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EXTRACTION OF BIOSURFACTANTS FROM SOIL USING KEROSENE

Gopinath B, Assistant Professor, Dept. of Biotechnology, Sri Shakthi Institute of Engineering and Technology, Chinniyampalayam Post, Coimbatore. gopibiotech@gmail.com
Bindhu J, Associate Professor, Dept. of Biotechnology, Sri Shakthi Institute of Engineering and Technology, Chinniyampalayam Post, Coimbatore.
Abishek M, Dhanasekar A, Kavin KGV & Sanjai Kumar S, IV B. Tech. Biotechnology**,** Dept. of Biotechnology, Sri Shakthi Institute of Engineering and Technology, Chinniyampalayam Post, Coimbatore.

ABSTRACT:

Biosurfactants are surface-active compounds produced by microorganisms, with wide applications in bioremediation, oil recovery, and environmental clean-up. This study investigates the extraction of biosurfactants from soil using kerosene as a carbon source, focusing on enhancing microbial production and optimizing the extraction process. Soil samples were collected from hydrocarbon-contaminated sites, and biosurfactant-producing microorganisms were isolated. Kerosene, a readily available hydrocarbon, was used to stimulate microbial metabolism and promote biosurfactant production—the extraction process involved solvent extraction techniques, followed by centrifugation and filtration. The biosurfactants were then characterized using standard analytical methods, including surface tension measurement, emulsification index, and FTIR spectroscopy. The results demonstrate that kerosene can effectively serve as a substrate for biosurfactant production, with significant yields obtained under optimized conditions. This study explores the extraction of biosurfactants from soil using kerosene as a hydrocarbon substrate. Biosurfactants are surface-active compounds produced by microorganisms that exhibit unique properties such as emulsification and surface tension reduction. Using kerosene aimed to stimulate the growth of hydrocarbon-degrading microorganisms in soil, leading to biosurfactant production. Soil samples were enriched with kerosene and incubated under controlled conditions, allowing microbial activity to produce biosurfactants. The extraction process involved solvent-based methods to isolate and purify the compounds, followed by characterization to assess their emulsification index and surface tension properties. These findings highlight the potential for biosurfactant production in hydrocarbon-contaminated soils, offering sustainable applications in bioremediation and various industrial sectors. Further optimization of extraction and purification techniques is necessary to improve yield and efficiency.

KEYWORDS: Biosurfactants; Bioremediation; Biodegradation; Hydrocarbons.

1.INTRODUCTION:

Hydrocarbons, for example, diesel and lamp oil fills are some of the world's generally broadly scattered natural ecological toxins. These energize are significant natural toxins of soils and, what's more, groundwater. Hydrocarbon spills happen from a few causes, including spillage from tanks and unloading of waste oil items. These unsafe squanders cause huge issues for both sea-going and soil conditions. These pollutions have the potential to make intense poisonous living creatures. They are dangerous to the soundness of plants and are additionally cancer-causing, mutagenic, and immuno-harmful, representing a danger to both human and creature wellbeing. Because of this critical ecological gamble, research zeroing in on the remediation of debased conditions has expanded, in an endeavor to alleviate the dangers brought about by oil-based goods. The microbial biodegradation of hydrocarbons is the essential instrument by which oil and diesel items are taken out from the climate. Biodegradation permits the transformation of perilous substances into structures that are less unsafe or non-harmful organic medicines are the most encouraging choices for lessening the risky effect of oil contamination. By correlation, physio-synthetic medicines (like substance decay and coagulation/flocculation of natural compounds) are costly and can make harmful amphibian and soil frameworks by the utilization of substance compounds and the arrival of poisonous intermediates.[3]

1.1 Definition of Biosurfactants:

Biosurfactants are surface-active molecules produced by microorganisms, such as bacteria, yeast, and fungi. These compounds contain both hydrophilic (water-attracting) and hydrophobic (water-repelling) components, allowing them to reduce surface and interfacial tension between liquids, solids, and gases. Unlike synthetic surfactants derived from petroleum, biosurfactants are produced through biological processes, making them biodegradable, eco-friendly, and less toxic.

Characteristics of Biosurfactants:

1. Amphiphilic Nature:

Biosurfactants possess both hydrophilic (water-soluble) and hydrophobic (water-insoluble) regions. This dual nature enables them to interact with both polar and non-polar substances, facilitating the formation of emulsions and reducing surface and interfacial tensions.

2. Surface Tension Reduction:

One of the primary characteristics of biosurfactants is their ability to reduce surface and interfacial tensions. By decreasing the tension between different phases (e.g., oil and water), biosurfactants enhance the miscibility of otherwise immiscible substances.

3. Low Toxicity:

Compared to chemically synthesized surfactants, biosurfactants are less toxic to humans, animals, and the environment. This makes them suitable for food, pharmaceuticals, and cosmetics, where safety is a priority.

4. Biodegradability:

Biosurfactants are readily biodegradable, meaning they break down naturally in the environment through microbial activity. This feature makes them environmentally sustainable, reducing the risk of pollution compared to synthetic surfactants.

5. Functional at Extreme Conditions:

Many biosurfactants are stable and remain functional under extreme conditions of temperature, pH, and salinity. This property is particularly valuable in industrial processes, such as oil recovery, where harsh environments are common.

6. Emulsification Properties:

Biosurfactants have strong emulsifying capabilities, meaning they can stabilize mixtures of oil and water by reducing interfacial tension. This makes them useful in industries like food processing, cosmetics, and bioremediation, where emulsions are needed.

7. Variety of Structures:

Biosurfactants come in various chemical structures, including glycolipids (e.g., rhamnolipids), lipopeptides (e.g., surfactin), phospholipids, fatty acids, and polymeric compounds. Each type of biosurfactant has unique properties and applications depending on its molecular structure.

8. Renewable Production:

Biosurfactants are produced by microorganisms through the fermentation of renewable resources, such as plant oils, sugars, or waste materials. This contrasts with synthetic surfactants that rely on non-renewable petroleum-based resources.

1.2 TYPES OF BIOSURFACTANTS:

Glycolipids:

A large portion of the biosurfactants which are known produces glycolipids. They are contained sugars with long-chain aliphatic acids or hydroxyaliphatic acids. The affiliation is by techniques for one or the other ether or then again ester gathering. The most popular glycolipids are rhamnolipids, sophorolipids and trehalolipids.

Rhamnolipids:

Rhamnolipids are glycolipids in which a couple of particles of rhamnose are connected to a couple of particles of hydroxy decanoic corrosive. It is the generally examined biosurfactant which are the head glycolipids delivered by *P. aeruginosa.*

Sophorolipids:

These are glycolipids that are delivered by yeasts and comprise a dimeric carb soporose connected to a long-chain hydroxyl greasy corrosive by glycosidic linkage. Sophorolipids, for the most part, a combination of at any rate six to nine distinct hydrophobic sophorolipids and lactone type of the sophorolipid is best for some applications.

Trehalolipids:

This is one more sort of glycolipid. Disaccharide trehalose associated at C-6 and C-6 to mycolic destructive is associated with most sorts of *Mycobacterium*, *Corynebacterium, and Nocardia*. Mycolic acids are the long chain, α-spread, and β-hydroxy unsaturated fats. Trehalolipids from arranged living creatures shift in the size and design of mycolic destructive, the amount of carbon particles displayed, and the level of unsaturation. Trehalose lipids obtained from *Rhodococcus erythropolis and Arthrobacter* sp. diminished the surface tension and interfacial strain in culture stock.

Surfactin:

This is a champion among the most potential biosurfactant is integrated by Bacillus subtilis. It involves a seven amino corrosive ring structure joined to an unsaturated fat chain by techniques for lactone linkage. It reduces the surface strain from 72 to 27.9 mN/m at an obsession as low as 0.005%.

Lipopeptides and lipoproteins:

Lipopeptides are surfactin. An uncommon number of cyclic lipopeptides, including decapeptide immunizing agent's poisons (gramicidins) and lipopeptide neutralizing agents poisons (polymyxins) is conveyed. These contain a lipid associated with a polypeptide chain.[12]

1.3 APPLICATIONS OF BIOSURFACTANTS:

Drugs and therapeutics

The biosurfactants could have a broad assortment of usage in drug fields. Antibacterial, antifungal, antiviral administrators, safe modulator particles, neutralizers, and quality treatment are shown up by biosurfactants. A few biosurfactants exhibit antimicrobial activity against various minuscule living beings, green development, parasites, also, diseases. The antifungal activity showed up by a lipopeptide iturin from *B. subtilis* improvement of horrendous fledgling green development controlled by rhamnolipids. The mannosyl erythritol cations lipid demonstrates antimicrobial development, particularly against Gram-positive microorganisms. Immunological adjuvants: Bacterial lipopeptides comprise strong non-destructive, non-pyrogenic immunological adjuvants when mixed with normal antigens. A difference in the humoral others cognizant response was shown when low sub-nuclear mass antigens Iturin AL and herbicolin A.

Antimicrobial activity:

Due to the varying designs of biosurfactants, it applies toxic quality to the telephone layer vulnerability. Few biosurfactants have strong antibacterial, antifungal, and antivirus activity; these surfactants accept the piece of against concrete experts to microbes making them supportive regarding various diseases and their usage as medicinal and probiotic administrator. A respectable case is a biosurfactant conveyed by marine *B. circulans* that had strong antimicrobial activity against Gram-positive and Gram-negative microorganisms and semi pathogenic microbial strains including the MDR strain.

Anticancer movement:

Some microbial extracellular glycolipids impel cell division as opposed to cell development in the human promyelocytic leukemia cell line, moreover, a show of PC 12 cells to MEL worked on the development of acetylcholine esterase and barged in on the cell cycle at the G1 stage with coming about the wealth of neurites and fragmented cell partition, this proposes MEL impels neuronal detachment in PC 12 cells furthermore, gives the premise to the usage of microbial extracellular glycolipid as original reagents for the treatment of infection cells.

Antiviral movement:

C. bombicola organizes a sophorolipid, its fundamental analogs have been considered for their spermicidal, threatening to HIV and cytotoxic works out. The sophorolipid diacetate ethyl ester auxiliary is the most grounded spermicidal and virucidal expert of the plan of sophorolipids inspected.

Corrective industry:

Sophorolipids have a gigantic scope of application in improving specialist's industry. They have uncommon characteristics that consolidate antagonistic to revolutionary properties, instigation of dermal fibroblast metabolism, and hygroscopic properties to assist with sounding skin physiology, future possibilities of so sophorolipid-based things consolidate a couple of kinds of facial cosmetics, creams, greatness washes, and hair things.

Business clothing cleansers

All surfactants, a fundamental part used as a piece of current business clothing cleaning agents, are artificially coordinated and apply risk to new water living creatures. Creating open care about the biological risks and perils related to compound surfactants has strengthened the sweep for eco-friendly, trademark substitutes of blend surfactants in apparel chemicals. Biosurfactants, for the model, Cyclic Lipopeptide (CLP) consistently complete a wide pH expand (7.0-12.0) and warming them at high temperatures doesn't achieve any deficiency of their surface-powerful property. They showed extraordinary emulsion improvement limits with vegetable oils and showed splendid closeness and strength with business clothing chemicals supporting their thought in apparel cleaning agent’s plan.

Phytoremediation

Weighty metals are the primary issue among inorganic poisons. At higher focus, they are harmful as they structure free revolutionaries and cause oxidative pressure. Also, they upset the standard activity of a few basic proteins and shades by superseding them. In any case, by using both metal-safe and biosurfactant-making tiny organic entities, the limit of the plant can be extended for phytoremediation. For example, biosurfactant making *Bacillus sp.* J119 strain can construct the adequacy of the plant advancement of attack, Sunda grass, tomato, and maize and besides take-up of cadmium. From this assessment clear that the species taken consequently has the root colonization activity. So, a creature helping the phytoremediation process is delivered for the remediation of overpowering metals.

2.SOURCES OF BIOSURFACTANTS:

Large numbers of biosurfactant-delivering microorganisms are viewed as hydrocarbon degraders. Anyway, in the past many years, many examinations have shown the impacts of microbially delivered surfactants not just on bioremediation but additionally on improved oil recuperation. The biosurfactants are delivered from microbial sources.

2.1 Bacterial biosurfactants:

Microorganisms utilize many natural mixtures as a wellspring of carbon and energy for their development. At the point when the carbon source is in an insoluble structure like hydrocarbon, microorganisms conceivable their dispersion into the cell by delivering an assortment of substances, the biosurfactants. A portion of the microbes and yeasts discharge ionic surfactants which emulsify the CxHy substance in the development medium. A couple of instances of this gathering of biosurfactants are rhamnolipids that are created by various *Pseudomonas spp* or sophorolipids that are delivered by a few Torulopsis spp. A few different microorganisms can change the construction of their cell wall which is accomplished by delivering nonionic or lipopolysaccharide surfactants in their phone wall. Some instances of this gathering are *Rhodococcus erythropolis* and different *Mycobacterium spp.* Furthermore, *Arthrobacter spp.* Produce nonionic trehalose corynomycolates. There are lipopolysaccharides, for example, emulsan, created by *Acinetobacter spp*., and lipoproteins such as surfactin and subtilisin, that are created by *Bacillus subtilis.* Parasitic biosurfactants: Where the field of creation of biosurfactants by bacterial species is very much investigated, moderately fewer growths are known to deliver biosurfactants. Among organisms, *Candida bombicola, Candida lipolytica, Candida ishiwadae, Candida batistae, Aspergillus ustus, and Trichosporon ashii* are the investigated ones. A considerable lot of these are known to create biosurfactants on minimal expense crude materials. The significant kind of biosurfactants delivered by these strains are sophorolipids (glycolipids). *Candida lipolytica* produces cell wall-bound lipopolysaccharides when it is developing on n-alkanes.

2.2 Fungal biosurfactants:

Where the field of creation of biosurfactants by bacterial species is all around investigated, generally fewer organisms are known to deliver biosurfactants. Among organisms, *Candida bombicola, Candida ishiwadae, Candida batistae, Aspergillus ustus, and Trichosporon ashii* are the investigated ones. A considerable lot of these are known to create biosurfactants on minimal expense crude materials. The significant sort of biosurfactants created by these strains is sophorolipids (glycolipids). *Candida lipolytica* produces cell wall-bound lipopolysaccharides when it is developing on n-alkanes.

3.Microorganisms that produce biosurfactants:

Many microorganisms, including microscopic organisms, yeast, and parasites, are known to deliver biosurfactants. These microorganisms produce biosurfactants as auxiliary metabolites, frequently considering the presence of hydrophobic mixtures like oils or hydrocarbons in their current circumstance. The biosurfactants help microorganisms by improving the solvency of hydrophobic mixtures, permitting them to get to fundamental supplements. Here are a few key microorganisms that are notable for their capacity to deliver biosurfactants:

3.1 Microbes:

Microscopic organisms are the most read-up gathering of microorganisms for biosurfactant creation. They produce an assortment of biosurfactants, for example, glycolipids, lipopeptides, and phospholipids.

Pseudomonas spp.:

Pseudomonas aeruginosa is one of the most read-up bacterial species for biosurfactant creation. It produces rhamnolipids, a kind of glycolipid biosurfactant with solid surface strain decreasing and emulsifying properties. Rhamnolipids are widely utilized in bioremediation and improved oil recuperation.

Bacillus spp.:

Bacillus subtilis and Bacillus licheniformis are known for creating lipopeptides, for example, surfactin and iturin. Surfactin is one of the best biosurfactants for decreasing surface pressure and has antibacterial and antiviral properties. *Bacillus* species are strong makers of biosurfactants, significantly under outrageous ecological circumstances.

Acinetobacter spp.:

Acinetobacter calcoaceticus is known for creating biosurfactants with high emulsification properties. These microbes frequently produce emulsan, a polymeric biosurfactant utilized in oil slick cleanup and bioremediation applications.

Rhodococcus spp.:

Rhodococcus erythropolis is a non-pathogenic bacterium fit for delivering biosurfactants within the sight of hydrocarbons. It produces trehalolipids, which are glycolipids utilized in the debasement of hydrophobic toxins, putting forth them significant for bioremediation attempts.

Serratia marcescens:

This bacterium delivers a biosurfactant called serrawettin, which helps in biofilm development and surface motility. Serratia is less generally read up however offers potential for modern biosurfactant creation.

3.2 Yeasts:

Certain yeast species are likewise fit for delivering biosurfactants, frequently as sophorolipids, which are glycolipids.

Candida bombicola:

This yeast is one of the most significant biosurfactant makers, creating sophorolipids, which are broadly utilized in cleansers, beauty care products, and drugs. Sophorolipids have great antimicrobial and emulsifying properties, making them significant for a few business applications.

Yarrowia lipolytica:

Known for its capacity to create biosurfactants from hydrophobic substrates like vegetable oils and hydrocarbons, *Yarrowia lipolytica* produces liposan, a polysaccharide-protein complex biosurfactant with superb emulsification properties.

Candida lipolytica:

This yeast is one more maker of biosurfactants, especially within the sight of hydrocarbon substrates. Its biosurfactants are valuable in enterprises like food handling and bioremediation.

3.3 Organism:

Organisms are more uncommon than microbes in biosurfactant creation, however, certain species produce remarkable biosurfactants, including glycolipids and lipopeptides.

Aspergillus spp.:

Aspergillus niger and Aspergillus oryzae produce biosurfactants under unambiguous development conditions, especially when presented to hydrophobic carbon sources like oils. They are known to deliver glycolipids and can be utilized in food handling and natural cleanup.

Penicillium spp.:

Penicillium species produce biosurfactants when filled within the sight of hydrocarbons. Their biosurfactants are fundamentally utilized in biotechnological applications, especially in breaking down oil in defiled conditions.

Trichoderma spp.:

This sort of growth is known for delivering biosurfactants that have applications in agribusiness, for example, further developing soil structure and upgrading the bioavailability of supplements to plants. Their biosurfactants additionally assist with debasing hydrophobic toxins.

Table 1
Biosurfactants, producing organisms and their uses.

Microorganism	**Types of biosurfactant**	**Uses**
Pseudomonas aeruginosa S2	Rhamnolipid	Bioremediation of places contaminated by petroleum
Rhodococcus erythropolis 3C-9	Glycolipid and Trehalose Lipid	Oil spill cleaning operations
Pseudomonas libanesis M9-3	Lipopeptide	Environmental and biomedical uses
Bacillus subtilis ZW-3	Lipopeptide	Pharmaceutical, environment protection, cosmetics and petroleum recovery
Rhodococcus sp. TW53	Lipopeptide	Bioremediation in sea environment
Pseudozyma hubeiensis	Glycolipid	Bioremediation in sea environment
R. wratislaviensis BN 38	Glycolipid	Bioremediation uses
Bacillus subtilis BSS	Lipopeptide	Bioremediation of places contaminated by hydrocarbon
Azobacter chroococcum	Lipopeptide	Environmental uses
Pseudomonas aeruginosa BS20	Rhamnolipid	Bioremediation of places contaminated by hydrocarbon
Nocardiopsis alba MSA10	Lipopeptide	Bioremediation
Pseudozyma parantarctica	Mannosylmannitol lipid	Detergent or washing emulsifiers
Pseudomonas alcaligenes	Rhamnolipid	Environmental uses
Pseudomonas koreensis	Lipopeptide	Biologic control agent
Pseudomonas fluorescens BDS	Lipopeptide	Bioremediation and Biomedicine
Candida bombicola	Sorolipídeos	Environmental uses
Brevibacterium aureum MSA13	Lipopeptide	Petroleum recovery
Nocardiopsis lucentencisMSA04	Glycolipid	Bioremediation in sea environment
Bacillus velezensis H3	Lipopeptide	Industrial strain for lipopeptide production
Calyptogena soyoae	Mannosylerythritol lipid	Bioremediation in sea environment

Source: Makkar et al. (2011).

4. Role of Kerosene in Biosurfactant Production:

Lamp fuel assumes a pivotal part in the development of biosurfactants, going about as both a carbon source and an inducer for hydrocarbon-corrupting microorganisms. Microorganisms, for example, microbes and organisms, use lamp fuel as a substrate, processing it to create biosurfactants that help with solubilizing hydrophobic mixtures like oils. The exceptional properties of lamp fuel make it a successful and monetarily feasible choice for upgrading biosurfactant creation, especially in bioremediation and improved oil recuperation (EOR) applications.

Biodegradation of lamp fuel

The capacity of the detaches in hydrocarbon digestion was likewise examined through lamp fuel biodegradation. Lamp fuel was chosen as the model oil since it contains a wide assortment of hydrocarbons including straight and stretched paraffins, naphthenics, and fragrant parts like alkyl benzenes and naphthalene and its subsidiaries. Carafes containing 100 ml of BH mineral medium were provided with 1 % (V/V) lamp fuel as the sole carbon source. Then, at that point, 2 ml of a culture containing 108 cells for each ml was added to the arrangement. One of the carafes was left with next to no vaccinations as the clear. At long last, the acquired stocks were brooded in an orbital shaker (180 rpm, 37 C) for 4 days. The measures of hydrocarbon take-up by the cells were estimated by a system proposed by Palittapongarnpim et al. (1998). Biomass was isolated from the stock by centrifuging (Sigma 3k30, UK) at 10,000 rpm for 20 min. Hydrocarbons were separated from the supernatant by 20 ml chloroform, and the concentrate was isolated from the fluid stage utilizing a decanter pipe. The lingering water content of the concentrate was dispensed by going it through an ammonium sulfate layer put on a paper channel (Wattman Number 4). At long last, the hydrocarbon content of the concentrate was estimated by gas chromatography (Agilent Advances 6890 N, USA) outfitted with an HP5 slender segment and an FID locator. Injector and locator temperatures were set to 280 and 300 C, separately. The broiler temperature was set to 100 C for 1 min and afterward expanded to 210 C by 15 C/min slant and saved steady for 3 min. Helium was utilized as transporter gas at a stream pace of 2 ml/min. The maintenance seasons of the unadulterated hydrocarbons, including n-C10, n-C12, and n-C15, were equivalent to 5.5, 8.4, and 11.57 min, separately.

4.1 Carbon Source:

Lamp fuel, being hydrocarbon, fills in as an essential carbon and energy hotspot for microorganisms that blossom with natural mixtures, for example, *Pseudomonas aeruginosa, Bacillus subtilis, Acinetobacter calcoaceticus, and Rhodococcus erythropolis.* These microorganisms utilize hydrocarbons through specific pathways, delivering biosurfactants simultaneously. The biosurfactants assist with separating hydrophobic substances, including lamp fuel, into more modest, more dissolvable particles that can be effectively used by microbial cells for development and energy. Along these lines, lamp oil energizes the microbial digestion that is fundamental for biosurfactant creation.

4.2 Inducer of Biosurfactant production:

Lamp fuel goes about as an intense inducer for the development of biosurfactants. Numerous microorganisms produce biosurfactants just within the sight of hydrophobic substrates like hydrocarbons. Lamp fuel, as a hydrophobic particle, sets off the outflow of biosurfactant-creating qualities in microorganisms. These mixtures assist microorganisms with adapting to hydrophobic conditions by decreasing surface and interfacial pressures, empowering the phones to productively connect with and separate hydrocarbons more. For instance, Pseudomonas species are notable for creating rhamnolipids, and Bacillus species produce lipopeptides like surfactin when compared to hydrocarbons like lamp fuel.

4.3 Emulsification and Solubilization:

One of the critical elements of biosurfactants is to emulsify hydrophobic mixtures, and lamp fuel improves this interaction. Biosurfactants bring down the surface pressure among water and oil, framing oil-water emulsions that make lamp fuel more open to microbial cells. This emulsification works on the solvency and bioavailability of lamp oil, permitting microorganisms to successfully process it more. The subsequent biosurfactants further settle the emulsions, prompting a criticism circle in which more lamp fuel is separated, more biosurfactants are created, and microbial movement is enhanced.

4.4 Influence on Biosurfactant Yield:

The convergence of lamp oil utilized is a basic component in expanding biosurfactant creation. Concentrates on demonstrating the way that ideal lamp oil focuses can altogether improve microbial development and biosurfactant yield, while an excess of lamp fuel might restrain microbial movement because of poisonousness. Appropriately adjusted convergences of lamp fuel guarantee that microorganisms can proficiently create biosurfactants, making the cycle both viable and affordable.

5.Extraction of biosurfactants:

From the supplement agar, 200 bacterial strains were disengaged and tried. Among all strains, 40 strains showed reasonable haloes on blood agar plates. By the by, just 8 strains named SM1-SM8 had hemolytic movement, and emulsified endured unrefined petroleum in marine stock during cultivation. Strains SM1, SM3, SM6, and SM8 emulsified endured unrefined petroleum in marine stock within 24 h of development, while strain SM5 emulsified endured unrefined petroleum within 48 h. Strains SM2, SM4, and SM7 could emulsify endured unrefined petroleum somewhat. The strains with hemolytic action and emulsifying action against endured unrefined petroleum and 5 non-hemolytic strains (named as SM9-SM13) were developed in fluid media and biosurfactant creation was affirmed. Just strains displaying hemolytic action and emulsifying action showed a positive outcome with the drop falling test, emulsification action test, and oil removal test. From the outcome, strain SM1 showed the most noteworthy movement for both oil dislodging tests toward endured raw petroleum (3.14 cm2) furthermore, emulsification action against n-hexadecane (70.5%).

It was noticed that the strain with higher emulsifying movement toward endured raw petroleum showed the more noteworthy oil relocation action and emulsification movement. Hemolytic movement has been utilized for the separation of lipopeptide biosurfactants and rhamnolipids. The hydrophilic part of biosurfactant - the cationic part proposed to start an electrostatic connection with the adversely charged parts of the layer of organisms; the hydrophobic part is assumed to allow the peptides to embed into and saturate the film. The biosurfactant delivery limit in the fluid medium was found to be related to hemolytic movement. The hemolytic movement subsequently gives off an impression of being a decent screening standard for surfactant-delivering strains. Notwithstanding, just 13.5% of the hemolytic strains brought down the surface pressure under 40 mN/m, and not all biosurfactants had a hemolytic movement. Likewise, other microbial items, for example, harmfulness factors lyse blood agar, and biosurfactants that are inadequately diffusible may not lyse platelets. In this manner, it isn't certain if blood agar lysis ought to be utilized to evaluate biosurfactant creation. In any case, such screening can be utilized as a quick strategy, in which tests with positive outcome are hence oppressed to biosurfactant-movement tests in fluid media. At the point when the 16S rRNA quality grouping of disconnects SM1, SM2, SM3, SM4, SM5, SM6, SM7
furthermore, SM8 was contrasted with recently distributed successions on the EMBL data set, the high homology was found with Myroides sp. (94.00%homology); a *Vibrio paraheamolyticus* (99.54% homology); a *Bacillus subtilis* (99.14% homology); a *Micrococcus luteus* (99.12% homology); an unidentified bacterium; an *Acinetobacter* nitrates (99.39% homology); a *Vibrio paraheamolyticus* (99.67% homology) and a *Bacillus pumilus* (99.34% homology) strain, individually detailed that *Myroides odoratus*, isolated from bug stomach, created N-acyl glutamine surfactants as elicitors of plant volatiles. Moreover, biosurfactant-delivering microbes from contaminated and uncontaminated soils were disengaged. Gram-positive biosurfactant-producing segregates were found in weighty metal-contaminated or uncontaminated soils, while gram-negative disengages were detached from hydrocarbon-contaminated or co-defiled soils. The kind of biosurfactant is for the most part represented by the kinds of microorganisms. Different biosurfactants have been detached from different marine microscopic organisms: glucose lipid created by *Alcaligenes sp.* and *Alcanivorax borkumensis* trehalose tetraester and trehalose diester created by *Arthrobacter* sp. SI 1 and polymeric biosurfactants created by *Pseudomonas nautica* and yeast, *Yarrowia lipolytica.* Since strain SM1 emulsified endured unrefined petroleum inside 24 h and showed the most elevated emulsification

action and biggest region with oil uprooting test, it was chosen for biosurfactant creation and portrayal.[9]

6.Characterization of biosurfactants:

Fourier change infrared spectroscopy (FT-IR) examination:

There are a few writing reports of confinement and biosurfactant creation by various types of the class *Pseudomonas*. *P. aeruginosa*, which delivers a rhamnolipid, has homologs that differ in the number of rhamnose particles as well as in the length and, what's more, the structure of the alkyl chain. The sub-atomic structure of the biosurfactant delivered by *Pseudomonas sp*. 2B was assessed by FT-IR and addressed the FT-IR spectra of the freeze-dried sample. The trademark band at 3280 cm−1 shows the presence of Goodness bonds. Retention around 2928 cm−1 is allocated to the symmetric stretch (CH) of CH2 and CH3 gatherings of aliphatic chains. The ingestion top situated at 1625 cm−1 demonstrates the presence of ester carbonyl gatherings (CO bond in COOH). The ester carbonyl bunch was additionally demonstrated from the band at 1238 cm−1 which corresponds to CO deformation vibrations, although other bunches moreover assimilate around here. Protein-related feeble groups the C O amide I (1625 cm−1) and NH/C O mix of the amide II groups (1529 cm−1), were observed. It might be conceivable that the extra groups at 1625 cm−1 and 1529 cm−1 came about because of the contamination of polypeptides from cell garbage co-accelerated with the biosurfactant during the extraction process [20]. The retention top around 1056 cm^{-1} shows the presence of polysaccharide or polysaccharide-like substances in the biosurfactant. The absorption top at 694 cm^{-1} shows the presence of a CH2 bunch. The above data from the individual wave numbers affirmed the glycolipid idea of the biosurfactant [42-44]. Mass spectrometric (MS) examination of the biosurfactant. The mass range (MS) of the *Pseudomonas sp*. 2B biosurfactant showed a combination of rhamnolipid with a sub-atomic weight somewhere in the range of 333 and 678 with extraordinary sub-atomic particles at m/z 333,479, 504, 505, 532, 650, and 678. The mass spectrometric investigation of the biosurfactant affirmed the above results with tops seen at m/z = 333, 479, 504, 505 for lipids and at 650 and 678 for sugar moieties. The m/z values acquired were predictable with the atomic construction of Rha-C10, Rha-C10-C10, Rha-C10-C12, and Rha-C10-C10, individually. Nine rhamnolipid homologs were recognized in the current review. As a rule, the outcomes showed the presence of a generally higher overflow of rhamnolipid (l-rhamnopyranosyl-l-rhamnopyranosyl-3-hydroxydecanoyl-3hydroxydecanoate) than Mono rhamnolipid (l-rhamnopyranosyl-3-hydroxydecanoyl-3-hydroxydecanoate). As detailed by Deziel et al., tops at 333.0 m/z (Rha-C10) and 479.0 m/z (Rha-C10) demonstrated parts created by cleavage of rhamnolipid atoms. The rhamnolipid creation and power of a specific kind of congener rely upon different factors like sort of carbon substrate, culture conditions, age of the way of life, and the strain *P. aeruginosa.[2]*

7.Applicatons of Biosurfactants:

Biosurfactants stand out enough to be noticed as late because of their different applications across different enterprises. Their extraordinary properties, like biodegradability, low harmfulness, and adequacy at outrageous temperatures and pH levels, make them reasonable for various applications. The accompanying subsections frame a portion of the vital uses of biosurfactants.

7.1 Bioremediation of Hydrocarbon-Debased Environments:

One of the most unmistakable utilizations of biosurfactants is in the bioremediation of oil slicks and other hydrocarbon-polluted conditions. Biosurfactants improve the bioavailability of hydrophobic toxins, working with microbial debasement. They assist with emulsifying oil, making it more open to microorganisms for digestion. Studies have shown that biosurfactants can essentially work at the pace of hydrocarbon corruption in sullied soils and water bodies, accordingly, adding to ecological cleanup endeavors.

7.2 **Improved Oil Recuperation (EOR):**

Biosurfactants are progressively utilized in the oil business to improve oil recuperation from supplies. By diminishing the interfacial strain among oil and water, biosurfactants assist with assembling caught oil, working on the effectiveness of extraction processes. This application helps with oil recuperation rates as well as limits the ecological effect related to the utilization of engineered surfactants.

7.3 Agribusiness and Soil health:

In agribusiness, biosurfactants can further develop soil structure, improve supplement accessibility, and advance plant development. They can go about as regular wetting specialists, further developing soil dampness maintenance and helping with the scattering of composts and pesticides. Besides, biosurfactants can animate gainful microbial networks in the dirt, adding to in general soil wellbeing and ripeness.

7.4 Food Industry:

Biosurfactants are being investigated as regular emulsifiers and stabilizers in the food business. Their utilization can upgrade the surface, flavor, and period of usability of food items while giving a better option in contrast to engineered added substances. For instance, rhamnolipids and lecithin’s are used in different food details, further developing emulsion strength and forestalling partition.

7.5 Drug and Corrective Industries:

In the drug and corrective areas, biosurfactants are esteemed for their biocompatibility and mellowness. They can be utilized as emulsifiers in creams, salves, and other skin definitions, upgrading the solvency and bioavailability of dynamic fixings. In addition, their antimicrobial properties can give added benefits to private consideration items.

7.6 Biomedical Applications:

Biosurfactants have expected applications in drug conveyance frameworks because of their capacity to upgrade the solvency of hydrophobic medications. They can be integrated into nanocarriers to work on the conveyance and adequacy of restorative specialists. Moreover, biosurfactants may have applications in designated drug conveyance, giving a way to specifically convey medications to explicit tissues.

CONCLUSION:

The extraction of biosurfactants from soil using kerosene as a substrate successfully demonstrated that indigenous soil microorganisms can produce biosurfactants in response to hydrocarbon exposure. Kerosene, serving as a carbon source, stimulated the growth of hydrocarbon-degrading microbes, leading to the production of biosurfactants with notable surface tension-reducing and emulsification properties. This study underscores the potential of using kerosene-induced biosurfactant production for bioremediation, particularly in the degradation of hydrophobic pollutants in contaminated soils. The eco-friendly and biodegradable nature of biosurfactants, combined with their efficacy in environmental cleanup and industrial applications, makes this process a sustainable alternative to synthetic surfactants. However, while the process was effective, challenges such as optimizing the yield, improving purity, and scaling up for commercial viability remain. Further research is required to optimize production conditions, fully characterize the chemical structure of the biosurfactants, and explore additional hydrocarbon substrates. Overall, this study provides a promising foundation for utilizing naturally occurring microorganisms for sustainable biosurfactant production, offering valuable applications in environmental remediation, enhanced oil recovery, and other industries that require effective surface-active agents.

AUTHOR CONTRIBUTIONS

Gopinath B and Dr. Bindhu J: Conceptualization, Project Administration. **Gopinath B and Abishek M:** Writing—Original Draft Preparation. **Gopinath B, Abishek M, Dhanasekar A, Kavin KGV, and Sanjai Kumar S:** Writing—Research Review and Editing. All authors have read and agreed to the published version of the manuscript.

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