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## **Antimicrobial and immune modulating metabolites from Lactic Acid Bacteria**

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Lactic acid bacteria (LAB) are an underexplored source of nutraceuticals. Among these, almost every class of biochemical compounds are synthesized, the best known being exopolysaccharides (EPS), short-chain fatty acids (SCFA), conjugated linoleic acids (CLA), amino acid derivatives, bacteriocins, antimicrobial and immune regulating peptides, selenoproteins and moonlight proteins.

Recently, probiotic-derived nutraceutical compounds have been classified as post-biotics and para-biotics. Post-biotics are all the molecules that are released into the external environment, such as bacteriocins, acids, hormones, peptides, whereas para-biotics (exopolysaccharides, moonlighting proteins) are molecules exposed on the cell surface that can induce an immune response.

As far as infections are concerned, probiotic LAB can decrypt antimicrobial peptides (AMP) and immune stimulating peptides from diet-derived proteins thus indirectly controlling

microbial and viral populations at the gut level. Furthermore, *L.reuteri* can synthesize a non-canonical bacteriocin called Reuterin, which exerts its antimicrobial activity both by inducing oxidative stress in the target cells and by conversion into the toxic compound acrolein, thus displaying a spectrum of activity extended to fungi and viruses. EPS can contribute to control infection since they display immune-stimulating properties due both to their binding to toll-like receptors (TLR) on immune cells and to their prebiotic activity, promoting gut microbiota growth and diversity and, therefore, indirect immune activation. An additional immune-modulating effect is exerted by LAB-secreted selenoproteins and GABA. The production of the latter can be enhanced by supplying the precursor amino acid glutamate. Finally, several secreted moonlight proteins induced by growth in particular conditions (i.e. abundance of 5HT) can contribute to stimulate immunity and anti-infective responses.

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