Efficacy of three plant extracts in reducing sediment and heterotrophic bacterial load in surface raw water in Samburu District, Kenya.

BY

Cheluget Kipkemboi

BACKGROUND AND LITERATURE REVIEW

- Water quality changes associated with livestock production include changes in nutrients loads, (nitrogen and phosphorus), microorganisms (e.g. bacteria, faecal coliforms, *Cryptosporidium*, *Giardia*) and organic material such as livestock wastes.

Turbidity - relative clarity of water (Sadar, 1996). Turbidity can also be used to estimate loads for contaminants such as nutrients and bacteria (Ankcorn, 2003).

BACKGROUND AND LITERATURE REVIEW CONT..

- Thus the objective of water treatment is to provide potable water, i.e. pathogen free, with low in physical impurities and aesthetically acceptable to the consumer.
- To attain this, cheap, effective and sustainable water treatment technology using natural plant products need to be developed.
- Establish its effectiveness in waters from different sources and with different physico-chemical properties.

Other water purification methods

- Solar disinfection (SODIS)
- Chemicals- Alum,- Trihalomethanes; Alzehmier disease, Hypochlorite solutions
- Boiling- Anti-Environment; Deforestation, global warming
- Use of plant extracts
- *Tamarindus indica* Linn-50 mg L^{-1} remove 74 % and 76 % of sulphates and phosphates respectively after 30 minutes (Anuradha and Malvika, 2005)
- *Strychnos potatorum* Linn.- Microbial reductions of about 50 % (bacteria) and 95 % (turbidity)
- *Moringa oleifera* Lam. 80 to 99 % turbidity removal.

Problem statement and justification cont..

•Limited access to safe drinking water and appropriate water treatment technology in rural arid and semi-arid regions has contributed to frequent outbreaks of diarrheal disease

Problem statement and justification cont..

- In water scarce areas, livestock and wildlife density tends to be high in water catchment areas and near water sources, and contribute significantly to water pollution.
- According to WHO, turbidity above 1 NTU can compromise disinfection by increasing chlorine demand, and hence the cost of water treatment.
- However, it is important to optimise the removal of turbidity during water treatment in order to remove all micro-organisms.

Problem statement and justification.

Cheap, effective and sustainable water treatment technology using natural plant products need to be developed

Research Question

- How effective are the roots extracts of *Boscia coriacea* Pax., *Maerua decumbens* (Brogn.) Dewolf and seeds of *Moringa oleifera* Lam. in reducing bacterial and sediment load in water?

Hypothesis

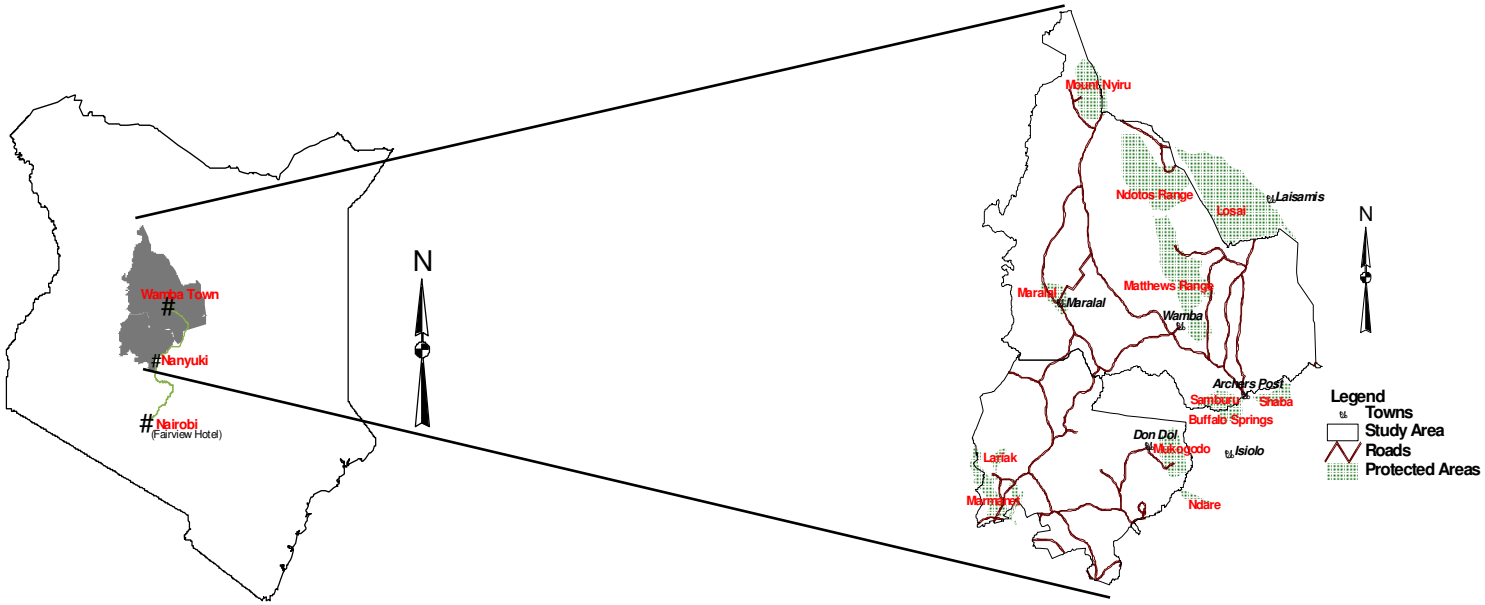
- The roots extracts of *Boscia coriacea* Pax., *Maerua decumbens* (Brogn.) Dewolf and seeds of *Moringa oleifera* Lam. are not effective in reducing bacterial and sediment load in water.

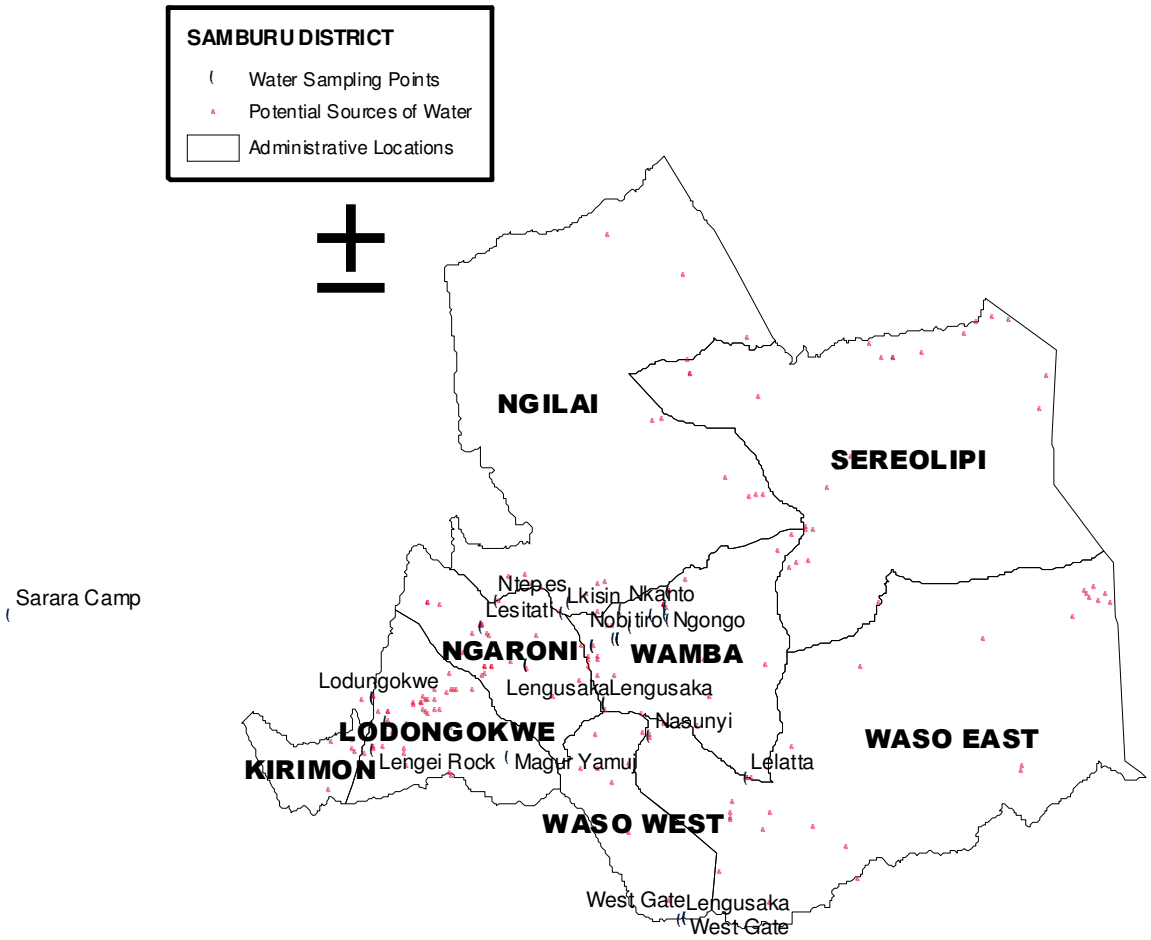
Specific objective

To determine the efficacy of roots extracts of *Boscia coriacea* Pax., *Maerua decumbens* (Brogn.) Dewolf and seeds of *Moringa oleifera* Lam. in reducing bacterial and sediment load in water.

MATERIALS AND METHODS

Site of the study




SAMBURU DISTRICT
Water Sampling Points
Potential Sources of Water
Administrative Locations
NGILAI
SEREOLIPI
Sarara Camp
Ntepes
Lkisin
Nkanto
Lesitati
Nobitiro
Ngongo
NGARONI
WAMBA
Lodungokwe
Lengusaka
Lengusaka
Nasunyi
LODONGOKWE
WASO EAST
KIRIMON
Lengei Rock
Magur Yamu
Lelatta
WASO WEST
West Gate
Lengusaka
West Gate

Significance and anticipated output

- The study will provide the basis of validating the use of plants extracts to provide an alternative to the existing water treatment technologies to achieve safe drinking water. This will in the long run provide a cost effective and user friendly option to be adopted for domestic household purification of water.

Water sampling

- Samples will be collected from water sources previously recorded to have high bacterial and sediment loads.
- Bacteriological analyses was carried out using heterotrophic plate counts technique, while turbidity and pH determination were carried out using a colorimeter (Smart - 26617) and portable WTW Multiline P4 meter (Weilheim, Germany) respectively.

Field measurements

Universal multiline meter

Plant collection and identification

- Plants identified using a questionnaire
- Identified plants collected and authenticated by taxonomist.
- Herbarium specimen kept for reference.

Preparation of plant extract

Extract for water treatment

- Washed plant materials cut into small pieces, dried in shade then milled into powder.
- 2gms of powder from each plant was weighed and packed in filter satchets.
- 200 ml of turbid water with predetermined bacterial density used.

Water treatment

- Number of bacteria in water sample before and during treatment determined using spread plate technique.
- Turbidity changes determined using a colorimeter.
- Changes in bacterial density and turbidity was determined after 30 min. and 24 hr. period in order to give an optimum time.

Results and Discussion

- The 15 samples analysed frequently recorded high levels of turbidity (range, 617 – 6100 NTU), (mean, 1192) and total heterotrophic bacterial counts (range, 2.2×10^3 - 2.0×10^7), (mean 2.75×10^6).
- Overall, all the treatments were effective.
- Except for some unidentified residual bacteria that resisted the disinfection properties of plant extracts.
- Changes in % (HPC) among the treatments used differed significantly (P = 0.05, DF = 5).
- *M. decumbens,(*46.00) *B. coriacea (*30.20), *M. Oleifera* Lam.,*(*26.51),
- Control (14.50), Alum (74.76) and Sodium hypochlorite (99.95)

Results and Discussion

- Changes in bacterial density- may be due to loss of viability or alteration in culturability.
- No significant difference in water turbidity reduction (P = 0.05) by all plant extracts.
- *B. coriacea* (50.36 %), *M. decumbens* (43.87 %) and *M. oleifera* (40.53 %).
- Water pH. (more acidic) Changes inactivate bacteria.

Efficacy of plant products against pathogenic bacteria

Test cultures

- *Staphylococcus aureus* (ATCC 25923), *E. coli* (ATCC 25922) standard cultures obtained from KNH.
- Environmental isolates of *E. coli*, *Shigella* spp and *Salmonella* spp

Antibiotic sensitivity testing

- The disk diffusion method (Kirby-Bauer) will be used to test for antibacterial activity (Harold,1985).
- Standard table- determined if the strain is resistant, intermediate or susceptible to the specific treatment tested (Harold,1985)

Bacterial inhibition effects of plant extracts

- *Staphylococcus aureus* (ATTC 25923), *E. coli* (ATCC 25922) and Streptomycin drug were used as positive controls in the experiment.
- All test bacterial strains were sensitive to the treatments used. The mean zone of inhibition recorded for all treatments ranged between 7.57 mm – 17.92 mm.
- *S. aureus* (ATCC 25923) was more sensitive to extracts from *M. oleifera* Lam. (24.6 mm).
- Using a one way ANOVA test, it was found that bacterial zones of inhibitions were significantly different among all treatments (DF = 5, P = 0.05).
- Streptomycin achieved a significantly greater inhibition than all other treatments followed by treatment with extracts from *M. oleifera*.

CONCLUSION

Use of plant extracts in water treatment proved to be effective in the elimination of heterotrophic bacteria and suspended solids.

Plants extracts may therefore be considered as alternative method of purifying water for the inhabitants of Samburu.

ACKNOWLEDGEMENTS

Prof. Kiplagat Kotut
Prof. Nkanatha Gitonga
Dr. Alexander Njue

- The author wish to thank the Earthwatch Institute for their support to the field and laboratory work of this study.
- The author also acknowledge staff in the Department of Plant and Microbial Science, Kenyatta University for their support during the study.

THANKYOU