

Antibiotic resistance:  
**New threat of infectious  
diseases**

## Regulatory Framework of **Synthetic Biology in Costa Rica**

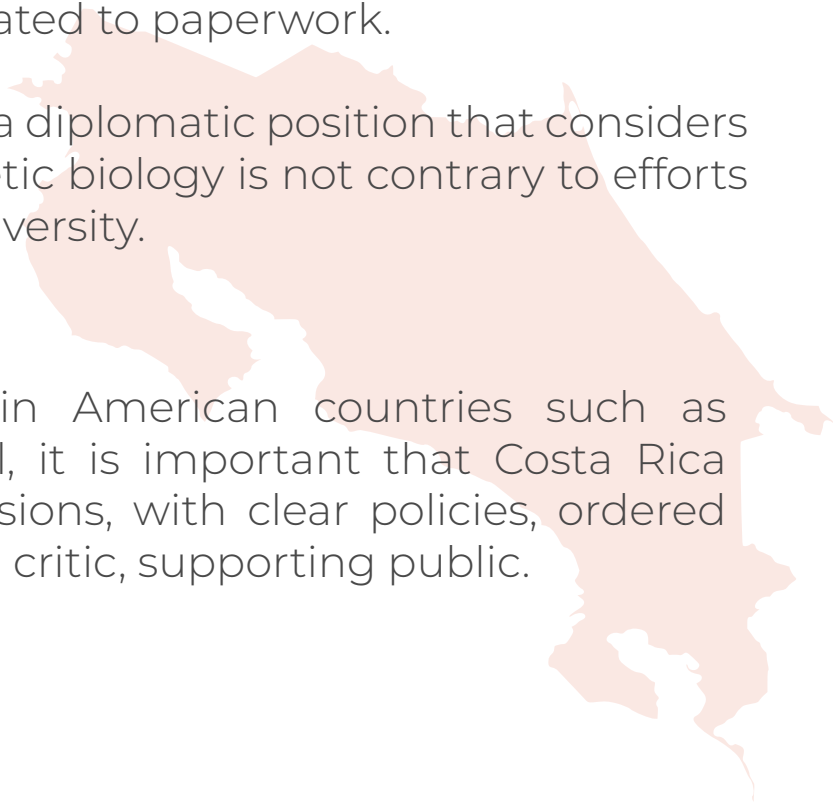
Despite GMO's (Genetically Modified Organisms) not being dangerous, when one is released to the market, it is mandatory to make a risk evaluation before its launch.

Costa Rica has laws and regulations in terms of GMO handling, specially in the areas of human and animal health, agriculture, pharmacy and environmental sciences.

There are problems that inhibit greatly the development of these technologies. Here we pose some possible solutions:

- Organize the administrative functions of each regulatory entity.
- Speed up and simplify the risk evaluation process, and the policies associated to paperwork.
- Clarify and define a diplomatic position that considers supporting synthetic biology is not contrary to efforts in protecting biodiversity.

Same as other Latin American countries such as Argentina and Brazil, it is important that Costa Rica make informed decisions, with clear policies, ordered administration, and a critic, supporting public.



Antibiotic resistance:

## **New threat of infectious diseases**

Antibiotics are highly popular, modern treatments. Their main function is to eliminate harmful bacteria from our bodies, which in certain cases, can cause serious diseases such as tuberculosis or syphilis.

In recent years, due to indiscriminate use of antibiotics, new resistant bacteria have arisen. This represents a threat to humanity, because this basically means new diseases that have no cure.

We emphasize that it is also necessary to develop new methods to attack these “superbacteria” and encourage the good use of antibiotics, in order to avoid further resistance to them.

**Important:** Despite of the antibiotic topic being treated as a hospital only issue, antibiotics are also widely used in agriculture and other production environments.

## Things to look for in **effective treatment of bacterial infections**

This “superbacteria” problem can be mitigated in a relatively easy way, by following these recommendations

- 1 Do not use antibiotics to treat a viral infection:** Antibiotics are designed to kill bacteria, not viruses. Illnesses such as the common cold are not to be treated with antibiotics. Only a doctor should be able to prescribe antibiotics, auto medication is not a safe decision.
- 2 Follow your treatment:** Patients who are receiving antibiotics should stick to their doctor’s instructions and never suspend or extend treatment without consulting. Doing this can contribute to the worsening of the infection and contribute to the resistance issue. Decrease of symptoms does not mean that there is no longer an infection. Also, increasing dosage can lead to serious secondary effects
- 3 Auto medication:** Taking antibiotics without prescription could cause serious illnesses in the future. Accepting or buying these medications can put the patient’s life at risk
- 4 Forget preventive measures:** It is always recommended to keep good hygiene habits, to refrigerate and cook meals properly, and have safe sexual intercourse.

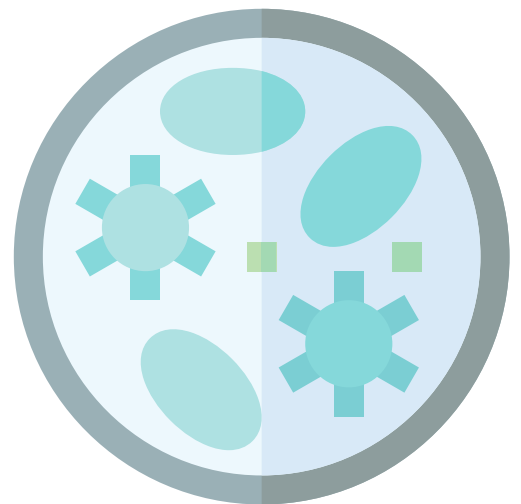
## Examples of **bioengineered probiotics**

- **Zbiotics:** A San Francisco-based company, the first to commercialize a bioengineered probiotic. They produce a microorganism capable of preventing hangover symptoms, by consuming chemicals the body produces as it metabolizes alcohol.
- **SYNB1618:** A bioengineered probiotic that treats Phenylketonuria (a metabolic disorder that prevents people to eat certain amino acids). The FDA assigned this study the category of fast track to run clinical tests, phase they are currently in.
- **Azittra:** They aim to engineer skin-based bacteria. In order to treat cutaneous infections.
- **ActoBio:** A Belgian company which is bioengineering microorganisms used in cheese industry, to create probiotics that can be use as diabetes treatment.

## Probiotics as an **alternative to antibiotics**

According to the WHO, probiotics are living microorganisms that, when administered in adequate amounts, are beneficial to the host's wellbeing.

Nowadays, the tools of synthetic biology are used to endow probiotics with new properties and functions. With this in mind, researchers are developing new probiotics capable of fighting known pathogens and administrate vaccines and medicines. Therefore, bioengineered probiotics are a new hope in the nutrition and health sectors.



# Synthetic **Biology**

There are two major issues:

- 1 The increase of drug resistant bacteria.
- 2 Millions of dollars are being used up in fruitless antibiotic research.

Synthetic Biology offers new technologies and solutions to tackle these two situations, in addition to classical methods.

## **What is Synthetic Biology?**

It is a field that allows scientists to create new solutions to difficult problems posed by nature as we know it.

## **Which problems?**

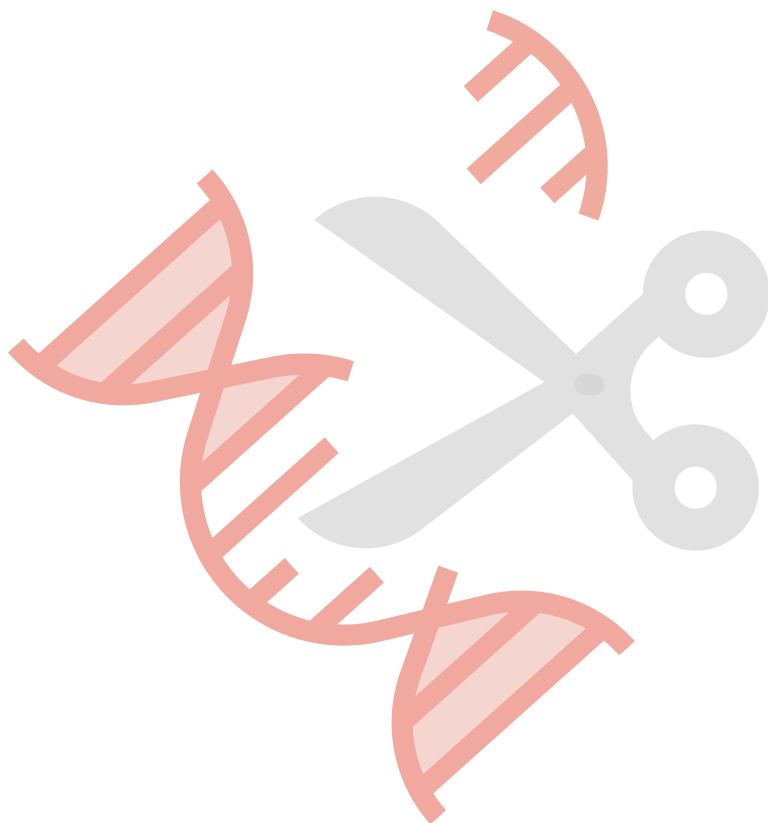
- Excessive pollution coming from industrial and residential areas.
- Oil spillage in rivers and oceans.
- High demand of food products.
- Diseases with no known cures or treatments.
- Among many others...

## How is it employed?

Via the study of different organisms that exist in the world, their properties can be harnessed and combined for our benefit.

Modern technology has allowed scientists to modify and exchange DNA sequences of many organisms, this is, to generate new functions on organisms that improve on previous characteristics, in order to solve problems.

The most employed organisms are bacteria and yeasts, however, many other species can be used, such as plant or human cells. All this to study the behavior of diseases and to produce possible cures and vaccines.





## Applications

### Synthetic Biology

- A revolutionary example is the American company **Bolt Threads**, who developed spider silk that was going to be used in the textile industry. Microsilk™ and Mylo™ are technologies that use fungi and yeasts in the massive manufacturing of leather and cloth. In the first case, yeasts were modified so that they were capable of processing the spider's genetic material and create large amounts of silk without animal cruelty. Mylo™ has bioengineered fungi that mimic leather texture and appearance, so that animals need not to be consumed.
- **Joyn Bio** is a company which, in collaboration with many others, have designed bacteria with the ability to fertilize wheat, corn, and rice fields, successfully substituting nitrogen-rich fertilizers, which are harmful for the land. They use beneficial bacteria for the produce, which have been engineered to optimize nutritional values, and diminish the use of land-based fertilizers.
- **C16 Biosciences** is an American company that has aimed their efforts towards fighting monoculture of palm oil. These practices are especially bad for the environment and are widely applied in countries such as Costa Rica or Indonesia. This company engineered microbes to generate oil from waste coming from agriculture, decreasing the impact of oil palm cultivation, transport, and processing.



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