

Quaternary Ammonium Compounds

Quaternary ammonium compounds, also known as “quats” or “QACs,” include a number of chemicals used as sanitizers and disinfectants, including benzalkonium chloride, benzethonium chloride, cetalkonium chloride, cetrimide, cetrimonium bromide, cetylpyridinium chloride, glycidyl trimethyl, ammonium chloride, and stearylalkonium chloride.¹

In general, quats cause toxic effects through all routes of exposure, including inhalation, ingestion, dermal application, and irrigation of body cavities. Exposure to diluted solutions may result in mild irritation, while concentrated solutions are corrosive, causing burns to the skin and mucous membranes. They can produce systemic toxicity and can also cause allergic reactions.²

ASTHMA AND ALLERGIES

Of particular interest with regard to use as disinfectants in the COVID-19 pandemic, quats increase the risk for asthma and allergic sensitization. Evidence from occupational exposures shows increased risk of rhinitis and asthma with exposure to quats. Quats are on the Association of Occupational and Environmental Clinics list of asthmagens and may be more potent than bleach.³

One quat, benzalkonium chloride, has also been associated with dermatitis.⁴ Quats appear to be sensitizers and irritants to the skin and mucous membranes. Particular quats are suspected to display an immunologic cross-reactivity between each other and with other chemical compounds containing ammonium ion, such as muscle relaxants widely used in anesthesia.⁵

MUTAGENICITY

Some quats are shown to be mutagenic and to damage animal DNA and DNA in human lymphocytes at much lower levels than are present in cleaning chemicals.⁶

ANTIMICROBIAL RESISTANCE

Genes have been discovered that mediate resistance to quats. There has been an association of some of these genes with beta lactamase genes, raising concern about a relationship between disinfectant resistance and antibiotic resistance.⁷

REPRODUCTIVE TOXICITY

Mice whose cages were cleaned with QACs had very low fertility rates.⁸ Exposure to a common quat disinfectant mixture significantly impairs reproductive health in mice.⁹



CONCLUSION

Avoid sanitizers and disinfectants containing quats, which have potential mutagenicity and reproductive toxicity and are known to increase the risk of asthma. See the Beyond Pesticides disinfectants and sanitizers webpage (bp-dc.org/disinfectants) for information about safer disinfectants and our article on safe return to school during the COVID-19 pandemic (bp-dc.org/backtoschool).

NOTES

- 1 International Programme on Chemical Safety INCHEM Internationally Peer Reviewed Chemical Safety Information, <http://www.inchem.org/documents/pims/chemical/pimg022.htm>.
- 2 International Programme on Chemical Safety INCHEM Internationally Peer Reviewed Chemical Safety Information, <http://www.inchem.org/documents/pims/chemical/pimg022.htm>.
- 3 Holm, S.M., Leonard, V., Durrani, T. and Miller, M.D., 2019. Do we know how best to disinfect child care sites in the United States? A review of available disinfectant efficacy data and health risks of the major disinfectant classes. *American journal of infection control*, 47(1), pp.82-91. [https://www.ajicjournal.org/article/S0196-6553\(18\)30731-4/fulltext#sec0018](https://www.ajicjournal.org/article/S0196-6553(18)30731-4/fulltext#sec0018).
- 4 Holm, S.M., Leonard, V., Durrani, T. and Miller, M.D., 2019. Do we know how best to disinfect child care sites in the United States? A review of available disinfectant efficacy data and health risks of the major disinfectant classes. *American journal of infection control*, 47(1), pp.82-91. [https://www.ajicjournal.org/article/S0196-6553\(18\)30731-4/fulltext#sec0018](https://www.ajicjournal.org/article/S0196-6553(18)30731-4/fulltext#sec0018).
- 5 Lim, XiaoZhi, 2020. Do we know enough about the safety of quat disinfectants? *Chemical and Engineering News*, vol. 98, issue 30. <https://cen.acs.org/safety/consumer-safety/know-enough-safety-quat-disinfectants/98/i30>.
- 6 Holm, S.M., Leonard, V., Durrani, T. and Miller, M.D., 2019. Do we know how best to disinfect child care sites in the United States? A review of available disinfectant efficacy data and health risks of the major disinfectant classes. *American journal of infection control*, 47(1), pp.82-91.
- 7 Holm, S.M., Leonard, V., Durrani, T. and Miller, M.D., 2019. Do we know how best to disinfect child care sites in the United States? A review of available disinfectant efficacy data and health risks of the major disinfectant classes. *American journal of infection control*, 47(1), pp.82-91.
- 8 Holm, S.M., Leonard, V., Durrani, T. and Miller, M.D., 2019. Do we know how best to disinfect child care sites in the United States? A review of available disinfectant efficacy data and health risks of the major disinfectant classes. *American journal of infection control*, 47(1), pp.82-91. [https://www.ajicjournal.org/article/S0196-6553\(18\)30731-4/fulltext#sec0018](https://www.ajicjournal.org/article/S0196-6553(18)30731-4/fulltext#sec0018).
- 9 Melin, V.E., Potineni, H., Hunt, P., Griswold, J., Siems, B., Werre, S.R. and Hrubec, T.C., 2014. Exposure to common quaternary ammonium disinfectants decreases fertility in mice. *Reproductive toxicology*, 50, pp.163-170.