

The background is a dark teal color with a repeating pattern of white line-art icons. These icons include various biological and industrial elements: microorganisms (bacteria, viruses, fungi), food items (lemons, mushrooms, wine glasses, bread), and industrial components (bags, jugs, cubes, leaves). There are also solid-colored shapes: a purple rounded rectangle in the top-left, a purple rounded square in the center, and a large green rounded rectangle in the bottom-right.

# Biosolutions Glossary

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As the world continues to evolve, the rapid pace of change brings forth unprecedented challenges. Climate change, biodiversity loss, pollution, and the depletion of natural resources are pressing issues that demand innovative approaches. Our traditional methods and regulations fall short in addressing these complex issues, necessitating a shift towards more sustainable and eco-friendly solutions.

These solutions already exist: Biosolutions. They are based on natural principles that we have used for thousands of years, and today they offer a promising path forward. To navigate this rapidly emerging field the European Biosolutions Coalition offers this glossary, which aims to provide clarity and helpful navigation, through what is otherwise uncharted territory for European regulation.

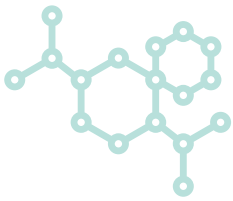
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## ALGAE

Algae are a diverse group of simple photosynthetic organisms. They are predominantly found in marine and freshwater ecosystems. They range from microscopic and single-celled forms to large varieties such as seaweed and kelp. In the ecosystem they produce oxygen and function as an important food source for marine animals such as fish and mussels, thus helping to sustain life on Earth.



## BETA-LACTOGLOBULIN

Beta-lactoglobulin is the primary component in whey protein and accounts for 10% of the total milk proteins. Beta-lactoglobulin is rich in essential amino acids and sizeable amounts of branched-chain amino acids; all of which are important for building and maintaining muscle mass. Today it is already used in food such as ice cream, chocolate, or protein bars and protein powder.



## BACTERIA

Bacteria are living single-celled microorganisms that we are unable to see with our naked eyes. They are enormously diverse and are found literally everywhere on Earth: in the ground, in our homes, on plants, and in and on our bodies. They are essential for how our ecosystems survive and thrive. Bacteria are some of the oldest life forms on Earth, and they have consequently evolved to function in a multitude of diverse ways.



## BIODEGRADATION

The biodegradation process is the natural breakdown of organic matter by microorganisms such as bacteria and yeast. Organic matter is broken down into different substances including CO<sub>2</sub>, other carbon compounds, and water. If left in nature, such materials will naturally decompose and dissolve, unlike current materials like plastic, that does not perish, since nature has not yet evolved a way to deal with fossil-based plastics. Many modern bio-based products, like “green” plastic, are bio-based products that will decompose naturally through biodegradation.



## BIOFOUNDRIES

Biofoundries, allow biomanufacturing to meet automation and data-driven technology. They are facilities that can help design and optimize efficient production of biosolution products at a large scale by allowing for precise cell design and fast production of proteins.



## BIOMANUFACTURING

Biomanufacturing is the use of biological mechanisms, typically via microorganisms such as bacteria, yeast, or algae, to produce or create products, act as specific tools, or undertake biological processes at an industrial scale. Biomanufacturing can either use biological processes to create desired products or biological materials.



## BIO-PHEROMONES

Pheromones are natural chemicals that act like hormones outside our bodies, sending signals to other individuals. Pheromones are probably best known as sex hormones, typically used to attract mating partners, and used by humans and insects alike. Pheromones can be produced using biomanufacturing (bio-pheromones) and used as bio-pesticides. When using (bio-)pheromones in traps, they can confuse and attract specific insects, disrupt mating and insect propagation, and thereby prevent damage to crop yields while preserving biodiversity. Bio-pheromones and other bio-pesticides are sustainable alternatives to traditional chemical pesticides by reducing soil and water pollution, and by targeting insects specifically, unlike current pest management practices.



## BIO-REFINEMENT

Bio-refinement is a method through which biological waste and residual products are refined and turned into valuable products using fermentation and other biomanufacturing processes. This approach mimics traditional petroleum, which are refineries based on chemical engineering processing, by separating the different elements of the biomass into different parts such as high-quality proteins which can subsequently be used in large-scale industrial manufacturing.



## BIOSOLUTIONS

The term “biosolutions” covers goods and services derived from combining biology and technology with the ambition of accelerating the Green Transition. ‘Inspired by nature’ is the principal concept of biosolutions. Through advances in technology, we can combine biology with technology to create biological industrial green solutions, or in short, biosolutions. Biosolutions have been used for thousands of years, such as fermentation processes to produce cheese and bread, but recent advancement in technologies have elevated their potential. Biosolutions leverage the potential of enzymes, microorganisms, bacterial cultures, and biological tools such as fermentation, enabling us to create a more sustainable food system.



## CASEIN

Casein is a common milk protein often used in the fitness and bodybuilding industry as protein supplements. Casein is the protein that coagulates in milk so that it becomes cheese. It contains almost all essential amino acids and many of the branched chain amino acids that humans need.



## BIOPESTICIDES

Pesticides are substances that destroy insects and other harmful infestations in our agriculture and through recent advancements we are now capable of creating pesticides made from biological sources: biopesticides. Their source and pest control mechanisms differ from chemical pesticides. However, their downsides are minor in comparison as they are less toxic to the remaining agricultural environment, is more easily biodegradable, and can target specific pests more precisely. There are different types of biopesticides including microbes, biophheromones, and proteins and genes, introduced into plants by genetic engineering. Most are used as part of an IPM approach [see: Integrated Pest Management].



## CELLULAR AGRICULTURE

Cellular agriculture is the production of animal-based foods directly from cell culture. Cellular agriculture bypasses the animal and its energy needs, and thus requires much less land. Through processes like cell cultivation and precision fermentation we now have the technology to produce products/ingredients molecularly identical to foods, such as dairy or meat, with a much smaller environmental footprint.



## CIRCULAR BIO-BASED ECONOMY

Instead of a linear take-make-waste economy, a circular and biobased economy builds on reusing, repairing, and recycling our existing materials and to rethink the production of everyday goods, allowing us to consume sustainable food, wear green clothing, and produce environmentally friendly materials. Through a circular and bio-based economy, and by using materials made from biological sources in a more sustainable manner, we can separate economic growth from using up limited resources.



## FERMENTATION

Fermentation is when microorganisms, such as bacteria or yeast, break down carbohydrates and organic carbon, like starch or sugar, and thereby convert them into ethanol or CO<sub>2</sub>. It is a process that humans have known and used for multiple purposes, mainly food preservation and production, for thousands of years. Through fermentation we have produced food like bread, preserved milk in the form of yoghurt and cheese, and we have been able to preserve fish and meats. In fact, it has been a core process for human development due to its importance to the world's food chain. Recent advances have made us able to tap into the vast potential of fermentation. Today, we can utilize it to enable a more sustainable food system, as the process allows us to reduce spoilage and waste, increase nutritional value, and prolong shelf life [see: Precision Fermentation].



## ENZYMES

Enzymes are proteins that function as small, biological catalysts increasing the speed of various processes in living organisms, including our bodies. When we consume food, enzymes help us break down the macronutrients and thus digest them. We used the knowledge on digestive enzymes and applied it to detergents, so when we wash our clothes, enzymes in laundry detergent catalyze reactions that help remove stains on fabrics. In fact, without enzymes, everyday chemical reactions would be so slow that organisms simply could not function.



## INTEGRATED PEST MANAGEMENT

Integrated Pest Management (IPM) is an effective and environmentally sensitive approach to pest management that relies on a combination of common-sense practices to solve problems with e.g., insects that harm agriculture. Plant protection products, such as sustainable biopesticides [see: Bio-pheromones], are considered environmentally friendly tools that are part of IPM, which allow farmers to protect their crops while preserving biodiversity. IPM encourages the use of natural pest control mechanisms with the aim to grow healthy crops with the least possible disruption to agroecosystems and least risks to human and environmental health.



## MICROORGANISMS

Microorganisms encompass various kinds of microscopic organisms that are found all around us in the millions. There are multiple kinds of microorganisms and specifically bacteria, yeasts, and algae are used in biosolutions. Their roles differ, yet they often use organic carbon as fuel for their natural processes, such as fermentation. Their processes and outputs are essential for our environment and for human life.



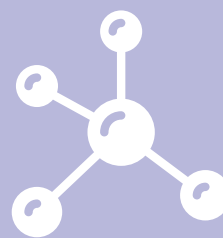
## PRECISION FERMENTATION

When we use microorganisms to produce specific molecules, it is precision fermentation. Bacteria, fungi or yeast cells are used to produce molecules we want such as milk proteins, enzymes, pheromones or flavouring and aroma substances for food. Specific genes encoding these molecules are introduced into the microorganisms and expressed through the fermentation process. Precision fermentation has already revolutionised the pharmaceutical industry. For example, for the last 30 years, insulin has been produced through precision fermentation of yeast by introducing the human insulin gene. Traditionally, this could only be done through extraction from animal pancreases. The potential for precision fermentation is great for the food system and represents an important biosolution. Moreover, the products are identical to the original ones (e.g., milk proteins, pheromones, or flavours), but no animals or plants are involved in their production, hence substantially reducing the environmental footprint.



## NGTs (NEW GENOMIC TECHNIQUES)

New Genomic Techniques (NGTs) encompass recent advances in gene technologies enabling us to alter the genetic composition of, for example, microorganisms, giving them new or improved functions such as the ability to produce high-value molecules including casein, beta-lactoglobulin, specific enzymes, and pheromones. Historically, we have used radioactivity or chemicals to introduce genetic modifications improving our fruits, vegetables, and grains. These processes are very lengthy, taking years to potentially obtain desired traits. Much more is known today about which genes affect which trait, and NGTs allow us to edit genes rapidly and specifically without haphazard and unintended changes to other genes. Thereby, breeders can quickly target a particular function, improving for example taste or climate resilience, or disrupting toxic compounds in plants and crops. All of this happens with greater precision and speed than conventional breeding techniques.



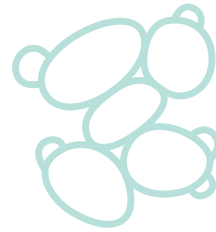
## PROTEIN

Proteins are large biomolecules and macromolecules composed of one or more long chains of amino acid residues. They hold numerous distinct functions in our organisms and are essential components of our very being. The structure, function, and regulation of our bodies are all dependent on proteins, and they have many different roles for us: as antibodies, messengers (hormones), and process catalysts (enzymes). Proteins are also one of the main macronutrients in the food we consume.



## REGULATORY SANDBOXES

Through regulatory sandboxes, businesses are granted an opportunity to develop and test innovations and explore their opportunities and risks. This allows businesses to get their products to market faster, but also supports regulatory learning, as regulatory regimes learn to best guide and aid businesses in their endeavours for a specific set of time. Innovation can often be fast in markets that are either brand-new or technologically advanced.



## YEAST

Yeast is a single-celled microorganism classified as a fungus. There are more than 1,500 species of yeast, the most well-known being baker's yeast (*Saccharomyces cerevisiae*), which has been used for thousands of years to make, for example, bread and beer. As yeast grows it converts its carbon source, typically sugar or starch, into alcohol and carbon dioxide. Yeast can be designed and engineered to be used in precision fermentation for the sustainable production of specific high-value molecules [see: Precision fermentation].



Read more: [EUBIOCOALITION.EU](https://eubiocoalition.eu)

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