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Synthesize Characterization Antimicrobial Studies And Applications Of Quaternary Ammonium Compound (Benzyl Dimethyl Phenyl Ammonium Iodide)

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Abstract:-

Quaternary Ammonium compounds positively influence in health care and commercially used in SARS COVID – 19 pandemic situations. The present study aims to synthesize Benzyl Dimethyl Phenyl Ammonium Iodide. QUATS and examine its pathogens like fungi bacteria, viruses. Most of these Quaternary Ammonium compounds actively works against disease causing micro organism In these research work , the synthesized BDAI works against disease causing micro organism due to their broad spectrum of antimicrobial properties were examined by FTIR, U-V elucidate into their molecular structure . In BDPAI also examined PH variation , termite resistance, solubility , fungal , bacterial studies , Alcohol based BDPAI sanitizer , soap have been tested . It proven does infections properties can helpful as a strong agent in hand sanitizer, soaps and various cleansing agents in various medical field. The synthesized BDPAI is eco friendly solvent due to their properties of non volatility.

Keywords:-

Benzyl dimethyl phenyl Ammonium Iodide , UV-visible , FTIR Bacteria , Fungi , Minimum Inhibitory Concentration

Introduction:-

Natural and artificial disaster influence many micro organisms are favorable to grow day to day in our worldwide [1,2,3,4,5]. In past three years globally 20 lakhs people dead in SARC COVID – 19. It is a challenge to overtake the human health in world wide. WHO suggest a series of emergence recommendations and suggest maintaining social distance wearing masks and personal hygiene using hand sanitizer and soap.

The newly prepared Quaternary Ammonium Compound like BDPAI to inhibit the activity of Bacteria prefer S. Aureus , S-mutans , K pneumonia , P. aeruginosa and E-coli and Fungus like A. Flavus and C.Albicans has been the ability to reduce the disease causing microorganism. QUATS are also the activities of many functions such as cleaning products, hand sanitizers antifungal soaps, herbicides, insecticides and nematicides. The Ph influences plays a vital role for the disruption of microorganism.

Quats are mixable with lower alcohols such as ethanol, methanol and glycerol . The length

affects different properties of QUATS. A shorter chain length is associated with higher antimicrobial activity but higher level skin sensitivity as a greater solubility in water[6,7,8,]. This research work apparent both alcohol based sanitizer and soap along with BDPAI has the ability to destroy microorganism and there by helps to reduce the spreading of infectious disease Alcohol has sudden action against vegetative form of bacterial, fungicidal and virucidal[9,10].

The structure of QUATS are constitute (N^+) in which the nitrogen atom is attached with four different groups of covalent bond. In most of the hospitals, health care facilities, and various industries QAC`S were marketed as antimicrobial [11,12,13,14].

Materials and methods

Materials

N-N, Dimethyl aniline, Iodobenzene, Isopropyl alcohol and glycerine were purchased from GLR Innovation Ltd, Sivaji MARG Delhi (India) and also all the chemicals are pure and analytical grade,

Synthesis of Benzyl dimethyl phenyl Ammonium Iodide

N-N,Dimethyl aniline and Iodo benzene is taken in a clean dry standard flask in a molar ratio of 1:1 along with HCl is added drop wise to the mixture. Here HCl serves to promote the amine group to produce the benzyl dimethyl phenyl ammonium iodide.

Demonstration Section,

UV-1700 series of spectrometer was used to record the spectra to examine the product benzyl dimethyl phenyl ammonium iodide. Jasco FTIR-4600 instrument used to identify the functional groups present in benzyl dimethyl phenyl ammonium iodide. Alcohols based hand sanitizer with benzyl dimethyl phenyl ammonium iodide were determined for PH using digital PH meter.

Antifungal Experiments

Preparation of fungus suspension

The bacterial strains were sub cultured in nutrient agar medium 1g/litre peptic digest of animal tissues and incubated for 24h, the selected fungi C.Albicans and A.Flavus were sub cultured in potato dextrose and agar medium. Both gram negative and gram positive bacteria were examined by disc diffusion techniques.

Results and Discusions

UV-Visible Spectroscopy.

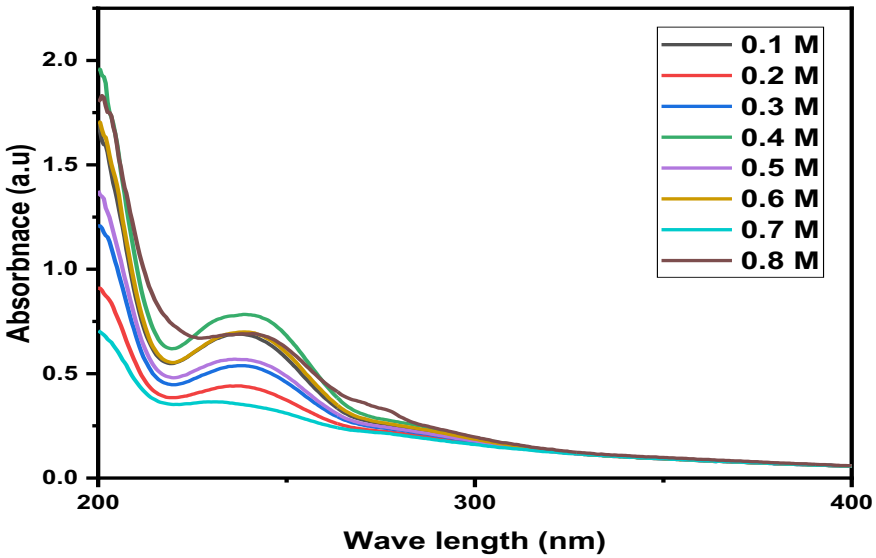
Table.1. Absorbance wavelength of prepared quaternary ammonium compound

CONCENTRATION (Molarity)	ABSORBANCE WAVELENGTH (nm)
0.1M	237nm
0.2M	238nm
0.3M	239nm
0.4M	236nm
0.5M	239nm
0.6M	231nm
0.7M	241nm

The synthesized eight distinct molar concentrations of QUATS absorbance wavelength were

determined by using ultra violet visible spectroscopy. The absorbance wavelength of 0.1M to 0.8M concentrations the maximum peaks values are 237nm, 238nm, 239nm, 236nm, 239nm, 231nm, 241nm respectively. The above peaks shows that the highest wavelength region at 0.3M and 0.6M concentrations and the least wavelength region at 0.7M

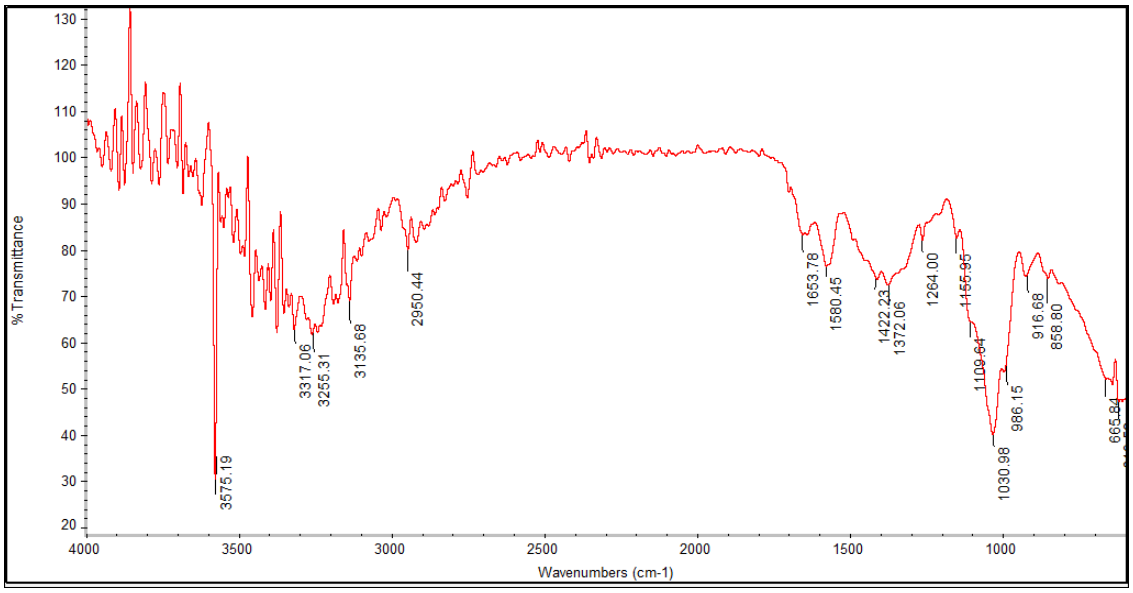
Fig.1.UV-Visible spectrum of Benzyl Dimethyl Phenyl Ammonium Iodide



FTIR Spectroscopy.

Fourier transform infrared spectroscopy (FTIR) is one of the most useful techniques to analyze the characterization and functional groups of organic and inorganic compounds. The FTIR spectra of newly prepared were consisted with their flourish structure absorption peaks. The 4000cm^{-1} to 500cm^{-1} range is covered by the FT-IR spectrum. There are various peaks that, identified for the synthesized BDPAI is shown in Fig. 3. The functional groups which belong to the ranges 3347cm^{-1}is N-H stretch of amines, 2929cm^{-1}C-H stretch of Alkanes, 1725cm^{-1}C=O stretch of ketones 1031 cm^{-1}is C-O stretching of carbonyl ,638cm^{-1} alkyl halides.

Fig. 2 FT-IR spectrum of Benzyl Dimethyl Phenyl Ammonium Iodide



Bactericidal Effect.

The bactericidal activity can be tested using BDPAI. The major classification of bacteria are monoderm bacteria and diderm bacteria. The BDPAI QUATS effect at molar concentration ranges from 0.1M to 0.8M with S.Aureous, S. Mutans, K,Pneumonia,Paraguinosa and Ecoli, Among these five types of bacteria S, Aureous monoderm and Ecoli are more active than other monoderm and diderm[20,15,18,21].

Table:2 Antibacterial result for BDPAI

Bacteria	***Zone of inhibition(mm)***								
	Concentration level								
	0.1	***0.2***	***0.3***	***0.4***	***0.5***	***0.6***	***0.7***	***0.8***	***Std***
Staphylococcus aureus	*12*	*9*	*7*	*7*	*7*	*8*	*8*	*9*	*35*
Streptococcus mutans	*11*	*7*	*7*	*7*	*7*	*7*	*7*	*7*	*11*
Klebsiella pneumonia	*11*	*9*	*7*	*7*	*7*	*7*	*7*	*7*	*25*
Escherichia coli	*11*	*7*	*7*	*7*	*7*	*7*	*7*	*7*	*25*
Pseudomonas aeruginosa	*12*	*7*	*7*	*7*	*7*	*7*	*8*	*8*	*25*

Fig. 1. Antibacterial activity results for BDPAI

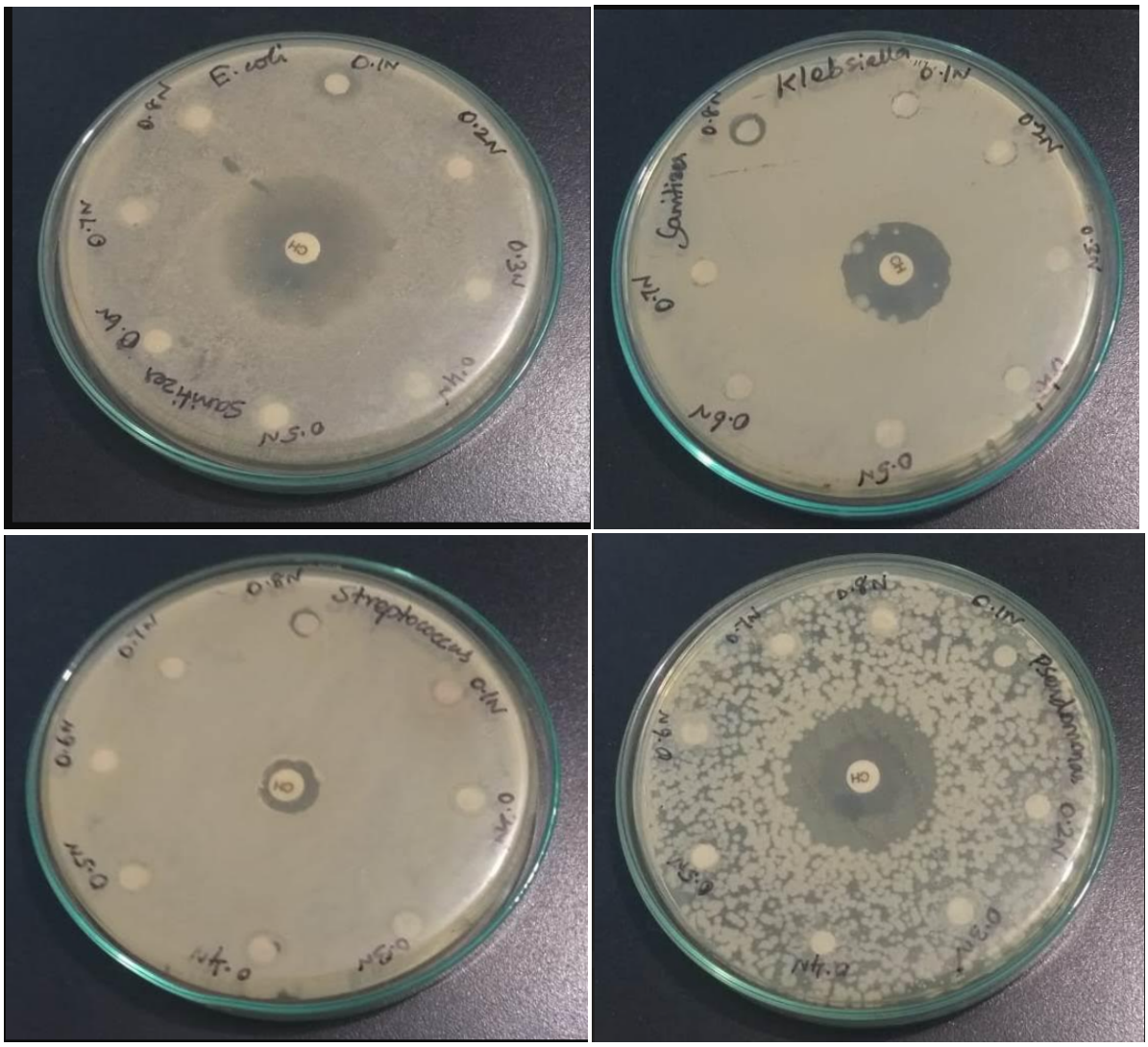
Sanitizer

BDPAI alcohol based sanitizer were tested against Staphylococcus aureus Streptococcus mutans Klebsiella pneumonia Escherichia coli and Pseudomonas aeruginosa[16,17,19] . Environmental protection agency and chemicals agency suggested that QUATS are highly affective sanitizer and disinfectants .The above table shows that it is safe for human skin[22,23,24].

Table.3: The Antibacterial activity results for sanitizer prepared from BDPAI

Bacteria	***Zone of inhibition(mm)***								
	Concentration level								
	0.1	***0.2***	***0.3***	***0.4***	***0.5***	***0.6***	***0.7***	***0.8***	***Std***
Staphylococcus aureus	*9*	*7*	*7*	*7*	*9*	*9*	*9*	*15*	*30*
Streptococcus mutans	*7*	*7*	*7*	*7*	*7*	*7*	*7*	*9*	*15*
Klebsiella pneumonia	*10*	*9*	*9*	*7*	*7*	*7*	*7*	*9*	*15*
Escherichia coli	*9*	*7*	*7*	*7*	*7*	*7*	*7*	*7*	*30*
Pseudomonas aeruginosa	*9*	*7*	*7*	*7*	*7*	*7*	*7*	*7*	*25*

Fig. 2. Antibacterial activity results for sanitizer prepared from BDPAI



Fungicidal Effect

Minimum Incubation Concentrations of BDPAI was tested from the above table that shows the QUATS containing halide like iodide has good antifungal activity. QUATS with different structures linked to nitrogen atom has varying antifungal activity. The MIC values of several concentration ranges shows that the synthesized BDPAI have a good antifungal activity of candida albicans and Aspergillus flavus [25,26,27].

Table :4 The Antifungal activity results for BDPAI

Fungi	***Zone of inhibition(mm)***								
	Concentration level								
	0.1	***0.2***	***0.3***	***0.4***	***0.5***	***0.6***	***0.7***	***0.8***	***std***
Aspergillus flavus	*11*	*7*	*7*	*7*	*7*	*7*	*7*	*8*	*20*
Candida albicans	*11*	*7*	*7*	*7*	*7*	*8*	*8*	*8*	*20*

Fig. 3. Antifungal activity results for BDPAI

Termite Resistant Test,

Due to moisture, humidity, and climate change, the growth of termites increase in large amounts. Termites that bites woods, wooden materials, cardboard and trees exist in large numbers. Economically, loss caused from termite's damage about millions per year[28,29]. A lot of termite's colonies are found in cycas plants at Thovalai in Kanyakumari Districts. Termites are collected and tested against this prepared compound BDPAI with different molar concentrations ranges at 0.1M, 0.3M, 0.6 and 0.8M. The finding shows that 0,1 M BDPAI kills the termites at 50 seconds and 0.8M reagents kills at 10 seconds . From the below table, 0.8M BDPAI takes less time than with 0.1M.

Table: 5 Time period for Termite Resistant Test

Molar Concentrations	Time
0.1M	50 seconds
0.3M	40 seconds
0.6M	30 seconds
0.8M	10 seconds

PH Fluctuation

Several investigations analyzed the PH problems to QUATS bactericidal effect. This research work has been explored a lot of reports. The reagents of BDPAI with concentrations ranges from 0.1M to 0.8M.Sanitizer also made with secondary alcohol and BDPAI. Both BDPAI and Sanitizer PH values are recorded using digital PH meter. According to the finding, lot of research , sanitizers with PH values 4 and 7 are not harmful[30]. The synthesized compound and sanitizer have a PH value is less than or equal to 7. So it is not harmful for people. This sanitizer tables (x) and (y) indicates PH fluctuation of the sample and sanitizer in this study .

Table.6. pH variations for prepared BDPAI

Concentrations	pH variations
0.1M	6
0.2M	5
0.3M	5.4

0.4M	5.1
0..5M	4.5
0.6M	4.8
0.7M	4.7
0.8M	5

Table.7. pH variations for sanitizer prepared from BDPAI

Concentrations	pH variations
0.1M	5
0.2M	4.8
0.3M	4.5
0.4M	4.4
0.5M	5.8
0.6M	4.6
0.7M	4.2
0.8M	4

Conclusion:-

QUATS BDPAI and alcohol based BDPAI sanitizer that synthesized and characterized by FTIR and UV. The synthesized compound has antibacterial activity against Staphylococcus aureus Streptococcus mutans Klebsiella pneumonia Escherichia coli and Pseudomonas aeruginosa and antifungal activity against candida albicans and aspergillus flavus. BDPAI was also tested against termites. The PH variation of the synthesized compound and sanitizer are measured alone to find out the depending upon the PH variation. BDPAI sanitizer is safe for human skin.

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Author's contributions

The authors (R. Suba Jelin Goldy, C. Isac Sobana Raj) have contributed equally to writing and reviewing the manuscript.

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Availability of data and materials

Not applicable

Declarations

Ethical approval

When preparing this article, we perform the experiments contain FTIR, UV instrumentations, then pH variation, antibacterial and antifungal activity.

Competing interests

The authors declare that they have no conflicts of interest.

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