# Fight or flight:
# Improving starter culture production and functionality

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## Background

Lactic acid bacteria (LAB) are widely used in starter cultures to make fermented dairy products, such as cheese and yoghurt. In these fermentations, LAB produce lactic acid causing acidification of the fermented product, thereby prolonging its shelf life. However, during the production of these starter cultures the lactic acid inhibits bacterial growth despite control of the pH, decreasing biomass productivity, titer and yield.

## Objective

To explore novel methods that can improve starter culture production of LAB and their functionality. Using these methods, we aim for an increased biomass yield and cell concentration, enhanced starter functionality (e.g. faster acidification and/or better aroma formation) and enhanced stress resistance. Moreover, this research aims to identify the mechanism by which lactic acid inhibits growth of LAB at neutral pH.

## Methods

Novel methods focus on 2 strategies:

- Fight: improve LAB resistance to lactic acid

  or

- Flight: reduce lactic acid level in fermentation

### 1. Cell recycling cultivation

With cell recycling cultivation, high biomass concentrations and productivities can be obtained, while using lower nutrient concentrations in the medium and thus with lower lactic acid concentrations and less product inhibition.

### 2. Alkaline fermentations

At high pH, more lactic acid is in its dissociated form, thereby minimizing passive diffusion and growth inhibition by lactic acid.

### 3. Adaptive evolution

Adaptive evolution at high lactic acid concentrations at neutral pH could improve the lactic acid resistance of LAB allowing them to grow to higher lactic acid concentrations.

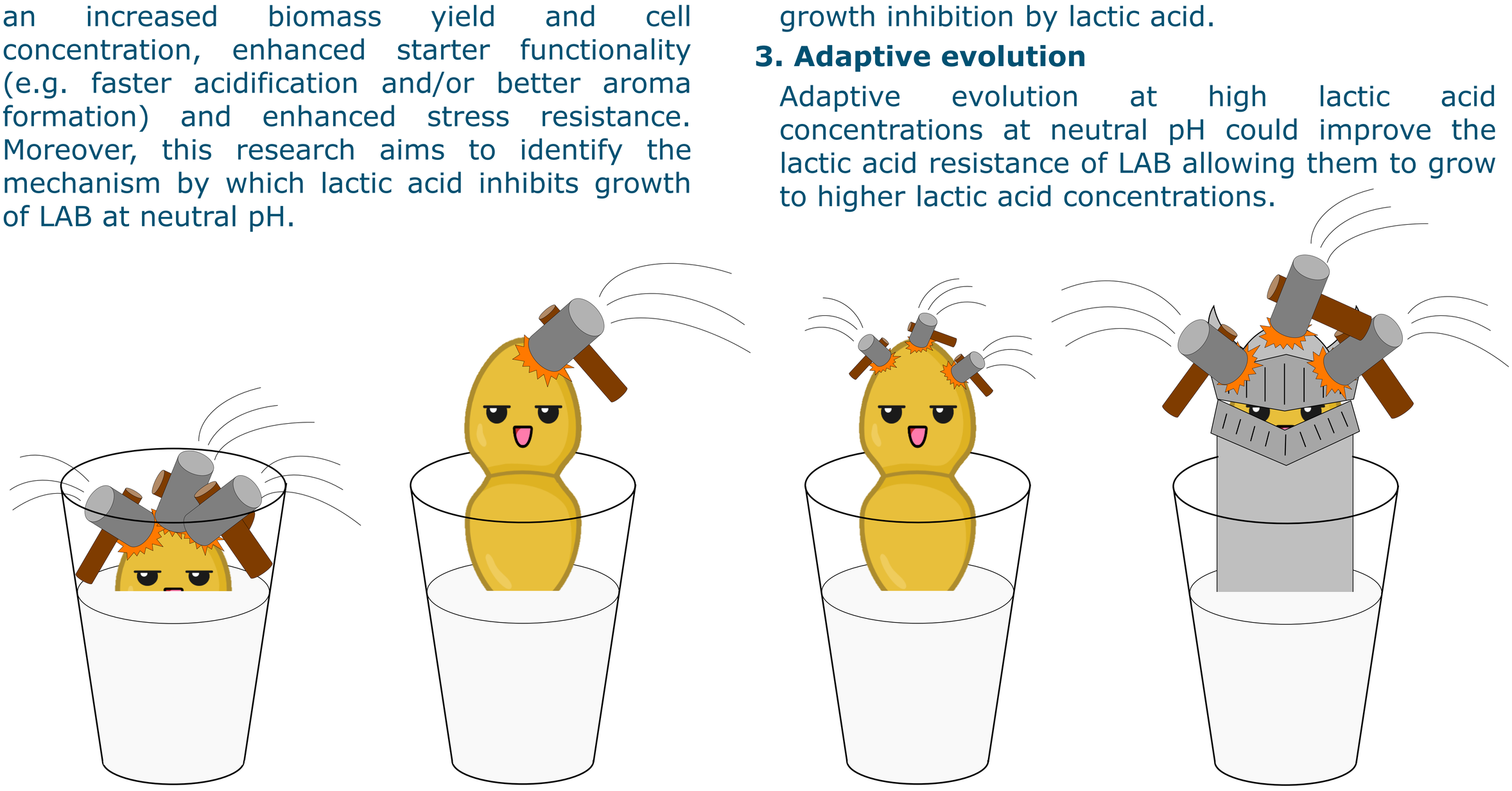

**Figure 1:** Overview of the project *fight or flight*.
From left to right: 1) inhibition by lactic acid in the current process; 2) lowering inhibition by decreasing total lactic acid using cell recycling; 3) lowering inhibition by decreasing undissociated lactic acid using alkaline fermentations; 4) improving lactic acid resistance of LAB using adaptive evolution.

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