Profile of an Emergent Probiotic Bacteria: *Lactobacillus helveticus*

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**Author’s contribution**

The sole author designed, analyzed and interpreted and prepared the manuscript.

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**ABSTRACT**

*Lactobacillus helveticus* is generally found as dominant species in the whey starter culture of many cooked long ripened cheeses, thanks to a perfect adaptation in the dairy environment. Recent bioinformatics studies and phenotypic tests highlighted traits of *Lactobacillus helveticus* in common with those related to gut bacteria. The ability to produce fermented foods with health-promoting properties is also of great importance as it could be exploited to produce new products with added biological value. Moreover, some strains of *Lactobacillus helveticus* are being investigated as probiotic candidates for food products in compliance with the updated EU regulations which are applied on a food label. Any nutritional claim requested by a company is individually evaluated by the competent authority and authorized after substantial scientific evidences.

**Keywords:** Cheese technology; gut adaptation; probiotics; health-promoting.

1. INTRODUCTION

The first strain belonging to the species *Lactobacillus helveticus* was isolated in 1919 from Swiss cheese, Emmental. Within the group of lactic acid bacteria (LAB), it is configured among the obligate homofermenters, with an optimum growth temperature between 42 and
From a metabolic point of view, *Lb. helveticus* is a very exigent species as it requires 14 essential amino acids, but this anabolic deficiency is offset by the evolution of a highly developed proteolytic system, finding ideal conditions to grow in dairy products, rich in protein proteins. Indeed, *Lb. helveticus* represents the dominant population of the natural whey-starter culture used in some cooked and long-aged cheese, such as Emmental, Gruyère, Grana Padano, Parmigiano Reggiano and Provolone, thanks to its ability to rapidly acidify and to resist to low pH values and to the curd heat treatments (53 - 56°C). Furthermore, the strains of *Lb. helveticus* often release a number of enzymes such as proteinases, peptidases, esterases and lipases, which are actively involved in the cheese ripening process, contributing to the flavor and development of aromatic compounds. It is therefore not surprising that different strains have been particularly adapted to a production reality, as a result of the selective pressure imparted by the cheese manufacture technology over the decades [1].

The strain-specific ability to produce bacteriocins also represents a strategy adopted by the species *Lb. helveticus* to successfully compete with the resident microflora. The bacteriocins, such as the helveticin J produced by the strain *Lb. helveticus* 481, are protein molecules that exhibit bactericidal activity against closely related species at the taxonomic level [2]. A problematic aspect that threatens the dairy sector is the ubiquitous presence of virulent bacteriophages, which cause starter infections with the risk of delaying or even fail the fermentation process. Consequently, to avoid uneconomical loss of productivity or alterations in product quality, the recent findings on phage-host interactions in *Lb. helveticus* can provide important solutions in the control of bacteriophages [3,4].

2. HABITAT AND BIODIVERSITY

LAB occupies different ecological niches, from food (dairy products, wine and some fermented vegetables) to very heterogeneous environments such as the soil and the gastrointestinal tract [5]. Microbial species such as *Lactobacillus plantarum* and *Lactobacillus salivarius*, are defined as multi-niches as they have rather elaborate regulation and transport systems, such as to allow them a remarkable ability to adapt to various environments. Among those, *Lb. helveticus*, *Streptococcus thermophilus* and

Fig. 1. Viable cells of *Lb. helveticus* detected by fluorescent microscope
*Lb. delbrueckii bulgaricus* found a perfect habitat in milk and dairy products, providing all the essential nutrients to satisfy their protein, carbohydrate and vitamin metabolism. Other species, such as *Lb. acidophilus*, *Lb. rhamnosus* and *Lb. johnsonii*, find ideal conditions of colonization in the intestinal tract. Although *Lb. helveticus* cannot be defined as an intestinal bacterium, it shares 98.4% of genetic identity with the species *Lb. acidophilus*, confirming the presence of biochemical traits having potential probiotic properties [5]. The genomic analysis of *Lb. helveticus* has demonstrated the presence of specific genes generally found for intestinal bacteria, although they are not functional, due to non-sense mutations, deletions and other types of mutations. An example is the bile salt hydrolase (bsh) gene, which was studied in the sequenced genome of the strain *Lb. helveticus* DPC4571, highlighting a frame-shift mutation which renders inactive the gene [6]. The bsh activity is a necessary requirement for a probiotic bacterium, to ensure the survival of the strain in the gastrointestinal tract. The presence of this ancestral gene in *Lb. helveticus* DPC4571 supports the hypothesis that it has only recently lost this function [7]. Nonetheless, the remarkable biodiversity demonstrated [8] and the discovery of several conserved genes, similar to other properly intestinal lactobacilli [9] suggests the usefulness to explore natural biotypes with probiotic potentialities.

Apart from the intestinal tract, the ability of some strains to adhere to other epithelial tissues has also been demonstrated. For example, *Lb. helveticus* KS300 was able to colonize the hypopharynx, competing effectively against the adhesion of *Streptococcus pyogenes* (etiologic agent of oropharynx infections) as well as inhibiting the adhesion of pathogens like *Gardnerella vaginalis*, *Prevotella bivia*, *uropathogenic E. coli* (UPEC) and *Salmonella typhimurium* [9].

### 3. HEALTH RELATED PROPERTIES

The safe use in the food field of *Lb. helveticus* is allowed since it has a long history of use without any side effects; it is sensitive to most antibiotics and has no acquired resistance genes. For these reasons, it was recognized with the GRAS (Generally Recognized as Safe) and QPS (Qualified Presumption of Safety) status, issued by the EFSA (European Food Safety Authority). Several studies have shown the ability of numerous strains of *Lb. helveticus* to exert antagonistic effects against pathogens, proving to be a valid alternative in place of the use of antibiotics in case of specific infections [10]. The defense properties shown by *Lb. helveticus* are not limited to the capacity to produce organic acids, hydrogen peroxide and other antimicrobial substances, but some strains can also stimulate the host's immune system, even at the system level [11]. Moreover, it was observed that the administration of a product containing only the metabolites produced by fermentation carried out by a probiotic strain, defined as "post-biotic", the therapeutic effect becomes safer and more effective, especially in cases of subjects with acute intestinal infections [12].

The ability to be highly proteolytic increases the chance to release bioactive peptides during the fermentation conducted by some *Lb. Helveticus* strains. This is an aspect deeply investigated by the Research & Development groups of research institutes and industry, since it could offer an important nutraceutical value. In fact, fermented beverages from *Lb. helveticus* CP790 based on milk, such as the Scandinavian Evo (produced by the Finnish company Valio Ltd) and the Japanese Calpis (produced by Calpis Co. Ltd., Tokyo), are two first examples of functional foods containing bioactive peptides (Val-Val-Pro and Ile-Pro-Pro) with ACE-inhibitory effects, capable of significantly containing arterial hypertension [13]. The consumption of milk fermented by *Lb. helveticus* CM4 has demonstrated evident improvements in dermatitis induced in mouse models [14] whereas the use of *Lb. helveticus* R0052, in association with *Bifidobacterium longum* R0175, enabled to reduce the depressive symptoms and a better recovery of intestinal functions in mice that had been induced myocardial infarction [15].

Other health related properties ascribed to some strains of *Lb. helveticus* are the ability to reduce the toxicity of molecules present in products of animal origin, such as aromatic heterocyclic amines [16] and to degrade the presence of allergens in propolis, such as the esters of caffeic acid and cinnamic acid [17].

### 4. BENEFITS AND REGULATORY LIMITATIONS

In the last years, many LAB strains have been defined as probiotics, promoting the ability to
exert their beneficial effects to the intestinal microbial flora. Benefits were related to the enhancement of the population of bacteria considered useful to the body (release of enzymes helping digestion) or preventing the adhesion and multiplication of pathogens in the intestinal mucosa. Further beneficial effects can also be indirect, through the enrichment in the intestinal lumen of secondary metabolites having antimicrobial, immunomodulatory, anti-inflammatory or antihypertensive activity, deriving from both live and inactivated cells.

Probiotic bacteria sold by pharmaceutical industries continue to be a globally accepted integrative product. Differently, a more controversial approach have recently affected food industries selling products with probiotics, due to the recent restrictions imposed by the European Community regarding the nutritional and health claims promoted on the label [18]. Indeed, about the use of the term probiotic in food products, the European Food Safety Authority (EFSA) has recently expressed a scientific report establishing that the action of a probiotic must have a concomitant decrease in potentially pathogenic microorganisms [19] in addition to satisfy all other prerequisites and documentation about colonization capacity at the intestinal level.

Therefore, the traditional indication of "probiotic product" which positively impacts on the intestinal micro flora is no longer authorized within the European market, unless the link between the consumption of the product and the claimed probiotic benefits is demonstrated on a large number of human volunteers, according to rigorous experimental tests with a statistical significance. Similarly, the possibility to indicate any health claim on the label of a food product shall satisfy the opinion of a group of EFSA experts, called to assess, on a case-by-case basis, all the scientific requirements and documentation necessary to support the health claim. Examples of companies that require approval of a particular benefit for their product and that are favorably evaluated by the group of experts are published in the EFSA Journal to provide guidance to applicants about the substantiation of the relationship between consumption of the product and the effect exerted. Likewise, negatively evaluated examples are also published to illustrate the shortcomings that prevented acceptance of requests, based on the demonstrations and documents provided [20,21,22].

5. CONCLUSIONS

*Lb helveticus* is one of the LAB species that is presently investigated by researchers and potential producers, thanks to the increasing therapeutic potentials reported in literature. More documents and experiments are being carried out to determine the real benefits provided by specific strain of this species, especially extending the studies *in vivo*. Thereafter, if a health property is identified, it is necessary to demonstrate the positive effect also from the consumption of the probiotic-like product. The restrictive trend adopted by EFSA addresses greater guarantees to consumers towards a transparent choice of products and with reliable information. The aim is to limit the use (sometimes abuse) of apparent beneficial, therapeutic or preventive effects promoted on the label, of a myriad of products launched in the market in the recent years. Besides the need to fill any regulatory gap, it is still important to explore the potential probiotic ability and health-promoting properties shown by some strains of *Lb. helveticus* to offer a valid alternative in the market.

COMPETING INTERESTS

Author has declared that no competing interests exist.

REFERENCES


22. EFSA Panel. Low-fat fermented milk with a combination of fructooli-gosaccharides and live *Lactobacillus rhamnosus* GG (ATCC 53103), *Streptococcus thermophilus* (Z57) and *Lactobacillus bulgaricus* (LB2), and defence against reactivation of *Herpes simplex* virus in the orolabial epithelia: Evaluation of a health claim pursuant to Article 13(5) of Regulation (EC) No 1924/2006. EFSA Journal. 2016;14. DOI: 10.2903/j.efsa.2016.4538

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