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Innovative Bilayer Tablet Design for Co-Delivery of Glibenclamide and Pioglitazone: A Step Towards Personalized Diabetes Therapy

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ABSTRACT: Water is a necessary component for all life on Kadukkai, Purification, and Siddha Earth. According to ancient Siddha literature, water purification, thantrikkai, and the system may be achieved by soaking various medicinal plants. The goal of the current study is to evaluate the water quality after being

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Introduction:

Using a scientific and comprehensive approach, the Siddha system of medicine is one of the traditional medical systems that offers healthcare that is preventative, promotional, curative, and rejuvenating. 1. Water covers the ¾th portion (75%) of the world. 2. According to international organizations like the United Nations, access to clean drinking water is a basic human right and water is an essential natural resource. Global water resource availability and quality are greatly impacted by both human activity and climate change. 3. It is essential for numerous bodily processes, including as supplying nutrition to cells, eliminating waste, safeguarding joints and organs, regulating body temperature, and more. Rain, surface water, and groundwater are the primary sources of water utilized in agriculture, industry, public spaces, and home settings. Infectious illnesses including cholera, diarrhea, dysentery, typhoid, and Guinea worm infection may also be spread by unsafe drinking water and poor sanitation. 4. The fact that development and human activities are to blame for water contamination is a more significant issue. Water contamination may still happen even with high-quality water sources and treatment because of pipeline corrosion, leaking joints, and cross-connections between sewage drainage pipes and water supply pipes. Two billion people lack safely managed water services at home, leaving them vulnerable to a variety of waterborne diseases that can result in illness, disability, and death, according to the WHO/UNICEF Joint Monitoring Program 2021 update and SDG baselines5. The purification process of drinking water aims to change turbidity, odor, color, bacterial impurities, hardness, and toxic elements. These days, there are many different kinds of water purification techniques accessible, including distillation, filtration, chlorination, passing UV radiation, softening, and ozonation. However, in order to protect health and boost everyone's contribution to a country's growth, we need a method that can filter water at home. In the past, water was cleansed by keeping it in copper containers or by adding readily accessible plant components, such as the leaf or seed coverings of Ocimum sanctum. Because of its therapeutic qualities and lovely scent, Vetiveria zizanoides was also used. Herbs with coagulation properties, such as Zee mays and Moringa oleifera, have been shown to lower alum in drinking water. Numerous plants are used to cleanse water. Waterborne illness transmission may be somewhat inhibited if the

public is aware of basic water purification techniques. According to Siddha literature, Noi Illa Neri, trees of the Terminalia chebula and Phyllanthusamarus were used in ancient times. TABLE 1: USE OF WATER In order to let their fruits to fall into the water and naturally cleanse and sweeten it, PROCEDUR and Terminalia bellerica were planted along the banks of rivers and lakes 7. Therefore, the purpose of this research is to use Terminalia chebula (Kadukkai) and Terminalia bellerica (Thantrikkai) to compare and objectively assess the drinking water quality before and after filtration.

RESOURCES AND METHODS:

Gathering and Cleaning Plant Materials: In Aminjikkarai, Chennai, Tamil Nadu, India, Terminalia chebula and Terminalia bellerica were gathered locally from a raw drug shop. The Botanist and specialists in the Gunapadam Department of the Government Siddha Medical College selected and verified the raw medications that were utilized in the research. The seeds were removed in order to purify Terminalia bellerica.

Water Collection: Chennai's Chembaramapakkam Lake provided the drinking water. Six liters of water were extracted straight from the lake and placed in three pots, each holding two liters. Samples 1, 2, and 3 are the labels on the pots. These water-filled pots were immediately stored at room temperature at the GSMC Chennai's Gunapadam Laboratory in a sterile facility.

Water Treatment Process: In the same setting, a sample container was used as control water, or untreated water. For six hours, 50g of pure Terminalia chebula (TC) and 50g of purified Terminalia bellerica (TB) were soaked in water (samples two and three, respectively) and maintained in the same setting. All of the samples were then labeled as samples A, B, and C after being separately filtered in three sterile plastic containers. after which it was examined physically, elementally, and for microorganisms

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Sample	Plant material	Quantityofplantmaterial	Procedure	Treatmenthours
SampleA	Controlwater	-	-	6 hours
SampleB	Terminaliachebula(TC)	50g	Plant material soakedinwater	6 hours
SampleC	Terminaliabellerica(TB)	50g	Plantmaterial soakedinwater	6 hours

Analysis Plan: The Indian Standard Drinking Water-Specification IS 10500:1991 (Reaffirmed 2009) was the standard methodology used to test all samples. These are the estimated parameters. Physical characteristics include conductivity at 25 °C, color, odor, pH value, total hardness, and total alkalinity. Level of Elements: Magnesium as Mg, Calcium as Ca, Sulfate as SO4, Nitrate as NaO3, and Chlorine as Cl. Microorganisms: Total Coliform, Total Faecal Coliform, and Escherichia coli. Literature Review: Terminalia chebula: This member of the Combretaceae family is extensively found in India, Sri Lanka, and Burma, reaching elevations of up to 1500 (-2000) meters above sea level. The English name for this blooming evergreen tree is "Black Myrobalan." It's also known as the "King of Medicine" in Tibet 9. According to ancient Siddha literature, Terminalia chebula is "superior to the nourishing mother" for its exceptional healing abilities and "cares for the patients as if a mother cares for her child." Seven distinct forms of Kadukkai are recognized in the Siddha medical system. These include Abayan 10, Visayan, Arogini, Piruthuvi, Amirdham, Sethagi, Sivanthi, and Thiruviruthi.

TABLE2:DIFFERENTVARIETIESOFTERMINALIACHEBULA

S.no.	Speciesname	Features	TherapeuticIndications	Placeoforigin
1.	Visayan	ResemblesCurcumis trigonus	Vathadiseases	Avanthicountry
2.	Arogini	Circularfourlinesonit	Curessannipaatham	Kanyakumari
3.	Prithivi	Softepicarp	Cures insanityandlengthensthe lifespan	Sowrastra
4.	Amirtha	Fleshy	Phlegmaticdisorders	Kasi
5.	Sivanthi	Goldencolor	Pilesdueto Vaayu	Growinforest

6.	Thirivirithi	Fivecolorswiththree lines	Allkindsofsores	Growinmountainregion
7.	Abayan	Blackincolor	Certainkindsofdiseasesinthebody	Pothigaihills

Features of Kadukkai 10,11 in general: Color: Depending on the type and provenance, the fruit's color may range from yellowish brown to light black. Taste: bitter, astringent, sweet, sour, and pungent. Potency: Warm Division: Sweet Athithoolam (obesity), Pandu (anemia), Mothrakireecharam (dysuria), Molam (hemorrhoids), Thamaraganoi (cardiac diseases), Kannnoikal (eye diseases), Aanmaiinmai (impotency), Gunmam (gastrointestinal conditions), Megharogam (sexually transmitted diseases), Kuttam (skin diseases), and other indications are listed. Chemical Components: Tannin is abundant in Terminalia chebula. The primary constituents of tannin are corilagin, gallic acid, chebulic acid, and chebulagic acid. Terminalia chebula contains pyrogallol (hydrolyzable) type 9 tannin. Mucilage, a brownish yellow substance, a significant quantity of gallic acid (1.21%), chebulagic acid (5%), ellagic acid, astringent principles, tannin (tannic acid) 45%, and chebulinic acid (12.5%) that separates into tannic and gallic acid when boiled in water are all present in myrobalans. tannins, which hydrolyze to produce d-galloyl glucose and chebulic acid. Corilegin, beta D-glucogallin, glucose, and sorbitol are all found in fruit. Further lowering sugars and starches are polyphenolic substances, triterpene glycosides, terchebulin (ellagi tannin), terchebin, syringic acid, punicalagin, terflavin A, and flavonoids. The fruit has yielded terpene glycosides, arjun glucoside-1, and arjungenin. Carminative, cardioprotective, digestive, hepatoprotective, hemetenic, immunomodulatory, antioxidative, antibacterial, antifungal, anticancer, antidiabetic, antiulcer, antiseptic, and styptic are some of the pharmacological actions.

FIG.1:TERMINALIACHEBULA

FIG.2:TERMINALIABELLERICA

Other names for Thantrikkai (Terminalia bellerica) include Aksham, Akkandham, Amutham, Aaramam, Ambalaththi, Erikatpalam, and Kandhakatpalamand. Terminaliabellerica 10,12 In Siddha medicine, boothavasagam. It is referred to as "Beleric Myrobalan" in English. It is a member of the Combretaceae 13 family and grows extensively over the Indian subcontinent, Bangladesh, Nepal, and Southeast Asia. It is a massive deciduous tree that may reach a height of 20 to 30 meters. It has a buttressed atrunk and thick, brownish-gray bark with tiny longitudinal cracks.Astringent in flavor Strength: Warm Separation: Adorable Indications include Aankurippun (genital ulcer), Velai (leucorrhea), and Silanthi Nanju (spider bite). RESULTS: Physical attributes include Kuruthiazhal noi (hypertension), ailments brought on by vali (Vatha) and thee (Pitha), and the way the body looks and feels.Chemical Components: Glucoside or bellericanin Resins, coloring agents, gallo-tannic acid, and a yellowish green oil. Anolignan B10, 7-hydroxy-3'4' (methylene dioxy) flavone, gallic acid, ellagic acid, and ellagic and thiolignans. Tannins, ellargic acid, ethyl gallate, galloyl glucose, chebulaginic acid, phenyllemblin, β-sitosterol, mannitol, glucose, fructose, and rhamnose are also included in the list. 14. Actions of Pharmacology: Analgesic, immunomodulatory, antihypertensive, antimicrobial, antidiabetic, antidiarrheal, hepatoprotective, antispasmodic, and bronchodilatory properties

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TABLE3:PHYSICALPROPERTIESOFDRINKINGWATERSAMPLESAFTER6 HRS

S.no.	CharacteristicTestand Units	Requirement (acceptablelimit)	Permissiblelimitin the absence of alternatesource	SampleA	SampleB	SampleC
1.	Color(Hazenunit)	5	50	1.01	20.0	15.0
2.	Odour	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable
3.	Taste	Unobjectionable	Unobjectionable	Unobjectionable	Unobjectionable	Unobjectionable
4.	pHvalue	6.2-8.5	No Relaxation	7.92	7.19	7.12
5.	Totalhardnessas $CaCO_3$(mg/l)	300	600	300	308	332
6.	Totalalkalinityas $CaCO_3$(mg/l)	200	2000	202	174	198
7.	Conductivity@25oc (µS/cm)	6000	80000	1122	1161	1070

Interpretation: The untreated control water's color, pH, conductivity, and other physical characteristics were all within an acceptable range, and it had a pleasant taste and odor. Water-treated TC and TB fruits had a pleasant smell and a flavor that was acceptable. The values for color and overall hardness fell within the acceptable range of ElementsLevel. The conductivity level, pH, and total alkalinity were all within the permissible range.

TABLE4:ELEMENTSLEVELOFDRINKINGWATERSAMPLESAFTER6HOURS

S.no.	Parameters	AcceptableLimit Requirement	Permissiblelimitintheabsenceof alternatesource	SampleA	SampleB	SampleC
1.	Cl(mg/l)	250	1000	155	149	174
2.	SO_4(mg/l)	200	400	70	65	76
3.	Ca(mg/l)	75	200	72	80	78
4.	Mg(mg/l)	30	100	31	24	33
5.	Fe(mg/l)	0.3	NoRelaxation	0.37	0.27	0.24
6.	NO_2(mg/l)	45	100	BDL	BDL	BDL

Interpretation: Calcium, sulfate, and chloride levels in untreated water were within permissible limits. Although slightly elevated, the levels of iron and magnesium were still within the acceptable range. Level of Microorganisms: Iron and chloride levels in TC and TB treated water were within acceptable bounds, while other elements were within acceptable bounds.

TABLE5:MICROORGANISMLEVELOFDRINKINGWATERSAMPLESAFTER6HOURS

S.no.	CharacteristicTestand Units	Requirement(acceptable limit)	Permissible Limit in the absenceofalternatesource	Sample A	Sample B	Sample C
1.	E.coli(MPN/100ml)	0	0	70	50	30
2.	TotalColiform (MPN/100ml)	0	<50	60	50	50
3.	FaecalColiform (MPN/100ml)	0	0	20	18	20

DISCUSSION: When current water sources—such as those supplied via a piped network or other enhanced sources—are not adequately treated or are polluted during distribution or storage, household water treatment measures may be crucial to preserving public health 15. Therefore, starting at household level 6, the purification procedure should be prioritized. The untreated water sample's color fell within an acceptable range when its physical characteristics were examined. TC and TB-treated water had more color, although it was still within acceptable bounds. The chemicals created during the biodegradation of the soaking raw materials might be the cause of this. According to the Indian Standards of Drinking Water Specification, the taste and odor of the treated and untreated water were equally acceptable. Alkalinity is the capacity of naturally existing water to neutralize acid that has been added to it. The amount of acid required to get a certain pH is known as the total alkalinity. The ability of water to transport electrical current is indicated by its conductivity. The corrosiveness of the water increases with total dissolved solids and electrical conductivity 16. In this case, the treated water samples' conductivity and total alkalinity fell within the permissible range. Every water sample has a pH value within the ideal range of 6.5 to 8.5. Some water samples are classified as alkaline, while others are almost neutral, according to WHO (2006). The neutral (pH=7) value of pure water is 17. Both TC and TB treated water have pH values of 7.19 and 7.12, respectively, which are close to neutral and signify cleansed water. Waters are categorized as "soft" to "very hard" based on their hardness, which is measured in mg/L CaCO3. 16. Within the allowable range, water treated with TC and TB showed a little rise from the acceptable level of 308 and 332, respectively. The presence of total dissolved solids may be the cause of the little rise. The amount of calcium, chloride, sulfate, magnesium, iron, and nitrates was evaluated using elemental analysis of both untreated and treated water containing TC and TB. Chloride is often present in all water, even rainwater. Water quality is determined by the quantity of chlorides since higher concentrations of these anions reduce the amount of natural water that can be used for various purposes (domestic, agricultural, industrial, and so on). When compounds of plant and animal origin oxidize, sulfates are released into natural water. On the one hand, the elevated sulfate concentrations negatively impact the flavor, smell, and other physical attributes of water, but on the other hand, they have detrimental effects on human intake. The bacteriological oxidation of nitrogenous elements in soil produces nitrate (NO3), which is present in natural water. One measure of the level of pollution caused by organic compounds containing nitrates is nitrates (NO3). 6. The quantities of iron, magnesium, sulfate, and chloride were all within the permissible range. The water treated with TC and TB samples had a nitrate level below the detection limit, which means there was no pollution present. The calcium levels in the treated Samples B and Chad were higher than those in the control water and within the allowable range. As a result, individuals may take it as a calcium supplement. Assaying for waterborne illnesses and confirming the presence of the causative agent are time-consuming and difficult procedures. Instead of doing specialist research, coliform organisms have been used to determine the biological characteristics of natural rivers. The rod-shaped, gram-negative, facultative, aerobic, nonspore-forming bacteria that belong to the coliform group convert lactose to gas. A typical indicator bacteria is Escherichia coli. Humans and other warm-blooded animals have this bacterium in their intestines. Thus, the presence of Escherichia coli in water samples suggests that pathogenic organisms of human origin may be present. 6. E. Coli, total coli form, and fecal coli form levels were lower in sample C. Compared to the control water, Sample B had lower levels of E. Coli, total coliform, and fecal coliform. This might be because of the presence of agricultural fertilizers or contamination from human and animal waste. Microorganisms were not completely eradicated. Boiling the water either before or after treating it with TC and TB might

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eliminate the germs.

CONCLUSION:

With the exception of the concentration of microorganisms like E. coli and coliform, the majority of the physio-chemical parameters of the examined samples were found to be within the suggested ranges as per the Indian Standard Drinking Water Specification, IS 10500:2012. While their content dropped in the treated water, they were found to be over the allowable limits. According to Siddha medicine, obtaining clean drinking water at the household level may be achieved by employing certain herbs. According to this scientific investigation, soaking Terminalia chebula and Terminalia bellerica undoubtedly changes the drinking water's characteristics. Given that it is a baseline study, further research is necessary to determine the quantity of plant material and soaking time needed to produce safe drinking water. This approach can undoubtedly be utilized for home reasons even if it cannot be applied on a wide scale.

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