

Novel Technique for Purification of Polluted Water by Using Plant Extracts in Rajkot

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ABSTRACT: There are many research studies on the purification of groundwater have mainly been carried out in developed countries and have focused on water purification systems using aluminium sulphate (a coagulant) and chlorine (a disinfectant). Such systems are expensive and not viable for rural communities due to abject poverty. There has been very little scientific research work into the use of plant extracts to purify groundwater. Findings from a preliminary lab-scale study show strong potentials of phytodisinfectants as a low-cost, appropriate and ecological alternative technology in purifying water in rural areas of Gujarat. The study involved creating an inventory of plant extracts that have been used for water and waste water purification. A prioritization system was derived to select the most suitable extracts, which took into account criteria such as availability, purification potential, yield and cost of extraction. Laboratory trials were undertaken on the most promising plant extracts, namely: *Moringa concanensis* (kernel), *Cassia fistula* (kernel) and *Azadirachta indica* (Leaf). The trials consisted of jar tests to assess the coagulation potential and the resulting effect on physico-chemical parameters (Yongabi *et al.*, 2011). The pH of the water samples decreased with dosage, but remained within acceptable levels for drinking water for all the extracts. Overall, *M. concanensis* powder produced superior results, followed by *Cassia fistula* (kernel) and *Azadirachta indica* (Leaf). There is a need to carry out further more detailed tests, which include toxicity to guarantee the safety of using plant extracts as a coagulant in the purification of drinking water for human consumption.

KEYWORDS: Water Pollution. Drinking water, Plant extract, Pure Water

I. INTRODUCTION

Around 1 billion people (15% of the world population) are without safe drinking water worldwide (UNICEF-2009). Around 5 million lives are lost annually due to drinking and using contaminated water (WHO, 2006). The people at greatest risk are children, people living under unsanitary conditions and the elderly (WHO, 2006). Globally, 4 billion cases of diarrhea are reported every year causing 1.8 million deaths, out of which about 90% are children under five (UNESCO, 2007). With 40 per cent of its estimated 1.2 billion populations under the age of 18, India is home to the largest number of children in the world. About half of the children from poor families belong to disadvantaged groups like Scheduled Castes and Scheduled Tribes. India contributes to more than 20 per cent of the world's child deaths, with approximately 1.73 million children dying annually before completing their fifth birthday. Water is a medium for thousands of microorganisms, some of which are disease-causing. Pathogens (e.g. bacteria, viruses, protozoa and helminthes) in water cause a variety of diarrhea-related diseases such as cholera, typhoid and dysentery. These pathogens are commonly derived from human faecal material. Around 2.5 billion people are without adequate sanitation in the world (UNICEF, 2009).

The mortality rate arising from the use of unsafe water is a major concern for both government and international institutions throughout the world. Water pollution is the contamination of water bodies (e.g. lakes, rivers, oceans, aquifers and groundwater). Water pollution occurs when pollutants are discharged directly or indirectly into water bodies without adequate treatment to remove harmful compounds. Natural plant extracts have been used for water purification for many centuries. Most of these extracts are derived from the seeds, leaves, pieces of bark or sap, roots and fruit extracts of trees and plants. For example, *Strychnos potatorum* was used as a clarifier between the 14th and 15th centuries BC. Shultz and Okun (1984) together with Sanghi *et al.* (2006) reported that seeds of the nirmali tree (*S. potatorum*) were used to clarify turbid river water about 4000 years ago in India.

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Laboratory, pilot-plant and full-scale studies on the performance of plant extracts such as nirmali tree (*S. potatorum*), tamarind tree (*Tamerindous indica*), guar plant (*Cyamopsis psoraloides*), red sorella plant (*Hibiscus sabdariffa*), fenugreek (*Trigonella foenum*) and lentils (*Lens esculenta*) have been conducted using raw water with turbidity that ranged from 50 to 7500 NTU (Shultz and Okun, 1984). The optimum dosage for the nirmali extract was 50 mg/l, which produced a 76% reduction in turbidity at 30 °C. The effective dose for the other extracts ranged from 2 mg/l to 20 mg/l at pH levels from 4 to 9, and proved to be more economical for turbidity values greater than 300 NTU (Shultz and Okun, 1984). Waterborne and water related diseases such as diarrhea, typhoid, cholera and drancunculiasis are fast becoming endemic in certain parts of world (Cheesbrough, 1984; Yongabi, 2004; Pritchard et al., 2009).

II. RELATED WORK

Most previous studies on the use of plant extracts have focused on surface water (e.g. Jahn, 1986; Muyibi and Evison, 1995; Sanghi et al., 2006). Attention has been focused on screening plants for coagulant activity (Eilert, 1978; Jahn, 1981; Muyibi et al., 2002a; Kebreab et al., 2005; Amir et al., 2010), but not all coagulants are disinfectant. We used some plant extracts to purify polluted water. Laboratory trials were undertaken on the most promising plant extracts, namely: *Moringa concanensis* (kernel), *Cassia fistula* (kernel) and *Azadirachta indica* (Leaf). Studies have been conducted since the early 1970's to test the effectiveness of *Moringa* seeds for treating water (Paterniani et al.2010). *Moringa concanensis* is a medicinal plant belonging to the family Moringaceae. *Cassia fistula* belongs to Fabaceae family and *Azadirachta indica* is a medicinal plant belonging to the family Meliaceae.

III. MATERIALS AND METHODS

Water samples were collected in 12th January 2016 from Nyari - II reservoir is located in Rajkot district of Gujarat State near Rangpar village on Jamnagar road at Latitude: 22° 21'45" N and Longitude: 70°40'15" E. The main purpose of construction of this reservoir is to provide water for irrigation in surrounding agriculture fields and drinking water to the Rajkot Urban Development Area. In this reservoir a domestic waste and wastage of sewage water treatment plant is added. Sample collection is carried out from Nyari - II reservoir. Water sample is collected 20 to 30 meter away from the shore and 4 to 5 feet deep water. The water sample was collected in the sterilized glass bottles. These sample bottles were rinsed three times with source water to minimize the risk of external contamination before sampling (Paqualab Manual, 2005). All the three experimental plants are collected from Botanical Garden of Bahauddin Science college, Junagadh. *Moringa concanensis* (Kernel), *Cassia fistula* (Kernel), *Azadirachta indica* (Leaf) is taken to Botany Laboratory and all plant material is washed thoroughly with tap water and finally with distilled water. This purification method helps all the people who lives at far and long areas, where latest purification system is not available. The ultimate purpose of this research was to carry out an inventory of plants used as disinfectants in rural area of Rajkot, Gujarat conduct an *in vitro* evaluation of crude plant powders and solvent extracts on directly disinfecting turbid surface water from Rajkot, Gujarat.

Plant extracts are prepared by taking 10gm of oven dried powdered plant material and dissolved in 1000ml double distilled water and shaking for 1hr. Filtration is done with Whatman No.-42 filter paper. Filtered plant extract is use for further physic chemical analysis.

Turbidity (Nephelometric Method), pH (Potentiometric Method), Electrical Conductivity (Conductivity Cell Potentiometric Method), Hardness, Total (EDTA Titrimetric Method), Org-NH₃-N (Kjeldahl Titrimetric Method), Solids, Total Dissolved (Gravimetric Method After Filtration), Chloride, Argentometric Titration Method, Dissolved Oxygen, (Winkler Azide Modification Titrimetric), Biochemical Oxygen Demand (Winkler Azide Modification Titrimetric),.

Statistical analysis

Student t test is performed for significance.

IV. RESULT AND DISCUSSION

All the plants studied showed phytoagglutinant activity but *Azadirachta indica* only shows phyto-disinfectant ability. This research has also shown there are many plants that need to be screened properly for water treatment. From statistical

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analysis, all plant extract shows significant difference at $P \leq 0.05$ values with comparison to polluted water. From this study, further studies on the actual application of *Moringa concanensis* (Kernel), *Cassia fistula* (Kernel), *Azadirachta indica* (Leaf) in water purification at household or large scale level in India is required. All these techniques are being developed to ensure that in near future everyone will have access to clean and pure water and that too at an affordable cost.

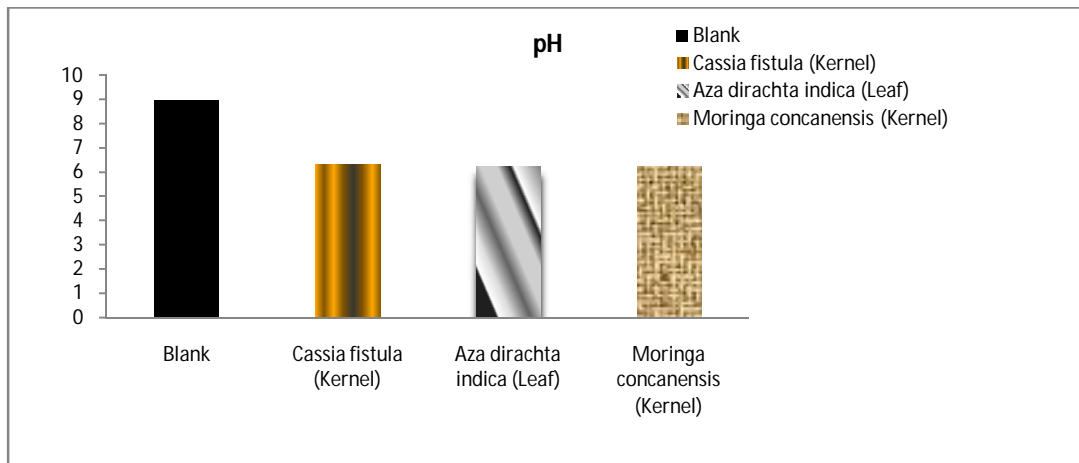


Fig.1. pH test for blank and treated water sample

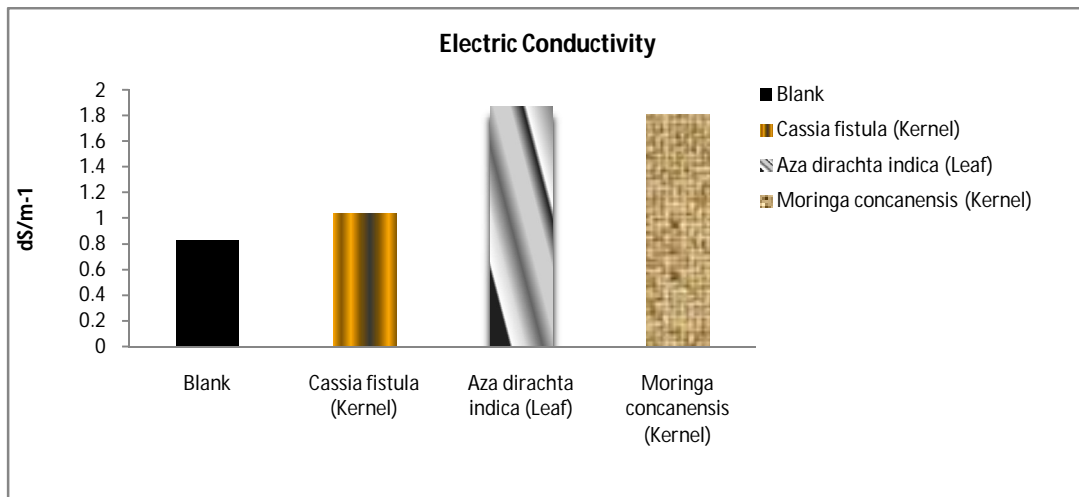


Fig.2. Electrical Conductivity test for blank and treated water sample

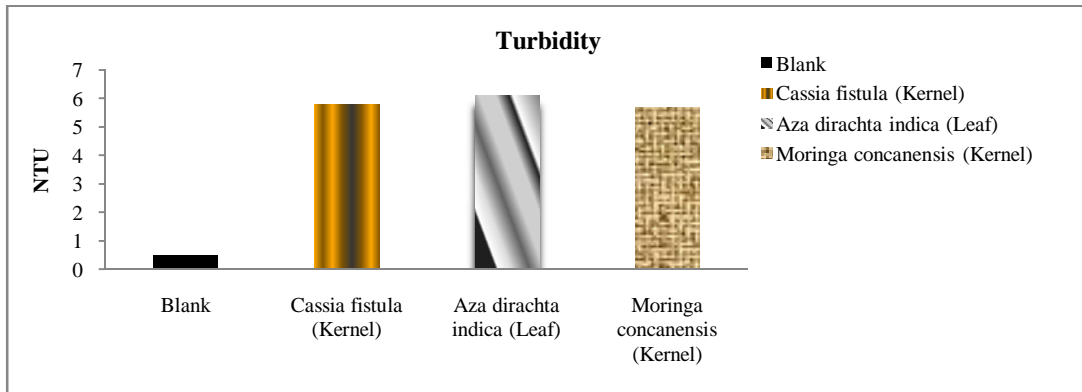


Fig.3. Turbidity test for blank and treated water sample

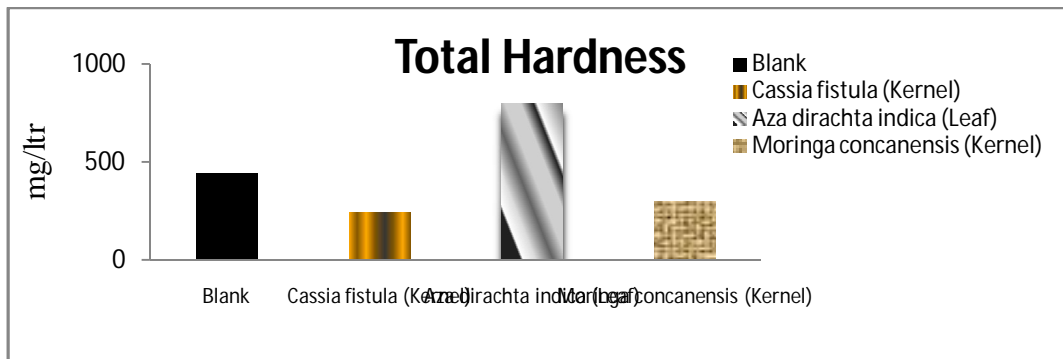


Fig.4. Total hardness test for blank and treated water sample

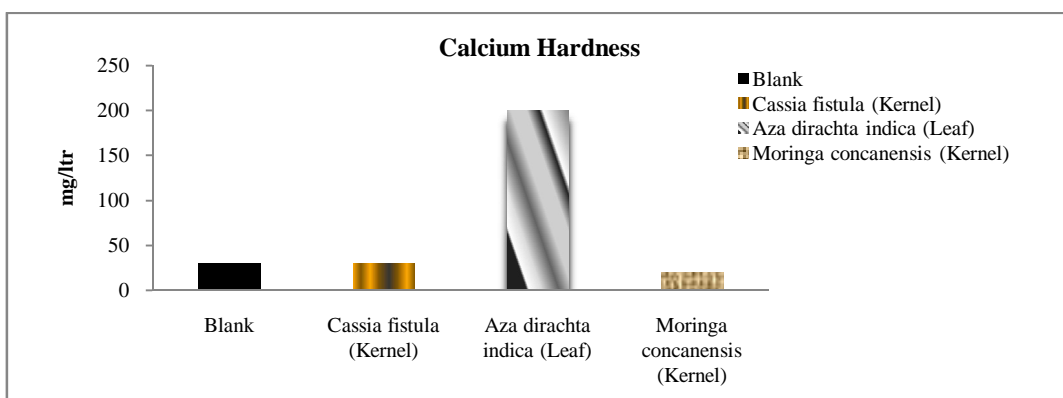


Fig.5. Calcium Hardness test for blank and treated water sample

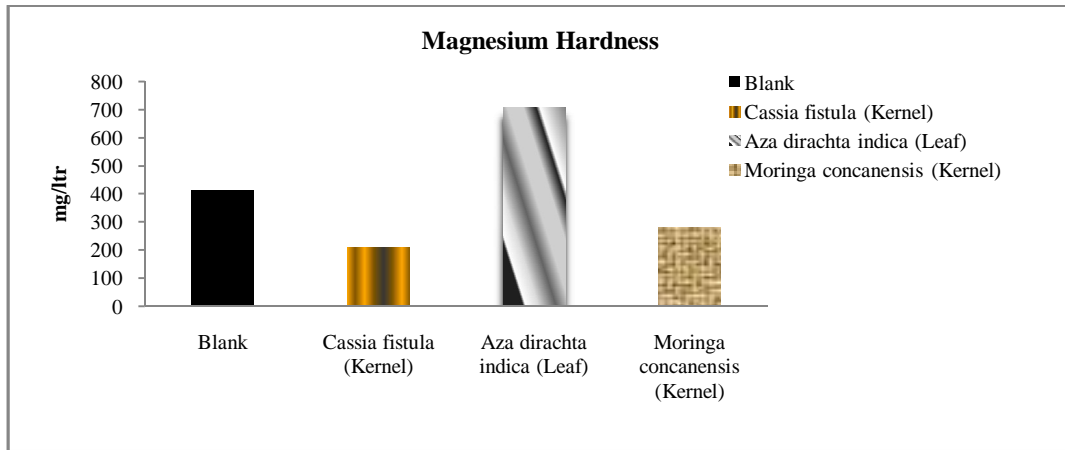


Fig.6. Magnesium Hardness Hardness test for blank and treated water sample

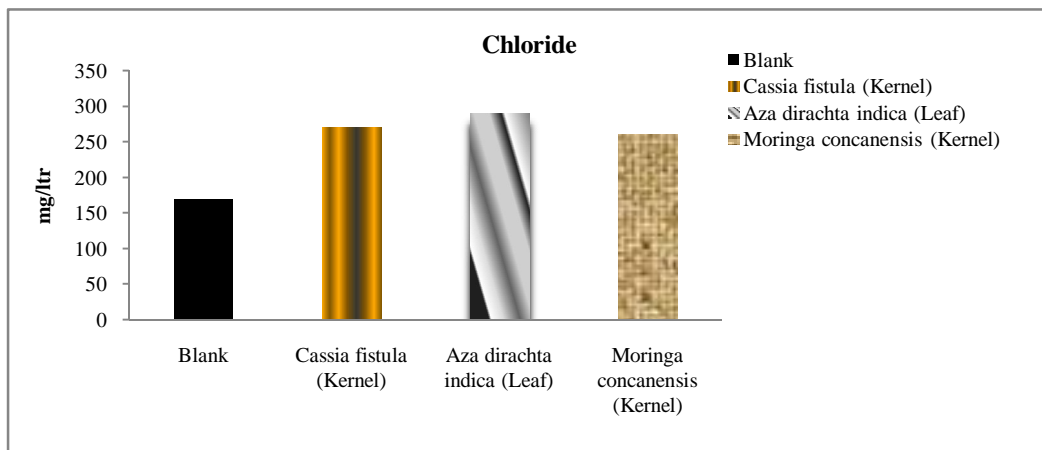


Fig7. Chloride test for blank and treated water sample

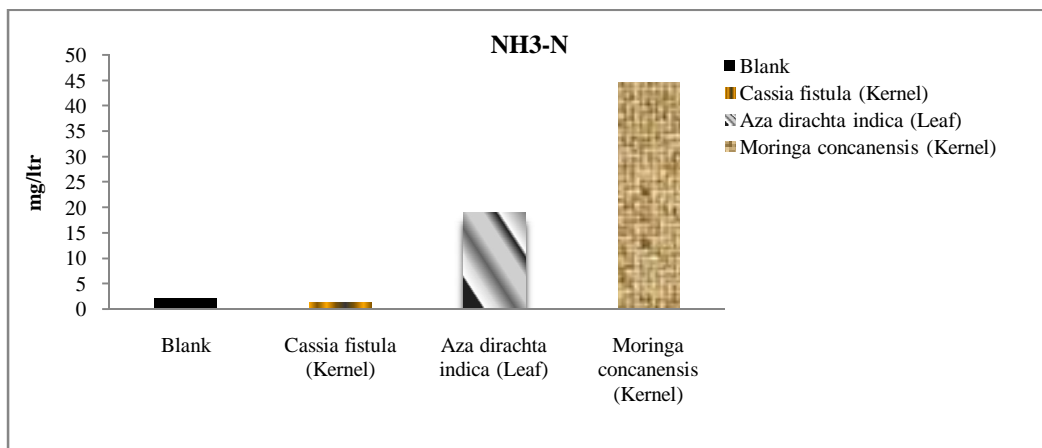


Fig 8. Ammonia - N for blank and treated water sample

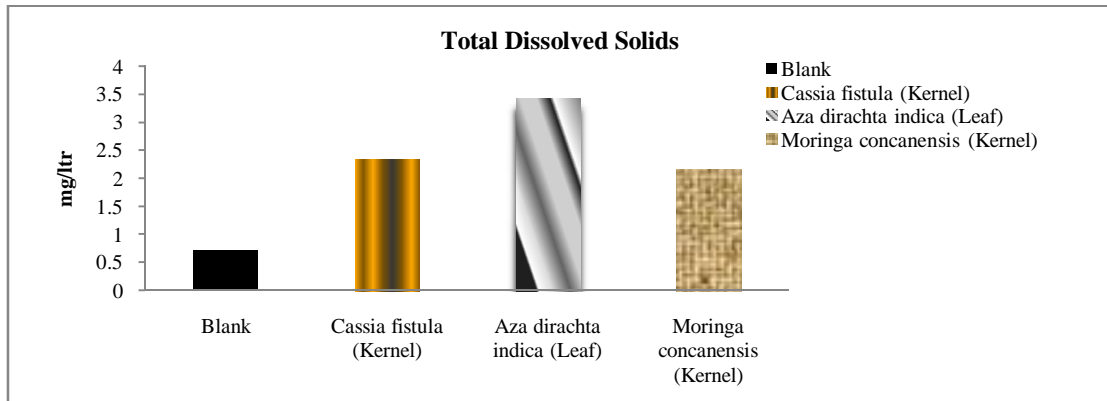


Fig 9. Total Dissolved Solids test for blank and treated water sample

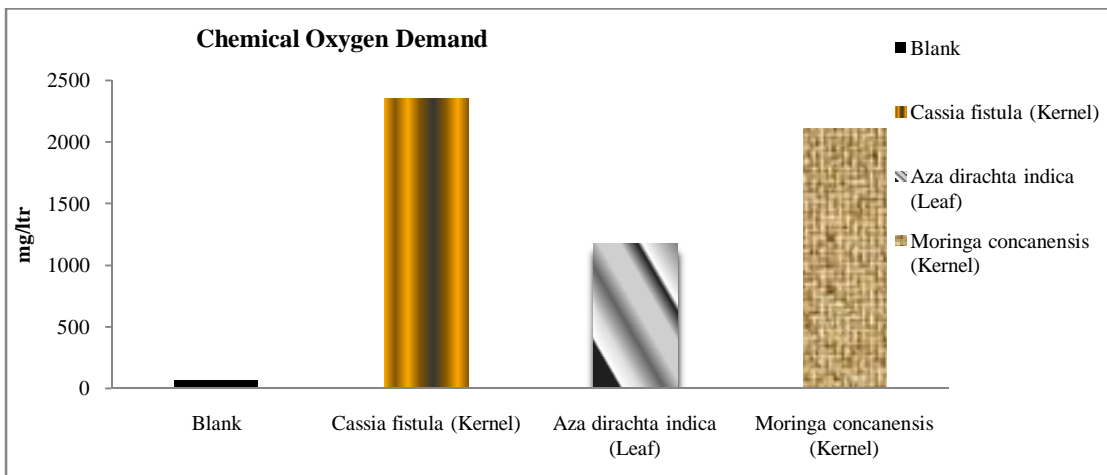


Fig 10. COD test for blank and treated water sample

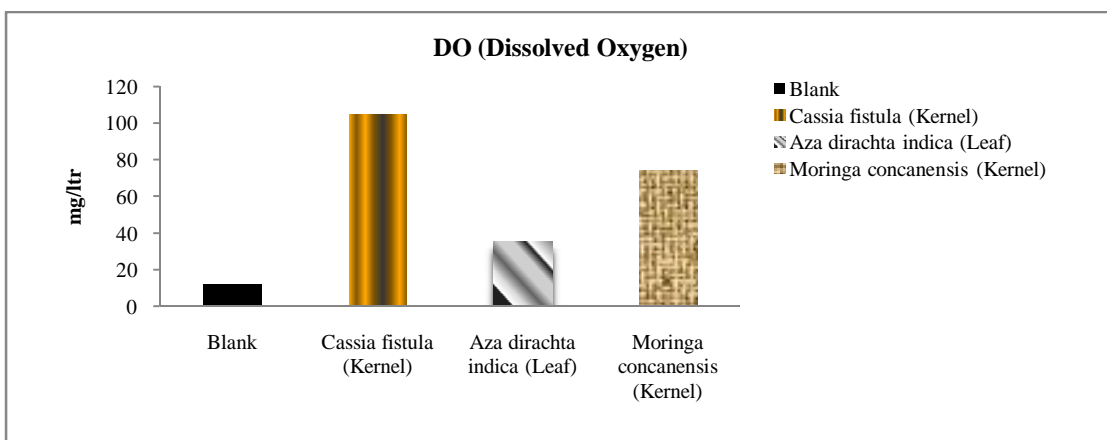


Fig 11. DO test for blank and treated water sample

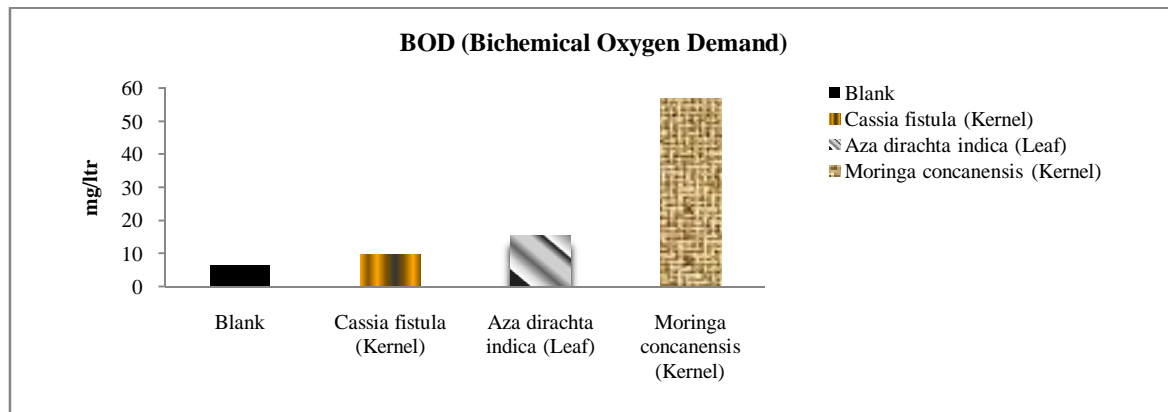


Fig 12. BOD test for blank and treated water sample

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REFERENCES

- [1] Jahn, S.A.A., Proper Use of African Natural Coagulants for Rural Water Supplies. Manual No. 191. GTZ, Eschborn, Germany, 1986.
- [2] Muyibi, S.A., Evison, L.M., Moringa oleifera seeds for softening hard water. Water Research 29 (4), 1099–1105, 1995.
- [3] Paqualab Manual, Operating Instructions. ELE International, 440-005 Issue 1, 2005.
- [4] Paterniani JES, Ribeiro TAP, Mantovani MC, Santanna MR. Water treatment by sedimentation and slow fabric filtration using Moringa oleifera seeds. *African Journal of Agricultural Research*, 5(11): 1256-1263, 2010.
- [5] Pritchard, M., Mkandawire, T. & O'Neill, J.G., Biological, chemical and physical drinking water quality from shallow wells in Malawi: case study of Blantyre, Chiradzulu and Mulanje. *Physics and Chemistry of the Earth Journal* 32, 1167–1177, 2007.
- [6] Pritchard, M., Mkandawire, T. & O'Neill, J.G., Assessment of groundwater quality in shallow wells within the Southern districts of Malawi. *Physics and Chemistry of the Earth Journal* 33, 812–823. 2008.
- [7] Sanghi, R., Bhattacharya, B., Dixit, A., Singh, V., Ipomoea dasysperma seed gum: an effective natural coagulant for the decolorization of textile dye solutions. *Journal of Environmental Management* 81 (1), 36–41, 2006.
- [8] Shultz, C.R., Okun, D.A., Surface Water Treatment for Communities in Developing Countries. John Wiley and Sons Inc., Intermediate Technology Publications, Great Britain, 1984.
- [9] UNESCO, Water Portal Newsletter No. 161: Water-related Diseases. <<http://www.unesco.org/water/news/newsletter/161.shtml>> (accessed 11.05.09), 2007
- [10] UNICEF, Soap, Toilets and Taps – A Foundation for Healthy Children, How UNICEF supports water sanitation and hygiene. UNICEF.<http://www.unicef.org/wash/files/FINAL_Showcase_doc_for_web.pdf> (accessed 11.05.09). 2009.
- [11] WHO (World Health Organisation), Guidelines for Drinking-Water Quality, First Addendum to Third Edition. Recommendations, vol. 1. <http://www.who.int/water_sanitation_health/dwq/gdwq0506.pdf> (accessed 10.05.09). 2006.
- [12] Godhani P.J., Adiyecha R. P., Viradia R. C.,Jani M. M., Joshi J. B. A new promising technique using plant extracts for purification of polluted water in Rajkot, *Lifescience Leaflets*, 49, 44-52, 2014.