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Human Pathogens on or Within the Plant and Useful Endophytes

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Several human pathogens and the plant can have close connection. A plant is not traditionally considered as a niche for human pathogen. But the literature data attest that many members of the family *Enterobactericeae,* including pathogenic *Salmonella* and *Shigella* genus strains, *Vibrio cholerae* strains, and the human opportunistic pathogen *Pseudomonas aeruginosa,* were found on plants or inside plants.

Salmonella enterica strains have been isolated as endophytic colonizers of barley roots, spreading to the rhizodermis layers [1]. *Salmonella* not only passively survive, but actively infected plants as alternative host [2]. Internalization of *E. coli* O157:H7 and *Salmonella* spp. in plants was presented by Deering et al. [3].

Enteric bacteria are able to colonize plants, and use them as alternative hosts. Plants as reservoirs for human enteric pathogens have been considered by Holden NJ [4]. The ability of enteric pathogens to survive for prolonged periods of time on fruits and vegetables has been described by Natvig et al. [5] and Gagliardi and Karns [6]. Brandl [7] has demonstrated schematic diagram of the various sources of contamination of fruits and vegetables, with human enteric pathogens.

Enteric pathogens develop novel niches on and within the plant, where they never were before as residents. The reports about the outbreaks caused by contamination of produce by human pathogens, continues to rise [7-9]. A link between recent outbreaks of gastroenteritis and the consumption of fresh produce raise was determined by Teplitski et al. [10]. Endophytic colonization of ready-to-eat-salad crops by enteric bacteria carries important public health implications. Enteric human pathogens–agriculture produce and public health risk are a great concern. Human pathogens acquire the ability to attack, infect, colonize, persist, multiplay, survive on plants or inside the plants.

On the other hand, the plant is a niche for endophytic organisms that live within the plant. Several groups of endophytic microorganisms have attractive commercial application. Bacterial, fungal endophytes and actinomycetes as novel source of potentially useful compounds have been described by Rathod et al. [11]. Endophytes as potential sources of novel natural products for exploitation in agriculture and medicine have been presented by Guo et al. [12], Mehanni and Safwat [13].

Antimicrobial activity of endophytic antagonists against several pathogens was determined. It is a broad research area today. *Streptomyces endophytes* strain against *Fusarium* vilt was isolated [14]. Antifungal activity of endophytic *Bacillus subtilis* and *Burkholderi*a sp. against *Fusarium circinatum* N. was shown [15]. Fungal endophytes as unique plant inhabitants with great promises have been described by Aly et al [16]. Antagonistic endophytic microorganisms against plant pathogens and against clean room pathogens were isolated from leaves and seeds of mistletoes. The authors indicate on an interesting bio-resource to control plant pathogens, but also clean room pathogens [17].

Significant inhibitory activity of endophytic yeast *Rhodotorula rubra* strain TG–1 against many members of the *Enterobactericeae* family, against *Vibrio cholerae* and *Pseudomonas aeruginosa* strains, was determined. Some information about it can read on my website**.** Antimicrobial activity of TG-1 strain against several pathogenic fungal and bacterial plant pathogens, including *Fusarium* genus strains and *Xanthomonas malvacearum* strains has been described [18]. The inhibitory activity of yeast *Rhodotorula rubra* strain TG–1 against some pathogens of human infectious diseases, and against several plant pathogens, will be able to indicate about some link between human pathogens and plant pathogens within the plant. It will be interesting comparative study of virulence, adhesive abilities and adaptive capacities of enteric bacterial isolates that infected both human tissue and plant tissue.

Our preliminary research has shown that one of the rhizosphere fungal strains can have a harbor, niche space for pathogens antagonist. Intracellular living bacterium *Erwinia* spp. has been isolated from a phytopathogenic fungus. This endofungal bacterium showed unexpected useful properties. A germination stimulating activity of *Erwinia* spp. on cotton seeds was determined. Antimicrobial activity of intracellular bacterium *Erwinia* spp. against some pathogens, for example, *Fusarium* genus strains was established. Different phage types inside isolated bacteria were detected. Some information shows on my website. How can be the impact of endofungal bacterium on the host fungus life cycle? Relationship and interactions between a plant–a phytopathogenic fungus–an intracellular bacterium–a phage (phages) may shed new light on the virulence diversity of phytopathogenic fungi population. It can be important for understanding the interactions of interdependence of microbial communities, living on and within the plant.

Fodor [19] describes pathogen niche, host niche and vector niche, within the environmental diagram. Interactions between a host niches–a pathogen niche–an antagonist niche–a phage (phages) niche and vector niche can be more difficult.

The quest for novel niches inhabiting useful endophytic microorganisms with antagonistic activity against pathogens of human infectious diseases, and against plant pathogens, and can be an active area for future investigations. Maybe endophytes will be able to help answer on several questions in a link between human pathogens and the plant.

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