

ALGAL TECHNOLOGY

Unit I

Taxonomy of Algae: Classification, structure and reproduction of algal; Distribution of algae, Characteristics of microalgae, Dinoflagellates, cyanobacteria and Seaweed; Morphological identification of microalgae and cyanobacteria; Salient features of Protochlorophyta, Chlorophyta, Charophyta, Xanthophyta, Bacillariophyta, Phaeophyta and Rhodophyta; algal blooms.

Unit II

Isolation, identification and Cultivation of Algae: Algal production systems; Different types of microalgal isolation, screening and identification methods; Technique of mass culture of Algae; Cultivation methods; Laboratory cultivation of micro and macro algae; Indoor cultivation methods and scaling up; Outdoor cultivation methods; closed system cultivation methods; Measurement of algal growth; Large-scale cultivation of algae.

Unit III

Optimization, Extraction & Estimation studies: Estimation studies: lipid, protein, carbohydrates, chlorophyll, biomass and pigments; Optimization of physical and chemical parameters - pH, Temperature, Light sources, CO₂ supplements and nutrients; Types of bioreactors; Extraction methods- lipid, pigments, Carbohydrate; Explain the different optimization software tools- RSM, SPSS, MiniTab, One factor and Plackett-Burman analysis.

Unit IV

Instrumental analysis: Principles, instrumentation and applications of adsorption, partition, exclusion, ion exchange, affinity, column chromatography, chromatofocussing, TLC, HPLC, FPLC and GLC; Principles, instrumentation and applications of gel electrophoresis (AGE and PAGE), Pulse field gel electrophoresis (PFGE); SWISS-MODEL, MODELLER, DaliLite and SSAP, Bioedit. Principle, methodology and application of Viscosity, Density and Flash point analyzer; Methods of measuring properties; Atomic structure, particle size determination, surface structure, Microscopy (TEM, SEM and Field Ion), Spectroscopy (IR and Raman) and X- ray crystallography.

Unit V

Bioactive metabolites from algae: Biotechnological approaches for production of important algae, pigments, biofuels, hydrogen production, important bioactive molecule; TAG, phospholipids, sphingolipids, glycolipids; Biosynthesis of lipid; Fatty acid oxidation: importance and regulation; Fatty acid biosynthesis, importance and regulation; Aqua, cattle feed and bio-

fertilizer conversion methods; Biodiesel separation and conversion methods; Transesterification methods.

References:

1. Robert A Andersen (2005) *Algal Culturing Techniques*. Academic Press
2. Kumar, H.D. Introductory Phycology. Affiliated East-West Press Ltd., New Delhi.
3. Round, F.E. The Biology of Algae. Cambridge University Press, Cambridge.
4. Barsanti, Laura & Paolo Gualtieri (2005) *Algae-Anatomy, Biochemistry and Biotechnology*. Taylor & Francis, London, New York.
5. Becker, E.W. (1994) *Microalgae-Biotechnology and microbiology*. Cambridge University Press.
6. Chandramohan, D. (2007) Prospects of Biodiesel from marine microorganisms.
7. Proceedings of the National Workshop on BIODIESEL, Organised by School of Energy, Environment & Natural Resources, Madurai Kamaraj University, Madurai and Ahimsa Agri division, Chennai, 17th and 18th October, 2007.
9. Trivedi, P.C. (2001) *Algal Biotechnology*. Pointer publishers, Jaipur, India.
10. Venkataraman, L.V & E.W. Becker (1985) *Biotechnology and Utilization of Algae – The Indian Experience*. Dept. Science and Technology, New Delhi and Central Food Research Institute, Mysore, India.

Web References

1. <https://docs.google.com/file/d/0B0Izh6GcIA.../edit>
2. <https://lawofalgae.wiki.zoho.com/Chapter-1----Introduction-to-Algae-Bi>
3. <https://www.northinlet.sc.edu/training/media/2012/.../Science-of-Algae.pdf>
4. [https://www.dbs.nus.edu.sg/biofuel2012/.../22%20Borowitzka%20\(ok\).pdf](https://www.dbs.nus.edu.sg/biofuel2012/.../22%20Borowitzka%20(ok).pdf)
5. https://www.enlightened-designs.com/growing_algae.html
6. <https://www.iimsam.org/images/growthtech.pdf>
7. https://www.biofuelstp.eu/downloads/epobio_aquatic_report.pdf
8. <https://www.jpsr.pharmainfo.in/Documents/Volumes/.../jpsr06011408.pdf>
9. <https://www.biomara.org/schools/Lesson%205%20-%20uses%20of%20algae.pdf>
10. <https://www.uni-bielefeld.de/biologie/Zellbiologie/publik/paper/2007tpj.pdf>

BIOLOGY OF MICROBIAL ENDOPHYTES

Unit I

Endophytes: Definition, Introduction & Discovery of Endophytes, Evolution of Endophytes, Types of Endophytes - Bacterial & Fungal, Host plant - Endophyte Interactions - Resistance to disease, Protection from Insect, Growth Promotion of host, Physiological and Ecological role of Endophytes.

Unit II

Fungal Endophyte Diversity: Endophytes of Woody plants, Seaweeds and Medicinal plants, Bioprospecting of endophytic fungi - Antimicrobial compounds, Anticancer, Antioxidant, Immunomodulatory and Immunosuppressive compounds from Endophytes- their importance and application, Analysis of Bioactive compounds.

Unit III

Isolation and Identification of Endophytic fungi: Method of Screening of Endophytes- Primary and Secondary, Cultivation of Endophytes- Media composition and Optimisation of media components, Molecular characterisation and Identification of Culturable and Non cultural Endophytic fungi.

Unit IV

Antibiotics: Definition, Classification based on Spectrum and mode of action. Tests for sensitivity to antimicrobial agents - Disc Diffusion, Agar Dilution and Broth Dilution Methods. Bacterial Resistance- Mechanism of Drug Resistance, Beta lactam resistance- Phenotypic and Genotypic Detection- Inhibitors of Betalactamase.

Unit V

Antibiotic resistance: Scope and Importance of the Problem, Impact on the society, Steps taken to reduce resistance - Role of Policy makers, HealthCare Professionals, Agricultural sector, Health care Industry and Individuals, WHO role in curtailing resistance- Global action plan and its impact on the Society.

References:

1. R Ananthanarayan and C.K JayaramPaniker (2009). Textbook of Microbiology 8th Edition Orient Longman, Hyderabad.
2. SatishGupte (2010) The Short Textbook of Medical Microbiology Including Parasitology 8th Edition, Jayapee publishers
3. Morag, C and Timbury, M.C. (1994) Medical Virology, 10th Edn. Churchill Livingston, London.
4. Greenwood, D., Slack, R.B and Peutherer J.F. (2002) Medical Microbiology, 16th Edition Churchill Livingstone, London.

5. Diagnostic Microbiology - Fine gold 10th Edn. CV. Mosby Company, St, Louis. (2000)
6. Jagadish Chandar, 1996. A Text book of Medical Mycology. Interprint. New Delhi.
7. Medical parasitology. D.R. Arora & B. Arora. (2002) CBS Publishers & Distributors, New Delhi (1stEdition)
8. Alexopolus C.J. and Mims C.W. (1979). Introductory Mycology. 3rd Edition. Wiley, NY.
9. R.C. Dubey and D.K.Maheswari (2003) S. A text book of Microbiology. Chand &Co.Ltd., New Delhi (1st Edition)

Web sites

1. pt.wkhealth.com/pt/re/ajhp/fulltext.00043627-199601010-00025.htm
2. www.lavoisier.fr/notice/gbDJOKXRLDO2XKKO.html
3. www.bookfayre.cz/books/item/9780443071645.html.cs

BIO-PROSPECTIVE OF MICROBIAL METABOLITES

Unit I

Microbial bioconversion of agro industrial waste: Physical, chemical and biological properties of soil. Novel approach for waste disposal and reuse. Principles and methods of waste management. Source and types of organic wastes. Microbes involved in the Bio-decomposition of organic waste. History and methods of composting. Factors influencing quality of composting. Microbial process in agro waste utilization and their applications.

Unit II

Microbial bio-prospecting for sustainable development: Microbial potential for generation of renewable energy – Bio-ethanol, hydrogen, methanol and microbial fuel cells. Microbe assisted biomass generation. Microbial enzymes for carbon di-oxide sequestration. Microbial enzymes for removing pollution load in effluent systems. Microbial metabolites as Bio-pesticides and Soil fertility enhancers.

Unit III

Microbial Pharmaceutics and cosmetics: System biology for the production of pharmaceutical and commercial products from microbes and plants. Production, recovery and purification of various secondary metabolites - Antibiotics, steroids, antioxidants, ellagitannins, anti histamines, antihelminthes. Vaccine preparation. Detection and assay of desired products. Strategies for media formulation for secondary metabolites production. Microbial nano-particles in drug delivery systems. Properties and applications of plant and microbial derivatives.

Unit IV

Value added food and feed preparation using microbes: Single cell proteins, Mushroom cultivation, Probiotics, Cheese, Win, Alcohol, Vinegar making, fermented foods. Bacteriophage-based sensors for the detection of food-borne pathogens. Microbial Silage preparation using food wastes. Degradation of food industry disposals for animal feed preparation.

Unit V

Bio-prospecting by microbial bio-engineering: Bio-prospecting strategies for identifying new bio-products using cultivable and non-cultivable microbes. Modification of microbes for increased product formation of commercial and industrial importance. *In-silico* bio-prospecting, Metagenomic library construction and applications.

References

1. Marine Biotechnology Vol I. Pharmaceutical and Bioactive Natural Products (1993) Edited by D.H. Attaway and O.R.Zaborsky, Plenum Press, USA.
2. Mukherjee S and Ghosh A.K. (2009). Plant Physiology, New Central Book Agency; 3rd Revised edition.

3. Cooper JR, Bloom FE, Roth RH (Eds.) (2003) The biochemical basis of neuropharmacology (8thedn.). Oxford University Press, Chennai. .
4. Merry Buckley and Judy Wall (2006). Microbial Energy Conversion. A report from the American Academy of Microbiology, NW Washington.
5. Sathyanarayana, U. (2008). Biotechnology. Books and Allied pvt.ltd. Calcutta.
6. Vijai Gupta Anita Pandey (2019) New and Future Developments in Microbial Biotechnology and Bioengineering. Microbial Secondary Metabolites Biochemistry and Applications. 1st Edition. Elsevier. Pg: 380
7. Bibek Ray, Arun Bhunia. (2013) Fundamental Food Microbiology. 5th Edition. CRC Press. 663 Pages
8. <https://aggie-horticulture.tamu.edu/food-technology/food-processing-entrepreneurs/microbiology-of-food/>

BIORESOURCE TECHNOLOGY

Unit I

Bioresource and Renewable energy: Introduction to Bioresource technology - Biomass, Biological wastes from domestic, agriculture and industries. Biomass - Feed stocks (agricultural crops, bioenergy crops, agricultural waste residues, wood residues, waste stream Energy resources - Hydropower, geothermal power, solar power, wind power, Biofuel.

Unit II

Fuel technology and bioconversion: History - Definition of biofuel, applications of biofuel for transport, direct electricity generation, home use and energy content of biofuel. Biogas from solid and liquid wastes, varying types of biogases. Biogas plant, feed stock materials, biogas production, factors affecting methane formation. Role of methanogens - Biohydrogen production - Oxygen sensitivity - problems in hydrogenases.

Unit III

Bio ethanol, butanol and biodiesel: Bioethanol from natural wastes - molasses, starch wastes and cellulosic wastes. Ethanol recovery, Advantages of ethanol. Biobutanol production, energy content and effects on fuel economy - Octane rating, air fuel ratio, specific energy, viscosity, heat of vaporization - Butanol fuel mixtures. Production of biodiesel, oil extraction from algae by chemical solvents, enzymatic, expeller press. Applications of biodiesel, environmental benefits and concerns.

Unit IV

Fermentation and its Processes: Definition of fermentation, History and origin of fermentation process. Types of fermentation, Fermentor structure and its functions. Upstream processes, Industrially important microbes, Formulation of industrial media and sterilization. Fermentor vessels and its method of sterilization. Downstream process. Fermentation economics.

Unit V

Microbial Products from Natural Resources: Definition of Microbial Products, Organic acids- Amino acids, Antibiotics, Enzymes, Vitamins, Alcoholic beverages - wine and beer, Fermented foods - bread, cheese and soy sauce. Recombinant Products - insulin, interferon and growth hormone, Microbial transformations - steroids and sterols. Non-steroid compounds -Antibiotics.

References

1. Kumar, Sachin, Sani, and Rajesh K (eds) (2018) *Biorefining of Biomass to Biofuels*, Springer Publisher, ISBN: 978-3-319-67678-4.
2. Mejdijeguirim and Lionel Limousy (Eds.) (2018) *Biomass Chars: Elaboration, Characterization and Applications*, MDPI Books Publisher, ISBN: 978-3-03842-690-5.

3. Stanbury, P.F., Whittaker, A. and Hall, S.J. (1995) *Principles of fermentation technology*, 2nd edition, Pergamon press.
4. Cassida, J.E. (1968). *Industrial Microbiology*, Willy Eastern.
5. Demain, A.L. and Soloman INA (1986) *Mammal of Industrial Microbiology and Biotechnology*, American society for Microbiology, Washington DC.
6. Chand and Subhash (2001) *Fermentation Biotechnology: Industrial Perspective*, New Delhi : All India Biotech Association, Delhi.
7. Belter, P.A., Cussler, E.L. and Hu, W.S. (1988) *Bioseparation: Down stream processing for Biotechnology*, John Wiley and Sons, N.Y.
8. Chisti, Y. (1999) *Fermentation, Biocatalysis and Bioseparation*, Encyclopedia of Bioprocess Technology, Vol. 5, John Wiley and Sons, N, Y.
9. Alain A.V. (2010). *Biomass to biofuels strategies for global Industries*, John Wiley & sons ltd, 1st Edition.
10. Twidell., J & Weir., T. (2006). *Renewable energy resources*, Taylor & Francis 2nd Edition.

BIOTECHNOLOGY OF ACTINOBACTERIA

Unit I

Introduction, history and importance of Actinobacteria. Diversity of actinobacteria, habitats - Terrestrial, aquatic and other extreme ecosystems. Sample collection, isolation and preservation of actinobacteria. Characterization, identification and taxonomy of actinobacteria based on phenotypic, chemotaxonomic and molecular methods.

Unit II

Screening methods - Preliminary and secondary screening for metabolites. Production and optimization of bioactive metabolites from actinobacteria. Bioassay guided fractionation of active compound - extraction, purification, bioautography. Characterization of purified compounds – based on spectral analysis such as UV, IR, Mass, NMR analysis and XRD analysis. MIC and MBC studies for bioactive compounds.

Unit III

Nanotechnology - Introduction to nanotechnology - history, scope and opportunities. Biosynthesis of nanoparticles and its mechanism. Applications - Biomedical and Environmental application of nanoparticles, dye degradation in nanotechnology, waste water treatment. Nano-composites - synthesis and its application.

Unit IV

Plant nutrition - primary and secondary plant nutrients - plant micronutrients. Bio fertilizers - biology of nitrogen fixation, preparation of different types of inoculants: nitrogen fixers, phosphate solubilizers, zinc solubilizers plant growth promoting rhizobacteria(PGPR), composting. Phytohormone production, antibiosis, plant growth promotion and biological control. Biofertilizers, Bioinsecticides, Biofortification, Mass production and delivery systems.

Unit V

Biofuel- Renewable and non renewable energy sources, Classes, types and applications of biofuels, current status of biofuels, Economical importance and application of biofuels, Organic waste management. Biofuel production- Primary and secondary screening for biofuel production, Bio gas production, Bio ethanol production, Bio diesel production, Microbes for biofuel production, Organic substrates for biofuel production, Characterization of biofuels, Dark fermentation and photo fermentation.

References

1. Holt, JS., Kreig NR., Sneath P.H.A and Williams S.T Bergeys Manual of Determinative Bacteriology (9th edition) Williams and Wilkins, Baltimore Madian MT, Martinko JM and Parker J Brock TD (1997). Biology of Microorganisms (8th edition) Prentice Hall International Inc. London.

2. M. Goodfellow, Marian Mordarski, Stanley Thomas Williams (1984), *The Biology of the actinomycetes*, Academic Press.
3. Zhyrgul Abdullaeva (2017), *Synthesis of Nanoparticles and Nanomaterials: Biological Approaches*, Academic Press.
4. Guozhong Cao (2004), *Nanostructures & nanomaterials*, Flag as inappropriate.
5. M.K. Rai (2005), *Handbook of Microbial Biofertilizers*, The Haworth Press.
6. Egamberdieva, Dilfuza, Shrivastava, Smriti, Varma, Ajit (2015), *Plant-growth-promoting Rhizobacteria (PGPR) and medicinal plants*, Springer.
7. Luque R, campelo J and clark J (2012). *Hand books of biofuels production and technology*. Woodhead Publishing Series in Energy.
8. Filemon FA (2010). *Biofuels from plant oil*. ASEAN Foundation

Web References

<http://www.the-compost-gardener.com/actinomycetes.html>

<http://www.biologydiscussion.com/bacteria/features-of-actinomycetes-with-diagram-bacteria/64814>

<https://www.britannica.com/science/actinomycete>

<http://www.nationalgeographic.com/environment/global-warming/biofuel/>

<http://biofuel.org.uk/>

<https://www.greenfacts.org/en/biofuels/1-2/1-definition.htm>

ENVIRONMENTAL MICROBIOLOGY AND BIODEGRADATION

Unit I

Environmental Microbiology: liquid Waste treatment - Characterization of liquid wastes. Treatment of liquid wastes - Primary, secondary (anaerobic and aerobic) - trickling, activated sludge, oxidation pond, and oxidation ditch-tertiary - disinfection.

Unit II

Microbiology of air and water: Composition of air, Number and types of organisms in air, Distribution and sources of air borne organisms, Droplet and droplet nuclei, Assessment of air quality, Airborne diseases, Air sanitation, Microbes and climatic change, Microbial carbon sequestration.

Unit III

Introduction - organic wastes in the biosphere-their source and composition - Various process of microbial conversion-aerobic and anaerobic degradation-mechanism and factors influencing degradation. Biodegradation of agricultural wastes – Compost - anaerobic digestion-methanogens - fermentative reactions -hydrogen metabolism- acetogenic reactions -Biogas yield-Factors affecting anaerobic digestion.

Unit IV

Bioremediation - types and its application. Hydrocarbon degradation - Bioaccumulation of metals - methylation of heavy metals. Biodegradation of xenobiotic compounds: Hydrocarbon, pesticides, paper, leather, wood, textile and paints. Genetically modified organisms and their impact- Genetically modified organisms in pesticide degradation and oil spills.

Unit V

Microbial assessment of water - MPN, BOD and COD. Quality assurance, quality control methods, disposable methods of wastes. Water borne diseases and their control measures. Air borne diseases and their control measures.

References

1. Alexander M (1971) Microbial Ecology. John Wiley and Sons Inc., New York.
2. Alexander M. (1977) Introduction to Soil Microbiology. John Wiley and Sons New York.
3. Frazier WC and Westhoff DC (1988) Food Microbiology. Tata Mc Graw Hill Pub Comp. New Delhi.
4. Robinson RK. (1990) Dairy Microbiology. Elsevier Applied Sciences, London.

5. Ecology and Biotreatment by Ec Eldowney, S. Hardman D.J. and Waite S. (1993) - Longman Scientific Technical.
6. Bioremediation by Baker K.H. and Herson. D. S, (1994), Mc Graw Hill Inc.,
7. Baker KH and Herson DS 1994. Bioremediation. New York.
8. Adams MR and Moss MO (1995) Food Microbiology. Royal Society of Chemistry Pub., Cambridge.
9. Stanbury PF, Whittaker A and Hall SJ (1995) Principles of fermentation technology. 2/e Pergamon Press.

MEDICAL MICROBIOLOGY

Unit I

Introduction to medical microbiology - Infection disease process- diagnosis- process of sample collection, transport and examination of the specimens, discarding of clinical specimens, Anti-biogram.

Unit II

Bacteriology: Gram positive organisms: morphology, culture characteristics, pathogenicity and laboratory diagnosis of *Staphylococcus aureus*, *S. pyogenes*, *Pneumococcus* sp., *Corynebacterium diphtheriae*, *Bacillus anthracis*, *Clostridium tetani*, *Mycobacterium tuberculosis*, *M. leprae*, Spirochaetes - *Treponema pallidum*, *Leptospira lacteroheamorrhagiae*, *Chlamydiae*.

Unit III

Bacteriology Gram negative organisms: morphology, culture characteristics, pathogenicity and laboratory diagnosis of *E. coli*, *Klebsiella* sp, *Salmonella* sp, *Shigella* sp, *Pseudomonas* sp, *Vibrio cholerae*, *Bordetella pertusis*, *Yersinia pestis*, and *Niesseria gonorrhoeae*, *N. meningitidis*.

Unit IV

Virology: Basic concept of Virology - general properties of human viruses, Pathogenicity, Life cycle, Laboratory diagnosis, treatment and control measures of viral infections- Hepatitis A, B, and C viruses, Polio virus, Rabies, Influenza virus, Measles, Mumps, Dengue virus, HIV, Ebola virus and newly emerging viral diseases.

Unit V

Mycology: general properties and approaches to laboratory diagnosis of Superficial mycosis - *Tinea*, *Pidia*, Subcutaneous mycosis and systemic infections - *Cryptococcosis*, *Madura mycosis*, *Histoplasmosis*, and *Candida albicans*.

Parasitology: pathogenicity and laboratory diagnosis of *Entamoeba histolytica*, *Taenia solium*, *Plasmodium falcipalum*, *Wucheraria bancroft*, and *Trichomonas vaginalis*.

References

1. Chakraborty P (2003). A Text book of Microbiology. Second edition, Published by New Central Agency (P) Ltd., Kolkata.
2. Ananthanarayan R and JayaramPanikerCK (2005). Text Book of Microbiology. Seventh edition, Orient Longman Limited, Hyderabad.

3. Satish Gupte (2005). The Short Textbook of Medical Microbiology. Eighth edition, Jaypee Brothers, Medical publishers (P) Ltd., New Delhi.
4. Baron EJ, Peterson LR and Finegold SM (1994). Bailey and Scotts diagnostic microbiology. 9th edition, Mosby publications.
5. Rajan S (2009). Medical Microbiology. First edition, MJP Publishers, Chennai.
6. Rajesh Bhatia and Ratan Lal Ichhpujani (2004). Essentials of Medical Microbiology. Third edition, Jaypee Brothers, Medical Publishers (P) Ltd., New Delhi.
7. Sundararaj, T (2005). Microbiology Laboratory Manual, Perungudi, Chennai-96.
8. Jawetz, Melnick, & Adelberg's. (2013). Medical Microbiology. 26th Edition.
9. Jagadish Chander (1996). A text book of Medical Mycology. Interprint, New Delhi.
10. Mehrotra RS and Aneja KR (2006). An Introduction to Mycology. New age international publishers.

MICROBIAL DIVERSITY

Unit I

Microbial Diversity Analysis: Introduction and scope of Microbial diversity: Analysis of Microbial Diversity - Archaea, bacteria, algae and fungi in different ecosystems, Major characteristics used in bacterial taxonomy: morphological, physiological, taxonomy, biogeochemical processes.

Unit II

Computational tools for microbiome profiling: Cultivation-independent methods to study microbial diversity; strategies for finding novel enzymes and antibiotics. Computational tools for taxonomic microbiome profiling of shotgun metagenomes. Prospects of microbiome.

Unit III

Genome Databases of *E.coli*, Data resources - EST, STS etc. Sequence analysis; basic concepts of sequence similarity, identity and homology, definitions of homologues, orthologues, paralogues and xenologues, pairwise sequence alignment algorithms.

Unit IV

Molecular tools for communities analysis: Genome level adaptation in extremophiles; hyperthermophiles, halophiles, microbial genome evolution. Interactions within microbial communities and between microorganisms and plants and animals. Microbial community analysis- PLFA, FAME, DGGE, TRFLP, qPCR, ITSPCR and ARDRA.

Unit V

Screening for metabolites: Screening for various prospective metabolites from bacteria, fungi and algae. Metabolic fingerprinting. Metabolomics - types - primary and secondary metabolites and Applications, drug discovery.

References

1. Vipin Chandra KaliaYogesh ShoucheHemant J. Purohit Praveen Rahi (2017). Mining of Microbial Wealth and MetaGenomics : Springer, Singapore <https://doi.org/10.1007/978-981-10-5708-3>
2. Joshi D, Kumar S, Suyal DC, Goel R. (2017) The Microbiome of the Himalayan Ecosystem. Mining of Microbial Wealth and MetaGenomics: Springer, Singapore.pp. 101–16.
3. Microbial Diversity: Form and Function in Prokaryotes (2004), ed. Oladele Ogunseitan DOI:10.1002/9780470750490 : Copyright © 2005 by Blackwell Science Ltd
4. Gerard J. Tortora, Berdell R. Funke , Christine L. Case, Derek Weber , Warner Bair Microbiology: An Introduction 13th Edition,

5. Frans J. de Bruijn, (2011) Handbook of Molecular Microbial Ecology I: Metagenomics and Complementary Approaches , Wiley Blackwell, DOI:10.1002/9781118010518.
6. Glick B.K. and Pasternak, J.J. (1999) Molecular Biotechnology. Principles and Applications of Recombinant DNA. ASM Press, Washington, DC.
7. Gerald Karp, (2002) Cell and Molecular Biology : Concepts and Experiments,3rd Edn John Wiley, New York.
8. Freifelder, D. (1995) Molecular Biology. Narosa Publishing House, New Delhi.
9. Winnacker, E.L. (1987) From Genes to Clones: Introduction to Gene Technology. VCH, Weinheim.
10. Brown, T.A. (1995) Gene Cloning. Chapman and Hall, London.
11. Maloy, S.R., Cronan, J.E., Jr. and David Freifelder. (1994) Microbial Genetics, 2nd Edn. Jones and Bartlett, Boston.

MICROBIAL TECHNOLOGY

Unit I

Microbial Biomass: Microbial Technology - Scope and Introduction. Production of microbial biofertilizers - Mass cultivation of *Spirulina*, *Azolla* and other N₂ fixers. Microbial insecticides - bacterial insecticide *Pseudomonas* Sp, *Bacillus* Sp. *Bacillus thuringiensis*.

Unit II

Bioprospecting of Microbes: Biotechnological potentials of microbes - pharmaceutical compounds, carotenoids, cobalamine and polysaccharides. Microbial production of new novel enzymes, steroids, organic acids and antibiotics.

Unit III

Prospective metabolites: Biosynthesis of natural products, Biomimics, Botanical Pharmaceuticals, Adhesion technologies, growth hormone, tissue plasminogen activator and subunit vaccines.

Unit IV

Microbes in warfare: Biological weapon - such as bacteria, viruses, toxins, or other biological agents. BioShield Biomining, Biosensors, Microbes in abatement of heavy metal pollution, Bioremediation of radioactive waste.

Unit V

Genetically modified organisms: Gene therapies - Antisense technologies and Gene knockouts animals. Transgenic plants - for nutrient deficiency, water stress and salinity resistant plants, pest and disease resistant plants.

References

1. Sathyanarayana, U. (2002) Essentials of Biochemistry 1st Edn. Books and Allied (P) Ltd., Kolkata.
2. Freifelder, D. (1995) Molecular Biology. Narosa Publishing House, New Delhi.
3. Winnacker, E.L. (1987) From Genes to Clones: Introduction to Gene Technology. VCH, Weinheim.
4. Brown, T.A. (1995) Gene Cloning. Chapman and Hall, London.
5. Maloy, S.R., Cronan, J.E., Jr. and David Freifelder. (1994) Microbial Genetics, 2nd Edn. Jones and Bartlett, Boston.
6. Grierson, D. and Covery, S. (1989) Plant Molecular Biology, 2nd Edn. Blackie, London.
7. Glick B.K. and Pasternak, J.J. (1999) Molecular Biotechnology. Principles and Applications of Recombinant DNA. ASM Press, Washington, DC.
8. Gerald Karp, (2002) Cell and Molecular Biology : Concepts and Experiments, 3rd Edn John Wiley, New York.

9. Arora, M.P., Gurdarshan and Sandhu, S. (2004) Genetics, 5th Edn. New Age International Publishers, New Delhi.
10. Raledge C and Kristiansen B Eds (2001). Basic Biotechnology, 2nd edition, Cambridge University Press.

PHARMACEUTICAL AND INDUSTRIAL MICROBIOLOGY

Unit I

Introduction and Strategies of strain improvement, Selection and adaptation, Selection of induced mutants, Selection of recombinants, Strain improvement for modification of properties other than yield, Preservation of industrially important organisms: Principle, methods and quality control.

Unit II

Introduction to downstream processes: Problems and designing, Removal of microbial cells and suspended solids - Foam separation, Precipitation, Filtration and Centrifugation. Cell disruption methods - mechanical methods, Chemical methods. Product concentration and purification - Liquid-liquid extraction, Chromatography, Membrane separation, Drying and Crystallization.

Unit III

Quality Assurance and Safety Measurement, Quality assurance of products- Bioassay, Sterility test, Pyrogen test. Methods for standardization of antibiotics, vitamins and aminoacids. Assessment of a new antibiotic. Evaluation of bactericidal & bacteriostatic. Drug synergistic effects, Adverse Drug Reactions (ADR).

Unit IV

Designing of aseptic area, laminar flow equipments, clean area classification, study of different sources of contamination. Principles, methods used in microbiological assay. Manufacturing and environment safety-Containment, Clean room environment, Effluent treatment.

Unit V

Types of spoilage, factors affecting the microbial spoilage of pharmaceutical products, sources and types of microbial contaminants, assessment of microbial contamination and spoilage. Preservation of pharmaceutical products using antimicrobial agents. Evaluation of microbial stability of formulations.

References

1. W.B. Hugo and A.D. Russel: Pharmaceutical Microbiology, Blackwell Scientific publications, Oxford London.
2. Prescott and Dunn., Industrial Microbiology, 4 th edition, CBS Publishers & Distributors, Delhi.
3. Pelczar, Chan Kreig, Microbiology, Tata McGraw Hill edn.
4. Malcolm Harris, Balliere Tindall and Cox: Pharmaceutical Microbiology.

5. Rose: Industrial Microbiology.
6. Prober, Hinsdill et al: Fundamentals of Microbiology, 9th ed. Japan
7. Cooper and Gunn's: Tutorial Pharmacy, CBS Publisher and Distribution.
8. Pepler: Microbial Technology. 9. I.P., B.P., U.S.P.- latest editions.
9. Ananthnarayan : Text Book of Microbiology, Orient-Longman, Chennai
10. Edward: Fundamentals of Microbiology.
11. N.K.Jain: Pharmaceutical Microbiology, Vallabh Prakashan, Delhi
12. Bergeys manual of systematic bacteriology, Williams and Wilkins- A Waverly company