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Evaluation of Heavy Metals and Antimicrobial Efficacy of Four Hand Sanitizers Used during COVID-19 in AFIT, Kaduna.

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----------***ABSTRACT***----------
This study was to evaluate the permissible exposure limit (PEL) of heavy metals and the antimicrobial efficacies of four hand sanitizers, in disinfection of bacterial contamination in Air Force Institute of Technology, during the pandemic of Corona virus disease-2019 (COVID-19). The products tested were that of Air Force Institute of Technology-AFIT, with other brands identified as sample A, B, C, and D respectively. AFIT sanitizer is an alcohol-based hand sanitizer certified by Standard Organization of Nigeria (SON). Sample A, B, C, and D; are alcohol-based hand sanitizers are products certified by Nigerian Agency for Food and Drug Administration Control (NAFDAC), which are commercial brands of hand sanitizers sold in the market. Sample A product was found to be more effective in reducing bacterial load when compared to sample C and D products. All samples had a bacteriostatic effect to E.coli. Sample B, C and D sanitizers were shown to have more presence of cadmium (Cd), while sample A, B and D had presence of Lead (Pb), sample C alone had the presence of copper (Cu), which are all toxic to the human body. The community showed more interest to antimicrobial efficacy and skin compatibility as a reasonable number were irritated by the scent.
Keywords*: COVID-19, hand-sanitizer, heavy metals, antimicrobial efficacy*

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I. INTRODUCTION

The Corona virus pandemic also known as severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) was initially reported to the World Health Organization (WHO) on December 31, 2019. On January 30, 2020, the WHO declared the COVID-19 outbreak a global health emergency [1]. Today, hygiene is associated with disease prevention and health promotion. The importance of hygiene is universally recognized and evidence based [2]. Physical contact between people and objects is a key vehicle for the transmission of pathogens. Therefore, effective hand hygiene is a key intervention in disease prevention [3]. In the health care practice, alcohol is used as a disinfectant for health care products, in order to prevent crossed transmission of microorganisms. Reviews have concluded the microbiological safety of semi-critical products that are disinfected with alcohol cannot be fully ensured, as some microbial groups detected are believed to be resistant to alcohol. It's worth mentioning that, despite alcohol not being a sterilizing agent, its action promoted the full elimination of microorganisms in four studies. [4, 5, 6, 7]. The COVID-19 outbreak gave rise to different preventive pharmaceutical and non-pharmaceutical measures, to mitigate the situation. It is therefore imperative, to know the level of heavy metals present in some hand sanitizers used during the COVID-19 pandemic.

II. MATERIALS AND METHOD

Reagents

McConkey agar, salmonella shigella agar, chocolate agar, and sensitivity agar. All other reagents were of analytical grade.

Experimental Design

A 15ml of AFIT, sample B, C and D Hand sanitizers were aseptically transferred into a sterile universal bottles and kept at room temperature. A locally prepared sensitivity disc was sterilized in a hot air oven at 170^0C for 1hour (fig 1) after which it was aseptically transferred into the sterile universal bottles containing hand sanitizer: and controls respectively and was allowed to stay for 24hours at 37C for proper impregnation.

A pure colonies of bacteria; Staphylococcus aureus, salmonella typhi, Escherichia coli and fungi; candida spp., was subcultured into chocolate agar, salmonella shegella agar and mcConkey agar respectively to ascertain their purity through gram staining and other biochemical test.(Fig 2).

After 24hour of incubation, a sensitivity test was carried out on various isolated bacteria and fungi using the impregnated antibacterial sensitivity disc prepared from AFIT, sample B, C and D sanitizer respectively (fig 4). The table 1 shows the effect of the hand sanitizers against pure colonies of pathogens.

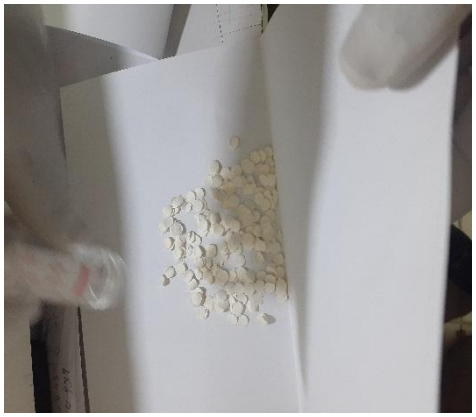

Figure 1: A standard, locally prepared sterilized sensitivity disc, impregnated with AFIT, sample B, C, and D Sanitizers.

Figure 2: A pure colonies of bacteria; *staphylococcus aureus, salmonella typhi, Escherichia coli,* and fungi; *candida spp.*

Statistical Analysis

Results are expressed as mean ±S.E.M. The levels of homogeneity among the groups were assessed using One-way Analysis of Variance (ANOVA) followed by kruskal-wallis test. All analyses were done using SPSS software Version 25 and p values ±0.003 were considered statistically significant.

III. RESULTS

The Bacteria and fungi collected, have an average of 10 colonies each. There was a significant overall increament in the level of Molybdenum (Mo) and Zirconium (Zr), there was a significant difference in the distribution of Zr among sample A, B, C and D. These differences were significant in <0.003 between the sanitizers. Sample B, C and D sanitizers were shown to have more presence of cadmium (Cd), while sample A, B and D had presence Lead (Pb), sample C alone had the presence of copper (Cu), which are all toxic to the human body (fig 3). The community showed more interest to antimicrobial efficacy and skin compatibility as a reasonable number were irritated by the scent.

Sample C and D antimicrobial efficacy against microorganisms were less bactericidal when compared to A and B, this is due to the high viscosity of Sample D, produced with a carbomer 940 gelling agent (carbopol), the more thick, the lesser the microbiological efficacy.[8] The carbopol additive is suspected to have reduced the antimicrobial efficacy (table 1).

Meanwhile, all the sanitizer samples AFIT, B, C and D were shown to be Bacteriostatic to E.coli (table 1). This further confirms recent studies, that alcohol is resistant to some groups of microorganisms.

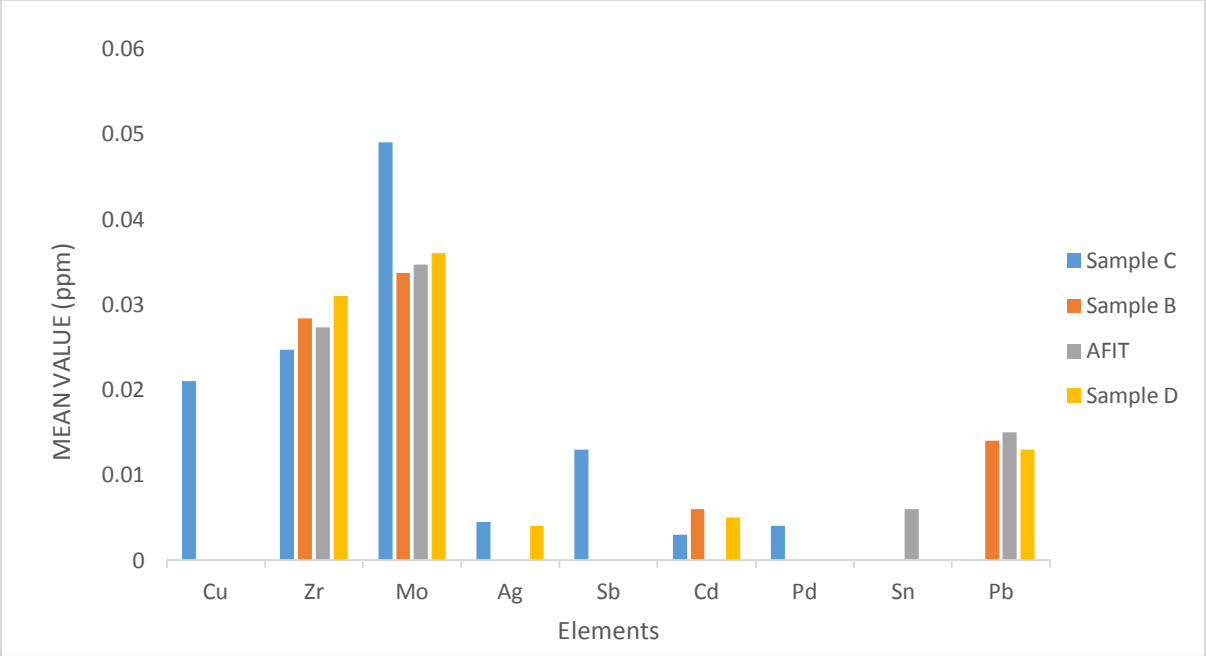

Figure 3. Heavy metals burden in absolute numbers of AFIT, Sample B, C, and D sanitizers

Table 1: The effect of antibacterial Hand sanitizers on Pathogens

MICROORGANISMS	AFIT HAND SANITIZER	Sanitizer B	Sanitizer C	Sanitizer D
Salmonella typhi	S+	S+++	S+	S+
Staphylococcus aureus	S+	S++	S+	S+
Escherichia coli	R	R	R	R
Candida spp.	S++	S+	R	S+

Effect of sanitizer samples on pathogens. (+) = level of significance against microorganisms. S=Sensitivity, R= Resistant

Figure 4: A sample of the sensitivity disc, incubated after 24hour at 37^0C. Showing the zone of inhibition against bacteria.

IV. DISCUSSION

Alcohol serves as the main ingredient in the effect of bactericidal. During hand sanitizer production, there has been two popular formulations of alcohol used worldwide, ethanol and isopropyl alcohol, meanwhile isopropyl alcohol is majorly used in this regard. Methanol or ethylene glycol are quite poisoning, the metabolites of isopropyl alcohol are considerably less toxic, and treatment is largely supportive. [9] All samples except sample B made their productions with Isopropyl alcohol. In 1990 over 5,000 metric tonnes were used for household purposes and in personal care products. Isopropyl alcohol is popular in particular for pharmaceutical applications,[10] Isopropyl alcohol has been revealed to be a skin irritant.[11] AFIT hand sanitizer indicates more safety at it usage, because of the presence of vitamin E and aloe vera constituents in its formulation with isopropyl alcohols, compared to sample B, C and D. Toxicological effects has shown that poisoning can occur from ingestion, inhalation, or skin absorption.[12] Therefore a proper labelling of caution should be in mind,

due to the alcohol content. For an effective usage of isopropyl alcohol in antibacterial hand sanitizer, 99% isopropyl alcohol is dissolved in water to give 70-75% concentration. Water is required to open up membrane pores of bacteria, which acts as a gateway for isopropyl alcohol. A 75% v/v solution in water may be used as a hand sanitizer.[13] This is evidence to why sample C sanitizer had more bactericidal effect than other samples. A reasonable population show microorganisms of faecal origin on their hands, which implies low or bad hand hygiene compliance after using the toilet.[14] All the tested hand sanitizers showed a satisfactory bacterial reduction to *Salmonella typhi*, a faecal origin bacteria. The findings of this study indicates that all sanitizer samples had a bacteriostatic effect to *Escherichia coli*, a further research is required on this.

V. CONCLUSION

The study shows that some of the hand sanitizers obtained, contain hazardous compounds which are toxic to the human body, therefore, manufacturers must carefully select gelling agents and other additives during production, some additives affect a sanitizer antimicrobial efficacy. The public must be informed on the need to exercise caution while using hand sanitizers to meet their health care need.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

[1]. Ramzy A and McNeil D., (2020). WHO declared global emergency as Wuhan coronavirus spreads. The New York times. Available at https://nyti.ms/2RER70M.

[2]. Semmelweis IP (1861) Die A¨ tiologie, der Begriff und die Prophylaxis des Kindbettfiebers. Wien, Leipzig: Pest.

[3]. Aiello AE, Coulborn RM, Perez V, Larson EL (2008) Effect of hand hygiene on infectious disease risk in the community setting: a meta-analysis. Am J Public Health 98: 1372–1382.

[4]. Alvarado CJ, Anderson AG, Maki DG. Microbiologic assessment of disposable sterile endoscopic sheaths to replace high-level disinfection in reprocessing a prospective clinical trial with nasopharygoscopes. Am J Infect Control. 2009;37(5):408–413.

[5]. Baldissera EZ, Fontanella V, Torriani MA. Avaliação da desinfecção de filmes radiográficos periapicais utilizando diferentes soluções. Rev Odonto Ciênc. 2006;21(52):153–157.

[6]. Ch ang D, Florea A, Rowe M, Seiberling KA. Disinfection of flexible fiberoptic laryngoscopes after in vitro contamination with Staphylococcus aureus and Candida albicans. Arch Otolaryngol Head Neck Surg. 2012;138(2):119–121.

[7]. Pepose JS, Linette G, Lee SF, MacRae S. Disinfection of Goldmann tonometers against Human Immunodeficiency Virus type 1. Arch Ophthalmol. 1989;107(7):983–985.

[8]. World Health Organization, Guide to Local Production, Recommended Handrub formulations revised April (2010).

[9]. Isopropyl alcohol poisoning" . uptodate.com. Retrieved 2017-10-10.

[10]. Papa, A. J. "Propanols". Ullmann's Encyclopedia of Industrial Chemistry. Weinheim: Wiley-VCH. doi:10.1002/14356007.a22_173

[11]. McInnes, A (1973-02-10). "Skin reaction to isopropyl alcohol" . British Medical Journal. 1 (5849): 357. doi:10.1136/bmj.1.5849.357-c . ISSN 0007-1447 . PMC 1588210 . PMID 4265463 .

[12]. Slaughter RJ, Mason RW, Beasley DM, Vale JA, Schep LJ (2014). "Isopropanol poisoning". Clinical Toxicology. 52 (5): 470–8. doi:10.3109/15563650.2014.914527 . PMID 24815348 . S2CID 30223646 .

[13]. Water is required to open up membrane pores of bacteria, which acts as a gateway for isopropyl alcohol. A 75% v/v solution in water may be used as a hand sanitizer.

[14]. Judah G, Aunger R, Schmidt W-P, Michie S, Granger S, et al. (2009) Experimental pretesting of hand-washing interventions in a natural setting. Am J Public Health 99: 405–411.

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