

Method for improving *Streptococcus thermophilus* strains for dairy production

Improving dairy strains

Identification

Key words	Streptococcus thermophilus, natural transformation, competence state, DNA, peptide, dairy
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Completed by	INRA - IATE

How does it work?

Primary objective	To improve the properties of <i>Streptococcus thermophilus</i> strains used as culture starter in dairy production
Working principle	<p>Dairy manufacturers are always looking for <i>Streptococcus thermophilus</i> strains with new properties for improving the yoghurt and cheese production. The worldwide dairy market makes these <i>S. thermophilus</i> starter strains of a major economic importance.</p> <p>Bacteria such as <i>S. thermophilus</i> are normally under a basic physiological state. Sometimes, they are under a specific physiological state, under which bacteria can transfer DNA with other bacteria. This state, which is called "competence state", only occurs after a specific biological signal; this phenomenon is the induction. Natural transformation is the transfer of DNA from a donor bacterium to a receptor bacterium, which is under a "competence state". This transfer, which is partial and can only occur between a few bacterial species, makes the donor bacteria gain stable and transmissible new genetic characteristics. The present method favours the natural transformation of <i>S. thermophilus</i> strains by inducing the required competence state. In a chemically defined, peptide-free culture medium, and at a particular moment of the cellular cycle, a specific peptide is used as a signal that makes the bacteria switch from basic state to competence state. The DNA transfer can then occur, giving modified properties (e.g. improved acidification rate, texture production, phage resistance, etc.) to the <i>S. thermophilus</i> strain. (1)(2) The method can work on strains that are naturally poorly or non competent (2)</p>

Images

Additional effects

Important process parameters

Chemical composition of the culture medium
Phase of the cellular cycle (short moment during the exponential growth phase)
Properties of the DNA donor (1)(2)

Important product parameters

What can it be used for?

Products	Dairy products
Operations	Dairy production
Solutions for short comings	Dairy strains with improved properties

What can it NOT be used for?

Products	Any other than dairy products Any other than Streptococcus thermophilus strains
Operations	Any other than dairy production
Other limitations	To be transferred from one strain to another, the properties must be encoded by a limited number of loci on the chromosome of S. thermophilus (not any property can be obtained using this method)
Risks or hazards	This technology is DNA transfer, but this transfer phenomenon occurs naturally. Moreover, the DNA that is transferred must be chromosomal DNA or plasmid DNA from S. thermophilus or a PCR product amplified from chromosomal DNA or plasmid DNA from S. thermophiles.

Implementation

Maturity	The technology has been patented with a worldwide application, but still at lab-scale (2)
Modularity /Implementation	Once upscaled for industrial application, the transformation batch could be set up in addition to the existing dairy production line.
Consumer aspects	Potential reluctance to consume products that could be interpreted as coming from GMO use.
Legal aspects	Please check local legislation
Environmental aspects	No problem is to be expected if DNA is transferred from one S. thermophilus strain to another S. thermophilus strain.

Facilities that might be interesting for you

Further Information

Institutes	INRA - MICALIS
Companies	INRA Transfert
References	<ol style="list-style-type: none">Gardan R, Besset C, Guillot A, Gitton C, Monnet V, 2009 The oligopeptide transport system is essential for the development of natural competence in Streptococcus thermophilus strain LMD-9. J Bacteriol. Jul;191(14):4647-55. Epub 2009 May 15.Gardan, R. & Monnet, V., 2010 New competence stimulating peptide. WO2010125091, US2012040365, EP2248823

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