



TOXTALKS

A BULLETIN FOR HEALTHCARE PROFESSIONALS WHO MANAGE POISONED PATIENTS

Blue Ridge Poison Center

| University of Virginia Health

| June 2022

Firework Ingestion

With summer in full swing and the Fourth of July just around the corner, emergency departments will start seeing their fair share of firework injuries. Ingestion of fireworks is far less common, but in some cases can lead to significant toxicity. The Consumer Product Safety Commission prohibits the use of certain chemicals in fireworks due to their potential to cause toxicity (arsenic sulfide, arsenates, arsenites, boron, chlorates, gallates, gallic acid, magnesium, mercury salts, phosphorous, picrates, picric acid, thiocyanates, titanium, or zirconium). However, danger lies in fireworks from other countries without these restrictions, which may cause significant toxicity if ingested.

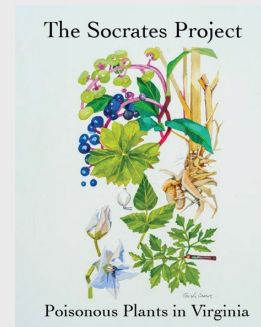
What makes up fireworks?

Fireworks require five basic ingredients: an oxidizer, a fuel source, a binder, a chlorine donor, and a metal salt to give them color. Gunpowder, which contains potassium nitrate (oxidizer), charcoal (fuel), and sulfur (fuel), is the source of combustion. Various metal salts are added that produce color when burned. Potassium perchlorate or less commonly potassium chlorate can act as chlorine donors, acting to enhance certain colors. All these ingredients are bound together by a starch (dextrin).

What symptoms can be expected from firework ingestion?

Most firework ingestions in the US are benign, causing no more than mouth irritation, nausea, vomiting, or stomach pain. These symptoms can be treated with supportive care. While fireworks do contain oxidizing agents that are known to cause hemolysis and methemoglobinemia, there are no case reports of this occurring with firework ingestions. Special attention is

NEWS AND NOTES:



The Socrates Project:
Poisonous Plants in Virginia, a reference guide to poisonous plants native to Virginia, is available for viewing or download from the Blue Ridge Poison Center website. Foragers should use caution when harvesting wild plants. The booklet is a joint effort between the Virginia Master Naturalist Program, the Blue Ridge Poison Center at University of Virginia Health, and the University of Virginia School of Medicine's Division of Medical Toxicology – Department of Emergency Medicine.

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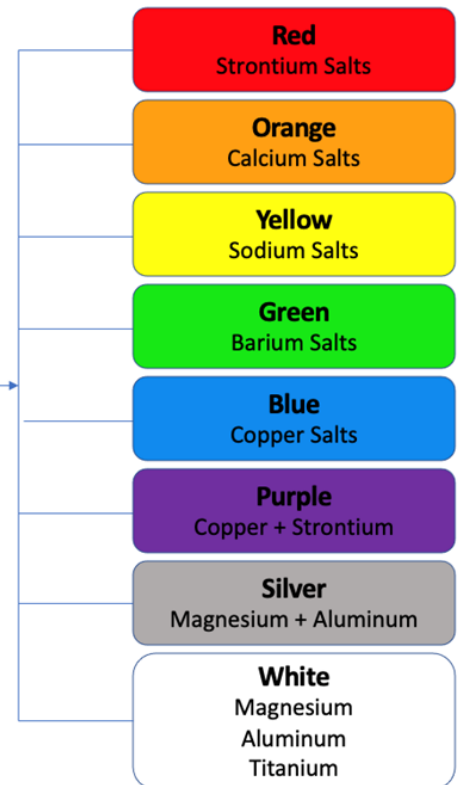
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required with fireworks containing barium, phosphorus, or arsenic, all of which can lead to significant toxicity.



Barium Toxicity

When ignited, fireworks containing barium salts produce a green color. When ingested, soluble barium causes severe hypokalemia by inhibiting potassium efflux, sequestering potassium inside cells. This buildup of intracellular potassium leads to depolarization and ultimately paralysis. Barium toxicity initially presents with GI symptoms (nausea, vomiting, diarrhea, abdominal pain) and progresses to hypotension, ventricular arrhythmias, and muscle paralysis leading to respiratory failure. Barium is radiopaque and may be visible on plain radiographs. Treatment is supportive with aggressive potassium repletion. If repletion is unable to maintain potassium levels, hemodialysis is recommended for rapid barium clearance. Once barium has been eliminated, watch for rebound hyperkalemia as potassium redistributes from inside the cells.

Phosphorus Toxicity

White or yellow phosphorus is a banned ingredient in fireworks in the US, however it may be present in fireworks from countries outside of the US. Severe toxicity and death from ingestion of yellow phosphorus containing fireworks are noted in case reports from the Turkey, South American, and Asia. Phosphorus is also used as an incendiary in military munitions and historically in strike anywhere matches. Phosphorus is highly toxic and corrosive if ingested; doses of 1mg/kg can be lethal. GI symptoms occur after ingestion, including garlic-smelling vomitus and diarrhea with smoking stools (spontaneous combustion on exposure to air). Phosphorus is a potent hepatotoxin, causing fulminant liver failure. N-acetylcysteine (NAC) is recommended for hepatoprotection. Severe cases may require liver transplantation. Cardiac arrhythmias, seizures, kidney failure, and electrolyte derangements may occur (hyponatremia, hyperkalemia, and hyperphosphatemia as phosphorus is converted to phosphate). Death can occur within 24hrs in large ingestions.

Arsenic Toxicity

Arsenic is another ingredient banned in fireworks in the US, but may be present in imported fireworks. Arsenic is a cellular poison that interferes with oxidative phosphorylation. Acute arsenic toxicity presents with nausea, vomiting, and profuse watery diarrhea within a few hours of ingestion. Ventricular arrhythmias, T wave morphology changes, and QTc prolongation may occur on EKG. Encephalopathy develops and worsens over several days with seizures also occurring. Arsenic is radiopaque which may help identify it on plain radiographs. Definitive diagnosis is made by examining 24 hour urine arsenic levels. If radiopaque arsenic is identified, whole bowel irrigation should be initiated until it is no longer visible on radiographs. IV fluids should be given to replace fluid losses with pressors if needed for continued hypotension. Electrolytes should be repleted as necessary. Chelation with dimercaprol (British anti-Lewisite) or succimer should be started immediately in severe cases and should not wait for urine arsenic levels to return.

While most firework ingestions are benign, severe toxicity may develop in rare cases. In the US, the most likely toxic ingredient to encounter is barium from green fireworks. In the event of a firework ingestion, please contact the University of Virginia Health's Blue Ridge Poison Center at 1-800-222-1222, or use our healthcare provider hotline: 1-800-451-1428. Our center is collecting data associated with firework ingestions and can help with management questions.

References Available Upon Request

The Blue Ridge Poison Center receives funding from University of Virginia Health, the Virginia Department of Health, and the U.S. Health Resources Services Administration (HRSA). We are accredited by the American Association of Poison Control Centers. We've been proudly serving the Commonwealth since 1978.

