

HAND SANITIZER EFFECT ON BACTERIA, VIRUS, AND FUNGI; COMPARISON BETWEEN ALCOHOL BASED AND NON-ALCOHOL BASED SANITIZER

INTRODUCTION

In the wake of the recent pandemic engulfing the world through covid19(Coronavirus), several preventive methods have been offered as tools to combat the spread of the disease. One key tool of prevention has been noted as handwashing with soap and water or with hand sanitizer. This is to decrease and interrupt the transmission of the virus from persons, hence, reducing mortality, morbidity, and associated health care costs. Presently, several health organizations currently back using alcoholbased sanitizers(containing at least 60% alcohol) as the only effective hand sanitizer, capable of destroying harmful microbes. However, recent and continuous shows that non-alcohol sanitizers containing benzalkonium chloride, are also capable of depleting the protein-membrane covering bacteria, viruses and fungi.

ALCOHOL BASED SANITIZER

As early as the 13th century, alcohol had been fondly used as antiseptic, with its modern use adapted in the 18th century. Although several people were indicated as the inventor of alcohol-based sanitizer, there seems to be no single inventor as no one came out to patent the invention. By the end of the 19th century, its wide use was seen across Europe. However, it wasn't until 2002 when CDC recognized its applicability, that it's use started gaining prominence. Alcohol hand sanitizers are often used in combating infectious agents found on the hands, as an alternative to soap and water, in situations where handwashing might be impracticable. They could be liquid or gel and in some cases foams, all dependent on the formulation used.

In certain healthcare settings, its often effective at depleting numerous microorganisms varying from bacteria, fungi, and viruses, except for norovirus and Clostridium difficile. Most alcohol-based hand sanitizers according to World Health Organization (WHO) and the Center for Disease Control (CDC) recommendations, are supposed to contain at least 60% alcohol to be effective against harmful microbes. The sanitizer composition oftentimes consist of either n-isopropyl, ethyl, and n-propane alcohol, as key compositions of the alcohol-based hand sanitizer.

The primary formulations of the sanitizers consist of alcohol, glycerol, hydrogen peroxide, and distilled water. The glycerol constituent offers a remedy to drying of the skin, while the hydrogen peroxides attack bacterial spores that alcohol cannot effectively tackle. Other varied versions also contain fragrance, coloring and other key ingredients. Presently, alcohol-based hand sanitizer is on the list of WHO's list of essential, safest, and most medicines, needed in every health system.

Using an alcohol-based sanitizer, you're expected to put an adequate amount of the substance on your palm and rub on both palms. You also have to ensure it reaches in-between the fingers and underneath

the nail. Hand sanitizers are overall popular as a result of their availability and non-reliance on water resources coupled.

Notably, research has also shown that hand sanitizer disinfection has improved hand-hygiene compliance, when compared to handwashing with soap and water.

NON-ALCOHOL BASED SANITIZER

Not lagging is the non-alcohol based hand sanitizer, which is capable of depleting the ability of bacteria, fungi, and viruses to cause varying illnesses. Their composition instead of alcohol is replaced with benzalkonium chloride, providone-iodine or triclosan, as the key ingredient. According to the WHO and CDC, "persistent" antiseptics are required for the efficacy of all hand sanitizers. This persistence refers to the prolonged half-life or activity that prevents or inhibits the survival of bacteria, fungi, or viruses after the application of the product.

Majorly, most non-alcohol based hand sanitizers are oftentimes available in a water-based foam, with benzalkonium chloride(quaternary ammonium) as the key ingredient. Compared to alcohol-based sanitizers, benzalkonium chloride is formulated at 0.1% concentration, whilst still providing a similar level of protection. The low-level concentration of benzalkonium in the hand sanitizers makes it relatively non-toxic, as the rest of the solution is comprised of distilled water and skin conditioners. The key to maintaining these non-alcohol based hand sanitizers is to ensure they are not contaminated, during handling of the contents into the containers and during its application. Although they are yet to gain traction in the market, their entrant into the market is as a result of complaints and concerns about its alcohol-based counterparts.

A major producer of non-alcohol based hand sanitizer is Dr. Eckl, where the antimicrobial gel consists of benzalkonium chloride as the main ingredient. Their antimicrobial gel was intended to primarily inhibit the multiplication of bacteria and fungi cells, to effectively heal cold sores. However, further investigation into the active properties of the benzalkonium chloride showed that their formulation attacked and effectively destroyed all pathogenic cells. These pathogenic cells includes viruses, bacterium, and fungus. On the application of the benzalkonium chloride formulated hand sanitizer, evidence showed that the antimicrobial action didn't wash off, when compared to alcohol-based hand sanitizers. This is truly important, as it ensures that hand surfaces are not only sterile, as they transfer traces of the sanitizer to surfaces they come in contact with. This enables individuals to unconsciously deposit the active ingredients on a contaminated surface, to further prevent re-infection from any pathogen, after application of the non-alcohol based hand sanitizer. This is one great benefit, as it ensures that asides from quality hand hygiene, your immediate contact environment becomes sterile. The chlorine which is the complementary key ingredient, acts to inhibit the further multiplication of broad-spectrum viral, bacterium, and fungus cells.

Also labeled as a wide spectrum virucide, the benzalkonium chloride is designed for all skin types with a well-balanced PH. This attributes makes it suitable for general everyday use by any family member. Furthermore, several notable researchers have identified this unique, non-drying cleanser to be effective for post-operative care use and as first aid.

COMPARISON BETWEEN ALCOHOL AND NON-ALCOHOL BASED HAND SANITIZERS

Inventions won't be necessary if there wasn't a problem to solve, hence, why these sanitizers were created to counter each other's drawbacks. One key factor that led to the invention of the non-alcohol based hand sanitizers was a result of safety issues that was linked to its use.

- 1. FIRE:** Written on most alcohol-based hand sanitizers is their hazardous propensity to catch fire. Alcohol which is the key ingredient in all alcohol-based hand sanitizers, produces a translucent blue flame if ignited by error or omission. With concentrations ranging from 60-90% as the recommended percentage required to kill bacteria, viruses, and fungus, the risk of a fire hazard can never be ruled out. It might be during application when not completely rubbed off and the person comes in contact with a fire substance. Even while in the respective container or dispenser, there is still a clear risk of fire explosion.

There have been certain times recorded in medical journals, where alcohol was nailed as the main culprit in fire outbreaks in the operating room. There was a clear case where antiseptic alcohol toppled under the surgical drapes in a medical theater, when a cautery instrument was been used, which led to a fire. Compared with the alcohol-free benzalkonium chloride sanitizers, there's no apparent risk of a fire hazard, as the key ingredients are not flammable.
- 2. SKIN:** All hand sanitizers are for external use on the skin, with researches showing no imminent risks associated with its use, although they eliminate beneficial microorganism alongside. Oftentimes the skin system replenishes the depleted beneficial microbes back, alcohol hand sanitizers however strips the skin outer layer of oil. This setback is indeed important as it poses negative effects on the barrier function of the skin. CDC and WHO recommends persistent use of alcohol-based sanitizers to provide protective functions, which oftentimes lead to drying and irritation of skin surfaces. Contrastingly, benzalkonium chloride-based hand sanitizers poses no drying and irritation risk to any skin surface with extended use.
- 3. INGESTION:** Hand hygiene is not only limited to adults but also important for children who have lower immunity and are more risk of infection, because of their curious nature. FDA guidelines stipulates that; manufacturers are to label the alcohol-based product of its dangers if ingested by both children and adults. Their guidelines also state that it should not be used on the eyes, whilst children are to use it under adult supervision. Ingestion of alcohol-based hand sanitizers by small children often leads to alcohol poisoning, with a report by the US Association of poison control estimating that over 11,000 children ingest hand sanitizers yearly. Solving this ingestion issue posed by alcohol-based sanitizers is the use of benzalkonium chloride product. If benzalkonium chloride sanitizer is accidentally ingested, it won't pose any significant risk to the children, as the concentration of the key ingredient is pegged at 0.1%. Ingestion guidelines are also important in some cases like prisons where alcohol is prohibited, various data's have shown that people were caught drinking alcohol-based hand sanitizer to fix their high, leading to its ban in those places. Hence, benzalkonium chloride applicability will be useful to keep people in such places safe from bacteria, fungi, and virus, while preventing any means of possible alcohol intoxication through the hand sanitizers.

4. **ABSORPTION:** FDA in late 2015 requested more data as regards the tolerance and safety of alcohol-based hand sanitizer. Some of the data from emerging studies were starting to show systemic exposure, with traces detected in the blood or urine than initially anticipated. This concern was linked to the constant repetitive use of alcohol-based hand sanitizers, whereas no present evidence has been linked to benzalkonium chloride.
5. **COST EFFICACY:** When dispensing hand sanitizers for use, a study showed that to effectively protect oneself, more alcohol-based hand sanitizers will be used compared to benzalkonium chloride compounded sanitizers. Hence, it indicates individuals, families, and organizations will save more money, when they use the non-alcohol based hand sanitizers as a result of lesser volume needed to battle microbes.
6. **RELIANCE:** On the application of alcohol hand sanitizers, they often dry off immediately when palms are rubbed together vigorously. However, benzalkonium chloride hand sanitizers provide extended protection as it continues to deplete any bacteria, fungi or virus it comes in contact with even after it has dried off(which is not immediate)

CONCLUSION

Although non-alcohol based hand sanitizers such as the benzalkonium chloride sanitizers, are struggling to be a major market force because it's presently unbacked by the government. However, it's obvious advantages over alcohol hand sanitizers cannot be overlooked, as it presents a staggering positive and less risk to the human body. Hand hygiene is indeed important as it disrupts transmission routes of communicable diseases. Hence, it's imperative to pick a safer choice to further protect everyone from harmful bacteria, fungi, and viruses.

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