

Efficacy of Tribasic Copper Chloride (TBCC™) Versus Copper Sulfate Pentahydrate for Improving Productive Performance of Broiler Chickens



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Brief Information About TBCC™

- TBCC™ is $\text{Cu}_2(\text{OH})_3\text{Cl}$ with 58% Cu versus 25.2% in $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$.
- Manufactured form of natural mineral called Atacamite by high-purity crystallization.
- Soluble in weak acid; insoluble in water. Copper sulfate is very water soluble.
- Highly bioavailable copper, ~113% relative to copper sulfate at 100%. Therefore, 0.17 kg is equivalent to 0.45 kg copper sulfate.

TBCC™ Information Continued

- Less environmental copper in manure.
- Less product inventory in warehouse.
- Free-flowing small granular form has low dust and disperses uniformly.
- Better vitamin stability in feeds during steam pelleting and storage.
- Low chloride content (16%).

Review of Previous Research

- Miles et al. (1998; Poultry Sci. 77:416-425)

Experiment 1 – TBCC vs Cu Sulfate

Ross x Ross in battery brooders

150, 300, 450 mg added Cu/kg feed

21-d Body weight, feed intake higher

Experiment 2 – TBCC vs Cu Sulfate

New litter; 200, 400, 600 mg Cu/kg

Highest levels detrimental (Wt, FCR)

Review of Research (Continued)

- Virginia Scientific Research, Inc. 1996
 - * TBCC vs Cu Sulfate
 - * High stocking density, used litter
 - * All Cu levels, sources improved Wt
 - * FCR improved vs Basal by TBCC 250, Cu Sulfate 125, 188 mg Cu/kg
 - * By Source, TBCC gave best Wt and FCR

Current Research Results

- Three Experiments at PARC Institute with Varying Disease Stress Levels

Exp. 1 * **High Stress:** used litter + inoculated with *Candida albicans* and coccidia

* 6 treatments; 5 reps x 10 chicks

Exp. 2 * **Low Stress:** raised on wire

* 7 treatments; 8 reps x 10 chicks

Exp. 3 * **Medium Stress:** used litter

* 7 treatments; 7 reps x 56 broilers

Experiment 1 – Cobb x Cobb Chicks

- Equal mixed-sexes
- *Candida albicans* 3d
- *Coccidia* (3 spp) 7d
- TBCC vs Cu Sulfate
- 0, 125, or 250 Cu mg/kg each source
- Used litter pens
- Statistical analysis
- 5 Pens of 10 chicks each per Treatment
- 21-d Performance and lesion scores

Experiment 1 – 21-Day Results

	Body Wt, g	FCR
-Control	575 a	1.388 a
+Control	482 e	1.459 b
TBCC 125	520 cd	1.416 ab
TBCC 250	550 b	1.389 a
Cu Sulf 125	507 d	1.420 ab
Cu Sulf 250	538 bc	1.404 ab

Experiment 1 – Results Continued

	Mort., %	Crop Mycosis	Coccidial Lesions
-Control	4.00 a	0.08 a	0.29 a
+Control	12.00 b	1.18 d	0.97 c
TBCC 125	10.00 ab	0.80 c	0.85 bc
TBCC 250	4.00 a	0.31 ab	0.37 a
CuSulf 125	10.00 ab	0.98 cd	0.96 c
CuSulf 250	6.00 ab	0.51 b	0.56 ab

Experiment 1 – Relative Efficacies: TBCC vs Copper Sulfate

Common-Intercept Slope Ratio Method
(MLR $P < 0.01$; Differences were Small)

- Body Weight 125% $r^2=0.82$ +13 g
- Crop Mycosis 135% $r^2=0.75$ -0.19
- FCR ($P < 0.09$) 128% $r^2=0.20$ -0.032
- Cocci Lesions 151% $r^2=0.40$ -0.15

Experiment 1 -- Conclusions

- *Candida albicans* and *Eimeria* inoculations worsened all performance measurements.
- All added Cu levels and sources improved body weight versus positive control.
- At equal Cu additions, TBCC equivalent to Cu Sulfate for chicks from 0 to 21 d.
- TBCC had relative efficacies: body wt, 125%; FCR, 128% ($P < 0.09$); crop mycosis, 135%; and coccidial lesions, 151%.

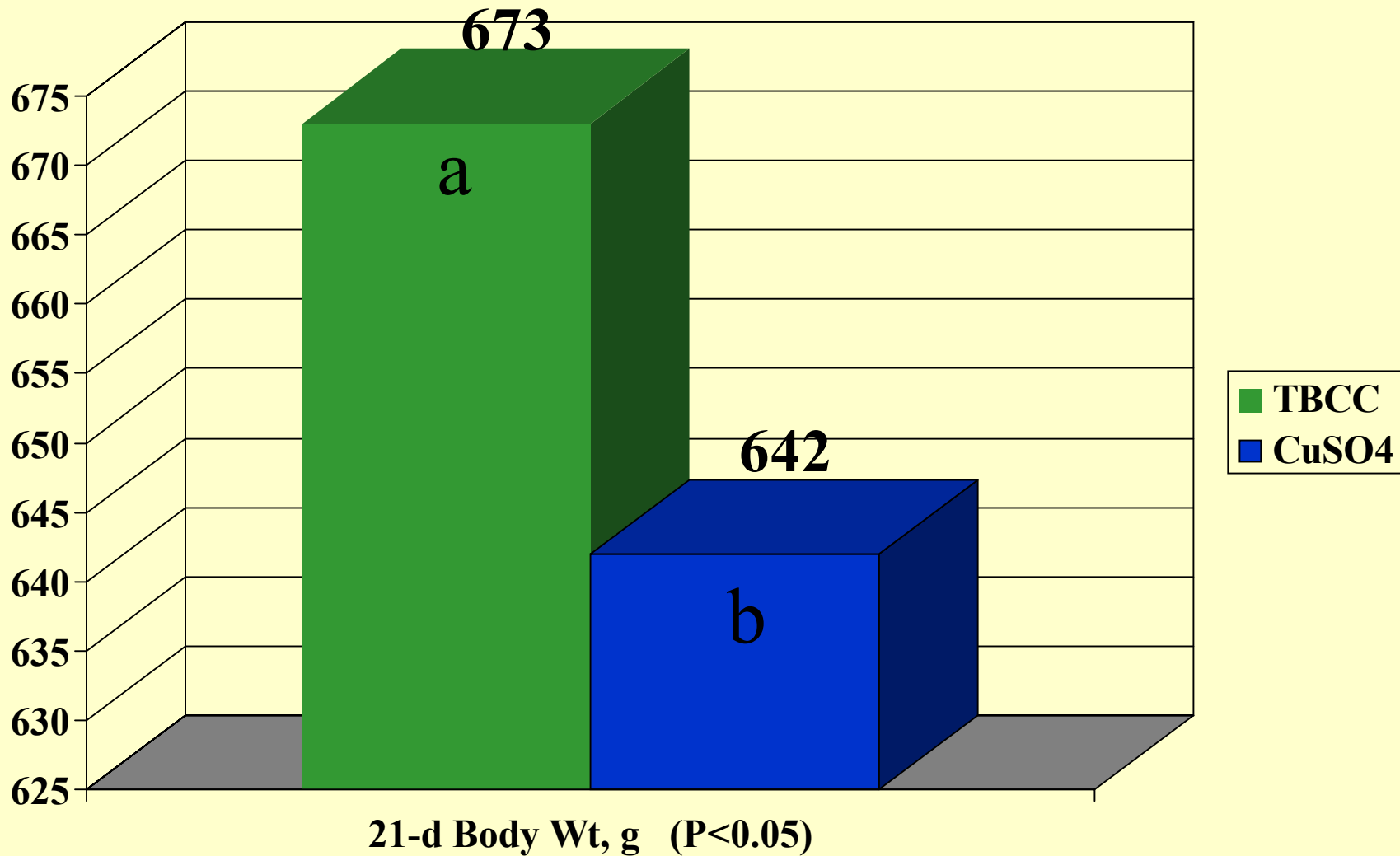
Experiment 2 – Ross x Cobb Chicks

- All males
- Battery brooders
- High health status
- TBCC vs Cu Sulfate
- 0, 125, 188, 250 Cu mg/kg each source
- Statistical analysis
2 x 4 factorial
- 8 Pens of 10 chicks each / treatment
- 21-d Performance

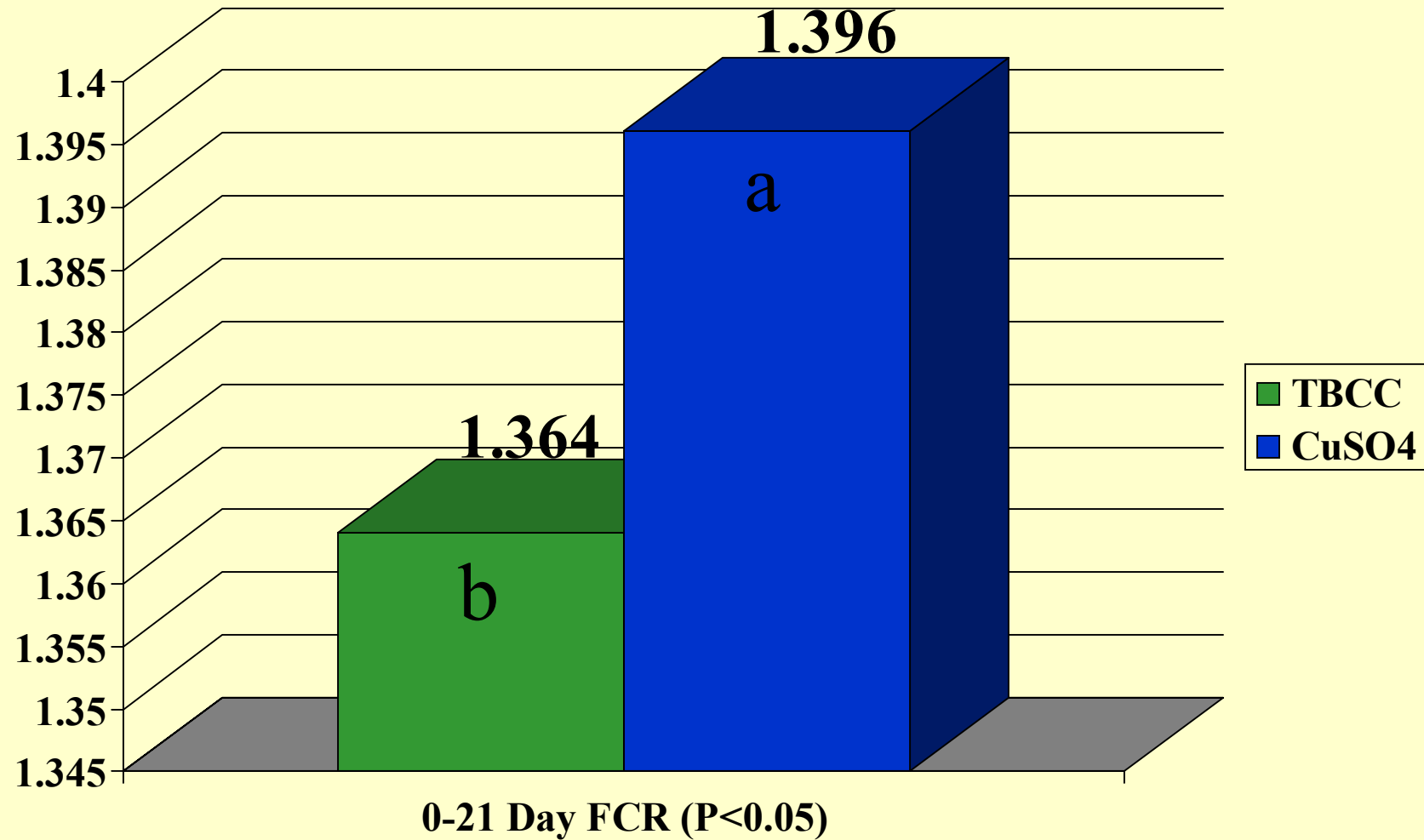
Experiment 2 – 21-Day Results

	Body wt, g	FCR	Mort., %
Control	608 d	1.416 c	2.50 a
TBCC 125	677 a	1.362 a	2.50 a
TBCC 188	682 a	1.366 a	3.75 ab
TBCC 250	661 bc	1.364 a	4.37 ab
CuSulf 125	663 b	1.390 b	3.75 ab
CuSulf 188	650 c	1.417 c	5.00 ab
CuSulf 250	613 d	1.384 b	6.25 b

Experiment 2 – Body Wt. by Cu Source



Experiment 2 – FCR by Cu Source



Experiment 2 -- Conclusions

- For healthy chicks on wire, Cu Sulfate at 250 mg Cu/kg had no benefit (= Control).
- All TBCC levels and 125 or 188 mg Cu/kg from Cu Sulfate improved body weight and FCR vs Control results.
- At each added Cu level using TBCC, FCR was better than any Cu level using Cu Sulfate.
- By source, TBCC gave significantly better 21-d body weight and FCR than Cu Sulfate.

Experiment 3 – Ross x HiY Chicks

- Equal mixed-sex
- Used litter
- TBCC vs Cu Sulfate
- 0, 125, 188, 250 mg Cu/kg each source
- Statistical analysis
2 x 4 factorial
- 7 Pens of 56 chicks each / treatment
- 21- and 49-day performance

Experiment 3 – 21-Day Results

	Body Wt, g	FCR	Mort., %
Control	590 d	1.346 d	2.43 a
TBCC 125	604 c	1.328 cd	2.60 a
TBCC 188	622 a	1.303 a	2.78 a
TBCC 250	609 bc	1.319 abc	2.26 a
CuSulf 125	591 d	1.333 cd	2.60 a
CuSulf 188	611 bc	1.322 bc	3.12 a
CuSulf 250	617 ab	1.309 ab	2.60 a

Experiment 3 – 49-Day Results

	Weight, kg	FCR	Mort., %
Control	2.261 b	1.945 b	3.13 a
TBCC 125	2.277 ab	1.929 ab	3.47 a
TBCC 188	2.304 a	1.914 a	3.47 a
TBCC 250	2.294 ab	1.921 ab	2.78 a
CuSulf 125	2.279 ab	1.940 ab	3.12 a
CuSulf 188	2.291 ab	1.925 ab	3.47 a
CuSulf 250	2.308 a	1.916 a	3.47 a

Experiment 3 -- Conclusions

- On used litter, TBCC improved 21-d body weight and FCR as much at 188 mg Cu/kg as Cu Sulfate at 250 mg Cu/kg. The trend continued, but was not significant at 49 d.
- Mortalities comparable by Cu level and source with no significant differences.
- Highest body weights, lowest FCRs were with TBCC at 188 and Cu Sulfate at 250 mg Cu/kg.

Overall Conclusions



- On used litter with disease, Cu sources statistically equivalent. Small numbers of chicks, but significant trends for improvement with TBCC.
- Cu was an important tool for improving performance (BW, FCR, Crop mycosis, Cocci lesions) in *Candida* and *Eimeria* inoculated chicks.

Overall Conclusions (Cont'd)



- On wire, efficacy of TBCC for body weight and FCR better than Cu Sulfate at each Cu level.
- On used litter, TBCC at 188 equivalent to Cu Sulfate at 250 mg Cu/kg.