

Lugol's iodine

Lugol's iodine, also known as **Lugol's solution**, first made in 1829, is a solution of elemental iodine and potassium iodide in water, named after the French physician J.G.A. Lugol. Lugol's iodine solution is often used as an antiseptic and disinfectant, for emergency disinfection of drinking water, and as a reagent for starch detection in routine laboratory and medical tests.

It has been used more rarely to replenish iodine deficiency.^[1] However, pure potassium iodide, containing the relatively benign iodide ion without the more toxic elemental iodine, is preferred for this purpose.

Formula and manufacture

Lugol's solution consists of 5 g iodine (I₂) and 10 g potassium iodide (KI) mixed with enough distilled water to make a brown solution with a total volume of 100 mL and a total iodine content of 150 mg/mL. Potassium iodide renders the elementary iodine soluble in water through the formation of the triiodide (I⁻) ion. It is not to be confused with tincture of iodine solutions, which consist of elemental iodine, and iodide salts dissolved in water and alcohol. Lugol's solution contains no alcohol.

Other names for Lugol's solution are I₂KI (iodine-potassium iodide); Markodine, Strong solution (Systemic); and Aqueous Iodine Solution BCP.

Lugol's is obtained from chemists and pharmacists who are licensed to prepare and dispense the solution. This indicator, also called a stain, is used in many different fields.

Applications

- This solution is used as an indicator test for the presence of starches in organic compounds, with which it reacts by turning a dark-blue/black. Elemental iodine solutions like Lugol's will stain starches due to iodine's interaction with the coil structure of the polysaccharide. Starches include the plant starches amylose and amylopectin and glycogen in animal cells. Lugol's solution will not detect simple sugars such as glucose or fructose. In the pathologic condition amyloidosis, amyloid deposits (i.e., deposits that stain like starch, but are not) can be so abundant that affected organs will also stain grossly positive for the Lugol reaction for starch.
- It can be used as a cell stain, making the cell nuclei more visible and for preserving phytoplankton samples.
- During colposcopy, Lugol's iodine is applied to the vagina and cervix. Normal vaginal tissue stains brown due to its high glycogen content, while tissue suspicious for cancer does not stain, and thus appears pale compared to the surrounding tissue. Biopsy of suspicious tissue can then be performed. This is called a Schiller's Test.
- Lugol's iodine may also be used to better visualize the mucogingival junction in the mouth. Similar to the method of staining mentioned above regarding a colposcopy, alveolar mucosa has a high glycogen content that gives a positive iodine reaction vs. the keratinized gingiva.^[2]
- Lugol's solution can also be used in various experiments to observe how a cell membrane uses osmosis and diffusion.
- Lugol's iodine may also be used as an oxidizing germicide, however it is somewhat undesirable in that it may lead to scarring and discolors the skin temporarily. One way to avoid this problem is by using a solution of 70% ethanol to wash off the iodine later.
- Lugol's solution is also used in the marine aquarium industry. Lugol's solution provides a strong source of free iodine and iodide to reef inhabitants and macroalgae. Although the solution is thought to be effective when used with stony corals, systems containing xenia and soft corals are assumed to be particularly benefited by the use of Lugol's solution. Used as a dip for stony and soft or leather corals, Lugol's may help rid the animals of unwanted parasites and harmful bacteria. The solution is thought to foster improved coloration and possibly prevent

bleaching of corals due to changes in light intensity, and to enhance coral polyp expansion. The blue colors of *Acropora* spp. are thought to be intensified by the use of potassium iodide. Specially packaged supplements of the product intended for aquarium use can be purchased at specialty stores and online.

- Preoperative administration of Lugol's solution decreases intraoperative blood loss during thyroidectomy in patients with Grave's disease.^[3] However, it appears ineffective in patients who are already euthyroid on anti-thyroid drugs and levothyroxine.^[4]

Historical applications

Lugol's was often used in the treatment of gout.

It was also used at one time as a first line treatment for hyperthyroidism, as the administration of pharmacologic amounts of iodine leads to temporary inhibition of iodine organification in the thyroid gland, a phenomenon called the Wolff-Chaikoff effect. However it is not used to treat certain autoimmune causes of thyroid disease as iodine-induced blockade of iodine organification may result in hypothyroidism. They are not considered as a first line therapy because of possible induction of resistant hyperthyroidism but may be considered as an adjuvant therapy when used together with other hyperthyroidism medications.

Because of its availability as a drinking water decontaminant, emergency use of it was at first recommended to the Polish government in 1986, after the Chernobyl disaster to replace and block any intake of radioactive ¹³¹I, even though it was known to be a non-optimal agent due to its somewhat toxic free-iodine content.^[5] Other sources state that pure potassium iodide solution in water (SSKI) was eventually used for most of the thyroid protection after this accident.^[6] There is "strong scientific evidence" for potassium iodide thyroid protection to help prevent thyroid cancer. Potassium iodide does not provide immediate protection but can be a component of a general strategy in a radiation emergency.^[7]

Historically, Lugol's iodine solution has been widely available and used for a number of health problems with some precautions.^[8] Lugol's is sometimes prescribed in a variety of alternative medical treatments.^[9] ^[10]

Until 2007, in the United States of America, Lugol's solution was unregulated and available over the counter as a general reagent, an antiseptic, a preservative,^[11] or as a medicament for human or veterinary application.

However, effective August 1, 2007, the DEA now regulates Lugol's solution (and, in fact, all iodine solutions containing greater than 2.2% iodine) as a List I precursor because it may potentially be used in the illicit production of methamphetamine.^[12] However, transactions of up to one fluid ounce (30 ml) of Lugol's solution are exempt from this regulation. By contrast, Lugol's iodine solution is available over the counter in Canada and Mexico.

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