

Financial evaluation of Maguey pulquero products portfolio in Mexico's central highlands

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Abstract: The objective of this research was to evaluate financially several maguey pulquero products and by-products and develop a business portfolio. Data were collected from a maguey pulquero cooperative society through the use of a strategic planning and investment instrument. The commercial diagnostic phases, market research and products portfolio design were considered. To obtain information for the portfolio, a productive chain analysis was conducted, considering productive links, post-harvest management and commercialisation. Market research was done in two important market centres in influential regions, where knowledge and frequency of consumption of maguey pulquero products was identified. The Boston Consulting Group Matrix was used to integrate the portfolio's products and by-products, and the Ansoff Matrix was employed to determine the product's positioning. Finally, an investment and economic viability analysis of the products portfolio was carried out. Six products were identified, with pulque and agave syrup being the investment priority products owing to the profits they generate. *Penca*, *ixtle* and *paper* generate complementary income. The strategies for pulque and agave syrup are market penetration, and the strategies for the remaining products are market and product development. The analysis of products include positive-to-net present value, investment return rate and cost benefit ratio.

Key words: Agave salmiana, by-products, rural development, strategic planning

Introduction

Maguey pulquero is a Mexican endemic plant (*Agave salmiana*) located in the highlands of central Mexico, and it provides raw material for a variety of by-products (García, 2007), with pulque being the main product. Pulque is a traditional alcoholic beverage obtained through the fermentation of the sugary sap, known as aguamiel,

which is extracted from the interior of the maguey (Escalante et al., 2008). The thick, green, pulpy leaves (*pencas*) are used for some traditional dishes as well as for the extraction of a fibre called *ixtle*, with which traditional crafts are made (Ruschel & Pérez, 2013; Santhe, 2005), and a fibre for paper production (Parra et al., 2010).

In 2017, the production value of this pulque was up to USD 41 million (SIACON, 2017). The State of Mexico produced USD 871,000 of pulque, and the Municipality of Jiquipilco produced USD 360,893, representing 41% of state production and less than 1% of total production. Jiquipilco held the second place of maguey pulquero production of the State of Mexico. In the municipality and in all of Mexico, maguey pulquero is recognised not only as a beverage but also as an identity symbol. The importance of maguey pulquero in economic, social and environmental terms was described many years ago. An example is León García's (2002) report identifying the richness and wellness of a pulque producer in 1791 due the profits of 57,883 magueyes pulqueros.

However, several crises have occurred in the production of maguey pulquero in Mexico and in the Municipality of Jiquipilco. The crop had been overexploited, and bad management practices had produced soil erosion and the loss of maguey varieties.

Government initiatives were undertaken to promote the cultivation of maguey pulquero being considered as a strategic natural resource, whose characteristics give it value not only in the social aspect but also in economic and ecological terms. Producers of maguey who have undertaken this cultivation for generations have unique knowledge of the benefits that this plant generates. They have faced difficulties in the commercialisation of their by-products, but they are still in business. The integration of cooperatives facilitated the protection, conservation and sustainable use of production and, somehow, allowed for marketing the products (Coss and Álvarez, 2013; SAGARPA, 2015; Salinas, 2007).

An important aspect to consider is that the generation of rural development projects for the use of maguey was based on the integration of producers. The productive activity based on maguey pulquero requires the associativity of small producers, as this is a way to foment local development. However, the vast majority of cooperatives have not generated a business portfolio that would allow them to evaluate the products that they can offer and determine which ones to invest in depending on the competitiveness of companies and market attractiveness.

The objective of this research was to evaluate financially several maguey pulquero products and by-products and develop a business portfolio. To this end, data from the Cooperative Society of Aguamiel and Derivatives of the *Agave salmiana* Producers, in Jiquipilco, Mexico, were used. This article can offer guidance for the investment possibilities of the cooperative society, having as a reference the strategic position of their products regarding their market participation and the growth rate.

Methods

This study was conducted in the central Mexican highlands, in the Municipality of Jiquipilco, located in the northeast region of Mexico. It is located at 19°33'27" north and 99°36'31" west, at an altitude of 2,751 metres (9,025.5 ft) above mean sea level (AMSL), with an average yearly temperature of 18°C or 65°F (INEGI, 2016). Jiquipilco is the second maguey producer in the state, with a total sown surface of 300 ha (741 ac) (SIACON, 2017). The Society Cooperativa de Productores de Aguamiel y Derivados del *Agave salmiana* was taken as a case study.

Thus, this article discusses a case study that was analysed from a strategic planning perspective, considering the commercial diagnosis phases, market research and product portfolio design (Fisher and Espejo, 2011; Kotler and Armstrong, 2012).

Commercial diagnosis

For the commercial diagnosis, micro- and macro-environmental analyses were done. The information was obtained by direct observation and interviews with the producers. Databases, laws, government regulations and previous works relating to maguey in the study area were also consulted and considered.

For the micro-environment, a description of the organisation was made that included analyses of the production, postharvest and commercialisation processes. The analysis provided the identification of a critical point and helped to identify possible alternative solutions.

For the macro-environmental analysis, the political, economic, social, technological, legal and economic contexts were evaluated. The analysis of primary information was based on monthly work sessions with producers, from February to November 2015, and observation and unstructured interviews with producers. As a secondary source of information, federal and municipal government information and research works were considered.

Market research

For the market research, a questionnaire containing dichotomic and multiple-choice questions was designed. The questions were related to the study variables with the intention of identifying the knowledge and frequency of the consumption of derivatives of maguey products. The questionnaire was distributed to people aged 18 years or older, and it was applied in two major agricultural markets of the cities of Toluca and Metepec, Mexico. The operators of organic and natural agricultural products stores were also interviewed.

The questions concerned, for instance, age, gender, knowledge of maguey pulquero

products and by-products, frequency of consumption, place of consumption, origin of consumption and residence of those interviewed.

A simple random sample with 95% trust and 3% error was calculated (Scheaffer *et al.*, 2012). The sample included 1,068 questionnaires recommended for the identification of potential markets in descriptive studies. The data were analysed via descriptive statistics and frequency analysis.

Design of products derived from the maguey portfolio

The Boston Consulting Group (BCG) and Ansoff Matrices were used to determine the products portfolio. These matrices allowed for classifying the strategic business units (SBU) according to their growth potential and benefits (Baca, 2010) and for establishing the possible strategies on which product could be based.

Economic viability analysis of the products portfolio

Finally, an economic viability analysis was conducted (Weston and Brigham, 1994). Investment, production costs and income calculations for the identified products were made. The project's life was set in a horizon of 10 years from the harvesting of the maguey crop to the end of its productive period.

Investment corresponds to the cost of investing in the cultivation of the plant, the extraction of the aguamiel and the machinery and equipment for the production and extraction of aguamiel. In all models, production costs were calculated with the Total Cost general formula:

Model 1: ordinary and extraordinary maguey pulquero costs; the cost of production of aguamiel.

Model 2: ordinary and extraordinary maguey pulquero costs; pulque production cost.

Model 3: ordinary and extraordinary maguey pulquero costs; the cost of production of aguamiel; the cost of production of syrup.

Model 4: ordinary and extraordinary maguey pulquero costs; pulque production cost; the cost of production of aguamiel; the cost of production of syrup.

Model 5: ordinary and extraordinary maguey pulquero costs; the cost of production of aguamiel; the costs of production of syrup, xitle and paper.

Income includes ordinary and extraordinary incomes of pulque, aguamiel, syrup, xitle and paper depending on the configuration of the production model.

Two case scenarios were considered: (a) Base scenario, equal to current production volume reported by the association, equivalent to 4,772 productive plants and 475 aguamiel litres per plant; (b) Goal scenario, with 4,772 productive plants and 750

aguamiel litres per plant (Vázquez and Hernández, 2014).

Five models were established to conduct the economic viability analysis:

Model 1: Aguamiel production and sale (M1)

Model 2: Pulque production and sale (M2)

Model 3: Syrup production and sale (M3)

Model 4: Syrup and pulque production and sale (M4)

Model 5: Syrup, ixtle and paper production and sale (M5)

In each model, profitability was evaluated considering an interest rate of 7% with an increase of 1% or 2% according to the national financing programme for small producers (FND, 2014). The viability indicators, Net Present Value (NPV), Internal Revenue Rate (IRR) and Cost Benefit Relationship (C/B), were evaluated. An interest rate of 7% was applied (SHCP, 2016). A sensibility analysis was then carried out (Van Horne and Wachowicz, 2010), considering a variation from -10% to +10% on investment and cash flow, and a discount rate from 7% to 9%.

The monetary values are expressed in USD with a currency rate of 1:19 (USD-MXP).

Results

Commercial diagnosis

The Cooperative Society of Maguey Producers (Sociedad Cooperativa de Productores de Maguey) was integrated with the objective of implementing actions to encourage maguey cultivation and obtain revenue from the diversification of its products. It was built under the rules established in the Cooperative Societies General Law (Ley General de Sociedades Cooperativas), in the hope of being candidates to participate in governmental programmes and having access to resources to strengthen productive activities. The producers envision such cooperative societies as a way of implementing productive activities in their communities. They stated that maguey was a source of employment back in the days of the pulque apogee, and they are certain that the integration of small producers can reactivate the maguey industry and foster a profitable activity.

The cooperative has 20 members, a president, a treasurer and a secretary. Their capital is constituted by the members' contributions. They are not part of a financial analysis project; in other words, they are not able to participate in financing programmes. Nonetheless, as a solidarity organisation making use of their own resources, they have made significant achievements, such as maguey replanting and presenting their products at regional agroalimentary fairs.

The producers have basic education (6 years of school), range in age between 35 and 75 years and undertake non-agricultural activities.

The micro-environmental analysis focused on the productive process from production to post-harvest management to commercialisation. The production starts with the cultivation of the maguëy, which comprises less than 1,000 plants per ha. The maguëy's life cycle is 10 years, which is the time needed to reach maturity for the product's extraction. In total, the producers count 20 ha of maguëy with 4,772 plants for the productive stage. Their products are aguamiel, pulque, agave syrup, ixtle and artisanal paper, seedlings and maguëy *pencas*.

Aguamiel is the nectar produced by the maguëy during its productive stage. It is a saccharine amyloid liquid with a cloudy whitest colour, slightly thick and has a sweet and fresh taste. It begins its fermentation process around six to seven hours after harvest. This product is sold to intermediaries or it is destined for pulque and syrup production.

Pulque is an alcoholic beverage resulting from aguamiel fermentation. It is characterised as a refreshing drink with a strong aroma, white in colour and a dense and viscous consistency. Its transformation process begins once the aguamiel is received from the collection centre, where it is left to rest in order for the fermentation process to start. The pulque elaboration is done according to a traditional practice. Pulque has long been commercially important for the people of Jiquipilco. It is possible to find the plants as a living fence surrounding maize crops, as a regular plantation or in an irregular distribution (INEGI, 2011).

Agave syrup is a product obtained after cooking the aguamiel so that the water within it can evaporate. It is a natural sweetener. It is produced following an artisanal process.

Maguëy leaves, better known as *pencas*, are thick and their width varies from 25 to 40 cm (9.84 to 15.79 in) on the bottom, and it becomes narrow towards the top, ending in a 10 to 20 cm thorn (3.93 to 7.87 in). Its length varies from 2 to 4 m (6.56 to 13.12 ft). It is used in Mexican gastronomy, mostly in lamb barbecue (*barbacoa de borrego*). About 40 *pencas* can be obtained from each maguëy. Generally, they are sold by the dozen.

Ixtle is a fibre obtained by the mechanical or manual scratching of the maguëy *pencas*. The process for obtaining the ixtle is lengthy, going from the extraction of the maguëy fibres to the making of the products, which are measured in bundles weighing approximately 200 g, obtained from 8 to 10 *pencas*.

Artisanal paper is a product made from the agave fibre, which is obtained from the *pencas*. It is a fine, flexible and resistant paper with a natural colour that can be used for a variety of crafts or accessories (e.g. envelopes, cards, bookmarks).

The commercialisation of products – pulque, *pencas* and syrup – is the work of intermediaries who distribute the products to the consumer. Sometimes the pulque might be sold in local markets, with the risk of having the product confiscated by the authorities due to the absence of legal permits that allow them to sell the products

themselves. The ixtle and paper products are exclusively sold at fairs and cultural shows.

In the political environment, despite the fact that there is a national programme to promote maguey pulquero, given its historical, social, gastronomic and environmental importance, the municipal development programme of Jiquipilco overlooks this. Producers can access four government programmes for support, but they must comply with the rules of operation and dates of opening and closing, which is where they find their main obstacle.

In the economic environment, as producers have not had access to financing sources, this production remains an informal economic activity.

In the social and cultural environments, the maguey products grant access to new consumption tendencies, such as functional, organic and natural foods, and they represent a market option.

Producers have attended several courses concerning the plantation of maguey pulquero, diversification of products and by-products and agronomic issues. They depend on the germplasm given by the government and traditional and heritage know-how.

The producers do not meet the standards set by the laws of regulation and health promotion: NOM-007-SEMARNAT-1997, maguey exploitation; NMX-V-22-1972, the norms applicable to aguamiel; NMX-V-037-1972, norms applicable to pulque; NOM-142-SSA1/SCFI 2014, norms applicable to the production and control of alcoholic beverages; NMX-FF-110-SCFI-2008, norms applicable to agave syrup.

In the ecological context, maguey pulquero allows the recovery of the soil and avoids erosion. It serves as a fence (live barrier) and an organic fertiliser and it enriches the diversity of species and the landscape.

Market study

The consumption of products linked to local and artisan communities that are also socially and environmentally responsible represents a viable portfolio of options. Maguey pulquero has been substituted for other products.

The results of the market interviews revealed the following:

- 33% of the interviewees were familiar with agave syrup, and 18% consumed it.
- 53% were familiar with ixtle and 9% identified it as a bath scourer; the frequency of the use of this material was once or twice a year.
- 99% of the interviewees were not familiar with maguey paper.
- 97% were familiar with pulque; 30% affirmed that they consume it regularly – 15% once a year, 6% once a month, 5% every other week and 4% once a week.

Design of products derived from maguery pulquero portfolio

The market study yielded information to build a portfolio comprising six products: pulque, agave syrup, ixtle, paper, seedling and *penca*. Table 1 presents the results of the calculus of relative market share and growth rate in the market according to the BCG.

Table 1 - Calculus of relative share and growth rate in the market according to BCG

PRODUCT	SALES YEAR 1	%	SALES YEAR 2	%	RELATIVE MARKET SHARE	GROWTH RATE
Pulque	\$ 572,640	42%	\$ 601,272	40%	0.76	5%
Agave Syrup	\$ 687,168	50%	\$ 790,243	52%	1.31	15%
Seedling	\$ 48,222	4%	\$ 54,009	4%	0.07	12%
Maguery Leaf	\$ 40,185	3%	\$ 48,222	3%	0.06	20%
Ixtle	\$ 9,042	1%	\$ 9,223	1%	0.01	2%
Maguery Paper	\$ 15,069	1%	\$ 15,220	1%	0.02	1%
TOTAL	\$1,372,327	100%	\$1,518,189	100%		

Agave syrup constitutes 50% of the total income of maguery by-products, followed by pulque at 42%.

The circles in the BCG matrix (Figure 1) represent the six current products of the cooperative and their market share. Agave syrup is located in the star product quadrant, meaning that investments in it should be made in order to ensure a market share. Pulque is located in the cash cow product quadrant, which means that it is a strategic product and represents an established cash flow source that allows for investments in other products.

The products in the question mark quadrant are the maguery leaf and seedling, meaning that they represent extraordinary income for the producer and that they are a residue of the productive system. Finally, ixtle and maguery paper are located in the dog quadrant, meaning that they are candidates for divestiture.

Figure 2 represents strategies for the products and existing markets that promote their growth and cost effectiveness.

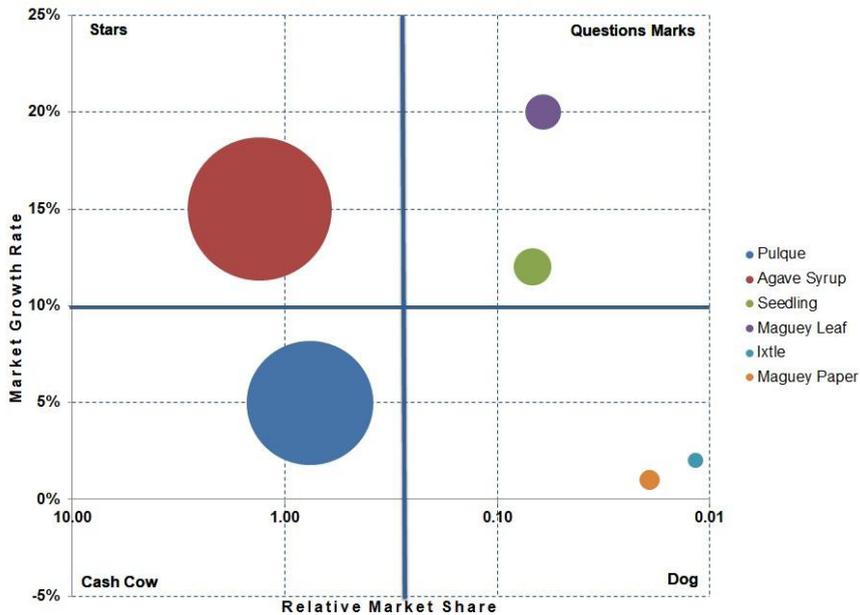


Figure 1 - Products derived from maguey portfolio

		PRODUCTS	
		EXISTING	NEW
MARKETS	EXISTING	Market penetration strategy Pulque Agave Syrup	Product development strategy Ixtle Maguey Paper
	NEW	Market development strategy Maguey Leaf Seedling	Diversification strategy

Figure 2 - Strategy for commercialisation of maguey products

Pulque and agave syrup (market penetration strategy) require strategies that will increase their market share and enable these products to respond to niche segments.

Regarding product development strategies, it is recommended that food regulations are followed. Further, agave syrup is a nutraceutical product and several studies have mentioned their importance and safe consumption for people with diabetes.

The distribution strategies include three selling actions: (a) direct sales, which entails *tianguis* (street vendors) selling maguey pulquero products and by-products at local and non-traditional markets, organic markets, agrifood fairs and the in traditional market in the municipalities of Toluca and Metepec; (b) register the products on the Sedagrobusiness web (official web of the Ministry of Agriculture of the State of Mexico); and (c) intermediary sales, which involves consolidating business and partnerships with sellers that can introduce the product in other markets near and in big cities.

For promotion strategies, it is recommended that sellers establish their 'own brand', develop a slogan and promote the selling points and health benefits of agave syrup. For pulque, since it is a fermented product, it is difficult to offer this product any other way than fresh.

There is no justification for investing in the development of ixtle and maguey paper.

The *pencas* and seedlings are products associated with the life cycle of the maguey; thus, establishing a growth strategy could be risky for the productive system.

Economic viability analysis of the products portfolio

The five models (Table 2) yielded positive values. In the first model, an NPV of \$166,862 was shown in the base scenario and \$282,728 in the goal scenario. This model was the one that showed the lowest NPV of all five presented.

The NPV for M2 was \$361,072 in the base scenario and \$596,315 in the goal scenario.

M3 and M5 showed a very similar NPV in their base scenarios: \$284,200 and \$281,033, respectively. The same can be said of their goal scenarios: \$483,419 and \$480,252, respectively.

The NPV in M4 was \$306,577 in its base scenario and \$520,543 in its goal scenario, with cost benefit rates of 1.64 and 1.90, respectively.

The financial performance of the presented models was superior to the Mexican investment instruments (CETES 28 days) of 4.23% and TIIIE of 4.57% (Banco de México, 2016).

The sensitivity analysis showed for M1 a strengths of 82% of reduction for expected revenue, 59% for M2, 65% for M3, 52% and 64% for M4 and M5, respectively, in the base scenario.

Table 2 - Economic indicators for the products derived from maguey

	Index	BASE SCENARIO			GOAL SCENARIO		
		$i = 0.07$	$i = 0.08$	$i = .09$	$i = 0.07$	$i = 0.08$	$i = .09$
M1	NPV	\$166,862	\$149,922	\$134,639	\$282,728	\$255,496	\$230,918
	IRR	33%	33%	33%	40%	40%	40%
	C/B R	1.93	1.78	1.63	2.70	2.46	2.25
M2	NPV	\$361,072	\$326,857	\$295,972	\$596,315	\$541,204	\$491,446
	IRR	43%	43%	43%	50%	50%	50%
	C/B R	1.92	1.85	1.78	2.19	2.13	2.06
M3	NPV	\$284,200	\$255,142	\$228,914	\$483,419	\$436,665	\$394,454
	IRR	32%	32%	32%	38%	38%	38%
	C/B R	1.84	1.73	1.61	2.30	2.17	2.03
M4	NPV	\$306,577	\$275,507	\$247,462	\$520,543	\$470,467	\$425,256
	IRR	32%	32%	32%	39%	39%	39%
	C/B R	1.64	1.57	1.49	1.90	1.83	1.76
M5	NPV	\$281,033	\$252,170	\$226,122	\$480,252	\$433,692	\$391,663
	IRR	31%	31%	31%	38%	38%	38%
	C/B R	1.79	1.68	1.57	2.23	2.11	1.98

M1 = aguamiel production and sales; M2 = pulque production and sales; M3 = agave syrup production and sales; M4 = agave syrup and pulque production and sales; M5: agave syrup, ixtle, paper production and sales

Discussion

Commercial diagnosis

Despite the good intentions of the cooperative, not all producers found that their objectives were met. In the first place, the municipal authorities did not fulfil their promises about materials and equipment for syrup production. At the beginning of the study, there were 33 producers, but 13 had to leave the business for different reasons, such as the lack of support from authorities. At the end of the study, none of the 20 producers had received any governmental support. The main reasons why producers do not access support programmes are their lack of knowledge of the rules of operation and inefficiency in fulfilling requests and monitoring the process. The rules of the federal programmes are general, not inclusive; they prioritise by the degree of marginalisation. In addition, the programmes are annual with a short registration

period. Most programs require co-financing. State programmes have their own rules, but lack specificity and are articulated in relation to the federal policy; they have their own rules and operation mechanisms, and money assignment is sometimes discretionary. At the municipal level, it is even more chaotic and uncertain (Basilio *et al.*, in press).

The environmental characteristics of the territory allowed for the adaptation and growth of maguey pulquero in Jiquipilco (SIFUPRO, 2013), and it is possible to find plants between 1,200 and 2,500 AMSL.

The means of production and agricultural and rural development have been identified as causes of extreme poverty (Levy, 1994). In the present study, the average of maguey pulquero plants was less than 1,000 per ha and the yield of aguamiel was 475 litres. According to Vázquez and Hernández (2014), it is possible to obtain 750 litres of pulque and other reports claim that is 1,000 litres. Other authors have mentioned that production ranges between 350 and 630 litres depending the terrain, management, etc. (Nieto *et al.*, 2016). It is common to find economic pluriactivity in Jiquipilco (including agricultural and non-agricultural activities) in an effort to gain more income. According to Reardon *et al.* (2001), since 2001, 47% of incomes in rural Latin American families have come from non-agricultural activities. According to Kay (2002) this has been part of a natural decline in the socioeconomic welfare of rural families (*campesino*).

It is possible to identify about 200 species of agave (SIAP, 2016) and 71 species of maguey pulquero in Mexico. They vary in phenotypic characteristics as well as productive characteristics and Brix degrees (Nieto *et al.*, 2016). The most common varieties used by the analysed producers are maguey pulquero verde, Ayoteco and Mexicano, and they are native species. It is also common to find them in other pulque regions of Mexico, like Hidalgo, Tlaxcala and Puebla.

Delgado *et al.* (2014) reported the maguey as an endemic species with cultural, environmental and economic relevance in central Mexico, given its multiple uses, physiological and morphological attributes, and the popular and traditional knowledge of obtaining a variety of products from it. It was possible to identify producers of different ages and years of dedication to pulque production.

Post-harvest management has been the same for many years. There is no regular consumption of pulque that guarantees sales; thus, producers must sell to intermediaries, who must then sell it cheaper.

The analysed producers are aware of the importance of organic production and concepts, and they not use chemical fertilisers.

Due to the differences in maguey pulquero species, the age of harvest and days of production vary. Nieto *et al.* (2016) reported an age of harvest from 10 to 18 years, depending the geographical characteristics and the maguey species used, with 70 to 90 days of production.

According to Gómez *et al.* (2012), the nectar that pulque comes from is essentially an agricultural product, exposed to multiple contamination sources; therefore, they proposed proper handling and correct food safety practices. This work considers compliance with sanitary standards as a key element in guaranteeing product quality and attaining a larger share of the national and international markets.

Market study

Although 97% of the participants in this study were familiar with pulque, there is a general way of thinking among consumers that it is difficult to find the product; although they know where to find it, it is not easily accessible. Yet producers mentioned that they have difficulty selling their product.

Design of products derived from the maguey pulquero portfolio

Pinheiro *et al.* (2018) mentioned that the failure of many companies at a strategic level lies in the fact that they focus on individual products. A product portfolio will define new products and projects and will allow the producers to make decisions concerning interrupting or actualising the products for the market (Jugend and da Silva, 2014). The products derived from the maguey portfolio evaluation in this research allowed for evaluating the best investment options using the available resources.

There are manifold cases where the portfolio has been integrated with this instrument. In Argentina, for instance, it has been used to evaluate the competitiveness of exports to the European Union (Cohen *et al.*, 2000), while in Ecuador, Gómez (2016) made different BGCs per economic sector, having as a contribution the development of useful strategies for public and private companies.

Products should not only be accompanied by a marketing campaign. Providing information regarding product quality is a market tendency that started in the 1970s (Jensen and Beghin, 2005) and it remains valid today.

There are still many issues to solve regarding the sale of maguey pulquero products. It is possible to find agave syrup in regular supermarkets, convenience stores and organic stores. But pulque must be sold fresh. There are brands of canned pulque, but it is not a fermented product.

The results of the portfolio obtained by using the BCG and Ansoff's growth matrix positioned the pulque and agave syrup as products with market penetration strategies. It is necessary to highlight its importance as a functional beverage (Puente *et al.*, 2015), the health benefits that it provides, and that it is part of the technological almanac and fermented alcoholic drinks of Latin America. Ramos and Schwan (2017) highlighted its importance as a nutrient and reservoir of probiotics in products such

as *caxiri* from Brazil, *champú* from Colombia and *chicha* from Peru.

A worldwide example of success is Japanese sake. It is a fermented alcoholic beverage, where the value of social and ecological characteristics has been added and is accompanied by government development strategies and producers associations (Kajima *et al.*, 2017).

Agave syrup is positioned as a star product for the cooperative, representing an investment priority. According to Mellado and López (2015), agave syrup gained popularity as a natural sweetener thanks to its low glycaemic level. The agave plant contains fructans that provide health benefits, and it has become an attractive product for the food industry (Reynoso *et al.*, 2017). They are useful as prebiotics and maintain the persistence of the probiotic strains (Martinez *et al.*, 2017). The physio-metabolic effects evaluation in Wistar rats with different doses of fructans from *Agave salmiana* provided evidence that fructans can be used as dietetic supplements with a beneficial health impact and prevent gastrointestinal diseases (Castillo *et al.*, 2018).

The chemical and microbiological profiles done on aguamiel showed the presence of maltooligosaccharides and fructooligosaccharides, which provide benefits to human health, thereby demonstrating its utility for the food industry (Enríquez *et al.*, 2017). Santiago *et al.* (2017) evaluated fructans as a fat substitute in cookie production. Their results indicated a positive contribution with nutritional advantages, low calorie content, prebiotic activity and a decrease in energy intake. Another work evaluated guava sauces and guava concentrate purees formulated with agave fructans, and the results showed an improvement in nutritional composition and prebiotic activity, thus indicating properties of a possible functional product (García *et al.*, 2017).

The functionality of agave syrup is the main element to consider in the design of marketing strategies and in its classification as a differentiated product. It is not new for agroalimentary differentiated products to be positively positioned in the market. A clear example of this is pork niches, where consumers are willing to pay more if the product counts with a label that shows the environmental protection, food safety or animal welfare (Honeyman *et al.*, 2006). Agave syrup can be presented as a functional product, or local and natural origin, and the cooperative can be shown as a socially responsible company (Sanclemente, 2017) owing to its contribution to the protection and conservation of a native species.

According to the positioning of the *penca* and the seedling in the BCG matrix, it is possible to suggest a market development strategy and have the possibility of growth. Madrigal, García and Velázquez (2014) estimated that there would be a demand for up to 8.5 million *penca*s in 2020, which can be used in Mexican gastronomy.

Ixtle and maguey paper, according to the economic analysis, should be retired. Both are products that require long processes of transformation, and their revenue is not significant to the producers, as there is no market willing to pay the value

of the traditional crafts (Rosas, 2014). The BCG matrix and the viability analysis revealed that these products should be removed from the portfolio. However, they are products valued for their traditional characteristics involving ancestral traditions, beliefs and artistic expressions that form part of the cultural identity. According to Rousso (2010), products like ixtle and maguey paper were appreciated in ancient Mexico for their usefulness for textile elaboration. Therefore, these products could be part of a conservation policy including workshops aimed at demonstrating the techniques and uses as part of the cultural patrimony.

The economic viability analysis showed positive values in all three analysed indicators.

Conclusion

The viability analysis provided evidence of the economic potential of maguey pulquero. This analysis did not detect weakness in the proposed models. All of the models showed that it is possible to increase the financial profitability up to 65% by increasing productivity. The sensitivity analysis showed for M1 a strength of 82% of reduction for expected revenue, 59% for M2, 65% for M3, 52% and 64% for M4 and M5, respectively, in the base scenario.

Pulque and agave syrup are income generators. They are investment priorities and the strategy to follow is market penetration to strengthen their commercialisation. *Pencas* and seedlings are products for which the strategy should be market development. Ixtle and maguey paper are products with no commercial feasibility, but they still have cultural value.

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