# Micronutrients

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# TBCC Notes

**Technical Information for Users of *Micronutrients TBCC®***

## Vitamin Stability

***Micronutrients TBCC®* (TBCC)** has been shown in several studies to be less active than copper sulfate in promoting oxidation reactions. This has commercial significance in animal nutrition for a variety of reasons. In the extreme case, oxidation can reduce palatability and nutrient value by oxidizing fats and oils. This would only be an issue with complete feeds which are stored for some time before consumption - such as pet foods.

However, the materials most prone to attack by oxidation are the labile compounds such as Vitamins A, E, D and Riboflavin. These so-called antioxidant ingredients are strong electron donors and help to eliminate free radicals in living organisms as well as in meat during processing and storage. Numerous publications have discussed the importance of adequate levels of vitamins. There are strong indications that levels well above NRC recommendations improve live performance under various stress conditions. Among other things, it appears that vitamins at higher levels facilitate functioning of the immune system.

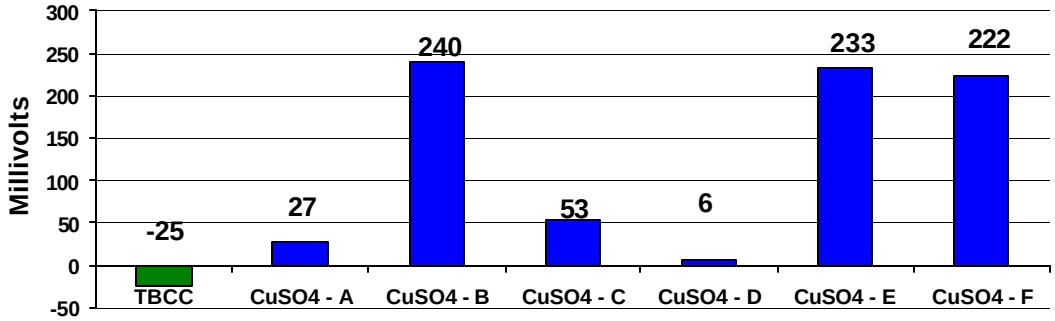
Copper is an effective catalyst for oxidation and is used for that purpose in chemical manufacturing processes. Numerous studies have shown that copper is antagonistic to vitamins in a feed mixture. Many producers strive to keep mineral premixes separate from vitamins as long as possible. However, oxidation and vitamin losses are inevitable in a complete feed and can be nutritionally significant in pelleted diets. The combination of air (oxygen), high moisture and intense energy input to form the pellets accelerates losses dramatically.

Copper sulfate is an acid salt and highly soluble in water. It is active in a mixed feed in two ways. 1) Copper ions diffuse through the moisture in the feed and, 2) The surface of each crystal is an active and acidic site for oxidation reactions.

By contrast, TBCC is a neutral salt of copper and insoluble in water. It is far less reactive in promoting oxidation. The following are brief summaries of several studies which illustrate this reduced pro-oxidant behavior of TBCC.

### Oxidation / Reduction Potential

This is a standard laboratory procedure to measure the relative tendency for a material to donate or accept electrons. It uses an inert electrode (gold or platinum) and measures the voltage between it and a standard reference electrode when exposed to the sample. The following results were obtained at Micronutrients by measuring six different copper sulfate samples sold into the feed industry and a sample of TBCC. The potentials were measured in a stirred slurry of one gram of each test specimen in 40 ml of isopropanol.




The large difference between the copper sulfate samples is apparently due to additives used by some producers to reduce either dusting or caking. These additives coat individual crystals and were insoluble under these test conditions.

**Oxidative Stability of Poultry Feeds**

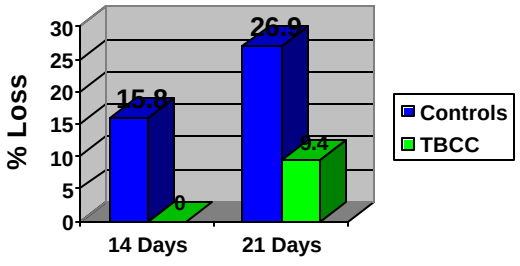
In 1994 a study was performed at the University of Florida to evaluate samples of complete feed for the rate and intensity of oxidation reactions using procedures standard in the food industry. Duplicate samples containing copper from two sources (sulfate and TBCC) at three levels (25, 100 and 300 ppm Cu) were evaluated at intervals while being incubated at $370^0$C. The results showed that TBCC is clearly a less active compound in promoting oxidation than copper sulfate. Copies of the detailed protocol and results are available on request.

**Impact of TBCC on Vitamin Stability in Poultry Feeds**

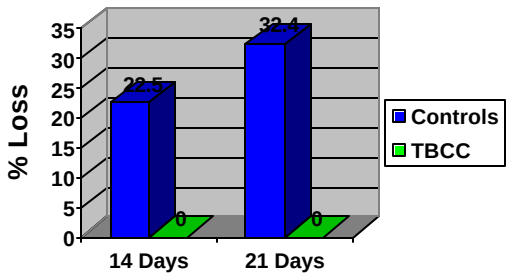
This study was done at PARC Institue, Easton, MD and completed in April 1997. In the initial screening phase of the work, single samples of raw mash and pelleted feed for Starter, Grower and Finisher diets were analyzed for Vitamins A, D3, E and Riboflavin. The results were variable due to the inherent imprecision in assaying a complete feed, but did show a consistent pattern with the samples containing TBCC losing less of each vitamin during the pelleting process.

In a subsequent phase, 240 chickens were fed for 21 days and samples of serum and liver tissue analyzed on days 14 and 21 for Vitamin E. There were six replications of 10 birds per treatment. Controls had only the basal amount of copper (12 ppm Cu) from copper sulfate and were fed as raw mash or crumbled pellets. The other two treatments were mash and crumbled pellets with 250 ppm Cu from TBCC added to the same starter diet as the controls. The following graphs show the loss of Vitamin E activity caused by pelleting, as measured in serum and liver samples and expressed as a percentage of the levels in the birds fed the corresponding unpelleted diet.

**Vitamin E Loss in Serum Due to Pelleting**




**Vitamin E Loss in Liver Due to Pelleting**




**Conclusions**

- TBCC improves the stability of animal feeds by reducing oxidation reactions.
- In the PARC study, TBCC reduced the loss of Vitamin E during pelleting by more than 17%