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Metabolic strategies boosting survival and functionality of beneficial lactic acid bacteria

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Statement of the problem: Lactic acid bacteria (LAB) are used as starter and adjunct cultures in the production of many fermented and functional foods, and as probiotics in different pharmaceutical preparations. In some LAB (mainly *Lactococcus lactis*, *Lactobacillus casei*, *L. plantarum*) the shift from anaerobic fermentative metabolism to aerobic respiration may result in several physiological advantages, including increase in biomass, production of ROS-scavenging enzymes and robustness to stresses. Aerobic cultivation, moreover, alters the central carbon metabolism, re-routing pyruvate away from lactate (homofermentative LAB) or from lactate and ethanol (heterofermentative LAB), and others metabolites (e.g. acetate, acetoine, diacetyl) may be accumulated.

Methodology and Theoretical Orientation: Our group studied the aerobic and respiratory metabolism of some beneficial lactobacilli (mainly in *L. casei* and *L. plantarum*) through physiological, metabolic, transcriptomic and proteomic approaches.

Findings: Respirative phenotypes had improved antioxidant capabilities, catalase activities, survival to oxidative, long-term starvation and freeze-drying stresses compared to anaerobically growing cells. Aerobic and respiratory growth significantly affected the production of organic acids and volatile organic compounds in *Lactobacillus* strains. Changes in proteome and genes expression were principally related to proteins involved in energy and carbon metabolism and stress response. Respirative *L. casei* strains improved the quality of different fermented foods (e.g. sourdoughs, Cheddar-type cheeses, i.e. prevention of oxidative processes and production of desirable aroma compounds) and were used for the production of diacetyl, acetoine and starter biomass from cheese whey permeate (dairy waste utilisation).

Conclusion and Significance: Aerobic respiration may be industrially exploited to develop more competitive and functional starter and/or probiotic cultures.