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Salmonella as an endophytic colonizer of plants - a risk for health safety vegetable production

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Abstract

Contamination of vegetables and fruits is the result of presence of human pathogen bacteria which can contaminate products in any part of production chain. There is an evidence of presence of: *Salmonella spp.* on the fresh vegetables and Salmonellosis is connected with tomato, sprouts, cantaloupe etc.

The goal of this research is transmission of pathogen bacteria from irrigation water to plants and studying/monitoring the ability of the *Salmonella spp.* to colonize the surface and interior (endophytic colonization) of root at different vegetable species.

Transmission of three *Salmonella spp.* strains from irrigation water to plants, as well as colonization of plants by these bacteria was investigated by using *Fluorescence In Situ Hybridization* (FISH) in combination with confocal laser scanning microscopy (CLSM).

All tested *Salmonella spp.* strains showed ability to more or less colonize the surface and interior niches of the root, stem and leaf of the investigated plant species. These bacteria also were found in plant cells cytoplasm, although the mechanism of their entrance has not been clarified yet.

Key words: *contamination vegetables, Salmonella spp., irrigation water, FISH, CLSM.*

1. Introduction

The consumption of vegetables is essential for healthy nutrition and it is an integral part of many diets which are recommended by various health organizations (World Health Organization, 2003; United States Department of Agriculture, 2011). Since fresh produce is one of the major components, such as essential vitamins, minerals, and fiber, the consumption of fresh produce has increased worldwide in recent years (EU, 2007; Betts 2014).

The number of outbreaks associated with the consumption of contaminated fresh produce, especially those caused by *Salmonella*, has also increased. In EU countries excluding Spain, a total of 37 Salmonellosis outbreaks have been linked to the consumption of food of non-animal origin including fresh produce have been reported between 2007 and 2011 (EFSA,2013).

The vegetables could become contaminated (Beuchat and Ryu, 1997) in contact with soil, manure, compost, irrigation water, contaminated water for washing and etc. Irrigation water contaminated with manure or animal waste is a common environmental source for the transmission of microorganisms into fresh produce (Olaimat and Holley, 2012).

The *Salmonella* is an important human and animal pathogen worldwide, mainly transmitted to humans through contaminated food (Jay et al.,2005). Each year, nontyphoidal *Salmonella spp.* have been estimated to be responsible for 1.0 million (Scallan et al., 2011) and 80.3 million human salmonellosis cases (Majowicz et al., 2010) in the United States and globally, respectively. The preharvest contamination vegetables by human pathogen is the most often cause of presence microbiologically unsafe products on the market (Pezzoli et al. 2007; CDC 2006b; Gillespie, 2004; Soderstrom et al., 2005). There is evidence that outbreak of tomato-associated salmonellosis was caused by *Salmonella* Newport. This strain was isolated from water which was used for irrigation tomato plants (Greene et al., 2008). Also, it was happened salmonellosis outbreak which was linked

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