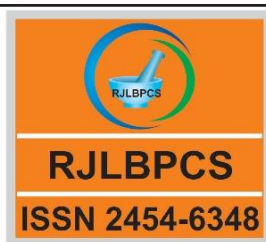


Life Science Informatics Publications
Research Journal of Life Sciences, Bioinformatics,
Pharmaceutical and Chemical Sciences
Journal Home page <http://www.rjlbpcs.com/>



Original Research Article

DOI - 10.26479/2017.0205.20

BACTERIOLOGICAL QUALITY OF HAND WASHING WATER IN HOTELS AND RESTAURANTS OF ILU ABA BORA ZONE, OROMIA REGION, SOUTHWESTERN ETHIOPIA

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ABSTRACT: The sanitation of water with respect to water borne diseases is a great concern worldwide. Therefore, this study aimed to assess the bacteriological quality and hygiene behaviors of hand washing water in the Hotels and Restaurants of Ilu ABA Bora zone, southwest Ethiopia. A cross sectional prospective study was conducted in Ilu ABA Bora zone from February - June, 2014. Forty eight water samples of hand washing water were collected randomly from 48 hotels and restaurants (one sample from each). All the water samples were collected in triplicate and analyzed by using laboratory standard method. Data were analyzed using SPSS statistical software version 20. The study found out there was poor hygiene such as improper storage and handling of hand washing water. The mean bacteriological counts of all water samples of present finding ranged from 1.2×10^4 CFU/ml to 1.1×10^8 CFU/ml. The overall mean counts of total bacterial, total coliform and spore former bacteria were 1.3×10^6 , 5.7×10^6 and 6.4×10^6 CFU/ml, respectively. The mean counts of total bacterial and coliform count were the highest in water of Yayo hotels and restaurants. There was no significant difference ($P > 0.05$) between mean counts of total coliform and spore-former bacteria. The presence of *Escherichia coli* (20%) was also tested in the study area. The study revealed that the bacteriological quality of water in some hand washing bowls used in the selected area were unacceptable for use by the customers. The study concluded that there was lack of proper hygienic and sanitation measures in most of the hotels and restaurants. Therefore, results focused on the need for further protocols for safe and hygienic status of hand washing water

KEYWORDS: Hand washing Water, Hygiene, Hotels and Restaurants, Bacteriological Quality

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1. INTRODUCTION

Inadequacy of water hygiene is one of the environmental health challenges in worldwide and a billion people lack access to safe water [17] and this has an unfavorable effect on individuals, households, communities and countries. The increased problem of communicable diseases among peoples due to poor hand washing practices and inadequate sanitary conditions remains a concern on the public health agenda in developing countries [5]. Lack of knowledge about the importance of hand hygiene in reducing the spread of infection and how hands become contaminated, poor access to hand washing facilities, and lack of institutional commitment to good hand hygiene are among the many factors that have contributed to poor hand washing compliance among societies [5]. Like in other countries, Ethiopia is also facing a report in restaurant industry. Most of the population of Ethiopia does not have access to safe and reliable sanitation facilities [11]. Majority of the Hotels and households do not have sufficient understanding of hygienic practices regarding food, water and personal hygiene, particularly small towns. In the study areas there are may not be safe and regular sanitary conditions which attributed to unsafe and inadequate water supply. The question that arises is what is the quality of water in the hand washing bowls available to the customers? As, past tract record in literature indicate that to date there has been no study on hand washing practices in such restaurants and hotels. That's why, this study was carried out to fill this gap; to evaluate the bacteriological quality, potential interventions in the storage and handling by owners and workers in hand-washing water of Hotels and Restaurants of Illu Aba Bora Zone, southwest Ethiopia.

2. MATERIALS AND METHODS

Study area description

Mettu is a capital town for Illu Aba Bora Zone. The town is located approximately 600 km southwest of Addis Ababa, Ethiopia. According to the 1997 population and housing census the districts population reached 113, 922 of which 20.9% (238,096.98) were living in Mettu town. The average household size of the district was 4.4 in both rural and urban with crude population density of 78.5 persons per km². According to the sample from the residential houses, the climate of the area is hot and humid. The moderate average of temperature of the study area is at 14 -18c⁰ plus altitude range from 1000-2027m above the sea level. The mean annual rainfall lies between 1,191.6 to 1,960.7mm with little variation from year to year. Under normal condition, the long rainy season starts early in May and goes up to September season, from June to September are months of heavy rainfall.

Experimental design and site

A cross sectional and laboratory based study design was carried out to assess the hygiene and bacteriological quality of hand-washing water available at Hotels and Restaurants of Illu Aba Bora Zone. Bacteriological quality analyses were done in Biology department, Microbiology laboratory of Jimma University, Ethiopia.

Socio demographic data collection

Structured and pre-tested questionnaires were used to obtain information on socio-demographic characteristics. Data were collected to assess the study populations' awareness of hygiene of hand washing water of the study area. In the preliminary survey data were collected from selected sites by interviewing the head of the Hotels and Restaurant and members of the workers.

Sample size and period

The study areas were Mettu town and its surrounding five (5) districts (woredas) these are: Bedele, Yayo, Hurumu, Alge, and Darimu. A total of 48 water samples were collected from from Mettu (n=12), Bedele (n=9), Hurumu (n=6) and seven samples (n=7) from each Yayo, Darimu and Alge; over six (6) months (November up to April, 2013). Triplicate samples were taken for all points. These sampling distributions, were designed depend on their weight proportion of Hotels and Restaurant's numbers in each study site.

Sample technique and collection

A systematic random sampling technique was used to address representative Hotels and Restaurants during data collection. Hand-washing water used by the consumers at Hotels and Restaurants were selected randomly for analysis. The method of sample collection was according to WHO hand-wash and drinking water guideline [14], and American public health association guideline. For the bacteriological analysis, water samples were collected using sampling bottles (500ml) sterilized in the autoclave. And the collected samples were labeled and transported to the Jimma University microbiology laboratory in ice box and immediately stored at 4°C. All the water samples were analyzed in triplicate and test on samples for bacteria were conducted within 6 hours of sampling.

BACTERIAL ANALYSIS

Total Bacterial enumeration

Five ml of water sample was added to a row of sterile bottles containing 45ml of peptone water; and serial dilutions were prepared. From appropriated dilutions, 0.1 ml aliquots were aseptically spread plated in duplicates on pre-solidified surfaces of Plate Count Agar (PCA) plates and incubated at 30-33 °C for 24-48 hours, finally colonies were counted from countable plates.

Count of aerobic Spore former bacteria

By making 1:10 dilutions of the sample in distilled water was heated to 80°C for 10 minutes. It was inoculated on the plate count agar by adding bromcresol purple and incubated at 37 °C and the plates were examined after 24 hours for typical colonies, to observe endospore-forming rods. Staining of the spores was done by making a 7% nigrosin solution in ethanol. So, by taking a clean glass slide 1 drop of the culture or a suspension made from the colony were added and then 1 drop of the nigrosin stain was added. A cover slip were placed over the mixture and sealed with finger nail polish. Finally it

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was inspected under high power and oil immersion. Spores were retractile and cells were dark (Cousin, 1989), or it was stained with malachite green.

Count of coliforms

A volume of 0.1 ml of appropriate dilutions was spread-plated in duplicate on pre-dried surface of Violet Red Bile Agar (Oxoid) plates. The plates were incubated at 30-32°C for 24 hours, after which purplish red colonies surrounded by reddish zone of precipitated bile were counted as coliforms.

Isolation of *Escherichia coli*

The samples were analyzed for fecal coliform on Violet Red Bile Agar (VRBA) by membrane filtration method (Standard Methods 9222 D). The isolated colonies were picked from plate using sterile toothpicks. The isolates were streaked onto MacConkey agar plate. MacConkey Agar plates were incubated at 37°C for 24 hours. Only colonies yielding typical results for *E. coli* on MacConkey agar (pink to red color with or without a zone of precipitated bile) were further tested by IMViC (where Indole +, Methyl red +, Voges-Proskauer -, and Citrate -) (Standard Methods for the Examination of Water and Wastewater, APHA-AWWA-WEF, 20th ed., 1998). These isolates were tested further by using API 20E test kits to determine if they are *E. coli*.

Physical parameter analysis

The turbidity and the pH of the each sample was determined using a HACH 2010 spectrometer (DR/2010 HACH, Loveland, USA) and a pH meter (Session, German) respectively, within one hour following the collection. The temperature of each sample was determined on the site of collection with a digital Thermometer (Multi Thermometer ST-9269, EUROLAB).

Method of data Analysis

Data were analyzed using SPSS statistical software version 20. Mean separation between samples categories was analyzed using One-Way ANOVA. The parameters were correlated against each other to determine their relationship. Ms Excel was also used for analysis. In all analysis, 95% confidence interval was used for determination of significant differences.

Ethical considerations Informed consent was obtained from Research review and Ethical committee of Natural and Computational Science, Mettu University

3. RESULTS AND DISCUSSION

Table 1 Socio demographic characteristics of the Hotels and Restaurants of Ilu Aba Bora zone, 2014

Background characteristics		Number of respondents	Percent (%)
Sex	Female	22	45.83
	Male	26	54.17
Age	20-25	20	41.7
	25-30	15	31.25
	30-35	9	18.75
	≥35	4	8.3
Education status	Illiterate	8	16.7
	Read and write	7	14.58
	Elementary school	14	29.2
	Secondary school	15	31.25
	Diploma and above	4	8.3

A total of 48 Hotels and Restaurants were selected from six different districts of Ilu Aba Bora zone viz. 12 from Mettu, 9 from Bedele, 6 from Hurumu, 7 from each Yayo, Alge and Darimu. Samples were analyzed in triplicate. About 54.17 % of the respondents were males where as 45.83% were accounted for females. Regarding the education status of respondents, 14.58% were capable of only reading and writing, 16.7% illiterate, 29.2% completed elementary school, 31.25% learnt secondary school and the rest were diploma holders and above (Table 1).

General Farm Conditions and Management Practices

The observed general characteristics of the Hotels and Restaurants are summarized in Table 2. The majorities of Hotels and Restaurants were not in good sanitary practices. The majority of the Hotels and Restaurants (41.7%) clean their water container more than two per week followed by twice (35.4%) and once (21.9%) per week.

Table 2. General Farm Conditions and Management Practices of Hotels and Restareuants of Ilu Aba Bora Zone, 2014

Characteristics	Frequency	Percent (%)
1. Frequency of cleaning of water container per week		
a. Once	11	21.9
b. Twice	17	35.4
c. More	20	41.7
2. Source of water for hand washing		
a. Pipe	20	41.7
b. Unprotected spring	7	14.58
c. River	12	25
d. Others	9	18.75
3. Hygiene status (color and odor of water in washing material)		
a. unsatisfactory	20	41.7
b. satisfactory	28	58.33
4. Manner of using water obtained from source		
a. Directly	43	89.58
b. After filtration	5	10.4
5. Availability of hand washing facilities near the latrine		
a. Yes	18	37.5
b. No	20	62.5
6. Hand washing practice after toilet		
a. Yes	16	33.33
b. No	7	13.58
c. Some times	25	52
7. Type of container		
a. Bucket	12	25
b. Jarkan	24	50
c. Tanker	12	25
8. Experience of disinfecting water before use		

a. Yes	9	18.75
b. No	5	10.4
c. Not at all	34	70.8
9. Way of hand washing		
a. With soap or ash	39	81.25
b. Without soap	9	18.75
10. Presence of container coverage		
a. With coverage	21	43.75
b. Without coverage	27	56.25
11. Methods taking hand washing water from storage container		
a. By pouring	10	20.83
b. By dipping	25	52.08
c. By others	13	27.08
12. Poster demonstration		
a. Present	9	18.75
b. Absent	39	81.25

Workers of hotels and restaurants brought water in gallons from different sources (river, & ponds) and poured into bowls that are mounted on wooden/metal stands in front of the hotels and restaurants from which all wash their hands without/with soap. The same water is used in different hotels for more than one day and does not constitute an adequate hand washing facility (Table 2). A poster demonstrating proper hand washing was not available in some (81.25%) visited hotels and restaurants. The majority (89.58%) of the workers of the Hotels and Restaurants use the water directly from the sources but minority (10.4%) of them use after filtration. Almost all of the Hotels and Restaurants use antiseptic for their costumers for washing hands. About 81.25% of the hotels provide bar soap for their customers to wash their hands, while 18.75% of them did not provide soap for hand washing (Table 2).—Out of the total 48 Hotels and Restaurants which indicated the availability of latrine; only 37.5% had hand washing facilities near the latrine. The study participants were also asked about their hand washing practice after handling of wastes. The majority reported that they regularly wash their hands after they handle wastes. Similarly, it was only 33.33 % of the respondents from Hotels and Restaurants with latrines reported washing their hands after toilet (Table

2). Three types of containers are used for storage and processing of hand-washing water, depending on the level and type of Hotels. These were jarkan (50%), tanker (25%), and bucket (25%). Jarkan is the major container used for transporting and storing of hand-washing water in the rural areas of Ilu Aba Bora district, especially by restaurants. Some of the restaurants and hotels in Mettu and Bedele had better water storage (tanker) and collection facilities (Table 2). Regarding container coverage, 43.75% of the hotels had no coverage. However, 56.25 % used coverage that has been observed during data collection. In relation to source of water for hand washing, 41.7% use pipe water, 14.58 % use ground water, 18.75% use river water and 25% use other sources of water on their surroundings (Table 2). About 52.08% of the workers of hotels withdrawn hand washing water by pouring their equipment whereas 20.83% participants of hotels collecting hand-washing water by dipping materials into the water

3.1.2 BACTERIOLOGICAL ANALYSIS

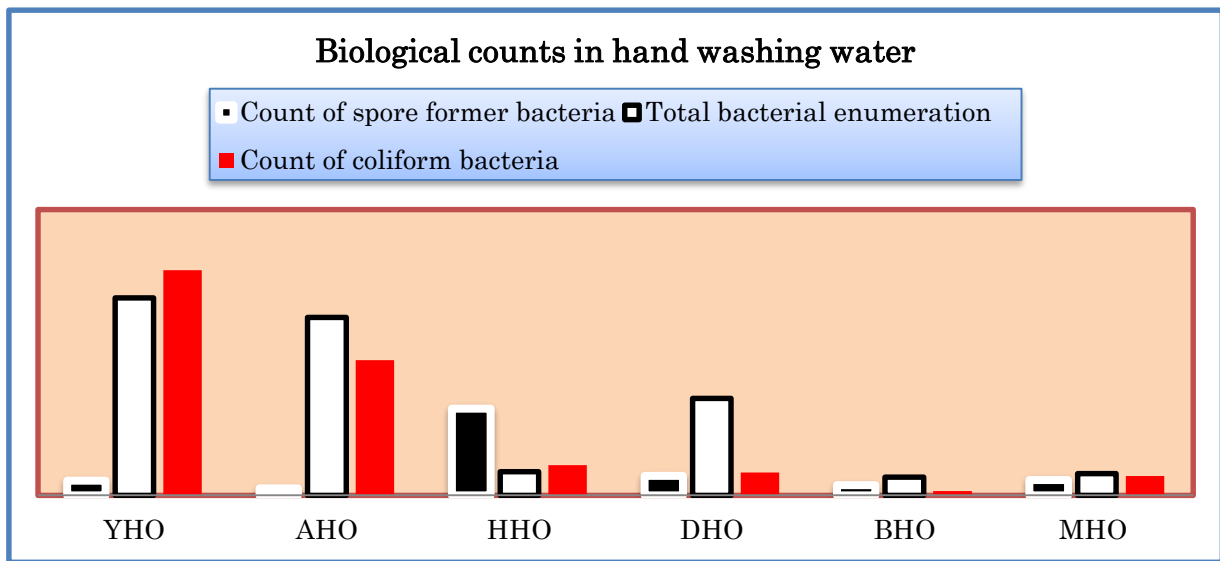


Figure 1: Overall mean counts of Bacteria (CFU/ml) of Hand-Washing water from Hotels and Restaurants of districts of Ilu Aba Bora zone, 2014.

Where: **BHO** - bedele hotels, **MHO** - mettu hotels, **HHO** - hurumu hotels, **AHO** - alge hotels, **DHO** - darimu hotels and **YHO** - yayo hotels: codes assigned to hotels and restaurants

As indicated in above figure 1, the overall mean counts of total bacterial; total coliform and spore former bacteria were 1.3×10^6 , 5.7×10^6 and 6.4×10^6 CFU/ml respectively. The mean count of total bacterial count was the highest (1.97×10^7 CFU/ml) in water of YHO. The mean bacteriological counts of all water samples of BHO, MHO, HHO, AHO, DHO and YHO ranged from $1.2 \times$

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10⁴ CFU/ml to 1.1 × 10⁸ CFU/ml. All the water samples obtained from Hotels and Restaurants had closer spore former bacteria (8.77x10⁵ to 7.59x10⁶ of CFU/ml), but with relatively high count (7.7x10⁶ CFU/ml) in HHO hotels. The minimal and maximal mean values of total bacterial, total coliform and spore former bacteria obtained per milliliter of hand-washing water of the different Hotels and Restaurants ranged from 1.58x10⁶ to 1.73x10⁷, 3.69x10⁵ to 1.97x10⁸ and 8.77x10⁵ to 7.59x10⁶ CFU/ml, respectively. On the other hand, microbial counts in a few Hotels and Restaurants were below countable. Analysis of variance of the mean counts (CFU/ml) of total bacterial, total coliform and spore-former bacteria revealed statistically significant (P< 0.05) difference between the mean counts of water samples obtained from hotels and restaurants. However, there was no significant difference (P > 0.05) between mean counts of total coliform and spore-former bacteria of water samples collected from the two Hotels. Likewise, the mean counts of total bacterial and total coliform were significantly different (p < 0.05) from counts of the others within Hotels and Restaurants (p >0.05). Of the 48 Hotels and Restaurants from which coliforms (which are indicative of unhygienic practices) were isolated, in the same way the presence of *Escherichia coli* (20) was also tested in hand washing water samples.

DISCUSSION

HAND WASHING SERVICES: Socioeconomic condition has prominent effect on overall hygienic condition of family and quality of food and water. In our study, socioeconomic condition of family's kept or maintains poor quality water. Furthermore, consumers' hygiene-sanitation practices were assessed through interview. The interview questions and sanitary inspection forms were adapted from world health organization and assessment of the conditions of hotels water containers was obtained through observation checklist [14]. Hand washing establishment is a fundamental and important part of the operations and entails the removal of bacteria as well as soluble and insoluble particles that may be a source of contamination. The establishment's hand washing container shall be kept in an appropriate state of repair and condition to facilitate all sanitation procedures and function as intended, particularly at critical steps [20]. There was a correlation between the services offered by the different hotels and the level of contamination of waters. Observations made on some of the premises of the sampled water suggested their contribution to the water contamination. Hand washing sinks can be sources of pathogenic bacteria because they usually contain stagnant water that supports the growth of microorganisms, which can be transferred to hands during hand hygiene practices [16] The majority of sinks were unclean, most were made of plastic and metals with a lot of cracks and none of them was used exclusively for hand washing. Also, some of the Hotels and Restaurants were not provided with a hand washing sink. The presence of hand washing facilities near the latrines encourages the users to wash their hands after toilet use. However, this study showed only 18 (37.5%) of the Hotels and Restaurants had hand-washing facilities near the latrines. Even then, 9 (18.75%)

Hotels reported that they use only water to wash their hands which is not an effective means to remove the waste and pathogenic microorganisms. Washing of hand with soap after visiting toilet (or after defecation) has a paramount importance in decreasing of diarrheal and other parasitic diseases [13]. The FDA specifies that in order to clean their hands, workers and consumers shall use running warm water or soap during their hand washing [3]. Both bar soaps and liquid soaps may become contaminated with bacteria during use, with bar soaps being associated with heavier contamination compared to liquid soaps [26]. However, other studies have suggested that these bacteria are unlikely to be transferred to hands [24]. The unavailability of a hand drying method or a poster demonstrating proper hand washing in the present visited Hotels and Restaurants might be contribute in lowering the acceptability and the mean score percentage of the hand washing facilities parameter. A sign or poster that notifies customers to wash their hands shall be provided at all hand washing sinks and shall be clearly visible, also each sink shall be provided with disposable towels or a heated-air hand drying device [3]. On the other hand, in the present study, the surfaces of walls, windows and doors of the water sinks used for hand washing were not in standard design. For that reason, the surfaces of walls and partitions shall be made of smooth durable and impervious materials. Windows shall be easy to clean, constructed to minimize buildup of dirt and where necessary, fitted with removable and cleanable insect-proof screens. Doors shall have smooth, non-absorbent surfaces and shall be easy to clean and disinfect. Working surfaces that come into direct contact with water shall be of sound condition, durable and easy to clean, maintain and disinfect [15; 20] Moreover, the present study of Hotels and Restaurants had temporary storage only 43.75 % were found with cover at the time of data collection. This indicates that the stored water was exposed to insects and rodents. The majority (41.7%) of the hotels and restaurants reported that they clean their water container more than two per month or week. Also 70.8 % reported that they have no experience of disinfecting water before use. These two practices need to be encouraged and enhanced, although with the safety measure of its proper treatment and handling. According to The storage practices and handling the water from storage container at home and hotels caused quality deterioration and water poses potential risk of infection to consumers [15].

PERSONAL HYGIENE: Many of the studies conducted have proven that it is imperative to care about personal hygiene, and especially hand cleanliness [2; 12]. Hand-washing which is a simple and effective way to cut down on cross-contamination is too often forgotten [21]. About 81.25% hotels provide bar soap and the rest allow water alone (18.75%) for hand washing that is considered insufficient to remove the microbial contaminants. It is worth mentioning that the majority of the observed hygiene of washing facilities failed to avoid contamination of their hands after washing. To avoid recontamination of hands after washing, customer may use disposable paper towels [3]. The method of withdrawing or collecting the water from storage container also significantly deteriorate

the quality of hand-washing water and resulted into contamination by direct dipping (52.08%), pouring (20.83%) and other method (29.08%) of collecting the water by jug /mug without handle or short handle by directly through tap indicating that the withdrawing the water by dipping hand or utensil without handle or short handle lead contamination in water. These findings are consistence with the results of other authors [7; 19] Hence, people should use dipper with long handle and avoid the use of glass or mug for withdrawal of water to prevent the transmission of contamination in the stored water. The majority of the Hotels and Restaurants (41.7%) clean their water container more than two per week followed by twice (35.4%) and once (21.9%) per week. The frequency of washing of storage containers had prominent effect on the quality of water and indicated that higher the frequency of washing, less the contamination and vice versa [7]. Tambekar *et al.* (2008) [6] showed that practicing additions of fresh water in residual water or unused water from dipper to storage container enhance the chances of contamination [7] which was consistence with our finding. Longer storage time leads to less acceptable as compare to regular water supply, thus indicating longer storage time implies more chances for contamination [4]. Concerning the education background in the present study, about 14.58% workers and owners were capable of only reading and writing, and 16.7% illiterate. Accordingly, the workers and owners with good knowledge of water hygiene and health kept the water least contaminated indicating that the highly educated is necessary to improve the storage and handling practices [7]. The educated owner or worker of hotel kept the water free from contamination indicated that the formal education also improved the quality of water [7].

BACTERIOLOGICAL ANALYSIS: The quality of hand-washing water of Hotels and Restaurants was analysed and found about 62.5% were poor quality. Microorganisms are transferred to the hands in the process of washing hand and through poor personal hygiene resulting in the hands being heavily contaminated with enteric pathogens [10]. In view of that, the hand-washing water available in the hotels significantly contaminated with different bacteria. Similarly, total coliforms were the highest (1.9×10^7 CFU/ml) in YHO (Yayo hotels) indicating that the hand washing was improperly done due to several drawbacks in one or more of the followings; the type of the used container, irregular washing of sink, the sources of hand washing water, methods of taking hand washing water from container or avoidance of post hand washing contamination. The mean coliform counts (1.9×10^7 cfu/ml) of water in this study were higher than the reports of Arthur and Danso [8] from Ghana (1.26×10^6 cfu/ml.) and [10] from Ethiopia (3×10^5 cfu/ml). Waters considered wholesome for drinking and washing must not have any coliforms [1] The presence of *Escherichia coli* bacteria was also tested in water samples (20%). Their presence in the water has water-borne disease significance. In terms of public health significance, E. coli has frequently been reported to be the causative agent of traveller's diarrhoea, urinary tract infection, haemorrhagic colitis, and haemolytic uraemia syndrome. The result of present *Escherichia coli* from hand-washing water samples was higher than the result

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obtained in another study (7.8%). Kroger and Noll (1969) [25] found high proportion of *E. coli* and other coliform from washed water. On the contrary, Dragas and Tratnik (1975) [24] found 2.3% *E. coli* from used water. Delaquis *et al.*, 2007 also isolate *E. coli* from Japanese restaurant hand washing water, fast food restaurant and western food restaurant in different cities of Taiwan. It is clear that out of all possibilities, *E. coli* can best fulfill conditions possible to act as an ideal indicator of faecal pollution. These organisms survive longer in water than most pathogens, and thus can detect recent as well as earlier pollution. The hand washing establishment followed by the some hotels in the present study failed to free their hands from the fecal coliforms but instead it increased the percentage of contaminated hand washes. There was no significant correlation in the level of total coliforms between Darimu hotels and Yayo hotels. Therefore, results of total coliforms recorded in the present study showed that all examined samples from Darimu hotels and Yayo hotels exceeded the guideline values recommended in accordance with international standards [22] The total bacterial count from the hotel with the worst hand-washing water hygiene checks, accordingly no coverage container, irregular cleaning of water container or type of container that allow the accumulation of microbes, were the highest (6.3×10^7 CFU/ml), but were least at the hotels with the best observed hand-washing water hygiene checks (3.5×10^4 CFU/ml) which indicating that the hygiene practices were not to the standard. When compared with the current reports in Ghana, the overall mean total aerobic plate counts (6.3×10^7 CFU/ml) of water obtained in this study was relatively lower than that of (1.04×10^8 cfu/ml) [8]. Spore former bacteria are gram-positive, aerobic and facultative, spore-forming rods found in diverse environments including rocks, dust, aquatic environments, and the gut of various insects and animals including humans. Whereas this study reestablished that hand-washing water contain high numbers of cultivable spore former bacteria. This group of bacteria can contaminate water specially *Clostridium perfringens* the species of spore former bacteria most often associated with the faeces of warm-blooded animals, but is only present in 13–35% of human faeces. The main criticism of the use of *C. perfringens* as a faecal indicator is its long persistence in the environment, which is considered to be significantly longer than enteric pathogens hence *C. perfringens* they used as the appropriate indicator for quality of water [22]. Therefore, the presence of these bacteria further strength the contamination of hand-washing water by enteric pathogens Generally, study concluded that there was poor hygiene such as improper storage and handling of hand washing water. The results obtained in this study indicate that hand washing water available to the customers has a high level of microbial contamination that does not meet the international standards. The high bacteria count indicates that effective hygienic practices were not implemented during the storage, handling, and collecting of water at the point of processing. The number of coliforms and *E. coli* were above the recommended international and national limits. Furthermore, this study shows that some hand-washing water in Hotels and Restaurants could serve as possible

TeshomeTadesse, et al RJLBPCS 2017 www.rjlbpcs.com Life Science Informatics Publications routes of transmission of pathogenic bacteria. This may be most significant causing diseases for immune-compromised individuals. Therefore, at the broader societal level, governments and other agencies responsible need to be made aware the high-quality of hand washing water amongst owners and workers of the hotels and restaurants. Finally, this study suggested that further investigations were needed to verify the possible bacterial transmission from bowls/sink during hand-washing.

CONFLICT OF INTEREST

The authors have no conflict of interest.

ACKNOWLEDGEMENT

The financial support from the Research and Community Service Directorate of Mettu University is gratefully acknowledged. In addition, we are grateful to Jimma University for their help in analyzing water samples. Finally, it would be unfair not to emphasize the role of workers and owners of Hotels and Restaurants of Ilu Aba Bora Zone for spending their precious time and energy for collaboration during the data collection.

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