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ATR-FTIR Quantitation of Isopropyl Alcohol (IPA) and Ethanol in Some Covid-19 Targeted Hand Sanitizers in Nigeria

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Abstract*: The Corona Virus originated from Wuhan, China in the later part of 2019. As at the end of 2020, no medication or vaccine is available for the treatment and/ or control of the Covid-19 pandemic yet. However, preventive measures have been suggested by the World Health Organization (WHO) which include proper and regular personal hygiene and a healthy life style. Regular washing of hands using soap and water and the use of Hand sanitizers have been suggested as the first line of defense against the SARS COV2 virus. In this study, the Shimadzu FTIR-8400S Fourier Transform Infrared Spectrophotometer with Attenuated Total Reflectance (ATR) accessory was used for the quantitation of the isopropyl alcohol (IPA) and Ethanol content of nineteen (19) different brands of hand sanitizers used in Kaduna state, Nigeria and its environs for the non-pharmaceutical prevention of COVID-19. Results revealed an Isopropyl alcohol concentration in the range of 10.155% to 85.684% and an Ethanol concentration in the range. Of the nineteen samples studied, five had an IPA concentration below 50%. Nine of the samples had concentrations above the World Health Organization (WHO) recommended 75%. The implications on the health of the populace, with respect to the efforts to combat and contain the ravaging SARS COV-2 virus and the resultant COVID-19 are discussed.*

Key Words: *CoV-2, COVID-19, hand sanitizers, isopropyl alcohol, ethanol, quantitation, ATR-FTIR*

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1.0 Introduction

The Corona virus pandemic has significantly altered the world economic, social, political and phsological stability especially during the lock down and post lock down era. According to WHO (2021), a total of one hundred and nine million five hundred and ninety-four thousand, eight hundred and thirty-three cases of corona virus has been reported globally as at 18th February 2021. Out of these cases, two million, four hundred and twenty-four thousand and sixty cases of deaths have been confirmed. WHO (2020) has encouraged the use of vaccine in an attempt to arrest the spread of the pandemic and yet hand washing and the use of face mask has become global practices that have been sustained even by legislation in most countries of the world. Hand washing is upheld by several scientific opinions especially since the real cure for the virus is yet to be discovered and the vaccines available still escalate some doubts on its efficacy (WTO 2021). The World Health Organization recommended hand washing as a major strategic non-pharmaceutical procedure for the prevention and control of the Pandemic. According to Kampf and Kramer (2004), in a common situation where there is shortage of soaps and water, the availability of a cheap and handy hand sanitizer can serve as a good control for germs and microorganisms. Consequently, in several nations of the world, provision is made in public places for safe water and/or hand sanitizers (containing at least 60 % alcohol) as an infrastructural challenge stop-gap measure. However, the WHO recommends a minimum of 75 % alcoholic content for the hand sanitizer (Berardi *et al*., 2020a; Bhalla 2020).

Alcohols are chaotropic agents, indicating that they are able to break down hydrogen bonds in most matrices. Proteins and amino acids depend on these

hydrogen bonds to form and maintain their structures; including their stereochemistry. Alcohols act as antimicrobial agents because of their ability to denature the proteins that make up the microorganisms, like the SARS-COV2 virus (Ewen *et al.,* 2010). Therefore, the introduction of most alcohols to a matrix containing a protein is most likely going to result in denaturing the protein and destruction of the microorganism (Chen, 2020; Berardi *et al.,* 2020b).

In this study, the efficacy of nineteen hand sanitizers vis a vis their ethanol and isopropyl alcohol (IPA) content was determined using the ATR FTIR method of quantification. The percentage of the disinfectant alcohols in the hand sanitizers were determined. Ethanol and isopropyl alcohol, a primary a secondary alcohol respectively, both have Infrared signature peaks at different positions in the spectra. The peak intensities of these signature peaks were used to quantify the isopropyl alcohol and ethanol present in the hand sanitizer sprays and rubs (Singh *et al.,* 2020; Babic *et al.,* 2020)

2.0 Materials and Methods

Beer Lambert's law was used to generate the calibration curve for isopropyl alcohol (IPA) – based hand sanitizers (Fig. 1) and ethanol – based hand sanitizers (Fig. 2). The calibration curve for IPA-based sanitizers was created based on the standard curve derived from the peak intensity of a peak at 1128.39 cm^{-1}, corresponding to the C – O stretch of a secondary alcohol (secondary alcohols typically have a strong C – O stretching at 1124 – 1087 cm^{-1}), while the one for ethanol-based hand sanitizers was created based on the standard curve derived from the peak intensity of a peak at 1045.45 cm^{-1}, corresponding to the C – O stretch in a primary alcohol.

3.0 Results and Discussion

Fig. 1 shows the calibration curve for isopropyl alcohol, while Fig. 2 shows similar plot for ethanol.

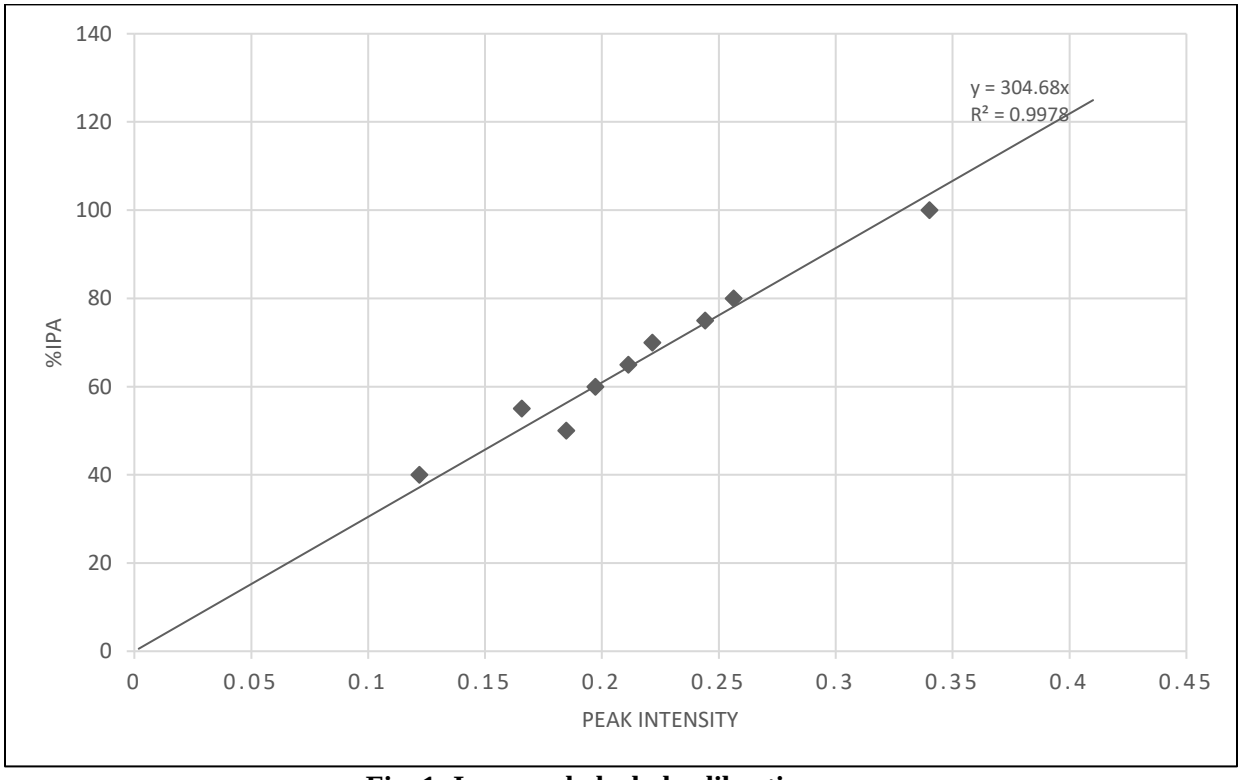

Fig. 1: Isopropyl alcohol calibration curve

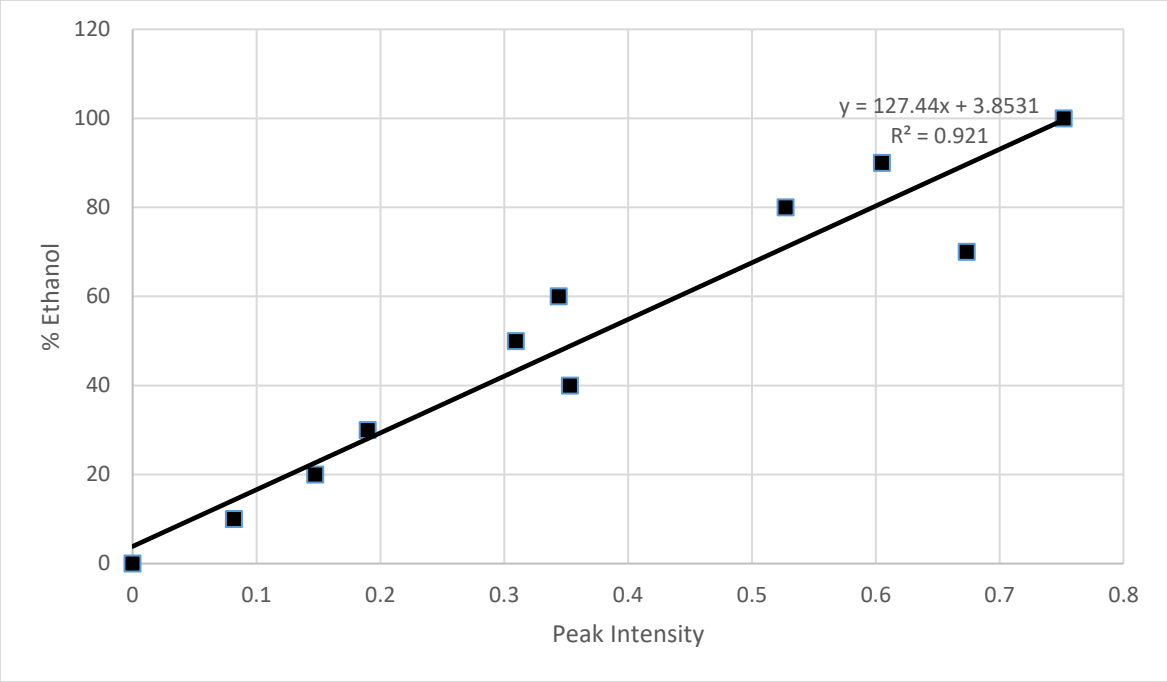

Fig. 2: Ethanol calibration curve

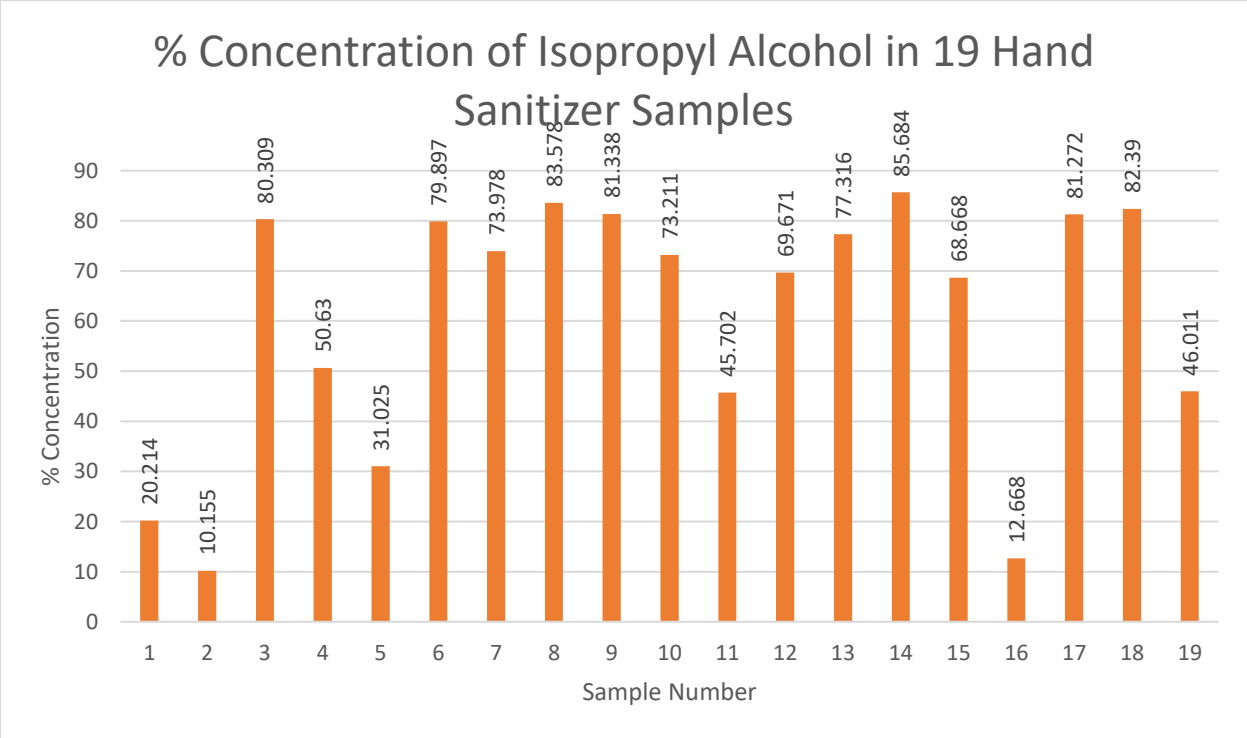

Fig. 3: Concentration of isopropyl alcohol in 19 hand sanitizers

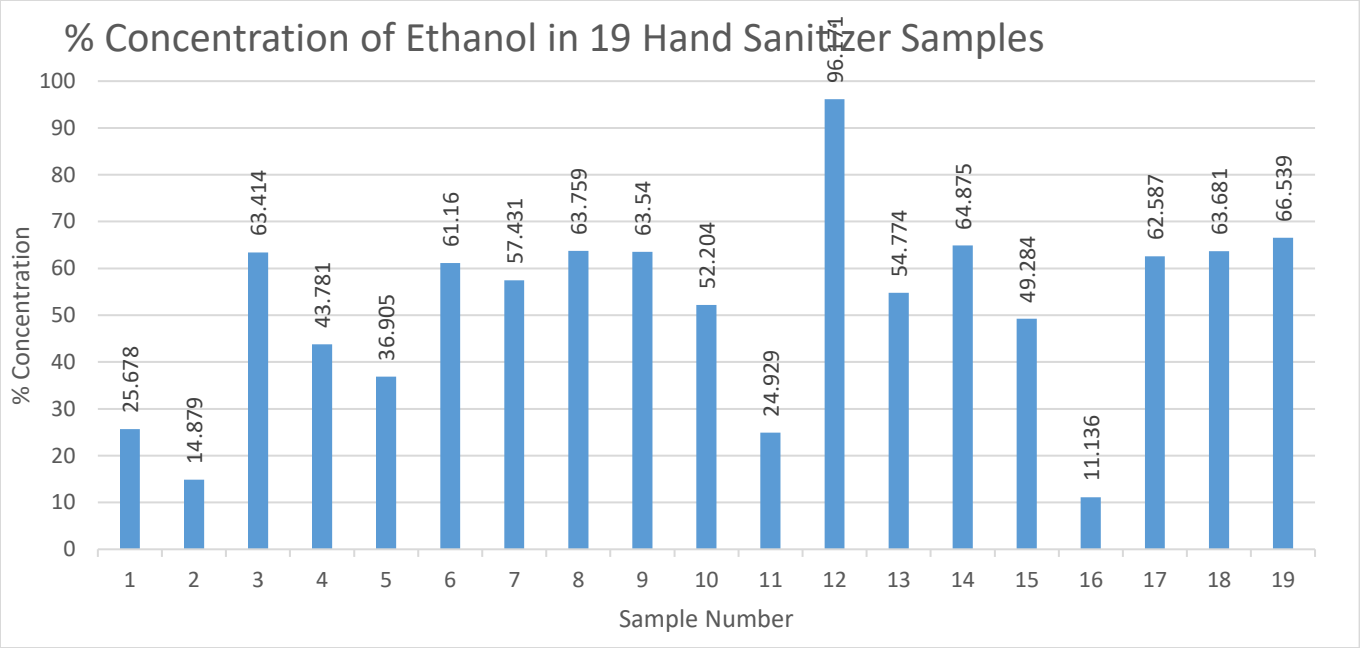

Fig. 4: Concentration of ethanol in 19 hand sanitizers

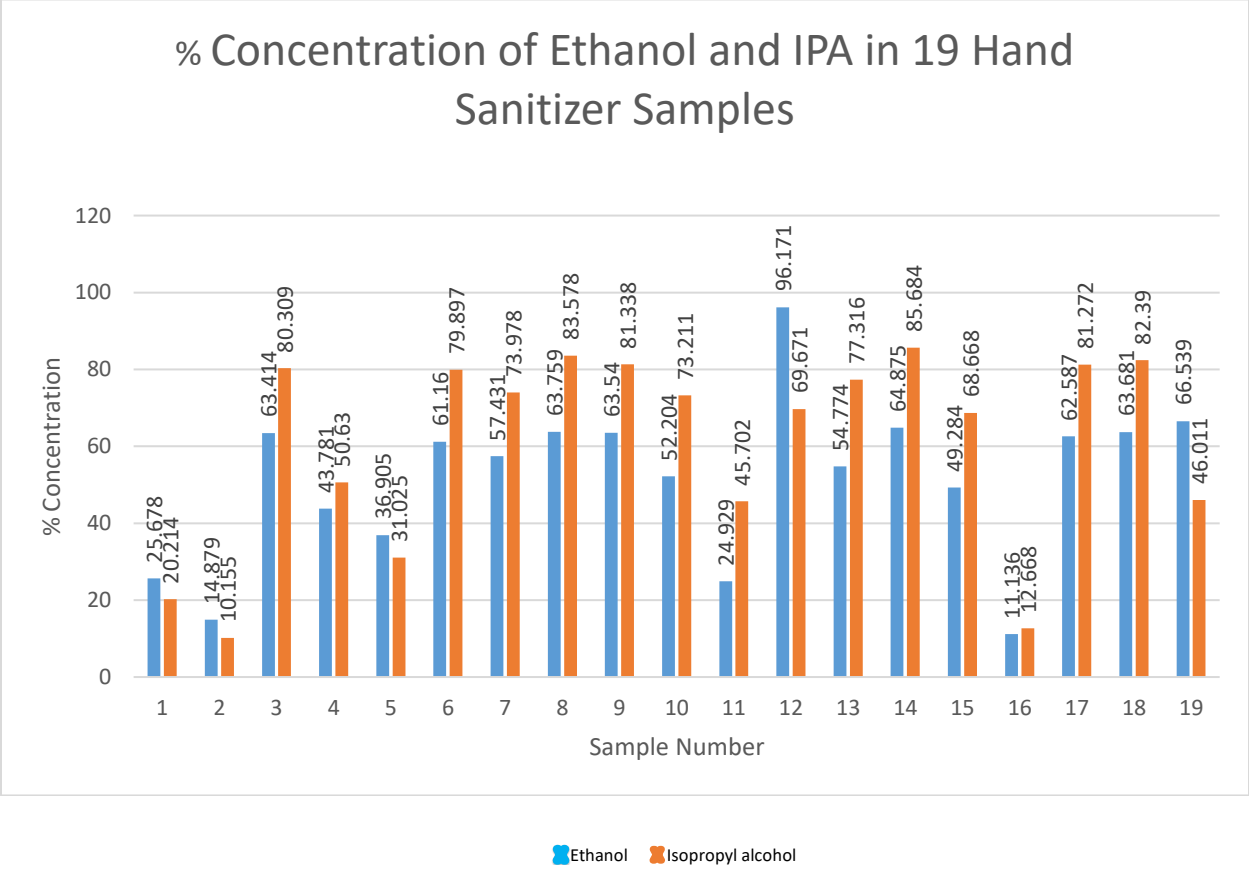

Fig. 5: Concentrations of ethanol and isopropyl alcohol in 19 hand sanitizers

From Fig. 3, it is evident that concentration of isopropyl alcohol ranged from 10.155 % (in sample 1, 2, 5, 11, 16 and 19) to 85.68% in sample 14. Out of the 19 samples selected for this study, six samples (Samples 1, 2, 5, 11, 16 and 19) were observed to have concentration of isopropyl alcohol below 50 %, while eight samples (Samples 3, 6, 8, 9, 13, 14, 17 and 18) had concentrations above the World Health Organization (WHO) recommended value of 75%. This indicates that only 42.11 % of the analyzed hand sanitizers met the WHO recommended minimum of 75 % with respect to concentration of isopropyl alcohol. Consequently, the expected activity of some of the sanitizers, may not be sufficient to inhibit the virus. This can result in unimaginable threat to public health since the users may not be aware that what they rest their confidence on may not yield the anticipated result. Therefore, the health of the populace, with respect to the efforts of combating and containing the ravaging SARS COV-2 virus and the resultant COVID-19 disease may be compromised. Also, Fig. 4, reveals that the concentration of ethanol in the hand sanitizers ranged from 11.136% to 96.171%, with the lowest concentration observed in sample number 16 (11.136%) and the highest in sample 12 (96.17%). Seven of the samples had ethanol concentrations below 50% (Samples 1, 2, 4, 5, 11, 15 and16) but only samples 12 had ethanol concentration above the World Health Organization (WHO) recommended 75%. This represent 5.26% of the number sampled. However, most of the samples had ethanol concentrations between 37 and 67%, which is not sufficient to achieve the intended result. Generally, 94.74% of the sampled hand sanitizers failed to meet the required threshold of 75% alcohol content.

Results also showed that 57.89% of the hand sanitizers analyzed were not useful as control against the corona virus since their isopropyl alcohol and ethanol content were below 75% (Fig. 5). This is a very disturbing finding as people in Kaduna and its environs depend on these commercially available hand sanitizer products as a first line of defense against contracting the novel disease.

4.0 Conclusion

The present study was designed to assess the level of ethanol and isopropyl alcohol in nineteen hand sanitizers common in the Nigerian market. The results and finding of the study indicate that most of the hand sanitizers in Nigerian market do not meet the WHO recommended limits with respect to ethanol and isopropyl contents. Therefore, the need for proper monitoring of the production and marketing of hand sanitizers is strongly recommended.

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