From Pharma to Beauty

Bacterial lysates hold many possibilities, including protection against diseases as they can act as an immune stimulant and reinforce the body’s natural barriers. Thus, they can be used in many applications, from pharmaceutical to cosmetic.

We are surrounded by microbes: in the air we breathe, our environment, and our body itself, which harbours billions of microbes in our gut, skin, eyes, urinary tract, etc. They interact with the body’s main functions and particularly its natural defences. Back in the 1970s, doctors had the idea to use parts of microbes (bacterial lysates) to stimulate immune defences. These mixtures of inactivated pathogenic bacteria were able to protect the body by stimulating both types of immune response: acquired and innate. Today, as people are looking for holistic approaches to protect their health, bacterial lysates have gained renewed interest. Their modes of actions are better understood as they have the ability to stimulate the immune defences, but also to reduce inflammatory reactions when the immune system is overloaded. Thus, their scope of applications has grown and they can currently be used in various areas: as drugs for the prevention of respiratory infections, but also in dermo-cosmetic applications.

What Are Bacterial Lysates?

Bacterial lysates are mixtures of inactivated, killed bacteria that may contain all the components of the bacteria cells (soluble and insoluble). In drug applications, bacterial lysates may be derived from inactivated pathogenic bacteria; the principle is to trigger immune surveillance thanks to the antigens derived from the bacteria and to up-regulate immune defences to prevent and help fight infections. In other cases, such as certain cosmetic applications, the bacteria used may be commensal or bacteria selected from the environment.

In the case of immunostimulant drugs, polyvalent bacterial lysates are prepared from different species of bacteria. Each strain is grown independently in fermenters, harvested, then inactivated by heat, and lysed using either mechanical or chemical lysis. Chemical lysates are obtained by the action of chemical alkaline substances that may denature the antigenic structures. Mechanical bacterial lysates are obtained by high pressure, which preserves the particulate antigens. This is of importance as the preservation of the antigenic structure warrantees a stronger immune response. After lyophilisation, the different lysates are mixed in fixed proportions, and formulated into finished products (sub-lingual tablets, capsules, sachets, and so on).

Immunomodulation

Bacterial lysates have proven to be effective in the prevention and management of various infections thanks to their immunomodulation potential.

Prevention of Respiratory Infection

Based on the WHO data, respiratory infections represent the third leading cause of deaths worldwide, and infections of the upper respiratory remain the major cause of general medicine consultations. The prevention of bacterial or viral infections of the upper and lower respiratory tract represents the most documented area of applications for bacterial lysates (1). A meta-analysis compiling the data of 15 controlled clinical trials concluded that polyvalent mechanical bacterial lysates based on common respiratory tract pathogens (13 different strains) is effective in preventing respiratory tract infections in both children and adults (2). Acute respiratory infections are responsible for the largest number of antibiotic prescriptions. In an environment where antibiotic resistance is on the rise,
the application of bacterial lysates is promising, showing a reduction of antibiotic usage with bacterial lysates.

Management of Chronic Respiratory Diseases

Chronic disorders such as chronic obstructive pulmonary disease (COPD), allergies, or asthma are a real burden for many patients and families (3). For instance, COPD concerns 4-10% of the European adult population. Bacterial lysates have shown benefits in their management:

- Many clinical trials have been conducted in COPD patients, and bacterial lysates were demonstrated to lower the frequency and number of acute exacerbations, translated into reduced hospitalisations and need for medications (2). A clinical trial published in 2015 indicates a 2.5-fold reduction of the number of days of hospitalisation in COPD patients (4).
- People suffering from allergic rhinitis could also benefit from bacterial lysates, with a marked reduction of symptoms reported in the majority of patients (5).
- In asthmatic children, bacterial lysates decrease the frequency of inflammatory episodes (ie wheezing exacerbations).

Prevention of Atopic Dermatitis

Atopic dermatitis (AD) is a multifactorial, chronic skin inflammatory disorder. Its prevalence has doubled or tripled in industrialised countries during the past 30 years. A close link exists between AD in infants and the development of asthma and allergic rhinitis through what scientists have called the 'atopic march', which appears to be mediated through the overproduction of a particular molecule by barrier-defective skin (6). Hence, it appears that early preventive treatment of skin-barrier defects in AD-prone patients may be a key strategy to prevent the progression from eczema to asthma (7).

Atopic disorders are often linked to the lack of microbial stimulation in our over-sterilised environments. It has been reported that young children living in farm environment, with continuous exposure to animals and thus microbial compounds, were less prone to atopy. Hence, the use of bacterial lysates to ‘educate’ a child’s immune system could be an interesting approach. A clinical study has shown that, in infants with hereditary risk of AD, bacterial lysates could help prevent the development of the condition (8).

Skin Care Applications

After the digestive tract, the skin harbours the largest microbiota: each cm² of skin is home to 10⁴ to 10⁶ bacteria. Today, we know that the more diverse the skin microbiota, the healthier the skin. Changes in the skin microbiome, due to environmental or individual stress factors, have been associated with certain skin conditions such as eczema, allergies, acne, dermatitis, or dandruff (9).

Acne

Acne is multifactorial, but studies have shown a link with the skin microflora, in particular the role of Propionibacterium acnes and Staphylococcus. Current antibiotic treatments are increasingly questioned due to the development of antibiotic resistance. Certain researchers in particular have shown an increased resistance of Staphylococi to macrolides (erythromycin). Trial with topical application of Lactobacillus plantarum bacterial lysates has shown reduction of erythema, acne lesion size, and improved skin barrier in patients with acne (10). In another trial with commensal bacterial lysates, a significant reduction in inflammatory lesions was also reported, indicating a potential for alternatives to topical antibiotics for treating acne (11).

Atopic Dermatitis Management

The skin microbiome has shown to differ between AD and healthy subjects, but also between affected and unaffected skin for the same patient, with evolution over time, indicating that skin dysbiosis is associated with AD. In particular, Staphylococcus aureus is linked with AD lesions. A study with lysate from a bacteria found in spa water (Vitreoscilla filiformis) shows a significant improvement of AD, a reduced S aureus colonisation of the skin, and improved skin barrier function (12). A recent study has shown that the topical application of a lotion containing heat-treated commensal bacteria (Lactobacillus johnsonii) for three weeks in AD patients also showed a reduction in S aureus skin colonisation, associated with local clinical improvement (improved SCORAD) (13). In this study, high baseline skin concentrations of S aureus were associated with good responses to the lotion, suggesting a great interest of this approach for patients with high levels of S aureus colonisation. The prevalence of S aureus colonisation has been found to increase with disease severity.

Cosmetic Potential

Positive trials have also been conducted with commensal bacterial lysate preparations to reduce sensitive and dry or reactive skin (sensitive to physical or chemical stresses and characterised by impaired skin barrier).
For example, a cream containing lysate of a *Bifidobacterium longum* SP in volunteers with reactive skin showed, after a two-month trial, a significant decrease in skin sensitivity and dryness, linked with an improved skin barrier function, when compared with placebo cream (14).

### How Do They Work?

Researchers have shown that bacterial lysates have the ability to stimulate both the specific and nonspecific immune response through several mechanisms. For example, they are able to induce dendritic cells maturation. Dendritic cells are sentinels of the immune system that play a key role as a link between nonspecific and specific immune response and act as the first element in the immune cascade. Bacterial lysates also have the ability to induce the production of specific antibodies in the mucosal lining.

In skin applications, the potential mechanisms of action involve local immune-stimulating and antimicrobial mechanisms, as well as improvement of the skin barrier function. One of the mechanisms suggested is the reinforcement of the link that holds two epidermal cells together or tight junctions (15). Another mechanism suggested is the presence of bioactive compounds (16).

### Great Potential

As the microbial world is extremely diverse and intimately linked with us, it appears as a natural, untapped source of bioactive compounds that can be captured as bacterial lysates. Depending on the bacterial or association of bacteria used, bacterial lysates can offer many possibilities, first of all as immune stimulant, but also to reinforce the body’s natural barriers. Protection is always better than a cure. This is why bacterial lysates have a huge potential from pharmaceutical to cosmetic applications in a context of antibiotic use reduction.

### References

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