



University of Groningen

### Metabolic shifts in Lactococcus lactis

Solopova, Ana

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: 2017

Link to publication in University of Groningen/UMCG research database

Citation for published version (APA): Solopova, A. (2017). Metabolic shifts in Lactococcus lactis: Regulation, evolution and phenotypic heterogeneity [Groningen]: University of Groningen

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).

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.

# Metabolic shifts in *Lactococcus lactis*:

regulation, evolution and phenotypic heterogeneity

The work described in this thesis was carried out in the Molecular Genetics group of the Groningen Biomolecular Sciences and Biotechnology Institute, Faculty of Science and Engineering, University of Groningen, The Netherlands. This research was supported by the Dutch Technology Foundation STW, which is part of the Netherlands Organisation for Scientific Research (NWO).

Printing of this thesis was financially supported by the Graduate School of Science and the University of Groningen.

Cover: "Reflection" by Vida Solopova. Printed by: Ipskamp Drukkers B.V., Enschede, the Netherlands.

ISBN:



# Metabolic shifts in Lactococcus lactis:

regulation, evolution and phenotypic heterogeneity

## PhD thesis

to obtain the degree of PhD at the University of Groningen on the authority of the Rector Magnificus Prof. E. Sterken and in accordance with the decision by the College of Deans.

This thesis will be defended in public on

Friday 13 October 2017 at 12.45 hours

by

## Ana Solopova

born on 3<sup>rd</sup> of October 1985 in Kėdainiai, Lithuania

## Supervisors

Prof. O. P. Kuipers Prof. J. Kok

### Assessment committee

Prof. I. J. van der Klei Prof. L. Dijkhuizen Prof. M. Kleerebezem

# CONTENTS

CHAPTER ONE. General introduction	5
CHAPTER TWO. A specific mutation in the promoter region of the cluster accounts for the appearance of lactose-utilizing <i>Lactoco</i> MG1363	ccus lactis
CHAPTER THREE. Monod revisited: bet-hedging during bacterial di	
<b>CHAPTER FOUR.</b> Experimental evolution of Lac <sup>-</sup> <i>Lactococcus lact</i> into Lac <sup>+</sup> shows profound adjustment of cellular nitrogen metabolism	
CHAPTER FIVE. A broader perspective on galactose utilization in <i>L lactis</i> MG1363	
<b>CHAPTER SIX.</b> Disruption of a transcriptional repressor by an integration leads to the activation of a novel silent cellobiose tran <i>Lactococcus lactis</i> MG1363	nsporter in
CHAPTER SEVEN. Regulation of cell wall plasticity by nucleotide met Lactococcus lactis	
CHAPTER EIGHT. Benchmarking various green fluorescent protein in <i>Bacillus subtilis, Streptococcus pneumoniae</i> , and <i>Lactococcus lactis</i> imaging	for live cell
CHAPTER NINE. Summary and general discussion	
NEDERLANDSE SAMENVATTING	
ACKNOWLEDGEMENTS	
PUBLICATIONS	