A Conserved Class II Type Thioester Domain-Containing Adhesin Is Required for Efficient Conjugation in *Bacillus subtilis*

César Gago-Córdoba, Jorge Val-Calvo, David Abia, Alberto Díaz-Talaver, Andrés Miguel-Arribas, Rocío Aguilar Suárez, Jan Maarten van Dijl, Ling Juan Wu, Wilfried J. J. Meijer

ABSTRACT Conjugation, the process by which a DNA element is transferred from a donor to a recipient cell, is the main horizontal gene transfer route responsible for the spread of antibiotic resistance and virulence genes. Contact between a donor and a recipient cell is a prerequisite for conjugation, because conjugative DNA is transferred into the recipient via a channel connecting the two cells. Conjugative elements encode proteins dedicated to facilitating the recognition and attachment to recipient cells, also known as mating pair formation. A subgroup of the conjugative elements is able to mediate efficient conjugation during planktonic growth, and mechanisms facilitating mating pair formation will be particularly important in these cases. Conjugative elements of Gram-negative bacteria encode conjugative pili, also known as sex pili, some of which are retractile. Far less is known about mechanisms that promote mating pair formation in Gram-positive bacteria. The conjugative plasmid pLS20 of the Gram-positive bacterium *Bacillus subtilis* allows efficient conjugation in liquid medium. Here, we report the identification of an adhesin gene in the pLS20 conjugation operon. The N-terminal region of the adhesin contains a class II type thioester domain (TED) that is essential for efficient conjugation, particularly in liquid medium. We show that TED-containing adhesins are widely conserved in Gram-positive bacteria, including pathogens where they often play crucial roles in pathogenesis. Our study is the first to demonstrate the involvement of a class II type TED-containing adhesin in conjugation.

IMPORTANCE Bacterial resistance to antibiotics has become a serious health care problem. The spread of antibiotic resistance genes between bacteria of the same or different species is often mediated by a process named conjugation, where a donor cell transfers DNA to a recipient cell through a connecting channel. The first step in conjugation is recognition and attachment of the donor to a recipient cell. Little is known about this first step, particularly in Gram-positive bacteria. Here, we show that the conjugative plasmid pLS20 of *Bacillus subtilis* encodes an adhesin protein that is essential for effective conjugation. This adhesin protein has a structural organization similar to adhesins produced by other Gram-positive bacteria, including major pathogens, where the adhesins serve in attachment to host tissues during colonization and infection. Our findings may thus also open novel avenues to design drugs that inhibit the spread of antibiotic resistance by blocking the first recipient-attachment step in conjugation.

KEYWORDS adhesion molecules, antibiotic resistance, conjugation, Gram-positive bacteria, mating, plasmids, thioester domain