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Water Quality in Different Storage Containers: A Comparative Study of Materials

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ABSTRACT: Access to safe drinking water is crucial for human health. However, water quality can be compromised during storage, particularly when using inappropriate containers. This review examines the effects of plastic, glass, and metal containers on water quality, highlighting the risks of contamination and potential health implications. Studies show that plastic containers can leach harmful chemicals, such as bisphenol A and microplastics, into stored water, while glass containers maintain water quality without leaching. Metal containers, including copper and stainless steel, demonstrate varying levels of contamination risk due to corrosion and coating degradation. The findings underscore the importance of selecting suitable containers for storing drinking water to prevent waterborne diseases. Recommendations for optimal container materials and storage practices are discussed to ensure the provision of safe drinking water and mitigate public health risks.

Keywords: Drinking Water Quality, Water Storage Containers, Plastic Containers, Glass Containers, Metal Containers

I. INTRODUCTION

Water is essential for life. Without water survival of plants, animals and microorganisms on the earth is impossible. Life on earth is unimaginable without precious liquid called water[1]. But now a day's people are polluting water resources like ponds, lakes, rivers etc. by disposing waste materials into them. As a result the water gets contaminated and turns turbid which cannot be used for drinking purpose ([2]. Pure water does not contain more number of bacteria.

However, it contains very few numbers of actinomycetes, yeasts, bacillus spores, clostridium spores, euglena, paramecium, autotrophic bacteria and etc. Contaminated water has large amounts of organic matter from sewages, faeces and industrial complex. Coliform bacteria a gram negative, non-spore forming bacilli is the most prevalent bacteria in contaminated water[3]. Escherichia coli, is an anaerobic bacteria which is more predominant in gastrointestinal tract of human and animals. But this usually does not harm the living organism, but it is also a clinically important bacteria causing a number of diseases (Friedman et al., 2002). Pathogenic microorganisms cause many harmful water borne diseases. They include polio, typhoid, cholera, hepatitis, shigellosis, salmonellosis, diarrhoea etc.[4].

So the water used for the purpose of drinking should be in high quality in order to lead a healthy life. The quality of water plays a major role in preventing us from water borne diseases[5]. The water has to be treated before the human consumption. Now a days we are receiving well treated water from Municipal Corporation. But there is a chance for contamination during storage at home. So the water has to be stored in appropriate way to prevent recontamination. Ancient Ayurveda suggest the use of metals like gold, silver, copper and brass for maintaining the purity of water by reducing number of pathogenic microorganisms. Our ancestors mostly used copper vessels for storing drinking water. Copper vessels shows antibacterial effect against most diarrhoeagenic bacteria including Vibrio cholerae, Enterotoxigenic E.coli, Enteropathogenic E.coli, Salmonella entericatyphi and Salmonella paratyphi (Preethisudha, 2012). Storing water in brass vessels is also good for health. Since it is an alloy of zinc and copper it protects against illness[6]. Silver vessels shows bactericidal effect against Shigella dysenteriae, Vibrio cholera and Salmonella typhi within an hour of storage. These microorganisms cause life threatening enteric human diseases[7]. Ancient Mediterranean and Asians are used silver vessels to store foods and beverages from spoilage[8]. They also placed silver and copper coins in water to prevent the growth of microorganisms. Silver dollars were also added to milk to keep it fresh[9].

But now a day's plastic containers are widely used for storing water. Plastic bottles are

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widely used for storing and drinking water. Plastic containers contain a harmful chemicals includes Bisphenol-A which is an endocrine disruptor [10]. These chemicals leads to early puberty in females, reduced sperm count, obesity, breast and prostate cancer and other serious health issues [11].

Fig 1. Water Analysis

II. TYPES OF STORAGE CONTAINERS:

A. Plastic Containers:

Fig 2. Plastic Container

Plastic is widely used for water storage due to its lightweight and cost-effective nature. Common types include:[11,12, 21, 22, 23]

- **Polyethylene Terephthalate (PET):** Often used for bottled water; concerns about leaching chemicals like antimony and phthalates.
- **High-Density Polyethylene (HDPE):** Used for larger containers; generally considered safer but can still leach substances over time.

Potential Contaminants:

- Microplastics: Breakdown of plastic over time leads to microplastic contamination.
- Chemical leachates: Studies show various chemicals can leach into stored water, particularly under heat or sunlight.

B. Glass Containers:

Fig 3. Glass Container

Glass is an inert material that does not leach chemicals, making it an excellent choice for long-term water storage.

- **Benefits:** Non-reactive, recyclable, and does not absorb odors or flavors.
- **Limitations:** Fragility, weight, and higher cost compared to plastic.

Interaction with Water:

- Glass does not contribute to water contamination, making it a preferred choice for preserving water quality.

C. Metal Containers:

Fig 4. Metal Container

Metal containers, such as stainless steel and aluminum,Copper are also popular. Important aspects include:[13,14]

- **Stainless Steel:** Durable and resistant to corrosion; however, the quality of the metal and any protective coatings can affect water quality.
- **Aluminum:** Lightweight but can react with acidic water; typically coated to prevent leaching.
- **Copper:** Copper improves brain and heart health and also has an antibacterial effect

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Corrosion and Coatings:

- Protective coatings in metal containers can degrade over time, potentially introducing contaminants into the stored water.

III. METHODOLOGIES FOR WATER QUALITY ANALYSIS:[15,16,17,18]

➢ **Physical Properties**

Physical characteristics like temperature, turbidity, and color are important indicators of water quality.

- **Temperature**: Influences microbial growth; higher temperatures may encourage bacterial proliferation.
- **Turbidity:** Measured using turbidity meters; higher turbidity often indicates contamination.

➢ **Chemical Properties:**

Chemical analyses assess various parameters critical to water safety.

- **pH:** Influences chemical reactivity and microbial activity; measured using pH meters.
- **Nutrient Levels:** Testing for nitrates and phosphates helps assess nutrient pollution.

➢ **Biological Properties:**

Microbial analysis is essential for assessing water safety.

- **Microbial Testing:** Methods include culture techniques and polymerase chain reaction (PCR) for detecting pathogens

IV. COMPARATIVE ANALYSIS OF WATER QUALITY:[19,20,21]

➢ **Findings from Plastic Containers:**

Research shows that plastic containers can lead to significant contamination.

- **Microplastics:** Studies indicate the presence of microplastics in water stored in plastic containers, affecting health and the environment.
- **Chemical Leaching:** Evidence of leaching of substances like bisphenol A (BPA) and phthalates into water, particularly under prolonged exposure to heat.

➢ **Findings from Glass Containers:**

Glass containers consistently show superior water quality.

- **Minimal Contamination:** Studies indicate very low levels of contaminants, making glass a preferred choice for quality preservation.
- **Long-term Storage:** Glass maintains water quality over long periods without leaching.

➢ **Findings from Metal Containers:**

Metal containers present mixed results**.**

- **Corrosion Risks**: Some studies show leaching of metals into water, especially when the protective coating is damaged.
- **Coating Effectiveness**: The efficacy of coatings varies, impacting overall water safety.

V. CONCLUSION:

The quality of stored drinking water is significantly influenced by the type of container used. Plastic containers pose health risks due to microplastic contamination and chemical leaching, while glass and metal containers offer antibacterial benefits. To ensure safe drinking water, glass containers are recommended for long-term storage, while copper vessels offer health benefits. Further research is needed to develop safer storage solutions and public awareness campaigns can educate individuals about proper water storage. Transitioning away from plastic containers can mitigate waterborne diseases and promote a healthier environment.

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