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Feasibilities Studies on the Disinfection of Water Using Natural Disinfectants (Polymers)

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Abstract - Water pollution caused by faecal contamination is a serious problem due to the potential for contracting diseases from pathogens (disease causing organisms). Many chemical substances are used as disinfectants to treat the water. These substances may produce a number of by products which have been reported to cause carcinogenic, mutagenic and teratogenic effects. Thus, some alternate cost effective method is pre-requisite to eliminate the bacterial population. Many plants possess antimicrobial activities and are used for the treatment of different diseases. The use of plants as source of remedies for the treatment of many diseases dated back to pre-history and people of all continents have this old tradition. The plants under study were Acacia nilotica and Tamarindus indica, the different plant like the leaves and the seeds were used for the treatment against the coliforms group of organisms. The natural disinfectants used in this study are suitable for the water disinfection used in this study are suitable for water disinfection.

Keywords— By-products, coliform, Faecal contamination, disinfection.

I. INTRODUCTION

Water is the essence of life. It is one of the major components of the human body and is a prerequisite for the metabolism, so the availability of good and safe drinking water in the adequate quantities is the basic physiological need.

Drinking water obtained directly from surface and ground water sources may contain a number of pollutants and pathogenic micro-organisms which may cause disease in animals and human beings after regular consumption.

Many chemical substances are used as disinfectants to treat the water. These substances may produce a number of by products which have been reported to cause carcinogenic, mutagenic and teratogenic effects.

Besides, the check at the microbial contamination of water by coliforms is most important. Coliforms are bacteria which are used as indicators of waste or faecal contamination in drinking water supplies. They were written into regulations and indeed law because they are relatively easy to test for and because they are believed to be found only in the gut of warm blooded animals including man. It was reasoned that if coliforms were present in water supply there was some contamination from a waste water source.

Total coliform counts give a general indication of the sanitary condition of a water supply. Water pollution caused by faecal contamination is a serious problem due to the potential for contracting diseases from pathogens (disease causing organisms). Frequently, concentrations of pathogens from contamination are small, and the numbers of different possible pathogens are large. As a result, it is not practical to test for pathogens in every water sample collected. Instead, the presence of pathogens is determined with indirect evidence by testing for an " indicator" organism such as coliform bacteria.

Thus, some alternate cost effective method is pre-requisite to eliminate the bacterial population which are invariably encountered in such raw drinking water(s) or the surface waters used for the recreational purposes without any side effect at the user end, especially at the rural level where the facilities are inadequate.

Since the beginning of time, mankind has used plants to supply most of his basic needs, such as food, clothing, medicines and shelters. Many plants possess antimicrobial activities and are used for the treatment of different diseases (Arora et. Al., 1999). The use of plants as source of remedies for the treatment of many diseases dated back to pre history and people of all continents have this old tradition. The early attempts used natural substances, usually

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native plants or their extracts and many of these herbal remedies proved successful (Sofowora, 1982).

Historical literatures revealed that ancient civilization of Greece, China, Egypt, India and others were fully familiar with the plant species having antimicrobial (bacteraial, fungal, protozoal, viral ets.) helminthic, nematodal, insecticidal properties and used them as curative agent of different types of diseases of humanbeings. Coincidentally, the last decade has also witnessed increasing intensive studies on extracts biologically active compounds isolated from plant species used for natural therapies or herbal medicine (Ryos et al, 2005).

1.1 Acacia nilotica

The genus Acacia belongs to family Mimosaceae. Acacia wild is a very large genus containing trees, shrubs and climbers. Acacia nilotica (linn), willd ex del is known in India asbabul, kikar (Hindi), It is a moderate sized tree with a spreading crown. It is indigenous to the Indian sub-continent as also in Tropical Africa, Burma, Sri Lanka, Saudi Arabia, Egypt and in West and East Sudan. In India, natural babul forests are generally found in Maharashtra, Gujarat, Andhra Pradesh, Rjasthan, Haryana and Karnataka. A. nilotica is truly a multipurpose tree. Its timber is valued by rural folks, its leaves and pod are used as fodder and gum has a number of uses. It tolerates extremes of temeperature and moisture. It is suited for planting on marginal lands and can survive both droughts and flooded conditions.

Medicinal Uses

The leaves , bark, gums and pods of A. nilotica are used for medicinal purposes. The tender growing tops and leaves are used as a douche in cases of gonorrhoea, dropsy and leucorrhea. Pulp of leaves, decoction of bark and the gum are prescribed in diarrhoea, dysenrty and diabetes. A paste of the burnt leaves with coconut oil makers a very efficacious ointment in cases of itch. The leaves and the gums are used for gargling for relaxing sore throat and spongy gums. Decoction of leaves is also used as wash for bleeding ulcers and wound (babul).

1.2 Tamarindus indica

Tamarind, *Tamarindus indica* L., is a multipurpose tropical fruit tree used primarily for its fruits, which are eaten fresh or processed, used as a seasoning or spice, or the fruits and seed are processed for non-food uses. The species, has wide geographical distribution in the subtropics and semi-arid tropics and is cultivated in numerous regions. Tamarind belongs to the dicotyledonous family Leguminosae which is the third largest family of flowering plants with a total of 727 genera recognized and the number of species is estimated at 19,327.

It is also grown commercially. Numerous national programmes have recognized tamarind as underutilized with wider potential since demand for products is substantial and the species can be incorporated into agroforestry systems. Further exploitation of tamarind can therefore provide added incomes for poor rural people thereby improving their well-being and living status. Tamarind is long lived, large, evergreen or semi –evergreen tree, 20-30 m tall with a thick trunk upto 1.5-2 m across and up to 8 m in circumference. The trunk forks at about 1 m above ground and is often multi-stemmed with branches widely spreading, drooping at the ends and often crooked but forming a spreading, rounded crown. The bark is brownish –grey , rough and scally.

Young twigs are slender and puberluent. A dark red gum exudes from the trunk and branches when they are damaged. Tamarind is a nutritious fruit with a variety of uses. The properties of this species have been extensively studied, particularly with reference to the components of the seed. All parts are used in traditional medicine.

Medicinal uses

The medicinal value of Tamarind is mentioned in traditional Sanskrit literature. The laxative properties of the pulp and the diuretic properties of the leaf sap have been confirmed by modern medicinal science. Tamarind fruits were well known in Europe for their medicinal properties, having been introduced by Arab traders from India. Tamarind products, leaves, fruits and seeds have been extensively used in traditional India and African medicine. Several medicinal properties are claimed for preparations containing tamarind pulps, leaves, flowers , barks and roots.

Seed

The seed is usually powdered and is often made into paste for the treatment of most external aliments. In India and Cambodia, it has been reported that powdered seeds have been used to treat boils and dysentery. Seed powder has also been externally applied on eye diseases and ulcers. Boiled, pounded seeds are reported to treat ulcers and bladders stones and powdered seed husks are used to treat diabetes. The seed can also be used orally, with or without cumin seed and palm sugar, for treatment of chronic diarrohea and jaundice. The anti-oxidative activity of tamarind seed was also investigated (EI-sidding k et.al, 2000).

II. MATERIALS AND METHODS

2.1 The plants under study are Acacia nilotica and Tamarindus indicus. For the study materials used are as under:

1. *Acacia nilotica*: leaves-dried powder, extract of the powder, juice of the green leaves.
2. *Tamarindus indica*: seeds-dried powder, extract of the powder.

2.2 Collection and preparation of plant material

The leaves used for investigation were collected from the trees in and around the study area. The leaves were initially cleaned with tap water and subsequently with sterile

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distilled water. The leaves were shade dried at room temperature for 15 days. The dried leaves were ground to powder with a help of an electrical blender. The powder was sieved through 1 mm mesh and was stored in an air tight container for future use. Similarly, the seeds were cleaned, dried and grinded into powder form.

2.2.1 Leaf Extract preparation

For extract preparation 10 g of the leaf powder/sample was shaken with the 1000 ml of sterile double distilled water at 28-30 0C. The mixtures were then filtered through the four folds of cheesecloth followed by sterile-filtering through 0.2 µm filter before immediate use.

Sample (50 g) of thoroughly washed fresh leaves of *A. nilotica* was macerated with 100 ml sterile distilled water in a electric blender for10min. The macerate was first filtered through double –layered muslin cloth and then centrifuged at 4000 g for 30 min. The supernatant was filtered through Whattman No. 1 filter paper filtered through 0.2 µm Millipore filter. These extracts were allowed to cool to room temperature, diluted (0.1%) and used in the experiments.

III. EXPERIMENTAL ANALYSIS

3.1 Time Optimization

Time dependent inhibition of the coliform population in the raw water was studied. To be autoclaved conical flask, containing 99 ml of distilled water , 1 ml of raw surface water was added along with the 1 gm of the leaf powder. Control were always kept as the reference. For the optimization, samples from flasks were always kept as the reference. For the optimization, samples from the experimental flasks were drawn at different time intervals and coliform growth was checked using the membrane filtration technique for both the total coliforms and the faecal coliforms. Colonies with gold metallic –green sheen on the M-Endo agar were considered to be positive for TC growth and light –to dark blue colonies on the M-FC agar as positive for FC growth. All results were reported as log CFU (coliform units)/100 ml(2005).

Same procedures were used for the seeds powder, leaf extracts and the juice of the green leaves.

3.2 Dose optimization

The samples were analysed for the optimum/minimum dose at which the total coliform and faecal coliform counts were reduced to Zero using the membrane filtration technique.

3.3 Dose toxicity experiments

Guppy fish lethality bioassay was carried out to investigate the toxic effect of the natural disinfectant (polymer) on the aquatic life. The 5 litre capacity tanks were filled with 3 litre of de chlorinated water. Each tank had four Guppy fishes, these were kept in the tank for at least seven days for acclimatization. The tanks were well aerated. To these tanks different samples of natural disinfectants (polymers) were added and observations for 50 % mortality were noted.

IV. RESULT AND DISCUSSION

Table 1 and table 2 summarises the optimum time and the optimum dose for the activity of the plant samples. From the study, it was found that for Acacia nilotica, the optimum time of activity against total coliforms and faecal coliforms for dried leaves powder was 8 hrs , while for dried seeds powder was 6 hrs and for green leaves juice was 5 hrs and for Tamarindus indica dried seeds powder against total and faecal coliforms was 8 hrs respectively (**Fig 1,2,3**) while the optimum dose for all dried powder was 1 g and for A. nilotica green leaves juice was 1 ml (**Table 1,2**).

Table 1

S. No.	Dose (g or ml)	Control (0 hr) (CFU/100 ml)		Dried leaves powder of *A. nilotica* (8 hrs) (CFU/100 ml)		Dried seeds powder of *A. nilotica* (6 hrs) (CFU/100 ml)		Green leaves juice of *A. nilotica* (5 hrs) (CFU/100 ml)		Dried seeds powder of T. indica (8hrs) (CFU/100 ml)	
		TC	FC	TC	FC	TC	FC	TC	FC	TC	FC
1.	0.5	1000	400	600	128	700	180	440	80	400	60
2.	1.0	1200	300	0	0	0	0	0	0	0	0
3.	1.5	1000	400	0	0	0	0	0	0	0	0
4.	2.0	1000	500	0	0	0	0	0	0	0	0
5.	2.5	1400	500	0	0	0	0	0	0	0	0
6.	3.0	1200	300	0	0	0	0	0	0	0	0

Table 2

S. No.	Name of Disinfectant	Optimum Period	Optimum Dose
1.	Leaves of *Acacia nilotica* (Dried , powder form)	08 hrs	1 g
2.	Seeds of *Acacia nilotica* (Dried , powder form)	06 hrs	1 gm
3.	Green leaves of *Acacia nilotica* (fresh juice)	05 hrs	1 ml
4.	Seeds of *Tamarindus indica* (Dried , powder form)	08 hrs	1 gm

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Table 3

S. No.	Name of natural disinfectant	Toxicity dose (g)	Time (min)	Of the 4 fishes, No. of fishes alive
1.	Leaves of *Acacia nilotica* (Dried, powder form)	30 45 60 75 90	180 120 60 30 10	02 02 02 02 02
2.	Seeds of *Acacia nilotica* (Dried, powder form)	30 45 60 75 90	360 180 120 60 30	02 02 02 02 02
3.	Seeds of *Tamarindus indica* (Dried, powder form)	30 45 60 75 90	120 60 30 20 10	02 02 02 02 02
4.	Leaves of *Acacia nilotica* (Extract of dried powder)	0.1%	5760	04
5.	Green leaves of *Acacia nilotica* (fresh juice)	0.1%	5760	04
6.	Seeds of *Acacia nilotica* (Extract of dried powder)	0.1%	240	02
7.	Seeds of *Tamarindus indica* (Extract of dried powder)	0.1%	240	02

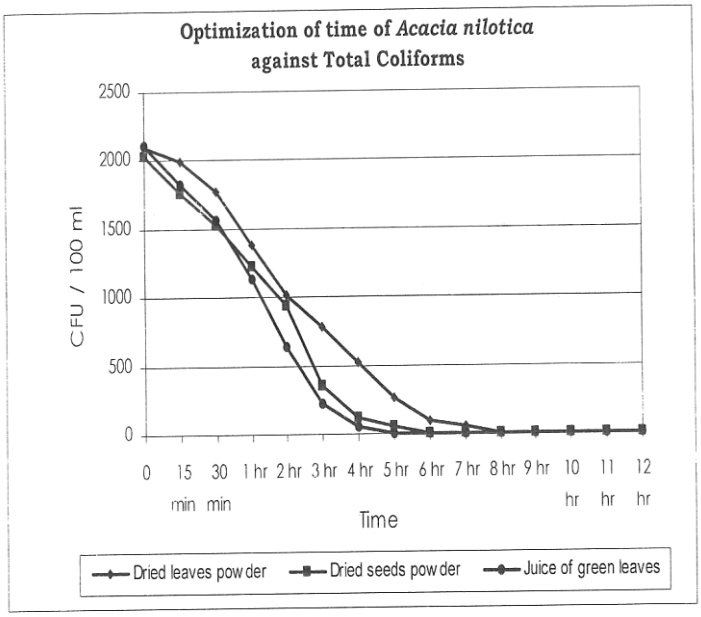

Figure 1

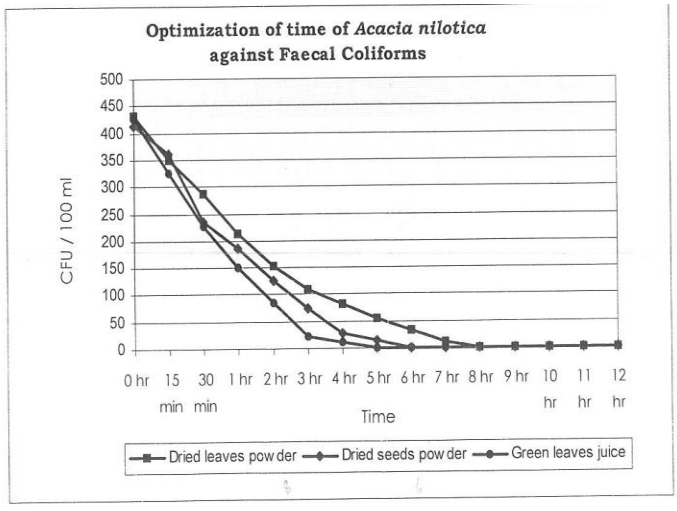

Figure 2

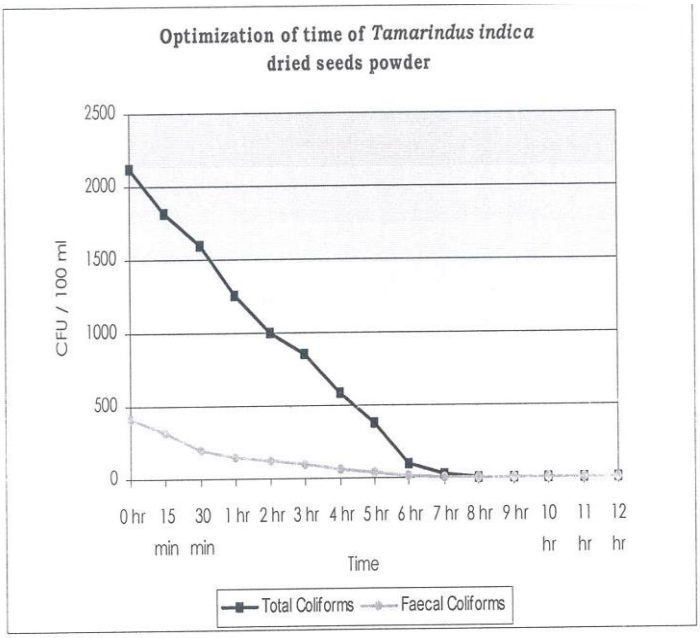

Figure 3

During the dose –toxicity experiments it was found that the degree of lethality was found to be directly proportional to the dose added, whereas the time and dose are in inverse proportion. The extracts of powdered form of leaves and the green leaves juice of *Acacia nilotica* in the given diluted form did kill the fish, while the other samples were toxic(**Table 3**).

From the study, it can be inferred that samples obtained from the natural disinfectants used in this study are suitable for the water disinfection used in this study are suitable for water disinfection but when it comes to the toxicity only the extract of powdered form of leaves and the green juice of *Acacia nilotica* in the given diluted form were nontoxic and can be used as the disinfectant.

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V. CONCLUSION

Drinking water obtained directly from surface and ground water sources may contain a number of pollutants. Many chemical substances are used as disinfectants to treat the water, but may have adverse impact on the human and animal health.

Many of the treatment procedures and the facilities are unavailable at the rural and interior regions of the study area. Hence, the study of use of the plants and trees grown in abundance for the treatment of water especially against the coliform group of microorganisms was carried out.

The plants under study were *Acacia nilotica* and *Tamarindus indica*, the different plant like the leaves and the seeds were used for the treatment against the coliforms group of organisms. Of the different products used the extract of powdered form of leaves and the green leaves juice of Acacia nilotica in the given diluted form were nontoxic and can be used as the disinfectant.

This study gives a general idea for the application of these plant parts as disinfectant. Considering the above documented reports and the large amount of literature available on our indigenous reports and the large amount of literature available on our indigenous species of plants, it would be very useful to explore these lines. Some of them could prove to be very cheap and very effective in treatment of water. There appears to be considerable prospects and necessary trails within the frame work of our present day knowledge on scientific lines needs a fair chance.

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