

The *in vitro* analysis of acid-binding capacity of South African feed ingredients for broiler chickens and possible effects on performance

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Introduction

Optimising animal performance requires some consideration of the interactions of feed ingredients and digestive function. The acid-binding capacity (ABC) of feed ingredients is measured as the amount of acid required to decrease the pH of 1 kg feed to pH 3 (ABC 3) and pH 4 (ABC 4), respectively. Each feed ingredient will therefore contribute to the overall ABC value of the complete feed and has the potential to alter stomach pH by buffering the HCl secreted. Protein digestion begins with pepsin, which is secreted as the enzyme precursor pepsinogen that requires a low gastric pH to be activated. Pepsin has also been shown to have an optimum pH of 2. Therefore, feed ingredients or diets with a high ABC value have the potential to raise the pH above a critical threshold and reduce protein digestibility. The impact of this can potentially be much greater in young birds due to their reduced ability to secrete adequate amounts of HCl required to maintain a low gastric pH. Based on this, an understanding of the variation in ABC values of South African feed ingredients is of importance to nutritionists, as was the objective of this study.

Methods

- Multiple samples of the 38 main feed ingredients used in South Africa were acquired from feed mills throughout the country.
- Samples were ground through a 2 mm screen at the beginning of the trial in order to ensure a standard particle size.
- Two *in vitro* experiments determined the initial pH of each feed ingredient and its ABC value in duplicate.
- The initial pH of the feed ingredient was determined by placing a 10 g of sample in a beaker with deionised water. The pH was measured after 2 minutes and again after 30 minutes.
- To determine the ABC of the feed ingredients, 1 g of each feed ingredient was placed in a beaker with 100 ml of deionised water that had been preheated to 42°C in a hot water bath. The beaker was then transferred to a hotplate magnetic stirrer and titrated with 0.1N HCl. The pH was measured continuously, and the ABC value was recorded once the pH had stabilised at 4 and 3 for more than 20 seconds, respectively.
- The ABC value was calculated as the amount of acid in milliequivalents (meq) required to lower the pH of a 1 kg sample to the desired pH.
- Data were analysed by one-way ANOVA using JMP Pro 13.1 statistical software to determine differences in the ABC value of different categories of ingredients.

Results

The ABC values for protein sources were higher ($P<0.05$) compared to the cereals that had a lower ABC value. Differences were observed between protein sources in their respective ABC values (Figure 2). The ABC-3 of vitamin and mineral premixes along with calcium sources such as limestone were significantly higher than either proteins and cereal grains and ranged between 5 000 and 18 250, respectively (Figure 3).

Figure 1: The acid-binding capacity 3 of cereal grains.

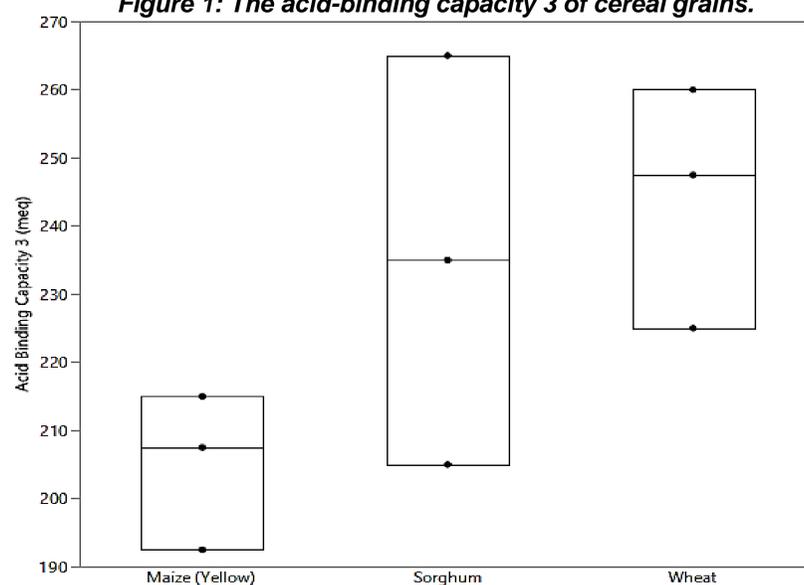


Figure 2: The acid-binding capacity 3 of protein sources.

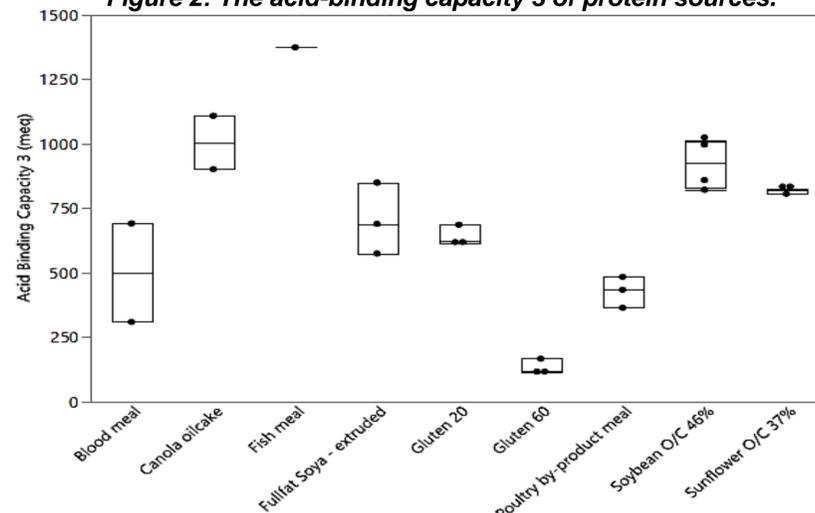
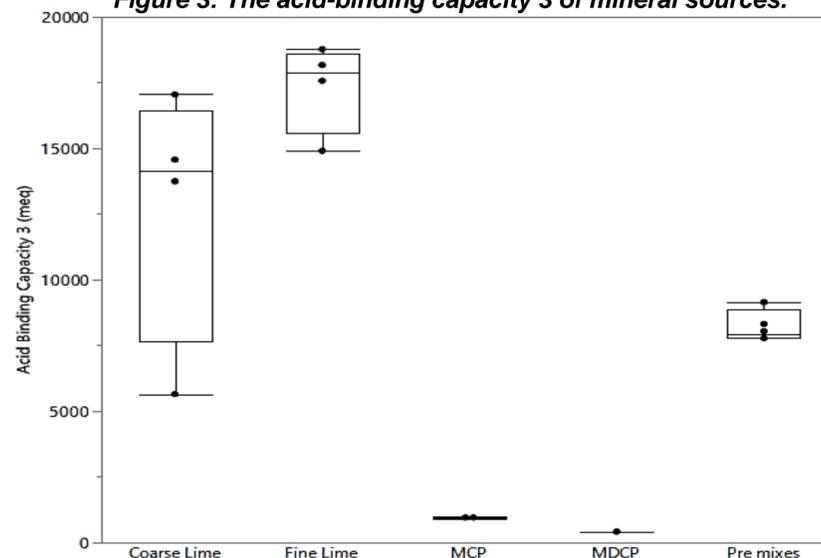


Figure 3: The acid-binding capacity 3 of mineral sources.



Conclusions

The values obtained from this experiment can be used by nutritionists to include an ABC value of different feed ingredients in diet formulation. Consideration of the ABC of the diet is recommended to support the digestive function of young broilers that may not yet have a fully developed capacity to secrete adequate amounts of HCl. Our future objective in this research will be to determine the effects of varying dietary ABC on nutrient digestibility and subsequent performance of broilers during various phases of production.