

iGEM FCB-UANL 2021

FIREFIGHTING FOAM BUSINESS PLAN

BUSINESS PLAN

As part of our two-year project within the iGEM competition, this document was retrieved from the [FCB-UANL's 2020 iGEM team](#). In light of developing a two-year project, slight modifications of the business plan were performed based on the FCB-UANL's 2021 iGEM team experience.

EXECUTIVE SUMMARY

Synbiofoam represents an alternative in the development of foams to mitigate urban and forest fires through key biological components designed for production and fire fighting, based on two main aspects; stabilizing components produced in *Bacillus subtilis* and *Escherichia coli* as well as additional surfactants required for the development of biofoam. The strategies and the approach of the project have enabled us to validate the demands of the potential clients in the market, considering legal, economic, social, environmental, and technical aspects for the employment of our project.

The increased incidence and intensity of urban and forest fires, besides representing a danger for the inhabitants near these places, also threatens the dozens of plant and animal species. Despite different tactics have been used to fight fires, the use of traditional foams partially solves a problem but with a high environmental cost due to the fluorochemical content in the foams, so we focus our attention mainly on the fire fighting foam market and current customers such as the fire department, environmental secretaries and companies with the need for greener certifications.

Developing a biofoam without fluorine and through biotechnology and synthetic biology involves the study of technical and regulatory aspects around the needs of customers, so we have taken into account every recommendation and commentary proposed both by researchers as well as potential customers who would be our target. Additionally, we have analyzed the competition and we are excited to venture into the development of biofoam due to the scarce or non-existent Mexican production of fire fighting foams, depending on foreign products. And although we have not been able to fully access the laboratory this year, the truth is that we have found ways to continue and understand the variables related to the project, among these, first predictions about the behavior of biofoams, production, components needed for development, biological and mathematical models and the impact that could be achieved.

BUSINESS DESCRIPTION

COMPANY DESCRIPTION

Synbiofoam is a company interested in the development and application of an ecological foam for class A and B fires, based on synthetic biology and biotechnology, which can be distributed through the purchase and sale of the product mainly for civil associations as well as companies in the environmental sector.

MISSION DESCRIPTION

Our mission is to develop, apply, and distribute profitable, highly competitive, and environmentally friendly AB firefighting biofoams based on synthetic biology for them to be widely used by civil associations and the private sector.

VISION DESCRIPTION

Our vision is to be one of the leaders in the migration of harmful industrial products towards more environmentally-friendly ones by introducing our product into the market of fire fighting strategies.

VALUES

Our main values will be based on high standards that allow us to cultivate a constant relationship with our customers and society in general, these can be summarized in honesty, due to the process of product development, quality, for the components and certifications needed to be used in real life, passion, for our constant commitment to research, experimentation, and adaptation of new and beneficial results, competitiveness, seeking areas of opportunity, and teamwork, by the intersection of multiple areas of study that make up the team.

VALUE PROPOSITION

Synbiofoam provides the first production line of AB biofoams made by biotechnology and synthetic biology dedicated to indoor fire fighting but with direct application in forests, serving to mitigate fire damage and the gradual consequences of the use of fire extinguishers with foams composed of fluorochemicals. The use of components inspired by a frog species for the generation of foam provides greener certifications in both, the processes and the product, that will be beneficial for businesses or institutions that require to reduce their environmental impact and adopt more ecological strategies for their regular processes, such as fire departments as secretaries of the environment

GOALS AND OBJECTIVES

- Reduce the environmental impact on forests and terrestrial ecosystems that are affected by the fire and the use of fluorochemical foams.
- To produce and commercialize biofoams at a national level, decreasing the cost of companies for purchases abroad of this equipment for fire control.
- Certify the production processes so that they can be recognized for their ecological components and can be integrated into companies and civil associations.
- To contribute to the general understanding of the scope of biotechnology and synthetic biology by providing a safe, accessible, biodegradable, and socially responsible biofoam.
- Standardize processes to achieve greater production efficiency in both development and product.
- Maintain constant research and customer relations to ensure that their needs are being met.

CRITICAL SUCCESS FACTORS

Safety would be one of the most used standards in the development and use of the product, mainly because its use would be related to a risk situation on which human lives can depend, so understanding the needs of our customers around the safety required by the biofoam, as well as the certifications we can obtain to ensure safety, is a critical and important factor in our customer's confidence.

Additionally, the price is important concerning the competition because the acquisition of firefighting equipment represents a mandatory expense for any institution, company, or place to maintain its daily operations, so a second important factor would be the cost-benefit relationship that our customers would obtain with Synbiofoam. Finally, the production and distribution capacity would represent one of the most important determinants due to the existing channels we could use to commercialize the product and to ensure that Synbiofoam's demand can and does meet the customer's requirements.

PRODUCTS AND SERVICES

Based on the product, the application, and its distribution, the following three general points are considered to be revenue-generating

- 1) Retail sale of biofoam to the general public
- 2) Wholesale to distributors and manufacturers
- 3) Licenses for the use of the modified bacteria

REGULATIONS AND CERTIFICATIONS

- 1) Official Mexican Standard NOM-154-SCFI-2005; PROY-NOM-202-SCFI-2017 (Fire fighting equipment) (1,2)
- 2) Mexican regulations under the recommendations of Civil Protection
- 3) National Fire Protection Association (NFPA)

UNIQUE FEATURES AND PROPRIETARY ASPECTS

The production of our biofoam is based on a previous investigation that includes regulation, manufacturing, safety, scalability, and the target market we want to impact. The main point of innovation is focused on research and production, creating early computational models (biological and mathematical), and employing modern biotechnological processes that do not depend on synthetic raw materials, which significantly reduces production costs.

This is reflected in the main compounds, such as surfactant proteins (which decrease the surface tension of the medium and help to generate foam) and stabilizers, which will make it possible to generate biofoam for AB class fire extinguishers, free of fluorochemicals, biodegradable, non-accumulative in the environment and without generating contaminants in its production. This biofoam based on synthetic biology and biotechnology would be the first of its kind, besides being an environmentally friendly alternative because it excludes the use of fluorinated compounds.

Additionally, the process includes the modification of bacteria to obtain the main elements of the foam such as the stabilizing proteins, there is already a biosafety committee that keeps the corresponding norms updated with the regulation, and finally, the bases of the process combine biotechnology and synthetic biology, there is no intellectual property registry with this approach for foams, the closest thing is a process that contemplates the use of microalgae, but nothing of bacterial origin.

MARKET

PROPRIETARY INDUSTRY ANALYSIS OVERVIEW

The global firefighting foam market size was valued at \$856.3 million in 2019 and is anticipated to generate \$1,141.5 million by 2027. The rise in awareness toward the presence of Perfluorooctanesulfonic acid (PFOS) and Per- and polyfluoroalkyl substances (PFAS) in firefighting foam contaminating drinking water sources have led to the introduction of acts and laws that restrict the usage of fluorine-based firefighting foam use. The activities regarding fluorine-free firefighting foam are expected to offer lucrative opportunities for industry growth (3,4).

For fluorine-free firefighting foams, it has been estimated that at least some 7,000 tonnes, but probably as much as around 9,000 tonnes are sold in the EU annually, the main alternatives used are based on hydrocarbon surfactants and detergents. North America firefighting foam market is analyzed across the U.S., Canada, and Mexico. The region holds a significant market share of firefighting foam owing to the presence of big market players in the U.S., and Canada (5).

THE NEED FOR EQUIPMENT

Emerging economies witnessing increasing construction of commercial spaces, such as supermarkets, multiplexes, shopping malls, hypermarkets, real estate, and office buildings, have also triggered the demand for detection and suppression systems to support the government norms and regulations. The European Norm, National Fire Protection Act, and many other local regulations as well as listings, building codes, and approvals by nationally recognized testing laboratories have mandated the construction authorities to equip the infrastructures with adequate fire suppression and detection systems.

REGIONAL MARKET CONTEXT

In Mexico, there are about 32 foam distributors in addition to 3 producers with products based on different components. The search among the different producers shows that they maintain hybrid production processes, among which the use of natural components such as synthetics for the development of the foam stands out (6).

Additionally, those that call themselves biodegradable, present certificates that endorse these titles but do not mention the full impact they generate in the environment because they are not specific to the processes or elements for the development of their products.

Companies like FSPM, represent an attractive business model that has established channels and distributors in the country to market products based on foams free of fluorochemicals, so it will take from this experience, the data of importance for the refinement of the model.

COMPETITORS ANALYSIS

The main competitors are the foam producers that are currently in the Mexican market. Some of the foams are produced traditionally, while others, such as those produced by ColdFire, are also biologically based. Therefore, we plan to join the production process of manufacturers and distributors of firefighting foams with our biodegradable foam. In other words, we are not so much focused on competing directly with them, but rather on proposing an environmentally friendly alternative that can reduce the costs and time needed to produce and distribute the foam.

	Best Option				
	Synbiofoam	Auxquimia	Bioex	Amiran Biochemicals	3F
Biodegradable	✓	✗	✓	✓	✓
Local Product	✓	✗	✗	✗	✗
Free of fluorochemicals	✓	✓	✓	✓	✓
5 years shelf life	✓	✓	✓	✓	✗
Outdoor application	✓	✓	✓	✓	✓
Green manufacturing	✓	✗	✗	✗	✗
Local Customer Service	✓	✗	✓	✗	✓
Easy to use	✓	✗	✗	✗	✗

PRELIMINARY COST PLAN

To estimate the total costs of production, we performed a simulation in the SuperPro Designer program. It enables us to consider several parameters, such as the plant construction costs and operation costs, based on the production diagram elaborated. Based on the analysis by the program, the following results were given.

Economics	
Total Investment	\$24,267,351 USD
Operating Cost	\$4,527,276 USD per year
Total Revenues	\$7,069,280 USD per year
Unit Production Reference Rate	353,464 kg/MP year
Unit Production Cost	\$12.55 USD/kg of biofoam

Project Indexes	
Gross Margin	37.25%
Return on Investment	36.65%
Payback Time	9.36 years

Despite the total investment needed to build the overall production plant exceeds several millions, an initial investment of \$31,794.00 USD can help further develop the product into the initial stages.

MARKET SEGMENTATION

The market can be categorized by the solution to fire detection and suppression. The detection devices led the market in 2018 accounting for 61.6% of the revenue share and are estimated to continue their dominance over the forecast period. Also, legislative requirements including the Building Code of Australia, USA, and National Fire Protection Association have mandated the installation of detection equipment, which is expected to propel the growth of the fire detection industry.

The fire suppression market can be categorized by product into extinguishers and sprinklers. The extinguishers segment accounted for 60.1% of the overall revenue share of the suppression market in 2018. The rise in the number of fire accidents and hazards subject to unsuitable housekeeping standards, poorly maintained electrical circuits, and availability of stock combustible materials including inflammable gases or liquids will drive the segment. Strict government regulations mandating the installation of extinguishers in residential, industrial, commercial, and public areas will further boost the demand.

The extinguishers segment has been further categorized by type into gas, water, dry chemical powder extinguisher. Dry chemical powder extinguishers led the segment in 2018 owing to their relatively low price and high versatility. The ability of the dry chemical powder to extinguish fire across the different applications is anticipated to support segment growth. Increasing popularity and demand for

lightweight extinguishers are also expected to drive the segment in the years to come.

To directly influence the current market, we aim to directly intervene in the production processes of the foams, by providing producers and distributors with our biofoam. There is an active register, not only of distributors but also of suppliers, government, and civil organizations and associations in charge of the foam and/or fire extinguisher market, with whom we have been in contact to validate and revalidate the current needs. Therefore, our main sales channels will be these established contacts, as well as potential distribution centers where we can provide help and support on our venture.

CUSTOMER DISCOVERY

The current market can be divided into 5 main areas(5). In order to guarantee a wide spectrum of potential customers, the corresponding sector and Mexican companies that already have the channels and background in the use of fire fighting foams, but have not yet fully implemented the use of fluorine-free firefighting foams, have been described in the following table.

Market	Percentage	Mexican Homology
Municipal fire brigades	44%	Local government Fire Department (such as Guadalupe's Civil Protection) Private companies (such as Amerex) Wildlife Park Supermarkets Office buildings Shopping malls Hotels

Petro and Chemical Industries	29%	PEMEX Breweries Sherwin Williams Quaker State Peñoles Shell Mexico
Marine Applications	16%	Related to PEMEX activities
Airports	8%	Across Group Mexico Aerovias de Mexico
Military	2%	Training and Test

MARKET SIZE

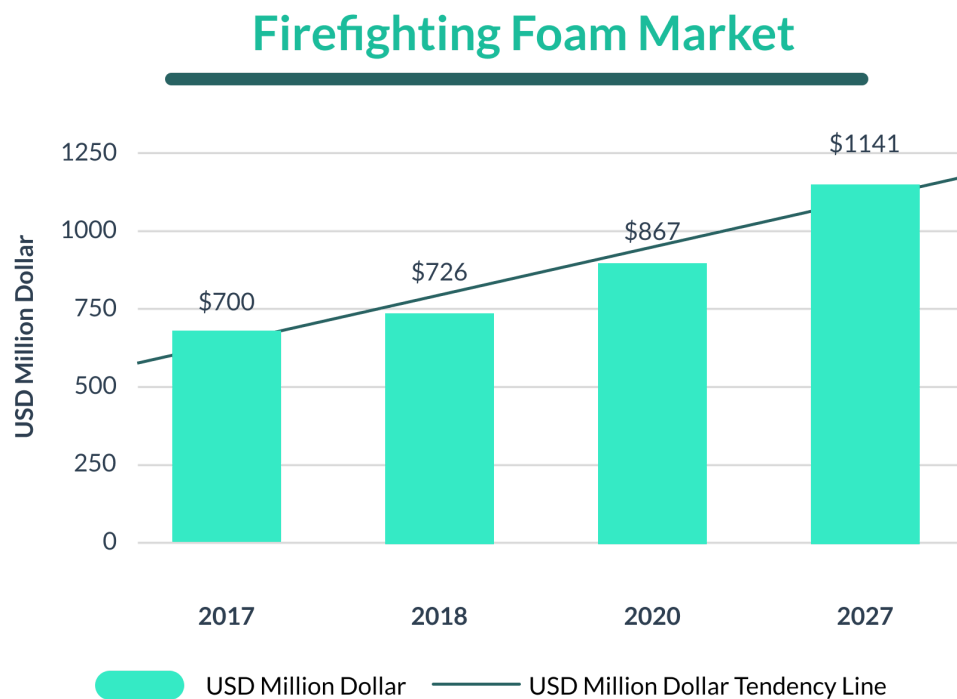
North America was the dominant regional market in 2018 and was valued at USD 22.81 billion. Various countries in this region, particularly the U.S. and Canada, have significantly contributed towards market growth due to rapid infrastructural developments and the implementation of stringent fire safety regulations and norms. Moreover, increasing concerns related to fire safety and security and quick adoption of technologies are several other factors driving the region's growth.

In Mexico, there are about 32 distributors of equipment directly related to fire fighting with products such as foams and about 2 producers that contemplate fire extinguishing equipment but based on chemical fire fighting powder. Additionally, both fire protection equipment and civil protection institutions represent a market due to their constant use of firefighting foams (6).

MARKET SCOPE

The key drivers that are expected to have a substantial impact on the growth of the market globally include an increasing shift toward environmentally-safe products

and increasing fire-related accidents leading to casualties and loss of property. The absence of a standardized regulatory body globally for approval of firefighting foam is the major restraint that might hinder the growth of firefighting foam. However, there is a tendency of growing as seen in the following graph.



MARKETING AND SALES

MINIMAL VIABLE PRODUCT

First, it is essential to know the characteristics of the product for a correct approach to a marketing analysis. We have made all the theoretical work needed for the further production of our MVP, while considering national and international standards on the product presentation and performance (1,2). Therefore, we plan that our foam concentrate will be offered to the final users in the form of containers (e.g. 20-liter capacity) to meet our client preferences of foam consumption. A sketch of the Minimal Viable Product is shown below.



Plastic canister attribution:

Packaging vector created by upklyak - www.freepik.com

POSITIONING STRATEGY

The positioning will be based on 4 main aspects of the product

1) Characteristics

The 3 main characteristics of the product are the production, composition, and application free of fluorochemicals, guaranteeing also the mandatory safety criteria but with the difference of being completely friendly with the environment.

2) Price

It is estimated that the standardized production of the product will generate less dependence on classic processes and materials for the production of a foam, thus reducing manufacturing costs and freeing Mexican companies from import payments to acquire the product from foreign companies.

3) Application

Synbiofoam foam will be the only Mexican foam with the potential to be applied not only indoors but also directly in forest fires, with which we will mitigate the previous consequences of the application of previously released traditional foams due to the content of fluorochemical they possess.

4) Process

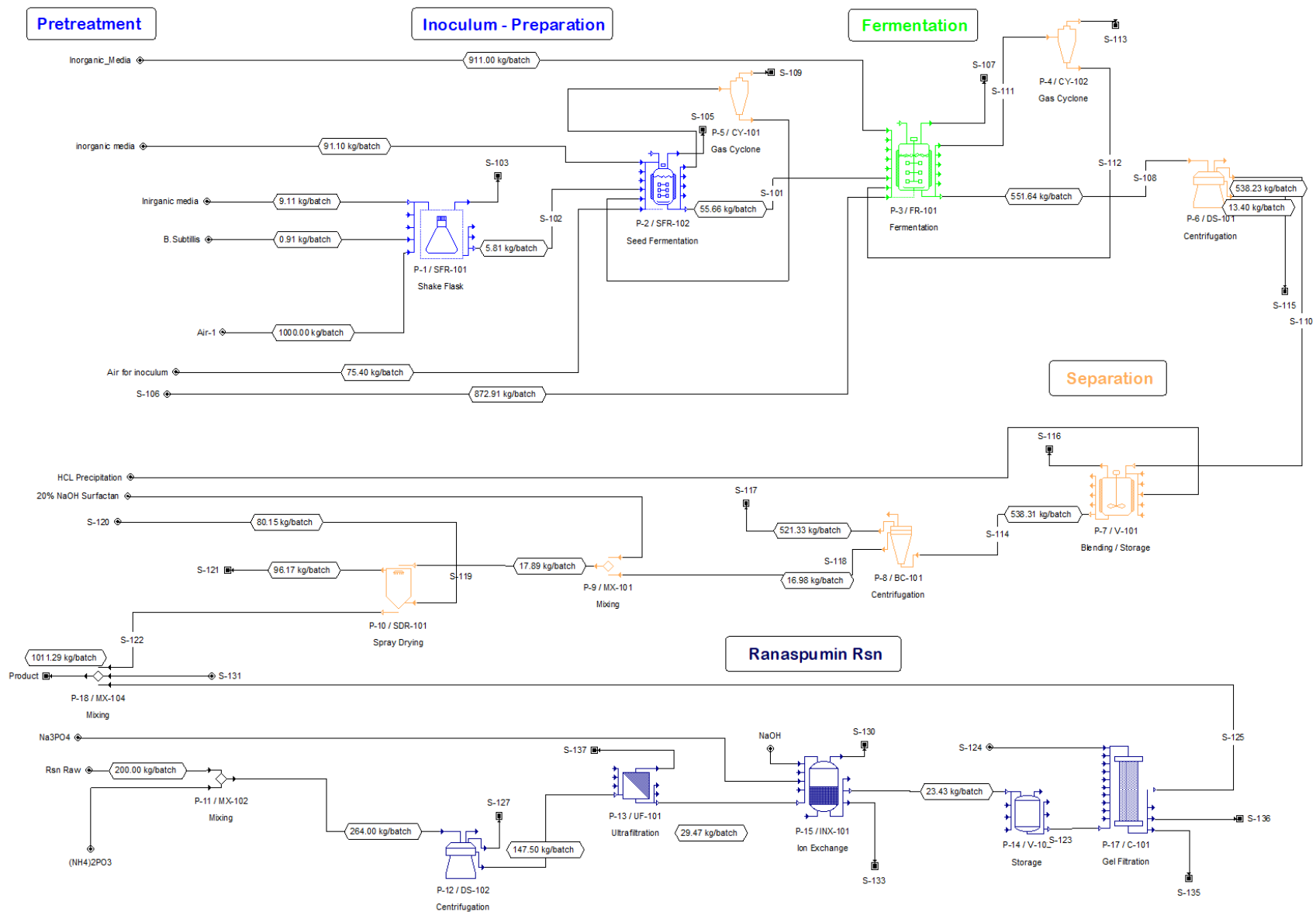
Synbiofoam concentrates processes based on biotechnology and synthetic biology, employing bacteria for the continuous production of the required elements for the development of the biofoam.

MARKETING STRATEGY

Based on the implications of the product, such as its impact on the environment and production processes, we have considered digital strategies. So, we designed a website to publicize the product and gather information on possible doubts that may be generated by customers. This idea represents a recommendation based on the incubation to which we currently belong.

PRODUCT STRATEGY

Due to the current situation and our restricted access to the laboratory, we have developed biological and chemical models that will allow us to estimate significant parameters on the composition and behavior of the foam. To represent this at the industrial level, we constructed the following diagram that contains a general map for the elaboration of the foam.



PRICING STRATEGY

To offer an alternative with advantages in the market, we estimate that the processes used will be able to reduce both production and sales costs for the commercialization of the products. The reduction of the cost will be the goal to reach once we know physical characteristics of the foam. We will continue adjusting the product as we further improve the minimum viable product and revalidate it.

DISTRIBUTION CHANNELS

To offer an alternative with advantages in the market, we estimate that the processes used will be able to reduce both production and sales costs for the commercialization of the products. The reduction of the cost will be the goal to reach once we know physical characteristics of the foam. We will continue adjusting the product as we further improve the minimum viable product and revalidate it.

- 1) Selective (First phase)
- 2) Wholesaler/Distributor
- 3) Direct/Internet
- 4) Direct/Catalog
- 5) Direct/Sales Team

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