zinc compounds were supplemented orally to the ponies in a Latin square design in single doses of 10 or 20 mg zinc/kg BW, respectively: zinc oxide, zinc sulfate and a zinc sulfate glycine chelate. One pony in each trial received the unsupplemented basal diet and functioned as a control. Zinc lactate was tested only at a dose of 10 mg/kg BW. Blood samples were taken before and 2, 4, 6, 8, 10 and 24 h after the zinc dose. The time elapsed between different supplementations was a minimum of 7 d. Serum zinc was determined by atomic absorption spectrometry directly in the flame. Differences between maximum zinc content in serum samples were compared using a 2-factor analysis of variance and the Tukey test. The study was approved by the Regierung von Oberbayern, which is the appropriate authority according to German laws on animal welfare (Deutsches Tierschutzgesetz).

RESULTS AND DISCUSSION

After a single dose of 20 mg/kg BW zinc sulfate or zinc sulfate chelate the serum zinc concentration increased relative to that of the control and zinc oxide groups (Table 1). This increase was also confirmed when comparing the area under the curves (mean zinc serum levels × time). The increase of zinc in serum was significantly dose dependent.

There are numerous investigations on zinc availability in different species under various conditions and with different results (2–5), depending on experimental conditions. For instance, Cheng (2) reported that after a supplementation of pigs for about 30 d, the bioavailability of zinc sulfate was higher than that of zinc lysine as long as diets with a high

### TABLE 1

Peak serum response after feeding a single dose of 10 or 20 mg Zn/kg BW\(^1,2\)

<table>
<thead>
<tr>
<th>Compound</th>
<th>10 mg Zn/kg BW</th>
<th>20 mg Zn/kg BW</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean ± SD</td>
<td>Range</td>
</tr>
<tr>
<td>Control</td>
<td>860 ± 220</td>
<td>660–1100</td>
</tr>
<tr>
<td>Zinc oxide</td>
<td>1100 ± 360</td>
<td>780–1560</td>
</tr>
<tr>
<td>Zinc sulfate</td>
<td>2080 ± 800</td>
<td>1030–2810</td>
</tr>
<tr>
<td>Zinc sulfate chelate</td>
<td>2120 ± 670</td>
<td>1400–2890</td>
</tr>
<tr>
<td>Zinc lactate</td>
<td>1810 ± 630</td>
<td>1170–2640</td>
</tr>
</tbody>
</table>

1 Zinc in μg/L serum (n = 4).
2 Values are means ± SD and range of peak responses, n = 4. Zinc lactate could not be tested in the 2-factor ANOVA with interaction because the compound was not used in the trial with 20 mg Zn/kg BW. All other data were analyzed by 2-factor ANOVA. P = 0.001 for the main effect of compound; P = 0.05 for the main effect of dose; P = 0.004 for the compound × dose interaction. There were no significant differences among compounds at a dose of 10 mg Zn/kg BW. At a dose of 20 mg Zn/kg BW, means not sharing a common superscript letter are significantly different at P < 0.05.
lysine content (1.1%) were fed. In contrast, if diets with a low lysine content (0.8%) were supplemented with zinc lysine, the bioavailability was higher than that of zinc sulfate. Our own results after a high single dose of zinc indicate that inorganic zinc sulfate as well as zinc sulfate glycin chelate have a higher bioavailability than that of zinc oxide. Ley (5) reported no difference in bioavailability between an inorganic zinc and a chelated mineral compound in horses supplemented for at least 30 d. Unfortunately, he did not further specify what zinc compounds he used. Danek (3) measured the serum response in long-term experiments (30 d) of different concentrations of zinc sulfate and also reported a high bioavailability of zinc sulfate. In contrast, Schryver (4) reported an increase in the zinc concentration in serum after a long-term supplementation with zinc oxide. Even though in the present investigation the increase of serum levels after a single application of zinc oxide was not significant, a tendency to higher values was obvious.

LITERATURE CITED