Global Advanced Research Journal of Chemistry and Material Science Vol. 1(4) pp. 071-075, December, 2012
Available online http://garj.org/garjest/index.htm

Full Length Research Paper

The use of some plants in water purification

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Accepted 08 September, 2012

This research was aimed at finding the efficiencies of powdered seeds of *M. olifeira*, *H. sabdariffa* and *C. tridens* as natural water treatment agents alternative to the use of synthetic chemicals. Similarly, the efficiency of mixture of each of the plant with alum was tested. The optimum dosages and turbidities (NTU) were observed to be 80ppm and 7 NTU (alum), 120ppm and 5 NTU (*M. oleifera*), 130ppm and 110 NTU (*C. tridens*); 130ppm and 80 NTU (*H. sabdariffa*) respectively. The optimum dosage (60ppm) and turbidity (NTU) of 5 were observed in mixture of alum – *M. oleifera,* while for alum - *C. tridens* and alum - *H. sabdariffa* were 80ppm to 5 NTU and 80ppm to 6 NTU respectively. The result obtained when for *M. oleifera* proved that the plant can be use for the treatment of turbidity in drinking water. The results obtained when each of the plant was combined with alum were much better. The values obtained for *M. oleifera* and combination of each plant with alum were observed to be within the WHO maximum permissible level of turbidity in drinking water.

Keywords: Flocculants, Turbidity, Alum, Optimum, Coagulation.

INTRODUCTION

Water covering over 70% of the earth, is undoubtedly one of the most precious natural resource of the world. However in spite of such large quantity of water present on the earth's surface, only 0.4 % is available for use, 97% is the salt water of oceans and seas while the remaining 2.6% is captured in polar ice caps, glaciers, atmosphere or underground (Himesh *et al*., 2007).

Growing population, increased economic activities and industrialization has not only created an incr-eased demand for fresh water but also resulted in severe misuse of this natural resource. Water resources all over the world are threatened not only by over exploitation and poor management but also by ecological degradation.

According to a survey conducted by United Nation Environmental Programme, 20% of world's population lacks access to safe drinking water and 50% of the world's population lacks access to safe sanitation (Berger *et al*., 1984).

Lack of water is one of the biggest problems that many poor countries have encountered in progressing their way of living. The problem has reached such endemic proportions that 2.2 million deaths per annum occur from unsanitary water –and 90% of these are children under the age of five (Schulz, 1984).

Access to safe water in adequate quantity is one of the biggest challenges in the recent times. Despite the

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commitment to supply safe drinking water, access to water is difficult especially in the rural areas (Schulz, 1984). Water scarcity in terms of quantity and quality has severe implications on the overall development and health of citizens. Factors such as poor availability, affordability and distance between water source and home may lead households to depend on less safe sources and reduce the volume of water used for hygiene purposes resulting in water-related infections (Suleyman, 2005).

Access to safe drinking water is estimated by the percentage of the population using improved drinking water sources, but a number of studies have documented higher concentrations of faecal coliforms in household water containers (Suleyman, 2005). This indicates that access to safe drinking water depends not only on the quality of water at source but also on contamination throughout its way to the user and practices related to purification and sanitation.

Many areas have water containing impurities from natural or artificial sources. These impurities may cause health problems, damage equipment or plumbing, or make the water undesirable due to taste, odour, and appearance or staining (Kenneth, 2006). As a result of high cost of water treatment, the supply of drinking water in many communities is not possible. This situation is stigmatizing in that most people in the developing countries cannot boast of 25 litres of clean water a day (Kenneth, 2006).

In line with current problems facing local communities, the investigations into the possible usage of local plant materials for water treatment in rural areas is becoming the major focus. Special considerations are placed on the softening of hard water, lowering of turbidity, removal of suspended solids (SS) and elimination of bacteria (pathogens).

The use of plant materials as natural coagulants to clarify turbidity of wastewaters is of common practice since ancient times (Nilanjana, 2005) Powdered roasted grains of Zea mays were used by soldiers in Peru as a means of settling impurities in the 16^{th} and 17^{th} century. In India, ancient writings refer to the use of the seeds of the Nirmali tree *Strychnos potatorum* as a clarifier. The sap of tuna cactus (*Opuntia fiscus indica*) is widely used in Chili as water purifying agent. Similarly, dried beans (*Vicia faba*) and peach seeds (*Percica vulgaris*) are widely used for this purpose in Bolivia and Peru. Tunaflex and Nirmali seeds have been successfully employed in municipal treatment plants in combination with alum (Sutherland *et al*., 1990).

Moringa oleifera (known in Hausa as Zogale) belongs to the family Moringaceae. It is an exceptionally nutritious vegetable tree with a variety of potential uses. *Corchorus tridens*: is a plants genus of about 40-100 species of flowering plants in the family Malvaceae, native to tropical and subtropical regions throughout the world. The leaves from the *Corchorus tridens* plant has been part of food in many Egyptians and Hausa communities in Northern Nigeria, it has a mucilaginous (somewhat "slimy") texture, similar to okra, when cooked. It's also cultivated as a source of fibre production. Habiscuss sabdariffa is a large genus of about 200–220 species of flowering plants in the family Malvaceae. Habiscuss sabdariffa is grown for their showy flowers or used as landscape shrubs. It is also used as a green vegetable and to make herbal teas and jams (especially in the Caribbean). It is source of a red beverage (said to contain citric acid and salts, serving as a diuretic). Calyx is used in jams, jellies, sauces, and wines and fibre. *Habiscuss sabdariffa* has medicinal uses such as antiseptic, aphrodisiac, astringent, cholagogue, demulcent, digestive, diuretic, emollient, purgative, refrigerant, resolvent, sedative, stomachic, and tonic.

The aim of this study is to find some natural water treatment agents as an alternative to the use of synthetic chemical such as Alum and to estimate the optimum dosage of the plants flocculants.

MATERIAL AND METHODS

Sample Collection and treatment

The ponds of *Moringa oleifera,* calyx of *Habiscus sabdariffa* and leaves *Corchorus tridens* were purchased from Kalambaina market, Wamakko local government area of Sokoto State. The three samples were identified at the Taxonomy section of Department of Biological Sciences, Usmanu Danfodiyo University, Sokoto, Nigeria before sun drying for four days. The samples were pulverised to fine powder using (Pestle and Mortar) and packed in cleaned labelled bottles. Raw water samples were obtained from River Rima at intake of Sokoto New Extension Water Treatment Plant, Western Bye Pass near Illela Garage in Sokoto.

Coagulation-flocculation test

Jar test of Awwa (1996) and Raveendra and Malay (2005) was employed to determine the optimum dosage and performance of alum and each plant flocculant used in the treatment for removal of impurities from raw water. The test was conducted by measuring 1L of raw water to be treated into series of 1L beakers arranged on a flocculator (mixing) machine, within which alum was dosed in an increasing order of concentration, from 0, 10, 20 - - - 150ppm. After rotation at a speed of 200 r.p.m for 2 minutes, it was then set at slower speed of 40 r.p.m. for 5 minutes. The settled water was used to test for the quality of treatment and optimum dosage of each plant flocculants.

Turbidity measurement was conducted using Hach Turbidometer as described by Hach (1975). The Measurement of temperature was conducted using bulb

Table 1. Effect of optimum dosage on raw water turbidity and pH

Dosage (ppm)	Raw water turbidity (NTU) Alum	*M. olefera*	C. tridens	*H. sabdariffa*	pH Alum	*M. olefera*	C. tridens	H.Sabdariffa
0	632±3.20	632±3.20	632±3.20	632±3.20	7.45±0.23	7.45±0.23	7.45±0.23	7.45±0.23
10	512±2.35	520±2.93	630±0.94	620±4.18	7.45±0.15	7.35±0.36	7.45±0.10	7.43±0.20
20	400±3.78	490±2.05	600±1.60	600±2.47	7.35±0.22	7.30±0.15	7.35±0.21	7.42±0.15
30	320±5.06	450±5.51	580±2.89	570±2.95	7.30±0.18	7.20±0.11	7.30±0.09	7.32±0.18
40	240±2.61	410±3.66	520±4.31	530±2.42	7.20±0.06	7.10±0.05	7.25±0.23	7.30±0.28
50	190±1.88	390±2.13	490±2.18	500±4.76	7.10±0.08	7.00±0.03	7.25±0.15	7.20±0.19
60	95±3.81	365±1.81	460±5.22	480±3.44	7.00±0.03	6.90±0.05	7.20±0.17	7.15±0.10
70	40±1.73	240±5.91	420±2.70	450±2.13	6.75±0.12	6.70±0.04	7.20±0.06	7.13±0.14
80	7±0.88	150±8.20	400±3.33	410±2.61	6.70±0.05	6.60±0.04	7.15±0.09	7.10±0.10
90	7±1.12	100±4.44	360±5.19	360±5.69	6.70±0.07	6.50±0.05	7.10±0.22	7.10±0.05
100	70±0.50	40±4.98	330±2.50	280±4.50	6.70±0.08	6.45±0.03	7.10±0.13	7.10±0.05
110	123±5.20	20±3.21	240±7.67	205±4.11	6.70±0.04	6.20±0.03	7.00±0.05	7.10±0.09
120	230±4.15	5±2.36	205±5.51	190±3.86	6.70±0.03	6.15±0.09	7.00±0.10	7.10±0.05
130	332±7.43	5±1.52	110±3.12	80±2.12	6.70±0.04	6.10±0.12	7.00±0.08	7.10±0.04
140	460±9.91	5±2.10	450±4.92	304±5.33	6.70±0.03	6.10±0.15	7.00±0.10	7.10±0.08
150	520±5.80	5±2.93	580±5.82	450±5.47	6.70±0.05	6.10±0.17	7.00±0.05	7.10±0.05

type mercury in glass thermometer.

RESULTS AND DISCUSSION

Discussion

Jar test was used investigated and compared with alum. Results obtained are presented in tables I and 2.

Potassium aluminium sulphate (Alum) optimum dosage

The result of alum using jar test analysis (Table 1) shows that, the turbidity of raw water decreases with increases in alum dosage concentration, but at the optimum dosage (80ppm) the turbidity of water remained constant (NTU = 7). Further increase in dosage concentration resulted to an increase in the turbidity of the water. The pH value of the raw water decreases with increase in alum dosage concentration, but remain constant (mildly acidic) towards and after the optimum dosage.

Plant optimum dosage

The result of the jar test analysis (Table 1) has shown that *M. oleifera* has proved to be a better coagulant for water treatment, due to its higher clarity on raw water. Therefore the effect of *M. oleifera* optimum dosage shows that the optimum dosage at 120ppm with the corresponding turbidity of 5 NTU shows decrease in turbidity. Similarly, the addition of *M. oleifera* had also effect on the pH of the raw water by making it mildly acidic. Ndabigengesere et al. (1995) reported that the action of *M. oleifera* as a coagulant lies in the presence of water soluble cationic proteins in the seeds. The result obtained in this study compared well with that of Sanda (2001), and was also within the WHO (2004) maximum permissible level of turbidity in drinking water.

In C. tridens, the best result (110 NTU) was observed when the dosage was 130ppm which indicated that the (La-lo) *C. tridens* alone cannot be used as water coagulants because its turbidity reduction potential was very low.

A result similar to that of *C. tridens* was observed in *H. sabdariffa.* Its optimum dosage was 130ppm at which the turbidity

Table 2. Effect of mixture of Alum-plant optimum dosage on raw water turbidity and pH

Dosage (ppm)	Turbidity (NTU)			pH		
	Alum-M	Alum-C	Alum-H	Alum-M	Alum-C	Alum-H
0	632±3.20	632±3.20	632.±3.20	7.45±0.23	7.45±0.23	7.45±0.23
10	512±5.95	500±5.18	600±4.77	7.35±0.19	7.35±0.12	7.40±0.08
20	310±8.14	450±9.83	560±6.13	7.30±0.08	7.25±0.10	7.35±0.10
30	110±5.42	315±8.14	320±5.10	7.20±0.12	7.20±0.05	7.30±0.06
40	40±10.15	190±8.27	120±8.76	7.10±0.05	7.15±0.05	7.20±0.03
50	20±5.60	80±5.40	30±5.61	6.90±0.03	7.10±0.08	7.10±0.05
60	5±2.33	40±3.61	15±6.43	6.85±0.07	7.00±0.04	7.00±0.05
70	5±1.74	18±2.33	10±3.12	6.82±0.05	6.90±0.05	6.93±0.02
80	5±2.10	6±2.45	5±1.71	6.80±0.06	6.70±0.12	6.85±0.05
90	5±2.49	6±1.96	5±1.32	6.80±0.03	6.70±0.08	6.85±0.08
100	5±2.13	6±1.83	5±1.09	6.80±0.04	6.70±0.05	6.85±0.05

The plant optimum dosage was maintained at 5ppm throughout the jar test
M = Moringa olefeira, C = Corchorus trdens, H = Habiscus sabdariffa

turbidity of the water reduced from 632 NTU to 80 NTU.

Alum- *plant* optimum dosage

The result of combination of Alum and *M. oleifera* optimum dosage (Table 2) was observed to be 60ppm to 80ppm in which the water turbidity changes from 632 NTU to 5 NTU for water clarity. When the result of the *M. oleifera* - alum were compared with that of alum and *M. oleifera* respectively, it shows that the *M. oleifera* - alum was more effective for turbid treatment than other samples used in the study. The result compared well with that of Sanda, (2001).

In contrast to the result obtained for *C. tridens* alone in which there was no much clarity during the treatment, its combination with alum gave a better result. The optimum dosage was 80ppm to 100ppm range with the corresponding turbidity of 6 NTU, while the pH was 6.70.

The combination of the Alum- *H. Sabdariffa* dosage showed a better result than when *Habiscus sabdariffa* was used alone. The optimum dosage was at 70ppm with the corresponding turbidity of 5ppm.

Effect of the flocculants on the pH

The maximum permissible level of pH for drinking water specified by WHO adopted from Sanda (2001) is between 6.5 and 9. The treatments with alum gave a range of 7.45 to 6.70 which makes the solution to be acidic. This was attributed to the fact that the alum in the treatment procedure produced sulphuric acid which lowered the pH levels. The increase in acidity could be due to the trivalent cation aluminium which serves as Lewis acid. Similar results were obtained for M. oleifera which had the range of 7.45 – 6.10 making the treated water to be acidic. The results for treatment with *Habiscus sabdariffa and Corchorus tridens* yield water samples with pH within the accepted WHO standard.

CONCLUSIONS AND RECOMMENDATION

The result indicated that the plants analyses have the ability to act as water coagulants. Based on the result obtained *Moringa oleifera* had the highest coagulant ability which may be compared with that of alum, followed by the *Habiscuss sabdariffa with Corchorus tridens* as the least. Better results were obtained when the individual plants were combined with alum. Since alum is very expensive, mixing of alum and M. olefera in water treatment may be considered in place of alum which is very expensive.

Further researches may be conducted to find out how these plants affect other physical and chemical properties of water. Similarly, the ability of the plant to destroy disease causing organisms in water need to be investigated for further recommendation in water treatment for people in local communities.

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