CITRIC ACID ENHANCES ENZYMATIC HYDROLYSIS OF PHYTATE

P. H. SELLE

A series of investigations, designed to assess the feasibility of eliminating phytate ('dephytinisation') from sorghum (2.019 g/kg phytate-P DM) and soybean meal (4.486 g/kg) by in vitro pre-treatment with exogenous Aspergillus niger-derived phytase, was completed. The purpose for this is to define the anti-nutritive properties of phytate, the mixed salt of myo-inositol hexaphosphoric acid (IP₆), in broilers via the experimental use of dephytinised feed ingredients.

Test feed ingredients were finely ground and mixed with liquid phytase (50,000 to 250,000 FTU/kg) and distilled water, heated to 55°C, to produce a slurry, and dried (~ 5% DM) at 40-70°C for 48 hours. Phytate-P concentrations in untreated, sham-treated and treated feedstuffs were determined by a ferric chloride-precipitation method (Miller et al., 1980). However, these standard methods for phytate analyses have limitations (Frolich et al., 1986); therefore, the intention is to use an HPLC method in future. Because dephytinisation did not approach the objective of > 90% phytate removal, citric acid was included in the slurry, which reduced average pH from 6.4 to 5.4, which is more optimal for the phytase used (Engelen et al., 1994). On average, (n = 37), incorporation of citric acid into the dephytinisation (exogenous phytase and water) procedure substantially increased hydrolysis of phytate in sorghum (54.8 to 94.6%) and soybean meal (60.4 to 94.1%).

Similar citric acid induced increases in in vitro dephytinisation have been reported in soybean meal (Cain and Garling, 1995). While the buffering capacity of citric acid would be conducive to phytase activity, it is probable that citrate's chelating potential is more important. It is likely that citric acid strips cations (e.g. Mg²⁺, Ca²⁺, Zn²⁺, Fe²⁺, Fe³⁺) from mineral-phytate complexes, rendering phytate more soluble and susceptible to phytase degradation (Maenz et al., 1999). Moreover, the addition of citric acid to broiler diets has been shown to enhance in vivo phytate-P utilisation in several experiments (e.g. Rafaez-Livingston et al., 2005). This probably reflects a reduction in the formation of insoluble Ca-phytate complexes in the gut (Wise, 1983). In the context of the dephytinisation project, the addition of citric acid to the slurry will permit adequate elimination of phytate at lower phytase inclusion levels. This, in turn, should result in satisfactorily low levels of residual phytase activity in the treated feed ingredient.

REFERENCES


1Faculty of Veterinary Science, The University of Sydney, Camden NSW 2570.