ARCOBACTER - EMERGING PUBLIC HEALTH RISK OF UNTREATED WASTEWATER EFFLUENTS OF CHICKEN ABATTOIR IN LAGOS

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ABSTRACT

Wastewater effluents from domestic and industrial sources can produce significant undesirable or harmful effects if not properly treated before disposal. Infectious wastewater can spread many agents of gastroenteritis that can endanger community life via contamination of surface and occasionally ground water. We reported recently the isolation of relatively new zoonotic bacterial organisms, Arcobacter butzleri (aerotolerant campylobacters) in the raw wastewater effluents of a chicken abattoir in the Lagos metropolis (Intern. J. Med. Microbiol. 2001, Vol. 291, Suppl.31, P-18, pg.143). Local awareness on the emerging organisms is presently non-existent. Untreated wastewater effluent of abattoir origin in the metropolis are emptied daily into public drainage systems and natural bodies of water, either because communities and municipalities are indifferent to the consequences or it is assumed the body of water is sufficiently large and so located that dilution prevents hazards. Infectious wastewater effluents limits the use of natural bodies of water for drinking supplies and recreational purposes, and endangers consumption of oysters and other shellfish due to pollution and contamination. Arcobacters are aerotolerant, metabolically inactive, curved or spiral rod shaped Gram-negative bacteria found in water, livestock and animal products, especially chicken carcasses. Human beings acquire them from contaminated food and water, leading to mild to severe gastroenteritis, which may further leads to extraintestinal complications. Abattoir wastewater effluent is thus an important risk factor in the epidemiology of Arcobacter. Animal slaughters in urban markets needs be educated on their role in public health protection. Disinfection by minimal chlorination is a proven method of reducing the risks of transmitting public health important organisms through wastewater effluents.

INTRODUCTION

Untreated wastewater effluents from domestic origins are capable of spreading many microbial agents of human diseases. The pathogens most frequently transmitted through water are those which cause infection of the intestinal tract; typhoid and paratyphoid bacteria, dysentry (bacillary and amoebic), cholera bacteria, and enteric viruses. These infectious agents get into the environment via improper disposal of faeces or urine of an infected person, and when discharged may gain entry into a body of water that ultimately serves as a source of drinking water (Pelczar *et al.*, 1985, 1999).

In recent past years, a considerable number of microorganisms that were previously unknown to cause infection have increasingly been implicated in both human and animal diseases (Meng and Doyle, 1997). Among the relatively new recognized pathogenic microbial agents are the bacterial organisms called Arcobacters. Studies on their ecological diversity showed that organisms can be found in wastewater effluents of abattoirs and carcasses of poultry birds and other animals (Stampi *et al.*, 1993; Atabay *et al.*, 1998; Amisu *et al.*, 2001a). Thus indicating an emerging public health risk potential of untreated abattoir wastewater.

Lagos is a cosmopolitan city where abattoir wastewater is generally untreated before they are emptied into public main drainage system and recently Amisu *et al.*, (2001a) reported successful isolation of the emerging infectious organisms, Arcobacter strains from an untreated wastewater effluent of chicken abattoir in the metropolis. Local awareness on the *Arcobacter* is presently nonexistent. Therefore, there is an urgent need for public awareness on the emerging organisms and untreated wastewater effluents of chicken abattoir as a potential risk factor in the possible spread of *Arcobacter* infections in Lagos.

WHAT ARE ARCOBACTERS?

Arcobacters are Gram-negative, slightly curved, curved, S-shaped, or helical non-spore forming rods that measure 0.2 to 0.9μm wide and 1-3 μm long. They possess a single unsheathed polar flagellum for darting-like characteristic motility Arcobacters share similar cell, cultural morphology and biochemical characteristics with true members of the genus *Campylobacter* (Nachamkin, 1995). However, unlike most *Campylobacter* species, arcobacters grow well in the presence of normal atmospheric oxygen at low temperature condition (15-30 ^{o}C) and microaerophically or anaerobically between 35-37^{o}C. They show poor growth at 42 ^{o}C. The genus is made up of three pathogenic species, *Arcobacter butzleri, A. cryaerophilus* (formerly Campylobacter cryaerophila [Neill *et al.*, 1985]), *A. skirrowii* and a symbiotic nitrogen fixing species called *A. nitrofigilis* (Formerly *Campylobacter nitrofgilis*) (McClung *et al.*, 1983). Molecular techniques are required for proper identification and this is the most reliable typing technique for epidemiological purposes (Wesley *et al.*, 1995; On 1996).

WHEN DID ARCOBACTERS EMERGE?

The organisms now known as Arcobacters were first isolated in the late 1970s from the tissues of aborted fetuses of bovine and cattle (Elli *et al.*, 1977, 1978). The taxonomy and knowledge of the public health importance of the organisms were obscured for about 14 years that followed reports of their first isolation, probably because of their inert metabolism that make their cultivation and identification somehow difficult. During the period, they were considered almost exclusively as veterinary pathogens and also designated with different names such as Vibrio/ Spirillum like organisms, aerotolerant campylobacters and *Campylobacter cryaerophila* (Elli *et al.*, 1978; Neill *et al.*, 1979, 1985; Amisu *et al.*, 2001b). A polyphasic study of the controversial organisms based on immunoblotting, sodium dodecyl sulfate (SDS) polyacrylmide gel electrophoresis (PAGE), nucleic acid hybridization and base sequence analysis gave a clear evidence of their distinct phylogenetic relationships with other organisms and subsequent recognition of a separate genus for Arcobacters (Vamdamme *et al.*, 1992).

Since reclassification, organisms have been shown to exhibit a considerable ecological diversity as well public health significance. They have been isolated from a wide range of environmental sources, drinking and wastewater effluents and food of animal origins, especially poultry carcasses wastewater effluents (Stampi *et al.*, 1993, Collins *et al.*, 1996, Musmanno *et al.*, 1997; Jacob Rice *at al.*, 1999; Amisu *et al.*, 2001b).

WHAT IS THE SOCIOECONOMIC IMPORTANCE OF ARCOBACTERS?

Arcobacters are well known bacterial pathogens of domestic and wild animals. They are frequently recovered from aborted fetuses of pigs and cattle, infertile sows with vaginal discharge, dairy cows with mastitis, and animals with mild to severe diarrhea (Nachamkin, 1995; Oliveira *et al.*, 1997).

The impact of arcobacters on human health has only been examined superficially. However, there is evidence to indicate that arcobacters may present a significant public health concern. *Arcobacter butzleri* and *A. cryaerophilus* has been isolated from patients with bacteremia, endocarditis, and peritonitis (Nachamkin 1995, On *et al.*, 1995). Arcobacters have been implicated in the outbreaks of children diarrhoea in Thailand and Italy (Taylor *et al.*, 1991; Vandamme *et al.*, 1993) while sporadic clinical case reports of Arcobacter gastroenteritis in all age groups is on the increase (Kiehlbauch *et al.*, 1991, Lerner *et al.*, 1994). Epidemiological analysis of the bacterial enteritis factors suggested that the infection would be more prevalent in developing countries due to poor supply of good water. Similarly, travelers to developing countries are also considered to be at the risk of acquiring the bacterial infections (Taylor *et al.*, 1991).

SOURCES OF ARCOBACTER INFECTIONS

Arcobacter infection is food borne (Meng and Doyle, 1997). The infection is derived from a wide range of foods and water-based environments. Organisms are most frequently isolated from the carcasses of poultry bird and other animals. *Arcobacter* have also been found on poultry eviscerator, machines used to process pig for pork and cattle for beef as well as their wash water samples (Atabay *et al.*, 1998; Collins *et al.*, 1994,1996; De Boer *et al.*, 1996). The incidence of *Arcobacter* organisms in foods has been considered to be in almost the same patterns of distribution with that of *Campylobacter* species (Wesley 1996, 1997; Johnson and Murano, 1999a,b). Other sources of acquiring *Arcobacter* infection include untreated drinking water, untreated milk (Meng and Doyle 1997).

EMERGING PUBLIC HEALTH RISK OF UNTREATED ABATTOIR WASTEWATER EFFLUENTS FOR ARCOBACTER INFECTION

Untreated wastewater effluents of abattoirs appear to play a significant role in the ubiquity of Arcobacters. The bacterial (*A. cryaerophilus*) load in an urban sewage before treatment was found to be 5639/100ml (Stampi *et al.*, 1993). Several considerations on the high level of these bacteria in the sewage showed that the organisms were been disseminated nto the urban environment via a daily high waste discharge for a municipal slaughterhouse for cattle and pigs. Arcobacter strains have also been isolated from the wastewater of chicken carcasses (Atabay *et al.*, 1998; Amisu *et al.*, 2001a). Untreated wastewater of abattoir origins may contaminate natural water supplies thereby constituting a potential health danger ito communities or municipals through contamination of. *Arcobacter* strains have been found in drinking water, ground water and water processing plants, canals (Dhamabutra *et al.*, 1992; Jacob *et al.*,1993; Rice *et al.*, 1999). Epidemiological typing of *Arcobacter* strains isolated from water and diarrhoea stool specimens suggested contaminated water as a possible route of transmission for the bacterial gastroenteric infection (Festy *et al.*, 1993; Jacob *et al.*, 1993). The discharge of untreated abattoir wastewater into natural bodies may also contribute to an increased health danger in human consumption of oysters and other shellfish harvested from contaminated or polluted natural water (Maugeri *et al.*, 2000).

EMERGENCE OF ARCOBACTER IN LAGOS

The presence of *Arcobacter* in Lagos has been reported by Amisu et al. (2001). Strains of the bacterial organisms were found in the wastewater effluents of chicken abattoir of a metropolitan market in Lagos. Generally, the chicken abattoir traders dispose untreated wastewater from the washings of the poultry bird carcasses and faecal contaminants directly into open drainage systems. The raw wastewater effluents run into the lagoons, the large natural body of water in the metropolis.

Lagos metropolitan area is about 37% of the land area (3,577sq.km) of the state with a built up urban population density of 20,000 per sq. km. It is occupied by over 85% of state population (approx. 6.million) (Lagos State Official Diary, 2001). One major social amenity problem is inadequate supply of drinking water. Consequently, the urban dwellers obtain water from boreholes and often from indiscriminate located shallow wells for domestic functions, such as cooking and washing bowls. The shallow characteristic of most metropolitan wells is due to the water log environment of Lagos (Lagoon Area). Indiscriminate location of the wells in the metropolis is due scarcity of land (due high population density) and high economic values attached to available land space.

Nearness of surface and ground water sources to drainage predisposes them to contamination with untreated wastewater effluents. Although, Lagos dwellers do not use surface water and wells for drinking but using them to wash plates may lead to post cooking contamination of food with organisms present in the water source. The health risk may also arrive from the use of contaminated surface water for preparation of food that rarely requires thorough cooking, such vegetable or salad. Therefore, dumping of abattoir wastewater into waterways in the metropolis or into a natural body of water, without a prior treatment must be discouraged.

MANAGEMENT AND CONTROL OF WASTEWATER INFECTIONS

Disinfection of wastewater is necessary to protect public health when the receiving waters are used for purposes such as downstream water supplies, recreation, irrigation, or shellfish harvesting. Most infectious microorganisms transmitted via wastewater are highly susceptible to disinfection, and Arcobacters are no exception. Arcobacters are known to be susceptible to chlorination at a concentration used for treatment of portable water supply (Rice *et al.*, 1999). The general effective chlorine dosage for water treatment is considered to lie between 0.2 to 2.0 mg/Litre chlorine residue (Pelczar *et al.*, 1986). It is also becoming a common practice that prior to release of treated wastewater it is necessary to dechlorinate it so as to reduce the negative impact of chlorination on aquatic life in the receiving water. Other methods of treating wastewater include the use of ultraviolet radiation and ozonation (oxidation) (Pelczar *et al.*, 1986).

CONCLUSION

Untreated wastewater effluents of chicken abattoir constitute a potential risk factor in the transmission of *Arcobacter*, a new agent of gastroenteritis. Adequate treatment of abattoir wastewater by disinfection before they are disposed into a natural body of water should be of a prime importance in the control of water borne infections. The urban

dwellers should be educated on the inherent danger of locating ground water sources close to abattoir drainage system as the demand for quantity of water required for domestic purposes is ever on the increase.

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