

MYTH VS SCIENCE: EVALUATING THE HEALTH EFFECTS OF SODIUM LAURYL SULPHATE

*Basina. Rishitha Ramya Sri | Dr. Kiran Manda | Ande. V.D.D.Prasanna

Shri Vishnu College of Pharmacy (Autonomous), Affiliated to Andhra University, Bhimavaram - 534202, West Godavari District, Andhra Pradesh, India.

Corresponding Author Email: ramyasribasina@gmail.com

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ABSTRACT

Sodium lauryl sulfate (SLS), also known as sodium dodecyl sulfate (SDS), is one of the most common surfactants in personal care, pharmaceutical, and cleaning products because of its strong emulsifying, wetting, and cleaning properties. Despite its widespread use, there are concerns about its potential health and environmental effects. This review collects data from clinical, toxicological, and ecological studies to evaluate the safety and risks associated with SLS. The evidence shows that SLS can irritate the skin and mucous membranes, especially at high concentrations or with prolonged exposure. SLS also impacts aquatic life and may persist in wastewater, despite being biodegradable. Recommendations include reducing SLS use in sensitive groups, creating safer formulations, and strengthening environmental regulations.

1. INTRODUCTION

Sodium lauryl sulfate (SLS) is a synthetic organic compound commonly found in industrial and consumer products. Its strong surface-active qualities make it effective at removing oils and residues, leading to its use in toothpastes, shampoos, and soaps. However, these surfactant qualities can also disrupt biological membranes and proteins, causing toxicity at high exposure levels. Given the prevalence of SLS-containing products, understanding its effects on human health and the environment is vital.

2. CHEMICAL PROPERTIES AND APPLICATIONS

Chemically, SLS is the sodium salt of lauryl sulfate, with the formula

$C_{12}H_{25}SO_4Na$. It has a 12-carbon tail linked to a sulfate group, which gives it amphiphilic properties. This characteristic accounts for its cleaning and foaming abilities. In products, SLS is typically used at:

- 1-2% in oral care (toothpaste, mouthwash)
- 1-5% in creams and cosmetics
- 10-25% in shampoos.

It is often mixed with other ingredients to reduce its irritant effects.

3. CLINICAL EFFECTS IN ORAL PRODUCTS

Clinical studies, including a 2022 review, show that SLS can worsen oral issues like recurrent aphthous stomatitis. It causes the mucosa to peel, produces a burning

sensation, and increases ulceration with frequent use. SLS-free toothpastes significantly lower pain and the frequency of ulcers in sensitive individuals. While safe for most users, its use in dental products should be assessed carefully for patients with existing mucosal problems.

4. TOXICOLOGY IN HOUSEHOLD PRODUCTS

The toxicological review by Bondi et al. (2015) indicates that SLS is not cancer-causing, does not cause mutations, and is not a reproductive toxin. However, it can cause temporary skin and eye irritation at levels above 2%. Common myths, such as SLS causing cancer or blindness, are based on misinformation. Regulatory agencies like the FDA and EPA consider SLS safe when used within recommended limits.

5. CYTOTOXIC AND MICROBIAL EFFECTS

Many studies show that sodium lauryl sulfate (SLS) has toxic effects on different types of cells, especially at concentrations over 1%. Due to its surfactant properties, SLS disrupts cell membranes by dissolving membrane lipids and breaking down proteins, leading to loss of cell integrity and function.

In vitro tests, like the MTT test, have shown that SLS reduces cell viability significantly at concentrations as low as 0.1% with prolonged exposure. Epithelial cells and HeLa cells show damage, nuclear condensation, and formation of apoptotic bodies with SLS exposure. Research by Shahidi et al. revealed that toothpaste and mouthwash with SLS had over 90% toxicity at a concentration of 50 mg/mL, especially after 30-minute exposure times. In addition to its toxic effects, SLS strongly influences microbial populations, particularly the beneficial bacteria found in the mouth and on the skin. SLS has

antimicrobial properties that can disturb the balance of commensal organisms. It has been shown to affect the activity of bacteria like *Streptococcus mutans* and *Lactobacillus acidophilus*, which are common in the human mouth. While this can help prevent oral infections, the disruption of microbial diversity may lead to dysbiosis, inflammation, and increased vulnerability to pathogens.

Moreover, studies on skin exposure indicate that SLS affects keratinocyte differentiation and skin barrier function. It can increase trans-epidermal water loss (TEWL) and raise protease activity, harming the skin barrier. Animal studies confirm that SLS exposure causes redness, thickening of the skin, and white blood cell infiltration, depending on the exposure time and concentration.

Overall, the toxic and microbial effects of SLS are significant at higher concentrations and with prolonged exposure. These effects highlight the need to use SLS in well-regulated formulations, particularly for products that contact mucosal areas or the skin for long periods.

6. ENVIRONMENTAL IMPACT

Although SLS is biodegradable, it remains a contaminant of growing concern. It has been found in wastewater, aerosols, and urban runoff at levels between 0.004 to 3509 mg/L. SLS is toxic to aquatic organisms like fish, mollusks, and phytoplankton even at low levels. Long-term exposure can cause enzyme inhibition, oxidative stress, and death. Few countries regulate its levels in runoff, and environmental monitoring is limited.

7. DISCUSSION

SLS poses a limited health risk at low levels, but it becomes harmful with prolonged or high exposure. The risk is especially high for people with sensitive

skin or mucosal issues. Environmental information suggests a risk to aquatic ecosystems that has not received enough attention. There is a need for stricter concentration limits, better formulations, and improved regulatory oversight in consumer products.

8. CONCLUSION AND RECOMMENDATIONS

SLS remains a useful surfactant across various industries. However, its safe use relies on responsible formulation and application. Recommendations include:

- Using SLS-free products for people with oral sensitivities
- Reducing concentrations in cosmetics and personal care items
- Promoting further research on chronic low-dose exposure
- Monitoring environmental discharge and bioaccumulation

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