COMPARATIVE ASSESSMENT OF ANTIBACTERIAL AND ANTIFUNGAL ACTIVITY OF HAND SANITIZERS PRODUCED BEFORE AND DURING COVID-19 PANDEMIC

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Alcohol hand sanitizers usage, according to WHO, is one of the most effective preventive methods for infectious diseases spreading. Their regular usage is recommended both on international and governmental levels. The most common active ingredients in hygiene-oriented sanitizers are ethanol and 2-propanol with a final concentration in the range between 60.0% and 85.0% (WHO Guidelines on Hand Hygiene in Health Care, 2009). The common myth is that the higher concentration, the better, but recent works show that presence of water is crucial for effective pathogen proteins denaturation, so the alcohol concentration higher than 85.0% for ethanol and 80.0% for 2-propanol would result in lack of such sanitizer efficacy (Gold & Avva, 2020). Besides, hand-sanitizer producers use alternative options of active ingredients: chlorhexidine, silver nanoparticles, quaternary ammonium compounds and plant extracts (i.e. Aloe vera, Calendula officinalis, Matricaria chamomilla) etc. (Madan et al., 2012).

The research aimed to test the antibacterial and antifungal activity of commonly available Ukrainian hand sanitizers and to compare their efficacy, depending on their production date: before the 12th of March (when quarantine in Ukraine had officially begun) and after it. Based on this parameter, 32 samples were divided into two equal groups: each contained 16 different hand sanitizers samples, and six of them were present in both groups (but bought at different times).

Since all the active compounds, declared to be present in studied hand sanitizers, are well known and have antimicrobial and antiviral properties, we suggest that if sanitizer shows no antimicrobial activity, it would not have antiviral one either (Van Engelenburg et al., 2002).

For observation of antibacterial and antifungal activity, the agar well diffusion method was used. Testing was performed using the following reference cultures and clinical isolates of microorganisms from patients with hospital-acquired infections: *Escherichia coli* ATCC 25922; *Staphylococcus aureus* ATCC 26923 (F-49); *Candida albicans* ATCC 885/653; *Pseudomonas aeruginosa* ATCC 27853 (F-51), *Escherichia coli* №5; *Candida albicans* №60; *Candida non-albicans* №67;
*Raoultella terrigena* №1; *Staphylococcus lentus* № 19; *Citrobacter sedlakii* №37; *Pseudomonas aeruginosa* №13; *Enterococcus spp.* №161; *Aerococcus viridans* №26. As control samples were used 70.0% ethanol, 65.0% 2-propanol and herbal extracts (*A. vera, M. chamomilla, Plantago major*).

From the 16 specimens studied in the first group, only seven have shown high levels of antimicrobial activity, showing the results, comparative with controls. Those hand sanitizers had the following active ingredients: ethanol, 2-propanol and silver nanoparticles. Furthermore, three samples have not shown any detectable activity. The other six samples have shown detectable antimicrobial activity, but their efficacy was either partial (i.e. only against Gram (+) bacteria), either far lower than control.

From the 16 specimens studied in the second group, ten have shown activity levels, comparative with the controls. Those hand sanitizers were based on ethanol, 2-propanol and polyhexamethylene guanidine hydrochloride. Only one sample has shown absolutely no detectable activity, and five more had either selective efficacy, either it’s level was lower than control.

The results of this study have shown a decrease in the non-effective hand sanitizers amount on Ukrainian market (Fig.1). What is notable, from the six samples, shared by both groups, no changes in their efficacy were seen.

![Fig.1. Comparison of hand sanitizers efficacy before and during COVID-19 pandemic](#)

We can’t claim, that it is the manufacturer, who produces non-active hand sanitizers, as they were bought in regional drug stores, groceries and pharmacies, where the possibility of forgery appearance is present. Nowadays, there necessary legal framework for hygiene-oriented hand sanitizers producing in Ukraine is not established yet and needs to be developed and updated, but most of hand sanitizers from Ukrainian market were effective and can be used for infectious disease spreading (SARS-CoV-2 in particular) prevention.

**References:**


