Treatment of Water Using Natural Materials

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Abstract- *A major role of water is for vitality for life on earth. Adequate supply of clean, safe and potable water regularly is the main issue faced by the people now days. However food security is a challenge as the community occasionally suffers from hunger. Food preservation may be one way of alleviating hunger and avoiding waste. The purpose of this study was to investigate fruit and vegetable processing practices in the community. To achieve this objective wastewater should be treated. So that it can be reused as well as environment should be saved without the negative effect of the treated wastewater. Several methods have been used for treatment of water so far some of which are very successful. The findings showed that the community produced enough quantities of food to last all year, however alarming losses occurred through inappropriate post-harvest handling and storage methods. A minority of people practiced food processing for preservation of fruits and vegetables produced or those collected from the wild. Fruit and vegetable processing methods mostly used were drying, bolting and pickling. Other processing methods like blanching, pasteurization, canning, concentration and freezing were less known in the community. It is, strongly recommended that Consumer Science Extension officers responsible, intensify teaching the community about appropriate post-harvest handling and processing of fruits and vegetables and other foods in order to attain food security and thus subsequently strive to meet the sustainable development goals.*

Keywords- Water treatment, Natural materials, Water, Waste water,WRRF(Water Resource Recovery Facility), Pollutants, Bacterias.

I. INTRODUCTION

India is a developing country with an increasing population density. In order to develop its economy, India requires establishment of new industries. Due to unplanned industrial growth, much of the land and nearby water bodies is polluted by indiscriminate dumping of solid and liquid wastes generated by these units. Increase in the levels of metal ions and organic pollutants in the environment are either due to absence of laws for various industries to treat their wastes or if there are laws, there is no strict enforcement by the Ministry of Environment and other regulatory authorities in India. Land contaminated by heavy metals is increasingly becoming an environmental, health, economic and planning issue in the India.

Eco-toxicity due to polluted water sources affect on living organisms has become a main concern for the last few decades. Due to rapid industrialization and substantial urbanization, the waste effluents get discharge directly in river water causing pollution to environment. Heavy metals are an important class of environmental pollutants. With the onset of fast developing industries and energy stations, metal wastes are getting discharged into the environment in many ways. There have been many instances when heavy metal toxicity has led to mass deaths. Removal of heavy metal ions from effluents can be achieved by various methods. The existing technologies for waste water treatment have major problems.

Costs involved in the construction of waste water treatment plants are un-economical, it consumes lot of space, and commercially they are unattractive and have disposal problems. The technologies are divided into three types namely biological, chemical and physical. There were many merits and demerits caused due to high cost and disposal problems. The technologies like electro floatation, electro kinetic coagulation, and coagulation combined with floatation and filtration, conventional oxidation methods by oxidizing agents, irradiation and electro chemical processes are the technologies which fall under chemical methods. These chemical technologies are having many disposal problems. Ion exchange and membrane technologies are very costly. So there was a need for some alternative method which can overcome all these problems and treat the waste water in an appropriate way.

Wastewater treatment is a process used to remove contaminants from wastewater or sewage and convert it into an effluent that can be returned to the water cycle with minimum impact on the environment, or directly reused. The latter is called water reclamation because treated wastewater can then be used for other purposes. The treatment process takes place in a wastewater treatment plant (WWTP), often referred to as a Water Resource Recovery Facility (WRRF) or a sewage treatment plant. Pollutants in municipal wastewater (households and small industries) are removed or broken down.

The treatment of wastewater is part of the overarching field of sanitation. Sanitation also includes the management of human waste and solid waste as well as stormwater (drainage) management

Even if controlling gases and odor from sewage weren't reason enough, every community needs to treat its wastewater because of the serious health problems it can cause. Although this may seem obvious, untreated wastewater is still the root cause of much environmental damage and human illness, misery and death around the world. Sometimes it is useful to re-examine basic ideas like why wastewater treatment is important especially today when so many communities need to save money and reprioritize their needs and funding for public projects.

Sources of wastewater from small communities include homes, farms, hospitals and businesses. Some communities have combined sewers that collect both wastewater runoffs from streets, lawns, farms, and other land areas. So wastewater can include any debris from streets and waste oils, pesticides, fertilizers and wastes from humans and animals. Wastewater from a typical household might include toilet wastes; used water from sinks, baths, showers, washing machines, and anything else that can be put down the drain or flushed down the toilet.

REASONS FOR GENERATION OF WASTEWATER

Much of our wastewater, treated or untreated, eventually ends up in our rivers, lakes, and oceans-sometimes via groundwater, the underground water sources we tap for well water. We often assume that groundwater is pure and it usually is- but unfortunately, well contaminated by sewage is a common cause of outbreaks of wastewater- related diseases.

When untreated wastewater reaches water used as a drinking water sources for the community, there can be significant health risks. The effectiveness of drinking water treatment can be reduced when water is heavily contaminated with waste. To ensure safe drinking water, communities need both effective water and wastewater treatment. In addition, communities need to make sure that untreated wastes are not disposed of improperly on land where people can come in direct contact with it or where it can attract diseases- carrying insects or animals.

EFFECTS OF WASTEWATER

Bacteria, viruses and parasites (including worms and protozoan) are the types of pathogens in wastewater that are hazardous to humans. Fungi that can cause skin, eye and respiratory infections also grow in sewage and sewage sludge. Scientists believe that there may be hundreds of disease-causing organisms present in sewage and wastewater that have yet to be identified are following

Diseases caused by Bacteria
Typhoid
Diseases caused by Viruses
Parasites in Wastewater

NEED OF AWARENESS

The potential for outbreaks of wastewater related illnesses in many small communities across the U.S. is significant and to protect public health, water and wastewater treatment projects need to be given priority and community leaders and residents need to be aware of potential problems.

Rural homeowners need to learn about what is good and bad for their onsite systems, what maintenance is needed, and how to identify possible problems. Homeowners with wells need to be informed about well water testing and preventing contamination.

Communities also need to monitor the quality of water regularly. Sometimes illegally dumped wastes can threaten water and groundwater resources. Strategies are needed for identifying and solving local pollution problems and residents, businesses and industry need to be educated about the health dangers associated with untreated wastewater.

II. MATERIALS AND METHODOLOGY

2.1 GUAVA LEAVES

Psidium guajava L. is a small medicinal tree that is native to South America. It is popularly known as guava (family Myrtaceae) and has been used traditionally as a medicinal plant throughout the world for a number of ailments. There are two most common varieties of guava: the red (P. guajava var. pomifera) and the white (P. guajava var. pyrifera)

All parts of this tree, including fruits, leaves, bark, and roots, have been used for treating stomachache and diarrhea in many countries. Leaves, pulp and seeds are used to treat respiratory and gastrointestinal disorders, and as an antispasmodic, anti-inflammatory, as a cough sedative, anti-diarrheic, in the management of hypertension, obesity and in the control of diabetes mellitus. It also possesses anticancer properties. The seeds are used as antimicrobial, gastrointestinal, anti-allergic and anti-carcinogenic activity.

Brazil is among the world’s top producers of guava and most of the country’s production is destined for the food industry to produce candies, juices, jams and frozen pulp. As result of the fruit process there is a discard of the leaves, seeds, part of the peel and pulp fraction not separated in the physical de-pulping process.

The high cost of pharmaceutical medications conduces to the search for alternative medicines to treat many ailments. In view of this, studies are necessary to confirm the effects of medicinal plants. The aim of this review is to show that several studies have demonstrated the presence of many different chemical compounds in P. guajava and their pharmacological effects.

Guava Leaves

CHEMICAL COMPOSITION AND BIOLOGICAL ACTIVITIES OF PSIDIUM GUAJAVA LEAF

Psidium guajava (P. guajava) is a medicinal plant belongs to the family Myrtaceae (Wagner et al., 1990). Its common name is guajava and Arabic name is Jewafa. The selected plant has several species and the majority of these species are essential oil-bearing plants.

About 75 genera and nearly 3000 species are available belong to the family. Most of the species are evergreen trees and shrubs and mainly grown tropical and subtropical countries (Wagner et al., 1990).

The selected plant is indigenous to Central America and some part of South America between Colombia and Peru (Sahu et al., 2016) and largely available in Mexico down to Sao Paolo state and Brazil (Almaguer et al., 1997). The plant is widely available in many countries like Nigeria, Philippines, Amazonia, Cuba, Ghana, Haiti, Malaya, India, Trinidad, and Pakistan (Sanda et al., 2011).

It is also grown in many Arabic countries like Saudi Arabia, Egypt, including Oman (Milyani and Ashy, 2012). The leaves and fruits are very important due to food and nutritional values throughout the world (Joseph and Priya, 2011) (Fig. 1). All parts of the selected plant possess well-known economic and medicinal value (Belardo et al., 1986; Kumar, 2012). In addition, the fruits, leaves, and roots of this plant are also well-known medicine in the traditional medical system (Shruthi et al., 2013).

The histochemical and phytochemical analyses showed that the plant contains several chemical compounds such as flavonoids, tannins, phenols, triterpenes, saponins, carotenoids, lectins, vitamins, fiber and fatty acids, resins, glycosides (Joseph and Priya, 2011; Gutierrez et al., 2008).
Some previous studied showed that the essential oil of the selected plant contains b-bisabolene, caryophyllene oxide, b-copanene, farnesene, humlene, selinene, cardinene, curcumene in the high percentage (Satyal et al., 2015). In addition, the essential oil also contains b-caryophyllene, apinene and 1,8-cineeole (Chen and Yen, 2007). The leaves extract was found to possess anticestoidal, analgesic, anti-inflammatory, cough sedative, anti-diarrheic, hepato-protective, antioxidant, anti-hypertension properties (Gutierrez et al., 2008).

Guava leaf powder

CHEMICAL CONSTITUENTS FROM THE LEAVES OF PSIDIUM GUAJAVA

Five constituents including one new pentacyclic triterpenoid guajanoic acid (1) and four known compounds -sitosterol (2), uvaol (3), oleanolic acid (4), and ursolic acid (5) have been isolated from the leaves of Psidium guajava. The new constituent 1 has been characterized as 3-p-E-coumaroyloxy-2- methoxyurs-12-en-28-oic acid through 2D NMR techniques and chemical transformations. This is the first report of isolation of compound 3 from the genus Psidium.

Psidium guajava (Myrtaceae) commonly known as guava is a native of tropical America and has long been naturalized in south East Asia. Different parts of the plant are used in the traditional system of medicine for the treatment of various human ailments such as wounds, ulcers, bronchitis, eye sores, bowels, diarrhoea, and cholera [1–3]. Phytochemical studies undertaken by different groups of workers on different parts of the plant have resulted in the isolation and identification of various terpenoids, flavonoids, and tannins [4–6].

In view of the attributed medicinal properties, studies were undertaken on the fresh and uncrushed leaves of the plant which resulted in the isolation and structure elucidation of one new triterpenoid guajanoic acid (1) along with four known compounds -sitosterol (2), uvaol (3), oleanolic acid (4), and ursolic acid (5). Compound 1 has been characterized as 3-p-E-coumaroyloxy-2-methoxyurs-12-en-28-oic acid based on spectral evidences and chemical transformations. This is the first report of isolation of compound 3 from the genus Psidium.

2.2 TAMARIND SEEDS

Tamarind seed is an underutilized byproduct o f the tamarind pulp industry. Only a small portion of the seed, in the form of tamarindkernelpowder(TKP),issue disseizing material in the textile, paper, and jute industries .Though many applications of this seed are possible, there have been hardly any other uses for it including using it as an additive in food formulations. The excellent gelling cum adhesive characteristics of the decorticated seed powder can lead to several applications in food and pharmaceutical industries which are evident by the number of research papers as well as patent applications.

This article thus focuses on the possibilities of using the seed in several food and non-food industries with particular reference to physical and engineering properties, hydration behavior, rheological properties, functional and nutritional characteristics, and the processing of the tamarind seed for wider applications.

Tamarind Seed powder

PROPERTIES OF TAMARIND SEED

The study of the chemical composition as well as of the physical and engineering properties of the tamarind seed and the kernel is essential for the development of useful extracted raw materials and blended foods, in the design and operation of the processing equipment, the removal of the seed coat, grinding into powder, and for storage. Data concerning these aspects are scarce.

Processing of Tamarind Seed

Tamarind seed consists of an outer hard brown testa. The testa is to be completely removed from the kernel; otherwise, undesirable effects such as depression, constipation, and gastrointestinal inflammation might result if the same is used for food purposes. The testa is separated from the kernels either by roasting or by soaking the seed in water.
Microstructure of the cross section of tamarind seed (Figure 6) shows the dicotyledons that are fused together and are enclosed by the seed coat. The latter is composed of an outer integument (elongated cells that are perpendicular to the outer surface) and an inner integument (.The thickness of these edcoatvaries is roughly between 100and250μ.

The cotyledons contain or parenchyma cells that are roughly overload in shape. The cotyledons are a composite of complex carbohydrate granules embedded in protein matrix. After roasting a gap is created between the seed coat and cotyledon that is beneficial for the removal of the seed coat.

As the mineral content of the seed coat is higher than that of cotyledon, it is expected that the thermal properties and behavior of the seed coat and cotyledons are different resulting in different extent of expansion and contraction that helps in detaching the seed coat from the seed.

Uses of Tamarind Seed

There are many possible uses for tamarind seed in food as well as in non-food industries. Tamarind seed or kernel is a byproduct of tamarind pulp industry. Tamarind seed kernels are generally used to obtain tamarind kernel powder (TKP). TKP came into commercial production in 1943 as a replacement for starch in the cotton industry as a sizing material in the Indian textile market (Gerad, 1980).

2.3. VETIVER [CHRYSOPOGON ZIZANIOIDES]

Vetiver [Chrysopogon zizanioides (L.) Robertysyn. Vetiveria zizanioides (L.) Nash] commonly known as khas-khas, khas, khus-khus or khus grass belongs to the family Poaceae. The roots of this grass on steam distillation yield an essential oil mainly consisting of sesquiterpenes (3-4 %), sesquiterpenols (18-25 %) and sesquiterpenones (7-8 %).

Among these, the major economically important active compounds are khusimol, α-vetivone and β-vetivone which constitute about 35 % of oil. The commercial grades, viz. Dharini, Gulabi and Kesari and Pusa Hybrid-7, Hybrid-8, Sugandha, KH-8, KH-40, are available in North India and South India, respectively for commercial cultivation.

The insecticidal, antimicrobial, herbicidal and antioxidant activities of essential oil and its components like vetivone, zizanal, epizizanal and nootkatone are well known. This review is an effort to collect all the information regarding chemical composition and biological activities of vetiver oil.
Chemical composition

The chemical composition of vetiver oil is influenced by various factors. Different methods of cultivation have significant effect on both the percentage yield and composition of vetiver oils. Among the three cultivated systems (normal soil, normal soil with added microbes and semihydroponic), the system utilizing microbes gave the highest yield of essential oil along with higher content of γ-vetivenene in addition to some low molecular weight volatiles such as 2-norzizaene and its derivatives.

However, volatile component profile of oils obtained by normal soil and hydroponic cultivation were found to be similar30. Similarly, tissue cultured vetiver (cleansed of bacteria and fungi) produced only trace amounts of oil and a strikingly different composition compared to the oils from non-cleansed (normal) vetiver plants.

Vetiver Plant Powder

III. TESTING OF WASTE WATER

CHARACTERISTIC OF WASTEWATER:

Waste water contains physical, chemical, and biological pollutants. Households may produce waste water from flush toilets, sinks, dish washes, washing machines, bathtubs, and showers. Municipal wastewater is mainly comprised of water (99.9%) with relatively small concentration of suspended and dissolved organic and inorganic solids. Among the organic substances present in sewage are carbohydrates, lignin, fats, soaps, synthetic detergent, proteins and their decomposition products as well as various natural and synthetic organic chemical from the process industries.

S.No.	Parameter	Value
1	pH	9
2	Color	Greenish yellow
2	Alkalinity	660mg/L
3	Hardness	1010mg/L
4	Chloride	900mg/L
5	TDS	1784mg/L
6	Fluoride	5.0mg/L
7	Iron	0 mg/L
8	Ammonia	5.0mg/L
9	Nitrite	2.0mg/L
10	Nitrate	150mg/L
11	Phosphate	2.0mg/L
12	Residual Chlorine	0.8mg/L
13	COD	420mg/L
14	BOD	1930 mg/L

TREATMENT OF WASTE WATER BY USING FRUIT PEELS, ORGANIC MATERIALS

There are more types of organic materials are available. Here guava leaf powder, tamarind seed powder, and vetiver powder are more effective in treating the household wastewater. More quantity of wastewater can be treated by using less (1% to 5%) amount of organic materials. In our present study, guava leaf, tamarind seed, and vetiver powder used to treat the household waste water with different percentages.

Organic materials have unique characteristics for example large surface area, size, shape and dimensions that make them particularly attractive for wastewater treatment applications such as disinfections, adsorption, and membrane separation.

In this present study, the treatment of household wastewater by using three different organic materials namely guava leaf, tamarind seed, and vetiver powder is analyzed. The organic materials are mixed with domestic water in different percentages as 25%, 75%, and 100%. After mixing the organic materials into the household waste water, the characteristics of treated (mixed) waste water is analyzed.

CHARACTERISTICS OF TREATED WATER USING PSIDIUM GUAJAVA (GUAVA)

S.No	Parameter	5% powder	15% powder	25% powder
1	pH	8.5	7.0	6.5
2	Color	colorless	colorless	colorless
3	Alkalinity	600mg/L	550mg/L	570mg/L
4	Hardness	750mg/L	610mg/L	550mg/L
5	Chloride	850mg/L	870mg/L	700mg/L
6	TDS	2640mg/L	2436mg/L	2184mg/L
7	Fluoride	5mg/L	5mg/L	3mg/L
8	Iron	3mg/L	2mg/L	0.3 mg/L
9	Ammonia	2mg/L	1mg/L	0.5mg/L
10	Nitrite	1mg/L	0.2mg/L	0.5mg/L
11	Nitrate	45mg/L	78mg/L	110mg/L
12	Phosphate	2mg/L	1mg/L	0.5mg/L
13	Residual Chlorine	0.5mg/L	0.3mg/L	0.4mg/L
14	COD	1430mg/L	1400mg/L	1390mg/L
15	BOD	400 mg/l	380mg/L	370mg/L

CHARACTERISTICS OF TREATED WATER USING TAMARIND SEED

S.No	Parameter	5% powder	15% powder	25% powder
1	pH	7.5	6.5	7.0
2	Color	colorless	colorless	colorless
3	Alkalinity	680mg/L	580mg/L	500mg/L
4	Hardness	870mg/L	650mg/L	640mg/L
5	Chloride	890mg/L	770mg/L	960mg/L
6	TDS	2928mgL	2400mgL	2520mgL
7	Fluoride	5mg/L	3mg/L	2mg/L
8	Iron	3mg/L	2mg/L	2mg/L
9	Ammonia	2mg/L	1mg/L	3mg/L
10	Nitrite	0.5mg/L	0.4mg/L	0.3mg/L
11	Nitrate	50mg/L	40mg/L	75mg/L
12	Phosphate	1.5mg/L	1.2mg/L	2mg/L
13	Residual Chlorine	0.5mg/L	0.4mg/L	0.4mg/L
14	COD	1130mgL	1100mgL	1092mgL
15	BOD	240 mg/l	230mg/L	230mg/L

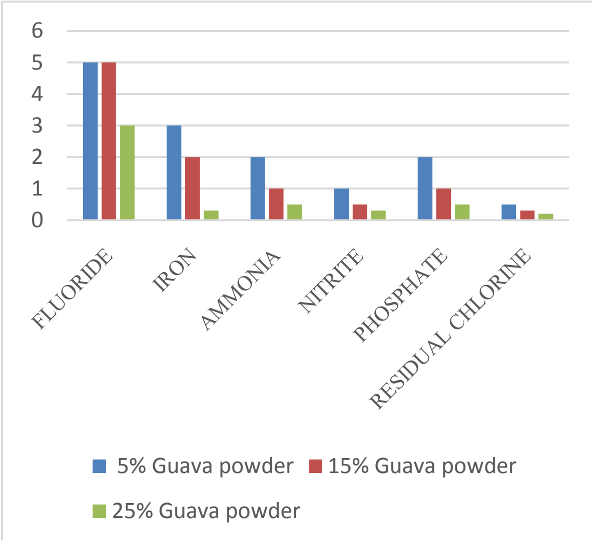
CHARACTERISTICS OF TREATED WATER USING VETIVER POWDER

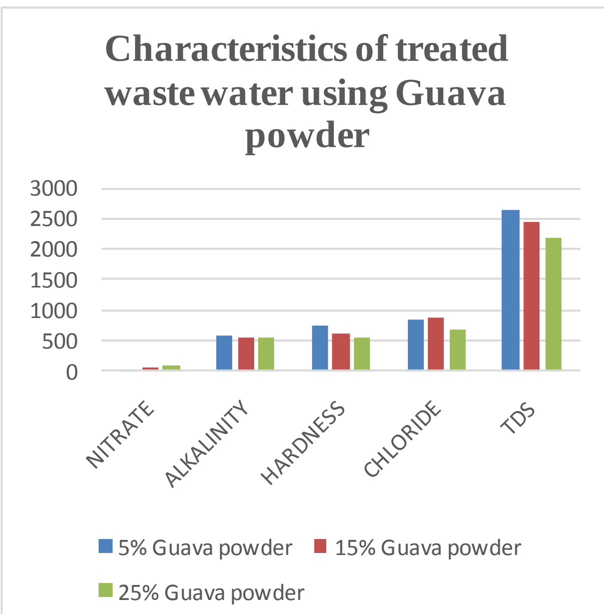
S.No	Parameter	5% powder	15% powder	25% powder
1	pH	7.5	7	6.5
2	Color	colorless	colorless	colorless
2	Alkalinity	560mg/L	450mg/L	610mg/L
3	Hardness	590mg/L	590mg/L	520mg/L
4	Chloride	880mg/L	670mg/L	880mg/L
5	TDS	2436mgL	2052mgL	2412mgL
6	Fluoride	5mg/L	3mg/L	3mg/L
7	Iron	3mg/L	2mg/L	1mg/L
8	Ammonia	3mg/L	2mg/L	0.5mg/L
9	Nitrite	1mg/L	0.4mg/L	0.2mg/L
10	Nitrate	75mg/L	110mg/L	120mg/L
11	Phosphate	2mg/L	1mg/L	0.4mg/L
12	Residual Chlorine	0.5mg/L	0.3mg/L	0.2mg/L
13	COD	930mg/L	920mg/L	890mg/L
14	BOD	240 mg/l	230mg/L	230mg/L

IV. RESULTS

COMPARISON RESULTS OF TREATED WATER USING GUAVA POWDER:

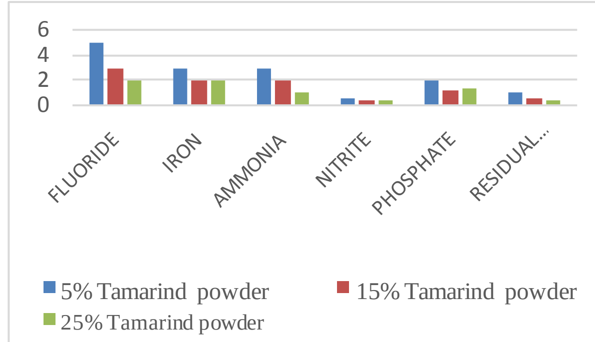
The removal efficiency of treated water using Guava powder with various percentages of 5%, 15% & 25% is increased by increasing percentages of Guava powder. The efficiency of treated water is increased from 60% to 80% by using Guava powder of 5%, 15% and 25%.

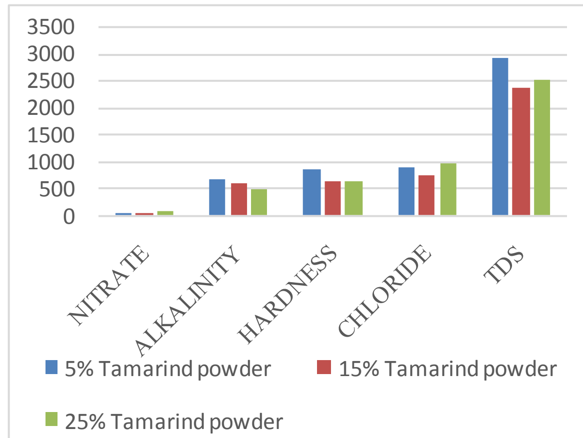




COMPARISON RESULTS OF TREATED WASTE WATER USING TAMARIND SEED POWDER

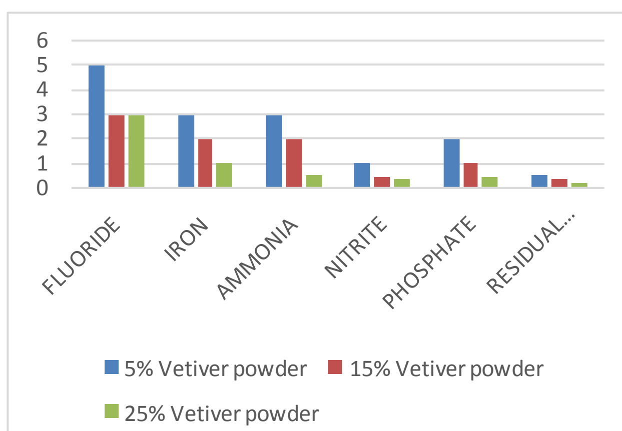
The removal efficiency of treated water using Tamarind powder with various percentages of 5%, 15%, and 25% is increased by increasing percentages of tamarind powder. The removal efficiency of treated water is increased from 60% to 80% by using tamarind powder of 5%, 15% and 25%.

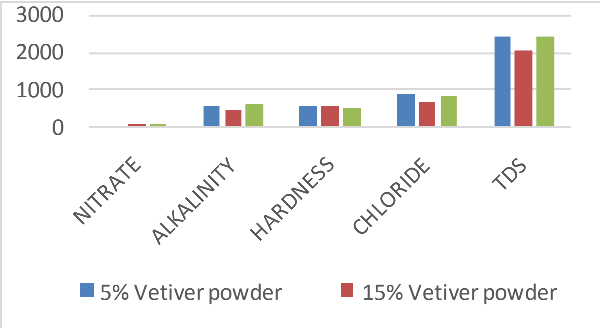




COMPARISON RESULTS OF TREATED WATER USING VETIVER POWDER

The removal efficiency of treated water using Vetiver powder with various percentages of 5%, 15%, and 25% is increased by increasing percentages of vetiver powder. The removal efficiency of treated water is increased from 60% to 80% by using vetiver powder of 5%, 15%, and 25%.





IV. CONCLUSION

From the results it is found that all the natural materials used for water purification is useful. When added by 10%,15%, & 25% all of the ingredients shows 60-80% increase in efficiency in water quality. So the suitable and easily available natural materials can be used for treating water. Even a combination of all these ingredients can also be used.

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