Salicylic acid: properties, uses and history

Salicylic acid is found naturally in the bark of the willow tree. It has been used for centuries to relieve a variety of ailments. It has also been developed in a variety of products in the areas of skin care, cosmetics and stomach relief. Salicylic acid is a wonder drug. But what are its physical and chemical properties? What chemical reactions are used in manufacturing and using salicylic acid? Does it represent any safety risks to society and the environment?

Salicylic acid was discovered by the Greek physician Hippocrates in the 5th century BC.[1]He found that the bitter powder extracted from willow bark could relieve aches and pains and reduce fevers.[2]The remedy is also mentioned in writings from ancient Sumer, Lebanon, and Assyria. Cherokee and other Native Americans used the bark for fever and other medicinal purposes for centuries. The medicinal part of the plant is the inner bark. It is used as a pain reliever for a variety of ailments. The reverend Edward Stone from Oxfordshire, England found in 1763 that willow bark was useful in reducing fever.

The active extract of the bark is called Salicin, after the Latin name of the white willow (salix alba).[3]The extract was isolated and named by Johann Buchner in Germany in 1826. A larger amount of the substance was isolated in 1828 by the French pharmacists, Hanri Laroux.[4]The Italian chemist, Raffaele Piria was able to convert the extract into a chemical which become salicylic acid when it oxidises.[5]

In 1839, Salicylic acid was also extracted by German researchers from the herb meadowsweet (Filpendula ulmaria). This extract was effective but it

caused digestive problems such as gastric irritation, bleeding, diarrhoea and death if consumed in high doses.[6]

Uses

Salicylic Acid is still used today to ease aches and pains and to reduce fevers. It was used as an anti-inflammatory drug even in ancient times.

Salicylic is a main ingredient in many skin care products treating acne, psoriasis, calluses, corns, keratosis pilaris and warts. Salicylic acid works as a keratolytic and comedolytic agent. It causes the cells of the epidermis to shed more easily, opening clogged pores and neutralizing bacteria within. It can also prevent pores from clogging up again by constricting pore diameter, and allowing for new cell growth. Due to its effect on skin cells, salicylic acid is used in some shampoos to treat dandruff.

Properties

Salicylic Acid has the appearance of a colourless crystalline powder. It is odourless or may have a slight phenolic odour.[7]It has a sweetish taste.[8]It has a melting point of 159°C and a sublimation point of 76°C. Its relative density is 1. 4 compared to water which has a relative density of 1. Its solubility in water is 0. 2 g/100 ml at 20°C.[9]It is soluble in alcohol, ether, boiling water.[10]It has a pH of 2. 4.

It is a polar molecule which explains its low solubility in water. It was a molar mass of 138. 1 g/mol. Its chemical formula is C6H4(OH)COOH and an empirical formula of C7H6O3. It will auto-ignite at as low as 540°C. It is a relatively stable compound but oxidizing agents, strong bases, iodine, and

fluorine may cause strong reactions.[11]It is also sensitive to light. It can be harmful if inhaled, ingested or absorbed through skin. It is an irritant.

Manufacturing Salicylic Acid

Salicylic acid forms in nature in Salix, the bark of the willow tree. While the powder extracted from the bark could be sold today, it rarely is because it purity is not constant.

To make salicylic acid in a lab, chemists can put sodium phenoxide and carbon dioxide under high pressurization.[12]Once this mixture is acidified using sulphuric acid, salicylic acid will result. This process is called a Kolbe-Schmitt reaction. This method results in much purer and more consistent product that can be used of pharmaceutical or commercial preparations.

Using Salicylic Acid

Salicylic acid works on skin by softening keratin, one of the proteins in the skin structure. With the keratin softened, the skin sheds easier. When being used for warts the skin is softened and the wart can fall off. When being used for acne, the increased shedding prevents clogging in the pore.

Medications like salicylic acid are called keratolytics because they can soften and facilitate the exfoliation of epidermal cells. Salicylic acid is also a comedolytic medication because it can break up comedones and open clogged pores.

Salicylic Acid, when taken orally, is also an analgesic and an anti-inflammatory. It can relieve pain and reduce inflammation. Salicylic acid blocks the production of certain hormones called prostaglandins that are

released from damaged cells. Prostaglandins, if not blocked, trigger the release of other hormones that cause the nerves to be sensitive to pain. By blocking prostaglandins, the pain and inflammation are significantly reduced.

Economic Benefits

There are many economic benefits to manufacturing salicylic acid. Since it relives aches, reduces fevers and is anti-inflammatory, it can help reduce the time people miss at school and at work. For employers, students and the entire economy this is a benefit. With people being in less pain and not suffering from fevers and swelling, visits to the hospital and doctor’s office will be reduced. This will ease the load on the medical system. One can imagine how high the sales of aspirin are and this would not be possible without salicylic acid. There is obviously also a tremendous economic benefit to the manufacture of many skin care products that use salicylic acid. Acne, wart, psoriasis, calluses, corns and keratosis are very common ailments therefore sales of the skin care products would be very high. There is money to be made in the area of cosmetics with products to exfoliate epidermal cells and open clogged pores. In addition to this, sales of dandruff shampoo and stomach aids (both of which contain salicylic acid or its derivatives), must be very high.

The history of salicylic acid represents continual technological development. What started as a simple extract from the willow tree became many useful products over the centuries. Throughout history chemists have worked hard to develop additional uses for salicylic acid. Chemists discovered its anti-inflammatory properties. These properties have been researched and have helped the development of modern anti-inflammatory medications.

Safety

Salicylic acid can be harmful if inhaled, ingested, or absorbed through skin. If inhaled, it can cause effects such as coughing, sneezing and shortness of breath. If ingested in a large amount salicylism may result which is characterised by abdominal pain, vomiting, mental disturbances and increased respiration.[13]It is a mild irritant and may cause a skin rash in individuals that are sensitive to it. Salicylic acid is an extreme eye irritant which was shown in animal testing.[14]Chronic exposure to salicylic acid can cause central nervous disturbances as serious as convulsions. It may cause harm to an unborn child although the effects of salicylic acid during pregnancy have not been fully investigated. The salicylic acid used topically is usually very diluted at only 2% or used in a very small amount. Plus the amount absorbed through the skin is very low. Therefore the risk to an individual applying it topically is minimal.

Salicylic acid should be stored in a tightly closed container that is stored in a cool, dry and ventilated place. It should be protected from physical damage and kept away from any source of heat, ignition or oxidizing materials. Care should be takes to avoid dust formation as it can ignite. Empting the contents of a salicylic acid container should be done with care as empting it into an atmosphere where flammable vapours are present can cause a flash fire. Salicylic acid should always be stored in the dark.

When salicylic acid is released into soil it will quickly biodegrade. The same will occur when it is released into water. Because it quickly biodegrade, there is not a major environmental effect of salicylic acid. However, it should be still disposed of properly. The low concentrations that are found in many skin

care products can be disposed of in the garbage. With Large concentrations or large amounts of salicylic acid, they should be disposed of carefully. They should be brought to a licenced waste disposal contractor that observes all local and national regulations.[15]

Other Interesting Facts about Salicylic Acid

Salicylic acid has been used as a food preservative. It works as one because of its antiseptic properties. It has to be used in very small doses because of its toxicity at high doses. It is no longer used as a food preservative anymore because of concerns with using any antiseptics in human food.[16]Salicylic acid can cause ear damage when taken orally because it inhibits prestin. This only happens in people with a zinc deficiency. However if zinc is injected, the hearing loss can be reversed.[17]Salicylic acid, was once the world’s bestselling drug in 1898.[18]Salicylic acid is also a plant hormone that causes an increase in growth, flowering and heat production.[19]

It is clear that salicylic acid is a very valuable substance. It has many uses and applications in medicine and cosmetics. It was been available to us for centuries. Salicylic acid is an odourless, colourless crystalline powder. It can react with certain chemicals. It is manufactured in a Kolbe-Schmitt reaction and it is used to soften the skin making it good for treating many ailments. Salicylic acid must be stored safely and disposed of properly.