J. Vet. Food Agri. Insights. 01(1) 2024. 19-26
https://doi.org/10.xxxxx/jvfai.01.1.0054

Journal of Veterinary, Food and Agricultural Insights

ISSN: 1234-xxxx (Print), 1234-xxxx (Online)
https://isciencepress.com/journals/index.php/JVFAI/index

Research Article

Corresponding Author:
Name:
Hassan Aziz
Email:
azizhassan008@gmail.com

Article History:
Received: August 22, 2024
Revised: November 16, 2024
Accepted: December 02, 2024

Purifying effect of *Moringa oleifera* seed in drinking water

Hassan Aziz[1]*, Asif Ahmad[1], Tahira Batool Qaisrani[2]

[1] Institute of Food and Nutritional Sciences, Pir Mehr Ali Shah Arid Agriculture University, Rawalpindi, Pakistan.
[2] Department of Agriculture Engineering and Technology, Ghazi University Dera Ghazi Khan, 32200, Punjab, Pakistan.

ABSTRACT

Water pollution is one of the major threats to public health throughout the world. In Pakistan, the drinking water quality is poorly managed and monitored. Both surface and groundwater sources are contaminated with municipal wastes, industrial effluents and agrochemicals wastes. Therefore, water purification is necessary to reduce the contamination effect. For water purification, available inorganic chemicals (alum) are costly, unfriendly to environment and result in serious health problems like cancer. As an alternative natural method is required, that may safe, effective in water treatment and eco-friendly. In this study the seeds of *Moringa oleifera* seed powder with different concentration (50, 75, 100, 125, 150 mg) with time duration (4, 8 and 12 hrs.) was applied for purification of water collected from Rawalpindi and Islamabad. *Moringa oleifera* seed powder showed the best purification results up to 60%. Water-soluble proteins in seed that performed as a coagulant reduced the contamination of TDS 40%, color 30%, pH to 60%. As a result, it provided inclusive results on the proficient use of *Moringa oleifera* seed in purification of drinking water and that purification technique is economical.

Keywords: Coagulant protein; Drinking water; *Moringa oleifera*; Purification

INTRODUCTION

For human beings drinking water is the basic need and is vital requirement for chemical and biochemical occurring in life as it constitutes two third of total body weight and life cannot occur in absence of water. Safe water is of supreme importance to the health of humans and the safe water is a major concern of humans living in underdeveloped countries (Fatombi et al., 2019). Almost 2 billion peoples have no access to safe water (Marobhe et al., 2021). Water pollution is mainly caused by human activities through physical such as; leakage of water distribution supply lines, over utilization of water resources and domestic sewage, chemical; agriculture and industrial wastes while the key risk is biological contamination includes different types of bacteria, viruses and other microbes etc. Chemical contamination beyond its limit that causes numerous health problems in humans like; high amount of chloride and fluorides in water can cause methemaglobinaemia, amoebiasis and cryptosporidiosis. Excess amount of heavy metal causes many disorders like; toxicity, disorder in nervous, reproduction system and kidney of human beings. Purification of drinking water is vital for the removal of contaminants including colloidal organic particles, microorganism and other substances that are toxic to human health. This involves two important procedures to purify the water such as conventional method using aluminum sulphate (alum) as clarification, coagulation, sedimentation and filtration.

However, these also have several drawbacks as costly and not eco-friendly, their residuals in treated water (e.g. aluminum) are linked with neurodegenerative such as Alzheimer's diseases as well as

carcinogenic effects, elevated level of chloride and fluoride in drinking water cause methemaglobinaemia and amoebiasis, excess amount of lead induces toxic effect to digestive, reproductive system of human body (PCRWR 2020). As the physical parameters like chlorides cause change in taste of water e.g. saltiness in drinking water. Hardness if exceed the recommended limit may cause several problems in human. The prolong ingestion of these chemicals may cause severe health issues. Heavy metals like cadmium and lead create problem in several body organs like in kidney, liver, skin irritation and nervous system if they exceed from safe limit recommended for drinking water. Excess amount of lead may cause various diseases as; cardiovascular and bone diseases, while zinc cause abnormal growth. Natural coagulants (e.g. *Moringa oleifera*) are beneficial and has advantages to chemical as biodegradable and easily available. The analytical study of plants like chickpea, cactus and *Moringa oleifera* (MO) shows that that they remove the turbidity to 78, 75 and 89 percent respectively.

Among all these plant-based natural coagulants, *Moringa oleifera* proves the best coagulants for drinking water treatments commonly in underdeveloped areas of the world. *Moringa oleifera* is a small, rapidly growing deciduous plant belongs to family Moringaceae. It contains the positively charged protein in nature particles named as *Moringa oleifera* cationic protein, that are readily dissolved in water, attract and bind with the suspended impurities present in water and move down by gravity (Arora et al., 2013). *Moringa oleifera* seed cationic protein also has antimicrobial activity in drinking water, the protein attracts the bacteria, hold them along with other suspended impurities and move down by the action of gravity. *Moringa oleifera* protein to purify and coagulation mechanism has been reported by several researches in different set of ways, either on the basis of adsorption phenomenon and charge neutralization or inter-particle bridging. *Moringa oleifera* seed contain 1 percent active agent named as polyelectrolyte that removes turbidity by neutralizing the negative charge of collides in the water (Chhikara et al., 2020). This polyelectrolyte is dimeric, stable and completely soluble in water; act as adsorption and charge neutralization. The better purification efficacy showed by MO seed led to increase the demand of MO seed day by day as compared to synthetic and other organic sources of water purification (Bancessi et al., 2020). This study was designed to achieve the following core objectives as; to investigate the effect of *Moringa oleifera* seed powder on physicochemical characteristics and its effect as an antimicrobial agent in drinking water.

MATERIALS AND METHODS

This research study was conducted at the Department of Food Technology, Pir Mehr Ali Shah Arid Agriculture University Rawalpindi. Moringa oleifera seed were collected from local market shelled grounded in an electric grinder, sieved in a mesh of 0.8 mm size to obtain a fine powder form. Raw water sample collected from Rawalpindi and Islamabad regions are also shown in Figure 1.

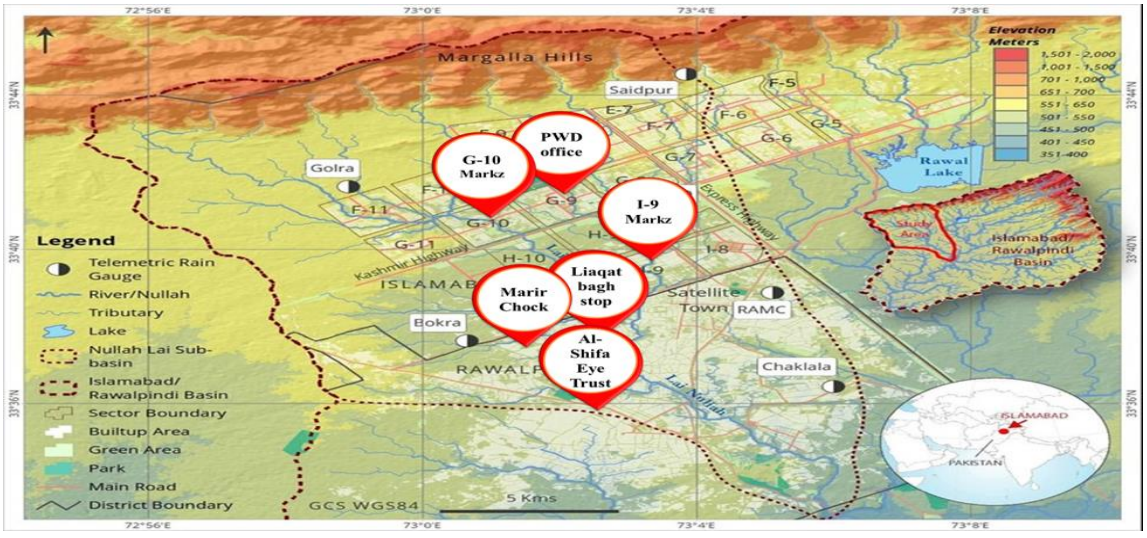

Figure 1. Water sampling points from Rawalpindi and Islamabad region.

An equal number of the samples were taken from Rawalpindi and Islamabad. The samples taken from Islamabad were labelled as I_1, I_2, I_3, and sampling from Rawalpindi was labelled as R_1, R_2, R_3. Six glass beakers were filled with 1 litter sampled water. Five different weighing like; 50, 75, 100, 125 and 150 mg of *Moringa oleifera* seed used for treatments were made General flow chart for preparation of *Moringa oleifera* seed for treatment is shown in Figure 2.

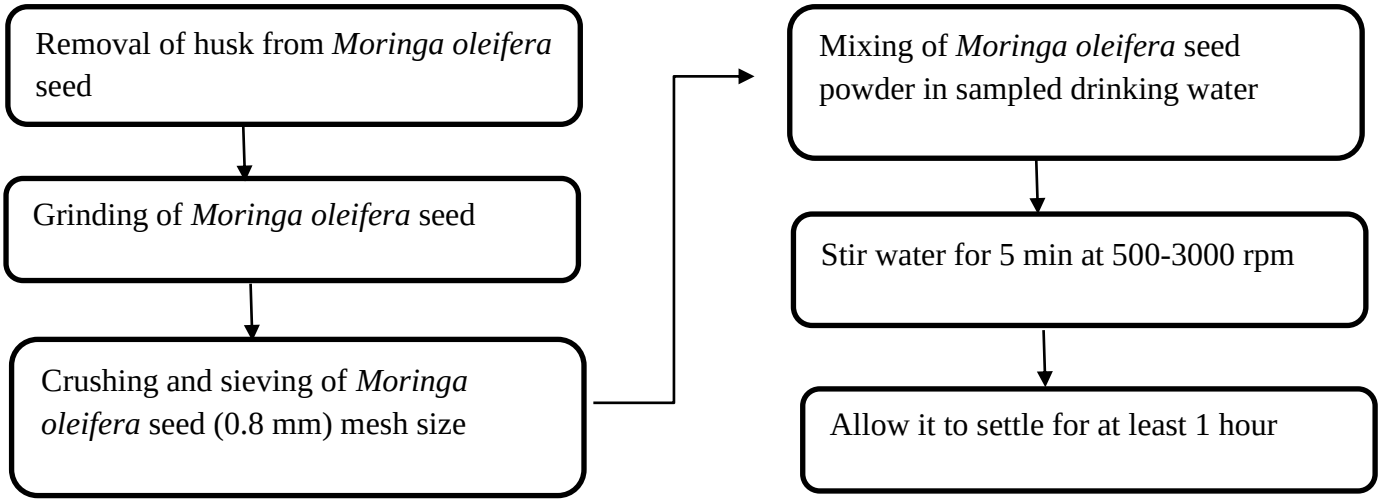

Figure 2. General flow chart for preparation of *Moringa oleifera* seed for application in water treatment.

Treatment plan of drinking water with Moringa oleifera seed Concentration (mgL^{-1}) T0 Control sample, T1 50mgL-1, T2 75mgL-1, T3 100mgL-1, T4 125mgL-1 and T5 150mgL-1

Physio-chemical Parameters

The physio-chemical parameters studied in current research were Color, TDS, pH, Nitrate and Sulphate in water was analyzed. All the parameters were analyzed by using methods of AOAC (2000). Data obtained from this study and results of all physio-chemical parameter were analyzed by ANOVA. All collected samples were analyzed and their statistical results shown in graphical forms below. The mean value of all parameters with respect to time (4-12 hrs.), treatment (increasing concentration), also the time and treatment interaction showed in the figures.

RESULTS AND DISCUSSION

Physio-chemical Parameters

Color

The mean value of color impurities with respect to time factor as depicted in Figure 3 (a). Color resulted values showed significant decreasing trend with increasing time from 4-12 hrs. At the initial four hours' interval, the color value was 26 true color unit (TCU), at the second four hours' interval the color value was observed 22 TCU and in the third interval of time (12 hours) *Moringa oleifera* seed influenced the water color was 20 TCU. It indicated that with passage of time more color can be removed from water. Overall, in 12 hours the color value decreased from a value of 26 TCU to 20 TCU. The treatment effected the color significantly as depicted in Figure 3 (b). A significant decreasing trend was observed with increasing concentration level. The color value in the control samples (T0) was 24.8 TCU, but at T1 treatment *Moringa oleifera* seed reduced it to 23.33 TCU, at T2 it decreased color to 23.30 TCU, at T3 *Moringa oleifera* seed reduced the color to 21 TCU, at T4 it influenced the color to 20.3 TCU while at T5 *Moringa oleifera* seed reduced the color to 19.01 TCU. Overall, in treatments difference the color value affected from 24.90-19.01 TCU. The time and treatment interaction data depicted in Figure 3 (c). Increasing concentration of *Moringa oleifera* seed, the change in color was observed in the drinking water. Overall, a significant decreasing trend was observed in color of water by applying *Moringa oleifera* seed. All values obtained were lower than 26 TCU. In the interval of 8 hours' 26 TCU at T0 was highest value and 17.11 TCU at T5 in the interval of 12 hours was lowest. Varkey (2020) studied the Moringa oleifera seed effect on drinking water and

observed that with respect to increasing dose the 20% decreased in color contamination of drinking water was observed.

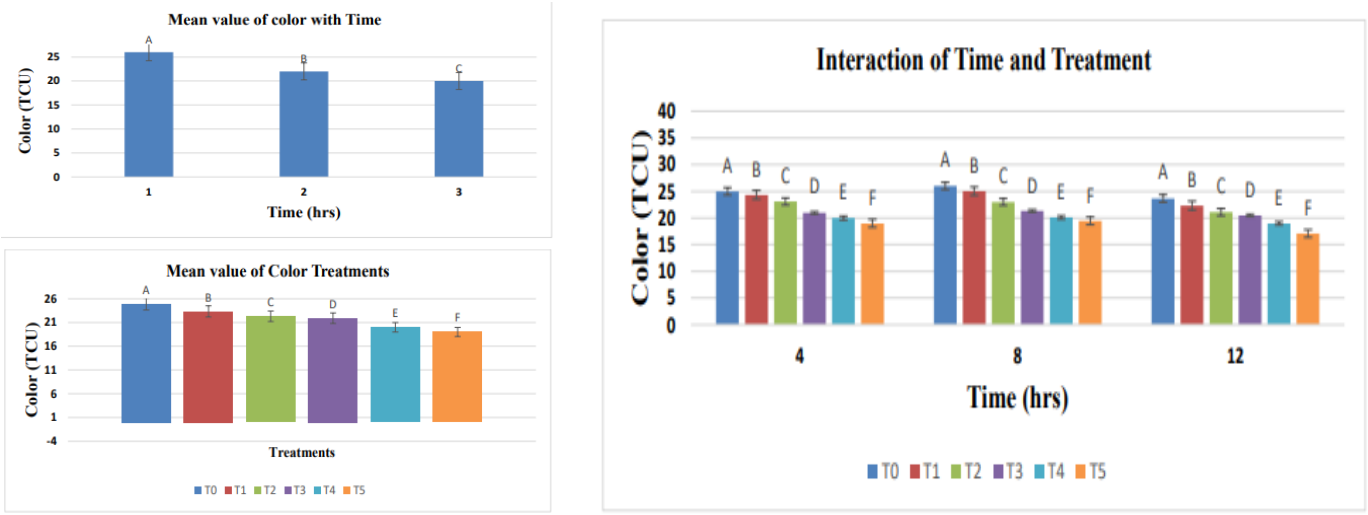

Figure 3 (a-c). Effectiveness of time duration, effect of different treatments, time and treatment interaction of Color (CFU) obtained after application of *Moringa oleifera* seed.

Total Dissolved Solids (TDS)

The excess amount of total dissolved solid in drinking water cause the scaling in water pipelines and undesirable flavor in drinking water. The mean values of TDS with respect to time factor showed a significant variation and data depicted in Figure 4 (a). *Moringa oleifera* seed showed a decreasing trend for TDS with increasing of time duration (4, 8, 12 hrs). At the initial four hours' interval, the TDS value was 340 mg/L, in the second four hours' interval the TDS was observed 300 mg/L and in the third interval of time (12 hours) TDS reduced to 290 mg/L. It indicated that with passage of time more TDS can be removed from water. Overall, the TDS removed from a value of 340 mg/L to 290 mg/L in water. The treatment difference influenced the TDS significantly and data depicted in the Figure 4 (b). A decreasing trend was observed with increasing concentration of *Moringa oleifera* seed. The control samples (T0) has the TDS value 390 mg/L, but at T1 treatment it was reduced to 370 mg/L, at T2 *Moringa oleifera* seed reduced the TDS to 330 mg/L TDS, in T3 it was influenced to 280 mg/L, at T4 it reduced the TDS to 260 mg/L, while at T5 *Moringa oleifera* seed removed the TDS to 250 mg/L level.

The treatment and time interaction of TDS data depicted in Figure 4 (c). *Moringa oleifera* seed influenced the TDS value significantly. By applying *Moringa oleifera* seed the contamination of TDS removed from 430-220 mg/L in drinking water. In control samples (T0) at 12 hrs of treatment the maximum TDS 430 mg/L was observed, while in treatment five (T5) during the time interval of 8 hours the lowest TDS value 220 mg/L was observed. In the interaction Figure 4 (c) the *Moringa oleifera* dose showing best result was 150 mg/L that significantly affect the TDS of water. The lower control sample value (360 mg/L) was observed during the time interval of 8 hours. The protein particles are active component bind with the dissolved solids presented in water and reduced their level. While 40% decreased with the interaction of time and treatment was observed for TDS contamination. The trend of graph shown in Figure 4 a, b and c indicated that the increasing concentration of *Moringa oleifera* seed is more effective for TDS removal. Patel and Shah (2020) also discussed the similar results in his study. They applied rice husk and coconut fiber with *Moringa oleifera* seed.

pH

The mean values of pH with respect to time factor as depicted in Fig 6.1 (a). At the initial four hours' interval, the pH value was 7.2, at the second four hours' interval the pH value was 7.1 and in the third interval of time (12 hours) pH value reduced to 6.9. Overall, the pH value affected from 7.1 to 6.9 was observed. The passage of time (4-12 hrs) showed a significant decreasing trend of pH in drinking water. The treatment influenced the pH significantly as depicted Fig 6.1 (b). The pH in the control

samples T0 was observed 7.12, but at T1 treatment Moringa oleifera seed reduced it to 7.09, at T2 pH was reduced to 7.07 at T3 it decreased to 7.05, at T4 Moringa oleifera seed reduced the pH value to 7.04, while at T5 it influenced the pH to 6.97.

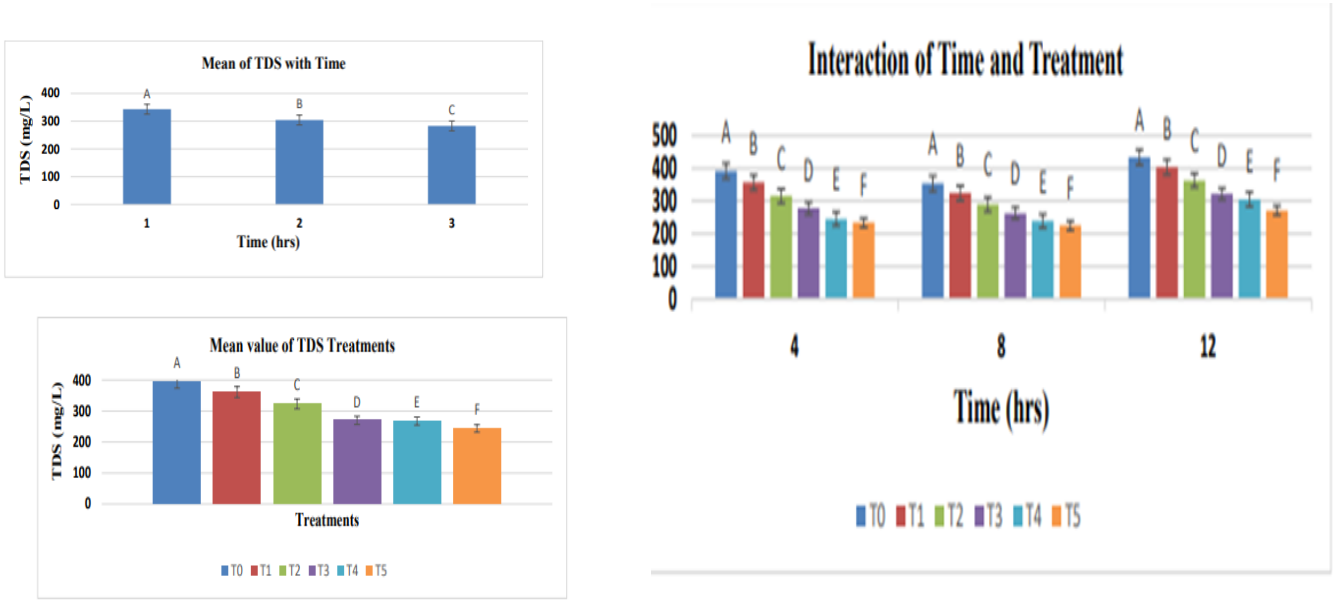

Figure 4 (a-c). Effectiveness of time duration, effect of different treatments, time and treatment interaction of TDS (mg/L) obtained after application of *Moringa oleifera* seed.

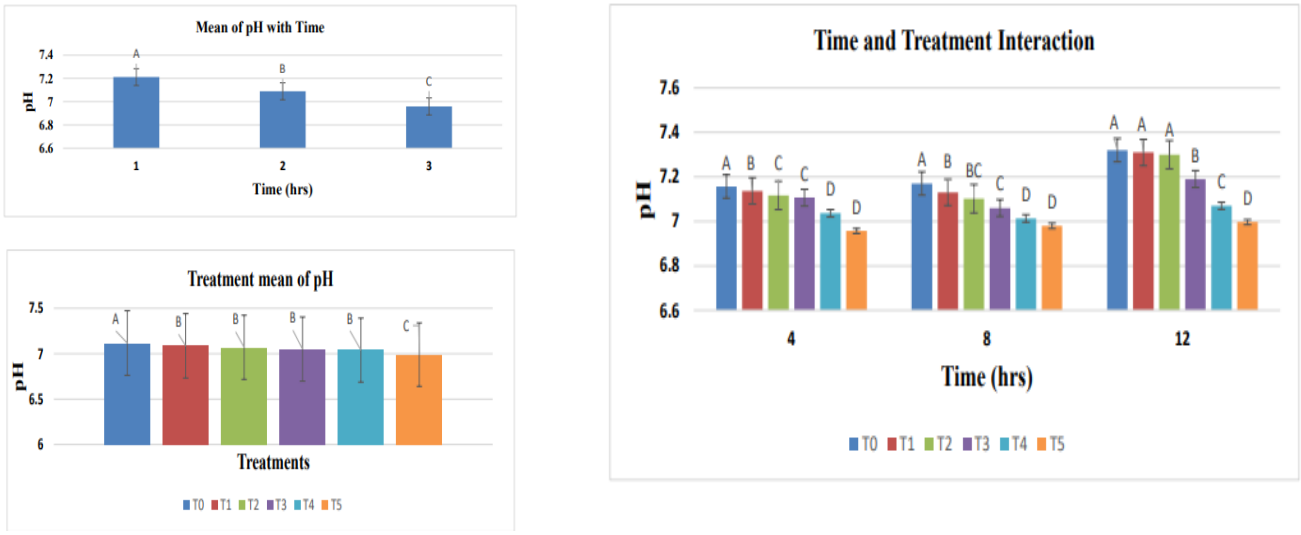

Figure 5 (a-c). Effectiveness of time duration, effect of different treatments, time and treatment interaction of pH obtained after application of *Moringa oleifera* seed.

In treatments the pH decreased from 7.12-6.97. A significant decreasing trend was observed with increasing concentration *Moringa oleifera* seed. The time and treatment interaction of pH in water samples collected from Rawalpindi and Islamabad depicted in Figure 5 (c) *Moringa oleifera* seed affected the pH significantly in a decreasing trend. The pH values ranged from 6.7-7.32, maximum pH was 7.32 in untreated sample (T0) at the time interval of 12 hours and minimum was 6.95 in treatment (T5) sample at the time 4 hours was observed. Mostly results observed lied in between the pH ranged from 7-7.2. *Moringa oleifera* seed showed the best purification rate at 4 and 8 hours. All the pH values obtained were in range permissible by PSQCA and WHO is 6.5-8.5. It indicated that all the results were in safe limit and not dangerous to human health. Most of researcher like; Zaman et al. (2017) and

Yamaguchi et al. (2020) stated that *Moringa oleifera* seed due to its natural buffering nature it adjusts pH. It maintains the buffering effect between the carboxyl and amine groups in water.

Nitrate

The mean values of nitrate with respect to time factor shown in Figure 6 (a). After applying *Moringa oleifera* seed a significantly decreasing trend of nitrate was observed with the duration (4, 8 and 12 hours) of time. Overall, the nitrate reduced from 88 mg/L to 60 mg/L. At the initial four hours' interval, the nitrate value was 16.8 mg/L, at the second eight hours' interval the nitrate value was 16.7 mg/L and on the third interval of time (12 hours) nitrate influenced was 16.3 mg/L. It indicates that with duration of time nitrates reduced non-significantly from water. The treatment difference in the nitrate is shown in Figure 6 (b). The nitrate effected significantly in a decreasing trend after applying the increasing concentration of *Moringa oleifera* seed. The maximum nitrate value 27 mg/L was observed in the control sample T0 but at T1 treatment it was reduced to 22 mg/L level, at T2 it was obtained 18 mg/L at T3 *Moringa oleifera* seed removed it to 13 mg/L, at T4 it influenced nitrate to 12 mg/L while at T5 *Moringa oleifera* seed influenced the nitrate to 10 mg/L. In all treatments the nitrate decreased from 27-10mg/L. All these results showed that the *Moringa oleifera* seed effectively reduced the nitrate in drinking water with increasing dose. The time and treatment interaction of nitrate in water samples collected from Rawalpindi and Islamabad is shown in Figure 6 (c). Nitrate of water samples ranged from 8-28 mg/L. The maximum nitrate was 28 and minimum was 8 mg/L. The highest value 28 mg/L was observed in 8 hours' time interval and the minimum 8 mg/L was observed in same time interval. The overall highest nitrate removal was also observed in 8 hours' time interval. It was observed that by increasing the level of *Moringa oleifera* seed dose the nitrate concentration decreased gradually in all time interval. All the observed results of nitrate with treatment were in safe range and meet permissible value by PSQCA and WHO is 10-45 mg/L for drinking water that cause no toxic effect to human's health. The polyelectrolyte particles in the *Moringa oleifera* seed found active against the nitrate contents in drinking water that bind with nitrate ions and form a floc. The similar study results were also discussed by Marobhe et al. (2021) they discussed that the polyelectrolytes present in *Moringa oleifera* seed has the ability to bind with the nitrate ion and 60% reduced its level. The trend of graph shown in Fig 4.11 a, b and c indicates that the increasing concentration of *Moringa oleifera* seed is more effective for nitrate removal as compared to time factor. Vunain et al. (2019) also discussed that the polyelectrolytes are in *Moringa oleifera* seed responsible to bind with nitrate particles.

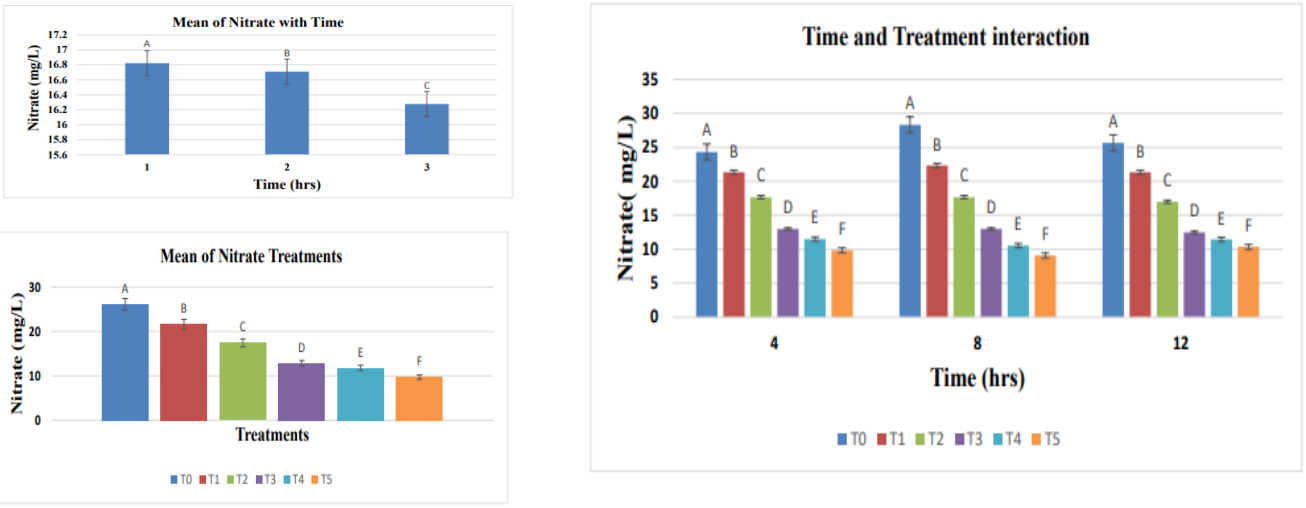

Figure 6 (a-c). Effectiveness of time duration, effect of different treatments, time and treatment interaction of Nitrate (mg/L) obtained after application of *Moringa oleifera* seed.

Sulphate

The mean values of sulphate with respect to time factor shown in Figure 7 (a). After applying *Moringa oleifera* seed a significant decreasing trend of sulphate was observed with the duration (4, 8 and 12 hours) of time. Overall, the sulphate reduced from 125 mg/L to 110 mg/L. At the initial four hours' interval, the sulphate value was 125 mg/L, at the second four hours' interval the sulphate value was obtained 120 mg/L and on the third interval of time (12 hours) sulphate was 110 mg/L. It indicated that with duration of time sulphate reduced significantly from water. The treatment influenced the sulphate significantly shown in Figure 7 (b). The sulphate showed a decreasing trend by application of increasing concentration of *Moringa oleifera* seed. In all treatments the sulphate ranged from 180-70 mg/L. The maximum sulphate value 180 mg/L was observed in the control sample T0 but at T1 treatment it was reduced to 140 mg/L level, at T2 the sulphate reduced to 120 mg/L at T3 *Moringa oleifera* seed influenced to 100 mg/L, at T4 sulphate reduced to 80 mg/L while at T5, the sulphate was observed 70 mg/L. All these results showed that the *Moringa oleifera* seed significantly reduced the sulphate in drinking water with increasing dose. The interaction between time and treatment of sulphate in water samples collected from Rawalpindi and Islamabad is shown in Figure 7 (c) ranged from 60- 200 mg/L. A decreasing trend of graph was obtained by application of *Moringa oleifera* seed. Maximum sulphate was observed 200 mg/L T0 at interval of 8 hrs and minimum T5 at time interval of 12 hrs was 60 mg/L. Sulphate time and treatment interaction mostly results obtained were in best limit on all three-time intervals. The sulphate range in drinking water permissible by PSQCA and WHO is less than 250 mg/L and best for human consumption is less than 150 mg/L. Eze and Ananso (2014) explained that *Moringa oleifera* is good for removal of contamination like sulphur and sulphate from drinking water and the also showed similar results in their study. The buffering nature of seed particles in *Moringa oleifera* become active with the passage of time and the increasing concentration the more particles were available to coagulate with the sulphate contaminants in drinking water or neutralized them. These particles binding with the sulphate present in water and reduced the sulphate level. While 40% decreased with the interaction of time and treatment was observed for sulphate contamination. The trend of graph shown in Figure 7 a, b and c.

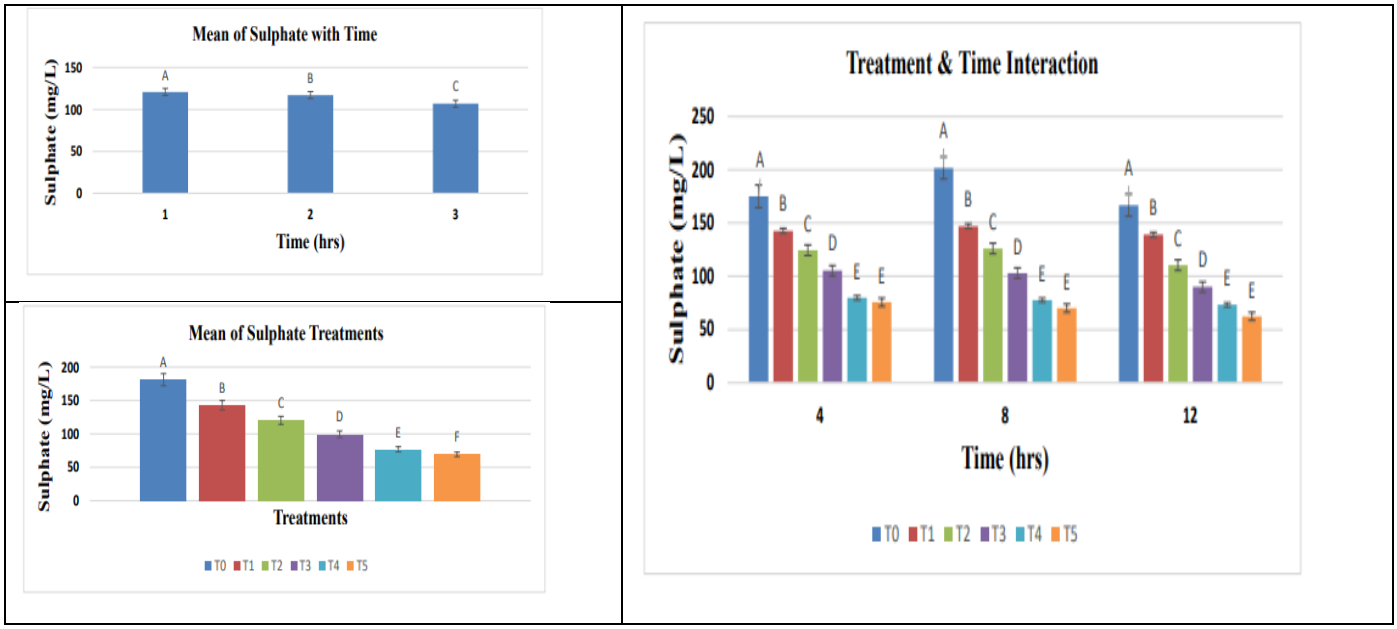

Figure 7 (a-c). Effectiveness of time duration, effect of different treatments, time and treatment interaction of sulphate (mg/L) obtained after application of *Moringa oleifera* seed.

CONCLUSION

Water is a great blessing of God on the earth, as it assures the occurrence of life. Unfortunately, this blessing is getting largely contaminated with several physio-chemical and biological factors that include trace elements, pesticides and detergents etc. that causes several diseases and a great threat to humans. For purification, several methods have developed for purification of drinking water. This

study was conducted on the purification potential effect of Moringa oleifera seed in the drinking water. The aim of the study was to analyze the effect of Moringa oleifera seed against the physicochemical and microbial properties in accordance with PSQCA and WHO safe range of drinking water. It was found in this study that polyelectrolytes present in Moringa oleifera seed removed the impurities 40-60% in drinking water with increasing passage of time (4-12 hrs.) and concentration of Moringa oleifera seed.

REFERENCES

AOAC. (2000). Official methods of analysis. Association of Official Analytical Chemists, (15), Washington, USA.

Arora, D. S., Onsare, J. G., & Kaur, H. (2013). Bioprospecting of moringa (Moringaceae): microbiological perspective. Journal of Pharmacognosy and Phytochemistry, 1(6), 22-25.

Bancessi, A., Pinto, M. M. F., Duarte, E., Catarino, L., & Nazareth, T. (2020). The antimicrobial properties of moringa oleifera Lam. for water treatment: a systematic review. SN Applied Sciences, 2(3), 1-9.

Chhikara, N., Kaur, A., Mann, S., Garg, M. K., Sofi, S. A., & Panghal, A. (2020). Bioactive compounds, associated health benefits and safety considerations of moringa oleifera L. an updated review. Nutrition & Food Science, 4, 23-30.

Eze, C., & Ananso, J. D. (2014). Assessment of water purification potential of moringa oleifera seeds. Int. Journal Microbiol Appl, 1(2), 23-30.

Fatombi, K. J., Ahoyo, T. A., Nonfodji, O., & Aminou, T. (2019). Physico-chemical and bacterial characteristics of groundwater and surface water quality in the lagbe town: treatment essays with moringa oleifera seeds. Journal of Water Resource and Protection, 4(12), 1001-1008.

PSQCA. (2020). Drinking water quality standards. Pakistan Standards and Quality Control Authority. Retrieved aug 22, 2022, from http://updated.psqca.com.pk/quality-control-center/quality-policy

PCRWR. (2020). Quarterly reported drinking water. Pakistan Council of Research in Water Resources, Islamabad. Pakistan.

Marobhe, N. J., & Sabai, S. M. (2021). Treatment of drinking water for rural households using moringa seed & solar disinfection. Journal of Water, Sanitation and Hygiene for Development, 12(2), 221-249.

Vunain, E., Masoamphambe, F., Mpeketula, P. G., Monjerezi, M., & Etale, A. (2019). Evaluation of coagulating efficiency and water borne pathogens reduction capacity of moringa oleifera seed powder for treatment of domestic wastewater from zomba, malawi. Journal of Environmental Chemical Engineering, 7(3), 103-118.

Patel, A., & Shah, A. (2020). Sustainable solution for lake water purification in rural and urban areas. Materials, 32, 740-745.

Varkey, A. J. (2020). Purification of river water using moringa oleifera seed and copper for point-of-use household application. Scientific African, 8, 03-64.

Yamaguchi, N. U., Cusioli, L. F., Quesada, H. B., Ferreira, M. E. C., FagundesKlen, M. R., Vieira, A. M. S., & Bergamasco, R. (2020). A review of moringa oleifera seeds in water treatment: trends and future challenges. Process Safety and Environmental Protection, 2(2), 15-21.

Zaman, S., Begum, A., Rabbani, K. S., & Bari, L. (2017). Low cost and sustainable surface water purification methods using moringa seeds and scallop powder followed by bio-sand filtration. Water Science and Technology: Water Supply, 17(1), 125-137