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CONTAMINATION OF WELL WATER WITH *SALMONELLA* SPECIES IN A RURAL COMMUNITY IN NORTH-EASTERN NIGERIA

Microbiology

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ABSTRACT

Waterborne diseases are linked to significant disease burden worldwide. Diarrhoeal diseases due to infectious agents such as pathogenic salmonella species are responsible for two million deaths each year. The bulk of morbidity and mortality due to pathogenic salmonella species occurs in developing countries such Nigeria due to poor sanitary and sewage facilities. This study was carried out to determine the extent of contamination of well-water by *Salmonella* spp and to ascertain its antimicrobial resistance profile to commonly prescribed drugs in Ganye town.A total of 98 samples from seven locations were collected and processed. 51 samples yielded *Salmonella* spp, which gives a total recovery rate of 52.04%. Rate of isolation was highest in Tappare (23.53%) and Tudun Wada (19.61%) but least in Ganye 1 (5.88%). Isolates were highly resistant/least sensitive to Gentamycin (78.43%/5.88%) and highly sensitive/least resistant to Ampicillin (92.15%/1.96%), Ciprofloxacin (90.2%/3.39%) and Ofloxacin (80.04%/0.00%). This study revealed heavy contamination of well-water with *Salmonella*. Thus, the need for the provision of portable pipe-borne water to the populace is hereby advocated.

KEYWORDS

Prevalence, Antimicrobial Resistance, Sensitivity Pattern, Salmonella, Well-Water, Gastrointestinal Diseases

INTRODUCTION

Water is the chief vehicle for the transmission of gastrointestinal diseases. Therefore, water for human consumption must be free from harmful chemical substances and microorganisms which may cause diseases in man (Arora *et al.,* 2014).

Its role as a medium for the transmission of water borne diseases, which constitute a significant percentage of the diseases that affect humans and animals, cannot be underestimated. This is the most important concern about water quality (Idowu, 2011) and because of its basic importance to human physiology; it becomes indispensable to man's continued existence (Lamikanra, 1999).

Microbiologically, contaminated water is a potential source of human enteric infections an example of which is caused by *Salmonella* species. This is usually indicative of poor maintenance of hygiene-related infrastructures and problems in the implementation of control measures especially in developing countries (Wright, 1989). Moreover, waterborne infections are prevalent where general standards of hygiene and environmental sanitation are poor and where there is shortage of protected water supply (Demena *et al.*, 2003).

This study is aimed at examining the prevalence and drug resistance profile of pathogenic *Salmonella* spp in local wells used as a source of drinking water by the population of Ganye town of Adamawa State, Nigeria.

MATERIALS AND METHODS

STUDY AREA

The study area (Ganye town) is located in the Northeastern part of Nigeria, which lies within latitude 8° 26' 0" N and longitude 12° 04' 0" E. It is a community with a population of 254,187. The major source of drinking water in the community is hand dug well approximately 15 meters from the surface. The inhabitants of the community consists of many tribes, but the major tribes are Fulani, Chamba, and Hausa who are mostly farmers and traders (Maduforo, 2011).

SAMPLE COLLECTION

A total of 98 water samples from 98 wells obtained from 7 different locations of Ganye town were randomly collected for bacteriological analysis. The sampling areas include Tappare, Tudun Wada, Luggere, Anguwan Jadda, Sangasumi, Leko and Ganye1 which cut across Ganye town. The locations were labeled as location A, B, C, D, E, F, and G respectively.

Water samples (1ml) were collected in sterile universal container. The bottle cap was aseptically removed and the weighted bottles were lowered into the well to a depth of about 1- 2 meters. The bottles were brought up to a surface and covered with a screw cap when no air bubbles are seen. They are then transferred to the laboratory for analysis (Idowu *et al*., 2011).

ISOLATION OF BACTERIA

Water samples were inoculated into 10ml Selenite F broth for enrichment and detection of *Salmonella* spp and incubated at 37°C for 24 hours. A loopfull of the broth culture was then streaked on to Xylose Lysine Deoxycholate agar (XLD) using a sterile bacteriological wire loop and incubated aerobically at 37°C for 24 hours.

Discreet colonies that appeared red or pink with black centre indicative of *Salmonella* spp were sub cultured onto Nutrient agar slant and incubated at 37°C for 24 hours and stored at 4°C for further analysis (Idowu *et al*., 2011).

BIOCHEMICAL CHARACTERIZATION OF ISOLATES

This was done based on standard techniques in which all isolates that gave reactions typical of *Salmonella* spp were inoculated onto various biochemical tests media which include Triple Sugar Iron (TSI) agar, Simon Citrate agar and Urease agar slants and incubated at 37°C for 24 hours (Idowu *et al*., 2011).

ANTIMICROBIAL SUSCEPTIBILITY TEST

The Kirby-Bauer disk diffusion susceptibility test was used to determine the sensitivity or resistance of all confirmed *Salmonella* spp isolates to 10 antimicrobial agents (Bauer *et al.,* 1966). Based on the recommendations of CLSI (2006), the zone of inhibition was measured and interpreted as sensitive, intermediate and resistant accordingly (Mondal *et al.,* 2008).

DATA ANALYSIS

Data were presented as percentage rates and frequencies.

RESULTS

The prevalence of *Salmonella* spp in water sample collected from wells in Ganye town were presented in table 1. The number of samples positive for *Salmonella* spp was 51 (52.04%) with Tappare (A) having the highest 12 (23.53%) while Ganye one (G) having the lowest 3 (5.88%).

Antimicrobial susceptibility test shows that Gentamycin recorded the highest resistance rate of 78.43% by the isolates, followed by Ceporex (35.29%), Streptomycin (33.33%), Septrin (17.65%), and Nalidixic acid (7.84%), while Travid recorded the least resistance with a rate of 0.00%.

The highest intermediate value is Septrin (72.25%), followed by Augumentin (62.75%), Ceporex and Streptomycin (54.90% respectively), while Ciprofloxacin recorded the least intermediate value of 5.88%. *Salmonella* isolates were highly sensitive to Ampicilin (92.15%), Ciprofloxacin (90.20%), Travid (80.04%), Peflacin and Nalidixic acid (72.35% respectively), while Gentamycin recorded the least sensitivity value of 5.88% (Table 2).

TABLE 1: PREVALENCE RATE OF *SALMONELLA* SPP IN WATER SAMPLES COLLECTED FROM WELLS

Locations	Number of Samples collected at each location	Number of positive samples	% prevalence
Location A	14	12	23.53
Location B	14	10	19.61
Location C	14	9	17.65
Location D	14	7	13.73
Location E	14	5	9.80
Location F	14	5	9.80
Location G	14	3	5.88
Total	98	51	100%

Key: Location A = Tappare, B = Tudun Wada, C = Luggere, D = Anguwan Jada, E = Sangasumi, F = Anguwan Leko and G = Ganye 1

TABLE 2: ANTIMICROBIAL SUSCEPTIBILITY PATTERN OF *SALMONELLA* SPP IN WATER SAMPLES

Antimicrobial Agents	Antimicrobial Susceptibility Test		
	Resistance (%)	Intermediate (%)	Sensitive (%)
Nalidixic acid	4 (7.84)	10 (19.61)	37 (72.35)
Ceporex	18 (35.29)	28 (54.90)	5 (9.80)
Gentamycin	40 (78.43)	8 (15.68)	3 (5.88)
Streptomycin	17 (33.33)	28 (54.90)	10 (19.61)
Septrin	9 (17.94)	37 (72.55)	5 (9.80)
Ciprofloxacin	2 (3.39)	3 (5.88)	46 (90.20)
Ampicilin	1 (1.96)	3 (19.61)	47 (92.15)
Travid	0 (0.00)	10 (19.61)	41 (80.04)
Peflacin	2 (3.39)	12 (23.53)	37 (72.35)
Augumentin	2 (3.39)	32 (62.75)	17 (33.33)

DISCUSSION

The spread of diseases through faecal contamination of water sources particularly in developing and under developed countries is a common phenomenon that has been well reported (Lamikanra, 1999). In Ganye town as well as most rural parts of Northeastern Nigeria, availability of treated pipe-borne water is rare, and restricted to urban areas. Even in these areas, public water supply is quite irregular. Consequently wealthy individuals drill boreholes as alternative water source. The poor or average class individuals, which constitute more than 80% of the population of Ganye town, cannot afford the high cost of borehole drilling and are forced to dig wells as alternative source of water supply for drinking and sanitary use.

In this study, 51 (52.04%) out of the 98 water samples collected yielded the growth of *Salmonella*. The high prevalence rate recorded is in agreement with the findings of Musa *et al* (2017) but higher than reported by Carvaho *et al.,* (2013) and Denise *et al.,* (2015). This could be partly due to differences in sample size, handling and processing techniques. The high rate of contamination as observed in this study may be due to the poor structure of wells as most of them are open and shallow. This allows easy entrance of dirt particles from the surroundings. It may also be due to poor sanitary condition around the areas where such wells are located or drawing water from the wells with contaminated containers.

Among the isolates tested, resistance was highest against Gentamycin (78.43%), Ceporex and Streptomycin (35.29% and 33.33% respectively). While lowest resistance was observed against Travid (0.00%). This is in agreement with 80% resistance towards Gentamycin as reported by Diyo (2016). It also concurs with the findings of Batuba (2009) who reported a 40% resistance rate against Ceporex and contrary to the findings of Tesfaw *et al.,* (2013), where 100% sensitivity to each of these antibiotics: Gentamycin, and Nalidixic acid was reported. Moderate sensitivity of 72.35% towards Nalidixic acid and least sensitivity of 5.88% towards Gentamycin was recorded in this study.

CONCLUSIONS

This study revealed a high incidence of contamination of well- waters by *Salmonella* spp in Ganye town. Ampicilin, Ciprofloxacin, Travid, Peflacin and Nalidixic acid were the most sensitive drugs and are hereby recommended for use in the treatment of waterborne diseases caused by *Salmonella* spp. Antibiotic use should be based on results of *invitro* antibiogram analysis

The provision of portable pipe-borne water to the populace is hereby advocated. Disease surveillance programmes should be established as a means for curtailing salmonellosis.

CONFLICT OF INTERESTS

The authors declare no conflict of interests.

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