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Zinc Intake and Concentration of Zinc in the Serum, Hoof and Hair of the Horse

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Abstract: This study was conducted to evaluate the effect of zinc addition in the diet on the concentration of this element in the serum, hair and hoof in the horse. 40 male horses were divided in two groups of control and treatment (each group was 20 horses). Zinc sulfate was supplied in the treatment group for 2 months. Blood samples were taken from jugular vein in the all horses and serum separated on days 0. 15, 30, 45 and 60 post administration. Also Samples from hair and hoof were collected. The concentration of zinc in these samples was analyzed by atomic absorption spectrometry. In the control group, Mean serum level of zinc and it concentration in the hair and hoof didn't show significant changes, but in the treatment group, it was upward and there was a significant statistical difference between mean of zinc levels in serum, hair and hoof on different days (p= 0.002, p= 0.001 and p= 0.000, respectively). By changing of zinc serum level on control group it was determined that on all days the changes in hair were non significant but the increasing of serum szinc was significant by increasing of zinc concentration in hoof in control group on day 0 and 15 and was non significant on day 30, 45 and 60 (r=0.176, r=0.201, r=0.462, r= 0.608 and r=0.508, respectively). In treatment group by increasing serum zinc increasing of hair zinc on day 0, 15 and 30 was non significant but on day 45 and 60 was significant (r=0.476 and r=0.874, respectively). Also by increasing of zinc serum level, hoof's zinc concentration showed a significant increasing on days 30, 45 and 60 (r=0.569, r=0.752 and r= 0.801, respectively) but on days 0 and 15 was no significant (respectively r=0.219 and r=0.401). The conclusion was that adding zinc supplement to horses' diet for 2 months results in increasing of zinc serum level and also hoof and hair. it is recommended to add zinc in ration of sport horses.

Key words: Horse · Zinc · Serum · Hoof · Hair

INTRODUCTION

Diseases seen in response to deficiency of zinc in farm animals come into existence because of zinc deficiency in diet [1-5]. The role of zinc as antioxidant and on immune system is primitively suggested and using supplementation containing zinc could have a protective role in animals [6-9]. Zinc is involved in hoof strength. Today in horse industry the use this element and other elements such as zinc, selenium and copper consciously in diet to increase hoof strength and varnish of skin but it is not clear yet that how adding the recommended amounts of these elements in horses' diet affect the level of hoof and amount of hair, but it is clear that these elements help to each other's absorption. Considering the progress of horse industry in Iran, a lot of investment has been done on this animal and providing animal's strength and beauty in appearance and the hoof's strength is very important. Therefore, this study was conducted to evaluate the effect of increasing dietary zinc on serum level and amount of this element in hair and hoof so basic strategies can be presented to increase the ability of the animal, the beauty of appearance and the horse's hoof strength.

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MATERIALS AND METHODS

This study was an experimental and interventional study that has been conducted on 40 horses in stables in Tabriz. The animals were male with a mean weight of 400-500 kg and age range of 3-6 years. They were divided in 2 groups of control and treatment. In the beginning of plan we make sure about health of horses based on clinical examinations and to then to diet of treatment group was used in addition to supplements containing zinc for 2 months (380 mg of zinc sulfate per day for each horse) [10]. The control group horses just get the usual diet. Their diet was alfalfa, barley and straw. On the day zero, blood samples were collected of all horses through the jugular vein and serum was detached. Also samples of hair and hoof were collected. Also, on days 15, 30, 45 and 60 post administrations, these samples were collected. Then serum value and its amounts in hair and hoof were measured by atomic absorption method (Unicam 939, autosampler; Fa. Unicam, Kassel, Germany). Values were represented as mean±SEM. Data were analyzed by one-way analysis of variance (ANOVA) followed by Dunnett's test using statistical package for social sciences (SPSS) version 10. $P<0.05$ was considered significant.

RESULTS

Serum level of zinc in control was averaged 707.14±56.94, 414.53±49.39, 698.44±67.74, 717.90±50.23and 703.11±46.83 µg/L on days 0, 15, 30, 45 and 60 post administration, respectively. It didn't show significant changes but in the treatment group, these values were 712.59±53.78, 763.86±49.16, 793.51±51.39, 813.49±49.33 and, 816.28±47.63 µg/L respectively, which increased from days 0 to 60 with a significant statistical difference between mean of zinc serum level on different days ($p=0.002$). Mean concentration of zinc in hair of the control group on different days didn't show significant differences and were 125.59±6.17, 131.71±8.09, 124.74±5.76, 130.26±5.91and 129.19±6.90 mg/kg DM respectively, but in the treatment group, values were

Table 1: Comparison of the mean zinc concentrations in serum, hair and hoof in control and treatment groups between different days

Group	Number	Parameter	Time(day)	Mean	SE	P value
Control	20	Mean of zinc in serum(µg/L)	0	707.14	56.94	0.087
			15	714.53	49.39	
			30	698.44	67.74	
			45	717.90	50.23	
			60	703.11	46.83	
		Mean of zinc in hair(mg/kg DM)	0	125.59	6.17	0.346
			15	131.71	8.09	
			30	124.74	5.76	
			45	130.26	5.91	
			60	129.19	6.90	
		Mean of zinc in hoof(mg/kg DM)	0	147.27	7.64	0.642
			15	146.50	7.23	
			30	143.53	6.32	
			45	151.39	6.03	
			60	149.84	8.97	
Treatment	20	Mean of zinc in serum(µg/L)	0	712.59	53.78	0.002
			15	763.86	49.16	
			30	793.51	51.39	
			45	813.49	49.33	
			60	816.28	47.63	
		Mean of zinc in hair(mg/kg DM)	0	127.36	7.09	0.001
			15	126.73	6.59	
			30	137.71	6.37	
			45	169.14	7.43	
			60	187.35	7.91	
		Mean of zinc in hoof(mg/kg DM)	0	146.87	7.21	0.000
			15	148.16	8.16	
			30	168.71	8.93	
			45	183.41	7.04	
			60	202.56	9.11	

Table 2: Comparison of the mean zinc concentrations in serum, hair and hoof in different days between control and treatment groups

Parameter	Time (day)	Group	Number	Mean	SE	P value
Mean of zinc in serum(µg/L)	0	Control	20	707.14	56.94	0.235
		Treatment	20	712.51	53.78	
	15	Control	20	714.53	49.39	0.053
		Treatment	20	763.86	49.16	
	30	Control	20	698.44	67.74	0.003
		Treatment	20	793.51	51.39	
	45	Control	20	717.90	50.23	0.000
		Treatment	20	813.49	49.33	
	60	Control	20	703.11	46.83	0.000
		Treatment	20	816.28	47.63	
Mean of zinc in hair(mg/kg DM)	0	Control	20	125.59	6.17	0.634
		Treatment	20	127.36	7.09	
	15	Control	20	131.71	8.09	0.217
		Treatment	20	126.73	6.59	
	30	Control	20	124.74	5.76	0.081
		Treatment	20	137.71	6.37	
	45	Control	20	130.26	5.91	0.021
		Treatment	20	169.14	7.43	
	60	Control	20	129.19	6.90	0.001
		Treatment	20	187.35	7.91	
Mean of zinc in hoof(mg/kg DM)	0	Control	20	147.27	7.64	0.873
		Treatment	20	146.87	7.21	
	15	Control	20	146.50	7.23	0.642
		Treatment	20	148.16	8.16	
	30	Control	20	143.53	6.32	0.063
		Treatment	20	168.71	8.93	
	45	Control	20	151.39	6.03	0.001
		Treatment	20	183.41	7.04	
	60	Control	20	149.84	8.97	0.000
		Treatment	20	188.57	8.28	

Table 3: Correlation the mean of zinc in the serum with the mean of zinc concentration in hair and hoof between two groups in different days

Group	Correlation with	Time (day)	r	P value
Control	Mean concentration of zinc in hair	0	0.211	0.532
		15	0.107	0.479
		30	0.098	0.782
		45	0.127	0.563
		60	0.308	0.061
	Mean concentration of zinc in hoof	0	0.176	0.607
		15	0.201	0.406
		30	0.462	0.027
		45	0.608	0.001
		60	0.503	0.017
Treatment	Mean concentration of zinc in hair	0	0.217	0.398
		15	0.086	0.532
		30	0.342	0.097
		45	0.476	0.001
		60	0.874	0.000
	Mean concentration of zinc in hoof	0	0.219	0.569
		15	0.401	0.060
		30	0.569	0.001
		45	0.752	0.000
		60	0.801	0.000

127.36±7.09, 126.73±6.59, 137.71±6.37, 169.14±7.43 and 187.35±7.91 mg/kg DM, respectively with significant variations in this group (p=0.001).

The mean concentration of zinc in hoof of the control group on different days of sampling were 147.27±7.64, 146.50±7.23, 143.53±6.32, 151.39±6.03 and, 149.84±8.97 mg/kg DM, respectively and in treatment group were 146.87±7.21, 148.16±8.16, 168.71±8.93, 183.41 ±7.04and 202.56±9.11 mg/kg DM that in control group the difference between means was no significant, but in treatment group was significant (p=0.642 and p=0.000) (Table 1).

The difference of mean in serum level of zinc between 2 groups is compared in Table 2 that in days 0 and 15 is no significant but in days 30, 45, 60 is significant. Also the mean concentration of zinc in hair and hoof on days 0, 15 and 30 in no significant and on days 45 and 60 is significant (Table 2).

In correlation study of zinc serum level to hair's zinc in control group was determined that on all days the relationship was no significant. The correlation between serum zinc and hoof's zinc in control group was non significant on days 0, 15 and 30 but on days 45 and 60 was significant (r=0.608, r=0.503, respectively). In treatment group this correlation with hair zinc on days 0, 15 and 30 was non significant and on days 45 and 60 was significant (r=0.476 and r=0.874, respectively). Also correlation between zinc serum level with hoof's zinc in treatment group in days 0 and 15 was no significant and on other days was significant (r= 0.569, r= 0.752 and r= 0.801, respectively) (Table 3).

DISCUSSION

Mean zinc serum level in the control group from day 0 to 60 post administration didn't show a significant change but in treatment group the mean from day 0 to 60 was upward that there was a significant statistical difference between mean of zinc serum level on different days (p=0.002). Mean concentration of zinc in hair and hoof in control group on different days didn't show a significant statistical difference but in treatment group the difference between values of mean zinc concentration in hair and hoof on different days was significant. These values in this time are acceptable in comparison to the values of other studies. Ludvikova and *et al.* [11] had expressed the values of zinc serum 721 µg/ml. In the study done by Stowe and Herdet [12] the mean values of zinc serum has been reported more than this. In the study done by Richardson *et al.* [13] by using zinc supplement after day 30 the significant increasment of zinc serum level has been titled and determined that as the amount of using zinc supplement in height the serum level increases more. In present study determined that amount of serum zinc in time 0 in both groups conforms with the values presented in NRC and in treatment group by using zinc, the amount of serum zinc increases that also these values are acceptable due to NRC values [10].

The difference of zinc serum level between two groups of control and treatment on days 0 and 15 was no significant, but it was significant on days 30, 45 and 60 Also the difference of mean zinc concentration on hair on days 0, 15 and 30 was no significant, despite it was significant on days 45 and 60. The difference of mean zinc concentration in hoof on days 0, 15 and 30 was no and on days 45 and 60 was significant. By changing of zinc serum level in control group it was determined that on all days the changes on zinc concentration in hair were non significant, but the increasing of serum zinc was not significant by increasing of zinc concentration in hoof in control group in days 0 and 15 but was significant on other days.

In treatment group by increasing serum zinc increscent of hair zinc on day 0, 15 was non significant, but on day 45 and 60, it was significant. Also by increasing of zinc serum level, hoof's zinc concentration showed a significant increscent on days 30, 45 and 60 but on days 0 and 15, it was no significant.Also in other studies, the correlation between serum zinc with hair and hoof's zinc was confirmed [11, 13-17].

It was concluded that adding zinc supplement to horses' diet for 2 months results increscent of zinc serum level and also increscent of its concentration in horse's hoof and hair and considering the important properties of zinc and the effect of it on immune system, it is recommended in sport horses.

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