



Purification of the Tigris River water using seeds extract of Al-Ruwag tree (*Moringa oleifera* Lamarck) cultivated in Iraq.

Esam J. Al-Kalifawi

Biology Department, College of Education for Pure Science Ibn -Al- Haitham, Baghdad University, Baghdad, Iraq.

Abstract

This study is the first in Iraq, in which the use of the Al-Ruwag tree seeds that were planted from seeds imported from Sudan and the age of the tree three years, and this is the second season of harvested bods. Al-Ruwag tree is very useful and all parts of the tree have potent medicinal value and seed has coagulant activity to remove the turbidity from water as a natural coagulant instead of chemical coagulant. In the present study preparation of dried seed powder of Al-Ruwag tree in many concentrations and that was treated with raw water. After treatment with raw water by Jar test, samples were analyzed for all the parameters such as pH, turbidity, TSS, and bacterial examination. The results of the present study showed that Al-Ruwag seed has more coagulant activity specific at concentration 10 and 15 percentage, in this concentration the turbidity values and total suspended solid were zero. The results of the present study demonstrated the of Al-Ruwag seeds extract was efficient against bacteria found in raw water. The concentration (1%, 2%, 3% and 5%) of Al-Ruwag seeds extract reduced the number of bacteria in raw water to about (93.75%, 95.5%, 99.37% and 99.68%) respectively. Whereas the concentration (10% and 15%) of Al-Ruwag seeds extract reduced the number of bacteria to 100% .We conclude from the current study that the Al-Ruwag seed is environmentally friendly, non-toxic and a natural coagulant, which is effective against the causes of water-borne diseases.

Keywords: Al-Ruwag tree, seeds extract, water treatment, natural coagulant, Tigris River.

INTRODUCTION

Water supply is a basic need required for living creatures and human beings specifically. In this world the amount of resources available to living creatures are limited. About 75% of the present world

However, it is untenable and unbelievable under all situations that waterborne diseases still kill on the average 25,000 people every day in developing countries while millions suffer the debilitating effects of these diseases [1]. Safe drinking water is essential to the health and welfare of a community, and water from all sources must have some form of purification before consumption. Various methods are used to make water safe and attractive to the consumer. The method employed depends on the character of the raw water. One of the problems with treatment of surface water is the large seasonal

Many coagulants are widely used in conventional water treatment processes for potable water production. These coagulants can be classified into inorganic coagulant, synthetic organic polymer, and naturally occurring coagulant.

population lives in the developing countries of the world. About 1.2 billion people still lack safe drinking water and more than 6 million children die from diarrhea in developing countries every year.

variation in turbidity [2]. Current operational procedures at many treatment works in developing countries are based on arbitrary guidelines, particularly in relation to the dosage of chemicals. Besides that, there is also the problem of inadequate number of skilled workers and inadequate laboratory facilities to monitor process performances required to operate the plants [3]. Coagulation-flocculation followed by sedimentation, filtration and disinfection, often by chlorine, is used worldwide in the water treatment industry before distribution of treated water to consumers [4].

Synthetic polyelectrolytes are used as primary coagulant as well as coagulant aid to improve the strength of particle aggregates, enhance coagulation and deposition (filtration) [5].



Naturally occurring coagulants are usually presumed safe for human health while there is a fear by using aluminum salts that may induce Alzheimer's disease [6]. Some studies on natural coagulants have been carried out and various natural coagulants were produced or extracted from microorganisms, animals or plants [7, 8, 9]. Recently, however, there has been a resurgence of interest in natural coagulants for water. Jahn (1984) has presented *Moringa oleifera* as a coagulant after her studies in the Sudan [11, 12] when she noticed that Sudanese village women used it at home to clear the turbid Nile water. Later, many researchers have reported on the various uses of *Moringa oleifera* seeds as coagulant and coagulant aid in the last 20 years. *Moringa oleifera* coagulant. This study is the first in Iraq, in which the use of the Al-Ruwag tree seeds that were planted from seeds imported from Sudan and the age of the tree three

Materials and Methods

1- Tigris River water samples collection

Water samples were collected from Tigris River at Al- Adhamiya, Abu Nawas and Al-Doura sites in
2- Collection and Identification of Al-Ruwag tree seeds:

Seeds of Al-Ruwag tree used in this study were collected from a single tree cultivated in my house (figure 1 and 2), Dura area Baghdad, Iraq. It was identified and authenticated by Prof. A. Al-Janabi, taxonomist in the Department of Biology, College of

treatment in developing countries [4]. *Moringa oleifera* is one of the most wide spread plant species that grows quickly at low altitudes in the whole tropical belt, including arid zones. It can grow on medium soils having relatively low humidity [10]. *Moringa oleifera* seeds are an organic natural polymer.

has been found to have high coagulation activity only for high turbidity water. The activity is low for low turbid water [13]. Therefore, it is important to improve the characteristics of this plant by identifying its bioactive constituents, which has high coagulation activity. This is one of the objectives of this study.

years, and this is the second season of harvested bods.

Baghdad, Iraq. Three samples taken from each site. Using the method given by (APHA) 1998, for river water sample collection.

Education for Pure Science Ibn -Al- Haitham, University of Baghdad. The taxonomy of this plant as follows; Kingdom: Plantae, (unranked): Angiosperms, (unranked): Eudicots, (unranked): Rosids, Order: Brassicales, Family: Moringaceae, Genus: *Moringa*, Species: *M. oleifera*, Binomial name *Moringa oleifera* Lam.



Figure 1. Al-Rawag Tree.



Figure 2. Al-Rawag treeSeeds.

3- Preparation of Al-Ruwag tree seed powder:

The Al-Ruwag seeds were de-shelled and dried at ambient temperatures (23 to 25°C) for a period of

five days before milling. The white kernels were milled into a fine powder using with the aid of El-

4- Preparation of Al-Ruwag seed solution and water treatment:

Different concentrations of Al-Ruwag seed solutions were made by dissolving 1 g, 1.5 g, 2 g, 3 g, 4 g, and 5 g of the Al-Ruwag seed powder into a 100 mls of distilled water each contained in a conical flask to

5- Flocculation Test

Water treatment was carried out according to [16]; it was carried out as follows: 1L of raw water from Al-Adhamiya site on Tigris River at Baghdad was introduced into a beaker and the initial turbidity was measured. A six dose of Al-Ruwag tree seeds extract

Araby blender (MX-5200) and was sieved through a small mesh to get the fine powder.

obtain 1 %, 1.5 %, 2 %, 3%, 4% and 5% concentration of the solution respectively [15]. The solution was shaken properly for 1 minute to extract and activate the coagulant and antimicrobial proteins in the seed powder. Each of the concentrations was poured into one liter of the raw water contained in a beaker (2 liter capacity).

was added and the beaker was placed into the JLT4 Jar-Test apparatus with 6 places figure 3. It was programmed to 100 rpm for 20 min. Beakers were then allowed to settle for 1 h after the Jar test. Subsequently, a sample was taken 3 cm from the surface in the center of each beaker for analysis. For this collection a syringe was used.



Figure 3. Jar test for turbidity river water.

6- Total bacterial count:

10-fold serial dilution of the water sample was made before plating using the methods given by [17]. Using a sterile syringe 9 mls each of the diluents (sterile water) was placed into 10 different test-tubes arranged in a rack. The water sample was then

shaked to mix and 1 ml was taken using sterile 5 ml syringe and then added into the first test tube in the rack and shaken properly to mix. 1 ml of the water was taken from the first test tube and delivered into the second test tube and mixed. This process was repeated for the 10-test tubes. 0.1 ml aliquot of each dilution 1 to 5 test tubes was then plated on an



already solidified nutrient agar. The water sample was spread evenly on the surface of the agar using sterile swab stick, after which the inoculated media

7- Physicochemical analysis of the water sample

7.1-Determination of turbidity:

The turbidity of the water sample was determined using machine (Martini Mi 415, Romania). The machine was switched on and then calibrated with

7.2-Determination of pH:

This was done using pH meter (Suntex TS-2, Taiwan). The instrument was calibrated with standard buffers. 5 mls of the water sample was measured into

7.3-Determination of total suspended solids (TSS):

This was determined by weighing a filter paper on weighing beam balance, the water sample was then filtered using the filter paper. The wet paper was then dried in the hot air oven at 103 to 105 °C, after which

Result and Discussion

The results of Tigris River samples examination shows, the lowest turbidity and number of colony

was allowed to dry and then incubated at 37°C for 24 hours. After the incubation period, number of colony growths on the agar were counted and recorded.

primary standard 0 FNU, 10 FNU, and 500 FNU. 5 mls of the water sample was poured into a cuvette holder with the vertical line on the cuvette aligning with the horizontal mark on the instrument. The value of the turbidity was then read on the crystal liquid display (CLD) as soon as the ready signal was seen on the screen.

a clean test tube and the electrode of the instrument inserted into the water and the start button pressed, the reading was taken as displayed directly on the crystal liquid display panel of the instrument.

the filter paper was removed and reweighed. The increase in weight was read and recorded as the total suspended solids in the water sample.

forming units were 36 NTU and 1.6×10^3 respectively at Adhamiya location. Whereas the highest turbidity and number of colony forming units were 50 NTU and 6×10^5 respectively at Ad-Dura area (Table 1).

Table 1. The sample collection from.

Sampling sites	pH measurement	Turbidity/NTU	TSS	TBC/100ml
Al-Adhamiya	8.5	36	0.7	1.6×10^3
Abu Nawas	7.6	40	0.75	4×10^4
Al-Doura	6.4	50	0.8	6×10^5

*These number are mean of triplicate, TSS= Total suspended solids, TCN=Total bacterial count.

The high level of turbidity and bacteria in Al-Doura site compared to others is attributed to the higher polluted materials discharged into the river from factories in Baghdad areas and moved down to the The collected water sample from Al-Adhamiya site was analyzed all the parameter before and after the treatment of various doses of Al-Ruwag seed powder. The present study was conducted to obtain preliminary information on the coagulant activity of Al-Ruwag seed the result was shown in table1. The seed grinded powder was tested the coagulant activity of crude extracted. The result was showed that Al-Ruwag seed has more coagulant activity specific at concentration 10 and 15 percentage, in this concentration the turbidity values and total suspended solid were zero. These finding are in agreement with

south at Al-Doura site. Adhamiya site was chosen because it is less polluted to test the ability of the Al-Ruwag seeds extract in water purification.

several studies, Bina *et al.*, 2010 has reported that the *Moringa oleifera* Coagulant Protein as coagulant aid can be used for drinking water treatment without the risk of organic or nutrient release. He has reported that *M.oleifera* more active against *E.coli* from the turbidity. Several studies were carried out to identify the efficacy of *M. oleifera* spp. as natural coagulants especially by [19, 20, 21, 22] was reported that the application of this low cost *Moringa oleifera* seeds is recommended for ecofriendly, nontoxic, simplified water treatment.



Table-2. Parameters studied before and after treatment of water sample with various doses of Al-Ruwag seed powder.

Parameters	Before treatment	After treatment with diff. conc.						WHO/USPH Standards
		1%	2%	3%	5%	10%	15%	
pH measurement	8.5	7	7	7	7	7	7	6.5-8.5
Turbidity (NTU)	36	10	8	5	3	0	0	5
TSS	0.7	0.2	0.2	0.1	0.1	0	0	Nil
TBC/100ml	1600	100	52	10	5	0	0	Nil

*These number are mean of triplicate, TSS= Total suspended solids, TCN=Total bacterial count.

The results of the present study demonstrated that Al-Ruwag seeds extract was efficient against bacteria found in raw water. The concentration (1%, 2%, 3% and 5%) of Al-Ruwag seeds extract reduced the number of bacteria in raw water to about (93.75%,

95.5%, 99.37% and 99.68%) respectively. Whereas the concentration (10% and 15%) of Al-Ruwag seeds extract reduced the number of bacteria to 100% Table 2 and figure (4-6).

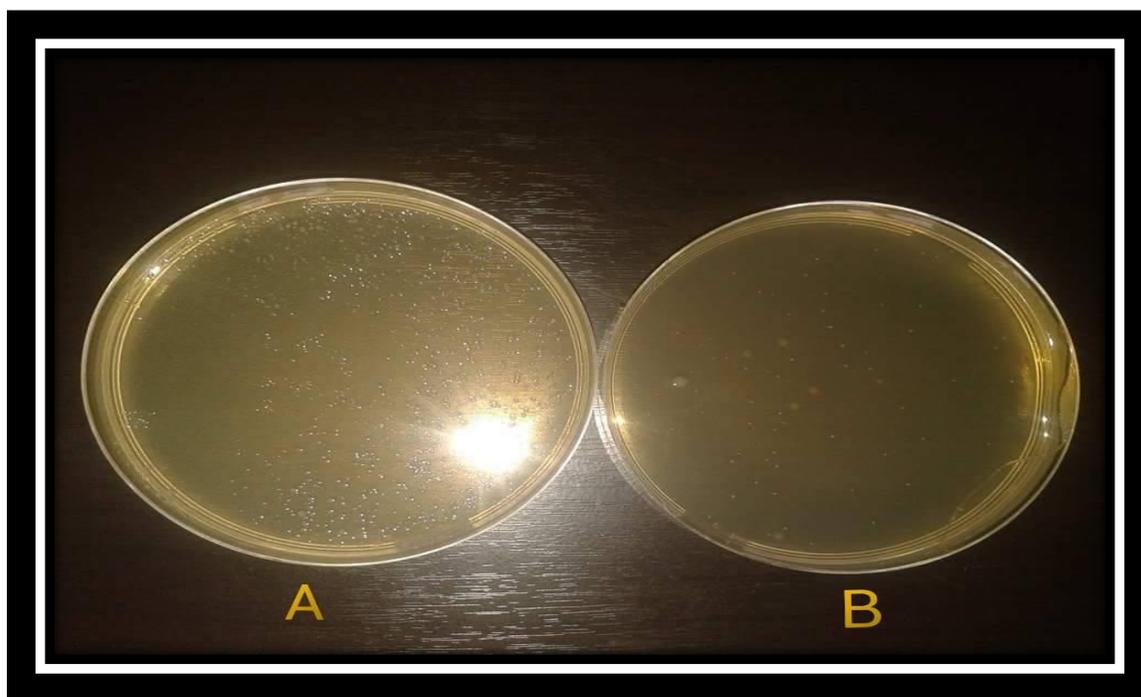


Figure 4. Effect of 2% Al-Ruwag seeds extract on the number of bacteria. A- before treatment. B- after treatment.

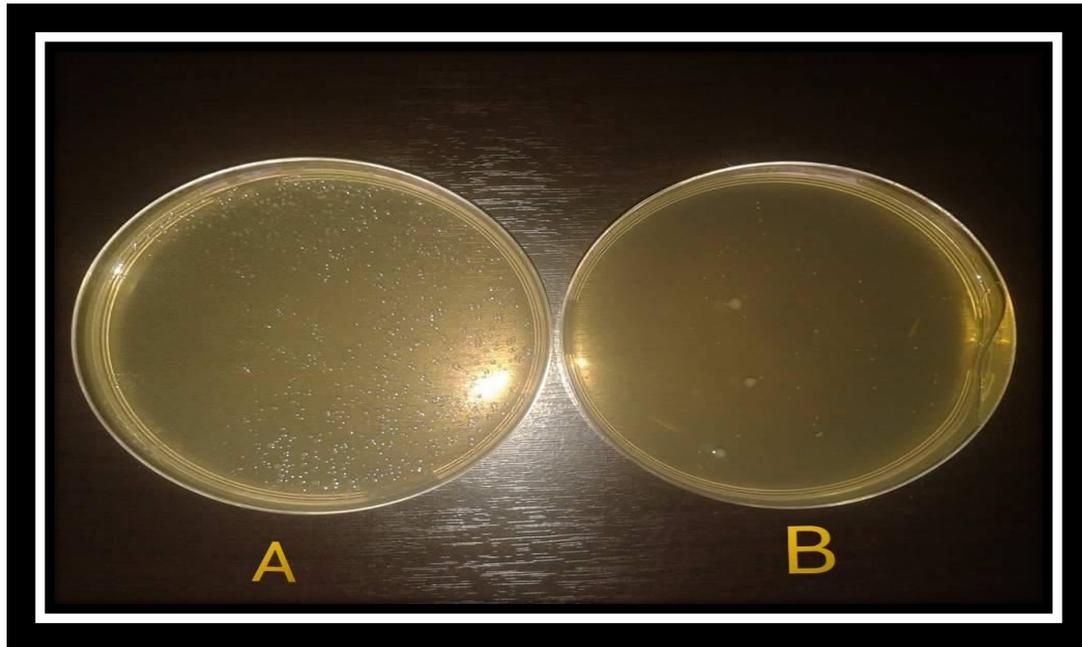


Figure 5. Effect of 3% Al-Ruwag seeds extract on the number of bacteria. A- before treatment. B- after treatment.

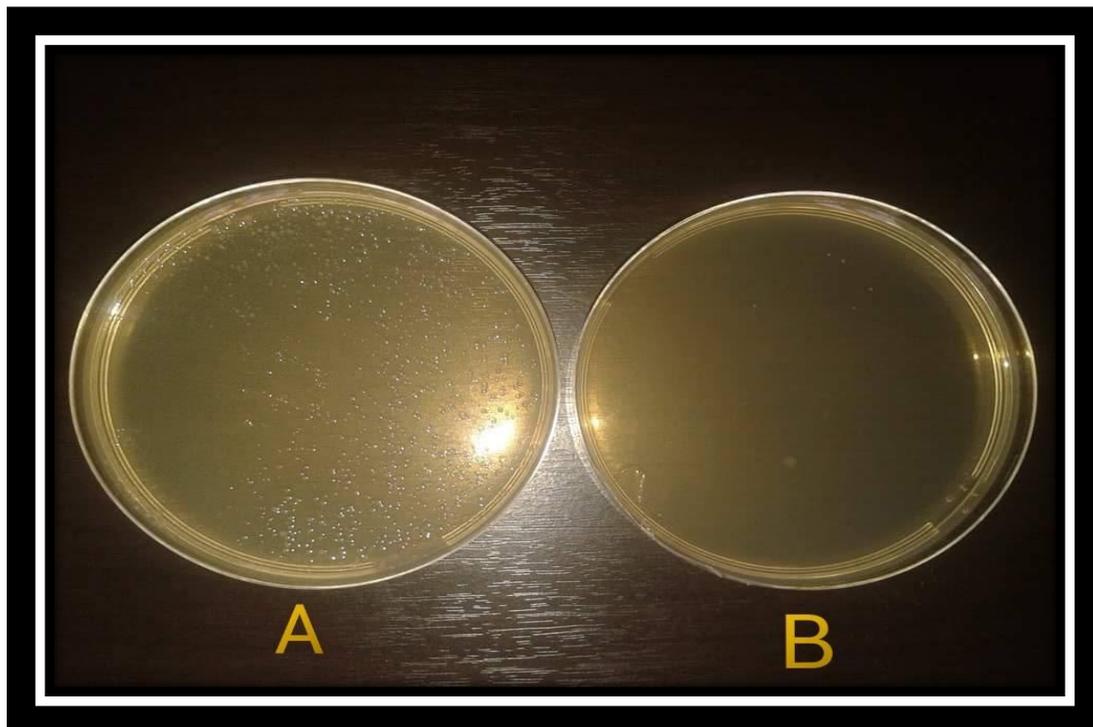


Figure 6. Effect of 5% Al-Ruwag seeds extract on the number of bacteria. A- before treatment. B- after treatment.



These finding in agreement with several studies. According to [23], moringa seeds contain the bactericidal substances pterygospermin, 4-(α -L-rhamnosyloxy)-benzylisothiocyanate and 4-(α -L-rhamnosyloxy)-henylacetonitrile. However, in addition to bacterial growth inhibitors [24], moringa seeds also contain a recombinant protein capable of flocculating Gram -negative and Gram-positive bacteria [25], making moringa seed extracts an even

Likewise, [27] reduced by 65% TTC levels in water treated with moringa extracts for 24 hours and, in a similar study using samples of surface water, [28] observed 97.5% TTC die-off after 24 hours of treatment. [29] purified water with powdered moringa

Conclusion

The Al-Ruwag seed powder was used to treat the Tigris River water has effective activity to remove the turbidity and bacteria from water, thus making water more suitable for drinking.

more attractive alternative to conventional water purifiers. Kumar and Gopal (1999) also tested extracts of *M. oleifera* on river water samples contaminated with TTC and reported die-off rates (89.72%) compatible with ours. The authors concluded that moringa seed extracts can be used to purify water bodies contaminated with TTC and *E. coli* and thereby potentially help prevent a number of water-borne diseases.

seed extract and observed significant reductions in MPN values. According to the authors, since bacteria are normally associated with solid particles, TTC die-off may have been due to the action of flocculating agents in the moringa extract.



References

- 1-Kalbamatten, J.M., and M. J. Burns, (1983). "Water supply and sanitation in developing countries -introduction". Water supply and sanitation in developing countries, B.J. Dangerfield, IWES, London, England.
- 2- McConnachie, G.L., G. K. Folkard, M. A. Mtawali, and J. P. Sutherland, (1999). Field Trials of Appropriate Hydraulic Flocculation Processes. *Wat. Res*;33(6): 1425-1434.
- 3- Muyibi, S. A., (1998). Moringa oleifera seed extract in water treatment. *J. Instit. Eng*; 59(3): 37-50.
- 4- Ndabigengesere, A. and Narasiah, K. S. (1998). Quality of water treated by coagulation using *Moringa oleifera* seeds. *Wat. Res*; 32(3): 781-791.
- 5-Muyibi, S.A., H. Hamza, I. Ibrahim, and M. M.J.M. Noor, (2001). Coagulation of river water with *Moringa oleifera* seeds and alum-a comparative study, *J. Instit. Eng*; 62 (2): 15-21.
- 6- Martyn, C. N., D. J. P. Barker, C. Osmond, E. C. Harris, J. A. Edwardson and R. F. Lacey, (1989). Geographical relation between Alzheimer's disease and aluminum in drinking water. *Lancet*;1: 59-62.
- 7- Ganjidoust, H., K. Tatsumi, T. Yamagishi, and R. N. Gholian, (1997). Effect of Synthetic and natural coagulant on lignin removal from pulp and paper wastewater. *Water Science Technol*;35: 286-291.
- 8- Kawamura, S. (1991). Effectiveness of natural polyelectrolytes in water treatment. *JAWWA*; 83(10): 88-91.
- 9-Lee, S.H., S. O. Lee, K. L. Jang, and T. H. Lee, (1995). Microbial flocculant from arcuadendron SP-49. *Biotechnol. Lett*; 17(1): 95-100.
- 10- Ndabigengesere, A., K. S. Narasiah, and B. G. Talbot, (1995). Active agents and mechanism of coagulation of turbid waters using *Moringaoleifera*. *Water Res*; 29(2): 703-710.
- 11- Jahn, S. A. A. (1984). Effectiveness of traditional flocculants as primary coagulants and coagulant aids for the treatment of tropical waters with more than a thousand fold flocculation in turbidity. *Water Supply*;2: 8-10.
- 12- Jahn, S.A. A., 1988. Using Moringa seeds as coagulants in developing countries. *J. AWWA*; 90: 43-50.
- 13-Muyibi, S.A., andL. M. Evison, 1995. Optimizing physical parameters affecting coagulation of turbid water with *Moringa oleifera* seeds. *Water Res*;29:2689-2695.
- 14- American Public Health Association (APHA), 1998. Standard methods for the examination of water and wastewater, 20th ed. Clesceri LS, Greenberg AE, & Eaton, AD, (Eds); American Public Health Association: Washington, DC.
- 15- Muyibi, S.A., and L. M. Evison, (1996). Coagulation of turbid water and softening of hard water with *Moring Oleifera* seeds; *Intern. J. Environmental Studies*; 49: 247-259.
- 16- Muyibi, S.A., A. H. M. Bitima, T. A. Mohammed, and M. M. N. Megat Hohari, (2004). Conventional Treatment of Surface Water Using *Moringa oleifera* Seeds extract as a Primary Coagulant. *IIUM Engineering Journal*;5: 25-35.
- 17- Omoigberale, M. N. O., J. O. Isibor, J. I. Izegaegbe, and M. I. Iyamu, (2013). Seasonal variation in the bacteriological quality of Ebutte River in ehor community EDO state, Nigeria. *American Journal of Research Communication*; 1(7): 59-69.
- 18-Bina, B., M. H. Mehdinejad, G. Dalhammer, G. Rajarao, M. Nikaeen and H. Movahedian Attar, (2010). Effectiveness of *Moringa oleifera* coagulant Academy protein as natural coagulant and in removal of turbidity and bacteria from turbid waters, *World of Science, Engineering and Technology*; 67.
- 19- Muyibi, S. A., S. A. Abbas, M. J. M. M. Noor, and F. R. Ahmadon, (2003). Enhanced coagulation efficiency of *Moringa oleifera* seeds through selective oil extraction. *IIUM Engineering Journal*; 4(1): 1-11.



- 20- Ndabigengesere, A., and K. S. Narasiah, (1998). Quality of water treated by coagulation using *Moringa oleifera* seeds. *Wat. Res*; 32(3): 781-791.
- 21-Okuda, T., A. U. Baes,W. Nishijima,and M. Okada,(1999). Improvement of extraction method of coagulation active components from *Moringa oleifera* seeds, *Water Res*;33(15):3373-8.
- 22- Mangale, S. M., S. G. Chonde,A. S. Jadhav,and P. D. Raut, (2012). Study of *Moringa oleifera* (Drumstick) seed as natural Absorbent and Antimicrobial agent for River water treatment.*J. Nat. Prod. Plant Resour*; 2 (1):89-100.
- 23- Jahn, S. A. A. (1986). Proper use of African natural coagulants for rural water supplies –Research
- 27- Olayemi, A. B., and L. O. Alabi, (1994). Studies on traditional water purification using *Moringa oleifera* seeds. *African Study Monographs*; 15 (3): 135-142.
- 28- Oluduro, A. O. and B. I. Aderiye, (2009). Effect of *Moringa oleifera* seed extract on vital organs and tissue enzymes activities of male albino rats. *Afr. J. Microbiol. Res*; 3(9): 537-540.
- in the Sudan and a guide to new projects. GTZ Manual No. 191.
- 24- Anwar, F.W. and M. I. Bhangar, (2003). Analytical Characterization of *Moringa oleifera* seed oil grown in temperate regions of Pakistan. *Journal of Agricultural and Food Chemistry*;51:6558-6563.
- 25- Broin, M., C. Santaella, S. Cuine, K. Kokou, G. Peltier, and T. Joet, (2002). Flocculent activity of a recombinant protein from *Moringa oleifera* Lam. Seeds. *Appl. Microbiol. Biotechnol*;60:114-119.
- 26- Kumar, K. and A. K. Goel, (1999). Frequently used ethno-medicinal plants of Bihar. *Journal of Economic and Taxonomic Botany*; 23(2): 645-649.
- 29- Amagloh, F. K. and A. Benang, (2009). Effectiveness of *Moringa oleifera* seed as coagulant for water purification. *African Journal of Agricultural Research*; 4 (1): 119-123.