

# Greenish-Blue Gastric Content: Literature Review and Case Report on Acute Copper Sulfate Poisoning

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**ABSTRACT:** A literature review of cases of acute poisoning by copper sulfate was conducted, emphasizing therapeutic interventions, and a new fatality case is reported. Specifically, the relevant literature was reviewed for incidence rates, sociodemographic variables, pathophysiology, diagnosis, prognosis, and therapeutic outcome of copper sulfate poisoning. Results conclude that copper sulfate poisoning incidence varies in different regions. It is rare in western countries, while it is very common in South Asian countries. The majority of patients belong to rural populations and are males in the third decade of their lives. The lethal dose of ingested copper is considered to be 10–20 g; 14–36% of the patients pass away within a few hours of ingestion, while the average hospitalization time is more than 20 days. The clinical features of copper sulfate poisoning include erosive gastropathy, intravascular hemolysis, methemoglobinemia, hepatitis, and acute kidney injury. The therapeutic management focuses on absorption reduction, close observation for complications, supportive therapy, and chelation therapy.

**KEYWORDS:** Acute, blue vitriol, bluestone, copper sulfate, cupric sulfate, depression, forensic pathology, forensic science, legal medicine, pesticide, poisoning, suicide.

## INTRODUCTION

### *The Essential Function of Copper in the Human Body as a Trace Dietary Element*

Copper is essential in the human body as a trace dietary element. It is an ingredient of certain enzymes including cytochrome c oxidase, catalase, tyrosinase, peroxidase, and uricase, functioning as a cofactor that participates in several enzyme reactions [19]. Its presence is also necessary in mediating the absorption of iron from the gastrointestinal tract.

### *Copper Sulfate in Its Available Forms*

Copper sulfate — also known as cupric sulfate — is considered to be the most important of copper salts. This salt exists in various forms that differ in their degree of hydration. The anhydrous form has the appearance of a pale greenish powder, while the pentahydrate ( $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$ ) is a bright blue crystalline material that contains five molecules of water. Copper sulfate pentahydrate (CSP) is colloquially called “blue vitriol” or “bluestone,” while in Asia, it is also known as “Neela Thotha” [35].

### *The Everyday Practices of Copper Sulfate Pentahydrate in Agriculture, Industry, and Religion*

Burning copper sulfate is a common domestic practice among Buddhists and Hindus for religious activities as a good luck charm. However, children find the marine blue color of copper sulfate crystals attractive, which sometimes results in unintentional poisoning [27,63].

CSP is widely applied in agriculture and industry, which makes it an easily available chemical compound

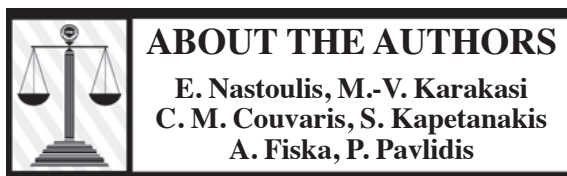
for some professionals in everyday life. It is frequently used as a fungicide, herbicide, and pesticide in common agricultural practice as well as an algacide in swimming pools, also inhibiting bacterial growth (e.g., *Escherichia coli*) [26,27,55,63]. Copper sulfate has multiple applications in industry, including photography and printing (as a component of binding pastes, glues, and dyes in order to prevent insect bites of paper) and in construction (as an additive to concrete for water resistance and sterilization) [27,63].

### *The Use of Copper Sulfate in Medical Science*

In medicine, copper sulfate was once used as an emetic, antifungal, and anthelmintic agent. It was withdrawn, however, when fatal incidents were reported implicating emetic drugs containing copper sulfate. Several chemical tests also utilize copper sulfate, including anemia blood tests, Fehling and Benedict’s solutions to test for reducing sugars, and the Biuret reagent used in the Biuret protein assay, which is a colorimetric test determining protein concentration by UV/VIS spectroscopy at a wavelength of 565 nm [38,59].

### *Copper Sulfate Poisoning — General Information*

Copper sulfate poisoning may occur by accident, due to suicide attempts, or after chronic exposure. It is reported that chronic occupational exposure to copper sulfate may cause liver disease after 3 to 15 years [60,63]. Animal research has revealed adverse effects on sperm quality, teratogenicity, and carcinogenicity [2,10,50]. Poisoning due to chronic exposure to copper sulfate is outside of the scope of the present paper and will not be discussed further. Acute copper sulfate poisoning due to



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