THE EFFECTS OF IODINE ON SKIN

By Jack Kessler, PhD

The History of Iodine in MEDICINAL PRACTICE

The discovery of iodine, like many other significant discoveries, was an accident.

Bernard Courtois, the man credited with the discovery, was a French chemist who manufactured saltpeter from seaweed. The process involved treating seaweed ash with sulfuric acid to obtain sodium and potassium salts. *One particular day in 1811, Courtois accidentally added too much acid which caused the iodides in seaweed to oxidize and form a violet vapor of iodine above the suspension.* Upon crystallization, he was able to create various iodide salts.

Since its discovery, iodine has been used by folk medicine as well as in rational therapy for its medicinal values. In 1819, eight years after Courtois' discovery, Swiss physician **Jean-Francois Coindet** used the tincture of iodine to successfully treat 150 goiter patients.[1] The results were published a year later. Throughout the 19th century, iodine was tested by physicians and surgeons for every conceivable pathology. Iodine, in its various forms, was prescribed for an astonishingly wide variety of diseases. This included paralysis, deafness, burns, asthma, ulcers, and syphilis.[2]

Towards the end of the 19th century, iodine was identified as the active ingredient of thyroid extracts. It was soon deduced that iodine was the essential chemical that regulates the healthy functioning of the thyroid gland.

Iodine and **THE SKIN**

Apart from regulating thyroid levels, iodine is responsible for various other important aspects of our body like metabolism, the immune system, and repairing damaged cells. Historically, iodine and iodide salts have been used to treat skin diseases and wounds. This is because, iodine acts as a catalyst in the regeneration of lower layers of the skin by accelerating cell function. As a result, iodine finds use in healing deep cuts to avoid extreme scar tissue formation.

Thyroid hormones, namely triiodothyronine (T3) and thyroxine (T4), are partially composed of iodine. These hormones are responsible for various bodily functions.[3] One of these functions is regulation of skin moisture. Low levels of T3 and T4 can result in reduced skin moisture, leading to dry, flaky skin. Thyroid hormones help maintain skin moisture. Iodide salts, like potassium iodide (KI) have also been used to treat various skin conditions such as **psoriasis, eczema, and various other forms of dermatoses.**[4]

These applications illustrate the medicinal value of iodine in treating skin conditions and wounds. Nevertheless, one of the most promising uses for iodine on skin remains skin antisepsis. For over 200 years, iodine has been used as topical disinfectant. Despite this, there have been no observed instances of microbial iodine resistance which makes it safe to use against bacteria. Iodine also rapidly inactivates virus and fungi and can even kill bacterial spores with prolonged contact. Iodine as an antimicrobial can be applied to the skin in the form of diatomic iodine (I_2) – often referred to as molecular or free iodine. Molecular iodine is the active biocide in all available iodine germicides.

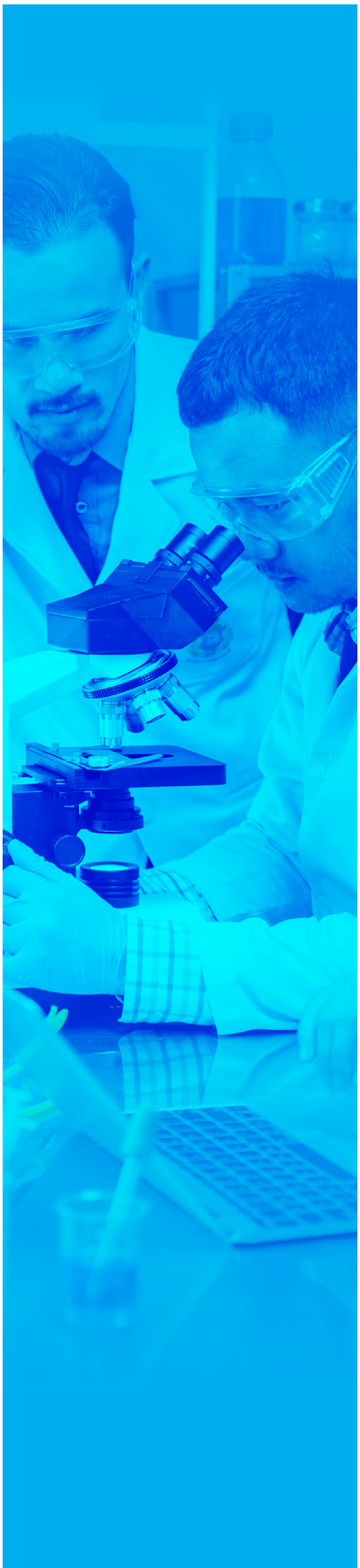
Iodine as **AN ANTISEPTIC**

Dermatology practices widely use antiseptics as prophylaxis (preventive treatment), acute and chronic wound management, and in the treatment of operating field disinfection. For these purposes, antiseptics are judged on basis of four broad characteristics.

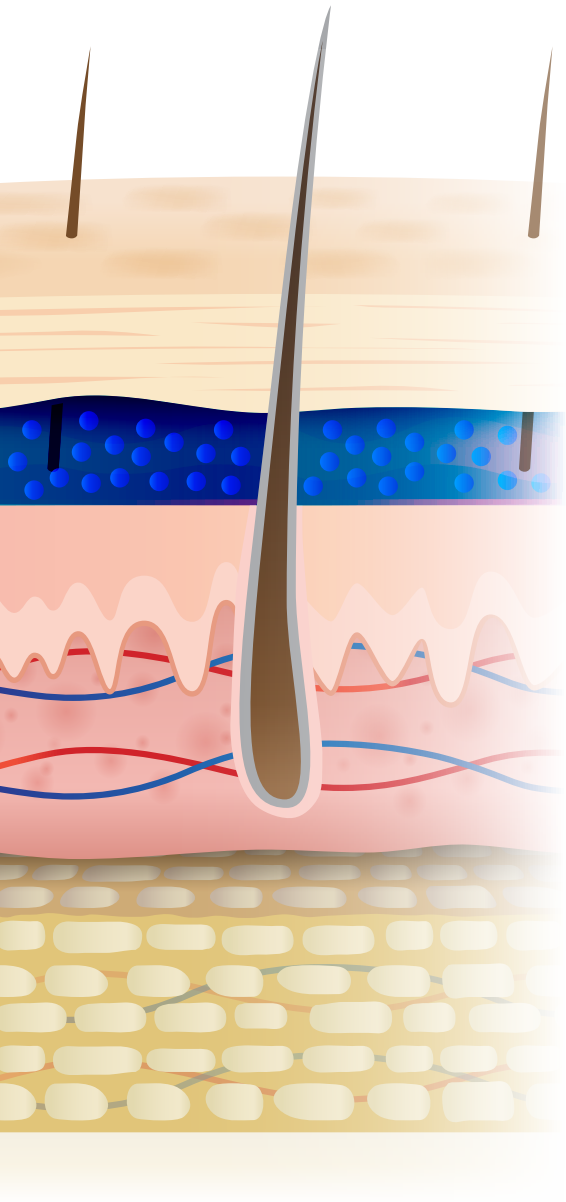
Four broad parameters of antiseptics in dermatology practice:

- Broad spectrum of activity
- Persistence of effect
- Speed of action
- Degree of penetration

Compared to other antiseptics such as chlorhexidine, the non-aqueous formulation of I2 has a more extensive spectrum of antimicrobial activity. Iodine has been observed to be effective against bacteria, viruses, and fungi. But what gives iodine a decisive advantage over other antiseptics is its degree of penetration and the persistence of its effect.



Penetration and persistence of Iodine when applied to skin



Iodine has excellent penetrability in unbroken skin. In fact, skin penetration is an important characteristic of iodine antimicrobial activity. Other topical antiseptics rely on oxidizing bactericidal complexes that remain on the surface of skin. In contrast, I2, when applied to the skin, kills all microbial load upon first contact and provides a persistent antimicrobial activity since it penetrates into beneath the epidermis of the skin.

When applied to the skin, iodine is rapidly absorbed into the epidermis, stays in situ in solution, and maintains its biocidal activity for more than 12 hours.[5] The stability of iodine in the skin and its excellent tolerance makes it ideal for topical use. Once iodine is absorbed into skin it does not wash away with soap and water. Instead, the iodine level in the dermis slowly reduces over time as molecular iodine, which is a gas at room temperature, diffuses out of the skin. Studies suggest that this deposit iodine can remain in the dermis for up to three days.[6]

This decrease in the deposit iodine is caused by gradual diffusion.

A small part of the absorbed iodine, which has been estimated to be 5%,[7] diffuses deeper into the tissue, forming serum iodide. The remaining part of the deposit iodine diffuses back to the surface of the skin as a colorless, odorless gas. This effectively creates an antimicrobial atmosphere at the skin surface. This atmosphere is what lends iodine its persistent antimicrobial effect.

The longer time taken by molecular iodine to completely diffuse from the skin ensures it exerts an antimicrobial effect that is sustained over long periods. On average a colloidal suspension of I2 is active for 12 to 24 hours. An ex vivo study of skin permeation of iodine under controlled condition showed that the extended availability of iodine combined with its permeability allowed it to suppress microbial regrowth.[8]

Two types of use for iodine-based antiseptics

Single-use application

- Antisepsis of intact skin
- Antisepsis of mucous membrane

Multiple (temporary) application

- Antisepsis of open wounds
- Treatment of dermatoses (with infection or superinfection)
- General hygiene

Iodine's antiseptic mechanism on microorganisms involves rapidly penetrating the cell wall and dislocating the cell's protein synthesis. It then proceeds to disrupt the cell's respiratory function and interfere with the lipid membrane and nucleic acid functions.

Conclusion

Over the years, various powerful drugs have been introduced that have targeted one or many areas of iodine's efficacy. However, in the current landscape with growing microbial resistance to drugs, the idea of a more advanced, more powerful iodine formulation as antiseptic has been gaining in importance. As a broad-spectrum antimicrobial, iodine-based antiseptics (iodophors) are capable of fighting off risks of bacterial infections such as tuberculosis, viral diseases such as H1N1 swine flu and even the incumbent COVID-19, as well as fungal infections like ringworm.

The spike in adoption rates could be further underpinned by iodine's exceptional virucidal activity considering the ongoing COVID-19 pandemic.

In addition to rapid antimicrobial treatment, iodine can also be used as hand rubs as opposed to alcohol-based disinfectants. The distinctive advantage over other popular disinfectants being iodine's ability to be carried by strong emollients creating a nourishing and hydrating effect on skin. While the rate of microbial resistance can be expected to rise, iodine-based antiseptics will witness more widespread adoption, at the commercial, large-scale medical, as well as the industrial level.

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About the Author

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I2Cure comes from a long line of revolutionary inventions by Dr Jack Kessler.
Dr. Kessler's academic journey began at Steven's Institute of Technology where he obtained his Bachelor of Science. He later went on achieve his Ph.D. in Chemistry from the State University of New York, Syracuse.

Jack Kessler has worked as Senior Scientist, New Technology Evaluation at Hoffman-LaRoche, a Swiss multinational healthcare company. He later went on to work as Senior Principal Systems Engineer at Elbit Systems of America. He is a member of the founding team of Symbollon Pharmaceuticals, Iotech International, and I2Pure, all three of which are focused on the development and commercialization of proprietary drugs based on molecular iodine technology.

He has led formulation teams responsible for the development of several iodine-based products including the Violet tablet, ioRinse line of oral care products and the initial generation (powder) of the Iodozyme teat dip product marketed by DeLaval. He has also published basic and applied research on iodine formulations and the biochemistry of iodine/thyroid hormones.

Apart from a 12-hour anti-microbial barrier for your skin, Dr Kessler's list of inventions includes a molecular iodine-based solid oral dosage for mammary dysplasia and methods, systems, and devices to identify microorganisms in culture samples. Dr Kessler has dedicated more than 25 years to the development of applicative areas of iodine-based formulations, bio-analytical assays, and in vitro diagnostic (IVD) medical devices.

Jack Kessler's patents have been filed for approval at the United States Patent and Trademark Office (USPTO). His patent listings include applications pending approval as well as patent already granted by the USPTO.