

SHORT COMMUNICATION

SELECTION OF COAGULANTS FOR CONTROLLING FLUORIDE IN WATER SAMPLES OF NALGONDA DISTRICT-TELANGANA INDIA

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ABSTRACT

The present study investigates the coagulation of fluoride by using natural coagulants such as *Coccinia grandis*, *Abelmoschus esculant*, *Hibiscus rosa-sinensis* and *Murraya Koenigii* (or) *Bergera Koenigii*. The physico chemical characterization of water samples collected from districts of Nalgonda was carried out in the month of (December - February) 2013. It is found that the water samples of Nalgonda district have high fluoride content than the WHO standards. Water scarcity and water quality are major problems of Nalgonda district. In this context, present study investigates for low bio based technology for removal of fluoride from ground water sources. The results revealed that percentage removal is 60-65% for both coagulants. It is found that gum of *Abelmoschus esculant* is efficient for removal of fluoride.

KEYWORDS: Fluoride water, Coagulants, Controlling,

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INTRODUCTION

Fluoride consists of fluorine which belongs to halogen group. Fluoride is a common constituent present in the ground water. When concentration of fluoride exceeds 1mg/L, it causes dental fluorosis and Skelton fluorosis. Fluoride concentration depends on various factors such as physical, geological, chemical characteristics of aquifer, porosity and acidity of soils and rocks, temperature and other chemical parameters present in the water and depth of aquifer.



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The situation in Nalgonda district of telangana is very alarming. Due to severe water scarcity in Nalgonda district people are using ground water for drinking. In Nalgonda district ground water exists with crystalline rocks containing fluoride rich minerals, granites and volcanic rocks. Due to climatic conditions high evaporation is observed in these regions. There are 15 defluorination units in Nalgonda district and are not functioning to expectations it has become mandatory to drink the untreated ground water in such areas due to non-availability fluoride free water. In this context a preliminary study has been carried out to identify the fluoride affected regions. Water analysis is carried out in 20 places of Nalgonda district. The results indicated that fluoride is ranging from 0.5mg/L to 1.5mg/L.

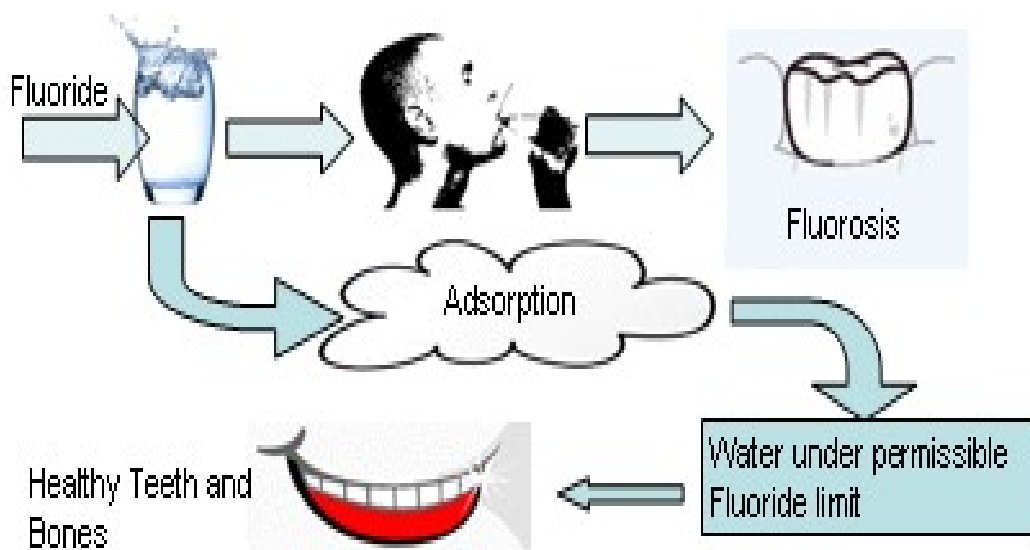


Fig.1 Fluorosis observed in bones and teeth by fluoride water intake by humans.

Taking the initial study into consideration, present research work aims to develop an individualized technology for controlling fluoride in ground waters taking locally available biomaterials. The screening and selection of coagulants for controlling fluoride is presented in the study.

EXPERIMENTAL

METHODS AND MATERIALS

The most common techniques for controlling fluoride are adsorption, precipitation, ion exchange, distillation membrane filtration and reverse osmosis. Besides these technologies crystalactor, memstill technology, water pyramid technology etc., have been developed. Defluorination of drinking water is technically feasible to small community users for large drinking water suppliers. There are community based treated technologies. All these methods



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are successfully not implemented because of high cost, limited efficiency, unobserved breakthrough, limited capacity and deteriorated water quality.

Taking all these that factors into consideration following coagulants listed below are taken up to study for the removal of fluoride in water from Nalgonda region.

SELECTION OF COAGULANTS

The four biomaterials selected for the present study are:

- i) *Coccinia Grandis*
- ii) *Abelmoschus Esculentus*
- iii) *Hibiscus rosa-sinesis*
- iv) *Murraya Koenigii* or *Bergera Koenigii*

Coccinia grandis

Coccinia grandis (The Ivy gourd) *Cephalandra indica*, *Coccinia indica* also known as baby watermelon, little gourd, gentleman's toes, tindora or sometimes inaccurately identified as, is a tropical belongs to *cucurbitaceae* family. It is a perennial plant widely grown in different parts of India and it is used as a vegetable and as traditional medicine from immemorial times. *Coccinia grandis* contains beta carotene and it is used as antioxidant, immune system modulator and antiglycemic agent. Phytochemical screening of *Coccinia grandis* reported the presence of saponin, cardenoloids, flavonoids and poly phenols which may be attributed to anti-bacterial activity. Phenolic compounds are generally noted for their anti-microbial activities(Mandal, *et al* 2011, Varsha and Jay, 2012).

CHEMICAL CONSTITUENTS

Aerial part - Heptacosane, Cephalandrol, β -sitosterol,

Alkaloids - Cephalandrins A and B

Fruits- β - Amyrin Acetate, Lupeol, Cucurbitacin B, Taraxerone, Taraxerol, β -carotene, Lycopene, Cryptoxanthin, Xyloglucan, Carotenoids.

β -sitosterol, Stigma-7-en-3-one.

Root - Resin, Alkaloids, Starch, Fatty Acids, Carbonic acid, Triterpenoid, Saponin Coccinoside, Flavonoid Glycoside, Lupeol, β -amyirin, β -sitosterol.

PHARMACOLOGICAL ACTIVITIES

Coccinia grandis has very good pharmacological activities as antibacterial (Bulbul *et al.*, 2011, Sivaraj *et al.* 2011, Farukhh *et al.*, 2008, Tamilselvan *et al.*, 2011, Sundaram *et al.*, 2012), Antimalarial (Samanta *et al.*, 2011, Rahumann 2008, Deshpande *et al.*, 2011, Bhattacharya *et al.* 2010), Anti-inflammatory (Deshpande *et al.*, 2011), Antioxidant (Syam *et*



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al., 2011, Ashwini *et al* 2012, Mongkolsilpet *al.*, 2004, Mujumde., 2008, Girish *et al.*, 2011), Antiulcer (Manoharan *et al.*, 2010, Aggarwal *et al.* 2011). Analgesic and Antipyretic (Mallick *et al.* 2007], Hypoglycemic (Gunjan *et al.*, 2010, Doss and Dhanabalan, 2008, Manjula and Ragavan, 2007. Saklani *et al.*, 2012; Eliza and Usha 2010, Bhattacharya *et al.*, 2011); Antifungal (Vadivu *et al* 2008], Hepatoprotective (Vinothkumar *et al.*, 2009), Antidyslipidemic (Anil 2012), Anticancer (Sunilson *et al.* 2009, Mishra *et al.*, 2012, Singha *et al.*, 2007, Behera *et al.*, 2012, Nanasombat and Teckchuen 2009, Bhuiyan *et al.*, 2009. Mutagenic effect (Jaiboon *et al.*, 2011).

METHOD

Coccinia grandis mucilage extract is prepared from fruits collected from local market. They were washed and soaked in distilled water overnight and extract was filtered and it is used as coagulant.

Abelmoschus esculants (LADIES FINGER)

It is known as *Abelmoschus esculents*. It is heat and drought tolerant species in the world and it will tolerate soils with heavy clay. It belongs to Malvaceae family. Okra pod contains thick slimy polysaccharides, rich in protein and unsaturated fatty acids such as linoleic acid (Gürbüz *et al.*, 2003). Phenolic compounds mainly composed of flavonol derivatives and oligomeric catechins, suggesting that it might possess some antioxidant properties. It is used in folk medicine as antiulcerogenic, gastroprotective, diuretic agents (Annie, 2006) and control diabetics, yellow Jaundice, constipation, and burning sensation in limbs. The mucilage is of sticky nature and it contains polymer molecules (Ani *et al.*, 2012, Varsha and Punitha, 2010, Paramar and Parika, 2012, Oyelade *et al.*, 2003). The flocculating activity is due to chemical reaction or complex formation.

CHEMICAL CONSTITUENTS

Polysaccharides

Rich in protein and unsaturated fatty acids,

Linoleic acid

Oligomeric catechins

phenol compounds

Chemical name Quercetin 3-O-glucoside, quercetin 3-O-glucosyl (1→6) glucoside

PHARMACOLOGICAL ACTIVITIES

Antioxidant,

Antiulcerogenic,

Gastro protective,

Diuretic agents

METHOD

Good quality of Okra pods purchased from the local market and okra gum and mucilage is collected from 5g pods in 100 ml of distilled water the sticky liquid is used as a coagulant for further study.



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Hibiscus rosa-sinensis

It belongs to *Malvaceae* family. 200 species are present all over the world. It is used as therapeutic, a laxative, anti-carcinogenic, anti-hypertensive and cholesterol lowering medicine. It is used in preparation of many foods, such as yogurts, ice creams and butter.

METHOD

Hibiscus rosa sinensis flowers are collected and washed carefully, soaked in distilled water overnight and mixed thoroughly in water. The liquid is used for the further study.

CHEMICAL CONSTITUENTS

Leaves and stems contain β -sitosterol, stigmasterol, taraxeryl acetate and three cyclopropane compounds and their derivatives. Flowers contain cyaniding diglucoside, flavonoids and vitamins, thiamine, riboflavin, niacin and ascorbic acid. Quercetin-3-diglucoside, 3, 7-diglucoside, cyanidin- 3, 5-diglucoside and cyanidin-3-sophoroside-5-glucoside and kaempferol-3- xylosylglucoside have been isolated from ovary white flowers

PHARMACOLOGICAL ACTIVITIES

It is well accepted that the leaves and flowers of *Hibiscus rosa-sinensis* have various pharmacological properties. *Hibiscus rosa-sinensis* belongs to family - Malvaceae is a perennial ornamental shrub available throughout India. Various parts of this plant, like leaves, flowers and roots, have been known to possess medicinal properties like aphrodisiac, menorrhagia, oral contraceptive, laxative, etc. Previous studies showed that the plant possesses anti-complementary, anti-diarrhetic and anti-phlogistic activity. It has been reported that the plant flower possesses anti-spermatogenic and androgenic, antitumour and anticonvulsant activities. Infusion of the petals is given as refrigerant and demulcent. Leaves are used as laxative while root is used in cough.

***Murraya koenigii*(CURRY LEAVES)**

It is a tropical and subtropical tree in the family of Rutacea. It is known as *Murrayakoenigii* and it is widely used as herb in ayurvedic medicine for curing diabetics, diarrhea, indigestion and constipation. Curry leaves are packed with carbohydrates, fiber, calcium, phosphorous, irons and vitamins like A, B, C, and E, and helps for better heart function, fights infections and can enliven hair and skin with vitality. It has anti diabetic, cholesterol reducing property, antimicrobial activity and anti-ulcer activity.

CHEMICAL CONSTITUENTS

Mahanimbine, girinimbine, koenimbine, isomahanine, mahanine, Indicolactone, 2-methoxy-3-methyl-carbazole. A 2011 study of isolated from this plant, found that it inhibited the growth and induced HepG2 cells (Syam, 2016, Tembhurne and Sakarkar, 2010).

PHARMACOLOGICAL ACTIVITIES

Murraya koenigii species show various pharmacology such as anti-diabetic property, hypo-cholesterolemic activity (Annie, 2006), Antiulcer Activity (Praveen *et al.*, 2011, Mandal *et al.*, 2010), Anti- Diarrheal activity (Shah *et al.*, 2008), Phagocytic activity (Khan *et al.*, 1995),



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Analgesic and antinociceptive activity(Khan *et al.*, 1995), Anti-lipidperoxidative activity, Radioprotective and chemoprotective activity, Antiamnesic activity, Antihelminthic activity(Anand *et al.*,2011), Memory enhancing (Annie *et al.*, 2006), Wound Healing effect (Rahma and Gray, 2005), Antimicrobial Activity (Kureel *et al.*, 1969, Yukari *et al.*, 2001), Antioxidative property (Yukari *et al.*, 2001, Rao *et al.*, 2006, Patil *et al.*, 2010),Skin pigmenting (Ito,*et al.*, 2006), Cytotoxic Activity (Thilahgavani *et al.*,2011), Anti-Tumor assay. The chemical constituents, pharmacological activity and other factors such as nontoxic and ecofriendly nature of these plants materials are taken into consideration and are used as coagulants for controlling fluoride in Nalgonda water (Pekamwar *et al.*,2013).

METHODOLOGY

In order to test the efficiency of the natural coagulants and avoid interference by other ions in ground water the experiments are conducted with aqueous solution of fluoride. A stock solution of 2mg/L was prepared by dissolving sodium fluoride. Experiments are carried out by using jar apparatus. This study is carried out by adopting batch experiments involving rapid mixing (to disperse coagulant in water) and slow mixing (to enhance flocs formation and sedimentation). 1g of coagulants mentioned above is added into the series of jars positioned in jar apparatus. The samples are stirred rapidly for 20 minutes at standard 100rpm speed for formation of flocs. Finally the flocs are made to settle for one hour and samples are withdrawn for the study. The initial and final concentrations of fluoride were determined by using SPANDS method. The results are shown in Fig1.

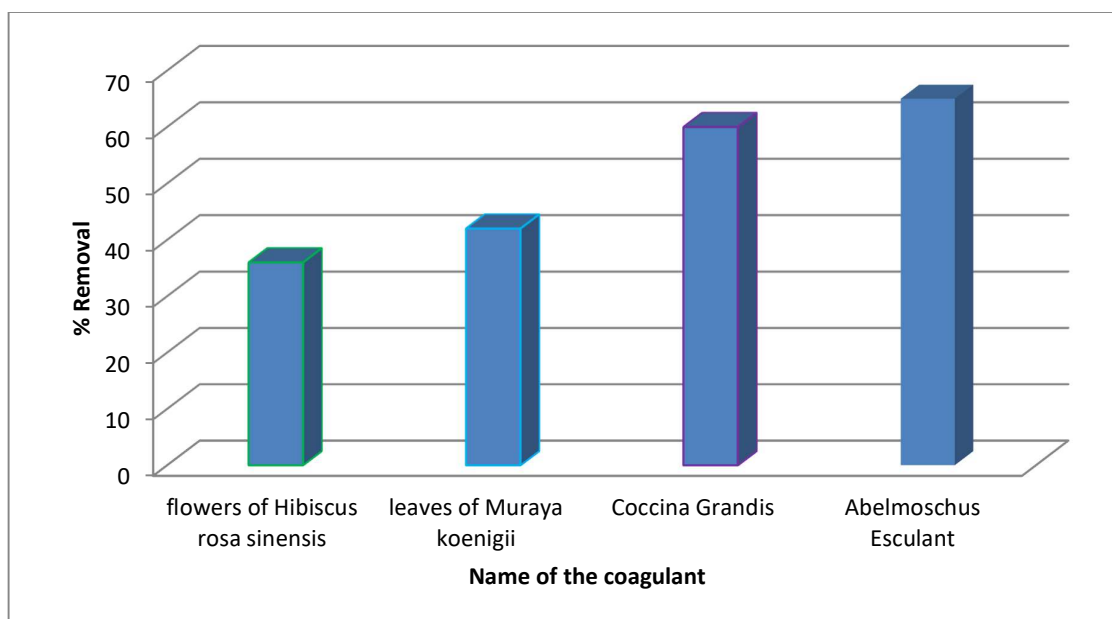


Fig.2 Relationship between percentage removal of fluoride with different coagulants



RESULTS AND DISCUSSIONS

The use of plant materials as coagulant/flocculent is a common practice in India. *Coccinia grandis* mucilage is natural anionic polysaccharide. These natural water soluble polysaccharides flocculate small particles and form large flocs by bridging mechanism. Fluoride ions get attracted to this anionic polysaccharide at slightly acidic pH. Mucilage of *Abelmoschus esculents* (ladies finger) is a polyvalent polymer with slightly anionic polysaccharide nature. *Hibiscus rosa sinensis* flowers are neutral polysaccharides and they are effective flocculent containing natural polymers. The structure, high reactivity, high selectivity towards compounds are due to presence of hydroxyl, acetaamide or amine functional groups which may bind the fluoride ions present in the water. Leaves of *Murrayakoenigii* are used as adsorbents and coagulants for removal of color and heavy metals. All these natural coagulants act via mechanism known as adsorption and neutralization of charge.

CONCLUSIONS

The people of Nalgonda district are facing the problem of water quality and water scarcity problem due to arid conditions. The low-cost and effective natural coagulants are examined and successfully used in this study showed promising and encouraging results for the removal of fluoride in ground waters.

The results of batch study with four medicinal such as *Coccinia grandis*, *Abelmoschus esculents*, *Hibiscus rosa-sinensis* and *Murraya Koenigii* species presented in this paper exhibited results with good percentage removal of fluoride by Precipitation mechanism. Removal efficiency was recorded more for *Abelmoschus esculents* (ladies finger). The comparison results shown by these plants materials for the removal of fluoride from the ground water is in increasing order - *Hibiscus rosa-sinensis* < *Murraya Koenigii* < *Coccinia grandis* < *Abelmoschus esculents*

Future research should include assessment of coagulant and regeneration, process optimization, conditional effects and a detailed cost-benefit analysis.

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