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***MoringaOleifera* – A natural bioflocculant in water treatment**

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ABSTRACT

The Moringa tree (*MoringaOleifera*) has been dubbed “The Miracle Tree” by many. This is because every part of the Moringa tree, from the roots to the leaves has beneficial properties that can serve humanity. One of the big problems in developing countries is the availability of clean drinking water. The seeds of Moringa tree can be used as an effective water clarifier and home water purification system. In order to make an effective water purification system, the Moringa seeds are dried and then ground into a powder. Unlike other particles in the water such as clay, bacteria, and other toxic materials which are negatively charged, the protein in the Moringa seed powder is positively charged, thereby attracting the negatively charged particles like a magnet. The flocs formed by the flocculation process can then be easily removed by allowing the water to settle, or removed by filtration. This process is said not only to clarify turbid water significantly, but also to remove 90-99% of bacteria contained in water. In the present study, the water sample was assessed for its purification characteristics before and after treatment and recorded the efficiency of water purification by *MoringaOleifera*. © 2014 Trade Science Inc. - INDIA

KEYWORDS

Water purification;
BOD;
COD;
DO;
TLC;
Bioflocculant

INTRODUCTION

MoringaOleifera contains more than 92 nutrients and 46 types of antioxidants. It is the commonly consumed tropical food with the common name ‘Drum stick’. Moringa is said to cure about three hundred diseases and almost have all the vitamins found in fruits and vegetables. Even in a larger proportions. With all the health benefits of this miracle herb, it can easily be termed as the most nutritious herb on Earth. There are no side-effects which also has tried, tested, documented and proved evidence to support the same. It can be consumed by small children and adults. Today, millions

world over have started using Moringa based products in porridge, pastas, bread and to reap the everlasting health benefits of the extraordinary ‘Moringa’ herb.

M. oleifera parts are being employed for the treatment of different ailments in the indigenous system of medicine, particularly in South Asia. In addition, *M. oleifera* seeds possess water purifying powers by flocculating Gram positive and Gram negative bacterial cells. *M. oleifera* seeds can also be used as a less expensive bio absorbent for the removal of heavy metals. The bark is thick, soft, corky and deeply fissured, the leaves are usually tripinnate, the leaflets are elliptic, the flowers are generally white and fragrant in large panicles, the

Pods are pendulous green in colour triangular and ribbed within trigonous winged seeds. In traditional Indian medicine various parts of the tree are used therapeutically for treatment of venomous bites, ascites and rheumatism and helps in lowering blood pressure. The root and bark of young trees are considered rubefacient, stomachic carminative, vesicant and abortifacient. The flowers and roots contain an antibiotic that is highly effective in the treatment of Cholera. The leaves, rich in vitamin A and C, are considered useful in respiratory ailments. The juice extracted from the leaves has strong antibacterial and antimalarial properties.

The interest on natural biological flocculants for cleaning contaminated turbid water is not new. However, of all plant materials that have been investigated over the years, the seeds from *Moringa* have shown to be one of the most effective as a primary natural coagulant for water treatment, even if the potential of the *Moringa* seeds as water purification has been almost overlooked. According to the researchers of the University of Leicester, managed by Mr. Geoff Folkard, the vegetable *Moringa* seed may easily help solve the third world's water woes. They have found that when the seeds are dried, crushed and added to water, the seed powder acts as a coagulant binding the particles and bacteria. After a short while the coagulated particles, known as a floc, sink to the bottom and clear water can be poured off. The coagulated solid matter is easy to be removed. It works on the basis that opposites attract: when mixed with water the crushed seeds produce positively charged proteins which attract the negatively charged particles and bacteria. The mixing action causes them to collide, coagulate and stick to each other: the seeds naturally reduce the turbidity of the raw water by 90 per cent leaving clear the water of solids, but also removing 90 to 99 percent of the bacteria. Now, it is scientifically proved that *Moringa* seeds, a natural substance locally available from villagers, give great purification results, with no harmful effects, better as those obtained with expensive commercial chemicals, as alum (alum residues may be carcinogenic). The results indicate the viability of *Moringa* as a natural coagulant-flocculant for highly turbid river water. Inlet river turbidity in excess of 300 NTU was consistently reduced to below 10 NTU in the finished water. Then using *Moringa* as sanitation process meets the needs for wa-

ter treatment in developing countries, as it is simple, robust, and, affordable by all with no maintenance.

MATERIALS AND METHODS

Water treatment by moringa seeds

a. Plant material

Good quality *Moringa oleifera* seeds are taken and removed its wings and coat from their seeds and dried. Fine powder was prepared by using mortar and pestle and this powder was directly used as coagulant. The powder was stored in jars and sealed.

b. Water sample

Water sample was collected from bore well for the study purpose. Water is treated by adding *Moringa* seed powder directly.

Key parameters for water treatment analysis

The water quality parameters were checked before and after treatment with the seeds. The key parameters includes

Colour

The seed powder was added and the colour was checked before and after the treatment. This is to show the absorbent property of moringa seeds.

pH

The pH of the given water sample was determined using the pH meter.

Acidity

Generally the pH of the water remains neutral. Acidity represents the presence of hydrogen ion in water. Hence it is the capacity of the water to neutralize strong base. 50ml of water sample was taken in a conical flask. A few drops of Phenolphthalein indicator was added. 0.1N NaOH was poured into the burette and titrated against the water sample. The end point is when the pink colour was observed. This procedure is done before and after treating the water with moringa seeds.

ACIDITY (mg/L) = Volume of 0.1 NaOH / Volume of sample × 100

Alkalinity

Alkalinity of water represents the presence of hydroxyl ions and thereby its capacity to neutralize a strong

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acid in natural or waste water. 50ml of water sample was taken in a conical flask. Two drops of phenolphthalein indicator was added. 0.1N of HCl solution was added to the burette and was used to titrate the sample till the pink colour becomes colourless.

ALKALINITY (mg/L) = Volume of 0.1N HCl / Volume of sample × 1000

Chemical oxygen demand

100ml conical flask was taken and 50ml of water sample was added. 5ml of $KmNO_4$ was added in each flask. The flask was kept in water bath at 100 c for 1 hour. The samples were allowed to cool for 10 minutes and 5ml KI solution was added to each flask. 10ml of sulphuric acid was added to each flask and titrated against sodium thiosulphate until a pale yellow colour appears. 1ml of starch solution was added and titrated with 0.1N sodium thiosulphate until a blue colour disappears completely.

CHEMICAL OXYGEN DEMAND (mg/L) = S × C × (B - A) / S
S - Vol., of sample, C - Conc. of titrant A, Vol. of titrant blank B, V - Vol. of titrant sample.

Biological oxygen demand

1ml of phosphate buffer, $MnSO_4$, $CaCl_2$, $FeCl_3$ were added to water and mixed thoroughly and the pH was adjusted to 7. The bottles were kept in BOD incubator for 5 days at 20 C. The BOD was determined after incubation.

BIOLOGICAL OXYGEN DEMAND (mg/ml) = T × N × 1000 × 8 / V

T - Volume of thiosulphate N - Normality of thiosulphate V - Volume of sample.

Thin layer chromatography

Different solvent systems were used respectively to identify the compounds present in the plant seeds, this was used as the mobile phase. Silica slurry filled TLC plate was used as a stationary phase. A line was drawn on the TLC plate leaving 2cm gap at the bottom and a spot of the colourant was placed on it. This setup was gently immersed into a beaker containing the mobile phase, the plate was left undisturbed until the solvent reached three fourth of the plate. After which it was taken out and air dried and identified for spot using Ninhydrin spray. The Retention factor (Rf) was then calculated using the formula:

Rf = Distance travelled by the compound / Distance travelled by solvent front

RESULT AND DISCUSSION

Purification of water

Every procedure were performed using varying concentration of *Moringaoleifera* seeds such as 10gm/500ml, 15gm/500ml and 20gm/500ml.

Colour

It was observed that the *Moringaoleifera* seeds showed absorbant property. On adding different doses of the seed powder reduced the colour of the turbid water from faint brown to colourless.

pH

The sample was acidic in nature before treatment (pH 6.5) but after treatment it was converted to basic nature. The pH increased depending upon the amount of seeds added. The 10gm/500ml showed pH 7, 15gm/500ml had a pH of 7.5 & 20gm/500ml had a pH of 8 after treatment. It was reported that the action of *Moringaoleifera* as a coagulant depends on the presence of water soluble cationic proteins in the seeds. The basic amino acids present in the protein of *Moringa* would accept a proton from water resulting the release of a hydroxyl group making the solution basic.

Acidity

Acidity was calculated using the following formula:

ACIDITY = Volume of 0.1 NaOH / Volume of sample × 100 mg / l

The acidity of water sample before treatment was 14.4, after treatment using different concentrations 10gm/500ml had a value of 10, 15gm/500ml had a value of 7.5 & 20gm/500ml had a value of 3 after treatment of the seed powder. Acidic nature of the sample was found to be decreased after treatment.

Alkalinity

ALKALINITY = Volume of 0.1N HCl / Volume of sample × 1000 mg/l

Alkalinity was found to be 0. The water sample taken for study was highly acidic in nature before treatment and after treatment the acidity was reduced but still remained in the acidic nature.

Chemical oxygen demand

CHEMICAL OXYGEN DEMAND = $S \times C \times (B-A) / S$ mg/l.

The COD of the water sample before treatment was 12, but after treatment with different concentrations of seed powders 10gm/500ml had a value of 9, 15gm/500ml had a value of 7 & 20gm/500ml had a value of 4. This implied that the COD of the water decreased after treatment.

Dissolved oxygen

The Dissolved oxygen of the water sample before treatment was 480, but after treatment with different concentrations of seed powders 10gm/500ml had a value of 320, 15gm/500ml had a value of 112 & 20gm/500ml had a value of 80. This implied that the DO of the water decreased after treatment when compared to Day1.

Biological oxygen demand

BIOLOGICAL OXYGEN DEMAND (mg/ml) = $T \times N \times 1000 \times 8$ mg/l.

The BOD of the water sample before treatment was 90, but after treatment with different concentrations of seed powders 10gm/500ml had a value of 160, 15gm/500ml had a value of 368 & 20gm/500ml had a value of 400. This implied that the BOD of the water Increased after treatment.

Thin layer chromatography

The Retention factor (R_f) was then calculated using the formula:

R_f = Distance travelled by the compound / Distance travelled by solvent front



Figure 1 : Thin layer chromatography

TABLE 1 : Thin layer chromatography

10mg/500ml Water	Flavonoid	Chloroform: methanol (9:1)	0.84
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TABLE 1 Thin layer chromatography was done to detect the compound that is acting as a flocculant. The R_f value was found to be 0.84 and the compound was identified as flavonoid.

CONCLUSION

Moringa is the perfect example of the third world producing what it does not consume and increasingly consuming what it does not produce. Moringa is a gift of the nature, a pure magic natural agro-biodiversity able to save billion of thirsty people in the world with a better health and sanitation. The dried Moringa seeds or seed powder is added to water it helps to treat turbid or cloudy water, Also the seed of the Moringa tree (*Moringaoleifera*) is a natural flocculant/coagulant which will a very promising factor for water purification in future.

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