

Lugol's iodine

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Lugol's iodine, also known as **aqueous iodine** and **strong iodine solution**, is a solution of [potassium iodide](#) with [iodine](#) in water.^[2] It is a medication and [disinfectant](#) used for a number of purposes.^{[3][4]} Taken by mouth it is used to treat [thyrotoxicosis](#) until surgery can be carried out, protect the [thyroid gland](#) from [radioactive iodine](#), and to treat [iodine deficiency](#).^{[4][5]} When applied to the [cervix](#) it is used to help in screening for [cervical cancer](#).^[6] As a disinfectant it may be applied to small [wounds](#) such as a [needle stick injury](#).^[3] A small amount may also be used for emergency disinfection of [drinking water](#).^[7]

Side effects may include [allergic reactions](#), [headache](#), [vomiting](#), and [inflammation of the whites of the eyes](#).^{[4][11]} Long term use may result in trouble sleeping and [depression](#).^[4] It should not typically be used during [pregnancy](#) or [breastfeeding](#).^[4] Lugol's iodine is a liquid made up of two parts [potassium iodide](#) for every one part elemental [iodine](#) in water.^[8]

Lugol's iodine was first made in 1829 by the French physician [Jean Lugol](#).^{[7][8]} It is on the [World Health Organization's List of Essential Medicines](#), the most effective and safe medicines needed in a [health system](#).^[9] Lugol's iodine is available as a [generic medication](#) and [over the counter](#).^[11] In the United Kingdom the NHS pays 9.57 pounds per 500 ml of solution.^[4] Lugol's solution is available in different strengths of [iodine](#). Large volumes of concentrations more than 2.2% may be subject to regulation.^[10]

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Lugol's iodine



Clinical data

Synonyms Potassium triiodide, Lugol's solution, aqueous iodine, strong iodine solution^[1]

[AHFS/Drugs.com Monograph](#)[↗]

Routes of administration topical, by mouth

Identifiers

CAS Number [12298-68-9](#)[↗]

Chemical and physical data

Formula I₃K

Molar mass 419.812

Uses [edit]

Medical uses [edit]

Preoperative administration of Lugol's solution decreases intraoperative blood loss during [thyroidectomy](#) in patients with [Graves' disease](#).^[11] However, it appears ineffective in patients who are already [euthyroid](#) on [anti-thyroid drugs](#) and [levothyroxine](#).^[12]

- 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](#).^[13]
- 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.

Science [edit]

- As a [mordant](#) when performing a [Gram stain](#). It is applied for 1 minute after staining with [crystal violet](#), but before ethanol to ensure that gram positive organisms' peptidoglycan remains stained, easily identifying it as a gram positive in microscopy.
- 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.
- Lugol's solution can also be used in various experiments to observe how a [cell membrane](#) uses [osmosis](#) and diffusion.
- 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.

Side effects [edit]

Because it contains free iodine, Lugol's solution at 2% or 5% concentration without dilution is irritating and destructive to mucosa, such as the lining of the esophagus and stomach. Doses of 10 mL of undiluted 5% solution have been reported to cause gastric lesions when used in endoscopy.^[14] The LD50 for 5% Iodine is 14,000 mg/kg (14 g/kg) [Rat] and 22,000 mg/kg (22 g/kg) [Mouse].^[15]

The World Health Organization classifies substances taken orally with an LD50 of 5–50 g/kg as the second

highest toxicity class, Class Ib (Highly Hazardous).^[16] The Global Harmonized System of Classification and Labeling of Chemicals categorizes this as Category 2 with a hazard statement "Fatal if swallowed".^[17] Potassium Iodide is not considered hazardous.^[18]

Mechanism of action [edit]

These uses are possible since the solution is a source of effectively free elemental iodine, which is readily generated from the equilibrium between elemental iodine molecules and [polyiodide](#) ions in the solution.

History [edit]

It was historically used 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.

Lugol's iodine has been used traditionally to replenish iodine deficiency. Because of its wide availability as a drinking-water decontaminant, and high content of potassium iodide, 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.^[19] Other sources state that pure [potassium iodide](#) solution in water ([SSKI](#)) was eventually used for most of the thyroid protection after this accident.^[20] 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.^[21]^[*not in citation given*]

Historically, Lugol's iodine solution has been widely available and used for a number of health problems with some precautions.^[22] Lugol's is sometimes prescribed in a variety of [alternative medical treatments](#).^[23]^[24] Only since the end of the [Cold War](#) has the compound become subject to national regulation in the English-speaking world.^[*citation needed*]

Society and culture [edit]

Regulation [edit]

Until 2007, in the United States, Lugol's solution was unregulated and available [over the counter](#) as a general [reagent](#), an [antiseptic](#), a [preservative](#),^[25] or as a medicament for human or veterinary application.

Since August 1, 2007, the [DEA](#) regulates Lugol's solution (and 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](#).^[26] Transactions of up to one fluid ounce (30 ml) of Lugol's solution are exempt from this regulation.

Formula and manufacture [edit]

Lugol's is available in various strengths from 1% to slightly less than 13% iodine (wt/v). The most commonly-used 15%

Concentration	Iodine (I ₂) [mg/drop]	Potassium iodide (KI) [mg/drop]	Total iodine [mg/drop]
2%	0.33	0.67	0.84

solution consists of 5% (wt/v) elemental iodine (I₂) and 10% (wt/v) potassium iodide (KI) mixed in distilled water, and has a total iodine content of 126.5 mg/mL. The iodide combines with elemental iodine to form a high concentration of potassium [triiodide](#) (KI₃) solution.

	3%	0.5	1	1.26
	5%	0.83	1.67	2.11
	7%	1.17	2.33	2.95
	10%	1.67	3.33	4.21
	15%	2.5	5	6.32

Lugol's solution is commonly available in different potencies of 1%, 2% (2.2%), 5% or 10% [iodine](#). Due to the chemical potency of the solution, concentrations more than 2.2% may be subject to national regulation. ^{[27][28][29]}

The most commonly used 15% solution consists of 5% ([wt/v](#)) iodine (I₂) and 10% ([wt/v](#)) [potassium iodide](#) (KI) mixed in [distilled water](#) and has a total iodine content of 126.5 mg/mL. The 15% solution thus has a total iodine content of 6.32 mg per [drop](#) of 0.05 mL; the 2% solution has 0.84 mg total iodine content per drop.

Potassium iodide renders the elementary iodine [soluble](#) in water through the formation of the [triiodide](#) (I₃[−]) 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 BP.

In the United Kingdom the NHS pays 9.57 pounds per 500 ml of solution. ^[4]

See also ^[edit]

Iodine antiseptics ^[edit]

- [Iodoform](#)
- [Iodophor](#)
- [Tincture of iodine](#)

Reagents ^[edit]

- [Benedict's reagent](#)
- [Melzer's reagent](#)
- [Verhoeff's Stain](#)

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