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ENDOPHYTIC ANTIBIOTIC PRODUCERS

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ABSTRACT

The resistance to antibiotics of the most pathogenic strains is a problem affecting human population and, it is the last challenge in infectious diseases. That is why, the screening of microbial life forms for new and improved molecules must be continued. One of the possible source are the endophytic microorganism living inside plants organs and tisues. This review paper show this possibility to find, by screening of this microbiota, new compounds which can be use against microbial pathogens.

KEYWORDS: Antibiotics, Bacterial Strains, Fungal Strains, Endophytes

INTRODUCTION

Endophytic microrganisms are part of the so called endobionts or in this case endophytobionts (endophytobiome) taking into account that macroorganisms has inside them a microbiome. Even marine plants like macroalgae hosts a fungal and bacterial microbiome like Bostrychia tenella [1] where a strain of endophytic fungi produce cytochalasin. There are a lot of plants containing a community of microorganisms which do produced any dammage to the host. It looks like they enter in symbiontic, commensalism and trophobiontic relations with it [2] and they originate from phyllospere. Studies on soil bacteria which produce antibiotics were performed, from Bacillus and Micrococcus genera [3]. The strains were characterized and tested using test human pathogenic microorganisms. The endophytic strains of fungi and bacteria producing antibiotics is still a domain to explore [4]. In the conditions of 90% antibiotic resistant pathogens as stated by WHO, the methanolic and aqueous extracts obtained from endophytic fungal strains were effective against many common human pathogens, for example Staphyllococcus aureus, Pseudomonas aeruginosa and the yeast Candida albicans [5].

FUNGI

Endophytic fungi produced antibiotics too for example, Muscodor albus isolated from Cinnamomum zeylanicum, and other plants and release volatile organic compounds with antibiotic effects [6]. From Eucryphia cordifolia were isolated a fungus strain Gliocladium wich release volatile organic compounds (1-butanol, 3-methyl-, phenylethyl alcohol and acetic acid, 2-phenylethyl ester, propanoic esthers and so on) active against phytopathogens [7]. In facts looks like that some metabolites from medicinal plants are fermentation products of fungal and bacterial endophytic strains [8], as example the fungus Mucor fragilis can produce kaempferol, or some component from silymarin can originate from Aspergillus Iizukae strain hosted in the Silibium plants.

A huge screening was performed in Brasil [9], with 388 strains of endophytic fungi and 13 of yeast were isolated from Brasilian Orchidaceae. The fungi were from Epicoccum, Fusarium, Acremonium, Alternaria, Trichocladium Gibberrella, Cylindrocarpon, Rhodotorula genera, and 22 extracts were tested against test strains of human pathogens, 6

being efficients against E coli,5 against S aureus, 9 against C albicans and 8 against C krusei. Endophytic fungi, from genera Alternaria, Aspergillus Penicillium Stemphylium, and others were isolated from a Rhododendron species from Nepal, showing an antibiotic activity against bacterial human pathogens (Salmonella typhy, Proteus mirabilis, Enterococcus faecalis, Klebsiella pneumonia, Acinetobacter sp, Shigella sp, Esherichia coli, Staphylococcus aureus and Bacillus subtilis), and antifungal activity against phytopathogenic fungi Fusarium oxysporum, F. moniliforme and others [10].

BACTERIA

Cultivated plants contains many endophytic strains, this were intensive studied as being important for agriculture applications. Soya plants Glycine max and G.soja, cover large surfaces being used in human and animal nutrition. Scientists [11] isolated about 65 bacterial strains and identified by BIOLOG system being from Deinococcus, Staphylococcus, Bacillus, Tsukamurella genera and others.Interesting, the endophytes are isolated from wild plants and from cultivated plants too. Strobel et Daisy [12] shown in an older review paper, the need for new medicine and specially antibiotics is growing in special after the apparition of cases of antibiotic resistance to main pathogenic strains.

Endophytic bacteria like Bacillus amyloliquefaciens is considered a new source of new antimicrobials, isolated from some plants from Thailand having an inhibitory effect against E coli, Staphyllococcusaureus, the minimum bactericidal concentration being between 0, 312-5 mg/ml [13]. Bacteria living inside plant Lantana camara, [14] from which, one was Bacillus amyloliquefaciens strain YB-1402, was very active against many pathogenic bacteria (methycillin resistant Staphyllococcus aureus), it is an phytopathogenic bacteria (Xantomonas vesicatoria –same authors) releasing compounds like Cyclohexanone, 2-[2-(1,3-dithiolan-2-yl)propyl]-6-methyl-3-(1-methylethyl), Tetracosane (CAS) n-Tetracosane, Octadecane (CAS) n-Octadecane. The strains [15] of Bacillus cereus, B. Thuringiensis, B. Pumilis, Clavibacter michinganensis, Pseudomonas Putida which produced all IAA, and two of them were Siderophores, and they inhibited E coli and Klebsiella pneumoniae.

Some bacterial and fungal isolates, from some medicinal plants like Terminalia arjuna, Catharanthus roseus, Azadirachta indica, demostrated antibiotic activity against human pathogens, Pseudomonas aeruginosa, Staphylococcus aureus, Klebsiella pneumonia, Enterococcus faecalis and the yeast Candida albicans, and they were selected for further experiments [16].

Actinomycetes are a group of bacteria known for their useful metabolites (from 23.000 of bioactive compond produced by microbesabout 10.000 are produced by actinomycetes), and the endophytic strains make no exception. The actinomicete, isolated from Syzygium cumini stem, roots and leaves, about 30 % of them demonstrated a antibiotic activity against Staphyllococci, with a maximum inhibition of 12 mm. One of the isolates J-5, demostrated a release of chloramphenicol [17].

By genomic screening and mining, the possible producers of antibiotics can be detected[18]. An example is the Streptomyces wadayamensis, which has a high potential in producing antibiotic compounds. Another endophytic Streptomyces from Chataranthes roseus, produce secondary metabolites effective against Bacillus subtilis, Staphylococcus aureus and Proteus vulgaris and against fungi - Botrytis cinerea, Curvularia lunata and Rhizoctonia solani [19]. From the plant, Flacourtia jangomas were isolated few bacterial strains which were tested for antibiotic activity production, the best

being FjR 1, and FjR2, in condition of culture on YPD, at 7 pH and 8% inoculum, with fructose presence in the culture media (20). Endophytic fungi from Bacopa monnieri, showed an intense antibiotic (MIC value 10–100 µg/ml-33% from the extract) and cytotoxic activity in vitro [21]. The endophytes can be a source of peptides antibiotic too [22].

CONCLUSIONS

The review shortly showed the enormous potential of bacterial and fungal strains, residents as endophytes in different plants species. Some of them can be source of antibiotics and antifungals in the modern medicine, in order to fight against the resistant strains of pathogenic bacteria and fungi. The work in this field of activity and new research programs will boost up the screening of endophytes, for new molecules of antimicrobials.

REFERENCES

1. A.J. Flewelling, J. Currie, C.A. Gray, J.A. Johnson, Endophytes from marine macroalgae promising sources of novel natural products, Current Science, 108, 2015, 1-17.
2. RP Ryan, K Germaine, A Franks, DJ Ryan, DN Dowling, Bacterial endophytes: recent developments and applications. FEMS Microbiol Lett.;278 (1) 2008, 1-9.
3. M. Abdulkadir, S., Waliyu, Screening and Isolation of the Soil Bacteria for Ability to Produce Antibiotics.Eur. J. Appl. Sci., 4(5), 2012, 211-215.
4. D.Menpara, S. Chanda, Endophytic Bacteria-in Unexplored Reservoir of Antimicrobials for Combating Microbial Pathogens Ed Formatex, 2013.
5. C. Glienke, F. Tonial, J. Figueiredo, D. Savi, V.Vicente, M. Sales, H. Beatriz, Y. Possiede, Antimicrobial Activity of Endophytes from Brazilian Medicinal Plants in: Antimicrobial Agents Editors: Varaprasad Bobbarala, 2012, 239-254.
6. Ashutosh Kumar, Prasad Abnave & Absar Ahmad, Cultural, Morphological and Molecular Characterization of Vinca Alkaloids Producing Endophytic Fungus Fusarium solani Isolated from Catharanthus roseus, International Journal of Botany and Research (IJBR), Volume 3, Issue 2, May-June 2013, pp. 1-12
7. D. Ezra, W. M. Hess, G.A. Strobel, New endophytic isolates of Muscodor albus, a volatile-antibiotic-producing fungus Microbiology 150, 2004, 4023–4031.
8. M. Stinson, D. Ezra, W.M. Hess, J. Sears; G. Strobel, An endophytic Gliocladium sp. of Eucryphia cordifolia producing selective volatile antimicrobial compounds. Plant Science, v.165, 2003, 913□922.
9. R. Nicoletti, A. Fiorentino, Plant Bioactive Metabolites and Drugs Produced by Endophytic Fungi of Spermatophyta. Agriculture, 5, 2015, 918-970.
10. A.B. Vaz, R.C. Mota, M.R. Bomfim, M.L. Vieira, C.L. Zani, C.A.Rosa, L.H.Rosa, Antimicrobial activity of endophytic fungi associated with Orchidaceae in Brazil. Can J Microbiol.;55(12), 2009,1381-91
11. B. Baral, P. Rana., B.L. Maharjan, Antimicrobial potentials of endophytic fungi inhabiting Rhododendron anthopogon D. Don Ecoprint.18: 39-44, 2011 ISSN 1024-8668.

12. PQ. Hung, K., Annapurna K (2004) Isolation and characterization of endophytic bacteria in soybean (Glycine sp.). Omonrice 2004, 12: 92-101.

13. Harshita Shukla & Sardul Singh Sandhu, Mycofabrication and Characterization of Silver Nanoparticles by Using Some Endophytic Fungi with Special Reference to their Antimicrobial Potential, International Journal of Nanotechnology and Application (IJNA), Volume 7, Issue 1, January-February 2017, pp. 7-22

14. G. Strobel, B. Daisy, Bioprospecting for Microbial Endophytes and Their Natural Products. Microbiol.Molec.Biol.Rev.; 67 (4) 2003, 491–502.

15. A.Bhoonobtong, S. Sawadsitang., S. Sodngamd, W. Mongkolthanaruk, Characterization of Endophytic Bacteria, Bacillus amyloliquefaciens for Antimicrobial Agents Production International Conference on Biological and Life Sciences IPCBEE vol.40 (2012) IACSIT Press, Singapore

16. D.D. Saputri, M. Bintang, F.H. Pasaribu, Isolation and Characterization of Endophytic Bacteria from Tembelekan (Lantana camara L.) as Antibacterial Compounds Producer. Curr Biochem; 2 (2) 2015, 77 – 89.

17. D.S. Fitri, Pangastuti A., Sutarno SA., Endophytic bacteria producing antibacterial against methicillin resistant Staphylococcus aureus (MRSA) in seagrass from Rote Ndao, East Nusa Tenggara, Indonesia Biodiversitas; 18(2) 2015: 2085-4722.

A. Kumar, R. Singh, A. Yadav, D.D. Giri, P. K. Singh, K.D. Pandey, Isolation and characterization of bacterial endophytes of Curcuma longa L. 3 Biotech 2016, 6:60.

18. G. Arun Kumar, A. R. Antony, V. Rajesh Kannan, Exploration of endophytic microorganisms from selected medicinal plants and their control potential to multi drug resistant pathogens. Journal of Medicinal Plants Studies 2015; 3(2): 49-57.

19. P. Saini, M. Gangwar, A. Kalia, N. Singh, D. Narang, Isolation of endophytic actinomycetes from Syzygium cumini and their antimicrobial activity against human pathogens JANS Journal of Applied and Natural Science 8 (1) 2016, 416 – 422.

20. F. Célio, F. Angolini, A.B. Gonçalves, R. Sigrist, B.S. Paulo, M.Samborsky, P.L.R. Cruz, A.F. Vivian, E.M.Schmidt, M.N. Eberlin, W.L. de Araújo, L.G. de Oliveira, Genome Mining of Endophytic Streptomyces wadayamensis Reveals High Antibiotic Production Capability J. Braz. Chem. Soc.; 27(8) 2016, 1465-1475.

21. Abdul Kafur, A.B. Khan, Ocurence of cultural parameters on antimicrobial activity of endophytic Cr 12 isolated from Catharanthes roseus Intl Journal of Drug Delivery 2011, 3: 425-431.

22. S. Shukla; G. Naik; S. K.Mishra, Potential antimicrobial activity of bacterial endophytes isolated from Flacourtia jangomas (Lour.) Raeusch, a less explored medicinal plant. Journal of Microbiology, Biotechnology and Food Sciences,4.(6,) 2015, 473-477.

23. Kuldeep Singh, Kavita Singh & CBS Dangi, Endophytic Fungi with Anti-Diabetic Activities Isolated from Amla Fruits, IMPACT: International Journal of Research in Applied, Natural and Social Sciences (IMPACT: IJRANSS), Volume 5, Issue 1, January 2017, pp. 121-128

24. M.Katoch, G. Singh, S. Sharma, N. Gupta, P. Lal Sangwan, A. Kumar Saxena, Cytotoxic and antimicrobial activities ofendophytic fungi isolated from Bacopa monnieri (L.) Pennell (Scrophulariaceae) BMC Complementary and Alternative Medicine 2014, 14:52 http://www.biomedcentral.com/1472-6882/14/52.

25. M.A. Abdalla, J.C. Matasyoh, Endophytes as Producers of Peptides: An Overview Aboutthe Recently Discovered Peptides from Endophytic Microbes Nat. Prod. Bioprospect.;4: 2014, 257–270.