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Contents

Antimicrobial Efficacy of Natural Flowers and Leaves Extract Based Herbal Hand Sanitizer

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Abstract

Hand sanitizer is the primary barrier to prevent transmission of enteric pathogens and it is one of the ways to avoid getting sick and spreading infection to others. Here, 70% ethanol extract of *Hibiscus rosa-sinenis* flower and leaves *Moringa oleifera*, Chrysanthemum flower and aloe vera is used for antimicrobial hand sanitizer production. The extract of *Hibiscus rosa-sinensis* has high antibacterial effect than the leaves. There is high possibility to use extracts as antibacterial agents and also used for the treatment which caused by *S. aureus* and *P. aeruginosa* infection. The natural acids present in Hibiscus plant helps for skin purification by breaking down dead skin and promoting healthy cell growth. Chrysanthemum flower has antibacterial properties and also acts as an antiseptic agent. It also gives gentle effect on the skin. Chrysanthemum flower has significant inhibitory effect on *S.aureus* and *E.coli*. Moringa plant helps to promote cellular growth and destruction of skin tissue. It has anti-inflammatory and nourishing properties. Aloe vera has natural moisturizer that helps to moisture on dry and rough skin. This hand wash is to detect the efficiency of flowers and the hand wash should be in organic form and anti-microbial form. The antibacterial activity against different microbes has been described in different in-vitro settings. For testing anti-microbial activity, anti-microbial susceptibility test, MIC MBC test was done to check for presence of microbes. The goal is to detect possible drug resistance in common pathogens and assure susceptibility to drugs of choice for particular infections.

Keywords: Hand wash; *Hibiscus rosa-sinensis*; Chrysanthemum flower; aloe Vera; *Moringa oleifera*; antimicrobial susceptibility; drug resistance

1. Introduction

Skin being the most exhibit part and need shield from skin microbes. Hand sanitizer has become a consistent part of many people lives due to their ability to destroy pathogens and other microbes through a rather simple procedure. Hand sanitizer is the primary barrier to prevent transmission of enteric pathogens. It is one of the ways to avoid getting sick and spreading infection to other. Hand sanitizer reduces the number of temporary organism on the skin surface. Hand sanitizer that contain many chemicals which causes diseases when used for a prolonged period. Hand sanitizer reduces levels of microorganism by killing them chemically, just like disinfectant kill germs on environmental surface. Antiseptic material used for hand sanitizer formulation is from ethanol at the concentration of 60%. The antiseptic material such as moringa oleifera leaves, hibiscus flowers, and chrysanthemum flowers was extracted.

Hibiscus rosa-sinensis is from Malvaceae family and which has antibacterial action. Hibiscus helps for skin purification by breaking down dead skin and promoting healthy cell growth [1, 2]. Chrysanthemum flower is from sunflower family which has antibacterial and anti inflammatory properties. It is a strong antiseptic agent and used as a natural moisturizer and gives gentle effect on the skin. Chrysanthemum has significant effect on *S.aureus* and *E.coli.* Moringa plant helps to promote cellular growth and destruction of skin tissue. It has antioxidant, antibacterial, anti-inflammatory and nourishing properties [3, 4, 5]. Aloe Vera has natural moisturizer that helps to moisture on dry and rough skin. After finishing sanitizing ethanol will dry up but the aloe vera will form shied on the skin and keeps soft [6, 7].

The hands of workers are the primary way to spread the multidrug resistant microbe and also nosocomial infection. So the antiseptic is used for hand washing. Many chemical disinfectants are available in marketplace as alcohol based disinfectant such as ethanol, methanol, and isopropanol etc. The food and drug administration (FDA) suggest a concentration of 60% to 95% ethanol or isopropanol for alcohol based hand sanitizer because the concentration ranges of greatest germicidal efficacy [8]. Chemicals can be toxic to human while inhaling but ethanol and isopropanol has less toxicity than methanol.

2. Materials and Methods
2.1 Materials

Moringa oleifera leaves, hibiscus flower, Chrysanthemum flowers were collected in Vandalur area, Chennai, Tamil Nadu. They were air dried and kept in hot air oven at 50° C till it was completely dried. It was then ground into powder with the aid of pestle and mortar. The grained material was stored in polythene bags.

2.2. Methods

2.2.1. Extraction process

The aqueous and ethanol extract were prepared using similar procedure.50 g of the crushed leaves/ flowers were weighed and put into titration flask in which 100 mL of ethanol/ water was added. The mixture was incubated for 12 hours and then filtered using whatman No.1 filter paper. Extracted mixture was ozonated for 30 minutes and then kept in glass container. Acquired mushy extract was kept in a cooler for further study. The aqueous and ethanol extracts of *Moringa oleifera* leaves, hibiscus flower, chrysanthemum flowers were prepared individually.

2.2.2. Preparation Of Herbal Sanitizer

Hand sanitizer was prepared in liquid and gel form.

2.2.2.1. Liquid Hand Sanitizer

The ethanol extract of moringa leaves, hibiscus flower and chrysanthemum flower was added in the beaker and mixed well. Then Aloe vera gel was included to the composition and for the fragrance orange essential oil was added and mixed properly and stored in glass bottle.

2.2.2.2. Gel Hand Sanitizer

The agar was weighed and heated with the distilled water. The ethanol mixture of moringa leaves, hibiscus flower and chrysanthemum flower was added to the agar solution and mixed well. Then aloe vera gel was included to the composition and for the fragrance orange essential oil was added and mixed properly and stored in glass bottle.

2.2.3. Antibiotic Sensitivity Test

The microorganism was retrieved from the workers hands. Out of all the microorganisms,*Staphylococcus aureus* and *Pseudomonas aeruginosa* were recognized and used for this study. The antibiotic activity of the sanitizer was analyzed by antimicrobial assay technique. Mueller-Hinton agar was used as culture medium. Spread plate method was performed. Firstly the test organism and the hand sanitizer

were mixed well. The mixed mixture was spread on the plates containing agar medium. Then plates were incubated under standard conditions and noticed for the presence or absence of bacterial development.

2.2.4.Well Plate Assay

This test was done in 96 well plates. Muller Hinton broth was prepared. The plates were marked in the concentration of drugs dilution such as 64, 32, 16, 8, 4, 2, SC, GC and C. The broth was added in all the wells and sample was added in first well. Then the serial dilution was performed. The culture was added all the wells and incubated overnight. On the next day OD was taken at 600nm and recorded. Growth was calculated and plotted in graph.

3. RESULTS AND DISCUSSION

The antimicrobial efficacy of hand sanitizer was tested by antibiotic susceptibility test and MIC growth test.

3.1 ANTIBIOTIC SUSCEPTIBILITY TEST

The prepared herbal hand sanitizer was tested by antibiotic susceptibility test (spread plate method). In this test, the test organism was *Staphylococcus aureus* and P*seudomonas aeruginosa.* The samples which inhibit the growth of bacteria were shown.

3.1.1.Antibacterial activity of herbal sanitizeragainst *Staphylococcus aureus*

Figure 1: Plates containing Staphylococcus aureus against A: liquid ethanol hand sanitizer, B: gel ethanol hand sanitizer, C: aqueous hand sanitizer and D: Growth control of *S. Aureus*

Figure 1 shows after the incubation growth of *Staphylococcus aureus* in ethanol hand sanitizer was lower than aqueous hand sanitizer because *Staphylococcus aureus* was resistant to both ethanol and aqueous hand sanitizer but ethanol has high resistance than aqueous.

3.1.2.Antibacterial activity of herbal sanitizeragainst *Pseudomonas aeruginosa*
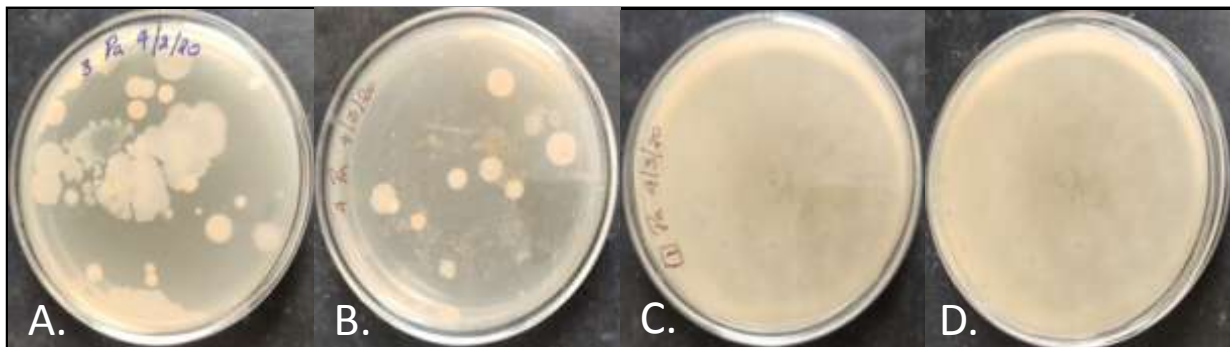
Figure 2: Plates containing *Pseudomonas aeruginosa* against A: liquid ethanol hand sanitizer, B: gel ethanol hand sanitizer, C: aqueous hand sanitizer and D: Growth control of *P.aeruginosa*

Figure 2 shows that the growth of *Pseudomonas aeruginosa* in ethanol hand sanitizer was lower than aqueous hand sanitizer because *Pseudomonas aeruginosa* was resistant to both ethanol and aqueous hand sanitizer but ethanol has higher resistance than aqueous sanitizer.

6.4 Antibacterial Assay
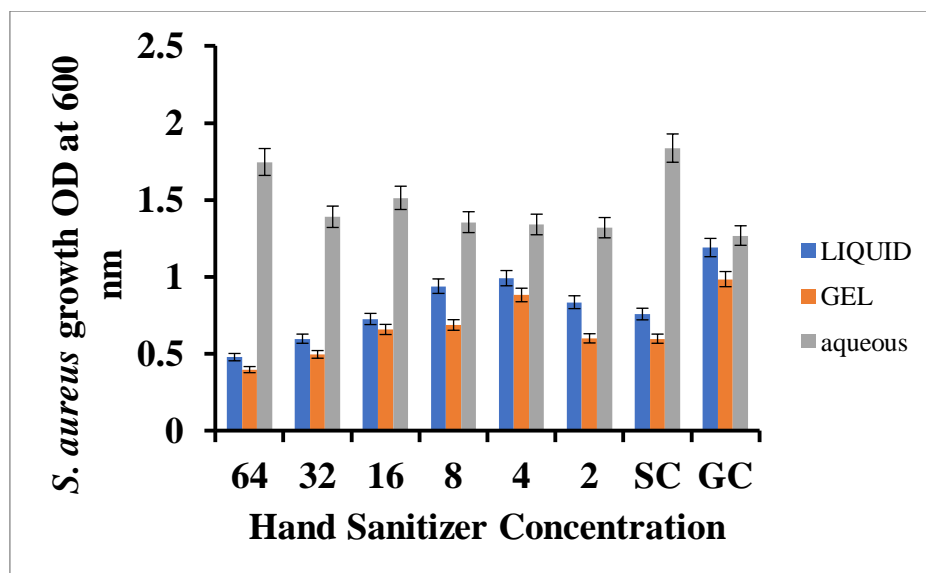
Fig 3.Antibacterial activity of herbal formulated sanitizer against *Staphylococcus aureus*

Seleshe and Kang (2019) conducted invitro antimicrobial activity assay of moringa leaves using different solvents. Moringa has multipurpose activity and contain more vitamins. It showed high antibacterial activity [5].Fouad et al 2019 shows the

antimicrobial efficacy of moringa leaves extract against pyogenic bacteria *Corynebacterium Pseudotuberculosis, E.coli, Pseudomonas aeruginosa, Streptococci sp, Staphylococci sp* etc*.* The test shows that the ethanol extract of moringa leaves has higher antimicrobial efficacy than cold & hot aqueous extract [9].

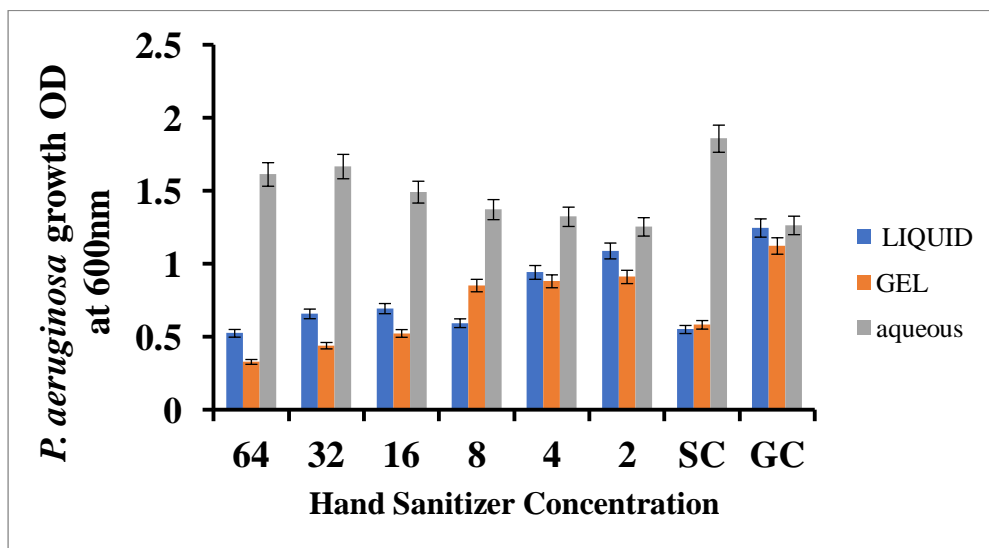In this graph the aqueous extract shows good activity at high concentration (<1 to >2) and ethanol extract shows good activity at low concentration (<0 to >1).

Fig 4.Antibacterial activity of herbal sanitizer against *Pseudomonas aeruginosa*
In this graph the aqueous extract shows high concentration (<1 to >2) and ethanol extract show low concentration (<0.5 to >1).

Bashir et al 2011 conducted comparative study of aloe vera extract and antibiotics against skin infection causing microbes [7]. The result showed that Aloe vera gel extract had higher efficacy than the antibiotics.Jain et al2016 shows antibacterial effect of aloe vera gel against oral pathogens. Aloe vera is a medicinal and natural herbal remedy and has anti-inflammatory, anti microbial and immune boosting properties. At low concentration there was no effect against bacteria but in high level the zone of inhibition was very high [6].

4. Conclusion

Hand sanitizers are the best alternative source for use of soap and water. It prevents spreading of diseases than using soap and water.It is safe, effective, and beneficial and

helps to stop transmission of diseases.However soap and water are not always available and this is where hand sanitizer comes into play. The small amount hand sanitizer was poured in hand and then rubbed the microorganism was killed and give good effect on skin.Hands can become soon contaminated and only proper hand hygiene can protect from contamination.The herbal formulated hand sanitizer has antimicrobial effect on *Staphylococcus aureus*and *Pseudomonas aeruginosa* which shows the herbal sanitizer has potential to control and protect the hands from contamination.70% of ethanol has good efficacy on killing of microorganisms and the plants and flower extract give good effect and nourishment to the skin.Although the removal is not 100%, it can reduce with natural economic. This hand sanitizer gives good efficiency on killing the pathogens in hands. It purifies the skin and gives promoting healthy cell growth. It helps to control the diseases to spread.

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Databases in Bioinformatics

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INTRODUCTION-

Modern technology has driven us into the information age enabling us to generate and record vast amount of information and scientific data. Advances in computational methods and information technologies has revolutionized the methodology of data storage accessibility and manipulation.

A database is an organized and persistent collection of information or data typically stored electronically in a computer system so that it can be easily accessed, managed and retrieve the stored data using computerized software (https://microbenotes.com/biological-databases-types-and-importance/). Biological databases consist of a wide range of information such as nucleotide sequences, macromolecular structures, metabolic interactions, molecular and functional relationships, protein families etc.

A few popular databases include GenBank, the National Institute of Health genetic sequence database built by National Center for Biological Information (NCBI). It is partnered with DNA Data Bank of Japan (DDBJ) and European Molecular Laboratory (EMBL) which together provide distinct points of data submission and making the same database available to us.

ORIGIN AND HISTORY OF BIOINFORMATICS AND DATABASE

Bioinformatics has started 50 years ago with computational analysis of protein sequence. Margaret Dayhoff is considered as one of the pioneer in the field of bioinformatics (Gauthier et al. 2019). By 1981, total 579 human genes had been mapped and the Human Genome Project had initiated at the same time. By 1991, a total of 1879 human genes were sequenced. In 1992, World Wide Web (WWW) started by CERN,

Switzerland. Aided by ever increasing computational power and internet, the field of bioinformatics started to gain attention of the scientists. Also, the urge to create efficient databases to store and analyze the DNA sequences data from the human genome project and genome projects created NCBI, EMBL and DDBJ.

The first bioinformatics database was constructed a few years after the first protein sequence (Bovine insulin, 1956) and nucleic acid sequence (Yeast alanine tRNA). One year later, Margaret Dayhoff gathered all the available sequences and created the first Bioinformatics Database. A huge and divergent data resources of various types and sizes are now available for public domain and commercial parties. These original databases were organized in a simple way like flat files or single large text files. Following the formation of the database, tools became available initially starting with matching of keywords and short sequence, later evolved into sophisticated methods of matching and alignment of the pattern. Now rapid and rigorous algorithms such as BLAST and FASTA respectively have been in mainstay of sequence database searching. Constant and Significant advances have been made in automating the collected information of sequence.

APPLICATIONS AND IMPORTANCE OF BIOINFORMATICS DATABASE

Big data is one of the crucial factor for advancements of various domains of science including molecular medicine, drug development, microbial genomics, antibiotics, agriculture, healthcare etc.

The billion dollar Genome Project took years of research throughout the world was a noble initiative. But today biotech companies with the help of tools and frameworks of database are able to decode the entire genome in a very short span of time and comparatively low cost.

Agriculture has also utilized database, by gathering and storing data from GPS technology and multiple GPS enabled tractors which helps farmers to predict and anticipate the climactic conditions and implement the required farming. Inputs from Data analytics has also contributed in creating GMO's and modifying engineered crops with high yield and enhanced quality and nutrition. Data based models uses large size storage programs like terabytes, which acts as library consisting of millions of details

and particulars of compounds and also identify the appropriate one for pre-clinical trials. These big data base modeling programs predict the desired outcomes of the chemical compounds against the target disease. This process of pharma automation ensures reduced risk factors, saves time and money, and enables fast marketing of the drugs. Just like every path has its puddle advancement and easy availability of drugs increased the threat of fake and dummy drugs prevalently. Some startups such as Sproxil are working in enabling the drug companies to spot the imitated drug pattern thereby preventing the drug fraud.

Health Care and medical field has also sought the aid of database in certain ways. Structured Electronic health records (ERHs) stores the critical information and medical data of patients based on their progress and response to the given treatments. There are high possibilities of ERHs becoming the most valuable resources of hospitals and health Institutions when combined with the genetic information. Apart from this, several diseases like Alzheimer's and diabetes can be studied by comparing gene sequence of various populations.

To conclude, the application of database in the field of biotechnology has led to growth and development in an innovative way, which would further rise more rapidly and promise to bring out it's full potential in contributing to the peak of scientific achievements and making our lives more easy.

(https://explorebiotech.com/applications-of-big-data-in-biotechnology/

http://www.ejbiotechnology.info/index.php/ejbiotechnology/article/view/v5n2-8/968)

 GROUPING OF BIOLOGICAL DATABASE BASED ON DATA SOURCES:

When bioinformatics is taken into account, there must be some data to be handled such as sequence from DNA, proteins etc. In spite of the fact that there are a more different ways to categorize information, perhaps the most helpful is by their source. Therefore on the basis of data source, data types are of three: primary, secondary and composite. It is significant to comprehend these types and its appropriate usage for the research or other works prior to search for material.

Primary databases:

As the name suggests it is the primitive data or raw data directly from laboratory. Primary database is also known as data repositories or archival databases. The data can be from biological molecules such as DNA and protein .These collections are then feed to the system as primary database.

They are profoundly coordinated, easy to understand doors to the colossal measure of biological information delivered by scientists all throughout the planet. Data repositories were first produced for the capacity of tentatively decided DNA and protein groupings during the 1980s and 90s.

Example: For protein sequences UniProt (https://www.uniprot.org/) & Protein Information Resources (PIR, https://proteininformationresource.org/) are used, when the sequences comes under genome category – DDBJ and Genbank are used Genome sequences and then for protein its protein Databank

Derived databases:

On the other hand, secondary database include information got from the aftereffects of examining data repositories. These are as well identified as derived databases. Secondary databases are frequently draw upon data from various sources, including different data sets (primary & secondary), controlled vocabularies, and the scientific documentation. They are exceptionally curated, regularly utilizing a perplexing mix of computational calculations, manual examination and translation to get new information from the freely available report of science.

In most cases, genes and proteins are further investigated by the implementation of secondary database. These sets will overlay extra data, regularly got from their own examination including a specific trait of the protein or grouping, for instance the event of an enzymatic reactant site or a site for a protein alteration. Numerous such databases are applied to the protein arrangements instead of nucleotide sequence.

Examples: InterPro, UniProt Knowledgebase, Ensembl.

Composite database:

Metadatabases are type of databases which amalgamates a wide range of essential information base sources, which forestalls the need to look through numerous assets. Diverse composite data set utilize distinctive essential information base and various models in their pursuit calculation. Different choices for search have additionally been joined in the composite data set.

Example: NCBI & OMIM.

The National Centre for Biotechnology Information (NCBI) which have PC servers have these structural units of nucleic acids and amino acid sequence data sets in their huge high accessible excess cluster that gives free admittance to the different people associated with scientific study. This has association to OMIM (Online Mendelian Inheritance in Man) which contains data about the hereditary infections affianced with proteins

BLAST:

Aside from keeping up the enormous data set, mining helpful data from these arrangements of archived and derived data sets is vital. Stacks of efficient calculations have been created for information mining and information revelation. These are calculation concentrated where need quick & equal figuring amenities dealing with different questions at the same time. It is these inquiry instruments that incorporate the client and the information bases. One of the generally utilized quest programs is BLAST (Basic Local Alignment Search Tool).

Impact is a bunch of close search programs intended to investigate the entirety of the accessible arrangement data sets irrespective of DNA or protein data. The BLAST programs have been planned for speed, with a negligible penance of affectability. BLAST search's tally have a very much characterized factual understanding, making genuine matches simpler to recognize from arbitrary background hits.

It utilizes a heuristic calculation which looks for local rather than global alignments and is in this way ready to recognize connections among successions which share just isolated sections of resemblance. It's a key benchmark in investigation of sequence.

FASTA:

A software which is utilized to examine either nucleotide or peptide arrangement. This product was initially evolved in 1985 by Lipmann and Pearson. Presently the 35 version of the product is accessible and it is viable with MS-Windows, UNIX, Linux, and Mac.

FASTA gives a manuscript format in which protein arrangement is introduced by utilizing solo-letter codes. It is otherwise called FASTA format. FASTA format permits the nomenclature of sequence and remarks to present the arrangement. The utilization of the FASTA design has gotten a norm for scientists to scrutinize the sequencing. The configuration of FASTA codes is not more than 120 characters.

Classification of database based on data types / nature of data

1. **Genome database:** They are online repositories of whole genomes which allow not only storing and sharing of data but also allows comparisons of various data which promotes better understanding in research studies. They have data of various genomic variants, nucleotide sequences (DNA & RNA), and annotations of gene information.

1. NCBI genome database : The National Center for biotechnology information provides various genomic information on genome sequences, mapped annotations, sequence read archive - SRA (online repository for high throughput sequencing data and helps in many discoveries through data analysis methods) etc. NCBI has developed a biological search engine called entrez.

2. Ensembl database: This database is founded by European Bioinformatics Institute online repositories which helps in retrieval of genomic data of various species, including vertebrate and invertebrate species. They help in manipulation, visualization, comparative analysis, sequence variation and transcriptional regulation.

2. **Structure database**

1. PDB - Protein Data Bank contains information generated from x- ray crystallography, electron microscopy and NMR experiments. It is a primary database which provides 3D structure data of proteins and nucleic acids (DNA and RNA). It also uses integrative modelling i.e. combining information from all available methods and capturing the strength of each model and creating one overall picture of assembly.

2. SCOP - Structural classification of protein has 5 classes (alpha, beta, mixed alpha and beta and small protein). It helps in determining structural and evolutionary

relationships among various proteins and also helps in finding close relatives, sharing of common evolutionary origin, folds and so on.

3. CATH – Class (alpha, beta, mixed alpha beta - secondary structure of domains) Architecture (similar secondary structure) Topology (common structural feature of arrangement etc) Homology (shares a common ancestor). It is an online protein domain database that provides us data on evolutionary relationships of protein domains, hierarchical classification data based on folding patterns.

3. Metabolic pathway database

1. SMPDB - Small molecule pathway database is a database that contains more than 350 small human molecular pathways each with detailed description about them. It provides detailed hyperlinked diagrams of metabolic, signaling and disease pathways.

2. KEGG - Kyoto Encyclopedia of gene and genome is a computer representation of biological data that provides information on metabolism and its various pathways, genomes, drugs and so on. It was developed due to the need of biological interpretation of genome sequence data.

4. Microarray database

1. Array Express - A public repository for functional genomics datasets and its data are measured on microarray or next generation sequencing platforms.

5. Literature database

1. PUBMED – PUBMED (https://pubmed.ncbi.nlm.nih.gov/) is a free literature database accessing MEDLINE database. PUBMED is maintained by NCBI, NIH (National Institute of Health) and NLM (National Library of Medicine- US). PUBMED does not have full articles, it is an index to published articles. PUBMED contains bibliographic details such as Author, Title, Journal details and abstracts of these articles. It includes 32 million citations in total as of now.

7. **Disease database**

1. OMIM - Online Mendelian Inheritance in Man (https://www.omim.org/) is an online disease database consisting of human genes it's genetic disorders and traits. It can be accessed by NCBI. Genes and phenotypes are described separately with unique and stable six digit identifiers. OMIM uses peer reviewed biomedical literatures for content curation purpose (Amberger et al. 2015).

7. **Sequence database** :

a) Nucleotide sequence database :

- GenBank - It is a comprehensive database for nucleotide sequences which is publicly accessible. It is built and hosted by NCBI (https://www.ncbi.nlm.nih.gov/genbank/). It contains more than 2.6 lakh of species. It contains sequence data available from expressed sequence tags, high-throughput sequencing data, whole genome shot gun sequencing data etc. It has single submission portal with one window system. (Benson et al. 2013).

- EMBL - European Molecular Biology Laboratory or EMBL is launched by EBI (European Bioinformatics Institute) (https://www.embl.org/) and uses sequence retrieval tool/ system (SRS). It is a primary database that is designed for nucleotide sequences. It also offers multiple tools used in bioinformatics research. There is user friendly web interface to access the tools (Madeira et al. 2019).

- DDBJ - DNA Data Bank of Japan is an online database (https://www.ddbj.nig.ac.jp) contains annotated collections of primary nucleotide sequences. It is maintained by the National Institute of Genetics (NIG) at Mishima, Japan. It is the only nucleotide sequence database in Asia. DDBJ is managed by NIG supercomputing facility which is designed for big data analysis of genomic data, massive parallel distributed file system and multi-cloud infrastructure (Ogasawara et al. 2020).

a) Protein sequence database:

- PIR - It is a primary database (https://proteininformationresource.org/) founded by National Biomedical Research Foundation (NBRF) which helps in identification and interpretation of protein sequences. It is a public resource of protein informatics. It has comprehensive classification of protein families and superfamilies, domain architecture and bibliographic search system (Wu et al. 2003).

- SWISS-PROT- This is also a primary database produced by EMBL and maintained by SIB (Swiss Institute of Bioinformatics) (https://www.expasy.org/resources/uniprotkb-swiss-prot). It is a curated and carefully annotated protein database containing functional information on proteins. The description of protein function, post translational modification etc. is available in SWISS-PROT. It distinguish itself through annotation based on function, secondary structure, post translational modification etc., minimum redundancy and interconnectivity with other databases (Bairoch and Apweiler 2000).

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❖ Mini Review

Pesticides: Farmer's Friend or Foe

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Introduction:

Pesticides are chemicals or substances that are used for controlling pests in the field. It includes herbicides, nematicides, insecticides, rodenticides, fungicides. Pesticides have served farmers as a great support in the field however after much research it is evident that there are adverse side effects caused by pesticides which affects food commodities, on environment other effects like surface water contamination, groundwater contamination, soil contamination, effect on soil fertility, contamination of air and non-target vegetation, as well as the health of a farmer and the people who come in direct contact with these chemical. The usage of pesticides has a high risk on the people who are exposed to it directly. Toxicity caused by commonly used pesticides like monocrotophosos, profenofos, chlorpyrifos, endosulfan, acephate. Farmers exposed to these pesticides suffered from fever, nausea, headache, and other abnormal symptoms. Deadly diseases such as leukemia, lymphoma, cancer of brain, breast, prostate, testis and ovaries.

Production of Pesticides in India:

Production of pesticides in India started in 1952 with the establishment of a plant of BHC near Calcutta. India is now the second-largest manufacturer of pesticides in Asia after China, India ranks 12th globally in the production of pesticides. At present, about 60 companies and their formulations are produced by 500 units. There are 256 registered pesticide products in India. According to the statistics, pesticide consumption has increased from 434MT to 46,195.16 MT between 1954-2000. The main use of pesticides in India is cotton (45%) followed by paddy and wheat. Andhra Pradesh is the

highest pesticide consuming state in India (23%) followed by Punjab and Maharashtra. There has been a constant rise in the production of pesticides in India.

Benefits of Pesticides:

Higher yield because of pest management and better quality of the yield- Food grain production which stood at mere 5 million tones in 1948-49, had increased almost to 198 million tons by the end of 1996-97 from 169 hectares

The result has been achieved by

1. High yield varieties of crop
2. Advanced irrigation technologies
3. Agricultural chemicals
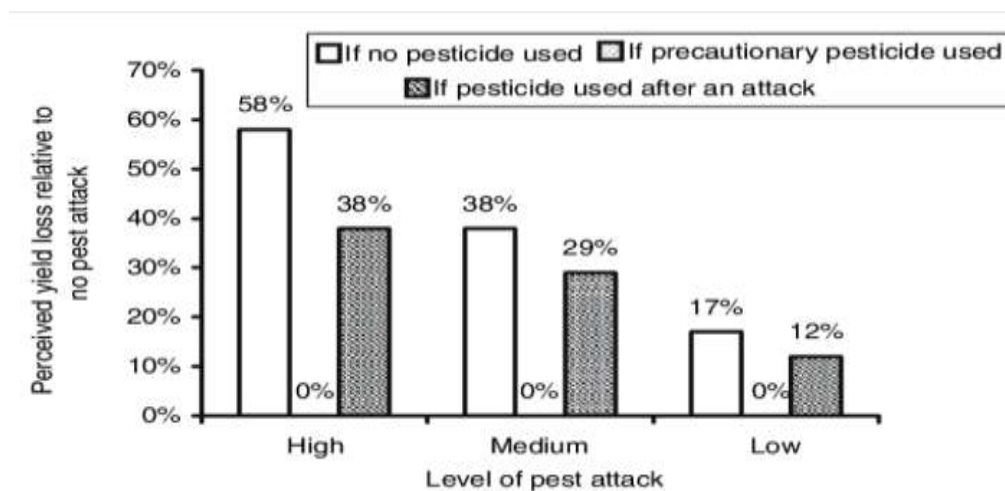
Fig 1. This graph shows the difference in the three scenarios

wherein in one case pesticide is not used, the second a precautionary amount of pesticide is used and third case pesticide is used after an attack, It can observe a great enhancement with the help of pesticide in the field. It can see the increase in the yield. Other examples include wheat yields in the United Kingdom, Corn yields in the United States of America. An increase in productivity has been many factors including the use of fertilizers. Protection of crop loses/ yield reduction- Weeds reduce yield/ dryland crops by 37-79%. Severe infestation of weeds particularly in the early stage of crop establishment, yield reduction- 40%.

Pesticides are an integral part in

1. Protecting the crops from the weeds
2. Diseases, insect and pests
3. Reduces the amount of harvestable produce.

Hazzards Caused by Pesticides:

Operation ranch hand-

Started on 12th January and Lasted from 1962 to 1971. During the Vietnam war, the US military forces sprayed nearly 19 million gallons of herbicides on approximately 36 million acres of Vietnamese and Laotian land to remove forest cover, destroy crops and clear vegetation from the perimeter of US bases. Various herbicide formulations were used but most were the mixtures of the phenoxy herbicides. Some of the Vietnamese exposed to Agent Orange show symptoms of cancer. There was evidence of cancer risk on Vietnam veterans, workers occupationally exposed to herbicides/ dioxins. Many children are born with the effect of it on them yet, due to the massacre.

Fig. 2 Vietnam people running with their injured kids during the war (a); Children in Vietnam born with severe genetic diseases caused by the high concentrations of dioxins in the environment (b); A forested area before and after Agent Orange was sprayed (c)
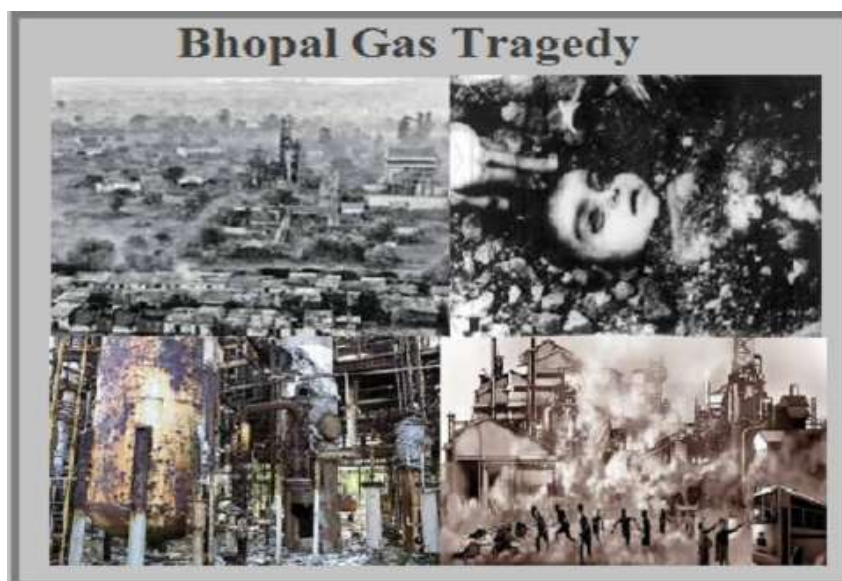
Bhopal gas tragedy

Gas leak incident, 2-3 December 1984 from Union Carbide India Limited a pesticide plant (UCC) in Bhopal Madhya Pradesh. One of the world's worst industrial disasters. Over 500,000 people were exposed to Methyl Isocyanate gas, the highly toxic substance that made its way into and around the small towns near the plant. Indian government and local activist claim that this was caused due to the pipe maintenance that caused a backflow of water into a MIC tank triggering the disaster however UCC claims that water entered the tank through an act of sabotage. Investigations later revealed that substandard operation and safety procedures at the understaffed plant had lead to the disaster.

Final death toll- 15,000 and 20,000

A million survivors suffered respiratory problems, eye irritation/ blindness, and other maladies resulting from the exposure.

Fig. 3 Bhopal gas tragedy

These are the two real-life examples which show us how hazardous exposure to pesticide can be for humans and the environment.

1. People who are directly exposed to it have a high risk of deadly diseases like cancer, as some chemicals are highly carcinogenic.
2. It has an impact on the food commodities; it can directly affect the consumers.
3. It has a bad impact on the environment which includes surface water contamination, groundwater contamination, effect on soil fertility and contamination of air.
4. It can affect the non-target vegetation in the field

Chemicals pose a potential risk to humans the high-risk group exposed to pesticides are formulators, sprayers, mixers, loaders and agricultural farm workers. No segment of the population is protected against exposure to pesticides and the potentially serious effects. The worldwide deaths due to pesticide poisoning number about 1 million per year. The production process is not risk-free; hazard is higher in the manufacture and formulation of pesticides. Effects such as immune suppression, hormone disruption, diminished intelligence, reproductive abnormalities and cancer are observed in the population exposed to these chemicals. Pesticide is also considered as endocrine disruptors due to their harmful nature; they are known to elicit their adverse effect by antagonizing natural human hormones in the body.

Condition caused due to the exposure to pesticides:

Pesticide exposure can cause short term adverse effect also known as acute effect and chronic adverse effects, which is caused due to months or years of exposure. Acute effects include stinging eye, rashes, blisters, nausea, dizziness, diarrhea and death. Chronic effects include birth defects, reproductive harm, neurological and developmental toxicity, immunotoxicity and disruption of the endocrine system. People who come in close contact are the worst affected, hence it is a must to follow the safety rules while using pesticides in the field.

Summary:

After all the study we can conclude that following all the safety measures, the right amount of pesticides and proper maintenance, the pesticide can be farmers friend. But chemicals added to the field will always have a side effect now or later, we must switch to a sustainable option that is beneficial for the farmer as well as the environment. According to the statistics around 800,000 people may have died since the onset of the green revolution. About 20,000 people die in developing countries due to pesticide consumption through food. Integrated pest management and farming are possible without the usage of chemicals, it was demonstrated in a unique program called community managed sustainable agriculture organized by the Andhra Pradesh government in 10 lakh acres of land which turned out to be successful. The government bodies must acknowledge these alternatives and provide proactive support to the farmers so they may shift to an ecological, sustainable and healthy way of living.

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Fig. *2b*

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