Lactobacillus helveticus—A brief overview of thermophilic lactic acid bacteria

Abstract

Generally Lactobacillus helveticus is an obligately homofermentative lactic acid bacterium that is widely used as a starter culture to manufacture set type yoghurt and certain cheeses and also as a flavor enhancing adjunct culture for some cheese types. This review usage possibilities of Lb. helveticus will be revised shortly.

Keywords: low fat cheese, ACE inhibitor, Autolysis, cheese flavor, S layer

Introduction

Raw material-associated lactic acid bacteria (LAB) have an essential role in the nutritious and organoleptic properties of fermented milk production. Lb. helveticus is a lactic-acid producing, rod shaped bacterium of the genus Lactobacillus. It is most commonly used in the production of Swiss type cheese, aged Italian and Emmental cheese. In Emmental cheese production Lb. helveticus is used in conjunction with a Propionibacter culture, which is responsible for “eyes” through production of carbon dioxide gas. Lb. helveticus has been shown to possess strong proteolytic activity in milk starter media. Lb. helveticus grows optimimatum pH 5.5 to 5.8 and 42 to 45°C. Surface layer proteins constitute the outermost structure of the cell envelope, which is an array of single non-covalently bound proteins. The biological functions of surface layer proteins are cell protection, determination of cell shape, molecular and ion trapping, and adhesion to surfaces. Cell adhesion and aggregation is well documented for gut-associated lactobacilli as is their protective role against digestive enzymes and acids. These surface proteins give the cell a hydrophobic character and play a role in specific interactions with intestinal epithelium cells and with other bacteria. Surface layer associated with moonlighting proteins could act as adherence factors. Lb. helveticus T159 has the high capability of adhesion, auto and coaggregation. This protein used to detected in Lb. helveticus strain.

The addition of lactobacilli as an adjunct to the normal starter has been studied by many researchers to increase casein hydrolysis and enhance flavour development during cheese ripening. Fenelon et al. demonstrated that Lb. helveticus strains produce novel flavors and improve the acceptability of reduced fat Cheddar cheese over that of the control cheeses containing only mesophilic starter lactococci in low fat cheeses. This study indicated that the use of Lb. helveticus adjuncts may be important in the manufacture of low-fat cheeses with more acceptable flavor to consumers. The structure of low-fat cheese varied when used Lb. Helveticus (Figure 1).

Use for milk products

Autolysis is the spontaneous disintegration of bacterial cells which results in the liberation of the cytoplasmic content of the cell, including the intracellular enzymes. Release of intracellular enzymes is considered to be highly important during cheese ripening as they play a key role in textural changes and flavour development. The strain Lb. helveticus DPC4571 has emerged as a promising flavor adjunct culture for Cheddar cheese given that it is consistently associated with improved flavor, but autolysis was not enhanced flavor development without high lipolytic and proteolytic activity.

Bacterial autolysis results from the enzymatic degradation of the cell wall pentaglycine by endogenous pentaglycine hydrolases named autolysins and it occurs within and without the cell. It also convert milk peptides and fats into desirable flavor compounds. After the initial breakdown of caseins by rennet, milk endogenous proteases and bacterial cell wall protease, a set of peptidases is able to degrade the resulting peptides into free amino acids. Lb. helveticus DPC4571 is one of the highly autolytic strain and its genome sequence revealed the presence of 8 putative lysin genes including autolysin amidases, enterolysins, and n-acetylaminohydrolases.

Bacteriophage infections represent a serious problem in dairy fermentative processes, Culture rotation programs and direct to vat-
inoculation of starters are longstanding practices to control phage infections in industrial fermentation, whereas similar approaches cannot be applied to undefined cultures. Although it is believed that the richness and heterogeneity of the microbial composition may represent a natural barrier against phage infection problems, phage contamination of undefined starter cultures frequently occurs because they are propagated under non-aerobic conditions, without any control measures.\(^8\) \textit{Lb. helveticus} phages have been isolated from natural whey starters.\(^9\) The presence of active lytic phages attacking \textit{Lb. helveticus} strains in natural whey starters used for production of long-ripened cheeses.\(^10\) LAB produced from bacteriocins which used in fermentation and meat and milk preservation for along time.\(^11\) They are of interest because of their inhibitory activity against food spoilage and food-borne pathogenic bacteria.\(^5\) The main targets of LAB bacteriocins are the cell membrane and cell wall but they can work through many mechanisms to exert an antimicrobial effect.\(^6\) \textit{Lb. helveticus} 481 produces a class III bacteriocin known as helveticin J, which inhibits growth of \textit{Lactobacillus} species.\(^7\)

Angiotensin-converting enzyme (ACE) inhibition leads to a decrease in the level of the vasoconstricting peptide, angiotensin II, and a corresponding increase in the level of the vasodilatory peptide, bradykinin, therefore yielding an overall reduction in blood pressure.\(^12\) Peptides with angiotensin converting enzyme inhibitors (ACE-I) activity have already been isolated from different food proteins.\(^13\) Fermented with \textit{Lb. helveticus} has source of ACE-I peptides.\(^14\) An alternative process has been developed to produce cultured butter without the formation of sour buttermilk. In this process lactose-reduced whey inoculated with \textit{Lb. helveticus} and skim milk inoculated with a starter culture to produce aroma compounds and lactic acid are added to the pasteurized cream. The cream is further churned and worked. The resulting butter is known as sour aromatic butter. Sweet buttermilk is noted high in acidity as sour buttermilk.\(^15\)

**Health benefit**

\textit{Lb. helveticus} has a suite of peptides and proteinases that can degrade milk proteins into discrete peptides. For this reason, \textit{Lb. helveticus} in particular is very effective in the production of bioactive peptides that have possible therapeutic values from milk. Elfahri et al.\(^16\) studied for four highly proteolytic strains of \textit{Lb. helveticus} ability to release antioxidative and anti-colon cancer compounds from skim milk during fermentation for up to 24h at 37°C. \textit{Lb. helveticus} 474 showed the highest free radicals scavenging activity at 12h of fermentation. Arterial stiffness is markedly accelerated in hypertension and it is an independent predictor of coronary heart disease in essential hypertension. Jauhiainen et al.\(^17\) evaluated the 10-week-treatment effect of \textit{Lb. helveticus} fermented milk containing the tripeptides isoleucyl-prolyl-proline and valyl-prolyl-proline on the tripeptides isoleucyl-prolyl-proline and valyl-prolyl-proline on the tripeptides isoleucyl-prolyl-proline and valyl-prolyl-proline on the tripeptides isoleucyl-prolyl-proline and valyl-prolyl-proline on the tripeptides isoleucyl-prolyl-proline and valyl-prolyl-proline on the tripeptides isoleucyl-prolyl-proline and valyl-prolyl-proline on the tripeptides isoleucyl-prolyl-proline and valyl-prolyl-proline on the tripeptides isoleucyl-prolyl-proline and valyl-prolyl-proline on the tripeptides isoleucyl-prolyl-proline and valyl-prolyl-proline on the tripeptides isoleucyl-prolyl-proline and valyl-prolyl-proline on the tripeptides isoleucyl-prolyl-proline and valyl-prolyl-proline on the tripeptides isoleucyl-prolyl-proline and valyl-prolyl-proline.

**Conclusion**

The cheeses containing \textit{Lb. helveticus} accelerated ripening and enhanced flavour. They have high level of lysis. \textit{Lb. helveticus} adjunct cultures not only used for flavour development in cheeses but also they have potential to produce bioactive compounds with antioxidative and anti-cancerogenic activities.

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**Conflict of interest**

The author declares no conflict of interest.

**References**

