CHAPTER IV

RESULTS

Experiment 1

No observation of any abnormal behavior and appearance of dogs throughout the experiment.

Effects of either Zinc Methionylglycinate or Zinc Sulfate Supplementation on Hair Coat Characteristics and Zinc Deposition in Hair

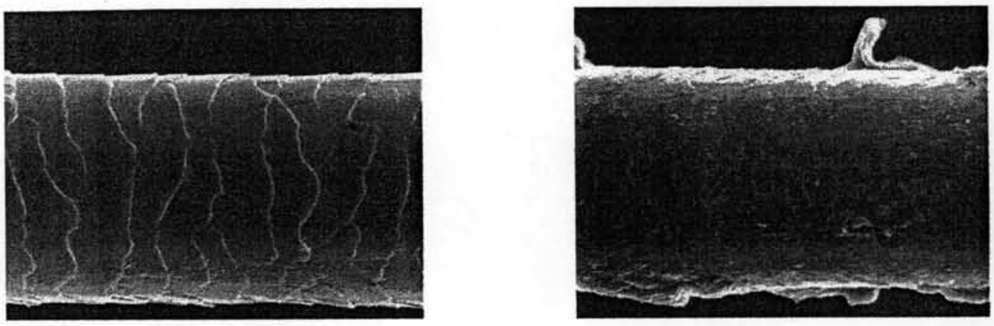
The hair growth rate and Zn deposition in hair was greater ($P < 0.05$) for the dog supplemented with ZnMG when compared to the dog supplemented with $ZnSO_4$ (6.2 ± 0.34 versus 3.8 ± 0.38 mg/d·20cm^2 and 26.5 ± 1.39 versus 19.2 ± 1.79 µg/21d·20cm^2, respectively; Table 5). Scanning electron microscopy revealed differences between treatments in hair condition with the hair taken from the ZnMG supplemented dogs apparently smoother and less fragmented than $ZnSO_4$ supplemented dogs (Figure 10).

Table 5 **Hair growth rate and Zn deposition in hair after receiving either ZnMG or $ZnSO_4$ supplementation[1]**

Item	Treatment	
	ZnMG	$ZnSO_4$
Hair growth rate (mg/d·20cm^2)	6.2 ± 0.34[a]	3.8 ± 0.38[b]
Zn deposition in hair (µg/21d·20cm^2)	26.5 ± 1.39[a]	19.2 ± 1.79[b]

[1] Mean ± SE

[a,b] Mean in the same row with different superscripts differed significantly ($P < 0.05$)



(a) ZnMG treatment (b) $ZnSO_4$ treatment

Figure 10. Comparison of scanning electron microscopy photographs of a strand of hair from dog supplemented with ZnMG versus $ZnSO_4$ (Magnification x 1,500)

Effects of either Zinc Methionylglycinate or Zinc Sulfate Supplementation on Zinc Concentration in Plasma and Serum Alkaline Phosphatase Activity

At the initiation of the experiment, the average plasma Zn concentration and serum ALP activity of all dogs were 11.2 $\pm$ 0.58 µmol/l and 213.5 $\pm$ 33.48 U/L, respectively. There were no differences ($P > 0.05$) in plasma Zn concentration and serum ALP activity of all dogs at the end of the pretest for both periods (8.6 $\pm$ 0.25 µmol/l and 148.8 $\pm$ 9.20 U/L and 8.2 $\pm$ 0.32 µmol/l and 142.3 $\pm$ 9.20 U/L for period 1 and 2, respectively). Levels of Zn concentration in plasma and serum ALP after receiving either ZnMG or $ZnSO_4$ supplementation are shown in Table 6. The dogs supplemented with ZnMG tended to have plasma Zn concentration greater ($P < 0.10$) than the dogs supplemented with $ZnSO_4$. The difference was observed on serum ALP activity ($P < 0.05$) between the two treatments. The value of serum ALP activity when the dogs received ZnMG treatment (193.9 $\pm$ 4.77 U/L) was greater ($P < 0.05$) than the dogs received $ZnSO_4$ treatment (164.4 $\pm$ 7.29 U/L).

Table 6 Levels of Zn concentration in plasma and serum ALP activity after receiving either ZnMG or $ZnSO_4$ supplementation[1]

Item	Treatment	
	ZnMG	$ZnSO_4$
Plasma Zn (μmol/l)	9.0 ± 0.09	8.6 ± 0.07
Serum ALP activity (U/L)	193.9 ± 4.77[a]	164.4 ± 7.29[b]

[1] Mean ± SE

[a,b] Mean in the same row with different superscripts differed significantly ($P < 0.05$)

Effects of either Zinc Methionylglycinate or Zinc Sulfate Supplementation on Fecal Zinc Excretion and Zinc Absorption

Table 7 shows the means value of the fecal Zn excretion and Zn absorption. The dogs supplemented with ZnMG had lower ($P < 0.05$) fecal Zn excretion (11.1 ± 0.16 versus 12.4 ± 0.24 mg/d or 63.0 ± 0.89 versus 70.2 ± 1.36 %) but greater ($P < 0.05$) Zn absorption (6.5 ± 0.16 versus 5.2 ± 0.25 mg/d or 37.0 ± 0.88 versus 29.8 ± 1.34 %) than the dogs supplemented with $ZnSO_4$.

Table 7 Amounts of fecal Zn excretion and Zn absorption (DM basis) after receiving either ZnMG or $ZnSO_4$ supplementation[1]

Item	Treatment	
	ZnMG	$ZnSO_4$
Fecal Zn (mg/d)	11.1 ± 0.16[a]	12.4 ± 0.24[b]
Fecal Zn (%)	63.0 ± 0.89[a]	70.2 ± 1.36[b]
Zn absorption (mg/d)	6.5 ± 0.16[a]	5.2 ± 0.25[b]
Zn absorption (%)	37.0 ± 0.88[a]	29.8 ± 1.34[b]

[1] Mean ± SE

[a,b] Mean in the same row with different superscripts differed significantly ($P < 0.05$)

For overall results, at the same level of Zn supplementation, the dogs supplemented with ZnMG had greater ($P < 0.05$) hair growth rate, amount of Zn deposition in hair, level of serum ALP activity, amount of Zn absorption, and tend to have plasma Zn concentration greater ($P < 0.10$) than the dogs supplemented with $ZnSO_4$. Zinc methionylglycinate demonstrated the better result than $ZnSO_4$. Therefore, ZnMG were used in the experiment 2.

Experiment 2

No observation of any abnormal behavior and appearance of dogs throughout the experiment.

Effects of Zinc Methionylglycinate Supplementation on Hair Coat Characteristics and Zinc Deposition in Hair

Hair growth rate of the dogs supplemented with ZnMG at 80, 120, and 160 ppm tend to increase as the amount of Zn supplementation increased (3.4 ± 0.48, 5.2 ± 0.59, and 8.7 ± 0.83 mg/d·20cm^2; r = 0.65; $P < 0.01$, respectively; Figure 11). The dogs supplemented with ZnMG at 160 ppm had greater ($P < 0.05$) hair growth rate than the dogs supplemented with ZnMG at 80 and 120 ppm. Hair growth rate shown no difference ($P > 0.05$) when compared between 80 and 120 ppm Zn treatment. However, the dogs received 120 ppm Zn treatment tended to have greater ($P < 0.10$) hair growth rate than the dogs received 80 ppm Zn treatment (Table 8). Increasing amount of Zn supplementation resulted in increase hair growth rate and level of Zn deposition in hair ($P < 0.05$). Scanning electron microscopy revealed differences between treatments in hair condition with the hair taken from the 120 and 160 ppm Zn supplemented dogs apparently smoother and less fragmented than 80 ppm Zn treatment (Figure 12).

Table 8 Hair growth rate and Zn deposition in hair after receiving ZnMG supplementation[1]

Item	Zn level (ppm)		
	80	120	160
Hair growth rate (mg/d·20cm^2)	3.4 ± 0.48[a]	5.2 ± 0.59[a]	8.7 ± 0.83[b]
Zn deposition in hair (μg/21d·20cm^2)	13.6 ± 1.20[a]	20.5 ± 1.48[b]	34.0 ± 2.08[c]

[1] Mean ± SE

[a,b,c] Mean in the same row with different superscripts differed significantly ($P < 0.05$)

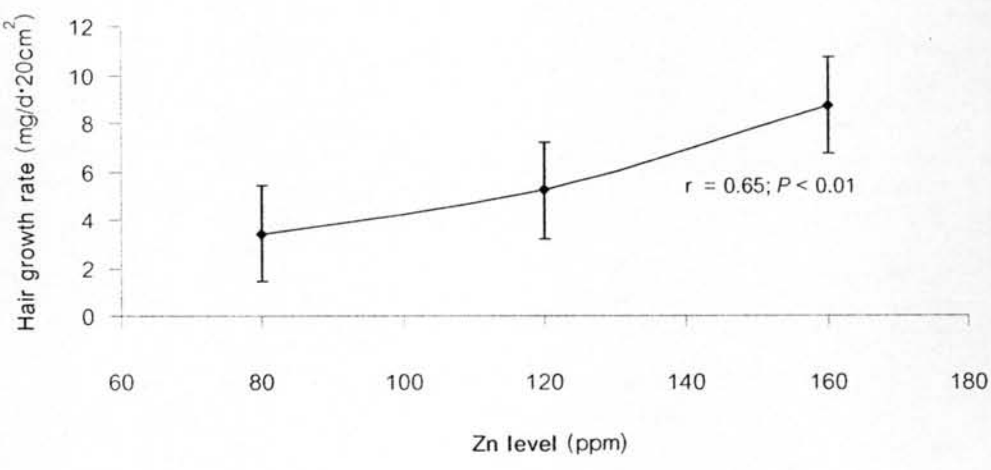
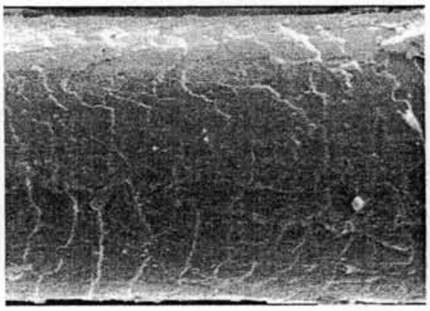
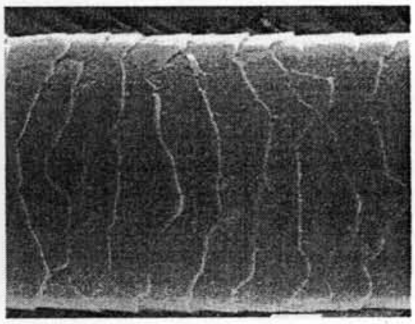
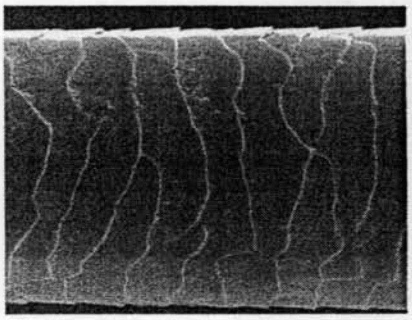


Figure 11. Linear correlation of hair growth rate on Zn level



(a) 80 ppm Zn DM treatment





(b) 120 ppm Zn DM treatment (c) 160 ppm Zn DM treatment

Figure 12. Comparison of scanning electron microscopy photographs of a strand of hair from dog supplemented with 80, 120, and 160 ppm Zn DM as ZnMG (Magnification x 1,500)

Effects of Zinc Methionylglycinate Supplementation on Zinc Concentration in Plasma and Serum Alkaline Phosphatase Activity

The averaged plasma Zn concentration and serum ALP activity of all dogs at the initiation of the experiment were 10.2 $\pm$ 0.36 μmol/l and 126.5 $\pm$ 15.86 U/l, respectively. There were no differences ($P > 0.05$) in the averaged plasma Zn concentration and serum ALP activity of all dogs at the end of the pretest periods (10.3 $\pm$ 0.21 μmol/l and 122.2 $\pm$ 4.21 U/l, 10.4 $\pm$ 0.21 μmol/l and 125.1 $\pm$ 3.04 U/l, and 10.4 $\pm$ 0.21 μmol/l and 127.8$\pm$ 3.92 U/l for period 1, 2, and 3, respectively). Levels of Zn concentration in plasma and serum ALP activity after receiving ZnMG supplementation are shown in Table 9. The differences were observed between treatments in plasma Zn concentration ($P < 0.05$) but not in serum ALP activity.

Plasma Zn concentration had the greatest when the dogs received 160 ppm Zn treatment. The dogs received 80 ppm Zn treatment tended to have lower ($P < 0.10$) plasma Zn concentration than the dogs received 120 ppm Zn treatment. Serum ALP activity tended to have greater ($P < 0.10$) for the dogs received 160 ppm Zn treatment when compared to 80 ppm Zn treatment.

Table 9 Levels of Zn concentration in plasma and serum ALP activity after receiving ZnMG supplementation[1]

Item	Zn level (ppm)		
	80	120	160
Plasma Zn (μmol/l)	10.7 ± 0.16^{a}	11.2 ± 0.16^{a}	11.8 ± 0.16^{b}
Serum ALP activity (U/l)	131.6 ± 7.16	143.3 ± 6.15	150.4 ± 5.28

[1] Mean ± SE

[a,b] Mean in the same row with different superscripts differed significantly ($P < 0.05$)

Effects of Zinc Methionylglycinate Supplementation on Fecal Zinc Excretion and Zinc Absorption

Table 10 shows the means value of the fecal Zn excretion and Zn absorption. Daily fecal Zn excretion of the dogs supplemented with ZnMG at 80, 120, and 160 ppm increased ($P < 0.05$) as the amount of Zn supplement increased (7.4 ± 0.19, 10.9 ± 0.19, and 13.5 ± 0.23 mg/d; r =0.85; $P < 0.0001$, respectively; Figure 13). The amount of daily Zn absorption increased ($P < 0.05$) with increased the amount of Zn supplementation (3.9 ± 0.16, 6.1 ± 0.16, and 9.3 ± 0.20 mg/d for 80, 120, and 160 ppm Zn; r = 0.85; $P < 0.0001$, respectively; Figure 14). The dogs received 160 ppm Zn treatment had the greatest ($P < 0.05$) amount of daily fecal Zn excretion and Zn absorption. Whereas the dogs received 80 ppm Zn treatment had the least ($P < 0.05$) daily fecal Zn excretion and Zn absorption. Increasing amount of Zn supplementation resulted in increase daily fecal Zn excretion and Zn absorption

(P < 0.05). The dogs received 160 ppm Zn treatment had lower (P < 0.05) percentage of fecal Zn but had greater (P < 0.05) percentage of Zn absorption than the dogs received 80 and 120 ppm Zn treatment.

Table 10 Amounts of fecal Zn excretion and Zn absorption (DM basis) after receiving ZnMG supplementation[1]

Item	Zn level (ppm)		
	80	120	160
Fecal Zn (mg/d)	7.4 ± 0.19[a]	10.9 ± 0.19[b]	13.5 ± 0.23[c]
Fecal Zn (%)	64.9 ± 0.86[a]	64.1 ± 0.86[a]	59.2 ± 1.04[b]
Zn absorption (mg/d)	3.9 ± 0.16[a]	6.1 ± 0.16[b]	9.3 ± 0.20[c]
Zn absorption (%)	35.1 ± 0.82[a]	35.9 ± 0.82[a]	40.8 ± 1.00[b]

[1] Mean ± SE

[a,b,c] Mean in the same row with different superscripts differed significantly (P < 0.05)

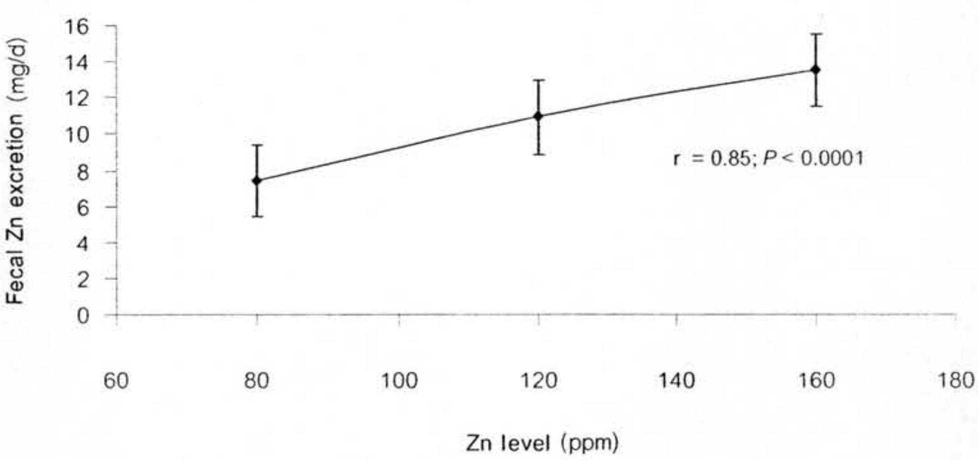


Figure 13. Linear correlation of fecal Zn excretion on Zn level

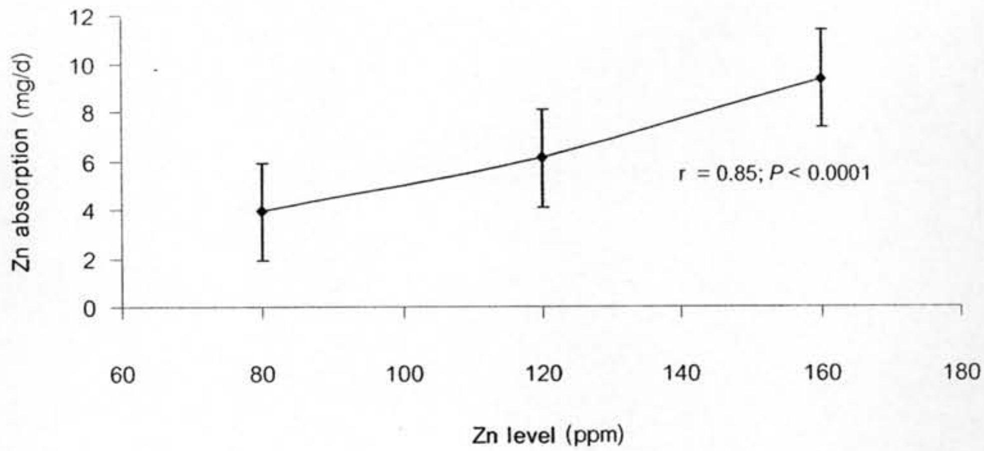


Figure 14. Linear correlation of Zn absorption on Zn level