Research Journal of Microbiology

ISSN 1816-4935

Academic Journals Inc.

www.academicjournals.com

Research Journal of Microbiology 10 (3): 126-131, 2015
ISSN 1816-4935 / DOI: 10.3923/jm.2015.126.131

Isolation of *E. coli* from Drinking Water Sources for Humans and Farm Animals in Nyankpala Community of Ghana

[1]Frederick Adzitey, [1]Nafisah Sumaila and [2]Courage Kosi Setsoafia Saba
[1]Department of Animal Science, Faculty of Agriculture, University for Development Studies, P.O. Box TL 1882, Tamale, Ghana
[2]Department of Biotechnology, Faculty of Agriculture, University for Development Studies, P.O. Box TL 1882, Tamale, Ghana

Corresponding Author: Frederick Adzitey, Department of Animal Science, Faculty of Agriculture, University for Development Studies, P.O. Box TL 1882, Tamale, Ghana

ABSTRACT

The study was conducted to determine the occurrence of *E. coli* in drinking water sources used by humans and farm animals in Nyankpala community of Ghana. Isolation of *E. coli* was done using a slightly modified procedure in the US Food and Drug Administration-Bacteriological Analysis Manual (FDA-BAM). A total of 200 water samples collected from six different water sources viz. sachet water (four different brands), tap water, well water, dam water, bottle water and water from the drinking troughs (drinkers) of farm animals were analysed. The average occurrence of *E. coli* in the different water samples was 58 (29%). The highest occurrence of *E. coli* was in well water 100% (20/20), followed by water from drinkers 80% (12/15), dam water 65% (13/20), rain water 50% (10/20) and tap water 10% (3/25). All sachet (0/80) and bottle water (0/20) samples were negative for *E. coli*. The number of well water samples positive for *E. coli* was significantly higher ($p<0.01$) than that of dam water, sachet water, rain water and tap water. This work indicated that some drinking water samples (well, drinkers, dam, rain water and tap water) in the Nyankpala Community of Ghana are contaminated with *E. coli* and thus humans and farm animals are at risk of foodborne infections from drinking water from such sources.

Key words: Drinking water, *E. coli*, farm animals, humans, isolation

INTRODUCTION

Safe water is one of the most important felt needs in public health in the twenty first century (Sobsey and Bartram, 2003). Visually clear and colorless drinking water is acceptable. However, it should also be safe and free from chemical toxin and pathogenic microorganism (Maheshwari, 2008). *Escherichia coli* are widely distributed in the gastro-intestine tract of humans, pests, ruminants, non-ruminants and wild animal, where they are known to live as commensals (Feng and Weagant, 2009; Frederick, 2011). They are gram negative facultative anaerobic bacteria (Feng and Weagant, 2009; Anonymous, 2012). They are also from the family Enterobacteriaceae and ferments glucose or lactose (Feng and Weagant, 2009; CDC., 2014a). Although most *E. coli* live in commensalism with their host, pathogenic *E. coli* strains exit and normally cause hemolytic uremic syndrome that can be fatal (Feng and Weagant, 2009; Anonymous, 2012; CDC., 2014a).

Escherichia coli have been isolated from humans, farm animals, wild animals, milk, water and environmental samples some of which have been responsible for foodborne illnesses and deaths (El Zubeir and Ahmed, 2007; Surendraraj *et al*., 2009; Adzitey *et al*., 2010, 2011, 2012, 2013,

2014; Islam *et al*., 2011; Geidam *et al*., 2012; CDC., 2014a, b; Carnot *et al*., 2014). Through poor processing and handling of foods or farm animals *E. coli* can cross contaminate a variety of sources including drinking water. Humans and farm animals can get *E. coli* infection by drinking water from such sources.

No work has been done on the occurrence of *E. coli* in drinking water samples in Nyankpala. Therefore, this work was carried out to find out whether *E. coli* is present or absent in drinking water sources for humans and farm animals in Nyankpala.

MATERIALS AND METHODS

Collection of sample: The study was carried out in the Nyankpala Community of the Northern Region of Ghana. Two hundred water samples were randomly collected from six different water sources within the Nyankpala community. The water sources were sachet water (four different brands, n = 20 each), bottle water (n = 20), tap water (n = 25), rain water (n = 20), well water (n = 20), dam water (n = 20) and water from the drinking troughs of poultry and ruminant (n = 15) were analysed for *E. coli*. The study was conducted between August 2013-January 2014.

Isolation and identification of *E. coli*: Bacteriological analysis of *E. coli* was done according to the procedures in the US food and drug administration-Bacteriological Analysis Manual (FDA-BAM). Five hundred milliliter of the various water samples were obtained and thoroughly mixed. One milliliter of water was taken from the 500 mL and transferred into 9 mL of EE Broth. It was then incubated at 37°C for 24 h under aerobic condition. After which a loopful of the enriched culture from EE broth was streaked onto LEMB Agar and incubated at 37°C for 24 h under aerobic condition. Presumptive *E. coli* colonies on LEMB Agar appear as dark centered and flat, with or without metallic sheen. Presumptive *E. coli* were picked and streaked onto nutrient agar and incubated at 37°C for 24 h under aerobic condition for purification to obtain a pure culture. Pure cultures were identified and/or confirmed using gram staining, *E. coli* latex agglutination test and biochemical tests (indole production, utilization of citrate and lactose production).

Statistical analysis: The data obtained was analysed using generalized linear model of Statistical Package for the Social Sciences (SPSS) Version 17.

RESULTS AND DISCUSSION

This is the first report on the prevalence of *E. coli* in drinking water sources in Nyankpala, Ghana. The prevalence of *E. coli* in drinking water sources for humans and farm animals in the Nyankpala Community of Ghana is presented in Table 1. Out of the 200 water samples examined, 58 (29%) samples were positive for *E. coli*. All well water samples (100%) were positive for *E. coli* and was significantly higher ($p<0.01$) than that of dam water, sachet water, rain water and tap water. Water samples collected from drinkers (80%), dams (65%), rain (50%) and tap (12%) were also positive for *E. coli* as shown in Table 1. Positive samples from drinkers did not differ significantly ($p>0.05$) from those obtained from well water and dam water, but differed significantly ($p<0.05$) from rain water, tap water, bottle water and sachet water.

Furthermore, positive samples from dam and rain did not differ significantly ($p>0.05$) from each other but differed significantly ($p<0.001$) from well, tap water, sachet water and bottle water. *E. coli* were not isolated from all the four brands of sachet and bottle water analysed. The non-occurrence of *E. coli* in the sachet and bottle water may be as a result of the addition of

Table 1: Occurrence of *Escherichia coli* in drinking water for humans and farm animals in Nyankpala Community of Ghana

Water samples	No. of tested	No. of positives	Prevalence (%)	Overall prevalence (%)
Well 1	5	5	100	100
Well 2	5	5	100	
Well 3	5	5	100	
Well 4	5	5	100	
Water from drinkers (poultry farmer 1)	5	5	100	80
Water from drinkers (poultry farmer 2)	5	4	80	
Water from drinkers (cattle farmer)	5	3	60	
Dam 1	4	4	100	65
Dam 2	4	2	50	
Dam 3	4	2	50	
Dam 4	4	1	25	
Dam 5	4	4	100	
Rain water stored in tank 1	5	5	100	50
Rain water stored in tank 2	5	5	100	
Rain water collected directly from the sky	5	0	0	
Rain water collected from roof	5	0	0	
Tap water from area1	5	3	60	12
Tap water from area 2	5	0	0	
Tap water from area 3	5	0	0	
Tap water from area 4	5	0	0	
Tap water from area 5	5	0	0	
Sachet water 1	20	0	0	0
Sachet water 2	20	0	0	
Sachet water 3	20	0	0	
Sachet water 4	20	0	0	
Bottle water 1	5	0	0	0
Bottle water 2	5	0	0	
Bottle water 3	5	0	0	
Bottle water 4	5	0	0	
Total	200	58	29	29

chlorine, proper filtration, good hygiene and treatment during production. This supports the finding that *E. coli* are more sensitive to chlorine (Payment, 1999). WHO (2002) stated that the level of *E. coli* or thermo-tolerant bacteria should be zero in a 100 mL sample of water directly intended for drinking, as such all the bottle and sachet water sample analysed are suitable for human consumption.

Coliform such as *E. coli* have been widely used as indicator of the microbiological quality of surface and ground waters (Ahmed *et al*., 2005), thus the presence of coliform is an index of bacteriological quality of water. The isolation of coliform especially *E. coli* from water sources is attributable to contamination by human and animal origin and this is of health significance as these organisms have generally been agent of gastroenteritis in humans (Ahmed *et al*., 2005). The tap water found positive might have been contaminated by water hoses connected to the tap, which was normally left on the ground after used and reused without cleaning. Also the source of contamination might have come from the point of treatment, point of distribution, or leaking water pipes since the tap water was allowed to flow for 5 min before the sample was taken. Garba *et al*. (2009) stated that tap water, which ought to be treated, must have been contaminated as a result of non-treatment, poor water treatment or as a result of leaky water pipes, which are buried in municipal drainage systems thus getting contaminated.

The rain water samples found to be contaminated with *E. coli* were obtained from rain water stored in tanks. This water samples might have been contaminated by the containers used for fetching the water because during sample collection it was observed that the container used for fetching water were normally left on the ground after use. The containers could easily be contaminated with fecal matter since animals were reared around the homes. But the other 10

samples for which five were obtained directly from the sky and the other five from the roof when it was raining, did not record any *E. coli* positives. The results obtained however, met the WHO standard for quality drinking water which stated that the level of *E. coli* or thermo-tolerant bacteria should be zero in a 100 mL sample of water directly intended for drinking. Thus microbiologically, rain water is safe for drinking.

Four samples each was taken from five different dams (D1, D2, D3, D4 and D5). All samples collected from D1 and D5 were contaminated. This may be due to the close nature of these dams to human habitant. Animals reared around these dams also drink from it and they may defecate in it during drinking thereby, contaminating it. Studies have shown that surface and groundwater contamination by fecal pathogens generally occur through surface run-off, leaching and direct fecal deposition into the water bodies via several livestock production activities like confined animal feedlot, free range system, abattoir wastes, land spreading of manure etc (Kuczynska *et al*., 2005).

Of the 15 water samples collected from drinkers, 12 were positive for *E. coli*. This may be attributed to the drinking and feeding activities of the birds and the ruminants. He *et al*. (2007) reported that pathogenic *E. coli* can be introduced into poultry flocks through contaminated water and its presence in drinking water is considered indicative of faecal contamination.

The high occurrence of contamination in the well may be attributed to the shallow nature of the well. Animal waste and rubbish were observed around the homes during sample collection. This could move into the well by running water when it rains. This however, supports the findings that during rain, faecal substances get mixed with water and by flooding; these substances are discharged into shallow wells. Observations show that the containers used for fetching water from the well were not hygienic and the wells were not covered properly.

This work is also comparable to that of other researchers. Duwiejuah *et al*. (2013) analysed sachet water samples in the Tamale Metropolis and found no *E. coli* in them. Ezeugwunne *et al*. (2009) found *E. coli* (36%) in sachet water samples. In this study we found no *E. coli* in the sachet water samples. Garba *et al*. (2009) isolated 63 *E. coli* isolates from water samples. They also reported a prevalence of 45.5, 23.3 and 13.3% in well water, tap water and packaged water, respectively. Positive samples from wells in this study were higher than that of Garba *et al*. (2009) but the positive samples from tap water was lower in this study compared to that of Garba *et al*. (2009). Momtaz *et al*. (2013) examined 448 water samples for *E. coli* and found 34 (7.58%) samples to be positive for *E. coli*. They also detected *E. coli* in 8 (2.63%) of 304 samples of bottled drinking water. We did not find any *E. coli* in bottled water but isolated *E. coli* from some of the water samples examined.

CONCLUSION

This study gives base line information about the occurrence of *E. coli* in drinking water sources for humans and farm animals in the Nyankpala Community of Ghana. It is recommended that more stringent measures be put in place both by the water company and homes to curb the spread of *E. coli* in water.

REFERENCES

Adzitey, F., G.A. Teye, A.G. Ayim and S. Adday, 2010. Microbial quality of chevon and mutton sold in Tamale Metropolis of Northern Ghana. J. Applied Sci. Environ. Manage., 14: 53-55.

Adzitey, F., G.A. Teye, W.N. Kutah and S. Adday, 2011. Microbial quality of beef sold on selected markets in the Tamale Metropolis in the Northern Region of Ghana. Livestock Res. Rural Dev., Vol. 23.

Adzitey, F., C.Y. Liew, A.P. Aronal and N. Huda, 2012. Isolation of *Escherichia coli* from ducks and duck related samples. Asian J. Anim. Vet. Adv., 7: 351-355.

Adzitey, F., G.R.R. Ali, N. Huda and S.L. Ting, 2013. Antibiotic resistance and plasmid profile of *Escherichia coli* isolated from ducks in Penang, Malaysia. Int. Food Res. J., 20: 1473-1478.

Adzitey, F., A. Abdul-Aziz and O. Moses, 2014. Microbial quality of beef in the yendi municipality of Ghana. Global J. Anim. Scient. Res., 2: 10-17.

Ahmed, W., R. Neller and M. Katouli, 2005. Host species-specific metabolic fingerprint Database for Enterococci and *Escherichia coli* and its application to identify sources of fecal contamination in surface waters. Applied Environ. Microbiol., 71: 4461-4468.

Anonymous, 2012. *Escherichia coli* infection from food or water. http://www.healthlinkbc.ca/healthtopics/content.asp?hwid=hw133795.

CDC., 2014a. Carbapenem-resistant Enterobacteriaceae in healthcare settings. http://www.cdc.gov/HAI/organisms/cre/.

CDC., 2014b. Multistate outbreak of Shiga toxin-producing *Escherichia coli* O157: H7 infections linked to ground beef (Final Update). http://www.cdc.gov/ecoli/2014/O157H7-05-14/index.html.

Carnot, A., J.S. Guerra, T.S. Souza and L.C. Carneiro, 2014. Antimicrobial resistance and plasmid characterization of *Escherichia coli* isolated in *in natura* water. Am. J. Drug Discov. Dev., 4: 80-84.

Duwiejuah, A.B., S.J. Cobbina and M.O. Akrong, 2013. Effect of storage on the quality of sachet-vended water in the Tamale Metropolis, Ghana. J. Environ. Protect., 4: 629-637.

El Zubeir, I.E.M. and M.I.A. Ahmed, 2007. The hygienic quality of raw milk produced by some dairy farms in Khartoum State, Sudan. Res. J. Microbiol., 2: 988-991.

Ezeugwunne, I.P., N.R. Agbakoba, N.K. Nnamah and I.C. Anahalu, 2009. The prevalence of bacteria in packaged sachets water sold in Nnewi, South East, Nigeria. World J. Dairy Food Sci., 4: 19-21.

Feng, P. and S.D. Weagant, 2009. Bacteriological analytical manual. http://www.fda.gov/Food/FoodScienceResearch/LaboratoryMethods/ucm2006949.htm.

Frederick, A., 2011. *Escherichia coli*, it prevalence and antibiotic resistant in Malaysia: A mini review. Microbiol. J., 1: 47-53.

Garba, I., M.B. Tijjani, M.S. Aliyu, S.E. Yakubu, A. Wada-Kura and O.S. Olonitola, 2009. Prevalence of *Escherichia coli* some public water sources in Gusau Municipal, North Western Nigeria. Bayero J. Pure Applied Sci., 2: 134-137.

Geidam, Y.A., Z. Zakaria, S.A. Aziz, S.K. Bejo, J. Abu and S. Omar, 2012. High prevalence of multi-drug resistant bacteria in selected poultry farms in Selangor, Malaysia. Asian J. Anim. Vet. Adv., 7: 891-897.

He, L.M., J. Lu and W. Shi, 2007. Variability of fecal indicator bacteria in flowing and ponded waters in southern California: Implications for bacterial TMDL development and implementation. Water Resour., 41: 3132-3140.

Islam, M., S. Hussin and M.M. Rahman, 2011. Respiratory bacterial flora from healthy as well as respiratory symptoms' subjects. Pak. J. Biol. Sci., 14: 456-460.

Kuczynska, E., D.R. Shelton and Y. Pachepsky, 2005. Effect of bovine manure on *Cryptosporidium parvum* oocyst attachment to soil. Applied Environ. Microbiol., 71: 6394-6397.

Maheshwari, N., 2008. Clinical Microbiology and Parasitology. 2nd Edn., Jaypee Brothers Medical Publishers, New Delhi, India, ISBN-13: 978-8184483314, Pages: 272.

Momtaz, H., F.S. Dehkordi, E. Rahimi and A. Asgarifar, 2013. Detection of *Escherichia coli*, *Salmonella* species and *Vibrio cholerae* in tap water and bottled drinking water in Isfahan, Iran. BMC Public Health, Vol. 13. 10.1186/1471-2458-13-556

Payment, P., 1999. Poor efficacy of residual chlorine disinfectant in drinking water to inactivate waterborne pathogens in distribution systems. Can. J. Microbiol., 45: 709-715.

Sobsey, M.D. and S. Bartram, 2003. Water quality and health in the new millennium: The role of the World Health Organization guidelines for drinking-water quality. Forum Nutr., 56: 396-405.

Surendraraj, A., K.H.S. Farvin, R. Yathavamoorthi and N. Thampuran, 2009. Enteric bacteria associated with farmed freshwater fish and its culture environment in kerala, India. Res. J. Microbiol., 4: 334-344.

WHO., 2002. Quantifying selected major risks to health. The World Health Report 2002: Reducing Risks, Promoting Healthy Life, World Health Organization (WHO), Geneva, pp: 47-97.