Effects on Quality of Household Drinking Water Assessed through Physico-chemical and Bacteriological Parameters - A review

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Abstract - *This paper presented and compared the practices of handling household drinking water, microbial quality, physico-chemical quality of drinking water. The sudden contamination or gradual contamination happens in the drinking water either by any unhygienic conditions or by any other wrong handling practices or lack of sanitation around the household drinking water. Again, variation in the degradation in the microbial and physico-chemical properties of drinking water were compared for the improvement in the quality of drinking water. Improvement in the drinking water quality definitely leads to reduction in the water borne diseases. The storage of water also plays important part in contamination of water. The containers used for storage of drinking water causes lot many effects on the health safety of consumer.*

Keywords:

Handling practices, Household drinking water, Microbial and phyico-chemical quality, Point-of-use (POU), Source of water, Storage of water, Water borne diseases.

1.INTRODUCTION

In rural and urban areas of each country the drinking water supply plays very important role on the health and economy of nation (Gedamu, 2017). It includes three phases to reach to the consumer. The first phase is the collection of water from the source. In that, the source may be municipal, may be groundwater or may be spring or lakes. These are to be decided on that as intrinsic or accessible. In the second phase water collected from the source is to be transported by the various means like distribution system in urban areas or by any other means. Last and the main part of the household drinking water is point-of-use in household. It includes the storage of water in the container or consumed directly (Gundry, 2006). The drinking water used after household water treatment system can be beneficial but if they are not handled, stored properly there will be high chances of contamination (Mushi,2018). Microbial contamination if increase can lead to many water-borne diseases like diarrhea, typhoid, cholera like diseases to the consumers (Yassin, 2006).

Consideration of the review based on the field studies and laboratory studies. Transportation of water from source to the houses and storage of the drinking water in the emergent nations (Mohammad,2020; Oloruntoba ,2008; Heitzinger, 2015). Water quality in the non-domesticated areas are not considered in the review. Coliform bacteria i.e. Total Coliform (TC), Fecal Coliform (FC) and *Escherichia coli (E. coli)* i.e. bacteriological study of water is the only point considered in the review. The quality of water at the source and water quality at point-of-use (POU) for the household's study results of developing countries are included in the review (Wright, 2008).

The objective of review is to know the causes and comprehensiveness of microbial, physico-chemical contamination happening in the household drinking water in developing countries between the source and point-of-use of drinking water. Also, to get aware of sanitation, hygiene and handling practices of drinking water.

2. Physico-chemical studies of drinking water:

2.1 turbidity

Many drinking water utilities endeavor to accomplish levels as low as 0.1 NTU. The European principles for turbidity express that it must be close to 4 NTU. The World Health Organization, sets up that the turbidity of drinking water ought not be more than 5 NTU, and ought to in a perfect world be underneath 1 NTU (Sheilds et al., 2015; Trevtt et al.,2004; Tumwine et al., 2002)

2.2 On the basis of physico-chemical parameters

Assessment of physico-chemical parameters of water can be a decent sign of the quality, profitability and maintainability of that water body (Mustapha, 2008). Changes in the physico-chemical properties not just give significant data about the water quality, yet the effects of these parameters on the capacities and biodiversity of the repository can be resolved (Mustapha, 2008). Poisons in the water cause an expansion in physico-synthetic parameters, for example, pH, turbidity which makes the water unseemly to utilize or to drink (Tariq et al., 2006). The significance of every one of different parameters that are routinely estimated is quickly depicted in the accompanying areas.

2.1.2 Total dissolved solids (TDS) and Electrical conductivity (EC)

Total dissolved solids (TDS) comprises mostly of inorganic salts, for example, calcium, magnesium, potassium, sodium, bicarbonates, chlorides and sulphates, however contains a limited quantity of natural issue too (WHO, 2011; Heydari and Bidgoli, 2012). Normal sources, sewage, urban overflow and mechanical wastewater cause

TDS in water (WHO, 2011). Electrical conductivity is an estimation of the capacity of water to direct power. Water with low salt levels, for example, refined water conducts power inadequately, while water with high salt levels, for example, ocean water conducts power adequately (DWAF, 1998). Saltiness is in this way an estimation of the measure of TDS present in the water (CSIR, 2010).

The EC level of water can be utilized to appraise the degree of TDS in the water. The EC is identified with the TDS by a normal transformation factor of 6.5 for most waters (DWAF, 1996b). The change condition is as per the following: EC (mS/m at 25°C) x 6.5 = TDS (mg/L) (DWAF, 1996b). As per the WHO (2011), there is no solid information on conceivable wellbeing impacts related with the ingestion of sensible degrees of TDS in drinking water. Drinking water with TDS levels above 1000mg/L turns out to be progressively unpalatable to customers and inordinate scaling of water pipes has likewise been noted (WHO, 2011). Electrical conductivity in drinking water causes an aggravation of salt and water balance in babies, heart patients, people with hypertension, and renal sickness (Memon et al., 2008). The SANS 241 (2011) standard for EC in drinking water is ≤170 mg/L and for TDS ≤1200 mg/L in drinking water **(**Mohsin et al.,2013, Ross et al., 2000)

2.1.3 pH

pH is a logarithmic articulation of the hydrogen fixation in water. It is an impression of the level of acridity (pH lower than 7) or alkalinity (pH more prominent than 7) of the water. The pH of most unpolluted water lies between 6.5 – 8.5. pH is a significant operational water quality parameter (WHO, 2011). Water with a low pH level may cause erosion in aroused or copper pipes. The immediate wellbeing impacts of low and high pH levels incorporate corrosive and antacid consumes, separately. These outrageous pH levels may likewise cause disturbance of the mucous films (DWAF, 1998). The SANS 241 (2011) standard for pH in drinking water is ≥5 to ≤9.7 pH units. The pH levels in the testing does plays any role in the contamination in the on-site testing and also the testing resulted in the laboratories. The found results in between 6.8 to 7.8 which is between the acceptable limit (Khan et al., 2012; Memon et al., 2010; Abdul et al., 2012; Nishtha et al., 2012; Islam et al., 2011; Dohri et al., 2015; Garoma et al., 2018).

2.3 On the basis of bacteriological parameters i.e. *Escherichia coli* (*E. coli*), Total Coliforms (TC), Fecal Coliforms (FC)

The investigation of microbiological nature of water means to guarantee that the customer is shielded from pathogenic living beings, for example, microscopic organisms, infections and protozoa (Figueras and Borrego, 2010). Inspecting and investigation of microbiological parameters must be accomplished more as often as possible than physico-concoction parameters, in light of the fact that microbial defilement can have intense wellbeing consequences for shoppers (DWAF, 2005b). Microorganisms can be utilized either as markers of fecal contamination or to demo **(**Abdul et al., 2012, Wingender and Flemming, 2011)

2.3.1 *Escherichia coli (E. coli)* and fecal coliforms:

Coliforms are found normally in different conditions, yet drinking water isn't considered as a common habitat for them (Rompre et al., 2002). Their essence in drinking water would thus be able to be viewed as a sign of conceivable breaking down water quality (Rompre et al., 2002). Complete coliforms are vigorous and facultative anaerobic, rod-shaped, Gram negative, non-spore framing microbes which mature lactose with gas and structures corrosive inside 24h at 35-37°C (WHO, 2011). They create red settlements with a metallic green sheen inside 24h at 35°C on Endo-type media containing lactose (Jain and Pradeep, 2005). The SANS 241 (2011) standard for complete coliforms in drinking water is ≤10 CFU/100ml. All out coliforms can be confined on m-Endo agar utilizing the layer filtration technique. m-Endo agar is specific for coliforms and produce states with a metallic sheen (Jain and Pradeep, 2005). m-Endo agar contains different supplements which advances the development of coliforms. It contains lauryl sulfate and deoxychlolate which restrains the development of different life forms (Merck, 2012). The response of lactose positive settlements with fuchsin-sulfite discharges fuchsin which actuates the red shade of the states (Merck, 2012). The metallic green sheen of the states creates because of the development of aldehydes during lactose aging (Sigma-Aldrich, 2012b). Unnecessary development of coliforms on m-Endo agar may restrain the arrangement of the unmistakable metallic green sheen (Burlingme et al., 1984; Rompre et al., 2002).

Fecal coliforms are utilized as markers of sewage in water (Kacar, 2011). The WHO Guidelines for Drinking-water Quality utilized Escherichia coli as fecal pointer of decision (Payment and Robertson, 2004; WHO, 2004b). The nearness of *E. coli* in drinking water means that ongoing or post-treatment fecal pollution. In the event that *E. coli* is available in water tests, it implies that the framework is tainted with fecal issue and that pathogenic microorganisms might be available because of disappointment of the treatment framework (Payment and Robertson, 2004). *E. coli* is generally a decent marker of Salmonella spp. in the drinking water framework (WHO, 2011). Despite the fact that *E. coli* frames some portion of the ordinary intestinal vegetation of the human, if present in different pieces of the body it can cause genuine maladies, for example, urinary tract diseases, bacteraemia and meningitis (WHO, 2011). The SANS 241 (2011) standard *for E. coli* in drinking water is 0 CFU/100ml. m-Fc agar can be utilized to detach fecal coliforms utilizing the layer filtration technique. Fecal coliforms produce blue settlements on m-FC agar (Farnleitner et al., 2001). m-Fc agar contains bile salts which repress the development of Gram-positive microscopic organisms (Merck, 2012). Peptone and yeast fill in as supplements for the development of fecal coliforms. The blue shade of the provinces is initiated by lactose aging at raised temperatures (44.5°C ± 0.2°C) (Merck, 2012).

Layer Lactose Glucuronide (MLG) agar can be utilized to recognize complete coliforms and *E. coli* (Hallas et al., 2008). Layer Lactose Glucuronide agar contains lauryl sulfate which represses the development of Gram-positive living beings (Oxoid Limited, 2012). The recognizable proof of coliforms and *E. coli* on MLG agar depends on two standards: 1) lactose aging instigates the yellow shade of the settlements when corrosive is delivered; 2) the compound glucuronidase divides the chromogenic substrate 5-bromo-4-chloro-3-indolyl-β-D-glucuronide (BCIG) and produces a blue chromophore which develops in the bacterial cells (Oxoid Limited, 2012). Coliforms age lactose so settlements will seem yellow on MLG agar, though *E. coli* matures.

The presence of coliforms indicates the possibility of deterioration of drinking water quality. *E. coli* is the commonly studied type of bacteria. The study of different cases of drinking water are analyzed with the help of surveys and laboratory testing. The testing of the samples resulted in different counts of *E. coli*, total and fecal coliforms. The tests which were carried out from the sources to storage and to the consumption point were analyzed and counts of them came in between 1.5 to 300 cfu/100ml counts of *E. coli* approximately (Amenu et al.,2013;Feleke et al., 2018; wang et al.,2017; Trent et al., 2018; Oswald et al.,2007;Payment et al., 2010; Shar et al., 2010; Oluyege et al., 2011).

However, by the WHO standards the testing results came at very high of some analysis. They found the results of analysis at almost from 40 to 80% of the total samples were at risk of contamination (wright et al., 2004, Bain et al., 2004, Machdar et al.,2013; Onabolu et al., 2009; Murphy et al.,2019;Kirby et al., 2016) and also found some studies with risks more than 80% samples (Olorentoba et al.,2008, Brick et al.,2004).

Some investigated the fecal coliforms together and found the results in between 2cfu/100ml to 6000cfu/100ml i.e. some were at high contamination and some were at lowest contamination depending on the surrounding and handling practices of drinking water (Falconi et al., 2016; Rufener et al., 2010; Eliku et al., 2011).

2.4 On the basis of storage, collection and handling practices: -

After study it was found that results of different cases and got the point that the handling practices, sanitation, maintenance of hygiene surrounds the drinking water and also the storage container plays the vital and very important role in the quality of drinking water which in worse conditions leads to the water-borne diseases (Mushi et al., 2018; Zamxaka et al., 2004; Cohen et al., 2015; McGuiness et al., 2020; Mohammed et al., 2019; Jensan et al., 2002; Yassin et al., 2006; Lye; 2002, Sheilds et al., 2015; Trevtt et al.,2004; Tumwine et al., 2002; Vasquez et al., 2015; John et al., 2014; Packoyam et al., 2016; Tambekar et al., 2016; Berhanu et al., 2015; Eshol et al.,2009; Heitzinger et al., 2015; Mishra et al., 2013; Cairncross et al., 2010; Tiku et al., 2003).

3. CONCLUSION

The study highlights the safeness of household drinking water which may not be count in good quality of drinking water due to many ways of contamination in it. The review shows that, the distribution system, handling practices, storage contamination, Hygiene, and sources of drinking water are responsible for the level of contamination. Those may lead to the other consequences due to water-borne diseases. Drinking water testing should be done regularly to determine the quality of drinking water to prevent outbreak of enteric water-borne diseases. Country should be educated about the spread and control measures of diseases related to drinking water and to improve the quality of household drinking water.

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