Detection of Faecal Coliforms in Biofilms of Water Tankers in Odongunyan, Ikorodu - A Peri-Urban Lagos Settlement

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Abstract

Unavailability of public piped water in Odongunyan- a peri-urban community in Ikorodu Local Government of Lagos State, South West Nigeria compelled the people to seek water from other sources. Water transportation with the aid of commercial tankers is one of the means used to convey water from source to other areas of need within the community without adequate concern to its public health implications. This study investigated the presence of *Escherichia coli*- an indicator of faecal contamination in the biofilms of thirty water tankers in the community. Of the thirty tankers investigated for *E. coli* using the membrane filtration technique, all the tankers showed the presence of *E. coli* in their biofilms. The *E. coli* counts ranged between 1.3 x 10^4 cfu/cm^2 and 4.2 x 10^4 cfu/cm^2. The total plate counts ranged between 5.1 x 10^4 cfu/cm^2 and 9.8 x 10^4 cfu/cm^2 and the pH of the water collected in all the tankers also ranged between 6.54 -7.03. The results showed that the water tankers biofilms are loaded with faecal contaminants and there is need for sanitation legislation at local levels to ensure regular disinfection compliance by commercial water hawkers.

Keywords: Biofilms, coliforms, sanitation, Escherichia coli

Introduction

As populations grow, more people, for economic reasons settle at the outskirt of cities which usually are without proper town planning programmes and adequate access to potable and safe water. Natural water sources available to them. like wells, get contaminated easily due to the various human activities like shallow and unprotected latrines, unguided drainages, flooding, refuse dumping and seepages. However, drainage, safe storage and distribution of water supplies are critical factors that determine the extent to which many diseases are either contained or propagated in urban communities (Sutherst, 2004). The distances of available water sources compound the problems of availability, where women have to travel long distances to fetch water. Transport systems introduced by commercial operators, though solve the problem of availability; it however introduces another critical problem of sanitation of the water tankers. Majority of the commercial water tanker operators completely abandon sanitation of the tankers or leave it for a long period without washing, leading to biofilm formation in the water tankers. This has a great health implication on communities that rely substantially on water from these tankers. This is due to the fact that bacteria, growing in a

free-living state after sometime, adhere to surfaces by producing extracellular polysaccharide, or in some cases, by means of specialised structures termed holdfasts (Marques *et al*, 2007). These bacteria form what is called microcolonies, which eventually accumulate to biofilms. The biofilms have even been found to contain microbes which may be deleterious to human health (Zottola and Sasahara, 1994). Biofilms primarily are usually composed of one bacterial species, but habitually develop to contain many other bacteria, thus creating an intricate community of microbes. *E. coli* is among the major etiologic agents endemic in essentially all developing countries that account for the estimated 1.5 million deaths per year usually transmitted in water. (Quadri *et al*, 2005). The bacterial species *Escherichia coli* is a normal inhabitant of the gastrointestinal tract of humans and other warm-blooded animals. While most *E. coli* strains do not cause human disease, some strains possess virulence factors which can cause life-threatening conditions (Grant *et al,* 1996). Several studies have confirmed that water-related diseases not only remain a leading cause of morbidity and mortality worldwide, but that the spectrum of disease is expanding and the incidence of many water-related microbial diseases is increasing (WHO, 2001; Payment*.,* 1991, 1997; Isaac-Renton *et al.,* 1996).

In peri-urban settlements that rely on water from distribution tankers, determination of the sanitary status of the tankers become indispensable due to biofilms' characteristic which is resistance to washing and protection from the common disinfectants that do not easily penetrate the polysaccharide matrix (Mattila-Sandholm and Wirtanen, *(*1992). Odongunyan community is a peri-urban settlement of Ikorodu, which is located on the outskirt of Lagos metropolis. The community is composed of people who have to travel several kilometres to their various places of work in the heart of the city of Lagos. Like many other peri-urban communities across the globe, it is characterised by poor drainages, poor access to safe piped water, poor sanitary facilities etc. Though a rapidly growing community, water facilities is below satisfactory, leading to a high reliance on commercial transport water tankers. The dearth of evidential facts on the progress made towards attaining the MDGs calls for concern particularly in the public health sector. There is a need to document our health status, including all facilities used in water systems thus giving clear perspective to government budgetary allocation and intervention programmes from local and international organizations to water improvements. The pathogenicity of these biofilms, particularly in water distribution networks, also need be determined periodically for a healthy water distribution, particularly in communities with poor sanitation and safe water facilities.

Materials and Methods

Interview with Water Tanker Drivers

A non formal interview was conducted with the drivers of the water tankers on the regularity of washing and disinfection of the water tankers.

Sample Collection

The method of Marques *et al* (2007) was adopted with slight modification. Sterile swab sticks were used to gently scrub an area of 1 cm^2 in the inner surfaces of the water tankers and transferred to tubes containing 9 ml of 0.1% (v/v) sterile peptone water for onward transfer to

the laboratory. This was vigorously vortexed for 2 mins for adequate dissolution of the microbes into the peptone water from where the samples were later taken for use.

Microbiological Analysis

Marques *et al* (2007) method of isolation of microbes from swabs for total plate count was adopted with slight modification. This was carried out by using 0.5 ml aliquots, which was transferred onto Nutrient agar and incubated for 24 hr at 37°C after which the viable cells were counted. For the isolation of *Escherichia coli*, the method of Grant *et al* (1996) was adopted. The presence of *Escherichia coli* was selectively cultivated on M-FC Nutri Disks (pre-prepared pads impregnated with a selective medium for the detection of *E. Coli* and Faecal Coliforms in water and foodstuffs supplied by Wagtech International Ltd, UK.). In this case the remaining diluted sample of 9 ml of 0.1% (v/v) sterile peptone water (total volume, 10 ml) was filtered under vacuum by using a vacuum filtration unit (Wagtech Int. Ltd, UK) through a micropore paper and placed on the MFC Nutri Disks and incubated at 44.5^{o}C for 24 hrs.

Results and Discussion

The results of the microbiological analysis are presented in Table 1. The interviews with the tanker drivers confirmed that the issues of cleaning the tankers do not cross the mind of the tankers drivers at all. Majority of these tanker drivers are always excited about the number of trips they can make in a day which translates to more income for them. This is their daily practice. Moreover the consumers are also less concerned about the quality of the water. Their preoccupation is the availability of the water as they also have to compete to get the drivers to look at their side. The importance of the values of the total plate count and the coliform counts cannot be over emphasized. They both have exceeded the 0/ml values recommended by the WHO and other regulatory bodies concerning the number of organisms expected to be found in potable water (Barrell *et al*, 2000). One important fact about these values is that the difference between the total plate count and the values of the *E, coli is* wide, indicating that several other organisms may still be found in the biofilms whose health implications have not been considered at all. This research finding contradicts the position of Wingender and Flemming (2004) that pathogens may not be found in biofilms of distribution networks. This research shows that there is therefore a need for policy to monitor the sanitation of water tankers within communities like this.

Recommendation

It is recommended that the drivers be educated on the importance of maintaining a good sanitary state of the tankers. This should also be extended to the consumers through different community fora on the need to ensure that the water brought to them meets adequate sanitary conditions that could ensure their safety as they are the recipients of the inadequacies of the drivers. Furthermore, local regulatory bodies can stipulate laws at the local government's councils on the need for a regular disinfection of the tankers bearing in mind the nature of the biofilms and their resistance to disinfection. Offenders may be fined to serve as deterrence..

Table 1: Water Tanker Test Results

Sample	pH	Coliform Presence	Total Plate Count/ 10^4cells/cm^2	*Escherichia coli*/ 10^3cells/cm^2
001	7.22	+	63 ± 8.9	24 ± 9.4
002	6.78	+	69 ± 11.8	15 ± 3.4
003	6.54	+	98 ± 11.2	36 ± 4.1
004	7.00	+	81 ±10.6	29 ± 9.4
005	7.03	+	70 ± 9.6	21 ± 9.4
006	6.72	+	90 ± 6.2	35 ± 2.6
007	6.74	+	90 ± 23.7	43 ± 4.5
008	6.55	+	73 ± 6.9	32 ± 2.5
009	6.80	+	67 ± 5.2	30 ± 7.1
010	6.81	+	69 ± 4.8	36 ± 4.1
011	6.82	+	82 ± 5.2	37 ± 10.2
012	6.72	+	57 ± 7.3	26 ± 4.1
013	6.78	+	72 ± 7.2	39 ± 9.5
014	6.54	+	57 ± 6.2	40 ± 8.7
015	6.57	+	69 ± 5.2	42 ± 4.8
016	6.70	+	75 ± 4.9	42 ± 3.7
017	6.72	+	55 ± 14.3	24 ± 7.8
018	7.00	+	82 ± 17.3	25 ± 5.7
019	6.81	+	76 ± 3.3	33 ± 1.3
020	7.02	+	57 ± 2.3	29 ± 4.6
021	7.03	+	82 ± 6.9	45 ± 5.2
022	6.84	+	71 ± 9.7	42 ± 6.3
023	6.55	+	63 ± 9.5	63 ± 5.1
024	6.72	+	72 ± 7.2	18 ± 4.3
025	6.70	+	78 ± 6.6	35 ± 2.5
026	6.82	+	69 ± 14.3	13 ± 2.1
027	6.81	+	69 ± 8.2	22 ± 5.2
028	6.84	+	51 ± 8.6	18 ± 1.1
029	7.03	+	67 ± 5.8	31 ± 9.4
030	6.78	+	66 ± 16.2	37 ± 4.6

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