Colegio de Postgraduados

Profitability and economic viability of the production of agave syrup

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ABSTRACT

Objective: To quantify the income and production costs of agave syrup and their determining factors, as well as their potential to improve the competitiveness and profitability of agave production.
Design/Methodology/Approach: Three representative production units (URP) of agave syrup were designed through a cross-sectional mixed method, using semi-structured interviews and the producer panel method, as examples of typical production systems of the region. Economic indicators, such as economic and financial viability and benefit/cost ratio (B/C), were obtained.
Results: The three URP recorded financially positive net incomes; consequently, they are a viable alternative in the short-medium term. The three URP recorded 1.87, 1.74 and 1.08 B/C ratios.
Study Limitations/Implications: The results are not statistically significant; therefore, they cannot be extrapolated to the rest of the population.
Findings/Conclusions: To increase the competitiveness of agave syrup, sharing its functional properties is fundamental to develop a highly consolidated market where the sales of the producer are certain.

Keywords: Maguey, artisanal products, functional products.

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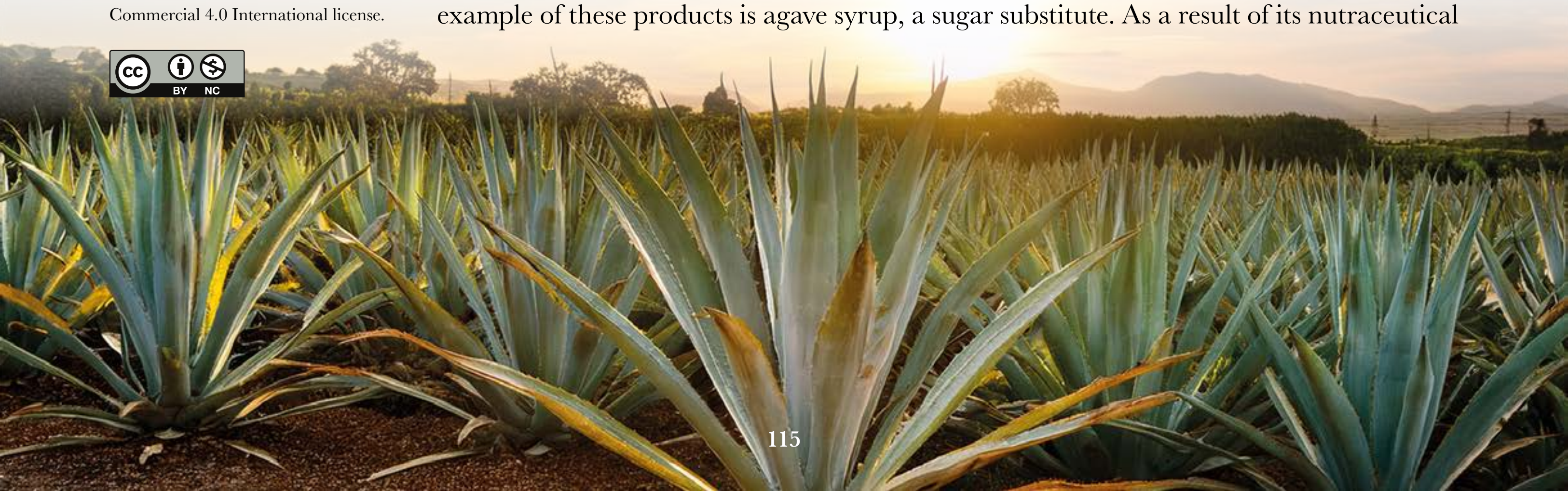
INTRODUCTION

Functional foods have been drawing attention since the COVID-19 pandemic, because their active ingredients can be used to prevent and treat several diseases (Kim *et al.*, 2022). Regular consumption of nutrient-rich functional foods —particularly plant-based foods— can improve metabolic health, reduce inflammation, control weight, and potentially reduce sugar consumption. Consequently, functional foods improve the overall human health (Jurek, 2022). As a result of the interest of people in an improved lifestyle, functional foods are becoming increasingly popular and the related industry is rapidly growing. An example of these products is agave syrup, a sugar substitute. As a result of its nutraceutical



properties (Ozuna and Franco-Robles, 2022), agave syrup has recently become very popular in the health, organic, and functional markets, as well as food for patients with diabetes. Agave syrup (AS) is mainly produced with agave sap from the *Agave tequilana* and *A. salmiana* species. This vegan sweetener has been used to substitute conventional saccharine sweeteners. As a result of its nutritional value, AS has a higher content of minerals, vitamins, and polyphenols than other traditional sweeteners (Saraiva *et al.*, 2022; Yargatti and Muley, 2022). Unlike other natural syrups and honeys, AS is a great natural sweetener due to its prebiotic potential and low glycemic index (Mellado-Mojica and López-Pérez, 2013). In addition, AS has a great potential in international markets, where it can be used as an alternative to diversify products, improving the entry of agave producers into the said markets (Narváez-Suárez *et al.*, 2016). Studies about AS are scarce and have mainly focused on the biotechnology, food, and health areas (Mellado-Mojica and López-Pérez, 2013; Ozuna and Franco-Robles, 2022), as a consequence of its physical and chemical properties and its biological functionality. Therefore, the socioeconomic factors of this product have not been fully analyzed, leading to a lack of information about its basic indicators, such as profitability and benefit/cost ratio, which are fundamental to evaluate AS competitivity.

Consequently, the objective of this study was to quantify the income and production costs of AS, to measure its competitivity level, and to determine its potential as an economic viable alternative for both agave producers and potential investors.

MATERIALS AND METHODS

The experiment consisted of a cross-sectional mixed method and a sample of 15 participants. Data were collected with semi-structured interviews and the producer panel method, adapted from the Delphi method, which consists of discussions and information exchange about technical management, prices, and product yield between experts and producers (Sagarnaga-Villegas *et al.*, 2014).

The study focused on three Representative Production Units (URP) of AS. These URP were used as models of the production systems frequently found in the home region of the participating producers. The URP were identified as IXAS10, THAS12, and CDAS800. The abbreviations referred to the study areas (IX: Ixtapaluca; TH: Teotihuacán; and CD: Cardonal, Hidalgo), the AS economic activity, and the monthly production scale (10, 12, and 800 liters). These URP were chosen based on the opinion of local experts. Fieldwork was carried out in January 2022. Based on the recognition of inflation of monetary and non-monetary assets (CINIF, 2020), the data from this study were updated to reflect 2024 values.

Economic and financial viability and the B/C ratio of the Mexican agricultural sector were determined using the modification proposed by Sagarnaga *et al.* (2014) to the method developed by the Agricultural & Applied Economics Association (AAEA, 2000) and the United States Department of Agriculture (USDA, 2013).

Total income was calculated based on the liters of AS sold multiplied by market price and other sources of income (bank transfers, self-consumption, etc.). Production costs included all the expenditures directly associated with the production of AS. According to the methodology used in this study, three types of costs were identified: operational costs (OC), general costs (GC), and economic costs (EC).

Operational costs (OC) are directly related to production level (supplies, direct labor, and interest payments on short-term loans, etc.). Meanwhile, general costs (GC) do not depend on production level (payment of services, taxes, insurances, interest payment on long-term loans, etc.).

Economic costs (EC) consist of OC, GC, and opportunity costs from factors of production (capital invested in land and in extraordinary improvements, working capital, labor payment, and unpaid management).

B/C ratio is used to calculate profitability, dividing total income by total operational costs: a >1 B/C indicates that the project is profitable; an=1 B/C shows that the project is not viable; and, finally, a <1 B/C indicates that the project is not profitable.

Financial viability measures the capacity of the company to tackle operational and general costs. Positive results indicates that the URP has a medium-term viability. Meanwhile, economic viability is the capacity of the company to pay opportunity costs from factors of production (land, workforce, and capital). Positive results indicate that factors of production are appropriately paid and, consequently, the company is viable and has a low chance of disappearing in the long-term, because producers will rarely find another highly profitable activity in which to invest the factors of production.

RESULTS AND DISCUSSION

Technical parameters and net income of URP

IXAS10 and THAS12 have an artisanal production system, using unpaid family labor and adapting home facilities. Fifty percent of producers pointed out that their main activity is agave cultivation. Producers sell pulque, pulque bread, leaves, distilled beverages, syrup, and other products. CDAS800 has a semi-industrialized production system. The URP has 4 employees working in the production process. It has specialized infrastructures and belongs to an organization of producers that only produce agave syrup.

In terms of agave sap yield, the three URP required 10 liters of sap to produce 1 liter of AS. These results match the findings of Vázquez-García *et al.* (2016), who reported that other producers obtained the same yield. Significant differences about production time and syrup standardization were recorded. Both artisanal processes resulted in a production of 2-4 liters per day, with substantial color and consistency differences. Meanwhile, the semi-industrialized process obtained up to 240 liters and the resulting agave syrup had the same color and consistency, due to the use of specialized machinery. According to Cechura and Hockmann (2014), the lack of homogeneity in artisanal food processing is the result of a low scale production and family labor, as well as a minimum use of machinery and a focus on traditional methods.

The three URP reported different prices, because producers establish their sell price based on market prices and the destination of their products. The price of CDAS800 was the closest to the actual price ($221.00 MXN per kilogram) reported by Franco-Malvaíz *et al.* (2014). In the net cash flow and the financial analysis, income is determined by the direct syrup sales, while self-consumption is added to the total income to calculate the income of the economic analysis. IXAS10, THAS12, and CDAS800 recorded a 10, 8.33, and 1% self-consumption, respectively (Table 1).

Production costs

The purchase of agave sap accounted for 50-70% of the operational costs of the three URP. After the operation costs, bottling is the second major element in the costs of artisanal producers. Meanwhile, 75% of the sales of CDAS800 were buck sales and, consequently, bottling costs were not significant. The second major cost for this URP was labor, which accounted for 14% of the total operational costs. For their part, IXAS10 and THAS12 did not employ paid workforce, which therefore was not significant in their costs. According to Jiménez-Jiménez *et al.* (2014), this situation limits their competitiveness. This type of URP does not consider family labor among its supply costs.

The semi-industrialized CDAS800 had higher machinery and equipment depreciation costs than the artisanal IXAS10 and THAS12. The latter URP do not always have the equipment and machinery required for their processes and, consequently, do not include deterioration costs among their general costs. The general costs of the artisanal URP ranged from 1.5 to 4% of the total costs, while the general costs of the semi-industrialized URP (CDAS800) accounted for 20% of the same heading. This URP has a specialized structure and a higher machinery and equipment investment and, consequently, a high depreciation cost (Table 2). Meanwhile, IXAS10 and THAS12 recorded low depreciation costs, because they have minimum infrastructure, furniture, and equipment. These results match the findings of Barrera *et al.* (2018), who reported that rustic agricultural activities have low depreciation costs, as a result of the lack of infrastructure and equipment.

The opportunity costs were a key factor for IXAS10 and THAS12 (who produce their own syrup), accounting for 48 and 49.5% of the total economic costs, respectively. Consequently, unpaid labor was included in their economic analysis. Meanwhile, the unpaid labor of CDAS800 accounts only for 12% of the total economic cost. A factor that stood out in the economic analysis was the management opportunity cost: it was 50 times higher in the industrial process than in the artisanal process. These results match the reports of Esquivel-Marín *et al.* (2022), who found that primary production requires scarce or no management at all. However, it increases depending on the integration degree of the producers.

As a result of their artisanal production, the producers of IXAS10 and THAS12 sold their products through short commercialization chains and at their own farms. Nevertheless, this study took into account the rent of premises for the viability analysis,

Table 1. Technical parameters and annual net income in thousands of pesos (2024).

URP	Type of Technology	Production (lt)	Self-Use (lt)	Selling Price (MXN$/lt)	Income	
					Financial	Economic
IXAS10	Rustic	120	12	545	65,364	71,901
THAS12	Rustic	144	12	409	58,828	63,730
CDAS800	Industrial	5700	60	216	1,229,129	1,242,066

Source: Table developed by the authors with information collected in the field.

Table 2. Annual productions costs in thousands of pesos (2024).

General Costs	IXAS10	THAS12	CDAS800
Agave sap	13,618	16,341	343,165
Packaging	9,532	5,760	70,812
Labor	0	0	163,412
Other	11,149	9,497	230,263
Operating costs	**34,299**	**32,375**	**807,652**
Depreciation	596	1,453	204,418
General subtotal	596	1,453	204,418
Financial	**34,895**	**33,827**	**1,012,070**
Opportunity Cost of Location	13,618	13,618	0
Family Labor	13,618	10,894	0
Management	2,724	2,451	137,771
Working capital	4,219	4,224	96,918
Economic	**69,073**	**65,014**	**1,149,841**

Source: Table developed by the authors with information collected in the field.

in case the producers wanted to sale their products in a permanent store. For its part, CDAS800 did not include rent costs in their sales, because they are distributors.

Given their use of intermediaries, the sale prices of THAS12 and CDAS800 were lower than IXAS10's. For its part, the policy of IXAS10 involves working with no more than one intermediary. This policy can be defined as a short commercialization chain (Ministerio de Agricultura, 2012). This strategy allowed them to capture most of the market value of the product, mainly in pulque and barbacoa establishments, as well as local fairs.

Competitiveness indicators

The net income was financially positive for the three URP; consequently, they have a short- and medium-term viability. However, only IXAS10 and CDAS800 have an economically positive income and therefore have a long-term viability. Meanwhile, THAS12 had an economically negative income and, therefore, its long-term viability is in question. According to Domínguez-García *et al.* (2017), the factors of production could be more efficiently used in another more profitable production activity. Therefore, the ongoing operation of THAS12 is at risk. The financial and economic B/C ratio of IXAS10, THAS12, and CDAS800 were 1.87 and 1.04, 1.74 and 0.98, and 1.21 and 1.08, respectively. These results match the findings of Franco-Malvaíz *et al.* (2014), who reported a 1.85 financial B/C ratio, a very similar figure than the one obtained by IXAS10 and THAS12 (Table 3).

IXAS10 recovered its economic cost and obtained a 4% profit, CDAS800 obtained an 8% profit, and THAS12 did not recover its total costs and recorded a 2% economic loss. Although CDAS800 is economically viable, it could make a better use of its resources, because at the time it only operated at 10% of its capacity. Consequently, this situation has a negative impact on the unit production cost. CDAS800 has a semi-industrialized

Table 3. Competitiveness indicators of the URP.

URP	Viability		Benefit-Cost Ratio	
	Financial	Economic	Financial	Economic
IXAS10	Viable	Viable	1.87	1.04
THAS12	Viable	Unviable	1.74	0.98
CDAS800	Viable	Viable	1.21	1.08

Source: Table developed by the authors with information collected in the field.

production which results in a higher fixed assets investment that generates high economic costs, due to depreciation and opportunity costs resulting from the capital invested in machinery. These costs could be reduced adjusting the production infrastructure to the volume of the URP or increasing production.

Overall, other reports about the agave value chain reported a lower competitivity in the production of AS. On the one hand, Fonseca-Varela and Chalita-Tovar (2022) found a 1.27 B/C ratio in mezcal production. On the other hand, Ávila-Lara *et al*. (2021) reported a 1.24 B/C ratio in the production of agave sap.

Taking into account the characteristics of the production of AS and the costs estimated in this study, the production of AS is a profitable activity for the three URP. However, the economic profitability indicator showed that THAS12 was inefficient and, consequently, its long-term permanence is not guaranteed. IXAS10 complemented its activities with the sale of other agave and local products, improving its profitability. Finally, CDAS800 can improve its economic benefits if it increases its production volume and its client portfolio.

CONCLUSIONS

The production of AS is an important opportunity to diversify and increase the income of the agave primary production. In addition, it is attractive to investors interested in the elements of the production chain that follow the production of agave sap. The growth of the functional product markets drives the AS demand. The AS profitability can be optimized through three key strategies: improving technical efficiency, strengthening its marketing based on its beneficial properties, and forming strategic alliances with specialized shops and gourmet restaurants. These actions will not only increase the positive perception among consumers, but also will guarantee a more efficient and sustainable commercialization of AS.

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