

## Unlocking Nature's Microbial Treasure Trove: Exploring the Potential of Bioprospecting

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### Bioprospecting

Bioprospecting is the systematic exploration, identification, and exploitation of suitable microorganisms, their compounds, or gene sequences contained within them that have beneficial effects on humankind.

It is like going on a treasure hunt in nature to search for gold or jewels scientists will be searching for living organisms called microbes like bacteria, fungi, microalgae *etc.* Scientists will be exploring different places like soil, water, extreme places (hot springs, deep sea vents), *etc.* From there they will collect the samples and bring them to the lab and analyze whether they have any potential abilities or not.

So simple bioprospecting is like discovering a hidden treasure (microbes) in the natural world that can solve our problems or which can improve our lives. Bioprospecting is focused on the ability of an individual organism to produce a compound of interest under normal or localized optimum conditions. So, bioprospecting is crucial for discovering novel compounds, developing new biotechnological applications, and addressing the challenges in various fields

### Bioprospecting

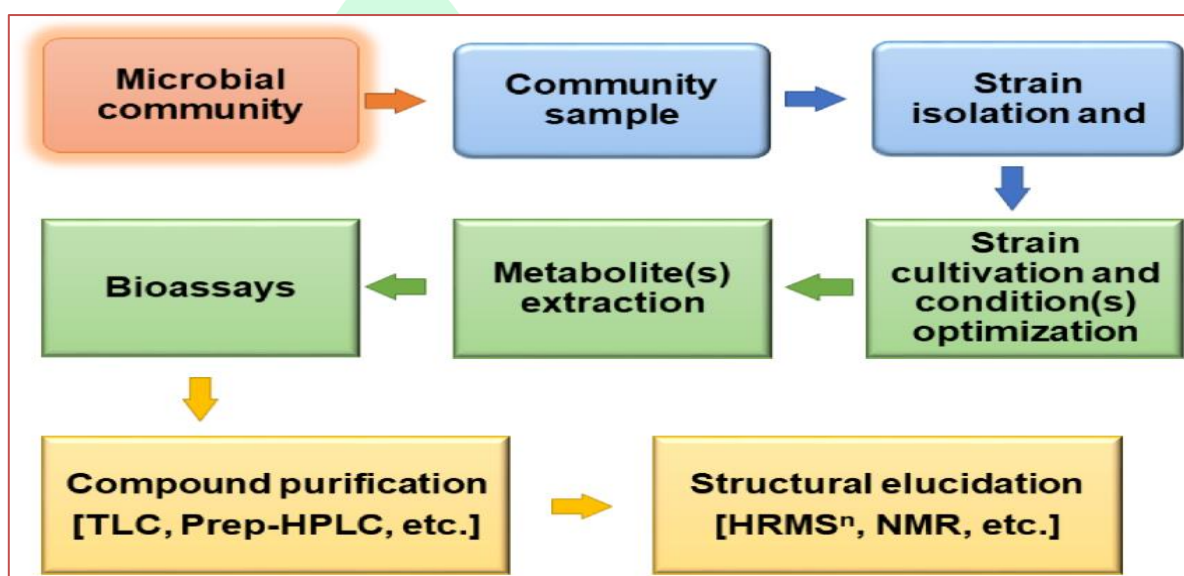


### Microbial diversity

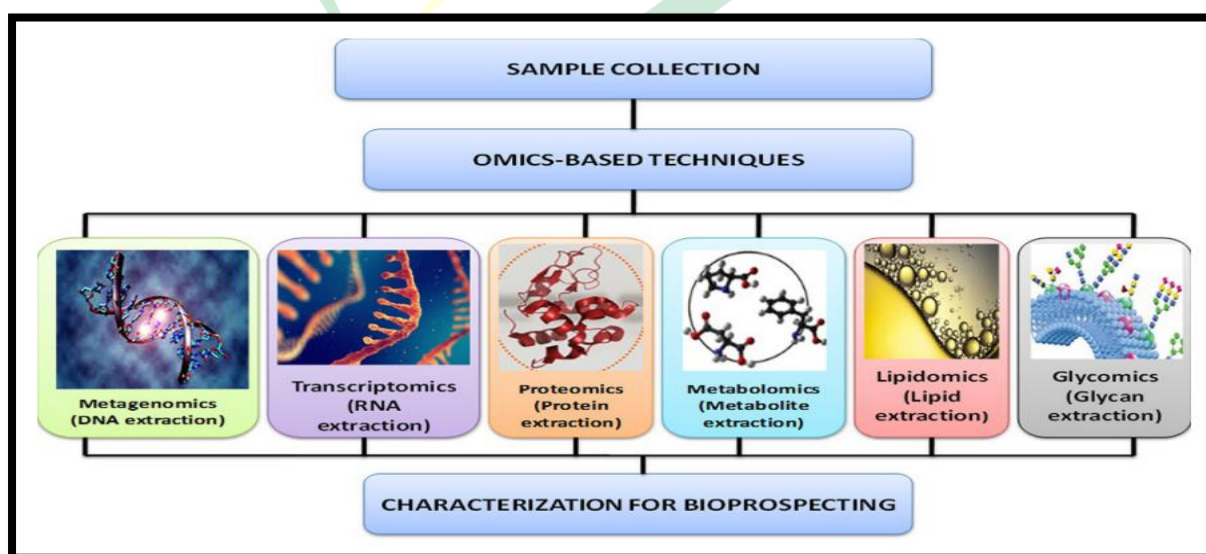


### Steps in bioprospecting

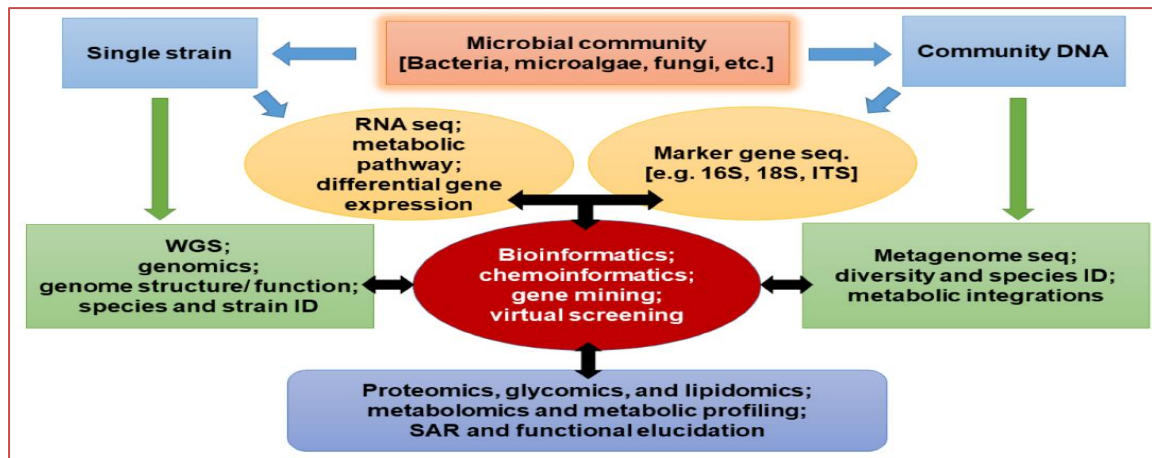
- A. **Source identification:** Different environments samples will be collected and microorganisms identified in the lab that have potential abilities or capabilities.
- B. **Evaluation of the source:** After recognizing and identifying microbes were Monitored and tested to evaluate their potential impacts
- C. **Screening for obtaining useful products:** Use of microorganisms that have the potential to produce valuable products. Thus, screening microbes is the most crucial step



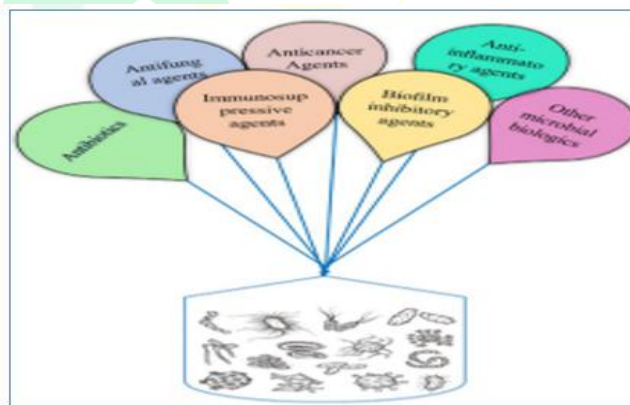
Conventional method of bioprospecting



Different omics-based techniques



Workflow for omics, integrating molecular, chemical, and computational science



Bioprospecting potential of microbes for therapeutic application



OSMAC approach

### Bioprospecting of microbial resources for industrial application

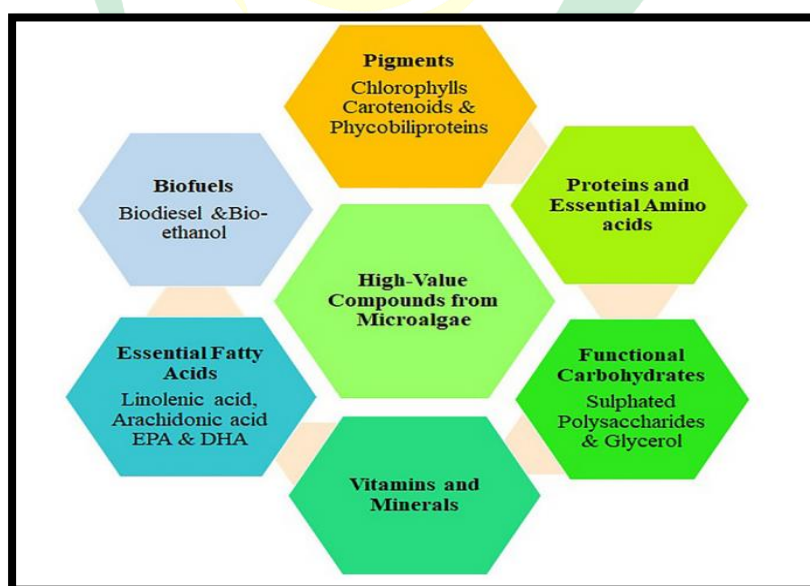
- Involves exploring microorganisms for potential use in various industrial processes
- Metabolic engineering:
  - Predicting and optimizing metabolic pathways for the production of valuable compounds
  - This involves manipulating the genetic makeup of MOs to enhance their productivity

### Microbial bioprospecting for industrial importance

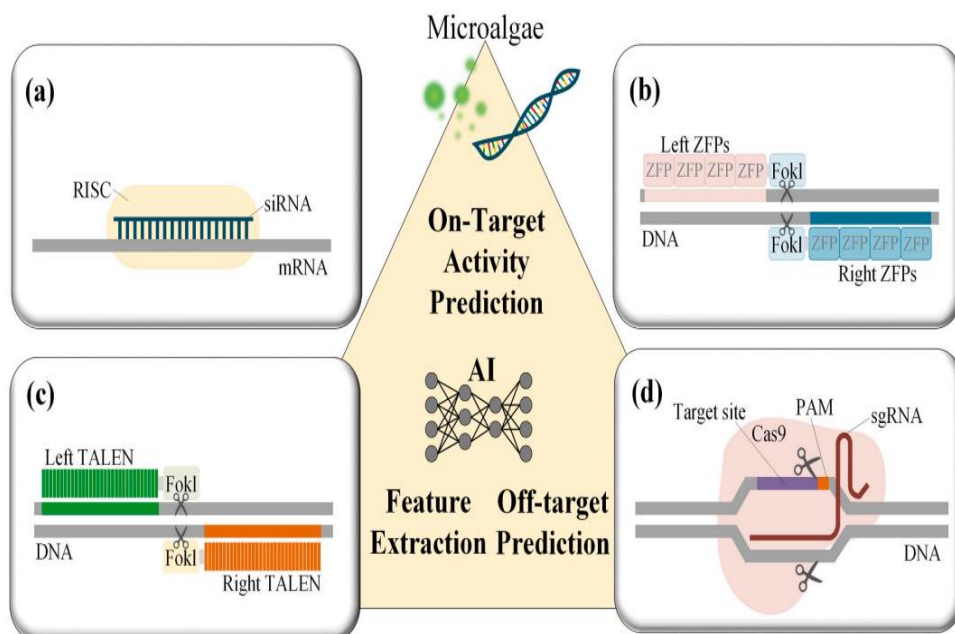
- **Enzymes:** Cellulase, hemicellulase, pectinase, lipase, protease, laccase
- **Value Added Products:** Single cell protein (SCP), Glyceric acid
- **Bioenergy:** Biodiesel, Bioethanol, Biohydrogen, Biogas
- **Pharmaceuticals:** Antibiotic, Antiparasitic, Anticholestrol, Anticancer, Probiotics, Vaccines, Steroids, Vitamins
- **Organic acids (OAs):** Citric acid, Lactic acid, Propionic acid

### Bioprospecting of microalgae derived high-value compounds with commercial significance

- Involves exploration of these microorganisms for bioactive substances with various industrial applications



High-value compounds of commercial importance derived from microalgae biomass



(a) RNAi

(b) ZFN

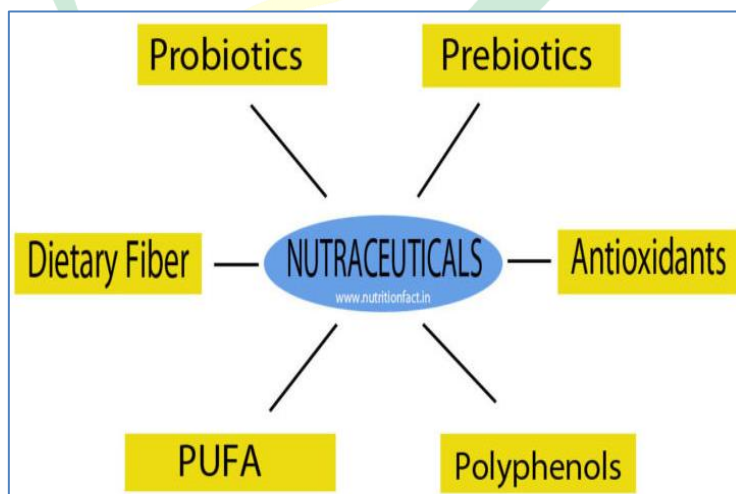
(c) TALENs

(d) CRISPR/CAS9

**PAM: Protospacer adjacent motif, sgRNA: Single guide RNA, RISC: RNA-induced silencing complex**

**Microbial bioprospecting for nutraceuticals and value-added compounds**

- Systematic exploration of microbial resources to identify and extract bioactive compounds that offer health benefits
- Various MOs produce a variety of metabolites with potential nutraceutical properties

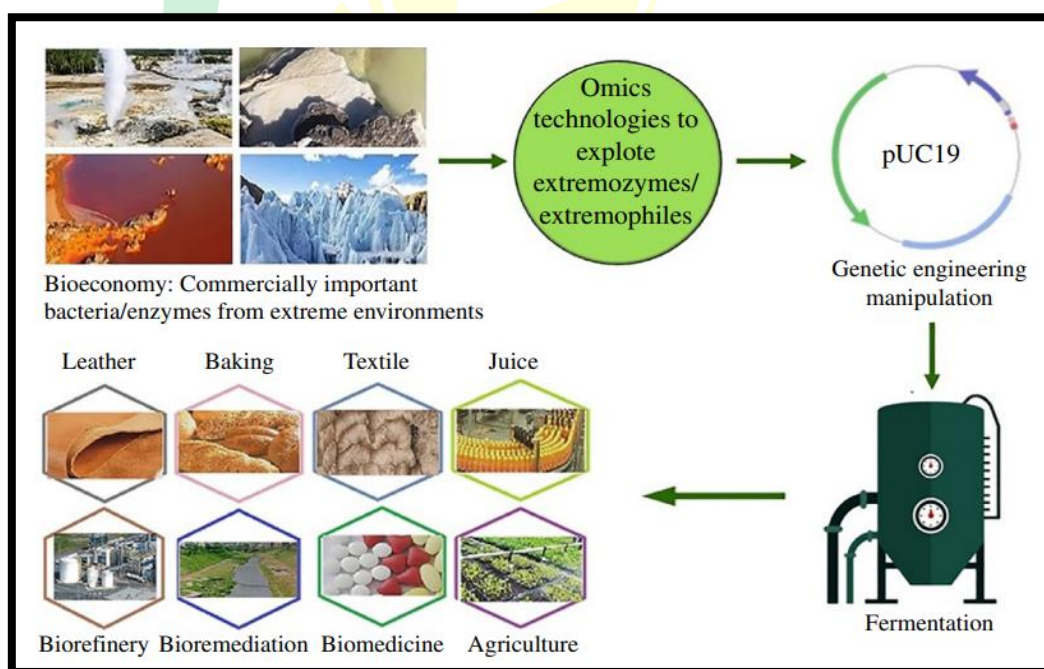
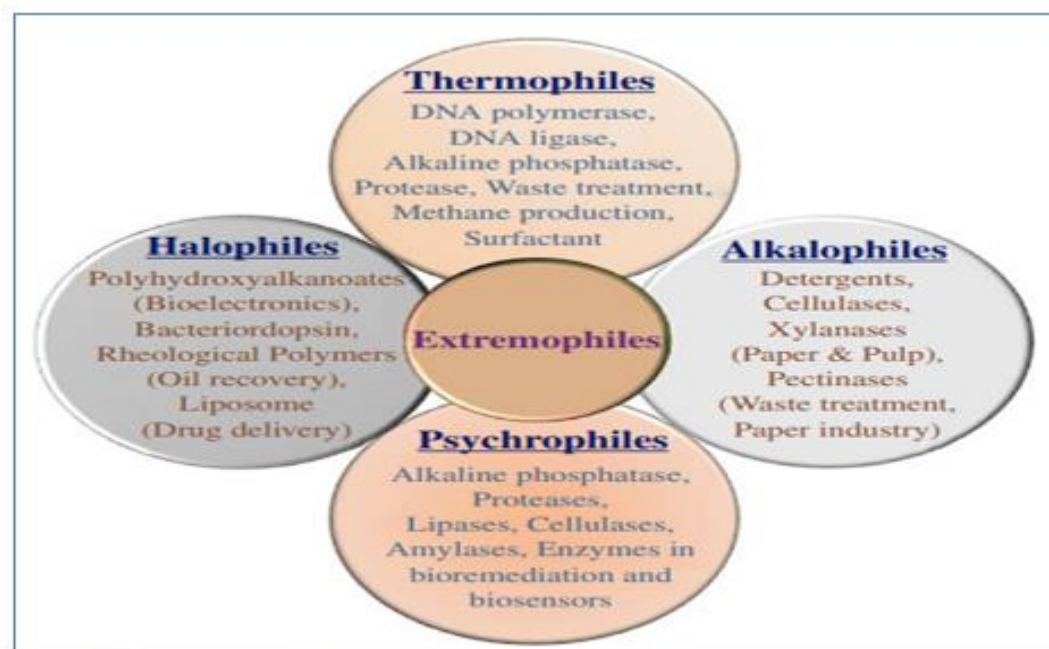


**Microbial-derived nutraceuticals**

**Bioprospecting of extremophiles for industrial enzymes**

- Exploring unique MOs thriving in extreme environments like hot springs or acidic lakes

- Produce enzymes with exceptional stability and activity, making them valuable for industrial applications.



### Omics in extremozyme

Microorganisms are immense sources of a wide array of unique natural products and play a significant role in drug discovery. During the golden era, several life-saving antibiotics and anticancer agents were isolated from microbes; moreover, they are still widely used.

However, difficulties in the isolation methods and repeated discoveries of the same molecules so it times a time-consuming and laborious process and artificial intelligence (AI) has had a profound impact on various research fields, and its application allows the effective performance of data analyses and predictions.

### **A comprehensive bioprospecting policy**

It involves regulations and guidelines for the exploration of biological resources for potential, commercial or scientific purposes which ensures ethical and sustainable practices.

Key aspects of bioprospecting policy include:

- ✚ Access and benefit sharing
- ✚ Intellectual property rights
- ✚ Conservation
- ✚ Ethical considerations
- ✚ Research permits
- ✚ International collaboration
- ✚ Biological safety

### **Conclusion**

Bioprospecting of microbial resources represents a groundbreaking synergy as it facilitates the screening, identification and analysis of diverse microbial species or their products/compounds having applications in various fields viz., therapeutic, nutraceutical, and industrial applications. Help us to discover not only accelerates the pace of the discovery but also enhances the precision, enabling a more sustainable and targeted approach to harness the vast potential of microbial diversity.

### **References**

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