



In the Name of Allah
Sudan University of Science and Technology
College of Graduate Studies



Coagulation and Antimicrobial Activities of Moringa oleifera Seeds in Water Purification

**فعالية بذور المورينجا كمسبب وكمضاد للميكروبات في تنقية
المياه**

**A Thesis Submitted in Partial Fulfillment of the Requirements of the Master Degree in
Chemistry**

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بسم الله الرحمن الرحيم

قال تعالى:

{وَأَسْقِينَاكُمْ مَاءً فَرَاتًا}

صدق الله العظيم

سورة المرسلات الآية (27)

Dedication

I dedicate this work to my

-parents

-husband

-sister and brothers

Acknowledgement

- Praise to Allah, Almighty, who gave me health and patience to accomplish this work.
- I would like to express my deep and sincere thanks to my supervisor Dr. Kamal Mohamed Saeed for his invaluable help, guidance, and suggestions.

ABSTRACT

In this study, proximate analysis, jar test, turbidity, pH measurement and microbial count were carried out, to evaluate the coagulation and antimicrobial activities of obtained by solvent *Moringa oleifera* seeds. Defatted *Moringa oleifera* seeds extraction of *Moringa oleifera* seeds powder used n-hexane and seed cake was dried. Protein was obtained by extraction used NaOH. Results of this study revealed that seeds powder is rich in lipids (33.33%) and has carbohydrate, protein, moisture and ash content of 31.64%, 25.70%, 6.00%, 3.33% respectively. The pH of *Moringa oleifera* treated water were not significantly increased at the tested dose levels (50 – 500 mg/L), the pH Value of raw water 8.0 and treated water observed 7.9. The coagulation and antimicrobial efficiency of *Moringa* seeds, defatted seeds and protein extract solutions were carried out at different concentration in turbid surface water. There was progressive decrease in coliform count as seed dose increases, the lowest values 9×10^2 MPN/mL, 6×10^2 MPN/mL and 2×10^2 MPN/mL respectively at the dose (500mg/L) and the lowest turbidity values 14.3 NTU, 8.9 NTU and 5 NTU respectively at the dose 500 mg/L. These findings suggest that *Moringa oleifera* seeds good coagulation and antimicrobial.

مستخلص البحث

في هذا البحث حدد التركيب التقريبي لبذور المورينجا وتم قياس تأثيرها على العكارة والرقم الهيدروجيني لتقييم فعالية بذور المورينجا كمرسب و كمضاد للميكروبات. وتم الحصول على البذور منزوعة الدهن باستخدام طريقة الاستخلاص بالمذيب (الهكسان) وتم الحصول علي البروتين بالاستخلاص باستخدام NaOH. أوضحت النتائج أن محتوى الدهون و الكربوهيدرات والرطوبة والرماد على التوالي 33.3 و 31.64 و 25.70 و 6.00 و 3.33 % ، والرقم الهيدروجيني للمياه المعالجة ببذور المورينجا لم يتغير كثيرا من الرقم الهيدروجيني للمياه الغير معالجة حيث ان الرقم الهيدروجيني للمياه الغير معالجة 8.0 وللمياه المعالجة 7.9 . تم تحضير محاليل من بذور المورينجا و البذور منزوعة الدهن ومستخلص البروتين بتراكيز مختلفة ولوحظ من النتائج انخفاض البكتريا بزيادة تركيز المحلول وأقل قيم سجلت على التوالي 9×10^2 MPN/mL ، 6×10^2 MPN/mL و 2×10^2 MPN/mL عند التركيز (500mg/L) ، وأقل قيم للعكارة على التوالي 14.3 NTU، 8.9 NTU و 5 NTU ، عند تركيز 500 mg/L . من هذه النتائج المتحصل عليها يمكن إستخدام بذور المورينجا كمرسب جيد وكمضاد للميكروبات.

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Chapter one

INTRODUCTION AND LITERATURE REVIEW

CHAPTER ONE

Introduction

1-0 Introduction

Water is used for several purposes by humans but the level of purity of the water consumed is very crucial since it has a direct effect on health. Surface and ground water is polluted from agriculture, domestic and industrial activities. The quality and accessibility of drinking water are of permanent importance to human health. Drinking water may contain disease-causing agents and toxic chemicals and to control the risks to public health, systematic water quality monitoring and surveillance are required. When surface water is used for drinking water production, turbidity removal is an essential part of the treatment process. It is generally achieved using coagulation with metal salts followed by aggregation of particles through sedimentation and filtration. The conventional method of water purification using aluminum sulphate (alum) and calcium hypochlorite adds thousands of chemicals in drinking water supplies around the world and are considered potentially hazardous to human health at relatively high concentrations (World Health Organization WHO(2007)).

Most of the chemicals used in water purification and production are imported thereby making it expensive and beyond the reach of most people in the rural areas. Hence, they resort to sources such as clams, dug outs, streams, rivers and lakes.

Water from these sources is usually turbid and contaminated with micro-organisms that cause many diseases including guinea worm and bilharzias. Water-borne diseases are one of the main problems in developing countries, about 1.6million people were compelled to use contaminated water and more than a million people die from diarrhea each year. Water borne diseases still remain one of the major

causes of human morbidity and mortality in developing countries especially in the rural areas, where there is inadequate or no pipe-borne water supply. The possibility of use of plants that is inexpensive and easily available such as *Moringa oleifera* “Zogale” to remove turbidity, colour and reduce the microbial load in raw water, a function played by chemicals such as alum, will provide a cheap source of portable drinking water.

Most of the chemicals used in water purification and production are imported thereby making it expensive and beyond the reach of most people in the rural areas. Hence, they resort to sources such as clams, dug outs, streams, rivers and lakes.

Bacterial and fungal infections are wide spread throughout the world. The situation is more critical especially in developing countries where in most cases lack of adequate sanitation and primary health care programs make it difficult and expensive to combat diseases, this has encouraged scientists to screen higher plants for various biological activities including antibacterial and antifungal effects (Eilert and Walters (1980)-Saadabiet a(2000)). About 40% of pharmaceuticals are derived from natural sources (plant, animals, bacteria and fungi). Moreover several natural products obtained from medical plants lead to the development of various pharmaceuticals and analogues or derivatives. Recently, focus on plant research has increased and a large body of evidence has been collected to show immense potential medical plants used in various traditional system (Ernest *et al* (2007)). *Moringa oleifera* (vernacular name Alruway “the tree for purifying”, family (*Moringaceae*) is a topical tree with a capsulated and dehiscent fruit(NJoku and Adikwup(1997)). Report has been made on the finding of the antibiotic principle of *Moringa oleifera* seed through their purification, elucidation and antimicrobial properties (Eilert and Walters(1981)).

1-1 *Moringa oleifera*

Moringa is the only genus in the family *Morinagaceae*. The genus comprises 13 species, all of which are grown in tropical and sub-tropical climates. The most species is *Moringa oleifera* (Albeeht 1993).

1-1-1 Species identity

World Agroforestry Centre stated that

Taxonomy

Kingdom: Plant

Subkingdom: *Viridiplantae*

Infrakingdom: *Streptophyta*

Division: *Tracheophyta*

Subdivision: *Spermatophytina*

Infradivision: *Angiospermae*

Class: *Rosanae*

Order: *Brassicales*

Family: *Morinagaceae*

Genus: *Moringa*

Species: *Moringa oleifera*

Synonym

Guilandina: *Moringa*

Moringa: *Pterygosperma*

Gaertn.

(Arabic): Rawag

(English): Ben-oil tree, Cabbage tree, Clarifier tree, Drumstick tree, Horseradish tree, *Moringa* tree(Albeecht J(1993)).

1-1-2 Botanic Description

Moringa is a small, shrub or tree that can reach 12m in highest at maturity and can live for up to 20 years. A short but intense life .

A life in the fast lane *Moringa* is perhaps the fastest growing of all trees as it can reach to 3m in just 10 months after the seed is planted. It has deep roots, and therefore it can survive in dry regions, and a wide-open crown with a single stem.

Moringa produces cream colored flowers when it is 8 months old and flowering season begins in January and continues through to March. The *Moringa* fruits ripens from April to June and the pods are triangular in cross section, 30 to 50cm long and contain oily, black, winged seeds (Verzosa and Caryssa(2012)).



(1-1) *Moringa oleifera* Tree



(1-2) *Moringa oleifera* Flowers



(1-3) *Moringa oleifera* Fruits



(1-4) *Moringa oleifera* Seeds with it shell



(1-5) *Dehulled Moringa* Seeds

1-2 Distribution

Moringa tree is grown mainly in semi-arid, tropical and subtropical areas. While it grows best in dry sandy soil, it tolerates poor soil, including coastal areas. It is a fast-growing, drought-resistant tree that's native to the southern foothills of the Himalayas in northwestern India.

Reports that it grows wild in the middle east of Africa are completely unsubstantiated. Today it is widely cultivated in Africa, Central and South America. Sri Lanka, India, Mexico, Malaysia, Indonesia and the Philippines.

A traditional food plant in Africa, this little-known vegetable has potential to improve nutrition, boost food security, foster rural development, and support sustainable land care (National research council (2006)).

1-3 Cultivation

In the Philippines *Moringa oleifera* is propagated by planting 1-2m long limb cuttings preferably from June to August. The plant starts bearing pods 6 – 8 months after planting, but regular bearing commences after the second year, continuing for several years. It can also be propagated by seeds,

Which are planted and inch below the surface and can be germinated year - round in well-draining soil. As with all plants, optimum cultivation depends on producing the right environment for the plant to thrive. *Moringa oleifera* is a sun and Heat-loving plant, and thus dose not tolerate freeze or frost (Food and Agriculture Organization of united Nations (1999)).

Moringa is common in India, were its triangular, ribbed pods without expensive irrigation techniques. The yield is good even if the water supply is not. The tree can be grown even on land covered with 10-30 cm of mud (Rajangam (2001)).

Moringa is grown in home gardens and as live fences in Thailand, where it is commonly sold in local markets. In the Philippines, *Moringa* commonly sold in local markets. *Moringa* is also actively cultivated, by the principal international center for vegetable research and development in the world, in Taiwan. Its mission is to reduce poverty and malnutrition in developing countries through improved production and consumption of vegetables (Food and Agriculture Organization of united Nations (1999)).

1-4 Nutrition

The immature green pods called “drumstick” are probably the most valued widely used part of the tree.

They are commonly consumed in India and are generally prepared in a similar fashion to green beans and have a slight asparagus taste. The seeds are sometimes removed from more mature pods and eaten like peas or roasted like nuts. The flowers are edible when cooked and are said to taste like mushrooms. The roots are shredded and used as a condiment in the same way as horseradish; however, they contain the alkaloid spirochin, a potentially fatal nerve-paralyzing agent.

State that, the leaves are highly nutritious, being a significant source of beta-carotene, vitamin C, Protein, iron and potassium. The leaves are cooked and used like spinach, its leaves are commonly dried and crushed in to a powder, and used in soups and sauces. The tree is good source of calcium and phosphorus(Peter (2008)).

Moringa leaves and pods are helpful in increasing breast milk in the breast feeding months. One tablespoon of leaf powder provide 14% of the protein, 40% of the calcium, 23% of the iron and most of the vitamin A needs of a child aged one to three. Six tablespoons of leaf powder will provide nearly all of a woman’s daily iron and calcium needs during pregnancy and breastfeeding. *The Moringa* seeds yield 38 – 40 % edible oil (called Ben oil from the high concentration of behenic

acid contained in the oil).The refined oil is clear and are odorless and resists rancidity at least as well as any other botanical oil.The flowers are also cooked and relished as a delicacy in west Bengal and Bangladesh especially during early spring. It is usually cooked with green peas and potato (Michael (2010)).

Moringa trees have been used to combat malnutrition, especially among infants and infants and nursing mothers. Three non-governmental organization in particular – Trees for life, Church World service, and Educational Concerns for Hunger Organization have advocated *Moringa* as “natural nutrition for many month without refrigeration, and reportedly without loss of nutritional value(Fuglie (1999)).

Moringa is especially promising as a food source in the tropics because that tree is leaf at the end of the dry season when other foods are typically scarce (Fahey (2005)).

A Large number of reports on the nutritional qualities of *Moringa* now exist in both the scientific and the popular literature. *Moringa* leaves contain more vitamin A than carrots, more calcium than milk, more iron than spinach, more vitamin C than oranges, and more potassium than bananas, and the protein quality of *Moringa* leaves rivals that of milk and eggs,However , that leaves and stem of *Moringa oleifera* are known to have large amounts of their calcium available to the body(Olson (2001)).

The claim of “more calcium than milk” includes this non-bio available calcium needs to be addressed. The oral histories recorded by Lowell Fuglie in Senegal and throughout West Africa report countless instances of lifesaving nutritional rescue that attributed to *Moringa* (Fuglie (1999)).

The nutritional properties of *Moringa* are now so well-known that there seems to be little doubt of the substantial health benefit to be realized by consumption of *Moringa* leaf powder in situations where starvation is imminent.

Nonetheless, the outcomes of well-controlled and well-documented clinical studies would still be clearly of great value.

In Many cultures throughout the topics, differentiation between food and medicinal uses of plants (e.g. bank, Fruit, leaves, nuts, seeds, tubers, roots, and flowers), is very difficult because plant uses span.

Both categories and this is deeply ingrained in the traditions and the fabric of the community.

In traditional Indian medicine , children and adults used to drink a cup of “decoction” every Sunday, normally after an oil path, made of ginger, garlic a piece of *Moringa* tree bark and Mavelingam tree bark, and the root nodules of the kolinji plant(Lockett (2000)).

1-5 Uses

Its uses are as unique as the names it is known by, such as unique as the names it is known by, such as clarifier tree. Horseradish tree drumstick tree (referring to the large drumstick shaped pods) and in east Africa it is called “mother’s best friend” also called the tree of life. World Health Organization has been studying and using the plant for the last forty years as a low cost health enhancer in the poorest countries around the world, there is a reason why it’s still relatively unknown.

Moringa is a healer, food magician, beauty and beautician, a plant with surprising water purification capabilities, a best friend and humanitarian who works for so little. It is one of the most useful trees on earth. *Moringa* makes a major contribution to human and animal health; in many cases, it can mean the difference between life and death. Absolutely no negative effects to daily consumption of *Moringa* leaves have ever been reported. There is much evidence from a round the world, from various tradition and cultures that have used this Miracle Tree for so many ailments and troubles(Vogt K (1995)).

1-5-1 Using *Moringa* in traditional medicine

The leaves, fruits, seeds, roots, bark, flowers and gum each possess their own particular medicinal virtues.

All these uses have not been scientifically verified, but *Moringa* is considered an effective treatment for anemia, loss of appetite and it increases lactation in women. It also combats gastric discomfort, stomach ulcers, diarrhea, dysentery, colitis and can be used as laxative. Purgative and a discomfort, muscular cramp, bruises and bruises-skin infections, scabies, ring worm and insect bites. In certain case of diabetes, *Moringa* can be used to stabilize sugar levels and can stabilize arterial tension; however the roots peelings must never be given to pregnant women.

The leaves are believed to have a stabilizing effect on blood pressure and control glucose levels. They are also used to treat anxiety, and inflammation of the colon, scurvy, intestinal parasites.

Moringa is so safe, it can be consumed by children and nursing mothers. Students athletes, working professionals, and elderly, will all benefit from over 90 bio-nutrients delivered to the body, to improve clarity, focus, and concentration.

A health blood sugar levels and provides nutritional support for diabetics,

They aid in eliminating toxins, stimulating digestion, and strengthening the immune system. *Moringa* in Tamil Nadu and Kerala is used in Siddha medicine.

In Siddha medicines, these drumstick seeds are used a sexual virility drug for treating erectile dysfunction in men and also in women for prolonging sexual activity.

So many benefits from a single plant. No wonder that *Moringa oleifera* is called nature's most nutritious super food (Hartwell (1967)).

1-5-2 Culinary Uses

The fruit of the tree is quite popular as a vegetable in Asia and Africa. The fruit is a long thin pod resembling a drum stick. The fruit itself is called drumstick in India

and elsewhere. *Moringa* leaves are also eaten as a leaf vegetable, particularly in the Philippines, South India and Africa.

a- India

In South India the *Moringa* pod is used to prepare a Variety of sambar and is also fried. In other parts of India, especially West Bengal and also in neighboring countries like Bangladesh, it is enjoyed very much. It is made in to a variety of curry dishes by mixing with coconut, poppy seeds, and mustard or boiled until the drumstick are semi-soft and consumed directly without any extra processing or cooking. It is used in curries sambars, kormas, and dals, although it is also used to add flavor to cutlets. In Maharashtra, the pods are used in sweet and sour curries.

Tender drumstick leaves, finely chopped, are used as garnish for vegetable dishes, dals, sambars, salads, etc. It is also used in place of or along with coriander, as these leaves have high medicinal value. In some regions the flowers are gathered and cleansed to be cooked with besan to make pakoras. It is also preserved by canning and exported worldwide (Elizabeth (2001)).

b- Philippines

In the Philippines, the leaves are widely eaten. Bunches of leaves are available in many markets, priced below many other leaf vegetables. The leaves are most often to broth to make a simple and highly nutritious soup. The leaves are also sometimes used as a characteristics ingredient in tinola, a traditional chicken dish consisting of chicken in a broth, *Moringa* leaves, and either green papaya or another secondary vegetable. The leaves can also be processed with olive oil and salt for a pesto-like paste sauce that has become popular on the Filipino culinary scene.

The leaves are now used in making “polvoron” , which is a milky and powdered snack.

In Leyte, extracted *Moringa* juice is mixed lemonsito juice to make ice candies or cold drinks, making it more palatable and agreeable to children who dislike vegetables.

On September 14, 2007, Senator Loren Legarda campaigned for the popularization of *Moringa*. She asked the government to make *Moringa* among its priority crops for propagation. The Bureau of Plant Industry, in its report, stated that weight per weight, *Moringa* leaves have the Calcium equivalent of 4 glasses of milk, the vitamin C content of 7 Oranges, potassium of 3 pananas, 3 times the iron of spinach, 4 times of vitamin A in carrot, and 2 times the protein in milk.

c- Maldives

The leaves are often fried and mixed with dried-fried tuna chips, onions and dried chillies and eaten along with rice and curry. The pods are used to cook a mild curry.

d- Myanmar

The fruit meat of drum sticks, including young seeds, is used for soup. Young leaves can either be fried with shrimp or added as topping in fish soup. Leaves soup is said to increase urination and thus benefit the kidneys. It is widely used in Myanmar traditional medicine (Food and Agriculture Organization of United Nations (1999)).

1-5-3 Other Uses of *Moringa*

All part of *Moringa* trees are edible and have long been consumed by humans. The many uses for *Moringa* include:

Alley cropping (biomass production), animal forage (leaves and treated seed-cake), biogas (from leaves) ,domestic cleaning agent (crushed leaves) , blue dye (wood), fencing (living trees) fertilizer (seed-cake) , foliar nutrient(juice expressed from the

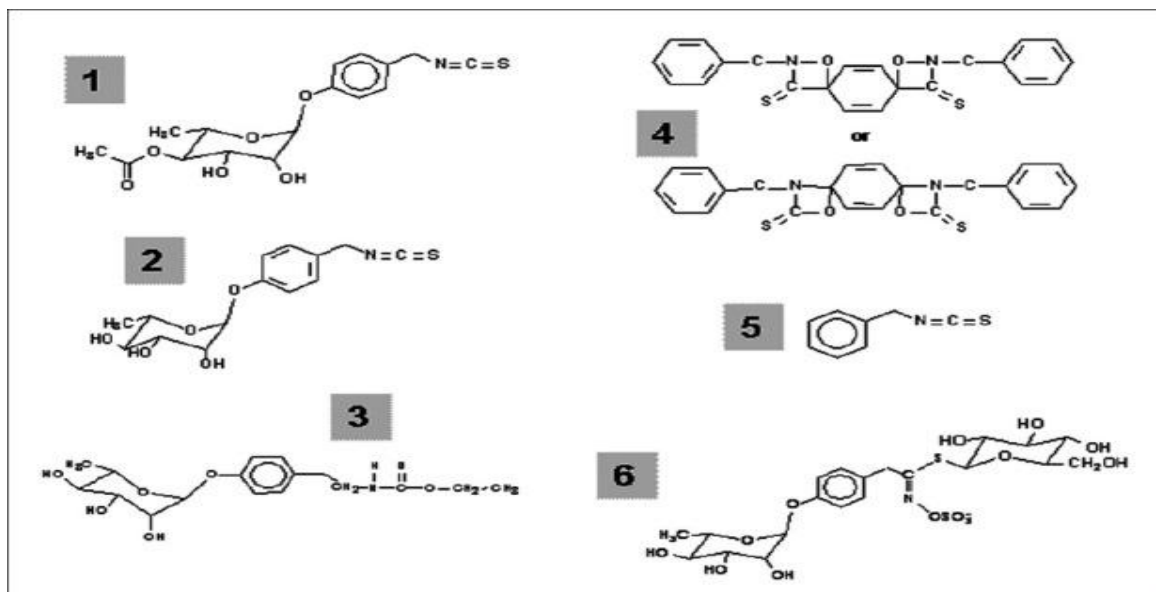
leaves) , green manure (from leaves), gum (from tree trunks), honey-and sugar cane juice-clarifier(powdered seeds), honey(flower nectar), medicine (all plant parts), ornamental plantings, biopesticide (soil incorporation of leaves to prevent seedling damping off), pulp(wood), rope(bark), tannin for tannin hides (bark and gum), water purification (powdered seeds). *Moringa* seed oil (yield 30 – 40% by weight), also known as Ben oil, is a sweet non-sticking, non-drying oil that resists rancidity. It has been used in salads, for fine machine lubrication and in the manufacture of perfume and hair care products. In the West, one of the best known uses for *Moringa* is the use of powdered seeds to flocculate contaminants and purify drinking water, but the seeds are also eaten green, roasted, powdered and steeped for tea or used in curries. The tree has in recent times been advocated as an outstanding indigenous source of highly digestible protein, Ca, Fe, Vitamin C, and carotenoids suitable for utilization in many of the so-called “developing” regions of the world where undernourishment is a major concern (Fuglie (1999)).

1-6 Photochemistries

The Photochemicals are, in the strictest sense of the word, chemicals produced by plants. Commonly, though, the word refers to only those chemicals which may have an impact on health, or on flavor, texture, smell, or color of the plants, but are not required by human as essential nutrients. An examination of the phytochemicals of *Moringa* species affords the opportunity to examine a range of fairly unique compounds. In particular, this plant family (*moringaceae*) is rich in compounds containing the simple sugar, rhamnose, and it is rich in a fairly unique group of compounds the called glucosinolates and isothiocyanate, for example, specific components of *Moringa* preparations that have been reported to have hypertensive, anticancer, and antibacterial activity include 4-(4, -O-acetyl- α -L-rhamnopyransyloxy) Benzyl glucosinolate. While these compounds are relatively unique to the *Moringa* family, it is also rich in a number of vitamins and minerals

as well as other more commonly recognized phytochemicals such as carotenoids (including-carotene or pro-vitamin A)(Fuglie(1999)).

Structure of selected phytochemicals from Moringa



[1] 4-(4, -O-acetyl-a-L-rhamnopyransyloxy) Benzyl glucosinolate.

[2] 4-(a-L-rhamnopyransyloxy) Benzyl glucosinolate.

[3] niazimicin.

[4] pterygospermin.

[5] benzyliothiocyanate.

[6] 4-(a-L-rhamnopyransyloxy) Benzyl glucosinolate

1-7 *Moringa* Seeds

The seeds of the *Moringa oleifera* plant are among the most nutritious and useful, these versatile seeds can be used in a variety of ways including as medicinal and herbal remedies, as nutritional supplements and for industrial agricultural purposes. *Moringa* seeds are edible in both fresh and dried forms and along with the seed pods that contain them, can be properties of the *Moringa* seed are well documented in the scientific literature and further supported by the experiences of generations of traditional practitioners.

While many parts of *Moringa oleifera* trees deemed useful, the seeds are especially prized for their medicinal powers. The seeds have valuable properties that enable them to treat a wide array of illnesses and conditions.

The National Charity for Organic Growing has studied the efficacy of *Moringa oleifera* seeds as a medical treatment and found that they provide legitimate relief for many medical Problems. These include rheumatism, gout, sexually transmitted disease, urinary infections, boils, and even epilepsy.

When used as medicine, the seeds where pounded and mixed with coconut oil.

Often, seed oil derived from the *Moringa oleifera* seeds will be used in place of the mashed seeds (Fahey (2005)).

1-7-1 *Moringa* seeds in traditional Medicine

The seeds of the *Moringa* plant have been used in Ayurveda medical practice for centuries to treat a variety of *Moringa* seeds make them valuble in poultices and topical treatments for bacterial infections and other conditions of the skin. Taken internally, *Moringa* seeds have traditionally been used to reduce the frequency of epileptic fits and to treat arthritis and rheumatoid disorders. *Moringa* seeds are also recommended by traditional practitioners to treat a variety of sexual dysfunctions and to improve sex drive in both men and women (Astutiet al (2007)).

1-7-2 Modern medical use

The antibiotic properties of *Moringa* seeds have been proven in laboratorytesting. *Moringa* seeds can be used to treat fungal infections as well due to the presence of pterygospermin, a naturally occurring antibiotic present throughout the *Moringa* plant. Additionally, the high protein and iron content of these seeds make them a valuble resource in combating malnutrition and anemia in developing regions of the world (Fahey (2005)).

1-7-3 Nutritional value

Moringa oleifera seeds are eaten like green peas. The peas are harvested until they harden and strained or boiled to remove the bitter coating. The seeds offer

concentrated nutrients including amino acids, proteins, and a wide range of vitamins and minerals, making them an outstanding supplement for stressed and hurried individuals and a solid source of nutrition for undernourished populations around the world .

The nuts can be served fresh or dried and often are pressed to remove the oil contain, which is useful for cooking and can be added to other dishes to boost their nutrient content as well (Vermaet *al* (1976)).

1-7-4 Water Purification

Moringaoleifera seed powder is particularly effective in purifying water. This is important in many societies, where the only drinking water available may come from dirty river or lake. The *Moringaoleifera* seed powder removes dirt by joining with particles and sinking to the bottom. It also is extremely effective in removing harmful bacteria from bodies of water. *Moringa* seeds can serve to purify it for drinking and other uses. This cleansing property is the result of the coagulating nature of the *Moringa* seed.

Which can speed water clarification allow water to settle and become safe to drink much more quickly. The use of *Moringa* seeds in water purification is expected to provide healthier, safer drinking water for many areas of the world in which technologically advanced methods are not available.

So extract from the seeds is used as a flocculent in a low-cost form of water treatment. In February 2010, current protocols in Microbiology published a step by step extraction and treatment procedure to produce “90.00 to 99.99%” bacterial reduction (Michael (2010)).

1-7-5 Agriculture

Ground and defatted *Moringa* seeds can be used to supplement animal feed or as fertilizer for crops and enrichment of soil, allowing farmers and ranchers to enjoy increased production and improved results from their agricultural endeavors.

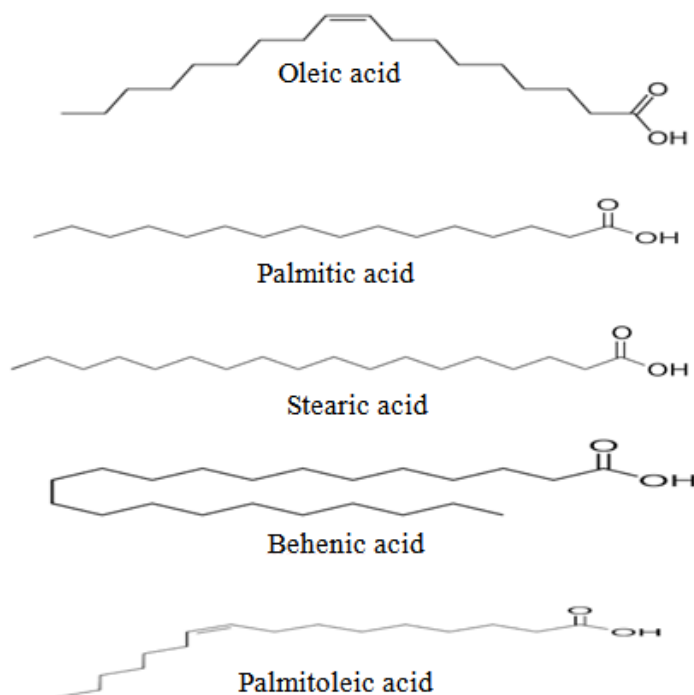
1-7-6 A source of bio fuel

Because *Moringa* seeds are rich in natural oil, they have been considered as potential source for biofuel materials. Newer extraction techniques may make this even more profitable and prevalent as fossil fuels supplies continue to shrink.

Concluded that, the *Moringa oleifera* tree provides some of the most useful and valuable seeds on earth. The *Moringa oleifera* seeds create powerful and natural medicine used to purify water, feed animals and clean cooking. The extracts can produce powerful fertilizers and pesticides that keep other plants healthy(Rashid *etal* (2008)).

1-8 *Moringa oleifera* seeds oil

Ben oil is pressed from the seeds of the *Moringa oleifera*. The oil is characterized by an unusually long shelf life and a mild, but pleasant taste. The name of the oil is derived from the high quantity of behenic (Ndabigengesere *et al*(2008)).



Seeds offer a relatively high yield of 22-38% oil, Ben oil has been used for thousands of years as a perfume base, and continues to be used in the capacity today. The oil can also be used as a fuel, also used as an excellent lubricant for metals to lubricate fine watches. It burns with a clear light and without smoke. It is lighting oil in oil lamps as it produces a practically smoke-free, clean light(Burkill (1966)).

1-8-1 Cosmetic:

Moringa seed oil is fatty oil. Vitamins A, B, C, E, unsaturated fatty acids and Palmitoleic, oleic and linoleic acids provide its great moisturizing and nourishing qualities. *Moringa* seed oil contains 1,700 antioxidants and is considered by experts to be one of the greatest cosmetic oils ever discovered(Ramachan *et al* (1980)).

Uses in Industry for:

- As a beauty oil, smoothed on skin
- In shampoos and hair conditioners
- In beauty creams and lotions
- For making soap
- In perfumes, as base

a-Skin care

Moringa seed oil is very fatty oil soft and nice to use. Despite its fattiness, it is readily absorbed by the skin. It is especially good to use for mature and dry skin and skin which has difficulty retaining its moisture. A special quality is that gives shine to the skin and lips when added to lip glosses, face oils and olive oil. The quantities of mono-saturated fatty acids give it good properties and make it particularly suitable for whole body.

Moringa oil has excellent antioxidant properties and is high in oleic acid, both of which are considered to be factors behind its remarkable oxidative stability and

therefore long shelf life. It spreads easily on the skin. This makes it excellent massage or aromatherapy oil or ingredient in creams, locations peeling and cleansing scrubs, balms, and hair care products. It also has nourishing, cleansing and emollient properties.

With high concentration of antiseptic and anti-inflammatory properties, use *Moringa* seed oil to help heal minor skin complaints. Great for psoriasis and eczema. Reduces the appearance of fine lines wrinkles, purifies the skin.

Exceptional ant-aging properties. Antioxidants and the nutrients degrade the free radical in the skin. Useful in removing environment pollutants out of the body. Natural detoxify and cleanser. Encourages skins natural health and glow. Help diminish wrinkles, pimples, and black heads.

B-Hair care

Moringa oil is useful in removing environment pollutants out of the hair. Beneficial in hair and scalp conditions. Gives hair a shine when used in hair oils and hair packs.

1-8-2 Cooking

Moringa oil is fatty oil with a subtle, nutty flavor and a slight yellow colour. Due to high quantities of saturated and mono-unsaturated fatty acids is very good cooking oil. (Smoke point 200C). Gives a buttery flavor and a lovely taste when used:

- For cooking oil
- As salad dressing
- Base for mayonnaise
- Stir-fry oil
- In sauces

- with herbs, for dipping bread
- To make popcorn
- Added to butter for garlic bread
- With pasta
- For frying fish and seafood
- On pizza(Lalas and JhonTsakins(2002)).

Objectives

- To examine the effectiveness of *Moringa oleifera* seeds cake for water purification.
- To Compare between the effective of *Moringa oleifera* Seeds , defatted *Moringa oleifera* seeds and protein extract of *Moringa oleifera* in water purification.

Chapter two

MATERIALS AND METHODS

CHAPTER TWO

Materials and Methods

2-1 Materials

2-1-1 Sampling

The Sample of raw water was collected from river Nile in Mogran area on October of 2016

The Sample of *MoringaOleifera* seeds were collected from ministry of forestry on October of 2016.

2-1-2 Chemicals

- n.hexane (95%)
- Sodium hydroxide (1M)
- Distilled water

2-2 Methods

2-2-1 Preparation of *Moringa oleifera* seeds powder

Mature *Moringaoleifera* Seeds were collected and the pods and seed were removed from seeds and white seed kernels were crushed into a fine powder using a pestle and mortar (AKaradamet *al* (2010)).

2-2-2 Preparation of Defatted *Moringa oleifera* seeds powder

150 g of *Moringa oleifera* seeds powder were weighed and added to 500ml of n-hexane 95% and kept for 4 days with intermittent shaking and filtered then the filtrate “Seed Cake” were dried at room temperature the dried seeds cake was termed defatted *Moringa oleifera* Seeds powder.

2-2-3 extraction of protein

50 g of the defatted *Moringaoleifera* Seeds were weighed and dissolved in a distilled water at ratio 1:20 (w/v) the mixture was stirred for 1h at room temperature using a magnetic stirrer while adjusting the PH at 9.0 with NaOH Solution(1M) . The mixture was then centrifuged for 15 min at room temperature and the supernatant was transferred into a beaker.

2-2-4 Proximate Analysis

Proximate analysis was carried out to determine ash content, crude fat, crude Protein, Moisture content and total carbohydrate (Association of Analytical Communities (2002) –Sullivan and carperter (1996)).

2-2-5 Jar test

1g of *Moringa oleifera* seeds powder and defatted powder was weighed and dissolved by distillwater and transferred to a volumetric Flask 100 ml to obtain 1% concentration of solution , the solution was shaken properly for 1 minute to extract and activate coagulant and antimicrobial proteins to Labeled Erlenmeyer flasks, *Moringaoleifera* Seeds Solution at doses of 5, 10,20,30,40 mL were transfemed one Liter of raw water contained in a beaker and put in Jar test 2 Minutes at 120 rpm and them slowly for 10 minutes at 30 rpm the treated water was then allowed to settle for 30 minutes , after which the supernatant was collected selected water quality parameters were determined from the supernatant (Clescenet *al* (1998)) .

2-2-6 Microbial analysis of the water sample

Most Probable Number (MPN)

To estimation the most probable number (M.P.N) of faecal coliform bacteria.The water sample was thoroughly mixed by inverting the bottle several times. The cap was then removed and 50 mls of water was added to the bottle containing 50 mls

of MarConkey broth (double strength), using a 10 mls syringe, 10 mls of water as added to each of the five bottles containing 10 mls of MarConkey broth (double strength). Also, 1 ml of the water was added into each of the 5 bottles containing 5 mls of MarConkey broth (single strength). For the treated water sample, 50 mls of water was added to the bottle containing 50 mls of MarConkey broth (double strength) and 10 mls of water placed into each of the 5 bottles containing 10 mls of MarConkey broth (double strength). The inoculated broths were then incubated at 44 °C for 24 hours with the bottles loosely capped. After the incubation period, the results were read and recorded using Cheesbrough (2000) standards (Oblinger and Koburger (1975)).

Chapter three
RESULT AND DISCUSSION

CHAPTER THREE

RESULTS AND DISCUSSION

3-1 Results

3-1-1 Proximate Composition of *Moringa oleifera* Seeds

Table (3.1): Proximate Composition of *Moringa oleifera* seeds powder

Parameter(%)	<i>M.oleifera</i>	Defatted <i>M.oleifera</i>
Moisture	6.00±0.866 ^a	5.33±0.577 ^a
Ash	3.33±0.289 ^a	4.33±0.289 ^b
Lipid	33.33±0.764 ^a	13.33±0.764 ^b
Crudeprotein	25.70±0.182 ^a	23.60±0.133 ^b
Carbohydrate	31.64±0.207 ^a	53.40±1.381 ^b

Data were expressed as Mean ± Standard deviation of triplicate values

Mean values with different superscript in a row indicate significant difference (p<0.05)

3-1-2 Physicochemical analysis of water

Table (3.2): physicochemical analysis of raw water

Parameters	Value
pH	8.0
Turbidity	241

Table (3.3): physicochemical analysis of treated water by using different concentration of *moringa oleifera* seeds solutions:

Concentration (ppm)	Turbidity (NTU)	pH
50	20.8	7.9
100	19.5	7.9
200	18.3	7.9
300	17.4	7.9
400	15.7	7.9
500	14.3	7.9

NTU: NePhelometric Turbidity Units

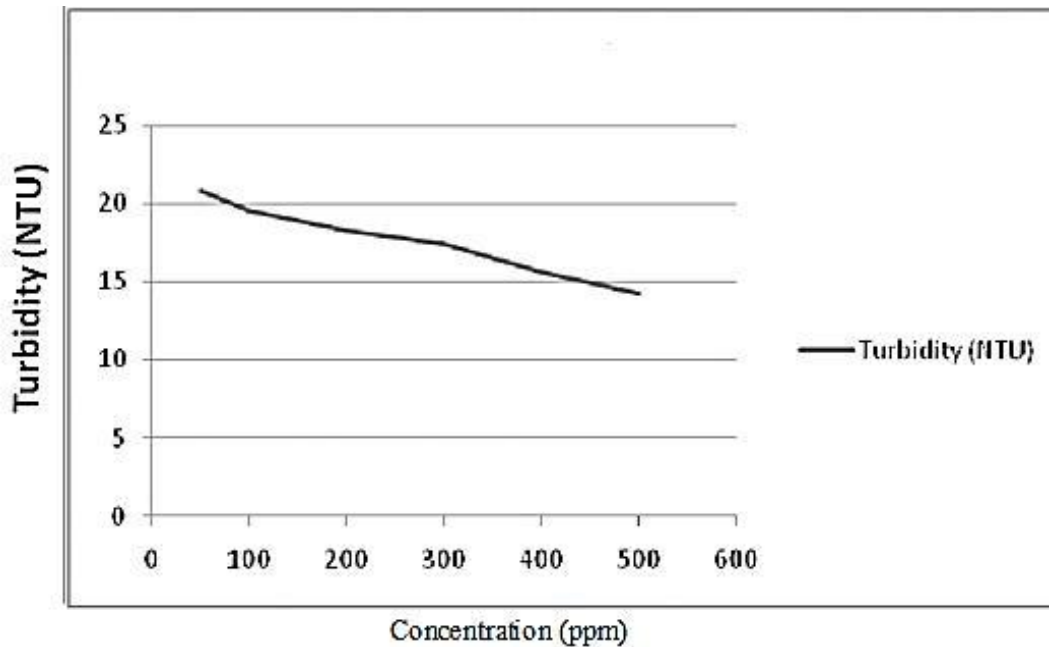


Figure (3.6): Curve Showing the Turbidity of Water Samples Treated with *Moringa oleifera* Seeds Solution.

Table (3.4): physicochemical analysis of the Treated water by using different Concentration of Defatted *Moringa oleifera* Seeds:

Concentration (ppm)	Turbidity (NTU)	pH
50	18.6	7.9
100	16.8	7.9
200	14.4	7.9
300	12.3	7.9
400	10.7	7.9
500	8.9	7.9

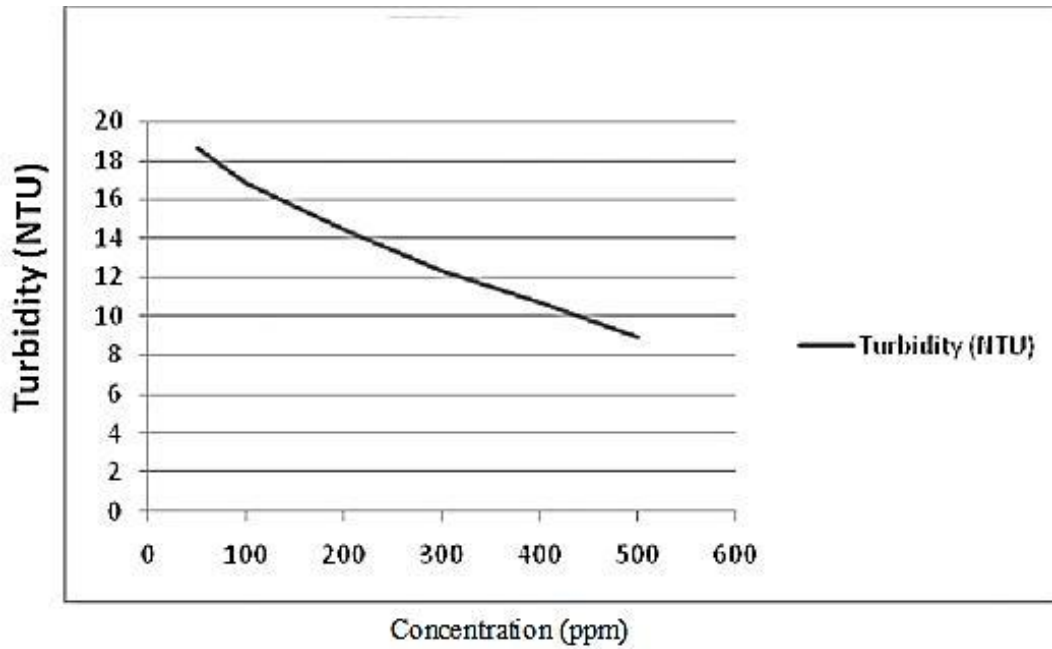


Figure (3.7): Curve Showing the Turbidity of Water Samples Treated with defatted *Moringa oleifera* Seeds Solution

Table (3.5): physicochemical analysis of treated water by using different concentration of protein extract solution:

Concentration (ppm)	Turbidity (NTU)	pH
50	11.6	7.9
100	8.9	7.9
200	7.8	7.9
300	6.9	7.9
400	5.8	7.9
500	5.0	7.9

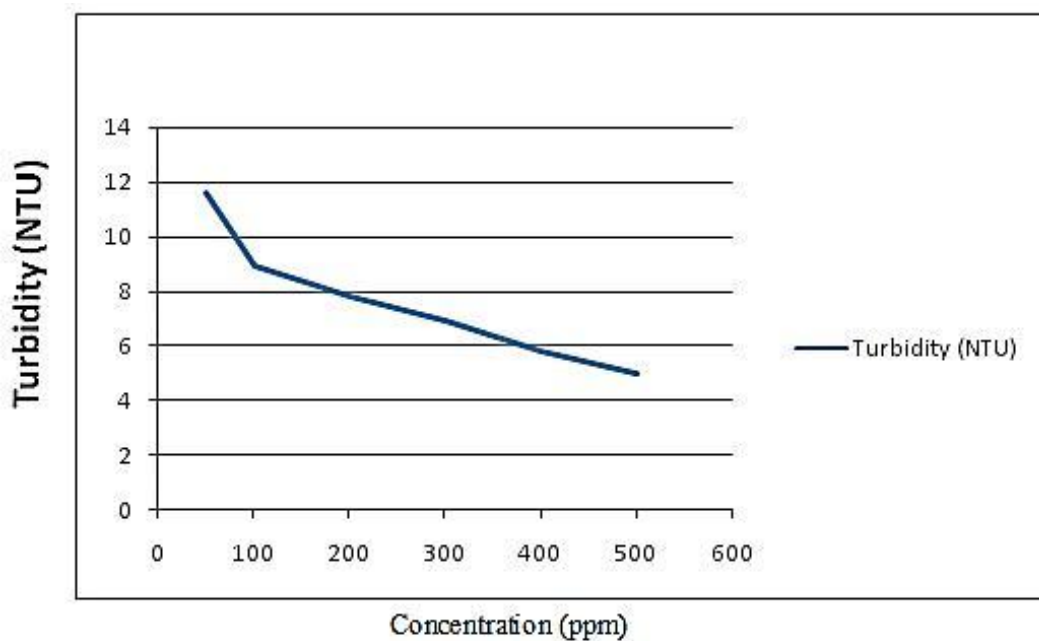


Figure (3.8): Curve Showing the Turbidity of Water Samples Treated with Protein extract

3-1-3 Microbial Analysis of the water

Table (3.6): Microbial analysis of raw water

Microbial Count	Number of Calorie
Total Coliform bacteria	30 x 10 ² MPN / mL

MPN: Most Probable Number

Table (3.7): Microbial analysis of water treated with *Moringa oleifera* Seeds, defatted seeds and protein extract solutions:

Total Coliform bacteria Count (MPN / mL)			
Concentration(ppm)	<i>Moringa oleifera</i>	Defatted <i>M.o</i>	Protein extract
100	25 x 10 ²	22 x 10 ²	15 x 10 ²
300	15 x 10 ²	12 x 10 ²	8 x 10 ²
500	9 x 10 ²	6 x 10 ²	2 x 10 ²

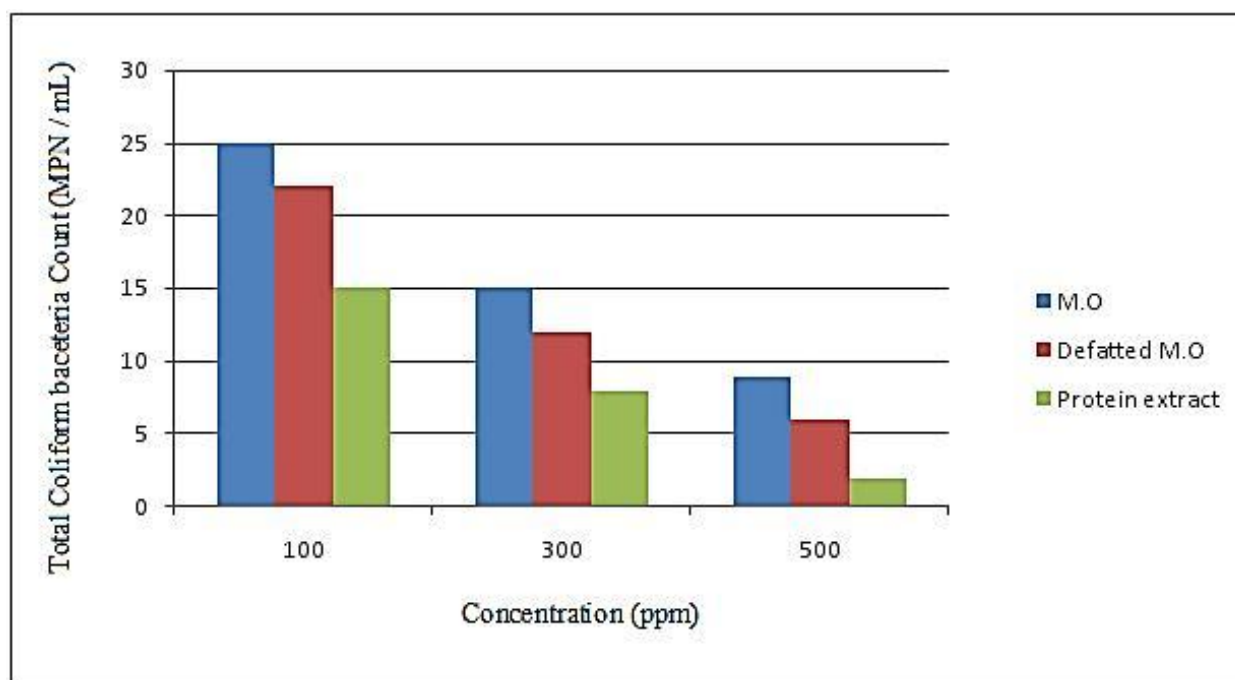


Figure (3.9): Chart Showing Coliform Count (MPN) of Water Samples treated with *Moringa oleifera* , defatted *Moringa oleifera* and Protein extract Solution

3-2 Discussion

This Study was investigated the use of Crushed seed from tree *Moringa oleifera* as a natural alternative to these conventional chemical such as aluminum sulphate (alum) and calcium hypochlorite. The use of synthetic coagulant is not regarded as suitable due to health and economic considerations.

The proximate composition of *M. oleifera* seeds and defatted *M. oleifera* seeds powder is given in Table (3-1). High lipid content (33.33%) was observed in the dried seeds powder, which was decreased significantly ($p < 0.05$) after defatting. Also, crude protein content was significantly decreased ($p < 0.05$), while ash and carbohydrate contents were significantly increased ($p < 0.05$) after defatting. Moisture content was not significantly affected ($p > 0.05$).

The study was carried in water from Nile River with high turbidity (241) and pH (8.0). The result of this study showed that the pH of *Moringa oleifera*, defatted seeds and protein extract treated water was not significantly increased at the test dose level (50, 100, 200, 300, 400, 500) ppm and equal 7.9.

Lowest turbidity values for water treated were achieved at a dose of 500 ppm and are in order of protein extract (5.0 NTU) < defatted *Moringa oleifera* (8.9 NTU) < *Moringa oleifera* (14.3 NTU).

Protein extract gave good turbidity reduction of raw water.

There was progressive decrease in coliform count for raw water, with increase dose for *Moringa oleifera* seed, defatted *Moringa oleifera* seeds solution and protein extract. However, an increase in coliform count was observed beyond the dose of 500 ppm. The antimicrobial activity of *Moringa oleifera* seeds is believed to be due to the ability of its cationic proteins to attract and neutralise charged molecules, thus, resulting in formation of flocs.

Moringa Oleifera seeds can be used as a source of oil, while the seed cake used in water treated.

Suggest for further study

-Compare with chemical coagulants.

-study the effect of *Moringa oleifera* seed in purification of wastewater sample.

Conclusion

The seeds extract of *Moringa oleifera* act as a natural coagulant, flocculent, absorbent for the treatment of drinking water. these reduces the turbidity after the treatment.They act as anatural antimicrobial agent against the microganisms which present in drinking water . The method can replace the classical method of water purification in house hold levels communities and companies at large.

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