

## University of Groningen

### Multidrug and peptide export in *Lactococcus lactis*

Berg van Saparoea, Hendrik Bart van den

**IMPORTANT NOTE:** You are advised to consult the publisher's version (publisher's PDF) if you wish to cite from it. Please check the document version below.

*Document Version*

Publisher's PDF, also known as Version of record

*Publication date:*  
2009

[Link to publication in University of Groningen/UMCG research database](#)

*Citation for published version (APA):*

Berg van Saparoea, H. B. V. D. (2009). *Multidrug and peptide export in Lactococcus lactis*. s.n.

**Copyright**

Other than for strictly personal use, it is not permitted to download or to forward/distribute the text or part of it without the consent of the author(s) and/or copyright holder(s), unless the work is under an open content license (like Creative Commons).

The publication may also be distributed here under the terms of Article 25fa of the Dutch Copyright Act, indicated by the "Taverne" license. More information can be found on the University of Groningen website: <https://www.rug.nl/library/open-access/self-archiving-pure/taverne-amendment>.

**Take-down policy**

If you believe that this document breaches copyright please contact us providing details, and we will remove access to the work immediately and investigate your claim.

*Downloaded from the University of Groningen/UMCG research database (Pure): <http://www.rug.nl/research/portal>. For technical reasons the number of authors shown on this cover page is limited to 10 maximum.*

# **Multidrug and peptide export in *Lactococcus lactis***

Bart van den Berg van Saparoea

2009

The work described in this thesis was carried out in the  
Molecular Microbiology group of the  
Groningen Biomolecular Sciences and Biotechnology Institute (GBB) of the  
University of Groningen, The Netherlands.

Cover design: Bart van den Berg van Saparoea

Printed by Ridderprint B.V., Ridderkerk, The Netherlands

**RIJKSUNIVERSITEIT GRONINGEN**

**Multidrug and peptide export  
in *Lactococcus lactis***

**Proefschrift**

ter verkrijging van het doctoraat in de  
Wiskunde en Natuurwetenschappen  
aan de Rijksuniversiteit Groningen  
op gezag van de  
Rector Magnificus, dr. F. Zwarts,  
in het openbaar te verdedigen op  
vrijdag 25 september 2009  
om 14.45 uur

door

Hendrik Bart van den Berg van Saparoea  
geboren op 26 juni 1976  
te Wageningen

Promotor: Prof. dr. A.J.M. Driessen

Beoordelingscommissie: Prof. dr. J. Kok  
Prof. dr. G.F.B.P. van Meer  
Prof. dr. B. Poolman

# Contents

<b>Chapter 1</b>	Introduction to multidrug transporters, cellular resistance and lantibiotic production in <i>Lactococcus lactis</i>	<b>7</b>
<b>Chapter 2</b>	Heterologously expressed bacterial and human multidrug resistance proteins confer cadmium resistance to <i>Escherichia coli</i>	<b>23</b>
<b>Chapter 3</b>	Proton motive force-dependent Hoechst 33342 transport by the ABC transporter LmrA of <i>Lactococcus lactis</i>	<b>35</b>
<b>Chapter 4</b>	Effect of the calcium channel blocker verapamil on drug extrusion and resistance mediated by the multidrug resistance protein LmrP of <i>Lactococcus lactis</i>	<b>51</b>
<b>Chapter 5</b>	Distinct contributions of the nisin biosynthesis enzymes NisB and NisC and the transporter NisT to prenisin production by <i>Lactococcus lactis</i>	<b>63</b>
<b>Chapter 6</b>	Summary and outlook	<b>79</b>
<b>Chapter 7</b>	Samenvatting in het Nederlands (Summary in Dutch)	<b>87</b>
<b>References</b>		<b>95</b>
<b>Dankwoord (Acknowledgements)</b>		<b>105</b>

