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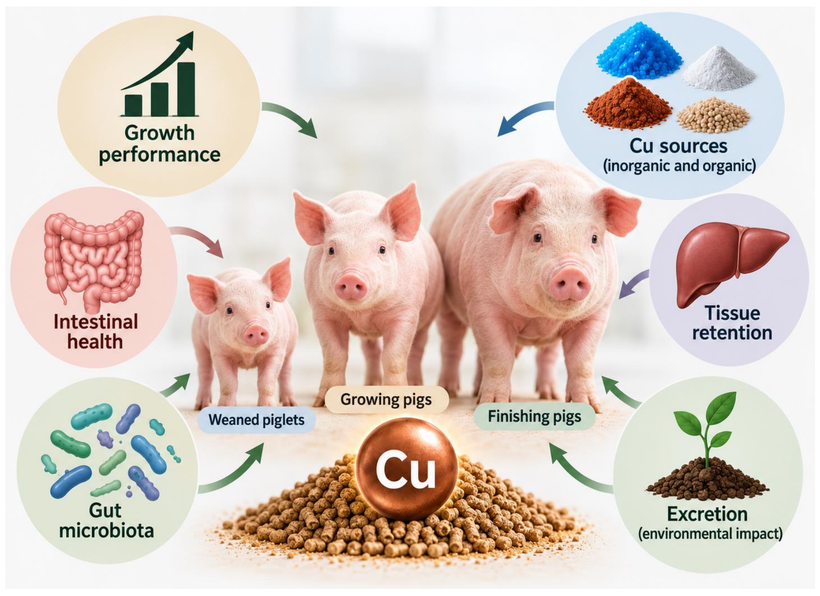
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# Bioproductive Effects of Copper (Cu) Supplementation at Different Forms and Levels in Growing Pigs – A Review

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**Abstract**: *Copper supplementation can improve growth performance and intestinal health in pigs, particularly during the post-weaning and early growing stages. However, the response depends on the supplementation level and Cu source, which also influence bioavailability, oxidative status, tissue retention, and excretion.*

## • Introduction

Copper (Cu) is an essential trace element involved in growth, metabolism, antioxidant defense, and intestinal health in pigs. Although physiological requirements are relatively low, higher dietary Cu levels have been widely investigated for their potential to improve growth performance and feed efficiency.

## • Material and method

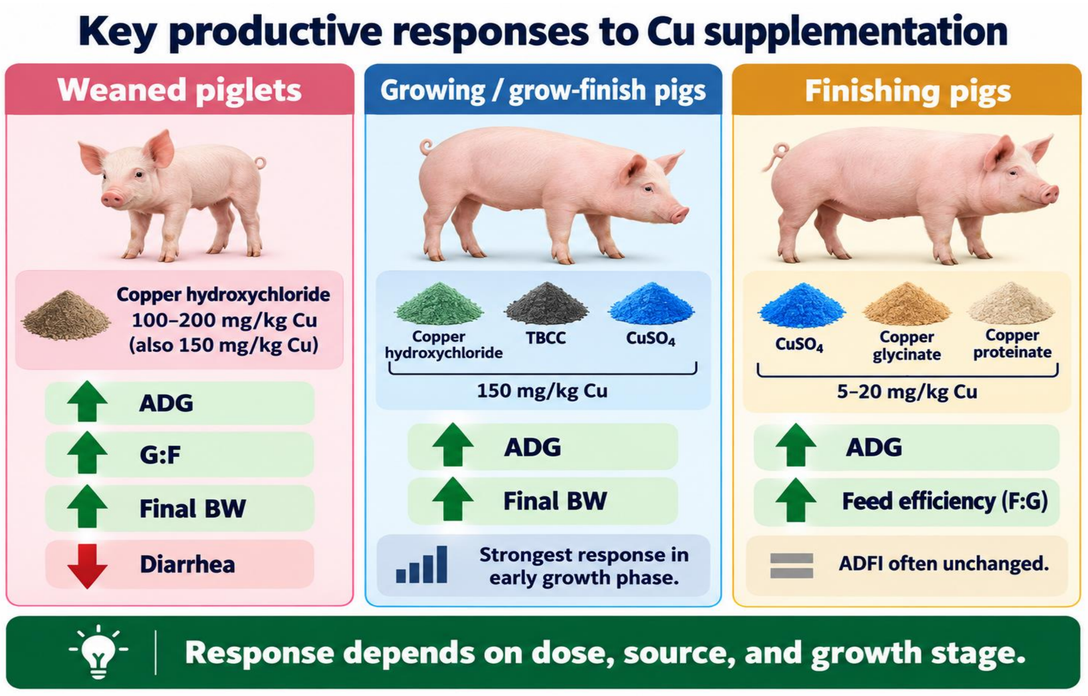
This review analyzed experimental studies and scientific reviews on Cu supplementation in weaned, growing, and finishing pigs. The comparison focused on Cu source and supplementation level, as well as their effects on growth performance, feed efficiency, intestinal health, Cu metabolism, tissue retention, and excretion.




**Table 1. Summary of selected studies on the effects of Cu level and source on pig performance**

| Study | Pig category | Cu source | Supplemental Cu level | Main reported effects |
|---|---|---|---|---|
| Espinosa et al. (2017) [11] | Weaned piglets | Copper hydroxychloride | 100–200 mg/kg | ↑ ADG, ↑ G:F, and ↑ final body weight; no clear differences between 100 and 200 mg/kg |
| Espinosa et al. (2017) [11] | Weaned piglets | Copper hydroxychloride | 150 mg/kg | ↑ ADG, G:F, and body weight; ↓ diarrhea frequency |
| Espinosa et al. (2020) [14] | Growing pigs | Copper hydroxychloride | 150 mg/kg | ↑ ADG and G:F; changes in the expression of genes involved in lipid metabolism |
| Forouzandeh et al. (2022) [21] | Growing pigs | $CuSO_4$ and $Cu_2O$ | 250 mg/kg | Changes in microbiota and gene expression; $Cu_2O$ associated with lower oxidative/inflammatory stress than $CuSO_4$ |
| Wen et al. (2022) [19] | Finishing pigs | $CuSO_4$, copper glycinate, copper proteinate | 5 and 20 mg/kg | ↑ ADG and improved F:G; Cu source did not significantly affect performance |
| Swanson et al. (2026) [8] | Piglets | TBCC | 150 mg/kg | ↑ ADG and ADFI during certain phases, without a clear overall performance advantage |
| Swanson et al. (2026) [8] | Grow-finish pigs | TBCC and $CuSO_4$ | 150 mg/kg | ↑ ADG and final body weight; greatest effect during the early growing phase |

## • Results and discussions




## • Conclusions

Copper supplementation can improve growth performance, feed efficiency, and intestinal health in pigs, particularly during the post-weaning and early growing stages. However, the productive response is not directly proportional to the supplementation level and depends on Cu source, animal age, and production stage. Organic and alternative Cu sources may provide advantages in terms of bioavailability, lower fecal excretion, and reduced oxidative stress. Therefore, Cu supplementation should be optimized to balance animal performance, mineral utilization, and environmental sustainability.