Evaluation of the effectiveness of filtered drinking water purification systems in Janzour Municipality in eliminating intestinal parasites

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Abstract- Provision safe drinking water is a fundamental public health priority. In recent years, filtered groundwater has become a widely used source of drinking water in Janzour Municipality. The present study aimed to evaluate the effectiveness of filtered drinking water purification systems in Janzour Municipality in eliminating intestinal parasites. The study's findings also serve to assure the local population about the safety and potability of the distributed water, contributing significantly to public health. To this end, 20 filtered drinking water samples were randomly collected from 20 groundwater treatment and filtration sites across the municipality. Approximately two liters of water were collected per site using clean, sterile plastic bottles. Following collection, the sample were placed in a refrigerated container and immediately transported to the laboratory at the Center for Communicable Disease Control and Prevention in Tripoli for analysis. Microscopic examination confirmed that none the samples contained intestinal parasite stages. These results demonstrate that the drinking water purification system in Janzour Municipality is highly effective in eliminating intestinal parasite contamination not only immediately after filtration but also during the storage and distribution phases. The system follows a well-designed, fully enclosed process from initial filtration through to final delivery, ensuring the continued safety and potability of the treated water.

Key word: filtered drinking water, purification systems, Janzour Municipality, intestinal parasites.

Introduction

Access to safe water and adequate sanitation is a fundamental need for all population groups and one of the core responsibilities of governments due to its significant health, social, and economic implications (World health organization, 2008). Safe drinking water is a primary preventive measure against numerous diseases, including intestinal parasitic infection and various waterborne bacterial diseases, such as those caused by Enterobacter and Vibrio cholera, as well as harmful chemical contaminants such as heavy metals, nitrates, nitrites, and compounds of calcium and magnesium are known to negatively affect kidney health (Gizaw et al, 2019; Yousefi, 2009). Additionally, proper sewage disposal is essential in preventing the contamination of groundwater, river, and seawater with harmful pathogens and chemicals (Esrey et al, 1991, Grimes et al, 2014).

Globally, millions lack access to clean and safe drinking water. One study estimated that approximately 28% of the global population consumes water that is microbiologically or chemically unsafe (Brown and Clasen, 2012; Yousefi et al, 2009). Contaminated water is a leading cause of serious illnesses, particularly diarrheal diseases, which are among

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the top causes of mortality among children under five years of age (Brown and Clasen, 2012; Aschale et al, 2021).

Libya, characterized by a semi-arid climate, experiences low rainfall and lacks perennial surface water sources. Consequently, the country depends almost entirely on groundwater, over 97% of which is non-renewable (Yassin, 2021). The widespread reliance on cesspools (septic or absorption pits), particularly in densely populated urban centers lacking effective sewage network coverage, directly facilitates the infiltration of untreated wastewater and associated pollutants into underlying groundwater aquifers. This practice leads to an elevated concentration of pathogens and nitrates in proximate water wells, consequently rendering the water unsuitable for human consumption and posing a significant threat to public health (Khaldoon et al, 2025; Abugdera, 2024). Furthermore, the escalating dependence on groundwater, often driven by unregulated agricultural practices, contributes substantially to the unsustainable depletion of subterranean reserves. The current abstraction rates routinely exceed the natural recharge capacity of the aquifers. This over-abstraction precipitates a decline in the static water level, especially in critical coastal areas, thereby exacerbating the risk of seawater intrusion. Ultimately, this process results in the salinization of production wells and their subsequent abandonment (Elyaagubi et al, 2019; Hamad et al, 2017).

Unsafe drinking water is a major contributor to disease transmission. Various intestinal pathogens bacteria and parasites alike can be transmitted through water contaminated by sewage or animal waste runoff (Ribas et al, 2017). Diseases caused by *Entamoeba histolytica*, *Giardia lamblia*, *Cryptospridium spp*, and *Strongyloides stercoralis* are particularly concerning in areas with limited access to clean water and sanitation. These infections are linked to high rates of malnutrition, morbidity, and mortality globally, particularly among vulnerable populations (Atabati et al, 2020; Aschale et al, 2021).

Improving access to clean drinking water and sanitation is among the most cost-effective public health interventions. Therefore, the study aimed to evaluate the effectiveness of filtered drinking water systems in removing intestinal parasites in various areas of Janzour Municipality. Furthermore, a primary objective was to provide critical evidence and assurance to the local population that the commercially distributed drinking water is healthy and very safe for consumption, which is a matter of paramount importance for public health in the community, as unsafe water is a major source of transmission for many serious illnesses. Therefore, it is imperative for local researchers to conduct continuous and systematic monitoring of the biological and chemical safety of filtered drinking water. In addition, regular surveillance of the performance and quality of groundwater filtration systems across all regions of Libya is essential in order to identify contamination sources and assess factors influencing drinking water quality, thereby supporting public health protection and sustainable water resource management.

Material and methods

Description of Study Area: Janzour Municipality is a coastal district in northwestern Libya, located along the Mediterranean Sea, approximately 12 kilometers west of Tripoli. It falls under the jurisdiction of the Tripoli Governorate and spans an area of approximately 86 square kilometers. The municipality includes comprises nine main districts areas (Janzour Assuge, Janzour West, Janzour East, Central Janzour, Al-Ghiran, Al-Najila, Shuhada Abdul Jalil, Sayyad, and Al-Hashan). The districts are not plotted on the map. Figure (1): Map showing the study area Janzour has an estimated population of 88,073 residents (Libyan Bureau of Statistics and Census, 2006). It includes both urban and agricultural zones, with all regions relying exclusively on groundwater for drinking and irrigation purposes.

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Figure (1): Map showing the study area

Water sample collection: The study was conducted between February and April 2025. Twenty filtered water samples were randomly collected from 20 different groundwater treatment and filtration facilities, representing approximately 70% of all filtered water distribution centers in the municipality. The study area was divided into 9 main administrative zones, and the number of samples collected from each zone was determined based on its population density and geographical area.

Around 2 liters of water collected from each site using sterile plastic bottles. Samples were collected specifically from the final delivery taps at each distribution center. The tap was not sterilized prior to collection to ensure the water was sampled exactly as delivered to the customer, thereby assessing the effectiveness of the system during storage and distribution. The sterile plastic bottles (one-liter capacity) were rinsed multiple times with the distribution water prior to collecting the final sample to ensure the collected water accurately represented the point-of-use water. Samples were stored in iceboxes and transported immediately to the laboratory of the National Center for Diseases Control in Tripoli, Libya (NCDC), Bacteriology department.

Additional data were gathered alongside each sample, including the type of purification system used, cleaning and disinfection practices for pipes and tanks, and proximity to potential contamination sources such as sewage drains, toilets, waste disposal areas, and agricultural lands.

Purification systems in study area: According to information obtained from several owners of filtered water shops within the Janzur municipality, the systems used for drinking water purification and filtration are of international origin and recognized for their high efficiency and reliability. One of the most commonly used systems is produced by the American company **AquaPro** Figure (3). The purification process in these systems is based on advanced technologies such as **Reverse Osmosis (RO)** desalination and a series of **multi-stage filters**, including sand, activated carbon, micro-membrane, and ultraviolet (UV) units. These systems employ ultra-fine membranes with a size of (0.0001 microns), which effectively filter and sterilize water from suspended impurities such as microorganisms and undesirable salts. After treatment, the purified water is stored in clean, well-maintained, closed tanks, and the distribution process is carefully controlled to avoid any possible contamination Figure (3).

Water sample analysis: Upon arrival at the laboratory, samples were filtered under vacuum using 0.8- micron cellulose acetate membrane filters. The membranes were then rinsed with 200 ml of distilled water, followed by centrifugation at 1500 rpm for 15 minutes. This centrifugation step was performed to concentrate the water sample for enhanced detection. The supernatant was discarded, and the sediment retained. Two drops of sediment from each sample were placed on a clean glass slide, covered with coverslip, and examined microscopically for intestinal parasite stages (trophozoites, cyst, eggs, and larvae). The remaining sediment was preserved using a 5% formalin solution. Two or three drops of this preserved sediment were dried on sterile slides using an electric dryer and stained using a modified Ziehl-Neelsen technique to detect spore-forming parasites such as *Cryptosporidium spp* Figure (2).

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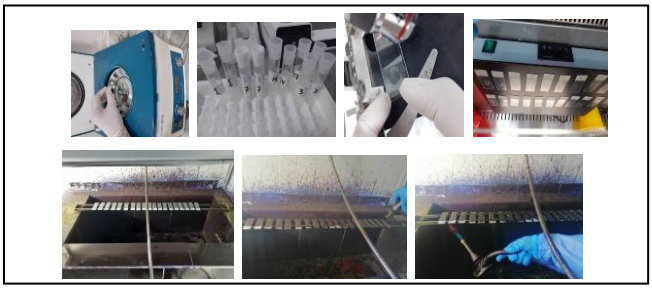

Figure (2): Photographs showing the processing of water samples in the laboratory

Result

A total of 20 water samples were analyzed across nine administrative areas. All samples tested negative for intestinal parasites. No protozoan cysts or trophozoites were detected, and no helminth eggs or larvae were observed. Stained smears also showed complete absence of *Cryptosporidium spp*. Or other spore-forming protozoa.

These results indicate a high level of microbiological safety in filtered drinking water in Janzour. The negative results suggest that: filtration units are functioning efficiently, storage tanks are well-maintained, distribution pipelines and taps are properly sealed, no post-filtration contamination occurred in the tested sites.

Table (1): water sample analysis results from various areas of Janzour Municipality:

Area No	Area Name	Number of samples collected from the area	Sampling Site Name	Parasite Detection Result
1	Janzour Assuge	2	Anabaa Water Shop	Negative
			Al-Wafaa Higher Institute Water	Negative
2	East Janzour	2	Nabaa Al-Nadi Water Store	Negative
			Bin Rawin Mosque Water Store	Negative
3	Central Janzour	4	Khairat Water Store	Negative
			Adam Water Store	Negative
			Awlad Ahmed Mosque Water Store	Negative
			Hamad Mosque Water Store	Negative
4	West Janzour	3	Saqata Mosque Water	Negative
			Al-Mazael Mosque Water	Negative
			Wabel Water Shop	Negative
5	Al-Najila	3	Al Jabel Water Shop	Negative
			Al Lualluaa Water Shop	Negative
			Alia Water Shop	Negative
6	Shuhada Abdul Jalil	2	Shuhada Abdul Jalil Secondary School Water	Negative
			Al Majd Secondary School Water	Negative
7	Al-Ghiran	1	Water of Libyan Atomic Energy Establishment	Negative
8	Sayyad	2	Gharib Mosque Water	Negative
			Manasir Mosque Water	Negative
9	Al Hashan	1	Al-Hashan Water Store	Negative
Total	Districts 9	20 water sample	20 Locations	Negative

Discussion

The findings of this study revealed that all collected water samples were entirely free from any species of intestinal parasites. This outcome is expected, given that the groundwater purification and filtration system used in Janzour Municipality is modern and highly efficient in removing microorganisms, including bacteria, fungi, parasites, and viruses. The system employs ultra-fine membranes with size of 0.0001 microns, which effectively filter and sterilize water from suspended impurities such as microorganisms and undesirable salts**.**

Filtration is considered one of the most effective methods for sterilizing drinking water, as it eliminates harmful microorganisms, mineral, and chemical compounds, including heavy metals and calcium compounds (Hikal, 2020).

The results demonstrated that the purification system implemented throughout the municipality is highly effective in preventing contamination of drinking water with intestinal parasites not only after filtration, but also during storage and distribution. The system is precisely designed and fully enclosed, covering all stages from filtration to storage, using closed tanks connected to sealed pipes that deliver the treated water to distribution taps (Strun et al, 2014). This closed design has proven to be both successful and efficient in maintaining the safety and potability of

drinking water throughout its handling process. Moreover, allocating a designated for the installation of groundwater storage tanks, the filtration unit, and treated water reservoirs-along with secure tape for distribution-forms a comprehensive system that ensures protection from contamination sources such as waste disposal areas, toilets, and sewage systems.

These finding serve as a positive indicator for safeguarding a critical aspect of public health. Access to safe and clean water remains one of the most essential services for communities and is among the most cost-effective methods for improving public health and preventing waterborne diseases (Montgomery, 2007). Furthermore, the complete absence of any intestinal parasites provides crucial, evidence-based assurance to the residents of Janzour Municipality that the commercially distributed filtered water is healthy and very safe for consumption, addressing a major public health concern. From a scientific and health perspective, such research is essential and should be conducted periodically to continuously monitor water quality and maintain public confidence in the safety of the drinking water supply.

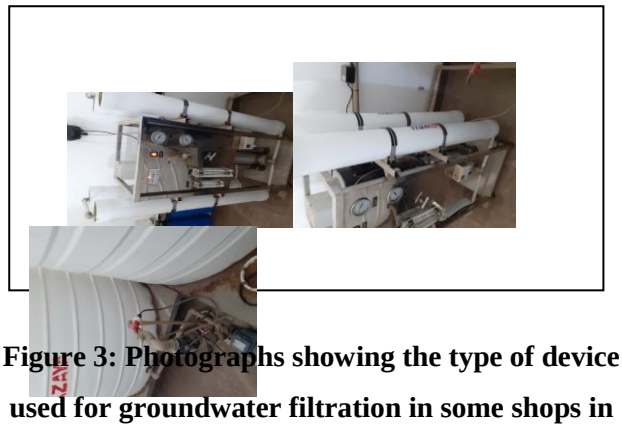

Figure 3: Photographs showing the type of device used for groundwater filtration in some shops in Janzour Municipality

Conclusion

Using high-quality filtration units, combined with closed and hygienic storage and distribution systems, effectively prevents intestinal parasite contamination in filtered drinking water in Janzour Municipality. Ensuring clean tanks, sealed pipelines, and careful handling of treated water is essential for maintaining public health and preventing waterborne diseases.

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