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PUBLISHER

WEDC, Loughborough University

VERSION

VoR (Version of Record)

LICENCE

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REPOSITORY RECORD

Ezenwaji, Emma, O.O.C. Evulobi, R.N. Amasiani, and P.A. Okeke. 2024. "Examining the Limitations of Solar Water Disinfection (SODIS) as a Household Water Treatment Technology in Nigeria". Loughborough University. <https://doi.org/10.17028/rd.lboro.28016630.v1>.

43rdWEDC International Conference

ONLINE: 9 – 13 September, 2024

WATER AND CLIMATE RESILIENCE

**Examining the limitations of solar water
disinfection (SODIS) as a household water
treatment technology in Nigeria**

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Introduction

There has been an on-going search to ensure that the global south, especially tropical countries can take advantage of high biodiversity and good solar irradiance to develop nature-based solutions to some of her challenges. One of such challenges is lack of safe drinking water which affects many rural communities. For example, in sub-saharan Africa, one in every 10 children under five years old dies due to diarrhoea or related ailments (Garcia-Gil, Garcia-Munoz, McGuigan & Marugan, 2021). In Nigeria, one in every thirteen children dies before reaching the age of one and one in every eight before reaching their fifth birthday of diarrhoea or related diseases (UNICEF, 2021). This is in addition to the fact that over 57 million Nigerians are without access to potable water; a larger proportion of which is in the rural areas and are farmers (Ezenwaji *et al.*, 2021). Since most of the vulnerable groups are farmers, there is a dire need for a study on the drinking water supply situation in such areas.

Aim of the study

The aim of this study was therefore to investigate the limitation of sodis technology in treatment of water at the household level. Two most common problems revealed by field work in achieving water treatment using sodis are those of unavailability of standard reactor bottles in Nigeria and high scattering index of the UV during harmattan season resulting from too much dust particles in the air. Two popular used plastic water bottles brands were utilised to ascertain which one would be more efficient as sodis reactor bottle. The harmattan months were chosen because it is the period posing greatest water challenge to most farmers in rural communities as wells and other water sources dry up making the communities vulnerable to water-borne diseases. Two known studies in Nigeria, Nwankwo *et al* (2020) and Amatobi and Agunwamba (2022), unfortunately did not discuss these two limitations on sodis, thus necessitating this study.

Methodology

This study is based in one of the peri-urban communities, in Awka Capital Territory, Anambra State, Nigeria, where most of the farmers live. The method adopted were field work and laboratory work. Ten (10) Composite water samples were collected from the community drinking water source and subjected to SODIS on roof-top using consumer-friendly used bottled water containers in the harmattan months of November to February. Five sample bottles marked as made from polyethylene terephthalate (PET), each from two different packaged water brands of 75 CL were filled with the water from the community drinking water source. One from each of the sampled branded bottles were kept in the dark as control while four each from the two branded bottles were exposed to sunlight on the rooftop between 8-12 hours. The spread plate method was used for isolation of bacterial pathogens from the water samples using Macconkey agar. One ML of each seed sample was aseptically collected and serially diluted in normal saline to the fourth dilution using a ten-fold serial dilution. About 0.1ml aliquot of each dilution was inoculated onto duplicate

set of Macconky agar to determine total E coli population. All plates were incubated at 35°C for 24 hours. After the incubation period, the samples were analysed for faecal Coliform bacteria (FCB) counts. The FCB count in each agar plate sample was determined as CFU/ml and was calculated using the formula:

$$\text{Cfu/ml} = \{(\text{No. of colonies} \times \text{dilution factor}) / \text{volume of inoculums}\}$$

Results and discussions

The result showed that brand B had the lowest FCB average counts of 0.4×10^4 (CFU/ml) while brand A recorded average of 1.9×10^4 (CFU/ml) making branded B the preferred container for SODIS treatment whereas the average recorded in the control treatment was 0.7×10^4 (CFU/ml). The above results indicate significant success in the understanding of a bottle brand that can be recommended to households for use as sodis reactor bottle, and how harmattan weather adversely affects sodis technology in Nigeria. This thus means that sodis may not be a good water treatment option during harmattan in Nigeria, although it is good for other months of the year. Despite these breakthroughs in knowledge, there are obvious challenges:

1. SODIS has not been used as a water treatment option for large volume of water.
2. SODIS require strict suitable weather condition.
3. It requires clear water turbidity <30NTU

Lessons learned

From the foregoing however, some lessons are learnt and they are:

1. Success recorded in any community can be upscaled
2. SODIS is not a good water treatment option during harmattan
3. Not all bottles marked as PET for use in sodis are actually PET bottles.
4. Volume of the bottles used are small and therefore do not meet the household water requirements
5. Communities are advised to use other water treatment methods for treatment of drinking water during harmattan for examples, boiling, use of chlorine and aquatabs.

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