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The Utilization of Date Palm *(Phoenix dactylifera)* Leaf Fiber as a Main Component in Making an Improvised Water Filter

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Abstract:- Access to clean and safe water is known to be an obstacle for many people globally, leading to the necessity of creating a water filtration method that is feasible and can be made even in rural and developing areas. This study aimed to make an Improvised Water Filter that is sustainable, cost-effective, and locally sourced, using Date Palm *(Phoenix dactylifera)* leaf fiber as a main component. The Date Palm leaf fibers were extracted by boiling, drying, and manual scraping. The study strived to investigate the capability of Date Palm leaf fibers alone to improve water quality by testing fungal presence through culturing, physical pollutants by utilizing a microscope, and pH level and salinity levels using a calibrated multitester. The research findings proved the effectiveness of the Improvised Water Filter specifically by reducing fungal colonies by 4.33 and 8.33 in saltwater and contaminated water respectively, eliminating the majority of the physical pollutants by 53.5 micrometers and by 256.3 micrometers, neutralizing the water pH levels by 0.60 and by 0.78, neutralizing the salinity levels by 149.67 ppm and by 338.33 ppm, and exhibiting reliable durability and functionality properties in terms of its structure and filtering media condition with a water flow rate of 1.1L/min and 1.02L/min, and a minimal reduction in the weight of the filtering media by 3.7g and by 3.3g in saltwater and contaminated water respectively. The Improvised Water Filter has effectively filtered and neutralized the water samples, improving the water quality. Future researchers are recommended to conduct comparative studies involving Date Palm *(Phoenix dactylifera)* and other natural materials, examining filtration capabilities and efficiency, material durability, and by further investigating other water quality indicators to create an improved product that can produce potable and safer water.

Keywords:- *Date Palm, Filtering Device, Plant Fiber, Water Filter, Water Quality.*

I. INTRODUCTION

Access to safe water has been a constant battle across underdeveloped countries leading to several health issues. 2.2 billion people do not have access to safely managed drinking water as of 2022 (United Nations Educational, Scientific and Cultural Organization, 2024). Water shortages and poor water quality are reported to disproportionately affect developing countries (Global Affairs Canada, 2024). Developing countries are often overlooked when it comes to monitoring water quality. It is said that water supply in urban areas is better resourced and more regularly checked than supplies in rural parts (Crocker & Bartram, 2014).

People must be able to utilize water that is free from harmful bacteria to avoid life-threatening situations. Pathogens including bacteria, fungi, viruses, and parasites present in water can also be detrimental. Water contamination has been linked to the spread of several diseases (World Health Organization, 2021). Contaminated water may come from different causes like lack of access to latrines or other basic sanitation services that have affected 2.3 billion people across the globe (United Nations Children's Fund, 2023). In the Philippines, the inconvenience of accessing good quality water has led to waterborne diseases reported to be one of the leading causes of morbidity in the country (Lomboy et al., 2016).

Various countries have been affected by water pollution as drainage water contains untreated wastewater, which poses a hazard to the quality of water processed and distributed to the community, particularly in the Middle East and North Africa Region (MENA). As the issue of water pollution arises, soil quality and crop production are not the only ones affected, but rather significantly, human health (Awaad et al., 2020). The salinity of the drainage water is also a major concern for water quality in the region. Desalination is a common method used to address the concern of saline water; however, it can be costly and by standard, tests must be done using industrial and high-end equipment by professionals in the industry which may be inaccessible and inconvenient for many underdeveloped nations. The brine from the desalination plants has double the salinity level (Ministry of Development Planning and Statistics, 2018, p. 293). Plants such as Mangroves have been used in reducing the salinity of water. Date Palm is among the most salt-tolerant plants. Salt-tolerant plants are characterized by their ability to endure high-saline environments. Moreover, plants can absorb salt through their leaves, stems, and roots (Lacoma, 2018).

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Maintaining safe pH levels is essential in ensuring the quality of safe water. The effectiveness of using Date Palm leaf fibers was proven as an absorbent to obtain a desired and constant value of pH level. Date Palm leaf fibers are acidic in nature. Its absorption mechanism is affected by the pH of the sample. The functional properties of Date Palm leaf fibers are not changed at a lower pH but neutralize and change their activity and binding aspects at a higher pH level (Rahman et al., 2017).

Plastic pollution in water has also been detected by several studies. Microplastics such as synthetic polymers with about 58% of this anthropogenic debris are found in tap water posing a threat to human health due to the ingestion of plastic particles (Kosuth et al., 2018). Consumption of plastic from pollutant-contaminated water has tremendously affected human health, most especially for vulnerable populations. Some plastics like butyl benzyl phthalate have been detected to have caused eczema and rhinitis in children and were classified as possible carcinogens (Alabi et al., 2019).

Water must be accessible and safe. Because of their ability to effectively remove pollutants and contaminants in the water, water filters are essential. It is evident that natural resources are being utilized as components in filtration systems in current times. In terms of water filtration, using current technologies to purify water has become costly and energy-intensive (Lee et al., 2016). As there exists the need for low-cost and efficient water filtration methods, the call for natural materials in devices such as the Improvised Water Filter using Date Palm leaf fibers serves as a potential substitute for commercial water filtration products.

The Date Palm *(Phoenix dactylifera)* plant is among the most abundant trees in the Middle East and Africa Region. Besides the consumption of its fruit, Date Palm trees serve as sources of supply for different purposes such as household materials, production, and manufacturing (Begum, 2023). A previous study also proved that Date Palm has the potential to purify and ionize air (Real, 2021). With the proven potential of Date Palm in improving air quality, the said study leads this research to investigate more on the potential of its fibers to be used in improving water quality. Furthermore, Date Palm leaves are fibrous and possess antifungal agents against A. alternate (Ahmed et al., 2016). Polymer composites are frequently used for water purification. Taking this into consideration, Date Palm leaf fibers exhibit substantial potential in filtration as it is a reinforced polymer composite (Ghori et al., 2018). A study has demonstrated the superior absorption efficiency of Date Palm leaf fibers for the removal of lead ions from wastewater (Al-Ghamdi, 2015). The study exemplifies the effectiveness of Date Palm leaf fibers to be incorporated into existing water filtration systems. Moreover, Date Palm has been found to possess significant antifungal properties. The leaves of the Date Palm contain bioactive compounds with antifungal activity (Ahmed et al., 2016). These compounds have been shown to inhibit the growth of various fungal pathogens (Abass, 2017).

This study benefits the Philippine School Doha (PSD), the communities of Qataris and Filipinos, and future researchers. The result of this study will help the Philippine School Doha community of students, teachers, and non-teaching staff by informing them of the consequences of unsafe water. As residents of Qatar, PSD students and staff must be mindful of the negative health impacts that may result from unsafe water. Moreover, this study enlightens the PSD community that Date Palm leaf fibers can potentially be utilized to produce feasible and resourceful ways and methods of water filtration.

This study benefits the Qatari community as Qatar has limited natural freshwater sources and mainly acquires water supply through desalination which has its dismissive repercussions to the hydrosphere. This study will serve as a reference for utilizing resources such as Date Palm plants, which are abundant in the country, for sustainable and potential water filtration. Additionally, this study also benefits the Filipino community by serving as a basis for potential, naturally sourced, and cost-efficient water filtration methods, particularly in remote locations and for communities lacking access to safe and better quality water due to costly water filtration techniques.

Furthermore, the information, data, and results of this study can be utilized as references for future researchers in carrying out their respective studies relating to resourceful and environmentally-conscious water filtration methods. They can also utilize this study to further investigate plant and fiber-based water filtration systems. This study can serve as the foundation for potential industrial-scale water filtration systems utilizing biological resources as main components. Through the results and other data of this research, producing a study of a bigger scale, higher quality, and with minimal errors will be achieved more efficiently.

II. RESEARCH QUESTIONS

The objective of this study was to create an Improvised Water Filter using Date Palm (*Phoenix dactylifer*a) leaf fiber. Specifically, it answered the following questions:

- *How Effective is the Improvised Water Filter in Filtering the Water in Terms of:*

  - Fungal presence; and
  - Physical pollutants?

- *How Neutral is the Filtered Water after using the Improvised Water Filter in Terms of;*

  - pH level; and
  - Salinity?

- *How Durable is the Improvised Water Filter in Terms of;*

  - Rate of water flow; and
  - Weight of filtering media?

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III. METHODOLOGY

A. *Research Method and Research Design*

This study utilized an experimental design of research. Experimental research design is defined as a design that creates a set of procedures to test a hypothesis systematically while considering the variables and their relationship (Bevans, 2019). Furthermore, in this research design, one or more independent variables were manipulated and their effect on the dependent variable was measured. In this study, the Date Palm *(Phoenix dactylifera)* leaf fiber is the independent variable and the Improvised Water Filter is the dependent variable. A quantitative method was used to properly organize the experiment and to ensure that the right type of data was available to answer the research questions. It is necessary to use this method because it provides a great degree of control over the variables that demonstrate an outcome. It serves as a gateway to the riddance of water contaminants and has an advantage in determining validity, accuracy, and consistency in its findings.

B. *Research Locale*

The research study was conducted in one of the researchers' houses in Doha, State of Qatar, particularly in the Al Thumama Area (Zone 47), Al Intelaq Street (St. 920) for the general assembly of the product. Additionally, the research study was also conducted in the Philippine School Doha, State of Qatar, specifically in the Mesaimeer Area (Zone 56), Al Khulaifat Al Jadeeda Street (St. 1011) as the researchers are also students of this school and required facilities that enabled them to create and test their product.

C. *Data Gathering Procedure*

The procedure shows the step-by-step process of how to make an Improvised Water Filter using Date Palm *(Phoenix dactylifera)* leaf fiber as a main component and how its efficacy, capabilities, and capacity are tested.

➢ *Ensuring the Protection and Maintaining Safety:*

- Dress appropriately by wearing personal protective equipment such as safety goggles, safety gloves, safety shoes, and a laboratory coat while carrying out the steps below to avoid potentially harmful situations.

➢ *Preparing the Date Palm (Phoenix dactylifera) Leaf Fiber:*

- Gather 15 Date Palm leaves.
- Boil the leaves in a pot with 1.5-liters of water for 40-60 minutes.
- Detach each leaflet and split them longitudinally, as narrow as possible.
- Press down on the leaf sheaths to remove the excess water and extract the fiber.
- Scrape the leaflet into fibers using a butter knife, spoon, or any flat utensil.
- Sun-dry these fibers for 12 hours or until fully dried.
- Set aside the fibers to put later in the mesh bags.

➢ *Preparing the Water Filter Body:*

- Wash one one-liter steel tumbler and two one-liter plastic tumblers with caps.
- Drill a six mm hole, enough to fit the silicone tube, at the center of the bottom and of the cap of the plastic tumblers.

➢ *Assembling the Improvised Water Filter Stand:*

- Gather four scrap fiberglass sheets, three of which measure 21.5 by 10 inches, and the other one measuring 21.5 by 20.5 inches.
- Attach the fiberglass sheets together creating a box structure with four planes using super glue.
- Dry the adhesive completely.
- Prepare three 1.5-liter plastic bottles which will serve as the holder of the steel and plastic tumblers.
- Cut off the bottom of each of the three 1.5-liter plastic bottles, about 2.5 cm from the base.
- Cut a U-shape on each of the three 1.5-liter plastic bottles turned upside down, about six inches from the cap and 6.5 inches around the bottle.
- Create a slit on the remaining back of the plastic bottle, 1.5cm, enough to fit the arm of the adhesive hook.
- Attach three adhesive hooks on the back pane of the box structure, 14 inches from the base and five inches from each other.
- Remove the cap of the cut 1.5-liter plastic bottles.
- Insert the arm of the adhesive hook into the slit made on the bottles, hanging them on the box structure wall.

➢ *Preparing the Improvised Water Filter Medium:*

- Fill the three mesh bags with about 100 grams of Date Palm leaf fibers or until the mesh bag is stuffed.
- Insert each mesh bag into another mesh bag to contain all fibers.
- Seal the mesh bags by pulling on the string or by wrapping a thread around the opening.
- Ensure that the fiber-filled mesh bags are big enough to fill and fit the plastic tumblers.
- Prepare three fabric softener plastic caps, which will prevent the filter media from blocking the water flow.
- Drill several spaced holes all around the caps.

➢ *Assembling the Improvised Water Filter Structure:*

- Cut four one meter silicone tubes.
- Unscrew the cap of the first steel tumbler.
- Insert one of the cut silicon tubes through the hole on the cap.
- Pull the tube through.
- Wrap around rubber tape with four inches of the tube pulled through from the end to prevent water leakage.
- Turn the tumbler bottom-side up.
- Insert another silicone tube through the bottom hole of the first steel tumbler.
- Pull the tube through.

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- Insert the end into the opening of the first fiber-filled mesh bag.
- Seal the mesh bag with the silicon tube inserted into it.
- Wrap around rubber tape from the sealed opening of the mesh bag.
- Pull the silicon tube back up to the bottom of the tumbler with the mesh bag attached along with it.
- Place the first fabric softener bottle cap hallowed-side down on the inside of the tumbler cap, leaving space for the first silicone tube.
- Screw the tumbler cap on the first tumbler.
- Pull the end of the first silicon tube attached to the hole of the cover, through the opening of the first hanging plastic bottle.
- Prepare the second plastic tumbler by turning it bottom-side up.
- Insert the other end of the second silicone tube from the bottom of the first tumbler into the bottom hole of the second tumbler.
- Pull the tube through.
- Insert the end into the opening of the second fiber-filled mesh bag.
- Seal the mesh bag with the silicon tube inserted into it.
- Wrap around rubber tape from the sealed opening of the mesh bag.
- Pull the silicon tube back up to the bottom of the tumbler with the mesh bag attached along with it.
- Insert the third silicone tube into the hole of the cap of the second tumbler.
- Pull the tube through.
- Wrap around rubber tape with four inches of the pipe pulled through from the end.
- Place the second fabric softener bottle cap hallowed-side down on the inside of the tumbler cap, leaving a space for the third silicone tube.
- Screw the tumbler cap on the second tumbler.
- Pull the end of the third silicon tube attached to the hole of the cover, through the opening of the second hanging plastic bottle.
- Prepare the third tumbler by turning it bottom-side up.
- Insert the other end of the third silicone tube from the cap of the second tumbler into the bottom hole of the third tumbler.
- Pull the tube through.
- Insert the end into the opening of the third fiber-filled mesh bag.
- Seal the mesh bag with the silicon tube inserted into it.
- Wrap around rubber tape from the sealed opening of the mesh bag.
- Pull the silicon tube back up to the bottom of the tumbler with the mesh bag attached along with it.
- Insert the fourth silicone tube into the hole of the cap of the third tumbler.
- Pull the tube through.
- Wrap around rubber tape with four inches of the tube pulled through from the end.
- Place the third fabric softener bottle cap hallowed-side down on the inside of the tumbler cap, leaving a space for the fourth silicone tube.
- Screw the tumbler cap on the second tumbler.
- Pull the end of the fourth silicon tube attached to the hole of the cover, through the opening of the third hanging plastic bottle.

➢ *Connecting the Improvised Water Filter to the Water Pump:*

- Connect a 1.5-meter plastic hose to the water pump entrance.
- Insert the other end of the silicone tube of the first tumbler into the other end of the hose adapter.
- Screw the hose adapter into the water pump outlet.
- Connect the pump power cable to the positive and negative terminals of the battery.

IV. RESULTS

This study aimed to create an Improvised Water Filter using Date Palm leaf fiber as the main component. The section below presents the results and interpretation of data that were gathered from assembling and testing the device, wherein the main research questions were answered, specifically, the effectiveness of the Improvised water in terms of filtration, neutralization, and durability.

A. Effectiveness of the Improvised Water Filter using Date Palm (Phoenix dactylifera) Leaf Fiber in Terms of:

➢ *Fungal Presence*

Table 1 Fungal Presence in Saltwater and Contaminated Water before and after using the Improvised Water Filter

	Trial	1st	2nd	3rd	Average
Saltwater					
Before FIltration	Number of detected fungal colonies	8	2	5	5
After Filtration	Number of detected fungal colonies	1	1	0	0.67
Contaminated Water					
Before FIltration	Number of detected fungal colonies	13	8	15	12

	Trial	1st	2nd	3rd	Average
After Filtration	Number of detected fungal colonies	5	1	5	3.67

Table 1 shows the fungal presence in the saltwater and contaminated water before and after using the Improvised Water Filter. The fungi in the sample water were cultured for 27 days and calculated by using the Promega ColonyCount application on a mobile device. To achieve accurate results, three trials were done and averaged by adding the measured number of colonies from the three trials and dividing the sum by three. All trials showed a decrease in the number of colonies for both saltwater and contaminated water.

Analyzing the results, the fungal presence in the saltwater before and after being filtered was at five colonies and 0.67 colonies on average respectively, resulting in a difference of 4.33 colonies. The fungal presence in the contaminated water before and after being filtered was at 12 colonies and 3.67 colonies on average respectively, resulting in a difference of 8.33 colonies. This shows that the Improvised Water Filter effectively reduced the fungal presence in both samples of water. Discussing further, Date Palm leaves exhibit antimicrobial and antifungal potential (Al-Alawi et al., 2017). Date palm leaf extract can show antibacterial effects towards bacteria such as *Klebsiella pneumoniae* (Sani et al., 2018). This further supports the results found in filtering the saltwater samples in terms of fungal presence. Furthermore, a study on antifungal properties of Date Palm analyzed the phenolic profile of the plant and showed that Date Palm was able to inhibit the growth of fungal presence such as species of *Fusarium oxysporum*, yeast, and mold (Zain et al., 2022).

➢ *Physical Pollutants*

Table 2: Physical Pollutants in Saltwater and Contaminated Water before and after using the Improvised Water Filter

	Trial	1st	2nd	3rd	Average
Saltwater					
Before FIltration	Actual length (in micrometers)	35	62.5	67.5	55
After Filtration	Actual length (in micrometers)	0.4	1.85	2.1	1.45
Contaminated Water					
Before FIltration	Actual length (in micrometers)	700	32.81	41.41	258.07
After Filtration	Actual length (in micrometers)	1	1.5	2.8	1.77

Table 2 shows the length of the physical pollutants in the saltwater and contaminated water before and after using the Improvised Water Filter. The length of the physical pollutants was calculated by using a microscope. To achieve accurate results, three trials were done and averaged by adding the measured length of the three trials and dividing the sum by three.

Analyzing the results, the length of the physical pollutants in the saltwater before and after being filtered was 55 µm and 1.45 µm on average respectively, resulting in a difference of 53.55 µm. The length of the physical pollutants in the contaminated water before and after being filtered were 258.07 µm and 1.77 µm on average respectively, resulting in a difference of 256.3 µm. The results show the capability of the Improvised Water Filter to lessen the presence of physical pollutants in saltwater and contaminated water based on its length. Date Palm fruits have significant antioxidant, antibacterial, antifungal, and anti-proliferative properties (Al-Alawi et al., 2017). Testing the presence of physical pollutants is significant to this study as inorganic pollutants are consistently contributing to the degradation of saltwater quality (Kumar et al., 2020). The Improvised Water Filter manifested disinfection properties that decreased the number and size of physical pollutants present in the sample water which is a necessary treatment process in water quality treatment (Gong et al., 2016). The introduction of an antibacterial and filtering asset, which is the Date Palm leaf fiber, effectively ensures that they are prevented from being contaminated by microorganisms during long-term use (Lu et al., 2021). Moreover, a similar study proved that Date Palm leaf fibers possess highly efficient absorption capacities used for removing metals, plastics, and other physical pollutants that are impactful in water purification (Elsayed et al., 2021). A few limitations were met due to extremely small pollutants. Advanced oxidation procedures and operations with special materials are needed for these circumstances (Fonseca-Correa et al., 2016). Furthermore, a similar study proved that Date Palm leaf fibers have potential in wastewater treatment, particularly in the removal of different pollutants through adsorption (Nujic et al., 2019).

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B. Neutrality of the Filtered Water after using the Improvised Water Filter out of Date Palm (Phoenix dactylifera) Leaf Fiber in Terms of:

- *pH Level*

Table 3 pH Level of Saltwater and Contaminated Water before and after using the Improvised Water Filter

	Trial	**1st**	**2nd**	**3rd**	**Average**
Saltwater					
Before FIltration	pH level (in logarithmic units)	7.65	7.65	7.67	7.66
After Filtration	pH level (in logarithmic units)	7.05	7.09	7.03	7.06
Contaminated Water					
Before FIltration	pH level (in logarithmic units)	7.80	7.89	7.72	7.8
After Filtration	pH level (in logarithmic units)	7.02	7.00	7.05	7.02

Table 3 shows the pH level of saltwater and contaminated water before and after using the Improvised Water Filter. The pH level of the water samples was calculated by using a calibrated pH meter. To achieve well-grounded results, three trials were administered and averaged by adding the three trials and dividing the sum by three of each saltwater and contaminated water samples. All of the trials showed a pH level close to pH seven which is considered neutral, therefore achieving the target of this study.

Analyzing the results, the average pH level of the unfiltered and filtered saltwater was pH 7.66 and pH 7.06 respectively, resulting in a difference of pH 0.60. The average pH level of the unfiltered and filtered contaminated water was pH 7.8 and pH 7.02 respectively, resulting in a difference of 0.78. This shows that the Improvised Water Filter can neutralize the pH level of saltwater and contaminated water at persistent levels. A similar study proved that Date Palm leaf fibers can be used to achieve constant values of pH level (Rahman et al., 2017). According to a study, Date Palm leaf fibers have been found to have a neutralizing effect on pH, particularly in the case of basic solutions (Al-Ghamdi et al., 2013). Furthermore, their ability to remove pollutants such as heavy metal ions and phosphates is highly evident (Ramezanpour et al., 2022). The results also indicate that the filtered samples adhere to the standard pH level of drinking water with the achieved value of pH 7.06 and pH 7.02.

- *Salinity Level*

Table 4 Salinity Level of Saltwater and Contaminated Water before and after using the Improvised Water Filter

	Trial	**1st**	**2nd**	**3rd**	**Average**
Saltwater					
Before FIltration	Salinity level (in parts per million)	9284	9248	9284	9272
After Filtration	Salinity level (in parts per million)	9086	9177	9104	9122.33
Contaminated Water					
Before FIltration	Salinity level (in parts per million)	6317	6475	6475	6422.33
After Filtration	Salinity level (in parts per million)	6090	6090	6072	6084

Table 4 presents the salinity level of saltwater and contaminated water before and after using the Improvised Water Filter. In determining the salinity level, a multitester was used by dipping the multitester's probe into the sample with its salinity meter setting engaged. To reach accurate results, three trials were conducted for each water sample and the sum of the three trials was divided by three to acquire the average. All trials for both water samples resulted in a decrease in the salinity level after using the Improvised Water Filter.

Analyzing the results, the average salinity level of the unfiltered and filtered saltwater was 9272 ppm and 9122.33 ppm respectively, resulting in a difference of 149.67 ppm. The average salinity level of the unfiltered and filtered contaminated water was 6422.33 ppm and 6084 ppm, resulting in a difference of 338.33 ppm. The trials show that the Improvised Water Filter is able to lower the salinity level due to the Date Palm leaf fibers. The Date Palm leaf fibers used in the Improvised Water Filter were extracted from the leaves of the Date Palm *(Phoenix dactylifera)* plant. The results are reinforced by the fact that plants are able to absorb salt water through their tissues, leaves, and roots (Lacoma, 2018). The results of the saltwater and

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contaminated water before and after it has been filtered are classified as moderately saline according to the United States Geological Survey official scale. The results may be higher than the required salinity level of drinking water, however, the product was still able to perform its expected ability of absorbing salts and reducing the water salinity. Furthermore, a study confirms that plant leaves can withstand far higher salt concentrations than their roots (Gaus et al., 2022). This proves that the Improvised Water Filter was able to perform effectively in terms of reducing the salinity levels of both water samples specifically through its filtering media.

C. Durability of the Improvised Water Filter using Date Palm (Phoenix dactylifera) Leaf Fiber in Terms of:

➢ *Rate of Water Flow*

Table 5 Rate of Water Flow of the Improvised Water Filter using Saltwater and Contaminated Water

Trial	**1st**	**2nd**	**3rd**	**Average**
Saltwater				
Rate of Flow (in liters per minute)	1.49	0.89	0.92	1.1
Contaminated Water				
Rate of Flow (in liters per minute)	1.06	0.87	1.13	1.02

Table 5 shows the rate of water flow of the Improvised Water Filter using saltwater and contaminated water. A stopwatch was used to determine the rate of water flow in liters per minute. To obtain reliable results, three trials were conducted and the average was calculated by adding the three trials and dividing the sum by three.

Based on the results, the Improvised Water Filter produced a water flow rate of 1.1 L/min on average with saltwater. Similarly, the rate of water flow of the Improvised Water Filter using contaminated water was 1.02 L/min on average. The trials show that the Improvised Water Filter can efficiently filter 1.5 liters of saltwater and contaminated water in less than two minutes which is average. This is supported by the average water flow rate of commercial water filters which use domestic carbon cartridges and sand filters, observed to have a flow rate of one to two liters per minute (Arad Branding, 2018). The average household faucet flow rate is from six to 12 gallons per minute which is considered as a fast flow rate. However, the measurement of flow rate depends on the size of the pipe and the filtration system, which implies that the bigger the pipe, the faster the water travels, and vice versa. Considering that the pipe has a diameter of only 0.5 inches, it is expected that the product functions at a normal rate. This explains that the Improvised Water Filter efficiently filters water in a small-scale setup. The rate of flow reflected upon testing is proven to be enough to filter out physical pollutants and decrease fungal properties. This shows that the Improvised Water Filter system is as effective as general water filtration products in filtering saltwater and contaminated water.

➢ *Weight of Filtering Media*

Table 6 Weight of the Filtering Media before and after Filtering Saltwater and Contaminated Water

	Trial	**1st**	**2nd**	**3rd**	**Average**
Saltwater					
Before FIltration	Weight (in grams)	94	94	94	94
After Filtration	Weight (in grams)	90	90	91	90.3
Contaminated Water					
Before FIltration	Weight (in grams)	95	94	94	94.3
After Filtration	Weight (in grams)	91	91	91	91

Table 6 shows the weight of the filtering media of the Improvised Water Filter before and after filtering saltwater and contaminated water. The weight of the filtering media was calculated by using a digital balance. To achieve consistent and accurate results, three trials were administered and averaged by adding the measured weight of the three trials and dividing the sum by three. All of the trials showed a decrease in the weight of the filtering media after filtration.

Analyzing the results, the weight of the filtering media before and after filtering saltwater was 94g and 90.3g on average respectively, resulting in a reduced difference of 3.7g. The weight of the filtering media before and after filtering contaminated water was 94.3g and 91g on average respectively, resulting in a reduced difference of 3.3g. A study on salinity stress and fiber quality stated that this is because salinity reduces the length, strength, and maturity of fibers while the fineness increases in trend hence resulting in a greater decrease in weight compared to the weight of the

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filtering media after filtering contaminated water (Sharif et al., 2019). This shows that the Improvised Water Filter's filtering media expectedly reduced in weight which is further supported by how the mechanical, chemical, and structural properties of natural fibers can decrease and weaken in terms of density and weight due to its immersion and prolonged contact with seawater (Djafar et al., 2020). This result indicates and emphasizes the need to replace the filtering media after use to ensure consistent and effective filtration.

V. DISCUSSIONS

According to the results, the Improvised Water Filter can filter out fungal presence effectively. Date Palm *(Phoenix dactylifera)* leaf fibers contain antifungal agents that can diminish fungal occupancy in both the saltwater and contaminated water samples. Specifically, the number of detected colonies in the saltwater was reduced by 4.33 colonies on average. Moreover, the contaminated water was reduced by 8.33 colonies on average. The Improvised Water Filter can also effectively filter out physical pollutants due to the structure of the components in the cartridge, with the physical pollutants clinging to or attaching to the fibers or getting contained into its mesh bag. Specifically, the calculated actual length of the physical pollutants in the saltwater decreased by 53.55 µm on average, and in the contaminated water, decreased by 256.3 µm on average. Moreover, the Improvised Water Filter was able to lower the pH level of the saltwater samples' by 0.60 on average and its salinity level by 149.67 parts per million on average. Similarly, the Improvised Water Filter was able to neutralize by lowering the contaminated water samples' pH level by 0.78 on average as well as its salinity level by 338.33 parts per million on average. The Improvised Water Filter also ensures the longevity of use of the filter, having an average water flow rate of 1.1 L/min and 1.02 L/min in filling up a 1.5-liter water bottle with filtered saltwater and contaminated water respectively. Likewise, its durability is also confirmed by the decrease in weight of the filtering media. The Improvised Water Filter's filtering media's weight decreased by 3.7g and 3.3g on average after filtering the saltwater and contaminated water samples respectively. All of these results affirm the hypothesis that it is feasible to create an Improvised Water Filter using Date Palm *(Phoenix dactylifera)* leaf fiber.

Access to safe and improved quality water is considered to be a global crisis, affecting the well-being of many people around the world. Water filters are among the products that help combat issues with quality water access and are particularly in demand in underdeveloped locations without access to water treatment facilities (Jiao et al., 2020). However, commercial water filters need to be completely replaced often, causing large amounts of waste and dangerous methods of disposal of materials to occur such as through harsh incineration and contributing to a landfill (Shin et al., 2021). Expanding further, one of the components commonly used in water treatments are carbon nano-materials which are found to be expensive (Chaplin, 2018). Additionally, cases of DNA damage, lysosomal damage, and mitochondrial dysfunction have been reported as toxic effects of carbon nano-materials (Yuan et al., 2019). These effects may pose harm to human life longevity. This study intended to make an Improvised Water Filter that is convenient, better quality, and accessible for everyone, especially in underdeveloped nations that are experiencing insufficient sources of water that is clean and safe to use. Furthermore, this study aimed to propose a starter for bigger-scale filtration systems that will utilize bountiful natural resources available in their regions. Date Palm *(Phoenix dactylifera)* trees are abundant in Qatar as well as in other Middle Eastern, Asian, and African nations such as Algeria, Pakistan, and Saudi Arabia. A study conducted in the United Arab Emirates used *Moringa peregrina* seeds and seed extract for water purification. It showed that both variables were able to remove turbidity, color, and soluble chemical oxygen demand (Elsergany, 2023). In similarity to *Moringa peregrina* seeds that are fibrous and have antifungal agents, Date Palm leaves possess the same characteristics (Al Rajhi et al., 2019). This research strived to assess the effectiveness of Date Palm leaf fibers as an agent in making an Improvised Water Filter that can neutralize pH and salinity levels.

This study can help the community abide by the school's pro-environment objective. The Improvised Water Filter is made of recycled and repurposed materials which makes it sustainable as well as convenient to reproduce. This study intended to pave the way for other studies to make use of other biological resources that possess the same characteristics as Date Palm leaf fibers in developing larger-scale methods of water filtration. Furthermore, students and school staff are advised to utilize higher-quality materials and equipment to increase the effectiveness, neutralizing ability, and durability of the Improvised Water Filter. They are also encouraged to conduct further research to improve the product's efficacy in terms of accessibility and availability of materials.

The Qatar and Philippine communities are recommended to use easily sourced materials in making an efficient Improvised Water Filter. Through this, they may produce similar products that are cost-effective, resourceful, and environmentally-conscious. The researchers suggest the communities find alternative materials to produce an approachable system that meets available resources. Lack of access to safe water still poses an existing problem in Qatar specifically in industrial areas. Moreover, it is a contributor to the spreading of diseases and bacteria in the Philippines. Although safe and standard quality water may be accessible in most areas where the two communities reside, it is still significant to propose methods and create efficient water filtration systems and products to ensure prolonged and extended access to safe and clean water.

Moreover, this study could serve as a reference for future researchers who are interested in developing projects with similar components or functionalities. With this study, future researchers can conduct comparative studies between Date Palm *(Phoenix dactylifera)* fibers and other natural or synthetic materials, examining filtration efficiency, durability, and cost-effectiveness. Additionally, with this study, future researchers would be able to prevent errors and deficiencies in their study through recommendations, which would counter the limitations met by the researchers in this study. The researchers recommend using solely steel tumblers instead of plastic ones to avoid the risk of over-expansion and explosion when water is flowing. Future researchers may utilize a water pump inverter and additional valves to ensure stable pressure among all three tumblers and avoid leakage. Additionally, future researchers are recommended to wash and dry the Date Palm leaf fibers after use to avoid further contamination and prevent pollutant buildup. Furthermore, more layers of a thinner net mesh bag are recommended to further trap the physical pollutants and fully eliminate them. Finally, future researchers are urged to find access to and utilize higher-grade testing instruments and equipment to acquire the findings more efficiently, more specifically the presence of microbial contamination which is one of the indicators for water safety. By using this study as a blueprint, future researchers can build upon its methodologies, expand its scope, and research more on the development and application of natural fiber-based filtration systems or similar projects to create an improved product that can produce potable and safer water.

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