ORIGINAL ARTICLE

Bacteriological Quality and antimicrobial susceptibility of some isolates of Well Waters Used for Drinking in Jimma Town, Southwest Ethiopia

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ABSTRACT

Well waters could be polluted with fecal materials due to inadequate protection, depth of wells, distance and position relative to latrine house, unhygienic practice at the source and poor environmental sanitation. The objectives of this study were to assess the current bacteriological safety of well waters being used for drinking and other domestic uses; and also to evaluate the antibiotic susceptibility patterns of bacterial species isolated from some of the wells in Jimma town, southwestern Ethiopia. Accordingly, bacteriological quality and safety, as well as physico-chemical properties of water samples collected from 30 purposively selected wells were assessed following the standard microbiological methods. Pure isolates were characterized to species level using API 20 E kit and evaluated for resistance patterns towards ten antimicrobial agents being used for human medication. The finding of the study showed that the mean pH (6.64- 6.8) of all the studied well water samples was within acceptable range (pH= 6.5-8.5), while the mean temperature was not. Likewise, the mean microbial counts (cfu/ml) of the samples were beyond the value recommended by World Health Organization. Accordingly, the mean count (cfu/ml) of aerobic mesophilic bacteria (AMB) was 908 (360 – 1490), while those of Entrobacteriaceae and coliforms were 332 and 234, respectively. A total of 15 representative bacterial species including Aeromonas hydrophilia (3), Enterobacter cloacae(1), Serratia liqueofaciens(1), Enterobacter sakazaki(1), Serratia marcesense(1), Klebsella orithinolytica(4), and Escherichia coli(1) were identified to species level. All isolates **were** ***sensitive to Amikacin (AK), Norfloxacin (Nx), Kanamycin (K), Bacitracin (B) and Tetracyclin (T). On the other hand, all isolates were resistant to Methicillin (M) and Pencillin G (P). Stains of Klebsella ornithinolytica showed the highest resistance against most of the antibiotics tested. In general, the well water samples analyzed in this study were found in unacceptable condition in terms of bacteriological quality. Moreover, the identification of Escherichia coli in some of the wells indicates the safety problem of the water for human consumption. Therefore, it calls for proper disinfection and monitoring of the water sources besides awareness creation to the well owners.***

Key words/phrases: Antimicrobial sensitivity, Bacteriological safety, Jimma, Well water

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INTRODUCTION

Well water is one of the potential sources for human consumption. Over 15 million U.S. households regularly depend on private ground water wells (U.S. Census Bureau, 2008). In developing countries, the share of well water could be even higher. For instance, 37.4% of households have access to piped water sources in Benin (Balk *et al*., 2003). However, improperly constructed or poorly maintained wells and well water could be the source of some waterborne diseases. Many diseases like diarrhea, gastroenteritis, keratoconjunctivitis, respiratory infections, and hepatitis are associated with viruses, often found in environmental samples including groundwater, surface water, and costal water (Borchardt *et al*., 2003, Borchardt *et al*., 2004; Xagoraraki *et al.*, 2007). Pathogenic bacteria such as *Salmonella* spp., *Shigella* spp., pathogenic *Escherichia coli, Vibrio cholerae, Yersinia enterocolitica, Campylobacter jejuni*, and *Campylobacter coli* can contaminate a drinking water via fecal material, domestic and industrial sewage and agricultural and pasture runoff (Geldreich, 1991: Wiggins, 1996). If water used for drinking or bathing contains sufficient numbers of pathogens such as *Pseudomonas aeruginosa* and species of *Flavobacterium*, *Acinetobacter*, *Klebsiella*, *Serratia*, *Aeromonas* and certain slow-growing non-tuberculous mycobacteria, they can create several infections of the skin and the mucus membranes of the eye, ear, nose and throat (WHO, 1993). Recent report by Verheyen *et al*. (2009) showed the possible isolation of viruses from well water.

About 80% of the disease cases in developing countries are attributed to inadequate sanitation and use of polluted water (Epstein *et al*. 1994). Similarly, about three-quarter of the health problems of children in Ethiopia are communicable diseases arising from the environment, specially water and sanitation (http://www.unicef.org/ethiopia/wes. html). The most communicable wide spread health risk associated with drinking water is microbial contamination (WHO, 1993). Thus, it is necessary to make a regular test the safety status of water being used for drinking and domestic uses. Water test could be done for the four most common indicators of trouble: bacteria, nitrate, pH, and total dissolved solids (TDS).

Access to potable drinking water is not dependable in Jimma town. Despite the availability of pipe lines for tap water in the majority of the households, people get water in a very intermittent condition. The poor access to safe water could be due to inconsistency in water supply and/or total lack of access to treated water for one or many reasons. Therefore, some population of the town, especially those living on peripheral part of the town are highly dependent on private well waters for various purposes such as cleaning utensils, washing clothes, bathing and drinking. This fact necessitates evaluation of the magnitude of risks associated with frequent dependence on well water. To this effect, this study was conducted to assess the bacteriological quality and safety of well water being used for drinking in Jimma town and also to determine the current antimicrobial sensitivity patterns of the isolates.

MATERIALS AND METHODS

Description of the study area

The study was conducted in Jimma town, located 353 km southwest of Addis Ababa. The town has an area of 220 Km^2. It is located at 07^{o}39’ latitude, 36^{o}50’longitude, and altitude ranging between 1700-1750 meter above sea level.

Preliminary survey

Socio-demographic data of the study population and the current status of wells and well water being used for different purposes were gathered through administration of pre-designed structured questionnaire (with both open and close-ended questions) and interview. Well water owners in Jimma town were selected purposely and a total of thirty well waters were assessed in this study. The study was conducted from February to June, 2010.

Sample collection and processing

About 100ml water samples from each 30 purposely selected wells were collected using sterile flask of 250 ml capacity. From each well, water samples were collected twice during the study period, making a total of sixty samples.

Physico-chemical analysis

The temperature and pH of well waters were determined on the spot of sampling using thermometer and digital pH meter (HANNA-211 meter, Portugal), respectively.

Microbiological Analysis

From appropriate dilution (1:10), 0.1ml of aliquots were spread plated in duplicate on pre-dried surfaces of plates of Violet Red Bile Agar (Oxoid), Plate Count Agar (Oxoid), and MacConkey agar (Oxoid) for the counts of coliforms, aerobic mesophilic bacteria and members of the family Enterobacteriaceae, respectively. Colonies were counted after the plates were incubated under aerobic condition at 30-32^{o}C for 24 hours. Purplish red colonies surrounded by reddish zone of precipitated bile were counted as coliforms. Pink to purple mucoid colonies were enumerated as members of *Enterobacteriaceae.*

Purification and floral assessment

After colony counting, 10 to 15 colonies were randomly picked from countable plates of Plate Count agar (PCA), MacConkey agar, and Violet Red Bile agar (VRBA) plates for further identification. All the colonies were transferred into nutrient broth for repeated purification on nutrient agar (Oxoid). The pure culture of aerobic mesophilic bacteria, coliforms and *Enterobacteriaceae* were streaked on slants of nutrient agar and kept at 4^{o}C for further characterization.

Characterization of isolates

Isolates were subjected to basic characterizations before identification using API 20E kits. The preliminary tests included microscopic observation for cell morphology (cell shape, cell grouping), motility, Grams reaction (KOH-test), production of catalase enzyme, cytochrome oxidase test and O/F test (oxidative or fermentative utilization of glucose) following standard microbiological methods.

Isolates were further characterized using API kits (API 20 E, V4.0) (Biomeriuex, Marcy I'Etoile, France). The strips were read after 20 hours of incubation by referring to the reading table provided by the manufacturer. The biochemical profiles obtained for the isolates were interpreted using the identification software with database (V4.0) (Biomeriuex, Marcy I'Etoile, France).

Antimicrobial susceptibility test

The isolates were tested for their susceptibility to different antibiotics on Mueller–Hinton agar (Oxoid) following the standard disc diffusion technique (Uzunovic-Kamberovic, 2006) using ten antibiotic discs; Ampicillin (A, 10µg), Amikacin (Ak, 30µg), Bacitracin (B, 10units), Cephaloxitin (Cn, 30µg), Erytromycine (E, 15µg), Kanamycin (K, 30µg), Methicilin (M, 5 µg), Norfloxacin (Nx, 10µg), Pencillin G (P, 10 units), Tetracyclin (T, 30 µg).

Inoculation of test plates

Pre-sterilized Mueller–Hinton agar (Oxoid) was swabbed with the standardized culture suspension (against 0.5MacFarland standard) using sterile cotton swab. The pre-determined antimicrobial discs were dispensed onto surface of the inoculated agar plate using antibiotic dispenser (Oxoid, Antimicrobial Susceptibility Test System, UK). After 24hrs of incubation at 30 to 32 ^{o}C, diameter of inhibition zones was measured. The strains were classified as sensitive or resistant based on the cut-off points set for the antibiotics [NCCLS, National Committee for Clinical Laboratory Standards). For the purpose of interpretation, those intermediate cases were considered sensitive (NCCLS, 2000).

DATA ANALYSIS

Data was analyzed using SPSS soft ware (version 16). The significances of differences among mean values were compared using one-way ANOVA. The carbohydrate fermentation profiles of isolates were analyzed using API WEB software (version 4, Biomeriuex, Marcy I'Etoile, France).

RESULTS

Preliminary information about the investigated well waters

The response of well water owners with respect to the purpose of using well water, associated risks, and hygienic practices are presented in Table 1. Accordingly, all the well waters were used equally for the purpose of drinking, cooking, washing clothes and utensils, and bathing. Some of well water owners also had tap water as alternative, though it was not accessible on regular basis and used only intermittently. Concerning the age and depth of wells, the majority of wells (70%, 21/30) had age of 0 -3 years and depth of 6-10 meters (60%, 18/30). Likewise, 70% (21/30) of the wells analyzed in this study were found at distance of 11-15 meter from latrine and almost half of them (43%, 13/30) were found on equal altitude to the latrine houses (Table 1).

Table 1. The status of some well waters found in Jimma town, February, 2010

S. No	Items	Alternatives	frequency	% of respondents
1	The Purpose of using well waters	· For drinking	30	100
		· For cooking food	30	100
		· For washing	30	100
		· For bathing	30	100
2	Method of using well waters	· Without any prio-treatment	24	80
		· After boiling	6	20
3	Age of the well (Year)	· 0-3	21	70
		· 4-7	9	30
4	Depth of the well (meter)	· 0-5	3	10
		· 6-10	18	60
		· 11-15	9	30
5	Distance of well from latrine (meter)	· 5-10	3	10
		· 11-15	21	70
		· 16-20	6	20
6	Position of the well relative to latrine	· uphill from latrine	9	30
		· level with latrine	13	43
		· downhill from latrine	8	27

Physio-chemical property of well water

The mean pH and temperature of the well waters were 6.71±0.08 and 21.46±1.45, respectively (Table 2). The variation in temperature and pH values of the well water samples was not significant (CV<10%).

Table 2. pH and temperature of well waters, Jimma town, February, 2010

Parameters	Mean± S.D	Min	Max	%CV
pH	6.71±0.08	6.64	6.80	1.2
Temp (^{o}C)	21.46±1.45	20.86	21.85	6.7

Microbial count of well waters

The total aerobic mesophilic bacterial count of all the samples analyzed was 907.86 cfu/ml (360 - 1490). Similarly, the mean count of total coliforms was 234.5 cfu/ml. Moreover, the mean count of *Enterobacteriacea* was also high (332 cfu/ml) (Fig. 1).

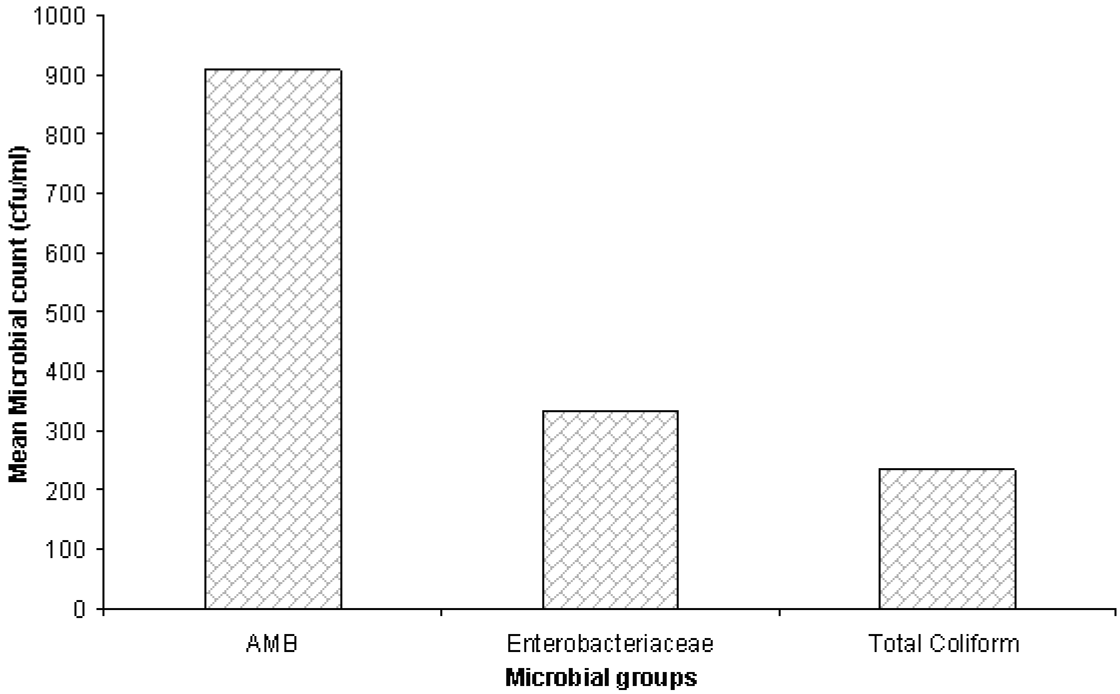

Fig. 1. Microbial load of some well water samples collected from Jimma town, February, 2010 Where, AMB, aerobic mesophiliic bacteria

A total of 15 representative gram-negative bacterial isolates were further characterized to species level using API 20E kit. The bacteria isolates were *Aeromonas hydrophilia*, (3), *Enterobacter cloacae* (1), *Serratia liqueofaciens* (1), *Enterobacter sakazaki* (2), *Serratia marcesense* (1), *Klebsella orithinolytica* (4), and *Escherichia coli* (3) (Table 3).

Table 3. API 20 E profiles of some representative bacterial species isolated from well water used for drinking, Jimma town, February, 2010

Isolates Code	Biochemical Tests for utilization of different substrates																					Isolates identity
	ONPG	ADH	LDC	ODC	CIT	H_2S	URE	TDA	IND	VP	GEL	GLU	MAN	INO	SOR	RHA	SAC	MEL	AMY	ARA	NO_3-NO_2	
Ju01	+	+	+	+	+	-	+	-	+	-	+	+	+	-	+	+	+	+	+	+	+	*Klebsella orithinolytica*
Ju02	+	V	-	+	+	-	+	-	+	+	+	+	+	-	+	+	+	+	+	+	+	*Aeromonas hydrophilia*
Ju03	+	-	-	-	-	-	-	-	V	-	+	+	+	-	+	+	+	V	-	+	+	*Escherichia coli*
Ju04	+	+	+	-	-	-	+	-	-	-	+	+	+	-	+	+	+	-	+	+	+	*Aeromonas hydrophilia*
Ju05	+	+	-	+	+	-	+	-	-	-	+	+	+	-	+	+	+	+	+	+	+	*Enterobacter sakazaki*
Ju06	+	+	-	+	+	-	-	-	-	-	-	+	+	+	+	-	+	+	+	+	+	*Enterobacter cloacae*
Ju07	+	-	+	-	-	-	-	-	+	-	+	+	+	-	+	+	v	+	-	+	+	*Escherichia coli*
Ju08	+	+	+	+	+	-	+	v	+	-	+	+	+	-	+	+	+	+	+	+	+	*Klebsella orithinolytica*
Ju09	+	+	-	+	+	-	+	-	-	-	+	+	+	-	+	+	+	+	+	+	+	*Enterobacter sakazaki*
Ju10	+	-	-	+	+	-	+	-	+	+	+	+	+	+	+	-	-	+	-	+	+	*Serratia marcesense*
Ju11	+	+	+	+	+	-	+	-	-	-	+	+	+	-	+	+	+	+	+	+	+	*Serratia liqueofaciens*
Ju12	+	+	+	+	+	-	+	-	+	-	V	+	+	-	+	+	+	+	+	+	+	*Klebsella orithinolytica*
Ju13	+	-	+	+	-	-	-	-	+	-	+	+	+	V	+	+	+	+	-	+	+	*Escherichia coli*
Ju14	+	-	+	-	+	-	+	-	+	-	+	+	+	V	+	+	+	+	+	+	+	*Aeromonas hydrophilia*
Ju15	+	+	+	+	+	-	+	-	+	-	+	+	+	-	+	+	+	+	+	+	+	*Klebsella orithinolytica*

ONPG= ß-galactosidase production, ADH= arginine dihydrolase, LDC= lysine decarboxylase, ODC= ornithine decarboxylase, URE= urease, TDA= tryptophane deaminase, CIT= Citrate, H_2S= production of hydrogen sulphide, and IND= indole, GLU= glucose, MAN= mannitol, INO= inositol, VP= Vogus prausker (acetoin production), GEL= Gelatin liquefaction, SOR= sorbitol, RHA= rhaminose, SAC=saccharose, MEL= melibiose, AMY= amylase, and ARA=arabinose, + = positive, - = negative, V = variable, Ju = Jimma University.

Results of the antibiotic susceptibility pattern of isolates showed that all of the isolates were sensitive to Amicacin (Ak), Norfloxacin (Nx) and Tetracyclin (T) (Table 4). In addition, 96.4% (14/15 isolates) were sensitive for Kanamycin (Ka) and Bacitracin (B). On the other hand, all isolates were resistant to Methicillin (M), Pencillin G (P) and cephaloxin (Cn) (except *Serratia marcesense*). Among the isolates, *Klebsella ornithinolytica* and *Aeromonas hydrophilia* showed the highest resistance to most antibiotics used (seven of the ten antibiotics). It has about 25% of resistance to Ampicillin, Bacitracin, Erytromicin and Kanamycin. Whereas, *Serratia marcesense* was sensitive to almost all antibiotics tested except for Methicillin and Pencillin G. Potentially pathogenic *Escherichia coli* identified in this study was sensitive to most of the antibiotics including Amikacin, Bacitracin, Cephaloxin, Erytromycine, Kanamycin, Norfloxacin, and Tetracyclin.

Table 4. Antibiotic susceptibility pattern of isolates identified from well waters used for drinking in Jimma town, February, 2010

S. No	Isolates	Antibiotics and number of isolates resistant or sensitive to the antibiotics																			
		A		**Ak**		**B**		**Cn**		**E**		**Ka**		**M**		**Nx**		**P**		**T**	
		R	**S**	**R**	**S**	**R**	**S**	**R**	**S**	**R**	**S**	**R**	**S**	**R**	**S**	**R**	**S**	**R**	**S**	**R**	**S**
1	*Aeromonas hydrophilia* (3)	1	2	0	3	1	2	3	0	3	0	0	3	3	0	0	3	3	0	0	3
2	*Enterobacter cloacae* (1)	0	1	0	1	0	1	1	0	0	1	0	1	1	0	0	1	1	0	0	1
3	*Enterobacter sakazaki* (2)	1	1	0	2	0	2	2	0	3	3	0	2	2	0	0	2	2	0	0	2
4	*Escherichia coli* (3)	1	2	0	3	0	3	3	0	0	3	0	3	3	0	0	3	3	0	0	3
5	*Klebsella ornithinolytica* (4)	1	3	0	4	1	3	3	1	2	2	1	3	4	0	0	4	4	0	0	4
6	*Serrtia liqueofaciens* (1)	1	0	0	1	0	1	1	0	0	1	0	1	1	0	0	1	1	0	0	1
7	*Serratia marcesense* (1)	0	1	0	1	0	1	0	1	1	0	0	1	1	0	0	1	1	0	0	1

Where: A, ampicillin; Ak, amikacin ; B,bacitracin; Cn, Cephaloxin; E, erytromycine; Ka, kanamycin; M, methicilin; Nx, norfloxacin; P, pencillin G; T, tetracycline; R, Resistant; S = Sensitive

A total of seven multiple drug resistance (MDR) patterns were observed. The highest MDR observed was A/B/Cn/E/Ka/M/P (resistance to ampicillin, bacitracin, cephaloxin, Erythromycin, kanamycin, methicillin and penicillin G) (Table 5).

Table 5. MDR pattern of bacteria isolated from well water, Jimma town, February, 2010

No of drugs in pattern	MDR patterns	Number of resistant isolates	Percentage (%)
7	A/B/Cn/E/Ka/M/P	4	26.66
6	A/B/Cn/E/M/P	3	20.0
5	A/Cn/E/M/P	2	13.33
4	A/Cn/M/P	3	20.0
	A/Cn/M/P	1	6.67
3	Cn/M/P	1	6.67
	E/M/P	1	6.67

Where: MDR, Multiple drug resistance ; A, ampicillin; B,bacitracin; Cn, Cephaloxin;

E, erytromycine; Ka, kanamycin; M, methicilin; P, pencillin G

DISCUSSION

The majority of private well water owners have been using the water directly without prior treatment, which could possibly expose them to infection with water borne diseases. Improper water quality causes major public health problems, increasing mortality rates among highly susceptible people (small children and immuno-compromised patients) besides its effect on the population income due to disease-related non-productive time (Verheyen *et al*., 2009).

The closeness of the well waters to latrine (11-15 meter) and their existence of (majority of them) on equal altitude to the latrine houses along with short depth were the major risk factors observed in the study area. The distance of wells from latrine is a determining factor for contamination with fecal coliforms. The presence of latrines within a radius of 50 m in the vicinity of pumps or wells was identified as being a risk factor for virus detection in Benin, West Africa (Verheyen *et a*l., 2009). According to the report, viral contamination was correlated with the presence of latrines in the vicinity of drinking water sources, indicating the importance of appropriate decision support systems in these socioeconomic prospering regions. According to the Hawaii's Pollution Prevention Information (2000), people consuming water from wells with depth less than 20 ft, age greater than 50 years and dug types are at risk. In our case, although all the wells were younger than the afromentioned risk ranges, the fact that

all the wells were made by digging along with the practice of utilizing water without treatment questions the safety of the studied well water for consumption. The depth from the surface, quality for drinking and chance of being polluted of ground water varies from place to place. Generally, the deeper the well, the better the ground water will be for drinking. The amount of new water flowing into the area also affects ground water quality. In addition to microbial contaminants, ground water may contain some natural impurities, even with no human activity or pollution. Natural contaminants can come from many conditions in the watershed or in the ground. Water moving through underground rocks and soils may pick up magnesium, calcium and chlorides (Environmental Protection Agency, 2002).
The recorded pH and temperature of well waters were around the optimum growth condition for the proliferation of aerobic mesophilic bacteria and, thus, contributed to the high microbial counts observed. pH and temperature are among the factors that determine microbial growth (LeChavallier *et al*., 1996). According to the guide line set by the World Health Organization, the pH of any drinking water should be in the range of 6.5 to 8.5 (WHO, 1993). On the other hand, the temperature should also be between 10 to 16^{o}C. With reference to the above specifications, the pH of all well waters was in acceptable range. However, the recorded mean temperature was beyond the WHO recommendation. As temperature is one of the most important factors for bacterial growth in drinking water (LeChavallier *et al*., 1996), the rise in temperature from the 10 to 16 ^{o}C of WHO recommendation to the current 21.46±1.45 could favor faster growth rate of any aerobic mesophilic microbes by shortening their lag-phase (Fransolet *et al*., 1985). Moreover, the absence of microbiological control system of the wells together with poor sanitation, and unhygienic practice of well owners observed during field survey (data not shown) could make the well waters the possible source of contamination risking health of the consumers.

The microbial counts (cfu/ml) of all the sampled well waters were higher (234-907) and found beyond the specification set for drinking water. According to WHO guideline (WHO, 1993), the total bacterial counts of a given drinking water should not be above 100 cfu/100ml. However, in all well water samples investigated in this study, the total aerobic mesophilic bacterial count were much higher than 100 (Mean = 907.86 cfu/ml). Moreover, the observed mean count of total coliforms (234.5 cfu/ml) was also above the guideline set for drinking water (0 cfu/100ml of water sample) as was the case for *Enterobacteriaceae*.

Aeromonas hydrophila were encountered at relatively higher frequency than *Enterobacter cloacae* (1), *Serratia liqueofaciens* (1), *Enterobacter sakazaki* (2), and *Serratia marcesense* (1). Likewise, *Aeromonas hydrophila* are reported to be among microbes associated with poorly handled public drinking water supply in north-east Scotland (Gavriel *et al.*, 1998), metropolitan water supply (Burke *et al*., 1984) where it was found contributing to infections of skin and soft tissue (Gold and Salit, 1993). *Aeromonas hydrophila* are frequently associated with fish infection being common pathogen of fish although it could infect human being as an opportunistic pathogen (Isonhood and Drake, 2002).

Except potentially pathogenic *Escherichia coli*, all bacteria species identified in this study are naturally available in the environment including water body (WHO, 1993). In terms of the degree of severity, the diseases caused by these isolates are relatively benign when compared to other pathogenic bacteria such as *Shigella*, *Salmonella* and *Vibrio cholera*. However, they are capable of causing disease in immuno-compromised people. If the well waters investigated (this study) are used for drinking or bathing, they may produce various infections of skin and the mucous membranes as previous report by WHO (1993).

E. coli is a type of fecal coliform bacteria commonly found in the intestines of animals and humans. Thus, the isolation of *E. coli* in well water is a strong indication of sewage or animal waste contamination. Infection due to *E. coli* often causes severe bloody diarrhea and abdominal cramps; sometimes the infection causes non-bloody diarrhea (Environmental Protection Agency (2002). In some people, particularly children under 5 years of age and the elderly, infection with *E. coli* can also cause a complication called hemolytic uremic syndrome, in which the red blood cells are destroyed and the kidneys fail (http://seniorhealth.about.com /library/prevention/ blecoli1.htm). About 2-7% of all infections lead to this type of complication. In the United States, hemolytic uremic syndrome is the principal cause of acute kidney failure in children, and most cases of hemolytic uremic syndrome are caused by *E. coli* O157:H7.

Besides water borne, the other possible routes of transmission of *E. coli* is mostly direct animal contact or the consumption of contaminated food, including beef, unpasteurized milk, cheese, as well as uncooked vegetables (Jay *et al*., 2005). In general, the possible factors that expose well water sources for contamination with bacterial pathogens could be construction defect, lack of fence, inadequate depth and distance of wells from the latrine, lack of protection, and poor sanitation. Furthermore, lack of regular supervision and failure to use disinfection are among the contributing factors to the high prevalence of contaminants. In addition to microbial contaminants, ground water may contain some natural impurities, even with no human activity or pollution. Natural contaminants can come from many conditions in the watershed or in the ground.

Relatively low resistance to Ampicillin by *E. coli* was observed in this study. Previous reports by Ahmed *et al*. (2000) revealed that *Escherichia coli*, isolated from urinary tract of patients were highly resistant to Ampicillin. Although all the isolates were sensitive to Amicacin (Ak), Norfloxacin (Nx) and Tetracyclin (T), multiple resistance to antibiotics (seven out of the ten tested) is an alarming issue. High resistance to the currently available antibiotics important in human medication is a challenge to effort being made to control infectious disease, especially in developing countries. Resistance to more antibiotics is an indication for dissemination of resistant genes within these microbial populations besides the isolates possible natural resistance to some antibiotics.

CONCLUSION

On bases of criteria set by WHO, the well waters used for drinking and washing in Jimma town were not found in acceptable range both in physico – chemical property (pH) and bacteriological safety. The identification of potentially pathogenic bacteria such as *E. coli* was good indicators of safety problems. The risk of well water contamination is unavoidable. Therefore, well water owners are expected to make periodic evaluation of the safety of their wells. Proper well construction and continued maintenance are keys to the safety of well water supply as already suggested by the United States Environmental Protection Agency.

Awareness development training should be given to the private well owners on the need for practicing proper hygiene, protecting well water from any source of contamination and on the depth, distance and position of well with respect to latrine. In addition, responsible bodies should pay attention to the scarcity and/or intermittence of potable drinking water in Jimma town and should work towards provision of alternative safe water sources. Although not analyzed in this study, some ground water naturally contains dissolved elements such as arsenic, boron, selenium, or radon, a gas formed by the natural breakdown of radioactive uranium in soil. Depends on the amount of the substance present, these natural contaminants could be health problems. Thus, it calls for further study on the current status of well waters of the study area with respect to the aforementioned toxic elements.

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