

Endophytes – the plant-associated microbial treasure troves

Elucidating the interspecies and multispecies cost-benefit crosstalks of endophytes harbored in *Cannabis sativa* L.
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Our work focuses on understanding and elucidating the multifaceted cost-benefit trade-offs between endophytes harbored in *Cannabis sativa* L. and interacting organisms (such as host-specific phytopathogens) that lead to desired biological functions (such as the production of defensive compounds that can be used as pharmaceutically relevant pro-drugs). This will enable the practical and efficient use of endophytes as biocontrol agents for plant protection against a plethora of phytopathogens, and further as competent microbial factories of bioactive natural products.

Beyond the generalized understanding of plants as multicellular organisms capable of performing photosynthesis, is a much more complex veracity of comprehending them. This includes commanding the network of associations of plants with other organisms, various biotic and abiotic selection pressures, an assortment of cost-benefit mutualisms, and interaction-directed coevolution of attack-defense-counterdefense mechanisms. A central 'partner' within these strata of natural acquaintances is a class of remarkably diverse group of microorganisms (fungi and bacteria) called endophytic microorganisms (known as endophytes). They inhabit living, internal tissues of plants, and retain a discreet association with their associated hosts for at least a part of their life (Fig. 1).

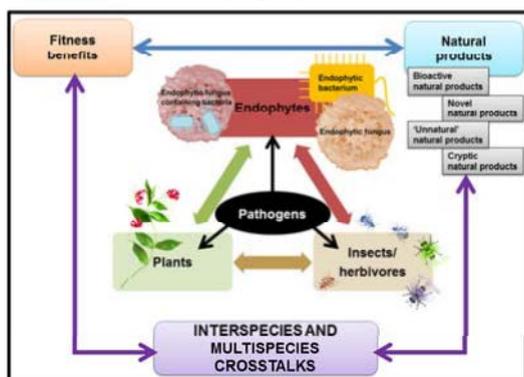


Figure 1. Schematic representation of the interspecies and multispecies crosstalks between endophytes (bacteria and fungi), pathogens, plants and feeders.

Our investigation focuses on isolation, microbiological and phylogenetic characterization, diversity evaluation, and assessment of biocontrol potential of endophytes harbored in the medicinal plant, *Cannabis sativa* L.

In spite of the production of secondary metabolites like cannabinoids, *C. sativa* suffers epidemic disasters and greenhouse destructions due to the attack of numerous phytopathogens. The total eradication and/or prevention of diseases are still open to further investigation. We have focused on the two major phytopathogens, namely *Botrytis cinerea* and *Trichothecium roseum*, known to cause grey mold and pink rot diseases in *C. sativa*. We devised dual culture setups to challenge the endophytes with these two phytopathogens in different culture conditions and parameters to evaluate the different attack-defense ecological strategies and biochemical fingerprints utilized by the endophytes in thwarting these host-specific phytopathogens.

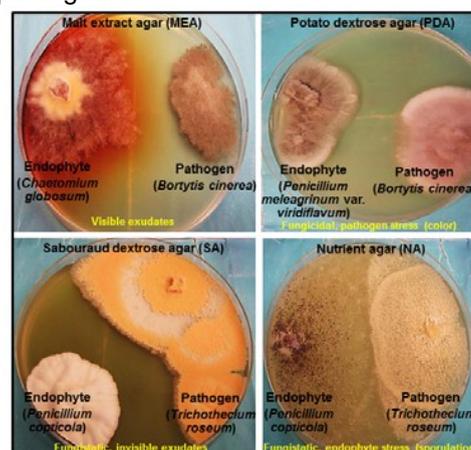


Figure 2. Representative types of *C. sativa* L. endophyte-pathogen interactions observed in dual culture antagonistic assay.

This study led to the establishment of various attack-defense-counterdefense interactions between competent endophytes and the challenging phytopathogens (Fig. 2).

Further investigation will be made for chemical elucidation of bioactive target and/or non-target compounds correlating to the endophyte-pathogen interactions, enabling us to elucidate the bio- and chemo-diversity of *Cannabis*-associated endophytes.

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Publications:

- ✓ Kusari P., Kusari S., Spiteller M., Kayser O. (2012) Endophytic fungi harbored in *Cannabis sativa* L.: Diversity and potential as biocontrol agents against host plant-specific phytopathogens. *Fungal Divers.* In Press (doi: 10.1007/s13225-012-0216-3)
- ✓ Kusari P., Kusari S., Spiteller M., Kayser O. (2012) Endophytic diversity of pharmaceutically important *Cannabis sativa*. *Planta Med.* 78, 1154-1154. [Abstract for poster presented at the International Congress on Natural Products Research (ICNPR 2012), the 8th Joint Meeting of AFERP, ASP, GA, PSE and SIF; New York, USA].
- ✓ Kusari P., Spiteller M., Kayser O., Kusari S. (2013) Recent advances in research on *Cannabis sativa* L. endophytes and their prospect for the pharmaceutical industry. In: Kharwar R.N. (ed.) *Endophytes*, (ICPMB 2012), Springer-Verlag, Heidelberg. In Press.