VOL. 02 NO. 2,
DECEMBER, 2023
E-ISSN 3026-958X
P-ISSN 3027-1169

African Scholar Publications & Research International
www.africanscholarpub.com

Journal of Science Innovation & Technology Research (JSITR)

Effect of Storage Condition of Pea Pod on Water Disinfection

Muhammad Muhammad Makki, PhD; Mukhtar Isa; & Abdulfatah Usman

Department of Civil Engineering, School of Engineering, BUPOLY Hadejia, Jigawa State Nigeria.
mmakkielleman@gmail.com

Abstract

Natural disinfectants are considered affordable and efficient substitutes to chemical disinfectants for use in developing countries where raw materials such as *Cicer arietinum* (green pea) are readily available. Polluted water is estimated to affect about 1200 million people and contribute to the death of 15 million children in the world per year. The excessive use of chemical disinfectant can affect human health in the long term; aluminum has been indicated to be a causative agent of neurologic diseases such as senile dementia. Researches confirms the high impact of Pea pod as a disinfectant in water treatment, but much researches have to be done to ascertain the effects of its storage on water disinfection. Therefore, the research aims at finding effect of storage condition (Temperature and pH) effect of pea pod on water disinfection. A suitable method was employed for the Pea pod processing. Pea pod was prepared and ground to powder. Phytochemical analysis of the Pea pod was done. 10% stock solution of the extract was prepared. Jar test for water disinfection, was carried out for High, Medium, low untreated synthetic waters, Kura surface (river) water and Zoo road well water. The process was repeated for the Pea pod powder at varying temperature and pH values. Disinfection increases with increase in dose of the Pea pod extract and Higher reductions were noted for Zoo road well water; for synthetic water, the % reduction ranges from 13.6 - 99.8%; for Kura surface raw water, the % reduction ranges from 3.36 - 99.99%, while for Zoo road well water, % reduction ranges from 50 - 99.99% corresponding to dose range of 400 –

2400mg/L for all samples. Disinfection increases with increase in initial infect. Also, pH increase of Pea pod towards alkalinity causes significant increase in infection, while the rate of pathogen removal increases with increase in temperature; p-value for t test and skewness range was 0.99 high indicating high correlations between 30, 40 and 50^0C. It was recommended that Comparative research should be done on the efficiency of the different methods of Pea pod extraction. Also, Research should be conducted to discover the mode of attack of the Pea pod extract on the microbes.

Keywords: Pea Pod, Extraction, Disinfection, Water Treatment, Storage Condition

Introduction

Access to safe drinking-water is essential to health, a basic human right and a component of effective policy for health protection. The United Nations (UN) General Assembly declared in 2010 that safe and clean drinking-water and sanitation is a human right, essential to the full enjoyment of life and all other human rights (WHO, 2017). Disinfection is accomplished both by filtering out harmful micro-organisms and by adding disinfectant chemicals. Disinfection is accomplished both by filtering out harmful micro-organisms and by adding disinfectant chemicals.

Researches confirms the high impact of Pea pod as a disinfectant in water treatment, but much researches have to be done to ascertain the effects of its storage on water disinfection. Therefore, the research aims at finding effect of storage condition (Temperature and pH) effect of pea pod on water disinfection.

WATER SAMPLES

The synthesized water was prepared at the Public Health Laboratory. The water quality parameters were checked before and after treatment. Doses of the Pea pod filtrates i.e. 0.25ml, 0.5ml, 1.0ml, 2.0ml and 3.0ml, 5.0ml and 7.0ml (Aweng *et al.*, 2012) were chosen so as to get the corresponding final concentrations. WHO 2018 Standard for Turbidity is 5NTU.

PEA (*CICER ARIETINUM*) POD SAMPLING AND PHYTOCHEMICAL ANALYSIS

Good quality fresh Pod of the Peas will be selected manually and randomly (in accordance with Kwaji *et al.*, (2010) from the market, and will be authenticated from the Department of Botany and dried under room temperature for two weeks.

Complete proximate standard procedure analyses of the pea pod were done in the Department of Animal Science and also in Biochemistry Department Bayero University Kano, Nigeria. The following materials and equipment were used throughout the tests: 10 liters of Synthesized water: pure water with 7.0 pH, 10 (500-1000ml) beakers, electric stirrers, pipettes, sieves (200-500mm), standard pH meter, thermometer, Turbid-

meter, clinical auto-clave, Autoclave or BIOSENS Machine for BOD test, photometer, 10-20 normal test tubes, 500-1000g Kaolin Bentonite, 1 complete pack of Whatman filter papers, 50,000mg of Calcium chloride dehydrate ($CaCl_2.2H_2O$), Jar test apparatus, Incubator, oven, 2ml Buffer solution, Erichrome T indicator and EDTA Standard Titrant, 0.1NHCl and 0.02NaOH, Gallankamp water bath and Controlled fridge etc.

PREPARATION OF PEA POD POWDERS AND CRUDE EXTRACTS

The dried pods were separately grounded to fine powder using domestic blender. The ground powders were then sieved through a 210μm sieve. The extraction was in accordance with Aweng *et al.,* (2012), but was mixed with a different mixer: Crude extracts was prepared by using 500ml of distilled water to 50g of the prepared powder, which was mixed by a British made (RPM=1400, HP=1/86, watt=8.6) stirrer for 60min and left to settle for 20 minutes to make 10% stock solution of the Pea pod extract. The crude extracts were finally filtered through Whatman filter paper. The filtrates were prepared at the time of conducting the tests, since deterioration sets in, with delay (Muyibi *et al.*, 1994). The filtrates were used within 48 hours.

PREPARATION OF SYNTHETIC WATER

Synthetic raw water was prepared to guarantee the homogeneity of raw water to be used with specific concentrations.

PROCEDURE FOR LABORATORY ANALYSIS

Phytochemical analysis was firstly conducted on the Pea pod of the plant to confirm the presence of Chemical and bioactive constituents of Pea pod that was responsible for the water treatment. Level of contamination of the synthetic water was determined. The synthesized water was separately treated using Pea pod filtrates. The test was carried out batch wise. Three water samples were mixed each homogeneously with the chosen doses of Pea Pod extract and then allowed to rest. The treated water samples were then analyzed to determine the levels of disinfection, temperature and pH.

DISINFECTION TEST

This was done in accordance with Food and Agriculture Organization of the United Nations, Rome, 1976 (FAO EC/Microbiol/75/Report 1/ Annex v): Enumeration of Mesophilic Aerobic Bacteria (Aerobic Plate Count): 1ml of coliform containing water was serially diluted in distilled water into 10^{-1}, 10^{-2}, 10^{-3} and 10^{-4} mg/land, then 1.0ml of each of these diluents was plated aseptically onto nutrient agar for total coliform counts. Disinfectant concentrations were made in each 10ml of the cell cultures and incubation was carried out at 37 °C (in Gallenkamp Cooled Incubator) for 24 hrs. for Total coliforms test. The colonies were enumerated. The cell survival ratio was estimated by comparison to a control experiment where no Pea Pod extract was added (Bichi, 2012).

TEMPERATURE VARIATION WITH TURBIDITY AND pH

Jar tests was completed for optimum doses for high turbidity, medium and low turbidity of Pea pod extract at 40, 30, 20, 10, 5 and 0.5°C but with slight variation starting from 0°C to 50°C. The procedure for the jar test was stated already in Section above. Gallenkamp water bath and a controlled fridge were used to control temperature (and they were different from instruments used in the referenced method). Also pH values were taken throughout the tests.
The whole procedure was repeated for varied temperature and pH.

Table 1: Temperature ranges with pH, Turbidity removal efficiency (%), % Disinfection

Temperature (^{0}C)	pH	Turbidity removal efficiency (%)	% Disinfection
30			
40			
50			

EFFECT OF THE PEA POD EXTRACT ON pH OF WATER

The initial pH values of the water samples were 6.7, 6.8, 6.9, 6.7 and 6.9 respectively for high, medium and low, Kura Open Channel Surface (river) water and Zoo road underground (Well) water turbidities, and the initial pH of the Pea Pod Extract was 3.5.
However, when the high, medium and low, Kura Open Channel Surface (river) water and Zoo road Underground (Wells) waters were treated with various doses of the Pea pod extract, the pH values changed (towards alkalinity) as shown in Figure 1.

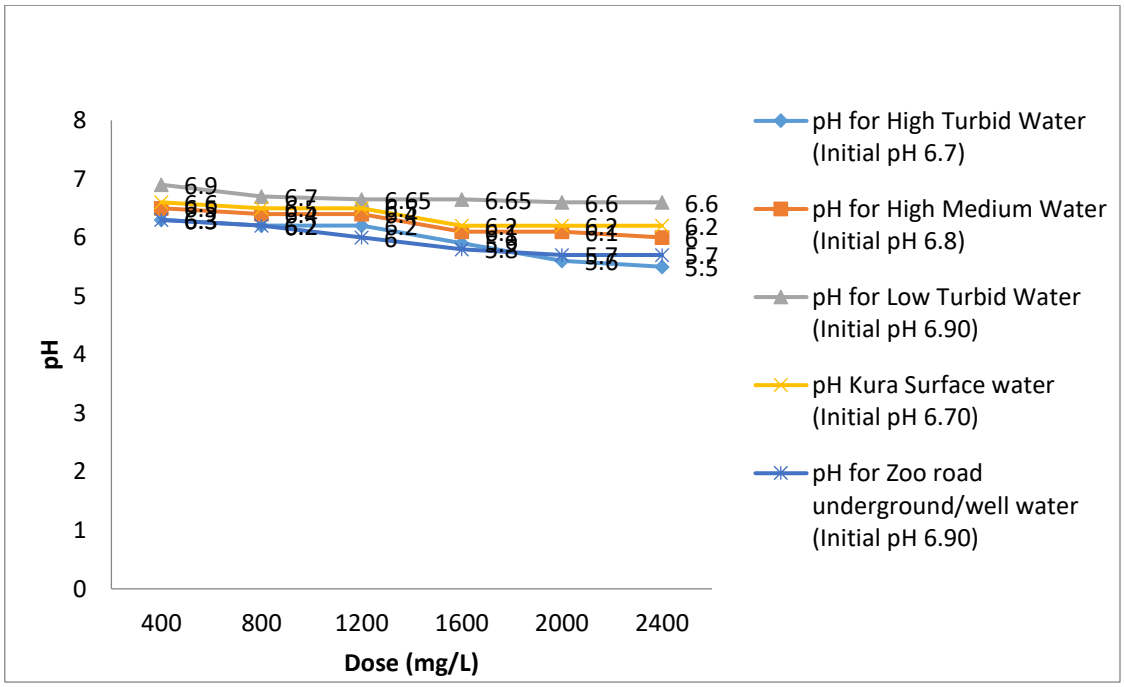


Figure 1: The Effects of Doses On pH for Different Water Samples for Pea Pod not stored

At optimum doses (1600mg/l for high, medium, low and Kura surface turbid waters and 1200mg/L for Zoo road well water), the Optimum pH values after treatment were 5.9, 6.1, 6.65, 6.2 and 6.0 respectively.

In a similar research on water treatment, the pH was observed in alkaline nature after treatment with Moringa seed powder, confirmed by the work of Jodi *et al.,* (2012). Musa (2016) in his work discovered a similar pH reduction while treating water with *Poliostigma thonningischum and Tamarinds india L*. leaves extracts. Sethupathy (2015), in his work, discovered a similar pH reduction while treating water with *Moringa oleifera* seed powder. Also Chadanand and Manika (2015) observed pH shift to slightly alkaline nature after treatment with Pea seed powder.

Although the pH of the water varied as a result of the introduction of the plant extracts, it was within the range set by WHO 2018 standard for drinking water i.e. (6.5-8.5).

EFFECT OF PEA POD UNSTORED IN DISINFECTION (BACTERIAL REDUCTION)

The prepared water, Kura Open Surface (river) water and Zoo Road Well and samples were treated with 400, 800, 1600, 200 and 2400mg/l of Pea Pod extract, and 1mg/l of chlorine. The result is shown in Appendix. Columns 2, 3, 4 and 5, in the appendix; give the counts for various treatments and Column 6 gives the percentage reductions in bacterial loads.

The total colony count that was too high before treatment (1,250,000) was reduced to manageable levels after treatment.

Table 2: Activity of Pea pod extract on bacteria load for Pea pod

		Dish Colony Count				Temperature (30^0C)
		1/10	1/100	1/1000	1/10000	% Disinfection
SOURCE						
Column		2	3	4	5	6
Synthetic Water	Untreated	TNC	TNC	TNC	125	0
	Treated with 400mg/L	TNC	TNC	TNC	108	13.6
	Treated with 800mg/L	TNC	TNC	TNC	101	19.2
	Treated with 1200mg/L	TNC	TNC	18	-	98.56
	Treated with 1600mg/L	TNC	TNC	15	-	98.80
	Treated with 2000mg/L	TNC	29	-	-	99.77
	Treated with 2400mg/L	TNC	25	-	-	99.80
	Untreated	TNC	TNC	TNC	59	0

Kura Open Channel Surface (river) water	Treated with 400mg/L	TNC	TNC	TNC	57	3.38
	Treated with 800mg/L	TNC	TNC	TNC	55	6.78
	Treated with 1200mg/L	TNC	TNC	18	-	96.95
	Treated with 1600mg/L	TNC	TNC	18	-	96.95
	Treated with 2000mg/L	TNC	10	-	-	99.85
	Treated with 2400mg/L	5	-	-	-	99.99
Zoo road Underground (Well)water	Untreated	TNC	TNC	TNC	20	0
	Treated with 400mg/L	TNC	TNC	TNC	10	50
	Treated with 800mg/L	TNC	TNC	TNC	8	60
	Treated with 1200mg/L	TNC	8	-	-	99.60
	Treated with 1600mg/L	TNC	8	-	-	99.60
	Treated with 2000mg/L	5	-	-	-	99.97
	Treated with 2400mg/L	1	-	-		99.99

TNC= Too Numerous to Count

It can be seen from Table 2 that the residual coliform levels for the maximum reduction were 2500/100ml, 50/100ml and 10/100ml for Synthetic, Kura surface (river) water and Zoo road well water respectively at 2400mg/L dose, and were above the average coliform level (0cfu/100ml) specified by WHO (2018).

Tauscher (1994) revealed that the coagulant properties of the seed are due to a series of low molecular weight cationic proteins. The seed kernels of M. oleifera contain significant quantities of low molecular weight (water soluble) proteins which carry a positive change when the crushed seeds are added to raw water. The proteins produce positive changes acting as magnets and attracting the predominantly negatively charged particles (such as clay, silk, bacteria and other toxic particles in water). The flocculation process occurs when the proteins bind the negative change forming flocs through the aggregation of particles which are present in water. These flocs are easy to remove by settling or filtration. This could be responsible for the considerable reduction in bacterial concentration with the addition of seed suspension. Presence of Salmonella spp, Shigella sp, Klebsiella sp, Proteus sp and E. coli showed the extent of contamination of the raw water. However, detection of E. coli which is one of the indicator organisms in all the water samples is an indication of faecal contamination especially with E; coli type I. bacterial reduction could also be related to the use of M. oleifera seed powder as primary coagulant for water treatment. Eilert *et al*., (1980); Eirlert *et al.*, (1981) reported the presence of antibacterial agent, 4 – (alpha – L – rhamnosyloxy) benzyl isothiocynate, a glycosidic mustard oil. Antibacterial agent

could be responsible for the elimination of some of the bacteria found in the raw water (Kawo and Daneji, 2011).

Similar research by Ndabigengesere *et al*., (1995), for Moringa Seed disinfection, *Zhang et al*.,*(*2006) for *Dolichos Lablab* L. *fruit*, Pritchard *et al*., (2009) for *Cyamopsis tetragono* seed, Sunil *et al*. (2011) for *Ocimum sanctum* L. leaves, Kihampa *et al*., (2011) for *Solanum incunum* L. Leaves all confirm the efficiency of natural plants for water disinfection.

Choubey *et al*., (2012) find that Pea seed was efficient in water disinfection with 90.47% disinfection reduction *Reducing Total Coliforms in Raw Water from* 1.25 × 102 to 1.0 × 101 *Using Natural Coagulants.*

Table 3: Activity of Pea pod extract on bacteria load for Pea pod

		Temperature (50^{0}C)				**Temperature (40^{0}C)**
		1/10	1/100	1/1000	1/10000	% Disinfection
SOURCE						
Column		2	3	4	5	6
Synthetic Water	Untreated	TNC	TNC	TNC	125	0
	Treated with 400mg/L	TNC	TNC	TNC	100	20
	Treated with 800mg/L	TNC	TNC	TNC	95	24
	Treated with 1200mg/L	TNC	TNC	17	-	98.64
	Treated with 1600mg/L	TNC	TNC	14	-	98.88
	Treated with 2000mg/L	TNC	27	-	-	99.78
	Treated with 2400mg/L	TNC	23	-	-	99.82
Kura Open Channel Surface (river) water	Untreated	TNC	TNC	TNC	59	0
	Treated with 400mg/L	TNC	TNC	TNC	55	6.78
	Treated with 800mg/L	TNC	TNC	TNC	53	10.17
	Treated with 1200mg/L	TNC	TNC	15	-	97.46
	Treated with 1600mg/L	TNC	TNC	14	-	97.63

	Treated with 2000mg/L	TNC	8	-	-	99.86
	Treated with 2400mg/L	3	-	-	-	99.99
Zoo road Underground (Well)water	Untreated	TNC	TNC	TNC	20	0
	Treated with 400mg/L	TNC	TNC	TNC	8	60
	Treated with 800mg/L	TNC	TNC	TNC	7	65
	Treated with 1200mg/L	TNC	6	-	-	99.70
	Treated with 1600mg/L	TNC	6	-	-	99.70
	Treated with 2000mg/L	3	-	-	-	99.99
	Treated with 2400mg/L	0	-	-		100

TNC= Too Numerous to Count

Table 4: Activity of Pea pod extract on bacteria load for Pea pod

		Dish Colony Count				**Temperature (50^0C)**
SOURCE		1/10	1/100	1/1000	1/10000	% Disinfection
Column		2	3	4	5	6
Synthetic Water	Untreated	TNC	TNC	TNC	125	0
	Treated with 400mg/L	TNC	TNC	TNC	90	28
	Treated with 800mg/L	TNC	TNC	TNC	70	44
	Treated with 1200mg/L	TNC	TNC	5	-	99.60
	Treated with 1600mg/L	TNC	TNC	5	-	99.60
	Treated with 2000mg/L	TNC	10	-	-	99.92
	Treated with 2400mg/L	TNC	5	-	-	99.96
Kura Open Channel Surface (river) water	Untreated	TNC	TNC	TNC	59	0
	Treated with 400mg/L	TNC	TNC	TNC	20	66.10
	Treated with 800mg/L	TNC	TNC	TNC	20	66.10
	Treated with 1200mg/L	TNC	TNC	9	-	98.47
	Treated with 1600mg/L	TNC	TNC	9	-	98.47
	Treated with 2000mg/L	TNC	5	-	-	99.91

	Treated with 2400mg/L	5	-	-	-	99.99
Zoo road Underground (Well)water	Untreated	TNC	TNC	TNC	20	0
	Treated with 400mg/L	TNC	TNC	TNC	2	90
	Treated with 800mg/L	TNC	TNC	TNC	1	95
	Treated with 1200mg/L	TNC	4	-	-	99.80
	Treated with 1600mg/L	TNC	2	-	-	99.99
	Treated with 2000mg/L	1	-	-	-	99.99
	Treated with 2400mg/L	0	-	-		100

TNC= Too Numerous to Count

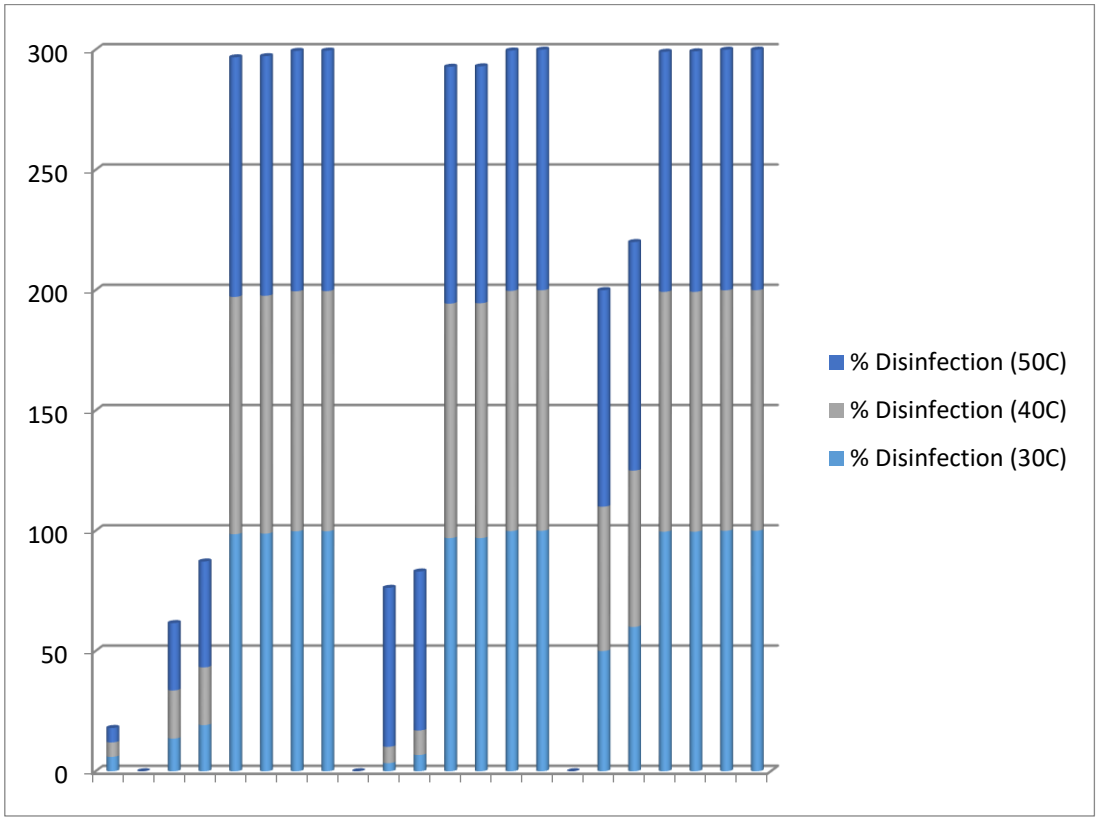


Figure 2: Graph Comparing %Disinfection for varying temperatures 30, 40 and 50^0C.

Comparing Table 2 with Table 3 and 4 for 30^0C, 40^0C and 50^0C respectively and Figure 2. it can be deducted that disinfection increases with increase in Temperature and ; p-value for t test and skewness range was 0.99 high indicating high correlations between 30, 40 and 50^0C. *WHO (2018) notes that bacteria are rapidly killed at temperatures above 65^0C.*

CONCLUSION AND RECOMMENDATION

Disinfection increases with increase in dose of the Pea pod extract and Higher reductions were noted for Zoo road well water; for synthetic water, the % reduction ranges from 13.6 - 99.8%; for Kura surface raw water, the % reduction ranges from 3.36 - 99.99%, while for Zoo road well water, % reduction ranges from 50 - 99.99% corresponding to dose range of 400 – 2400mg/L for all samples.

Disinfection increases with increase in initial infect. Also, pH increase of Pea pod towards alkalinity causes significant increase in infection, while the rate of pathogen removal increases with increase in temperature; p-value for t test and skewness range was 0.99 high indicating high correlations between 30, 40 and 50^0C.

It was recommended that Comparative research should be done on the efficiency of the different methods of Pea pod extraction. Also, Research should be conducted to discover the mode of attack of the Pea pod extract on the microbes.

REFERENCE

Aweng, E.R., Anwar, A.I., Siti, R., M.I. and Suhaimi, O. (2012).Cassia alataas a Potential Coagulant in Water Treatment. *Research Journal of Recent Sciences*, ISSN 2277-2502, Vol. 1(2), 28-33.

Bichi, M. H., Agunwamba, J. C. and Muyibi, S. A. (2012). Optimization of operating conditions for the application of Moringa oleifera (Zogale) seeds extract in water disinfection using response surface methodology. *African Journal of Biotechnology* Vol. 11(92), pp. 15875-15887, 15 November, 2012.

Bichi, M. H., Agunwamba, J. C. and Muyibi, S. A. (2012). Kinetics of Water Disinfection with Moringa Oleifera Seeds Extract. *Journal of Environment and Earth Science* www.iiste.org ISSN 2224-3216 (Paper) ISSN 2225-0948 (Online) Vol. 2, No.7.

Chadanand Patil and Manika Hugar (2015). *Treatment of dairy wastewater by natural coagulants.* International Research Journal of Engineering and Technology (IRJET) Volume: 02 Issue: 04.

Choubey Sonal, S.K.Rajput, K.N.Bapat (2012). Comparison of Efficiency of some Natural Coagulants-Bioremediation. International Journal of Emerging Technology and Advanced Engineering Website: www.ijetae.com (ISSN 2250-2459, Volume 2, Issue 10, October 2012).

Eilert U., Wolters B. and Nahrstedt (1981). The antibiotic principle of Moringa oleifera and Moringa stenopetalla. *Planta Medical* 42, 55-61.

Kihampa, C., Mwegoha, W.J.S., Kaseva, M.E. and Marobhe, N. (2011). Performance of Solanum incunum Linnaeus as natural coagulant and disinfectant for drinking water. *African Journal of Environmental Science and Technology* Vol. 5(10), pp. 867-872.

KWAJI, A., BASSI, P. U., AOILL, M., NNEJI, C.M., ADEMOWO, G. (2010). PRELIMINARY STUDIES ON PILIOSTIGMA THONNINGII SCHUM LEAF EXTRACT: PHYTOCHEMICAL SCREENING AND IN VITRO ANTIMALARIAL ACTIVITY. AFRICAN JOURNAL OF MICROBIOLOGY RESEARCH. VOL. 4 (9); PP735-739, 4 MAY.

Musa haruna (2016). WATER TREATMENT USING *PILIOSTIGMA THONNINGII SCHUM* AND *TAMARINDUS INDICA L.* LEAVES EXTRACTS Unpublished M.Eng. Thesis, Department of Civil Engineering, Bayero University Kano.

Muyibi, S. A. and Lilian M. E. (1994). Moringa Oleifera Seeds for Softening Hard water, *Water Resources.*Vol. 29, No. 4, Pp. 1099-1105.

Ndabigengesere A, Narasiah KS**. (**1998). Quality of water treated by coagulation using *Moringa oleifera* seeds. Water Research 32(3), 781–791.

Pritchard M, Mkandawire T, Edmondson A, O'Neill JG, Kululanga G**. (**2009). Potential of using plant extracts for purification of shallow well water in Malawi. Journal of Physics and Chemistry of the Earth 34, 799-805.

Sethupathy, A. (2015). An Experimental Investigation of Alum and Moringa Oleifera Seed in Water Treatment. *International Journal of Advanced Research* (2015), Volume 3, Issue 1, 515-518.

Sunil BS, Nitin WI, Shrikant SP. (2011). Performance evaluation of natural herbs for antibacterial activity in water purification. International Journal of Engineering Science and Technology 3(9), 7170-7174.

Tauscher, B. (1994): Water Treatment of Flocculant Compounds of higher plants. Plant research and Dev., 40:56 – 70.
WHO (World Health Organization) (2018). Guidelines for drinking-water quality, water quality, WHO Geneva
WHO and UNICEF (2017) Progress on Drinking Water, Sanitation and Hygiene: 2017 Update and SDG Baselines. Geneva: World Health Organization (WHO) and the United Nations Children's Fund (UNICEF), 2017.
Zhang J, Fang Z, Yuhong L, Hong Y. **(**2006). A preliminary study on cactus as coagulant in water treatment. Process Biochemistry **41,** 730–733.