



Hand Sanitizer: An Overview of Its Composition, Production, Materials, Methods, and Active Ingredients

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ABSTRACT :

Hand sanitizers are antimicrobial specialists intended to decrease or dispose of microbes from the hands, filling in as an elective when cleanser and water are not free. They turned out to be particularly common during the Coronavirus pandemic because of their job in forestalling viral transmission. Accessible in fluid, gel, or froth structure, the most well-known hand sanitizers are liquor based, regularly containing 60%-95% ethanol or isopropyl liquor. Liquor quickly denatures microbial proteins and disturbs their layers, making it exceptionally compelling against microorganisms, infections, and growths. Non-liquor-based plans, utilizing specialists like benzalkonium chloride, are likewise accessible however are for the most part less viable against a wide scope of microbes. Notwithstanding liquor, hand sanitizers frequently contain fixings, for example, glycerin to forestall skin dryness, aromas for fragrance, and thickening specialists for a gel-like consistency. Liquor's getting dried out impact on the skin can cause aggravation or dryness, particularly with successive use, which makes the expansion of lotions significant in diminishing these secondary effects. There are worries over long haul, inordinate use, including expected microbial protection from non-liquor-based definitions and the incorporation of hurtful added substances like methanol, which has prompted stricter administrative oversight. Arising research means to address these provokes by working on the definition to extend viability while decreasing aftereffects. Hand sanitizers stay a basic device in medical services, public settings, and regions lacking admittance to cleanser and water, offering a helpful and powerful method for keeping up with hand cleanliness.

INTRODUCTION :

Hand sanitizer is a widely-used personal hygiene product designed to reduce the spread of harmful microorganisms, including bacteria, viruses, and fungi [1]. It provides a quick and effective means of hand disinfection, especially in situations where soap and water are unavailable [2]. The product is commonly available in gel, liquid, or foam forms and is primarily formulated with alcohol as the active ingredient [3]. Alcohol-based hand sanitizers, which contain either ethanol or isopropyl alcohol, are considered the most effective, especially when their alcohol content ranges between 60% and 95% [4]. This concentration is critical for ensuring the rapid breakdown of microbial cell membranes and the denaturation of proteins, leading to pathogen inactivation [5]. In addition to alcohol, hand sanitizers may contain supplementary ingredients such as moisturizers (e.g., glycerine) to prevent skin dryness, fragrances for a pleasant scent, and thickeners to enhance texture and application [6]. While non-alcohol-based sanitizers exist, typically utilizing antimicrobial agents like benzalkonium chloride, these are generally less effective against certain pathogens [7]. Hand sanitizers have become indispensable in modern healthcare settings, workplaces, schools, and during global health emergencies such as the COVID-19 pandemic, where they serve as a frontline defence against infection [6,7]. The Centres for Disease Control and Prevention (CDC) and the World Health Organization (WHO) have established guidelines for the effective use of hand sanitizers, emphasizing their role in promoting hand hygiene [8]. However, despite their convenience and widespread usage, hand sanitizers have limitations [9]. They are not effective against all types of germs, such as bacterial spores, and their efficacy diminishes when hands are visibly dirty or greasy [10]. Overuse may also cause skin irritation, and concerns about improper formulations have led to stricter regulatory oversight to ensure safety and quality [11].

SANITIZER :

Hand sanitizer is a convenient hygiene product designed to reduce germs and pathogens on the hands, especially when soap and water are not available [12].

BENEFITS :

- **Germ Reduction:** Hand sanitizer effectively kills most germs, including bacteria and viruses, helping to prevent infections [13].
- **Convenience:** It's portable and easy to use, making it a great option for on-the-go situations, such as when you're traveling, at work, or in public places [14].

- Quick Drying: Hand sanitizer dries quickly, allowing you to clean your hands without needing towels[15].
- Moisturizing Options: Many hand sanitizers include ingredients like glycerine to help keep your skin from drying out[16].

COMPOSITION :

TYPES OF HAND SANITIZERS :

1. Alcohol-Based Hand Sanitizers:

- Description: These contain alcohol, usually ethanol or isopropyl alcohol, as the main ingredient.
- Concentration: Effective ones have an alcohol concentration between 60% and 95%.
- Benefit: They kill most germs quickly and are widely recommended for effective hand hygiene.

2. Non-Alcohol-Based Hand Sanitizers:

- Description: These do not contain alcohol and often use other antimicrobial agents, like benzalkonium chloride.
- Benefit: They can be gentler on the skin, but they may not kill as many types of germs as alcohol-based sanitizers[17].

Composition : Alcohol-based hand sanitizers are primarily made up of the following key ingredients:

1. **Alcohol :** The main active ingredient, usually either ethanol (ethyl alcohol) or isopropyl alcohol (rubbing alcohol). The alcohol concentration typically ranges from 60% to 95% to effectively kill germs.
2. **Water :** Used to dilute the alcohol and help achieve the desired consistency. It also aids in moisturizing the skin.
3. **Glycerine :** A moisturizer that helps prevent the skin from drying out due to the high alcohol content. It keeps hands feeling soft and hydrated.
4. **Thickening Agents :** Ingredients like carbomer are added to give the sanitizer a gel-like consistency, making it easier to apply.
5. **Fragrance :** Optional ingredient for a pleasant smell, though some formulations may be unscented, especially for sensitive skin.
6. **Preservatives :** Sometimes included to prevent the growth of bacteria or fungi in the product itself[18].

Table 1 :

Sr no	Names	Percentage
1	Ethanol (Ethyl Alcohol)	70% active ingredient
2	Water	20%
3	Glycerine	5% (for moisture)
4	Carbomer	1% (thickening agent)
5	Fragrance	0.5% (optional)
6	Preservatives	0.5% (optional)

Adverse Effects of Alcohol-Based Sanitizer or Hand washing Soaps :

While alcohol-based hand sanitizers and handwashing soaps are essential for maintaining hygiene and preventing the spread of infections, they can also have adverse effects on the skin[19]. Frequent use of alcohol-based sanitizers can lead to skin irritation, dryness, and allergic reactions due to the high concentration of alcohol, which strips the skin of its natural oils[20]. This can result in redness, itching, and peeling, particularly in individuals with sensitive skin or pre-existing skin conditions such as eczema[21]. Similarly, handwashing soaps, especially those containing harsh chemicals or fragrances, can disrupt the skin's natural barrier, leading to dryness and irritation[22]. Overuse of both sanitizers and soaps may cause a condition known as irritant contact dermatitis, characterized by inflammation and discomfort[23]. Furthermore, reliance on hand sanitizers can diminish the skin's microbiome diversity, potentially leading to increased susceptibility to infections[24]. It is crucial for individuals to balance hygiene practices with skin care, using moisturizers and selecting gentle, skin-friendly products to mitigate these adverse effects while ensuring effective hand hygiene[25].

Alcohol Mechanism of Action Against Bacteria:

The mechanism of action of alcohol against bacteria primarily involves the denaturation of proteins and the disruption of cell membranes[26]. When alcohol, typically in concentrations ranging from 60% to 95%, comes into contact with bacterial cells, it penetrates the cell membrane, which is composed

- **Early Beginnings:** The concept of hand hygiene dates back centuries, with people using various substances, like alcohol and essential oils, to clean their hands. However, these methods were not standardized or widely practiced.
- **Modern Development:** The first commercial hand sanitizer was developed in the late 1980s. It was primarily alcohol-based and aimed at healthcare workers to help reduce infections in hospitals.
- **Increased Awareness:** During the 2000s, public awareness about germs and hygiene grew, especially after outbreaks of illnesses like SARS and H1N1. This led to an increase in the use of hand sanitizers in everyday settings, not just in healthcare.
- **COVID-19 Pandemic:** The COVID-19 pandemic significantly boosted the popularity and availability of hand sanitizers. People began using them more frequently as a preventive measure against the virus, leading to a surge in demand and production. New formulations, including foams and wipes, emerged to meet consumer needs.
- **Regulation and Safety:** With the rise in use, regulatory agencies implemented guidelines to ensure the safety and effectiveness of hand sanitizers. Consumers became more aware of ingredients, prompting manufacturers to create gentler formulations that include moisturizers[35].

When to use ?

- **After Touching Surfaces:** Use hand sanitizer after touching commonly used surfaces like doorknobs, light switches, and public transportation handles.
- **Before Eating:** Apply hand sanitizer before eating or handling food, especially when soap and water are not available.
- **After Coughing or Sneezing:** Use hand sanitizer after you cough, sneeze, or blow your nose to eliminate germs.
- **After Using the Restroom:** If soap and water are not accessible, use hand sanitizer after using the restroom.
- **When Caring for Others:** Use hand sanitizer before and after providing care to someone who is ill or after changing diapers.
- **Before and After Handling Food:** Always use hand sanitizer before preparing or eating food, and after handling raw meat or other potentially contaminated items.
- **When Traveling:** Use hand sanitizer frequently while traveling, especially when you cannot wash your hands.
- **In Public Spaces:** Apply hand sanitizer after being in crowded places, like shopping centres or public transport[36].

Limitations :

- **Not Effective Against All Pathogens:** Hand sanitizers are less effective against certain types of germs, particularly non-enveloped viruses (like norovirus), bacterial spores (such as *Clostridium difficile*), and some parasites. In such cases, handwashing with soap and water is recommended[37].
- **Visible Soil and Dirt:** Hand sanitizers cannot remove dirt, grease, or organic matter from hands. If hands are visibly dirty or greasy, washing with soap and water is necessary for effective cleaning[37].
- **Skin Irritation:** Frequent use of alcohol-based hand sanitizers can lead to skin irritation, dryness, or allergic reactions, especially in individuals with sensitive skin or pre-existing conditions like eczema[37].
- **Alcohol Concentration Matters:** For optimal effectiveness, hand sanitizers should contain at least 60% alcohol. Products with lower alcohol concentrations may not effectively kill germs[38].
- **Limited Duration of Action:** Hand sanitizers provide a temporary reduction in germs and do not offer prolonged protection. If hands become contaminated again, the effectiveness diminishes[38].
- **Dependency on Proper Use:** The effectiveness of hand sanitizers is highly dependent on correct usage—applying enough product and rubbing it over all surfaces of the hands until dry is crucial. Inadequate application can reduce their effectiveness[39].
- **Chemical Ingredients:** Some hand sanitizers may contain ingredients that could be harmful if ingested or cause skin reactions. Consumers need to choose products carefully and be aware of potential adverse effects[40].
- **Resistance Concerns:** Overuse of certain antimicrobial agents in non-alcohol-based sanitizers could contribute to the development of antimicrobial resistance, making some pathogens harder to eliminate in the future[41].

Conclusion :

Hand sanitizer has become an essential tool in promoting hand hygiene and preventing the spread of infections, particularly in today's fast-paced and health-conscious world. Its effectiveness, especially when alcohol-based with concentrations of 60% to 95%, makes it a reliable option for reducing microbial load in various settings. However, it is important to recognize its limitations, such as reduced efficacy against certain pathogens, ineffectiveness on visibly dirty hands, and potential skin irritation from frequent use. For optimal hygiene practices, hand sanitizers should complement traditional handwashing with soap and water, particularly in situations where hands are heavily soiled or when dealing with specific types of germs. As awareness of hygiene continues to grow, selecting high-quality products and using them correctly will play a crucial role in enhancing public health. Ultimately, hand sanitizer is a convenient and effective solution for maintaining cleanliness and safeguarding against infections, but it should be used judiciously and in conjunction with comprehensive hygiene practices.

REFERENCES:

1. Kaltenthaler EC and Drasar BS. The study of hygiene behavior in Botswana : a combination of qualitative and quantitative methods. *Trop Med Int Health* 1996;1:690–698.
2. Vemeil T, Peter A, Kelpatick C, et al. Hand hygiene in hospitals: anatomy of a revolution. *J Hosp Inf* 2018;1:320–327.
3. Green away R E, Ormandy K , Fellows C, et al. Impact of hand sanitizer format (gel/foam/liquid) and dose on its sensory properties. *J Hosp Inf* 2018;2:411–416.
4. Pittet D. Improving adherence to hand hygiene practice: a multi disciplinary approach. *Emerg Infect Dis* 2001; 7:234–240.
5. Ejemot R, Ehiri J, Meremikwu M, et al. Hand washing for preventing diarrhoea. *Cochrane Database Syst Rev* 2008;23: CD004265.
6. David LD, Kenneth BG, and Peter SW. Testing a new alcohol free hand sanitizer to combat infection . *AORNJ* 1998;68(2):239–251. Accessed March 9, 2015.
7. Curtis V. Talking dirty: how to save a million lives. *Int J Environ Health Res* 2003; 13(Suppl 1):S73–S79.
8. Shulman L. Hand sanitizer: benefits & limitations. *Canadian Living: Prevention & Recovery* ; Nov10, 2006.
9. Kaltenthaler EC and Pinfold JV. Microbiological methods for assessing hand washing practice in hygiene behavior studies. *J Trop Med Hyg* 1995;98:101–106.1
10. Moadab A, Rupley KF, and Wadhams P. Effectiveness of a nonrinse, alcohol-free antiseptic handwash. *J Am Pediatr Med Assoc* 2001;91(6):288–293. Accessed March 17, 2015.
11. Larson EL, Cohen B, and Baxter KA. Analysis of alcohol based hand sanitizer delivery systems : efficacy of foam, gel, and wipes against influenza A (H1N1) virus on hands. *Am J Infect Contr* 2012;40(9):806–809. Accessed March 18, 2015.
12. Simone A. Hand hygiene and hand sanitizers . A series from the Family Yout hand Community Sciences Department ,Florida Co operative Extension Service , Institute of Food and Agricultural Sciences, University of Florida, Publication no. FCS8788; March 201 1. Accessed March 9, 2015.
13. Picke ring AJ ,Boehm AB, Mwanjali M, et al . Efficacy of water less hand hygiene compared with hand washing with soap: a field study in Dar es Salaam, Tanzania. *Am J Trop Med Hyg* 2010;82(2):270–278.
14. Ahmed K, Ahmed H, Ahmed FA, et al. Analysis of antimicrobial and anti-biofilm activity of hand was he sand sanitizers against *S.aureus* and *P.aeruginosa*. *JPakMedAssoc*. 2020;70(1):100–104.
15. Jain VM, Karibasappa GN, Dodamani AS, Prashanth VK, Mali GV. Comparative assessment of antimicrobial efficacy of different hand sanitizers : an in vitro study . *DentResJ (Isfahan)* 2016;13(5):424–431.
16. Ochwoto M, Muita L, Talaam K, et al. Anti-bacterial efficacy of alcoholic hand rubs in the Kenyan market, 2015. *Antimicrob Resist Infect Contr* 2017;6:17.
17. Kotia P, Gupta BD, Gupta R, et al. Comparing the antimicrobial efficacy of different hand sanitizers: an in vitro study . *J Ind Assoc Pub Health Dent* 2019;17:253–257
18. Fahimipour, A.K.; Ben Mazaar, S.; McFarland, A.G.; Blaustein, R.A.; Chen, J.; Glawe, A.J.; Kline, J.; Green, J.L.; Halden, R.U.; Van Den Wymelenberg, K.; et al. Antimicrobial Chemicals Associate with Microbial Function and Antibiotic Resistance Indoors. *Am. Soc. Microbiol.* 2018,3,e00200-18.
19. Honari, G.; Maibach, H. Skin Structure and Function. In *Applied toxicology*; Elsevier:Amsterdam, The Netherlands, 2014; pp.1–10.60. Wickett, R.R.; Visscher, M.O. Structure and function of the epidermal barrier. *Am . J. Infect . Control* 2006,34, S98–S110.
20. Feingold, K.R. Lamellar bodies: The key to cutaneous barrier function. *J. Investig. Dermatol.* 2012,132,1951–1953.

21. Clayton, K.; Vallejo, A.F.; Davies, J.; Sirvent, S.; Polak, M.E. Langerhans cells-programmed by the epidermis . *Front. Immunol.*2017,8,1676.
22. Abraham, J.; Mathew, S. Merkel Cells: A Collective Review of Current Concepts. *Int. J. Appl. Basic Med. Res.* 2019,9,9–13.
23. Chiller, K.; Selkin, B.A.; Murakawa, G.J. Skin microflora and bacterial infections of the skin. *J. Investig. Dermatol . Symp.Proc.* 2001,6,170–174.
24. Cogen, A.L.; Nizet, V.; Gallo, R.L. Skin microbiota: A source of disease or defence? *Br. J.Dermatol.*2008,158,442–455.
25. Grice, E.A.; Segre, J.A. The skin microbiome. *Nat.Rev.Microbiol.*2011,9,244–253.
26. Nash, A.A.; Dalziel, R.G.; Fitzgerald, J.R. Attachment to and Entry of Microorganisms into the Body. In *Mims' Pathogenesis of Infectious Disease*; Elsevier: Amsterdam, The Netherlands, 2015; pp.9–49.68. Wu, F.; Zhao, S.; Yu, B.; Chen, Y. M.; Wang, W.; Song, Z.-G.; Hu, Y.; Tao, Z.-W.; Tian, J.-H.; Pei, Y.-Y.; et al. A new corona virus associated with human respiratory disease In China. *Nature* 2020,579,265–269.
27. Zhou, P.; Yang, X.-L.; Wang, X.-G.; Hu, B.; Zhang, L.; Zhang, W.; Si, H.-R.; Zhu, Y.; Li, B.; Huang, C.-L.; et al. A pneumonia out break associated with a new corona virus of probable bat origin. *Nature* 2020,579,270–273.
28. Cascella, M.; Rajnik, M.; Cuomo, A.; Dulebohn, S.C.; Di Napoli, R. Features, Evaluation and Treatment Corona virus (COVID-19) ; Stat Pearls Publishing : St.Petersburg, FL, USA, 2020.
29. Goldsmith, C.S.; Tatti, K.M.; Ksiazek, T.G.; Rollin, P.E.; Comer, J.A.; Lee, W.W.; Rota, P.A.; Bankamp, B.; Bellini, W.J.; Zaki, S.R. Ultra structural Characterization of SARS Coronavirus. *Emerg.Infect.Dis.*2004,10, 320–326.
30. WHO. Annex 1 19th WHO Model List of Essential Medicines; WHO: Geneva, Switzerland, 2015.
31. Siddharta, A.; Pfaender, S.; Vielle, N.J.; Dijkman, R.; Friesland, M.; Becker, B.; Yang, J.; Engelmann, M.; Todt, D.; Windisch, M.P.; et al. Virucidal Activity of World Health Organization-Recommended Formulations Against Enveloped Viruses , Including Zika, Ebola, and Emerging Coronaviruses. *J.Infect.Dis.*2017,215,902–906.
32. Kampf, G. Efficacy of ethanol against viruses in hand disinfection. *J. Hosp. Infect.* 2018, 98,331–338.
33. Rabenau, H.F.; Kampf, G.; Cinatl, J.; Doerr, H.W. Efficacy of various disinfectants against SARS and corona virus. *J.Hosp.Infect.*2005,61,107-111
34. Wilhelm, K.-P. Prevention of Surfactant-Induced Irritant Contact Dermatitis. In *Current Problems in Dermatology*; Karger Publishers : London, UK, 1996; Volume 25, pp.78–85.
35. Ale, I.S.; Maibach, H.I. Irritant contact dermatitis. *Rev. Environ. Health*2014,29,195–206.
36. Misteli, H.; Weber, W.P.; Reck, S.; Rosenthal, R.; Zwahlen, M.; Fueglistaler, P.; Bolli, M.K.; Oertli, D.; Widmer, A.F.; Marti, W.R. Surgical glove perforation and the risk of surgical site infection. *Arch.Surg.*2009,144,553–558.
37. Larson, E.L.; Hughes, C.A.; Pyrek, J.D.; Sparks, S.M.; Cagatay, E.U.; Bartkus, J.M. Changes in bacterial flora associated with skin damage on hands of health care personnel. *Am. J. Infect. Control*1998,26, 513–521.
38. Löffler, H.; Kampf, G.; Schmermund, D.; Maibach, H.I. How irritant is alcohol? *Br. J. Dermatol.*2007,157,74–81.
39. Graham, M.; Nixon, R.; Burrell, L.J.; Bolger, C.; Johnson, P.D.R.; Grayson, M.L. Low rates of cutaneous adverse reactions to alcohol-based hand hygiene solution during prolonged use in a large teaching hospital. *Anti microb. Agents Chemother.* 2005,49,4404–4405.
40. Angelova-Fischer, I.; Dapic, I.; Hoek, A.K.; Jakasa, I.; Fischer, T.W.; Zillikens, D.; Kezic, S. Skin barrier integrity and natural moisturising factor levels after cumulative dermal exposure to alkaline agents in atopic dermatitis. *ActaDerm.Venereol.*2014,94,640–644.
41. Emilson, A.; Lindberg, M.; Forslind, B. The temperature effect of in vitro penetration of sodium lauryl sulfate and nickel chloride through humans skin. *ActaDerm.Venereol.*1993,73,203–207.