Effect of organically–complexed Cu, Fe, Mn and Zn on broiler performance and excretion of minerals

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Trace minerals are essential for broiler growth. Traditionally these trace minerals are supplemented in the form of inorganic salts such as sulphates, oxides and carbonates, to provide levels of minerals which prevent clinical deficiencies and/or allow the bird to reach its genetic potential for growth. However, these supplemental inorganic trace minerals result in a high level of mineral excretion. It is believed that organic chelates of minerals provide alternative pathways for absorption, thus leading to a reduction in the excretion of minerals. However, the requirements of organic trace minerals for poultry are not known and data on the difference between inorganic and organic mineral sources on mineral excretion are scarce. Most studies on organic minerals for broilers have used conventional diets, which makes it difficult to separate the effect of the supplemental minerals from that of the endogenous minerals in the ingredients. On the other hand, purified diets usually decrease feed intake of broilers and compromise the growth of the chick (Wedekind 1992).

We conducted an experiment to examine the effect of three levels of Cu (2, 4, 8 mg/kg), Fe (20, 40, 80 mg/kg), Mn (20, 40, 80 mg/kg) and Zn (20, 40, 80 mg/kg) fed as proteinates (Organic 1, 2, 3) on broiler performance and mineral excretion in comparison to: an inorganic diet with minerals provided as sulphates (Cu 5, Fe 70, Mn 80, Zn 50 mg/kg; Inorganic); a low–mineral basal diet (Cu 4.2, Fe 45.1, Mn 13.1, Zn 20.3 mg/kg; Basal) consisting of sorghum and isolated soy (ME 13.4 MJ/kg, CP 22.5%, Ca 0.84%, available P 0.42%, lysine1.12%); and a commercial diet (ME 13.6 MJ/kg, CP 22.6%, Ca 0.86%, total P 0.71%, Cu 22.2, Fe 185.7, Mn 103.2, Zn 92.5 mg/kg). Each diet was fed to 8 pens of 4 birds and excreta trace mineral concentrations were determined from total collection of excreta during week 3. Weight gain and feed conversion ratio (FCR) were measured from day one to day 29. The data were analysed statistically using one–way ANOVA with SPSS software.

The growth of broilers fed the basal diet was compromised by a deficiency of trace minerals. Supplemental Cu, Fe, Mn and Zn, regardless of their source, improved ($P<0.05$) broiler performance. Organic chelates of Cu, Fe, Mn and Zn showed positive effects on liveweight gain and FCR in a dose–response manner. The diet organically supplemented with 4 mg/kg Cu, 40 mg/kg Fe, 40 mg/kg Mn and 40 mg/kg Zn (Organic 2), achieved a superior FCR and lower mineral excretion than the inorganic control ($P<0.05$) and the commercial diet. However, the diet supplemented with the highest levels of organic proteinates tended to increase excretion and compromise growth. These results suggest that organically chelated minerals meet the requirements of the birds more efficiently than their inorganic counterparts.

Wedekind, K.J., Hortin, A.E and Baker, D.H. (1992). Methodology for assessing zinc bioavailability: efficacy estimates for zinc methionine, zinc sulphate and zinc oxide. *Journal of Animal Science* 70, 178–184.

Table 1 Effect of Cu, Fe, Mn and Zn proteinates on broiler performance and mineral excretion rates.

Treatment diet	Gain (g/bird)	FCR	Mineral excretion rates			
			Cu (mg/bird/d)	Fe (mg/bird/d)	Mn (mg/bird/d)	Zn (mg/bird/d)
Basal	979.94^{c}	1.55 ± 0.031^{b}	0.28^{c}	17.66^{b}	1.34^{c}	2.30^{c}
Basal+Organic 1	1380.68^{ab}	1.43 ± 0.027^{c}	0.56^{d}	17.05^{b}	3.85^{d}	4.44^{d}
Basal+Organic 2	1499.47^{a}	1.33 ± 0.023^{d}	0.83^{c}	24.74^{b}	6.22^{c}	6.47^{c}
Basal+Organic 3	1494.93^{a}	1.38 ± 0.028^{c}	1.22^{b}	30.27^{ab}	10.12^{a}	10.91^{b}
Basal+Inorganic	1481.96^{a}	1.43 ± 0.025^{c}	0.86^{c}	46.66^{a}	8.92^{b}	11.05^{b}
Commercial	1093.00^{b}	1.86 ± 0.042^{a}	3.02^{a}	38.81^{a}	10.96^{a}	13.55^{a}
Pooled SEM	33.40	0.028	0.132	3.168	0.528	0.625

^{a,b,c,d,e}Means within columns with different superscripts differ significantly ($P<0.05$)