



protected minerals

# Influence of dietary iron source and phytase levels on broiler performance

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## INTRODUCTION

The goal in livestock nutrition is to feed animals the necessary amount of nutrients to optimize their overall performance and maximize the producer's profitability. Getting the most nutrients out of a single feed is key to maximizing animal performance and minimizing feed required. Different processing methods have been developed to increase the digestibility of nutrients such as starch and protein. Also, the addition of enzymes is becoming more prevalent and, in the case of phytase, is required by regulation in certain regions. The addition of phytase increases the release of bound phosphorus, thus reducing the need for phosphorus supplementation and decreasing its environmental impact. Phytase works by breaking bonds that keep phosphorus from being absorbed through the intestinal tract of monogastrics such as poultry and swine. But phosphorus isn't the only mineral that can be bound by phytic acid. Calcium, potassium, magnesium and the trace minerals (zinc, copper, manganese and iron) can all be bound to some degree by phytic acid. With the high level of iron occurring naturally in the environment (water and soil sources), the additional release of iron by phytases has the potential to create new issues. Iron is a known antagonist to other minerals, reducing their bioavailability, and iron can also reduce the effectiveness of enzymes included in diets to improve digestibility. A current practice that is being adopted is to increase the inclusion rate or "super dose" the enzyme to overcome unintended negative impacts. Another way would be to use an organic source of iron in the diet to avoid the cumulative effects of high levels of exposed iron. The objective of this study was to evaluate the combination of incorporating phytase and an organic iron source in diets for broilers.

## MATERIALS AND METHODS

The study was designed as a 3x3 factorial arrangement examining iron source and phytase level in diets of broilers from hatch to 42 days of age. The iron source treatment was a negative control with no supplemental iron, and supplementing at 60 ppm iron with either iron sulfate (Fe sulfate; inorganic source) or SQM iron (SQM Fe; organic source). The phytase used in this study was Quantum Blue® Phytase (AB Vista, Marlborough, Wiltshire, SN8 4AN) with the inclusions being 0, 0.2 (1x), or 0.6 (3x) lb/ton. Broiler chicks (2,160 straight run, Ross 708 newly hatched chicks) were randomly assigned to pens. There were 8 blocks of 9 pens each for a total of 72 pens with 30 birds per pen in the study. Pen dimensions

were 4'x5' to provide a stocking rate of 0.67 ft<sup>2</sup> per bird. A three-phase mash feeding program was used with starter (1.25 lb/pen), grower (3.5 lb/pen) and finisher (~5 lb/pen) diets. Pens were inspected twice daily. All chickens and remaining feed were weighed on Days 21 and 42. Foot pad scoring was conducted on 10 birds from each pen at the conclusion of the study. Scoring was as follows: 0 = No lesions or very small superficial lesions, slight discoloration on a limited area, mild thickening of the skin; 1 = Mild lesion, discoloration of the foot pad, superficial lesions, dark papillae; 2 = Severe lesion, ulcers or scabs, signs of hemorrhages or swollen foot pads. All broilers that died during the study were observed post-mortem to determine probable cause of death; all birds that died were incinerated after necropsy. All data were analyzed by NCSS using a Randomized Complete Block Design for analysis of variance.

## RESULTS AND DISCUSSION

Bird weights at Day 21 showed a trend ( $p < 0.08$ ) for heavier birds receiving the SQM Fe compared to Control (Table 1). Phytase inclusion resulted in a significantly ( $p < 0.02$ ) heavier bird at Day 21 for those receiving the 3x compared to both the Control and 1x. Feed efficiency (FCV) or FCV adjusted for mortality for performance up to Day 21 was not significantly ( $p > 0.3$ ) affected by either iron supplementation or phytase. Mortality was similar across treatments through Day 21.

Final weight of the birds at Day 42 was significantly influenced by iron supplementation but there was also a significant ( $p < 0.01$ ) interaction between iron source and phytase (Figure 1). This same result showed up when evaluating feed efficiency (also, adjusted for mortality and to a common body weight) where there was a significant ( $p < 0.01$ ) interaction between the iron supplementation and phytase (Figure 2). Bird mortality was not significantly influenced by iron supplementation or phytase in this study. Footpad score (Table 1) was significantly influenced by iron supplementation but an interaction between treatments also occurred. This interaction appeared to be between no supplemental iron and when phytase was fed without supplemental iron.

The feeding of phytase has been shown to be beneficial in releasing minerals, specifically phosphorus, from feed



Table 1. Performance of broilers

Item	Phytase level	0			1x			3x			SE	P-value		
		Iron source	None	Fe Sulfate	SQM FE	None	Fe Sulfate	SQM FE	None	Fe Sulfate		SQM FE	Source	Phytase
<b>Bird weight, lb</b>														
21 days		1.845	1.906	1.939	1.859	1.902	1.898	1.916	1.939	1.923	0.021	0.074	0.013	0.114
42 days		4.777	4.693	4.770	4.665	4.688	4.974	4.886	4.420	4.953	0.074	0.0001	0.859	0.004
<b>FCR, feed/gain</b>														
21 days		1.449	1.470	1.482	1.410	1.426	1.463	1.442	1.441	1.399	0.034	0.859	0.308	0.638
42 days		1.850	1.938	1.876	1.911	1.886	1.765	1.871	1.970	1.794	0.033	0.0001	0.388	0.040
<b>FCR, adj for mortality</b>														
21 days		1.443	1.464	1.476	1.404	1.424	1.463	1.440	1.436	1.396	0.034	0.832	0.355	0.607
42 days		1.832	1.928	1.758	1.883	1.856	1.758	1.863	1.946	1.773	0.030	0.0001	0.215	0.037
<b>FCR, adj for mortality and to an average body weight</b>														
42 days		1.829	1.939	1.863	1.896	1.866	1.727	1.845	1.994	1.745	0.035	0.0001	0.258	0.010
<b>Mortality, %</b>														
21 days		2.160	1.730	0.860	2.590	1.290	0.430	1.290	1.290	1.290	0.886	0.290	0.924	0.811
42 days		3.450	2.160	1.730	4.740	3.010	0.860	1.720	3.020	3.020	1.190	0.337	0.903	0.296
<b>Footpad score</b>														
		1.250	1.890	1.890	1.680	1.730	1.740	1.480	1.790	1.580	0.088	0.0003	0.265	0.006

thus reducing the need for high levels of phosphorus supplementation. But in recent years, it has been

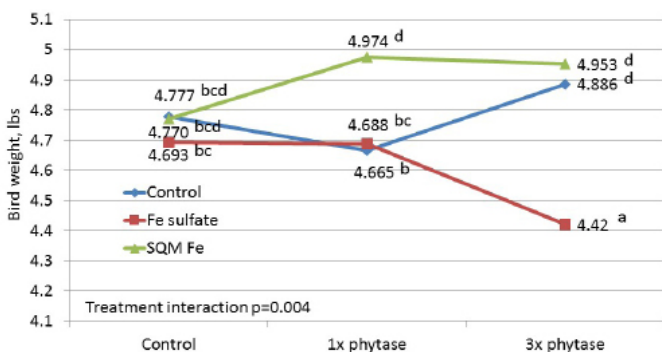


Figure 1. Bird final weight, lbs, (Day 42)

observed that higher levels (super dosing) have provided improved benefits. Research presented at Poultry Science meetings (O'Rourke et al., 2016) indicated that inorganic iron sources had an antagonistic effect of reducing or even blocking the activity of typical phytase enzymes, but some organic sources of iron did not have that same detrimental effect. The results of this study using the organic iron source, SQM Fe, showed that it would not be antagonistic to the enzyme activity of a typical phytase source. In the case of supplementation with SQM Fe, the necessity of super dosing was avoided when comparing the bird's growth and feed conversion. The combination of 1x phytase with SQM Fe resulted in the same performance as feeding the higher 3x level. It was interesting that feeding the 3x level with supplemental iron from Fe sulfate actually reduced overall performance of the birds. One hypothesis is that the action of the

phytase in releasing trace minerals such as iron occurred at such a high level with the super dosing that this accumulation of iron started an antagonistic effect that reduced the effectiveness of the phytase or antagonized other minerals/nutrients in the diet. Further research is needed to verify this hypothesis.

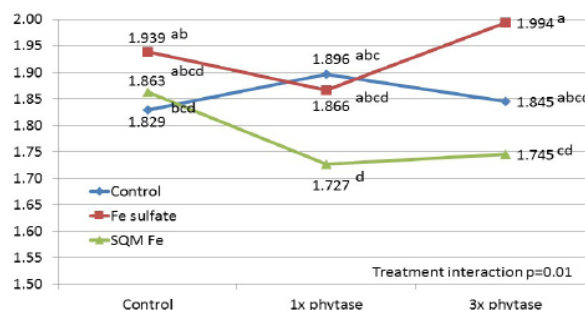


Figure 2. Feed efficiency through Day 42

(Adjusted for mortality and to a common final bird weight.)

## CONCLUSION

The overall conclusion of this study is that when feeding phytase in the diet the addition of an organic iron source, such as SQM Fe, avoids any potential antagonistic effects and allows the use of normal enzyme inclusion levels. Including phytase and SQM Fe in poultry diets can optimize bird performance.



To learn more about the benefits of feeding SQM protected minerals<sup>TM</sup>, contact Jack Garrett at 303-506-7200 or email [jackg@qualitechco.com](mailto:jackg@qualitechco.com)