

NEXTCOA: How an Entrepreneurial University can Transform the Cocoa Industry Towards Circularity

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Abstract: As the economy has evolved from being driven by physical capital to knowledge and entrepreneurship, the role of the university has also evolved over time; besides its responsibility to generate technology transfer and knowledge-based startups, universities have broadened to focus on enhancing entrepreneurship capital and facilitating behavior to prosper in an entrepreneurial society (Audretsch, 2014). This article talks about Nextcoa, an academic spin-off initiative which wants to revolutionize the cocoa industry by modernizing the production and transformation of the fruit to obtain the traditional chocolate, but also using the current waste to produce new goods and services. The research question is focus on how challenging is for a Colombian entrepreneurial university to contribute to circularity, trying to produce sweeteners and biopolymers obtained from cocoa mucilage that can be used to produce and package chocolates, replacing sugar cane and plastic bags, while gives use to a residue that is currently wasted. First, it is explained the development process of new products from Nextcoa since its conception. Then, an analysis of external conditions for the cocoa sweetener and biopolymer is done, using the Porter diamond model. In third place, it is presented an internal capabilities profile of Nextcoa. Finally, the challenges for the new products to be successful in the market are synthesized, thus contributing to the circularity of the cocoa industry. As main results, it is obtained that there is an important technological limitation in obtaining the cocoa mucilage to produce the sweetener and biopolymer as well as in the little knowledge and management of biotechnological processes of those involved in the cocoa value chain. On the other hand, there is a significant demand for plastics and sweeteners for chocolate production and packaging, and a prevailing need to reduce related contamination and consumption of sugar cane for health issues. Also, being produced by an academic spin-off gives good-will to Nextcoa products but, given the bureaucracy typical of a public university in Colombia, it can mean complications for doing business. Finally, cocoa biopolymer and sweetener would have an interesting market, especially if they can be produced at a competitive cost.

Keywords: entrepreneurial university, spin-off, cocoa

1. Introduction

Cocoa is one of the main products consumed worldwide that is similar to coffee; a primary difference between coffee and cocoa is that cocoa is produced in developing countries and is consumed mainly in industrialized countries (Duana-Ávila et al. 2023). As Suuh & Molua (2022) cited, worldwide, about 95% of cocoa is grown on smallholder farms ranging from 2-5 hectares (Anga, 2016), and employing about 5–6 million cocoa farmers from Asia, Africa, Oceania, and Latin America (Kozicka et al, 2018). Currently, the top 10 cocoa producing countries in the world, in the ranking order, are Cote Ghana, Indonesia, Nigeria, Cameroon, Brazil, Ecuador, Peru, Dominican Republic and Colombia (Aremu-Dele et al, 2022). They jointly produced 91.5% (5,268,666 tonnes) of the global annual production of (5,756,953 tonnes) according to FAOSTAT (2020).

As Savitri et al (2022) says, based on Voora et al. (2019) and Yolanda et al. (2022), “cocoa has been widely marketed worldwide for its importance and popularity as raw material for food industries, cosmetics, and pharmaceuticals”. Roasted cocoa beans are processed into cocoa liquor, cocoa butter, cocoa powder, and final cocoa products such as chocolate bars, chocolate drinks, etc. (Hartatri et al., 2021). However, only 10% of the annual production of cocoa corresponds to the cocoa bean and the remaining value corresponds to a high number of residues, cocoa bean shell, pulp and husk (Soares and Oliveira, 2022). In this context, “more than 550,000 m³ of juice from mucilage of cocoa beans are produced and abandoned in farms each year. This cloudy substance is composed of 85.3% of moisture” (Anvoh, et al., 2009).

Trying to contribute to cocoa industry circularity in a producer country as Colombia, *Nextcoa* has been working in developing new cocoa derivatives from residues. Between them, a sweetener and a biopolymer have been created, made of cocoa mucilage that is currently wasted. As they can be used in chocolate production and packaging, their development contributes doubly to the sustainability of the cocoa industry; first, they use a waste that is currently thrown away but, additionally, they help to reduce the use of cane sugar and plastic packaging in chocolate production. The consumption of chocolate is expected to grow by 4.78% by 2025 reaching

sales of more than 180 billion dollars (Gil et al., 2022), so these sweetener and bioplastic could be highly demanded and therefore contributing to cocoa industry competitiveness.

Nextcoa is a spin-off initiative from *Universidad Industrial de Santander*, a Colombian public university that is highly recognized for its research contributions as these ones related to cocoa derivatives. As the economy has evolved from being driven by physical capital to knowledge and entrepreneurship, the role of the university has also evolved over time; besides its responsibility to generate technology transfer and knowledge-based startups, universities have broadened to focus on enhancing entrepreneurship capital and facilitating behavior to prosper in an entrepreneurial society (Audretsch, 2014). However, as Fernández-Alles et al. (2015) says about the development of an academic spin-off (ASO), it “is challenging for academics, who face important obstacles that can reduce an ASO’s chance of survival and success, particularly because growth implies that ASOs must compete in a commercial environment that is very different from the university context in which they are created (Vanaelst et al. 2006; Vohora et al. 2004)”.

This article presents a research about *Nextcoa*, whose question is focus on how challenging is for an entrepreneurial university to contribute to circularity, trying to produce sweeteners and biopolymers obtained from cocoa mucilage that can be used to produce and package chocolates.

After literature review and methodology chapters, this document presents findings and discussion, starting with an abbreviated report of the development process of new products from *Nextcoa* since its conception, followed by an analysis of competitive conditions for the cocoa sweetener and biopolymer using the Porter diamond model and an internal capabilities profile. Finally, as conclusions, the challenges for the new products to be successful in the market are synthesized, thus contributing to the circularity of the cocoa industry.

2. Literature review

University technology transfer refers to the process by which intellectual property, innovations, and knowledge generated within universities and research institutions are transferred and commercialized for practical applications and societal impact. According to Rasmussen et al. (2020), university technology transfer involves translating academic research findings into tangible products, services, or processes that can be utilized by industry, entrepreneurs, and society at large; this process typically involves activities such as intellectual property protection, licensing agreements, forming spin-off companies, seeking funding, and establishing collaborative partnerships between academia and industry.

That concept is closely with entrepreneurial universities because they actively promote and foster entrepreneurship, innovation, and knowledge exchange within its academic community, while university technology transfer involves the process of translating academic research and innovations into practical applications for commercialization and societal impact (Link & Scott, 2005).

In this context, one of the common ways of transferring technology in the case of entrepreneurial universities is the creation of academic spin-off companies. They refer to a new venture that is established based on intellectual property, technology, or research outcomes developed within an academic institution; it is formed by faculty members, researchers, or students who aim to commercialize their innovative ideas or technologies and bring them to the market (Shane, 2004). In that sense, academic spin-off companies serve as a bridge between academia and industry, translating scientific knowledge into practical applications and products.

Just like any business, according to Clarysse et al. (2005) and Colombo & Grilli (2005), it is important for an academic spin-off company to be competitive for several reasons, between them: i. Market Success: Being competitive allows the spin-off to effectively position itself against existing competitors and seize opportunities in the market. ii. Sustainable Growth: By offering innovative products or services that address market needs and surpass competitors' offerings, a spin-off can achieve sustained revenue growth and this growth is essential for the spin-off's survival, expansion, and long-term viability. iii. Attracting Investors and Funding: A spin-off that demonstrates competitiveness through a solid business model, market understanding, and differentiation is more likely to gain the confidence and financial support of investors. iv. Recruitment and Retention of Talent: In a highly competitive landscape, skilled individuals are drawn to companies that offer challenging and rewarding opportunities. v. Industry Partnerships and Collaborations: Established companies are more inclined to collaborate with spin-offs that demonstrate competitive advantages, as such partnerships can lead to mutual benefits, such as accessing new markets, leveraging complementary expertise, and enhancing technological capabilities. vi. Technology Differentiation: By continuously improving and innovating their technology, spin-offs can maintain a competitive edge, protect intellectual property, and prevent rivals from easily replicating their

offerings. vii. Economic Impact: By successfully competing in the market, the spin-off can create jobs, contribute to economic growth, attract investments to the region, and foster innovation and entrepreneurship within the academic ecosystem.

3. Methodology

This research adopts an interpretive, exploratory, and inductive approach, in which data are taken at a single moment in time. A qualitative methodology of case study was followed, using what was previously found in the literature to categorize and compare analytical units. This methodology is relevant to this research because a contemporary phenomenon is analyzed within its real context, where the limits between the phenomenon and the context are not clearly evident (Yin, 2014). As methodological steps, in the first place, the data collection instruments were designed for both secondary and primary sources. Then, an analysis of web content about Nextcoa was done, as well as a review of available documents about the process of creation of the academic spin-off company. Subsequently, semi-structured interviews were conducted with the entrepreneurial scientists. The data obtained were then analyzed based on the established research question.

4. Findings and discussion

4.1 The magic of Nextcoa

The origin of Nextcoa initiated around 2017, when professors Cristian Blanco Tirado and Marianny Yajaira Combariza, from the Industrial University of Santander UIS, started to research about cocoa, seeking to make the most of these fruits. Until now, Nextcoa helps to promote the cocoa business; using mucilage, shells and others cocoa residues that are considered waste, they develop biomaterials and food products. Its developments include premium chocolate bars and bonbons, produced with high-class manufacturing standards, and a technology to remove cadmium from cocoa beans. Also, they produce sweeteners and biopolymers from fermentable sugars and bacterial cellulose obtained from biotechnological processes using cocoa mucilage (Blanco Tirado, 2019).

4.2 Producing cocoa sweeteners and biopolymers in a rough environment

As it was mentioned before, Nextcoa is a Colombian academic entrepreneurship. Its competitiveness depends on its own capabilities but also in the opportunities and threats that its context offers. That is why, to analyze the challenges that this ASO faces, in first place an analysis was done through the porter's diamond model.

Porters diamond model helps to assess the sources of competitive advantages of an industry in a particular country and consists of four determinants of competitive advantage: factor conditions, demand conditions, related and supporting industries, and firm strategy, structure, and rivalry (Bakan and Doğan, 2012).

4.2.1 Factor conditions.

According to Porter, these can be of two types of factor conditions: basic and advanced. Basic resources include land, natural resources, and unskilled labor, while advanced resources involve capital, infrastructure, skilled labor, and cutting-edge technology. In this case, producing cocoa sweetener and biopolymer need capabilities for develop biotechnological processes. Finding cocoa and even native bacteria as raw material won't be a problem; however, in a developing country as Colombia it is a challenge to find skilled labor, infrastructure and technology for managing bioindustries. As Buitrago (2012) says, "In Colombia, developments in biotechnology have been around three decades and show significant growth in terms of the formation and consolidation of communities dedicated to research, for which universities and some research centers undertook actions within the framework of strategic plans to train at the postgraduate level in foreign schools ... in contrast, the emergence of companies that are supported by biotechnologies or traditional companies that are recognized as such, has been limited compared to the previous community".

4.2.2 Demand conditions.

The main clients of the packages and sweeteners manufactured from residual cocoa biomass are the companies dedicated to the production of chocolates. In 2021 the value of this market was approximately 304 billion pesos, and it is expected that by 2026 this figure will increase to 362.5 billion pesos, with big actors as *Compañía Nacional de Chocolates*, *Comestibles Italo*, among others (Euromonitor International, 2022). However, as the

use of these new cocoa products could increase the price of chocolates, it can be assumed that buyers would be those manufacturing premium chocolates.

In the last decade, a series of local brands specializing in premium chocolates have emerged in the country; *Cacao Hunters Food, Sagu Co, Chocolate Santander, Chuculat* are examples of this type of brand which offer dark chocolate with more than 70% cocoa content (Euromonitor International, 2022). For this kind of chocolates, cocoa content increases while the sugar content decreases; as they are promoted as healthier, their makers try to replace caloric sweeteners for non-caloric ones.

On the other hand, in premium chocolates the packaging has two purposes: preservation and to improve visualization. This must keep the perishable chocolate fresh and protecting it against environmental risks, temperature fluctuations, moisture absorption or loss, being a barrier to foreign odors; for this reason, the packaging must be hermetic and impermeable. Likewise, the packaging must highlight the beauty of the product, therefore, elegant packaging with beautiful graphics adds value for consumers (Bertrand, 2003).

This means, cocoa biopolymer and sweetener would have an interesting demand as soon as they reach market conditions.

4.2.3 Related and supporting industries

For the preparation of sweetener and biopolymer from Nextcoa, the necessary raw material is the cocoa mucilage. Cocoa production in Colombia has experienced growth of 6.1% and 8.9% for the year 2020 and 2021 respectively, which demonstrates an excellent performance of this sector in recent years (National Cocoa Growers Federation of Colombia, 2022). In addition to this, it must be considered that the commercialization of this fruit both nationally and internationally is carried out only from the dry grain, wasting the rest of the harvest. However, as the mucilage is not valuable right now for farmers, they are not used to picking it up or giving it a hygienic and proper handling; this could represent a supply problem.

4.2.4 Firm strategy, structure, and rivalry

European company SMW developed in 2016 a unique cocoa fiber, called Cocoa Paper, which has patented technology that increases the value of waste of cocoa shells by transforming them into creative packaging materials; this fiber can be used for the manufacture of paper and cardboard to create customized solutions applicable to industries such as confectionery, bakery, decoration, among others (SWM, s.f.). At the national level, no companies producing or marketing cocoa packaging were found. However, aluminum foil wrappings and transparent cellophane pouches are currently very attractive to customers (Bertrand, 2003).

Something similar happens with cocoa sweeteners. There is no evidence that it is being produced in Colombia. There is an Equatorian one, produced by Mindo Chocolate Makers, that can be considered a substitute, but it is still in development and is not well distributed. On the other hand, KOA Concentrated Juice, Valrhona Oabika, Honey, Corn and Date Syrup, Monk Fruit Extract, Coconut Sugar and Stevia Powder, are some of natural sweeteners that are used in chocolate premium production.

4.3 From an entrepreneurial University to the market

Nextcoa is a new competitor in the market. As it is still an spin-off initiative, it has produced and commercialized its goods and technologies only on a pilot scale. However, to evaluate its current competitiveness, an internal capabilities profile was done, assessing Nextcoa's buildings, equipment and inventory, employees' skills and knowledge, and organizational structures and processes.

4.3.1 Buildings, equipment, and inventory.

As it was mentioned before, Nextcoa is an ASO initiative from UIS. Nowadays, it is located in Guatiguará Technology Park, in Bucaramanga-Colombia. Its buildings, equipment and inventory are mainly from university, and they have efficient and state-of-the-art technology, included biotech for production of cocoa derivatives as sweeteners and biopolymers. However, its productive capacity is small size and that represents a high cost of production and low economy of scale. On the other hand, it has a strength based on intellectual property assets; for example, its researchers have recently made a patent application for a technology to reduce cadmium from cocoa.

4.3.2 Employees' skills and knowledge.

Being part of a well-known research university, Nextcoa has talented employees, especially for I+D+i. They help to produce with excellent standards and to develop new products and processes.

4.3.3 Organizational structures and processes.

Nextcoa has developed high-tech processes for producing sweeteners and biopolymers based on cocoa mucilage, that are innovative and demanded products for chocolate makers. Although their technology readiness level TRL could be 6, they have only been produced on a pilot scale, so their manufacturing readiness level MRL is still in pre-production level.

On the other hand, talking about organizational processes, being an ASO of a public university could not be the best scenario for making business in Colombia given the bureaucracy that is managed specially to sell and buy goods and services.

5. Conclusion

Nextcoa is definitely promoting cocoa industry circularity. Producing a sweetener and a biopolymer, made of cocoa mucilage, it contributes doubly to the sustainability of the cocoa industry; first, they use a waste that is currently thrown away but, additionally, they help to reduce the use of cane sugar and plastic packaging in chocolate production.

As an advantage for Nextcoa, there is a significant demand for plastics and sweeteners for chocolate production and packaging, and a prevailing need to reduce related contamination and consumption of sugar cane for health issues. However, there is an important technological limitation for being competitive, in obtaining the cocoa mucilage to produce the sweetener and biopolymer as well as in the little knowledge and management of biotechnological processes of those involved in the cocoa value chain.

Additionally, being an academic spin-off, Nextcoa has the advantage of being backed by a recognized university, that provide excellent infrastructure and skilled employees. However, it could also be problematic given the bureaucracy typical of a public university in Colombia, that mean complications for doing business.

As a conclusion, cocoa biopolymer and sweetener may have an interesting market and can turn Nextcoa into a great player in the cocoa industry, especially if they can be produced at a competitive cost. This could mean that the company becomes independent from the university but also that it makes productive alliances to guarantee the availability of cocoa mucilage in excellent conditions.

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