MEDWIN PUBLISHERS
Committed to Create Value for Researchers

Open Access Journal of Microbiology & Biotechnology
ISSN: 2576-7771

Biotechnological Perspectives of Few Microbes

Khan NT*

Department of Biotechnology, Faculty of Life Sciences & Informatics, Balochistan University of Information Technology, Engineering and Management Sciences, Pakistan

***Corresponding author:** Nida Tabassum Khan, Department of Biotechnology, Faculty of Life Sciences & Informatics, Balochistan University of Information Technology, Engineering and Management Sciences, Takatu Campus, Airport Road, Quetta, Balochistan, Pakistan, Tel: 03368164903; Email: nidatabassumkhan@yahoo.com

Mini Review

Volume 7 Issue 1

Received Date: January 17, 2022

Published Date: January 31, 2022

DOI: 10.23880/oajmb-16000213

Abstract

There are numerous microbial species with a wide scope and unique physiological properties, because of which they might be utilized in many disciplines such as industry, microbial technology, fermentation, pharmaceuticals etc. Notwithstanding the way that a great deal of these microbial species is pathogenic, some of them are utilized in medication, in disease treatment, and in cosmetology etc. Also, compounds separated from these microbes are usually utilized in present day biotechnology. Thus, microorganisms have numerous valuable and significant properties which make them usable in widespread applications for the welfare of mankind.

Keywords: *Pseudomonas stutzeri;* Alkane; Penicillin G; β-lactam; Biocides; Biotherapeutics

Introduction

Penicillin was first made at end of WW2 utilizing the organism *Penicillium notatum*, however presently *Penicillium chrysogenum* is utilized for synthetization of penicillin for more noteworthy creation [1]. The synthesis of penicillin and different other anti-toxins are the most sensational in modern microbial science [2]. The production of penicillin is currently achieved by superior penicillin-delivering mold specie, *Penicillium chrysogenum* [3]. Advancement in submerged culture procedures improved the cultivation of mold on massive scale by utilizing a sterile air supply [4]. *Penicillium chrysogenum* can produce multiple times more penicillin than Fleming's unique culture of *Penicillium notatum* [5].

Beneficial products obtained from *Penicillium chrysogenum* are as follows:

- Penicillin G production: Penicillin G is characteristic penicillin that is delivered straightforwardly from fermentation of *Penicillium chrysogenum* [6]. Due to its weak oral bioavailability, it is by and large given intravenously as sodium, potassium, benzathine, or procaine salt [7]. A beta-lactam anti-infection, penicillin G is dynamic against gram-positive cocci, including nonpenicillin resistant *streptococcal, staphylococcal*, and *Enterococcal* species [8,9].
- Penicillin V production: Phenoxy methyl penicillin or penicillin V is accessible just for oral use as a sodium or a potassium salt in suspension or tablets [10]. In any case, penicillin V is less dynamic than penicillin G against Hemophilus and Neisseria [11].
- β-lactam compounds production: β-lactam anti-infection agents are the ones that contain beta-lactam ring in their structural construct [12]. The first β-lactam anti-toxin found, penicillin, was separated from an uncommon variety of *Penicillium chrysogenum* [13]. Modern production of β-lactam anti-infection agents by the filamentous growth *Penicillium chrysogenum* depends on progressive strain improvement [14]. In any case,

with the improvement in the area of biotechnology, presently these anti-microbials are obtained from different sources [15].

Pseudomonas stutzeri

Pseudomonas stutzeri is a pervasive bacterium with a serious level of physiological and hereditary flexibility [16]. Like other *Pseudomonas* species, *Pseudomonas stutzeri* is engaged with naturally significant metabolic exercises such as metal cycling and debasement of biogenic and xenobiotic compounds (oil subordinates and nonaromatic hydrocarbon) [17,18].

Beneficial role of *Pseudomonas stutzeri* are as follows:

- Metal cycling: In spite of the fact that metals are fundamental supplements, they can be poisonous in overabundance. Thus, microbes have created frameworks to guarantee the accessibility of fundamental metals and, at the same time, to deal with metal toxicity [19]. *Pseudomonas stutzeri* guarantee the accessibility of fundamental metals, like cobalt, copper, iron, and nickel [20]. Moreover, *Pseudomonas stutzeri* have been portrayed because of their high biosorption potential and protection from metals like aluminum, chromium, cobalt, copper, germanium, lead manganese, nickel, plutonium, selenium, silver, thallium, titanium, uranium, vanadium, and zinc [21,22].
- Hydrocarbon degradation: *Pseudomonas stutzeri* is one of the main alkane-degrading microorganisms distinguished and is ranked third as key microorganism in dispersing hydrocarbon contamination [23].
- Detoxification of biocides: A biocide is a synthetic compound that, under controlled conditions, can kill life forms on items and materials [24]. Biocides are utilized widely (in rural, clinical, and modern fields, and is released from human activities into the environment e.g., the arrival of cyanide from industry has been assessed to be over 14 million kg each year [25,26]. Biocides persevere in nature and stay as a possible source of contamination therefore bacterial populaces could be helpful in detoxifying these compounds [27]. Biocides that are degraded by *Pseudomonas stutzeri* are tributyltin which is utilized mechanically as a stabilizer in plastics/wood additives [28] and as an antifouling agent in boat paints [29].
- Degradation of aromatic hydrocarbons: The capacity of *Pseudomonas* species to vigorously degrade benzene and its associated compounds are well documented [30]. *Pseudomonas stutzeri* can utilize benzoate mono-and di-halogen Br, Cl, I, or F benzoates [31].
- Proteolytic activity: Few strains of *Pseudomonas stutzeri* exhibited proteolytic activity in culture [32].

Aspergillus Terreus

Aspergillus terreus produces various metabolites and mycotoxins, including territrem A, citreoviridin, citrinin, gliotoxin, patulin, terrain, terreic corrosive, and terretonin [33]. In addition, it also produces lovastatin by using glycerol and glucose as their carbon source, a powerful medication for lowering blood cholesterol levels [34].

Pichia Pastoris

Pichia pastoris is utilized as an expression system platform for the production of numerous heterologous proteins such as therapeutics [35]. Over the most recent years, *Pichia pastoris* had been utilized for the synthesis of 500 kinds of biotherapeutics [36]. In addition, *Pichia pastoris* is utilized to produce various types of catalysts, used in bread and wine making [37].

Lactobacillus Curvatus

Lactobacillus curvatus has a remarkable ability to produce bacteriocins with strong anti-listeria activity and the ability to inhibit some spoilage bacteria [38,39]. As a native bacterium in meat products, it also plays a certain role in the maturation of these products and the formation of desirable flavors [40]. Therefore, *Lactobacillus curvatus* is often used in the food industry as a starter for fermented sausages and as a biological protection culture for meat products [41]. In addition, it can be used to produce active food- packaging films [42].

Tolypocladium Inflatum

Tolypocladium inflatum has for a long while been of interest in biotechnology in view of its ability to produce Ciclosporin A, an immunosuppressant drug used in the organization of insusceptible framework diseases and the aversion of excusal in organ transplantation [43].

Rhodotorula Rubra

Rhodotorula Rubra presently assumes a huge part in yeast biotechnology and is ready to venture into different modern business sectors: biofuels, carotenoid, biocontrol specialists, protein, bioremediation, cosmetics, and others [44].

Beneficial products obtained from *Rhodotorula Rubra* are as follows:

- Biofuels: Biofuel keep on developing as a worldwide industry, microorganisms might add to biofeedback in more ways than one; bisabolene (diesel elective) can be delivered through bioengineering the isoprenoid pathway [45], and alkane and alkane can be created

through unsaturated fat biosynthesis inside the cell [46].

- Carotenoids: Additionally, *Rhodotorula rubra* produces carotenoid, which are of modern interest such as alpha-carotene, beta-carotene, beta-cryptoxanthin, lutein, lycopene, toluene, and torularhodin [47,48].

Acetobacter Aceti

Acetobacter aceti is financially significant in light of the fact that it is utilized in the development of vinegar [49]. Additionally utilized in the assembling of acetic acid derivation rayon, plastics and visual synthetic substances [50].

Conclusion

Thus, microbes play an important role in the field of biotechnology by serving as a source of many vital products and lies in the center of every innovative microbial technology.

References

1. Nawfa R, Purnomo AS, Putro HS (2019) Synthesis of antibiotic penicillin-G enzymatically by Penicillium chrysogenum. Asian J Chem 31(10): 2367-2369.

2. Delong EF (2007) Modern microbial seascapes. Nat Rev Microbiol 5(10): 755-757.

3. VanGulik WM, Antoniewicz MR, Delaat WT, Vinke JL, Heijnen JJ (2001) Energetics of growth and penicillin production in a high-producing strain of Penicillium chrysogenum. Biotechnol Bioeng 72(2): 185-193.

4. Nielsen J, Johansen CL, Jacobsen M, Krabben P, Villadsen J (1995) Pellet formation and fragmentation in submerged cultures of Penicillium chrysogenum and its relation to penicillin production. Biotechnol Prog 11(1): 93-98.

5. Gailey FB, Stefaniak JJ, Olson BH, Johnson MJ (1946) A Comparison of Penicillin-producing Strains of Penicillium notatum-chrysogenum. J Bacteriol 52(1): 129-140.

6. Asnaashari M, Ghanbary MAT, Tazick Z (2012) Optimization of penicillin G production by Penicillium chrysogenum. Ann Biol Res 3(12): 5434-5440.

7. Bush K (2010) Beta-lactam antibiotics: Penicillins. Antibiotic and chemotherapy, pp: 200-225.

8. Khatoon N, Alam H, Khan A, Raza K, Sardar M (2019) Ampicillin silver nanoformulations against multidrug resistant bacteria. Scientific reports 9(1): 1-10.

9. Hwang IY, Koh E, Kim HR, Yew WS, Chang MW (2016) Reprogrammable microbial cell-based therapeutics against antibiotic-resistant bacteria. Drug Resist Updat 27: 59-71.

10. Sheehan JC, Logan HKR (1959) The total synthesis of penicillin V. J Am Chem Soc 81(12): 3089-3094.

11. Hobby GL, Meyer K, Chaffee E (1942) Observations on the Mechanism of Action of Penicillin. Proceedings of the Society for Experimental Biology and Medicine 50(2): 281-285.

12. Demain AL, Elander RP (1999) The β-lactam antibiotics: past, present, and future. Antonie Van Leeuwenhoek 75(1-2): 5-19.

13. Elander RP (2003) Industrial production of β-lactam antibiotics. Appl Microbiol Biotechnol 61(5-6): 385-392.

14. Weber SS, Bovenberg RAL, Driessen AJM (2012) Biosynthetic concepts for the production of β-lactam antibiotics in Penicillium chrysogenum. Biotechnol J 7(2): 225-236.

15. Demain AL, Solomon NA (1983) Biosynthesis of β-lactam antibiotics. Antibiotics, Springer, Berlin, Heidelberg, USA, pp: 189-228.

16. Lalucat J, Bennasar A, Bosch R, Valdés EG, Palleroni NJ (2006) Biology of Pseudomonas stutzeri. Microbiol Mol Biol 70(2): 510-547.

17. Zhang J, Wu P, Hao B, Yu Z (2011) Heterotrophic nitrification and aerobic denitrification by the bacterium Pseudomonas stutzeri YZN-001. Bioresource Technology 102(21): 9866-9869.

18. Slawson RM, Trevors JT, Lee H, Vogel EML (1994) Silver resistance in Pseudomonas stutzeri. Biometals 7(1): 30-40.

19. Zawadzka AM, Paszczynski AJ, Crawford RL (2009) Transformations of toxic metals and metalloids by Pseudomonas stutzeri strain KC and its siderophore pyridine-2, 6-bis (thiocarboxylic acid). In Advances in Applied Bioremediation, Springer, Berlin, Heidelberg, pp: 221-238.

20. Cortese MS, Paszczynski A, Lewis TA, Sebat JL, Borek V, et al. (2002) Metal chelating properties of pyridine-2, 6-bis (thiocarboxylic acid) produced by Pseudomonas spp. and the biological activities of the formed complexes. Biometals 15(2): 103-120.

21. Azmat R (2014) The impact of siderophore secretion by pseudomonas stutzeri to chelating cu metal in solution culture. Pak J Bot 46(1): 383-387.

22. Butterfield CN, Lee SW, Tebo BM (2016) The role of bacterial spores in metal cycling and their potential application in metal contaminant bioremediation. Microbiol Spectr 4(2): 4-2.

23. Kaczorek E, Jesionowski T, Giec A, Olszanowski A (2012) Cell surface properties of Pseudomonas stutzeri in the process of diesel oil biodegradation. Biotechnol Lett 34(5): 857-862.

24. Russell AD (2001) Mechanisms of bacterial insusceptibility to biocides. Am J Infect Control 29(4): 259-261.

25. Russell AD, Russell NJ (1995) Biocides: activity, action and resistance. Symposia-Society for General Microbiology, Cambridge University Press, USA, pp: 327-327.

26. Beumer R, Bloomfield SF, Exner M, Fara GM, Nath KJ, et al. (2000) Microbial resistance and biocides. International Scientific Forum on Home Hygiene, pp: 1-42.

27. Goudarzi M, Navidinia M (2019) Overview perspective of bacterial strategies of resistance to biocides and antibiotics. Archives of Clinical Infectious Diseases 14(2).

28. Badar U, Shoeb E, Qureshi FM, Akhtar J, Ahmed N (2013) Removal of Copper via bioreactor by soil isolate Pseudomonas stutzeri. Academic Research International 4(3): 253-259.

29. Gadea R, Fuentes MÁF, Pulido RP, Gálvez A, Ortega E (2016) Adaptive tolerance to phenolic biocides in bacteria from organic foods: Effects on antimicrobial susceptibility and tolerance to physical stresses. Food Research International 85: 131-143.

30. Kaczorek E, Salek K, Guzik U, Jesionowski T, Cybulski Z (2013) Biodegradation of alkyl derivatives of aromatic hydrocarbons and cell surface properties of a strain of Pseudomonas stutzeri. Chemosphere 90(2): 471-478.

31. McNally DL, Mihelcic JR, Lueking DR (1999) Biodegradation of mixtures of polycyclic aromatic hydrocarbons under aerobic and nitrate-reducing conditions. Chemosphere 38(6): 1313-1321.

32. Franzetti L, Scarpellini M (2007) Characterisation of Pseudomonas spp. isolated from foods. Annals of Microbiology 57(1): 39-47.

33. Huang X, Men P, Tang S, Lu X (2021) Aspergillus terreus as an industrial filamentous fungus for pharmaceutical biotechnology. Current Opinion in Biotechnology 69: 273-280.

34. Prabhakar M, Lingappa K, BABU V, Amena S, Vishalakshi N (2016) Characterization of Physical Factors for Optimum Lovastatin Production by Aspergillus terreus KLVB28mu21 under Solid State Fermentation. Journal of Recent Advances in Applied Sciences, pp: 27.

35. Romanos M (1995) Advances in the use of Pichia pastoris for high-level gene expression. Current Opinion in biotechnology 6(5): 527-533.

36. Zahrl RJ, Peña DA, Mattanovich D, Gasser B (2017) Systems biotechnology for protein production in Pichia pastoris. FEMS yeast Res, pp: 17(7).

37. Cereghino GPL, Cereghino JL, Ilgen C, Cregg JM (2002) Production of recombinant proteins in fermenter cultures of the yeast Pichia pastoris. Curr Opin Biotechnol 13(4): 329-332.

38. Barbosa MDS, Todorov SD, Ivanova I, Chobert JM, Haertlé T, et al. (2015) Improving safety of salami by application of bacteriocins produced by an autochthonous Lactobacillus curvatus isolate. Food Microbiol 46: 254-262.

39. Benkerroum N, Daoudi A, Hamraoui T, Ghalfi H, Thiry C, et al. (2005) Lyophilized preparations of bacteriocinogenic Lactobacillus curvatus and Lactococcus lactis subsp. lactis as potential protective adjuncts to control Listeria monocytogenes in dry-fermented sausages. J App Microbiol 98(1): 56-63.

40. Zommiti M, Connil N, Hamida JB, Ferchichi M (2017) Probiotic characteristics of Lactobacillus curvatus DN317, a strain isolated from chicken ceca. Probiotics Antimicrob Proteins 9(4): 415-424.

41. Janßen D, Eisenbach L, Ehrmann MA, Vogel RF (2018) Assertiveness of Lactobacillus sakei and Lactobacillus curvatus in a fermented sausage model. Int J Food Microbiol 285: 188-197.

42. Massani MB, Vignolo GM, Eisenberg P, Morando PJ (2013) Adsorption of the bacteriocins produced by Lactobacillus curvatus CRL705 on a multilayer-LLDPE film for food-packaging applications. LWT-Food Science and Technology 53(1): 128-138.

43. Murthy MRV, Mohan EVS, Sadhukhan AK (1999) Cyclosporin-A production by Tolypocladium inflatum using solid state fermentation. Process Biochemistry 34(3): 269-280.

44. Johnson EA, Erasun CE (2011) Yeast biotechnology. 5th(edn.), The yeasts, Elsevier, pp: 21-44.

45. Khot M, Ghosh D (2017) Lipids of Rhodotorula mucilaginosa IIPL32 with biodiesel potential: oil yield,

fatty acid profile, fuel properties. J Basic Microbiol 57(4): 345-352.

46. Gohain M, Bardhan P, Laskar K, Sarmah S, Mandal M, et al. (2020) Rhodotorula mucilaginosa: A source of heterogeneous catalyst for biodiesel production from yeast single cell oil and waste cooking oil. Renewable Energy 160: 220-230.

47. Frengova G, Simova E, Beshkova D (2004) Use of whey ultrafiltrate as a substrate for production of carotenoids by the yeast Rhodotorula rubra. Appl Biochem Biotechnol 112(3): 133-141.

48. Simova ED, Frengova GI, Beshkova DM (2004) Synthesis of carotenoids by Rhodotorula rubra GED8 co-cultured with yogurt starter cultures in whey ultrafiltrate. J Ind Microbiol Biotechnol 31(3): 115-121.

49. Adachi O, Miyagawa E, Shinagawa E, Matsushita K, Ameyama M (1978) Purification and properties of particulate alcohol dehydrogenase from Acetobacter aceti. Agricultural and Biological Chemistry 42(12): 2331-2340.

50. Okiyama A, Shirae H, Kano H, Yamanaka S (1992) Bacterial cellulose I. Two-stage fermentation process for cellulose production by Acetobacter aceti. Food Hydrocolloids 6(5): 471-477.