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Evaluation of the efficacy of hydro-alcoholic products for hand skin disinfection: Case study Bactigel® used in the Livulu district of Lemba, Kinshasa City (Democratic Republic of Congo)

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A B S T R A C T

Preventing, reducing, and improving infection control have been struggles that have preoccupied the World Health Organization for many years. The present study aims to evaluate the efficacy of Bactigel hydro-alcoholic gel on the cutaneous flora of hands. The study was conducted by interviewing people on their knowledge and use of hydro-alcoholic products and culture of palm flora samples before and after hand disinfection. Results showed that 90% of respondents knew about hydro-alcoholic products, 96.3% of whom had already used them, and 92.3% were still used. In addition, 90% do not have alcohol-sensitive skin, and 80% use soap and water with soap for hygiene in their homes. Bactigel significantly reduced the microbial load on palms by 90.04%. Based on these results, Bactigel hydro-alcoholic gel is effective against skin germs. It is concluded that Bactigel can only be effective in the community when compliance is good hand hygiene.

Keywords: Skin flora, Hydro-alcoholic products, Palm disinfection, Bactigel, Efficacy

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Introduction

The prevention, reduction and improvement of infection control have been struggles that have preoccupied the World Health Organization for many years (WHO, 2009). Hands are one of the major pathways for the circulation of germs, some of which are pathogenic (Vogel *et al.*, 2021); in Tanzania, a study revealed the presence of bacteria indicative of faecal pollution on the hands of housewives (Pickering *et al.*, 2011). The mothers' poor hand hygiene was implicated in the occurrence of the onset of 50% of diarrheal episodes in children under the age of 5 years (Diakite *et al.*, 2018). In 2019, a study showed that there were means of cholera in East Africa (11%), South Africa (13%) and West Africa (15%) (Alkassoum *et al.*, 2019). In addition, a recent study shows that hands have been involved in the spread of COVID-19 since its first appearance in late 2019 (Umakanthan *et al.*, 2020).

Since the emergence of this new coronavirus pathology, numerous measures have been put in place to combat it, including preventive public health measures. Despite the development of a vaccine, these measures remain, nevertheless, the first choice in the fight against COVID-19, especially in regions where vaccination is less widespread (Talic *et al.*, 2021), particularly in Africa and the DRC (Bukasa *et al.*, 2021). It demonstrated that these measures have had a significant impact on common infections in society by reducing their incidence and impact (Launay *et al.*, 2021). Among these measures, hand hygiene is one of the most important against the spread of COVID-19 (Güner *et al.*, 2020). It helps to avoid, with the observance of certain practices, 70% of infections in hospitals (WHO, 2022). Moreover, hydro-alcoholic products are highly effective against SARS-Cov-2, Ebola virus, etc., and one study has shown their

effectiveness against multi-resistant bacteria (Ciotti *et al.*, 2021). In China, household disinfection with alcohol- and chlorine-based products reduced COVID-19 transmission by 77% (Talic *et al.*, 2021). After the WHO's declaration of a global health emergency, hand hygiene became an important means of limiting the transmission of COVID-19 (Zengarini *et al.*, 2020). However, in a global analysis of three studies, hand washing reduced the incidence of COVID-19 by 53%, but statistical analyses showed that the reduction was not statistically significant (Talic *et al.*, 2021). In 2016, Dokunde demonstrated in vitro the ineffectiveness of certain hydro-alcoholic products on certain bacterial strains, and according to Ali and Abed-Eliazim (2021) quoted by Pidot et *al.* (2018), certain bacterial able to survive exposure to low doses of alcohol. In our study, we evaluated the efficacy of hydro-alcoholic products for hand skin disinfection. The case of Bactigel® is used in the Livulu district of Lemba.

Materials and Methods

This was a cross-sectional study lasting two months, September and October. Our study focused on the Lemba population, aged over or equal to 15 years of age, and fixed sellers in small markets. We used hydro-alcoholic gel (Bactigel®) disinfectant and tested it on the cutaneous flora of the hands (palm). We inoculated our samples before and after disinfection on Mueller-Hinton II agar medium.

Sampling method

We sampled 30 people using a simple random method based on voluntary participation. Using a questionnaire we designed, we interviewed them in a face-to-face question-and-answer format (Uwingabiye *et al.*, 2015; Bukasa *et al.*, 2021). For the microbiological analysis, we used a method based on skin flora culture skin microbiota (Vogel *et al.*, 2021), which we sampled by swabbing the palm of the right hand before disinfection (T0) and after disinfection (T1) (Vogel *et al.*, 2021; Uwingabiye *et al.*, 2015) and we considered the hands macroscopically clean. Hand disinfection was performed using the hand friction method proposed by the WHO to control infections during the filovirus outbreak (WHO, 2014). We inoculated on Mueller-Hinton II agar using surface plating (Vogel *et al.*, 2021).

We used the surface enumeration method to assess our samples' microbial load. Colony counting was done by hand; we divided the petri dishes by 4, 8, 16, 32, or 64, depending on the load present. Petri dishes, and we counted the parts with a low load and the estimated value by multiplying it by the number of parts according to the division. In addition, we considered a "culture" without counting when counting was difficult. We verified heterogeneity by macroscopic examination of the cultures. This enabled us to determine the possible number of species in each dish (hands).

Data processing

Data were entered and analyzed using Excel 2010. We applied the Student's t-test to our data to compare the means of independent parametric data, the correlation and correlation coefficient correlation, and the paired data comparison test to identify relationships between parametric data. We consider significance (at the 5% threshold) when the $p < 0,05$ and the existence of a relationship when $p < 0,05$ and strong when $0,75 \leq r < 1$.

Results and Discussion

Table 1. Socio-demographic characteristics of the sample.

Sex	Number	Percentage
Masculine	11	36.7
Feminine	19	63.3
Age (years)	Number	Percentage
15-21	2	6.7
22-28	11	36.7
29-25	4	13.3
36-42	9	30.0
43-49	1	3.3
50-56	3	10.0
Civil status	Number	Percentage
Single	19	63.3
Married	10	33.3
Abstained	1	3.3
Study level	Number	Percentage
Primary	5	16.7
State graduate	11	36.7
Graduate	11	36.7
Licensee	2	16.6
Abstained	1	3.3

In our study, we interviewed and sampled the skin flora of the hands of 30 people, the majority of whom were women (63.3%), with a sex ratio of 0.58. The average age of our respondents was 33.3 ± 10 years; with a mode of 23 years modal class comprised individuals aged 22 to 28, with a frequency of 36.7%. Singles dominated the sample (63.3%), and graduates and postgraduates were the most represented, with 36.7% each (Table 1). According to our results, the majority of respondents (90%) claimed to know about hydro-alcoholic products under the term "disinfectant" (Figure 1). This result is higher than that found by Uwingabiye *et al.*, (2015) and Longembe and Kitronza (2020). Indeed, the myths surrounding vaccination have led the DRC's population to turn to preventive public health measures to combat COVID-19 (Bukasa *et al.*, 2021).

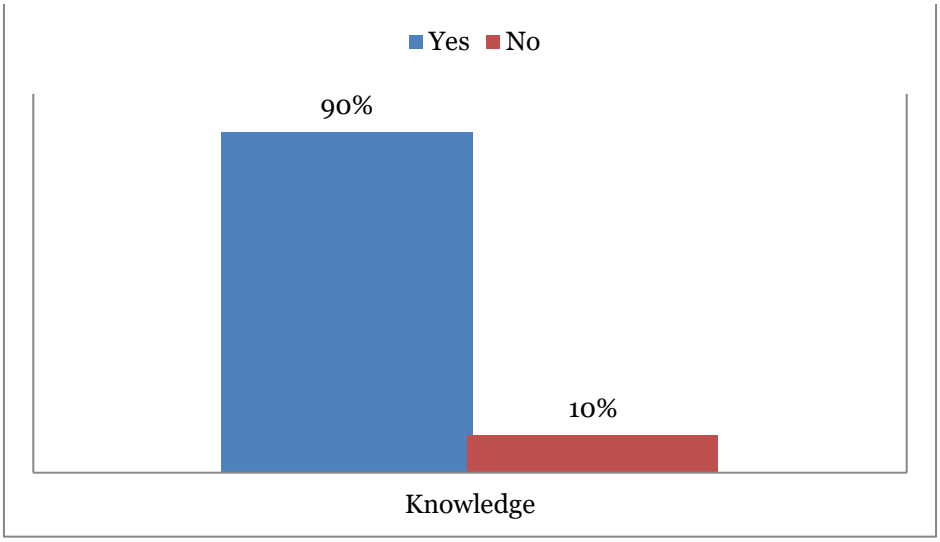

Figure 1. Distribution of respondents according to the knowledge of hydro-alcoholic products (disinfectant).

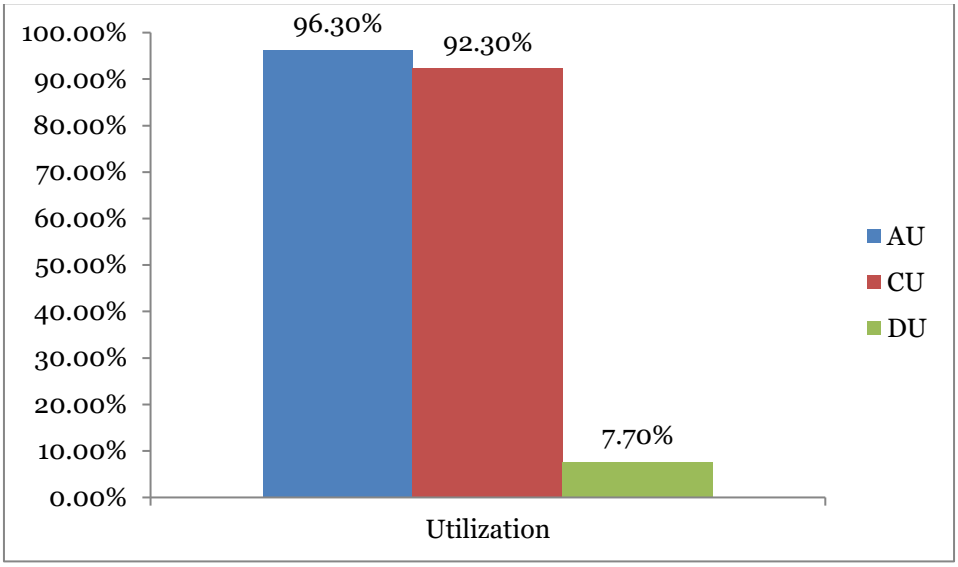

Figure 2. Use of hydro-alcoholic products in our sample, AU: already used; CU: continued use; DU: discontinued use.

Our analyses also showed that those who claimed to know about hydro-alcoholic products had already used them at least once in 96.30% of cases, and more than 90% continue to use them. However, 7.70% had stopped using them (Figure 2). These results concur with those of Lokonon (2020) since more than 80% of healthcare workers were using them, but they are higher than those found by Bukasa *et al.* (2021). Hand hygiene is one of the key measures against nosocomial infections (WHO, 2014), and Mwembo *et al.* (2021) have shown that hand hygiene with a hydro-alcoholic product was high in the DRC during this global health crisis. Furthermore, our data showed that the majority (90%) have skin that is tolerant to hydro-alcoholic products. This result confirms that of Derraji *et al.* (2013) and demonstrates the effectiveness of the new WHO formula (INSPQ, 2018). On the other hand, the hand rub technique is not known in the community (0%), as observed by Lukonon (2020) in the 4 health centers of Parakou, but 6% of healthcare workers at Kisangani General Hospital (Longembe and Kitronza, 2020). The population has not received any training, and awareness of practical observance has not been raised among the people. Bukasa *et al.* (2021) pointed out that practical knowledge was among the DRC population.

Despite widespread knowledge and use in the population, the frequency of use was low, with only 29% of respondents using them daily and only 37% using them often. We noted that 17% used them rarely (figure 3). A systematic study showed that hand hygiene was the preventive measure that did not significantly reduce the incidence of COVID-19 (Talic *et al.*, 2021). At least 90% of people do not comply with WHO guidelines for good hand hygiene (Zogblatin, 2018).

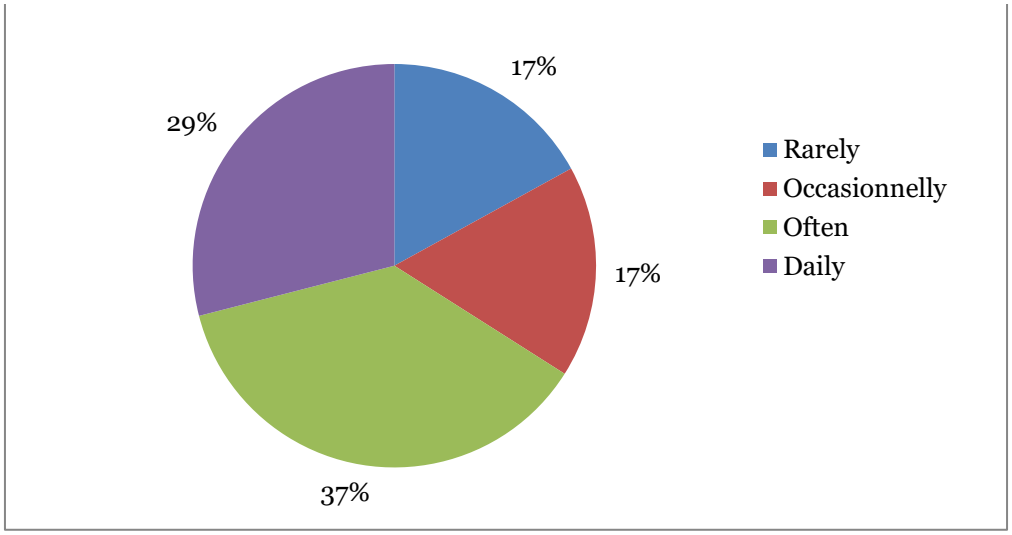

Figure 3. Frequency of hydro-alcoholic product use in the population.

Nevertheless, in the homes of our respondents, water and soap remained the most widely used means (80%) for hygiene in the house and only 3.3% for hydro-alcoholic products (figure 4). These results concur with those found by Uwingabiye *et al.* (2015) in the community environment. Still, they are higher than those found in the hospital environment and those found by Bukasa *et al.* (2021) among saleswomen at Lubumbashi's Texaco market. Hand hygiene with soap and water is the cheapest and most widely available for the entire population (INSPQ, 2018).

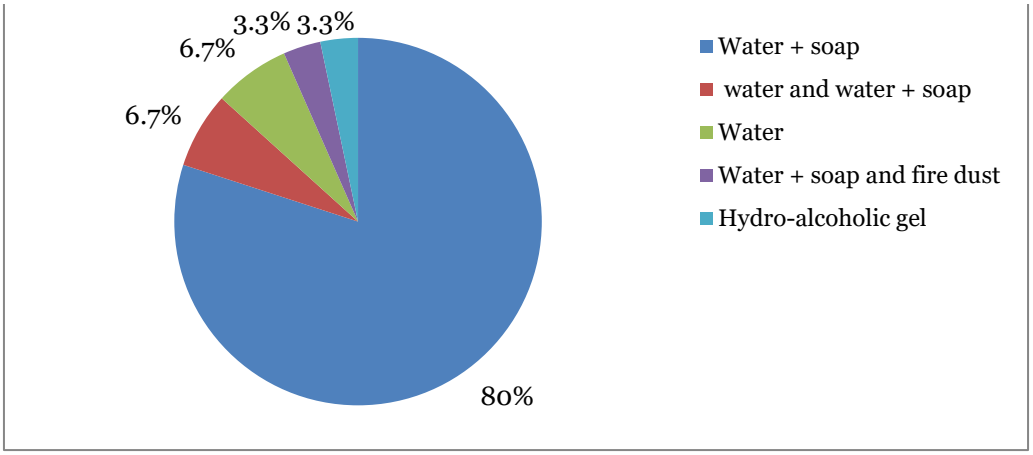

Figure 4. Types of hand hygiene used by people in their homes.

Microbiological data from the vendors' hands showed that the contamination rate was 100%. However, Vogel *et al.* (2021) and Zèbre *et al.* (2022) showed 76% and 69% contamination rates, and Uwingubiye *et al.* (2015) found that all phone jackets were contaminated. However, we observed that the microbial load on women's hands was not statistically different from that on men's ($p = 0{,}40$).

Our cultures were heterogeneous, with an average of 6.4±2.2 species. Vogel *et al.* (2021) identified numerous species on hands, some of which were pathogenic, and Uwingabiye *et al.* (2015) identified numerous species of transient hand flora on telephone covers. We also noted that women's hands were not statistically more heterogeneous than those of men were ($p = 0{,}53$); in addition to age ($r = -0{,}26$; $p = 0{,}01$) and microbial load ($r = -0{,}39, p < 0{,}05$) had little influence on the number of species. For Bactigel's germicidal activity, we noted that the microbial load prior to microbial load before disinfection was significantly higher than the load after disinfection ($p = 0{,}008$). Bactigel gel reduced the load on the hands by up to 90.04% (figure 5). On inert surfaces, hydro-alcoholic products reduce the microbial load by up to 99.5% (Uwingabiye *et al.*, 2015). In addition, some studies have shown that certain hydro-alcoholic products are not effective in vitro (Dokounde, 2016; Zèbre *et al.* (2022). It has been demonstrated that hydro-alcoholic products with 70° alcohol were more effective than those containing 98° alcohol (Zèbre *et al.*, 2022). This is because alcohol evaporates more quickly when it is in concentration.

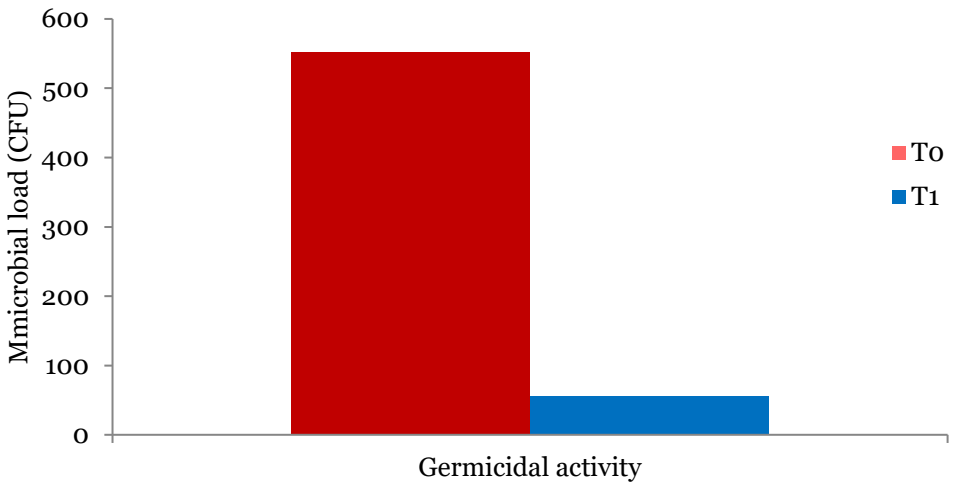

Figure 5. Germicidal activity of alcohol contained in hydro-alcoholic gel (Bactigel®).

Conclusion

We have carried out a study of the efficacy of hydro-alcoholic products for hand disinfection in the case of Bactigel. It concerned small market vendors in the Livulu district. It provided an overview of the effectiveness of the hydro-alcoholic product (Bactigel) on the germs that contaminate hands, as well as the knowledge and use of hydro-alcoholic products among the population. We conclude that understanding of hydro-alcoholic products is widespread in the population (90.00%) during this period of health crisis, with 96.30% having already used them. Most of the population (90.00%) does not suffer from the undesirable adverse effects of alcohol (skin irritation and dryness). Using soap and water is the main means (80.00%) of hand hygiene in menages. Although these proportions of the population hand rubbing technique are unknown (0.00%). The hydro-alcoholic product, Bactigel, significantly reduced the microbial load by 90.04% on hands. Our results confirm our hypothesis that proper application of hydro-alcoholic gel could reduce the microbial load on hands. However, daily use is required for good protection and infection control. Because of these results, we affirm that hydro-alcoholic gel (Bactigel) is effective; however, it cannot be used as a means of prevention against possible epidemics and the current pandemic only if its use complies with the standards for good hand hygiene.

Conflicts of interest

The authors confirm that there are no conflicts of interest.

Contribution of the authors

Odette Kabena and Anicet Kuabayina conceived, designed, and developed the research protocol. Lionel Asamboa, Josué Mbobo, and Lyz Makwela did the laboratory work. Jean-Jacques Amogu, Ruth Katunda, and Didier Dianzuangani wrote the present manuscript.

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