iGEM FCB-UANL 2021

SURFACTANT BUSINESS PLAN

EXECUTIVE SUMMARY

We have been witnessing how our natural ecosystems have slowly started to be more and more contaminated due to the exploitation of non-renewable resources to obtain materials and the vast contamination generated by compounds that are not biodegraded with ease. Therefore, the world has started to shift towards a stance where more environmentally friendly products have been started to be implemented instead of harmful, pollutant chemicals. In particular, surfactants, or compounds that reduce surface tension, are no exception in this quest.

Taking this into consideration, Synbiofoam stands as an alternative in the manufacturing of green, bio-based surfactants. Biological compounds would be produced through modern biotechnology techniques. To do so, an extensive research and development process involving theoretical work, mathematical modeling and experimentation will be performed in order to properly characterize the compounds and to offer an approach of optimized industrial production.

Thus, an initial investigation on some biosurfactants, especially surfactin and ranaspumin-2, has been performed. Yet, additional research on other alternatives such as rhamnolipids, latherin, and other surface-active, biological compounds is also contemplated in order to adapt the product's characteristics to the customers' needs. To achieve this, an analysis of the surfactant market, which includes its size, segmentation, and other aspects, was conducted in order to find potential customers in different industries that would be interested in adopting biosurfactants in the elaboration of their products.

As we continue to complement our previous research performed to understand the characteristics of the products and strategies to make their production more efficient, we hope to establish this modern biotechnological approach to produce alternatives inspired in nature to replace chemical surfactants and

BUSINESS DESCRIPTION

COMPANY DESCRIPTION

Synbiofoam intends to produce a wide array of biosurfactants through synthetic biology techniques and bioprocess optimization. These biosurfactants will be produced and distributed nationally and internationally according to the customers' needs and in response to the increasing trend of migration towards more environmentally friendly products to fight pollution.

MISSION DESCRIPTION

Our mission is to develop and optimize the industrial production of biosurfactants and distribute them to the main users, to achieve a replacement of chemical surfactants that cause damage to the environment.

VISION DESCRIPTION

Our vision is to be one of the leading companies producing biosurfactants, in this way being a paramount example of migration towards eco-friendly products and new applications of biotechnology.

VALUES

With the utmost respect towards the environment and society, we aim to offer a series of products which would reduce the negative impact of some surfactants found nowadays in the market. We shall show perseverance to place in the market biosurfactants produced through novel approaches using synthetic biology. In addition, integrity, honesty, and commitment will prevail when dealing with our customers, always offering the best option in regards to their needs. Also, we will maintain the highest level of transparency for us to develop healthy and stable relationships both inside and outside the company.

VALUE PROPOSITION

We aim to industrially produce biosurfactants, which tend to be more environmentally friendly and effective than chemical surfactants, using a novel approach through synthetic biology and bioprocess optimization.

GOALS AND OBJECTIVES

- Reduce the time needed to degrade surfactants by offering a biologically-based alternative as opposed to synthetic, chemical surfactants;
- Achieve production at an industrial level while using wastes from other industries;
- Validate with the potential users and main industries using surfactants to direct efforts towards the production of new alternatives that meet their needs;
- Develop specific approaches that enable the production of several biosurfactants as a way to reduce production cost as much as possible for each kind of biosurfactant;
- Continue with the design and constant improvement of the genetic circuits and industrial production plant optimization for costs reduction;
- Obtain certifications to demonstrate quality assurance and control of the products

CRITICAL SUCCESS FACTORS

There are several factors that must be taken into consideration for ensuring the success of our company. In the first place, the production process must be considered. Ensuring the optimization of the industrial bioprocess is an important aspect that will ensure maintaining the prices within a competitive range in comparison with those products already found in the market. The incorporation of wastes from other industries as raw materials to use can help reduce the production costs of our biosurfactants.

In addition, another critical success factor relies on the production of a wide array of products that would meet the customers' needs according to the reduction in

surface tension, among other characteristics. Thus, a solid and positive relationship with the customers is also needed in order to obtain constant validation and continue to improve our products.

Besides, other outside factors -such as the presence of already established competitors, biotechnology industry investment, and the development of new technologies and techniques- could ensure an ongoing research and development process that would help the project grow. Also, properly determining the biodegradability standards for biosurfactants through the appropriative normativity (such as the NMX-Q-901-CNCP-2016) can give a competitive advantage over surfactants not as readily biodegradable as the products we plan to offer.

PRODUCTS AND SERVICES

Different biosurfactants, such as ranaspumin-2 and surfactin, are the products to be offered to the customers. These tend to biodegrade easier than chemical surfactants do. In this case, the sale of the products in different presentations will be the main source of revenue. In particular, it is expected that the bulk sale of the biosurfactants to manufacturers in different industries, such as personal and house care products, to be the principal source of income. In addition, patent obtention could further benefit revenue generation through the protection of the intellectual property involved in potential, optimized processes involving synthetic biology and bioprocesses.

REGULATIONS AND CERTIFICATIONS

Several regulations or certifications are expected to be related to the development and quality assurance of our products. These include national and international standards, from which the following stand out:

1) NMX-Q-901-CNCP-2016: which oversees the biodegradability of surfactants found in domestic products (1) and other related Mexican normaivities;
2) International certifications in relation to the physicochemical properties of surfactants, such as:

a) ISO 304:1985/COR 1:1998, Surface active agents — Determination of surface tension by drawing up liquid films — Technical Corrigendum 1 (2);
b) ISO 696:1975, Surface active agents — Measurement of foaming power — Modified Ross-Miles method (3);
c) ISO 4198:1984, Surface active agents — Detergents for hand dishwashing — Guide for comparative testing of performance (4);
d) Among others

3) Other recognitions certifying the biological origin of the product, such as the BioPreferred Program (5).

UNIQUE FEATURES AND PROPRIETARY ASPECTS

We aim to produce biosurfactants through a synthetic biology-based approach. To do so, a detailed investigation that is focused on, but not limited to, biomolecules with unique characteristics ranaspumin-2 and surfactin was performed. In it, we performed a theoretical analysis based on mathematical models and extensive research to propose an approach for enhancing the production of biosurfactants through modern biotechnology. In addition, other biosurfactants, such as rhamnolipids, have also been started to be analyzed. Thus, after improving the production process and complying with the appropriate regulatory process to ensure the quality and safety of the biosurfactants, we intend that the products help different industries to start using compounds that contribute much less to pollution due to the fact that they do not come from non-renewable resources and biodegrade easier.

MARKET

MARKET SIZE AND SCOPE (nacional e internacional)

Surfactants market size is expected to grow during the following years. With an expected compound annual growth rate of 4.5%, the overall surfactants market, dominated by the non-ionic surfactants, is expected to grow up to a value of 52.4 billion USD by 2025, being North America an important region in the surfactants market (6,7). In addition, the biosurfactants market is also expected to continue to increase at a rate of 5.6%, reaching a total value of 5.52 billion USD in 2022 (8).

This increase in the surfactant market is due to several reasons. Among them stand out the emergence of stricter regulations in some regions such as Europe or the United States; also the rise in awareness of the need for environmentally friendly products and better infrastructure are also two characteristics leading to the growth of the biosurfactant market (9).

COMPETITORS ANALYSIS

The main competitors consist of the surfactant and biosurfactant companies established nowadays. The following are some of them (6):

- BASF SE,
- Evonik Industries AG,
- Stepan Company,
- Among others.

In Mexico, some of the following companies producing and distributing surfactants to different industries can be found:

Market	Main Enterprises
Cosmetic Industry	Axo Chemical Algon Corporation Abaquium

Medicine and pharmaceutical industry	Croda Personal Care
Metallurgy	Stepan Kao Chemicals Solvay Mexicana
Petroleum industry	Sika Mexicana Naviera Meximares S.A de C.V
Textile Industry	Quimi Kao Fast Forward Consolidators
Pupicide Products Industry	Nalco de México Oxiteno
Industrial and Institutional Cleaners	Clariant Oxiteno
Food Processing	GHH Group Aniq Nalco de México Oxiteno Adyfarm
Paints and Coatings	Celanese Mexicana (CelMex) Mexichem Resinas Vinílicas

In regards to the biosurfactant market, the following companies have made important steps towards the production of these compounds (6,8):

- Jeneil Biotech
- Ecover.

In order to differentiate ourselves from the competition, we plan to use synthetic biology techniques in order to produce a wide array of biosurfactants that would meet customer needs. Besides, a detailed plan on the bioprocess to be implemented has been developed in order to estimate production costs in order to establish competitive prices within the biosurfactant market.

MARKET SEGMENTATION

First, we would focus on Mexico and the North American region, since it is one where the biosurfactant market is on the rise. Once the initial geographic region is delimited, potential customers would be determined. Some of the most important industries involved in surfactant use are home and personal care, cosmetic industry, metallurgy, among others (10). Thus, we will establish contact with potential customers within these sectors that can adopt the use of our products.

CUSTOMER DISCOVERY

Biosurfactants can be used in many areas such as in medicine, bioremediation, cosmetic industry, metallurgy, petroleum industry, textile industry, applications for its pupicidal activity, among others (10). The customer categorization and some potential customers are shown in the following table:

Market	Mexican Homology
Cosmetic Industry	L'Oreal
Medicine and pharmaceutical industry	Galderma Mexico
Metallurgy	MECLEMSA Química Magna
Petroleum industry	Clariant
Textile Industry	Sanper
Pupicide Products Industry	GreenHow Atlántica Agrícola
Industrial and Institutional Cleaners	Silimex Quimlow
Food Processing	Intrakam
Paints and Coatings	Berel Pinturas Acuario

MARKETING AND SALES

MINIMAL VIABLE PRODUCT

The minimal viable products would consist of extracts of the biosurfactants obtained through synthetic biology techniques. Through literature research, some of the most promising biosurfactants have been studied, from protein surfactants such as ranaspumins to other surfactants of different nature such as surfactin. These would be offered in the form of purified extracts in different presentation volumes according to the customer's needs, whose quality and safety would be determined according to the previously mentioned standards.

POSITIONING STRATEGY

Based on the nature of the products offered, two of the main characteristics that would be key to assuring our position in the market rely on the beneficial characteristics of the product in relation to chemical surfactants and the underlying production process. Once proven that the biosurfactants produced comply with the quality and safety standards, adoption of biosurfactants will further provide the customer and the final users with products with a much more reduced environmental impact. Besides, the use of synthetic biology and a detailed plan on the bioprocess involved can further help improve the efficiency of the production process, thus eventually reducing costs in the future.

MARKETING STRATEGY

Several methods are considered to efficiently direct the information to the target customers, such as direct contact with them is considered as a first approach. Despite not being the most efficient method, this would construct an initial communication with the potential customers for them to know the company. Besides, diffusion through other platforms, either in-person or digital, would be other valuable methods for reaching the target audience.

PRODUCT STRATEGY

As a commitment to always offer the best to our customers, a constant validation process will be carried out in order to incorporate their needs with the products portfolio. With this in mind, the product presentation is intended to be adapted for the customers in terms of volume and characteristics. Besides, the products could be subject to certifications that sustain the quality of the product.

PRICING STRATEGY

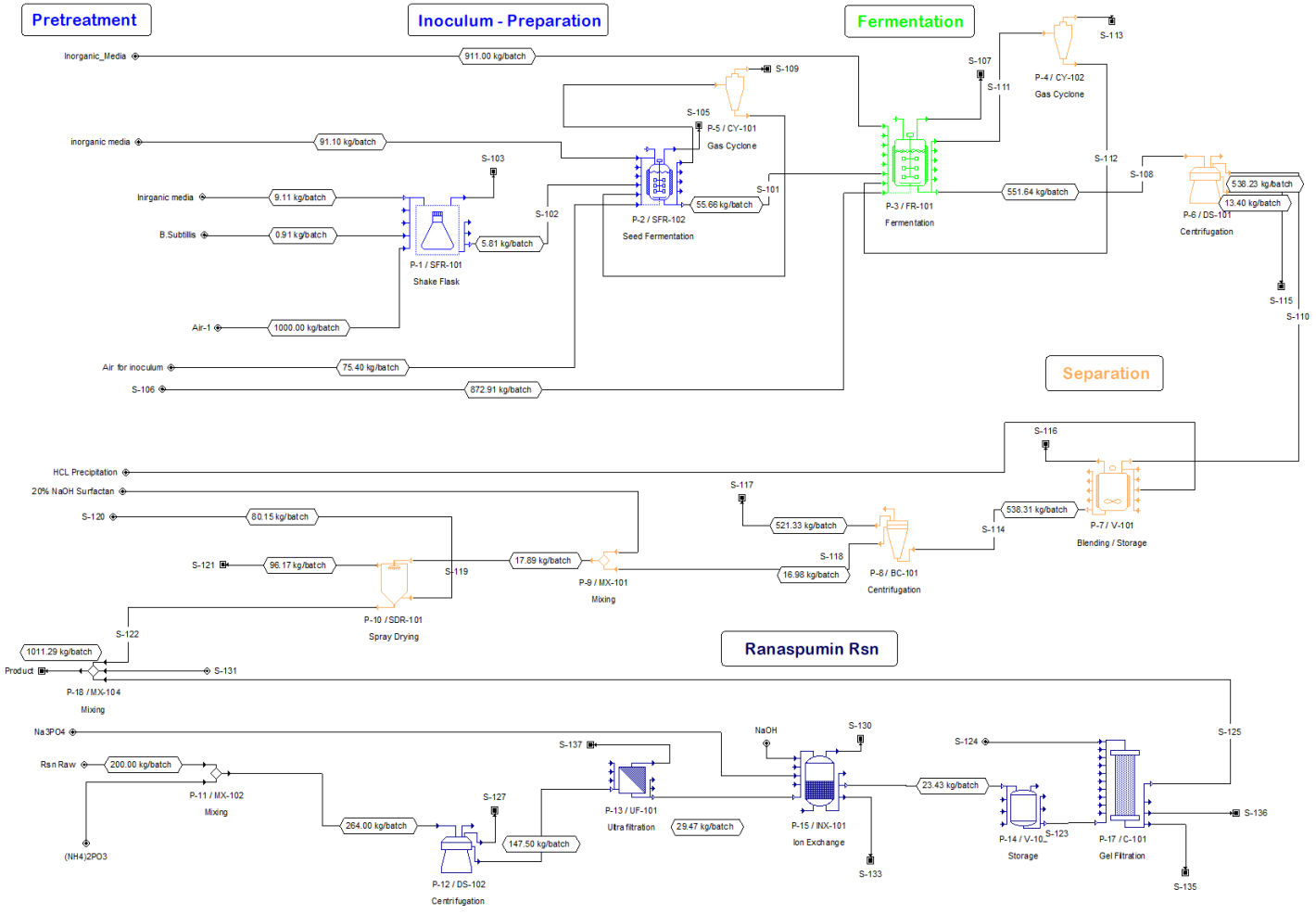
Biotechnologically-based products tend to be more expensive than their synthetically obtained, chemical counterparts. Despite our analysis places our products within the range of the retail prices of some biosurfactants, major efforts should be performed for optimizing the industrial production process, either by exploring alternatives of more efficient equipment use, incorporation of other materials that would further reduce costs, among other aspects.

DISTRIBUTION CHANNELS

The biosurfactants will be distributed through different strategies. They will be sold either by direct contact with a sales team in a physical facility or through different platforms, such as a webpage. In addition, key partnerships with distributors will be established in order to transport the material with the appropriate measures.

FINANCIAL ANALYSIS

To get an initial perspective on the finances involved in our project, we developed a simulation in the SuperPro Design Software. In it, a production plant was built based on previous literature (11,12), which can be observed in the following image:



Based on the production plant proposed, the software helped in the estimation of the costs related to the plant construction and the operating costs. With this in mind, the following table shows the direct fixed capital cost calculated:

Capital Costs Related to Plant Construction	
Total Plant Direct Cost (TPDC)	***Cost ($USD)***
Equipment Purchase Cost	3,860,000
Installation	1,439,000
Process Piping	1,351,000
Instrumentation	1,544,000
Insulation	116,000
Electrical	386,000
Buildings	1,737,000
Yard Improvement	579,000
Auxiliary Facilities	1,544,000
TPDC	12,556,000
Total Plant Indirect Cost (TPIC)	
Engineering	3,139,000
Construction	4,395,000
TPIC	7,534,000
Contractor's Fee & Contingency (CFC)	
Contractor's Fee	1,004,000
Contingency	2,009,000
CFC	3,013,000
Direct Fixed Capital Cost (DFC=TPDC+TPIC+CFC)	23,103,000

In addition, the operating costs were also calculated considering the production plant's needs for maintenance and correct functioning. Thus, labor costs, as well as materials, utility, and facility-dependent costs were incorporated and a total operating cost of $4,527,276 USD per year was estimated, as shown in the following table that summarized the economics.

Economics	
Total Investment	$24,267,351 USD
Total Revenues	$6,041,102 USD per year
Operating Cost	$4,527,276 USD per year
Unit Production Reference Rate	604.11 kg of biosurfactants per year

Based on the previously presented information, an approximate cost of $100 USD per gram of surfactant is expected. Thus, a gross margin of approximately 25% is expected, and an estimated payback time would be around 8 years. Despite the cost being still a little elevated in comparison to chemical surfactants, our proposed cost lies within the range of costs of biosurfactants found nowadays in the market (11).

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